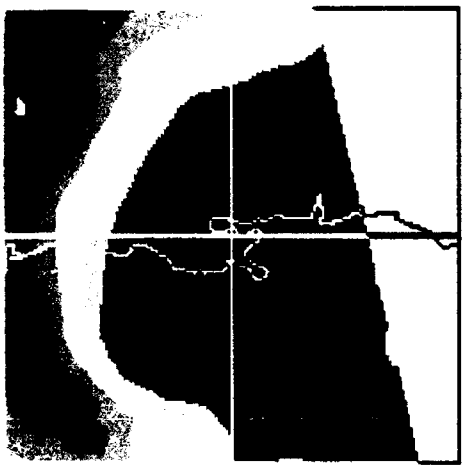
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DMSP F11 SSM/T-2 Calibration and Validation

Hurricane Andrew



SSM/T-2 183 GHz



SSM/T-2 150 GHz



SSM/T-2 91 GHz



OLS Visible



OLS Infrared

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PL-TR-92-2293
Environmental Research Papers, No. 1111

SSM/T-2 CALIBRATION AND VALIDATION DATA ANALYSIS

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29 October 1992

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REPORT DOCUMENTATION PAGE

Form Approved
OMB No 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	29 October 1992	Final Report JAN 92 - NOV 92

4. TITLE AND SUBTITLE
SSM/T-2 Calibration and Validation Data Analysis

5. FUNDING NUMBERS
PE: 35160F
PR 6670 TA GR WU 88

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Phillips Laboratory (GPAS)
Hanscom Air Force Base, MA 01731-5000

8. PERFORMING ORGANIZATION REPORT NUMBER
PL-TR-92-2293
ERP, No. 1111

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
SMC/CI
Los Angeles AFB, CA 90009

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
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12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The Phillips Laboratory (PL/GPAS) is the principal investigator for the calibration and validation of the Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave Water Vapor Sounder (SSM/T-2). The objective of the effort is to obtain simultaneous independent measurements of microwave radiance, water vapor mass, specific humidity and relative humidity to quantitatively measure the performance of the instrument (calibration) and to validate the ability of the SSM/T-2 to measure the water vapor parameters, i.e. the environmental data records (EDRs) of Air Force Global Weather Central (AFGWC).

Analysis of Satellite and aircraft data for calibration using both underflights and radiative transfer calculation show that the SSM/T-2 is performing within or exceeds the original contract specifications (1K). The SSM/T-2 retrieved vertical moisture profiles (EDRs) are performing within the contract specification of ±30 RH when compared with collocated radiosonde data except over certain ocean atmospheres.

14. SUBJECT TERMS
microwave, 183 Ghz, retrieval, water vapor profiler, calibration

15. NUMBER OF PAGES
432

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

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FOREWORD TO SSM/T-2 CAL/VAL REPORT, VOLUME 1

The launch of DMSP F-11 on 28 November 91 marked several milestones. First, it marked the first flight of the Special Sensor Microwave Water Vapor Sounder (SSM/T-2). Second, it marked the first on-orbit microwave instrument containing 183.3 GHz channels. Finally, it marked the beginning of the calibration and validation to determine the accuracy of all the engineering and science behind the SSM/T-2.

As we write this report, the SSM/T-2 on-orbit performance has met or exceeded specifications. The instrument has been electrically and thermally stable since initial turn-on.

On the ground, the algorithms that convert microwave TBs into moisture parameters are exceeding specified requirements (best effort with goal of ± 30 percent). In fact, our statistical retrieval approach, using multiple linear regression, is meeting predicted performance for most atmospheric types and surface backgrounds. In the few cases where we are not meeting predicted performance, we expect algorithm coefficient updates to improve accuracy to the predicted levels. At Air Force Global Weather Central, the software is operating within throughput and memory allocations.

We express our respect for those visionaries of the past who conceived of the idea of an SSM/T-2 and worked to make the project a reality. We express our thanks to all those who worked so hard to design, develop, and test the SSM/T-2 hardware and software. Finally, we express our thanks to the CAL/VAL team members whose data collection and analysis set the stage for operational use of SSM/T-2 data and a quantum leap in weather forecasting.

We look forward to the weather forecasters and scientific community finding ways to exploit the SSM/T-2 data and increase moisture retrieval accuracy.

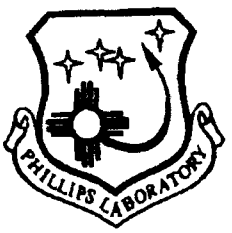
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Acknowledgements

The authors wish to thank Col. John Goyette, Program Director; Lt. Col. Nelson B. James, III, Program Manager, Current Satellite Systems; Lt. Col. Edwin Arrance, AWS Liaison; Capt. John Cadou, Deputy Program Manager, Capt. Thomas Piatkowski, Chief Sensor Development (1987-1990) and Capt. Michael J. LaPointe, Chief Sensor Development of the Defense Meteorology Satellite Program Office; Dr. Neil Baker, Aerospace Corporation - DMSP; Dr. John Theon, NASA Headquarters, Chief Atmospheric Dynamics, Radiation and Hydrology Branch; and Dr. Robert A. McClatchey, Phillips Laboratory, Director Atmospheric Sciences Division, for their direction and strong support throughout the calibration/validation effort. A sincere thanks to Dr. Joseph W. Snow, Phillips Laboratory, Branch Chief, Satellite Meteorology, without whose help and support this report would not have been possible. We appreciate the support from the Air Force Global Weather Central personnel Capt. Don Rhudy for project management, Capt. Tom Neu and Staff Sgt. Keith Hopkins for software support. Special thanks to Ms. Elizabeth Stenhouse who processed this report.

Cover Picture

Hurricane Andrew making landfall on the coast of Louisiana, August 25, 1992. Displayed are the visible and infrared radiances from the Operational Linescan System (OLS) and the raw radiances of the SSM/T-2.



Millimeter Wave Moisture Sounder (SSM/T-2) Calibration/Validation Program

SSM/T-2 CALIBRATION AND VALIDATION DATA ANALYSIS

VOLUME I

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1. Executive Summary

1.1 Introduction

The Phillips Laboratory Geophysics Directorate (PL/GP) presented a proposal to the Defense Meteorological Satellite Program (DMSP) to formulate, initiate and conduct a program to calibrate the Special Sensor Microwave Water Vapor Sounder (SSM/T-2) and to validate the retrieved water vapor profiles (Cal/Val). DMSP (SMC/CI) appointed PL/GPAS the principal investigator to lead the SSM/T-2 Cal/Val program. The objective of this effort is to obtain simultaneous, independent measurements of microwave radiance, water vapor mass, specific humidity and relative humidity to quantitatively measure the performance of the instrument (calibration) and to validate the ability of the SSM/T-2 to measure the water vapor parameters, i.e. environmental data records (EDRs) of Air Force Global Weather Central (AFGWC). Phillips Laboratory organized a team of experts from government and industry to undertake the study. The team members and responsibilities are:

Phillips Laboratory - program management, sensor calibration

Aerospace Corporation - product validation

NASA Headquarters and Goddard Space Flight Center - sensor calibration and ER-2 aircraft underflights of F-11

Atmospheric and Environmental Research, Inc. - sensor calibration, database and analysis

The importance of relative humidity is that it determines the spatial and vertical distribution of clouds. Indeed cloud forecast model initialization is intimately tied to accurate specification of moisture fields. Satellite remote sensing of meteorological parameters such as temperature, moisture and clouds helps to provide the initial conditions for NWP forecasts (Isaacs et al., 1986). Specification of sufficiently accurate moisture fields from satellite data in data sparse regions can improve the analysis and forecast of relative humidity (Hoffman et al., 1990). One note of caution: recent literature (Lindzen and Fox-Rabinowitz, 1989) indicates that numerical models may not fully benefit from high horizontal resolution satellite observations unless the vertical resolution is also high. Most satellites today can sense mesoscale weather features with their given horizontal resolution, but do not have the necessary vertical resolution to detect the vertical detail and extent of these features. This may be one contributing factor to the mixed success of satellite data assimilation to date. Operational use of satellite data in global forecast models has shown little or no skill increase for the Northern Hemisphere, where many other data sources are available. However, satellite data has proved important in improving forecast skill in the Southern Hemisphere, where little else is available.

The first SSM/T-2 was launched November 28, 1991 aboard the DMSP Block 5D-2 Spacecraft F-11. The SSM/T-2 is a cross-track scanning, five channel, passive, total power microwave radiometer system which measures microwave radiance at 183.3 $\pm 1, \pm 3, \pm 7$; and at 150.0 and 91.655 GHz. The nadir resolution of the SSM/T-2 is on the order of 48 km at 183.3 GHz, with a swath width of 1400 km. The SSM/T-2 was built by Aerojet Electronic Systems Division under the direction of SMC/CI. SSM/T-2 is the first operational microwave water vapor sounder to be placed on orbit.

The F-11 spacecraft is in a sun-synchronous polar orbit at an altitude of 833 kilometers with an inclination of 98.4 degrees and an orbital period of 101 minutes. F-11 completes 14.25 full orbit revolutions per day and has a local ascending nodal crossing time of 1714 hours. Figure 1.1-1 shows a global color composite of three of the SSM/T-2 channels for all passes on May 15, 1992.

The SSM/T-2 consists of a single, self-contained module with a step-scan motion in the cross-track direction $\pm$ 40.5°. During each scan period, and for all five channels, twenty-eight discrete earth viewing positions, four discrete calibration measurements of a hot-load target (~300 K), and cosmic background radiation (cold load ~3 K) are monitored. The beams of the five SSM/T-2 channels have coincident centers.

An examination of the stability of the SSM/T-2 electronics has shown the instrument to be very stable. Figure 1.1-2 shows the absolute stability of the SSM/T-2 sensor. The differences are almost constant throughout the orbit.

Figure 1.1-3 shows the total noise (thermal and electronic) of the instrument over the calibration period of 8 consecutive scans. 183.3 ± 7 and 150 GHz are the noisiest with standard deviations of 5 counts. The sensitivity (ΔT) is the "minimum detectable" signal of a radiometer. Meteorological radiometer systems detectability or sensitivity is defined in terms of the radiometer output when referred to the input of the antenna collecting aperture, defined as the Noise Equivalent Temperature Difference (NEΔT). From Figure 1.1-3, ΔT is approximately 0.45 K. All these measurements are raw data with no thermal variations applied, thus both thermal and electronic noise variations are included. This approach assumes the worst case scenario for SSM/T-2 sensitivity.

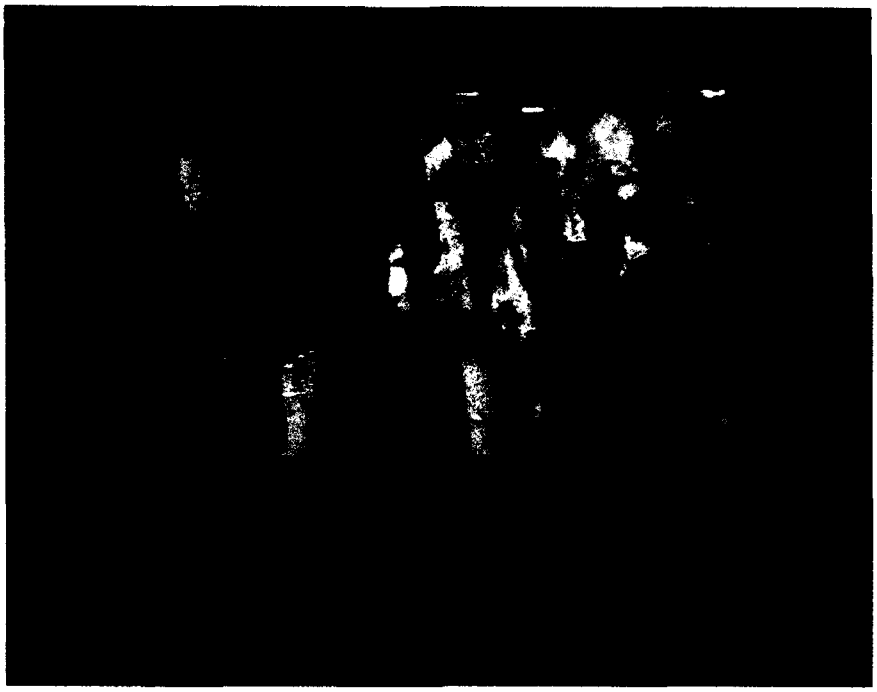


Figure 1.1-1. 24-hour global composite of 3 channels of the SSM/T-2 for May 15, 1992. The 91, 150 and 183 ± 7 GHz channels are associated with the green, blue and red image colors, respectively, with bright colors representing higher moisture amounts and dark colors representing low water vapor amounts.

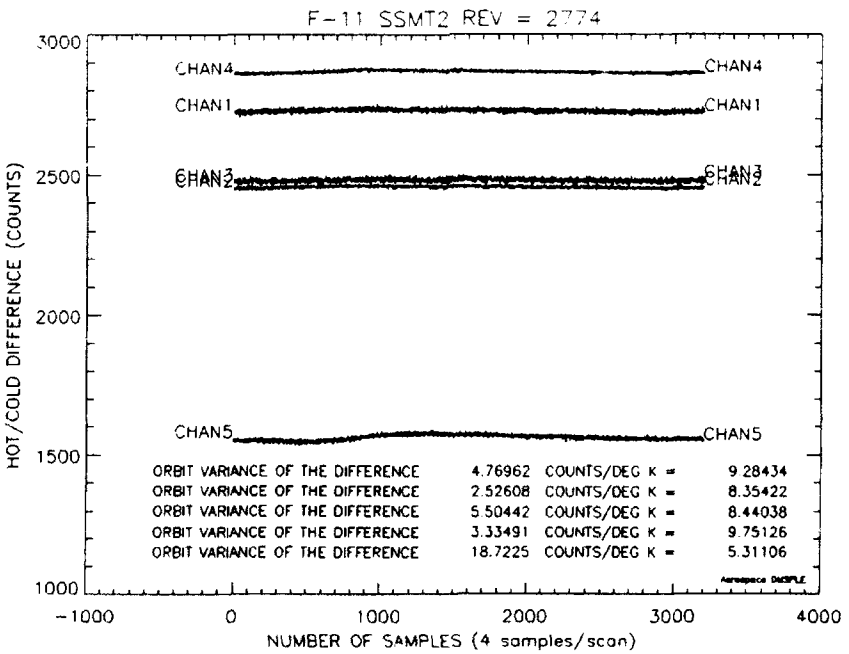


Figure 1.1-2. The absolute stability of the SSM/T-2 sensor based on the hot load - cold load differences versus sample number for Rev. #2774 (June 11, 1992).

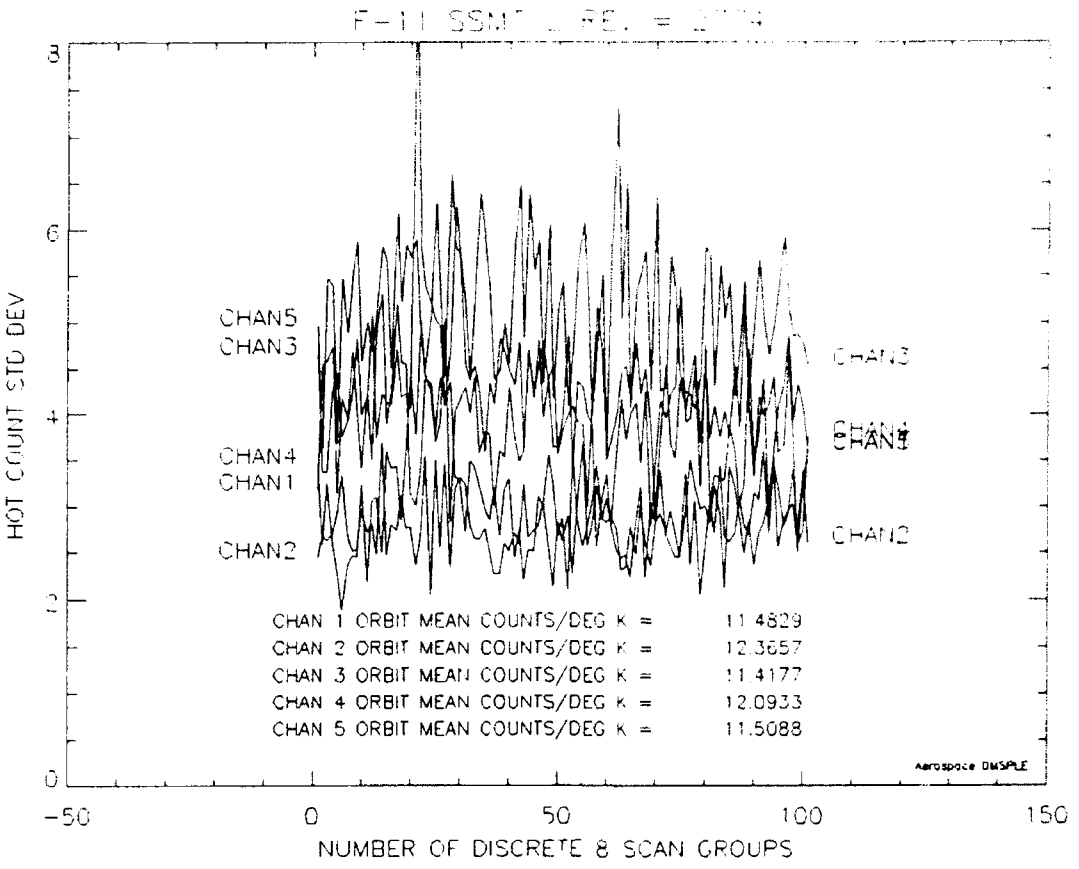


Figure 1.1-3. The total noise (thermal and electronic) of the SSM/T-2 instrument over the calibration period of 8 consecutive scans for Rev. #2774 (June 11, 1992).

1.2 SSM/T-2 Instrument Calibration

Of primary importance to the success of any satellite instrument is its calibration. Without a fully calibrated instrument there is no way to guarantee that the operational product is accurate. The ground calibration performed by Aerojet showed that the instrument performed as contracted, i.e., within design specifications. On orbit, that calibration has to be recalibrated to insure that the instrument has not changed due to launch forces or mechanical or electronic problems.

Two independent approaches were taken to calibrate the SSM/T-2: (a) SSM/T-2 TB data were compared with contemporaneous NASA Millimeter-wave Imaging Radiometer (MIR) data from NASA ER-2 underflights, and (b) available upper air temperature and moisture profile data (radiosondes) were used in radiative transfer models to calculate the outgoing microwave radiance for the SSM/T-2 channels.

Two aircraft campaigns were planned, one along the west coast and the other along the east coast of the United States (see Figures 1.2-1 and 1.2-2). The MIR has four channels in common with the SSM/T-2 ($183.3 \pm 1, \pm 3, \pm 7$ and 150 GHz) and a fifth channel at 89 GHz which differs slightly from the SSM/T-2 91.655 GHz channel. The small frequency difference between 89 and 91.655 GHz does not appreciably effect their comparison since the atmospheric and earth surface properties vary little over this frequency range.

Aircraft MIR - SSM/T-2 comparisons were stratified according to background (land, ocean, coast) and RMS differences and biases were computed. Weather during the west coast aircraft campaign was characterized by stable atmospheric conditions. For the west coast data, water vapor absorption line (i.e., 183.3 GHz) channels over water surfaces produced SSM/T-2 - mean MIR RMS differences of 0.7 - 1.3 K with biases of a few (up to 0.7 K) tenths of a degree (see Table 1.2-1). The RMS variation for these channels is larger for coastal FOVs (up to 1.7 K) with the largest variation for land backgrounds (up to 3.8 K). The RMS differences are slightly greater for the three 183 GHz channels over the Atlantic Ocean. The window channels (e.g. 91 and 150 GHz) show larger RMS variation and bias, especially for the mixed (e.g., coastal) FOVs. This increased RMS is caused by there being large variation in the surface emissivity within the SSM/T-2 FOV which is less well represented by the limited area scanned by the MIR. Over the ocean, the surface emissivity is more homogeneous, allowing the MIR's smaller areal measurement to be more representative of the average surface emissivity affecting the SSM/T-2's FOV. The RMS difference for the window channels for the east coast data were roughly comparable in magnitude to the west coast data.

The second method used to calibrate the SSM/T-2 was the comparison of operational satellite data records (SDRs) with model calculated TBs using co-located radio-

sondes as input into radiative transfer models. The criteria for co-location in time and space is ± 1 hour and 100 km. Radiosonde profiles consisting of significant and mandatory levels were only used if the moisture measurements extended up to at least 300 hPa. Radiosonde data span the time period between January 31 to August 7, 1992. Radiative transfer calculations based on co-located radiosondes are generally in good agreement with SSM/T-2 TBs. Discrepancies are noted for the window channels which see the surface, for which mean emissivities were used in the simulations. This resulted in an underestimation of the SSM/T-2 observations over land and an overestimation for ocean surfaces. Other sources of discrepancies between the forward calculated TBs and the satellite-measured values are the lack of consideration of clouds and/or precipitation within the radiative transfer model, uncertainties of low RH radiosonde measurements, errors in radiative transfer modeling, varying abilities of the different types of radiosonde instruments to measure temperature and moisture, different reporting procedures of radiosonde data used by different countries (Garand et al., 1992), and the addition of estimated high altitude (> 300 hPa) moisture data for input into the radiative transfer models. This document describes the results of a 6-month effort. Due to time constraints, the Cal/Val team has not been able to explore all the areas of question with the radiosonde data. Further data analyses will be undertaken in the Volume II Cal/Val report.

Table 1.2-1. RMS difference / bias between the mean of the co-located MIR TBs and the observed SSM/T-2 TBs at the five SSM/T-2 channels. Frequency of SSM/T-2 FOVs follows the RMS difference in parentheses. Bias is based on the mean of the co-located MIR TBs - the SSM/T-2 TBs. The scan angle of the MIR data matched that of the co-located SSM/T-2 FOV. The time between the SSM/T-2 and the MIR measurements was ± 1 hour.

WEST COAST FLIGHTS

SSM/T-2 FOV TOPOGRAPHY	91 GHz	150 GHz	183 ± 7 GHz	183 ± 3 GHz	183 ± 1 GHz
WATER	3.4 / -1.5 (40)	2.4 / 0.5 (26)	0.7 / -0.3 (23)	0.8 / 0.2 (23)	1.3 / 0.7 (23)
LAND	3.5 / 0.5 (40)	4.3 / 1.1 (28)	3.8 / -0.1 (25)	2.9 / 1.5 (25)	3.2 / 2.1 (25)
COAST	9.1 / 4.1 (36)	3.8 / 1.5 (20)	1.2 / 0.0 (17)	1.1 / 0.2 (17)	1.7 / 0.0 (17)

EAST COAST FLIGHTS

SSM/T-2 FOV TOPOGRAPHY	91 GHz	150 GHz	183 ± 7 GHz	183 ± 3 GHz	183 ± 1 GHz
WATER	3.7 / 0.2 (54)	3.6 / 2.7 (35)	1.2 / -0.6 (29)	2.1 / -1.8 (29)	1.2 / 0.2 (29)
LAND	4.7 / -1.1 (18)	2.6 / 1.2 (11)	1.9 / -1.4 (10)	2.6 / -2.5 (10)	1.2 / -0.5 (10)
COAST	10.9 / -1.2 (81)	4.5 / 1.2 (53)	1.6 / -0.8 (41)	2.4 / -1.9 (41)	1.8 / 0.3 (41)

Table 1.2-2. RMS difference / bias between the calculated TBs generated by the Eyre RT simulation model using a global set of radiosondes and co-located SSM/T-2 TBs at the five SSM/T-2 channels. Bias is based on SSM/T-2 TBs - co-located Eyre-calculated TBs. co-location criteria are ± 1 hour and 100 km. Frequency follows the RMS difference in parentheses.

Precipitable Water (kg/m^2)	91 GHz	150 GHz	183 ± 7 GHz	183 ± 3 GHz	183 ± 1 GHz
0 - 10	18.5 / 6.4 (296)	16.4 / 6.5 (296)	10.3 / 4.4 (296)	5.9 / 0.0 (296)	5.3 / -1.4 (296)
10 - 20	22.6 / 15.4 (343)	13.5 / 9.1 (343)	4.5 / -0.4 (343)	4.0 / -0.7 (343)	5.6 / -0.8 (343)
20 - 30	20.9 / 13.8 (204)	9.1 / 3.8 (204)	5.9 / -1.7 (204)	4.9 / -0.6 (204)	6.6 / 0.9 (204)
30 - 40	17.2 / 5.8 (176)	9.0 / -0.8 (176)	8.8 / -2.1 (176)	7.4 / -0.7 (176)	8.8 / 1.3 (176)
40 - 50	13.6 / -4.0 (110)	10.3 / -3.3 (110)	8.3 / -3.3 (110)	6.0 / -2.2 (110)	6.6 / -0.2 (110)
50 - 60	12.3 / -7.0 (80)	6.9 / -3.2 (80)	6.5 / -2.4 (80)	5.7 / -1.2 (80)	6.6 / 1.1 (80)
60 - 70	10.8 / -4.8 (16)	22.2 / -13.6 (16)	17.0 / -10.2 (16)	12.5 / -4.1 (16)	12.5 / 1.7 (16)
70 - 80	11.9 / -3.9 (2)	6.3 / 1.4 (2)	7.0 / 2.3 (2)	4.1 / 1.3 (2)	2.6 / 2.1 (2)
TOTAL	19.2 / 8.1 (1227)	12.7 / 4.0 (1227)	7.8 / -0.2 (1227)	5.7 / -0.7 (1227)	6.5 / -0.1 (1227)

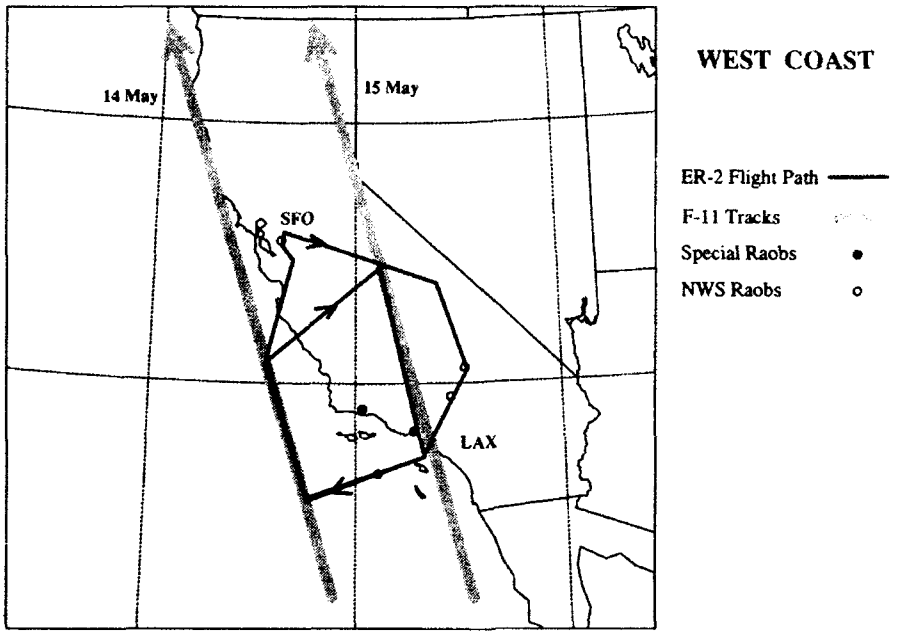


Figure 1.2-1. Diagram of the afternoon ascending passes of the DMSP F-11 satellite over the west coast of the U.S. on May 14 and 15, 1992. Also shown in the NASA ER-2 flight path.

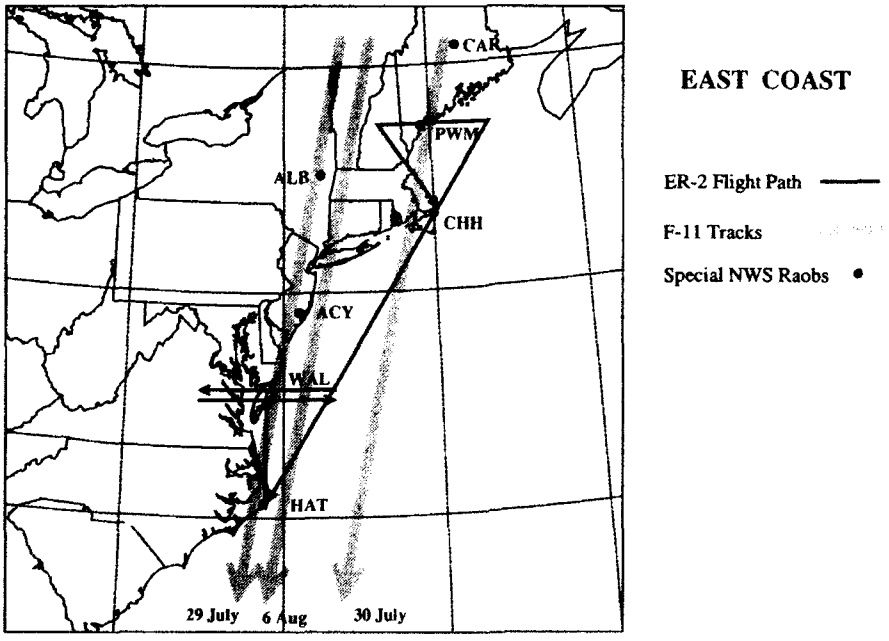


Figure 1.2-2. Diagram of the morning descending passes of the DMSP F-11 satellite over the east coast of the U.S. on July 29 and 30 and August 6, 1992. Also shown is the NASA ER-2 flight path.

1.3 Retrieval Algorithm Validation

The required derived parameters of the SSM/T-2 are relative (RH) and specific humidity (Q) at 1000, 850, 700, 500, 400, and 300 hPa. In addition, water vapor mass in seven layers (surface to 1000 hPa if available, 1000-850, 850-700, 700-500, 500-400, 400-300, 300 on up to the top of the atmosphere) is retrieved. It should be kept in mind that the accuracy of the SSM/T-2 moisture retrievals were to be on a "best effort" with a goal of ± 30% basis by the contractor.

The expected RMS performance of the SSM/T-2 D-matrix retrieval algorithm via radiative transfer theory is given in the Table 1.3-1.

Table 1.3-1. Expected RMS performance for the SSM/T-2 D-matrix retrieval algorithm.

Parameter	Units	Ocean	Land	Coast
RH @ 1000 hPa	%	13.5	20.3	16.5
RH @ 850 hPa	%	13.9	20.5	22.6
RH @ 700 hPa	%	16.0	19.4	19.6
RH @ 500 hPa	%	12.5	17.3	13.4
RH @ 400 hPa	%	11.8	15.1	13.5
RH @ 300 hPa	%	11.8	12.9	12.4
Q @ 1000 hPa	g/kg	1.41	2.79	2.71
Q @ 850 hPa	g/kg	1.09	1.88	2.32
Q @ 700 hPa	g/kg	.942	1.14	1.26
Q @ 500 hPa	g/kg	.319	.428	.391
Q @ 400 hPa	g/kg	.149	.200	.183
Q @ 300 hPa	g/kg	.054	.059	.059

Retrievals over the ocean were anticipated to have the better overall RMS performance compared to those for either the land or coast backgrounds. Ice retrievals are not listed since the database collected for this study contained no ice radiosondes versus SSM/T-2 co-locations.

A large radiosonde database has been collected from the AFGWC operational systems in support of this study. Ten thousand radiosondes pairs of co-located SSM/T-2 and radiosonde profiles were used in this study. co-location criteria were set to data within ±1 hour in time, and 100 km in distance. Note one radiosonde profile may be co-located to multiple SSM/T-2 measurements. Table 1.3-2 displays the results of comparing the radiosonde measurements RH and Q as calculated from dew-point depression, to the SSM/T-2 derived RH and Q.

Table 1.3-2. RMS/bias between radiosonde measurements and satellite-derived RH and Q.

Parameter @ Level	Units	Ocean	Land	Coast
RH/Bias @ 1000 hPa	%	15.7 / 4.2	16.1 / 5.6	16.2 / -0.6
RH/Bias @ 850 hPa	%	22.7 / -3.1	24.2 / - 3.7	25.1 / - 7.4
RH/Bias @ 700 hPa	%	22.8 / -6.8	22.6 / -2.6	21.7 / -3.6
RH/Bias @ 500 hPa	%	25.1 / -12.2	21.8 / -4.8	20.1 / -2.0
RH/Bias @ 400 hPa	%	22.6 / -14.1	22.1 / -10.4	18.9 / - 4.0
RH/Bias @ 300 hPa	%	23.2 / -13.2	19.6 / -2.5	17.4 / 0.2
Q/Bias @ 1000 hPa	g/kg	3.80 / 0.37	2.74 / -1.47	2.86 / -0.21
Q/Bias @ 850 hPa	g/kg	3.13 / - 0.43	3.04 / -0.02	2.47 / -0.31
Q/Bias @ 700 hPa	g/kg	3.15 / -1.07	1.87 / 0.16	1.46 / 0.04
Q/Bias @ 500 hPa	g/kg	2.54 / -1.04	0.88 / -0.10	0.64 / 0.01
Q/Bias @ 400 hPa	g/kg	1.00 / -0.45	0.46 / -0.16	0.34 / -0.06
Q/Bias @ 300 hPa	g/kg	0.24 / -0.13	0.14 / -0.01	0.24 / -0.13

In general, the SSM/T-2 derived RH and Q have larger than predicted RMS. The RMS over ocean backgrounds are larger than either land or coast which is an unanticipated result. It has subsequently been discovered that of the five categories of SSM/T-2 ocean atmospheres, the very moist atmospheres are clearly the major contributors to the RMS. The cause could be as simple as a coding error in the generation of the a-priori regression coefficients, or more fundamental in nature. It is possible that there are physical processes that the SSM/T-2 algorithms have not properly modeled, or perhaps the shape of the absorption curve at 150 GHz is not adequately modeled. Work in this area will continue until the problem is understood and corrected.

The SSM/T-2 ocean background soundings that are flagged as contaminated by heavy cloud are removed from the statistics, and RMS are re-calculated. The heavy cloud flag over the ocean is constructed using a scatter plot of the SSM/T-1 50.5 GHz and the 53.2 GHz channels. Table 1.3-3 lists the RMS performance of all observed (i.e. in the Validation database) ocean type atmospheres against the expected RMS performance. Type 2 atmospheres are relatively dry, whereas Type 5 atmospheres are very moist. As mentioned previously, the RMS for the Type 5 (very moist) ocean atmosphere, and the Type 3 at two levels, are still larger than anticipated, however, all remaining types show significant improvement.

Table 1.3-3. RMS of all observed ocean-type atmospheres versus the expected RMS performance.

Parameter @ Level	Expected	Type 2	Type 3	Type 4	Type 5
RH (%) @ 1000 hPa	13.5	16.5	11.6	8.0	11.1
RH (%) @ 850 hPa	13.9	16.0	28.1	14.0	20.3
RH (%) @ 700 hPa	16.0	16.3	25.4	12.9	24.3
RH (%) @ 500 hPa	12.5	14.6	19.6	9.1	24.7
RH (%) @ 400 hPa	11.8	11.0	14.9	6.4	18.2
RH (%) @ 300 hPa	11.8	13.3	12.4	9.5	18.5
Q (g/kg) @ 1000 hPa	1.41	1.11	1.27	1.43	2.92
Q (g/kg) @ 850 hPa	1.09	.578	3.11	1.75	3.01
Q (g/kg) @ 700 hPa	.942	.393	2.99	1.64	2.54
Q (g/kg) @ 500 hPa	.319	.107	.346	.411	1.47
Q (g/kg) @ 400 hPa	.149	.040	.094	.141	.557
Q (g/kg) @ 300 hPa	.054	.014	.030	.067	.189

Overall, the performance of the SSM/T-2 moisture retrievals is promising. The reader is reminded that these statistics have been calculated using the original a-priori coefficients and a radiosonde database screened by very simple error checks. Updated coefficients will eliminate the observed system biases and most certainly bring down the RMS. As a follow-on to this initial study, SSM/T-2 derived layered water vapor mass will be compared to the total water vapor mass retrieved from the SSM/I.

1.4 Conclusions and Recommendations

Over water, measurements of SSM/T-2 channels in the vicinity of 183.31 GHz water vapor absorption line produce RMS deviations from the mean of the co-located MIR-measured TBs of 0.7 - 2.1 K with biases of up to 1.8 K in magnitude. RMS variation for these frequencies is larger for coastal FOVs (up to 2.4 K) with the largest variation for land backgrounds (up to 3.8 K). For the surface channels, 91 and 150 GHz, show larger RMS and bias, especially for the mixed (i.e. coastal) FOVs.

Radiative transfer calculations based on co-located radiosondes are generally in good agreement with SSM/T-2 TBs considering that there was no consideration of clouds and weather conditions within the SSM/T-2 FOV which could also affect the TBs measured within the SSM/T-2 FOV as well as the forward-calculated TBs. The three 183.3 GHz channels had RMS differences of up to 7.8 K. The larger discrepancies for the transparent channels are a result of the channels sensing the surface, for which mean emissivities used in the RT simulations underestimate the SSM/T-2 observations over land and overestimate them over the ocean.

Studies of the variations of the on-orbit calibration performed by Aerospace indicate the instrument is very stable. The analysis of the underflights indicate that the SSM/T-2 is performing within or exceeds the original specifications. This calibration study has shown that for operational utilization there are no apparent or consistent instrument biases.

The SSM/T-2 retrieved vertical moisture profiles (excluding observations contaminated by heavy cloud) compare within ± 30% RH with co-located radiosonde data except over certain ocean atmospheres. The radiosonde database included Asian continent stations where high altitude stations may have questionable observation accuracies. These stations were not removed from the database for this study, therefore the results should be considered as a worst case scenario. The linear biases that were observed between the SSM/T-2 versus radiosonde comparisons will be eliminated when the a-priori regression coefficients are updated. The improvement in retrieval accuracy via the update of regression coefficients is a high priority task and will be pursued as soon as possible.

The SSM/T-2 has not been advertised as an imager; however, this study indicates that the SSM/T-2 is capable of yielding high quality EDR imagery. The detailed imagery should motivate the modeling community to consider assimilating the SSM/T-2 data into operational analysis as well as using the imagery itself as a means of rapid quality control of the data prior to assimilation in the numerical models. In addition, the SSM/T-2 TBs rendered as multichannel imagery are interesting. Work to date includes combining the 91, 150 and the 183.3 ± 1 GHz channels. This particular choice of channels and colors brings out the structure of small scale storms very effectively. The interpretation of the

multichannel data is, at times, very complex. The 183.3 GHz channel is the most difficult to deal with since both absorption, re-emission and scattering are occurring.

This initial validation study has the following set of recommendations: (1) detailed analysis of the a-priori ocean atmosphere Types 3 and 5, (2) careful inspection of the radiative transfer code implementation, (3) detailed analysis of the inferred heavy cloud flag over ocean, and finally (4) a careful update to the a-priori D-Matrices.

In summary, the experience that the user community gains by working with the SSM/T-2 data as both a point measurement and a volume averaged variable in the numerical weather prediction models, will simplify the transition to the higher resolution SSMIS soundings. It is imperative that proper attention be given to the fine tuning of the SSM/T-2 during a follow-on effort since all lessons learned will be directly applicable to the SSMIS system.

SSM/T-2 CALIBRATION DATA ANALYSIS

2. SSM/T-2 Instrument Calibration

2.1 Introduction

The Phillips Laboratory (PL/GPAS) is the principal investigator for the calibration and validation (Cal/Val) of the Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave Water Vapor Sounder (SSM/T-2). The calibration portion of this study is a cooperative PL/NASA/AER program. The aim of this research project is to calibrate the SSM/T-2. The first calibration technique is to underfly the DMSP F-11 satellite with a NASA ER-2 high-altitude aircraft which is outfitted with the NASA MIR and compare the co-located measurements. MIR measured TBs are accurate to less than 1 K (Wang, personal communication, 1992). The second calibration method compares SSM/T-2 TBs to co-located TBs calculated using radiosonde profiles in radiative transfer models.

Two specific air campaigns were planned: 1) on the west coast of the U.S. during the 14th and 15th of May 1992; and 2) over the east coast of the U.S. on the 29th and 30th of July 1992 and/or the 6th and 7th of August 1992. The ascending pass of the F-11 parallels the west coast of the U.S. (Figure 1.2-1) whereas the descending pass closely parallels the east coast of the U.S. (Figure 1.2-2). These campaign choices allowed water vapor measurements under varying weather conditions and atmospheric air masses.

The aircraft flight paths were designed to maximize the variety of land and ocean background measurements for the calibration process. Figure 1.2-1, displaying the west coast ER-2 flight path and F-11 subsatellite track, illustrates this strategy. On 14 May, the ER-2 flew along the subtrack and along the side of the SSM/T-2 swath looking away from the sun (eastern side). On 15 May the ER-2 flew along and on both sides of the SSM/T-2 subtrack which looked toward and away from the sun. These measurements were examined to identify solar effects on the instrument.

The second method used to calibrate the SSM/T-2 was the comparison of operational satellite TBs with model-calculated TBs using co-located radiosondes as input into radiative transfer models. The criteria for co-location in time is $\pm$ 1 hour, and in space, 100 km. Radiosonde profiles were only used if measured moisture profiles extended up to at least 300 hPa. Radiosonde data span the time period between January 31 to August 7, 1992. Two radiative transfer models were used: (a) the Enhanced RADTRAN model (Falcone et al., 1979, 1982 and Isaacs et al., 1989), and (b) the Eyre microwave simulation model (Eyre and Woolf, 1988).

2.2 SSM/T-2 Instrument

The SSM/T-2 is a five-channel, total power, microwave radiometer. It has three channels situated symmetrically about the 183.31 GHz water vapor resonance line, at 183.31 ± 1, ± 3, ± 7 GHz, and two window channels at 150.0 and 91.655 GHz (see Table 2.2-1). Throughout section 2 the SSM/T-2 channels are referred in the text by their frequency rather than the Aerojet channel numbering system. The SSM/T-2 instrument consists of a single, self-contained module with a step-scan motion in the cross-track direction of ± 40.5°. The SSM/T-2 scan mechanism is synchronized with the SSM/T-1 so that the beam cell patterns of the two sensors coincide as shown in Figure 2.2-1. During each scan period, and for all five channels at twenty-eight discrete earth viewing positions, four discrete calibration measurements of a hot-load target (~300 K), and cosmic background radiation (~3 K) are monitored. Figure 2.2-2 shows the scan diagram of the SSM/T-2. The beams of the five SSM/T-2 channels have coincident centers (see Figure 2.2-3). A photograph of the SSM/T-2 unit with the thermal blanket and cover plates removed to disclose the interior construction is shown in Figure 2.2-4. The antenna aperture is covered with a protective cover which is removed upon installation of the unit on the spacecraft.

The SSM/T-2 employs a single offset parabolic reflector with a 2.6-inch diameter projected aperture. The reflector is shrouded to eliminate the possibility of rays from the sun striking either of the calibration paths and causing unwanted thermal gradients. The feedhorn is a corrugated pyramidal horn with a flare designed to minimize phase center separation over the bandwidth (91 to 183.3 GHz), while providing a spherical wave illumination of the reflector. Figure 2.2-5 shows the antenna pattern. For 183.3 GHz, the

Table 2.2-1. SSM/T-2 channel characteristics.

Center Frequency (GHz)	IF (GHz)	Nadir Field-of-View (km)	Beamwidth (degrees)	Peak Altitude (hPa)
91.665	1.5	84	6.0	surface
150.0	1.5	54	3.7	1000
183.3 ± 7	1.5	48	3.3	800
183.3 ± 3	1.0	48	3.3	650
183.3 ± 1	0.5	48	3.3	500

antenna efficiency is greater than 94%. Table 2.2-2 shows the antenna subassembly beam efficiency. A 3.3° beamwidth is achieved for the 183.3 GHz channels and larger beamwidths of approximation 3.7° and 6.0° for 150 and 91.655 GHz, respectively. These correspond to the following FOV diameters at nadir of ~48 km at 183.3 GHz, ~54 km at 150 GHz and 84 km at 91.655 GHz.

To achieve the cross-track scanning, the reflector alone rotates. The rotation of the reflector produces a rotation of the plane of polarization of the upwelling scene TBs which is permitted provided that the polarization remains identical for the two window channels and 183.3 ± 7 GHz. These channels must have the same polarization characteristics because they measure contributions from both the atmosphere and the surface. Note that all SSM/T-2 channels possess the same polarization.

The SSM/T-2 inflight warm-load calibration target is a derivative of the SSM/T-2 warm load calibration target. The warm load (~300 K) is shrouded to improve RF coupling of energy to the reflector/feedhorn antenna. This minimizes potential calibration errors arising from the reception of extraneous energy due to scattering of earth or solar radiation off of the spacecraft. The cold path shown in Figure 2.2-4 (lower right of instrument) is a cylindrical oversized waveguide tube which permits a direct view of the cosmic background (~3 K) by the antenna reflector during calibration (see Aerojet reports, June, 1990; January, 1991; and April, 1988)

Table 2.2-2. Antenna subassembly beam efficiency of the SSM/T-2 B5 unit aboard F-11.

Beam Position	Specified Beam Efficiency	Measured Beam Efficiency
1	≥93%	94.29%
14	≥93%	94.43%

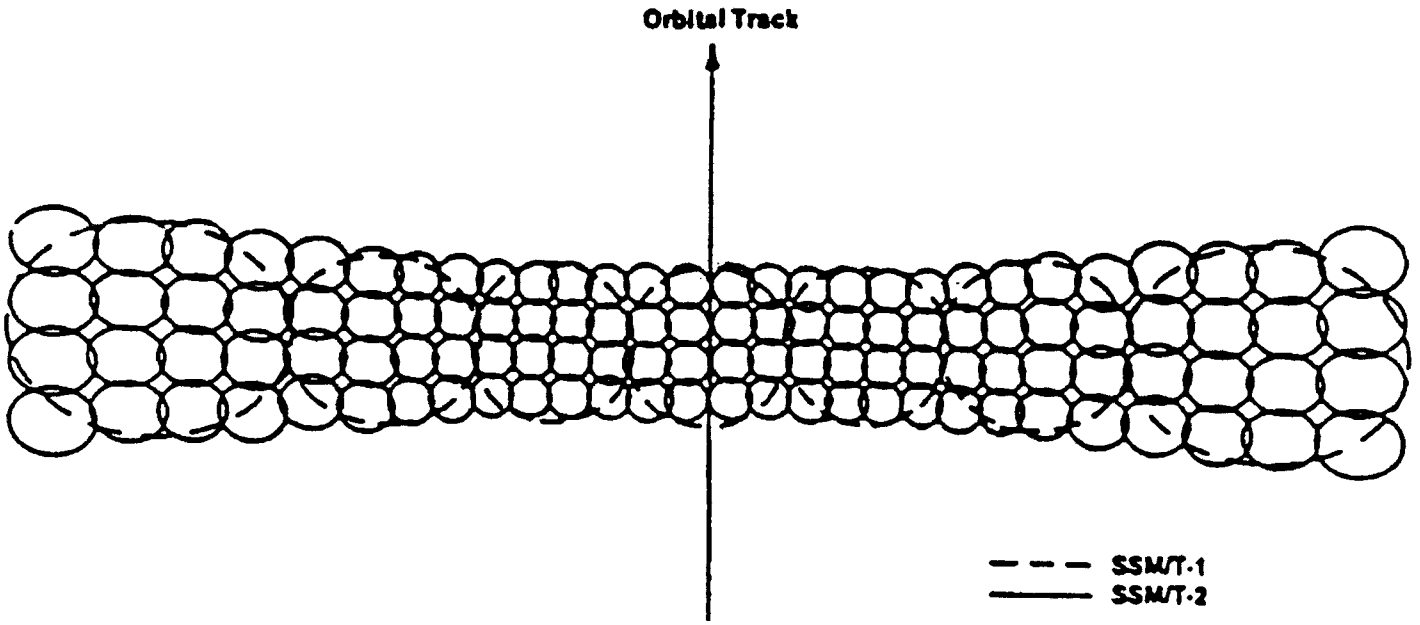


Figure 2.2-1. Comparison of SSM/T-1 and SSM/T-2 FOV patterns.

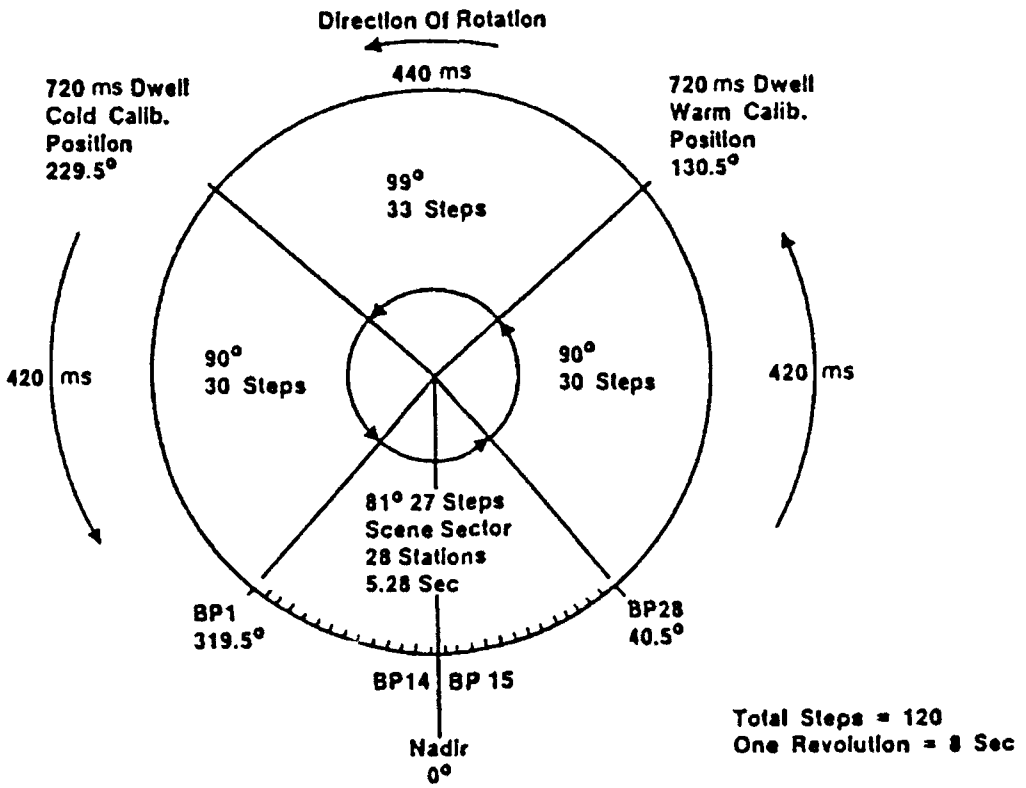


Figure 2.2-2. SSM/T-2 scan diagram.

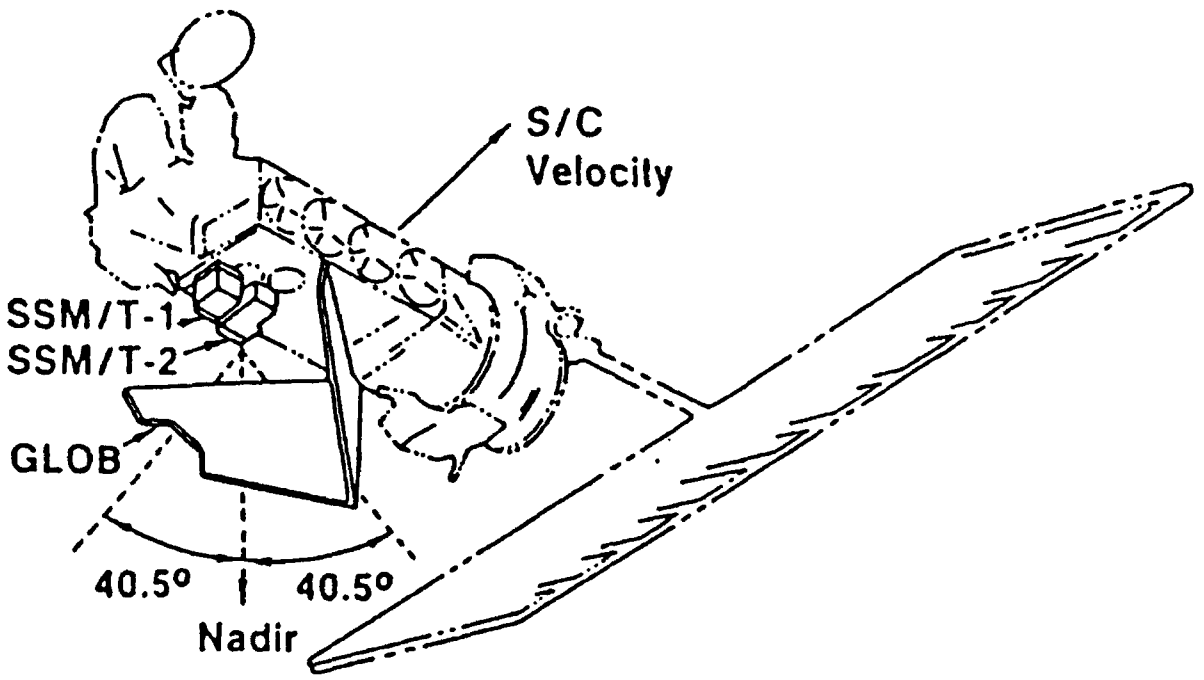


Figure 2.2-3. The configuration of the SSM/T-2 and its location of the DMSP spacecraft (F-11).

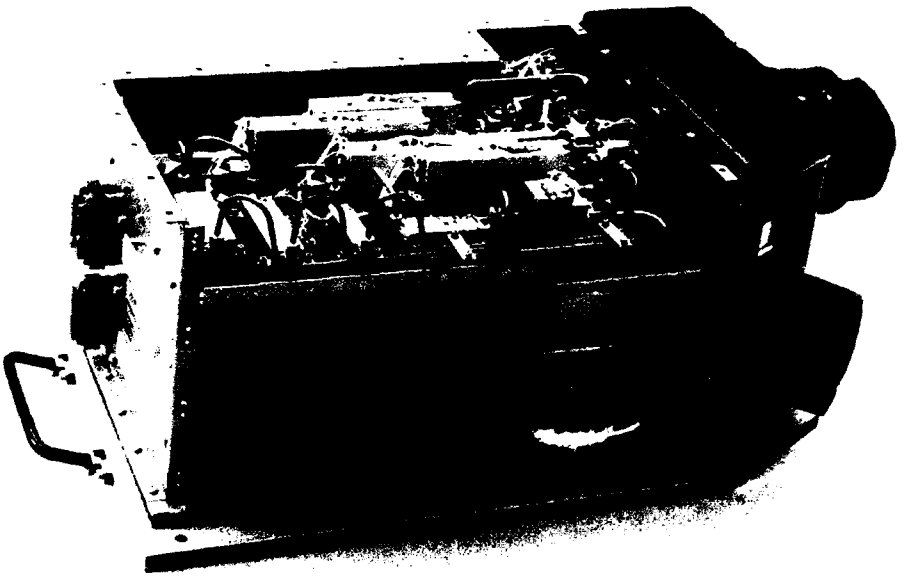


Figure 2.2-4. A photograph of the SSM/T-2 unit with the thermal blanket and cover plates removed to disclose the interior construction. The antenna aperture is covered with a protective cover which is removed upon installation of the unit on the spacecraft.

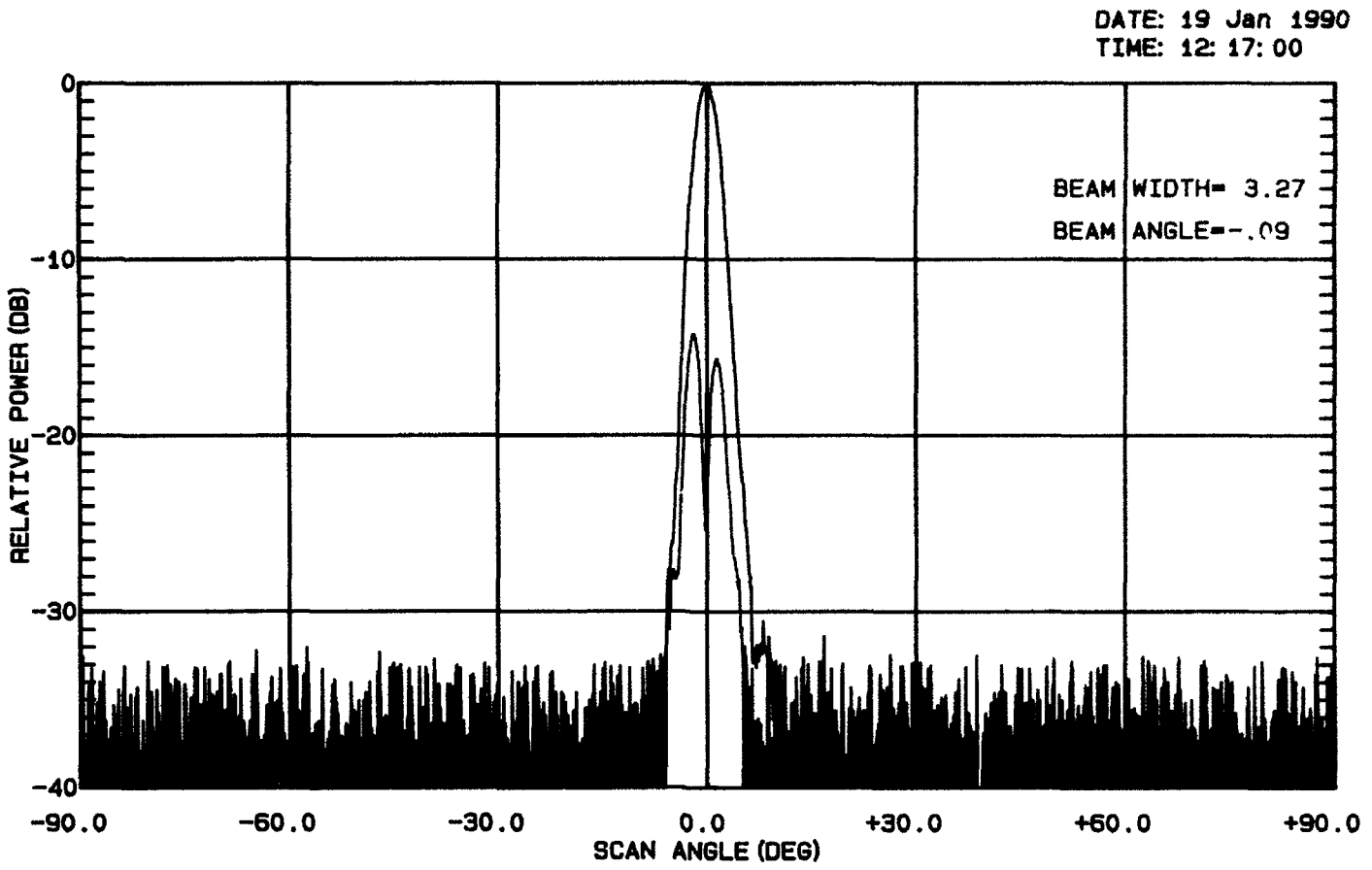


Figure 2.2-5. SSM/T-2 183.3 GHz antenna pattern.

2.2.1 Instrument Sensitivity

Since the SSM/T-2 has a total power radiometer receiver configuration, the radiometer sensitivity, i.e. the minimum detectable change in the radiometric antenna temperature ΔT of the observed system is:

$$\Delta T = T_{sys}\left[\frac{1}{B\tau}+\left(\frac{\Delta G}{G}\right)^2+\left(\frac{\Delta T_v}{T_{sys}}\right)^2+\left(\frac{\Delta T_q}{T_{sys}}\right)^2\right]^{\frac{1}{2}}$$

where T_{sys} = $T_A + T_{REC}$ (the system noise temperature),

ΔT = noise equivalent temperature difference,

T_A = the scene TB incident on the antenna aperture,

T_{REC} = the receiver input noise temperature,

B = the predetection bandwidth,

τ = radiometer scene integration time,

$\frac{\Delta G}{G}$ = effects of characteristics associated with total power radiometer, i.e. gain fluctuations, $\frac{1}{f}$ type electronic noise, power supply variations, etc.,

ΔT_v = RMS video electronic noise,

ΔT_q = RMS quantization noise.

By design the contributions to the ΔT from the video and quantization noise are much smaller than the wide-band thermal noise term (i.e., the $1/B\tau$ term). The contribution of $\Delta G/G$ are minimized by employing stable components and frequent radiometer calibrations at the input to the antenna aperture.

The SSM/T-2 employs a calibration period of 8 seconds in which four samples are taken of a warm-load calibration target along with four samples of the cosmic background. The periodic calibration data are modeled by a linear transfer function to characterize the state of the total power radiometer and remove time variations of the receiver gain and offset for frequencies less than half the reciprocal of the calibration period. As a consequence relatively large temperature-related receiver gain drifts are taken into account in the periodic construction of the transfer function.

Ground based calibration estimates of the ΔT are obtained by operating the SSM/T-2 in a thermal/vacuum chamber in a configuration that resembles actual orbital conditions. Two primary standard calibration targets operating in the range of 300 K and 80 K are sequentially viewed by the SSM/T-2 every 8 seconds for a duration of 4

samples. The warm primary standard is subsequently viewed for 28 samples which corresponds to the number of earth viewed scenes on orbit. This procedure is repeated until eight scans of data are collected. At this point the warm and cold calibration data are fitted by a linear transfer function to characterize the state of the radiometer over the eight scans. The sampled variance of the 224 samples (8 * 28) of raw output counts is computed next and referenced to the input of the antenna aperture using the slope of the transfer function. This procedure is repeated many times, averaged and the square root taken to obtain an estimate of the ΔT. Table 2.2.1-1 shows the ΔT.

Table 2.2.1-1. Calibration test results of the SSM/T-2 B5 unit aboard F-11.

All Values K Baseplate Temperatures - Nominal 10 C, Low 5 C, High 25 C						
GHz	Channel	ΔT Nominal	ΔT High	ΔT Low	ΔT Required	Accuracy Required
183.3 ± 3	1	0.50	0.53	0.50	≤0.6	≤1.5
183.3 ± 1	2	0.44	0.43	0.49	≤0.8	≤1.5
183.3 ± 7	3	0.64	0.60	0.63	≤0.6	≤1.5
91.655	4	0.43	0.43	0.41	≤0.6	≤1.5
150	5	0.49	0.50	0.47	≤0.6	≤1.5

2.2.2 Instrument Stability

An examination of the stability of the SSM/T-2 electronics has shown the instrument to be very stable. Figure 1.1-2 shows the absolute stability of the SSM/T-2 sensor. The differences are almost constant throughout the orbit.

Figure 1.1-3 shows the total noise (thermal and electronic) of the instrument over the calibration period of 8 consecutive scans. 183.3 ± 7 and 150 GHz are the noisiest with standard deviations of approximately 5 counts (where 11 counts = 1 K). This translates to a "minimum detectable" temperature difference (ΔT) of 0.45 K. All these measurements are raw data with no thermal variations applied, thus both thermal and electronic noise variations are included. This approach assumes the worst case scenario for SSM/T-2 stability.

2.3 MIR Instrument

This section describes the MIR that has recently been developed by NASA Goddard Space Flight Center. The MIR is a 9-channel total power radiometer developed for atmospheric research. Three dual-pass band channels are centered about the strongly opaque 183.3 GHz water vapor absorption line; the frequencies are 183.3 ± 1, ± 3, and ± 7 GHz. Another channel is located on the wing of this line at 150 GHz. These four channels have varying degrees of opacity from which the water vapor profile can be inferred. In addition, there are two window channels located at 89 GHz and 220 GHz. The design includes three additional channels centered about the 325 GHz water vapor line which are to be supplied by Georgia Institute of Technology. The 325 GHz channels were not available for these campaigns and the 220 GHz channel was not utilized in this study.

The MIR is designed using total power radiometric principles. Low receiver noise temperature, wide bandwidth, stable temperature, and frequent through-the-lens calibration (every 3s) yield single-pixel temperature sensitivities of less than 1 K for all the channels. There are five lens/feedhorn antennas, each immediately followed by a double-side band mixer. The 89 GHz and 150 GHz channels use balanced mixers; the 183.3 GHz, 220 GHz, and 325 GHz use subharmonic mixers. Gain fluctuations and drifts in oscillator frequency are minimized by using proportional controllers to stabilize receiver component temperature. The IF mixer output is amplified 60 dB by a two-stage low-noise amplifier and bandpass filtered. A triplexer is used for the 183.3 GHz and 325 GHz channels to separate the received signal into three bands. Absolute calibration is performed every scan cycle by consecutively staring at the hot (~330 K) and cold (~250 K) calibration loads. The MIR is mounted in the fore body of the super wing pod on board the NASA ER-2 high altitude (~20 km) research aircraft (see photographs in Figure 2.3-1).

Table 2.3-1 summarizes characteristics of each channel (Racette et al., 1992). The sensitivity is calculated using a 75 ms integration period and gain variations factor of 10^{-4}. During the SSM/T-2 underflights, the sensor was directed to view the hot and cold calibration targets sequentially on every scan and for an extended period of time every 30 minutes. Analysis of the ~360 radiometric samples from either the hot or cold calibration targets, gave an estimation of the actual temperature sensitivity (ΔT) of the sensor. For the three window channels at 89, 150 and 220 GHz, ΔT is on the order of 0.2 K, which is comparable to that from theoretical calculations. For the other three channels near 183.3 GHz, ΔT is about 0.5 K, which is somewhat higher than those given in Table 2.3-1.

The temperature distribution on the hot and cold calibration targets is measured using an array of eight resistive temperature devices (RTDs) embedded in each target.

Table 2.3-1. MIR receiver characteristics.

Center Frequency (GHz)	IF Pass Band (GHz)	Receiver Temperature (K)	Sensitivity (K)
89.0	1.0 ± 0.5	< 630	< 0.2
150.0	1.0 ± 0.5	< 860	< 0.2
183.0	1.0 ± 0.5	< 2000	< 0.4
	3.0 ± 1.0		< 0.3
	7.0 ± 1.0		< 0.3
220	2.5 ± 1.5	< 2000	< 0.3
325	1.0 ± 0.5	< 3500	< 0.6
	3.0 ± 1.0		< 0.5
	8.5 ± 1.5		< 0.5

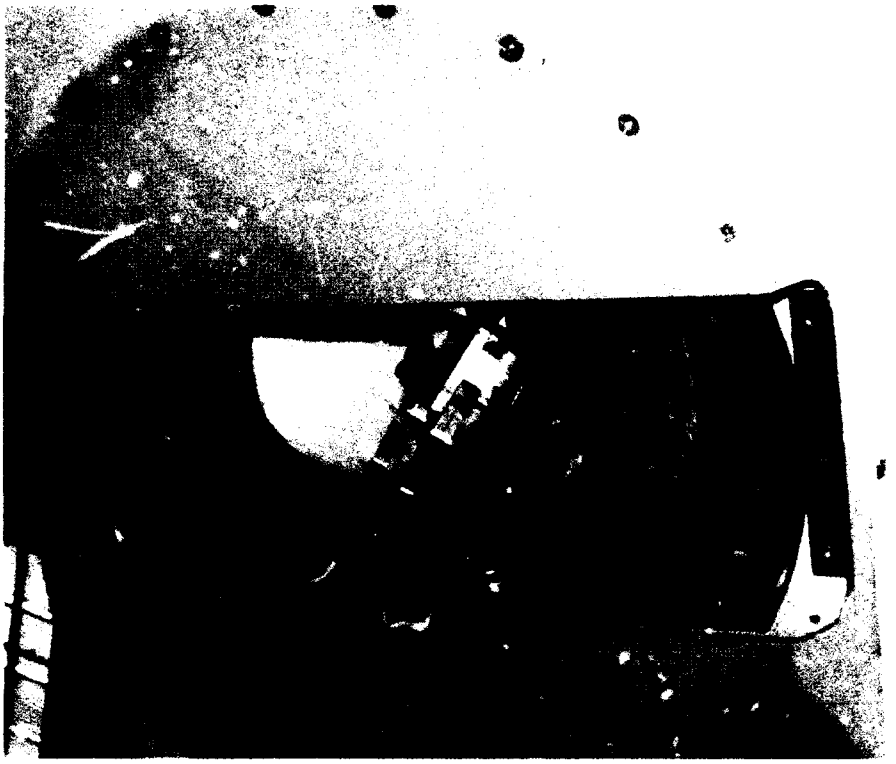
Thermal gradients during the flights were found to be no greater than ± 0.5 K across the targets. This suggests that the probable error in the calibrated MIR TB should be less than ± 1 K in the TB range of 250 - 330 K. The measured TBs for the three 183.3 GHz channels fall in this range. For the 89 GHz channel, the measured TB over the ocean surface could be as low as 200 K and the error in the radiometric measurements could exceed 1 K. The calibration accuracy of the MIR in the temperature range outside of that defined by the hot and cold calibration targets is currently under investigation.

Each of the four receiver channels (89, 150, 183.3 and 220 GHz) has its own antenna system, which consists of a corrugated feed horn and lens. All the lenses have surface-matching groves on both sides to maximize beam efficiency. Table 2.3-2 summarizes the E- and H-plane half-power beamwidths and first side-lobe levels. Figures 2.3-2 and 2.3-3 show the typical E-plane antenna patterns measured at 89 GHz and 183.3 GHz respectively. Scanning of the beam patterns is achieved by rotating a flat gold-plated reflector. The antenna beam efficiency exceeds 92% for all four receiver channels.

Table 2.3-2. MIR half-power beamwidths and first side-lobe levels.

Antenna Pattern Summary	Beamwidth		1st Sidelobe	
	E-Plane	H-Plane	E-Plane	H-Plane
89 GHz	3.2°	3.6°	24 dB	25 dB
150 GHz	3.3°	3.3°	24 dB	21 dB
183.3 GHz	3.5°	3.5°	29 dB	27 dB
220 GHz	3.3°	3.4°	27 dB	30 dB

a



b

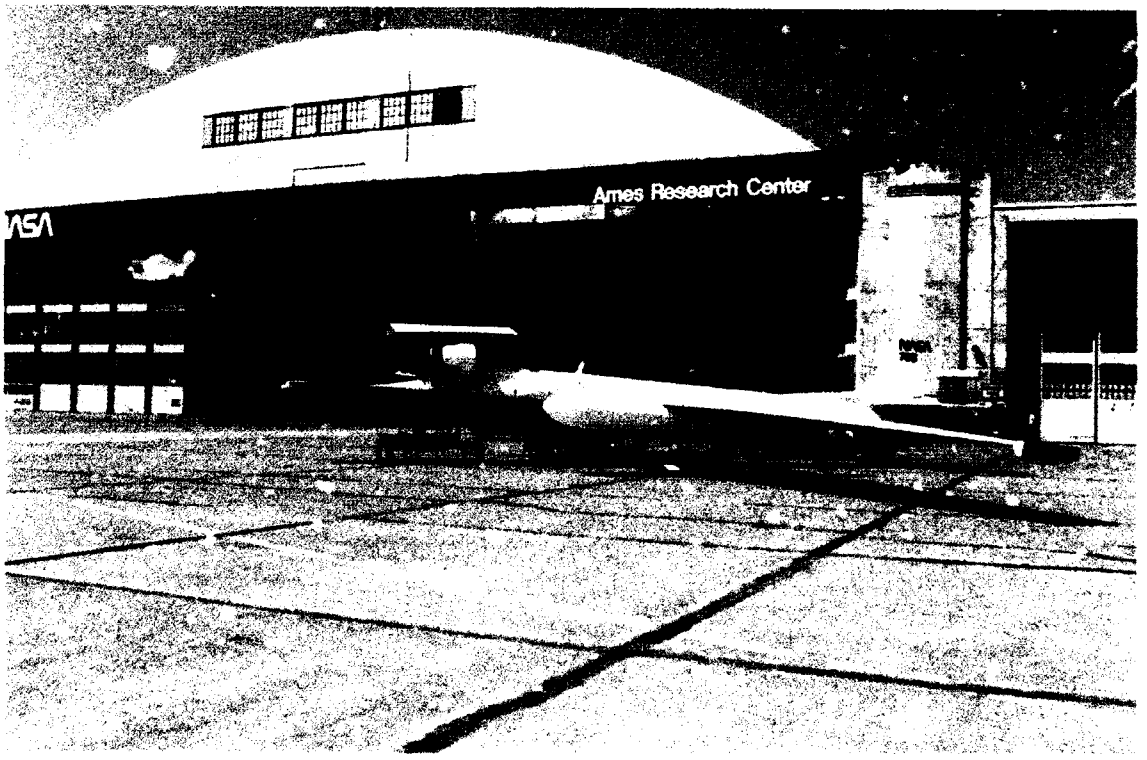


Figure 2.3-1. Photographs of the MIR (a), which is mounted in the fore body of the super wing pod on board the NASA ER-2 high altitude (~20 km) research aircraft (b).

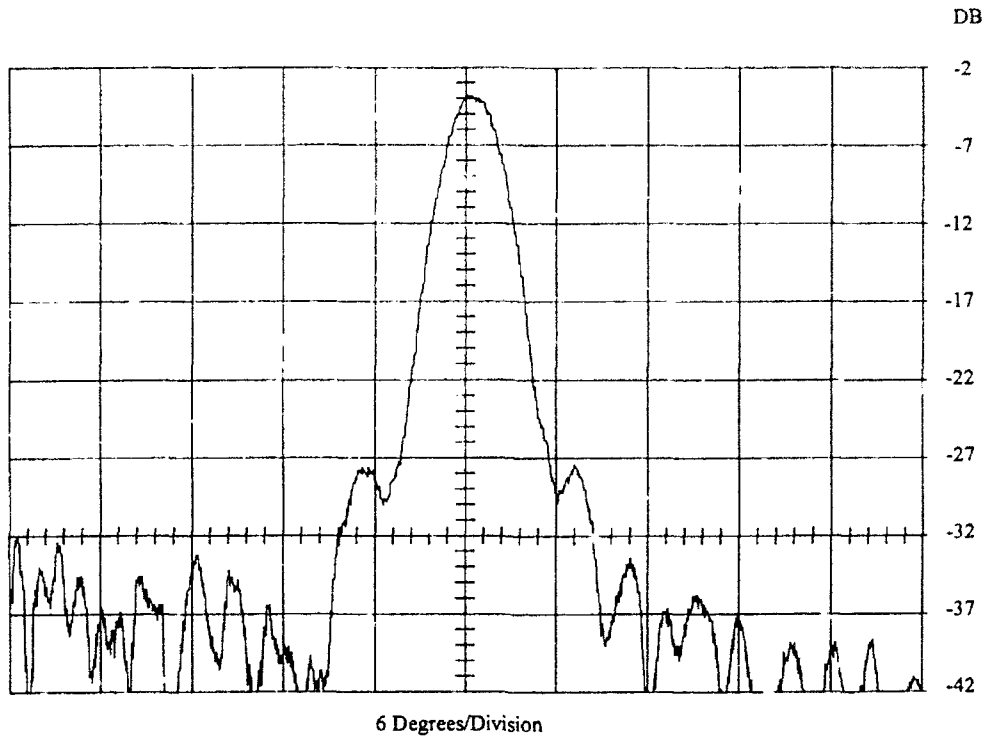


Figure 2.3-2. The typical E-plane antenna pattern measured at 89 GHz.

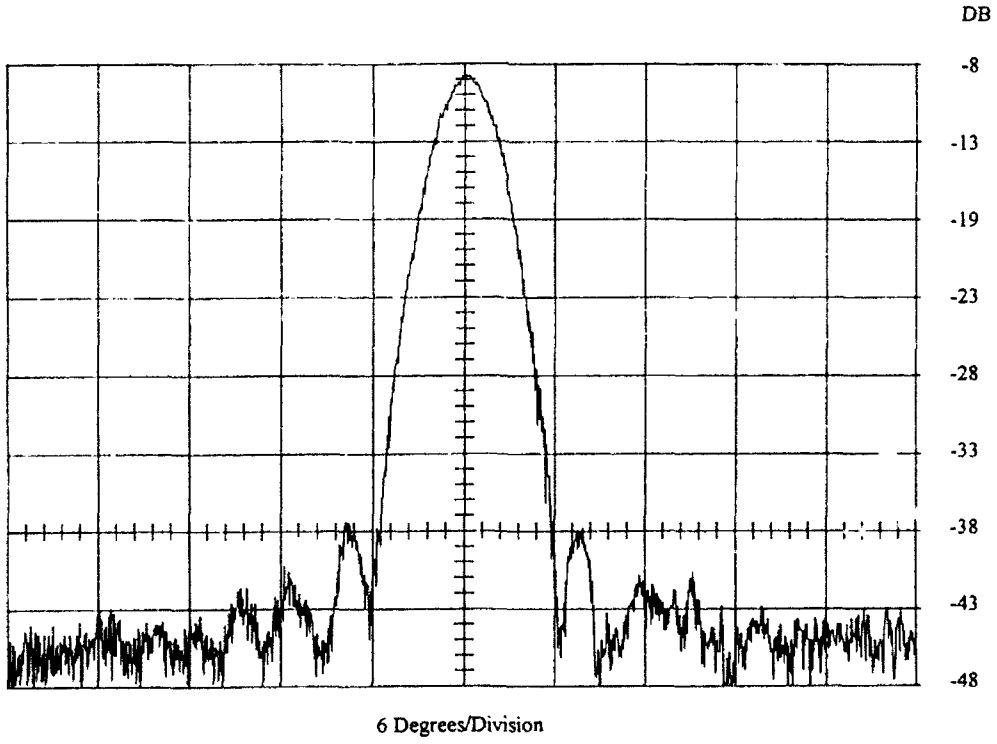


Figure 2.3-3. The typical E-plane antenna pattern measured at 183.3 GHz.

2.4 Description of Aircraft Campaigns

Weather support for the calibration/validation effort was critical. In calibrating the SSM/T-2 a comparison of the same scene as viewed by the satellite and by a similar instrument (MIR) on a high altitude aircraft (ER-2) are compared. Since both instruments are affected by water vapor and clouds of varying degrees, the atmospheric conditions have to be known before flights are made. In theory, what must be known before flight time is satellite track, aircraft track, cloud and earth surface properties. The latter condition of earth surface properties is required because the window channels (91 and 150 GHz) and possibly 183.3 ± 7 GHz see the surface. The "best" possible flight conditions for calibration and validation are a cloudless atmosphere over a flat (no wind) ocean surface. The satellite and aircraft should view the same varied atmosphere (with the exception of a frontal system which is too inhomogeneous in water vapor and clouds within a field-of-view) and as varied an earth surface as possible.

2.4.1 West Coast Aircraft Campaign

The proposed flight path of the ER-2 along the west coast of California was to traverse as much dissimilar terrain as possible in order to gather data from a wide variety of atmospheric paths and underlying surfaces. Roughly half the time airborne was spent over the water due to the belief that the best calibration is over ocean surfaces. Also, in order to test the time variance of water vapor at a specific location, the flight path was to have overlapping segments. The path was chosen to pass near the sites of a number of radiosonde launch events which were coordinated with the SSM/T-2 overpass. In particular, Vandenberg AFB, Point Magu and San Nicolas Island radiosonde stations provided additional non-synoptic soundings during the two days that the ER-2 flew. The proposed flight plan along the west coast, shown in Figure 1.2-1, is given below:

1) Take off from Moffet Field and fly east-southeastward to Mt. Whitney,
2) turn southeastward to China Lake Naval Air Station,
3) turn south-southwestward over Los Angeles to Santa Catalina,
4) turn westward and fly over San Nicolas Island to the satellite subtrack point (0050 UTC for 15 May) arriving at the position 33 N 122 W at the time of the satellite overpass for that day,
5) turn north-northwestward, parallel to the satellite subtrack for 15 May 0050 UTC until north of 35 N,
6) turn northeastward and fly to Fresno,
7) turn southeastward to Bakersfield,
8) turn south-southwestward and fly over Los Angeles to Santa Catalina,
9) turn westward and fly over San Nicolas Island to the satellite subtrack point,

10) turn north-northwestward, parallel to the satellite subtrack of 15 May 0050 UTC until north of 35 N, and
11) return to Moffet Field.

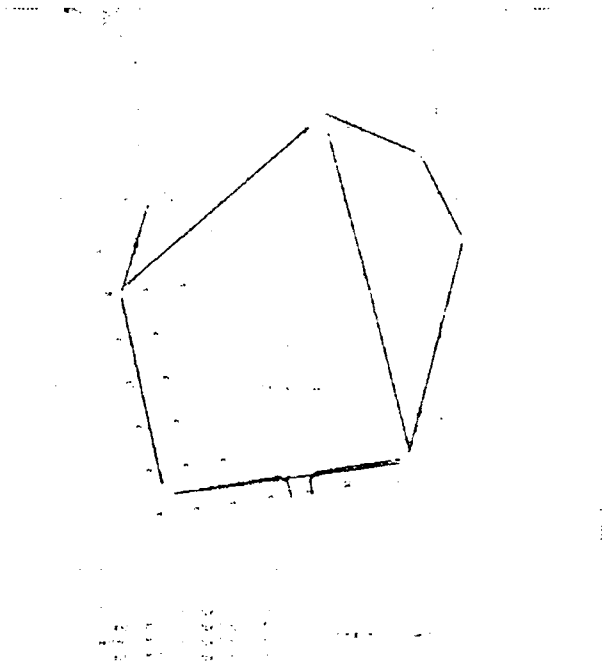
The ER-2 flights were made on May 14 and 15 (NOTE: the dates May 14 and 15 are based on local time, roughly 1700 local time; in universal time, the flights were made on May 15 and 16 at roughly 0050 UTC. For the purposes of this report, unless UTC is specified, the dates will refer to local time), with the only deviation from the above flight path arising from restricted airspace clearance not being given for a second overpass of China Lake NAS on 14 May, forcing the ER-2 to turn towards Los Angeles before reaching Bakersfield (7-8 above) (Figures 2.4.1-1 a-c and 2.4.1-2 a-c). On both days, low, thin stratus were located off the California coast, with some clear patches over water and clear over land as depicted by the visible GOES imagery (Figures 2.4.1-3 and 2.4.1-4). Also shown are the ER-2 flight tracks and SSM/T-2 FOV center locations.

On May 14, weak high pressure was located off the California coast with weak low pressure inland. This synoptic situation forced dry air southward along the California coast resulting in large areas of clear to scattered skies within 200 kilometers of the coast line. Inland was mostly clear with scattered cirrus clouds over central and southern California.

The synoptic situation on May 15 was dominated by a large ocean storm located several hundred kilometers off the California coast. The storm produced onshore flow and widespread low, thin, stratiform clouds over ocean areas. Inland sections remained mostly clear.

After the flights, NASA analyzed the MIR data, and Aerospace collected the SSM/T-2 data at AFGWC. In order to make the data more compatible with the calibration effort, NASA averaged the MIR data into 32 - 3° scan angle bins across the swath, with scan angles ranging ± 48°. The FOV of the averaged 3° values was 1 km in diameter at nadir.

a (91 GHz)



b (150 GHz)

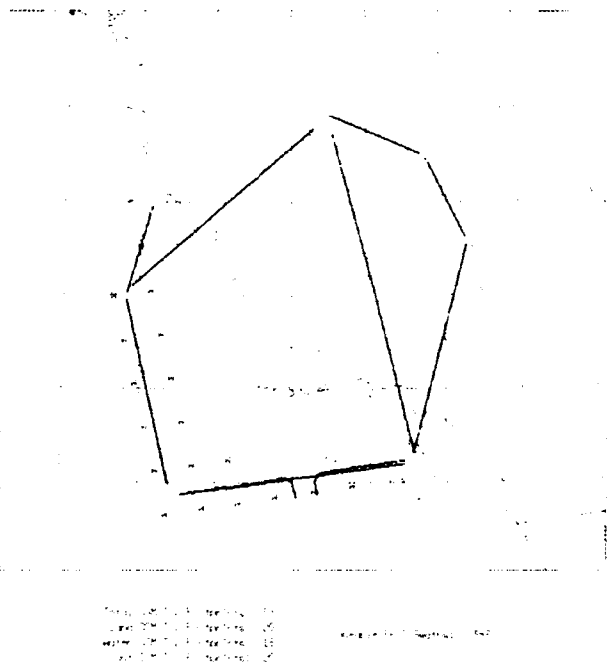


Figure 2.4.1-1 a-c. The positions and topographic distributions of SSM/T-2 FOVs that have co-located MIR data for roughly 0100 UTC May 15, 1992. The land (L), water (W) and coastal (C) classifications were determined by AFGWC. The fine dots represent the nadir positions of the MIR data. Usable MIR data were defined as data collected when the aircraft was above 19 km altitude and had a pitch and roll of less than 3°.

c (183.3 GHz)

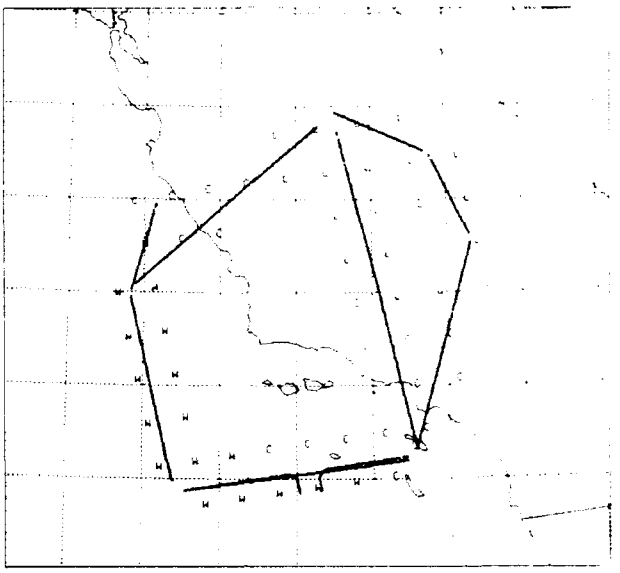
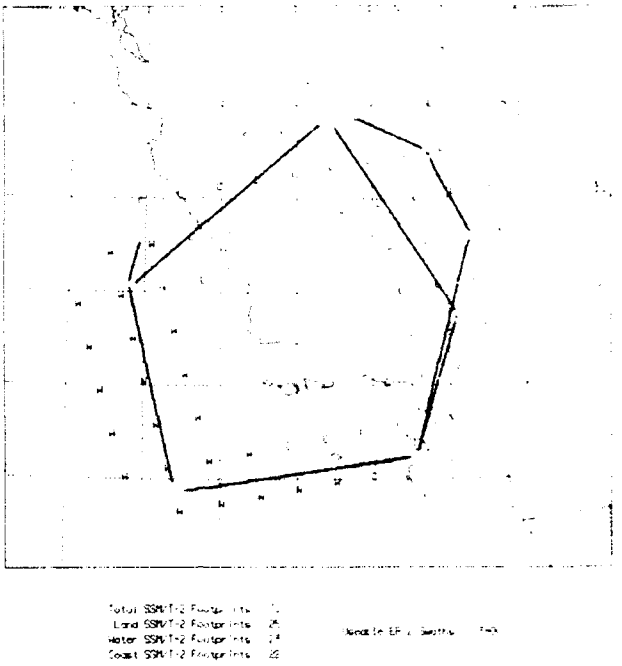


Figure 2.4.1-1. (continued).

a (91 GHz)



b (150 GHz)

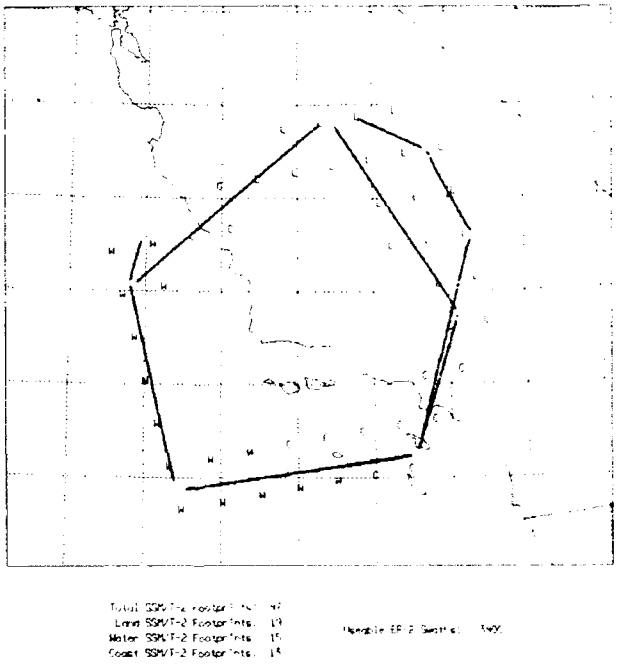


Figure 2.4.1-2 a-c. The positions and topographic distributions of SSM/T-2 FOVs that have co-located MIR data for roughly 0100 UTC May 16, 1992. The land (L), water (W) and coastal (C) classifications were determined by AFGWC. The fine dots represent the nadir positions of the MIR data. Usable MIR data were defined as data collected when the aircraft was above 19 km altitude and had a pitch and roll of less than 3°.

c (183.3 GHz)

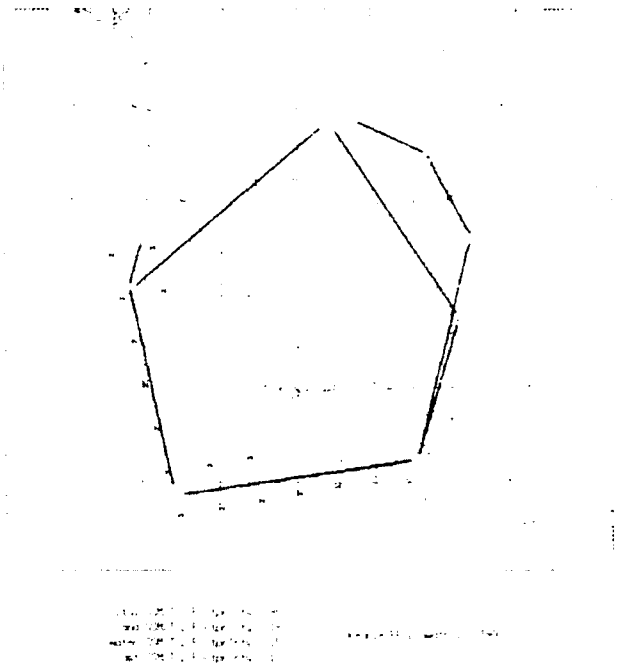


Figure 2.4.1-2. (continued)



Figure 2.4.1-3. Visible GOES imagery at 2330 UTC May 14 , 1992.



Figure 2.4.1-4. Visible GOES imagery at 0030 UTC May 16, 1992.

2.4.2 East Coast Aircraft Campaign

The two months separation between the west coast and east coast flights allowed time for some analysis of the May data set. The preliminary analysis of the west coast flights showed excellent agreement between the two instruments (SSM/T-2 and MIR) over water (~1 K). Data recorded by Aerospace concerning SSM/T-2 stability, showed the SSM/T-2 to be very stable (see Figure 1.1-2). These early results allowed Phillips Laboratory to declare that the SSM/T-2 was performing within or exceeding the original specifications and that for operational utilization there are no apparent or consistent instrument biases.

The early positive results allowed greater flexibility in the choice of aircraft flights on the east coast. It was decided that all weather systems be overflown with the ultimate goal of investigating atmospheric water vapor from clear to cloudy to rainy atmospheres, including frontal systems. The ER-2 flight paths of 29 and 30 July and 6 August were chosen to be the same without regard for the weather. The flight paths were chosen so as to fly over varied earth surfaces (land, ocean and coast) with emphasis on ocean surface temperature variations from 285 K in the Gulf of Maine to 297 K off Cape Hatteras and crossing the Gulf Stream. Also, as with the west coast flights, the flight path was to have overlapping segments in order to test the time variance of water vapor at a specific location. A number of National Weather Service (NWS) radiosonde launch sites provided additional non-synoptic soundings during the three days that the ER-2 flew along the east coast: Atlantic City (New Jersey), Albany (New York), Caribou (Maine), Chatham (Massachusetts), Cape Hatteras (North Carolina), and Portland (Maine). The proposed flight plan along the east coast, shown in Figure 1.2-2, is given below:

1) Take off from Wallops Island (37.85N 75.48W) and fly due west for 200 km during ascent,
2) turn and fly back across Wallops Island along a due east heading; fly past Wallops Island out over the ocean to the great circle arc intersecting Chatham (41.66N 69.96W) and Cape Hatteras (35.26N 75.55W),
3) turn and fly toward Chatham along the great circle arc intersecting Chatham and Cape Hatteras,
4) after flying over Chatham and reaching the latitude of Portland, Maine (43.65N), turn to a due west coarse,
5) fly for 200 km passing past Portland, Maine (43.65N 70.31W) along the due west heading,
6) turn and fly back to Chatham,
7) a Chatham, turn and follow the same great circle track that was initially followed to Cape Hatteras,
8) at Cape Hatteras, turn and fly to Wallops Island,

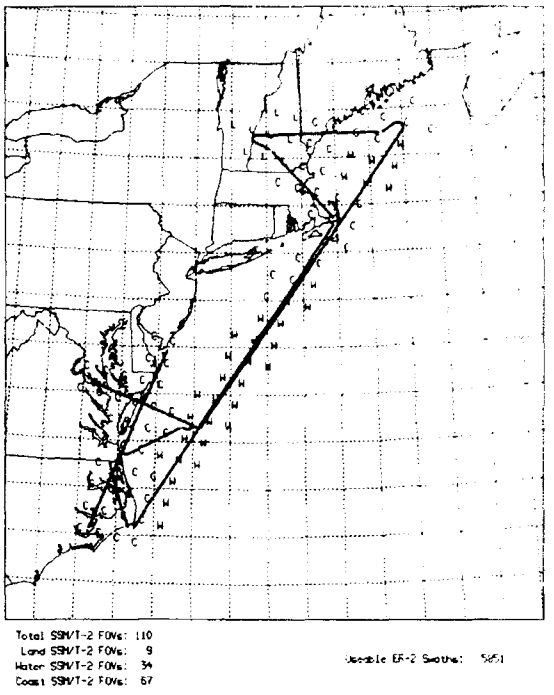
9) at Wallops Island, turn due east and fly to point that intersects the great circle arc between Chatham and Cape Hatteras,
10) at intersection, turn to a westward heading, flying back across Wallops Island, 200 km inland, and
11) turn and land at Wallops Island.

The only difference between the flight paths during each day of flying was the timing of the ER-2 with respect to that day's F-11 overpass. The ER-2 aircraft was required to be at roughly the halfway point of the flight (based on the total estimated flight time) at the time of the F-11 overpass. Figures 2.4.2-1 a-c through 2.4.2-3 a-c show the ER-2 flight path and SSM/T-2 FOVs for July 29 and 30 and August 6, 1992, respectively.

The ER-2 flights were made on July 29 and 30 and August 6. GOES visible imagery (Figures 2.4.2-4 through 2.4.2-6) show the cloud cover over the eastern seaboard for the three days (imagery is valid at 1230 UTC for each day). During the early morning hours of July 29, weak high pressure over the mid-Atlantic states resulted in mostly clear skies from New England to Cape Hatteras. On July 30, a cold front had passed through New England overnight and was located just offshore at daybreak. Extensive strato-cumulus clouds and fog were located over coastal sections with light rain showers just offshore. Broken clouds were present over inland sections of New England. The front was stalled along the mid-Atlantic coast where broken clouds and scattered thunder-storms were present. On August 6, high pressure was building into the New England and mid-Atlantic states, scattered clouds were present over inland areas from Maine south-westward to Maryland. Overcast skies and scattered showers were observed in Virginia and North Carolina. Broken clouds were present offshore from Maine to North Carolina.

The same procedure for MIR calibration and collection used for the west coast flights was followed for these flights. Again, NASA averaged the MIR data into 32-3° scan angle bins across the swath, with scan angles ranging ± 48° and FOVs of the averaged 3° values was 1 km in diameter at nadir.

a (91 GHz)



b (150 GHz)

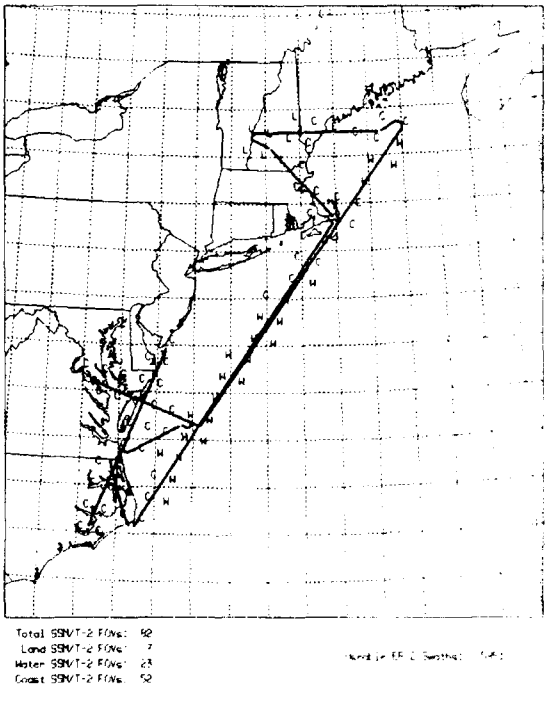


Figure 2.4.2.1 a-c. The positions and topographic distributions of SSM/T-2 FOVs that have co-located MIR data for roughly 1041 UTC July 29, 1992. The land (L), water (W) and coastal (C) classifications were determined by AFGWC. The fine dots represent the nadir positions of the MIR data. Usable MIR data were defined as data collected when the aircraft was above 19 km altitude and had a pitch and roll of less than 3°.

c (183.3 GHz)

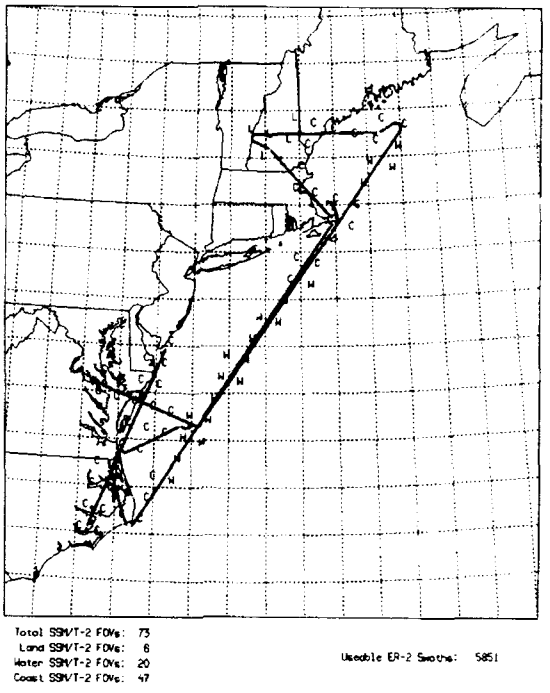
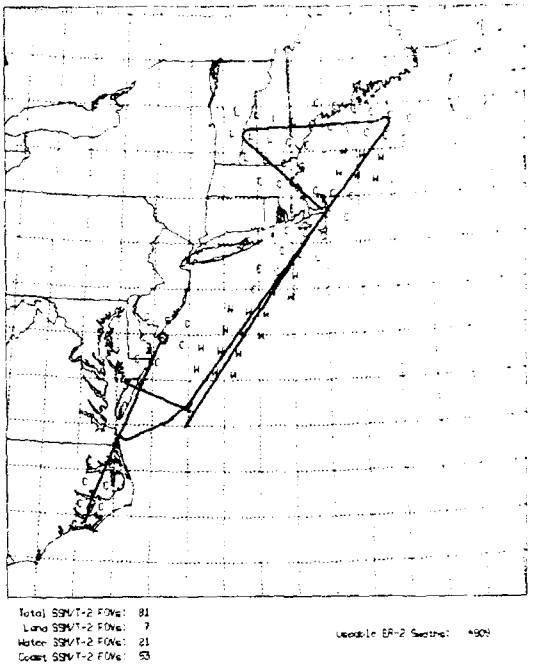


Figure 2.4.2-1. (continued).

a (91 GHz)



b (150 GHz)

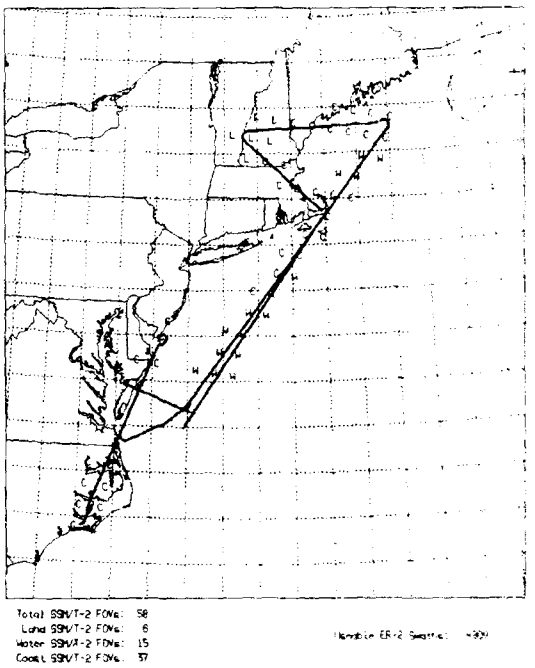


Figure 2.4.2-2 a-c. The positions and topographic distributions of SSM/T-2 FOVs that have co-located MIR data for roughly 1028 UTC July 30, 1992. The land (L), water (W) and coastal (C) classifications were determined by AFGWC. The fine dots represent the nadir positions of the MIR data. Usable MIR data were defined as data collected when the aircraft was above 19 km altitude and had a pitch and roll of less than 3°.

c (183.3 GHz)

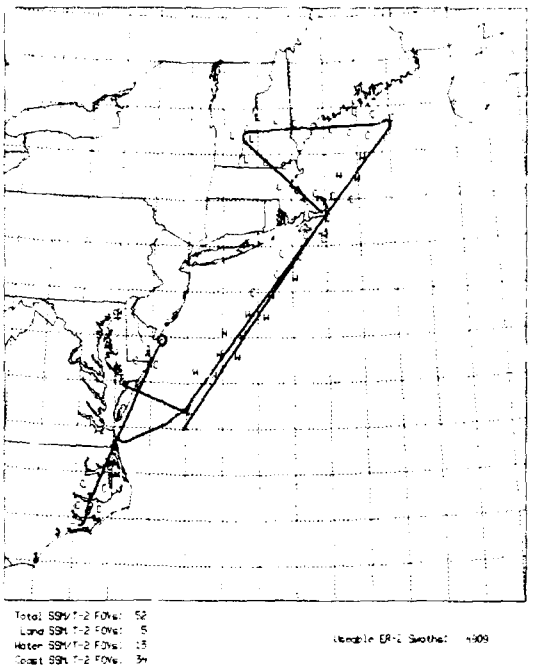
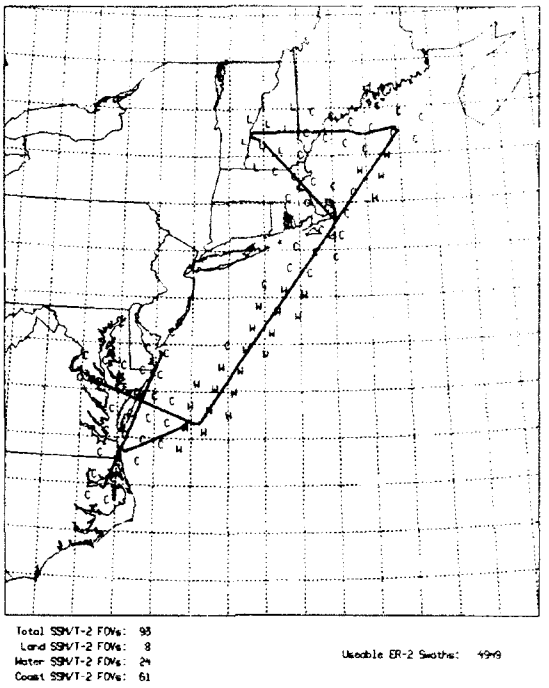


Figure 2.4.2-2. (continued).

a (91 GHz)



b (150 GHz)

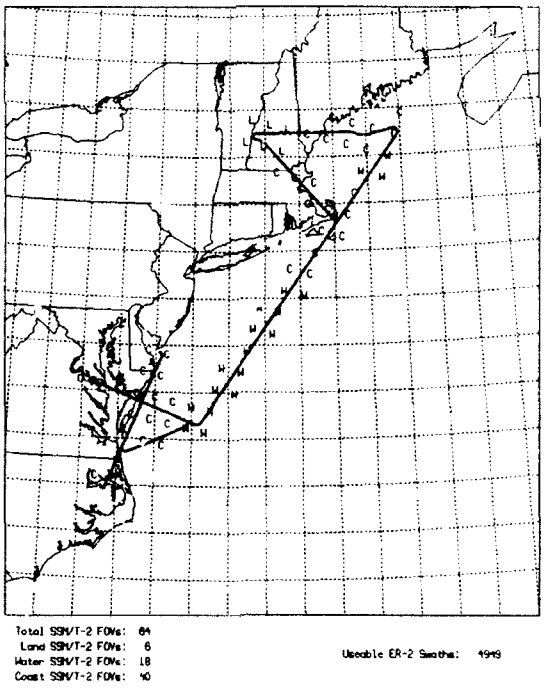


Figure 2.4.2-3 a-c. The positions and topographic distributions of SSM/T-2 FOVs that have co-located MIR data for roughly 1040 UTC August 6, 1992. The land (L), water (W) and coastal (C) classifications were determined by AFGWC. The fine dots represent the nadir positions of the MIR data. Usable MIR data were defined as data collected when the aircraft was above 19 km altitude and had a pitch and roll of less than 3°.

c (183.3 GHz)

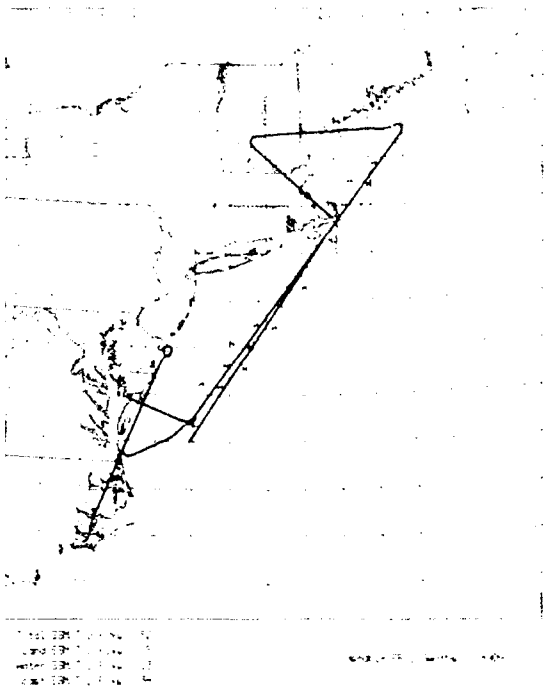
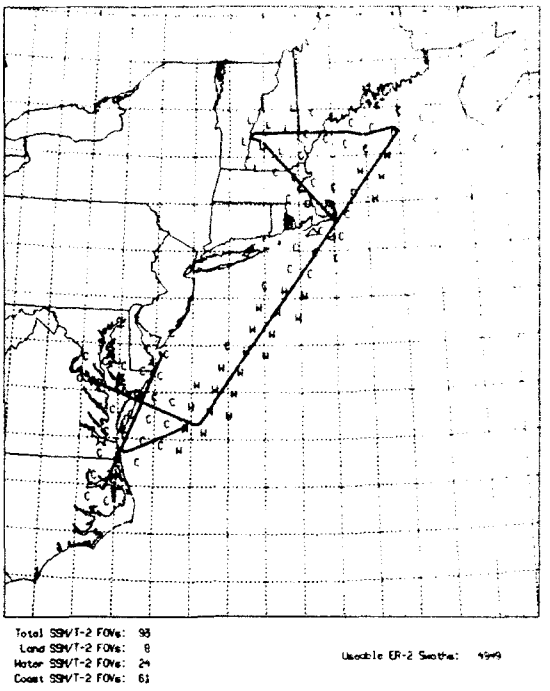


Figure 2.4.2-2. (continued).

a (91 GHz)



b (150 GHz)

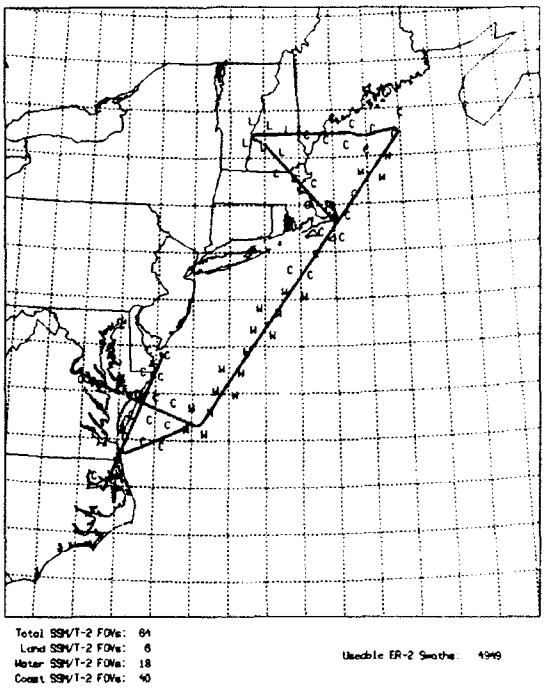


Figure 2.4.2-3 a-c. The positions and topographic distributions of SSM/T-2 FOVs that have co-located MIR data for roughly 1040 UTC August 6, 1992. The land (L), water (W) and coastal (C) classifications were determined by AFGWC. The fine dots represent the nadir positions of the MIR data. Usable MIR data were defined as data collected when the aircraft was above 19 km altitude and had a pitch and roll of less than 3°.

c (183.3 GHz)

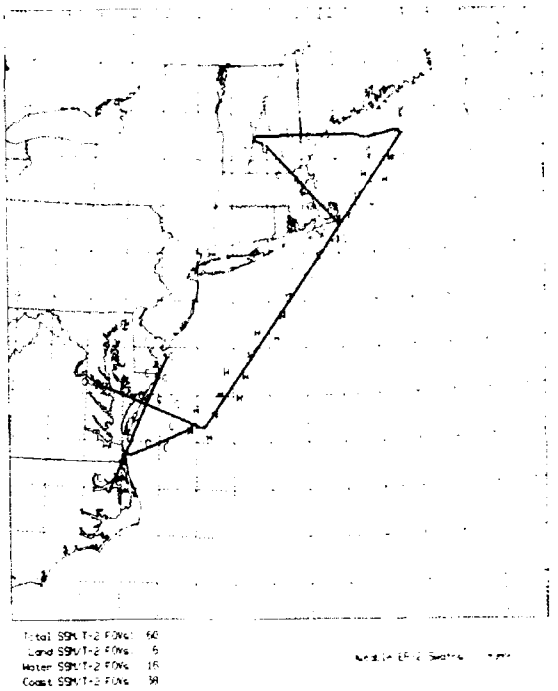


Figure 2.4.2-3. (continued).

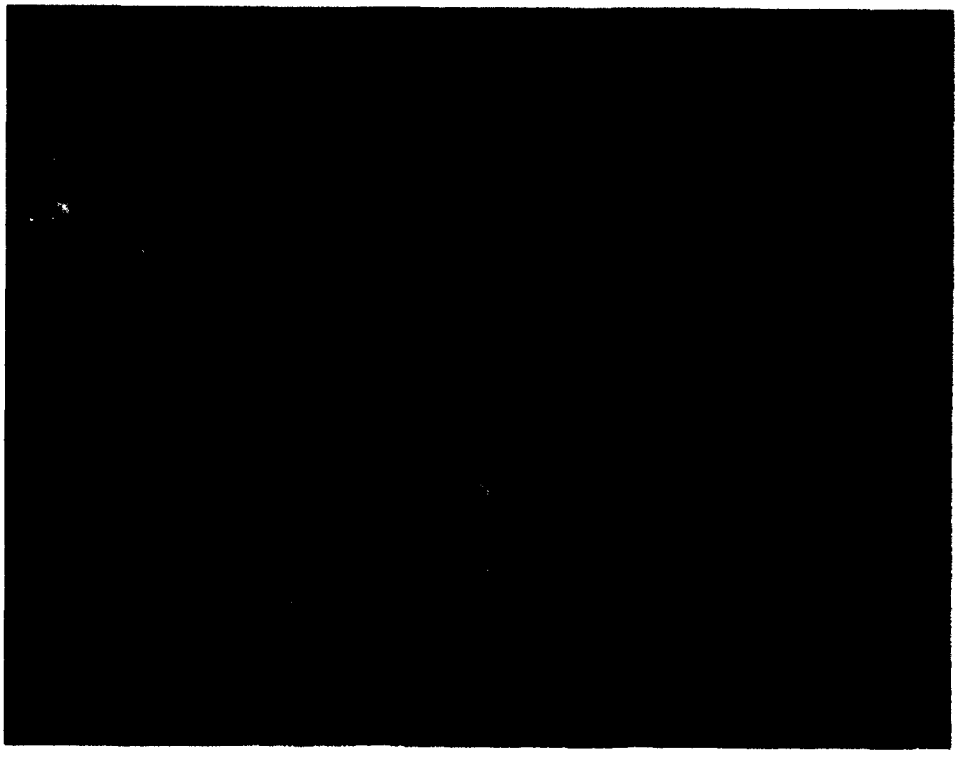


Figure 2.4.2-4. Visible GOES imagery at 1230 UTC July 29, 1992.

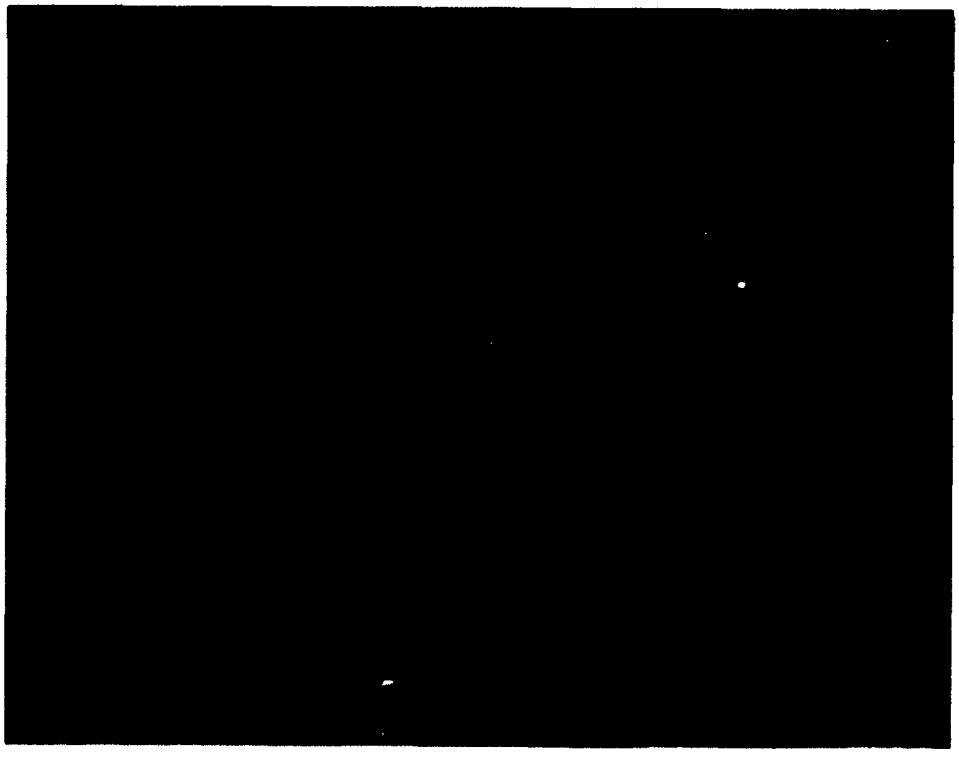


Figure 2.4.2-5. Visible GOES imagery at 1230 UTC July 30, 1992.



Figure 2.4.2-6. Visible GOES imagery at 1230 UTC August 6, 1992.

2.5 SSM/T-2 to MIR Co-locations

Co-locations of SSM/T-2 and MIR measurements were determined by calculating the distance between the center of the MIR FOV and the center of the SSM/T-2 FOV. co-location thresholds were defined for each channel frequency based on beamwidth for each SSM/T-2 channel (see Table 2.2-1). There was an adjustment made for the elliptical deformation of the FOV away from the SSM/T-2 subtrack (Figure 2.2-1). Since only the latitude and longitude of the ER-2 subtrack point were provided in the MIR data set, the latitude and longitude of each of the MIR FOVs across the swath had to be calculated. This was done by first calculating the heading of the ER-2 from positions during the previous 60 seconds of flight, and using this value along with the scan angle to compute the latitude and longitude of the FOVs across the swath. In order to minimize atmospheric path length effects on the MIR TB and ensure accuracy in the location of the MIR FOV, data were used only if the aircraft was at an altitude greater than 19 km with an aircraft pitch and roll less than 3°.

The SSM/T-2 data were limited to scan angles less than 28.5° due to operational processing of the SSM/T-1 and SSM/T-2 data at AFGWC. This limitation was imposed on the MIR data so that all scan angles greater than 28.5° were not used in this study. From this abbreviated database, two data sets of co-located SSM/T-2 and MIR data were created: the first containing only MIR data with the same scan angle as the co-located SSM/T-2 FOV and the second using all of the MIR data with scan angles $\leq 28.5°$ which fell within the SSM/T-2 FOVs regardless of MIR scan angle. In addition, since the ER-2 flight paths contained overlapping tracks, the time difference between the SSM/T-2 and MIR measurements was also calculated.

Figures 2.4.1-1 a-c and 2.4.1-2 a-c show the west coast ER-2 flight paths and the positions and topographic background classifications determined by AFGWC of the SSM/T-2 FOVs for the 91, 150 and 183.3 GHz channels that have co-located MIR data for May 14 and 15, respectively. The background stratification of land (L), water (W) and coast (C) is taken from the AFGWC fixed field data base (XFIX64), an eighth-mesh (48 km) gridded database (Kiess and Cox, 1988). For displays of the SSM/T-2 FOV topographic classifications for both the entire west coast and east coast regions, see Appendix C. In addition, the displays of the five SSM/T-2 channel TBs measured for both the west coast and east coast regions are shown in Appendix C. Figures 2.4.2-1 a-c, 2.4.2-2 a-c, and 2.4.2-3 a-c show the east coast ER-2 flight paths and the positions and topographic background classifications of the SSM/T-2 FOVs that have co-located MIR data for July 29 and 30 and August 6, respectively. Gaps or missing segments of the ER-2 flight paths are a result of the altitude and pitch/roll restrictions described above. The 91 GHz channel displayed more SSM/T-2 FOV co-locations than the higher frequency channels since the FOV beamwidth of the FOV is almost twice that of the higher frequencies, resulting in more overlapping fields-of-view.

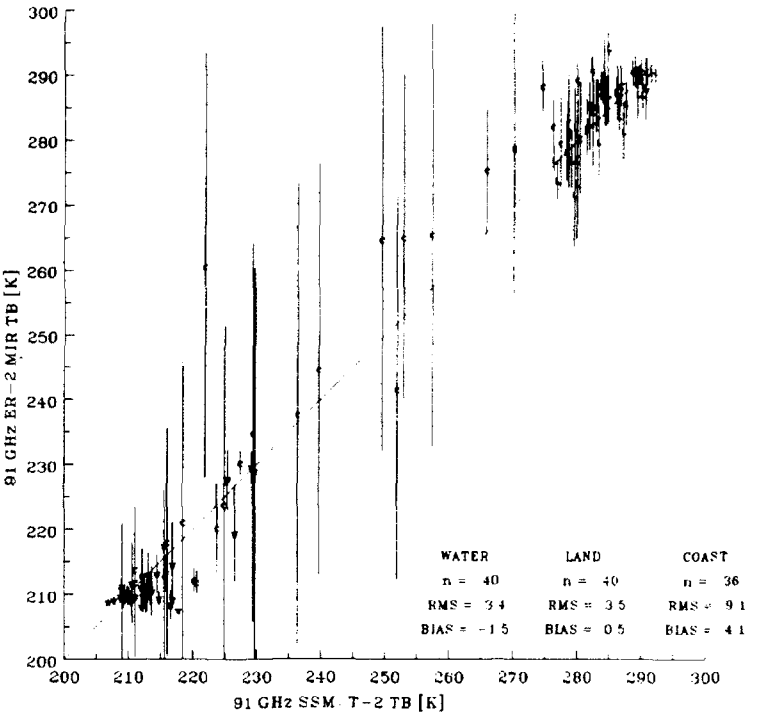
2.6 Comparison of SSM/T-2 and MIR Data

2.6.1 SSM/T-2 / MIR Comparisons Stratified by Topographic Background

SSM/T-2 data was stratified by topographic background to provide a dynamic range between low and high emissivity surfaces. For the combined west coast data, the SSM/T-2 TBs are compared to the mean co-located MIR TBs for the five channels of the SSM/T-2 sensor in Figure 2.6.1-1 a-e. The east coast data comparisons are presented in Figure 2.6.1-2 a-e. Unless stated otherwise, all MIR comparison data were limited to ± 1 hour of the time of the SSM/T-2 observations and to only those which had the same scan angle as the co-located SSM/T-2 data. The topographic backgrounds of the SSM/T-2 FOVs (land = L, water = W, and coastal = C) were determined by AFGWC and did not vary for the five sensor channel FOVs. The root mean square (RMS) and bias differences between the mean values of the co-located MIR data and the SSM/T-2 values were calculated for the three topographic backgrounds. In all cases, both the 91 and 150 GHz channels display large variations between the MIR and SSM/T-2 measurements for the coastal FOVs and considerably smaller variations for the land and water areas. This is due in part to large variations in surface emissivity (and hence observed TBs) for coastal FOVs where MIR FOVs over land and water areas are combined for comparison to a single SSM/T-2 measurement.

For the 89 GHz channel, examining the variance of MIR data within SSM/T-2 FOVs that are classified as water for both the west coast and east coast (Figures 2.6.1-3 a-e) reveals that the amount of variation of the MIR measurements within each SSM/T-2 FOV appears to be related to the distribution of clouds in the SSM/T-2 FOVs. Along the west coast and discounting the water-classified 89 GHz FOVs near Santa Catalina, the highest variance occurred where a cloud boundary appeared within the SSM/T-2 FOV. Since the GOES satellite images are 30 minutes apart and the ER-2 flights are greater than 4 hours in duration, it is difficult to precisely define the cloud boundaries within the SSM/T-2 and MIR FOVs. A more in-depth study of the relationship between the MIR and SSM/T-2 measurements of clouds in the FOVs will be considered in the near future.

a (91 GHz)



b (150 GHz)

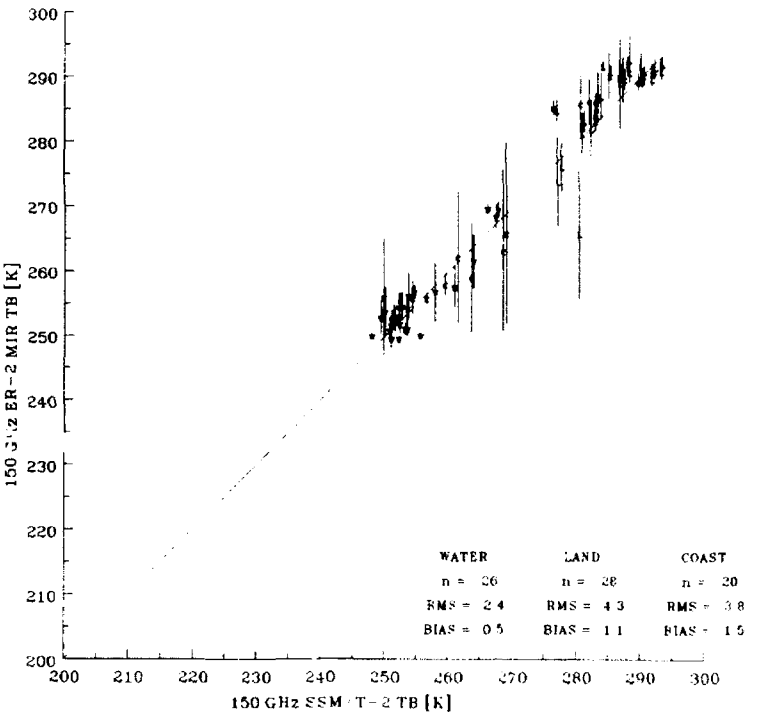
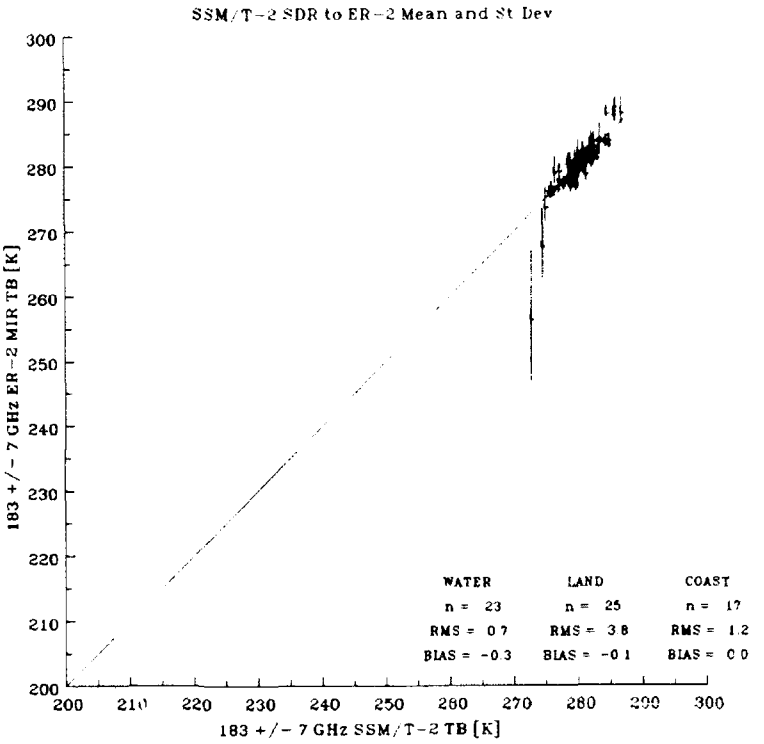


Figure 2.6.1-1 a-e. Comparison of SSM/T-2 TBs to the mean co-located MIR TBs for the five channels of the SSM/T-2 sensor of the west coast data. Vertical bars represent one standard deviation of the co-located MIR data in each SSM/T-2 FOV. MIR data were limited to ± 1 hour of the time of the SSM/T-2 observations and to only those which had the same scan angle as the co-located SSM/T-2 data. The topography of the SSM/T-2 FOVs is land = L, water = W, and coastal = C.

c (183.3 ± 7 GHz)



d (183.3 ± 3 GHz)

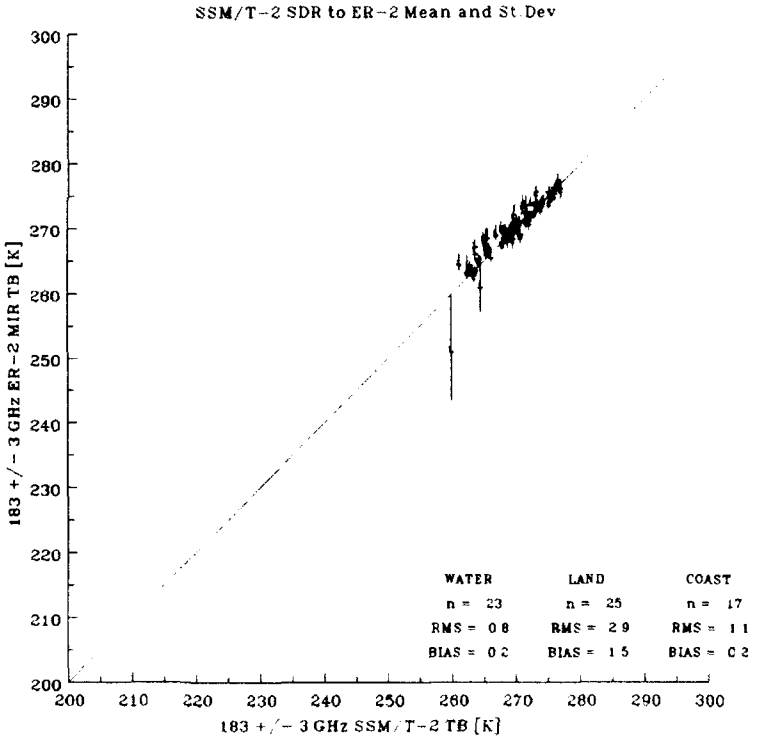


Figure 2.6.1-1. (continued).

e (183.3 ± 1 GHz)

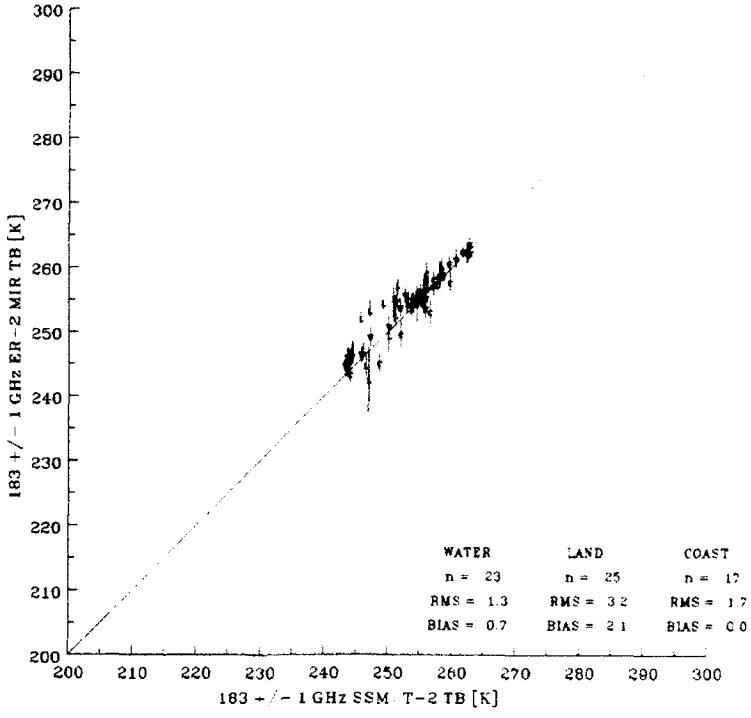
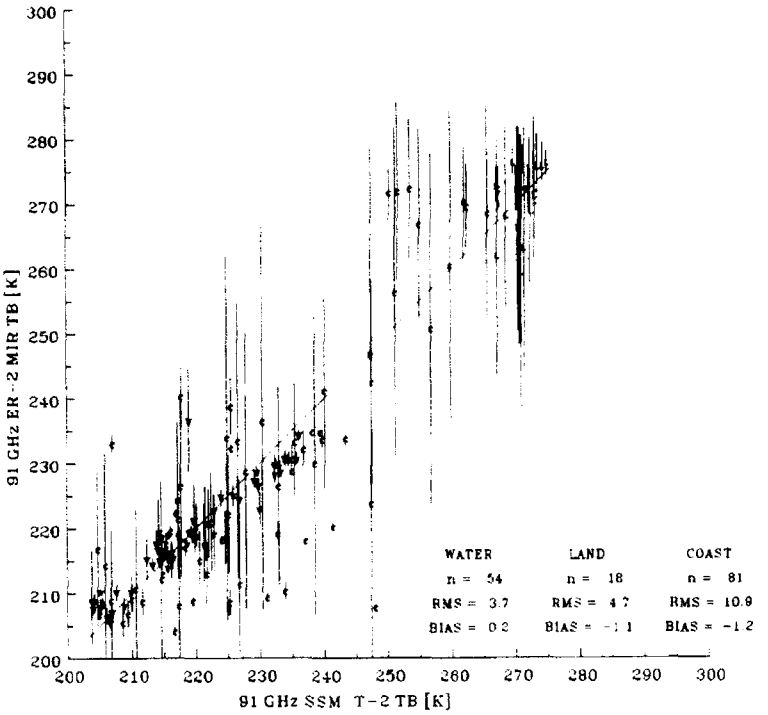


Figure 2.6.1-1. (continued).

a (91 GHz)



b (150 GHz)

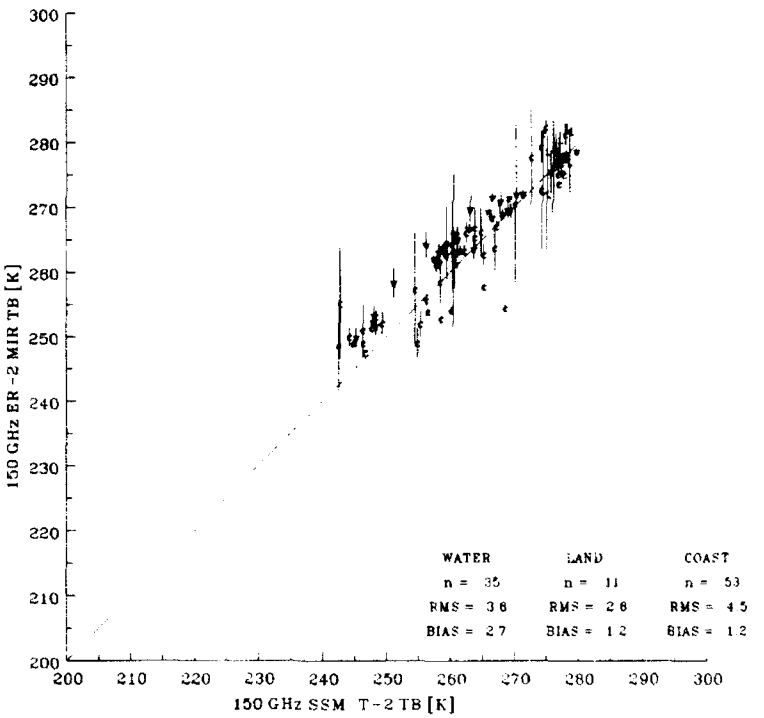
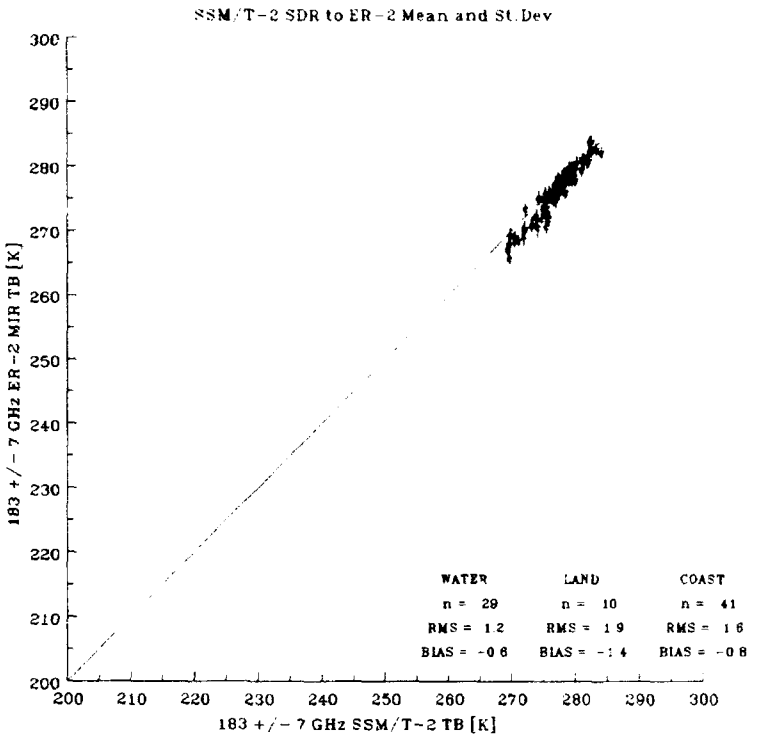


Figure 2.6.1-2 a-e. Comparison of SSM/T-2 TBs to the mean co-located MIR TBs for the five channels of the SSM/T-2 sensor of the east coast data. Vertical bars represent one standard deviation of the co-located MIR data in each SSM/T-2 FOV. MIR data were limited to ± 1 hour of the time of the SSM/T-2 observations and to only those which had the same scan angle as the co-located SSM/T-2 data. The topography of the SSM/T-2 FOVs is land = L, water = W, and coastal = C.

c (183.3 ± 7 GHz)



d (183.3 ± 3 GHz)

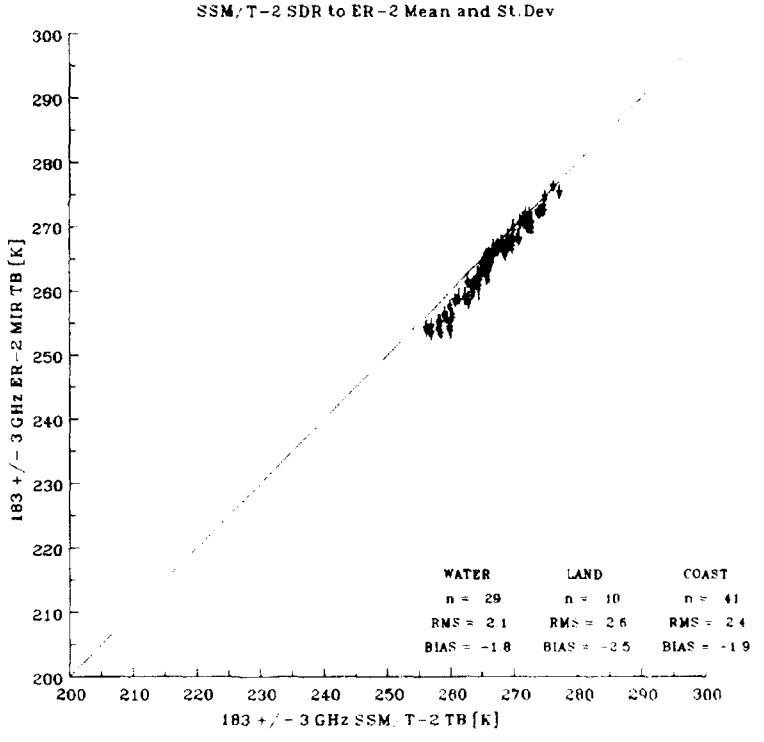


Figure 2.6.1-2. (continued).

e (183.3 ± 1 GHz)

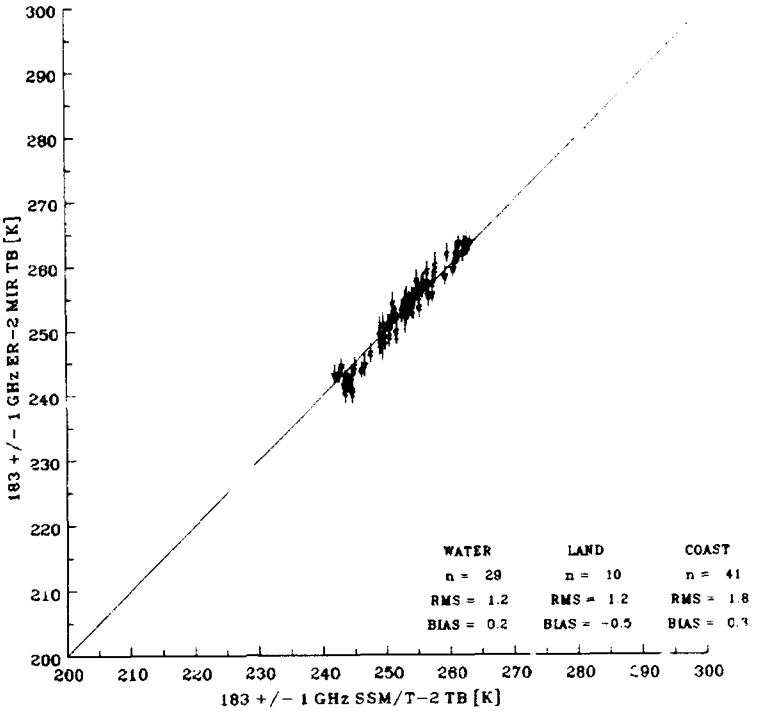
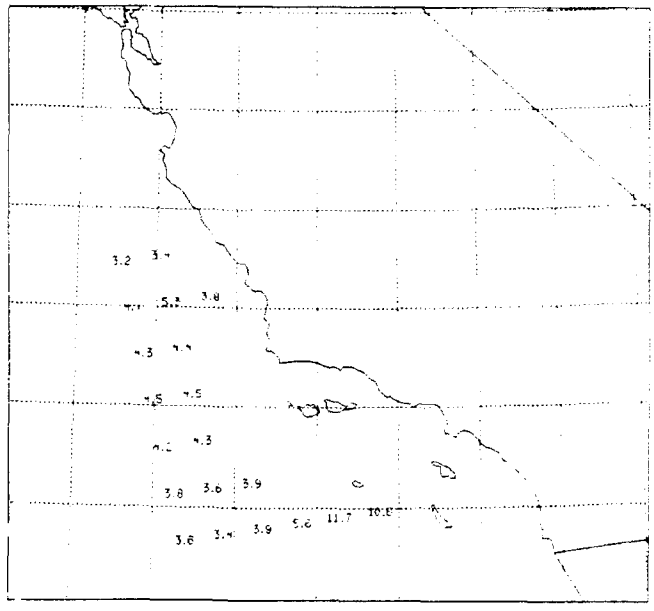


Figure 2.6.1-2. (continued).

a (May 14, 1992)



b (May 15, 1992)

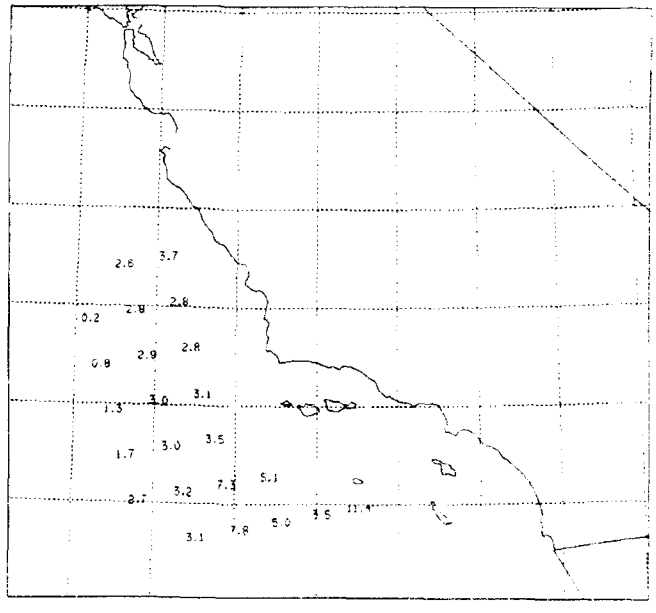


Figure 2.6.1-3 a-e. Standard deviation of the co-located MIR TBs within each of the SSM/T-2 FOVs that are classified as water during the a) west coast May 14, 1992 flight, the b) west coast May 15, 1992 flight , the c) east coast July 29, 1992 flight, the d) east coast July 30, 1992 flight, and e) the east coast August 6, 1992 flight. Only the MIR data that was ± 1 hour of the SSM/T-2 measurements were used.

c (July 29, 1992)



d (July 30, 1992)



Figure 2.6.1-3. (continued)

e (August 6, 1992)

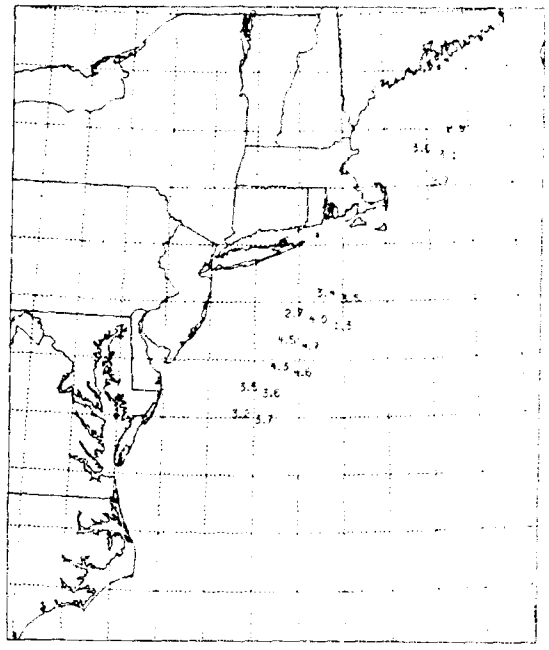


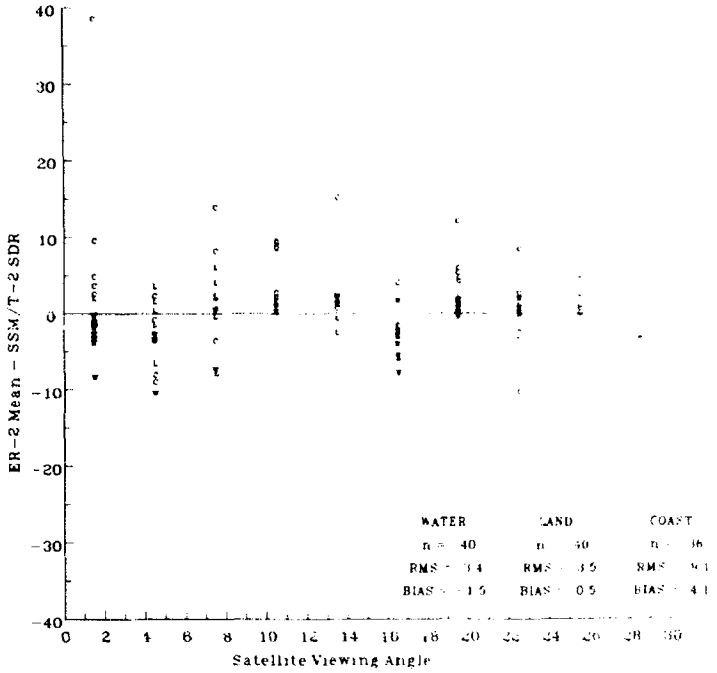
Figure 2.6.1-3. (continued)

2.6.2 SSM/T-2 / MIR Comparisons as a Function of Scan Angle and Direction

For the west coast data, the effect of variations in the scan angle and viewing direction (east or west) of the SSM/T-2 sensor on the difference between SSM/T-2 and mean co-located MIR TBs for the five channels of the SSM/T-2 sensor is presented in Figures 2.6.2-1 a-e through 2.6.2-3 a-e. Only SSM/T-2 FOVs that were classified as water were used in the directional study. The MIR data were limited to ± 1 hour from the time of the SSM/T-2 observations and to only those which had the same scan angle as the co-located SSM/T-2 data. In studying the effect of scan angle, both scan directions of the MIR, if contained within the SSM/T-2 FOV were used; whereas, when studying the effect of the scan direction, only MIR data with the same scan angle as the SSM/T-2 were used. Again, coastal locations show the largest difference for each scan angle. There appears to be no systematic variation between SSM/T-2 and MIR measurements with scan angle or direction. This implies that the two independent sensors are not biased by atmospheric path or scan angle; however, since SSM/T-2 data was recorded by AFGWC only for angles between ± 28.5°, surface polarization effects would be negligible and were not investigated.

Since the east coast weather conditions were such that strong predominant winds were not present over water, the effects of scan direction and angle on the east coast data were not examined at this time.

a (91 GHz)



b (150 GHz)

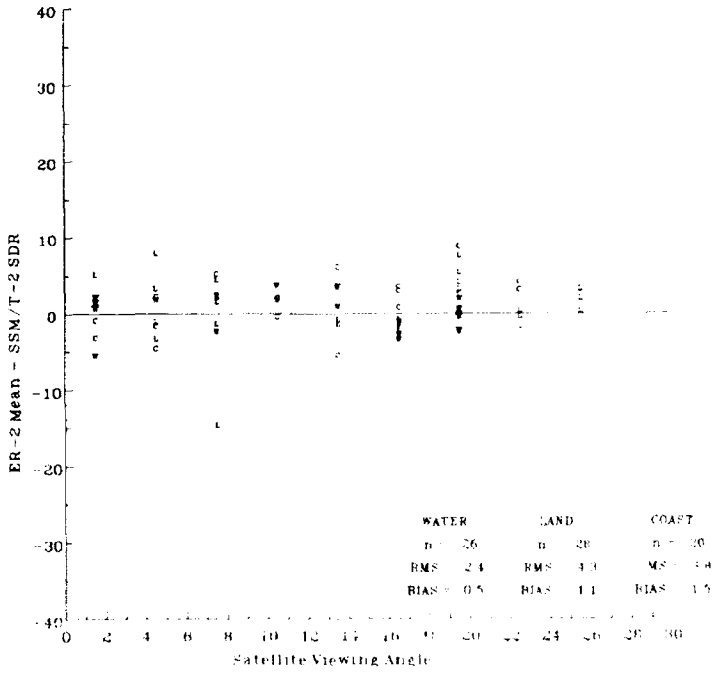
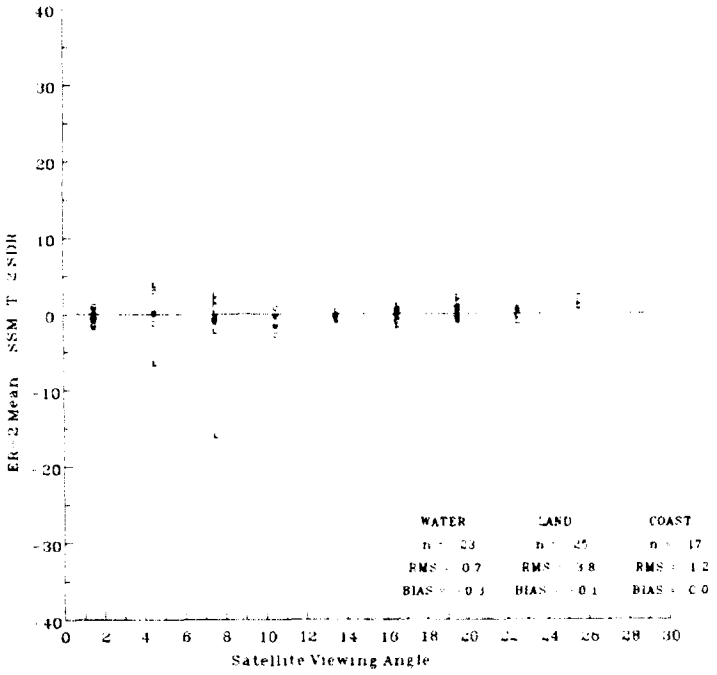


Figure 2.6.2-1 a-e. For the west coast data, the effect of the scan angle of the SSM/T-2 sensor on the difference between SSM/T-2 TBs and the mean of the co-located MIR TBs for the five SSM/T-2 channels. MIR data were limited to ± 1 hour from the time of the SSM/T-2 observations and to only those which had the same scan angle as the co-located SSM/T-2 data. The topography of the SSM/T-2 FOVs is land = L, water = W, and coastal = C.

c (183.3 ± 7 GHz)



d (183.3 ± 3 GHz)

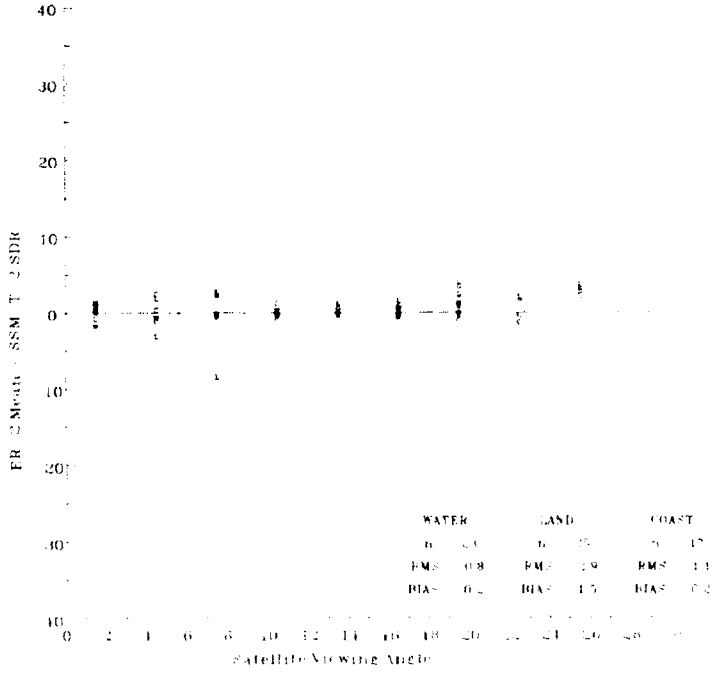


Figure 2.6.2-1. (continued).

e (183.3 ± 1 GHz)

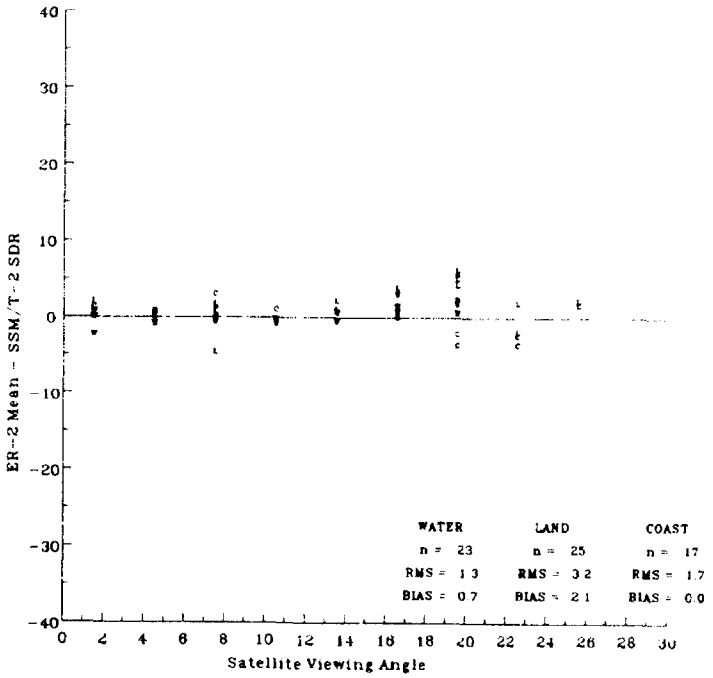
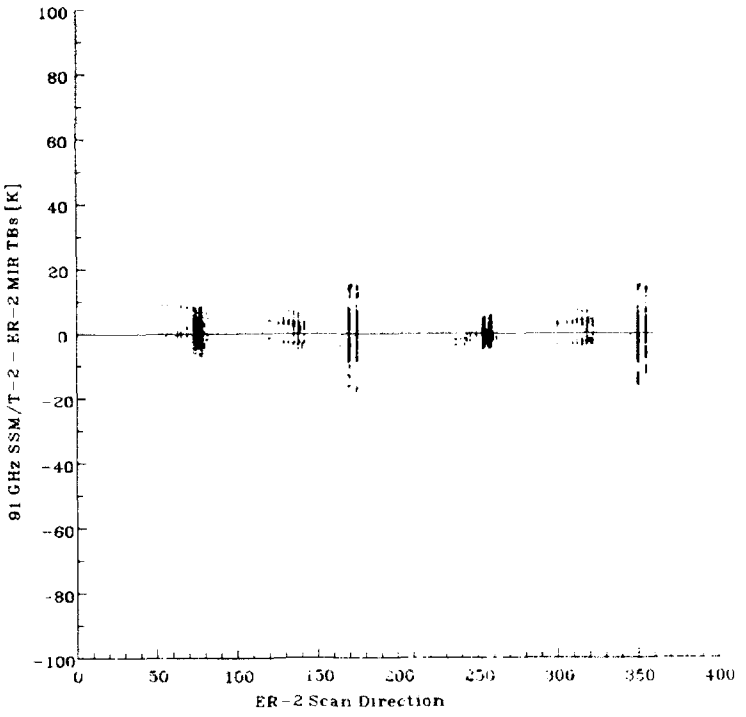


Figure 2.6.2-1. (continued).

a (91 GHz)



b (150 GHz)

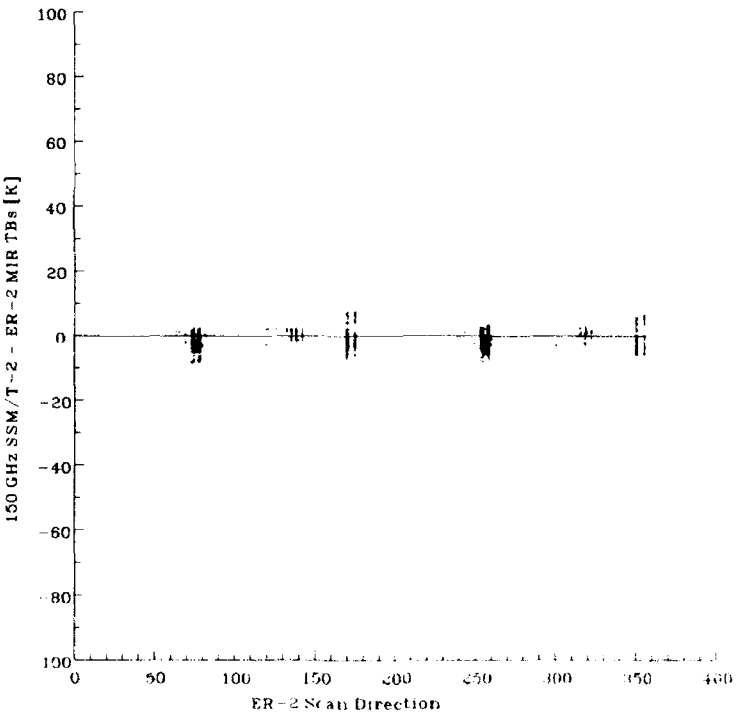
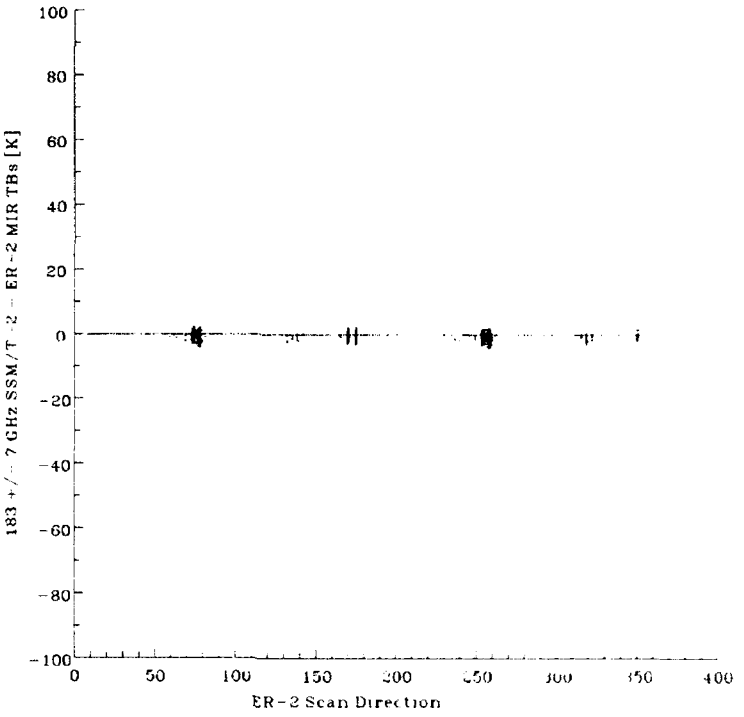


Figure 2.6.2-2 a-e. For the west coast SSM/T-2 water-classified FOVs, the effect of the scan direction of the MIR sensor on the difference between SSM/T-2 TBs and the mean of the co-located MIR TBs for the five SSM/T-2 channels. The SSM/T-2 sensor was looking westward. MIR data were limited to ± 1 hour from the time of the SSM/T-2 observations and to only those which had the same scan angle as the co-located SSM/T-2 data. The topography of the SSM/T-2 FOVs is land = L, water = W, and coastal = C.

c (183.3 ± 7 GHz)



d (183.3 ± 3 GHz)

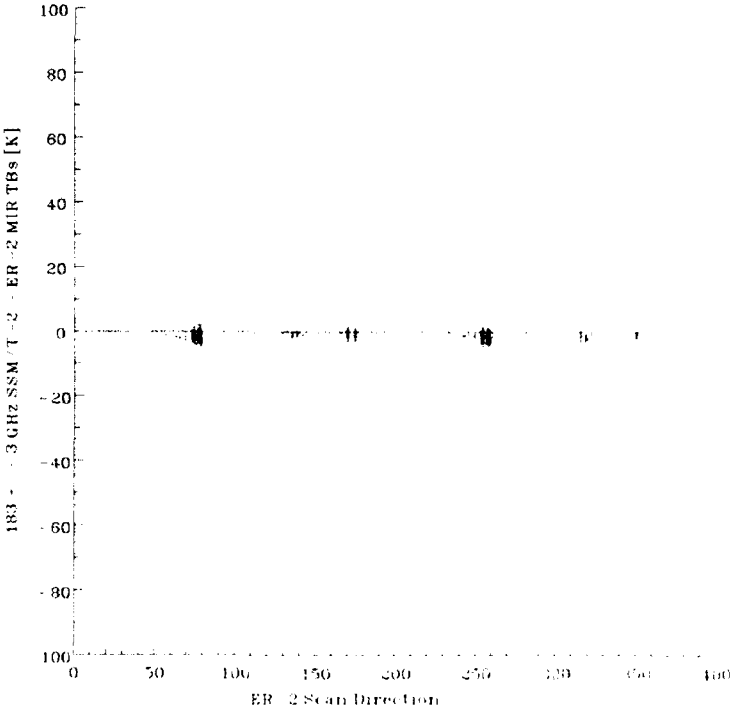


Figure 2.6.2-2. (continued).

e (183.3 ± 1 GHz)

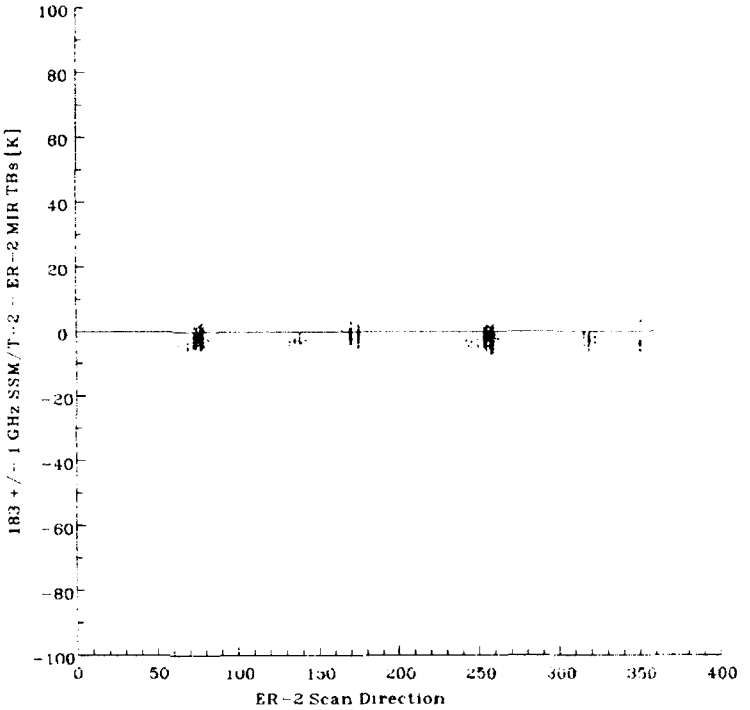
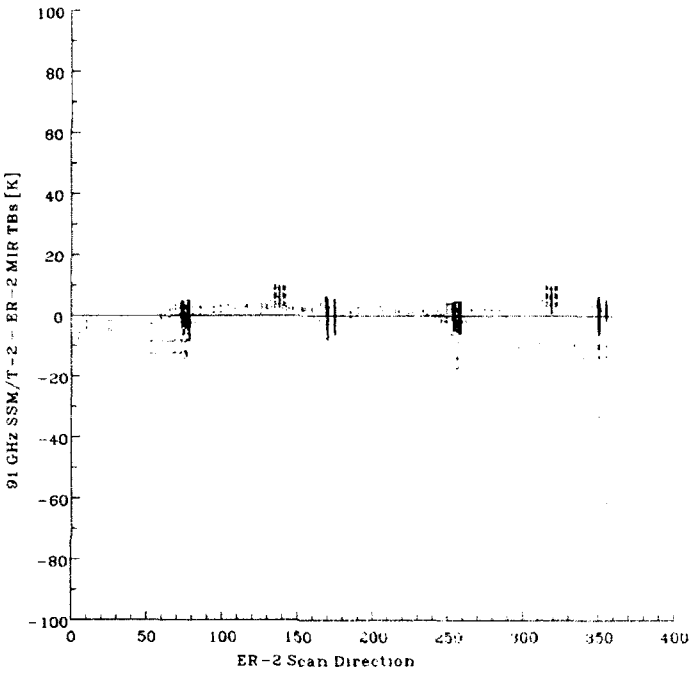


Figure 2.6.2-2. (continued).

a (91 GHz)



b (150 GHz)

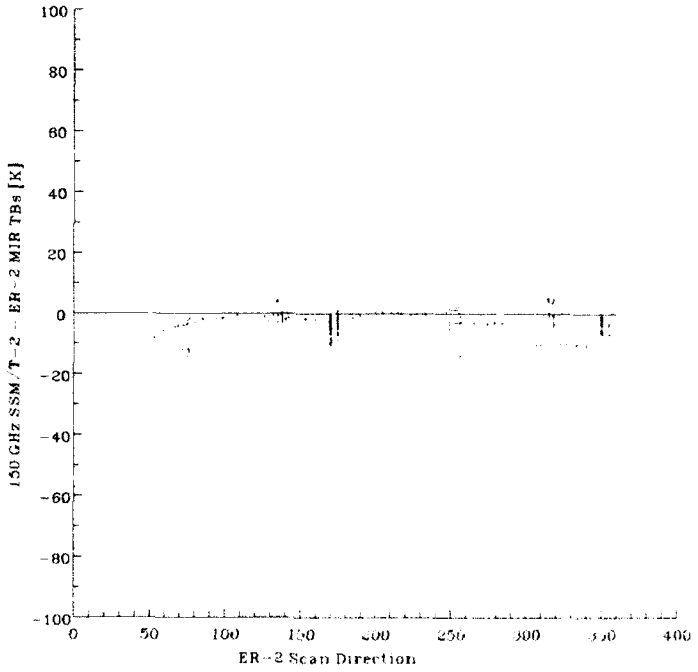
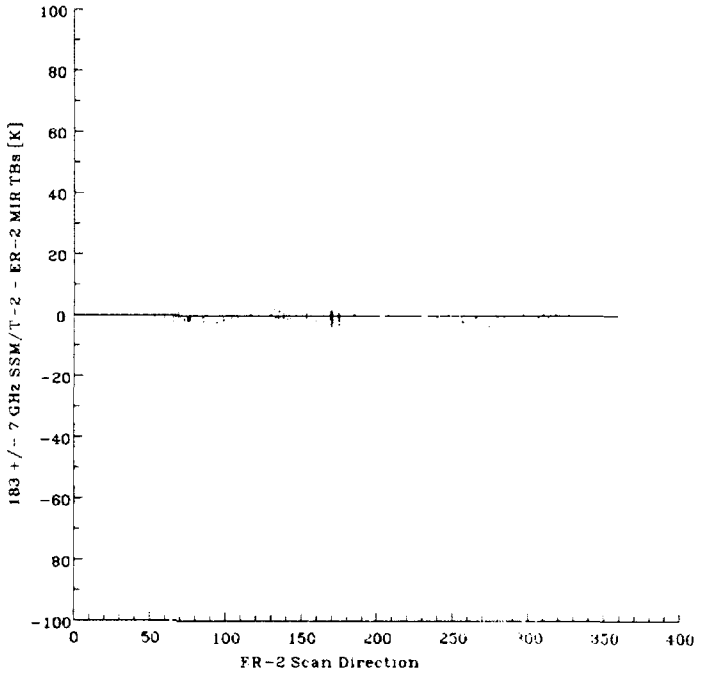


Figure 2.6.2-3 a-e. For the west coast SSM/T-2 water-classified FOVs, the effect of the scan direction of the MIR sensor on the difference between SSM/T-2 TBs and the mean of the co-located MIR TBs for the five SSM/T-2 channels. The SSM/T-2 sensor was looking eastward. MIR data were limited to ± 1 hour from the time of the SSM/T-2 observations and to only those which had the same scan angle as the co-located SSM/T-2 data. The topography of the SSM/T-2 FOVs is land = L, water = W, and coastal = C.

c (183.3 ± 7 GHz)



d (183.3 ± 3 GHz)

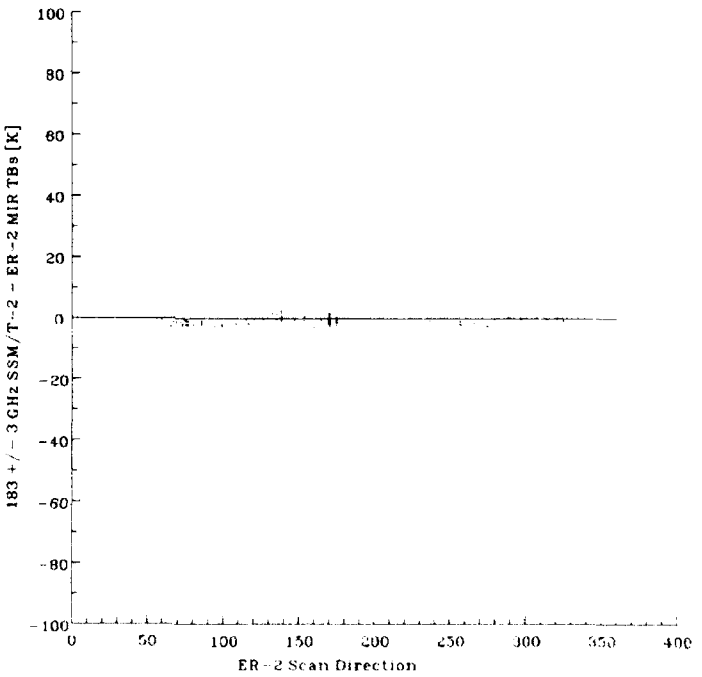


Figure 2.6.2-3. (continued).

e (183.3 ± 1 GHz)

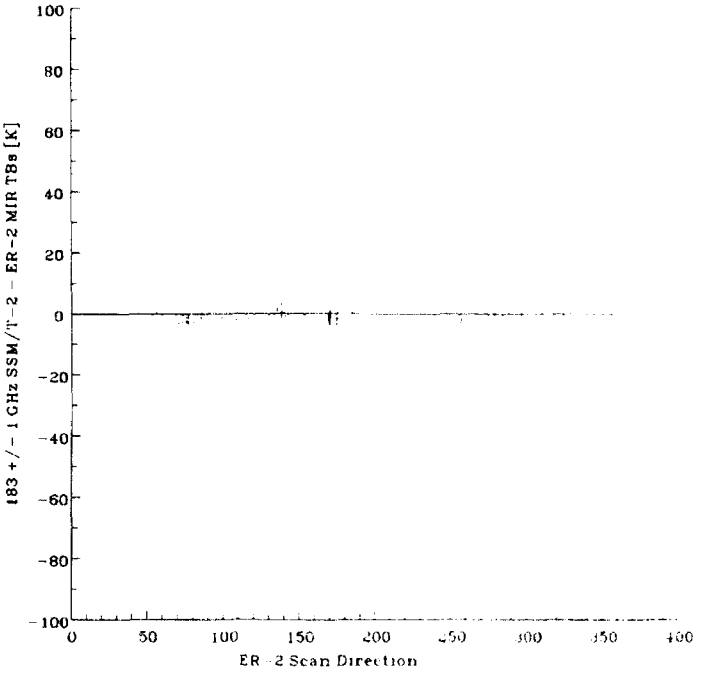
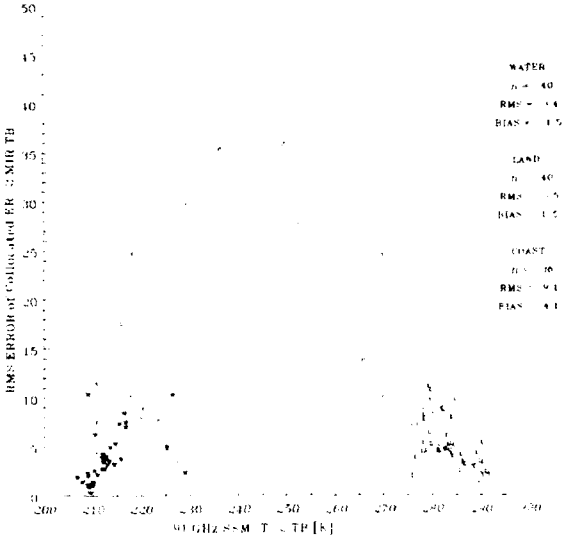


Figure 2.6.2-3. (continued).

2.6.3 Variation of MIR Within Each co-located SSM/T-2 FOV

Variation of the MIR TBs within each of the co-located SSM/T-2 FOVs for the five channels of the SSM/T-2 sensor are presented in Figure 2.6.3-1 a-e. Again, for the surface channels of 91 and 150 GHz, coastal FOVs display the largest inter-FOV variations; land and water variations are nearly all confined to 10° or less RMS. The one anomalous land FOV within the atmospheric channels occurs over the Mt. Whitney region.

a (91 GHz)



b (150 GHz)

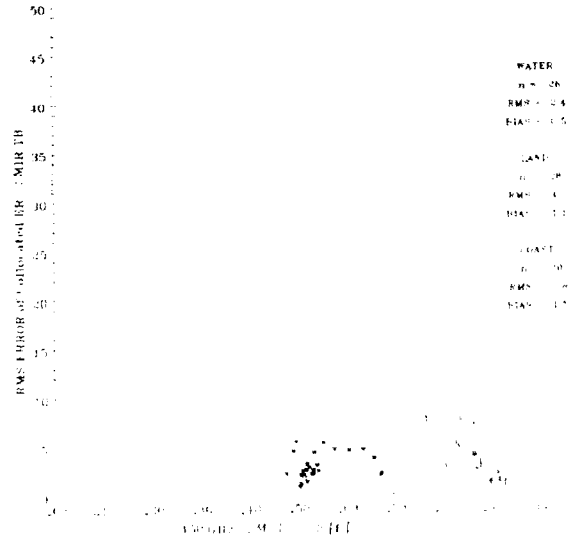
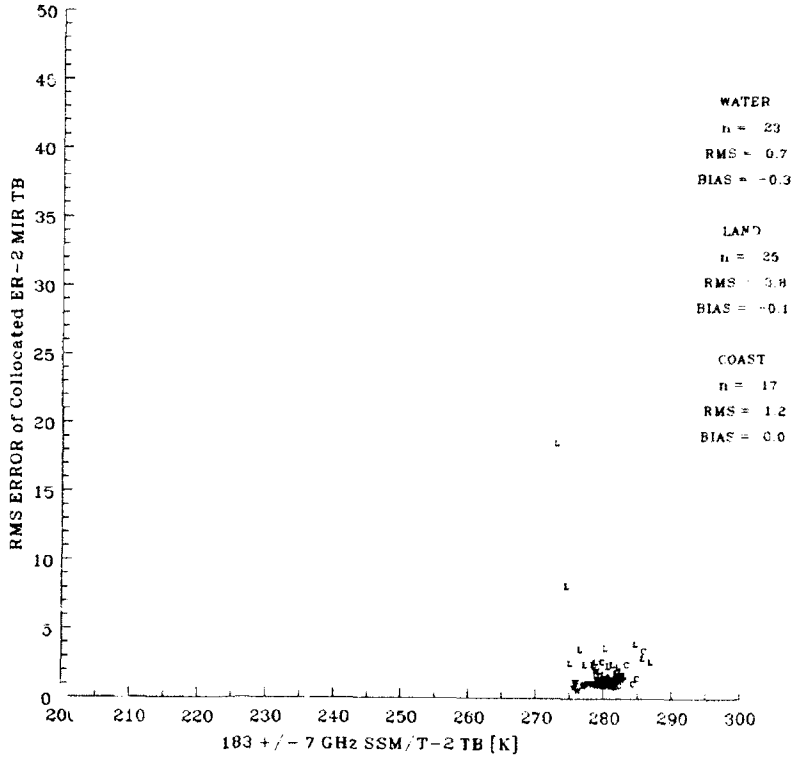


Figure 2.6.3-1 a-e. Based on the west coast data, RMS of the MIR TBs within each of the co-located SSM/T-2 FOVs for the five SSM/T-2 channels. MIR data were limited to ± 1 hour of the time of the SSM/T-2 observations and to only those which had the same scan angle as the co-located SSM/T-2 data. The topography of the SSM/T-2 FOVs is land = L, water = W, and coastal = C.

c (183.3 ± 7 GHz)



d (183.3 ± 3 GHz)

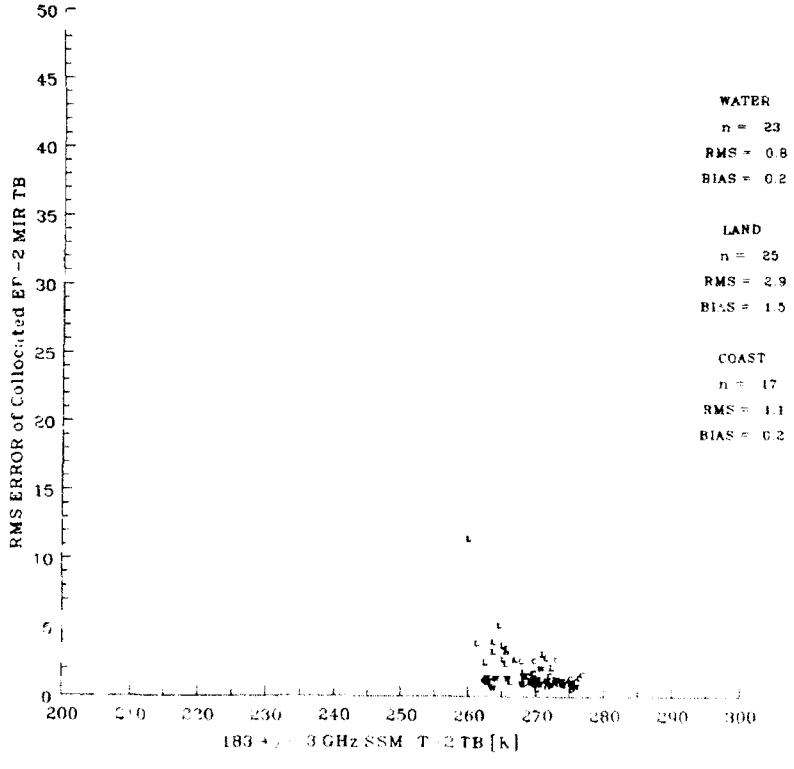


Figure 2.6.3.1. (continued).

e (183.3 ± 1 GHz)

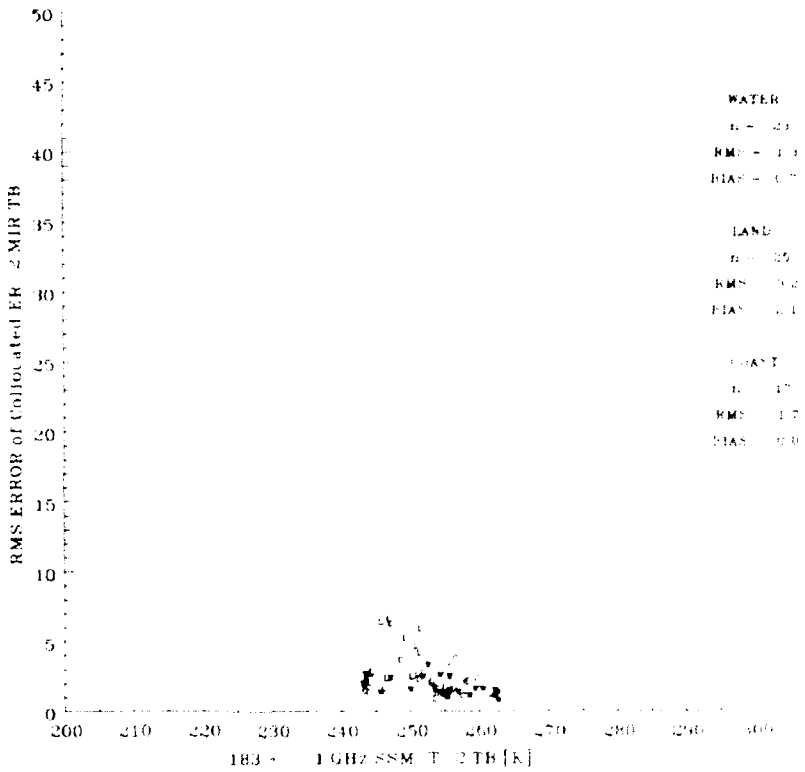


Figure 2.6.3-1. (continued).

2.6.4 SSM/T-2 / MIR Comparisons as a Function of Time Difference

The separation in time between the SSM/T-2 observations (spanning 3-4 minutes along the west coast) and the MIR data (which span over four hours) are examined in Table 2.6.4-1. In each of the tables, the RMS difference between the mean of the co-located MIR data and the observed SSM/T-2 TBs are stratified by the two sets of MIR data used: one where the scan angle of the MIR data matched that of the SSM/T-2 data, and the second where all MIR data with scan angles $\leq 28.5^{\circ}$ located within the SSM/T-2 FOV were used. Data are presented as a function of the time between the SSM/T-2 and the MIR data and the topographic classification of the SSM/T-2 FOV.

With the exception of coastal FOVs, the 91 and 150 GHz channels display the greatest differences between MIR and SSM/T-2 measurements as well as increasing RMS with increasing time away from the overpass time. As would be expected, the atmospheric channels display less deviation between MIR and SSM/T-2 measurements than the surface channels and also show a smaller range of variation across the three topography types. Under dry conditions or over high terrain it is possible for the atmospheric channels (183.3 GHz) to include surface contributions to its total measured radiance which could tend to increase the variance in the MIR measurements. This does not seem to be occurring for the west coast flights since the RMS differences are similar for all 3 channels, with the exception of the flight path over Mt. Whitney. Interestingly, the differences between the MIR and SSM/T-2 do not increase with the time difference of the measurement, which was not the case for the surface channels.

	Same Scan Angle					
ΔT (hrs)	91	150	183 ± 7	183 ± 3	183 ± 1	**WEST COAST**
0-1	3.4 (40)	2.4 (26)	1.3 (23)	0.8 (23)	0.7 (23)	Water
1-2	3.7 (25)	2.2 (15)	1.3 (13)	0.7 (13)	0.7 (13)	
2-3	4.3 (23)	3.0 (11)	3.0 (11)	0.9 (11)	0.6 (11)	
0-1	3.5 (40)	4.3 (28)	3.2 (25)	2.9 (25)	3.8 (25)	Land
1-2	7.0 (25)	5.5 (13)	2.5 (10)	1.5 (10)	2.3 (10)	
2-3	---	---	---	---	---	
0-1	9.1 (36)	3.8 (20)	1.7 (17)	1.1 (17)	1.2 (17)	Coastal
1-2	8.8 (23)	3.8 (15)	3.2 (10)	2.0 (10)	0.8 (10)	
2-3	19.2 (4)	9.7 (2)	0.7 (1)	1.2 (1)	0.6 (1)	
						EAST COAST
0-1	3.7 (54)	3.6 (35)	1.2 (29)	2.1 (29)	1.2 (29)	Water
1-2	3.4 (51)	3.2 (30)	2.2 (28)	3.3 (28)	2.5 (28)	
2-3	1.9 (6)	2.1 (2)	4.3 (1)	5.8 (1)	6.8 (1)	
0-1	4.7 (18)	2.6 (11)	1.2 (10)	2.6 (10)	1.9 (10)	Land
1-2	1.5 (7)	1.3 (3)	5.1 (2)	5.7 (2)	2.9 (2)	
2-3	---	---	---	---	---	
0-1	10.9 (81)	4.5 (53)	1.8 (41)	2.4 (41)	1.6 (41)	Coastal
1-2	10.4 (65)	5.0 (37)	3.4 (35)	2.0 (35)	1.6 (35)	
2-3	12.0 (63)	5.3 (41)	3.5 (32)	2.3 (32)	2.4 (32)	
	±28.5° Scan Angle					
ΔT (hrs)	91	150	183 ± 7	183 ± 3	183 ± 1	**WEST COAST**
0-1	2.9 (43)	4.0 (32)	1.3 (31)	0.8 (23)	0.7 (23)	Water
1-2	3.3 (25)	4.5 (23)	1.3 (21)	0.8 (21)	0.8 (21)	
2-3	4.3 (25)	4.1 (13)	2.8 (11)	0.8 (11)	0.5 (11)	
0-1	4.3 (43)	4.6 (30)	3.2 (28)	2.9 (28)	3.7 (28)	Land
1-2	6.5 (28)	4.7 (17)	3.1 (16)	2.4 (16)	2.7 (16)	
2-3	---	---	---	---	---	
0-1	7.9 (41)	5.5 (28)	1.3 (25)	1.0 (25)	1.1 (25)	Coastal
1-2	6.3 (28)	4.7 (17)	3.1 (16)	2.4 (16)	2.7 (16)	
2-3	16.4 (4)	8.0 (2)	0.6 (2)	0.6 (2)	0.8 (2)	
						EAST COAST
0-1	3.7 (66)	4.6 (44)	1.7 (37)	2.5 (37)	1.3 (37)	Water
1-2	3.8 (57)	4.5 (39)	2.6 (35)	3.7 (35)	2.7 (35)	
2-3	3.6 (7)	4.4 (4)	3.9 (2)	7.3 (2)	8.6 (2)	
0-1	3.7 (21)	2.3 (16)	2.3 (13)	3.5 (13)	2.5 (13)	Land
1-2	1.3 (7)	1.4 (6)	5.4 (4)	6.1 (4)	3.1 (4)	
2-3	---	---	---	---	---	
0-1	11.1 (92)	4.2 (60)	2.3 (57)	3.2 (57)	2.0 (57)	Coastal
1-2	8.3 (79)	5.1 (50)	3.4 (43)	2.6 (43)	1.6 (43)	
2-3	11.5 (69)	6.7 (50)	7.0 (46)	7.2 (46)	8.7 (46)	

Table 2.6.4-1. RMS between the mean of the co-located MIR data and the SSM/T-2 TBs at the five SSM/T-2 channels. Frequency of SSM/T-2 FOVs follows in parentheses. Two sets of MIR data were used: one where the scan angle of the MIR data matched that of the co-located SSM/T-2 FOV and the second where the MIR data has a scan angle ≤ 28.5 °.

2.7 Calibration of the SSM/T-2 using Radiative Transfer Calculations

2.7.1 Radiative Transfer Models

Radiative transfer (RT) simulations of SSM/T-2 TB observations were performed using: (a) the RADTRAN computer code which was developed by the Phillips Laboratory (GP) (Falcone et al., 1979, 1982), and (b) the Eyre microwave simulation model (Eyre and Woolf, 1988). These simulations were supported by the availability of the global set of co-located radiosonde data spanning from late January to early August, 1992. The purpose of these calculations is to examine the calibration of the sensor based on known radiative transfer properties of the atmosphere. This examination of the "forward problem" directly supports understanding of the retrieval or "inverse" problem being investigated by the validation study.

The RADTRAN code has been utilized and tested against experimental data for frequencies up to 1000 GHz. RADTRAN provides atmospheric attenuation and TB calculations for typical atmospheric paths over the frequency range from 1 to 300 GHz. It is a design tool which can readily be used to assess potential environmental impacts on microwave and millimeter wave sensors. The version we have used in our simulations is the Enhanced RADTRAN computer code which has been widely applied within the DoD and elsewhere to provide the capability to perform sensor simulation studies for satellite borne and ground based microwave and millimeter wave systems (Isaacs et al., 1989).

The Eyre simulation model essentially creates an accurate "rapid algorithm" model for the desired spectral region required using an exact line-by-line RT simulation model as a driver. The approach is described by Eyre and Woolf (1988) and is similar to that employed by NOAA/NESDIS to model passive infrared temperature channel transmittances (Fleming and McMillin, 1977). In the microwave spectral region, the rapid algorithm results in a computational savings of at least 50 times over the line-by-line method using a preselected set of microwave lines with a loss in accuracy of only 1% or less.

Modifications were required to both RT models to facilitate interfacing with the upper air data (radiosondes) in the appropriate units (for water vapor) and at the required levels (including significant levels). To accommodate missing upper-air levels, an isothermal temperature profile was added from the highest interpolated level to the top level used in both model simulations. Missing water vapor values were supplemented by an exponentially decreasing mixing ratio from 300 hPa to 70 hPa with an in Eyre's model and by a linear decrease of RH from the top of the radiosonde data to zero at the top of the Enhanced RADTRAN layer calculation. Quality control of the radiosonde data was applied to remove any soundings which did not include measured water vapor information to at least 300 hPa. In addition, the Enhanced RADTRAN required modification of the radiosonde data file to set flags and use formats required within Enhanced RADTRAN. Comparisons were made between the satellite-measured TBs and the TBs calculated by RT simulation models using co-located *in situ* radiosonde profiles.

2.7.2 SSM/T-2 Comparison Results

The results of the intercomparison for an ensemble of SSM/T-2 FOVs and calculated TBs using the Eyre model supplied with co-located upper air soundings (see Figure 2.7.2-1 for global locations and Appendix B for a detailed listing of contributing radiosonde stations and the time, latitude and elevation distributions of the stations and co-located profile measurements) are shown in Figures 2.7.2-2 a-e. The data span the time period from January 31 to August 7, 1992. co-locations were determined using a time limit of ± 1 hour between the release time of the radiosonde and the time of the SSM/T-2 measurement and a distance limit of 100 km. When countries reported the release time as the synoptic reporting time, e.g. the United States, the release time was assumed to be 45 minutes before the synoptic time. Note that only one SSM/T-2 measurement was finally co-located with each radiosonde, i.e., the one that was spatially closest to the radiosonde station location.

Soundings were required to have measured water vapor values up to at least 300 hPa (required by the Eyre model). Any missing dewpoint data below 300 hPa eliminated the radiosonde from further consideration. Some countries, e.g. the United States, do not report a moisture measurement when the temperature is less than -40 C or when RH is less than 20% due to uncertainties in the radiosonde's accuracy in these conditions. By limiting the data to have measured water vapor values to 300 hPa, the number of dry atmospheres and/or clear (not cloudy) cases was most likely decreased and the percentage of cloudy and/or precipitating profiles increased; however, the uncertainties of keeping these data was too large for this phase of the analysis. In this first phase of this study, the Eyre and Enhanced RADTRAN models were set to calculate TBs using clear sky conditions.

Since the Enhanced RADTRAN model produced comparable results as the Eyre model (Figure 2.7.2-3 a-e), only the Eyre model results are plotted here; however, differences range up to 4 K. One factor causing the discrepancy between the calculated outputs is the difference in vertical scale: the Eyre models requires fixed pressure coordinates from 1000 hPa to 0.1 hPa; whereas the Enhanced RADTRAN requires height coordinates (in this case, the heights were fixed from 0 to 50 km) (Table 2.7.2-1). The Eyre model log-linearly interpolated the temperature and mixing ratio sounding data to the fixed pressure values, whereas Enhanced RADTRAN linearly interpolated temperature and RH radiosonde data to the fixed height coordinates. Data being used in both radiative transfer models was not identical due to differences in interpolation schemes and due to different vertical scales which influenced how the fine structure of the sounding profile was included in the model.

Problems and discrepancies arise when temperatures and/or dewpoints are less than -50 C. The equations used to calculate the mixing ratio were developed on data with temperatures greater than -40 C, and have been extrapolated to temperatures between -50

and -40 C. When dewpoint temperature was below -50 C, the Eyre model assumed a saturated mixing ration of 0.003 gm/kg and the Enhanced RADTRAN model assumed a RH of 20% (the cutoff of reported radiosonde RH for U. S. radiosondes). An additional factor contributing to the deviation of the models at the 91 GHz channel is that the Eyre model does not use a surface or near-surface moisture measurement as does the Enhanced RADTRAN code. A factor that increased the deviation between the two models at the 183.3 ± 1 GHz (the channel sensing water vapor at the upper levels of the troposphere) compared to the lower atmospheric channels (183.3 ± 7 and 183.3 ± 3 GHz) is the difference in the handling of the upper-level sounding data by both models. The Eyre model used an isothermal atmosphere above the highest sounding level up to 0.1 hPa and an exponential decay of mixing ratio from 300 hPa to 70 hPa followed by a constant mixing ratio (0.003 gm/ kg) above 70 hPa to 0.1 hPa. Enhanced RADTRAN used an isothermal atmosphere above the highest interpolated level up to 50 km and a linear decay of RH with height from the highest-level of reported RH to 1% at 50 km.

The Eyre radiative transfer code described above was used to simulate SSM/T-2 TBs using co-located upper-air data on temperature and moisture profiles to provide information on atmospheric opacity. Surface temperature was estimated from the lowest atmospheric layer available in the temperature profile soundings. Surface emissivity values are required for each SSM/T-2 channel which is transparent enough to see the earth's surface. Surface emissivities were based on the mean of a set of optimal surface emissivities calculated for 91 and 150 GHz using a global SSM/T-2 radiosonde data base from early March 1992 in the Eyre RT simulation model (Figure 2.7.2-4). The optimal surface emissivity was defined to be that value which minimized the difference between the forward-calculated TB using a specific radiosonde and the co-located TB measured by the satellite. These values are intermediate between land and ocean, but weighted more toward land emissivities.

Figures 2.7.2-2 (a-e) illustrate scatter plots of the comparison of observed and calculated TBs. Total precipitable water is indicated by the plotted numbers, e.g. 0 represents a precipitable water content ranging from 0 to 10 kg/m^2, 1 ranging from 10 to 20 kg/m^2, and so on. Large RMS and biases are observed for the most transparent channel at 91 GHz (and to a lesser degree for the 150 GHz channel) due to the uncertainty in surface emissivity used in the simulation. Bias and RMS are reduced for the less transmissive atmospheric channels which tend to exhibit rather good agreement between the observed SSM/T-2 TBs and the RT-calculated TBs; except at the 183.3 ± 1 GHz, which measures highest atmospheric water vapor, there is a slight increase in RMS compared to the lower atmospheric channels (183.3 ± 7 and 183.3 ± 3 GHz).

The sounding data used in this report come from many different types of radiosonde instruments. These sonde instruments have been shown to have both random and bias differences when flown on the same balloon (Nash and Schmidlin, 1987; and

Schmidlin, 1988). A preliminary investigation was made to demonstrate that radiosonde system differences do indeed contribute to the overall scatter of the data between the observed and calculated radiation temperatures. This was done by plotting observed versus calculated temperatures for various parts of the world. In the overall data for 183.3 ± 7 GHz (Figure 2.7.2-2 c), there is a significant group of relatively moist data around the computed 270 K which bulges out to the left of the calculated=observed line. Combined data from the United States and India (Figure 2.7.2-5) contribute over 60% of the points to this feature. Whereas combined data from Scandinavia, England, Germany and Russia (Figure 2.7.2-6) contributed only one point to this anomaly. This is only one item chosen to demonstrate differences due to different types of radiosondes. There are certainly many more, but more careful analysis is needed to identify biases and effects of different types of radiosondes on calculated TBs.

A second technique for examining the possible impact of radiosonde errors on the calculated radiation temperatures was tried. Using the summed errors caused by insolation and thermal lag (Brousaides and Morrissey, 1974) on the ability of radiosondes to measure water vapor at various levels of the atmosphere, maximum correction factors were determined for the pressure levels used in the Eyre radiative transfer program up to 300 hPa (Table 2.7.2-2). These correction factors were used to estimate the moistest moisture profile that the radiosonde could have passed through and still report the measurements that it did. Keeping the temperature profile and surface emissivity constant, these moister moisture profiles were used in the Eyre model to calculate the changes in TBs relative to the change in precipitable water for the five SSM/T-2 channel frequencies (Figure 2.7.2-7 a-e). The data represents the global data base of 1227 radiosondes which are predominantly land and coastal stations ranging from tropical to polar climates. Again, these calculations do not take into account weather conditions (rain, clouds, etc.) or the type of radiosonde instrument (AIR, Vaisala, VIZ, etc.). The moister profiles could produce up to a 3 K increase in 91 GHz TBs, a 1 K decrease in 150 GHz TBs, and generally a 2-3 K decrease in the 183.3 GHz TBs. The drier profiles tend to generate smaller positive changes in the 91 GHz TBs, and larger positive changes in the 150 and 183.3 ± 7 and 3 GHz TBs compared to the moister profiles. Little difference is evident between the 183 ± 1 GHz TBs generated by moist or dry profiles.

The problems associated with using a worldwide radiosonde data base to either calibrate a satellite system or to act as the basis of an empirical fit is a complex one due to the many sources of error which corrupt such a data base. A program to evaluate the sources of error and ways to improve the usefulness of a radiosonde data base for satellite application will be carried out at Phillips Laboratory over the next two years.

Table 2.7.2-1. Pressure levels required by the Eyre radiative transfer model, and height levels used in the Enhanced RADTRAN model.

Eyre Model Pressure Levels [hPa]	Enhance RADTRAN Height Levels [km]
0.1	50.
0.2	45.
0.5	40.
1.0	35.
1.5	30.
2.	28.
3.	26.
4.	24.
5.	22.
7.	20.
10.	19.
15.	18.
20.	17.
25.	16.
30.	15.
50.	14.
60.	13.
70.	12.
85.	11.
100.	10.
115.	9.5
135.	9.
150.	8.5
200.	8.
250.	7.5
300.	7.
350.	6.5
400.	6.
430.	5.5
475.	5.
500.	4.5
570.	4.
620.	3.5
670.	3.
700.	2.5
780.	2.
850.	1.75
920.	1.5
950.	1.25
1000.	1.0
Surface	0.75
	0.5
	0.25
	0.

Table 2.7.2-2. RH correction factors used to determine the maximum limit of moisture that the sounding could have passed through and still reported the moisture profiles that it did (Brousaides and Morrissey, 1974). Pressure levels are those used in the Eyre radiative transfer program.

Correction Factor	Pressure Level (hPa)
.230	300
.190	350
.163	400
.148	430
.133	475
.125	500
.105	570
.095	620
.086	670
.081	700
.069	780
.060	850
.053	920
.050	950
.048	1000

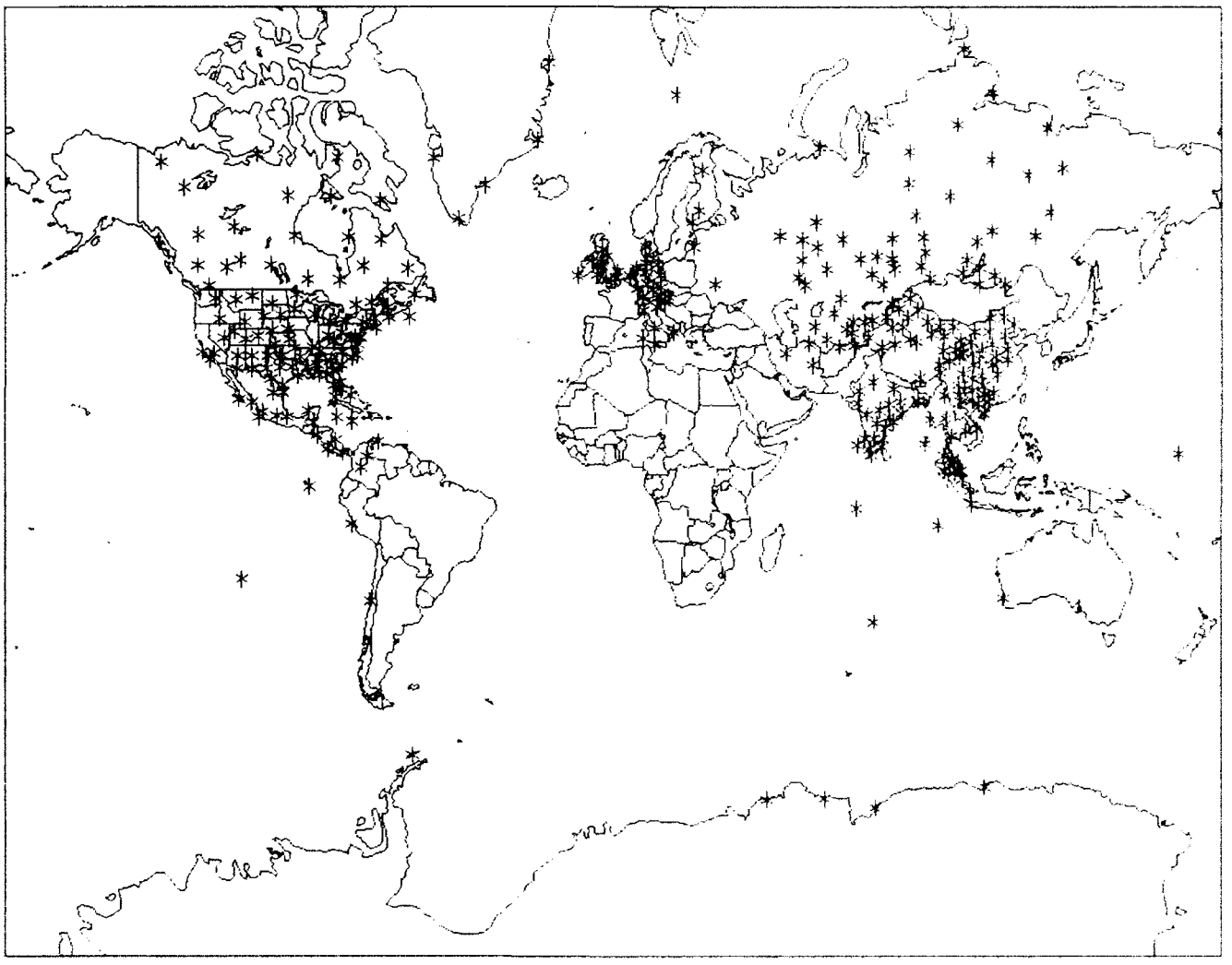
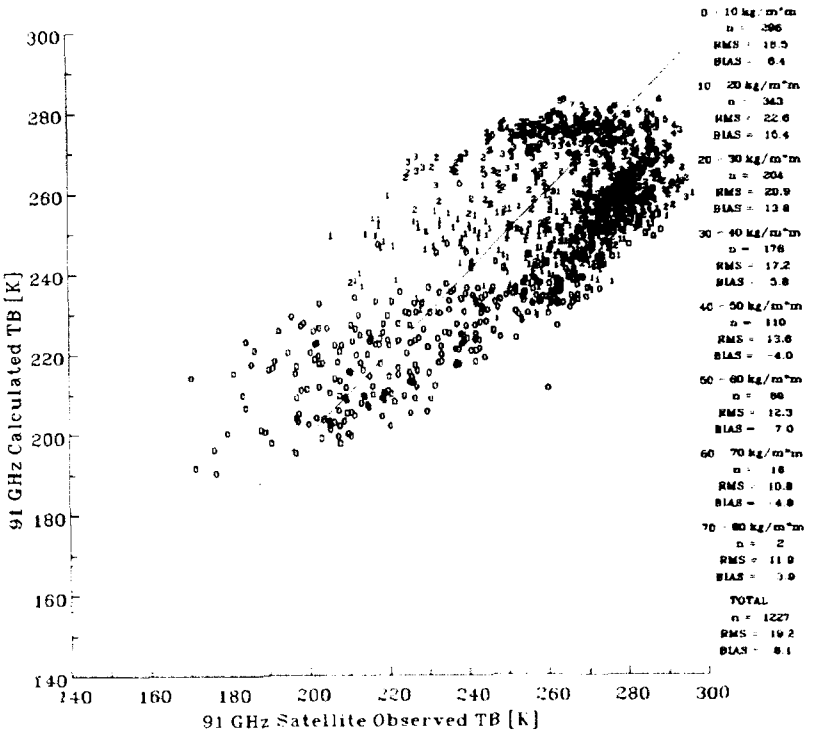


Figure 2.7.2-1. Global locations of radiosondes that were co-located with SSM/T-2 FOVs. co-locations were determined to be within ± 1 hour and 100 km of the measurements. Radiosonde profiles were used only if the measured moisture profile extended up to at least 300 hPa. Data spans the time period from January 31 to August 7, 1992.

a (91 GHz)



b (150 GHz)

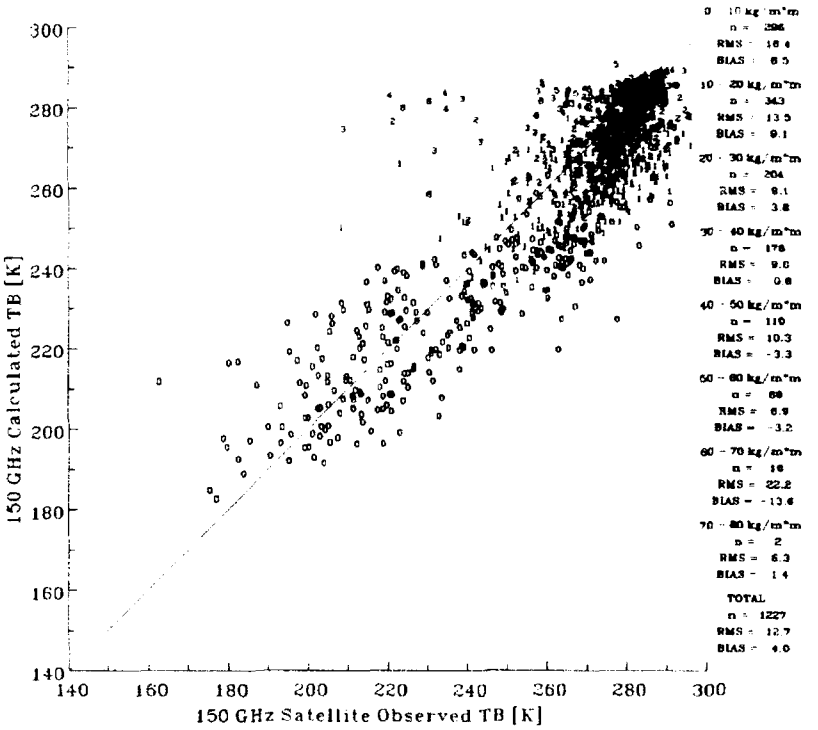
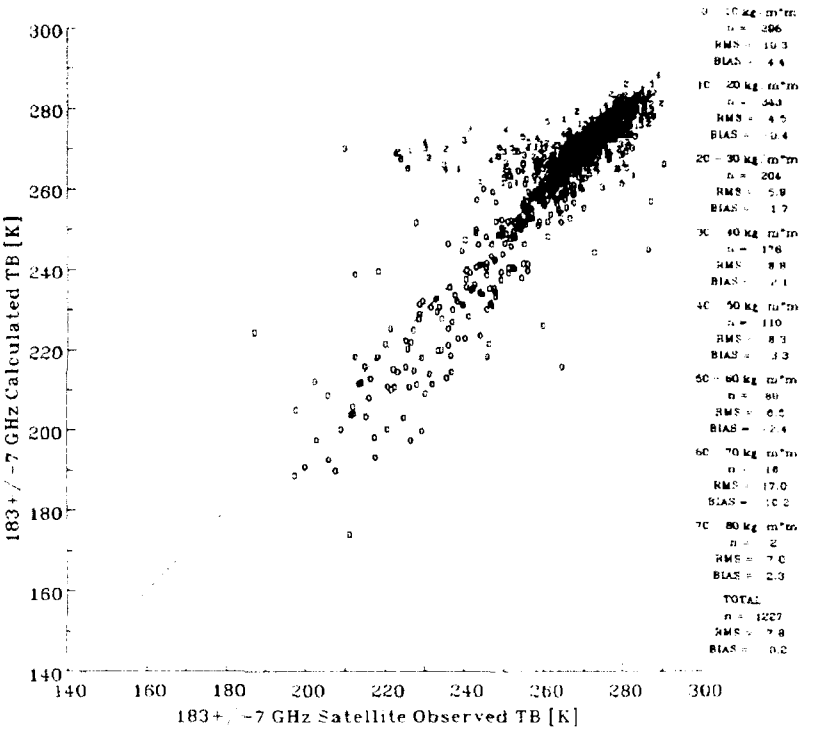


Figure 2.7.2-2 a-e. Calculated TBs using the Eyre RT simulation model versus SSM/T-2 observation for the five SSM/T-2 channels. Plotted numbers represent total precipitable water content of the radiosonde profile used in the Eyre model, e.g., 0 represents a profile with a precipitable water content ranging from 0 to 10 kg/m^2, 1 represents a range from 10 to 20 kg/m^2, and so on.

c (183.3 ± 7 GHz)



d (183.3 ± 3 GHz)

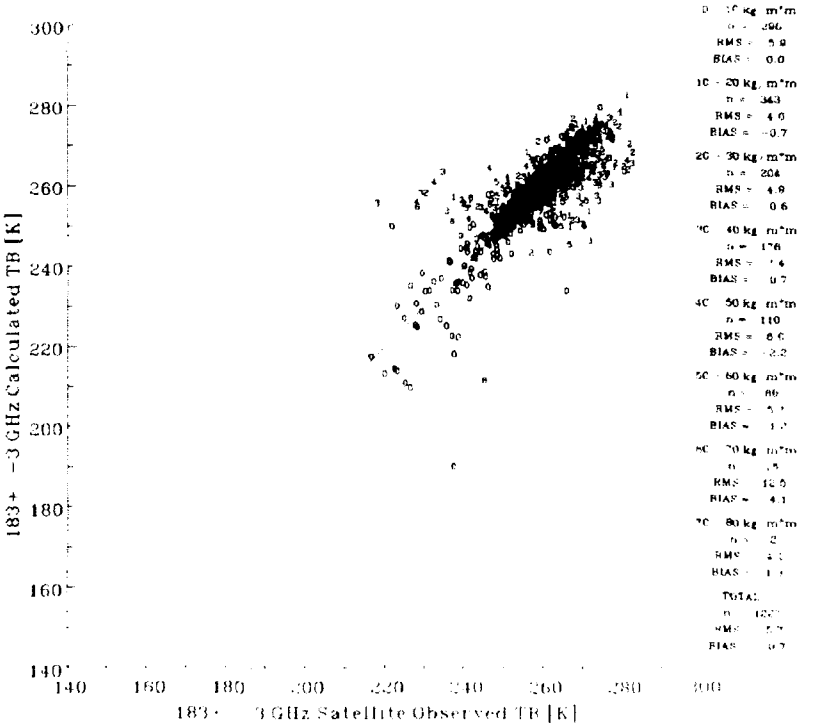


Figure 2.7.2-2. (continued).

e (183.3 ± 1 GHz)

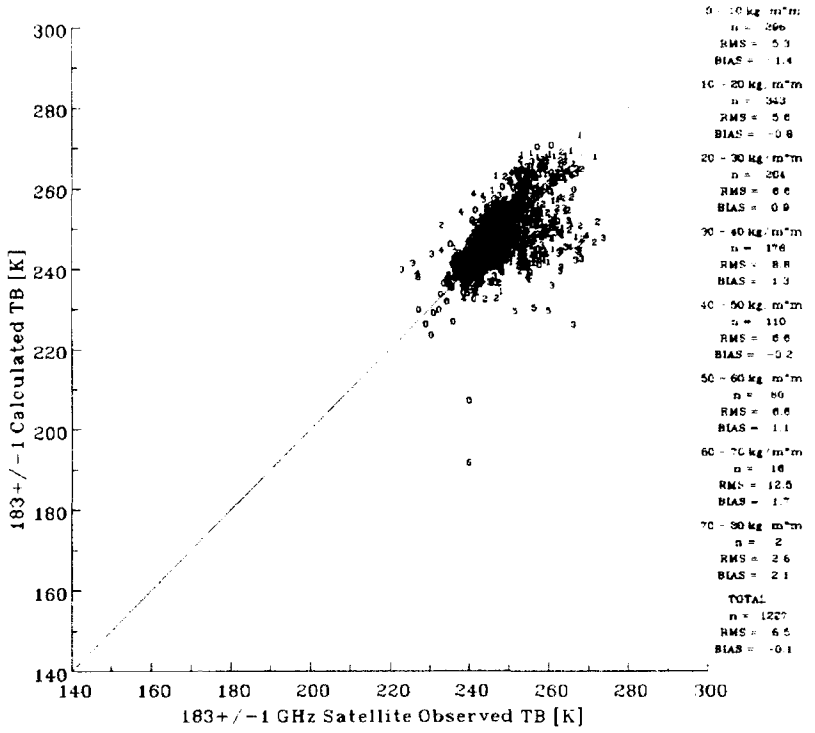
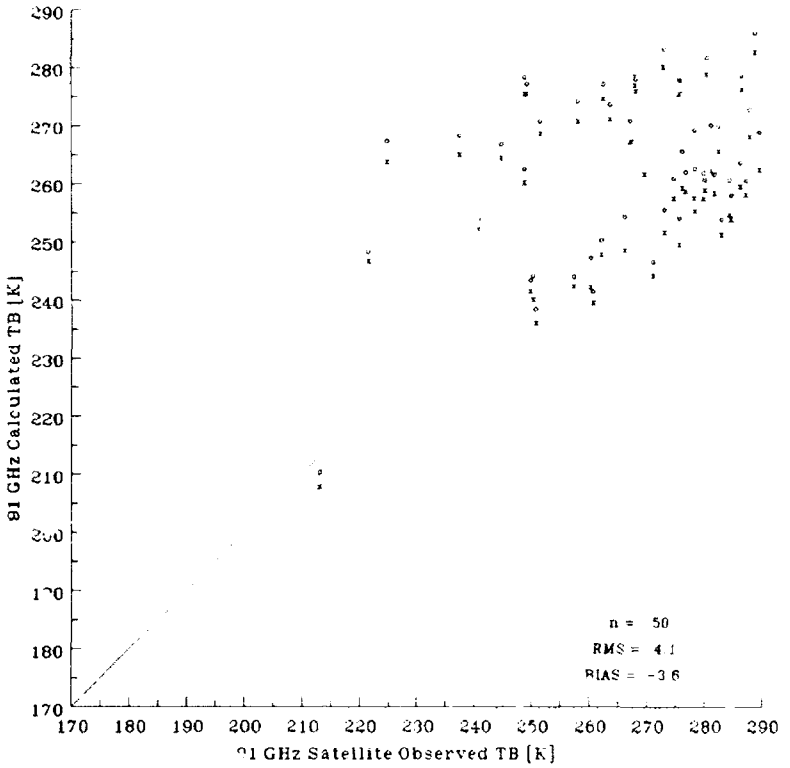


Figure 2.7.2-2. (continued).

a (91 GHz)



b (150 GHz)

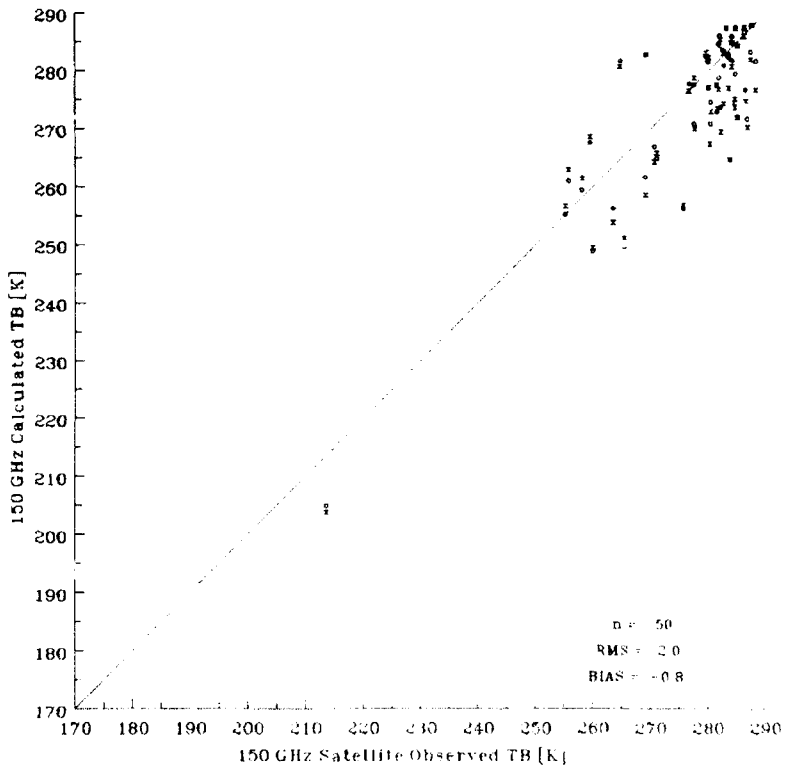
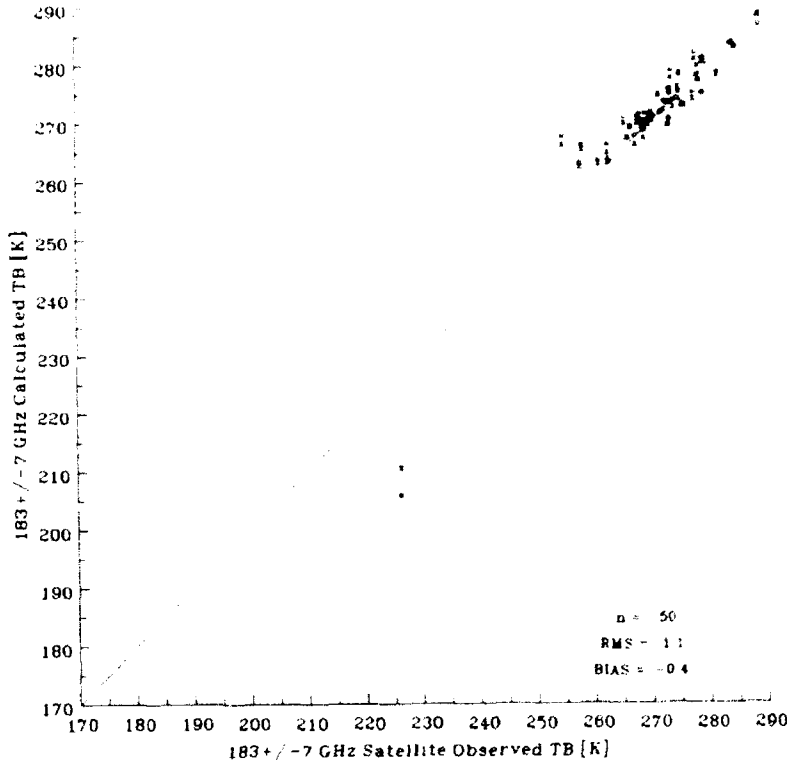


Figure 2.7.2-3 a-e. Comparison of Eyre model results (x) to Enhanced RADTRAN model results (o) for the five SSM/T-2 channels using a global set of radiosondes.

c (183.3 ± 7 GHz)



d (183.3 ± 3 GHz)

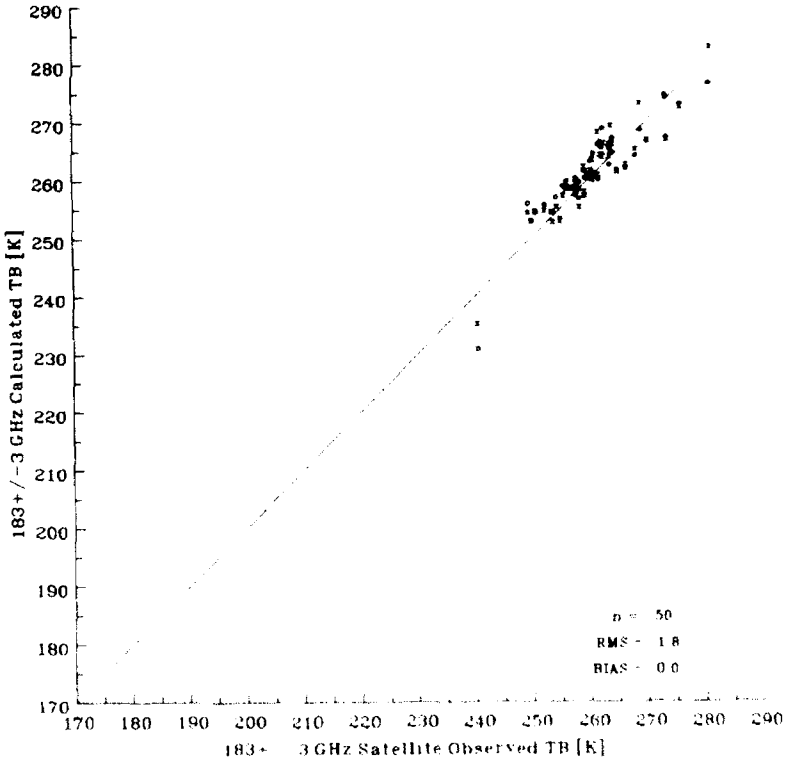


Figure 2.7.2-3. (continued).

e (183.3 ± 1 GHz)

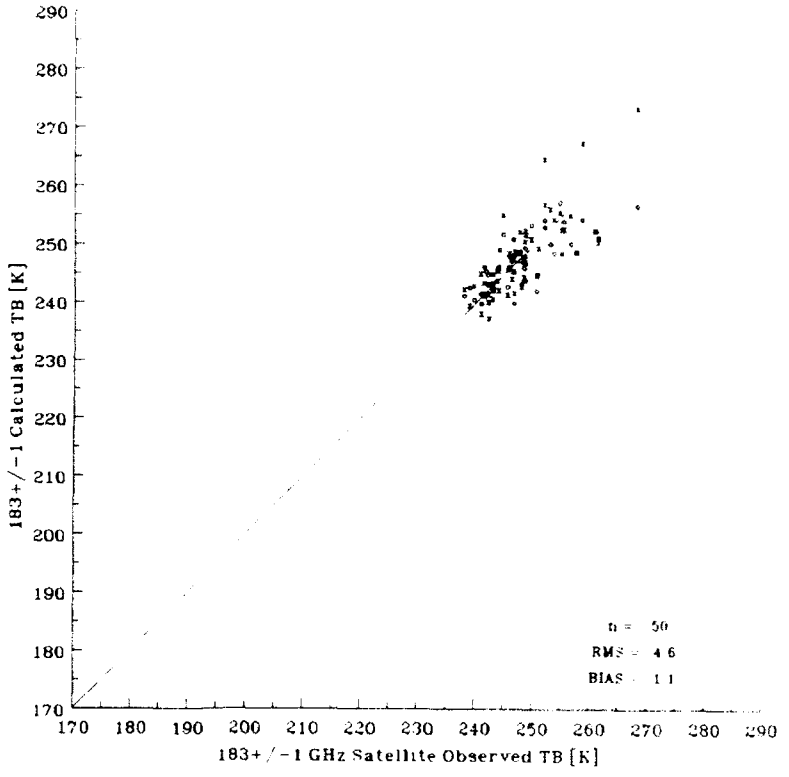


Figure 2.7.2-3. (continued).

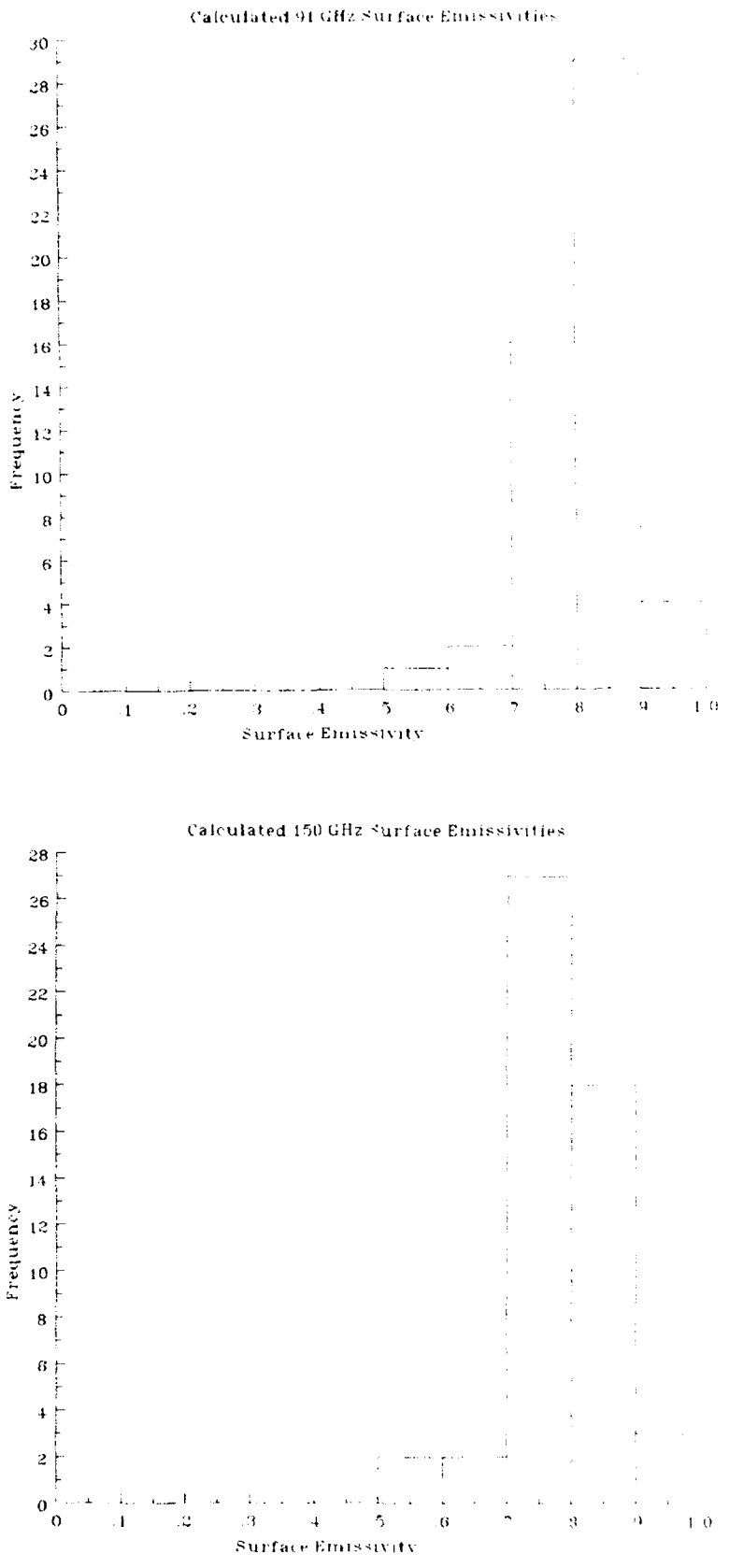


Figure 2.7.2-4. Distribution of optimal surface emissivities for 91 and 150 GHz, iteratively calculated using a global set of radiosonde profiles (all over land) from late March, 1992.

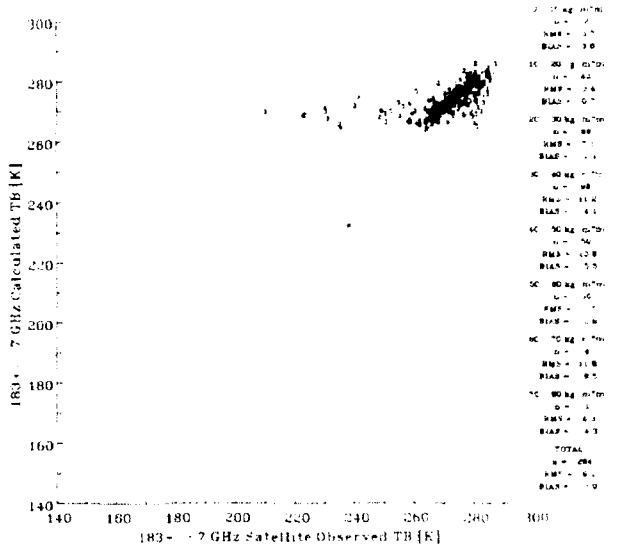


Figure 2.7.2-5. Calculated TBs using radiosondes from India and the United States in the Eyre RT simulation model versus SSM/T-2 observations for 183.3 ± 7 GHz. Plotted numbers represent total precipitable water content of the radiosonde profile used in the Eyre model, e.g., 0 represents a profile with a precipitable water content ranging from 0 to 10 kg/m², 1 represents a range from 10 to 20 kg/m², and so on.

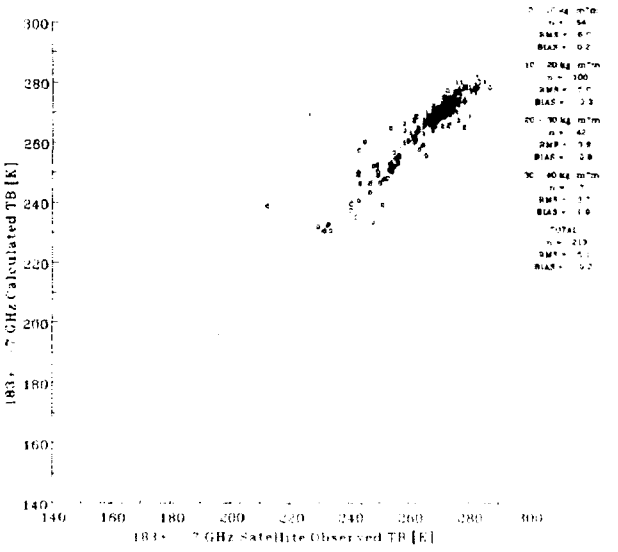
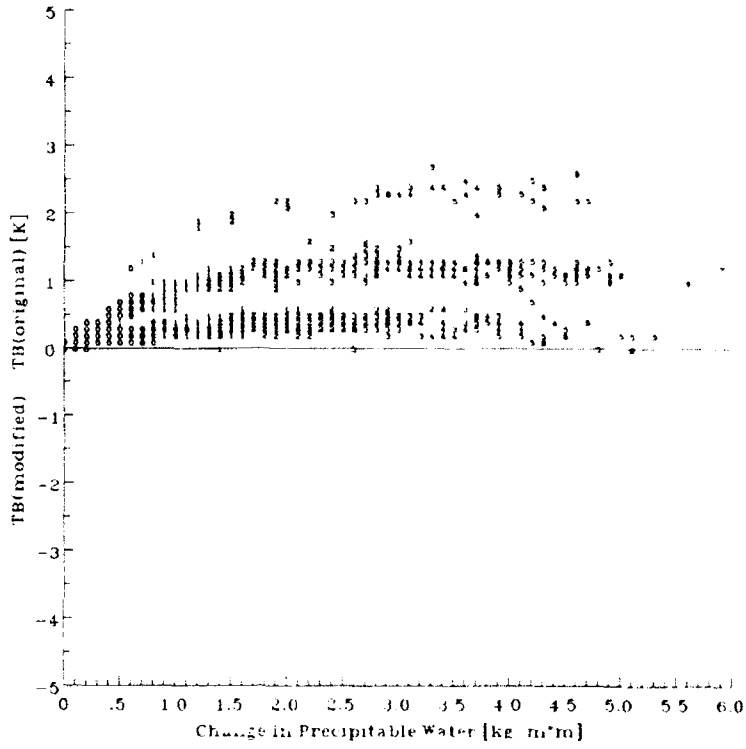


Figure 2.7.2-6. Calculated TBs using radiosondes from England, Germany, Scandinavia and Russia in the Eyre RT simulation model versus SSM/T-2 observations for 183.3 ± 7 GHz. Plotted numbers represent total precipitable water content of the radiosonde profile used in the Eyre model, e.g., 0 represents a profile with a precipitable water content ranging from 0 to 10 kg/m², 1 represents a range from 10 to 20 kg/m² and so on.

a (91 GHz)



b (150 GHz)

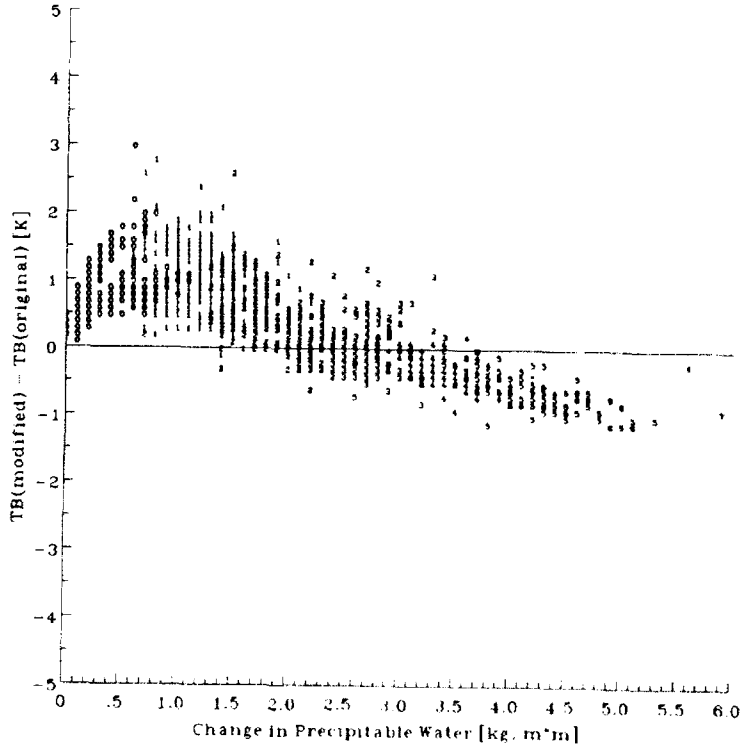
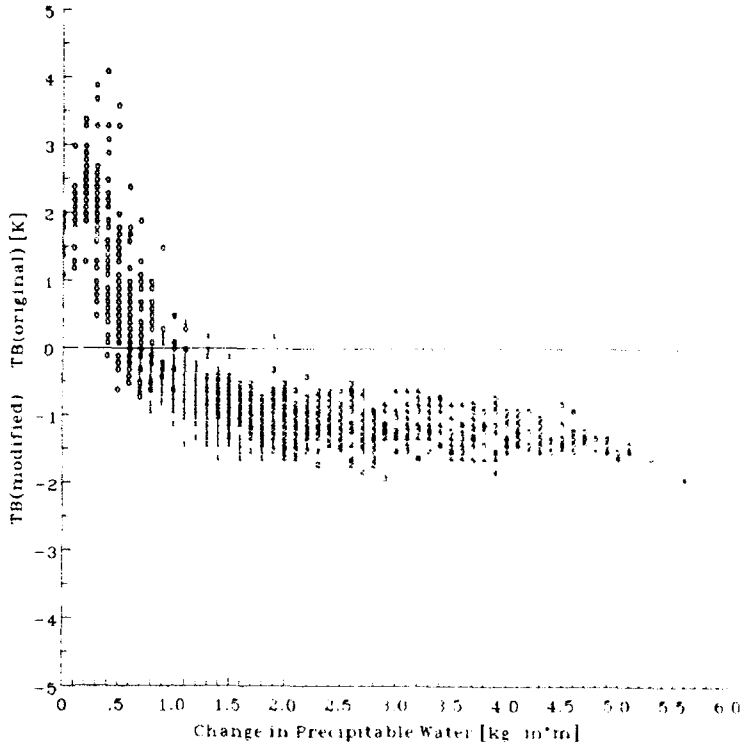


Figure 2.7.2-7 a-e. Calculated changes in TBs relative to the change in precipitable water caused by modifying the humidity profiles by the correction factors presented in Table 2.7.2-2 (see Brousaides and Morrissey, 1974 for discussion) for the five SSM/T-2 channel frequencies .

c (183.3 ± 7 GHz)



d (183.3 ± 3 GHz)

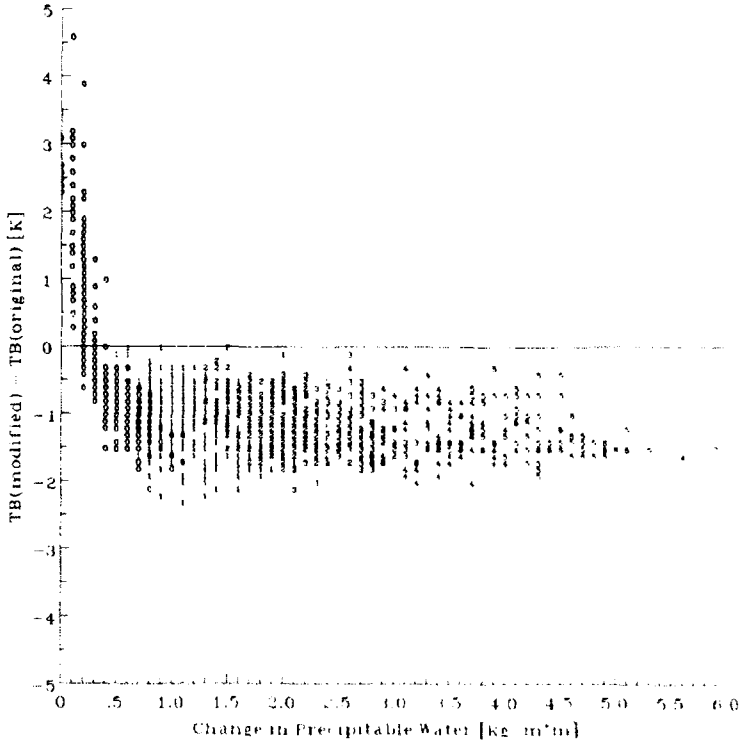


Figure 2.7.2-7. (continued).

e (183.3 ± 1 GHz)

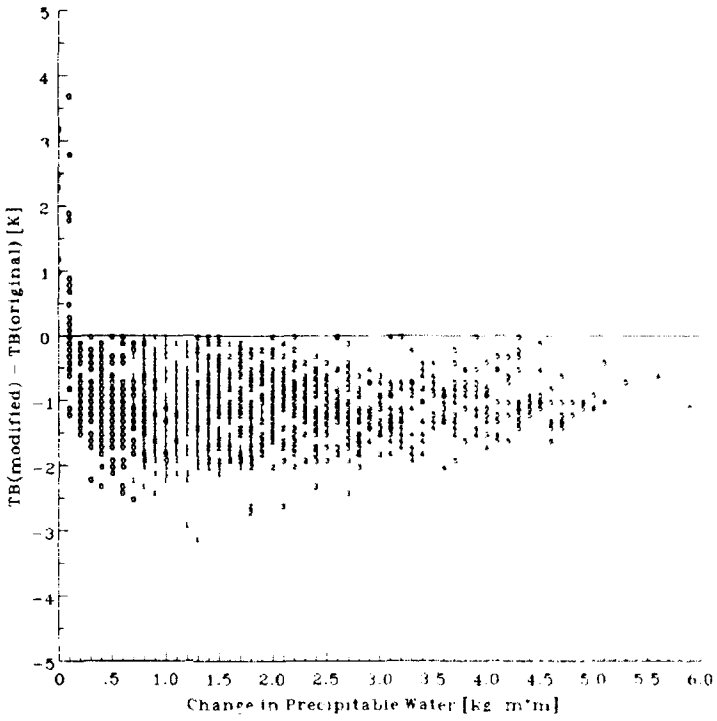


Figure 2.7.2-7. (continued).

SSM/T-2 VALIDATION DATA ANALYSIS

3. SSM/T-2 Validation

3.1 Introduction

This section reports on the moisture retrieval performance of the first operational SSM/T-2 on DMSP F-11. The SSM/T-2 derived RH and Q are quantitatively compared to co-located radiosondes. A qualitative comparison of SSM/T-2 RH and Q to model analyzed moisture fields is also provided. The results of this study should not be taken as the final determination of the SSM/T-2 performance, but as an initial evaluation of a new sensor, and new ground processing algorithms.

No absolute error requirements were levied on the contractor for the SSM/T-2 system as a whole. The vertical moisture profile performance is on a best effort basis. With this in mind, this study will place initial RMS limits on the SSM/T-2 derived RH and Q at 1000, 850, 700, 500, 400, and 300 hPa. Water vapor mass at the seven required layers (i.e. surface-1000 hPa if available, 1000-850, 850-700, 700-500, 500-400, 400-300, and above 300 hPa) will be quantified in a follow-on effort, and compared directly to the SSM/I total water vapor mass. It should be noted that this study addresses the performance of only the first estimate (i.e. a-priori) linear regression coefficients computed by the contractor. This is not necessarily the optimal set. An update of the regression coefficients using co-located radiosonde data will most certainly improve performance.

3.2 Ground Processing Software At AFGWC

The SSM/T-2 Ground Processing Software (GPS) contains four main modules, two of which are "on-line", and two "off-line". The on-line software generates SDRs, which are the calibrated TBs, and the EDRs for the RH and Q. The off-line software performs SSM/T-2 moisture sounding verification and statistically based algorithm "D-matrix" update functions. The following paragraphs will discuss in some detail both the on-line, and the off-line processing at AFGWC.

3.2.1 On-Line Software: Sensor Data Record Processor (SDRP)

The SDRP manipulates raw sensor data by time and data continuity checking, absolute calibration, earth location, determination of terrain type/height, retrieving numerical model 1000 hPa heights, and co-locating SSM/T-2 and SSM/T-1 SDRs.

Time checks are applied to the raw data based on time as reported by the Operational Linescan System (OLS), such that no time gaps are allowed within the data about to be calibrated. Each distinct group of four SSM/T-2 scans will be checked against the previous scans for time continuity. If all 28 SSM/T-2 scenes from each scan are not available, a time discontinuity or beam position error occurs. Should a time gap occur, the software dumps the raw data until the next contiguous four scan group is found.

Terrain types and heights are determined by utilizing the AFGWC terrain type/heights databases. For a given latitude and longitude, the relative grid points are located within the polar-stereographic database, and interpolated to the desired latitude and longitude. The terrain type is used for D-matrix selection criteria while the terrain heights are used to correct land and coastal retrievals for surface effects. The 1000 hPa heights are obtained from the AFGWC High Resolution Analysis System (HIRAS). For a given latitude and longitude, the relative grid points are located within the Mercator database, and interpolated to the desired latitude and longitude. The 1000 hPa heights are used to determine if a given atmospheric pressure surface is below the surface elevation. This information is used by the EDR generation software to properly report missing data. Co-locating SSM/T-1 SDRs to SSM/T-2 raw data is accomplished by comparing scan start time for SSM/T-1 to the SSM/T-2 four scan block time. If the time difference is less than 4 seconds, then matching scan data have been found. The matching SSM/T-1 SDR data is appended to the SSM/T-2 SDRs once calibration is complete. Should SDRP fail to match SSM/T-2 to the corresponding SSM/T-1 data, then the process is repeated for the next available four scan SSM/T-2 block. It should be noted that both SSM/T-1 and SSM/T-2 SDRs are required to process SSM/T-2 to the EDR level. All successfully processed data, along with the ancillary data, are then saved to disk for later processing.

At this point, only a qualitative evaluation of the precision of the SSM/T-2 earth location has been completed. The 91 GHz SSM/T-2 SDRs are interpolated and mapped onto a projection to include land/sea boundaries. At this frequency, the land/sea contrast is very high, and the agreement as to where the land/sea transition occurs has been found to be universally excellent. The reader is referred to SSM/T-2 Aerojet Report (1990) for a detailed discussion on the algorithms used to earth locate SSM/T-2 data. The significant change from the SSM/T-1 to the new SSM/T-2 algorithm is that the effect of earth rotation in the one minute blocks between ephemeris data points has been properly incorporated.

3.2.2 On-Line Software: Environmental Data Record Processor (EDRP)

The EDRP software computes RH, Q, and water vapor mass at the required levels and layers from the SDRs produced by the SDRP, relying on a stratified, multiple linear regression algorithm. A brief discussion of the retrieval scheme at AFGWC follows.

Linear regression coefficients are partitioned by background (i.e. ocean, land, coast, ice), view angle, and integrated water vapor mass (MV in kg/m^2) in a column, and by TB (see Table 3.2.2-1 as an example of ocean background stratifications). The TB thresholding uses the SSM/T-1 54.35 and the 53.2 GHz data as well as the SSM/T-2 183.3 ± 1 GHz data.

There are 25 atmospheres subdivided by surface/background type. Atmosphere Types 1-5 are for ocean background retrievals and are listed in Table 3.2.2-1. Atmospheres 6-20 are for the land, 21 and 22 are designed for the ice backgrounds, and 23-25 are for coast. Five discrete terrain height categories (0-1499 meters, 1500-2999, 3000-4499, 4500-6199, and 6200 meters and above) are used to adjust the SSM/T-2 coefficients over land backgrounds.

Table 3.2.2-1. Atmospheric types over ocean surfaces stratified by MV and temperature.

Type 1	MV < 10 and cold atmosphere
Type 2	MV < 10 and not cold
Type 3	MV between 10 and 26
Type 4	MV > 26, small upper level MV
Type 5	MV > 26, large upper level MV

A quality flag is also computed within EDRP for subsequent use in the verification software. It is preferable that SDRs be collected in cloud free conditions for subsequent use as input to the verification cycle since the radiative transfer calculations within the verification software will not adjust TBs for the presence of heavy cloud. The quality flag over ocean is constructed from a scatter diagram of the 50.5 GHz and 53.2 GHz channels TBs. Figure 3.2.2-1 shows this scatter plot from the contractor's radiosonde database. In order to verify the shape of this scatter plot, Figure 3.2.2-2 was generated using the dataset archived for this study. Water vapor mass and other collected cloud data will subsequently categorize the plot by clear/cloudy. Experience with co-located radiosonde data has allowed the SSM/T-2 contractor to effectively identify areas of heavy cloud over the ocean. Over non-ocean backgrounds, the quality flagging utilized SSM/T-1 temperature profiles in conjunction with the AFGWC Real-Time NEPHanalysis (RTNEPH) data. The inferred cloud type, amount, and thickness are used to determine the approximate cloud vapor mass. Should the vapor mass exceed 0.15 kg/m^2, then a quality flag is set to identify cloudy conditions.

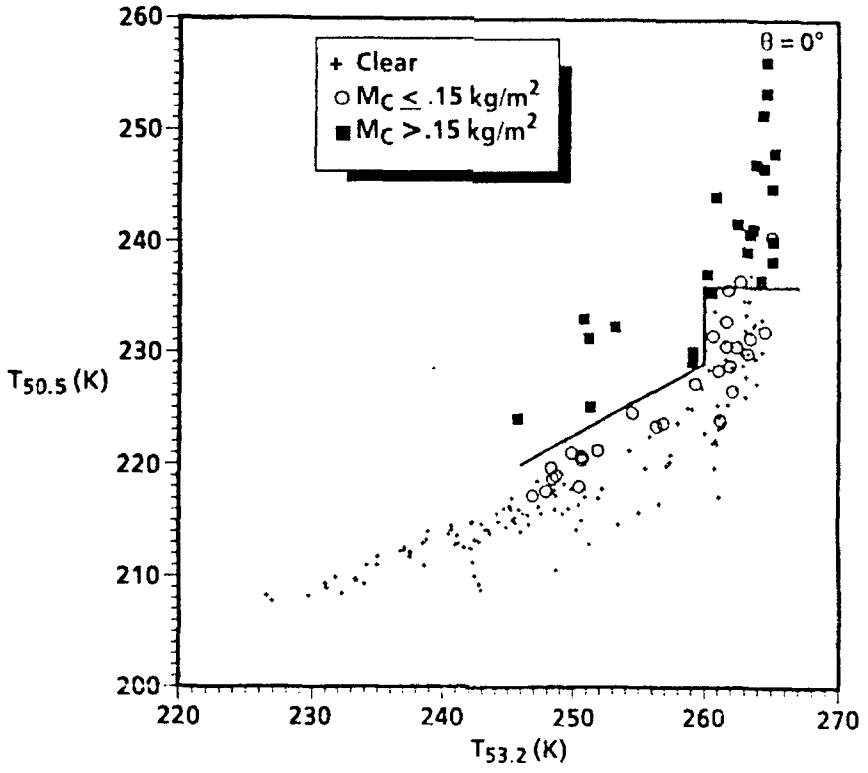


Figure 3.2.2-1. Aerojet's heavy cloud flag over ocean using the 50.5 and 53.2 GHz channels.

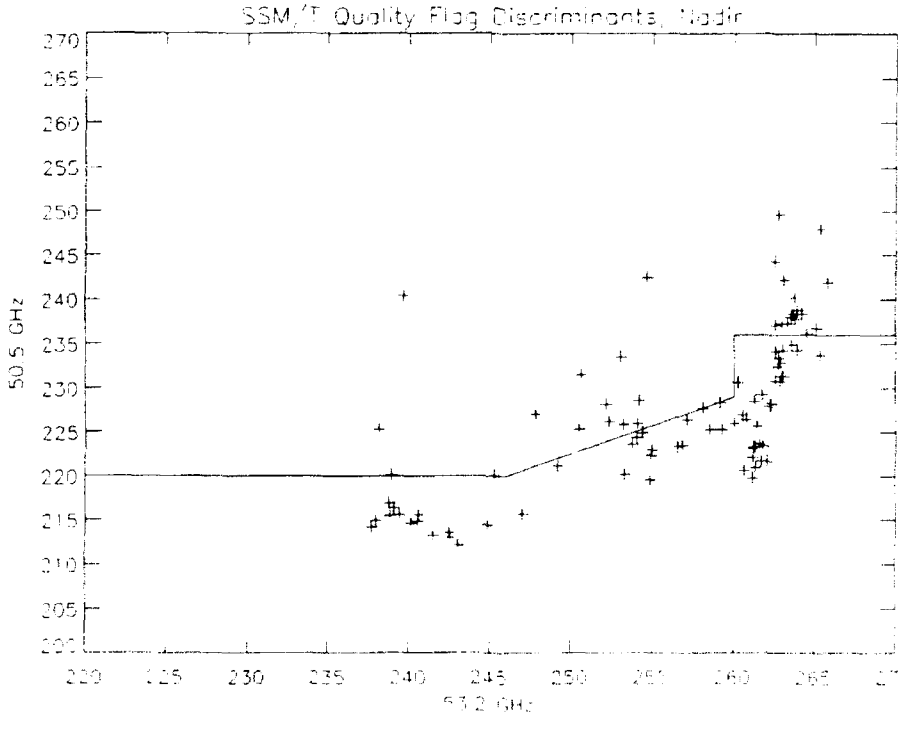


Figure 3.2.2-2. Radiosonde data set verification of Figure 3.2.2-1.

3.2.3 Off-Line Software: Verification Processor (VERP)

The VERP software matches SSM/T-2 EDRs to conventional radiosondes, both in time and space (co-location criteria are user selectable at run time), in order to assess quantitatively the performance of the regression coefficients. The processing flow is as follows: VERP accesses the AFGWC upper-air database directly for collection of the required radiosonde data. Approximately 650 radiosonde observations are available for each major synoptic launch time, i.e. 00 UTC and 12 UTC. The radiosonde data collected by VERP have been quality screened using the AFGWC upper-air validation criteria (a little more discussion on this will follow in a later section). For each valid SSM/T-2 versus radiosonde match, VERP will check each radiosonde reported level for useful temperature and dew point depression data. Should a value at a level be missing, VERP will reject the observation. Each radiosonde profile will be vertically interpolated to the 38 standard levels for the detailed calculations involved in the radiative transfer processing. Microwave radiances are computed from the interpolated radiosonde data and compared directly to the observed SSM/T-2 radiances. Adjustments to the regression coefficients are made in order to minimize the variance between the observed radiances, and the calculated radiances.

3.2.4 Off-Line Software: D-Matrix Update (DMUP)

The DMUP software utilizes the measured SSM/T-2 radiances and the calculated radiances generated in the VERP from co-located SSM/T-2/radiosonde pairs via radiative transfer theory, to statistically remove systematic error (i.e. bias) in the moisture retrievals. Due to the complexities of modeling an atmosphere containing heavy cloud (e.g. multiple scattering and re-emission), DMUP will not use SSM/T-2 versus radiosonde pairs that have been previously flagged as containing heavy cloud. Updating of the a-priori coefficients are independent of how these coefficients have been stratified. For example, the beam angle dependent coefficients can be updated independently for each set of background (ocean, land, coast, ice) coefficients. Exercising the DMUP software and updating the a-priori coefficients will be a high priority task.

The radiative transfer calculations within VERP will be tested against known standards such as Enhanced RADTRAN or the Eyre model. Accurate regression coefficient updates rely on precise radiosonde temperature to frequency dependent TB inversion.

3.3 Expected Level of Performance of the D-Matrix Retrieval Algorithm

Table 3.3-1 is a summary of the Aerojet expected level of RMS performance of the SSM/T-2 D-matrix retrieval algorithm via radiative transfer theory. The data have been beam averaged, with noise added for the model calculations (varying from 0.6 to 0.8 degrees Kelvin).

It is not surprising that the best retrieval statistics are expected to be over ocean backgrounds where the ocean surface emissivity is relatively uniform over a beam position. Land and especially coast background retrievals suffer from large variations in the surface emissivity within the SSM/T-2 FOV causing a correspondingly higher RMS. Ice retrievals have the difficulty of having old and new ice, and the possibility of multiphase surface water (e.g. snow or thin sheets of liquid water). Since no ice background SSM/T-2 and radiosonde co-locations have been observed to date, the ice statistics are not included in Table 3.3-1, nor is it discussed further.

Table 3.3-1. Expected RMS performance of the SSM/T-2 D-matrix retrieval algorithm.

Parameter @ Level	Units	Ocean	Land	Coast
RH @ 1000 hPa	%	13.5	20.3	16.5
RH @ 850 hPa	%	13.9	20.5	22.6
RH @ 700 hPa	%	16.0	19.4	19.6
RH @ 500 hPa	%	12.5	17.3	13.4
RH @ 400 hPa	%	11.8	15.1	13.5
RH @ 300 hPa	%	11.8	12.9	12.4
Q @ 1000 hPa	g/kg	1.41	2.79	2.71
Q @ 850 hPa	g/kg	1.09	1.88	2.32
Q @ 700 hPa	g/kg	.942	1.14	1.26
Q @ 500 hPa	g/kg	.319	.428	.391
Q @ 400 hPa	g/kg	.149	.200	.183
Q @ 300 hPa	g/kg	.054	.059	.059

3.4 Data Collection and Database Description

An extensive dataset has been collected (reference Appendix D) for this validation study. AFGWC allowed Aerospace to develop and to run data collection software on their development and production UNISYS computer systems. The software included executive control to run time sensitive batch jobs, and FORTRAN software to retrieve, reformat and write data to 9-track tape. In addition, a special computer production check-list was provided to operations staff to assist with the data collection scheduling. The detailed scheduling minimized impacts on the AFGWC operational computer systems.

In order to maximize the UNISYS computer (CPU and I/O) efficiency, the bulk of the magnetic tapes were written in UNISYS 36 bit packed format. The 36 bit word size architecture prevented direct communication of data to the Aerospace VAX and UNIX platforms. As a result, it was necessary to reload the 36 bit data collected on the operational systems, onto the development systems for post processing of the data into compatible formats. In all, some 1200 9 track tapes (approximately 108 GBytes) were written on the operational systems, post-processed on the development systems, reformatted on Aerospace computers, and archived to 8 mm tape. The following is a brief list of the data types that have been archived. (1) DMSP F-11 data to include OLS visible and infrared in the form of the Satellite Global Database (SGDB), SSM/I earth located TBs, SSM/T-1 earth located TBs, SSM/T-1 derived vertical temperature profiles, SSM/T-2 earth located TBs and vertical moisture profiles. (2) Conventional data including approximately 10,000 co-located SSM/T-2 to worldwide WMO radiosonde observations (note that more than one SSM/T-2 measurement may be co-located with each individual radiosonde observation; hence, there are not 10,000 unique soundings in this data set), and (3) data from the AFGWC Numerical Models including the RTNEPH, HIgh Resolution Analysis System (HIRAS) RH, Winds, Temperatures, Heights, and data from the Global Spectral Model.

The reader should keep in mind that the SSM/T-2 has an artificially reduced swath width for this study. This is due to a software limitation in the SSM/T-1 processing when a glare obstructor (GLOB) is present on the spacecraft. The SSM/T-1 software eliminates the beam position that intersects the GLOB. However, not only is the GLOB obscured beam position eliminated, the symmetric beam on the other side of nadir is also eliminated. Recall that it is required to have matching SSM/T-1 and SSM/T-2 data, therefore, the missing SSM/T-1 scenes result in the loss of 8 out of 28 SSM/T-2 scenes (~28%). This extensive database can be made available to researchers in the field. Interested parties should contact one of the validation authors for further information.

3.5 Quantitative Comparison of Radiosonde versus SSM/T-2

The orbital geometry of F-11 and the synoptic release times (using only the 00 and 12 UTC times) of the worldwide World Meteorological Organization (WMO) radiosonde network confined the geographical distribution of co-located land-launched radiosonde and SSM/T-2 measurements. Another limiting factor is establishing SSM/T-2 versus radiosonde co-location criteria. There is no heritage in the scientific literature from which to make a choice of co-location criteria for moisture variables except for the astronomy community who deal with different horizontal correlation scales than the atmospheric sciences community. Therefore, for this initial study, 100 km in space and ±1 hour in time was chosen primarily based on the assumption that the horizontal correlation lengths and temporal correlations for RH and Q are on this order. These criteria yield a significant set of SSM/T-2 versus radiosonde matches, on the order of 10,000. Note that there may be numerous SSM/T-2 retrieved profiles that are co-located with a single radiosonde profile. The geographical distribution of stations contributing to the matches are plotted in Figure 3.5-1. There could be a quality control problem for some of the high altitude Asian continent stations, and perhaps those over India. AFGWC does routinely reject a number of these WMO stations during the operational assimilation cycle of the HIRAS. The quality controls imposed on the radiosonde database are the first-pass error checks given in Table 3.5-1 that are used operationally at AFGWC. In addition to the WMO stations, ship-launched radiosondes are also part of the database. Unfortunately only a small number of island stations contribute to the co-location database.

For this study, radiosonde measured RH and Q are considered as "ground truth"; however, it is generally accepted that radiosonde dew point depressions are valid at the 10-15% level and can be even more suspect at low levels when launched from ships. The reader should keep this in mind when reviewing the quantitative SSM/T-2 versus radiosonde work to follow. In addition, the radiosonde observation is a "point" measurement whereas the SSM/T-2 is more appropriately a "volume" measurement. Perhaps the most

Table 3.5-1. Operational error checks on radiosondes at AFGWC.

Pressure (hPa)	Min. Temp (k)	Max. Temp (k)
1000.	183.2	333.2
850.	183.2	315.2
700.	183.2	305.2
500.	192.2	290.2
400.	200.2	278.2
300.	198.2	268.2

appropriate (operational) use of SSM/T-2 data would be along the lines of the European Centre for Medium Range Weather Forecasting (ECMWF) humidity analysis scheme (see "The Treatment of Humidity in ECMWF's Data Assimilation Scheme", 1980). The ECMWF analysis variable is the integrated Q between pressure levels p1 and p2 defined simply as:

$$\underset{1,2}{\Delta} = \int_{p1}^{p2} (Q)dp$$

ECMWF therefore recognizes the volumetric measurements and exploits this characteristic in the data assimilation design for the numerical weather prediction models.

Results of the radiosonde versus SSM/T-2 matches are presented in Table 3.5-2, and may be compared directly to the expected results in Table 3.3-1. The co-location criteria for Table 3.5-2 are 100 km in space and 1 hour in time. For readers who prefer to see vertical profiles in a soundings format, Appendix E is included and is a subset of the 10,000 co-located pairs. Bias is defined as (Radiosonde - SSM/T-2).

Initially, both land-launched and ship-launched radiosondes were considered as a single database. For completeness, the land and ship observations were plotted separately with surprising results (Appendix F). The quantity (Radiosonde - SSM/T-2) RH and Q is plotted on the ordinate, and index of the co-locations on the abscissa. Each four-plot panel represents one atmospheric level. In addition, the plots in Appendix F are stratified by atmosphere type. The co-location criteria are routinely annotated at the top of the plots. It is clear that the ship-launched radiosonde measurements and the SSM/T-2 derived parameters have a substantial bias. Further analysis has begun to understand the large discrepancies between the ship and SSM/T-2 data. However, as a result of this discovery, ship-launched radiosondes have been excluded from the Table 3.5-2 statistics.

The RH RMS over ocean backgrounds are certainly higher than initially predicted, and slightly higher than predicted over the land and coast backgrounds. Q RMS show similar results. In order to attempt to isolate the major contribution(s) to the variance of the data, the atmosphere types 1 through 5 with ocean backgrounds (reference Table 3.3-1) have been plotted separately in Appendix G. Ocean atmosphere 5 stands out at all levels, as well as Type 3 at several of the lower levels. Table 3.5-3 below summarizes the RMS performance of each ocean atmosphere type by level for both RH and Q. It should be noted that no Type 1 ocean atmospheres have been observed to date. Clearly, ocean atmospheres Type 5 and Type 3 (at 850 and 700 hPa) require additional investigation and will be addressed during the follow-on SSM/T-2 work. It is possible that the source of the error for the very moist Type 5 ocean atmosphere is as simple as a coding error, an error in the a-priori coefficients, or a more complex physical problem. It

Table 3.5-2. RMS/bias of radiosonde measurements versus SSM/T-2-derived RH and Q.

Parameter @ Level	Units	Ocean	Land	Coast
RH @ 1000 hPa	%	15.7 / 4.2	16.1 / 5.6	16.2 / -0.6
RH @ 850 hPa	%	22.7 / -3.1	24.2 / -3.7	25.1 / -7.4
RH @ 700 hPa	%	22.8 / -6.8	22.6 / -2.6	21.7 / -3.6
RH @ 500 hPa	%	25.1 /-12.2	21.8 / -4.8	20.1 / -2.0
RH @ 400 hPa	%	22.6 / -14.1	22.1 / -10.4	18.9 / -4.0
RH @ 300 hPa	%	23.2 / -13.2	19.6 / -2.5	17.4 / 0.2
Q @ 1000 hPa	g/kg	3.80 / 0.37	2.74 / -1.47	2.86 / -0.21
Q @ 850 hPa	g/kg	3.13 / -0.43	3.04 / -0.02	2.47 / -0.31
Q @ 700 hPa	g/kg	3.15 / -1.07	1.87 / 0.16	1.46 / 0.04
Q @ 500 hPa	g/kg	2.54 / -1.04	0.88 / -0.10	0.64 / 0.01
Q @ 400 hPa	g/kg	1.00 / -0.45	0.46 / -0.16	0.34 / -0.06
Q @ 300 hPa	g/kg	0.24 / -0.13	0.14 / -0.01	0.24 / -0.13

Table 3.5-3. RMS of SSM/T-2 retrievals by atmospheric types over ocean surfaces.

Parameter	Level	Expected	Type 2	Type 3	Type 4	Type 5
RH (%)	1000	13.5	17.0	11.6	11.4	16.3
RH (%)	850	13.9	17.1	28.1	17.4	22.5
RH (%)	700	16.0	17.5	25.6	13.1	23.2
RH (%)	500	12.5	14.9	19.8	11.0	26.4
RH (%)	400	11.8	13.1	14.9	6.6	24.5
RH (%)	300	11.8	13.7	13.2	9.8	25.2
Q (g/kg)	1000	1.41	1.44	1.34	2.23	4.10
Q (g/kg)	850	1.09	.618	3.11	1.85	3.26
Q (g/kg)	700	.942	.420	2.99	1.66	3.31
Q (g/kg)	500	.319	.201	.351	.650	2.79
Q (g/kg)	400	.149	.078	.101	.145	1.11
Q (g/kg)	300	.054	.019	.032	.069	.266

has been assumed that the line shapes at 150 and 183.3 GHz are well known and that the contribution to the absorption at these frequencies by aggregates of water vapor (e.g. dimers) is minimal. It is possible that these assumptions may not be completely valid. Follow-on work will include exercising the radiative transfer routines in the Verification Processor and calculating radiances at 183.3 GHz from the radiosonde data. In addition, considerable work is being done on the water vapor aggregates as they apply to the SSM/T-2 retrievals.

In order to assess any beam dependent RMS contributions to the statistics, RH and Q are plotted (Appendix H) by symmetric beam pairs about nadir. Recall that beam position 5 is the artificial edge of the SSM/T-2 scans due to the GLOB effects on

SSM/T-1 mentioned earlier. Beam position 24 is the symmetric beam on the opposite side of nadir. Beam positions 14 and 15 straddle nadir. The layout of Appendix H is similar to the plots of Appendix G. Table 3.5-4 summarizes the statistics.

No clear beam dependent RMS trends are observed in the analysis of the SSM/T-2 versus radiosonde comparisons in Table 3.5-4.

Heavy clouds have not been factored out of the results presented thus far. A flag for heavy cloud cover over ocean backgrounds can be estimated by examining a scatter plot of the TBs from the 50.5 GHz and 53.2 GHz channels from the SSM/T-1 (Figures 3.2.2-1 and 3.2.2-2) as mentioned earlier in the text. Results of re-computing the RMS statistics computed using only those observations tagged as heavy cloud contaminated are presented in Table 3.5-5. Only the non-cloud contaminated observation statistics are given in Table 3.5-6. Atmosphere Types 2-4 have no heavy cloud contaminated soundings as expected.

The RMS for both RH and Q are substantially reduced when cloud contamination is accounted for. The Table 3.5-2 RMS over land and coast cannot be flagged for heavy cloud contamination effectively by using the SSM/T-1 scatter plot technique due to the unknown variability in the 50.5 GHz SSM/T-1 TBs within a beam position, over the land. It is reasonable to assume that if a heavy cloud flag over land were available (and reliable), that the RMS over land and coast backgrounds would improve.

Table 3.5-4. RMS of SSM/T-2 retrievals as a function of beam positions.

Parameter@ Level	Ex-pected	5/24	6/23	7/22	8/21	9/20	10/19	11/18	12/17	13/16	14/15
RH@1000	13.5	17.9/12.7	15.5/15.5	15.4/19.1	15.2/17.8	15.3/18.4	16.0/17.7	15.5/15.9	15.0/17.9	15.9/13.8	15.1/13.9
RH@850	13.9	23.7/24.1	24.5/22.0	24.9/23.7	24.6/25.0	24.6/25.8	26.2/25.5	25.5/24.9	22.9/24.8	24.2/25.8	24.2/23.5
RH@700	16.0	24.5/22.4	24.1/21.0	23.2/20.8	23.1/21.8	22.9/22.8	24.1/23.5	21.2/23.5	18.4/22.9	20.3/21.7	21.5/21.9
RH@500	12.5	19.2/21.0	20.7/20.9	21.6/20.6	22.4/22.2	21.0/23.4	22.5/22.7	21.4/21.8	22.2/21.0	22.1/19.3	19.6/19.5
RH@400	11.8	19.4/20.8	19.5/19.8	19.6/19.9	19.9/22.4	20.3/22.6	21.5/21.6	22.1/22.2	21.8/20.8	21.4/20.8	20.6/22.0
RH@300	11.8	17.4/17.3	16.3/19.2	16.7/18.7	17.6/20.1	18.4/19.0	18.7/20.3	19.2/21.0	20.4/18.5	20.5/19.9	18.5/20.2
Q@1000	1.41	2.39/3.11	2.00/2.74	2.92/2.97	3.15/3.04	3.05/3.50	2.64/2.83	2.12/3.04	2.52/3.95	2.65/3.22	3.07/3.50
Q@850	1.09	2.50/2.40	3.05/2.35	3.57/2.67	3.69/2.90	3.48/2.70	2.83/2.75	2.58/2.87	2.35/2.98	2.45/2.90	2.56/2.69
Q@700	.942	1.81/2.28	1.72/1.52	1.67/1.70	1.83/2.00	1.70/2.09	1.80/2.10	1.57/1.93	1.44/1.91	1.57/1.52	1.71/1.70
Q@500	.319	.731/.856	.750/.752	.881/.798	1.21/.976	1.02/1.06	.863/.874	.805/.949	.809/1.07	.852/.777	1.05/.848
Q@400	.149	.363/.447	.352/.396	.383/.427	.502/.501	.518/.492	.426/.424	.429/.476	.383/.495	.409/.461	.486/.493
Q@300	.054	.114/.111	.118/.122	.117/.121	.127/.130	.149/.125	.133/.138	.135/.151	.135/.138	.140/.150	.132/.153

Table 3.5-5. RMS of SSM/T-2 retrievals by heavy cloud-type atmospheres over ocean surfaces.

Parameter @ Level	Expected	Type 2	Type 3	Type 4	Type 5
RH @ 1000 hPa	13.5	N/A	N/A	N/A	19.8
RH @ 850 hPa	13.9	N/A	N/A	N/A	24.1
RH @ 700 hPa	16.0	N/A	N/A	N/A	22.1
RH @ 500 hPa	12.5	N/A	N/A	N/A	27.5
RH @ 400 hPa	11.8	N/A	N/A	N/A	28.5
RH @ 300 hPa	11.8	N/A	N/A	N/A	29.3
Q @ 1000 hPa	1.41	N/A	N/A	N/A	4.91
Q @ 850 hPa	1.09	N/A	N/A	N/A	3.44
Q @ 700 hPa	.942	N/A	N/A	N/A	3.78
Q @ 500 hPa	.319	N/A	N/A	N/A	3.48
Q @ 400 hPa	.149	N/A	N/A	N/A	1.41
Q @ 300 hPa	.054	N/A	N/A	N/A	.314

Table 3.5-6. RMS of SSM/T-2 retrievals by non-heavy cloud-type atmospheres over ocean surfaces.

Parameter @ Level	Expected	Type 2	Type 3	Type 4	Type 5
RH @ 1000 hPa	13.5	16.5	11.6	8.0	11.1
RH @ 850 hPa	13.9	16.0	28.1	14.0	20.3
RH @ 700 hPa	16.0	16.3	25.4	12.9	24.3
RH @ 500 hPa	12.5	14.6	19.6	9.1	24.7
RH @ 400 hPa	11.8	11.0	14.9	6.4	18.2
RH @ 300 hPa	11.8	13.3	12.4	9.5	18.5
Q @ 1000 hPa	1.41	1.11	1. 27	1.43	2.92
Q @ 850 hPa	1.09	.578	3.11	1.75	3.01
Q @ 700 hPa	.942	.393	2.99	1.64	2.54
Q @ 500 hPa	.319	.107	.346	.411	1.47
Q @ 400 hPa	.149	.040	.094	.141	.557
Q @ 300 hPa	.054	.014	.030	.067	.189

A final concern is the question as to whether a different choice of spatial co-location criteria (other than the assumed 100 km value) would substantially alter the SSM/T-2 Vs radiosonde RMS statistics. In order to address this concern, the spatial co-location criteria were changed to 25 and 50 km (keeping the temporal value of ±1 hour), and RMS statistics were re-calculated (again stratified by the ocean, land, and coast backgrounds). The results are plotted in Appendix I and summarized below in Table 3.5-7. There are improvements in RMS at some levels, and poorer results at others when compared to the 100 km co-location statistics by background (Table 3.5-7). However the number of co-locations begin to suffer and the resulting sample size is insufficient to determine statistically significant results at the 25 km value. Overall, the 100 km spatial

co-location criteria gives consistent results compared to the 50 km data, and has a significant sample size.

These co-location results (a-priori coefficients only) are very encouraging, except for the type 3 and type 5 atmospheres over ocean, in light of the unknown quality of a large number of the radiosondes collected over the Asian continent. The errors will most certainly decrease after the a-priori coefficients are replaced by an updated set.

Perhaps the best comparison of the overall utility and versatility of the SSM/T-2 is to examine the horizontal structure of the relatively high resolution SSM/T-2 measurements. In the following Section, SSM/T-2 RH and Q imagery will be compared to the High Resolution Analysis System (HIRAS) analyzed RH and Q imagery.

Table 3.5-7. RMS of SSM/T-2 retrievals stratified by spatial co-location criteria.

Co-location @	Parameter @ Level	Units	Ocean	Land	Coast
25 km	RH @ 1000 hPa	%	12.4	16.2	16.1
50 km	RH @ 1000 hPa	%	12.5	15.7	14.5
25 km	RH @ 850 hPa	%	14.1	24.1	24.0
50 km	RH @ 850 hPa	%	18.1	23.5	24.3
25 km	RH @ 700 hPa	%	26.8	21.9	20.3
50 km	RH @ 700 hPa	%	21.0	22.3	20.9
25 km	RH @ 500 hPa	%	27.6	19.5	19.1
50 km	RH @ 500 hPa	%	24.5	20.2	19.7
25 km	RH @ 400 hPa	%	15.7	21.2	18.1
50 km	RH @ 400 hPa	%	16.9	20.7	18.5
25 km	RH @ 300 hPa	%	19.3	19.0	17.9
50 km	RH @ 300 hPa	%	21.1	19.0	17.8
25 km	Q @ 1000 hPa	g/kg	3.26	2.15	2.92
50 km	Q @ 1000 hPa	g/kg	3.00	2.22	2.69
25 km	Q @ 850 hPa	g/kg	2.06	2.65	2.38
50 km	Q @ 850 hPa	g/kg	2.64	2.98	2.35
25 km	Q @ 700 hPa	g/kg	2.70	1.74	1.47
50 km	Q @ 700 hPa	g/kg	2.48	1.77	1.43
25 km	Q @ 500 hPa	g/kg	1.69	.856	.565
50 km	Q @ 500 hPa	g/kg	1.64	.827	.610
25 km	Q @ 400 hPa	g/kg	.560	.443	.326
50 km	Q @ 400 hPa	g/kg	.519	.433	.318
25 km	Q @ 300 hPa	g/kg	.228	.131	.115
50 km	Q @ 300 hPa	g/kg	.209	.132	.107

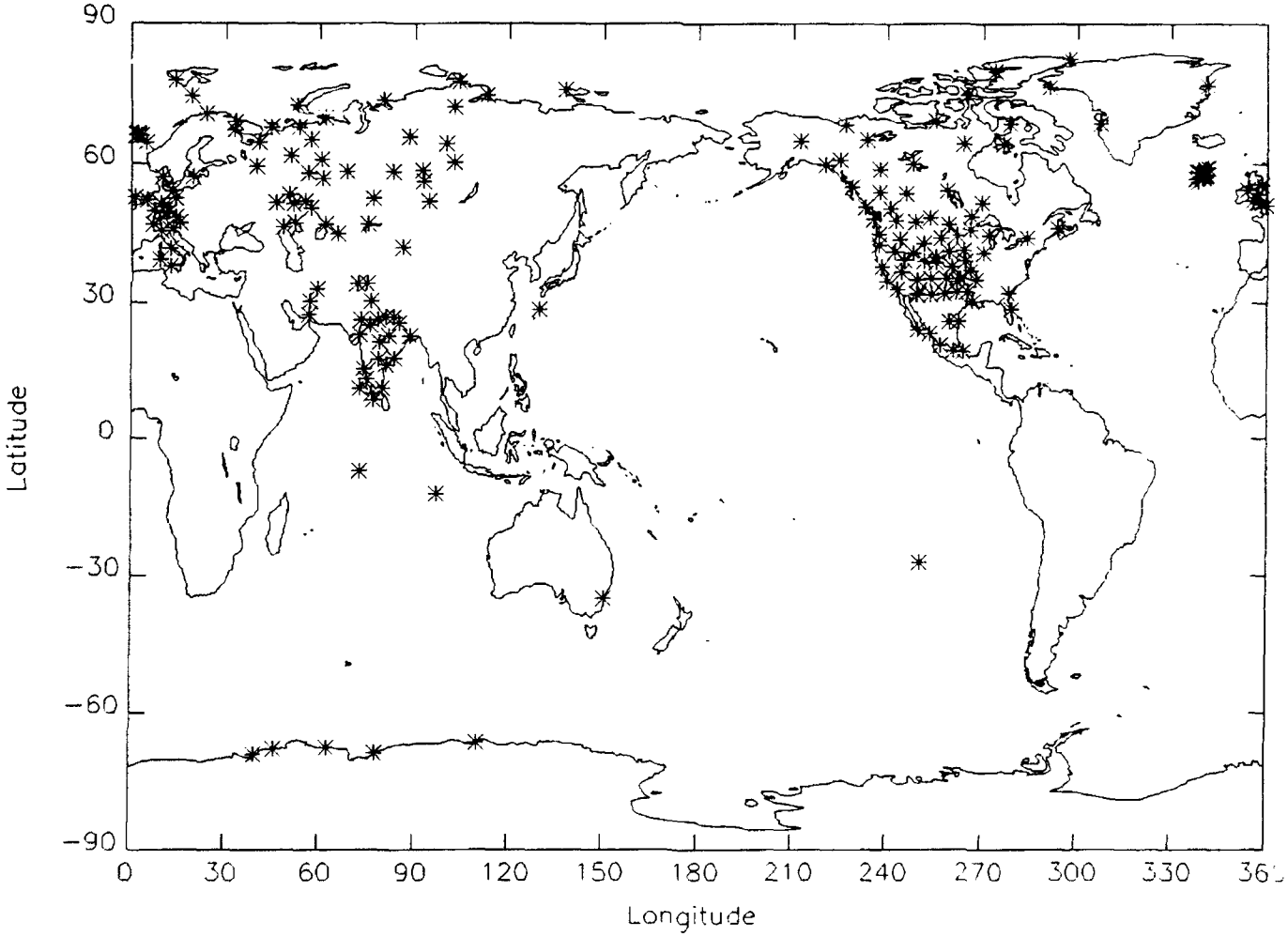


Figure 3.5-1. Geographic distribution of the locations of radiosondes that were used in the SSM/T-2 validation study.

3.6 Qualitative Comparison of Model Analyzed Moisture versus SSM/T-2

An extensive set of SSM/T-2 and model analysis imagery are available in the DMSP Library. A small subset is included in Appendix J. The purpose of including this qualitative dataset is to anticipate the use of the SSM/T-2 data in global numerical weather prediction models. The SSM/T-2 has tremendous horizontal resolution compared to existing moisture analysis at AFGWC. It is hoped that these data will encourage the users to exploit the capabilities of the SSM/T-2 system and spark new research in small-scale energy conversion processes, as well as global water vapor budgets for climate research.

The authors encourage the modeling community to examine the small dataset in Appendix J in detail. The SSM/T-2 has never been advertised as an imager; however, with proper horizontal interpolation, the SSM/T-2 may be transformed into useful imagery. Tools were written in Interactive Data Language (IDL)® to construct imagery from the SSM/T-2 and the model data. The color lookup tables are scaled consistently between the SSM/T-2 EDRs and the model analysis to permit the direct overlay of data for comparison. This dataset consists of SSM/T-2 RH and Q at several levels, as well as the corresponding HIRAS analysis. In addition, the wind analysis from HIRAS is included as well as the ground track of the analyzed F-11 SSM/T-2 orbit. Each orbit contains cyclones or convective clusters directly overflown by the SSM/T-2. Analysis of the imagery should proceed as follows: compare the F-11 ground track to the HIRAS wind field analysis in order to isolate areas of interest. Begin with RH at low levels. The signature of small scale convective activity is depletion (via convergence and entrainment) of the local moisture. Moving to the upper levels (i.e. 500 hPa), look for saturation due to the convective energy conversions, and eventual RH depletion by detrainment further aloft. Specific humidity shows similar features. A note of caution over land. Missing data appear as light purple giving the impression of very dry conditions. The larger scale synoptic features should be compared directly to the HIRAS analysis. The SSM/T-2 imagery show convection and post-frontal drying in great detail. These clearly defined physical processes have the potential to improve the moisture specification significantly.

In addition, viewing the SSM/T-2 data as imagery is a very fast means of quality control. Out of range values can be spotted by the eye very quickly, bogused out of the dataset, and past on to the data assimilation schemes. Workstations are now fast enough to handle these multidimensional datasets in a very short (processing) time.

The assimilation of SSM/T-2 data into HIRAS could begin by a judicious averaging of the RH/Q since adjacent SSM/T-2 observations appear to be reasonably well correlated. Perhaps a more rigorous interpolation scheme along the lines of Kriging (1973) would yield an optimum interpolation. What is clear after examining the SSM/T-2 RH/Q imagery compared to the HIRAS equivalent is that new research must be started in order to take advantage of the excellent horizontal resolution of the SSM/T-2, and the overall quality of the observations on a given pressure level.

4. CONCLUSIONS

Over water, measurements of SSM/T-2 channels in the vicinity of 183.31 GHz water vapor absorption line produce RMS deviations from the mean of the co-located MIR-measured TBs of 0.7 - 2.1 K with biases of up to 1.8 K in magnitude. RMS variation for these frequencies is larger for coastal FOVs (up to 2.4 K) with the largest variation for land backgrounds (up to 3.8 K). For the surface channels, 91 and 150 GHz, show larger RMS and bias, especially for the mixed (i.e. coastal) FOVs.

Radiative transfer calculations based on co-located radiosondes are generally in good agreement with SSM/T-2 TBs considering that there was no consideration of clouds and weather conditions within the SSM/T-2 FOV which could also affect the TBs measured within the SSM/T-2 FOV as well as the forward-calculated TBs. The three 183.3 GHz channels had RMS differences of up to 7.8 K. The larger discrepancies for the transparent channels are a result of the channels sensing the surface, for which mean emissivities used in the RT simulations underestimate the SSM/T-2 observations over land and overestimate them over the ocean.

Studies of the variations of the on-orbit calibration performed by Aerospace indicate the instrument is very stable. The analysis of the underflights indicate that the SSM/T-2 is performing within or exceeds the original specifications. This calibration study has shown that for operational utilization there are no apparent or consistent instrument biases.

The SSM/T-2 retrieved vertical moisture profiles (excluding observations contaminated by heavy cloud) compare favorably with co-located radiosonde data except over certain ocean atmospheres. The radiosonde database included Asian continent stations, and high altitude stations that may have questionable observation accuracies. These stations were not removed from the database for this study, therefore the results should be considered as a worst case scenario. The linear biases that were observed between the SSM/T-2 versus radiosonde comparisons will be eliminated when the a-priori regression coefficients are updated. The improvement in retrieval accuracy via the update of regression coefficients is a high priority task and will be pursued as soon as possible.

The SSM/T-2 has not been advertised as an imager, however, this study has proved that the SSM/T-2 is capable of yielding high quality EDR imagery. The detailed imagery should energize the modeling community to consider assimilating the SSM/T-2 data into operational analysis as well as using the imagery itself as a means of rapid quality control of the data prior to assimilation in the numerical models. In addition, the SSM/T-2 TBs rendered as multichannel imagery are interesting. Work to date includes combining the 91 GHz window channel, the 150 GHz (middle atmosphere) channel, and the 183.3 ± 1 GHz channel. This particular choice of channels and colors brings out the

structure of small scale storms very effectively. The interpretation of the multichannel data is, at times, very complex. The 183.3 GHz channel is the most difficult to deal with since both absorption, re-emission and scattering are occurring.

This initial validation study has the following set of recommendations: (1) detailed analysis of the a-priori ocean atmosphere Types 3 and 5, (2) careful inspection of the radiative transfer code implementation, (3) detailed analysis of the inferred heavy cloud flag over ocean, and finally (4) a careful update to the a-priori D-Matrices.

In summary, the experience that the user community gains by working with the SSM/T-2 data as both a point measurement and a volume averaged variable in the numerical weather prediction models, will simplify the transition to the higher resolution SSMIS soundings. It is imperative that proper attention be given to the fine tuning of the SSM/T-2 during a follow-on effort since all lessons learned will be directly applicable to the SSMIS system.

5. POSSIBLE FURTHER ANALYSIS

In the Cal/Val Volume II an attempt will be made to address the following areas:

1) weather analysis of FOV on calibration,
2) plot of time line of the ER-2 data and demarcation of topography (as determined by the SSM/T-2 classification),
3) MIR TB changes over the same location with time,
4) global rawindsonde comparison during this time,
5) compare polarization difference between SSM/T-2 and MIR, and
6) examine increased 183.3 ± 1 GHz RMS over land and water compared to the 183.3 ± 3 and 183.3 ± 7 GHz,
7) experiment with different retrieval techniques,
8) research surface problems, such as cold air outbreaks and snow/ice surfaces,
9) examine statistics of global water vapor distribution as it impacts the D-matrix retrieval technique,
10) research water retrievals,
11) cloud impact and use in retrievals, and
12) earth surface polarization studies.

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Appendix A

Abbreviations and Acronyms

Abbreviation or Acronym	Definition
AER	Atmospheric and Environmental Research, Inc.
Aerojet	Aerojet Electronic Systems Division
AFGWC	Air Force Global Weather Central
Cal/Val	Calibration/Validation
CI	Two-letter Military Abbreviation for Defense Meteorological Satellite Program
CPU	Central Processing Unit
DMSP	Defense Meteorological Satellite Program
DMUP	D-Matrix Update
ΔT	Minimal Detectable Change in Radiometer Antenna Temperature
ECMWF	European Centre for Medium Range WeatherForecasting
EDR	Environmental Data Record
ER-2	Earth Resources Aircraft (U-2)
FOV	Field-of-View
GLOB	Glare Obstructor
GPS	Ground Processing Software
HIRAS	High Resolution Analyses System
IDL	Interactive Data Language
I/O	Input/Output
MIR	Millimeter-wave Imaging Radiometer
MV	Integrated Water Vapor Mass
NAS	Naval Air Station
NASA	National Aeronautics & Space Agency
NEΔT	Noise Equivalent Temperature Difference

Appendix A (continued)

Abbreviations and Acronyms

Abbreviation or Acronym	Definition
NOAA/NESDIS	National Oceanic and Atmospheric Administration/National Environmental Satellite Data and Information Service
OLS	Operational Linescan System
PL/GP	Phillips Laboratory/Geophysics Directorate
PRT	Platinum Resistance Thermometer
Q	Specific Humidity (gm/kg)
RF	Radio Frequency
RH	Relative Humidity (%)
RMS	Root Mean Square
RT	Radiative Transfer
RTD	Resistive Temperature Devices
RTNEPH	Real-Time NEPH Analysis
SDR	Sensor Data Record
SDRP	Sensor Data Record processor
SGDB	Satellite Global Database
SMC	Space & Missiles Center
SSM/I	Special Sensor Microwave, Imager
SSMIS	Special Sensor Microwave Imaging Sounder
SSM/T-1	Special Sensor Microwave, Temperature
SSM/T-2	Special Sensor Microwave, Water Vapor
TB	Brightness Temperature
UTC	Universal Time Coordinated (formally Greenwich Mean Time)
VERP	Verification Processor
WMO	World Meteorological Organization

Appendix B. Distributions of radiosonde stations and measurements that were used to calibrate the SSM/T-2. Co-locations were determined by the thresholds of ± 1 hours and ± 100 km. The soundings were required to have reported moisture profiles up to 300 hPa.

Latitude Distribution of Radiosonde Measurements and Radiosonde Stations

Latitude	Latitude	Number of RAOBs	Number of Stations
90	80	11	2
80	70	31	7
70	60	112	24
60	50	238	67
50	40	193	62
40	30	274	76
30	20	153	37
20	10	95	25
10	0	60	15
0	-10	11	4
-10	-20	10	2
-20	-30	1	1
-30	-40	4	3
-40	-50	0	0
-50	-60	0	0
-60	-70	34	5
-70	-80	0	0
-80	-90	0	0
	TOTAL	1227	330

Elevation Distribution of Radiosonde Measurements and Radiosonde Stations

Elevation [m]	Elevation [m]	Number of RAOBs	Number of Stations
0	50	435	106
50	100	122	32
100	200	157	43
200	300	75	23
300	400	71	23
400	500	45	13
500	600	22	9
600	700	29	11
700	800	24	8
800	900	33	8
900	1000	36	10
1000	2000	140	32
2000	3000	24	6
3000	4000	14	6
4000	5000	0	0
5000	99999	0	0
	TOTAL	1227	330

Time Distribution of Radiosonde Measurements

Time (UTC)	Number of RAOBs
0	410
6	104
12	675
18	38
TOTAL	1227

Individual listing of radiosonde stations (block number and station number), latitude, longitude, elevation and frequency of radiosonde profiles that were co-located with SSM/T-2 observations (using ± 1 hour and 100 km)

Block & Station Number	Latitude + North - South	Longitude - East + West	Elevation [m]	Frequency
10280	74.51	-19.01	18.	6
28360	67.36	-26.65	178.	9
29350	62.40	-25.66	139.	7
29630	60.81	-23.50	103.	7
31700	56.43	2.86	4.	1
32130	54.31	3.40	8.	2
32400	55.41	1.60	23.	5
33220	53.55	2.91	54.	8
34960	52.68	-1.68	13.	1
35020	52.13	4.56	133.	1
36930	51.55	-0.83	2.	1
37430	51.20	1.80	132.	2
37740	51.08	0.21	143.	5
39200	54.48	6.10	37.	10
39530	51.93	10.25	9.	1
42200	68.70	52.75	40.	2
42700	61.18	45.43	4.	1
43200	76.76	18.66	14.	10
43390	70.48	21.96	65.	1
60300	57.10	-9.86	3.	1
62600	52.10	-5.18	2.	3
93930	52.21	-14.13	115.	2
95480	50.56	-10.38	450.	1
100460	54.38	-10.15	31.	2
101840	54.10	-13.40	2.	8
102000	53.35	-7.21	5.	3
102380	52.81	-9.93	70.	1
103040	52.71	-7.31	19.	2
103930	52.21	-14.11	115.	5
105480	50.56	-10.36	450.	8
106180	49.70	-7.33	376.	3
107710	49.43	-11.90	419.	3

109210	47.98	-8.90	807.	1
110110	48.23	-14.18	298.	2
110350	48.25	-16.36	200.	1
112390	47.00	-15.43	340.	1
115200	50.00	-14.45	303.	6
160440	46.03	-13.18	93.	2
160800	45.43	-9.28	107.	4
163200	40.65	-17.95	15.	2
164290	37.91	-12.50	7.	4
165600	39.25	-9.05	4.	4
200460	80.61	-58.05	20.	7
202920	77.71	-104.28	13.	1
208910	71.98	-102.46	33.	4
215040	74.66	-112.93	35.	3
218240	71.63	-128.85	8.	6
230220	69.76	-61.68	53.	11
230780	69.33	-88.10	62.	4
234720	65.78	-87.95	32.	10
238840	61.60	-90.00	63.	5
239210	60.68	-60.43	101.	12
241250	68.48	-112.43	209.	5
242660	67.55	-133.38	137.	3
243430	66.76	-123.40	84.	4
245070	64.16	-100.06	188.	6
249590	62.08	-129.75	103.	2
264220	56.96	-24.06	3.	5
271960	58.65	-49.61	164.	3
282750	58.15	-68.18	44.	8
284400	56.80	-60.63	237.	11
286980	54.93	-73.40	94.	13
287220	54.81	-56.15	104.	1
289520	53.21	-63.61	171.	3
292310	58.30	-82.90	76.	3
292630	58.45	-92.15	78.	3
295740	56.00	-92.88	215.	6
296120	55.36	-78.40	120.	3
296340	55.03	-82.90	141.	7
298380	53.33	-83.70	250.	4
298650	53.75	-91.40	256.	6
300540	59.45	-112.58	193.	1
302300	57.76	-108.11	258.	1
305210	54.80	-105.16	428.	1
306350	53.43	-108.98	457.	1
307150	52.48	-103.85	450.	1
307580	52.01	-113.33	668.	1
309350	50.36	-108.75	770.	1
309650	50.38	-116.51	684.	1
333450	50.40	-30.45	168.	1
351210	51.75	-55.10	120.	1
352290	50.28	-57.15	219.	3
356710	47.80	-67.71	345.	3
360030	52.28	-76.95	119.	3
360960	51.66	-94.38	629.	7
361770	50.35	-80.25	194.	11

368700	43.23	-76.93	847.	10
380620	44.76	-65.53	129.	3
383410	42.85	-71.38	653.	4
383530	42.83	-74.58	828.	4
383920	41.83	-59.98	88.	1
384570	41.26	-69.26	493.	10
386060	40.55	-70.95	405.	1
386870	39.08	-63.60	193.	2
388800	37.96	-58.33	304.	1
389270	37.28	-67.31	310.	1
389540	37.50	-71.51	2120.	3
407540	35.68	-51.31	1204.	1
408090	32.86	-59.20	1491.	1
421820	28.58	-77.20	211.	1
423390	26.30	-73.01	217.	1
423790	26.75	-83.36	76.	2
426470	23.06	-72.63	55.	1
427000	23.36	-85.33	612.	2
427790	22.76	-81.90	624.	1
428670	21.10	-79.05	308.	2
429710	20.25	-85.83	45.	1
430140	19.85	-75.40	582.	2
430410	19.08	-82.03	552.	1
431280	17.45	-78.46	545.	1
431500	17.70	-83.30	66.	4
431850	16.35	-81.15	3.	2
432790	13.00	-80.18	10.	2
432850	12.95	-74.83	32.	1
432950	12.96	-77.58	920.	5
433110	11.11	-72.73	3.	1
433330	11.66	-92.71	79.	2
433460	10.91	-79.83	7.	2
433530	9.93	-76.23	1.	2
480800	18.46	-94.35	9.	1
483270	18.78	-98.98	323.	4
484070	15.25	-104.86	123.	4
484550	13.73	-100.50	4.	4
485650	8.10	-98.30	3.	5
485680	7.20	-100.60	4.	7
486010	5.30	-100.26	3.	5
486150	6.16	-102.28	5.	3
486480	3.10	-101.65	46.	5
486570	3.78	-103.21	18.	2
486980	1.36	-103.98	14.	9
488550	16.03	-108.18	7.	2
510760	47.73	-88.08	737.	9
511330	46.73	-83.00	549.	3
512430	45.60	-84.85	428.	2
512880	45.36	-90.53	1651.	2
514310	43.95	-81.33	663.	7
514630	43.78	-87.61	919.	3
516440	41.71	-82.95	1100.	10
516560	41.75	-86.13	933.	1
517770	39.03	-88.16	889.	8

518280	37.13	-79.93	1375.	7
518480	37.93	-83.65	1264.	11
518860	38.35	-90.15	3139.	1
522030	42.81	-93.51	739.	1
522670	41.95	-101.06	941.	6
523230	41.80	-97.03	1770.	6
524180	40.15	-94.68	1140.	4
525330	39.76	-98.51	1478.	3
526810	38.63	-103.08	1367.	6
528360	36.30	-98.10	3192.	3
528660	36.71	-101.75	2296.	2
528890	36.05	-103.88	1518.	7
530680	43.65	-112.00	966.	5
534630	40.81	-111.68	1065.	2
535130	40.76	-107.40	1041.	1
536140	38.48	-106.21	1112.	2
537720	37.78	-112.55	779.	3
538450	36.60	-109.50	959.	3
539150	35.55	-106.66	1348.	5
542180	42.26	-118.96	572.	1
545110	39.80	-116.46	55.	2
548230	36.68	-116.98	58.	1
555910	29.66	-91.13	3650.	2
560290	33.00	-97.01	3682.	3
560460	33.80	-99.80	3968.	1
560800	34.96	-102.90	2910.	2
561370	31.15	-97.16	3307.	4
562940	30.66	-104.01	508.	7
565710	27.88	-102.30	1592.	6
566910	26.86	-104.28	2235.	5
567390	25.03	-98.48	1649.	10
567780	25.01	-102.68	1894.	8
569850	23.38	-103.38	1302.	8
570360	34.30	-108.93	398.	3
570830	34.71	-113.65	111.	2
571270	33.06	-107.03	509.	5
571780	33.01	-112.53	131.	2
574470	30.26	-109.48	466.	1
574940	30.58	-114.26	23.	1
577490	27.56	-110.00	261.	2
578160	26.48	-106.65	1222.	3
579570	25.33	-110.30	167.	2
579720	25.81	-113.01	185.	1
580270	34.28	-117.16	42.	1
592110	23.91	-106.61	245.	4
592650	23.48	-111.30	120.	1
594310	22.81	-108.35	73.	1
597580	20.03	-110.35	18.	1
619670	-7.30	-72.40	1.	1
619960	-37.80	-77.53	27.	2
690020	36.00	121.31	320.	2
691194	34.68	77.03	7.	1
710430	65.28	126.75	95.	2
710810	68.76	81.21	8.	2

710820	82.50	62.33	64.	4
711150	50.23	119.28	555.	1
711190	53.55	114.10	766.	3
711240	54.75	110.05	700.	1
716000	43.93	60.01	4.	1
717010	45.83	66.43	51.	9
717160	46.90	71.48	178.	2
717220	46.36	75.98	170.	6
718110	50.21	66.25	53.	7
718150	48.53	58.55	60.	1
718160	53.30	60.36	36.	3
718230	53.75	73.66	307.	6
718360	51.26	80.65	10.	3
718450	51.45	90.20	386.	2
718670	53.96	101.10	273.	2
718960	53.88	122.66	675.	1
719060	58.10	68.41	60.	6
719070	58.45	78.11	7.	3
719090	63.75	68.55	20.	3
719130	58.73	94.08	27.	4
719150	64.20	83.36	52.	4
719250	69.13	105.06	25.	1
719260	64.30	96.00	49.	3
719340	60.03	111.93	204.	4
719450	58.83	122.60	378.	3
722010	24.55	81.75	2.	11
722030	26.68	80.11	6.	14
722080	32.90	80.03	14.	5
722100	27.70	82.40	12.	10
722130	31.25	82.40	46.	6
722140	30.38	84.36	25.	5
722210	30.48	86.51	20.	1
722290	32.90	87.25	140.	2
722350	32.31	90.08	105.	7
722400	30.11	93.21	4.	7
722470	32.35	94.65	124.	7
722500	25.90	97.43	7.	8
722510	27.76	97.50	13.	5
722600	32.21	98.18	402.	8
722610	29.36	100.91	310.	6
722650	31.95	102.18	875.	3
722700	31.80	106.40	1206.	2
722740	32.11	110.93	802.	2
723040	35.26	75.55	2.	7
723110	33.95	83.31	246.	2
723270	36.25	86.56	180.	2
723400	34.83	92.25	172.	7
723490	36.88	93.90	437.	5
723550	34.65	98.40	360.	3
723570	35.21	97.45	357.	6
723630	35.23	101.70	1099.	6
723650	35.05	106.61	1619.	2
723740	35.01	110.73	1487.	3
723910	34.11	119.11	4.	1

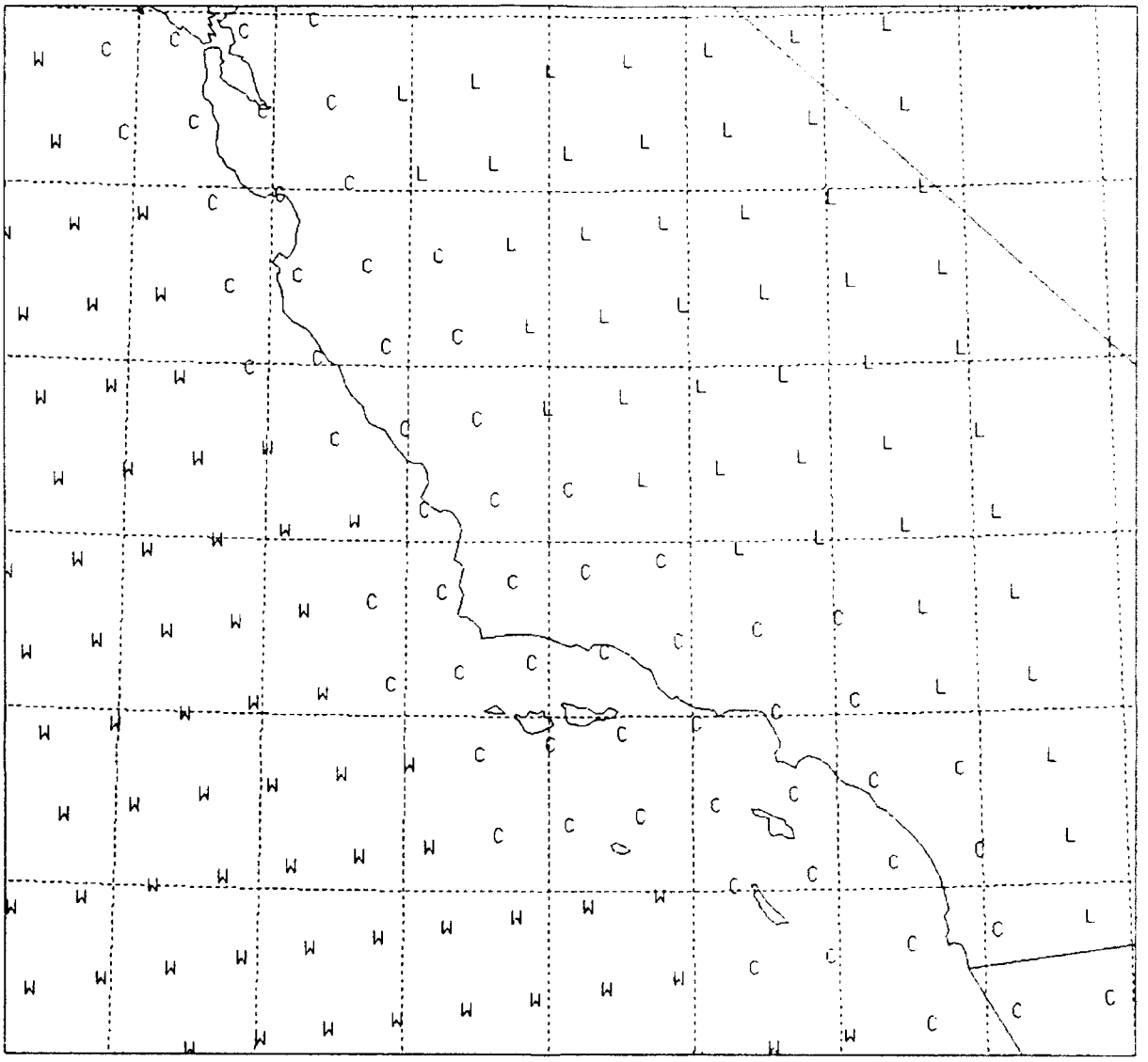
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724030	38.98	77.46	95.	5
724070	39.45	74.56	21.	6
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724290	39.86	84.11	298.	3
724350	37.06	88.76	126.	2
724510	37.76	99.96	791.	5
724560	39.06	95.63	268.	5
724690	39.75	104.86	1611.	3
724760	39.11	108.53	1472.	2
724860	39.28	114.85	1908.	1
725200	40.53	80.23	359.	5
725280	42.93	78.73	220.	3
725530	41.36	96.01	399.	3
725620	41.13	100.68	847.	3
725720	40.76	111.96	1288.	2
725760	42.81	108.73	1703.	2
726060	43.65	70.31	23.	2
726370	42.96	83.73	236.	1
726450	44.48	88.13	212.	1
726540	44.38	98.21	392.	2
726550	45.55	94.06	313.	2
726620	44.05	103.06	970.	3
726810	43.56	116.21	871.	2
727120	46.86	68.01	190.	1
727470	48.56	93.38	360.	2
727640	46.76	100.75	511.	1
727680	48.21	106.61	699.	1
727750	47.48	111.36	1118.	2
727850	47.63	117.53	723.	1
740010	34.60	86.63	175.	1
744940	41.66	69.96	14.	3
746120	35.68	117.68	696.	1
747940	28.46	80.55	3.	9
763940	25.86	100.20	450.	3
764050	24.16	110.30	18.	1
764580	23.20	106.41	4.	2
766120	20.68	103.38	1589.	1
766440	20.95	89.66	11.	3
766540	19.06	104.33	6.	6
766790	19.43	99.08	2231.	11
766920	19.15	96.11	13.	11
780730	25.05	77.46	3.	8
783840	19.30	81.36	3.	8
783970	17.93	76.78	3.	6
785830	17.53	88.30	5.	5
787200	14.03	87.25	999.	4
787620	9.98	84.21	920.	5
788060	8.98	79.55	69.	7
789880	12.20	68.96	62.	1
800010	12.58	81.70	0.	5
804470	7.85	72.45	378.	1
840080	-0.90	89.61	6.	8
846280	-12.01	77.03	13.	1

854690	-27.16	109.43	41.	1
855430	-32.78	71.51	8.	1
890500	-62.20	58.93	16.	1
895420	-67.66	-45.85	40.	2
895640	-67.60	-62.88	15.	9
895710	-68.58	-77.98	12.	8
896110	-66.25	-110.53	15.	14
913660	8.73	-167.73	2.	2
946100	-31.91	-115.96	20.	1
960350	3.56	-98.66	27.	3
962370	-2.16	-106.13	33.	1
967490	-6.13	-106.66	10.	1
969960	-12.18	-96.83	3.	9

Appendix C. Displays of the SSM/T-2 FOV topographic classification and the TBs for the five SSM/T-2 channels for the west coast region on May 14 and 15, 1992 and for the east coast region on July 29 and 30 and August 6, 1992.

SSM/T-2 FOOTPRINTS

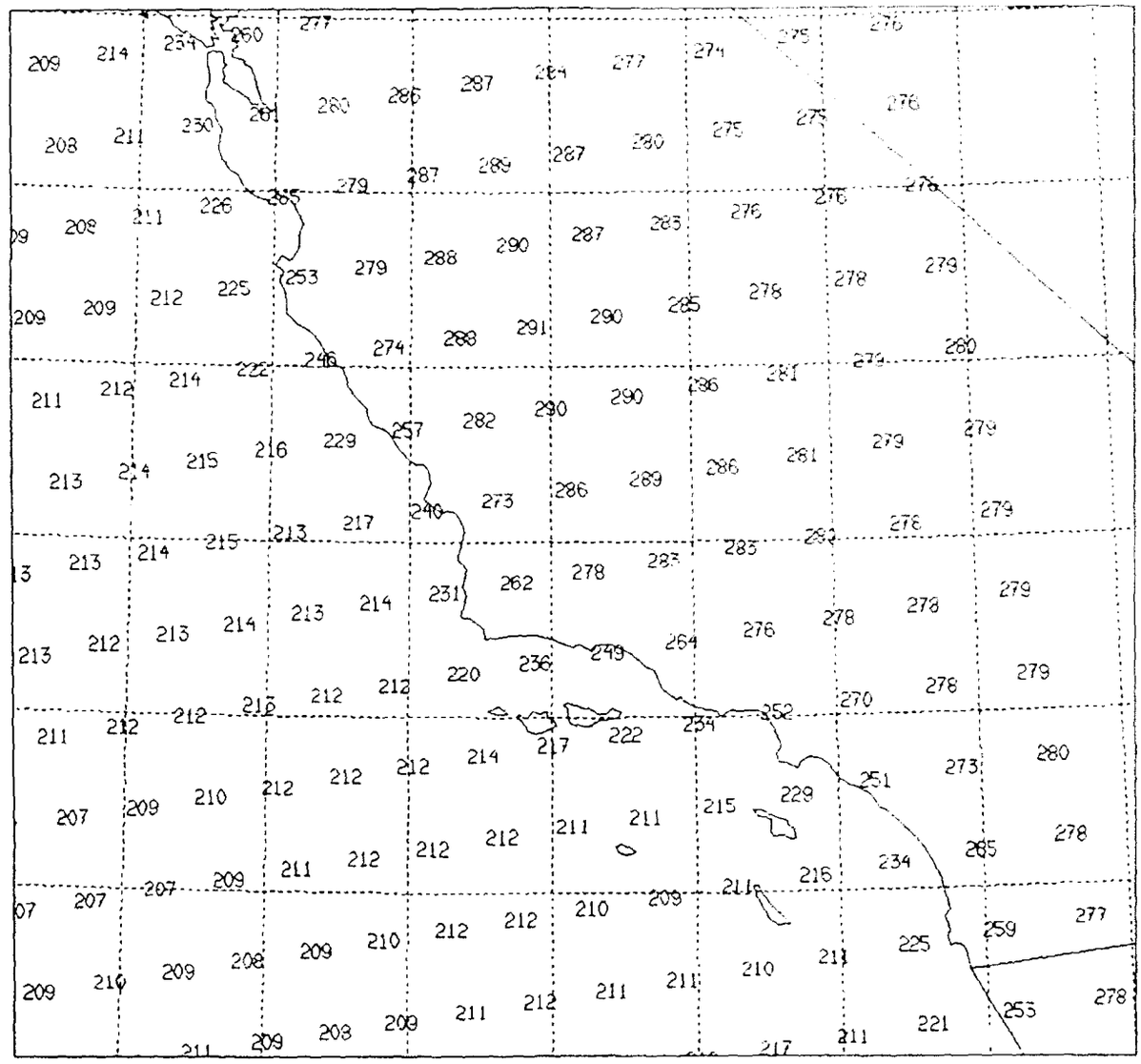
14 MAY 1992



SSM/T-2 FOOTPRINTS

91 GHz

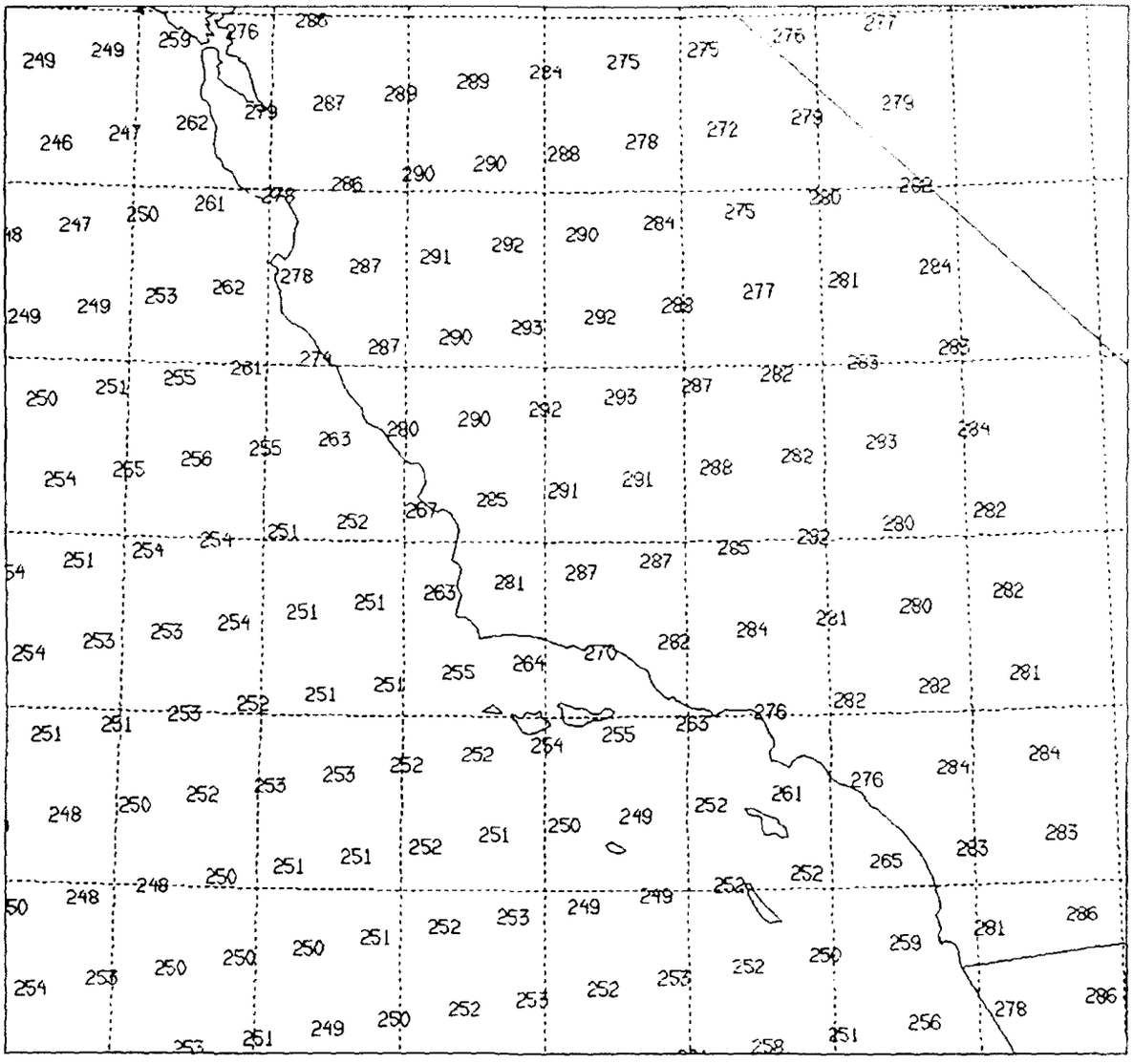
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SSM/T-2 FOOTPRINTS

150 GHz

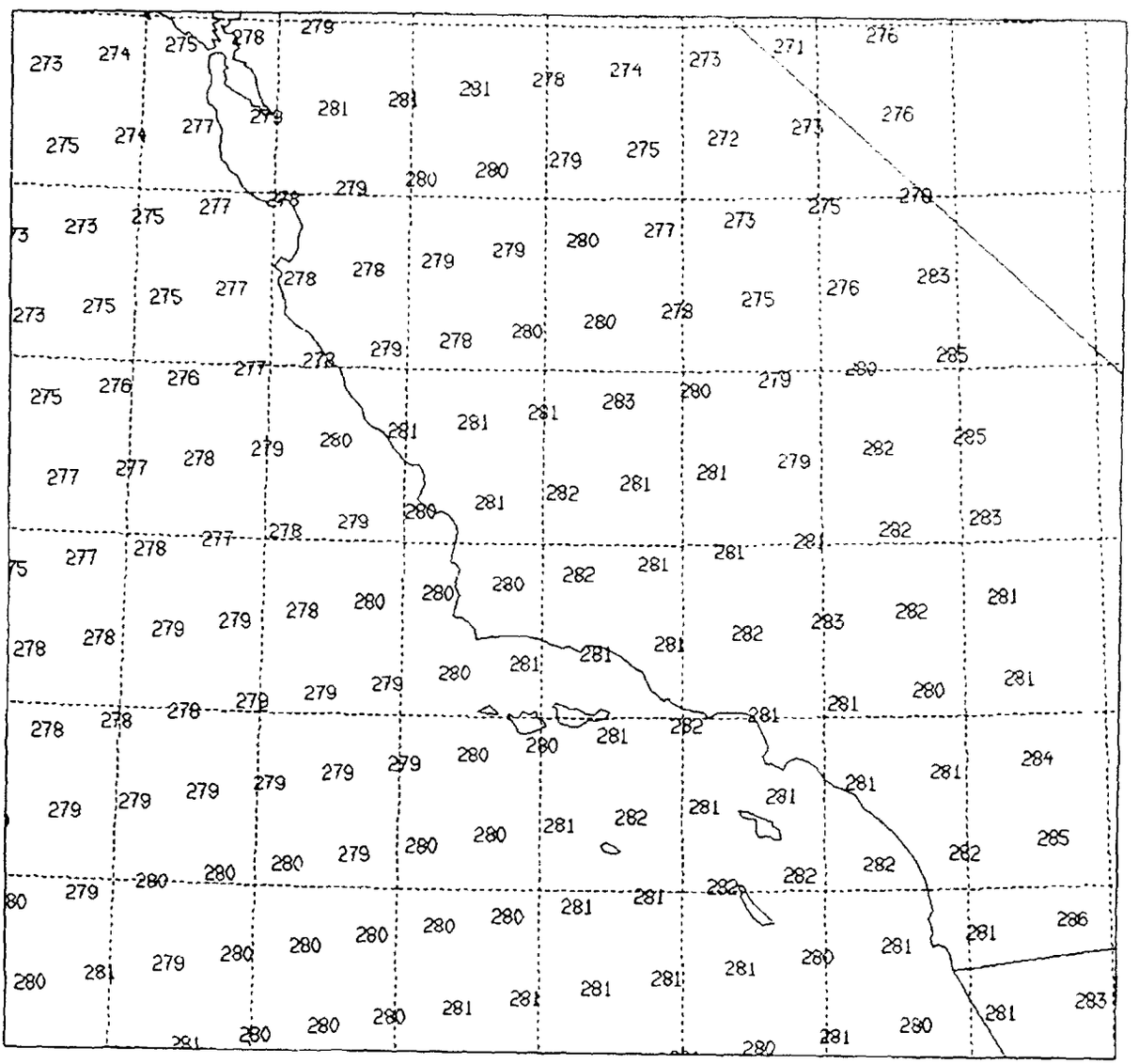
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SSM/T-2 FOOTPRINTS

183 +/- 7 GHz

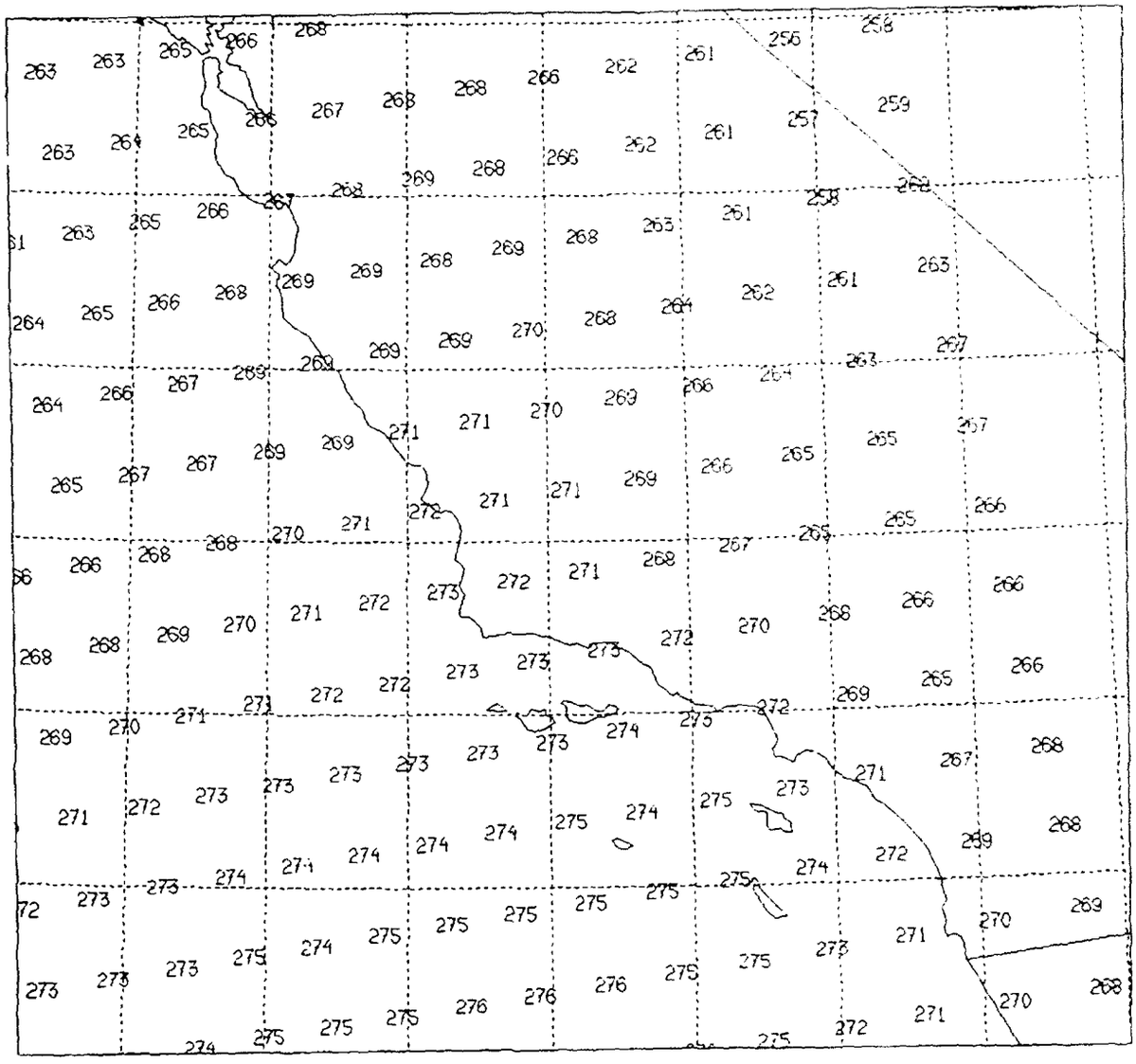
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SSM/T-2 FOOTPRINTS

183 +/- 3 GHz

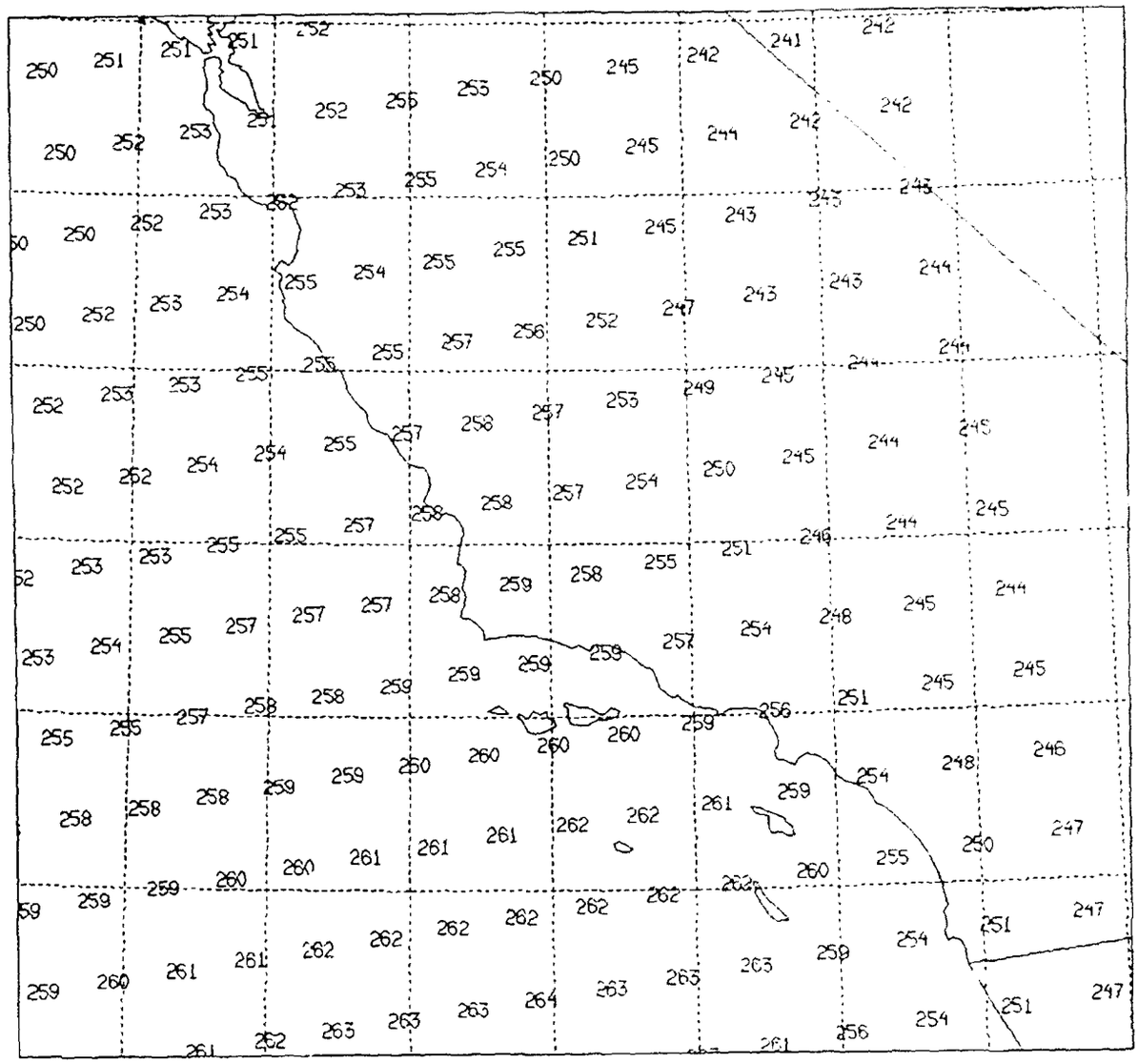
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SSM/T-2 FOOTPRINTS

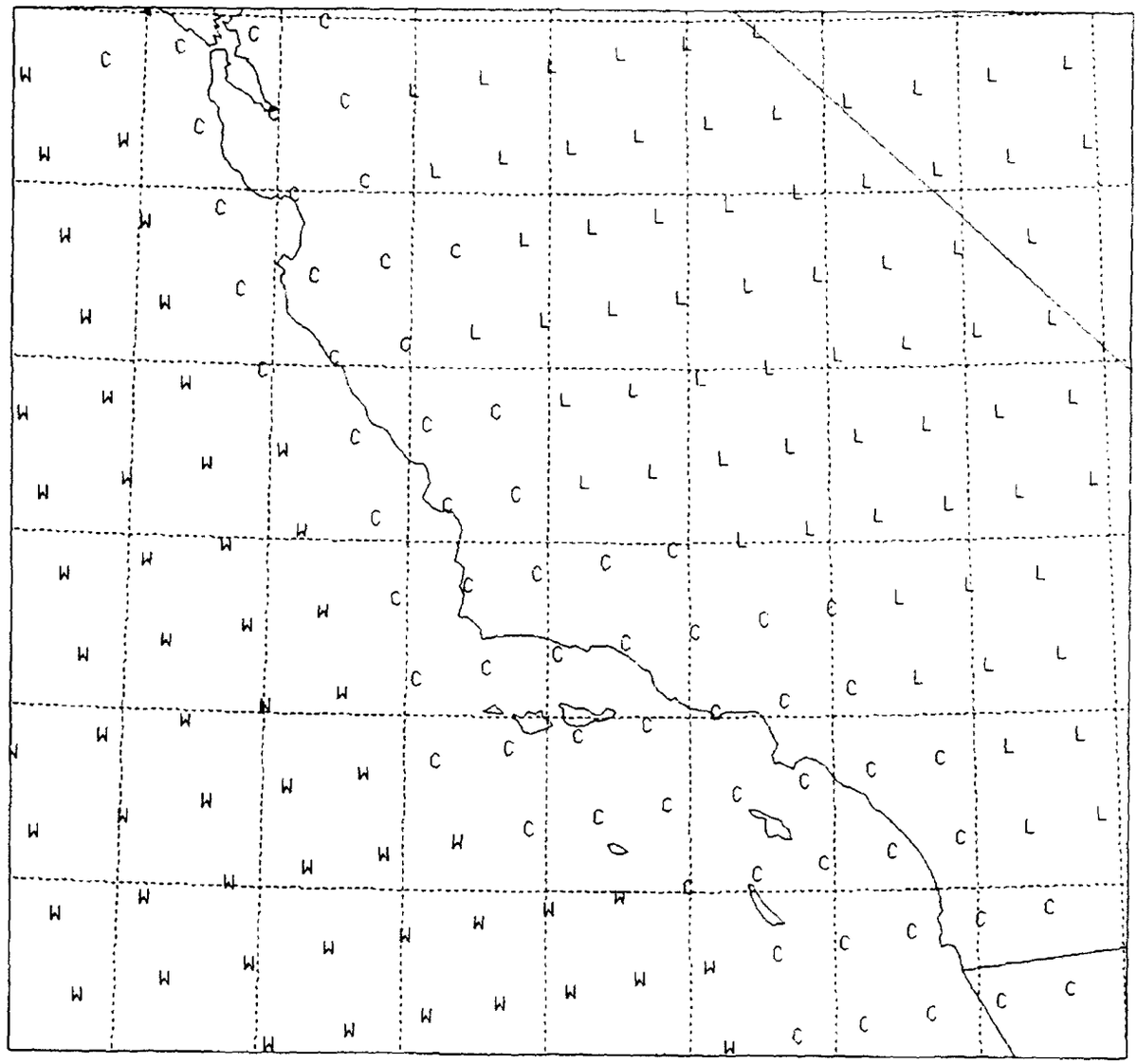
183 +/- 1 GHz

14 MAY 1992



SSM/T-2 FOOTPRINTS

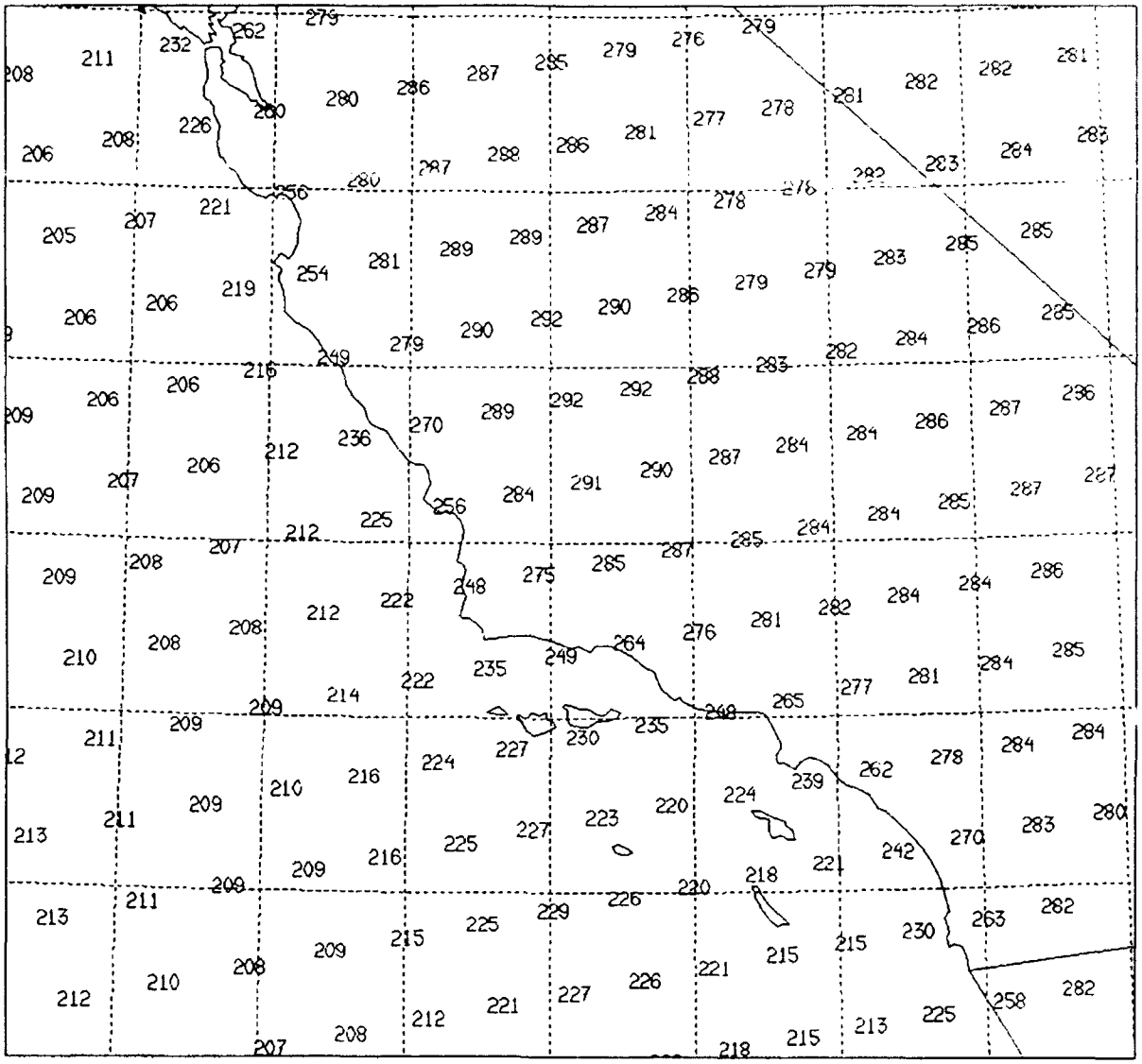
15 MAY 1992



SSM/T-2 FOOTPRINTS

91 GHz

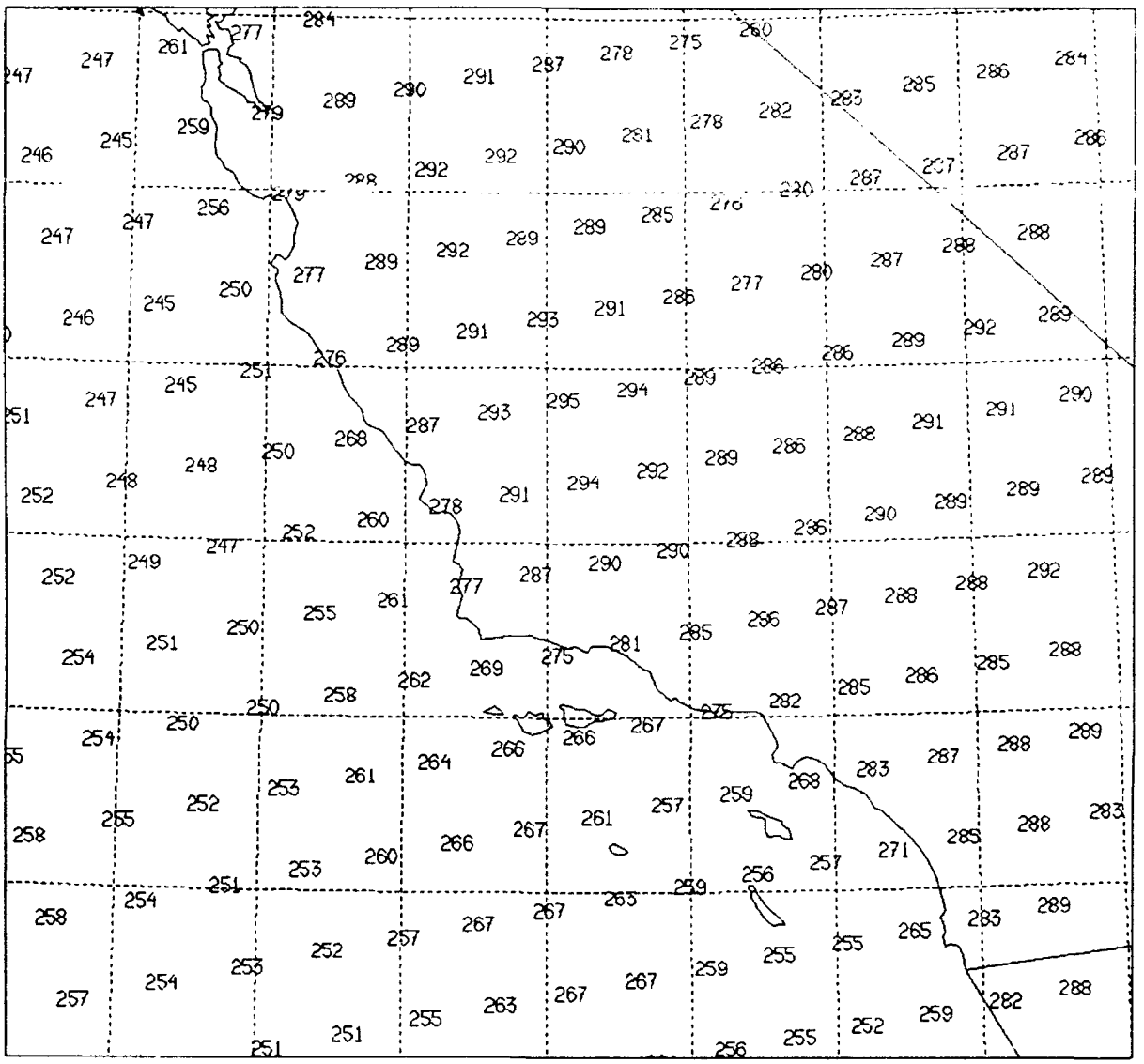
15 MAY 1992



SSM/T-2 FOOTPRINTS

150 GHz

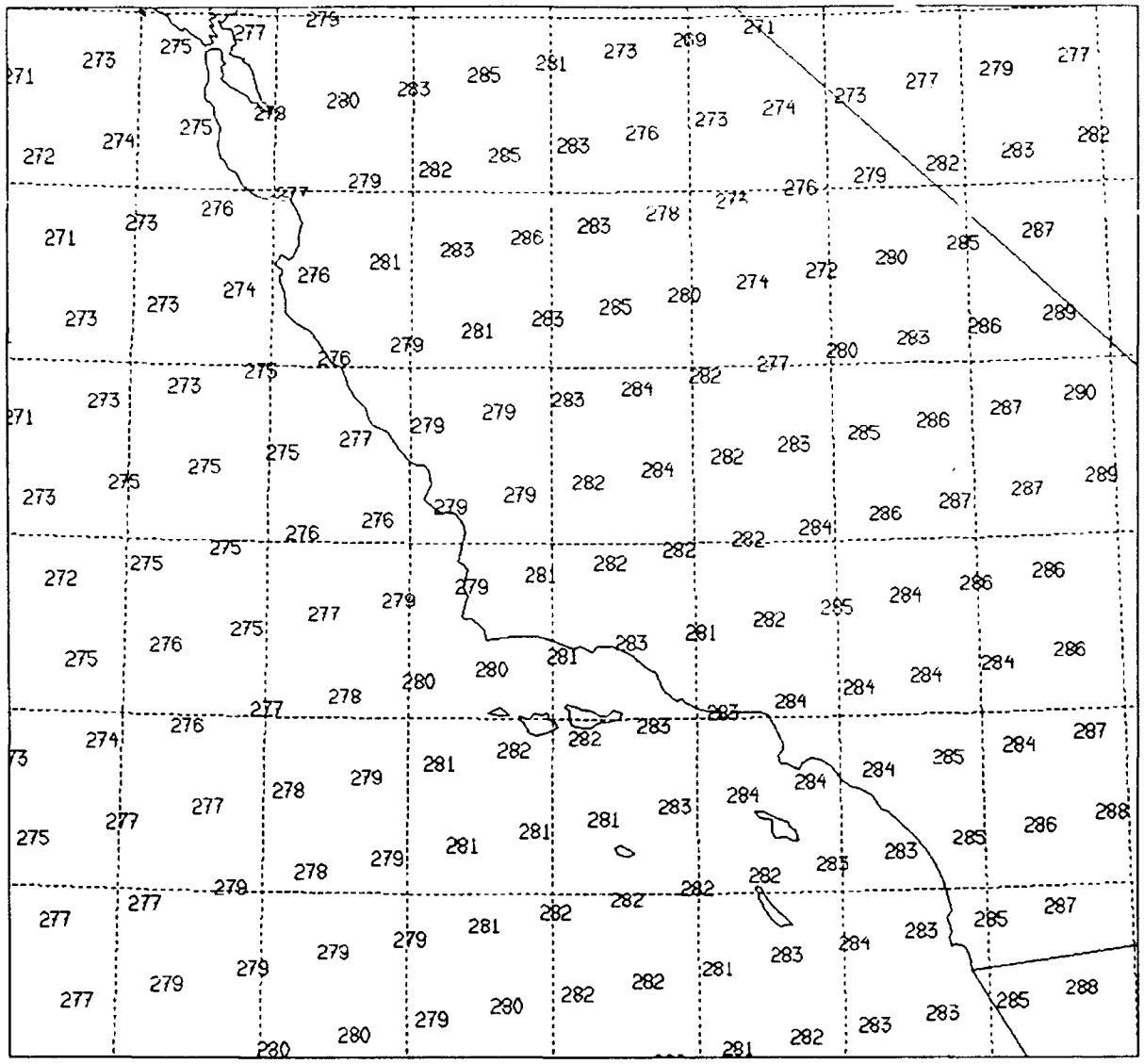
15 MAY 1992



SSM/I-2 FOOTPRINTS

183 +/- 7 GHz

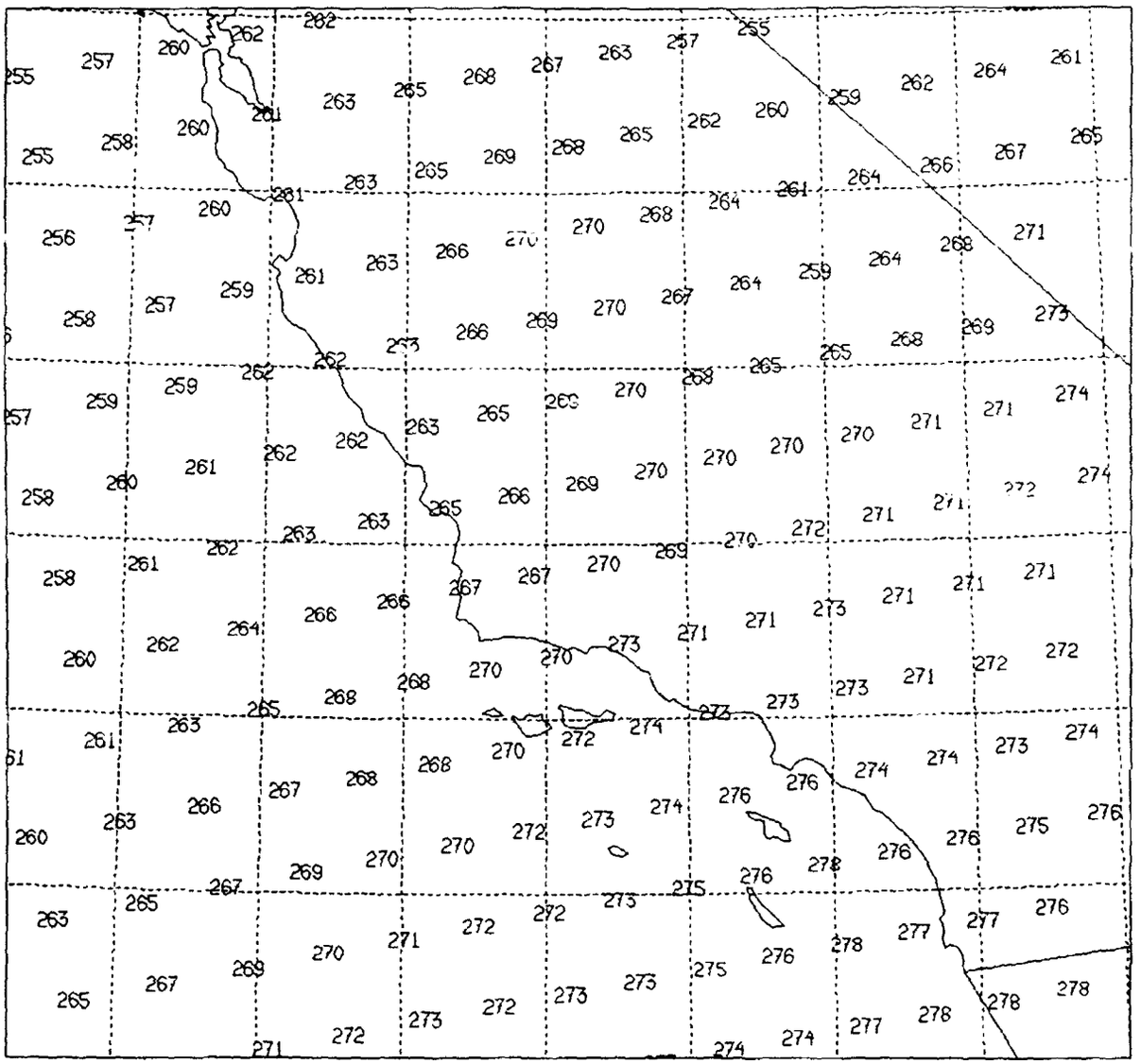
15 MAY 1992



SSM/T-2 FOOTPRINTS

183 +/- 3 GHz

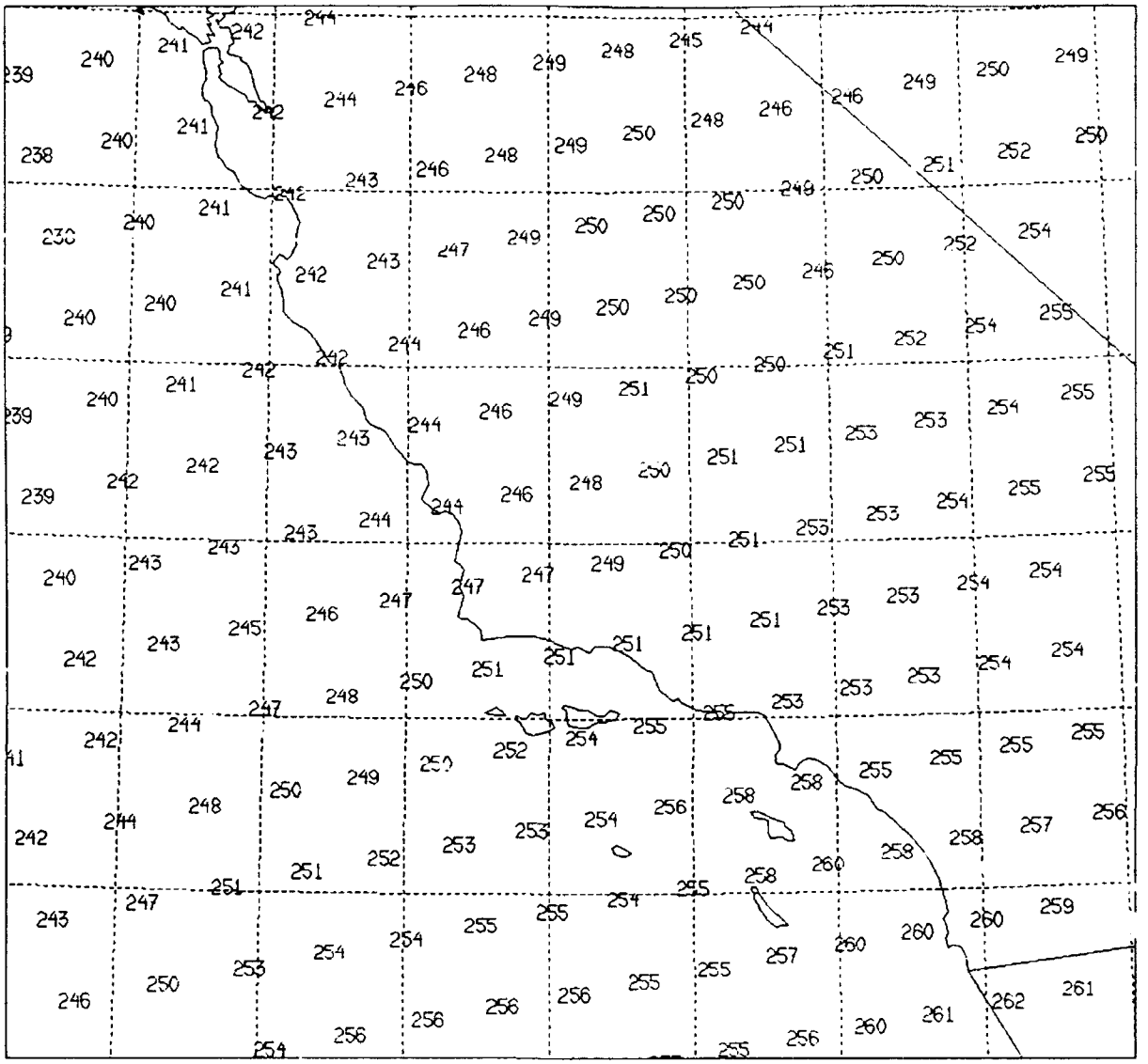
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SSM/T-2 FOOTPRINTS

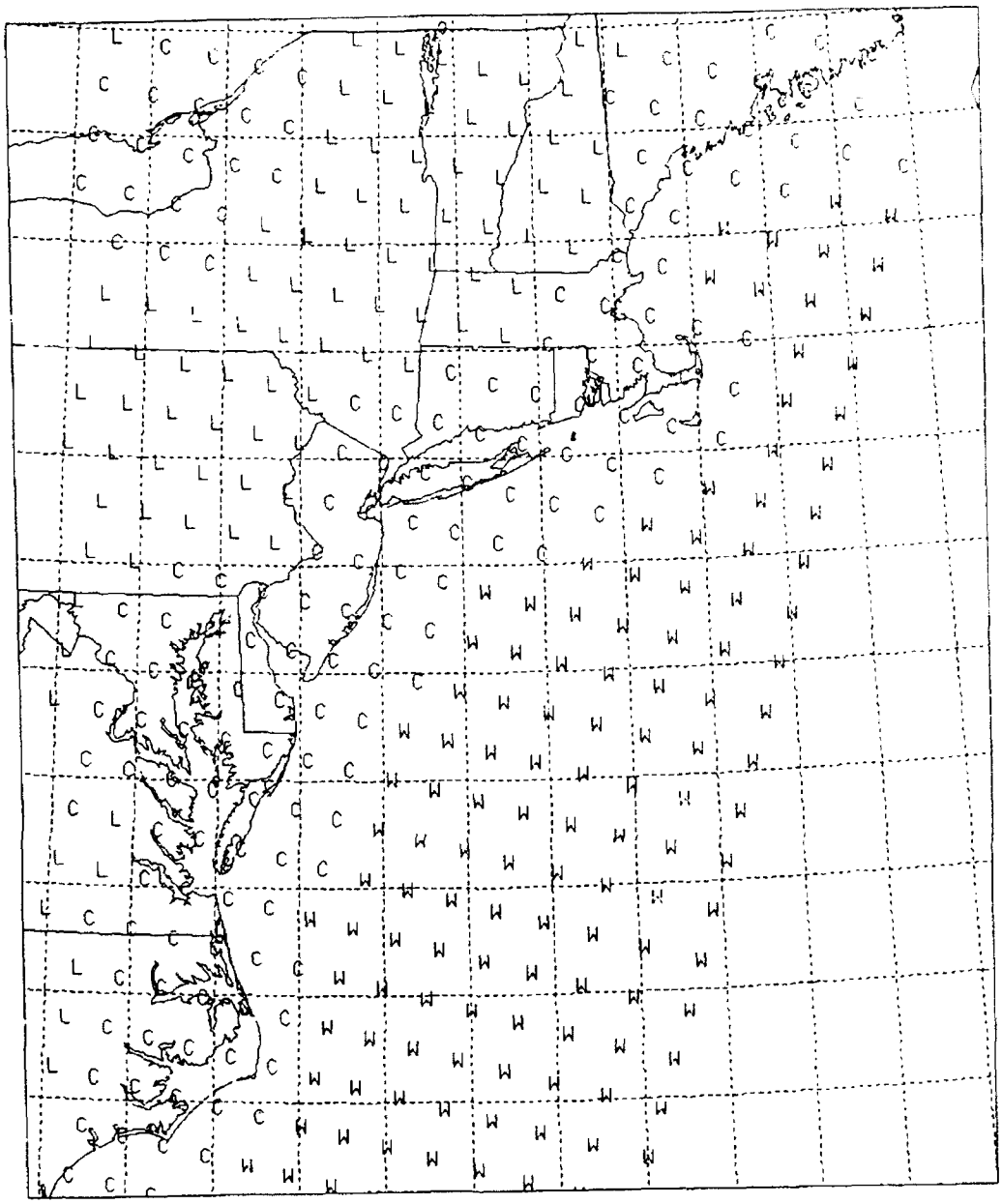
183 +/- 1 GHz

15 MAY 1992



SSM/T-2 FOOTPRINTS

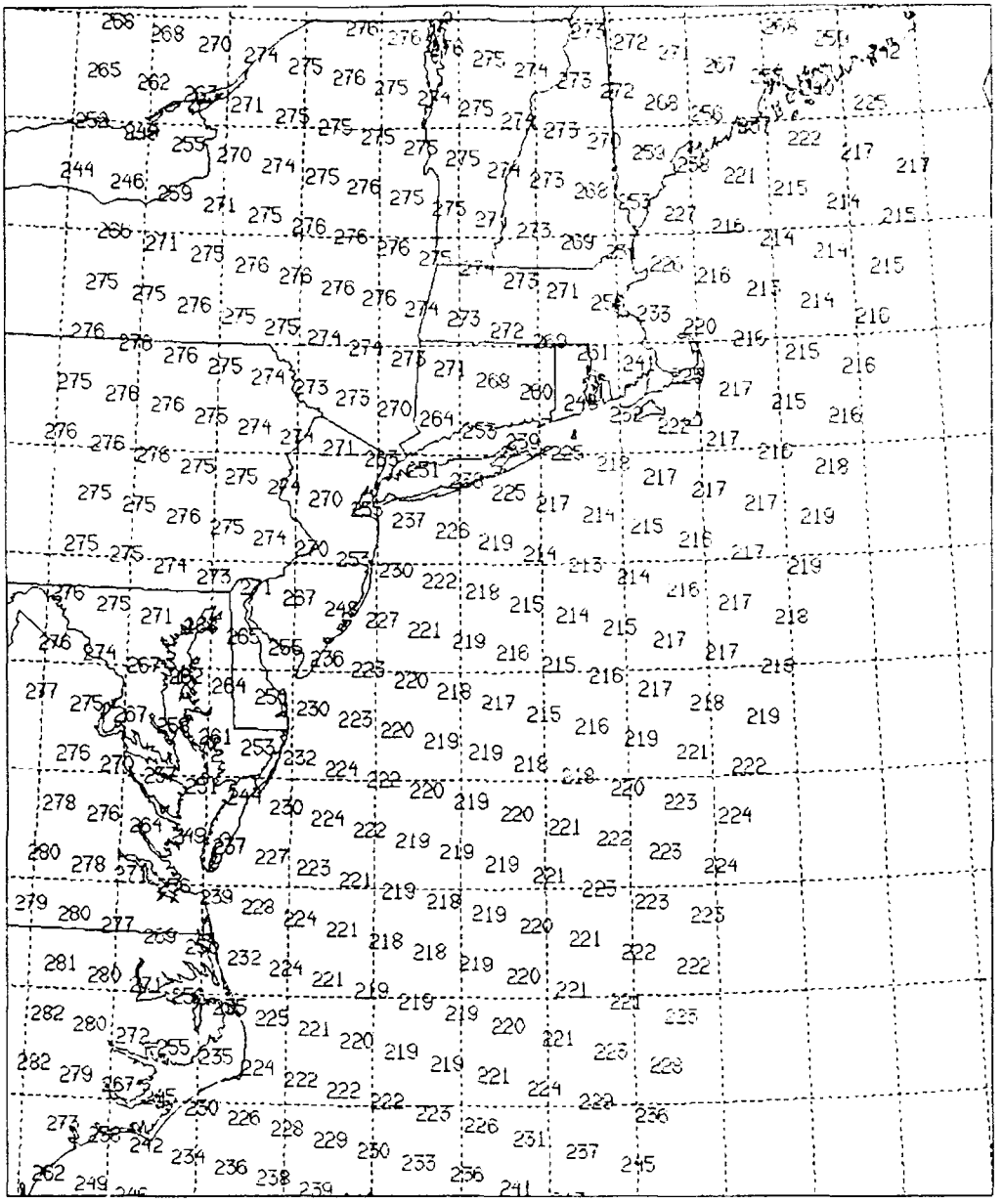
29 JUL 1992



SSM/T-2 FOOTPRINTS

91 GHz

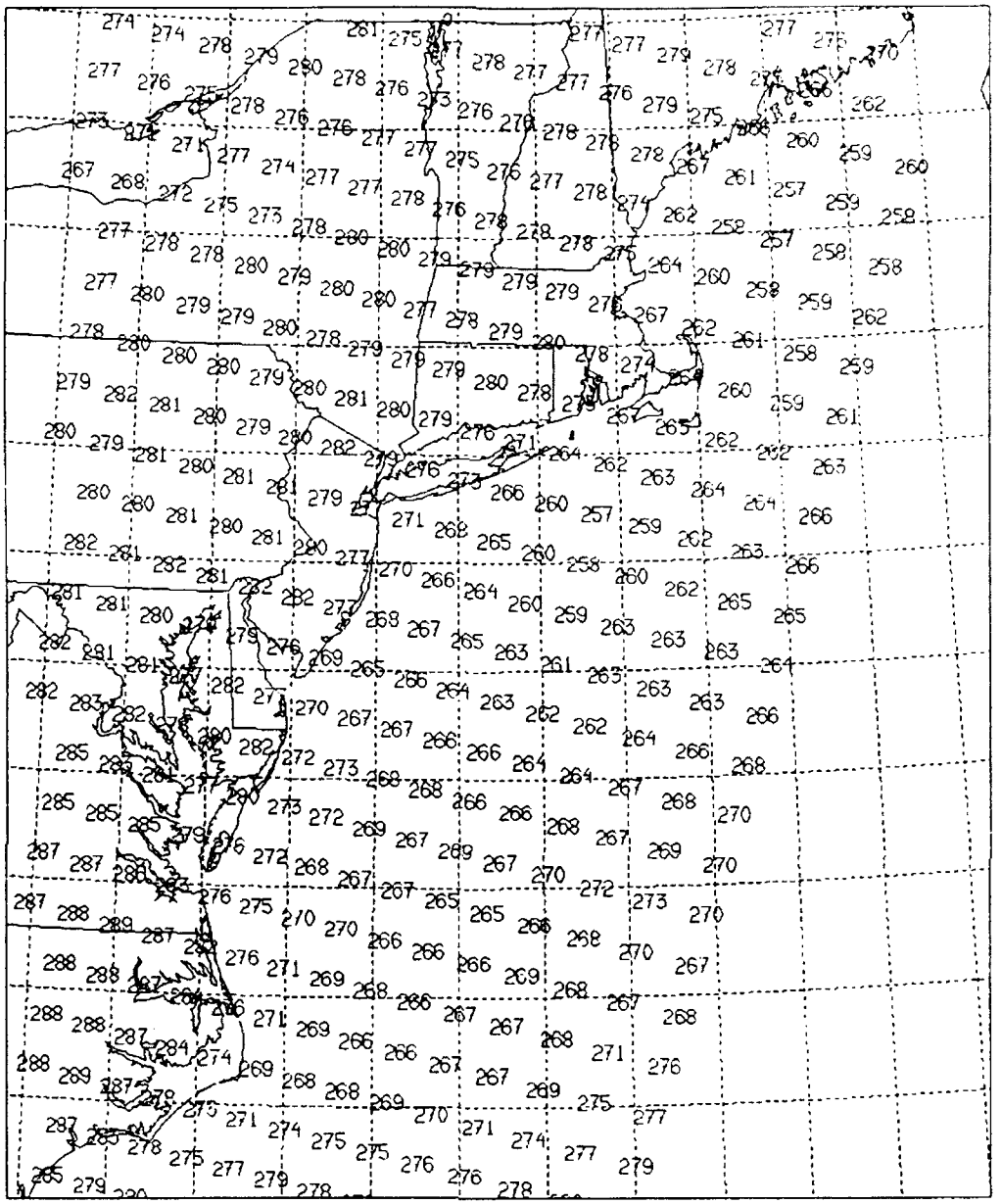
29 JUL 1992



SSM/T-2 FOOTPRINTS

150 GHz

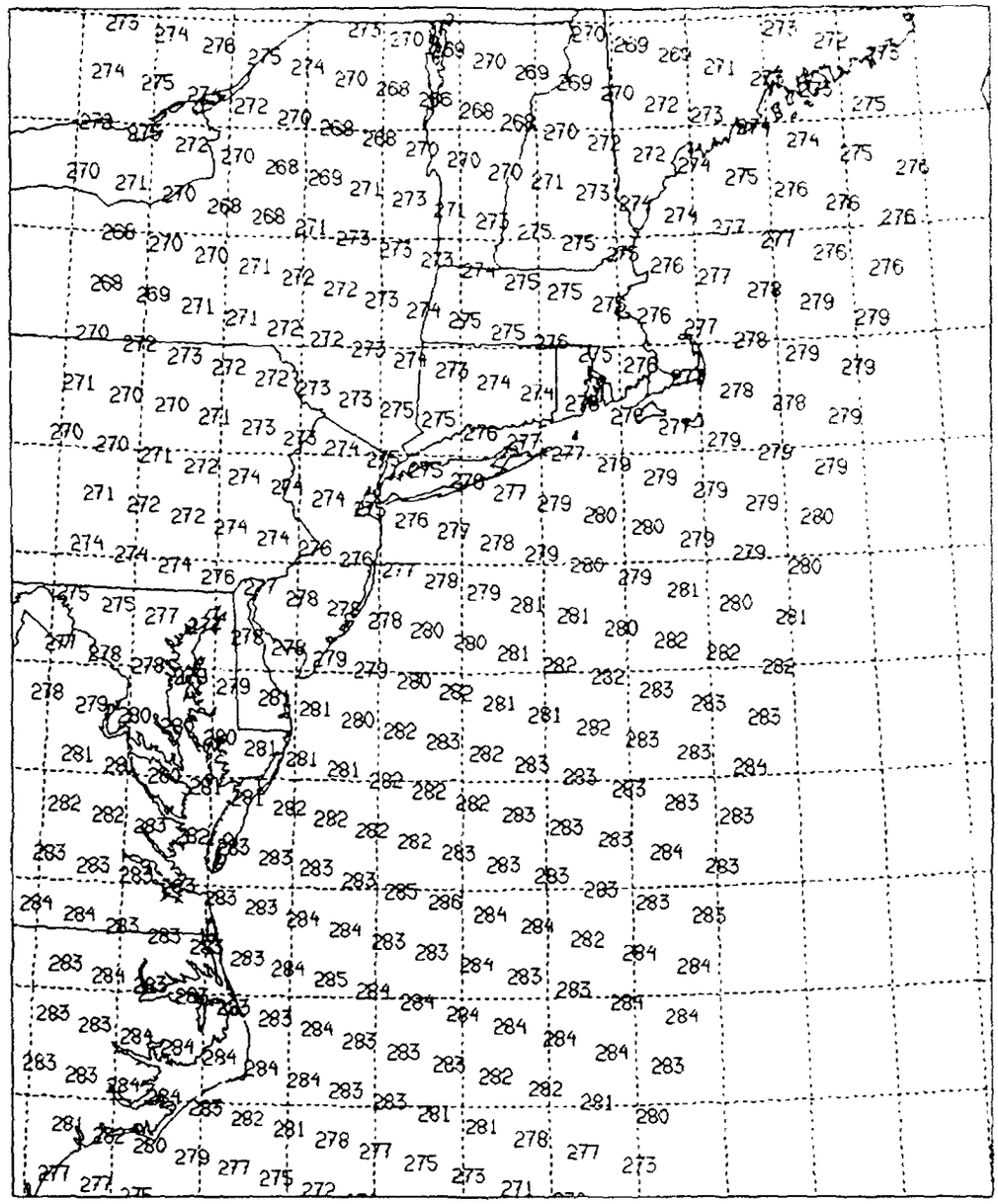
29 JUL 1992



SSM/T-2 FOOTPRINTS

183 +/- 7 GHz

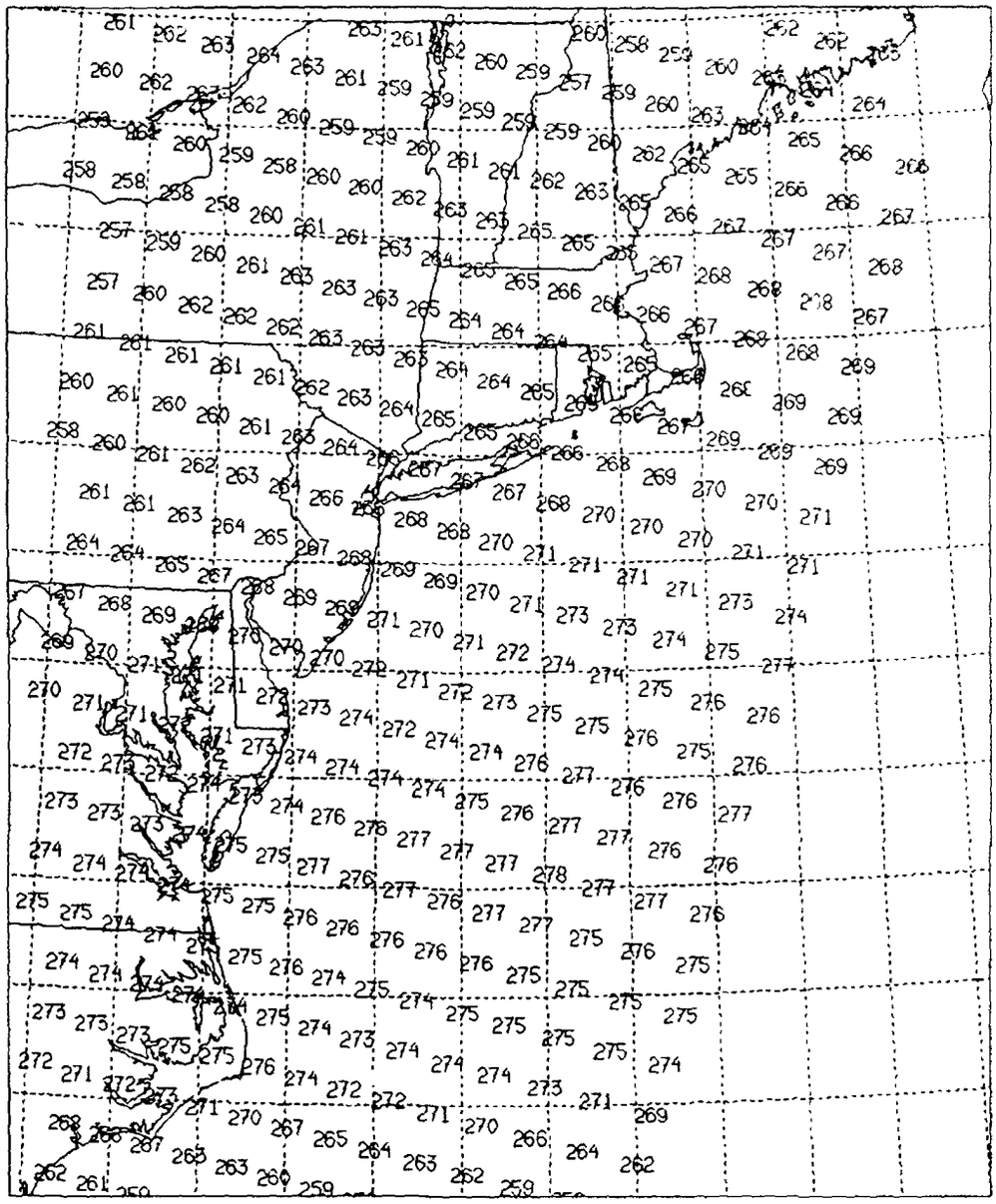
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SSM/T-2 FOOTPRINTS

183 +/- 3 GHz

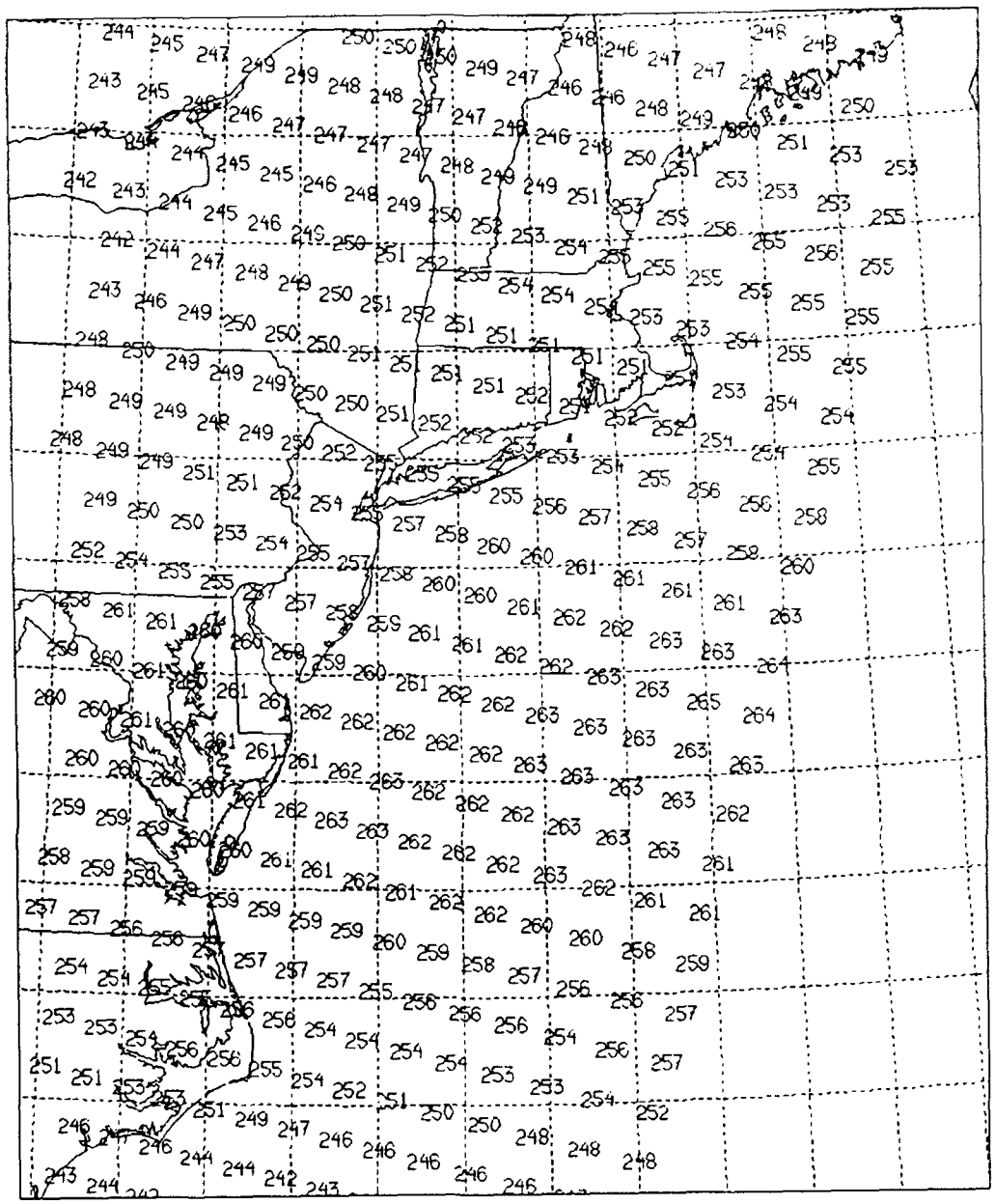
29 JUL 1992



SSM/T-2 FOOTPRINTS

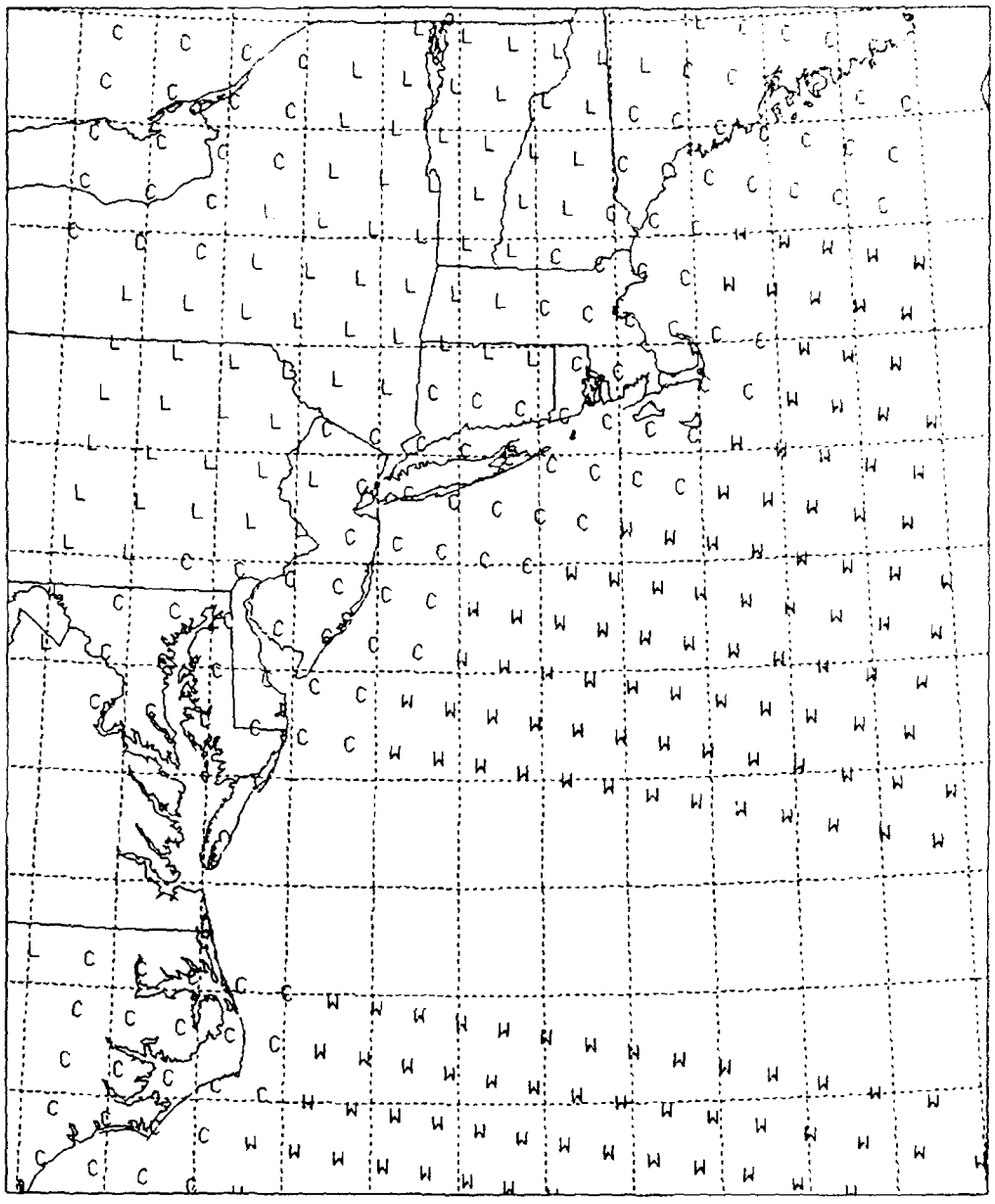
183 +/- 1 GHz

29 JUL 1992



SSM/T-2 FOOTPRINTS

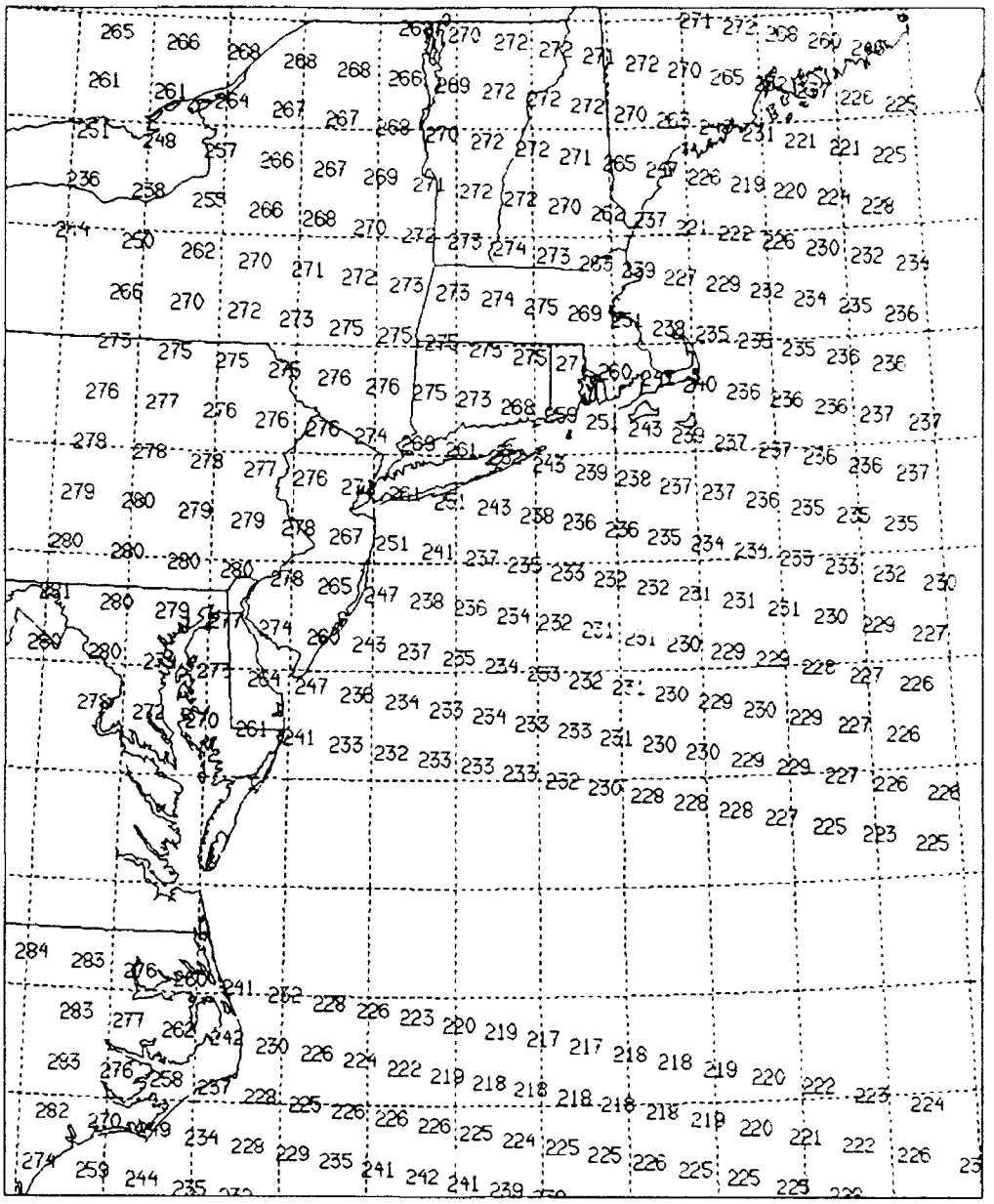
30 JUL 1992



SSM/T-2 FOOTPRINTS

91 GHz

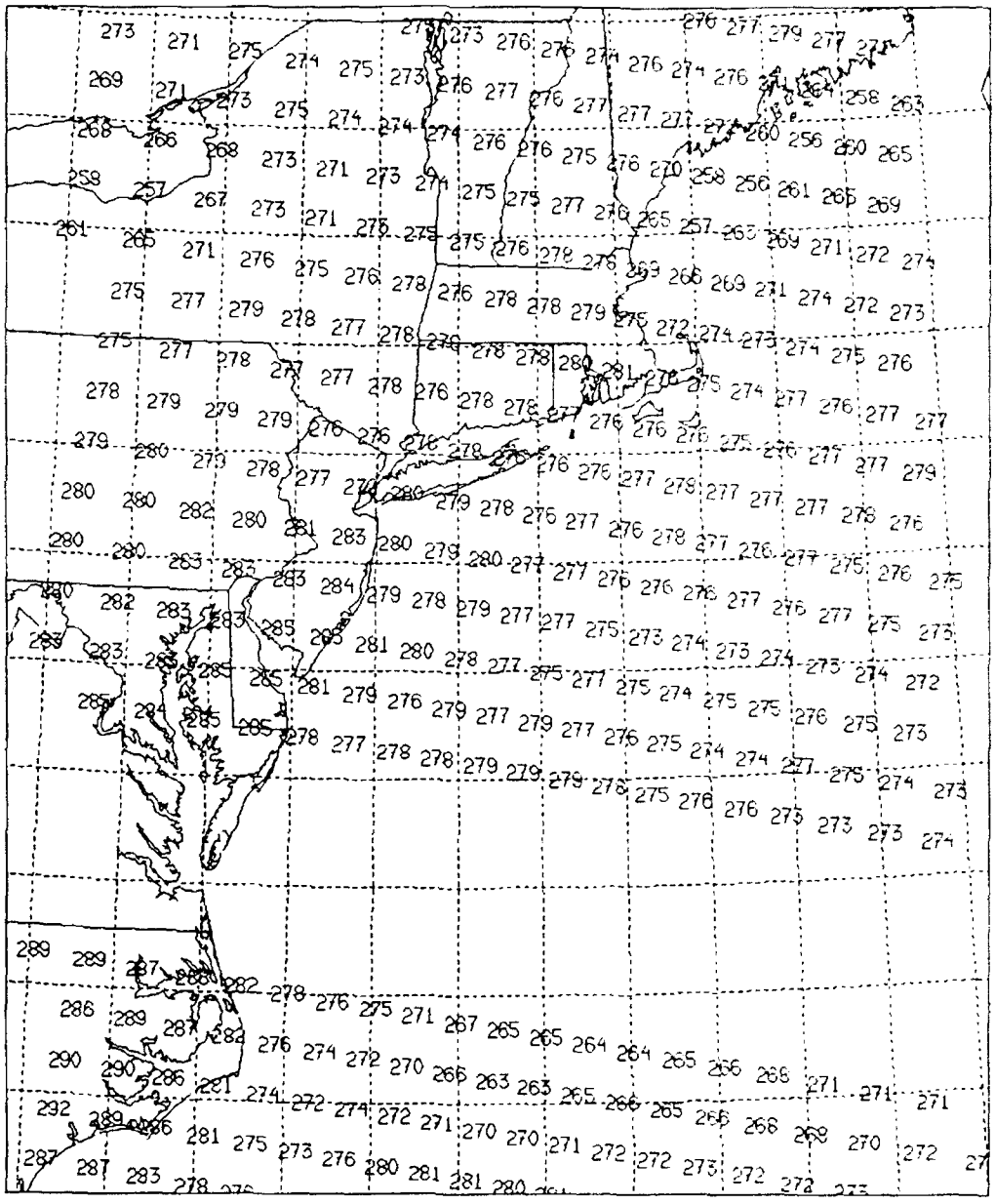
30 JUL 1992



SSM/T-2 FOOTPRINTS

150 GHz

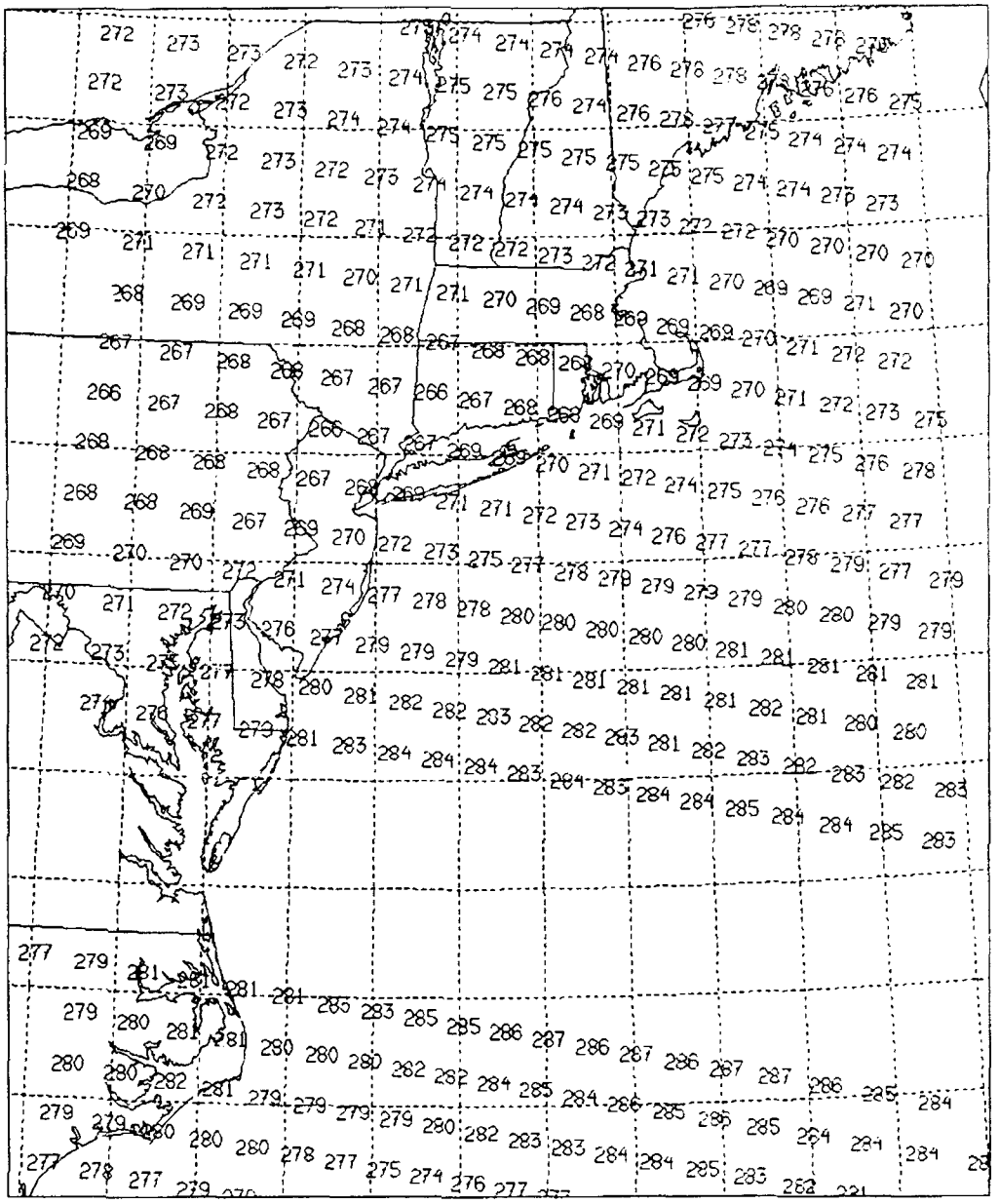
30 JUL 1992



SSM/T-2 FOOTPRINTS

183 +/- 7 GHz

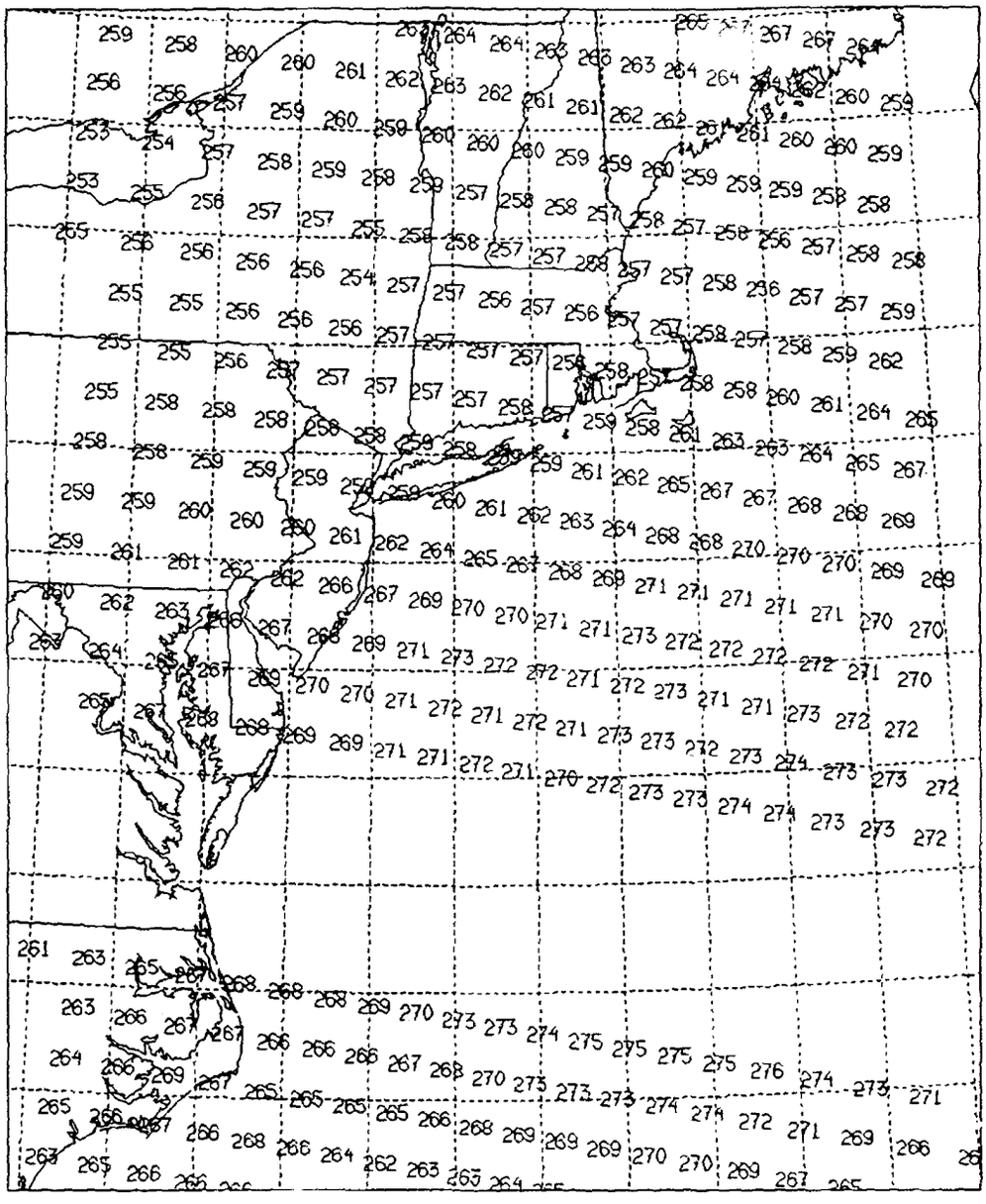
30 JUL 1992



SSM/T-2 FOOTPRINTS

183 +/- 3 GHz

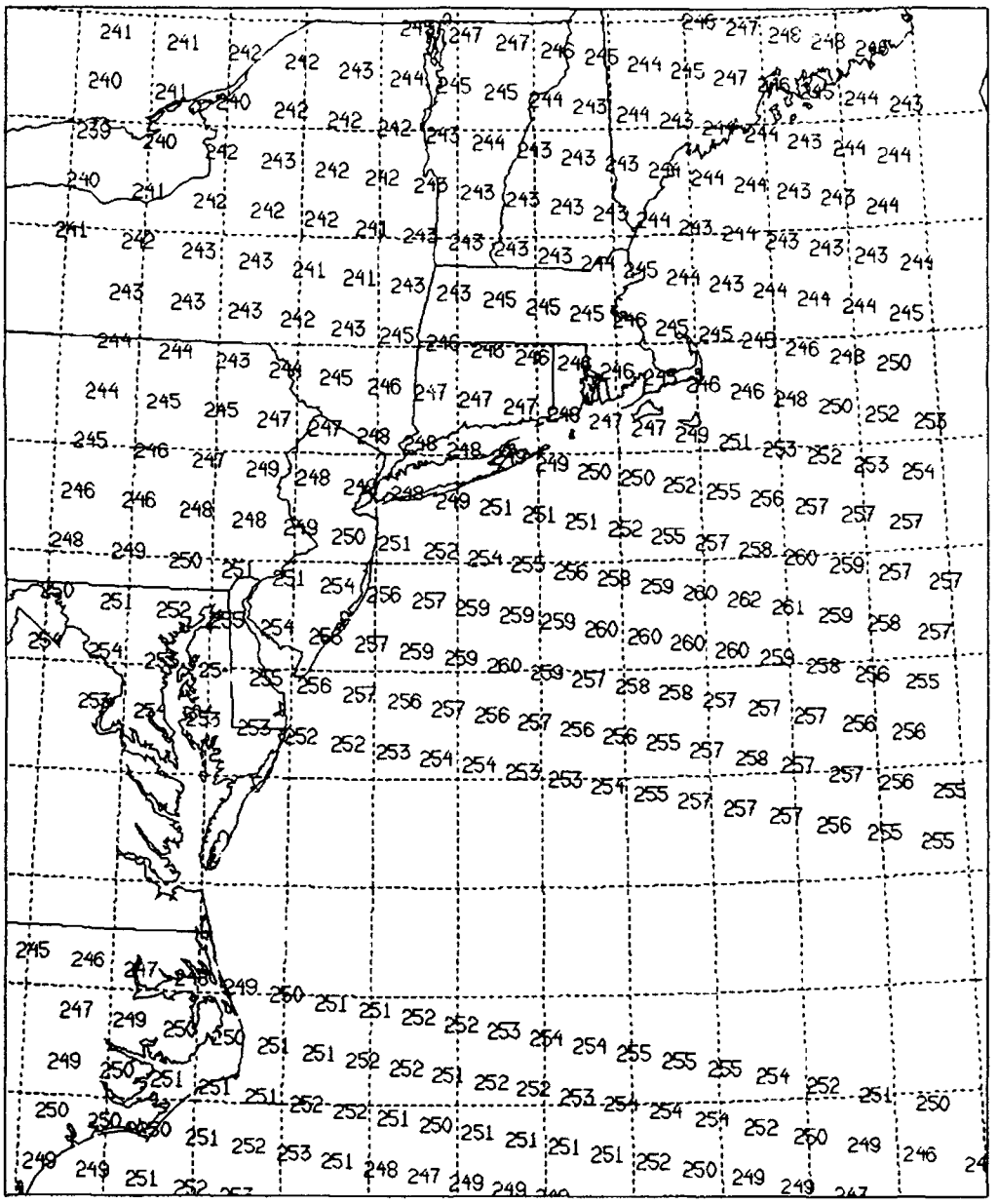
30 JUL 1992



SSM/T-2 FOOTPRINTS

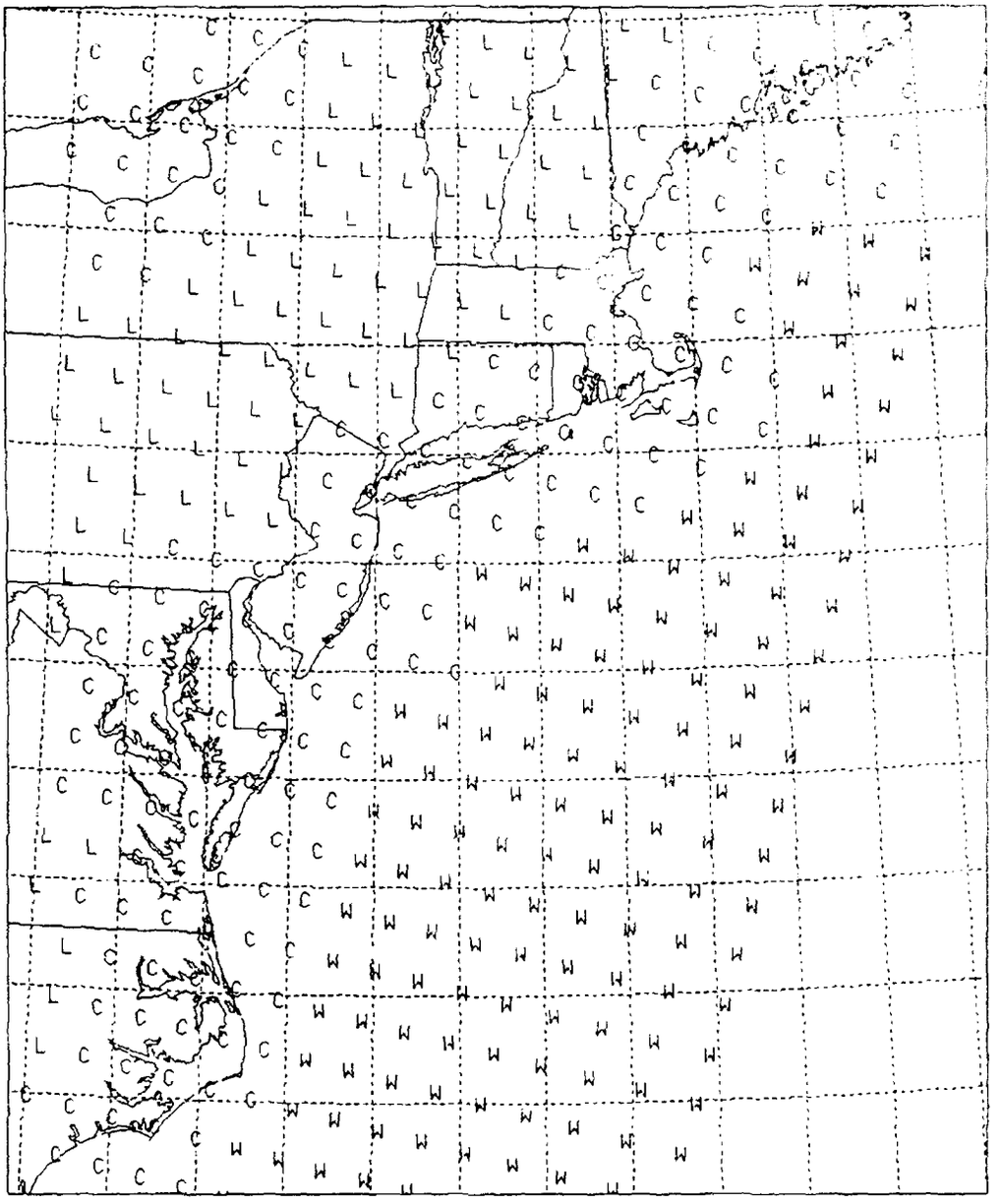
183 +/- 1 GHz

30 JUL 1992



SSM/T-2 FOOTPRINTS

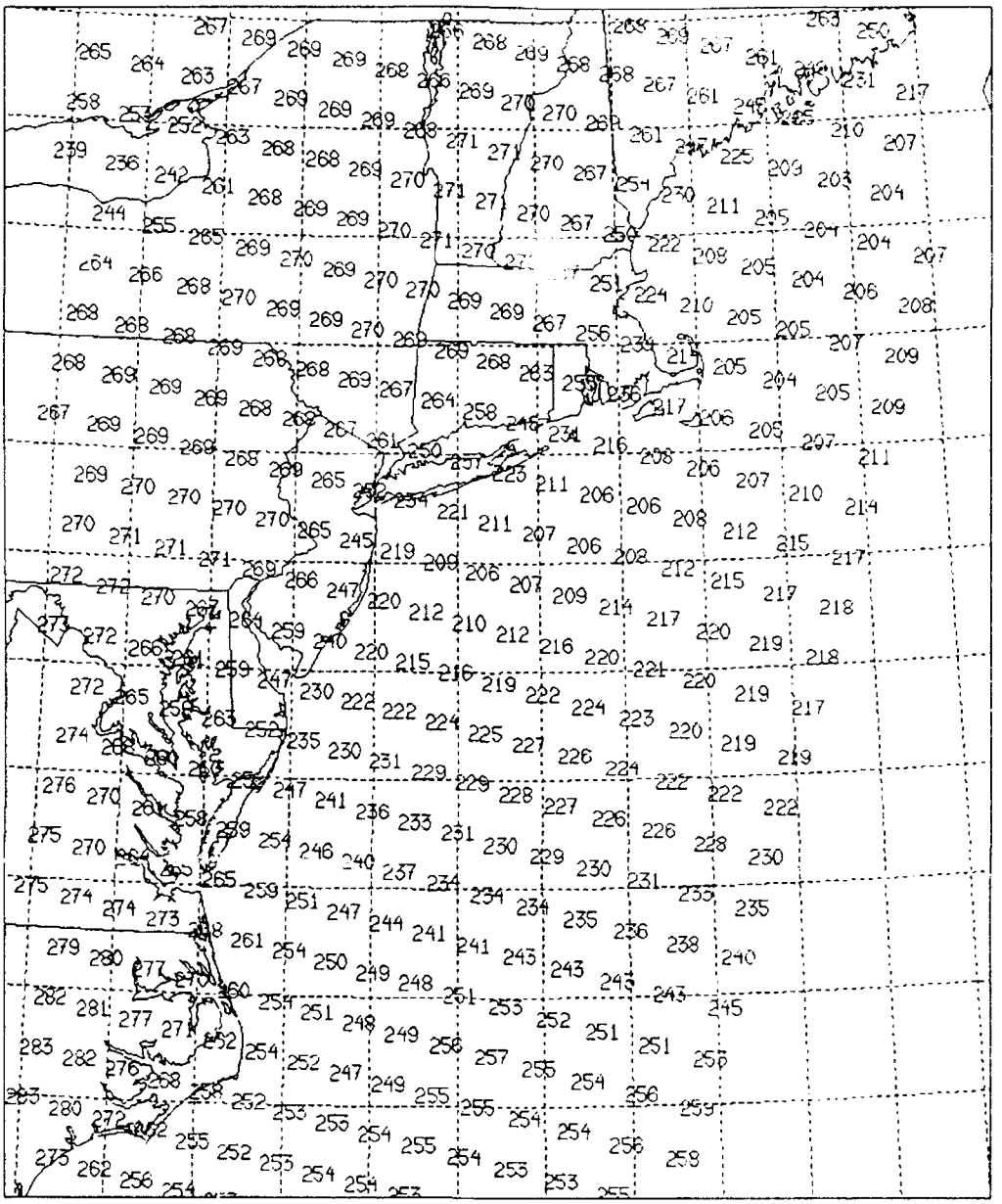
6 AUG 1992



SSM/T-2 FOOTPRINTS

91 GHz

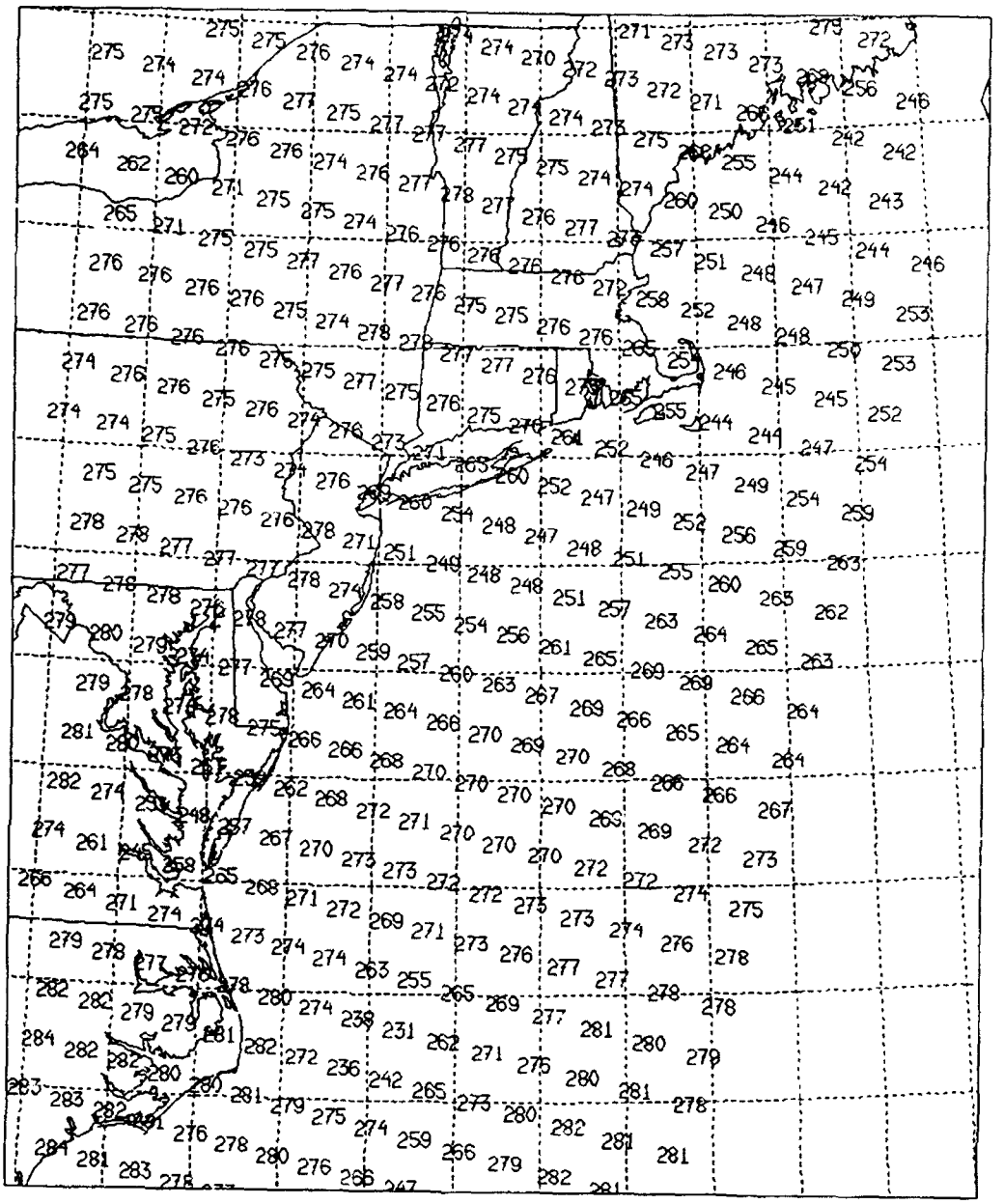
6 AUG 1992



SSM/T-2 FOOTPRINTS

150 GHz

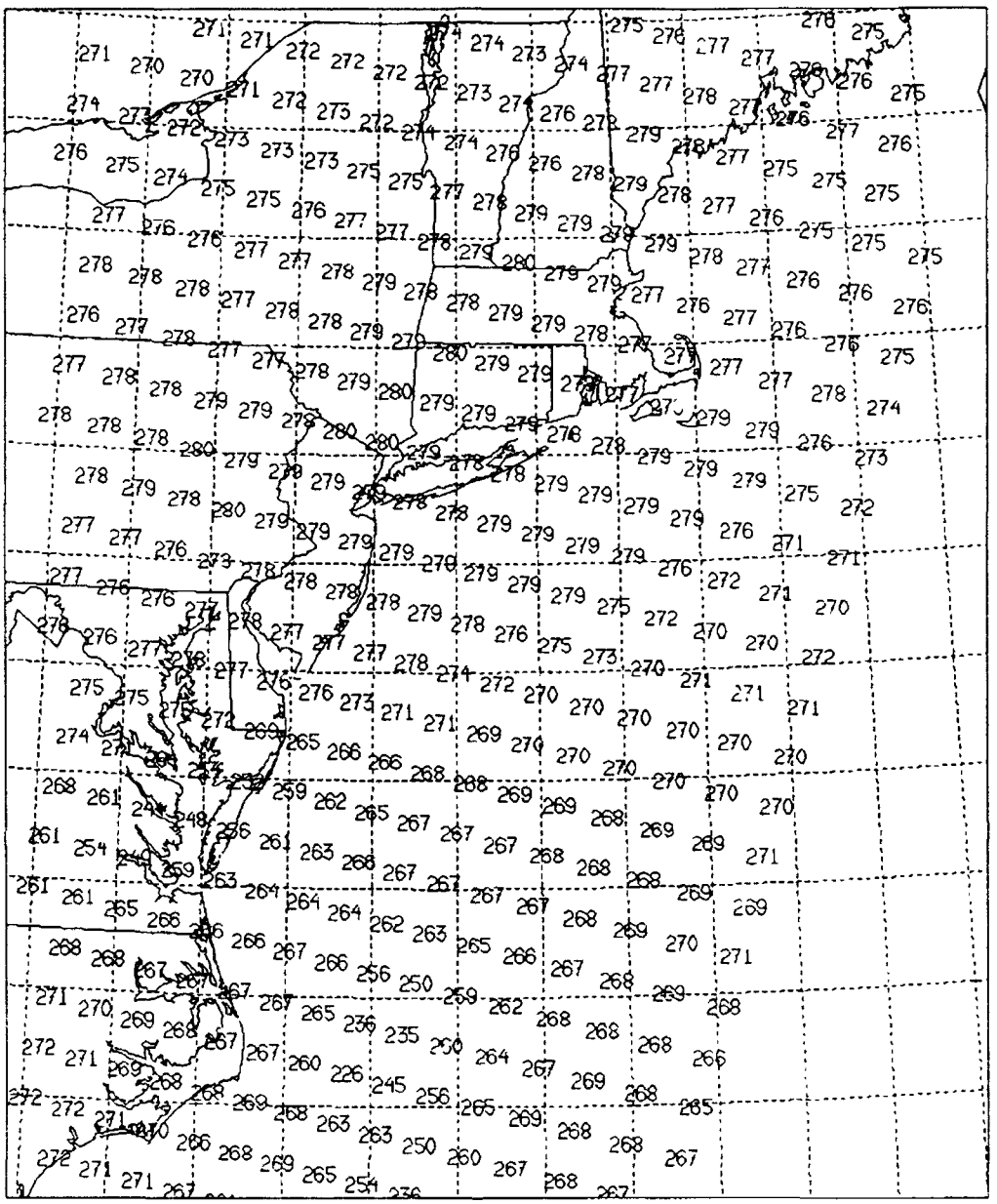
6 AUG 1992



SSM/T-2 FOOTPRINTS

183 +/- 7 GHz

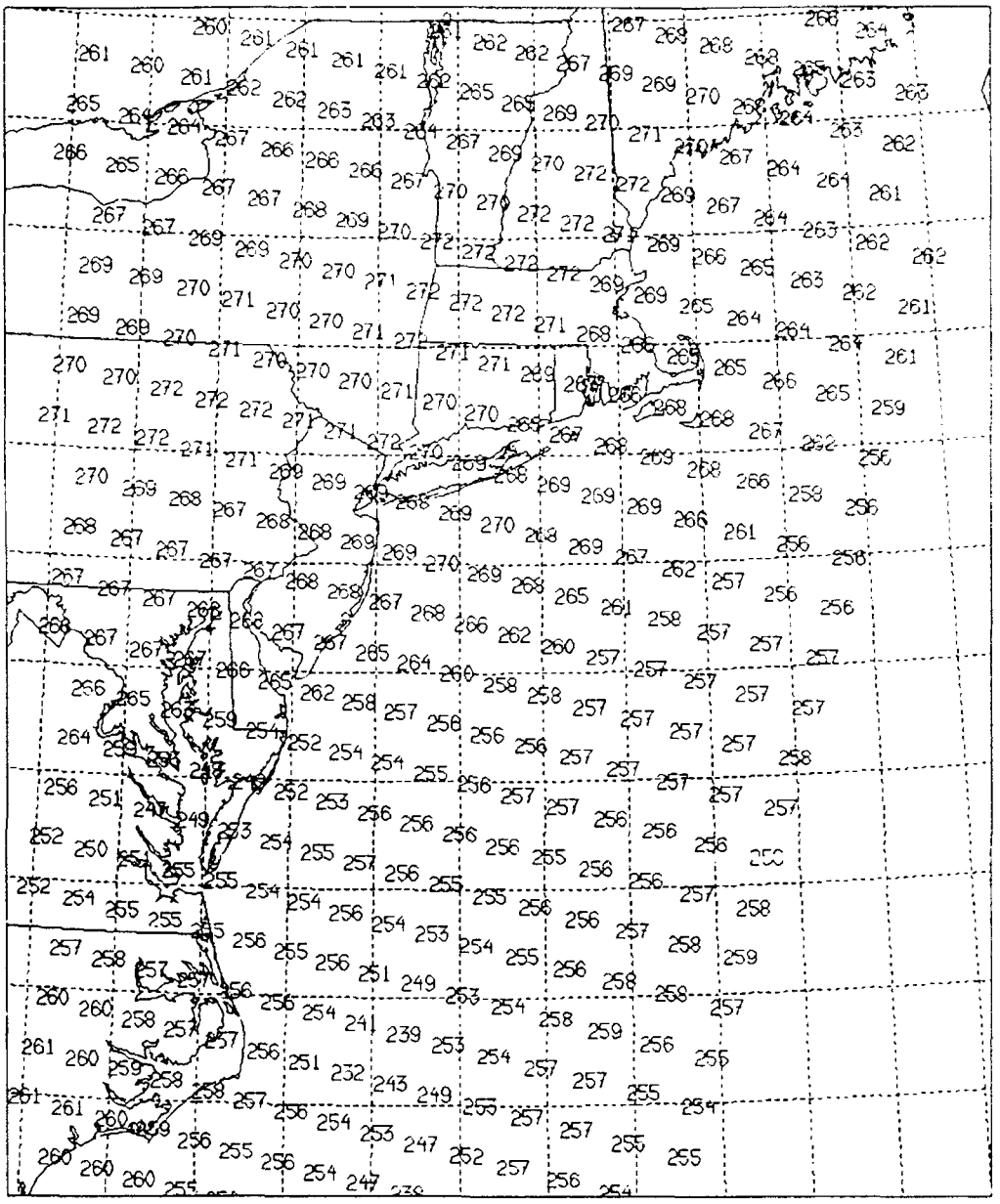
6 AUG 1992



SSM/T-2 FOOTPRINTS

183 +/- 3 GHz

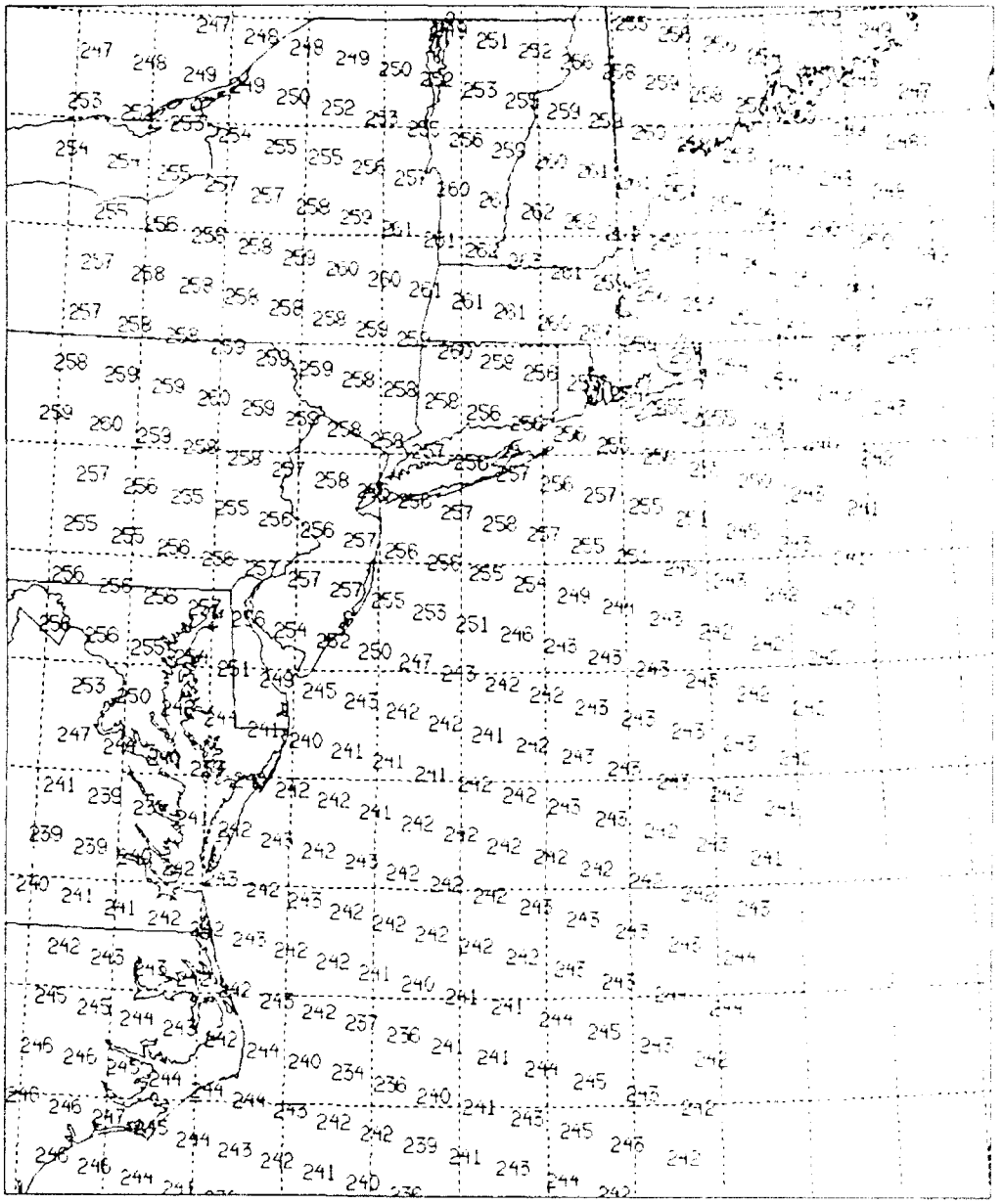
6 AUG 1992



SSM/T-2 FOOTPRINTS

183 +/- 1 GHz

6 AUG 1992



Appendix D. Listing of data collected by Aerospace for the SSM/T-2 Cal/Val study.

SSMT/2 Calibration / Validation Datasave

REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH MODEL
897	2319Z 30JAN92			YES	YES					
898	0101Z 31JAN92									
899	0243Z			YES	YES					
900	0606Z			YES	YES			211134		
901	0748Z									
902	0930Z			YES	YES					
903	1112Z			YES	YES			211140		
904	1254Z									
905	1436Z 31JAN92	YES	YES	YES	YES					
906	1618Z			YES	YES					
907	1800Z	YES	YES	YES	YES			211146		
908	1942Z			YES	YES					
909	2124Z	YES	YES	YES	YES					
910	2306Z	YES	YES	YES	YES					
911	0048Z 01FEB92	YES	YES	YES	YES			211152		
912	0230Z	YES	YES	YES	YES					
913	0412Z	YES	YES	YES	YES					
914	0554Z	YES	YES					211158		
915	0736Z	YES	YES							
916	0918Z	YES	YES	YES	YES					
917	1100Z									
918	1242Z	YES	YES					211164		
919	1424Z	YES	YES	YES	YES					
920	1605Z			YES	YES					
921	1748Z	YES	YES					211170		
922	1929Z			YES	YES					
923	2112Z	YES	YES							
924	2254Z	YES	YES	YES	YES					
925	0035Z 02FEB92	YES	YES	YES	YES			211176		
926	0217Z			YES	YES					
927	0359Z	YES	YES	YES	YES					
928	0541Z	YES	YES	YES	YES			211182		
929	0723Z	YES	YES							
930	0905Z	YES	YES							
931	1047Z			YES	YES					
932	1229Z	YES	YES	YES	YES			211188		
933	1411Z			YES	YES					
934	1553Z									
935	1735Z	YES	YES					211194		
936	1917Z									

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REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH	MODEL
937	2059Z	YES	YES	YES	YES						
938	2241Z	YES	YES	YES	YES						
939	0023Z 03FEB92	YES	YES	YES	YES			211200			
940	0205Z	YES	YES	YES	YES						
941	0347Z	YES	YES	YES	YES						
942	0529Z	YES	YES					211206			
943	0711Z	YES	YES								
944	0853Z	YES	YES								
945	1035Z	YES	YES								
946	1216Z							211212			
947	1358Z	YES	YES	YES	YES						
948	1540Z										
949	1722Z							211218			
950	1904Z	YES	YES	YES	YES						
951	2046Z	YES	YES	YES	YES						
952	2228Z	YES	YES	YES	YES						
953	0010Z 04FEB92	YES	YES	YES	YES			211224			
954	0152Z										
955	0334Z			YES	YES						
956	0516Z			YES	YES						
957	0658Z							211230			
958	0840Z										
959	1022Z										
960	1204Z	YES	YES	YES	YES			211236			
961	1346Z			YES	YES						
962	1528Z										
963	1710Z										
964	1852Z	YES	YES					211242			
965	2034Z	YES	YES	YES	YES						
966	2215Z	YES	YES	YES	YES						
967	2357Z			YES	YES						
968	0139Z 05FEB92	YES	YES					211248			
969	0321Z	YES	YES								
970	0503Z	YES	YES								
971	0645Z	YES	YES	YES	YES			211254			
972	0827Z	YES	YES	YES	YES	YES					
973	1009Z			YES	YES	YES					
974	1151Z	YES	YES	YES	YES	YES		211260			
975	1333Z	YES	YES			YES					
976	1515Z					YES					
977	1657Z	YES	YES			YES					

Courtesy of The Aerospace Corporation, DMSPLE

REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH	MODEL
978	1839Z							211266			
979	2021Z	YES	YES								
980	2203Z	YES	YES	YES	YES						
981	2345Z	YES	YES	YES	YES						
982	0127Z 06FEB92	YES	YES	YES	YES			211272			
983	0309Z	YES	YES								
984	0451Z	YES	YES	YES	YES						
985	0633Z			YES	YES			211278			
986	0814Z	YES	YES								
987	0956Z	YES	YES								
988	1138Z	YES	YES	YES	YES			211284			
989	1320Z	YES	YES	YES	YES						
990	1502Z	YES	YES	YES	YES						
991	1644Z										
992	1826Z	YES	YES	YES	YES			211290			
993	2008Z	YES	YES	YES	YES						
994	2150Z	YES	YES	YES	YES						
995	2332Z	YES	YES	YES	YES			211296			
996	0114Z 07FEB92	YES	YES	YES	YES						
997	0256Z	YES	YES	YES	YES						
998	0438Z	YES	YES	YES	YES						
999	0620Z							211302			
1000	0802Z	YES	YES								
1001	0944Z										
1002	1126Z	YES	YES	YES	YES			211308			
1003	1308Z	YES	YES	YES	YES						
1004	1450Z	YES	YES								
1005	1630Z										
1006	1813Z	YES	YES					211314			
1007	1955Z	YES	YES								
1008	2137Z	YES	YES	YES	YES						
1009	2319Z							211320			
1010	0101Z 08FEB92	YES	YES	YES	YES						
1011	0243Z	YES	YES	YES	YES						
1012	0425Z			YES	YES						
1013	0607Z			YES	YES			211326			
1014	0749Z										
1015	0931Z										
1016	1113Z			YES	YES						
1017	1255Z			YES	YES			211332			
1018	1437Z			YES	YES						

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REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH MODEL
1019	1619Z									
1020	1801Z							211338		
1021	1943Z									
1022	2125Z	YES	YES							
1023	2307Z	YES	YES	YES	YES					
1024	0049Z 09FEB92	YES	YES	YES	YES			211344		
1025	0231Z	YES	YES							
1026	0413Z									
1027	0554Z	YES	YES					211350		
1028	0736Z	YES	YES							
1029	0918Z			YES	YES					
1030	1100Z			YES	YES					
1031	1242Z	YES	YES	YES	YES			211356		
1032	1424Z	YES	YES							
1033	1606Z			YES	YES					
1034	1748Z							211362		
1035	1930Z	YES	YES	YES	YES					
1036	2112Z	YES	YES	YES	YES					
1037	2254Z	YES	YES	YES	YES					
1038	0036Z 10FEB92	YES	YES	YES	YES			211368		
1039	0218Z	YES	YES	YES	YES					
1040	0400Z	YES	YES	YES	YES					
1041	0542Z	YES	YES					211374		
1042	0724Z	YES	YES	YES	YES					
1043	0906Z			YES	YES					
1044	1048Z			YES	YES					
1045	1230Z	YES	YES	YES	YES			211380		
1046	1412Z	YES	YES							
1047	1553Z	YES	YES							
1048	1735Z			YES	YES	YES		211386		
1049	1917Z	YES	YES	YES	YES	YES				
1050	2059Z	YES	YES	YES	YES	YES				
1051	2241Z	YES	YES			YES				
1052	0023Z 11FEB92	YES	YES	YES	YES	YES		211392		
1053	0205Z			YES	YES	YES				
1054	0347Z	YES	YES	YES	YES	YES				
1055	0529Z	YES	YES	YES	YES	YES		211398		
1056	0711Z	YES	YES	YES	YES	YES				
1057	0853Z	YES	YES			YES				
1058	1035Z	YES	YES			YES				
1059	1217Z	YES	YES	YES	YES	YES		211404		

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REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH	MODEL
1060	1359Z	YES	YES	YES	YES	YES					
1061	1541Z					YES					
1062	1723Z			YES	YES	YES		211410			
1063	1905Z					YES					
1064	2047Z			YES	YES	YES					
1065	2229Z					YES					
1066	0011Z 12FEB92					YES		211416			
1067	0153Z	YES	YES	YES	YES	YES					
1068	0334Z	YES	YES	YES	YES	YES					
1069	0516Z	YES	YES	YES	YES	YES		211422			
1070	0658Z	YES	YES			YES					
1071	0840Z	YES	YES			YES					
1072	1022Z	YES	YES	YES	YES	YES					
1073	1204Z	YES	YES	YES	YES	YES		211428			
1074	1346Z	YES	YES	YES	YES	YES					
1075	1528Z	YES	YES	YES	YES	YES					
1076	1710Z	YES	YES	YES	YES	YES					
1077	1852Z	YES	YES	YES	YES	YES		211434			
1078	2034Z	YES	YES	YES	YES	YES					
1079	2216Z	YES	YES	YES	YES	YES					
1080	2358Z	YES	YES	YES	YES	YES		211440			
1081	0140Z 13FEB92	YES	YES								
1082	0322Z			YES	YES						
1083	0504Z			YES	YES						
1084	0646Z			YES	YES			211446			
1085	0828Z										
1086	1010Z			YES	YES						
1087	1152Z							211452			
1088	1334Z										
1089	1515Z										
1090	1657Z										
1091	1839Z	YES	YES	YES	YES			211458			
1092	2021Z	YES	YES	YES	YES						
1093	2203Z					YES					
1094	2345Z	YES	YES	YES	YES	YES		211464			
1095	0127Z 14FEB92	YES	YES	YES	YES	YES					
1096	0309Z			YES	YES	YES					
1097	0451Z	YES	YES			YES					
1098	0633Z			YES	YES	YES		211470			
1099	0815Z	YES	YES			YES					
1100	0957Z			YES	YES	YES					
1101	1139Z	YES	YES			YES		211476			

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REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH MODEL
1102	1321Z	YES	YES	YES	YES	YES				
1103	1503Z			YES	YES	YES				
1104	1645Z	YES	YES	YES	YES	YES			YES	
1105	1827Z	YES	YES	YES	YES	YES		211482		
1106	2009Z			YES	YES	YES				
1107	2151Z	YES	YES	YES	YES	YES			YES	
1108	2333Z	YES	YES	YES	YES	YES		211488		
1109	0114Z 15FEB92	YES	YES	YES	YES					
1110	0256Z	YES	YES						YES	
1111	0438Z	YES	YES							
1112	0620Z	YES	YES			YES		211494		
1113	0802Z	YES	YES			YES				
1114	0944Z					YES			YES	
1115	1126Z					YES		211500		
1116	1308Z	YES	YES	YES	YES	YES				
1117	1450Z	YES	YES			YES			YES	
1118	1632Z					YES				
1119	1814Z			YES	YES	YES		211506		
1120	1956Z			YES	YES	YES				
1121	2138Z	YES	YES			YES			YES	
1122	2320Z	YES	YES	YES	YES	YES		211512		
1123	0102Z 16FEB92			YES	YES	YES				
1124	0244Z			YES	YES	YES				
1125	0426Z	YES	YES			YES				
1126	0608Z	YES	YES	YES	YES	YES			YES	
1127	0750Z	YES	YES			YES				
1128	0932Z	YES	YES	YES	YES	YES			YES	
1129	1113Z									
1130	1255Z	YES	YES	YES	YES					
1131	1437Z					YES				
1132	1619Z					YES			YES	
1133	1801Z	YES	YES	YES	YES	YES				
1134	1943Z	YES	YES	YES	YES	YES				
1135	2125Z	YES	YES			YES			YES	
1136	2307Z			YES	YES	YES				
1137	0049Z 17FEB92			YES	YES	YES				
1138	0231Z			YES	YES	YES			YES	
1139	0413Z	YES	YES	YES	YES	YES			YES	
1140	0555Z	YES	YES			YES				
1141	0737Z	YES	YES			YES				
1142	0919Z	YES	YES	YES	YES	YES				
1143	1101Z	YES	YES			YES				

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REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH	MODEL
1144	1243Z	YES	YES	YES	YES						
1145	1425Z	YES	YES			YES			YES		
1146	1607Z					YES					
1147	1749Z			YES	YES	YES			YES		
1148	1931Z			YES	YES	YES					
1149	2112Z	YES	YES	YES	YES	YES					
1150	2254Z	YES	YES	YES	YES	YES					
1151	0036Z 18FEB92	YES	YES	YES	YES					YES	
1152	0218Z	YES	YES	YES	YES	YES			YES	YES	
1153	0400Z	YES	YES	YES	YES	YES					
1154	0542Z	YES	YES	YES	YES	YES		211566		YES	
1155	0724Z	YES	YES			YES					
1156	0906Z					YES			YES	YES	
1157	1048Z	YES	YES	YES	YES	YES					
1158	1230Z	YES	YES			YES		211572		YES	
1159	1412Z					YES					
1160	1554Z					YES			YES	YES	
1161	1736Z	YES	YES			YES		211578		YES	
1162	1917Z										
1163	2059Z	YES	YES	YES	YES	YES				YES	
1164	2241Z	YES	YES	YES	YES	YES					
1165	0023Z 19FEB92	YES	YES	YES	YES	YES		211584		YES	
1166	0205Z	YES	YES	YES	YES	YES					
1167	0347Z	YES	YES			YES				YES	
1168	0529Z	YES	YES	YES	YES	YES		211590			
1169	0711Z					YES				YES	
1170	0853Z					YES					
1171	1035Z					YES					
1172	1217Z					YES			YES	YES	
1173	1359Z					YES					
1174	1541Z					YES				YES	
1175	1723Z					YES		211602			
1176	1905Z			YES	YES	YES					
1177	2047Z			YES	YES	YES					
1178	2229Z			YES	YES	YES			YES		
1179	0011Z 20FEB92			YES	YES	YES		211608			
1180	0152Z			YES	YES	YES					
1181	0334Z			YES	YES		YES			YES	
1182	0516Z			YES	YES					YES	
1183	0658Z										
1184	0840Z						YES		YES	YES	
1185	1022Z			YES	YES	YES					

Courtesy of The Aerospace Corporation, DMSPLE

REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH	MODEL
1186	1204Z					YES				YES	
1187	1346Z					YES	YES		YES		
1188	1528Z					YES				YES	
1189	1710Z			YES	YES	YES					
1190	1852Z			YES	YES	YES				YES	
1191	2034Z	YES	YES	YES	YES	YES				YES	
1192	2216Z	YES	YES			YES					
1193	2358Z	YES	YES	YES	YES	YES				YES	
1194	0140Z 21FEB92	YES	YES	YES	YES	YES					
1195	0322Z			YES	YES	YES				YES	
1196	0504Z	YES	YES			YES					
1197	0646Z			YES	YES	YES				YES	
1198	0828Z	YES	YES	YES	YES	YES					
1199	1009Z					YES					
1200	1151Z										
1201	1333Z	YES	YES	YES	YES	YES					
1202	1515Z			YES	YES	YES					
1203	1657Z					YES			YES		
1204	1839Z			YES	YES	YES					
1205	2021Z					YES					
1206	2203Z	YES	YES	YES	YES	YES					
1207	2345Z	YES	YES	YES	YES	YES					
1208		YES	YES								
1209		YES	YES								
1210		YES	YES								
1211		YES	YES								
1212		YES	YES								

Courtesy of The Aerospace Corporation, DMSPLE

SSMT/2 Calibration / Validation Datasave

REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH	MODEL
1277	2241Z 26FEB92			YES	YES						
1278	0023Z 27FEB92			YES	YES						
1279	0205Z			YES	YES						
1280	0347Z	YES	YES								
1281	0529Z	YES	YES	YES	YES						
1282	0711Z	YES	YES	YES	YES						
1283	0853Z	YES	YES	YES	YES						
1284	1035Z	YES	YES								
1285	1217Z	YES	YES								
1286	1359Z	YES	YES								
1287	1541Z										
1288	1723Z							211794			
1289	1905Z			YES	YES						
1290	2047Z			YES	YES					YES	
1291	2229Z			YES	YES						
1292	0011Z 28FEB92			YES	YES	YES		211800		YES	
1293	0153Z			YES		YES					
1294	0334Z	YES	YES			YES				YES	
1295	0516Z	YES	YES			YES		211806		YES	
1296	0658Z	YES	YES	YES	YES	YES					
1297	0840Z	YES	YES			YES				YES	
1298	1022Z			YES	YES	YES					
1299	1204Z			YES	YES	YES				YES	
1300	1346Z	YES	YES	YES	YES	YES					
1301	1528Z	YES	YES	YES	YES	YES				YES	
1302	1710Z	YES	YES	YES	YES	YES					
1303	1852Z	YES	YES			YES		211818		YES	YES
1304	2034Z	YES	YES			YES					
1305	2216Z	YES	YES			YES					
1306	2358Z					YES		211824			YES
1307	0140Z 29FEB92						YES		YES		
1308	0322Z			YES	YES						
1309	0504Z			YES	YES			211830		YES	YES
1310	0646Z			YES	YES		YES		YES	YES	
1311	0828Z					YES					
1312	1010Z	YES	YES			YES					
1313	1151Z					YES		211836		YES	
1314	1333Z	YES	YES	YES	YES	YES					
1315	1515Z			YES	YES	YES	YES		YES	YES	
1316	1657Z	YES	YES	YES	YES	YES					

Courtesy of The Aerospace Corporation, DMSPLE

REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH	MODEL
1317	1839Z	YES	YES	YES	YES	YES				YES	
1318	2021Z	YES	YES	YES	YES	YES				YES	
1319	2203Z					YES					
1320	2345Z	YES	YES	YES	YES	YES		211848		YES	YES
1321	0127Z 01MAR92	YES	YES	YES	YES	YES					
1322	0309Z	YES	YES	YES	YES	YES				YES	
1323	0451Z	YES	YES	YES	YES	YES					
1324	0633Z	YES	YES			YES		211854			YES
1325	0815Z					YES	YES		YES		
1326	0957Z										
1327	1139Z			YES	YES			211860			YES
1328	1321Z			YES	YES		YES		YES		
1329	1503Z			YES	YES						
1330	1645Z	YES	YES	YES	YES						
1331	1826Z	YES	YES				YES	211866	YES		
1332	2008Z	YES	YES	YES	YES						
1333	2150Z	YES	YES	YES	YES						
1334	2332Z	YES	YES	YES	YES			211872			
1335	0114Z 02MAR92	YES	YES								
1336	0256Z	YES	YES	YES	YES						
1337	0438Z	YES	YES	YES	YES						
1338	0620Z							211878			
1339	0802Z	YES	YES	YES	YES						
1340	0944Z	YES	YES	YES	YES						
1341	1126Z	YES	YES	YES	YES			211884			
1342	1308Z	YES	YES	YES	YES						
1343	1450Z	YES	YES	YES	YES						
1344	1632Z	YES	YES	YES	YES						
1345	1814Z			YES	YES			211890		YES	
1346	1956Z	YES	YES	YES	YES						
1347	2138Z	YES	YES	YES	YES					YES	
1348	2320Z	YES	YES					211896		YES	
1349	0102Z 03MAR92	YES	YES								
1350	0244Z			YES	YES					YES	
1351	0425Z			YES	YES						
1352	0607Z	YES	YES	YES	YES			211902		YES	
1353	0749Z	YES	YES	YES	YES						
1354	0931Z	YES	YES	YES	YES					YES	
1355	1113Z			YES	YES	YES		211908		YES	
1356	1255Z	YES	YES	YES	YES	YES					
1357	1437Z	YES	YES	YES	YES	YES				YES	
1358	1619Z	YES	YES	YES	YES	YES					

Courtesy of The Aerospace Corporation, DMSPLE

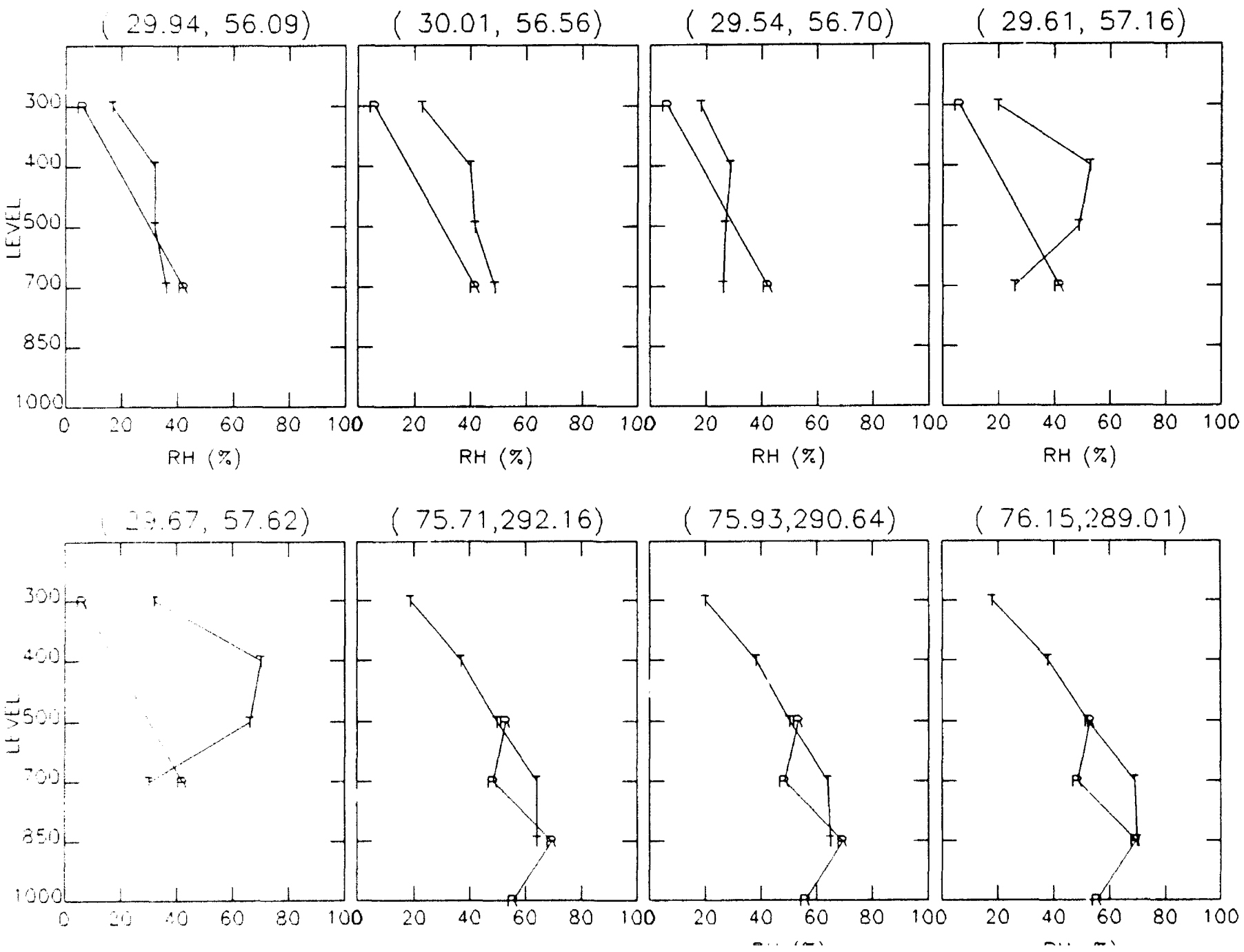
REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH	MODEL
1359	1801Z	YES	YES	YES	YES	YES		211914		YES	
1360	1943Z	YES	YES			YES					
1361	2125Z					YES				YES	
1362	2307Z	YES	YES	YES	YES	YES					
1363	0049Z 04MAR92	YES	YES	YES	YES	YES		211920		YES	
1364	0231Z			YES	YES	YES				YES	
1365	0413Z	YES	YES	YES	YES	YES					
1366	0555Z	YES	YES	YES	YES	YES		211926		YES	
1367	0737Z	YES	YES	YES	YES	YES					
1368	0919Z	YES	YES			YES				YES	
1369	1100Z	YES	YES			YES					
1370	1242Z	YES	YES			YES		211932		YES	
1371	1424Z					YES			YES	YES	
1372	1606Z					YES					
1373	1748Z					YES		211938			
1374	1930Z					YES					
1375	2112Z					YES					
1376	2254Z					YES					
1377	0036Z 05MAR92					YES		211944			
1378	0218Z					YES					
1379	0400Z					YES					
1380	0542Z					YES		211950			
1381	0724Z					YES					
1382	0906Z					YES			YES		
1383	1048Z			YES	YES	YES					
1384	1230Z	YES	YES	YES	YES	YES		211956			
1385	1412Z			YES	YES	YES					
1386	1554Z			YES	YES	YES			YES		
1387	1736Z	YES	YES	YES	YES	YES		211962			
1388	1917Z	YES	YES	YES	YES	YES					
1389	2059Z	YES	YES	YES	YES					YES	
1390	2241Z	YES	YES			YES					
1391	0023Z 06MAR92	YES	YES			YES		211968		YES	
1392	0205Z	YES	YES			YES					
1393	0347Z			YES	YES	YES				YES	
1394	0529Z			YES	YES	YES		211974		YES	YES
1395	0711Z			YES	YES	YES	YES				
1396	0853Z			YES	YES	YES				YES	
1397	1035Z	YES	YES	YES	YES	YES			YES		
1398	1217Z	YES	YES	YES	YES	YES		211980		YES	YES
1399	1359Z	YES	YES	YES	YES	YES	YES		YES		
1400	1541Z	YES	YES			YES				YES	

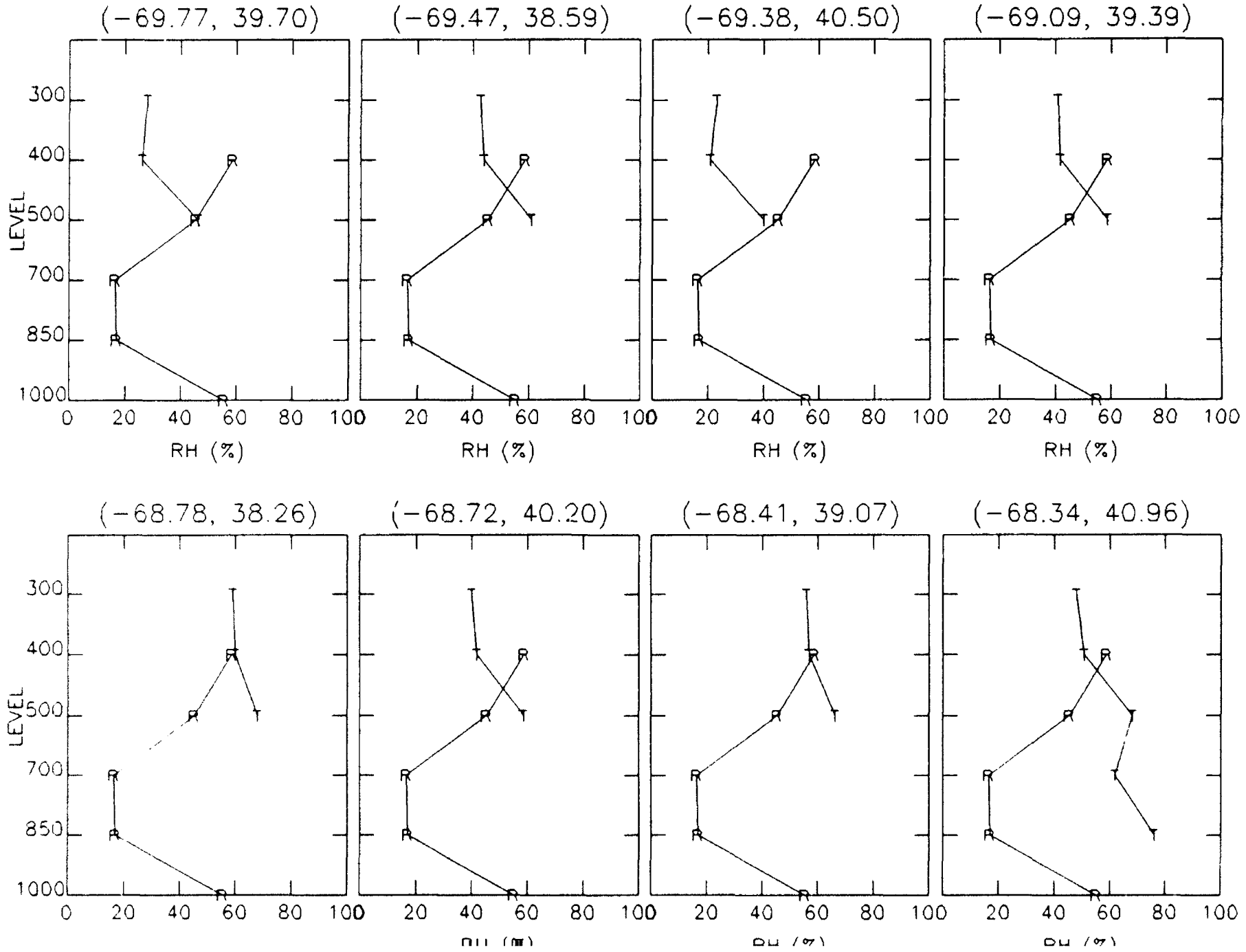
Courtesy of The Aerospace Corporation, DMSPLE

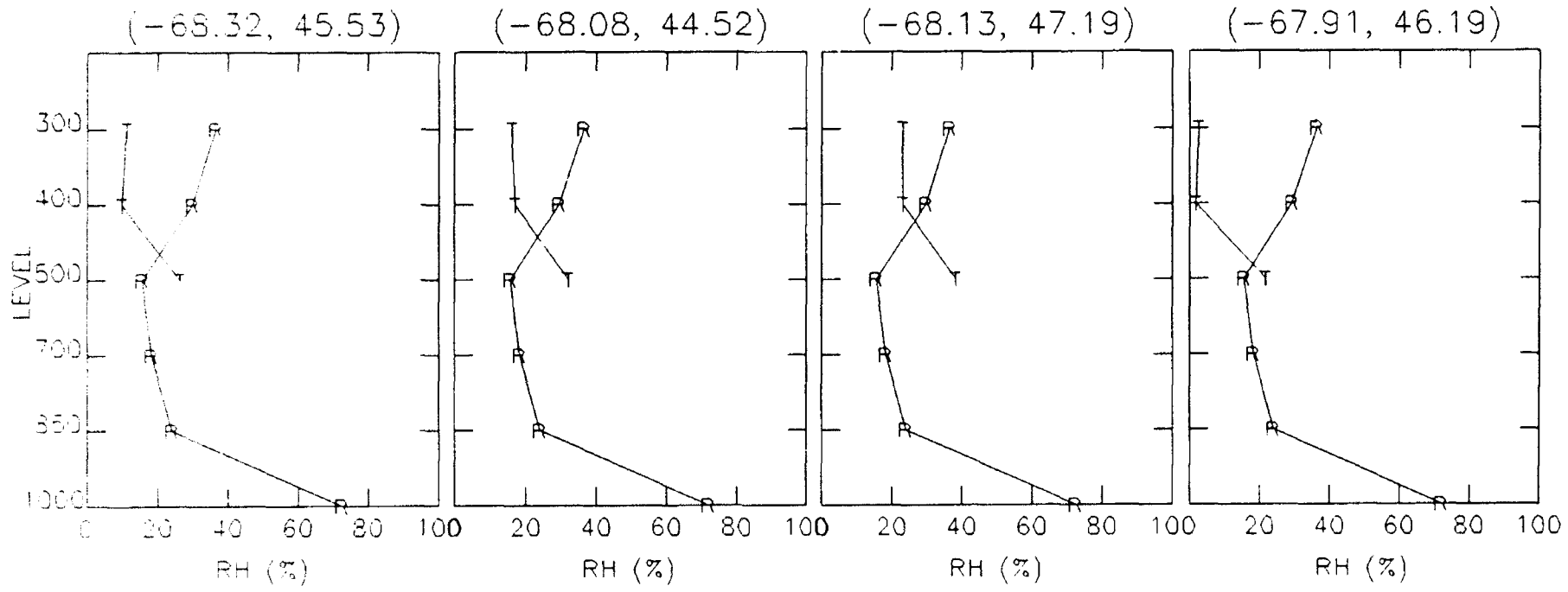
REV#	ANODE DTG	MTSDRS	MTEDRS	T2SDRS	T2EDRS	MISDRS	MIEDRS	CONV JUHR	SGDB	RTNEPH	MODEL
1401	1723Z	YES	YES			YES		211986		YES	YES
1402	1905Z	YES	YES	YES	YES	YES					
1403	2047Z	YES	YES	YES	YES	YES	YES			YES	
1404	2229Z	YES	YES	YES	YES	YES					
1405	0011Z 07MAR92	YES	YES	YES	YES	YES		211992		YES	YES
1406	0152Z			YES	YES	YES					
1407	0334Z	YES	YES	YES	YES	YES	YES		YES	YES	
1408	0516Z			YES	YES	YES		211998		YES	YES
1409	0658Z	YES	YES			YES					
1410	0840Z	YES	YES			YES	YES		YES	YES	
1411	1022Z	YES	YES			YES					
1412	1204Z			YES	YES	YES		212004		YES	
1413	1346Z	YES	YES	YES	YES	YES					
1414	1528Z	YES	YES			YES	YES		YES	YES	
1415	1710Z	YES	YES	YES	YES	YES		212010		YES	YES
1416	1852Z			YES	YES	YES					
1417	2034Z	YES	YES	YES	YES	YES				YES	
1418	2216Z	YES	YES	YES	YES	YES					
1419	2358Z					YES		212016		YES	
1420	0140Z 08MAR92					YES					
1421	0322Z					YES	YES		YES	YES	
1422	0504Z					YES					
1423	0646Z					YES		212022		YES	YES
1424	0828Z					YES	YES			YES	
1425	1009Z					YES					
1426	1151Z							212028		YES	YES
1427	1333Z						YES		YES		
1428	1515Z										
1429	1657Z							212034			YES
1430	2021Z						YES		YES		
1431	2203Z										
1432	2345Z										YES
1433	0127Z 09MAR92										
1434	0127Z						YES				
1435	0309Z										
1436	0451Z										
1437	0633Z										YES
1438	0815Z						YES				
1439	0957Z										
1440	1139Z										
1441	1321Z						YES				

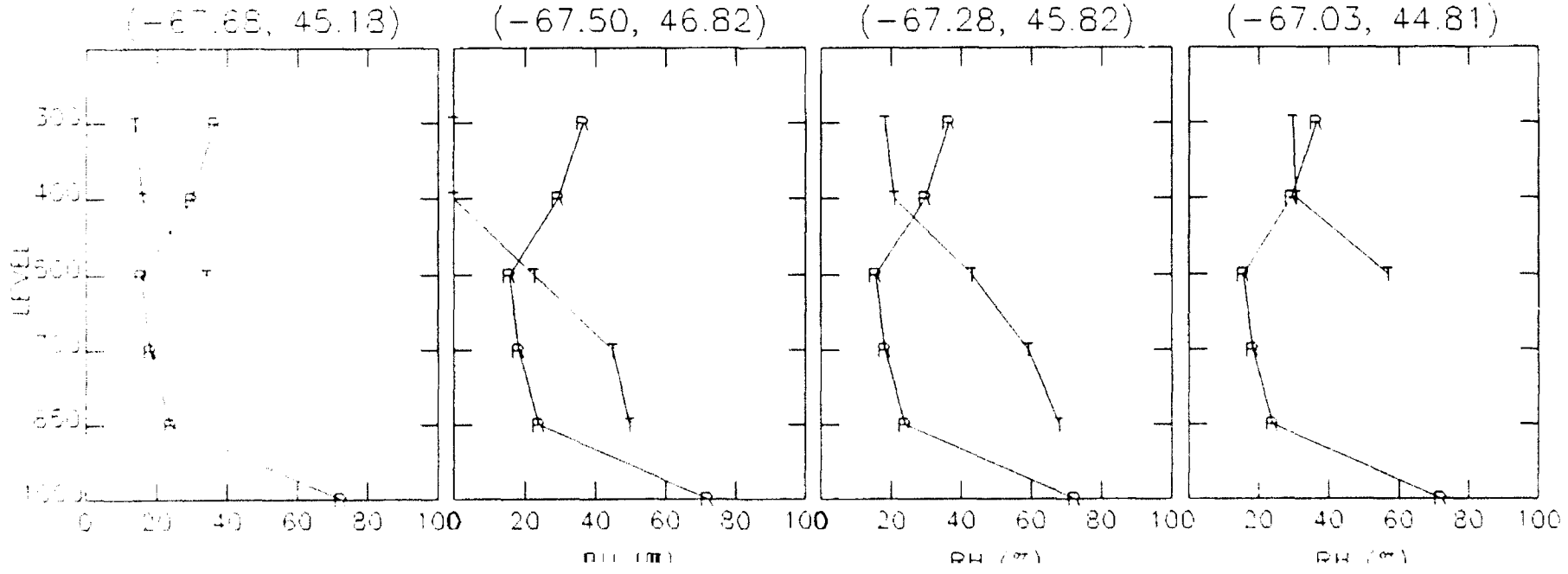
Courtesy of The Aerospace Corporation, DMSPLE

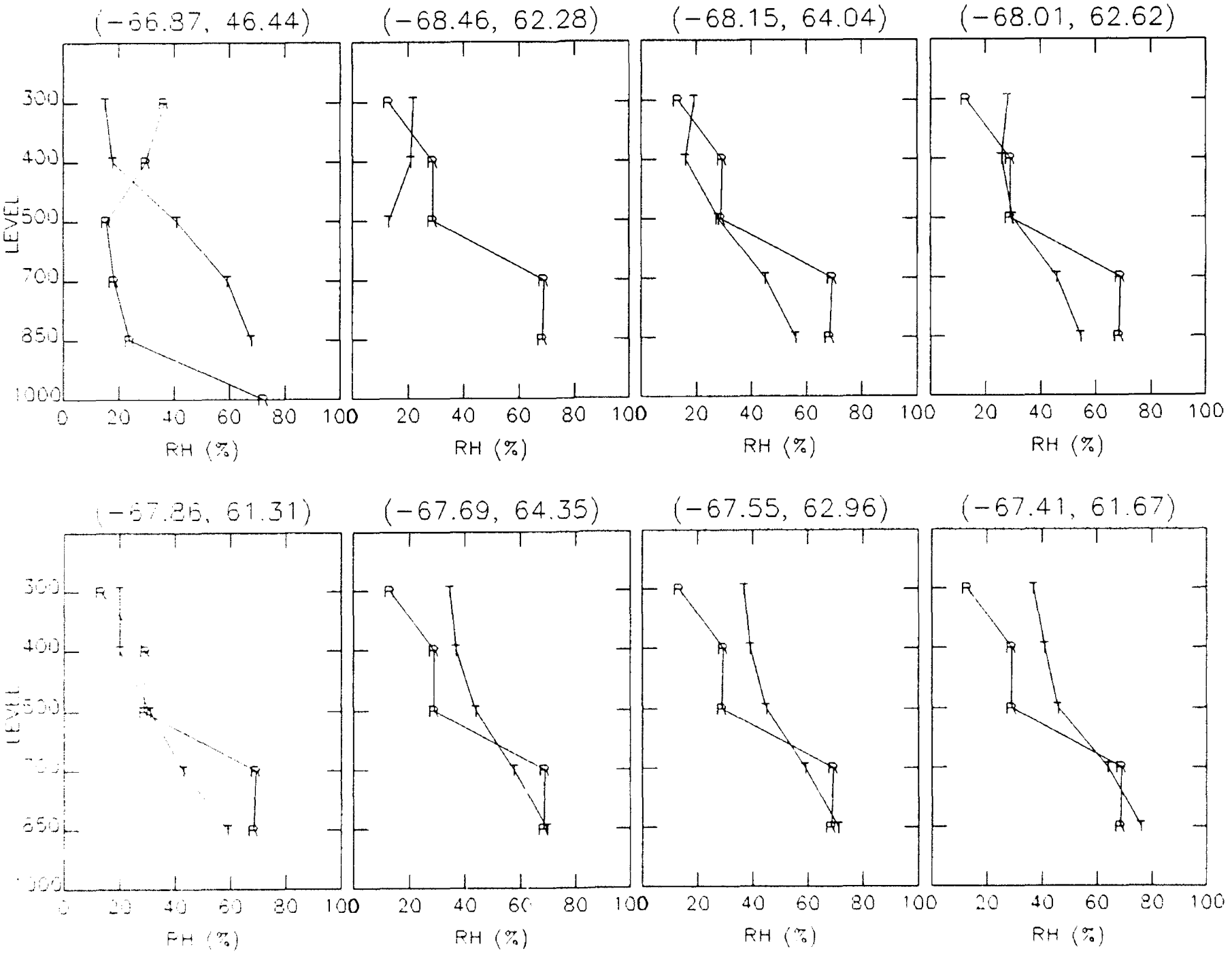
Appendix E. Display of selected radiosonde (R) and SSM/T-2-retrieved (T) RH profiles.

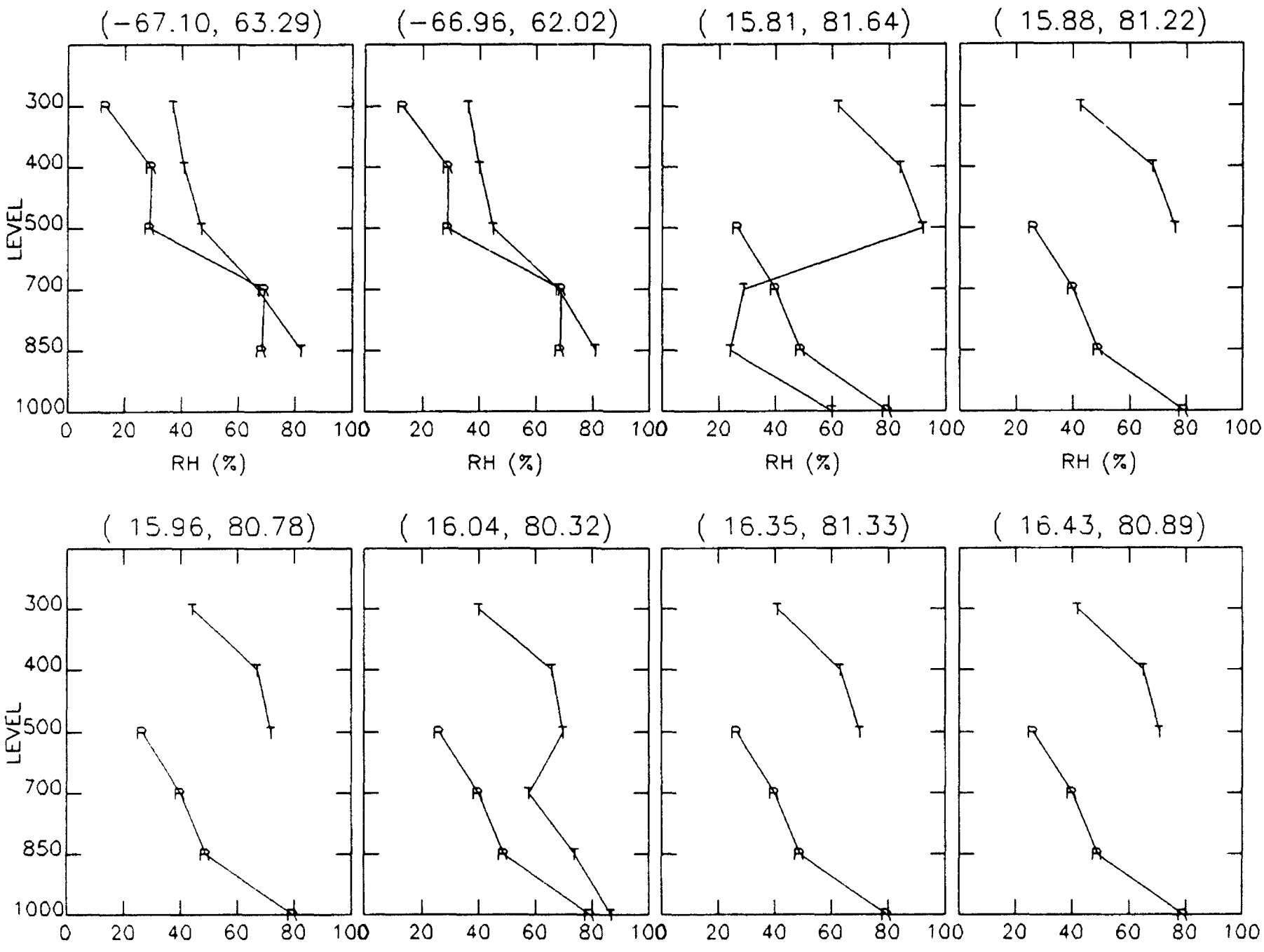

(29.94, 56.09)
(30.01, 56.56)
(29.54, 56.70)
(29.61, 57.16)
(29.67, 57.62)
(75.71,292.16)
(75.93,290.64)
(76.15,289.01)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

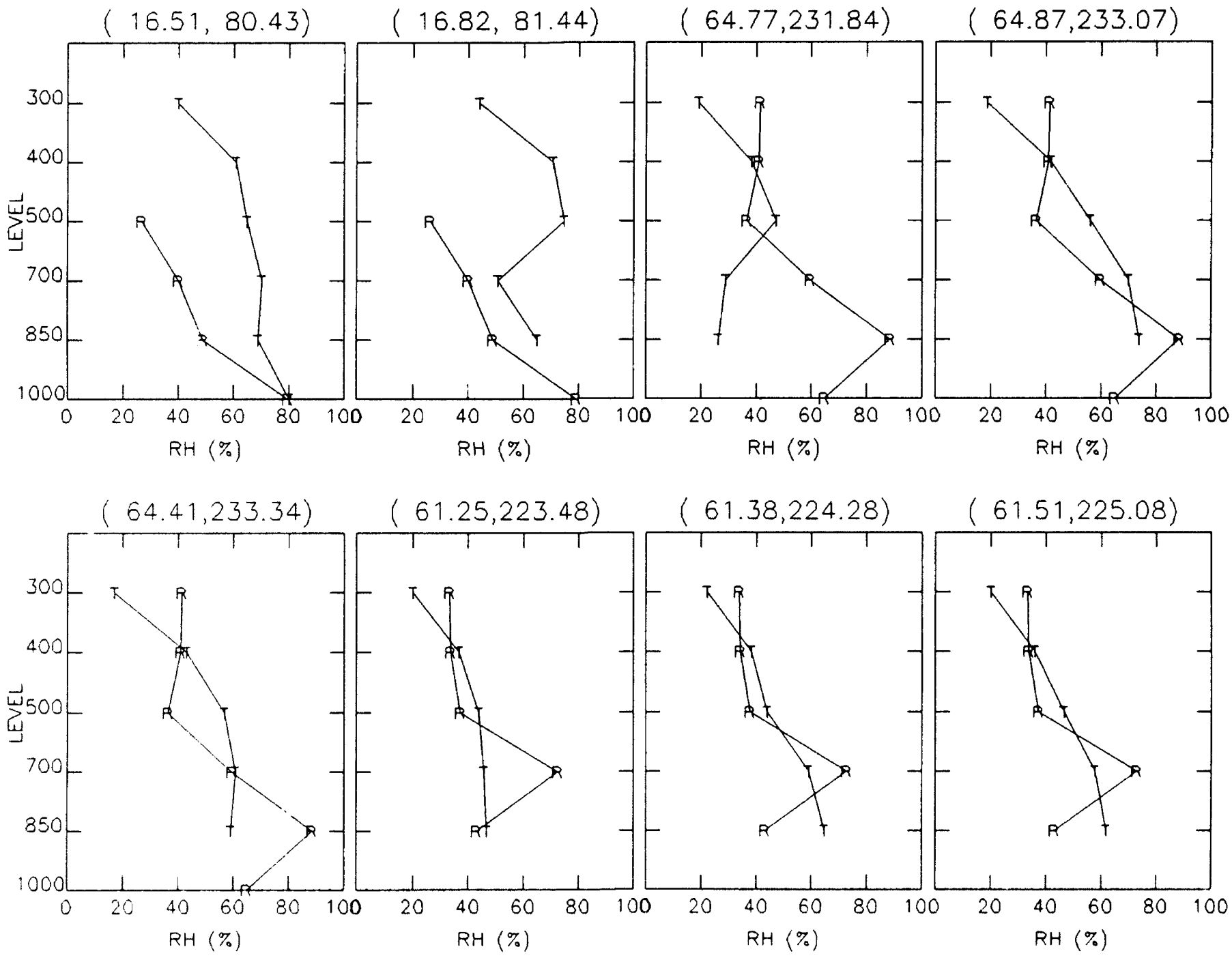

(-69.77, 39.70)
(-69.47, 38.59)
(-69.38, 40.50)
(-69.09, 39.39)
(-68.78, 38.26)
(-68.72, 40.20)
(-68.41, 39.07)
(-68.34, 40.96)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

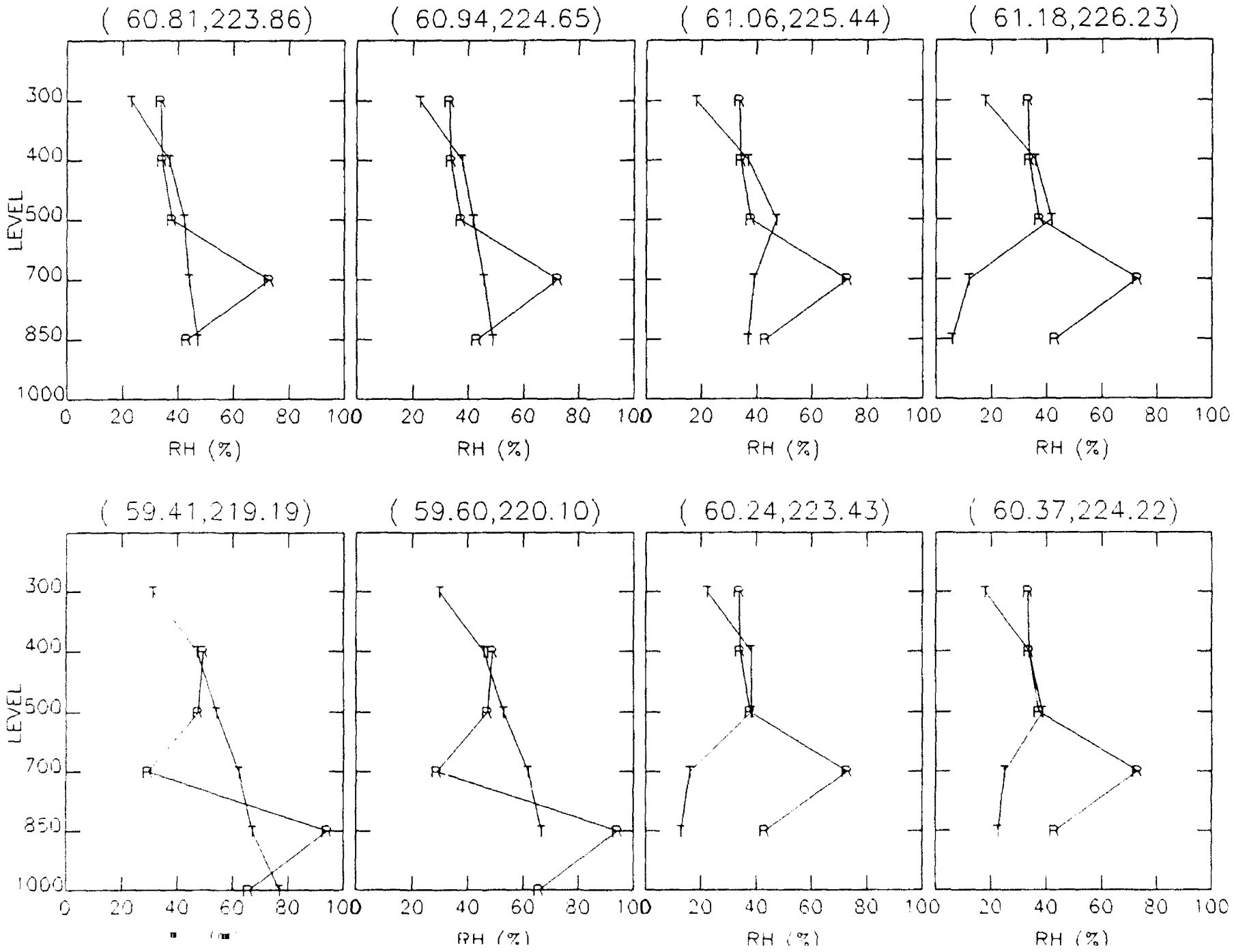

(-68.32, 45.53)
(-68.08, 44.52)
(-68.13, 47.19)
(-67.91, 46.19)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

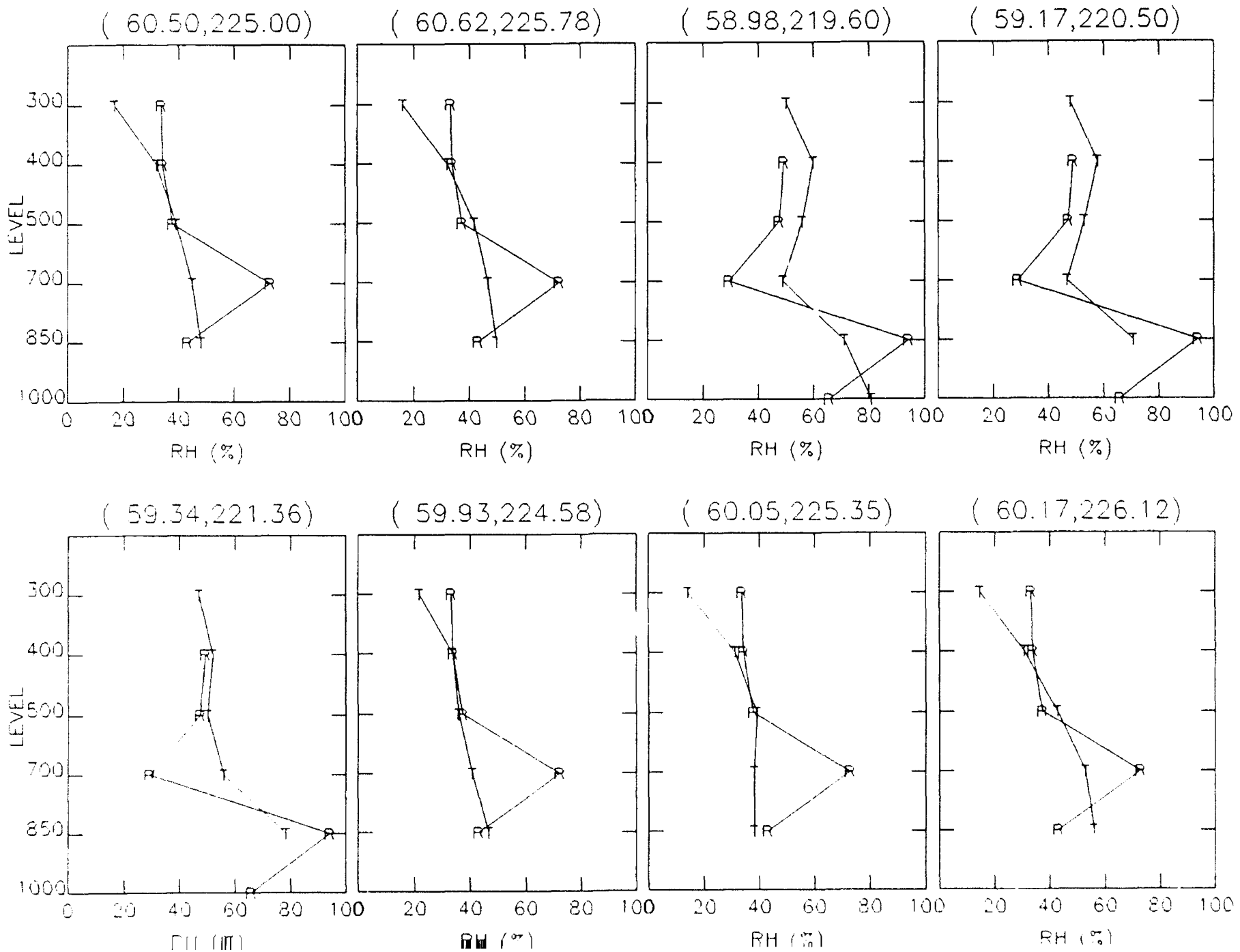

(-67.68, 45.18)
(-67.50, 46.82)
(-67.28, 45.82)
(-67.03, 44.81)
LEVEL
20
40
60
80
100
RH (%)

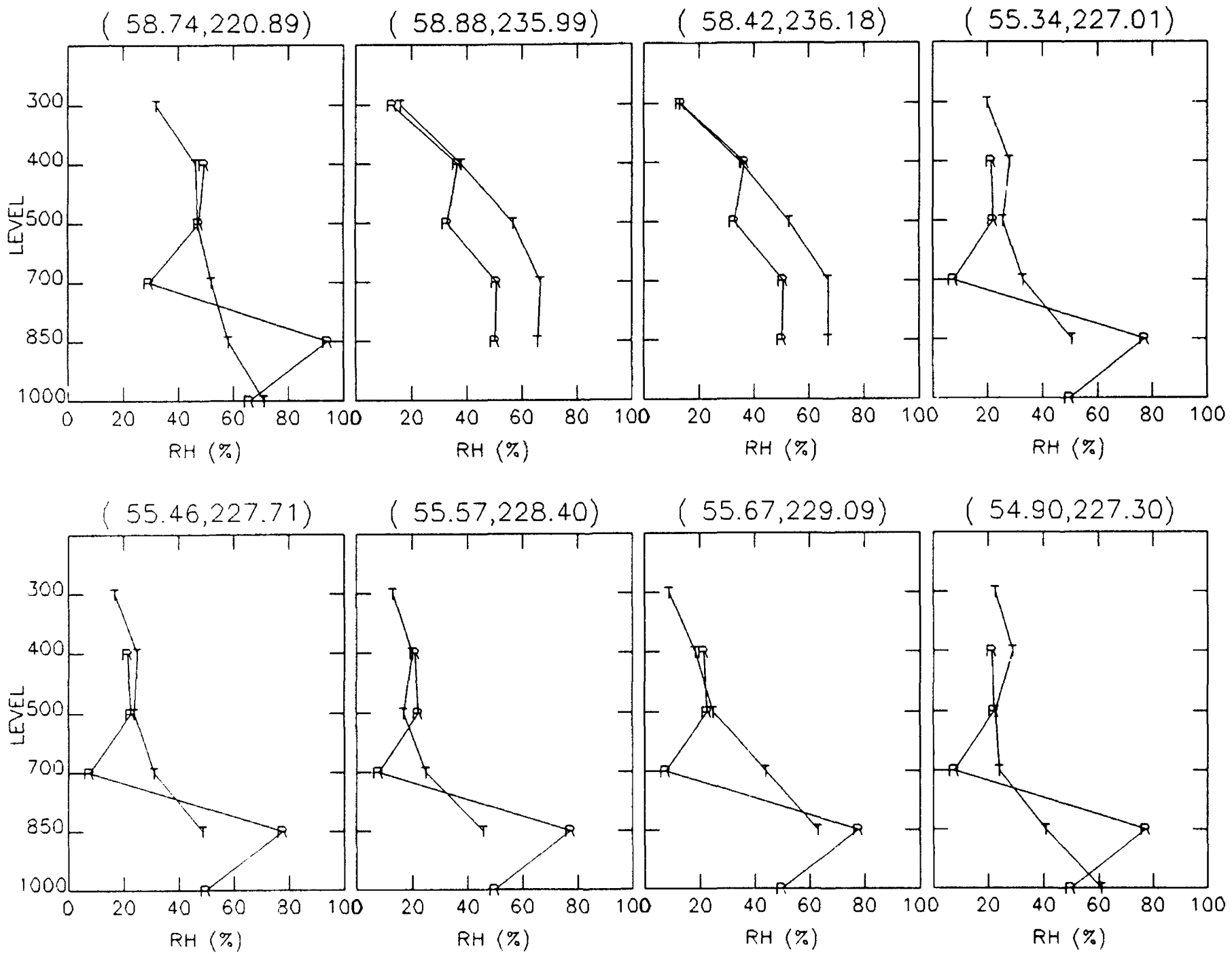

(-66.87, 46.44)
(-68.46, 62.28)
(-68.15, 64.04)
(-68.01, 62.62)
(-67.26, 61.31)
(-67.69, 64.35)
(-67.55, 62.96)
(-67.41, 61.67)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

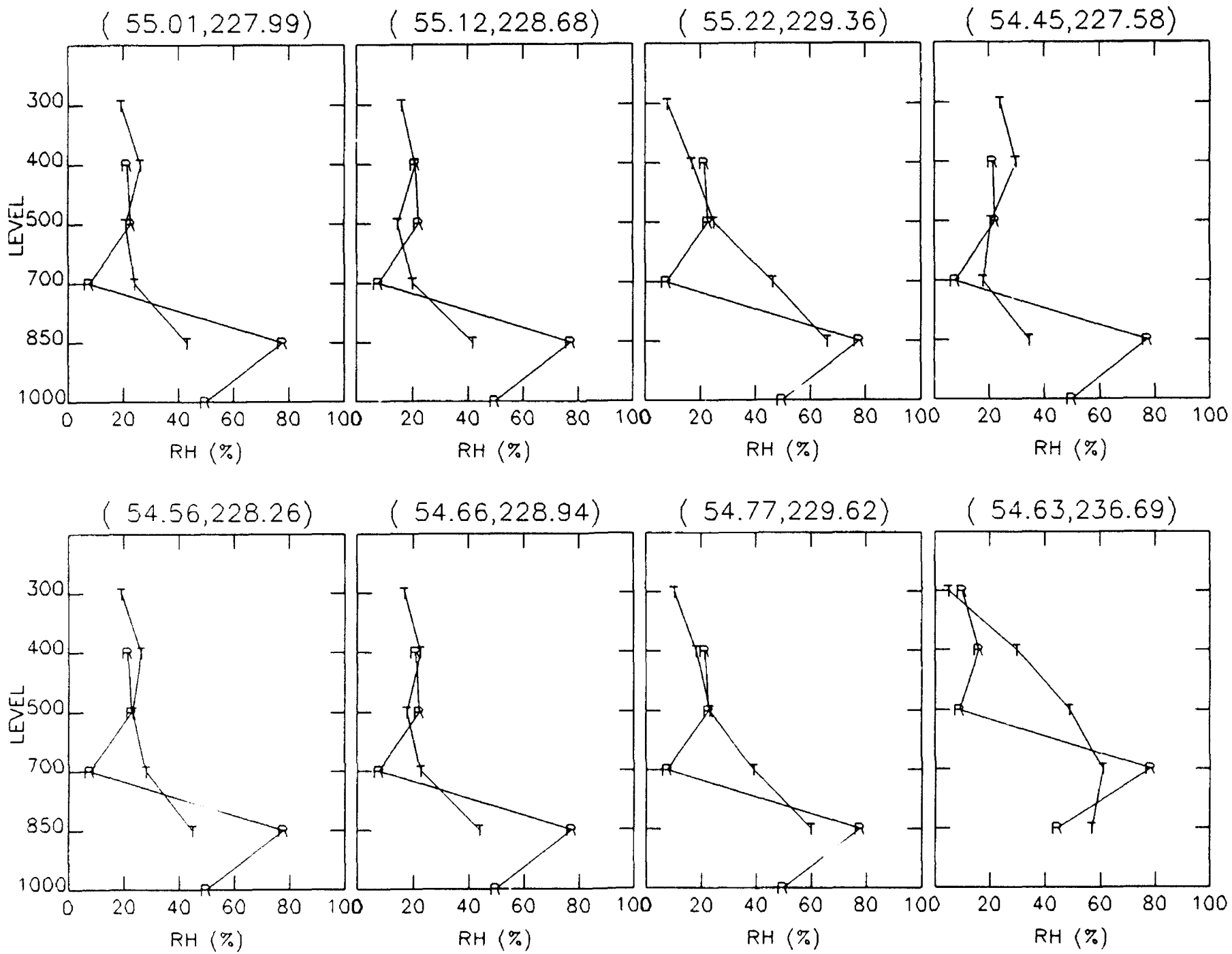

(-67.10, 63.29)
(-66.96, 62.02)
(15.81, 81.64)
(15.88, 81.22)
(15.96, 80.78)
(16.04, 80.32)
(16.35, 81.33)
(16.43, 80.89)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

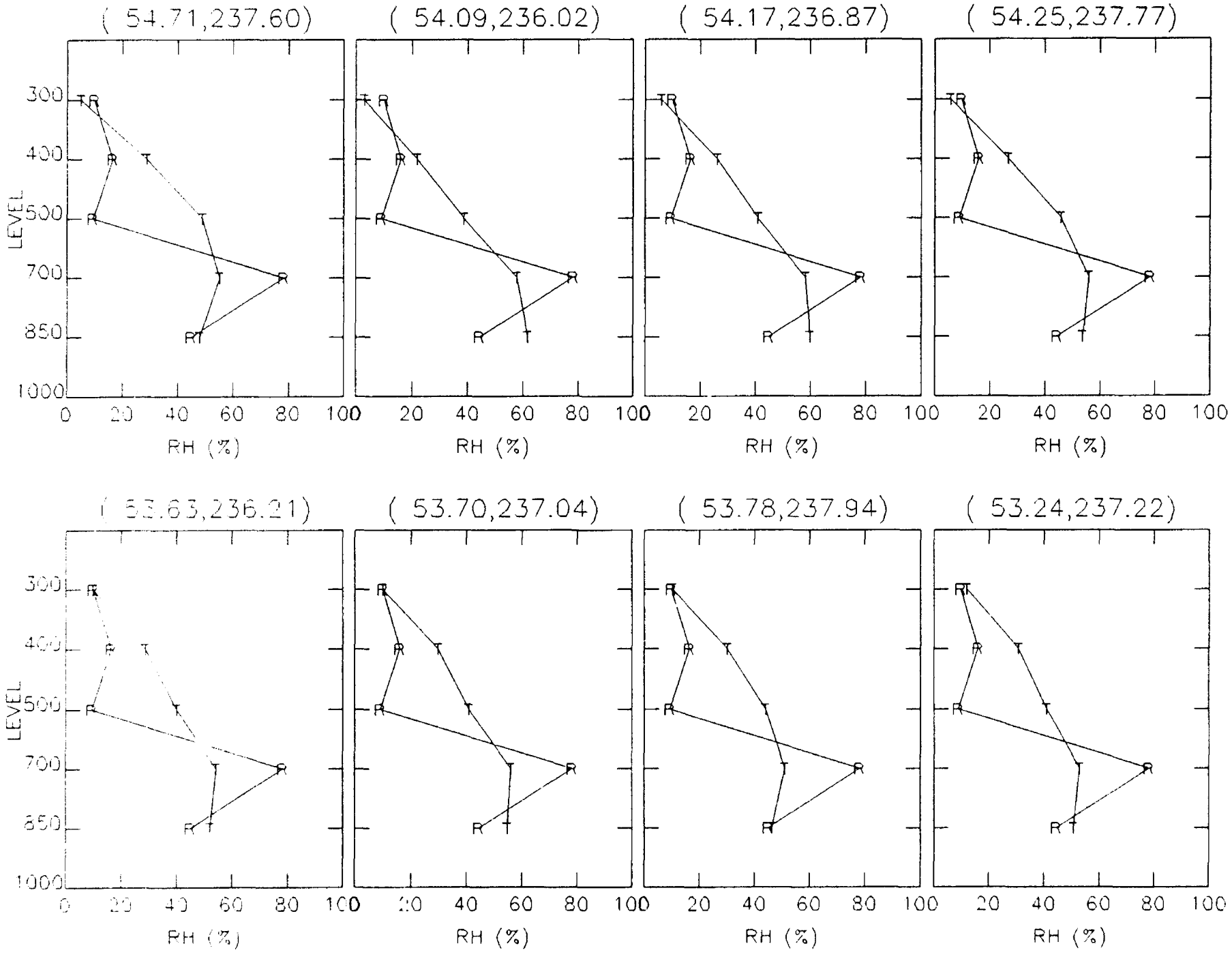

(16.51, 80.43)
(16.82, 81.44)
(64.77,231.84)
(64.87,233.07)
(64.41,233.34)
(61.25,223.48)
(61.38,224.28)
(61.51,225.08)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

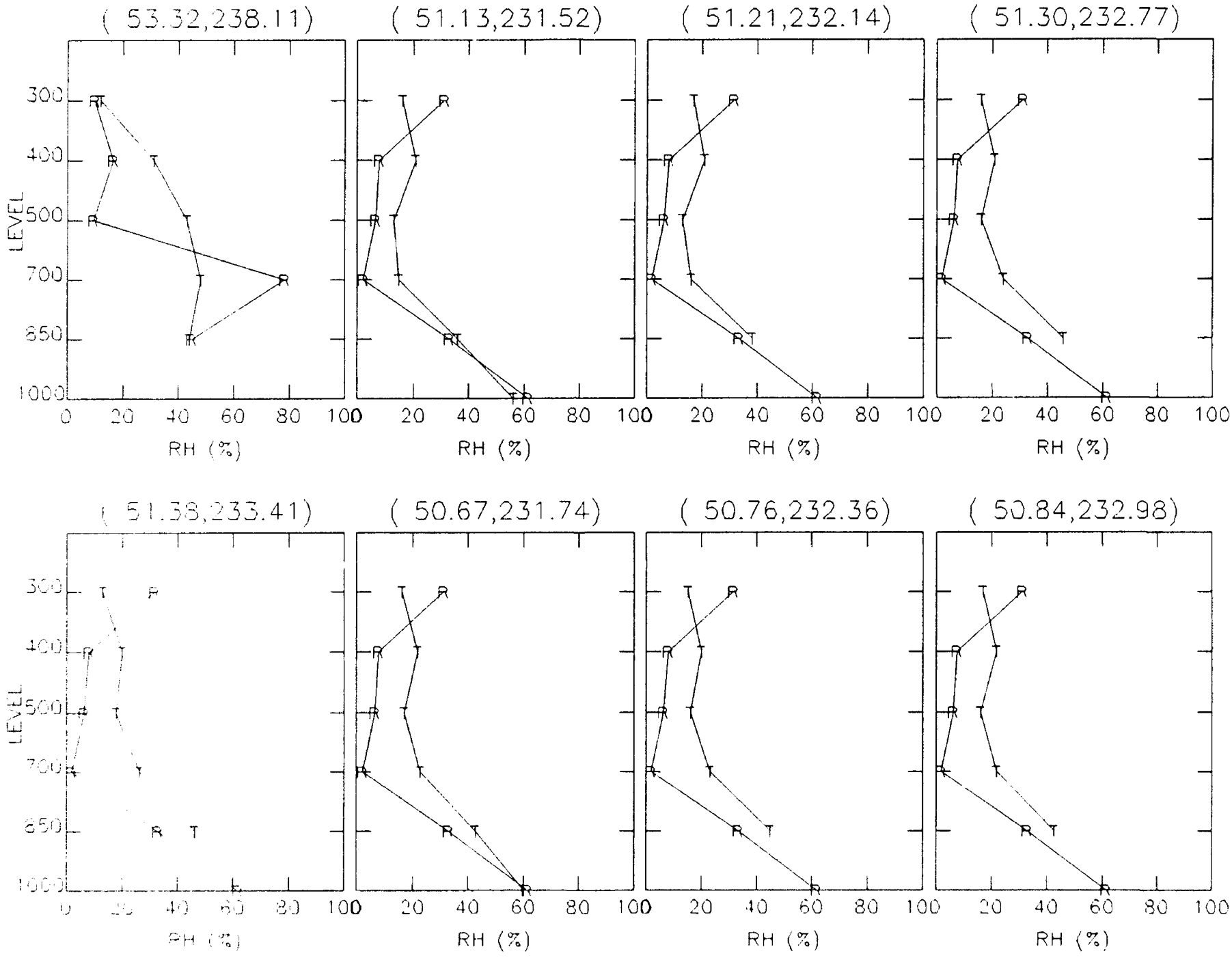

(60.81,223.86)
(60.94,224.65)
(61.06,225.44)
(61.18,226.23)
(59.41,219.19)
(59.60,220.10)
(60.24,223.43)
(60.37,224.22)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)
T
R

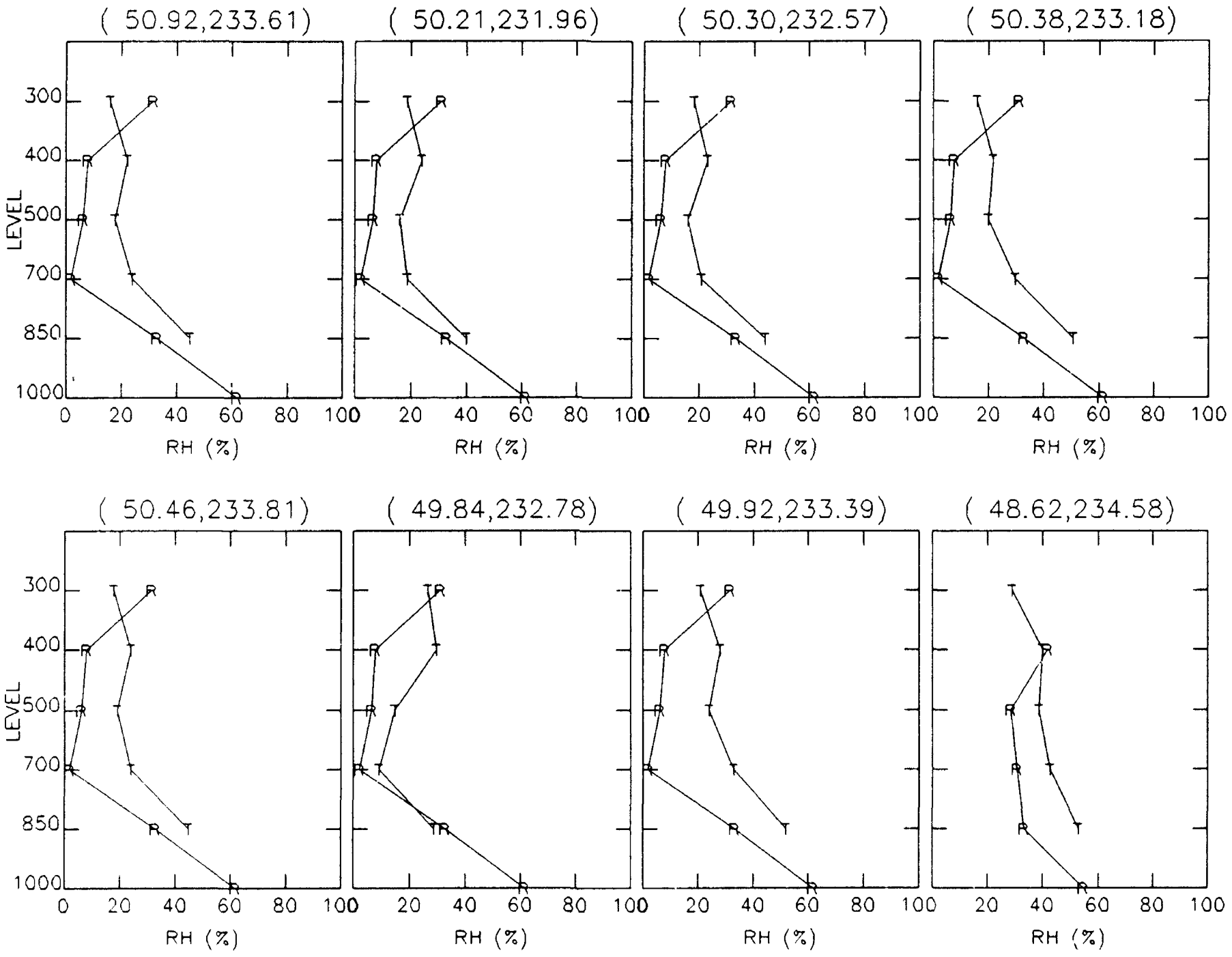

(60.50,225.00)
(60.62,225.78)
(58.98,219.60)
(59.17,220.50)
(59.34,221.36)
(59.93,224.58)
(60.05,225.35)
(60.17,226.12)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)
T
R

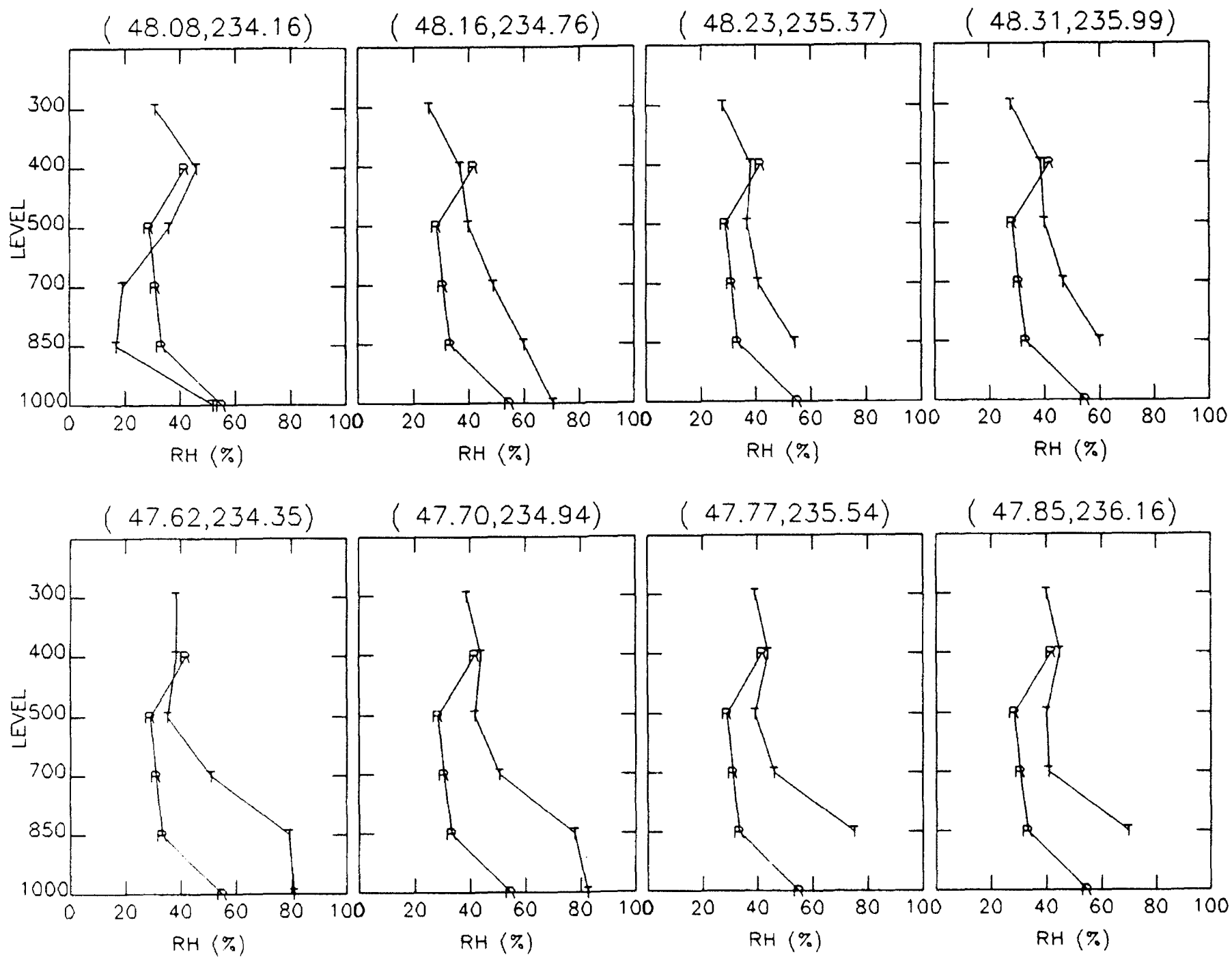

(58.74,220.89)
(58.88,235.99)
(58.42,236.18)
(55.34,227.01)
(55.46,227.71)
(55.57,228.40)
(55.67,229.09)
(54.90,227.30)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

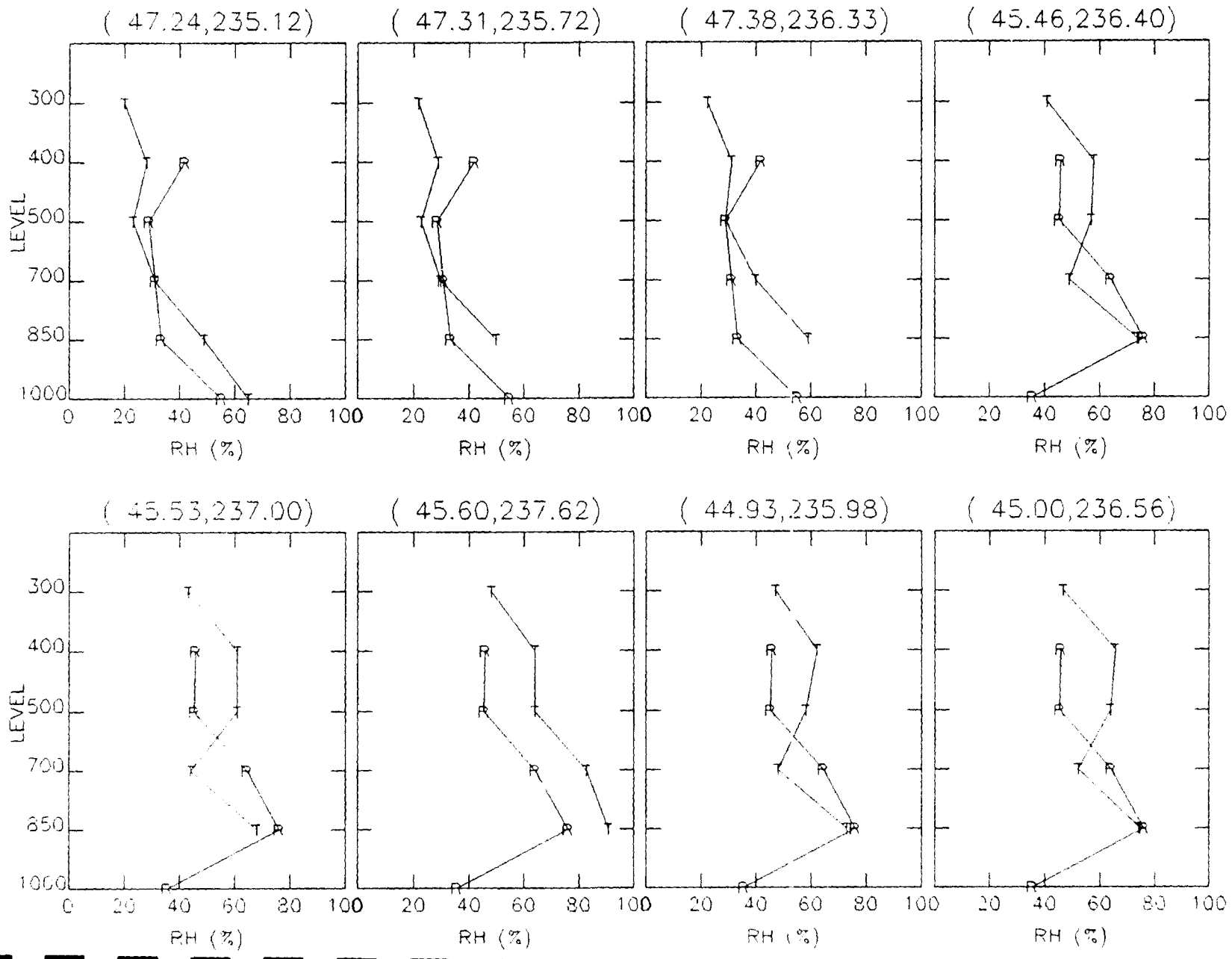

(55.01,227.99)
(55.12,228.68)
(55.22,229.36)
(54.45,227.58)
(54.56,228.26)
(54.66,228.94)
(54.77,229.62)
(54.63,236.69)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

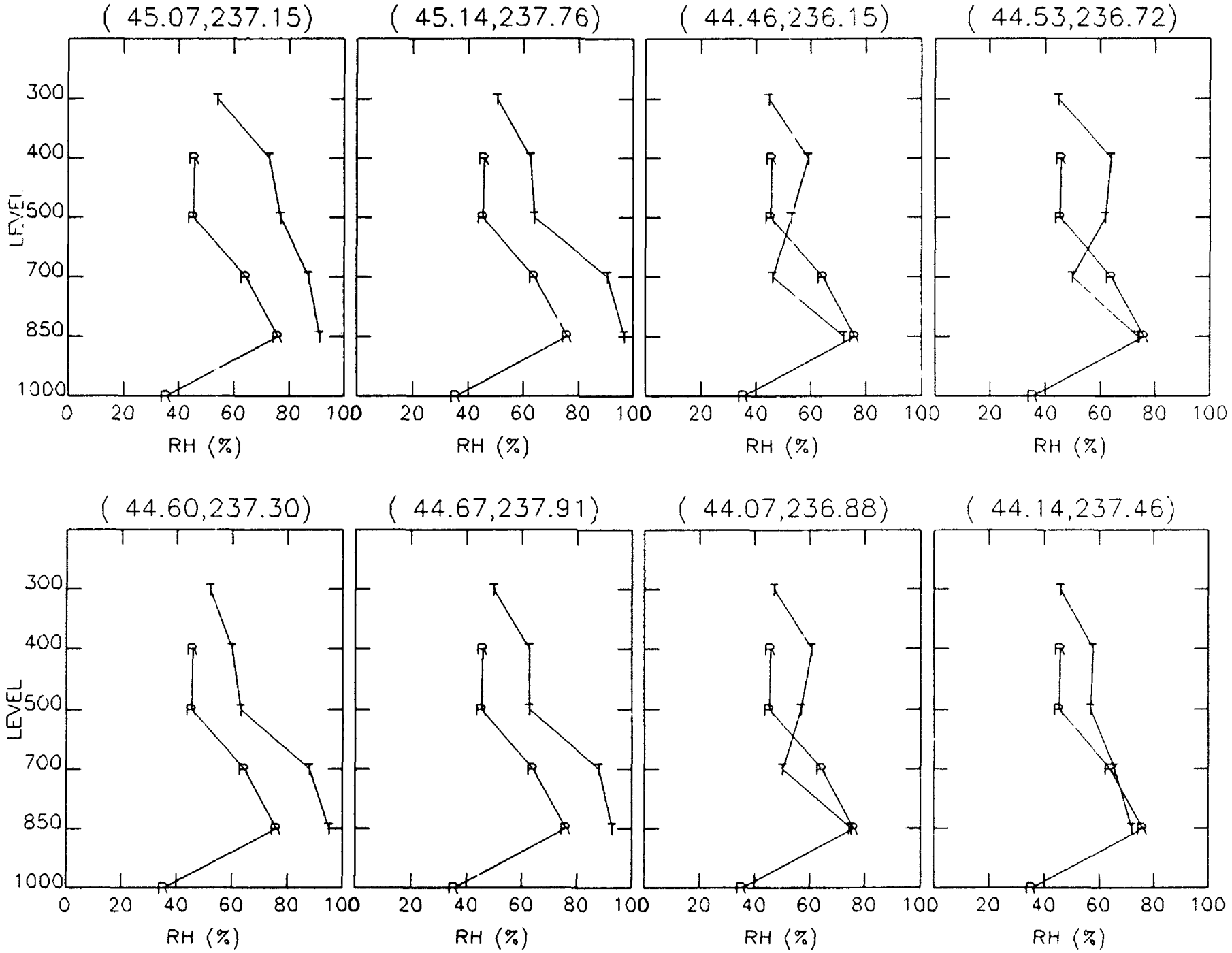

(54.71,237.60)
(54.09,236.02)
(54.17,236.87)
(54.25,237.77)
(53.63,236.21)
(53.70,237.04)
(53.78,237.94)
(53.24,237.22)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)
R
T

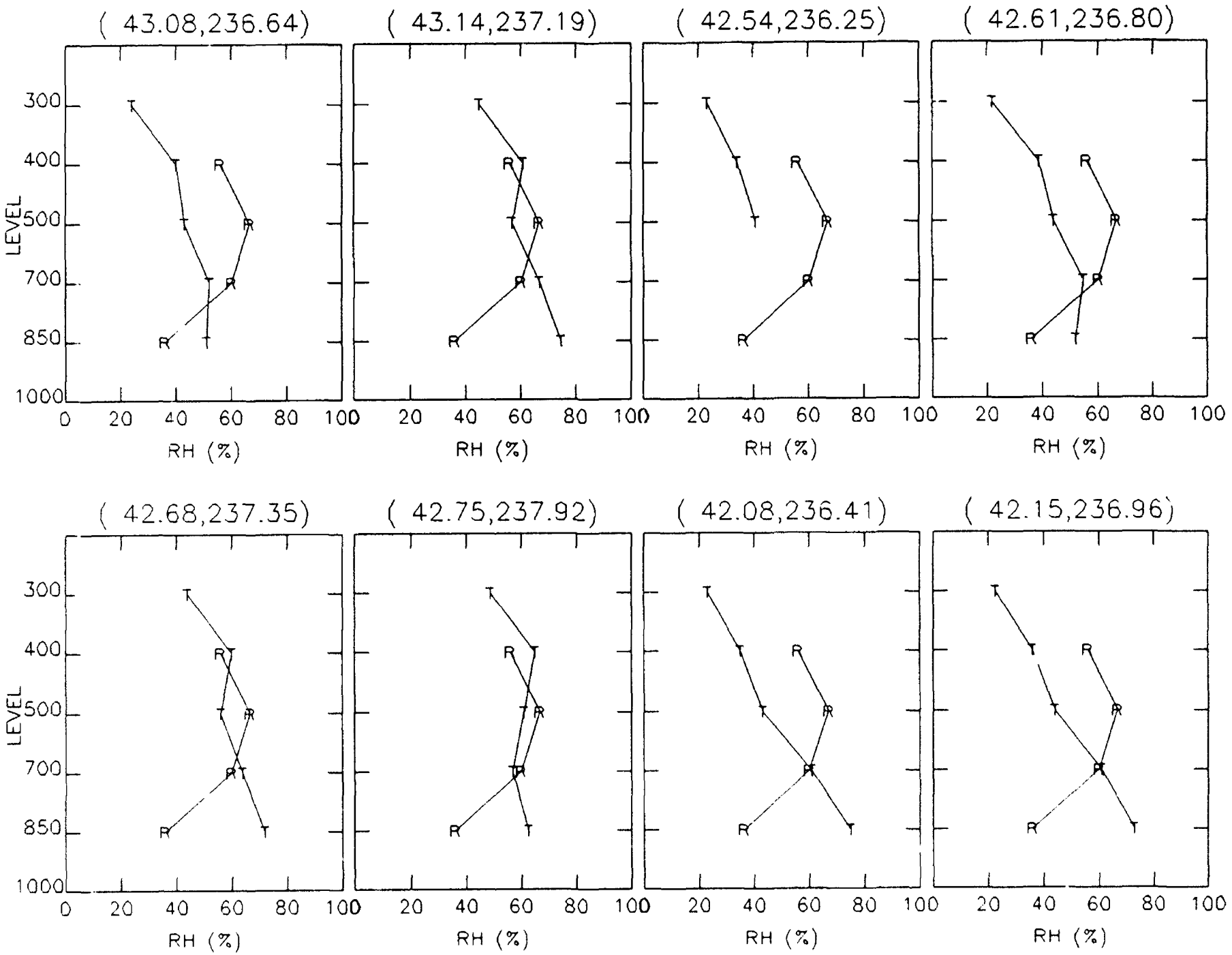

(53.32,238.11)
(51.13,231.52)
(51.21,232.14)
(51.30,232.77)
(51.38,233.41)
(50.67,231.74)
(50.76,232.36)
(50.84,232.98)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)
R
T

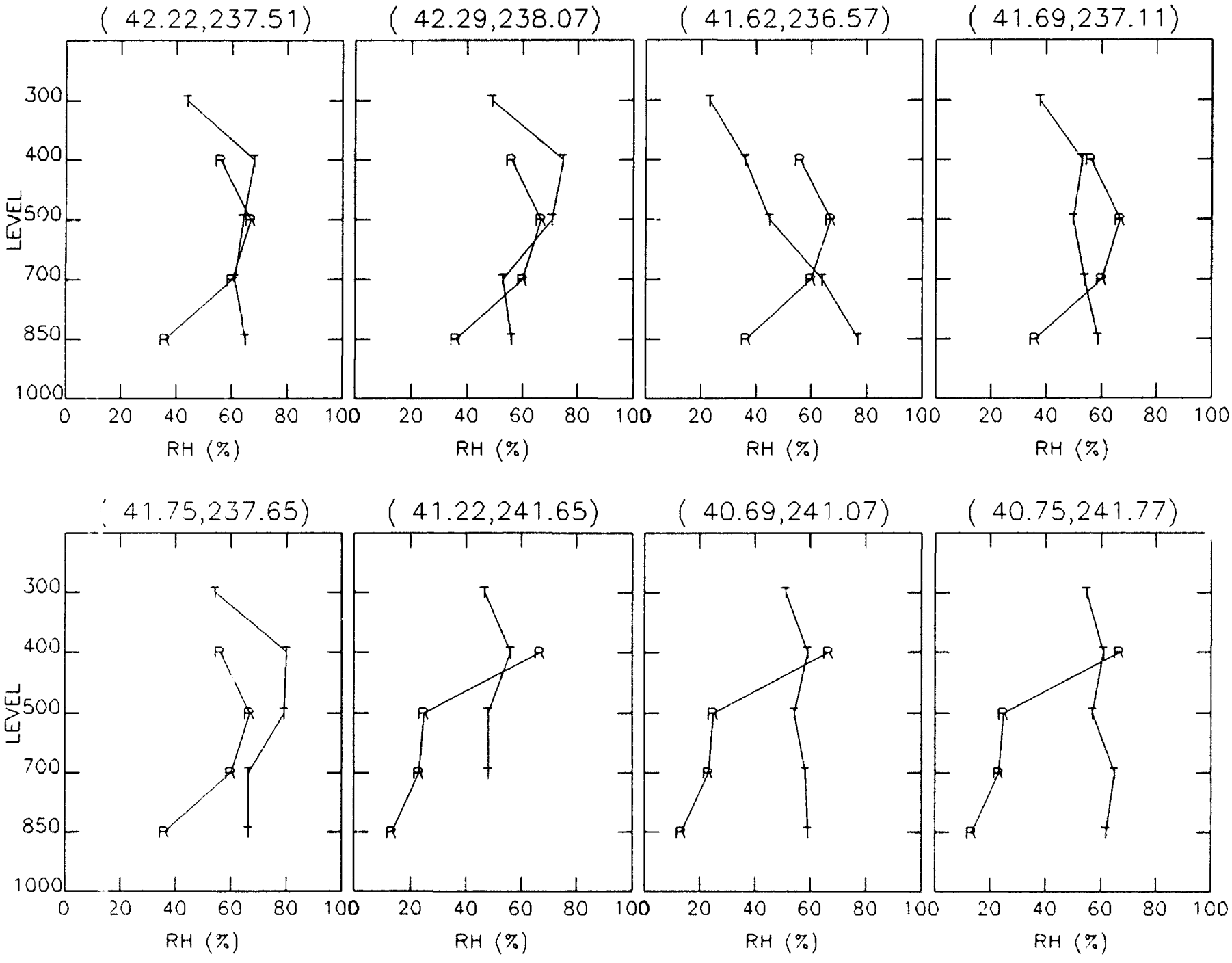

(50.92,233.61)
(50.21,231.96)
(50.30,232.57)
(50.38,233.18)
(50.46,233.81)
(49.84,232.78)
(49.92,233.39)
(48.62,234.58)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

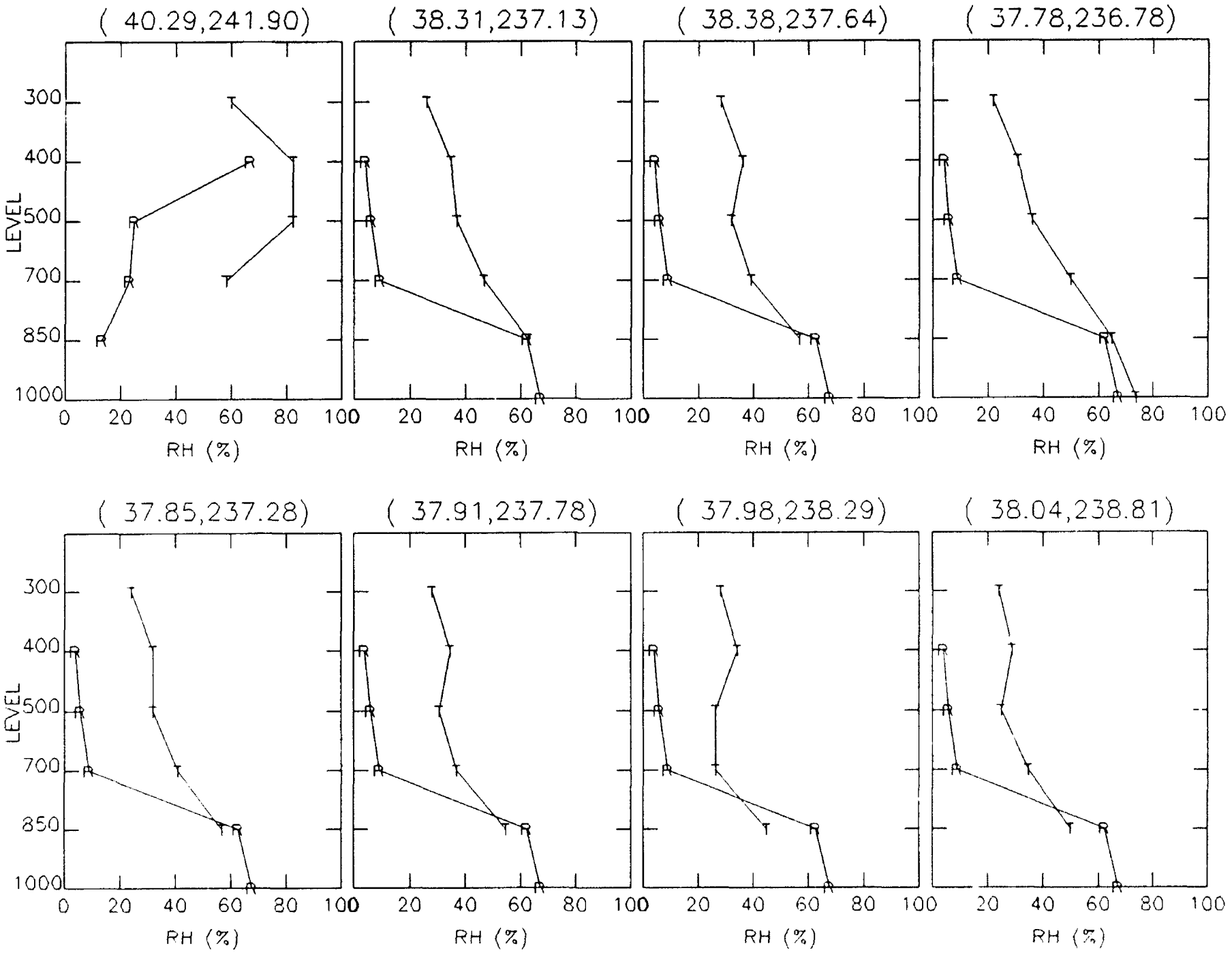

(48.08,234.16)
(48.16,234.76)
(48.23,235.37)
(48.31,235.99)
(47.62,234.35)
(47.70,234.94)
(47.77,235.54)
(47.85,236.16)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

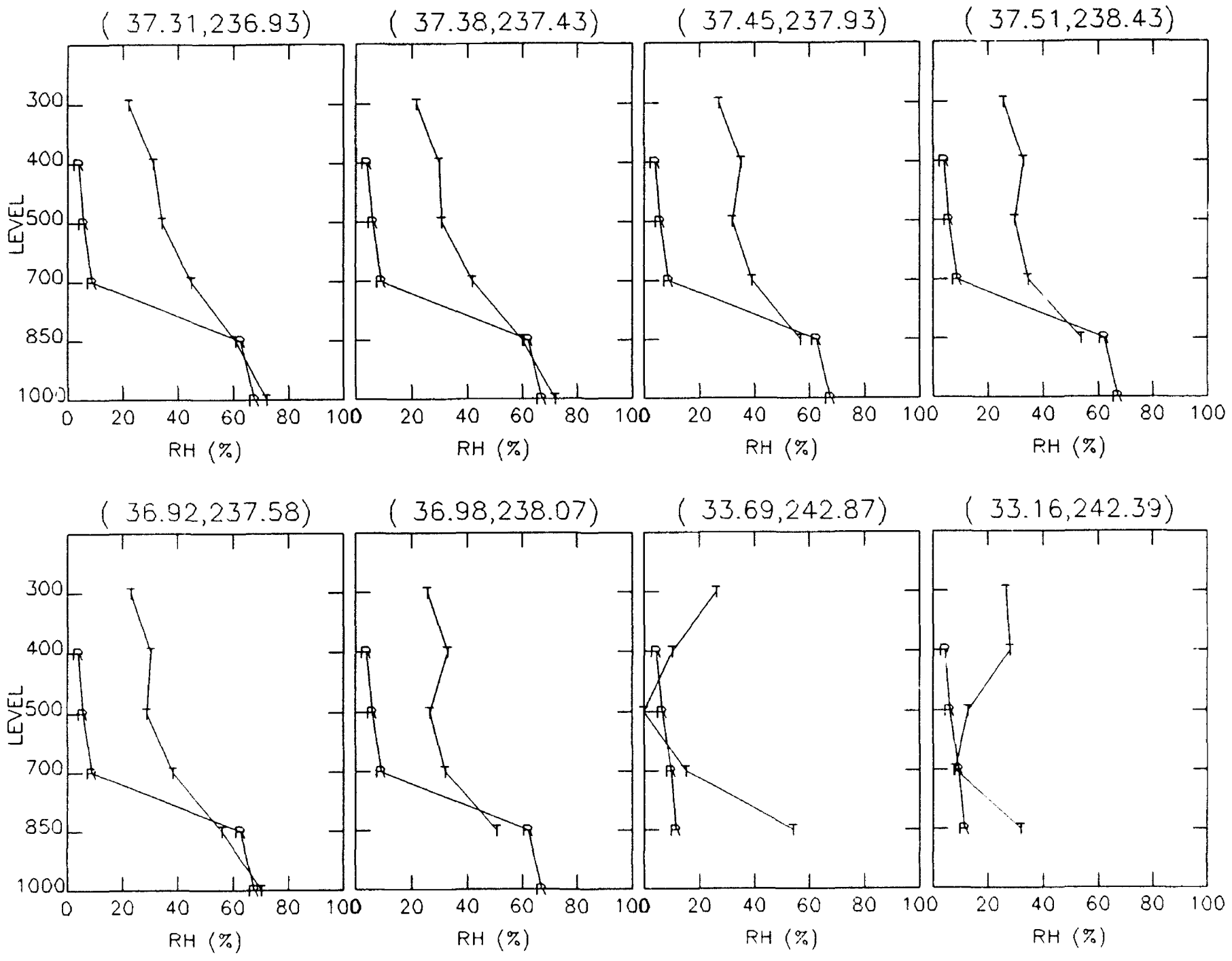

(47.24,235.12)
(47.31,235.72)
(47.38,236.33)
(45.46,236.40)
(45.53,237.00)
(45.60,237.62)
(44.93,235.98)
(45.00,236.56)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

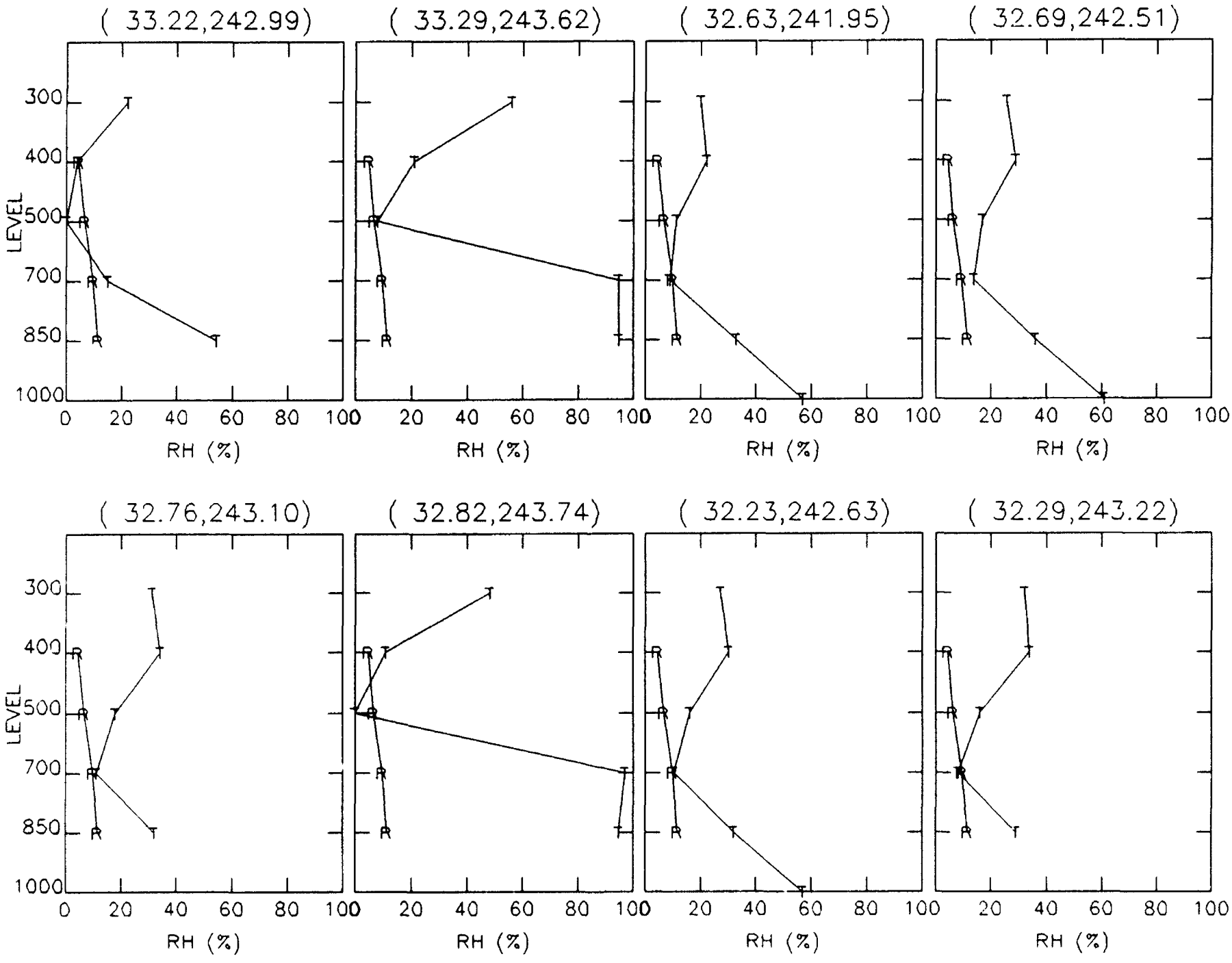

(45.07,237.15)
(45.14,237.76)
(44.46,236.15)
(44.53,236.72)
(44.60,237.30)
(44.67,237.91)
(44.07,236.88)
(44.14,237.46)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

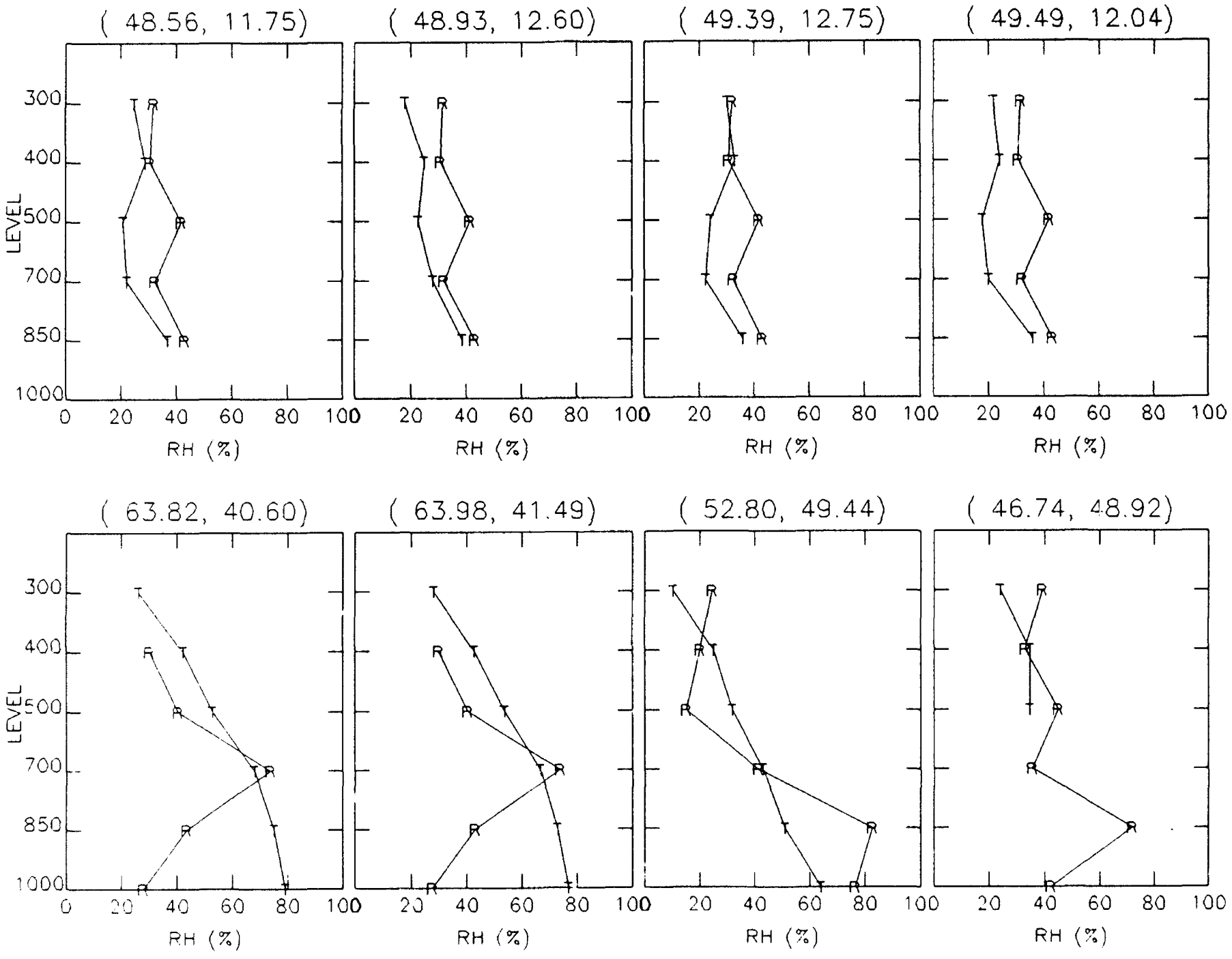

(43.08,236.64)
(43.14,237.19)
(42.54,236.25)
(42.61,236.80)
(42.68,237.35)
(42.75,237.92)
(42.08,236.41)
(42.15,236.96)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

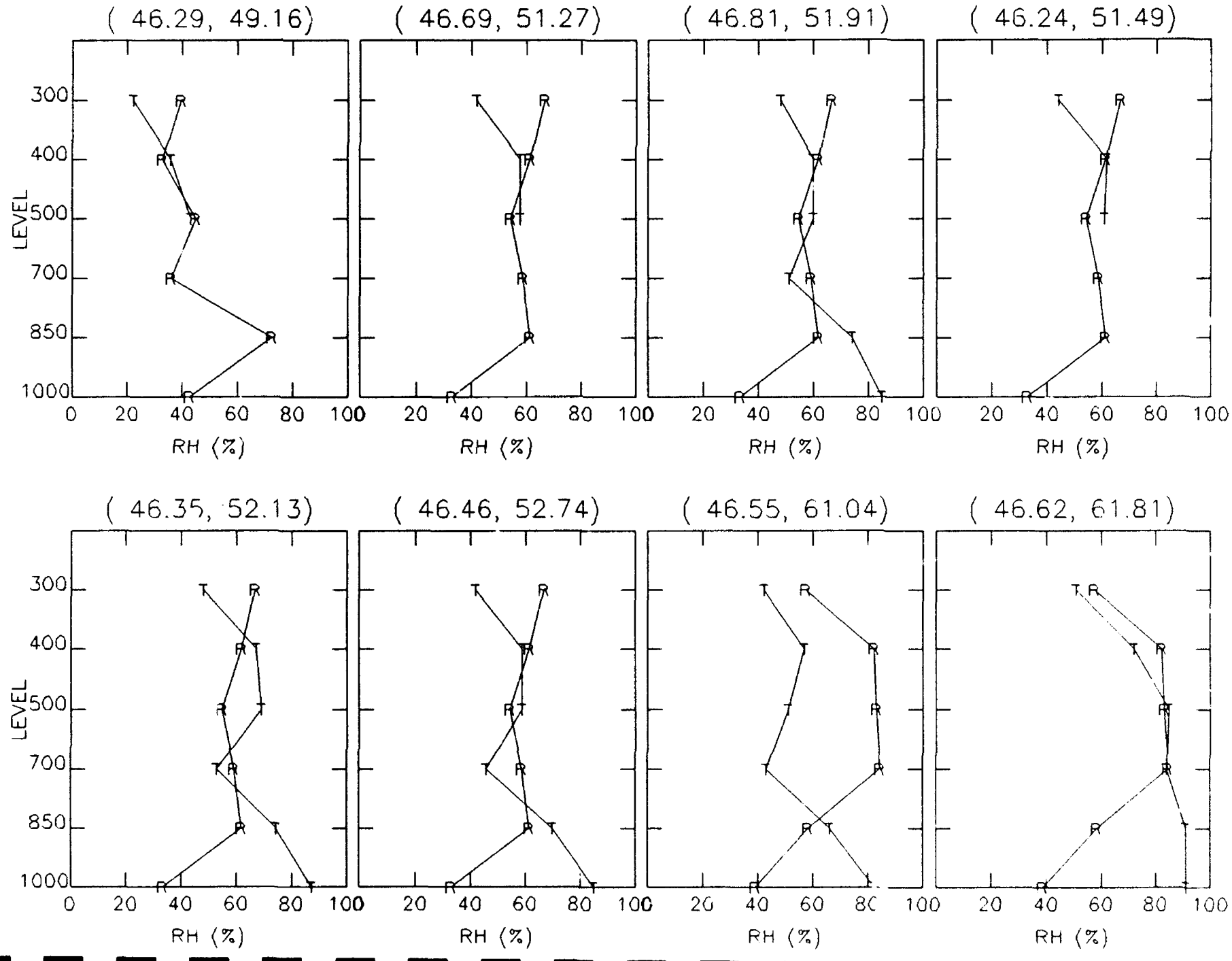

(42.22,237.51)
(42.29,238.07)
(41.62,236.57)
(41.69,237.11)
(41.75,237.65)
(41.22,241.65)
(40.69,241.07)
(40.75,241.77)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

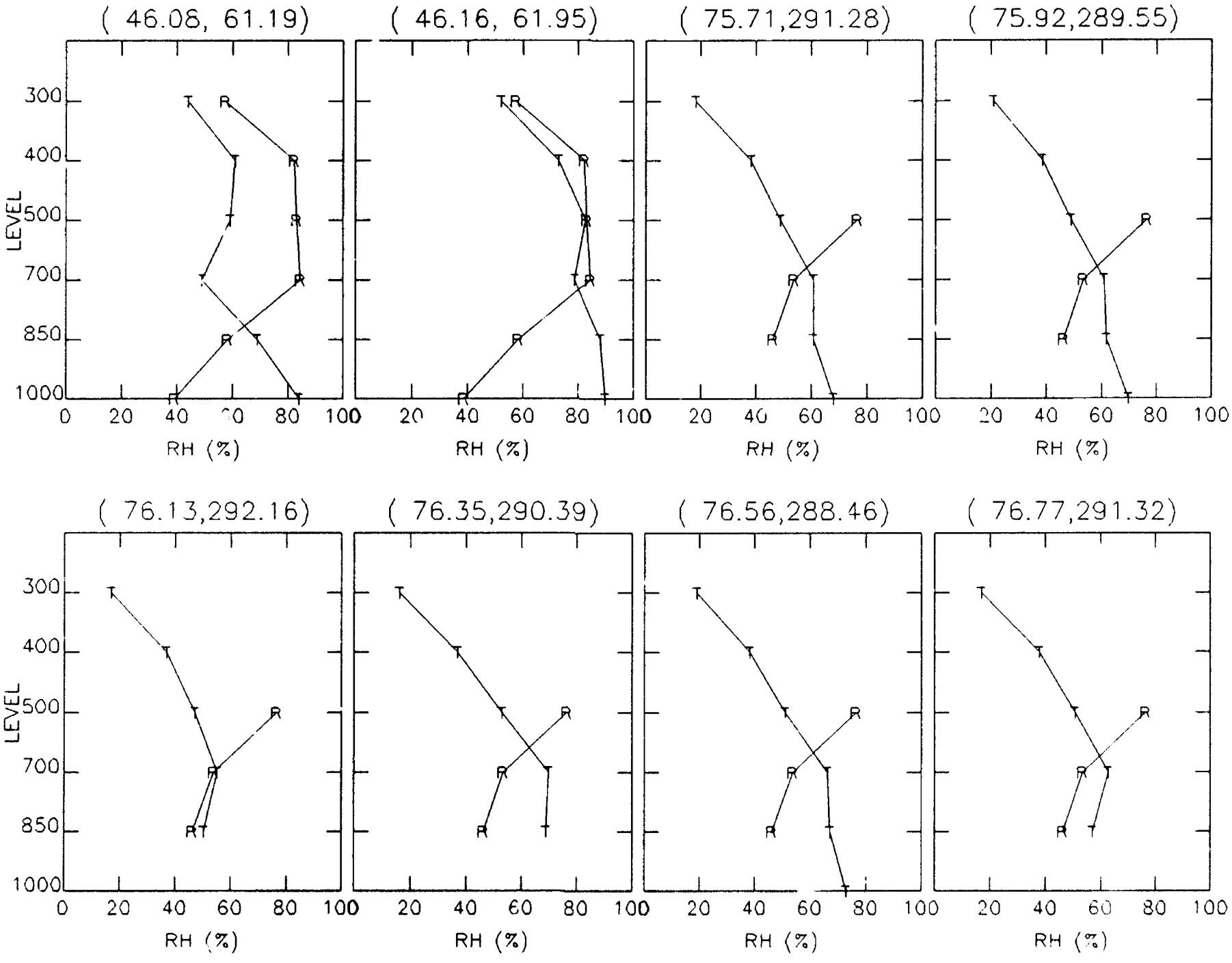

(40.29,241.90)
(38.31,237.13)
(38.38,237.64)
(37.78,236.78)
(37.85,237.28)
(37.91,237.78)
(37.98,238.29)
(38.04,238.81)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

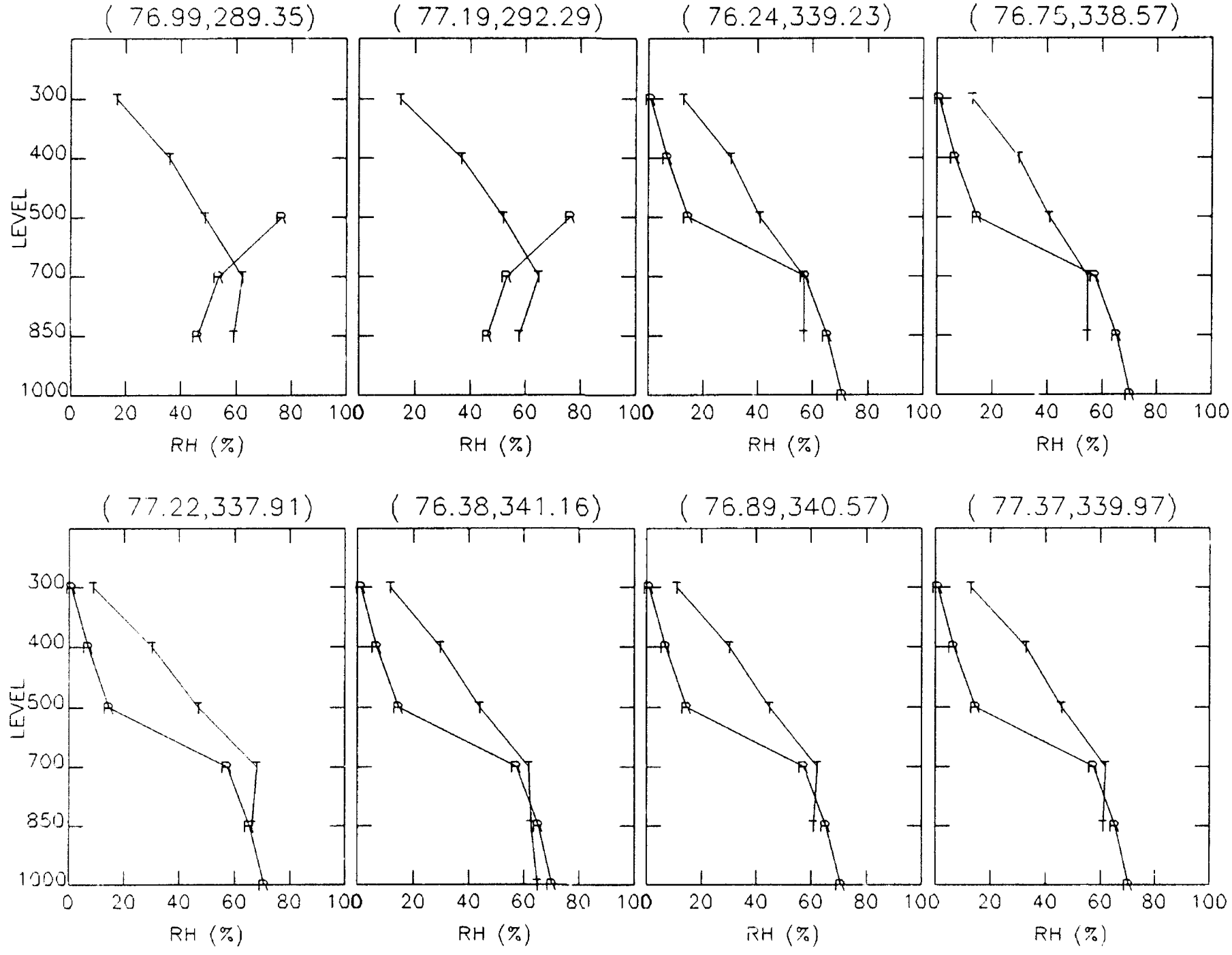

(37.31,236.93)
(37.38,237.43)
(37.45,237.93)
(37.51,238.43)
(36.92,237.58)
(36.98,238.07)
(33.69,242.87)
(33.16,242.39)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

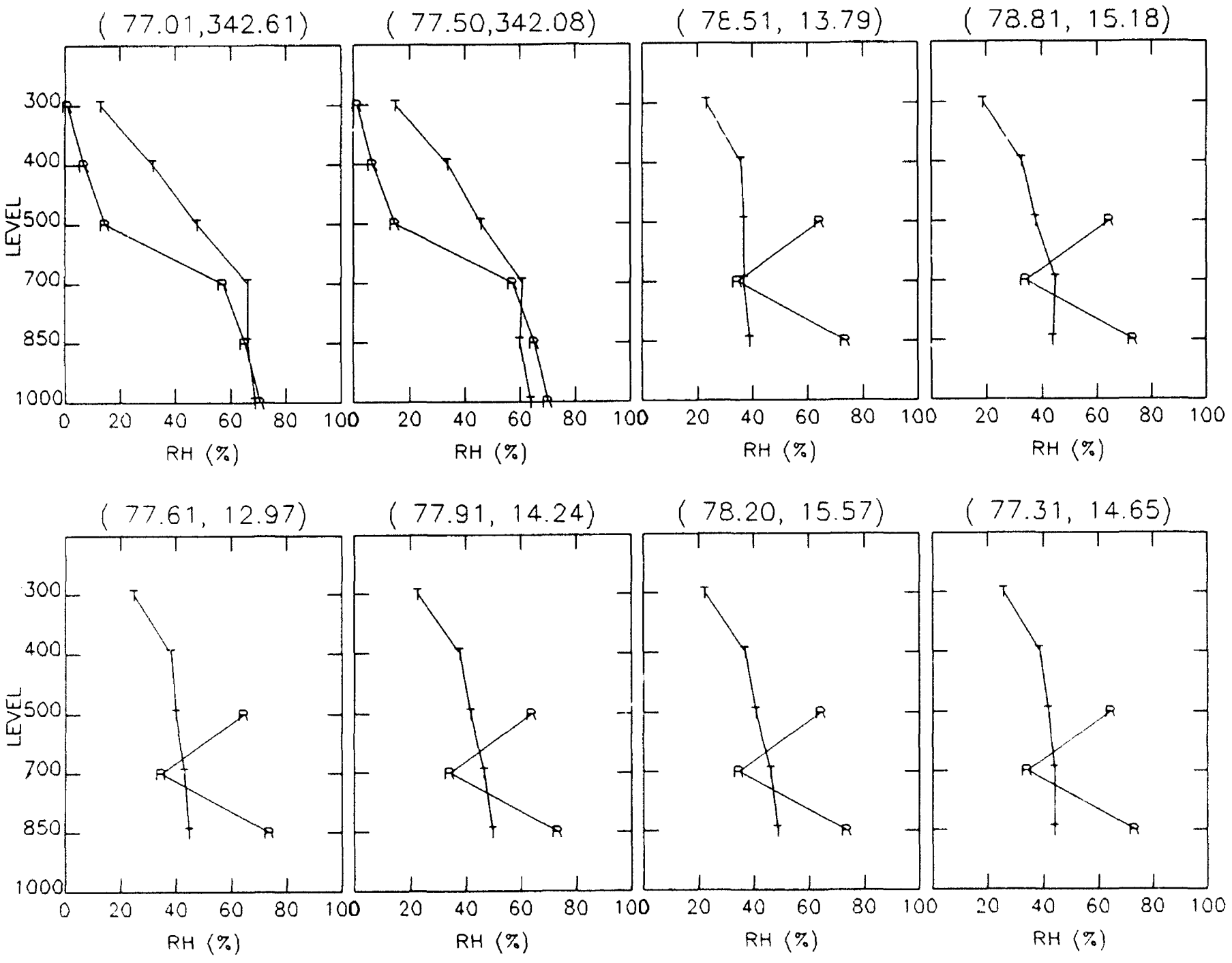

(33.22,242.99)
(33.29,243.62)
(32.63,241.95)
(32.69,242.51)
(32.76,243.10)
(32.82,243.74)
(32.23,242.63)
(32.29,243.22)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

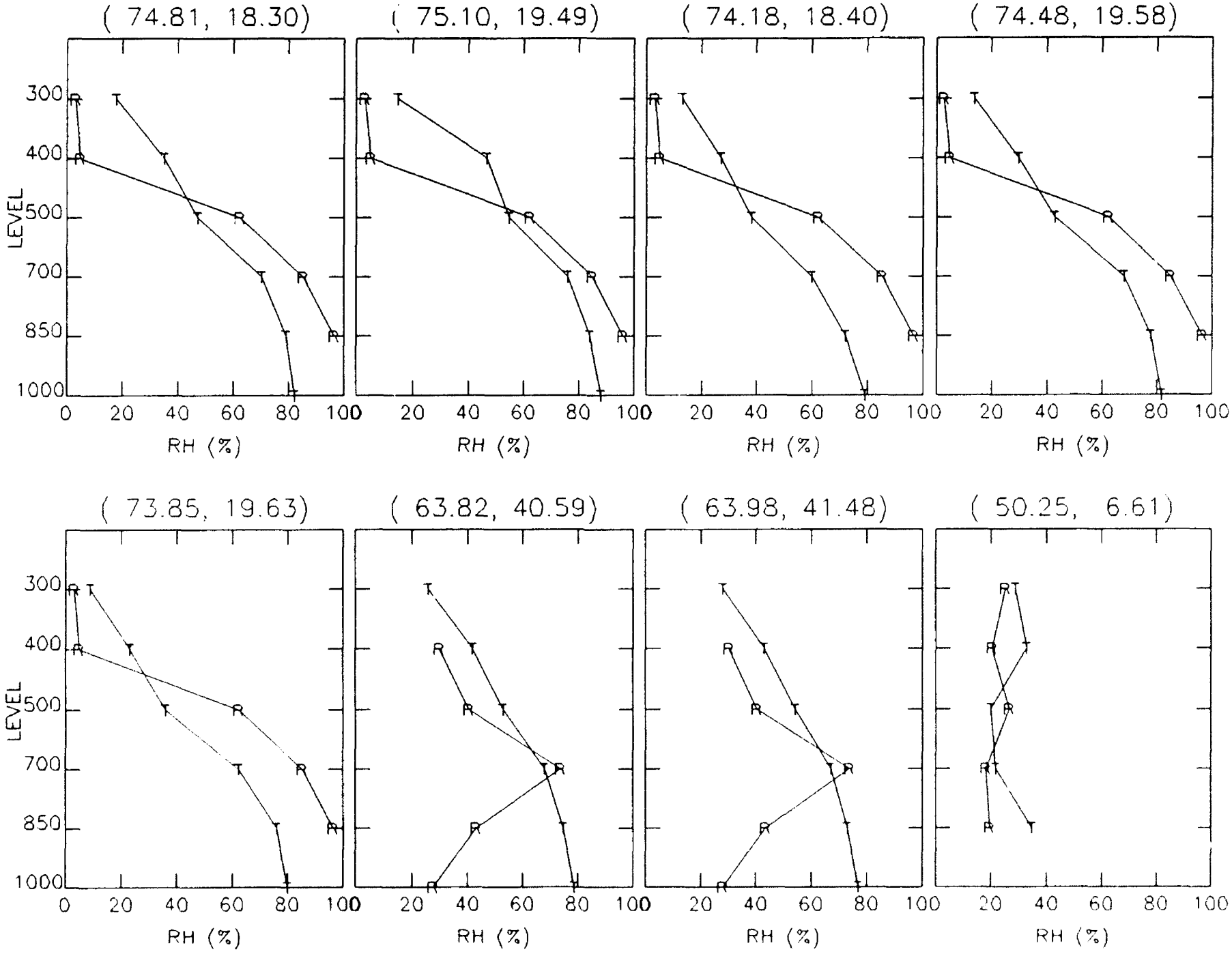

(48.56, 11.75)
(48.93, 12.60)
(49.39, 12.75)
(49.49, 12.04)
(63.82, 40.60)
(63.98, 41.49)
(52.80, 49.44)
(46.74, 48.92)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

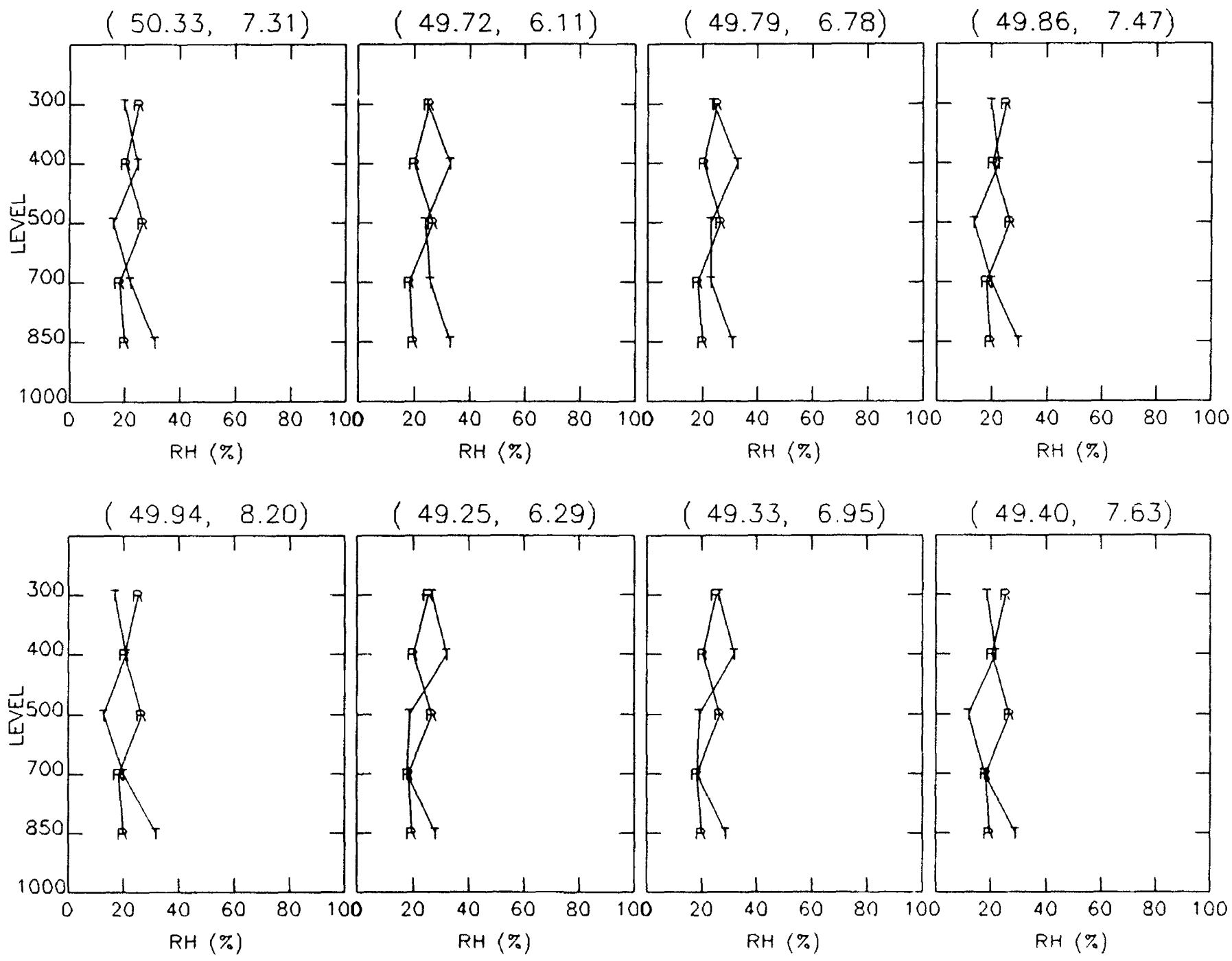

(46.29, 49.16)
(46.69, 51.27)
(46.81, 51.91)
(46.24, 51.49)
(46.35, 52.13)
(46.46, 52.74)
(46.55, 61.04)
(46.62, 61.81)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

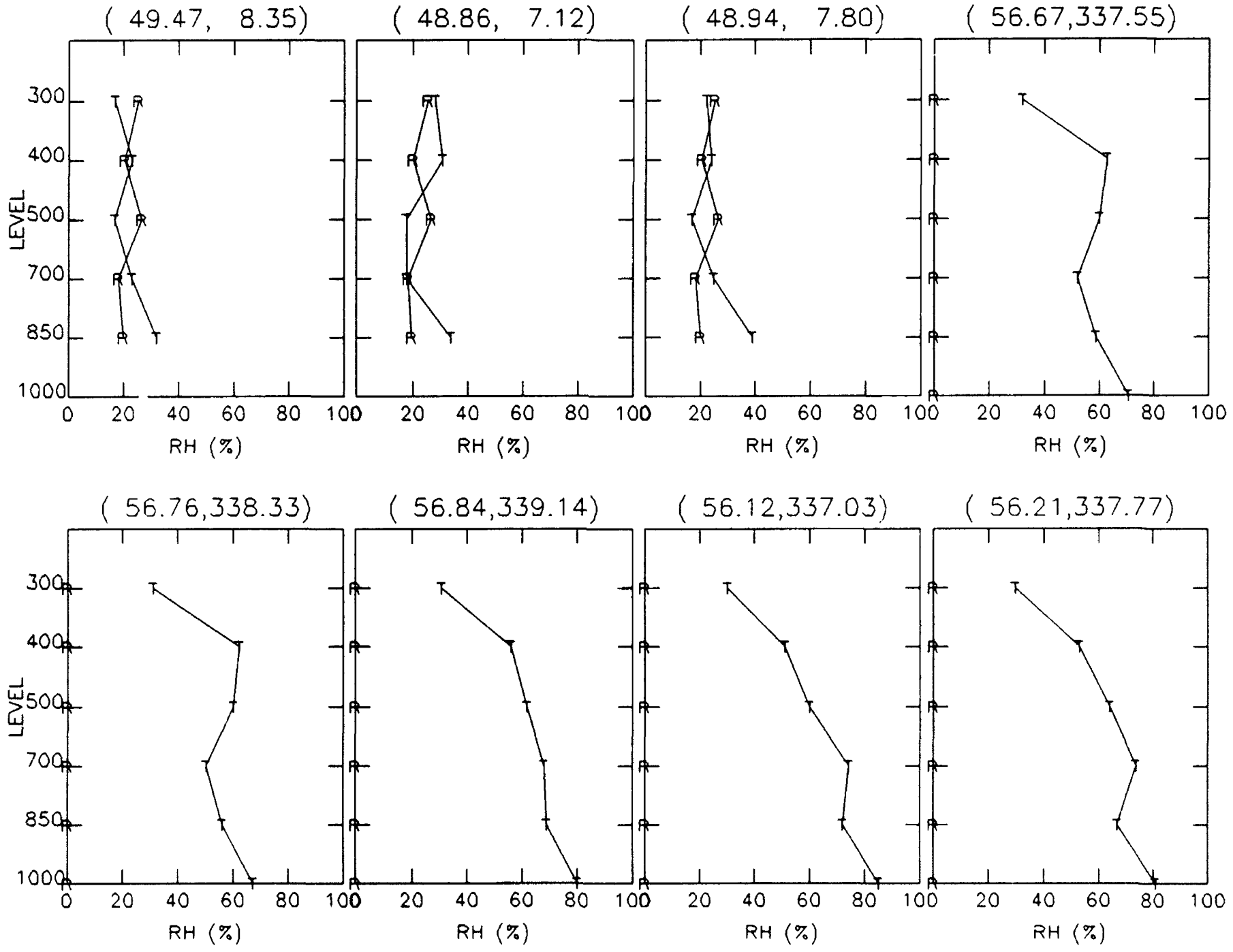

(46.08, 61.19)
(46.16, 61.95)
(75.71,291.28)
(75.92,289.55)
(76.13,292.16)
(76.35,290.39)
(76.56,288.46)
(76.77,291.32)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

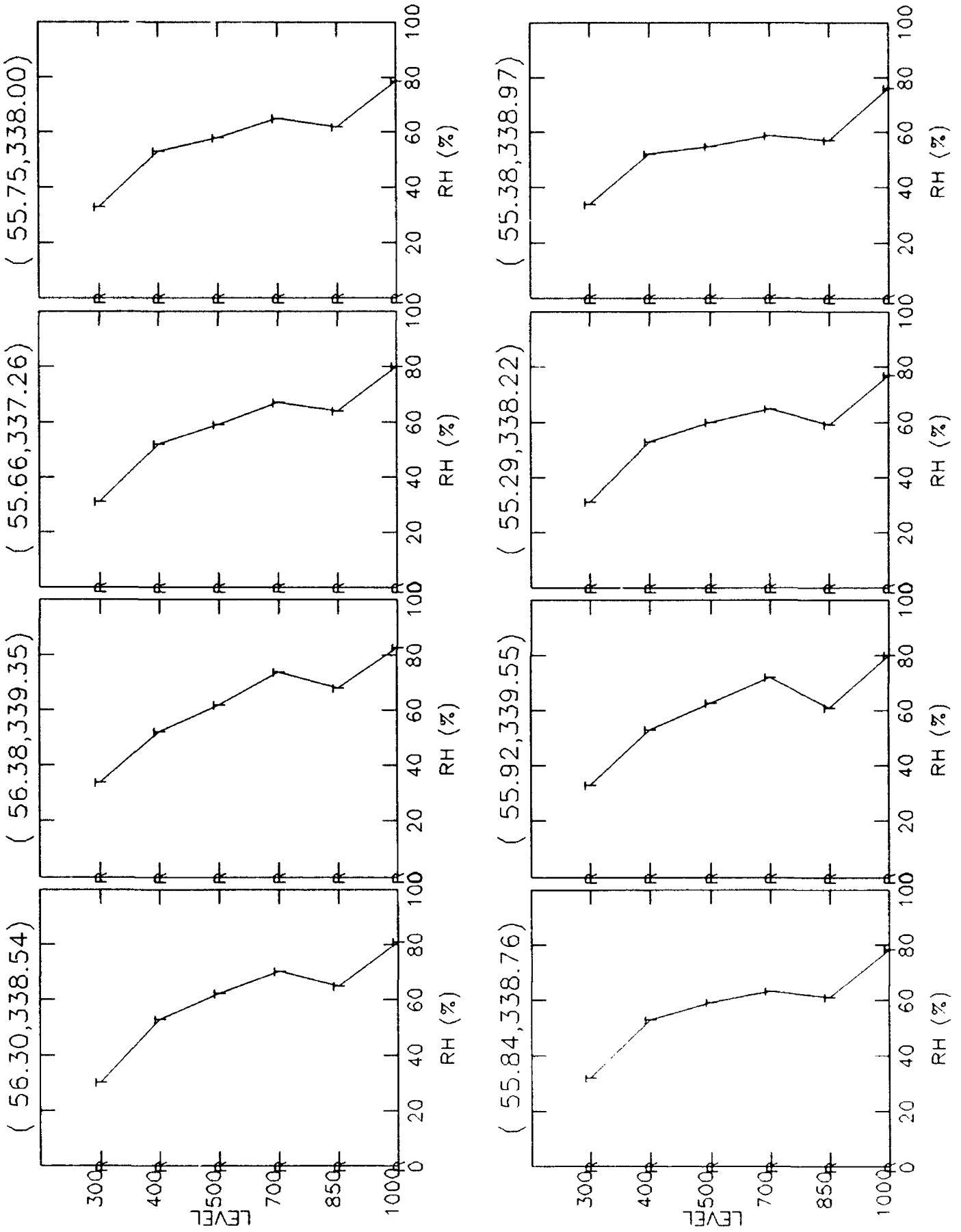

(76.99,289.35)
(77.19,292.29)
(76.24,339.23)
(76.75,338.57)
(77.22,337.91)
(76.38,341.16)
(76.89,340.57)
(77.37,339.97)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

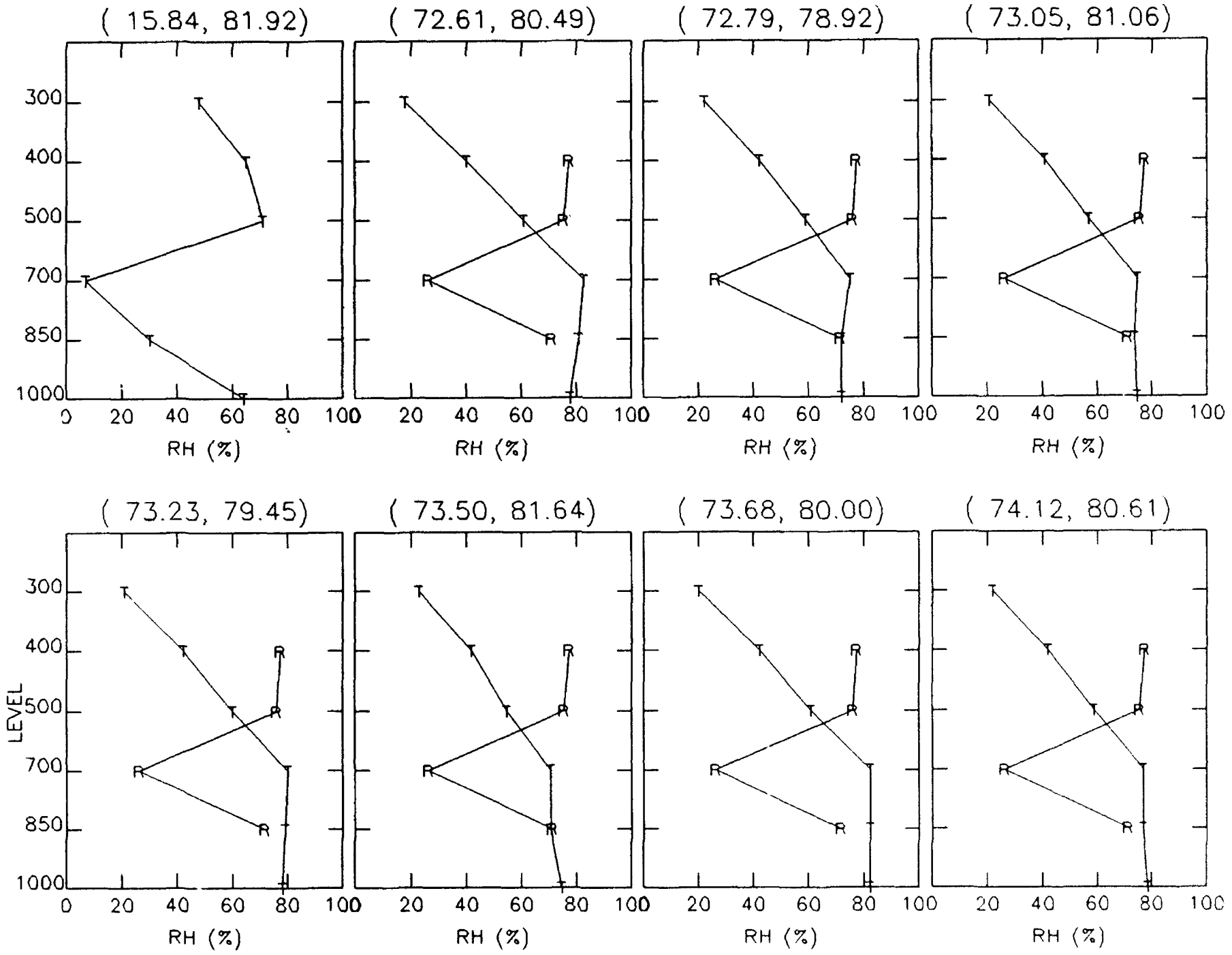

(77.01,342.61)
(77.50,342.08)
(78.51, 13.79)
(78.81, 15.18)
(77.61, 12.97)
(77.91, 14.24)
(78.20, 15.57)
(77.31, 14.65)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

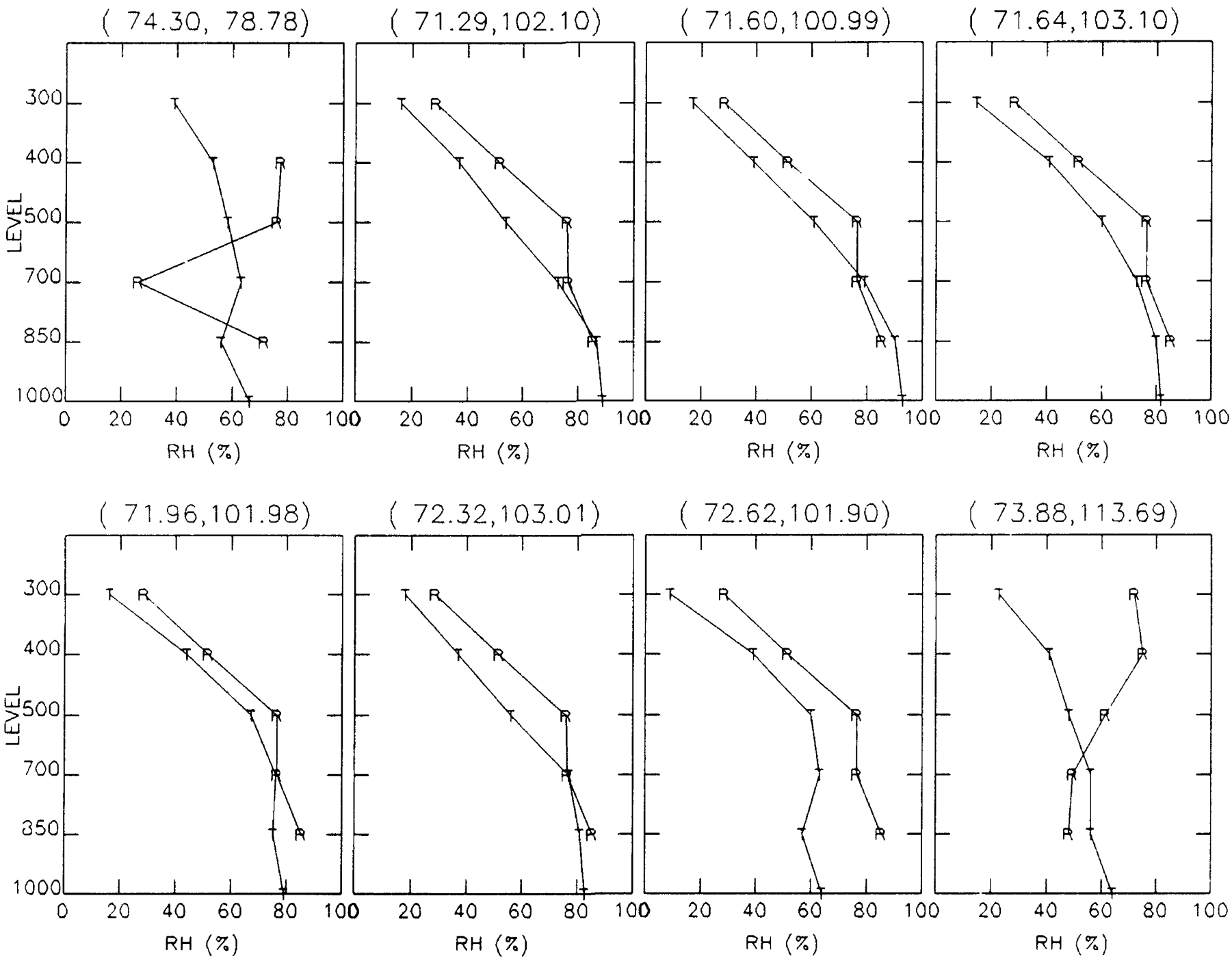

(74.81, 18.30)
(75.10, 19.49)
(74.18, 18.40)
(74.48, 19.58)
(73.85, 19.63)
(63.82, 40.59)
(63.98, 41.48)
(50.25, 6.61)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

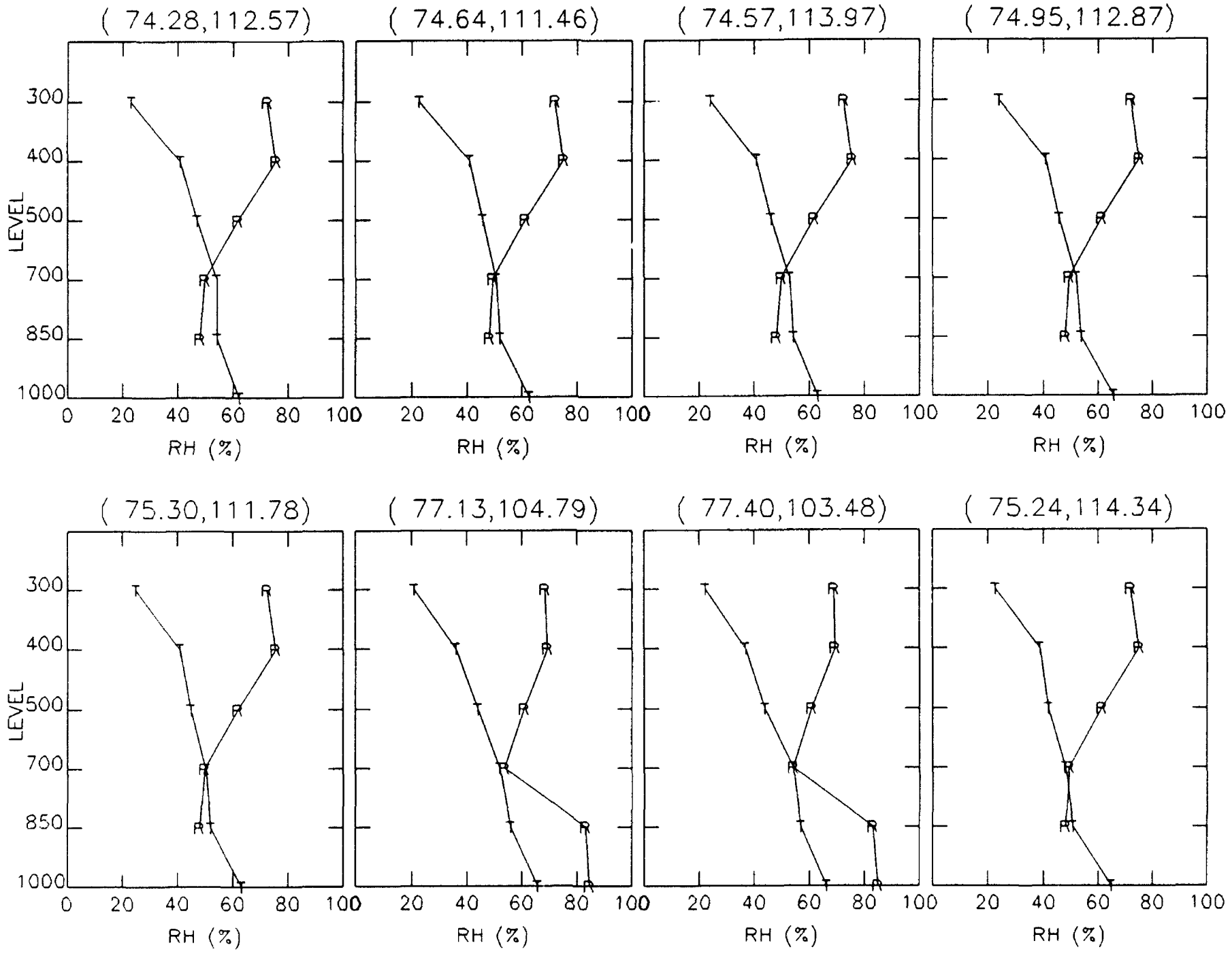

(50.33, 7.31)
(49.72, 6.11)
(49.79, 6.78)
(49.86, 7.47)
(49.94, 8.20)
(49.25, 6.29)
(49.33, 6.95)
(49.40, 7.63)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

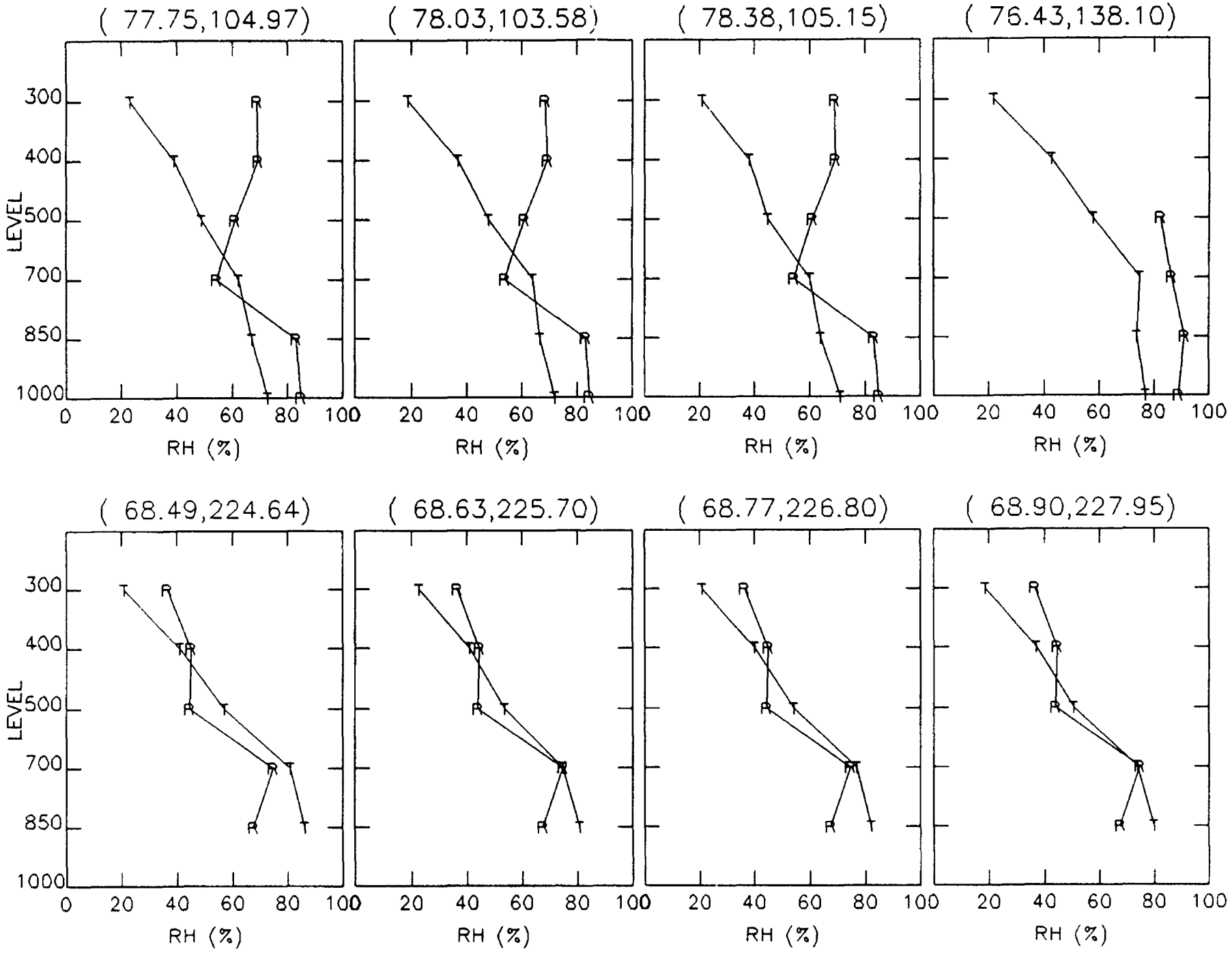

(49.47, 8.35)
(48.86, 7.12)
(48.94, 7.80)
(56.67,337.55)
(56.76,338.33)
(56.84,339.14)
(56.12,337.03)
(56.21,337.77)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

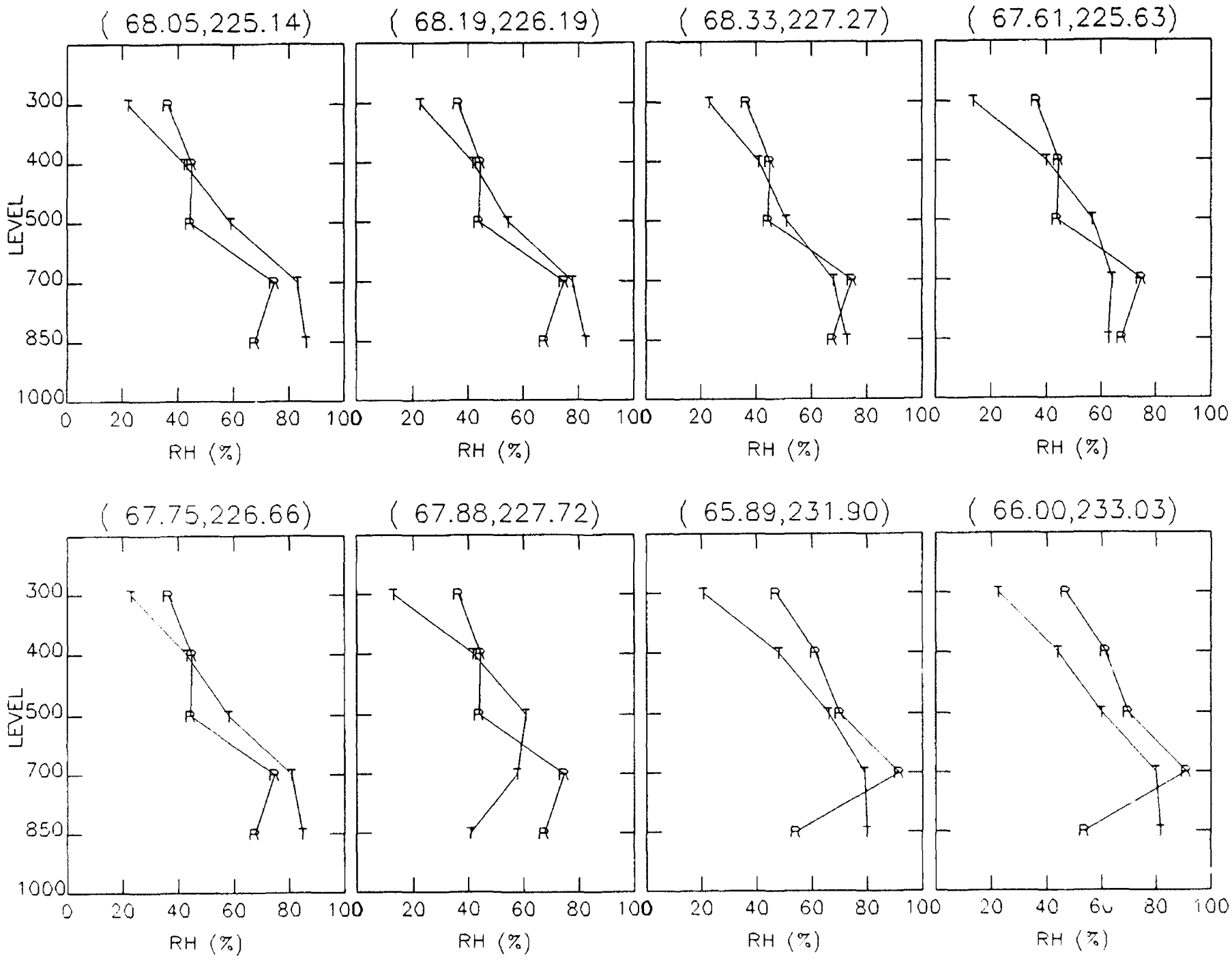

(56.30,338.54)
(56.38,339.35)
(55.66,337.26)
(55.75,338.00)
(55.84,338.76)
(55.92,339.55)
(55.29,338.22)
(55.38,338.97)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

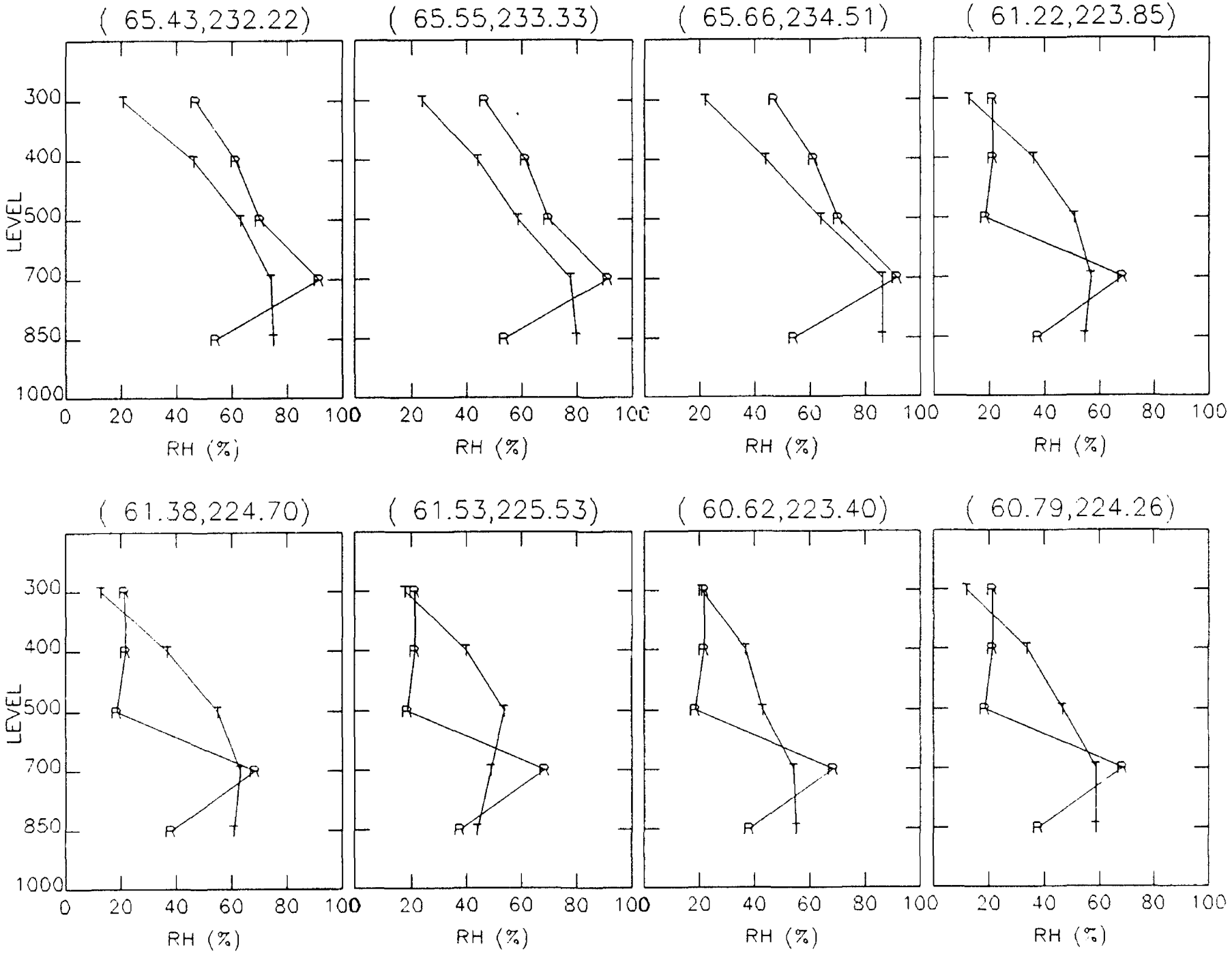

(15.84, 81.92)
(72.61, 80.49)
(72.79, 78.92)
(73.05, 81.06)
(73.23, 79.45)
(73.50, 81.64)
(73.68, 80.00)
(74.12, 80.61)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

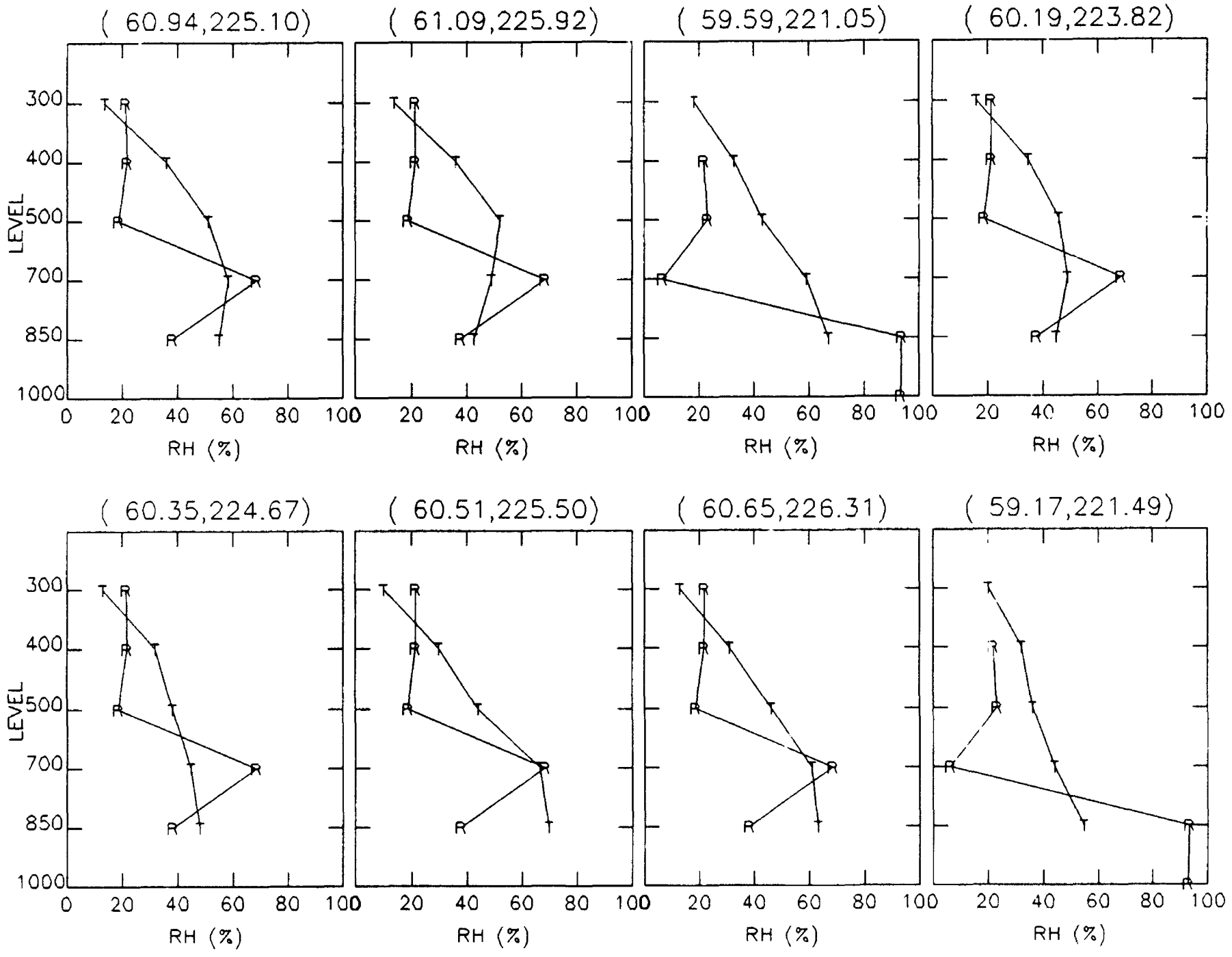

(74.30, 78.78)
(71.29,102.10)
(71.60,100.99)
(71.64,103.10)
(71.96,101.98)
(72.32,103.01)
(72.62,101.90)
(73.88,113.69)
LEVEL
300
400
500
700
850
1000
350
0
20
40
60
80
100
RH (%)

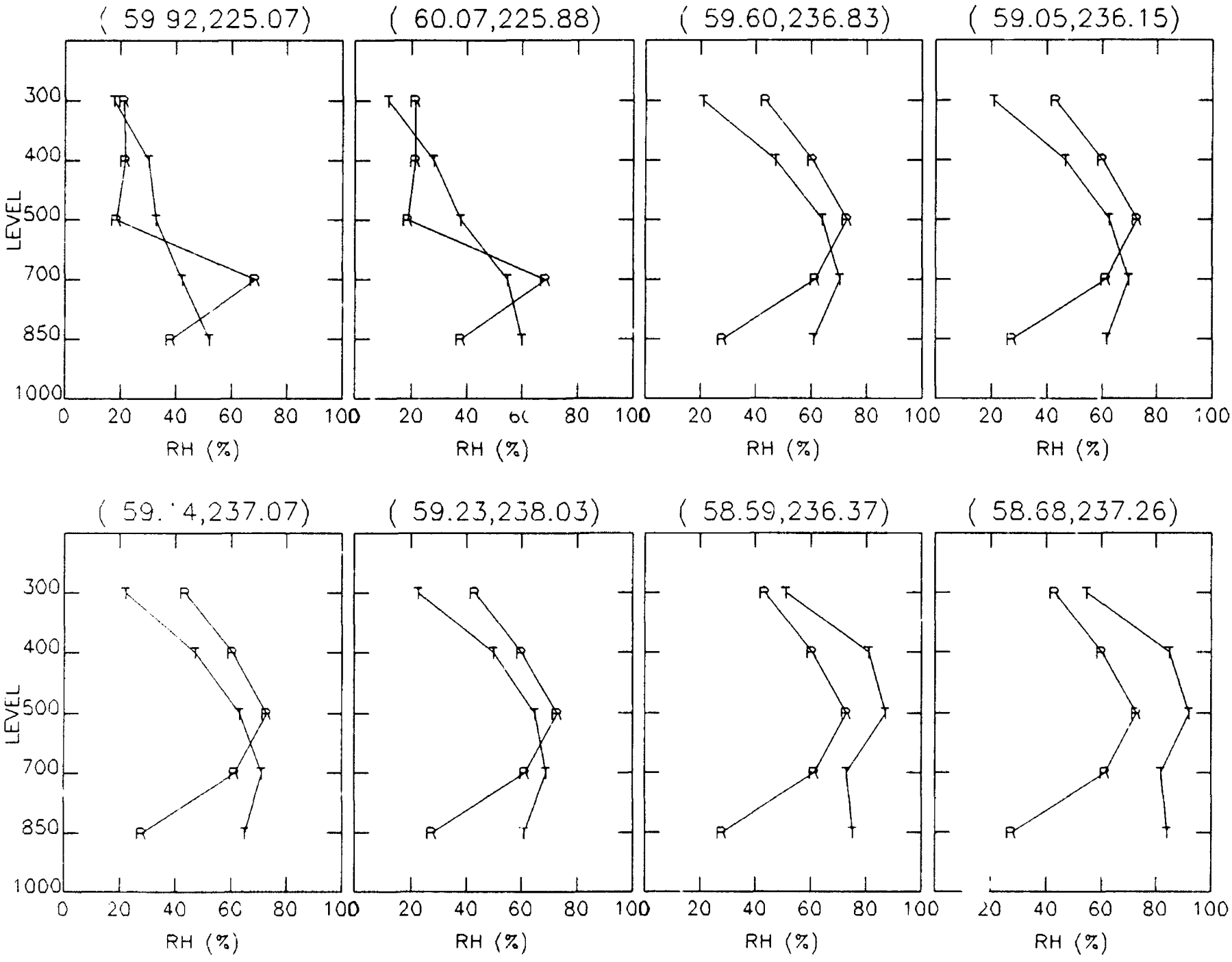

(74.28,112.57)
(74.64,111.46)
(74.57,113.97)
(74.95,112.87)
(75.30,111.78)
(77.13,104.79)
(77.40,103.48)
(75.24,114.34)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

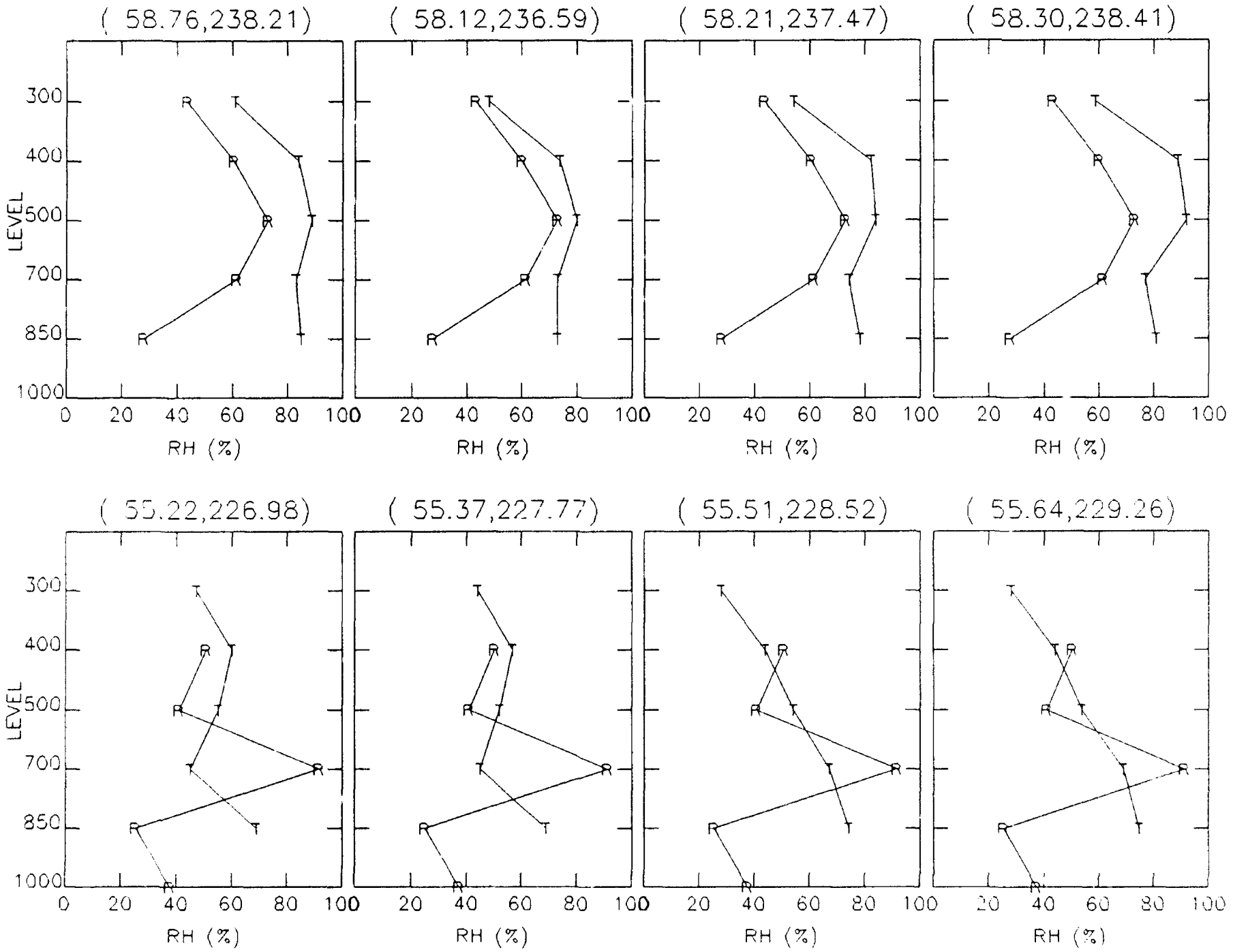

(77.75,104.97)
(78.03,103.58)
(78.38,105.15)
(76.43,138.10)
(68.49,224.64)
(68.63,225.70)
(68.77,226.80)
(68.90,227.95)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

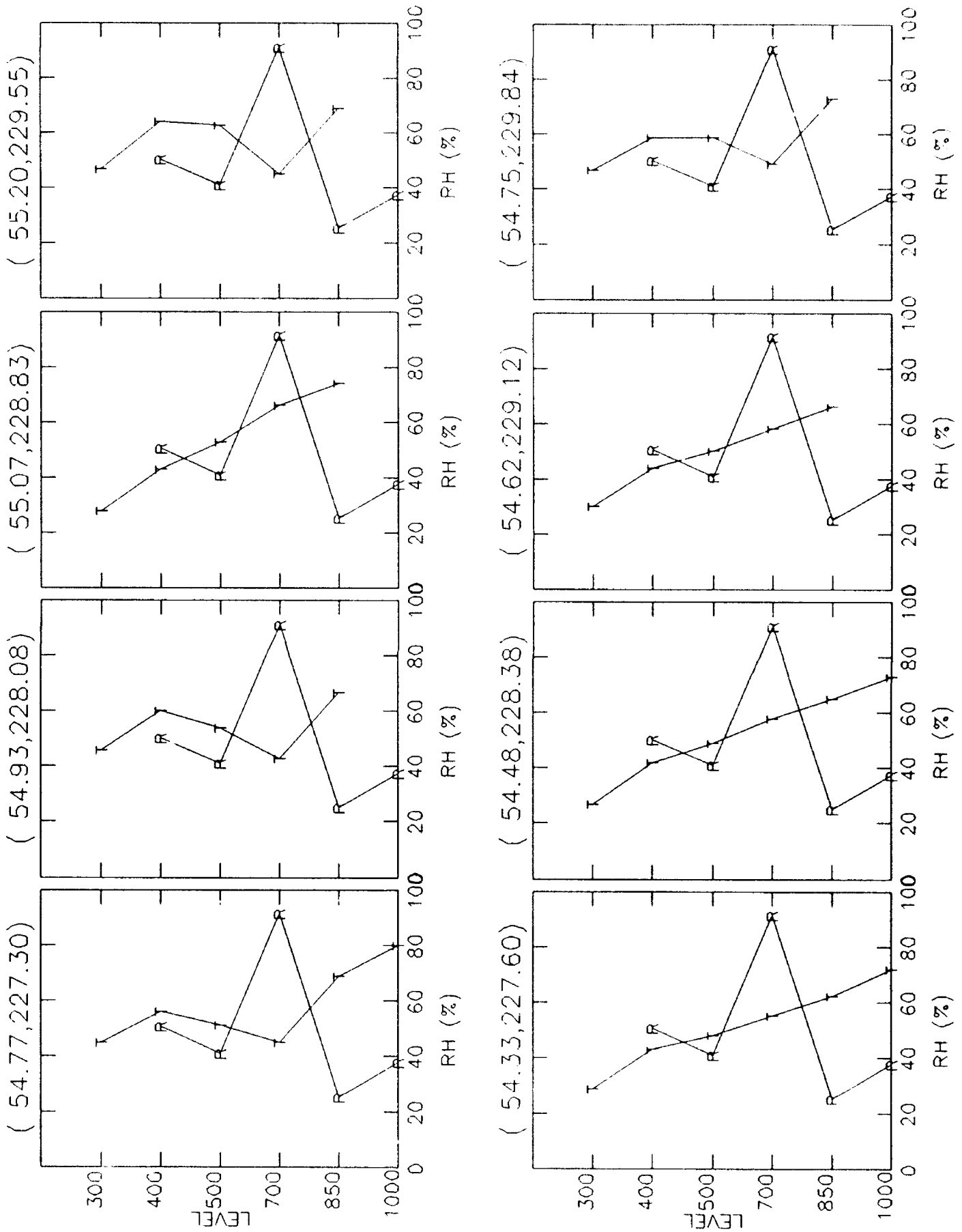

(68.05,225.14)
(68.19,226.19)
(68.33,227.27)
(67.61,225.63)
(67.75,226.66)
(67.88,227.72)
(65.89,231.90)
(66.00,233.03)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

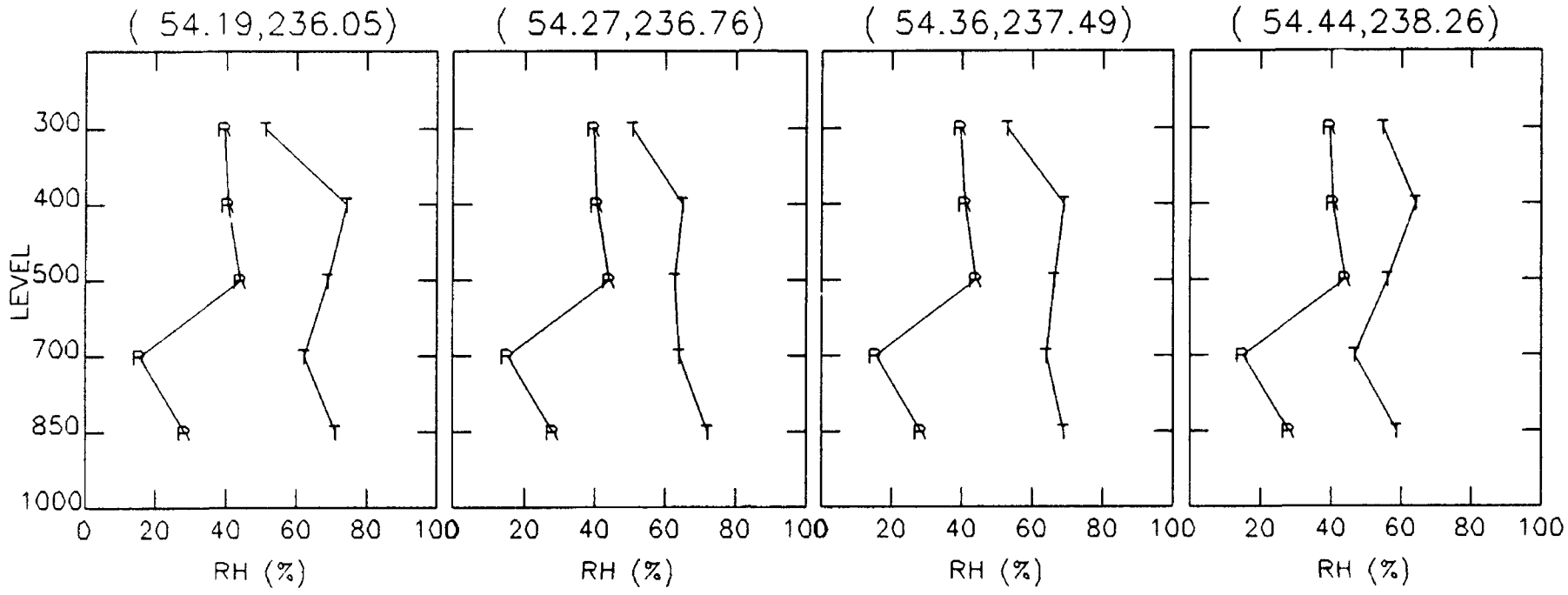

(65.43,232.22)
(65.55,233.33)
(65.66,234.51)
(61.22,223.85)
(61.38,224.70)
(61.53,225.53)
(60.62,223.40)
(60.79,224.26)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

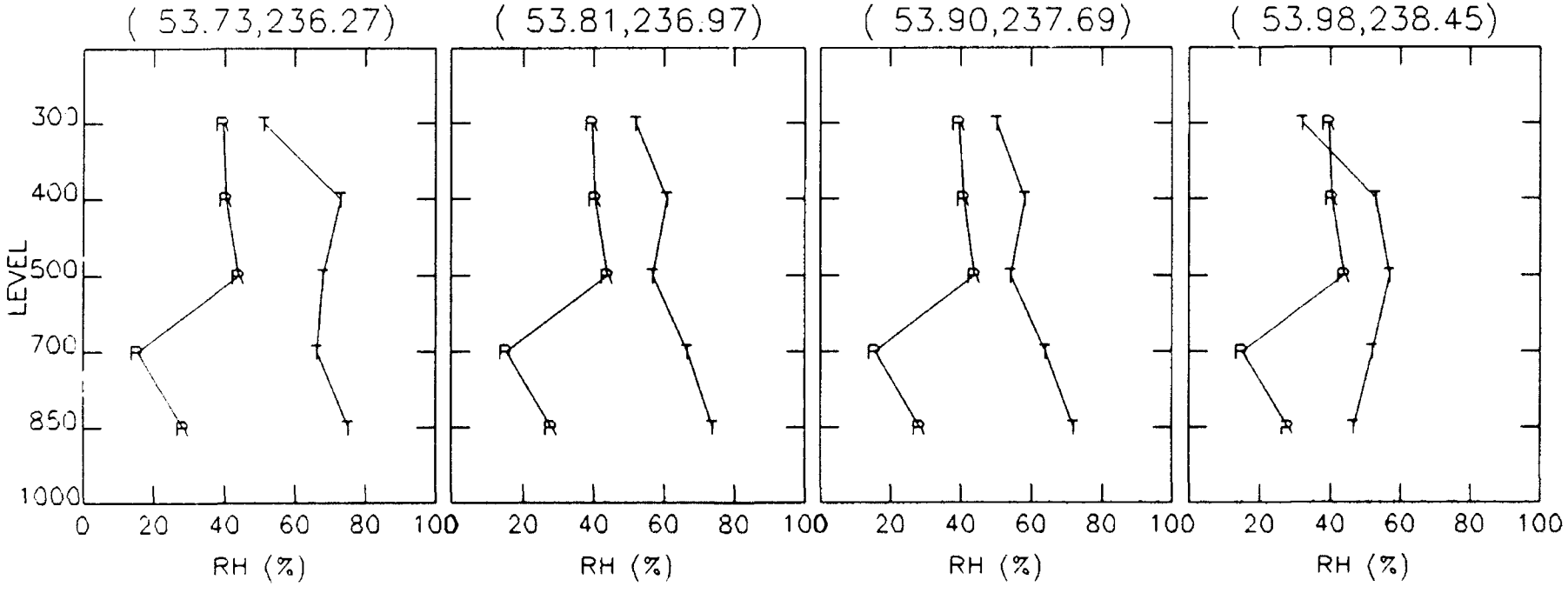

(60.94,225.10)
(61.09,225.92)
(59.59,221.05)
(60.19,223.82)
(60.35,224.67)
(60.51,225.50)
(60.65,226.31)
(59.17,221.49)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

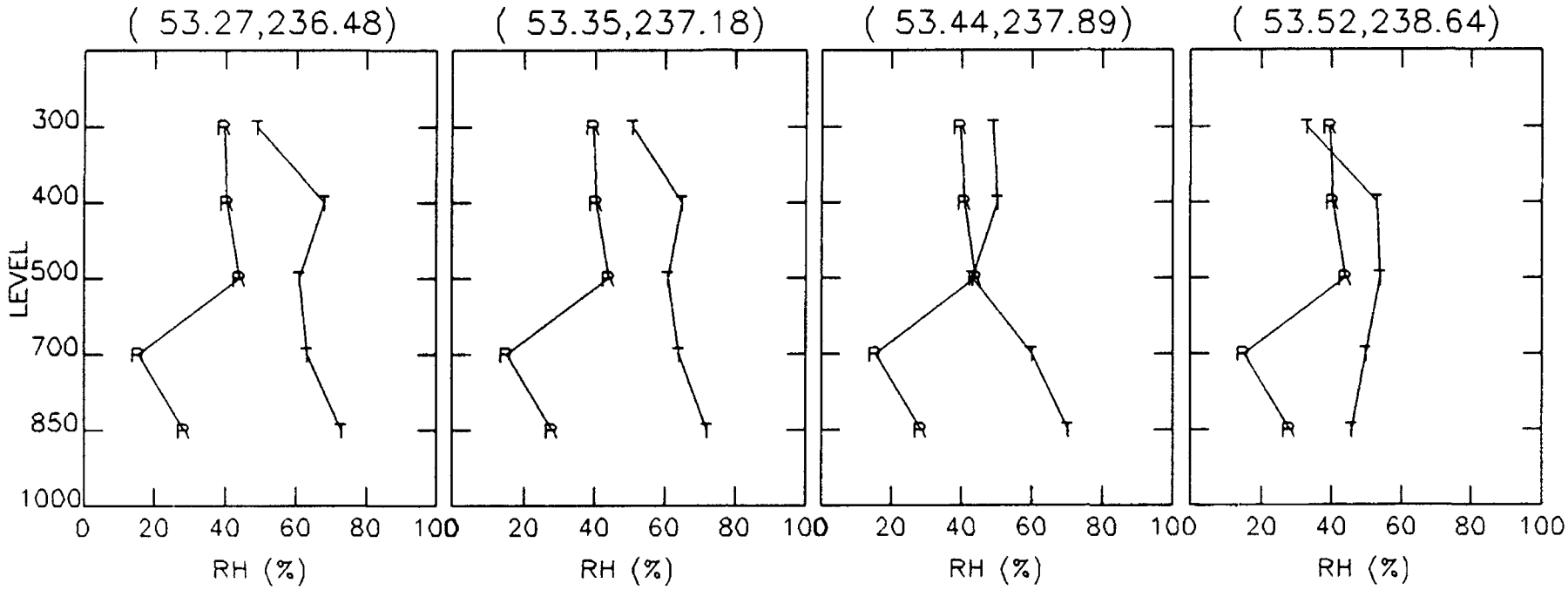

(59 92,225.07)
(60.07,225.88)
(59.60,236.83)
(59.05,236.15)
(59.74,237.07)
(59.23,238.03)
(58.59,236.37)
(58.68,237.26)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

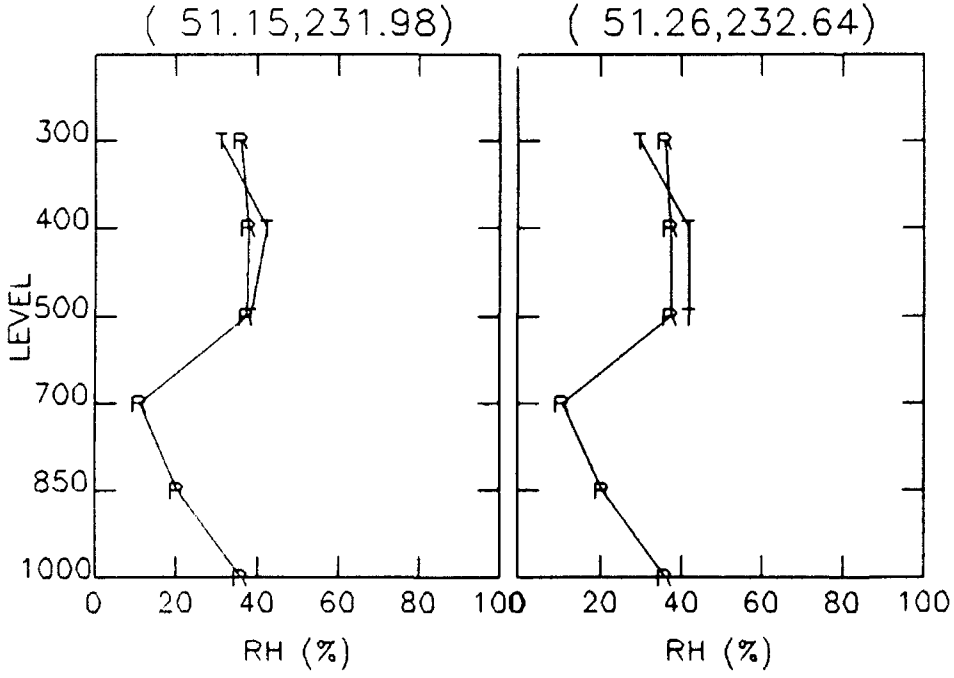

(58.76,238.21)
(58.12,236.59)
(58.21,237.47)
(58.30,238.41)
(55.22,226.98)
(55.37,227.77)
(55.51,228.52)
(55.64,229.26)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)
R
T


(54.77,227.30)
(54.93,228.08)
(55.07,228.83)
(55.20,229.55)
(54.33,227.60)
(54.48,228.38)
(54.62,229.12)
(54.75,229.84)
LEVEL
300
400
500
700
850
1000
RH (%)
0
20
40
60
80
100
T
R


(54.19,236.05)
(54.27,236.76)
(54.36,237.49)
(54.44,238.26)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)
R
T


(53.73,236.27)
(53.81,236.97)
(53.90,237.69)
(53.98,238.45)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)
R
T


(53.27,236.48)
(53.35,237.18)
(53.44,237.89)
(53.52,238.64)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)


(51.15,231.98)
(51.26,232.64)
LEVEL
300
400
500
700
850
1000
0
20
40
60
80
100
RH (%)

Appendix F. Land and ship observations are plotted separately with the quantity (Radiosonde - SSM/T-2) RH and Q plotted on the ordinate, and the index of the co-locations on the abscissa. Each four-plot panel represents one atmospheric level. In addition, the plots are stratified by atmosphere type. The co-location criteria are annotated at the top of the plots.

Ocean Atm, 1000 Mb, (100 Km, 1 Hour) Non Ship
Bias = 4.18931 Abs Error = 11.0802
RMSE = 15.6928 St Dev = 15.1482
Total Ocean Atm Matches = 638
Land Atm, 1000 Mb, (100 Km, 1 Hour)
Bias = 5.60386 ABS Error = 13.7010
RMSE = 16.1017 St Dev = 15.1208
Ocean Atm, 1000 Mb, (100 Km, 1 Hour) Ship
Bias = -68.3548 ABS Error = 68.7570
RMSE = 73.9267 St Dev = 33.1028
Coast Atm, 1000 Mb, (100 Km, 1 Hour)
Bias = -0.890354 ABS Error = 12.4630
RMSE = 16.3699 St Dev = 16.3723
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Land Atm, 850 Mb, (100 Km, 1 Hour)
Bias = -3.71845 ABS Error = 19.5750
RMSE = 24.2291 St Dev = 23.9448
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Coast Atm, 850 Mb, (100 Km, 1 Hour)
Bias = -7.56517 ABS Error = 20.2026
RMSE = 25.3133 St Dev = 24.1604
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Ocean Atm, 850 Mb, (100 Km, 1 Hour) Non Ship
Bias = -3.13421 Abs Error = 17.6540
RMSE = 22.7159 St Dev = 22.5340
Total Ocean Atm Matches = 865
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Ocean Atm, 850 Mb, (100 Km, 1 Hour) Ship
Bias = -62.2181 ABS Error = 62.8524
RMSE = 70.0018 St Dev = 32.1272
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Land Atm, 700 Mb, (100 Km, 1 Hour)
Bias = -2.62403 ABS Error = 18.2510
RMSE = 22.6388 St Dev = 22.4884
Roob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Coast Atm, 700 Mb, (100 Km, 1 Hour)
Bias = -3.85969 ABS Error = 17.5045
RMSE = 21.9661 St Dev = 21.6279
Roob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Ocean Atm, 700 Mb, (100 Km, 1 Hour) Non Ship
Bias = -6.78998 Abs Error = 17.6091
RMSE = 22.8503 St Dev = 21.8511
Total Ocean Atm Matches = 649
Roob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Ocean Atm, 700 Mb, (100 Km, 1 Hour) Ship
Bias = -55.5208 ABS Error = 56.9175
RMSE = 62.3329 St Dev = 28.3755
Total Ocean Atm Matches = 649
Roob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Land Atm, 500 Mb, (100 Km, 1 Hour)
Bias = -4.83480 ABS Error = 16.6337
RMSE = 21.7856 St Dev = 21.2445
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Coast Atm, 500 Mb, (100 Km, 1 Hour)
Bias = -2.20059 ABS Error = 15.8059
RMSE = 20.2774 St Dev = 20.1604
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm, 500 Mb, (100 Km, 1 Hour) Non Ship
Bias = -12.2694 Abs Error = 19.8102
RMSE = 25.1371 St Dev = 21.9769
Total Ocean Atm Matches = 639
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm, 500 Mb, (100 Km, 1 Hour) Ship
Bias = -40.4104 ABS Error = 42.3478
RMSE = 47.7832 St Dev = 25.5368
Total Ocean Atm Matches = 639
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Land Atm, 400 Mb, (100 Km, 1 Hour)
Bias = -10.4363 ABS Error = 17.2154
RMSE = 22.0901 St Dev = 19.4711
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Coast Atm, 400 Mb, (100 Km, 1 Hour)
Bias = -3.83811 ABS Error = 14.7651
RMSE = 18.8332 St Dev = 18.4400
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Ocean Atm, 400 Mb, (100 Km, 1 Hour) Non Ship
Bias = -14.1116 Abs Error = 17.8681
RMSE = 22.6665 St Dev = 17.7678
Total Ocean Atm Matches = 643
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Ocean Atm, 400 Mb, (100 Km, 1 Hour) Ship
Bias = -34.3697 ABS Error = 36.7020
RMSE = 41.5009 St Dev = 23.2942
Total Ocean Atm Matches = 643
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Land Atm, 300 Mb, (100 Km, 1 Hour)
Bias = -2.47340 ABS Error = 15.2113
RMSE = 19.5968 St Dev = 19.4421
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Coast Atm, 300 Mb, (100 Km, 1 Hour)
Bias = 0.200325 ABS Error = 13.3774
RMSE = 17.3737 St Dev = 17.3756
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm, 300 Mb, (100 Km, 1 Hour) Non Ship
Bias = -13.2042 Abs Error = 18.8212
RMSE = 23.1921 St Dev = 19.1004
Total Ocean Atm Matches = 613
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

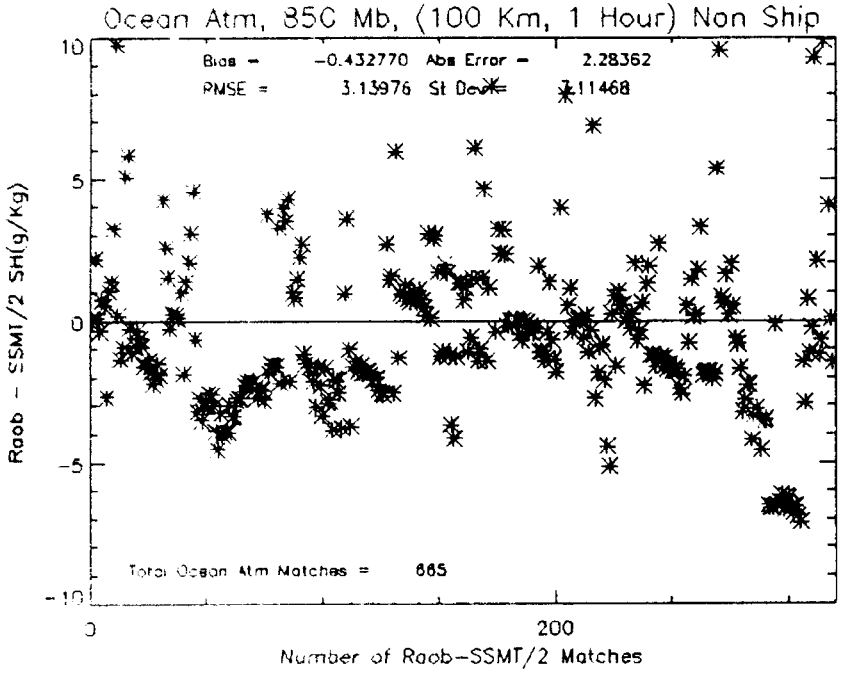
Ocean Atm, 300 Mb, (100 Km, 1 Hour) Ship
Bias = -20.6046 ABS Error = 25.3652
RMSE = 27.9210 St Dev = 18.8709
Total Ocean Atm Matches = 613
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

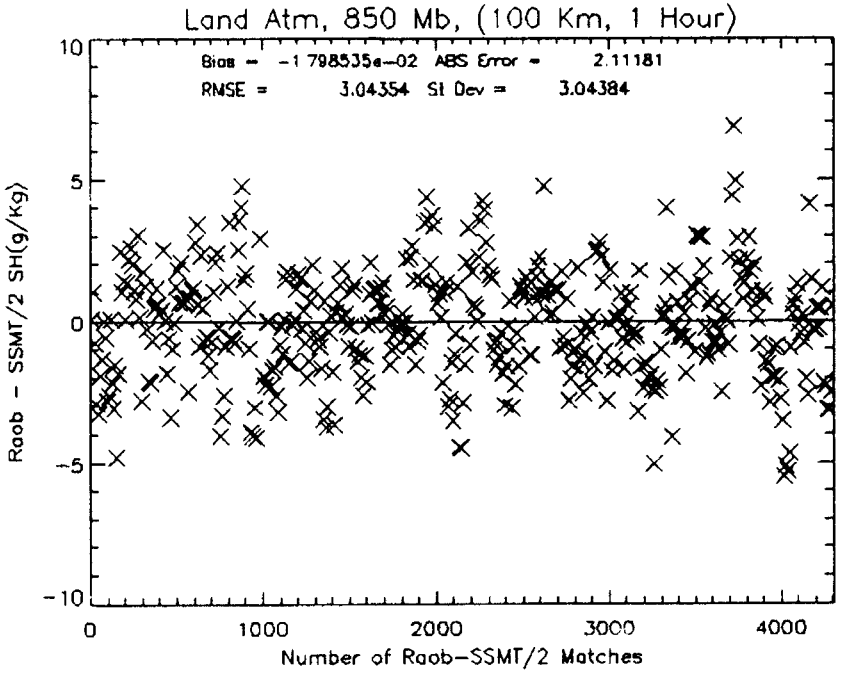
Land Atm, 1000 Mb, (100 Km, 1 Hour)
Bias = -1.47144 ABS Error = 2.13377
RMSE = 2.74540 St Dev = 2.32172
Raob - SSMI/2 SH(g/kg)
Number of Raob-SSMI/2 Matches

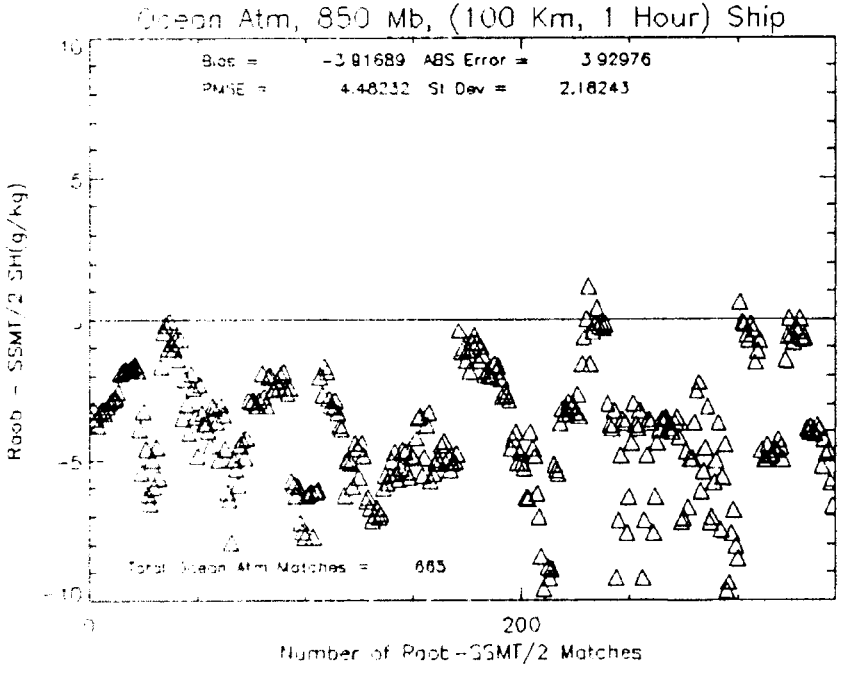
Coast Atm, 1000 Mb, (100 Km, 1 Hour)
Bias = -0.248199 ABS Error = 2.14881
RMSE = 2.88218 St Dev = 2.87263
Raob - SSMI/2 SH(g/kg)
Number of Raob-SSMI/2 Matches

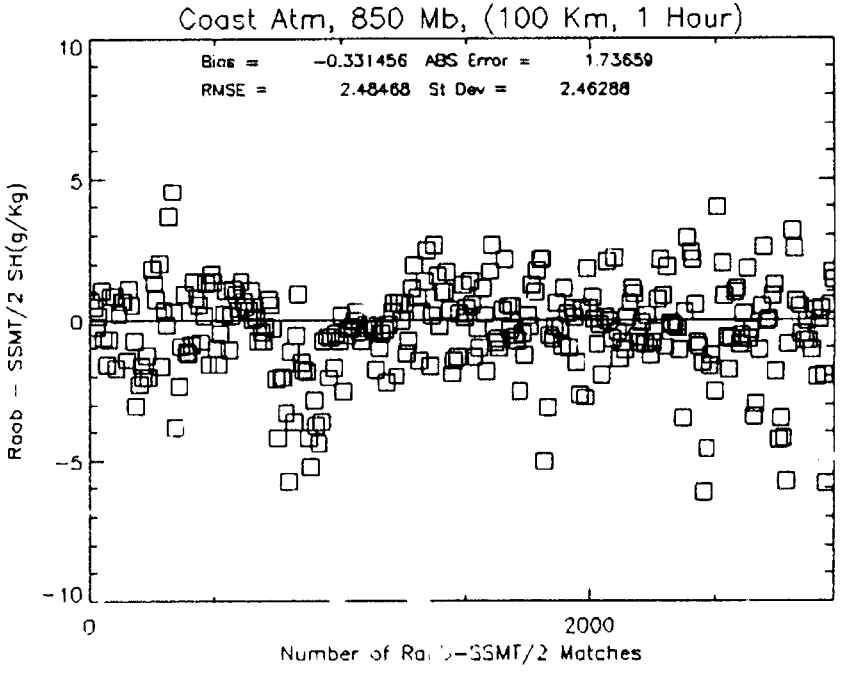
Ocean Atm, 1000 Mb, (100 Km, 1 Hour) Non Ship
Bias = 0.373797 Abs Error = 2.45467
RMSE = 3.80681 St Dev = 3.79466
Total Ocean Atm Matches = 635
Raob - SSMI/2 SH(g/kg)
Number of Raob-SSMI/2 Matches

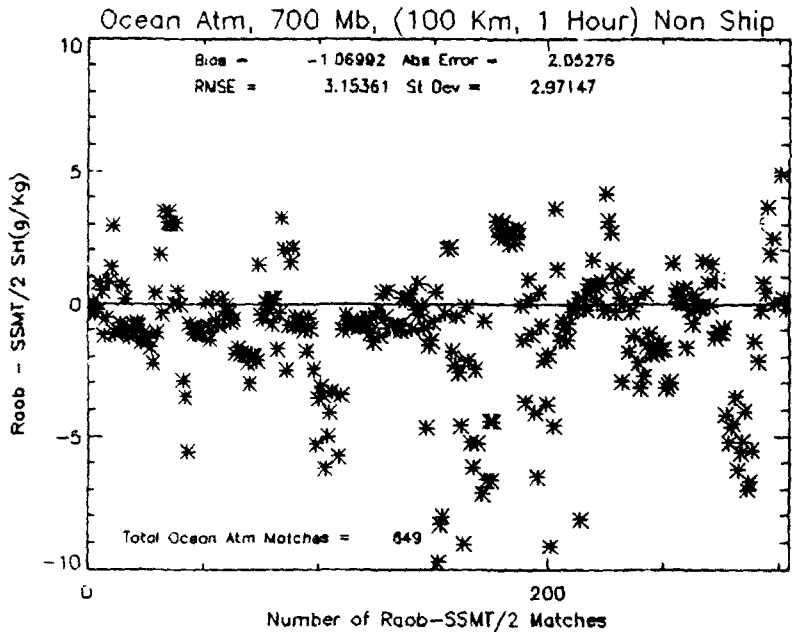
Ocean Atm, 1000 Mb, (100 Km, 1 Hour) Ship
Bias = -4.73335 ABS Error = 4.77430
RMSE = 1.37237 St Dev = 2.54503
Total Ocean Atm Matches = 636
Raob - SSMI/2 SH(g/kg)
Number of Raob-SSMI/2 Matches

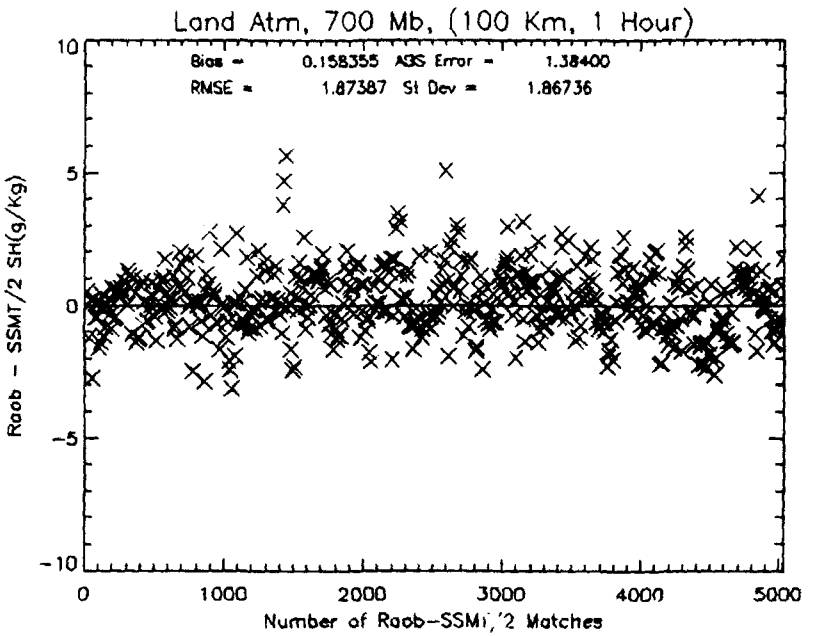

Ocean Atm, 850 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.432770 Abs Error = 2.28362
RMSE = 3.13976 St Dev = 3.11468
Total Ocean Atm Matches = 665
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

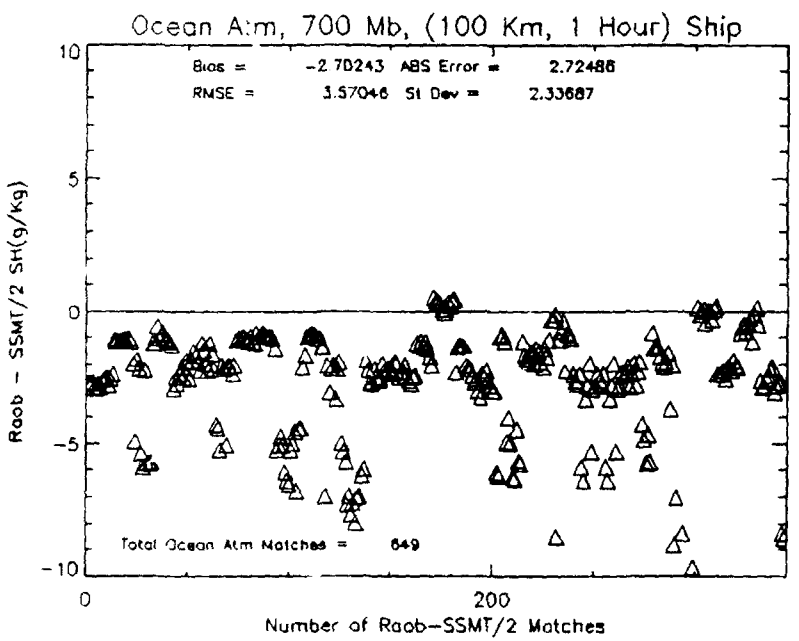

Land Atm, 850 Mb, (100 Km, 1 Hour)
Bias = -1.798535e-02 ABS Error = 2.11181
RMSE = 3.04354 St Dev = 3.04384
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

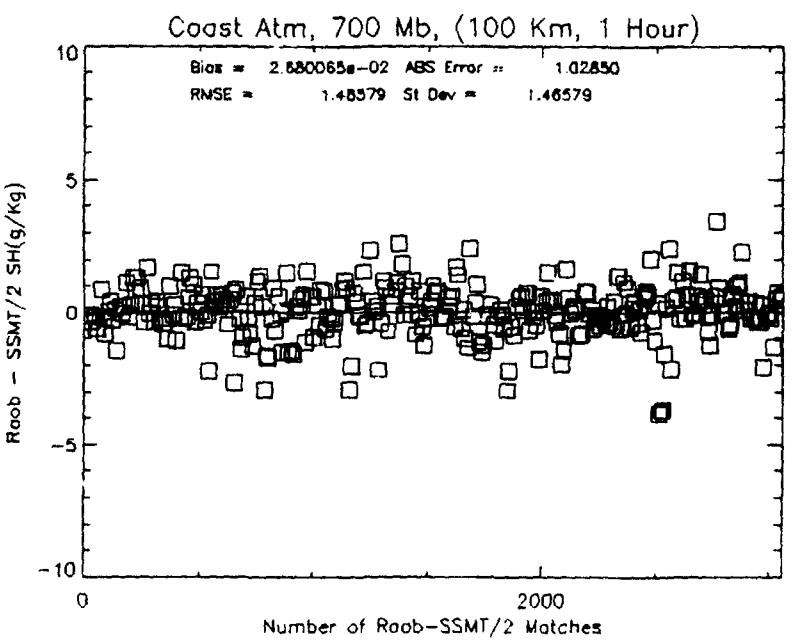

Ocean Atm, 850 Mb, (100 Km, 1 Hour) Ship
Bias = -3.81689 ABS Error = 3.92976
RMSE = 4.48232 St Dev = 2.18243
Total Ocean Atm Matches = 665
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

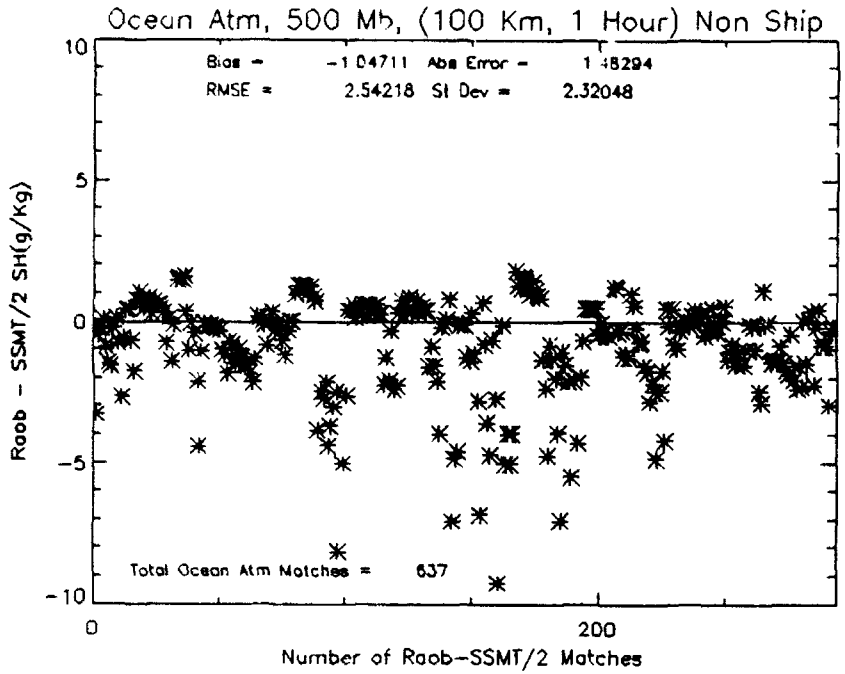

Coast Atm, 850 Mb, (100 Km, 1 Hour)
Bias = -0.331456 ABS Error = 1.73659
RMSE = 2.48468 St Dev = 2.46288
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

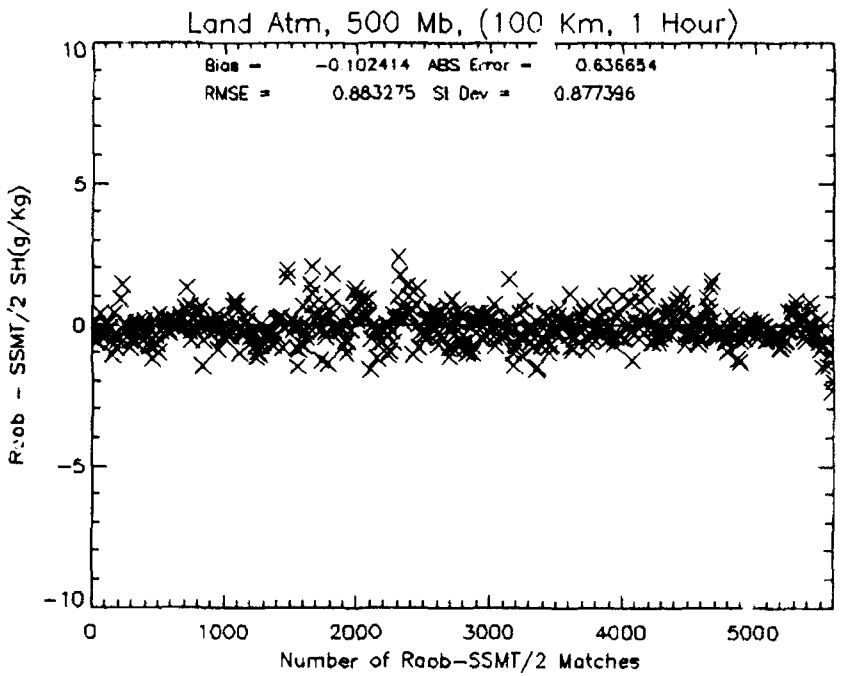

Ocean Atm, 700 Mb, (100 Km, 1 Hour) Non Ship
Bias = -1.06992 Abs Error = 2.05276
RMSE = 3.15361 St Dev = 2.97147
Total Ocean Atm Matches = 649
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

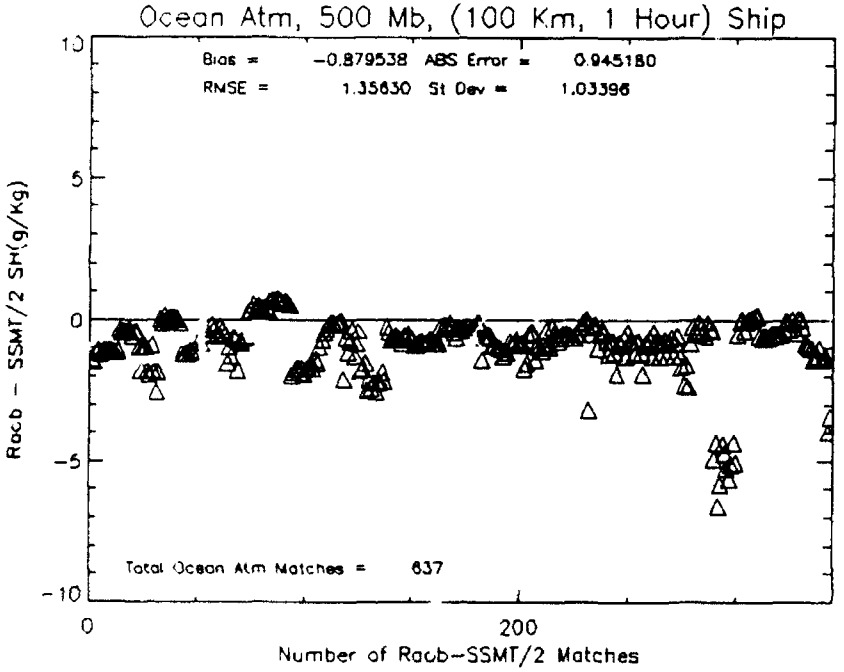

Land Atm, 700 Mb, (100 Km, 1 Hour)
Bias = 0.158355 ABS Error = 1.38400
RMSE = 1.87387 St Dev = 1.86736
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

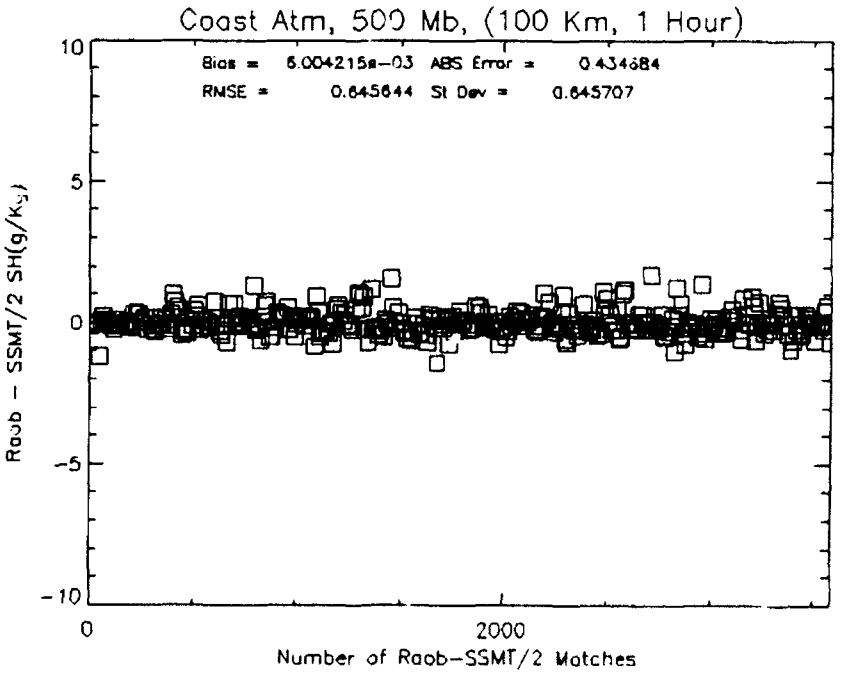

Ocean Atm, 700 Mb, (100 Km, 1 Hour) Ship
Bias = -2.70243 ABS Error = 2.72486
RMSE = 3.57046 St Dev = 2.33687
Total Ocean Atm Matches = 649
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

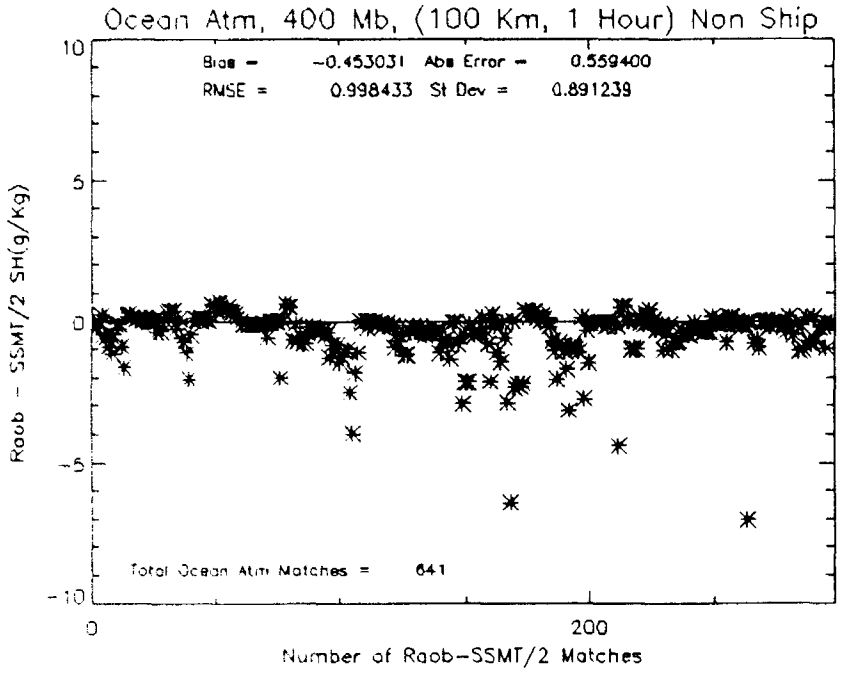

Coast Atm, 700 Mb, (100 Km, 1 Hour)
Bias = 2.680065e-02 ABS Error = 1.02850
RMSE = 1.48579 St Dev = 1.46579
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

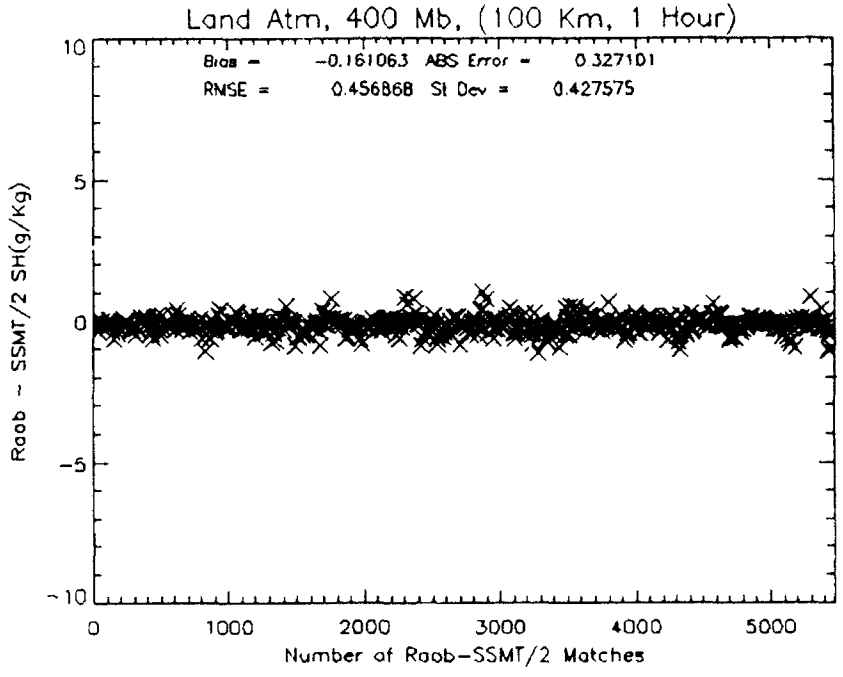

Ocean Atm, 500 Mb, (100 Km, 1 Hour) Non Ship
Bias = -1.04711 Abs Error = 1.48294
RMSE = 2.54218 St Dev = 2.32048
Total Ocean Atm Matches = 637
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

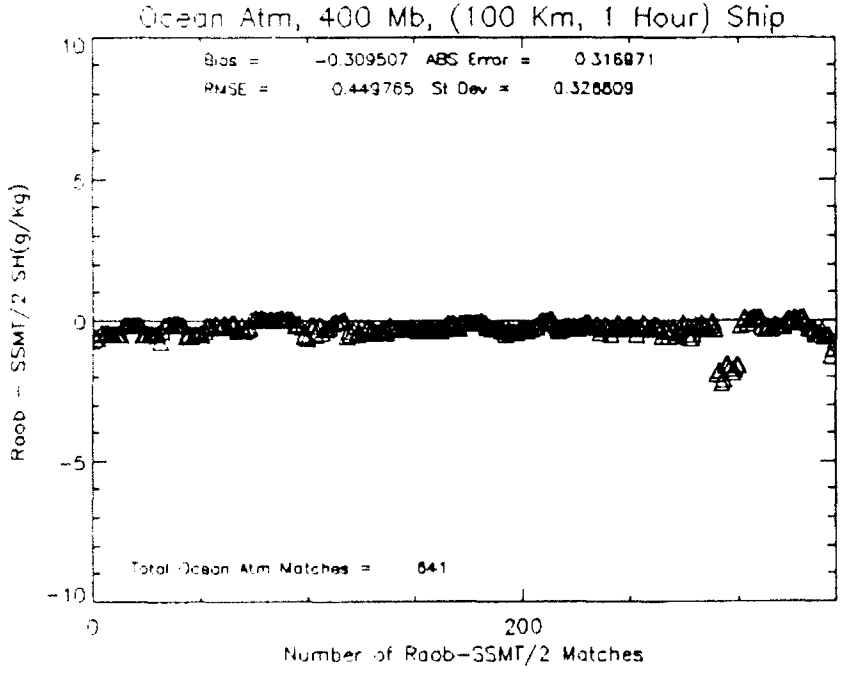

Land Atm, 500 Mb, (100 Km, 1 Hour)
Bias = -0.102414 ABS Error = 0.636654
RMSE = 0.883275 St Dev = 0.877396
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

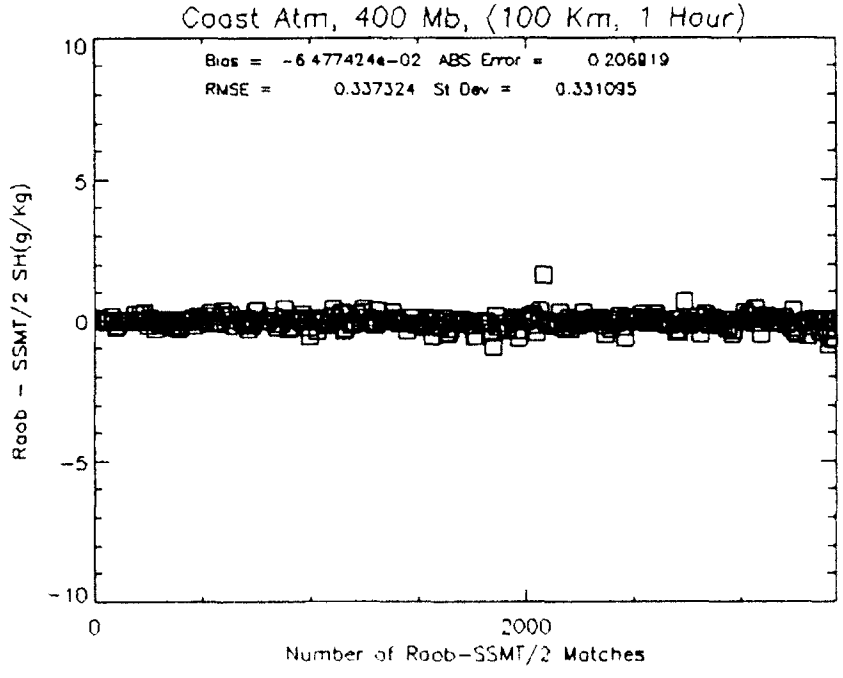

Ocean Atm, 500 Mb, (100 Km, 1 Hour) Ship
Bias = -0.879538 ABS Error = 0.945180
RMSE = 1.35630 St Dev = 1.03396
Total Ocean Atm Matches = 637
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

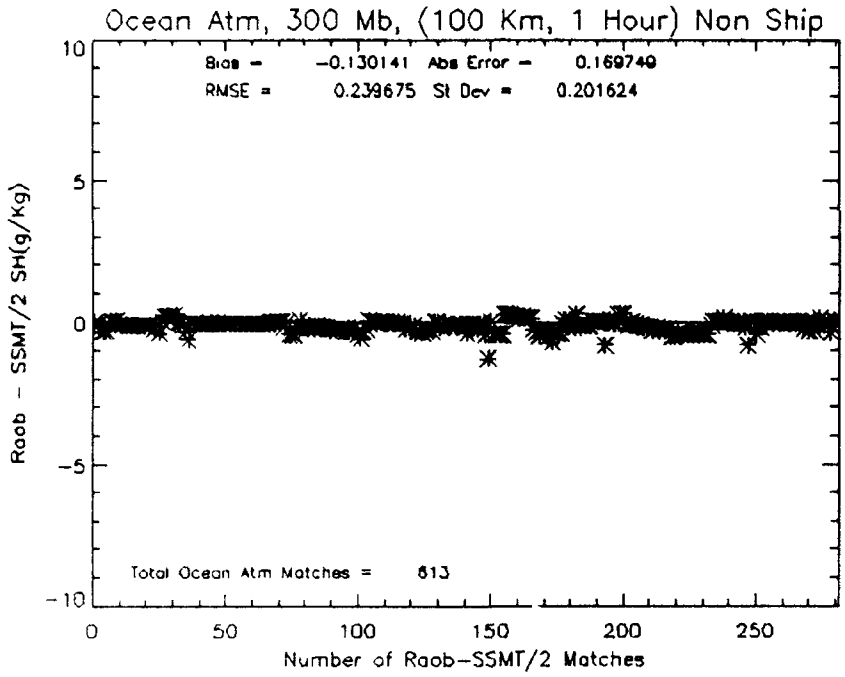

Coast Atm, 500 Mb, (100 Km, 1 Hour)
Bias = 6.004215e-03 ABS Error = 0.434684
RMSE = 0.645644 St Dev = 0.645707
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

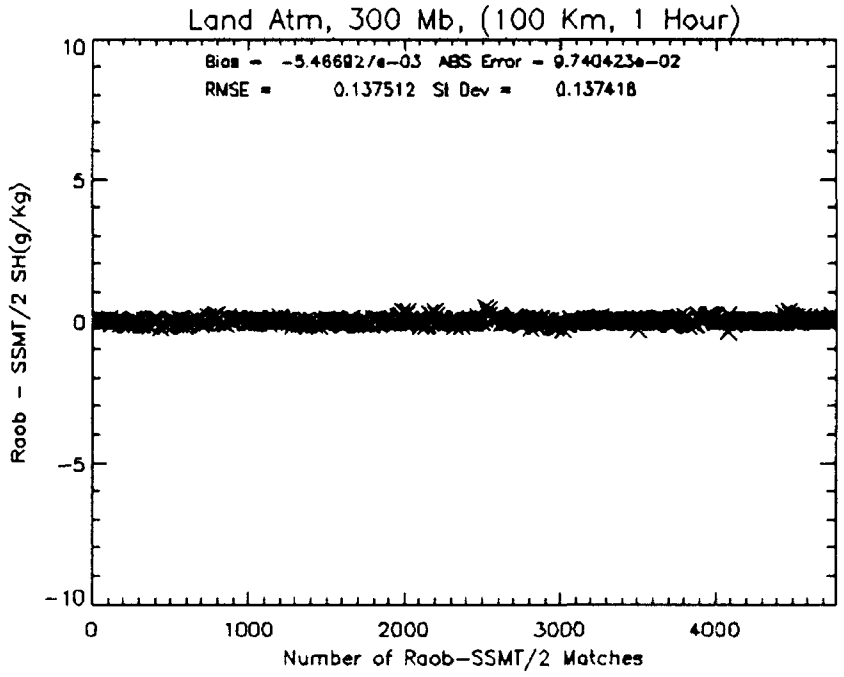

Ocean Atm, 400 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.453031 Abs Error = 0.559400
RMSE = 0.998433 St Dev = 0.891239
Total Ocean Atm Matches = 641
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

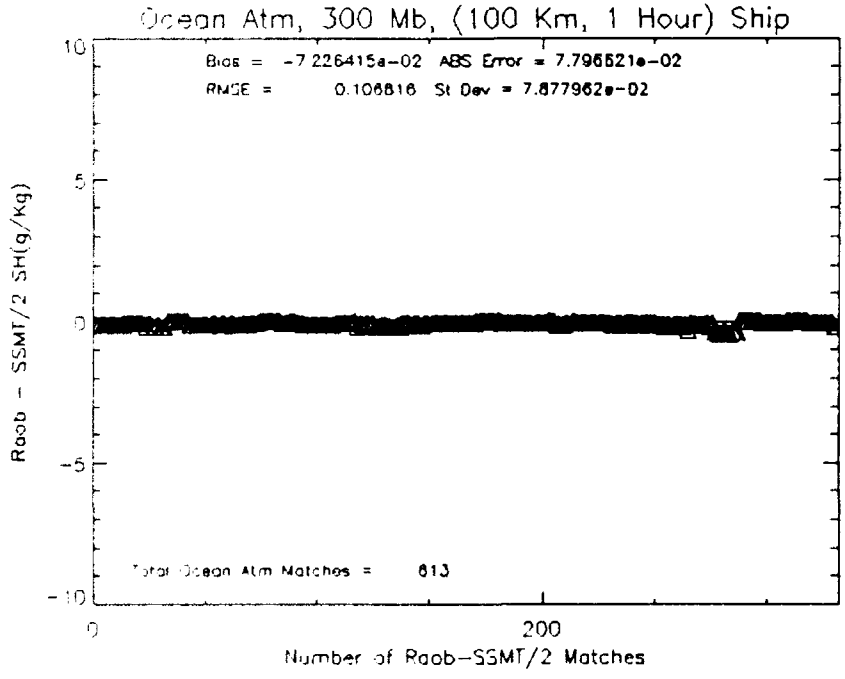

Land Atm, 400 Mb, (100 Km, 1 Hour)
Bias = -0.161063 ABS Error = 0.327101
RMSE = 0.456868 St Dev = 0.427575
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

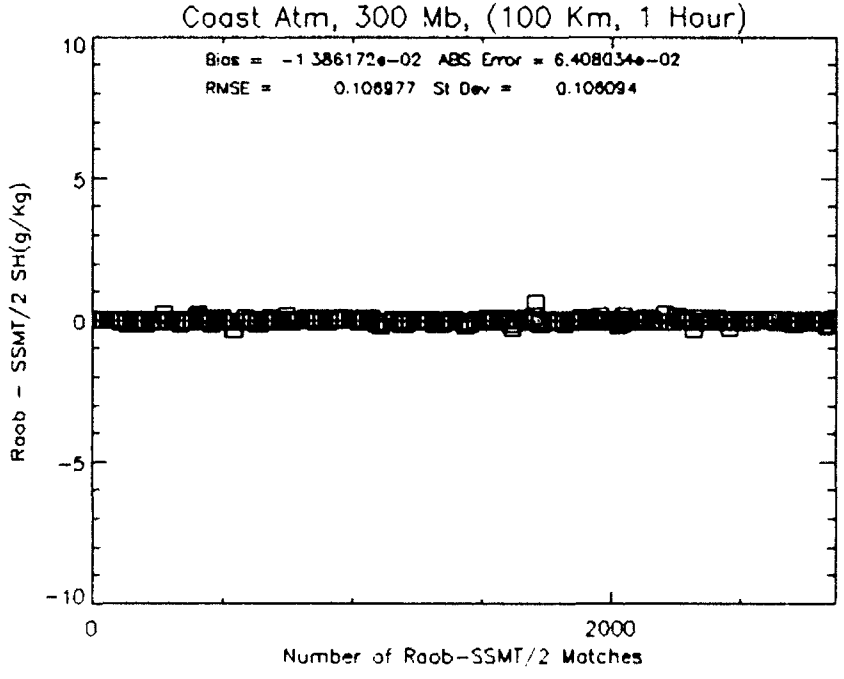

Ocean Atm, 400 Mb, (100 Km, 1 Hour) Ship
Bias = -0.309507 ABS Error = 0.316871
RMSE = 0.449765 St Dev = 0.328809
Total Ocean Atm Matches = 641
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Coast Atm, 400 Mb, (100 Km, 1 Hour)
Bias = -6.477424e-02 ABS Error = 0.206819
RMSE = 0.337324 St Dev = 0.331095
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

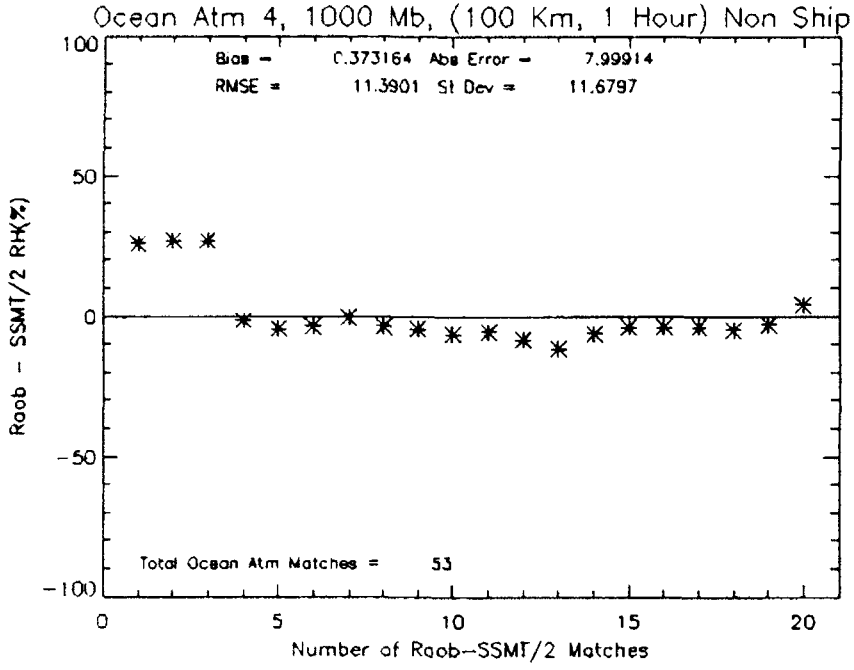

Ocean Atm, 300 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.130141 Abs Error = 0.169749
RMSE = 0.239675 St Dev = 0.201624
Total Ocean Atm Matches = 613
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

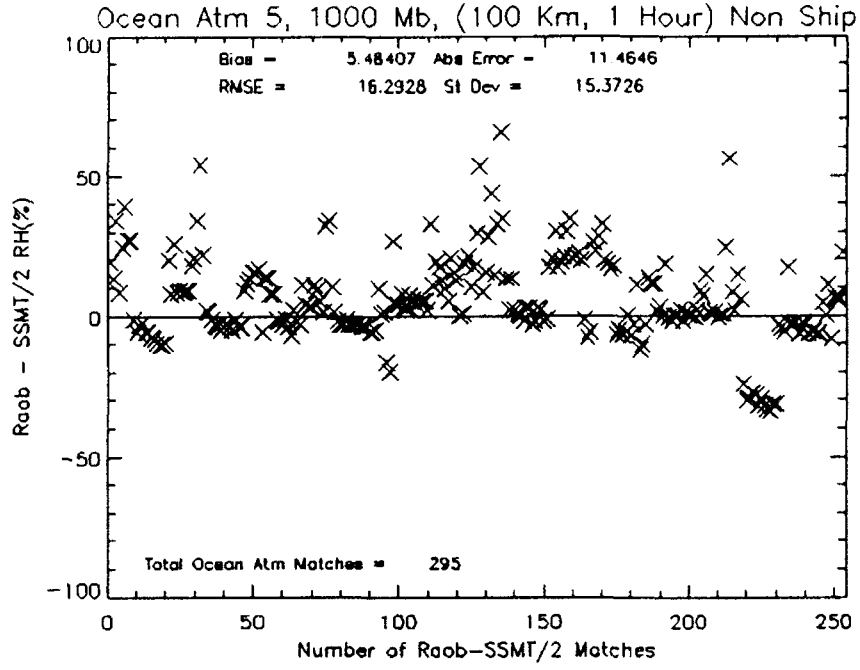

Land Atm, 300 Mb, (100 Km, 1 Hour)
Bias = -5.466927e-03 ABS Error = 9.740423e-02
RMSE = 0.137512 St Dev = 0.137418
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

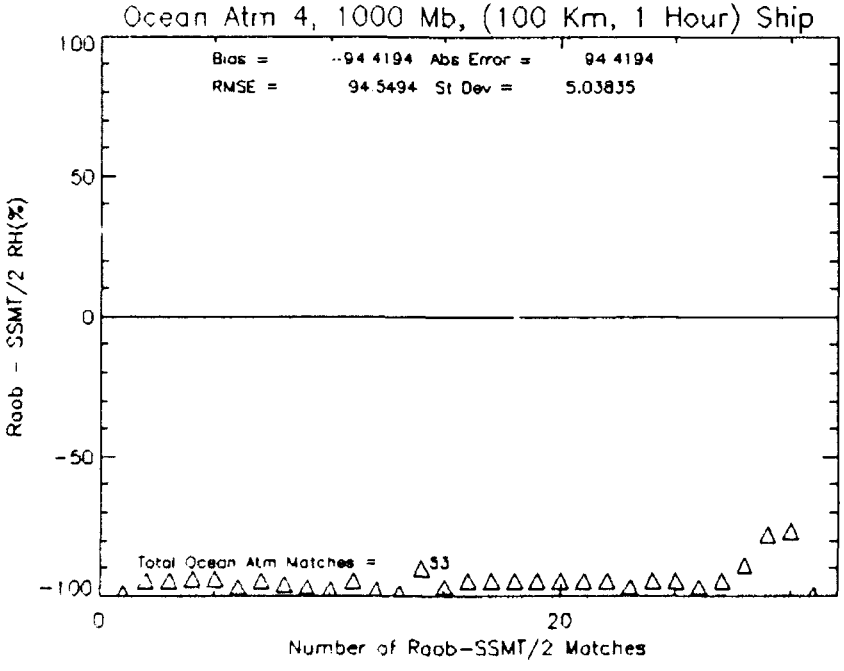

Ocean Atm, 300 Mb, (100 Km, 1 Hour) Ship
Bias = -7.226415e-02 ABS Error = 7.796521e-02
RMSE = 0.106816 St Dev = 7.877962e-02
Total Ocean Atm Matches = 613
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

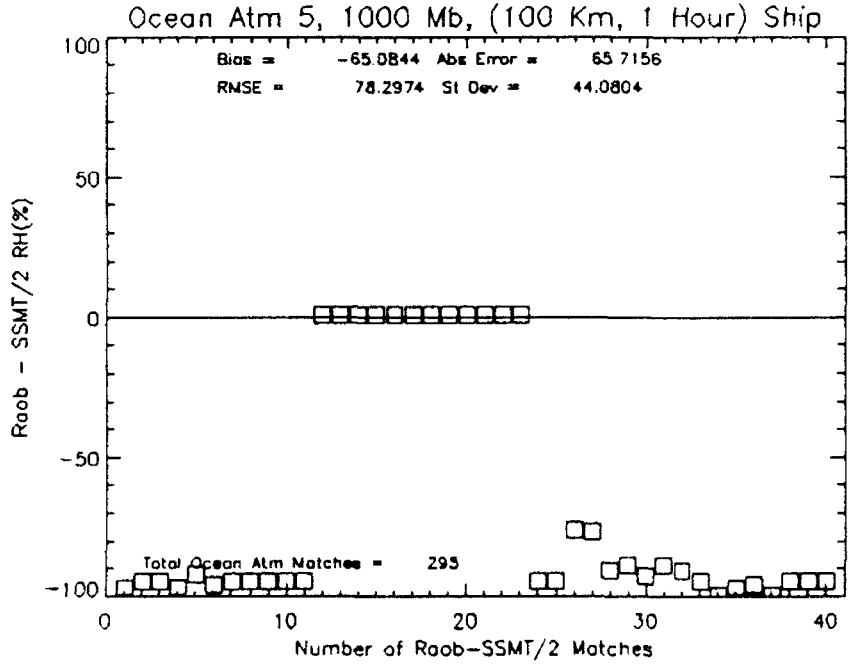

Coast Atm, 300 Mb, (100 Km, 1 Hour)
Bias = -1.386172e-02 ABS Error = 6.408034e-02
RMSE = 0.106877 St Dev = 0.106094
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

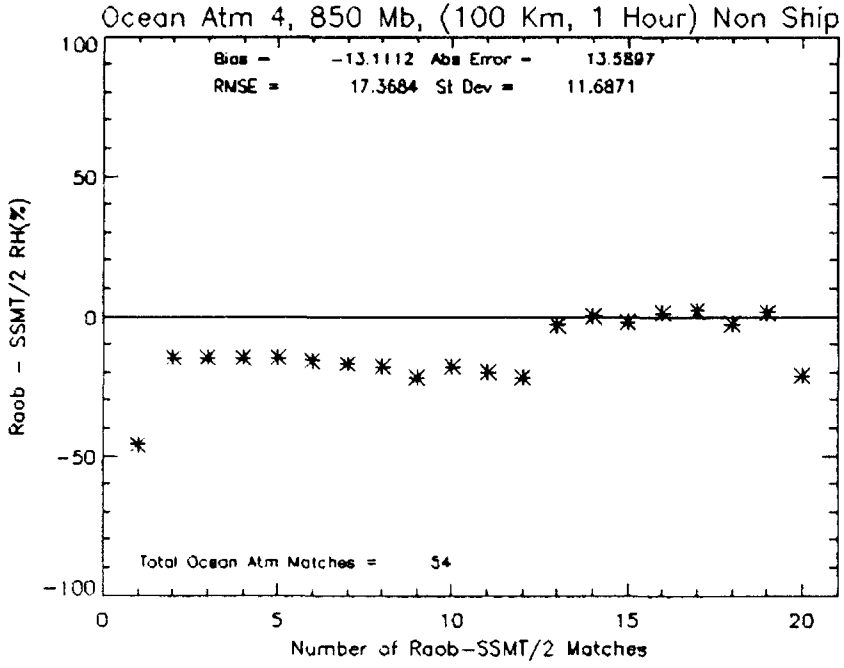
Appendix G. For the atmosphere types 1 through 5 with ocean backgrounds, the quantity (Radiosonde - SSM/T-2) RH and Q plotted on the ordinate, and the index of the co-locations on the abscissa. Each four-plot panel represents one atmospheric level. The co-location criteria are annotated at the top of the plots.

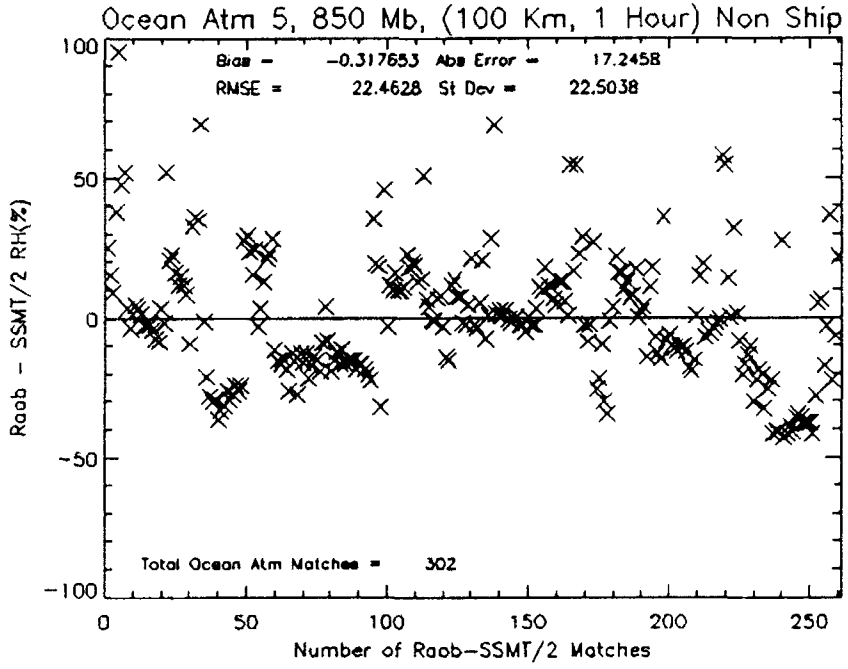

Ocean Atm 4, 1000 Mb, (100 Km, 1 Hour) Non Ship
Bias = 0.373164 Abs Error = 7.99914
RMSE = 11.3901 St Dev = 11.6797
Total Ocean Atm Matches = 53
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

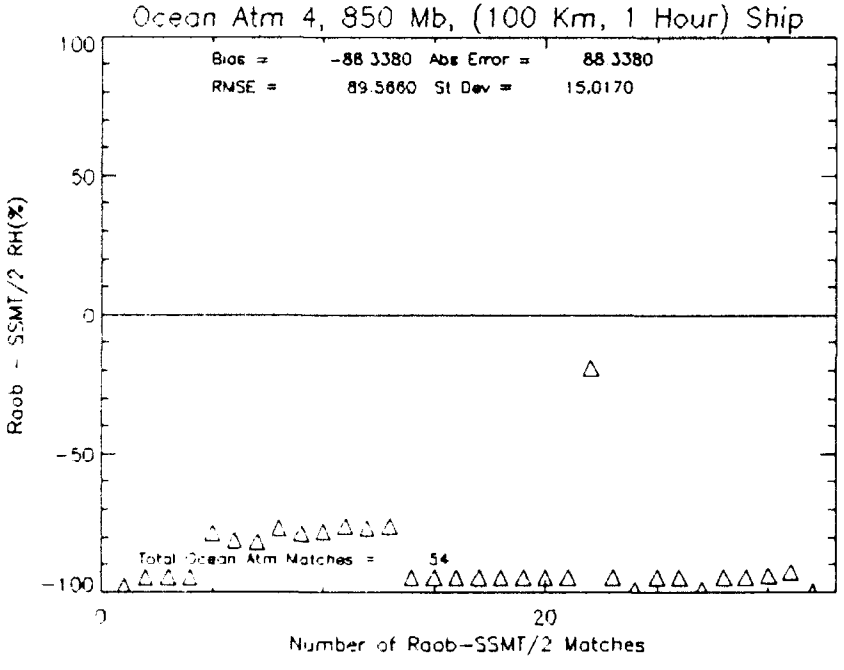

Ocean Atm 5, 1000 Mb, (100 Km, 1 Hour) Non Ship
Bias = 5.48407 Abs Error = 11.4646
RMSE = 16.2928 St Dev = 15.3726
Total Ocean Atm Matches = 295
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

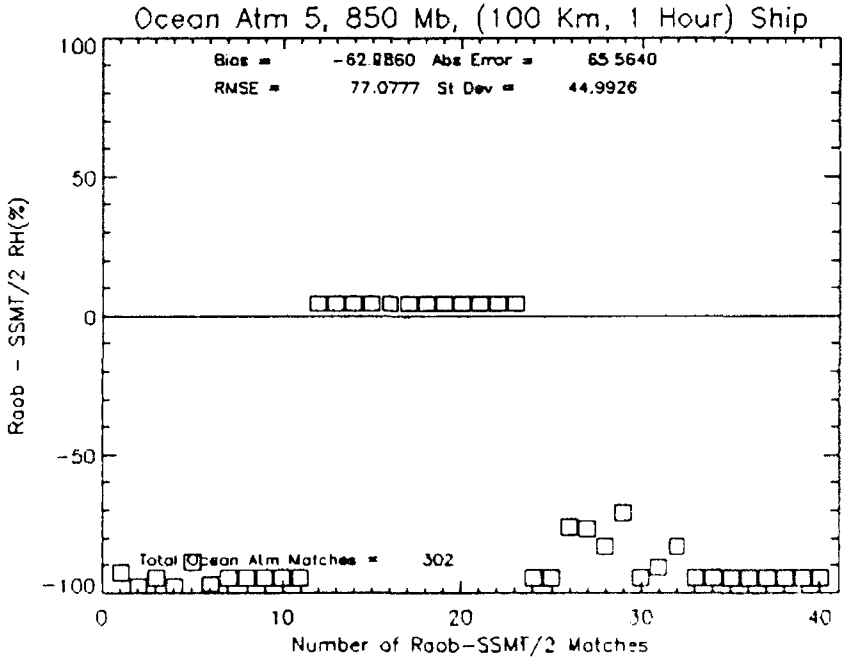

Ocean Atm 4, 1000 Mb, (100 Km, 1 Hour) Ship
Bias = -94.4194 Abs Error = 94.4194
RMSE = 94.5494 St Dev = 5.03835
Total Ocean Atm Matches = 53
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 1000 Mb, (100 Km, 1 Hour) Ship
Bias = -65.0844 Abs Error = 65.7156
RMSE = 78.2974 St Dev = 44.0804
Total Ocean Atm Matches = 295
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 4, 850 Mb, (100 Km, 1 Hour) Non Ship
Bias = -13.1112 Abs Error = 13.5897
RNSE = 17.3684 St Dev = 11.6871
Total Ocean Atm Matches = 54
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 850 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.317653 Abs Error = 17.2458
RNSE = 22.4628 St Dev = 22.5038
Total Ocean Atm Matches = 302
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 4, 850 Mb, (100 Km, 1 Hour) Ship
Bias = -88.3380 Abs Error = 88.3380
RNSE = 89.5660 St Dev = 15.0170
Total Ocean Atm Matches = 54
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 850 Mb, (100 Km, 1 Hour) Ship
Bias = -62.8860 Abs Error = 65.5640
RNSE = 77.0777 St Dev = 44.9926
Total Ocean Atm Matches = 302
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 5, 700 Mb, (100 Km, 1 Hour) Non Ship
Bias = -5.48795 Abs Error = 17.7583
RMSE = 23.2309 St Dev = 22.6198
Total Ocean Atm Matches = 286
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 5, 700 Mb, (100 Km, 1 Hour) Ship
Bias = -64.2506 Abs Error = 66.7994
RMSE = 78.4171 St Dev = 45.5294
Total Ocean Atm Matches = 286
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 4, 700 Mb, (100 Km, 1 Hour) Non Ship
Bias = -8.46260 Abs Error = 11.8015
RMSE = 13.1021 St Dev = 10.2623
Total Ocean Atm Matches = 34
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

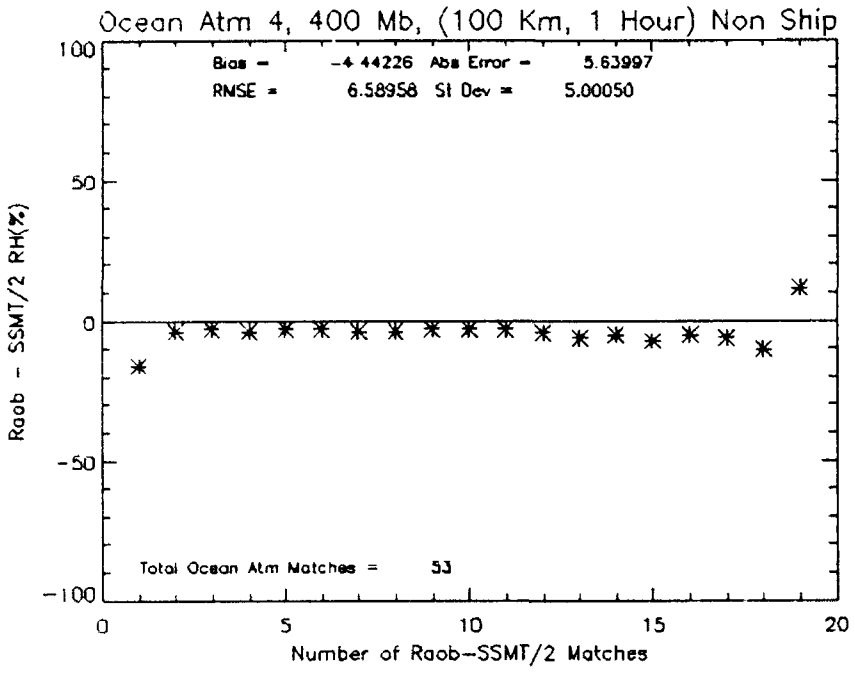
Ocean Atm 4, 700 Mb, (100 Km, 1 Hour) Ship
Bias = -87.2418 Abs Error = 87.2418
RMSE = 87.8976 St Dev = 9.07290
Total Ocean Atm Matches = 34
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

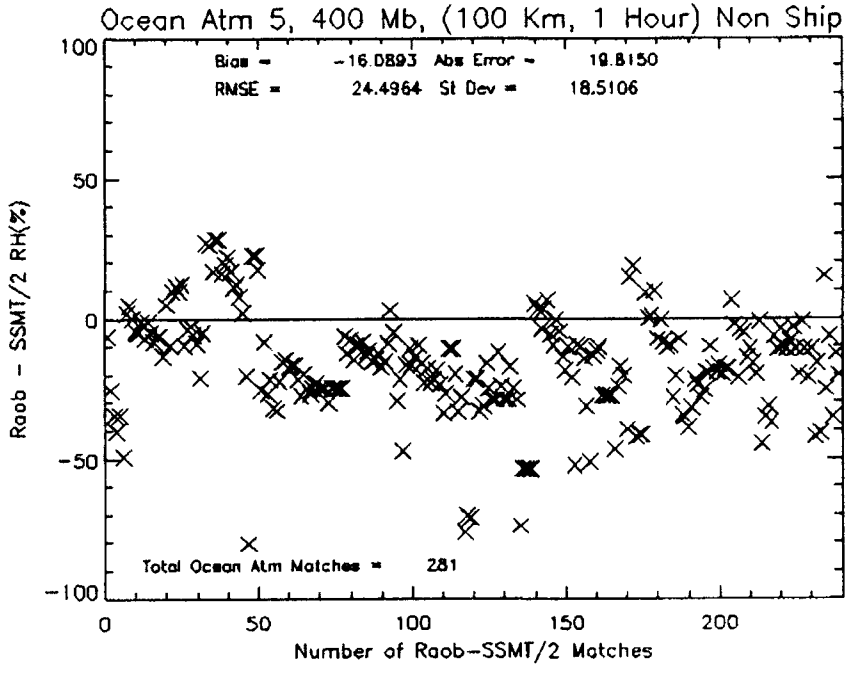
Ocean Atm 5, 500 Mb, (100 Km, 1 Hour) Non Ship
Bias = -12.8860 Abs Error = 21.0820
RMSE = 26.4139 St Dev = 23.1050
Total Ocean Atm Matches = 285
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

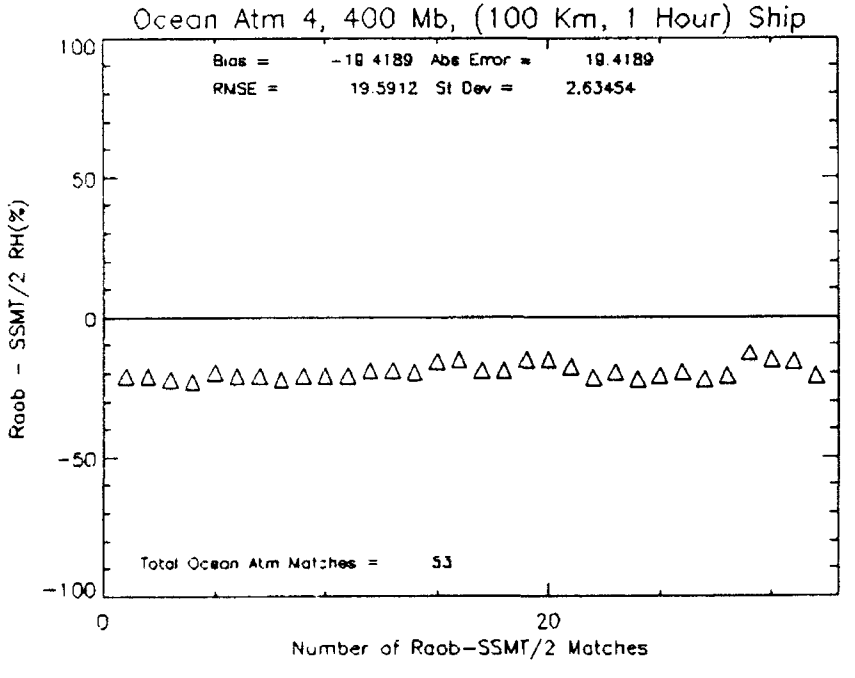
Ocean Atm 5, 500 Mb, (100 Km, 1 Hour) Ship
Bias = -62.0213 Abs Error = 62.0213
RMSE = 70.5033 St Dev = 33.9590
Total Ocean Atm Matches = 285
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

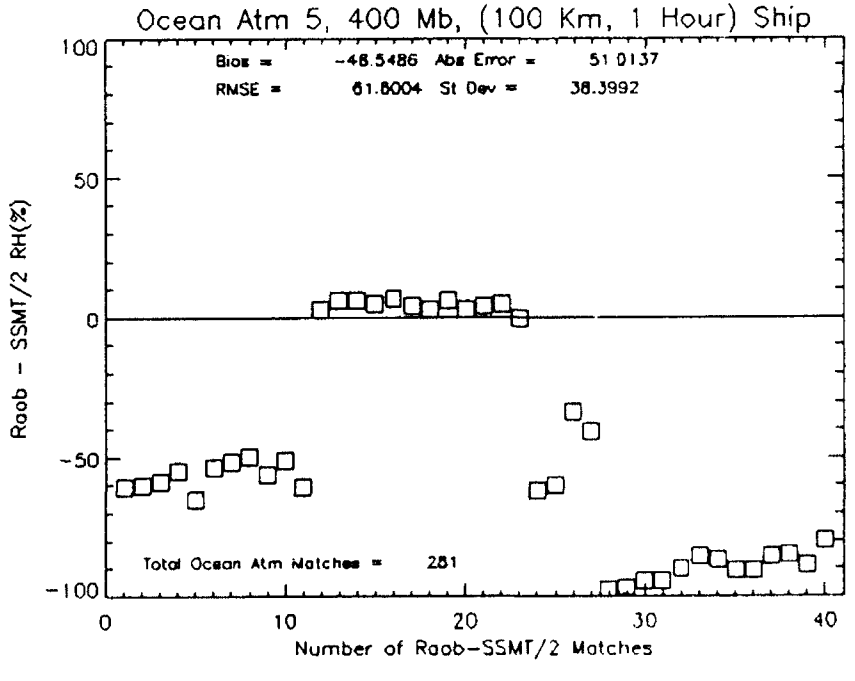
Ocean Atm 4, 500 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.827578 Abs Error = 9.91392
RMSE = 11.0389 St Dev = 11.6033
Total Ocean Atm Matches = 44
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

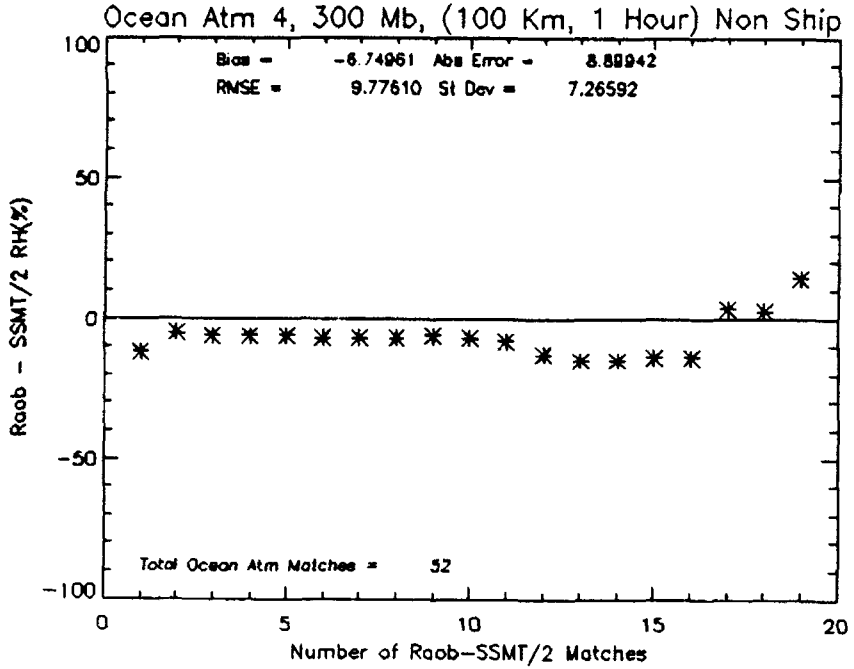
Ocean Atm 4, 500 Mb, (100 Km, 1 Hour) Ship
Bias = -54.6610 Abs Error = 54.6610
RMSE = 55.5130 St Dev = 9.84386
Total Ocean Atm Matches = 44
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

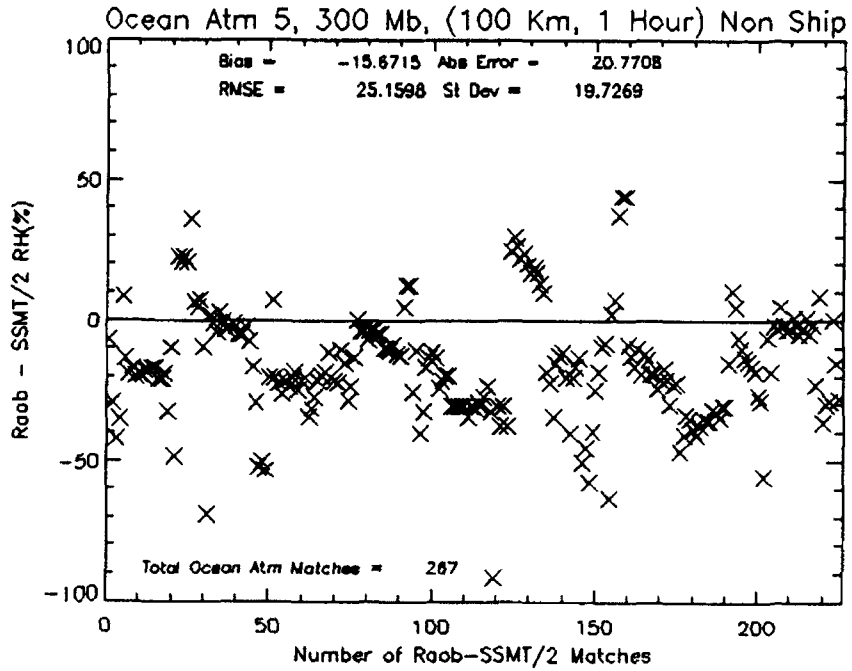

Ocean Atm 4, 400 Mb, (100 Km, 1 Hour) Non Ship
Bias = -4.44226 Abs Error = 5.63997
RMSE = 6.58958 St Dev = 5.00050
Total Ocean Atm Matches = 53
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

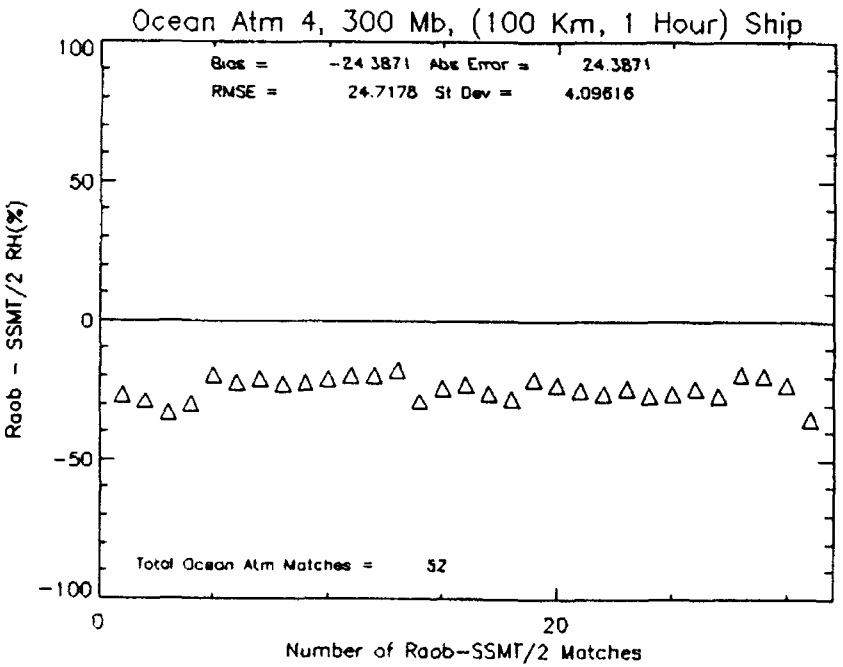

Ocean Atm 5, 400 Mb, (100 Km, 1 Hour) Non Ship
Bias = -16.0893 Abs Error = 19.8150
RMSE = 24.4964 St Dev = 18.5106
Total Ocean Atm Matches = 281
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

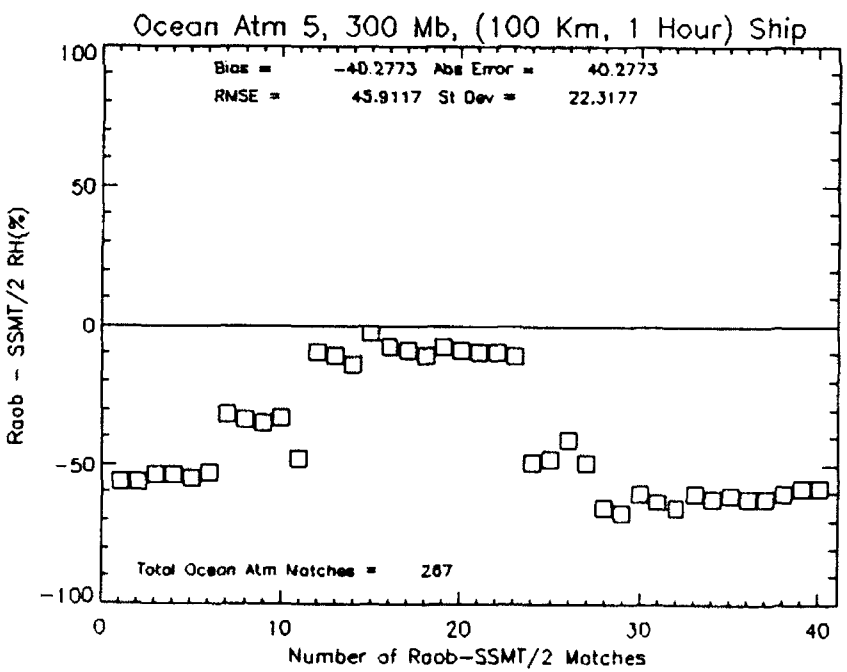

Ocean Atm 4, 400 Mb, (100 Km, 1 Hour) Ship
Bias = -18.4189 Abs Error = 18.4189
RMSE = 19.5912 St Dev = 2.63454
Total Ocean Atm Matches = 53
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

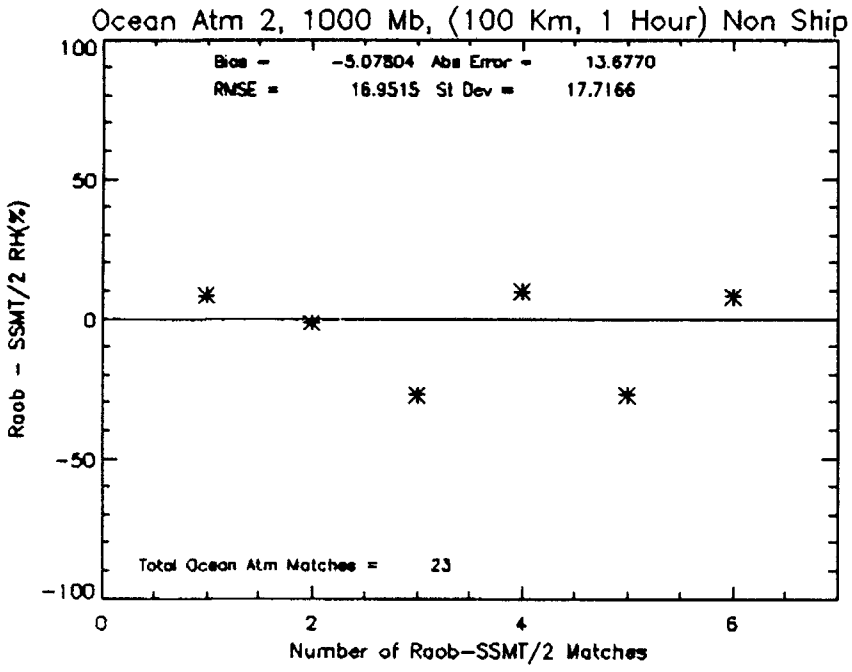

Ocean Atm 5, 400 Mb, (100 Km, 1 Hour) Ship
Bias = -46.5486 Abs Error = 51.0137
RMSE = 61.8004 St Dev = 38.3992
Total Ocean Atm Matches = 281
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

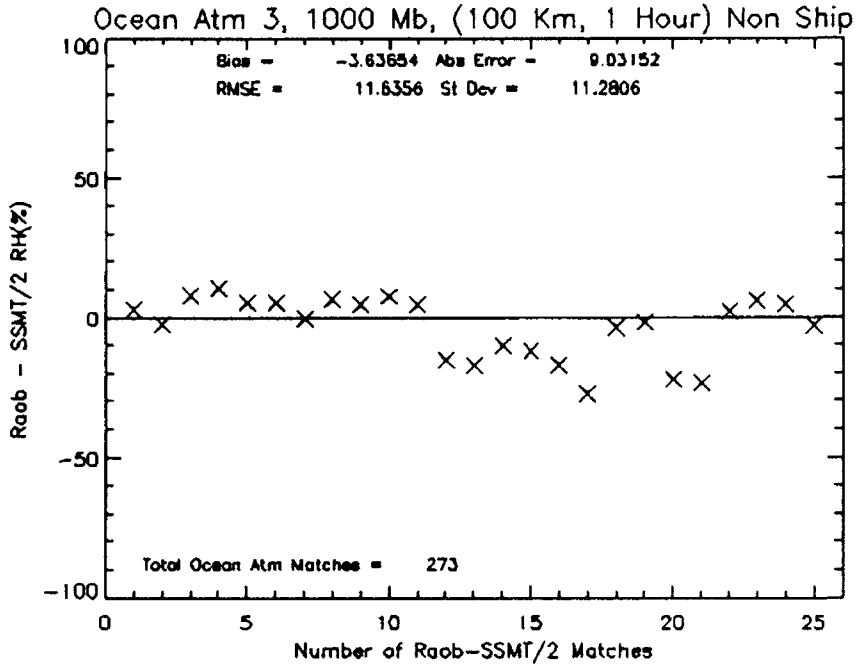

Ocean Atm 4, 300 Mb, (100 Km, 1 Hour) Non Ship
Bias = -6.74961 Abs Error = 8.88942
RMSE = 9.77610 St Dev = 7.26592
Total Ocean Atm Matches = 52
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

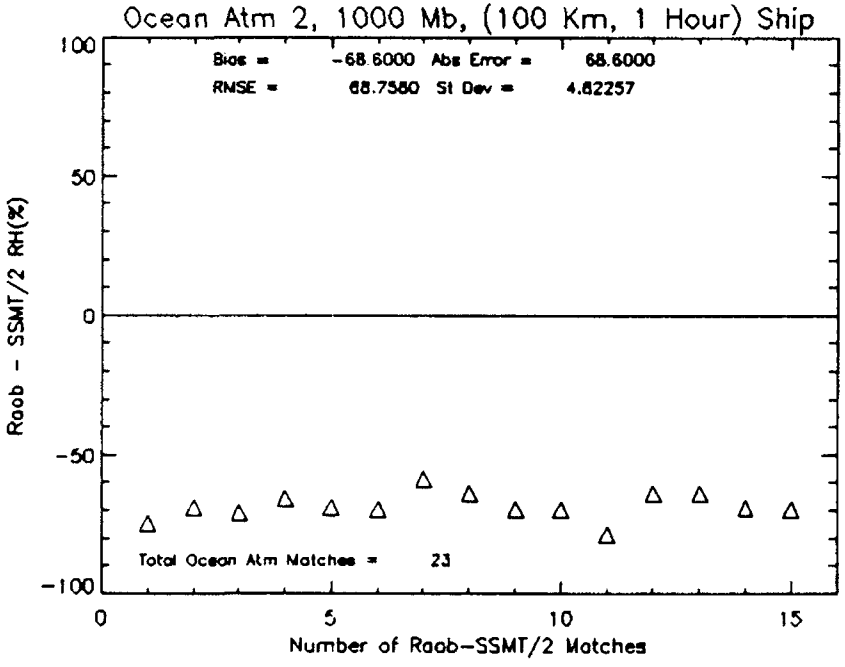

Ocean Atm 5, 300 Mb, (100 Km, 1 Hour) Non Ship
Bias = -15.6715 Abs Error = 20.7708
RMSE = 25.1598 St Dev = 19.7269
Total Ocean Atm Matches = 267
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

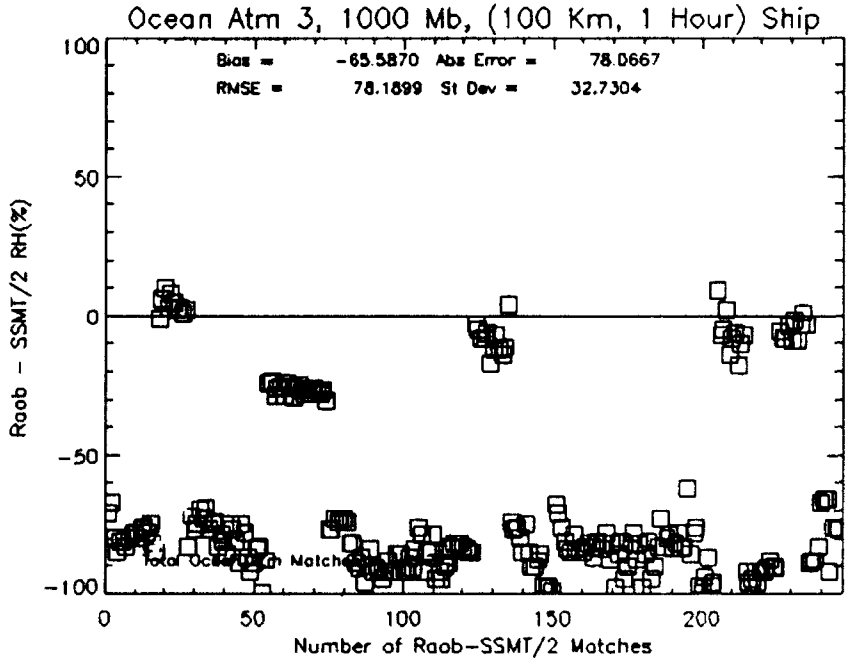

Ocean Atm 4, 300 Mb, (100 Km, 1 Hour) Ship
Bias = -24.3871 Abs Error = 24.3871
RMSE = 24.7178 St Dev = 4.09616
Total Ocean Atm Matches = 52
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 300 Mb, (100 Km, 1 Hour) Ship
Bias = -40.2773 Abs Error = 40.2773
RMSE = 45.9117 St Dev = 22.3177
Total Ocean Atm Matches = 267
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 1000 Mb, (100 Km, 1 Hour) Non Ship
Bias = -5.07804 Abs Error = 13.6770
RMSE = 16.9515 St Dev = 17.7166
Total Ocean Atm Matches = 23
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 1000 Mb, (100 Km, 1 Hour) Non Ship
Bias = -3.63654 Abs Error = 9.03152
RMSE = 11.6356 St Dev = 11.2806
Total Ocean Atm Matches = 273
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 1000 Mb, (100 Km, 1 Hour) Ship
Bias = -68.6000 Abs Error = 68.6000
RMSE = 68.7580 St Dev = 4.82257
Total Ocean Atm Matches = 23
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

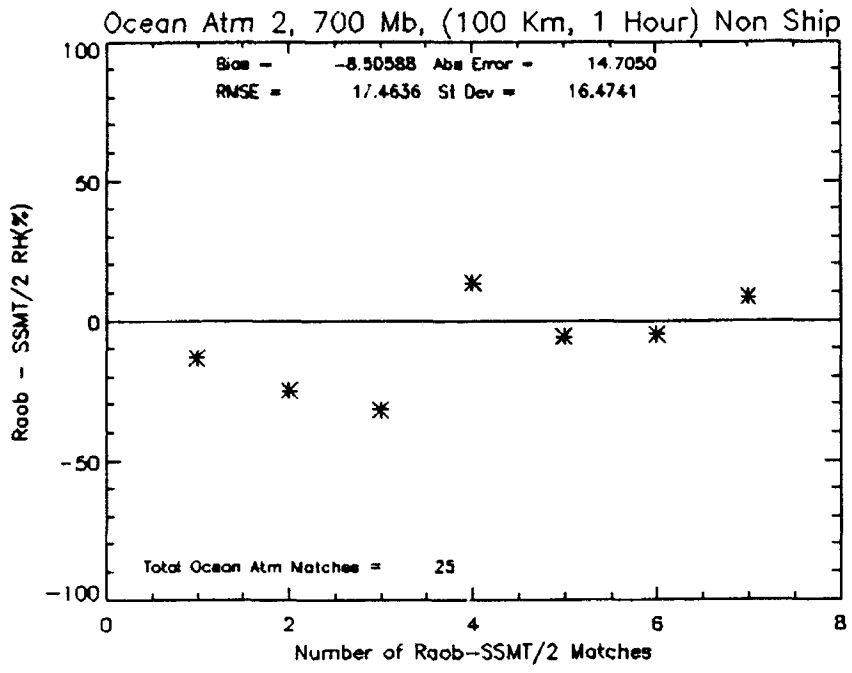

Ocean Atm 3, 1000 Mb, (100 Km, 1 Hour) Ship
Bias = -65.5870 Abs Error = 78.0667
RMSE = 78.1899 St Dev = 32.7304
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

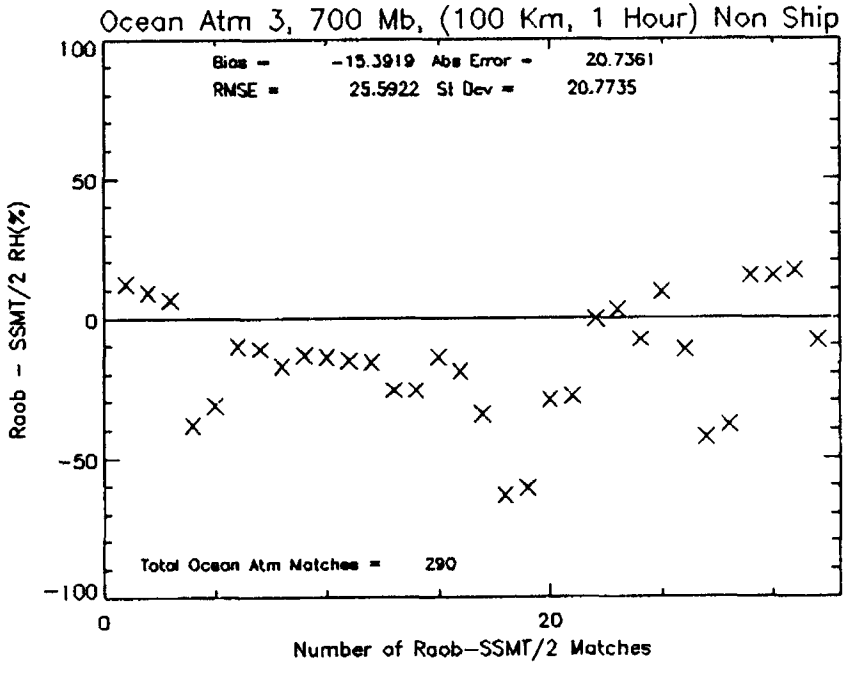
Ocean Atm 3, 850 Mb, (100 Km, 1 Hour) Non Ship
Bias = -18.8917 Abs Error = 24.0208
RMSE = 28.1446 St Dev = 20.1273
Total Ocean Atm Matches = 290
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

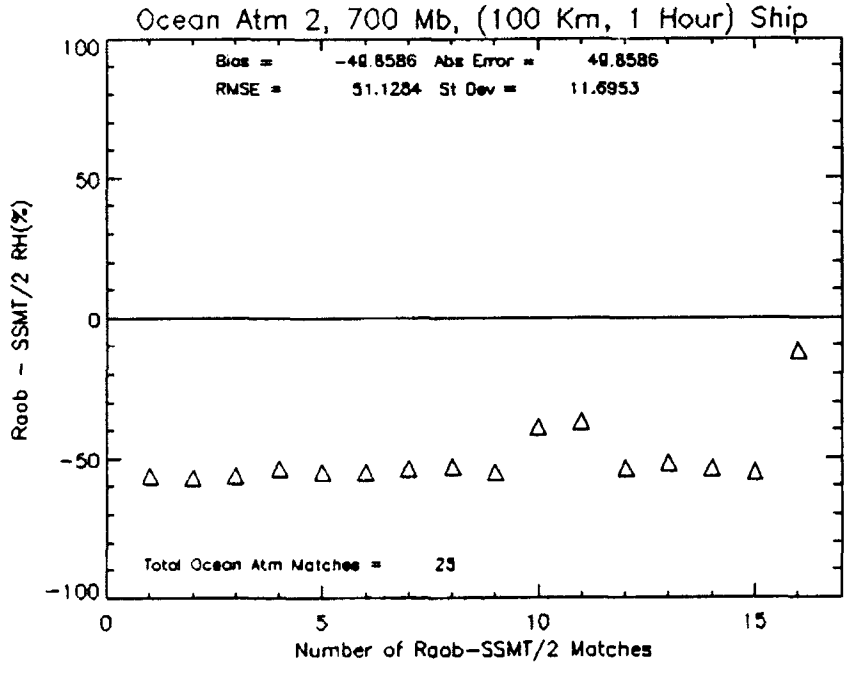
Ocean Atm 3, 850 Mb, (100 Km, 1 Hour) Ship
Bias = -58.4920 Abs Error = 63.3750
RMSE = 63.8003 St Dev = 30.5253
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

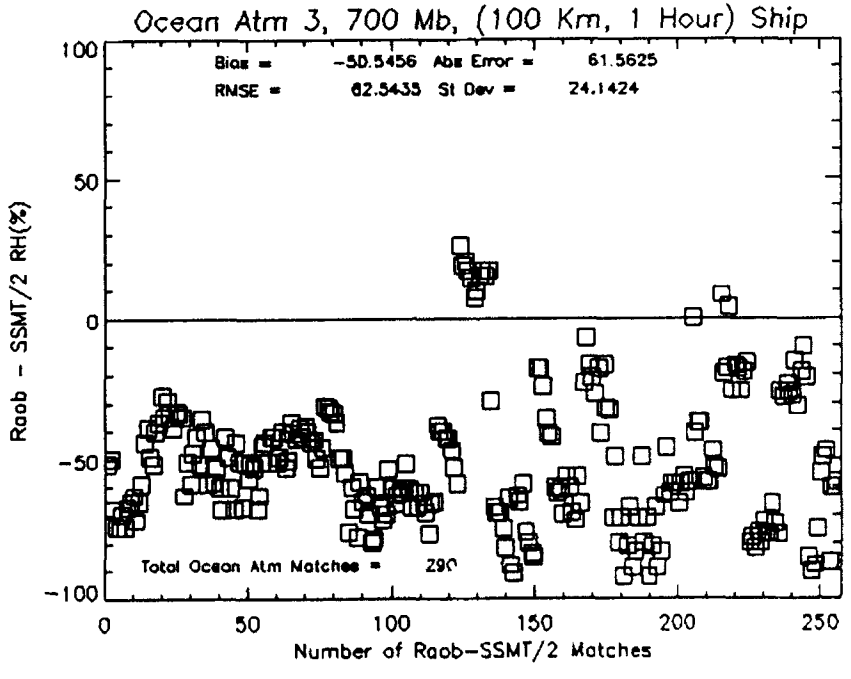
Ocean Atm 2, 850 Mb, (100 Km, 1 Hour) Non Ship
Bias = -2.18069 Abs Error = 15.3205
RMSE = 17.0616 St Dev = 18.2775
Total Ocean Atm Matches = 25
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

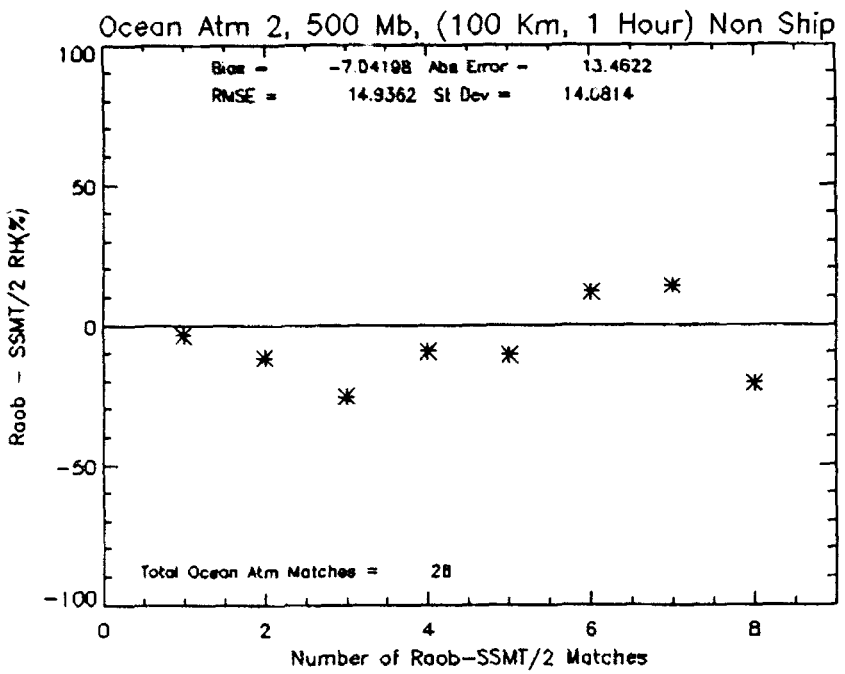
Ocean Atm 2, 850 Mb, (100 Km, 1 Hour) Ship
Bias = -51.6760 Abs Error = 53.4490
RMSE = 54.5861 St Dev = 18.1616
Total Ocean Atm Matches = 25
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

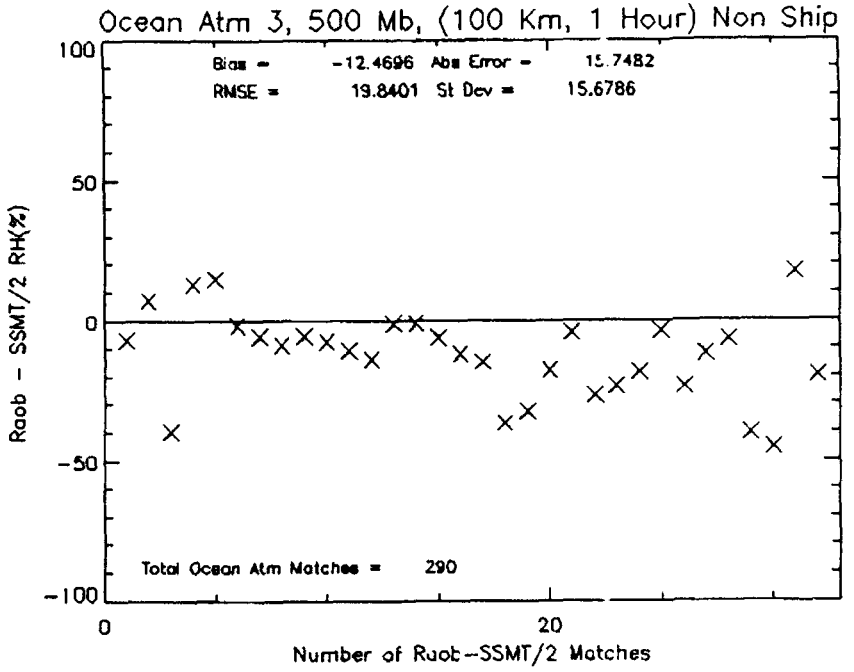

Ocean Atm 2, 700 Mb, (100 Km, 1 Hour) Non Ship
Bias = -8.50588 Abs Error = 14.7050
RMSE = 17.4636 St Dev = 16.4741
Total Ocean Atm Matches = 25
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

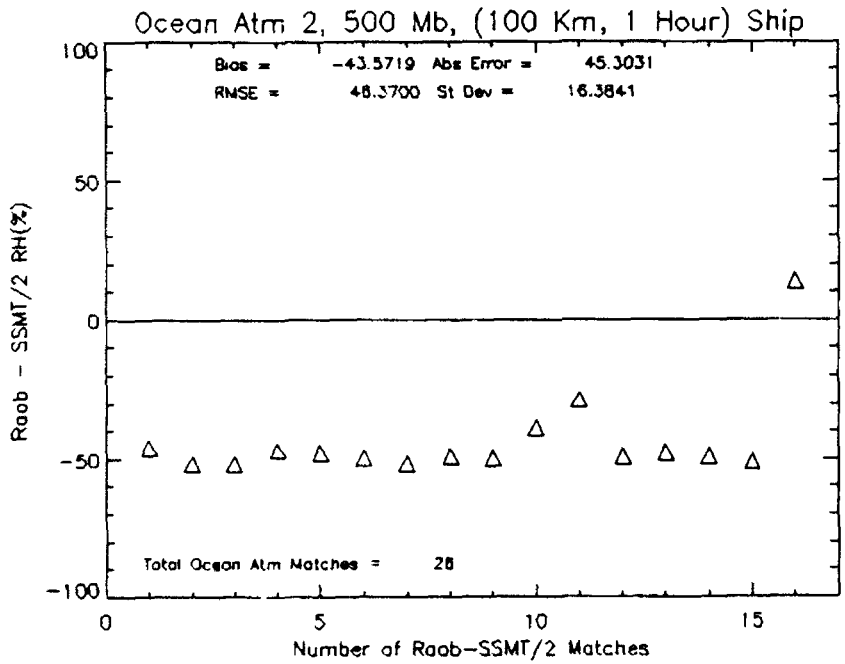

Ocean Atm 3, 700 Mb, (100 Km, 1 Hour) Non Ship
Bias = -15.3919 Abs Error = 20.7361
RMSE = 25.5922 St Dev = 20.7735
Total Ocean Atm Matches = 290
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

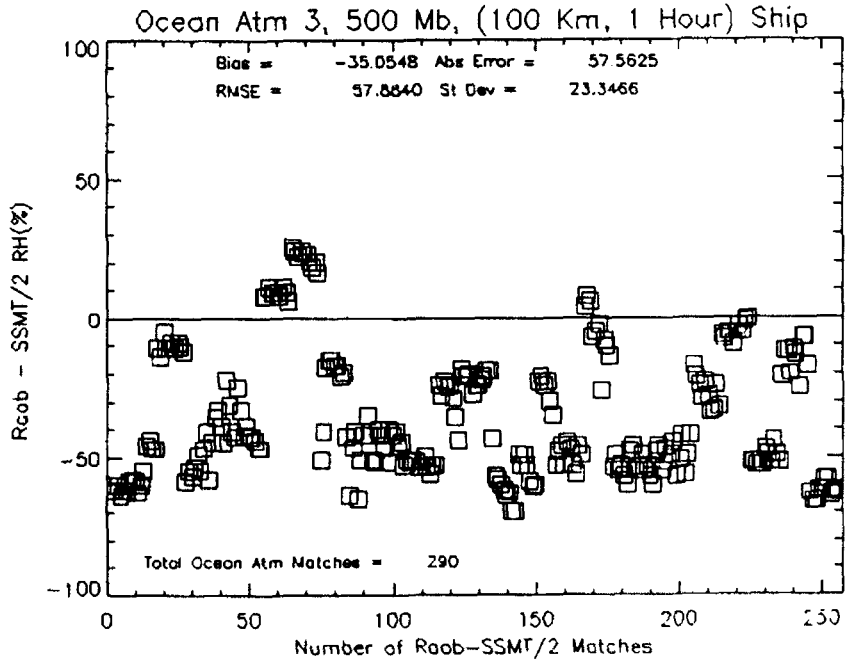

Ocean Atm 2, 700 Mb, (100 Km, 1 Hour) Ship
Bias = -49.8586 Abs Error = 49.8586
RMSE = 51.1284 St Dev = 11.6953
Total Ocean Atm Matches = 25
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

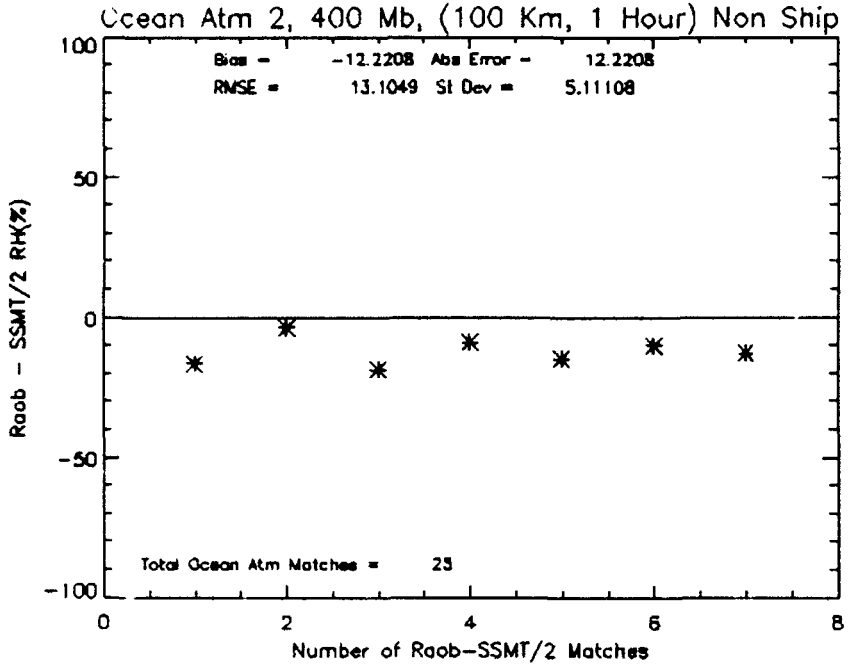

Ocean Atm 3, 700 Mb, (100 Km, 1 Hour) Ship
Bias = -50.5456 Abs Error = 61.5625
RMSE = 62.5435 St Dev = 24.1424
Total Ocean Atm Matches = 290
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

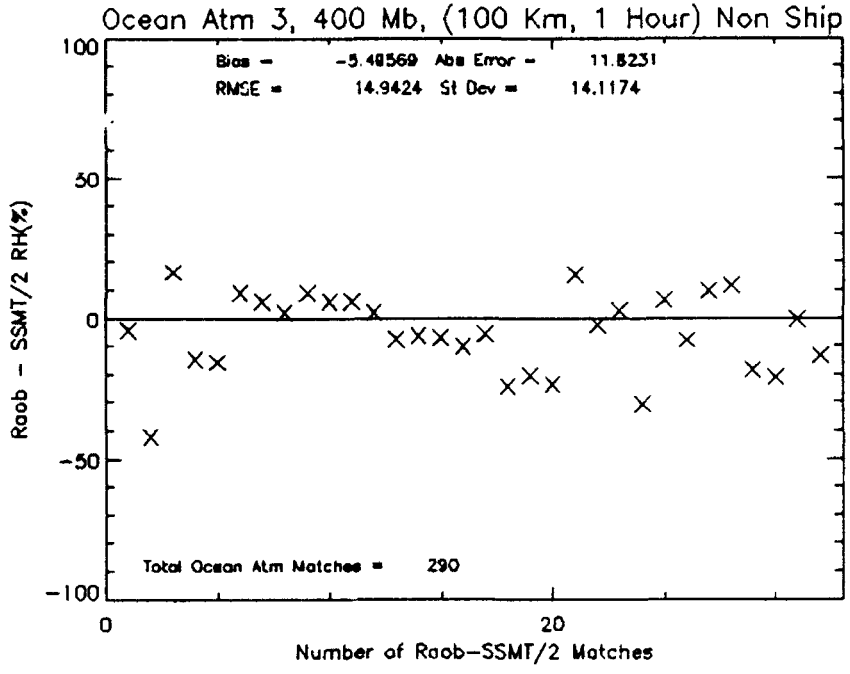

Ocean Atm 2, 500 Mb, (100 Km, 1 Hour) Non Ship
Bias = -7.04198 Abs Error = 13.4622
RMSE = 14.9362 St Dev = 14.0814
Total Ocean Atm Matches = 28
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

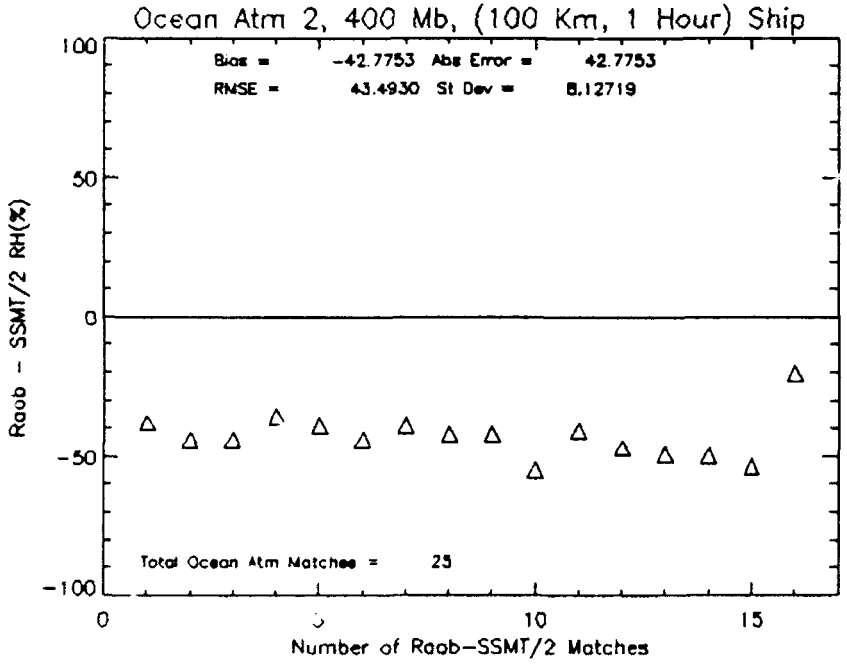

Ocean Atm 3, 500 Mb, (100 Km, 1 Hour) Non Ship
Bias = -12.4696 Abs Error = 15.7482
RMSE = 19.8401 St Dev = 15.6786
Total Ocean Atm Matches = 290
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

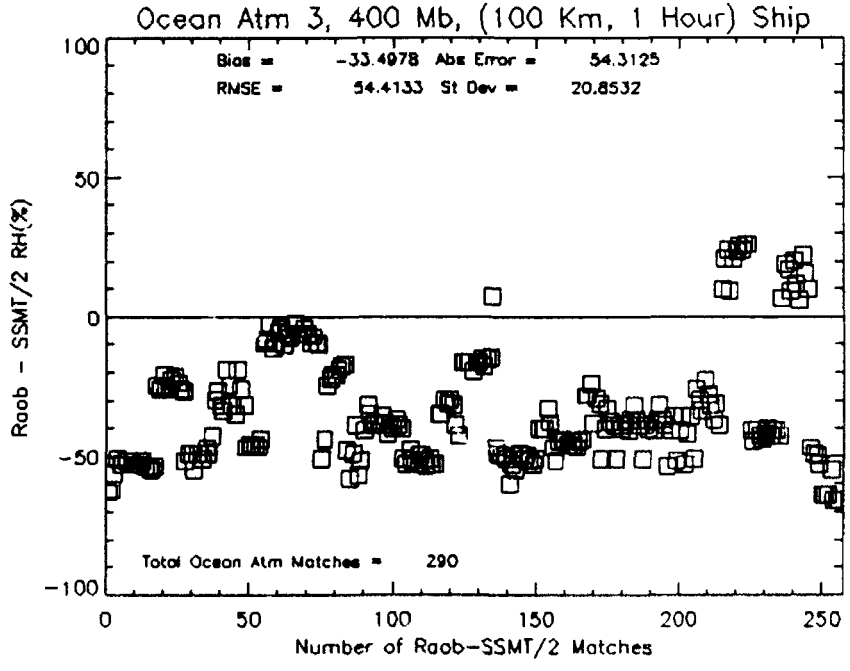

Ocean Atm 2, 500 Mb, (100 Km, 1 Hour) Ship
Bias = -43.5719 Abs Error = 45.3031
RMSE = 48.3700 St Dev = 16.3841
Total Ocean Atm Matches = 28
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

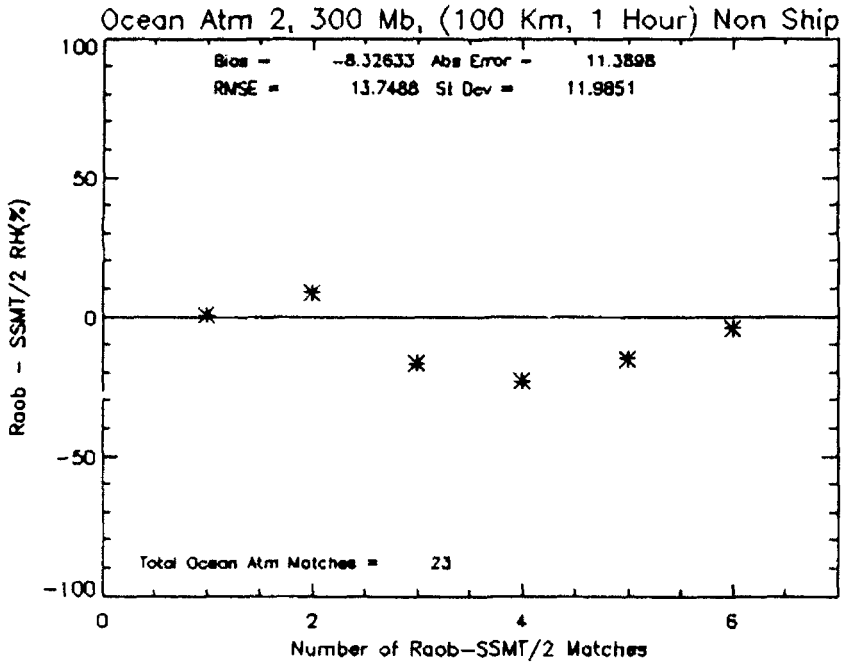

Ocean Atm 3, 500 Mb, (100 Km, 1 Hour) Ship
Bias = -35.0548 Abs Error = 57.5625
RMSE = 57.8840 St Dev = 23.3466
Total Ocean Atm Matches = 290
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

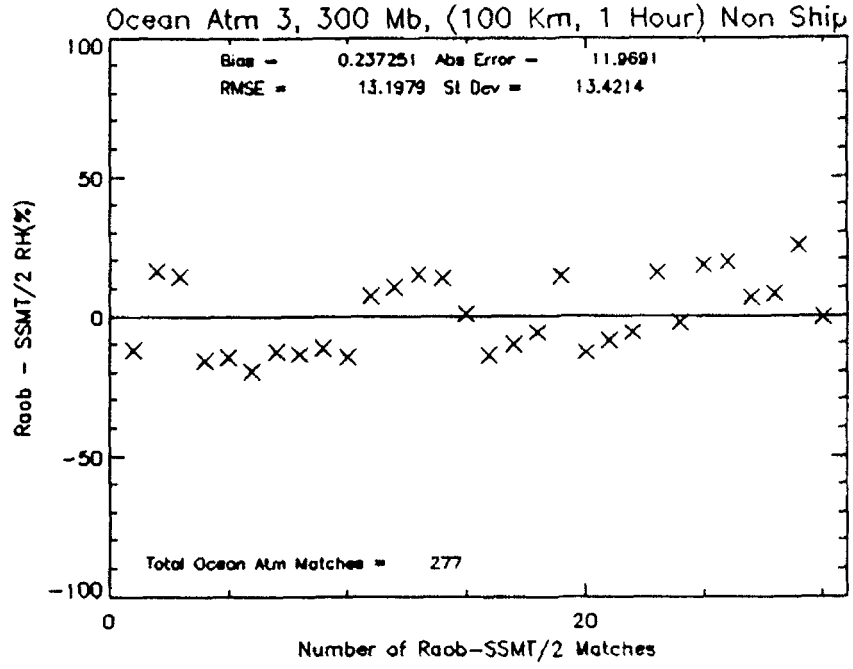

Ocean Atm 2, 400 Mb, (100 Km, 1 Hour) Non Ship
Bias = -12.2208 Abs Error = 12.2208
RMSE = 13.1049 St Dev = 5.11108
Total Ocean Atm Matches = 25
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

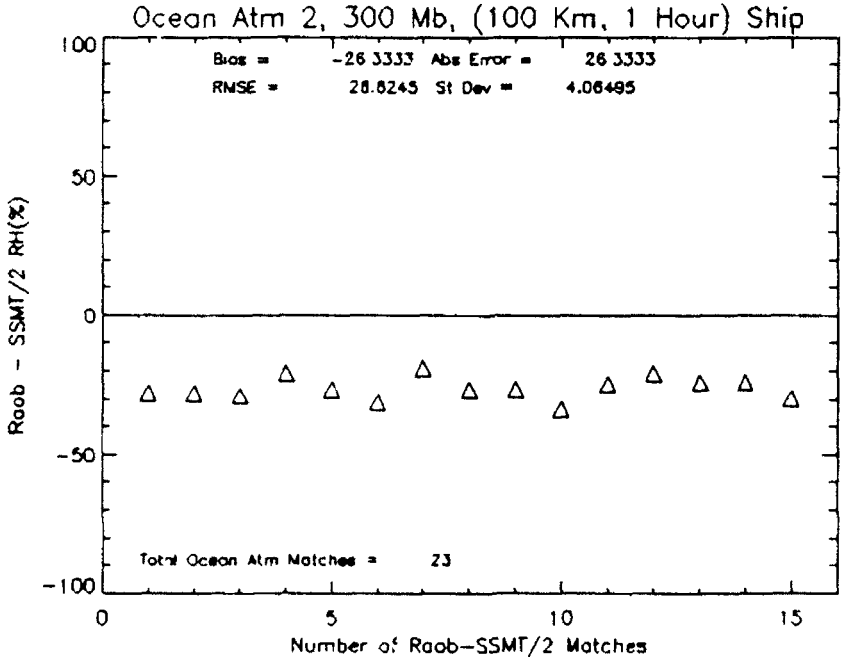

Ocean Atm 3, 400 Mb, (100 Km, 1 Hour) Non Ship
Bias = -5.48569 Abs Error = 11.8231
RMSE = 14.9424 St Dev = 14.1174
Total Ocean Atm Matches = 290
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

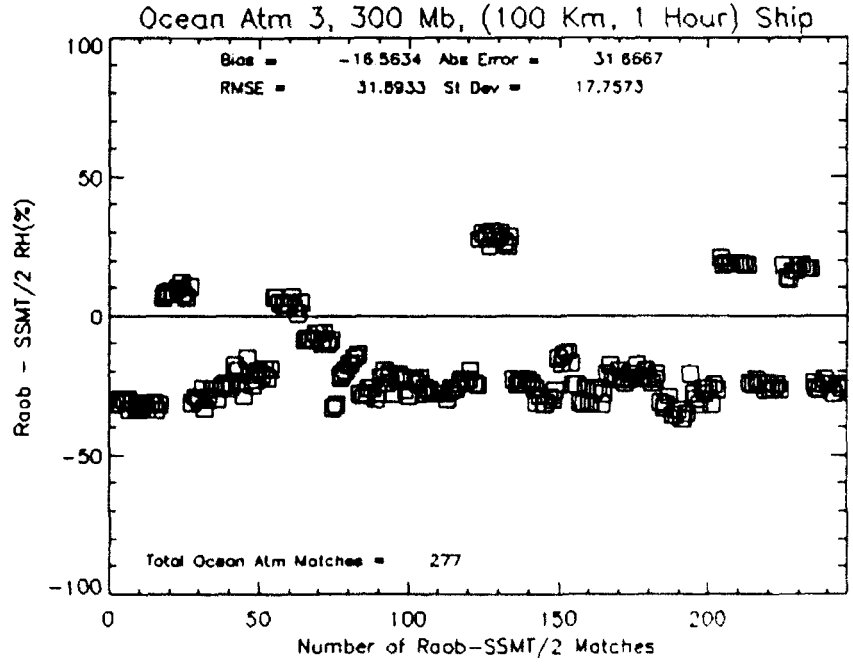

Ocean Atm 2, 400 Mb, (100 Km, 1 Hour) Ship
Bias = -42.7753 Abs Error = 42.7753
RMSE = 43.4930 St Dev = 8.12719
Total Ocean Atm Matches = 25
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

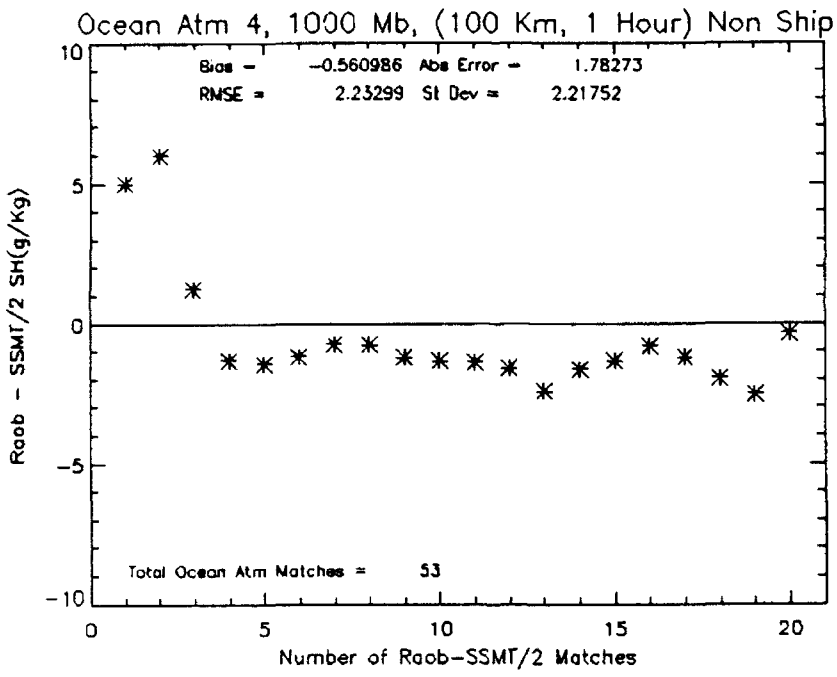

Ocean Atm 3, 400 Mb, (100 Km, 1 Hour) Ship
Bias = -33.4978 Abs Error = 54.3125
RMSE = 54.4133 St Dev = 20.8532
Total Ocean Atm Matches = 290
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

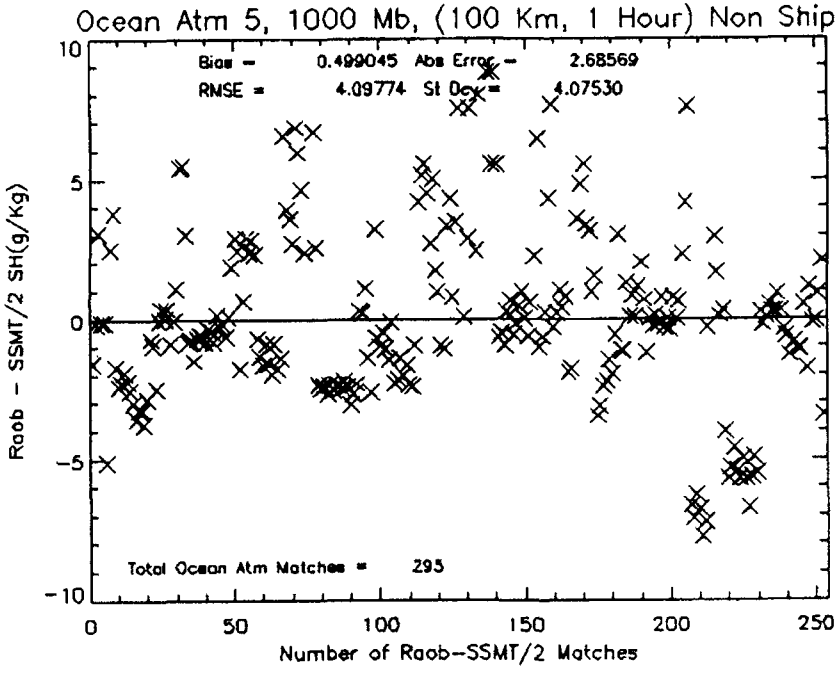

Ocean Atm 2, 300 Mb, (100 Km, 1 Hour) Non Ship
Bias = -8.32633 Abs Error = 11.3898
RMSE = 13.7488 St Dev = 11.9851
Total Ocean Atm Matches = 23
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

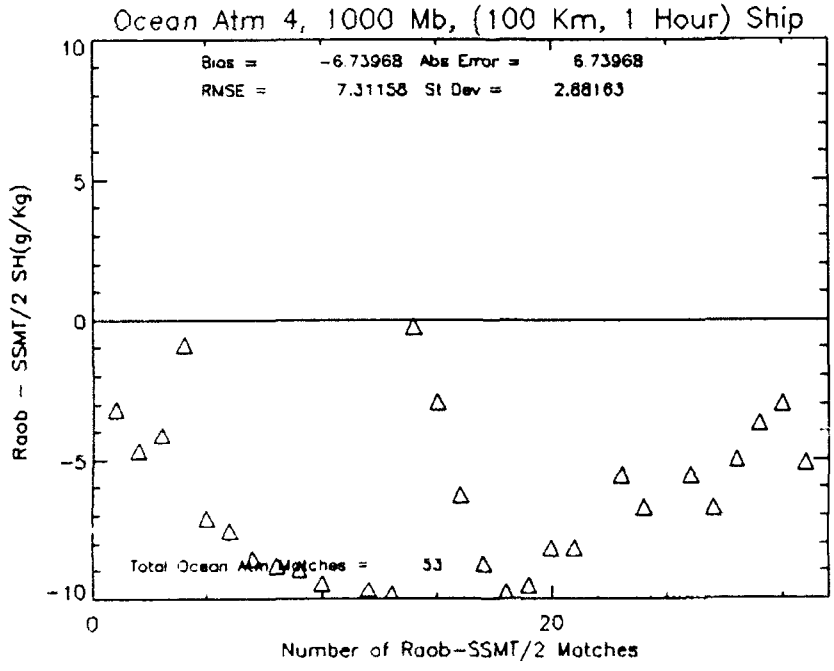

Ocean Atm 3, 300 Mb, (100 Km, 1 Hour) Non Ship
Bias = 0.237251 Abs Error = 11.9691
RMSE = 13.1979 St Dev = 13.4214
Total Ocean Atm Matches = 277
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

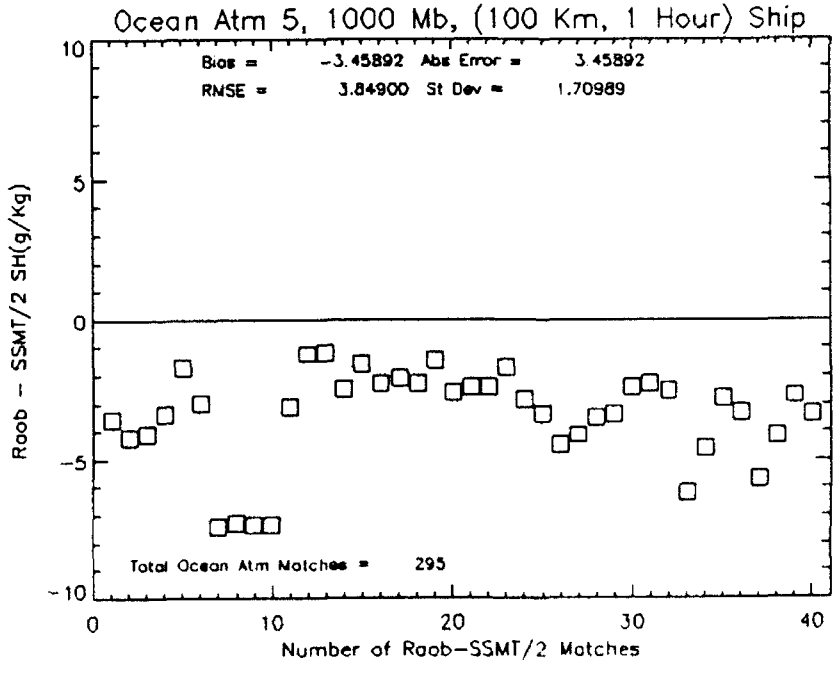

Ocean Atm 2, 300 Mb, (100 Km, 1 Hour) Ship
Bias = -26.3333 Abs Error = 26.3333
RMSE = 26.6245 St Dev = 4.06495
Total Ocean Atm Matches = 23
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

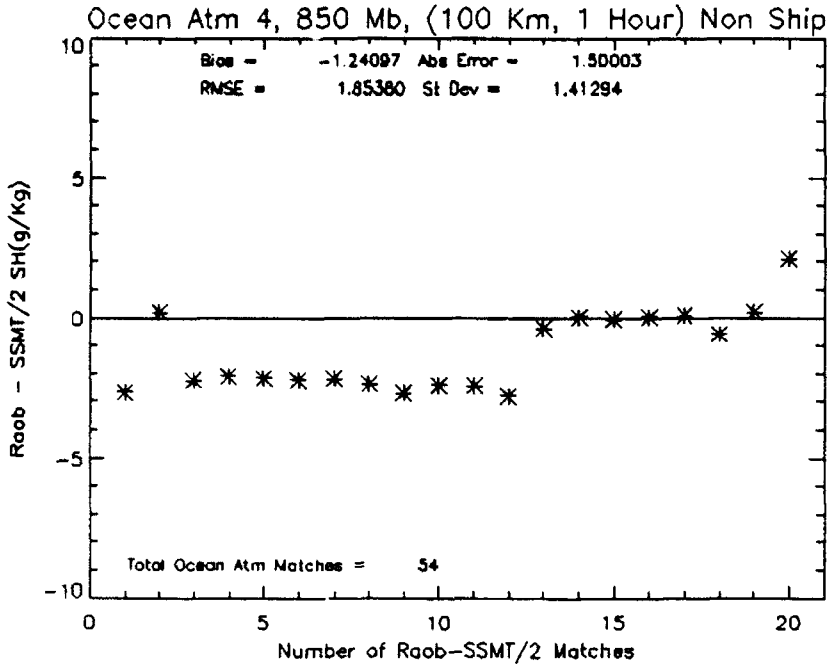

Ocean Atm 3, 300 Mb, (100 Km, 1 Hour) Ship
Bias = -16.5634 Abs Error = 31.6667
RMSE = 31.8933 St Dev = 17.7573
Total Ocean Atm Matches = 277
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

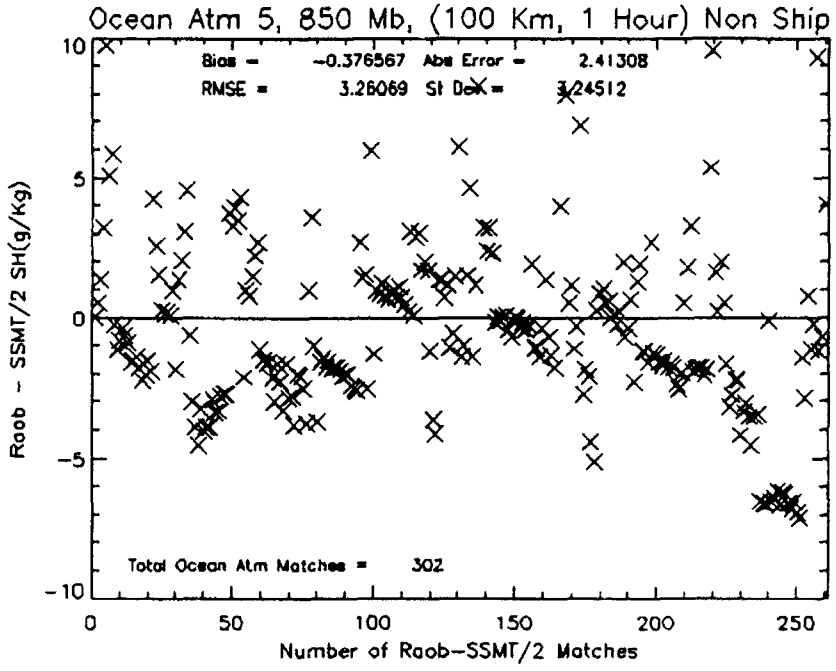

Ocean Atm 4, 1000 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.560986 Abs Error = 1.78273
RNSE = 2.23299 St Dev = 2.21752
Total Ocean Atm Matches = 53
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

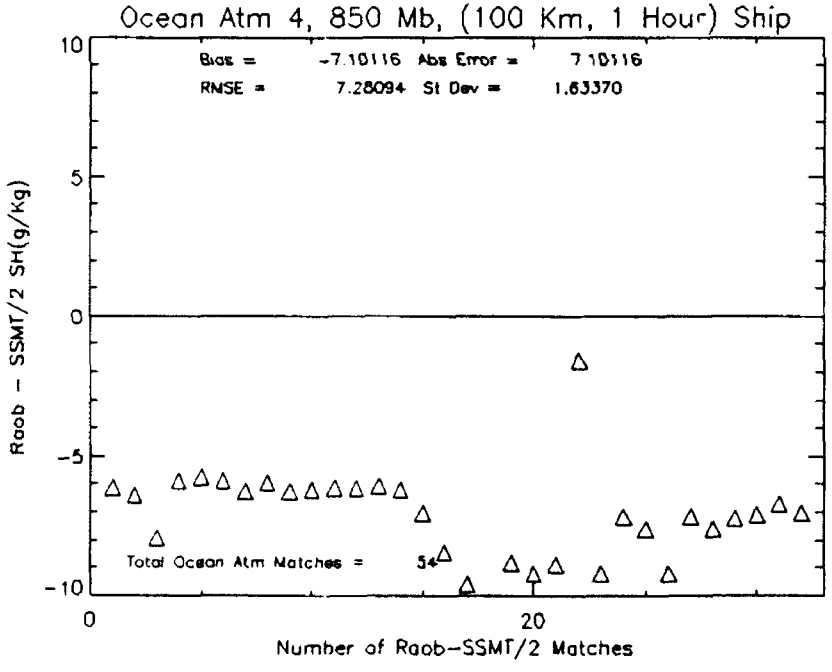

Ocean Atm 5, 1000 Mb, (100 Km, 1 Hour) Non Ship
Bias = 0.499045 Abs Error = 2.68569
RNSE = 4.09774 St Dev = 4.07530
Total Ocean Atm Matches = 295
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

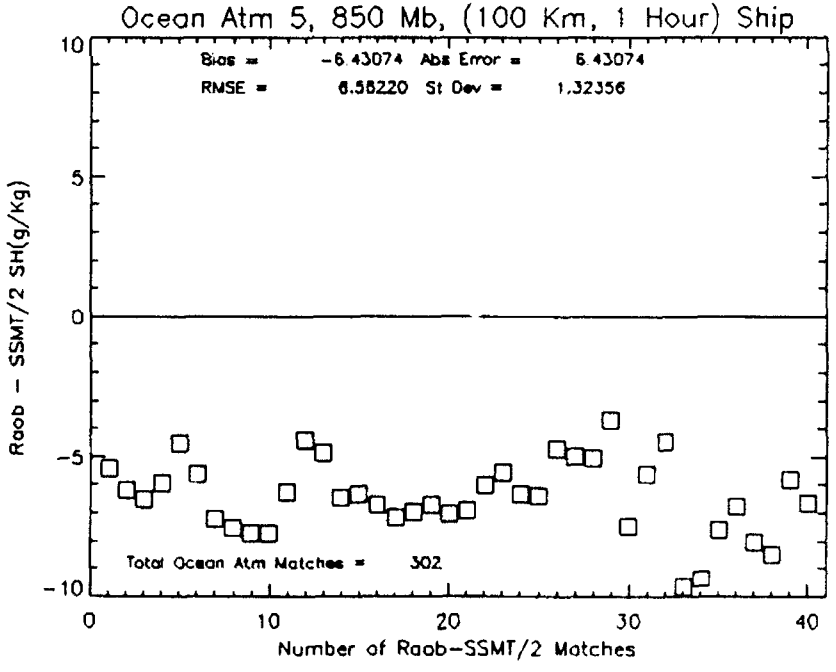

Ocean Atm 4, 1000 Mb, (100 Km, 1 Hour) Ship
Bias = -6.73968 Abs Error = 6.73968
RNSE = 7.31158 St Dev = 2.88163
Total Ocean Atm Matches = 53
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

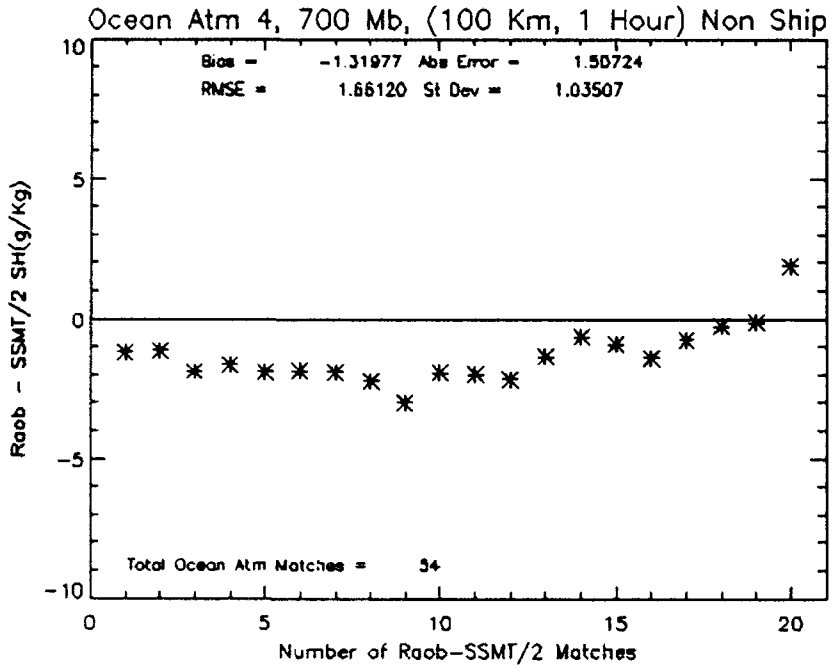

Ocean Atm 5, 1000 Mb, (100 Km, 1 Hour) Ship
Bias = -3.45892 Abs Error = 3.45892
RNSE = 3.84900 St Dev = 1.70989
Total Ocean Atm Matches = 295
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

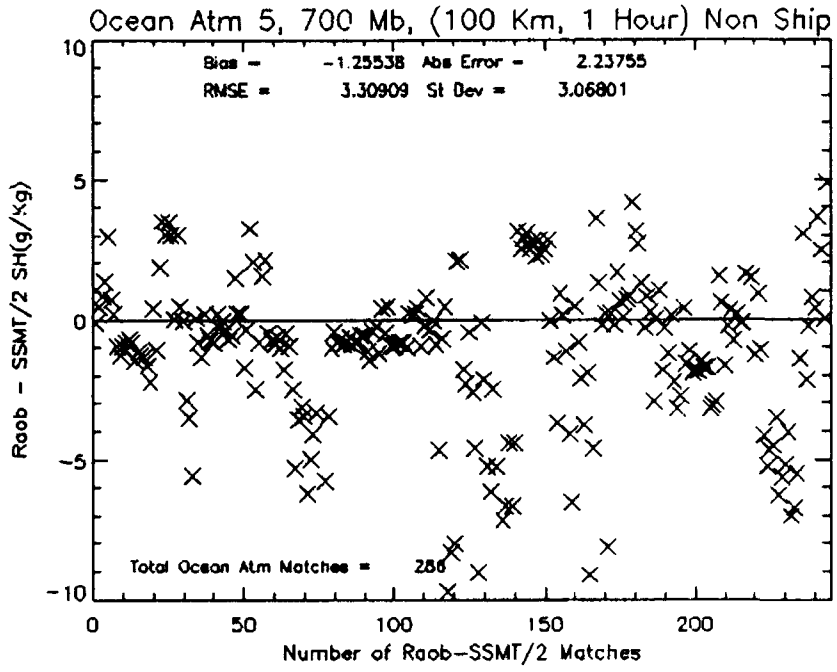

Ocean Atm 4, 850 Mb, (100 Km, 1 Hour) Non Ship
Bias = -1.24097 Abs Error = 1.50003
RMSE = 1.85380 St Dev = 1.41294
Total Ocean Atm Matches = 54
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

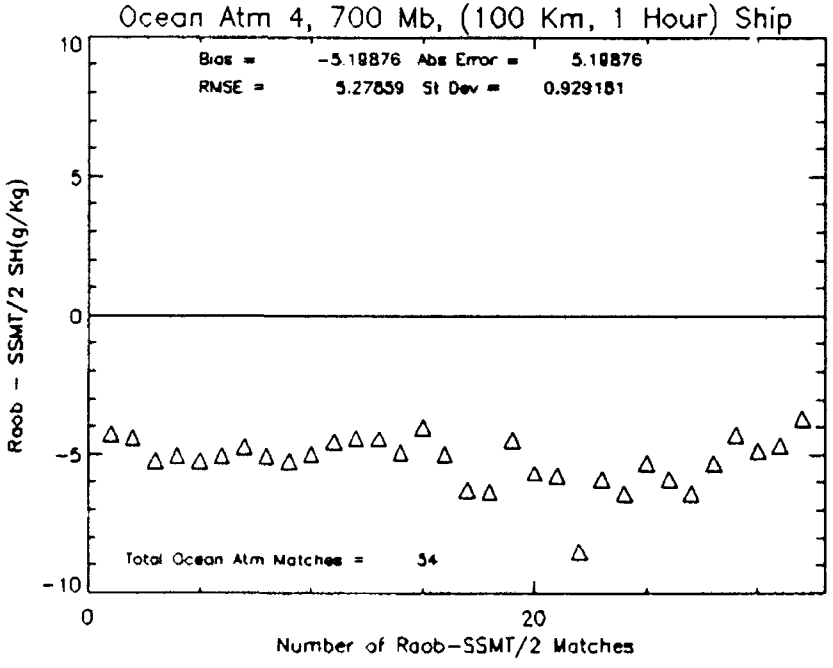

Ocean Atm 5, 850 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.376567 Abs Error = 2.41308
RMSE = 3.26069 St Dev = 3.24512
Total Ocean Atm Matches = 302
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

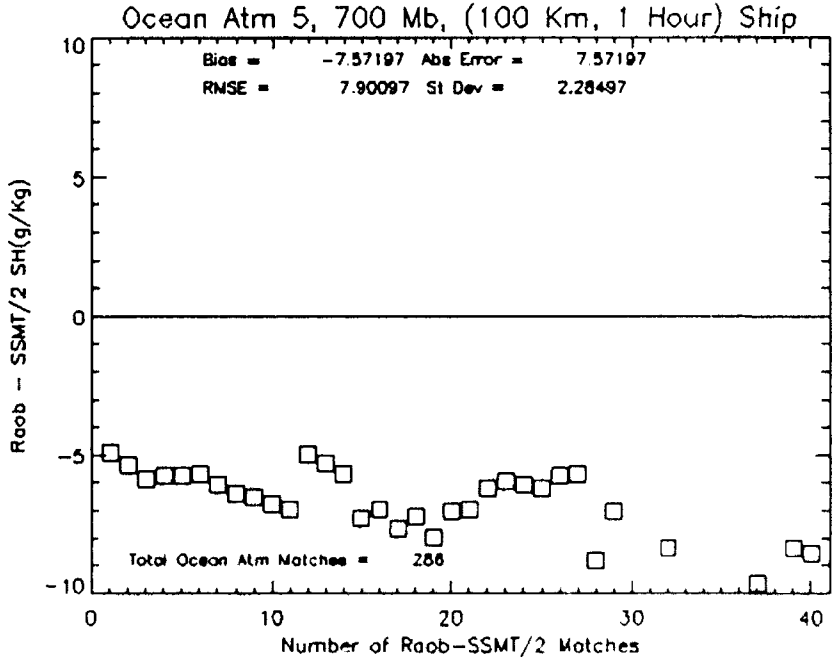

Ocean Atm 4, 850 Mb, (100 Km, 1 Hour) Ship
Bias = -7.10116 Abs Error = 7.10116
RMSE = 7.28094 St Dev = 1.63370
Total Ocean Atm Matches = 54
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

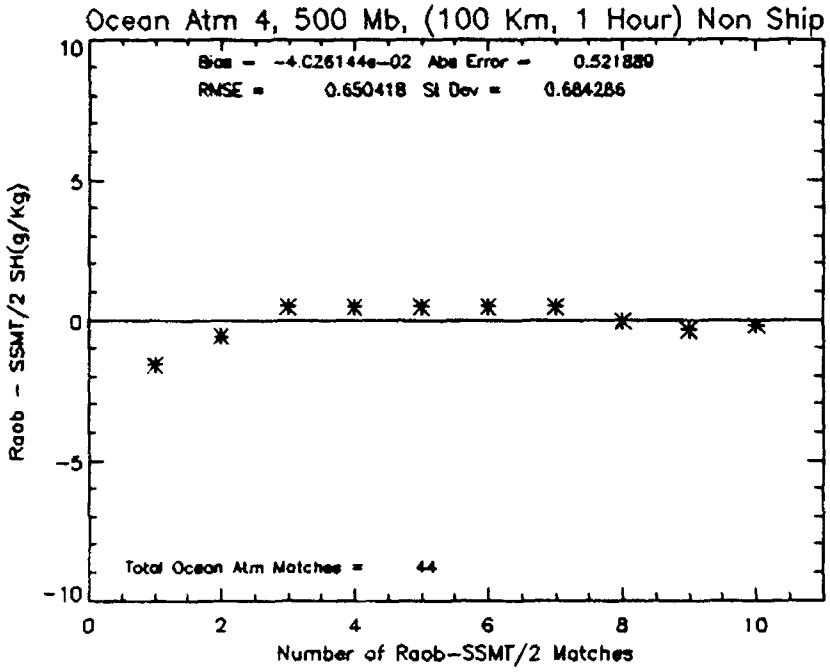

Ocean Atm 5, 850 Mb, (100 Km, 1 Hour) Ship
Bias = -6.43074 Abs Error = 6.43074
RMSE = 6.58220 St Dev = 1.32356
Total Ocean Atm Matches = 302
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

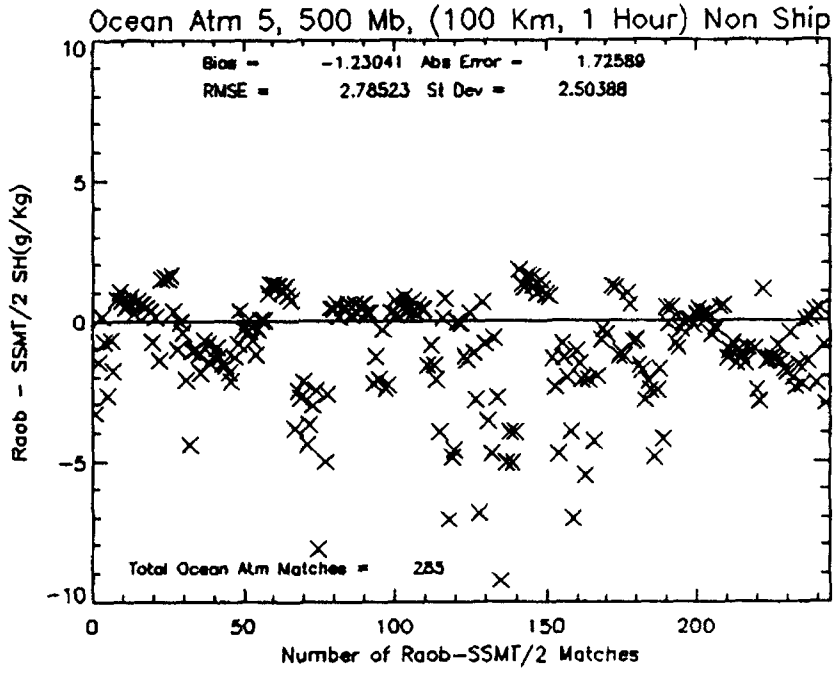

Ocean Atm 4, 700 Mb, (100 Km, 1 Hour) Non Ship
Bias = -1.31977 Abs Error = 1.50724
RMSE = 1.66120 St Dev = 1.03507
Total Ocean Atm Matches = 54
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

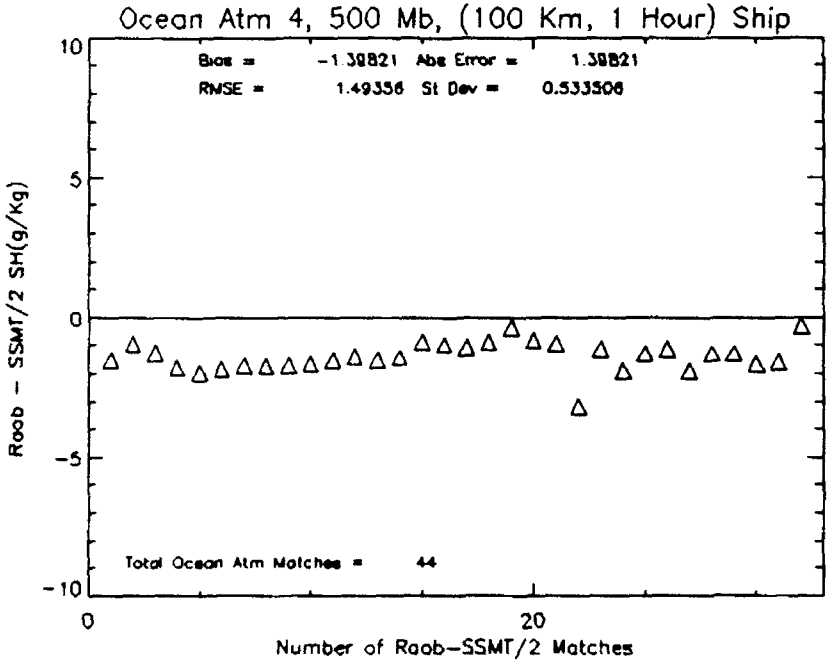

Ocean Atm 5, 700 Mb, (100 Km, 1 Hour) Non Ship
Bias = -1.25538 Abs Error = 2.23755
RMSE = 3.30909 St Dev = 3.06801
Total Ocean Atm Matches = 286
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

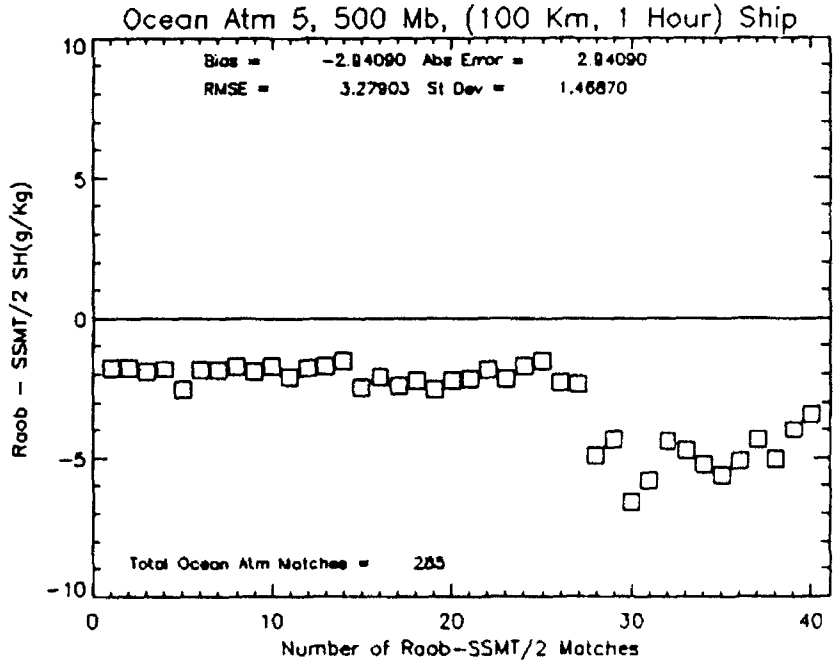

Ocean Atm 4, 700 Mb, (100 Km, 1 Hour) Ship
Bias = -5.18876 Abs Error = 5.18876
RMSE = 5.27859 St Dev = 0.929181
Total Ocean Atm Matches = 54
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

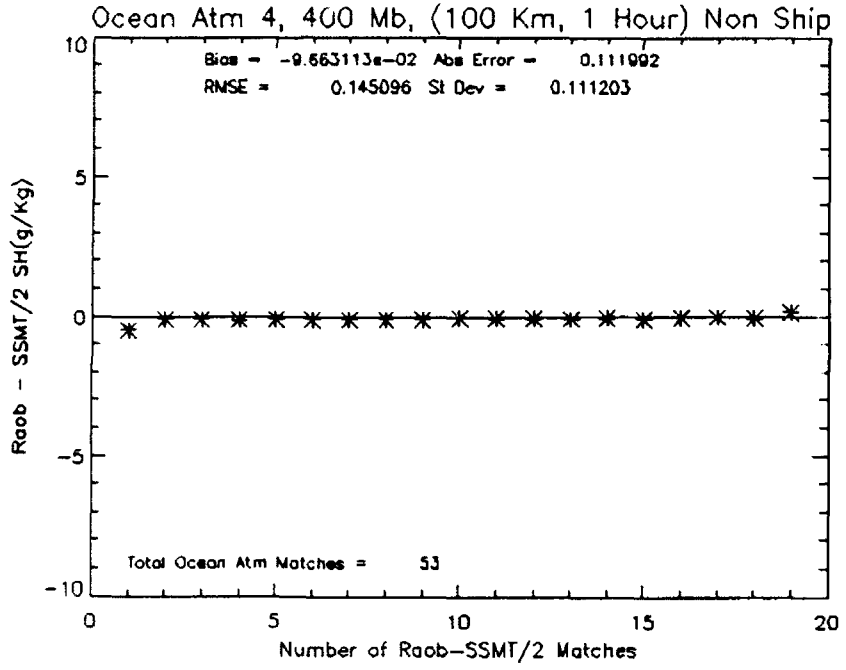

Ocean Atm 5, 700 Mb, (100 Km, 1 Hour) Ship
Bias = -7.57197 Abs Error = 7.57197
RMSE = 7.90097 St Dev = 2.26497
Total Ocean Atm Matches = 286
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

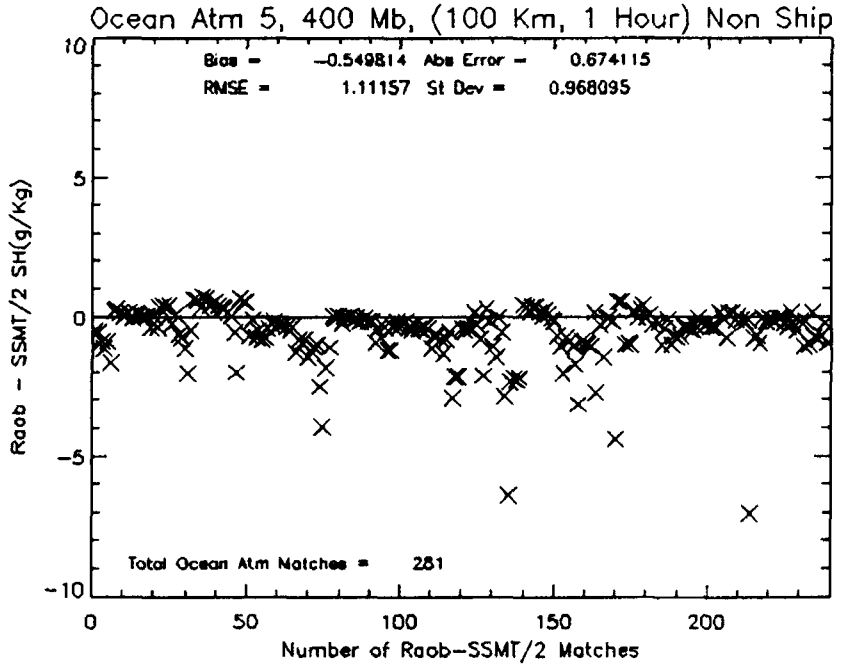

Ocean Atm 4, 500 Mb, (100 Km, 1 Hour) Non Ship
Bias = -4.C26144e-02 Abs Error = 0.521889
RMSE = 0.650418 St Dev = 0.684286
Total Ocean Atm Matches = 44
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

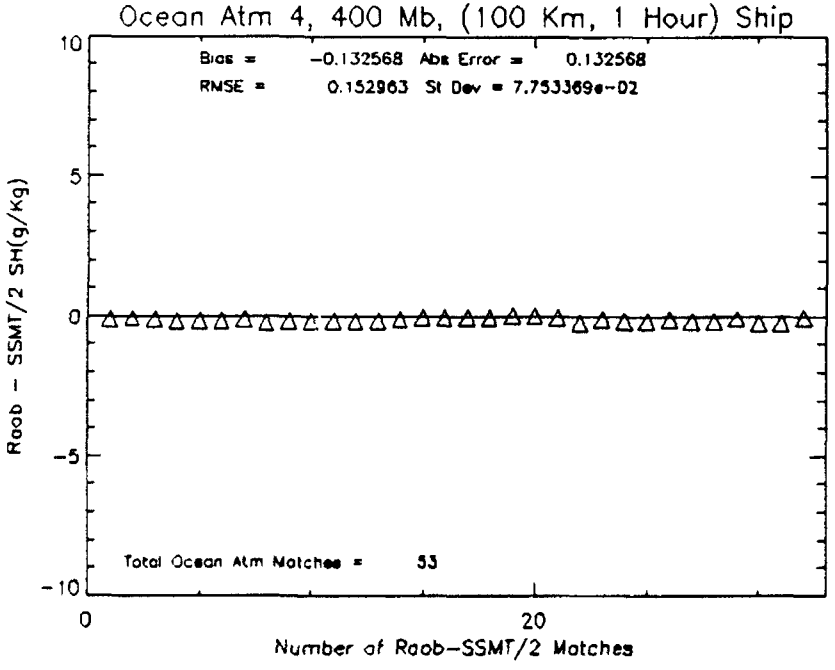

Ocean Atm 5, 500 Mb, (100 Km, 1 Hour) Non Ship
Bias = -1.23041 Abs Error = 1.72589
RMSE = 2.78523 St Dev = 2.50388
Total Ocean Atm Matches = 285
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

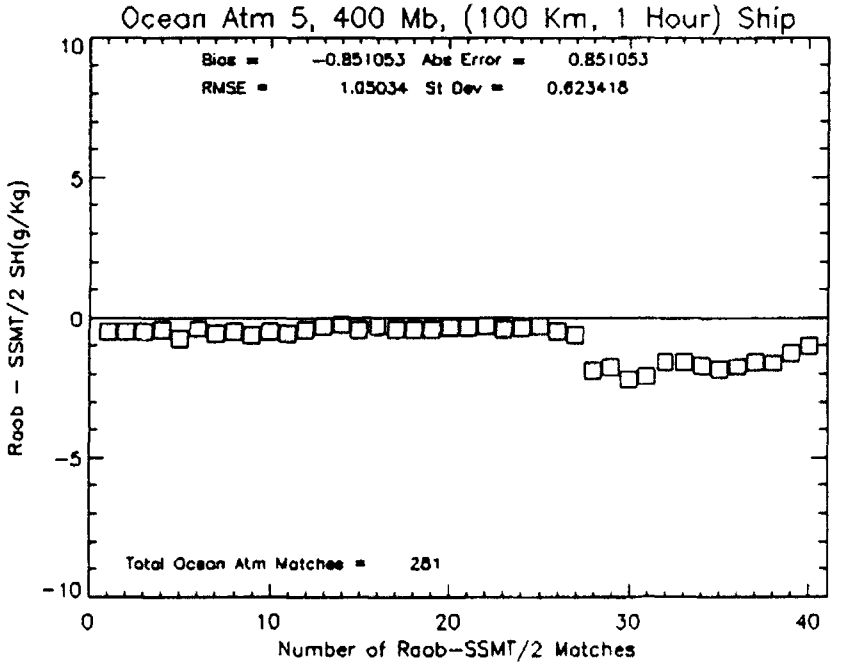

Ocean Atm 4, 500 Mb, (100 Km, 1 Hour) Ship
Bias = -1.38821 Abs Error = 1.38821
RMSE = 1.49356 St Dev = 0.533506
Total Ocean Atm Matches = 44
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

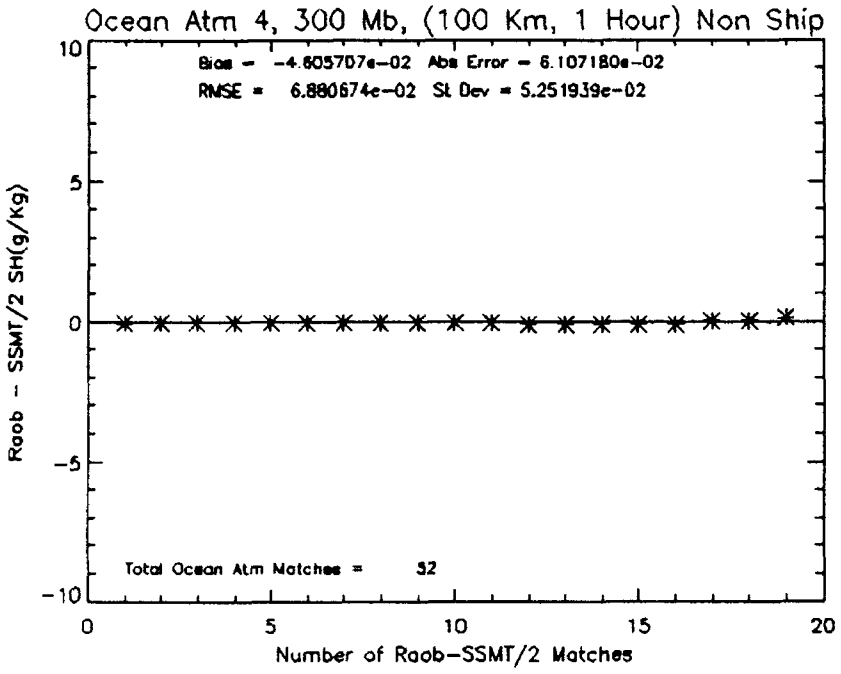

Ocean Atm 5, 500 Mb, (100 Km, 1 Hour) Ship
Bias = -2.84090 Abs Error = 2.84090
RMSE = 3.27803 St Dev = 1.46870
Total Ocean Atm Matches = 285
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

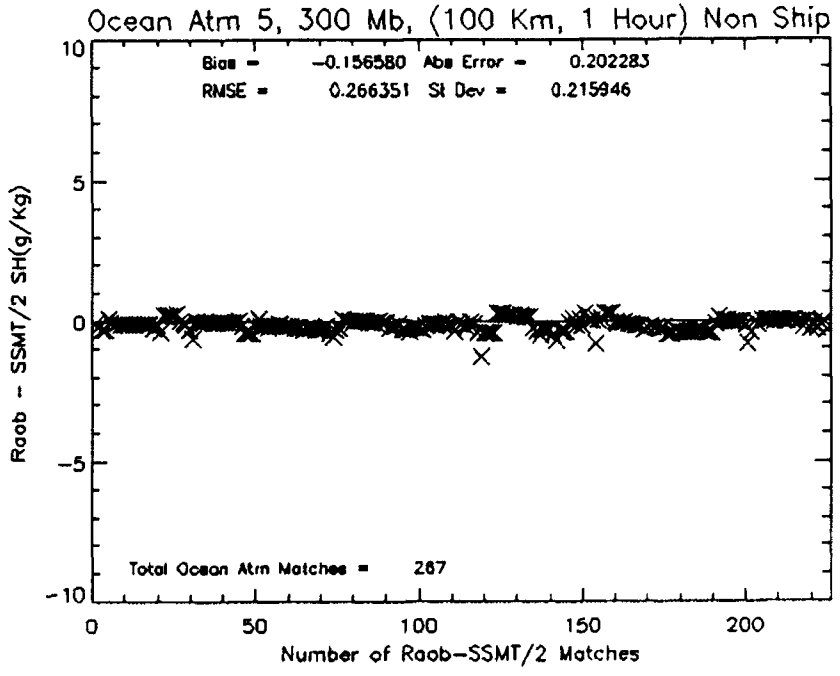

Ocean Atm 4, 400 Mb, (100 Km, 1 Hour) Non Ship
Bias = -9.663113e-02 Abs Error = 0.111992
RMSE = 0.145096 St Dev = 0.111203
Total Ocean Atm Matches = 53
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

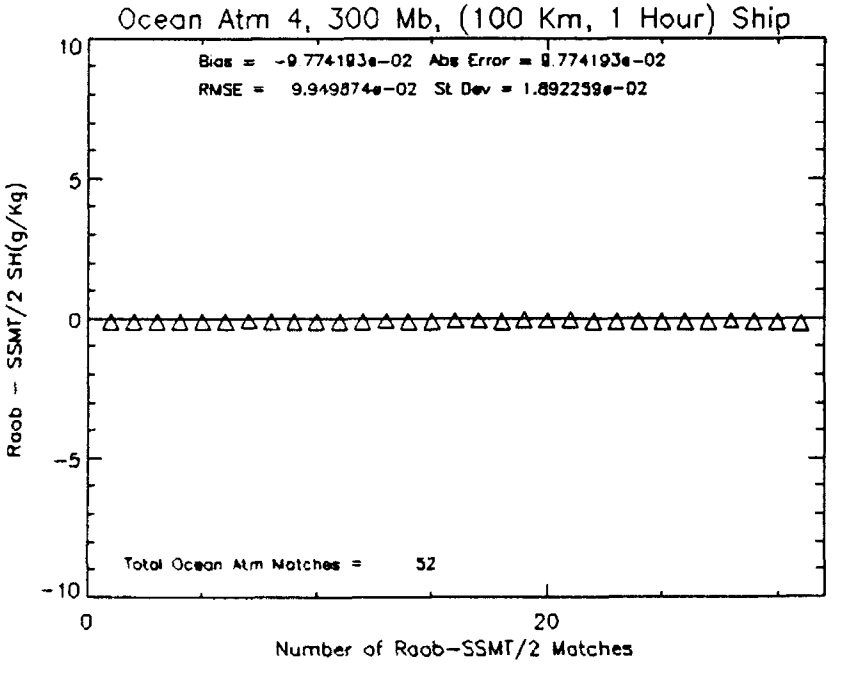

Ocean Atm 5, 400 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.549814 Abs Error = 0.674115
RMSE = 1.11157 St Dev = 0.968095
Total Ocean Atm Matches = 281
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

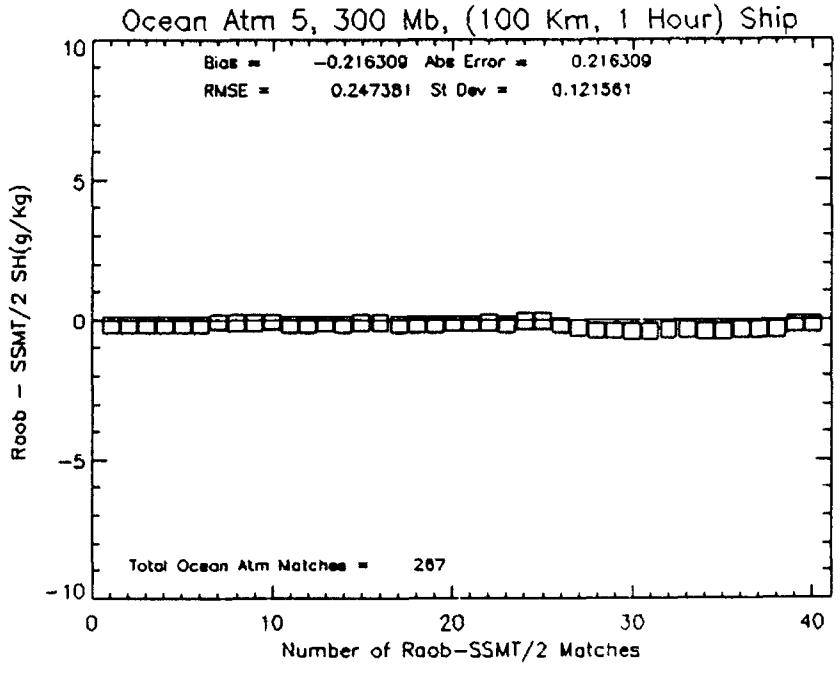

Ocean Atm 4, 400 Mb, (100 Km, 1 Hour) Ship
Bias = -0.132568 Abs Error = 0.132568
RMSE = 0.152963 St Dev = 7.753369e-02
Total Ocean Atm Matches = 53
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

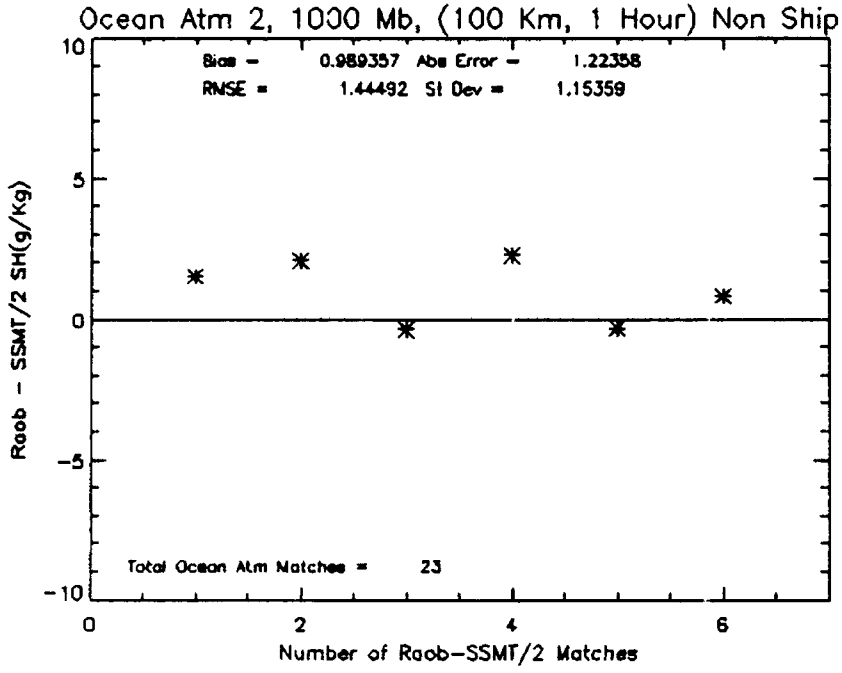

Ocean Atm 5, 400 Mb, (100 Km, 1 Hour) Ship
Bias = -0.851053 Abs Error = 0.851053
RMSE = 1.05034 St Dev = 0.623418
Total Ocean Atm Matches = 281
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

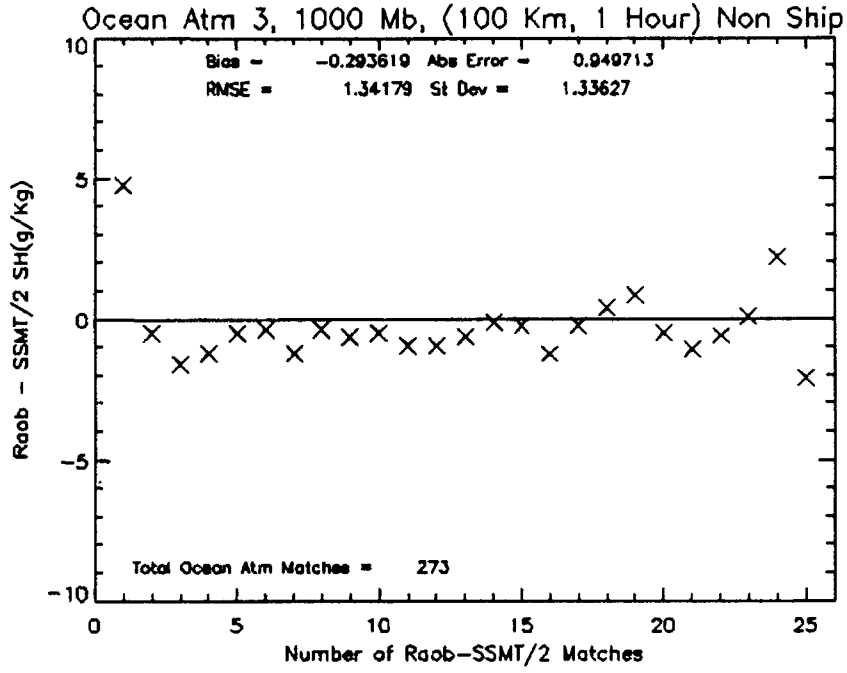

Ocean Atm 4, 300 Mb, (100 Km, 1 Hour) Non Ship
Bias = -4.605707e-02 Abs Error = 6.107180e-02
RMSE = 6.880674e-02 St Dev = 5.251939e-02
Total Ocean Atm Matches = 52
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

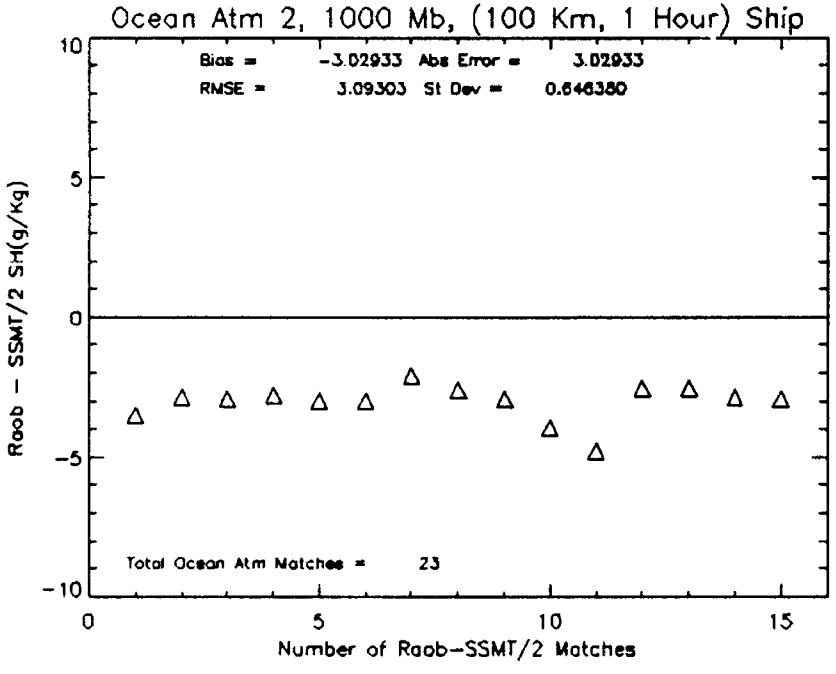

Ocean Atm 5, 300 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.156580 Abs Error = 0.202283
RMSE = 0.266351 St Dev = 0.215946
Total Ocean Atm Matches = 267
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

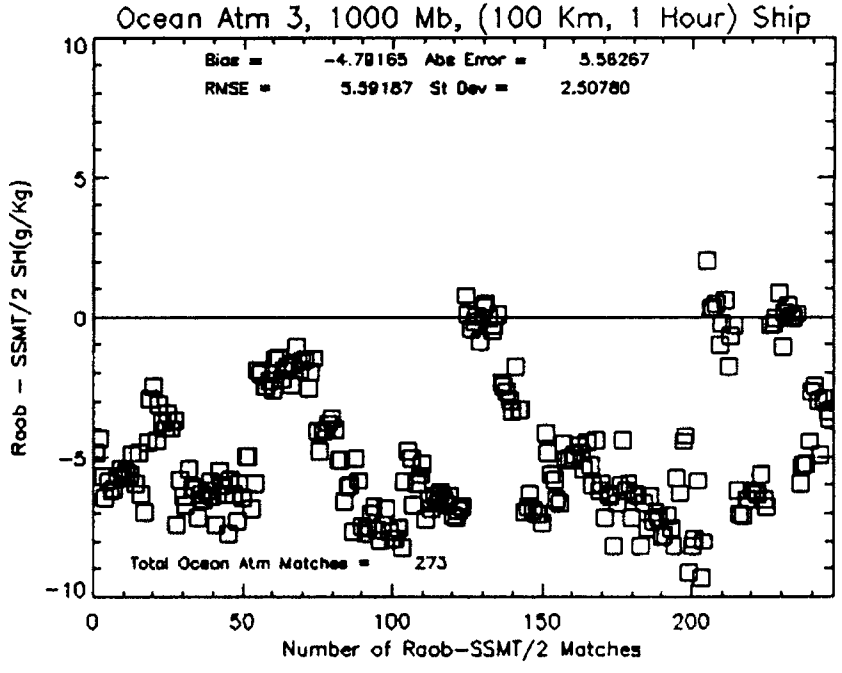

Ocean Atm 4, 300 Mb, (100 Km, 1 Hour) Ship
Bias = -9.774193e-02 Abs Error = 9.774193e-02
RMSE = 9.949874e-02 St Dev = 1.892259e-02
Total Ocean Atm Matches = 52
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 300 Mb, (100 Km, 1 Hour) Ship
Bias = -0.216309 Abs Error = 0.216309
RMSE = 0.247381 St Dev = 0.121561
Total Ocean Atm Matches = 267
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 1000 Mb, (100 Km, 1 Hour) Non Ship
Bias = 0.989357 Abs Error = 1.22358
RMSE = 1.44492 St Dev = 1.15359
Total Ocean Atm Matches = 23
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 1000 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.293619 Abs Error = 0.949713
RMSE = 1.34179 St Dev = 1.33627
Total Ocean Atm Matches = 273
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 1000 Mb, (100 Km, 1 Hour) Ship
Bias = -3.02933 Abs Error = 3.02933
RMSE = 3.09303 St Dev = 0.646380
Total Ocean Atm Matches = 23
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

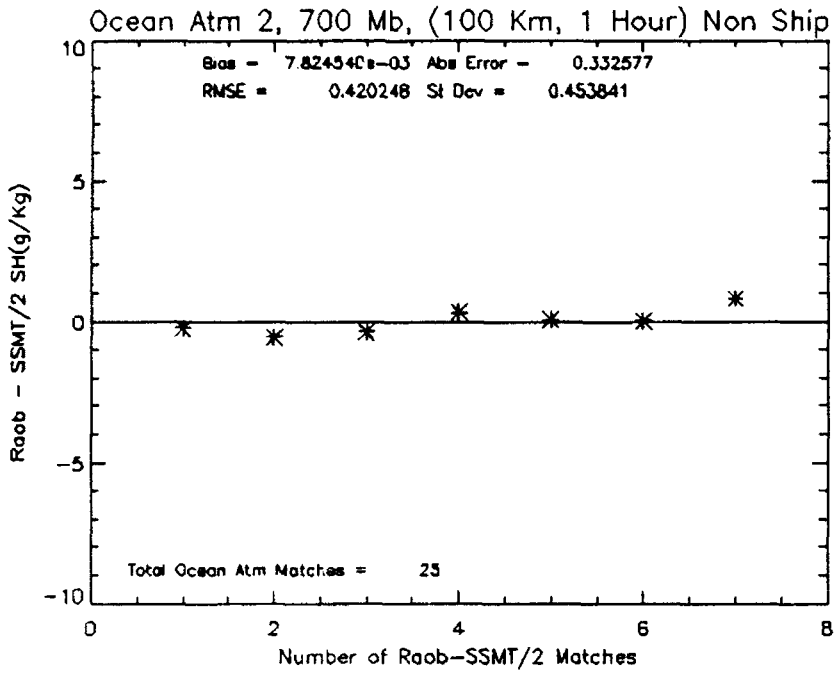

Ocean Atm 3, 1000 Mb, (100 Km, 1 Hour) Ship
Bias = -4.78165 Abs Error = 5.58267
RMSE = 5.39187 St Dev = 2.50780
Total Ocean Atm Matches = 273
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

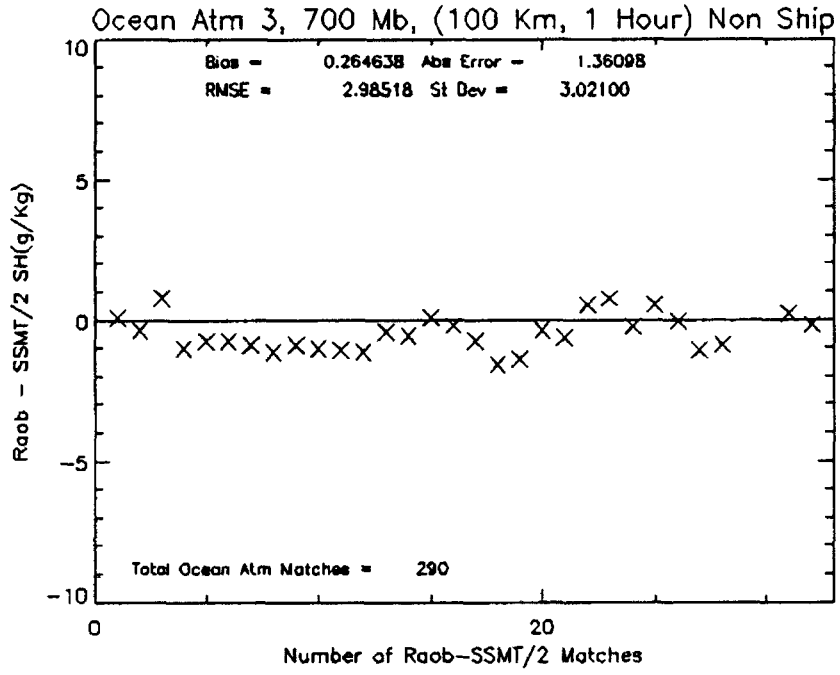
Ocean Atm 3, 850 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.504120 Abs Error = 2.10711
RMSE = 3.10740 St Dev = 3.11530
Total Ocean Atm Matches = 290
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

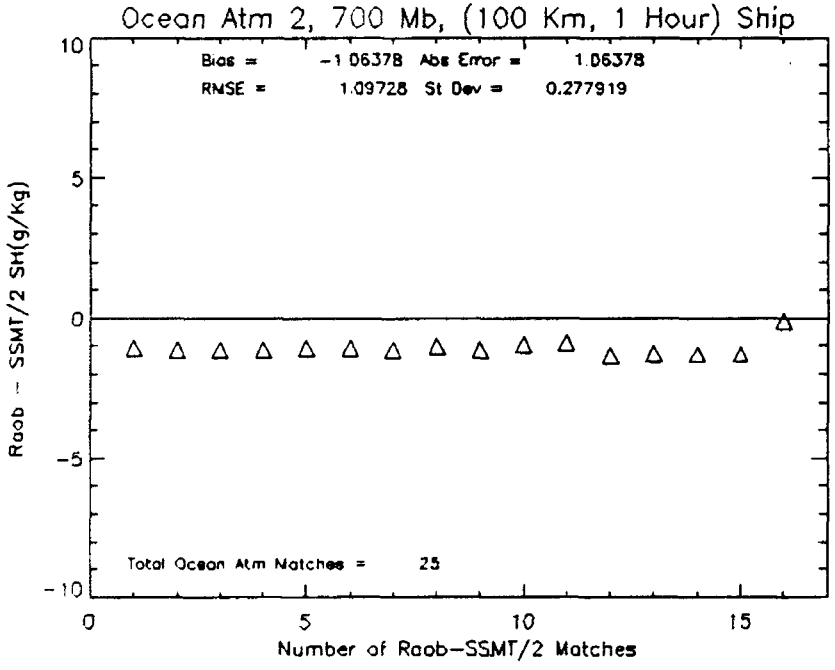
Ocean Atm 3, 850 Mb, (100 Km, 1 Hour) Ship
Bias = -3.26917 Abs Error = 3.27813
RMSE = 3.31537 St Dev = 1.66322
Total Ocean Atm Matches = 290
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

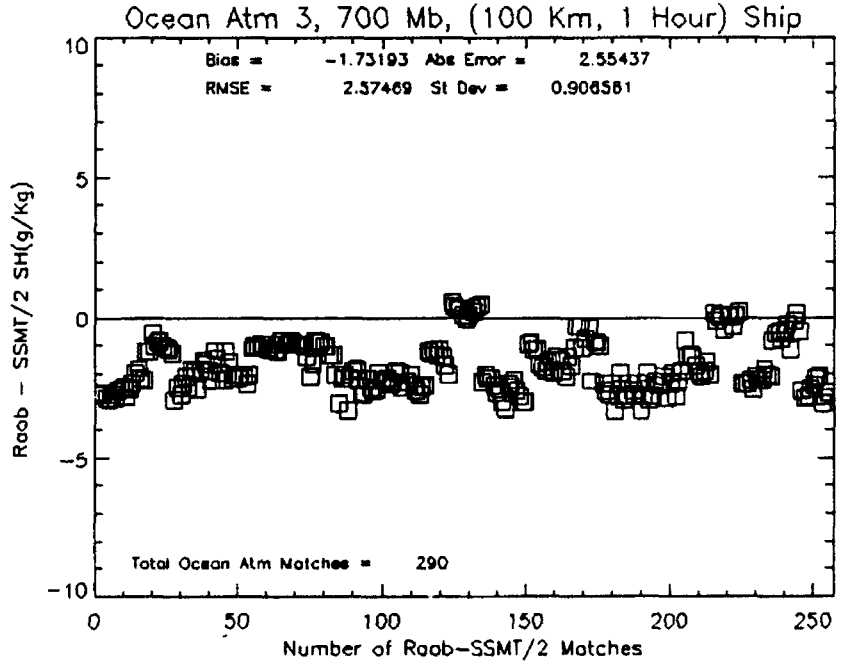
Ocean Atm 2, 850 Mb, (100 Km, 1 Hour) Non Ship
Bias = 0.114986 Abs Error = 0.520655
RMSE = 0.617616 St Dev = 0.655438
Total Ocean Atm Matches = 25
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Ocean Atm 2, 850 Mb, (100 Km, 1 Hour) Ship
Bias = -1.82732 Abs Error = 1.77643
RMSE = 1.78702 St Dev = 0.762833
Total Ocean Atm Matches = 25
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 700 Mb, (100 Km, 1 Hour) Non Ship
Bias = 7.824540e-03 Abs Error = 0.332577
RMSE = 0.420248 St Dev = 0.453841
Total Ocean Atm Matches = 25
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 700 Mb, (100 Km, 1 Hour) Non Ship
Bias = 0.264638 Abs Error = 1.36098
RMSE = 2.98518 St Dev = 3.02100
Total Ocean Atm Matches = 290
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 700 Mb, (100 Km, 1 Hour) Ship
Bias = -1.06378 Abs Error = 1.06378
RMSE = 1.09728 St Dev = 0.277919
Total Ocean Atm Matches = 25
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

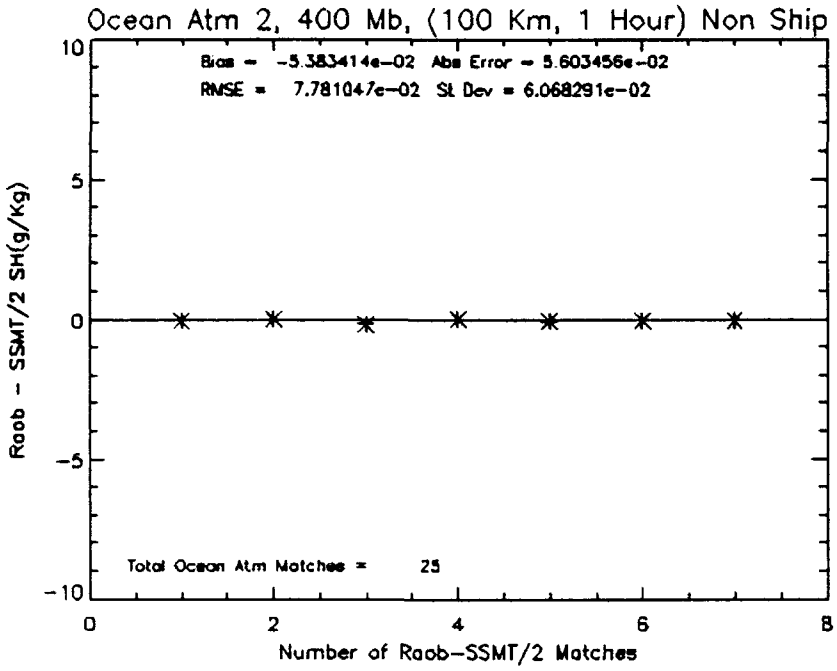

Ocean Atm 3, 700 Mb, (100 Km, 1 Hour) Ship
Bias = -1.73193 Abs Error = 2.55437
RMSE = 2.57469 St Dev = 0.906581
Total Ocean Atm Matches = 290
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

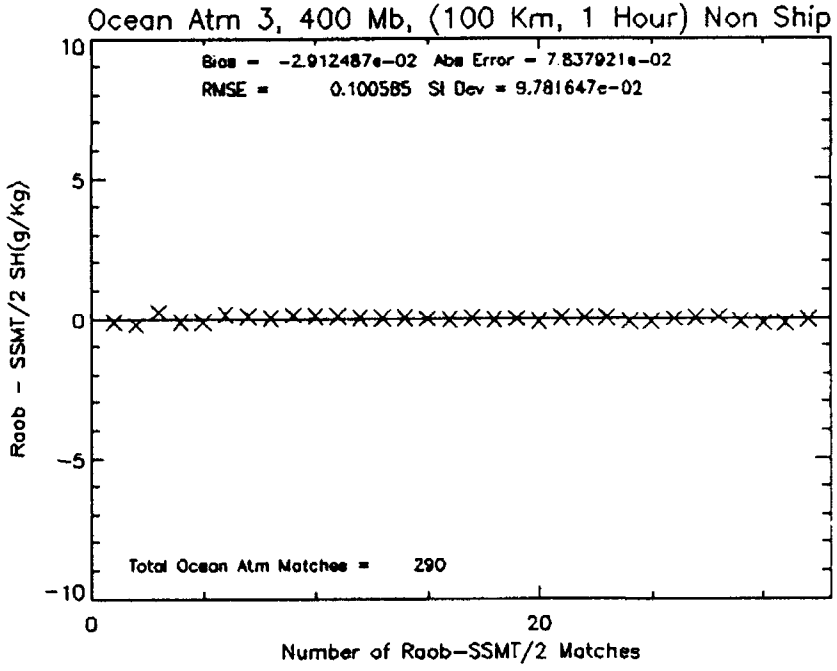
Ocean Atm 2, 500 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.110610 Abs Error = 0.137970
RMSE = 0.201495 St Dev = 0.180050
Total Ocean Atm Matches = 28
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

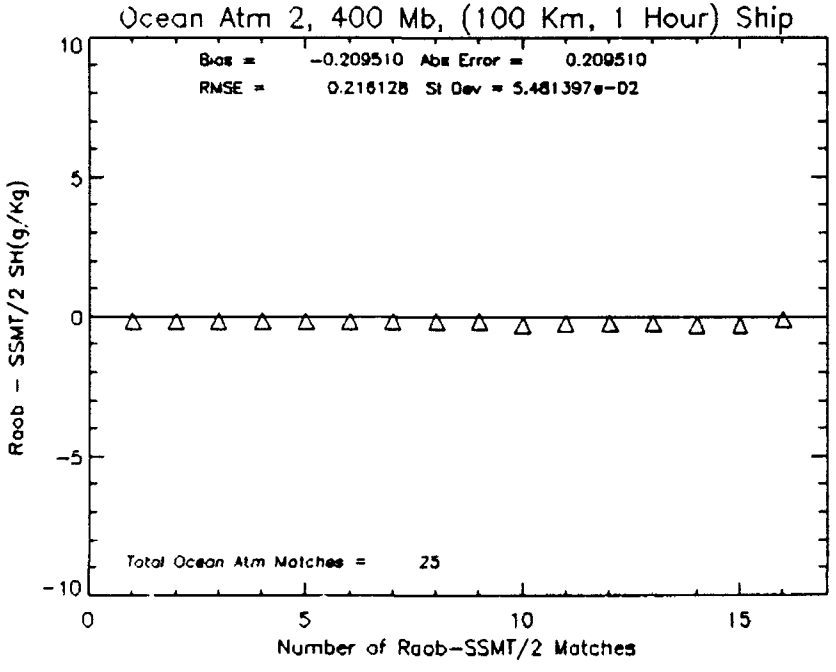
Ocean Atm 2, 500 Mb, (100 Km, 1 Hour) Ship
Bias = -0.428920 Abs Error = 0.434830
RMSE = 0.454638 St Dev = 0.133688
Total Ocean Atm Matches = 28
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

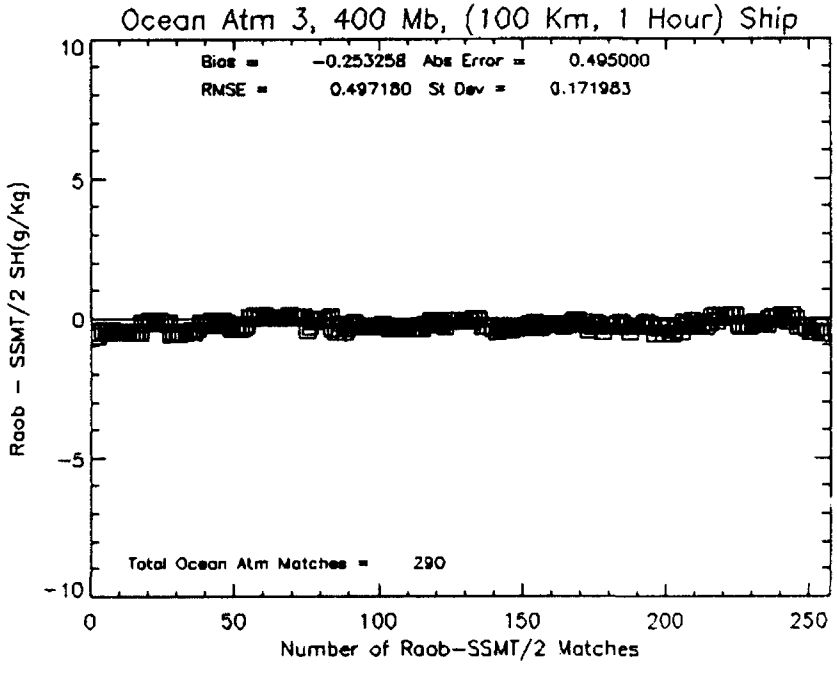
Ocean Atm 3, 500 Mb, (100 Km, 1 Hour) Non Ship
Bias = -0.203995 Abs Error = 0.274568
RMSE = 0.350620 St Dev = 0.289730
Total Ocean Atm Matches = 290
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

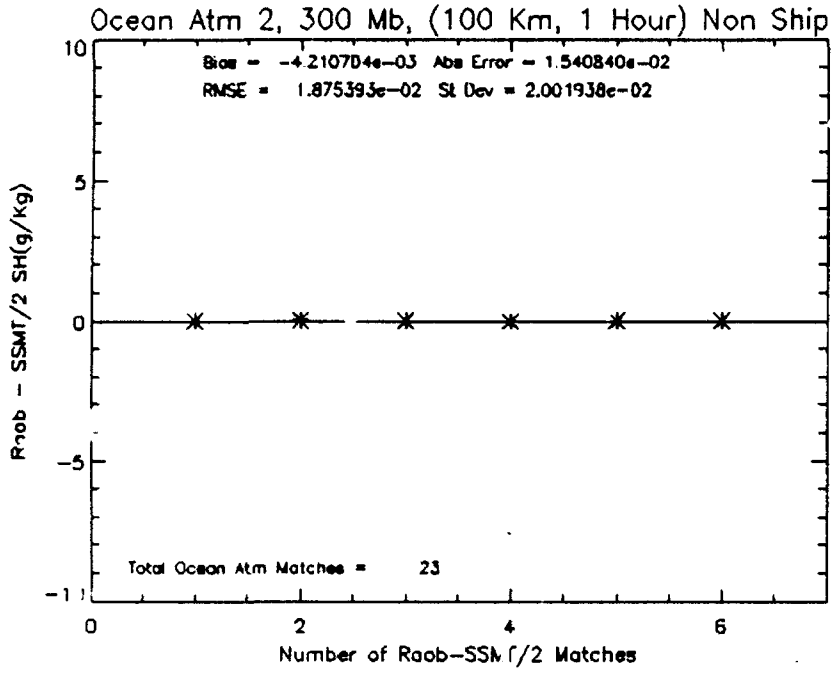
Ocean Atm 3, 500 Mb, (100 Km, 1 Hour) Ship
Bias = -0.520780 Abs Error = 1.11188
RMSE = 1.12100 St Dev = 0.479402
Total Ocean Atm Matches = 290
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

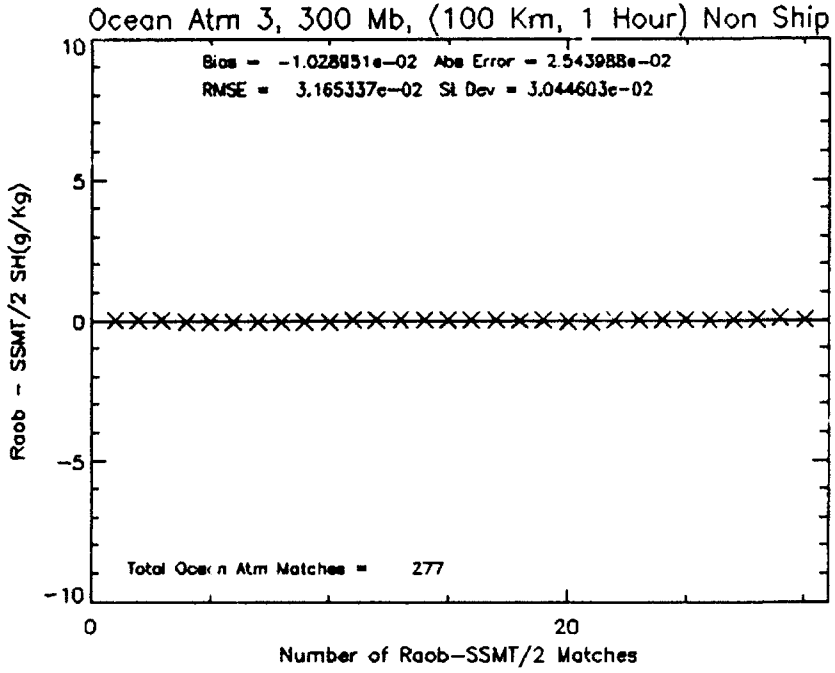

Ocean Atm 2, 400 Mb, (100 Km, 1 Hour) Non Ship
Bias = -5.383414e-02 Abs Error = 5.603456e-02
RMSE = 7.781047e-02 St Dev = 6.068291e-02
Total Ocean Atm Matches = 25
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

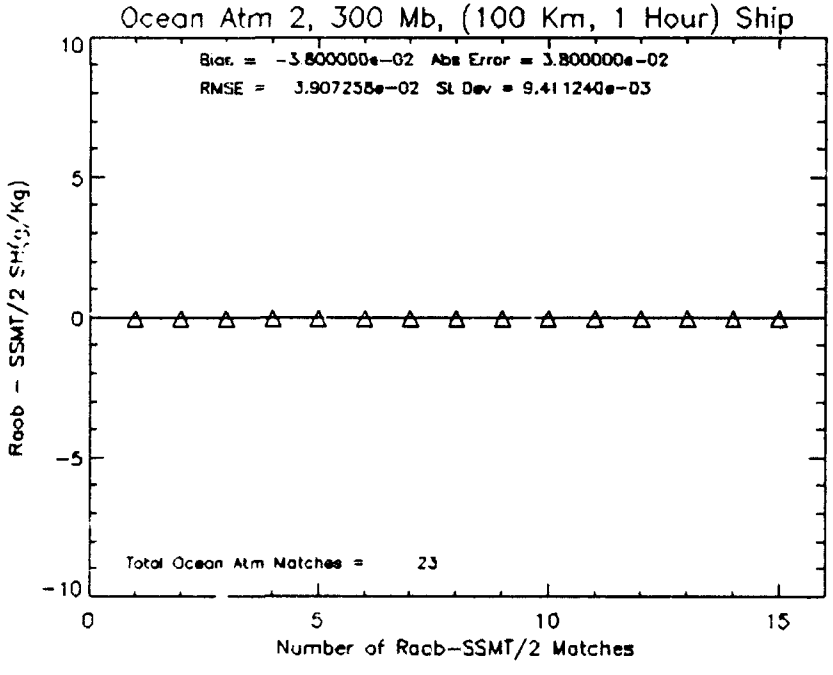

Ocean Atm 3, 400 Mb, (100 Km, 1 Hour) Non Ship
Bias = -2.912487e-02 Abs Error = 7.837921e-02
RMSE = 0.100585 St Dev = 9.781647e-02
Total Ocean Atm Matches = 290
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

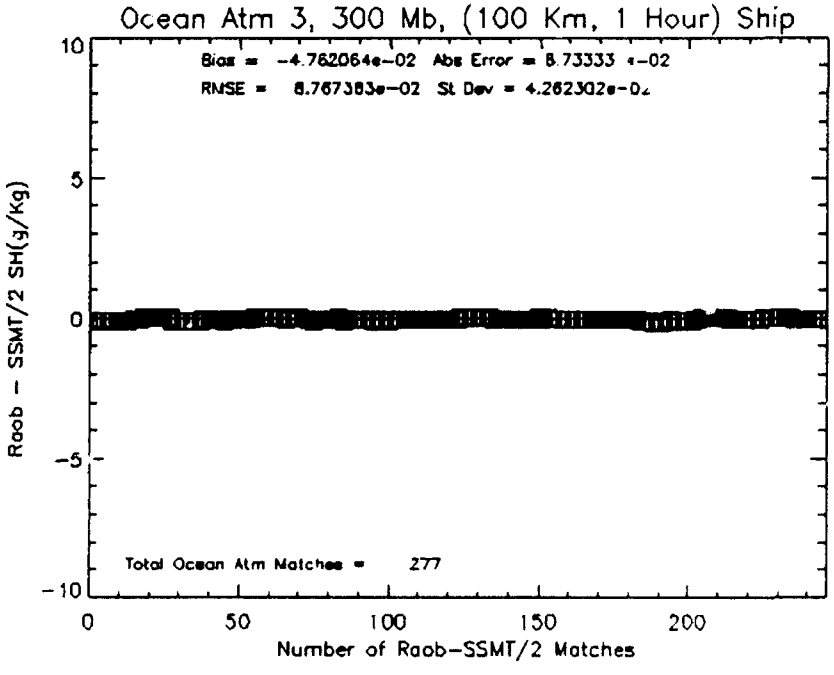

Ocean Atm 2, 400 Mb, (100 Km, 1 Hour) Ship
Bias = -0.209510 Abs Error = 0.209510
RMSE = 0.216128 St Dev = 5.481397e-02
Total Ocean Atm Matches = 25
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 400 Mb, (100 Km, 1 Hour) Ship
Bias = -0.253258 Abs Error = 0.495000
RMSE = 0.497180 St Dev = 0.171983
Total Ocean Atm Matches = 290
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 300 Mb, (100 Km, 1 Hour) Non Ship
Bias = -4.210704e-03 Abs Error = 1.540840e-02
RMSE = 1.875393e-02 St Dev = 2.001938e-02
Total Ocean Atm Matches = 23
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 300 Mb, (100 Km, 1 Hour) Non Ship
Bias = -1.028051e-02 Abs Error = 2.543988e-02
RMSE = 3.165337e-02 St Dev = 3.044603e-02
Total Ocean Atm Matches = 277
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 300 Mb, (100 Km, 1 Hour) Ship
Bias = -3.800000e-02 Abs Error = 3.800000e-02
RMSE = 3.907258e-02 St Dev = 9.411240e-03
Total Ocean Atm Matches = 23
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 300 Mb, (100 Km, 1 Hour) Ship
Bias = -4.762064e-02 Abs Error = 8.73333 e-02
RMSE = 8.767383e-02 St Dev = 4.262302e-02
Total Ocean Atm Matches = 277
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

Appendix H. For symmetric beam pairs about nadir, the quantity (Radiosonde - SSM/T-2) RH and Q plotted on the ordinate, and the index of the co-locations on the abscissa. Recall that beam position 5 is the artificial edge of the SSM/T-2 scans due to the GLOB effects on SSM/T-1 mentioned earlier. Beam position 24 is the symmetric beam on the opposite side of nadir. Beam positions 14 and 15 straddle nadir. Each four-plot panel represents one atmospheric level. The co-location criteria are annotated at the top of the plots.

Beam Pos 24, 1000 Mb, (100 Km, 1 Hour)
BIAS = -6.492393e-02 Abs Error = 1.94609
RMSE = 3.11145 St Dev = 3.12403
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Beam Pos 23, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.758144 Abs Error = 1.99233
RMSE = 2.73969 St Dev = 2.64364
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Beam Pos 5, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.666523 Abs Error = 2.00697
RMSE = 2.38885 St Dev = 2.31553
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

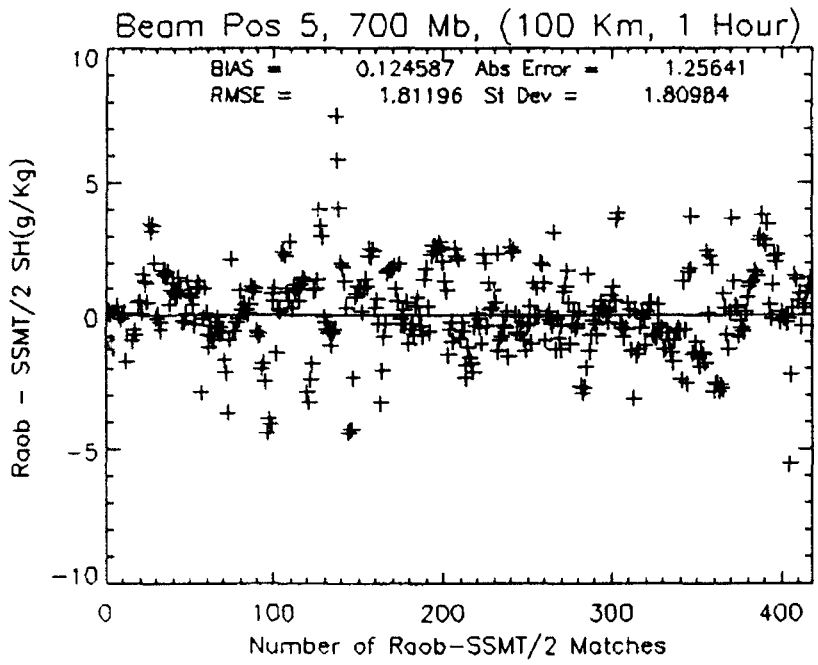
Beam Pos 6, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.568337 Abs Error = 1.60612
RMSE = 1.99724 St Dev = 1.93056
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

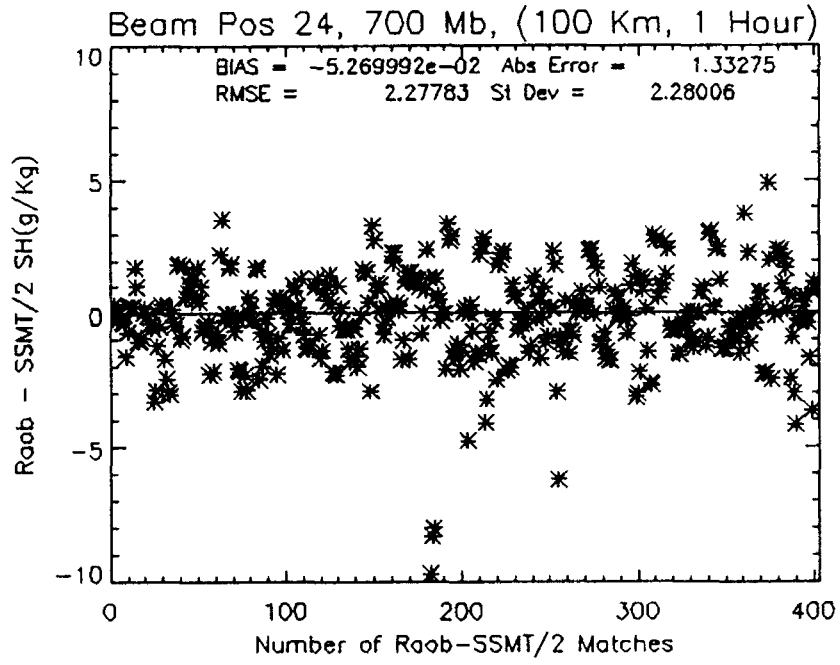
Beam Pos 24, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.157708 Abs Error = 1.84664
RMSE = 2.40256 St Dev = 2.40044
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

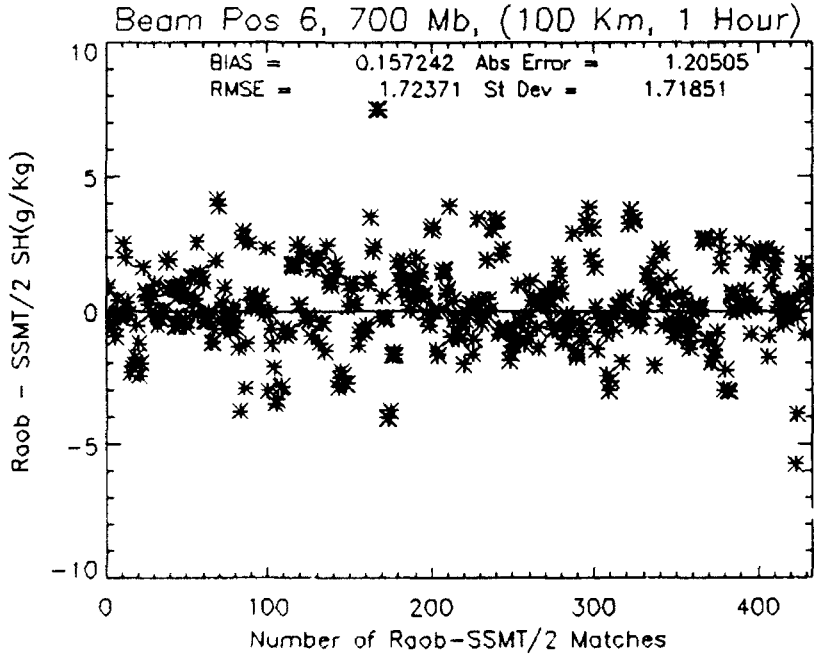
Beam Pos 23, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.129107 Abs Error = 1.77899
RMSE = 2.35151 St Dev = 2.35068
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

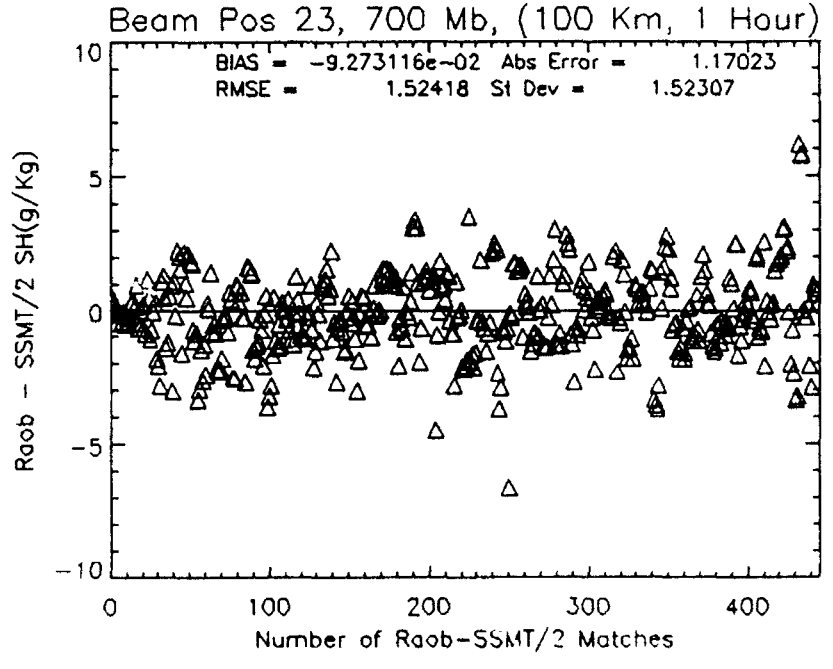
Beam Pos 5, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.269203 Abs Error = 1.58808
RMSE = 2.49481 St Dev = 2.48380
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Beam Pos 6, 850 Mb, (100 Km, 1 Hour)
BIAS = 2.766586e-02 Abs Error = 1.78011
RMSE = 3.04078 St Dev = 3.04065
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches


Beam Pos 5, 700 Mb, (100 Km, 1 Hour)
BIAS = 0.124587 Abs Error = 1.25641
RMSE = 1.81196 St Dev = 1.80984
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 24, 700 Mb, (100 Km, 1 Hour)
BIAS = -5.269992e-02 Abs Error = 1.33275
RMSE = 2.27783 St Dev = 2.28006
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 6, 700 Mb, (100 Km, 1 Hour)
BIAS = 0.157242 Abs Error = 1.20505
RMSE = 1.72371 St Dev = 1.71851
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

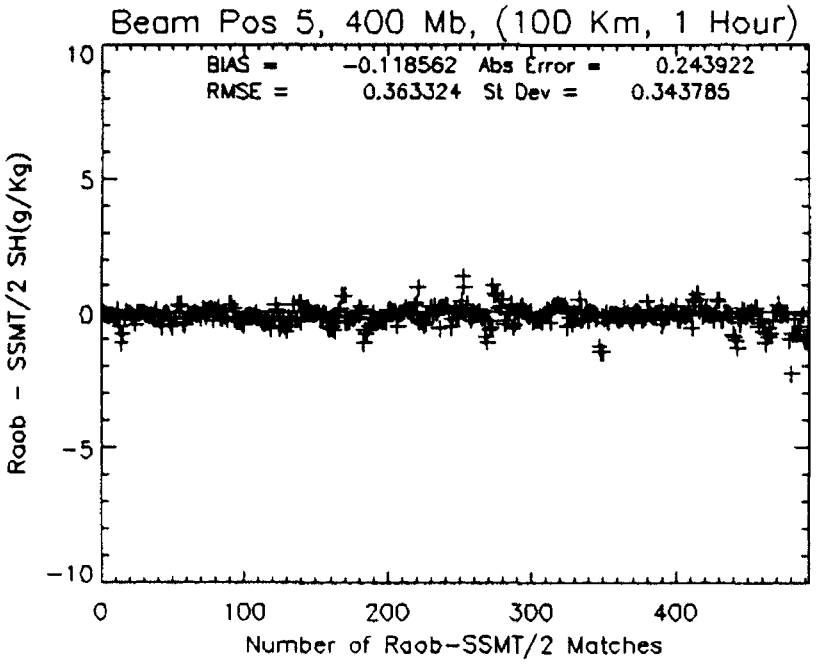

Beam Pos 23, 700 Mb, (100 Km, 1 Hour)
BIAS = -9.273116e-02 Abs Error = 1.17023
RMSE = 1.52418 St Dev = 1.52307
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

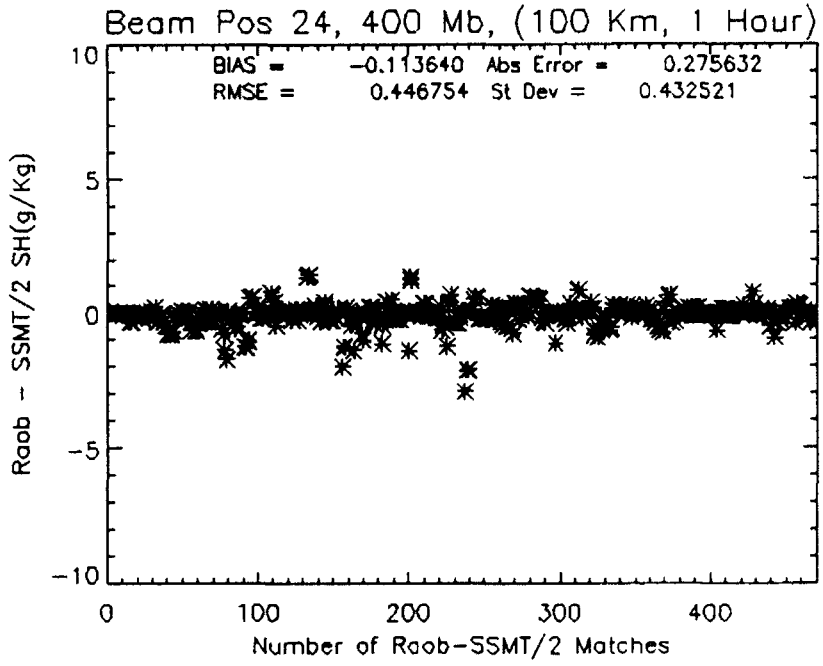
Beam Pos 24, 500 Mb, (100 Km, 1 Hour)
BIAS = -9.157130e-02 Abs Error = 0.524152
RMSE = 0.856084 St Dev = 0.852084
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

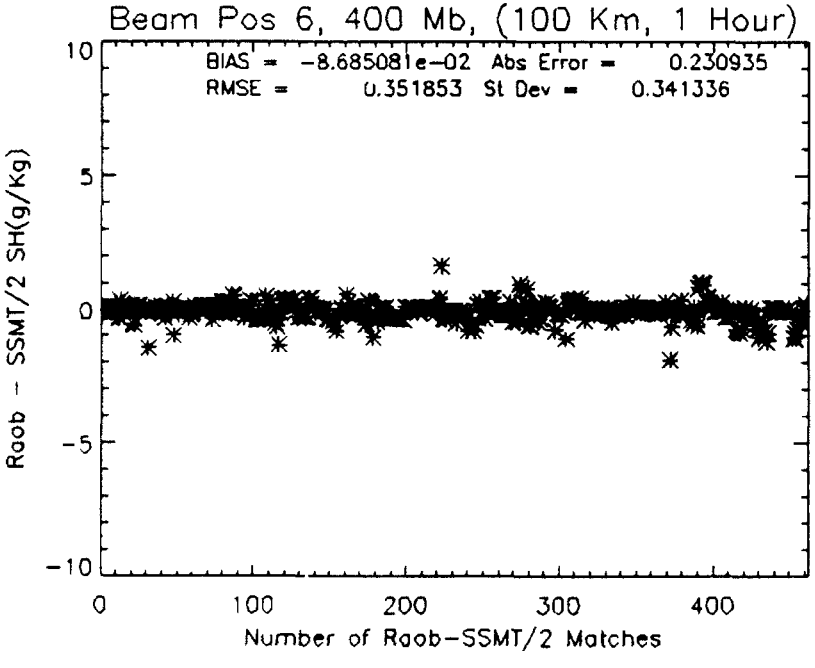
Beam Pos 23, 500 Mb, (100 Km, 1 Hour)
BIAS = -6.045437e-02 Abs Error = 0.502097
RMSE = 0.751813 St Dev = 0.750089
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

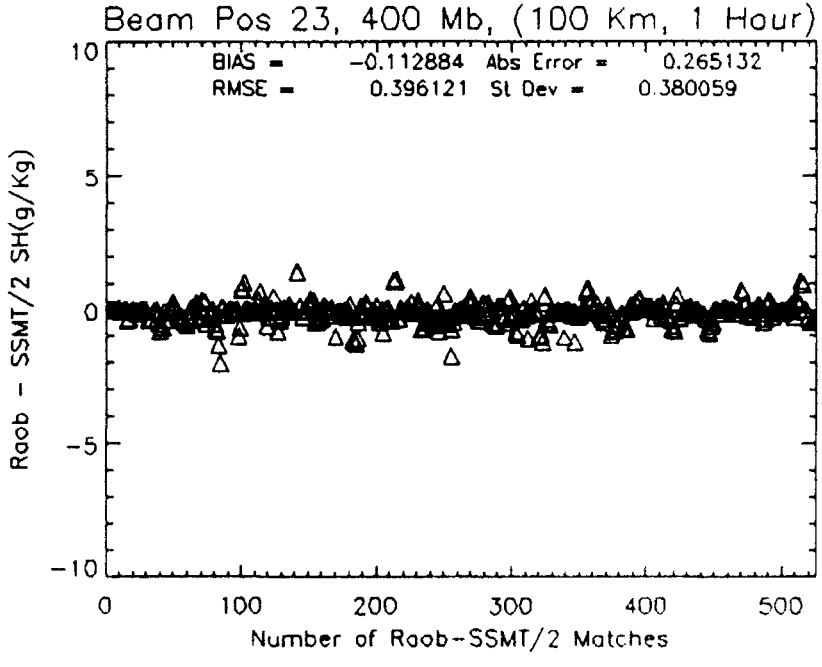
Beam Pos 5, 500 Mb, (100 Km, 1 Hour)
BIAS = -2.208940e-02 Abs Error = 0.508425
RMSE = 0.730484 St Dev = 0.730880
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

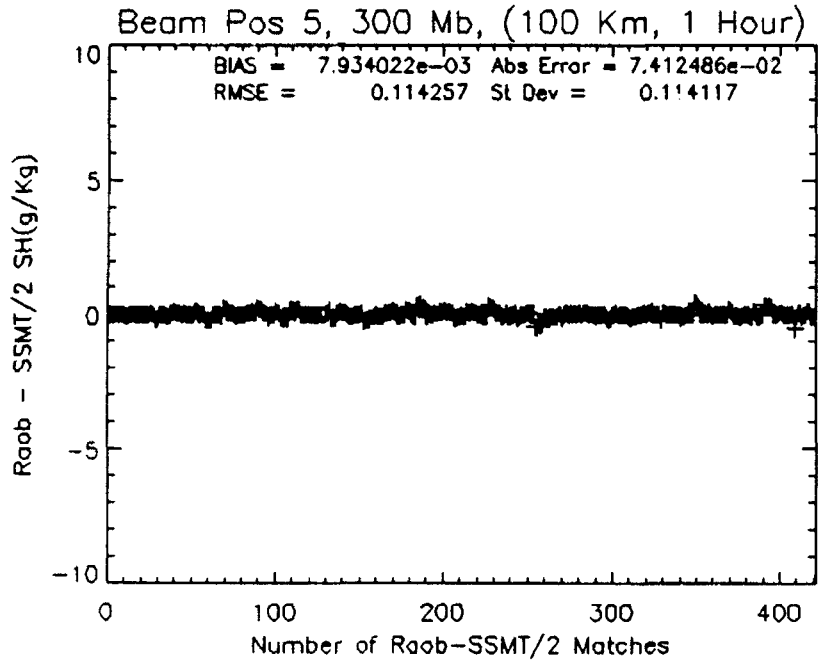
Beam Pos 6, 500 Mb, (100 Km, 1 Hour)
BIAS = -5.370671e-02 Abs Error = 0.512890
RMSE = 0.750157 St Dev = 0.749006
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

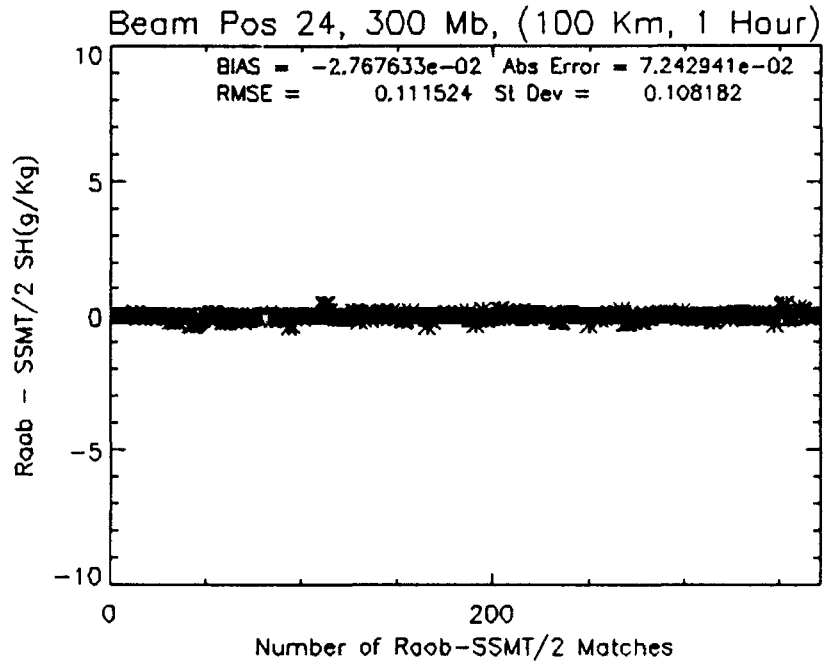

Beam Pos 5, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.118562 Abs Error = 0.243922
RMSE = 0.363324 St Dev = 0.343785
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

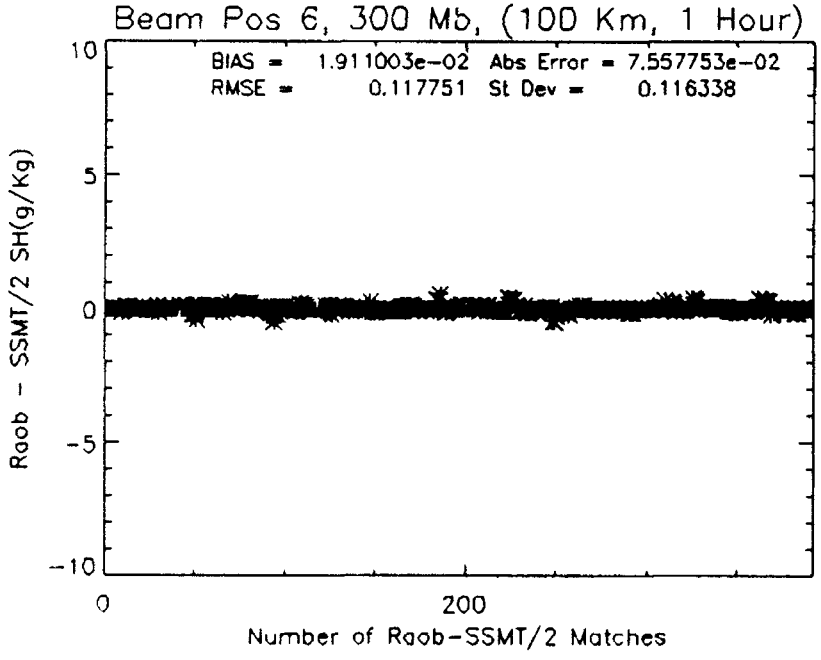

Beam Pos 24, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.113640 Abs Error = 0.275632
RMSE = 0.446754 St Dev = 0.432521
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

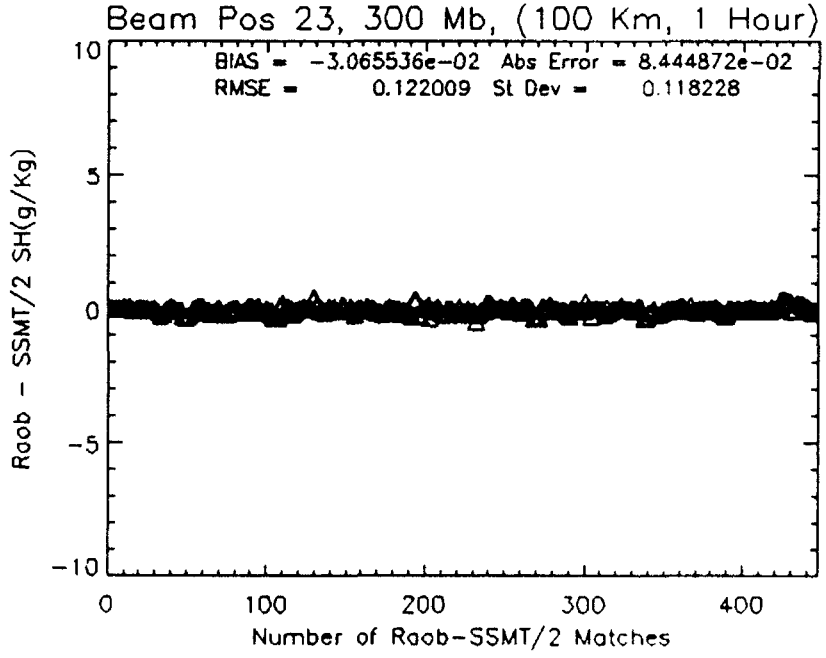

Beam Pos 6, 400 Mb, (100 Km, 1 Hour)
BIAS = -8.685081e-02 Abs Error = 0.230935
RMSE = 0.351853 St Dev = 0.341336
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

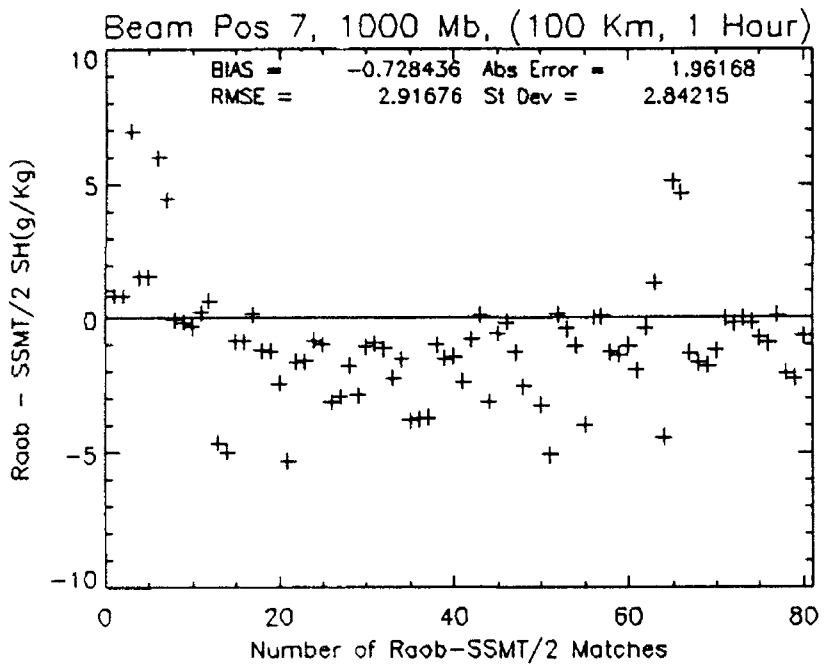

Beam Pos 23, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.112884 Abs Error = 0.265132
RMSE = 0.396121 St Dev = 0.380059
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

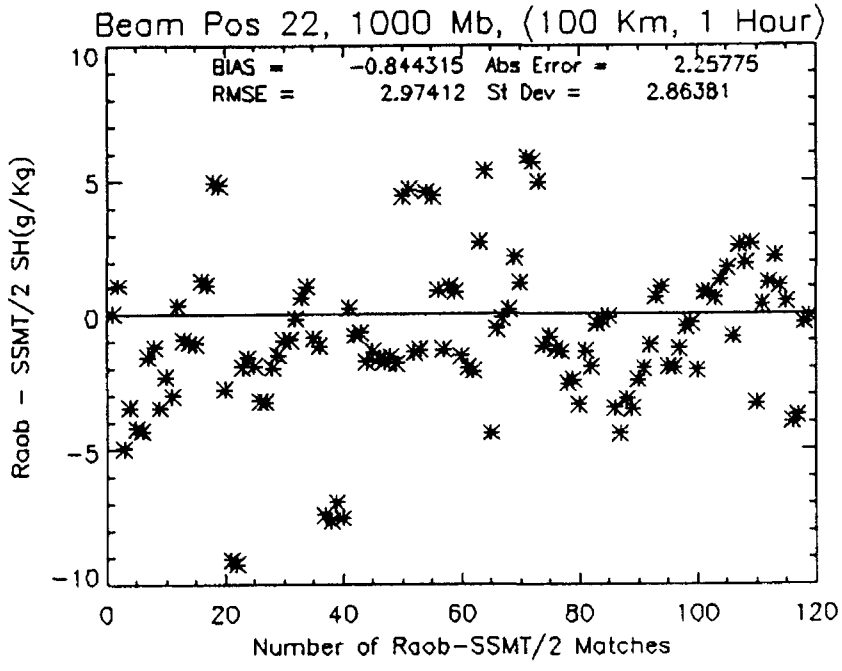

Beam Pos 5, 300 Mb, (100 Km, 1 Hour)
BIAS = 7.934022e-03 Abs Error = 7.412486e-02
RMSE = 0.114257 St Dev = 0.114117
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

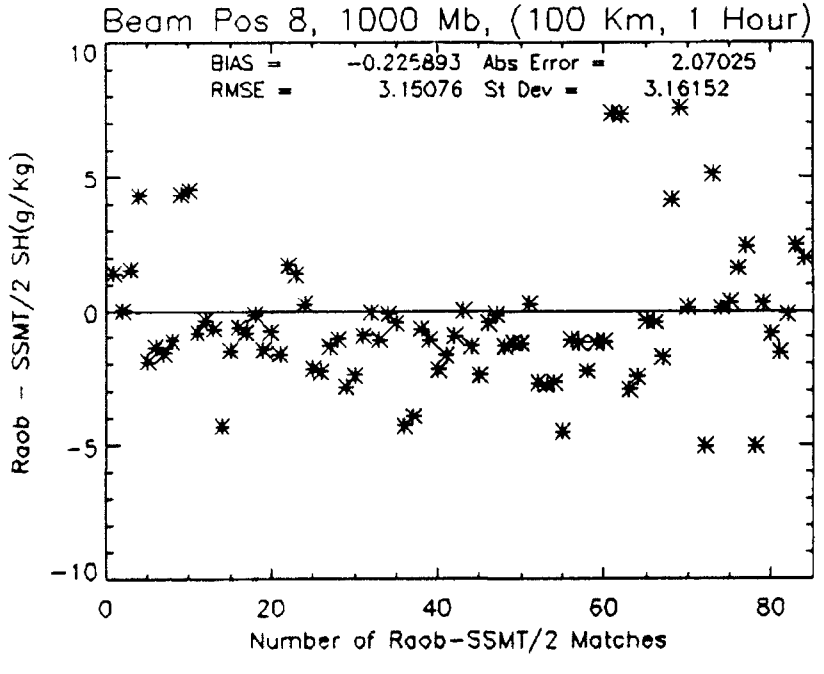

Beam Pos 24, 300 Mb, (100 Km, 1 Hour)
BIAS = -2.767633e-02 Abs Error = 7.242941e-02
RMSE = 0.111524 St Dev = 0.108182
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

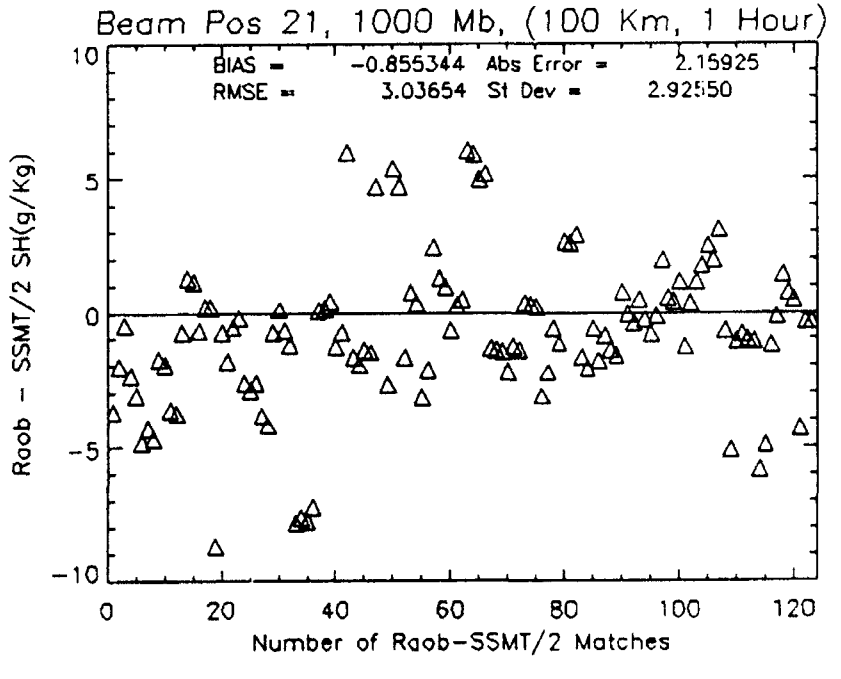

Beam Pos 6, 300 Mb, (100 Km, 1 Hour)
BIAS = 1.911003e-02 Abs Error = 7.557753e-02
RMSE = 0.117751 St Dev = 0.116338
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

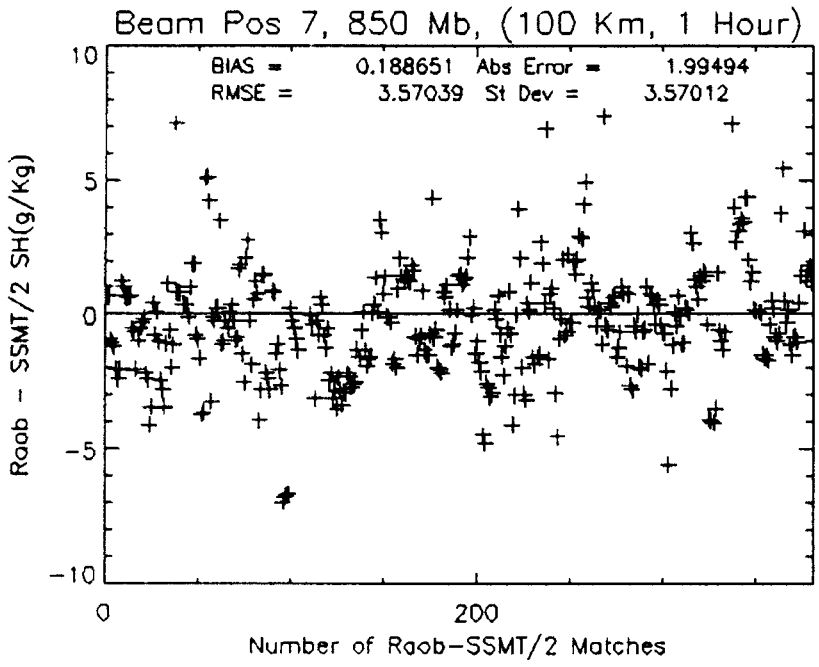

Beam Pos 23, 300 Mb, (100 Km, 1 Hour)
BIAS = -3.065536e-02 Abs Error = 8.444872e-02
RMSE = 0.122009 St Dev = 0.118228
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

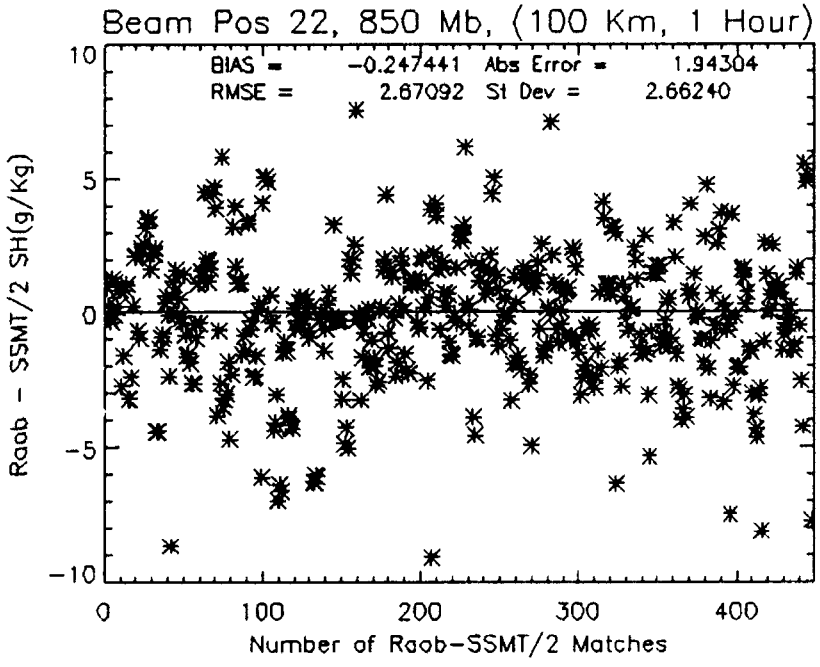

Beam Pos 7, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.728436 Abs Error = 1.96168
RMSE = 2.91676 St Dev = 2.84215
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

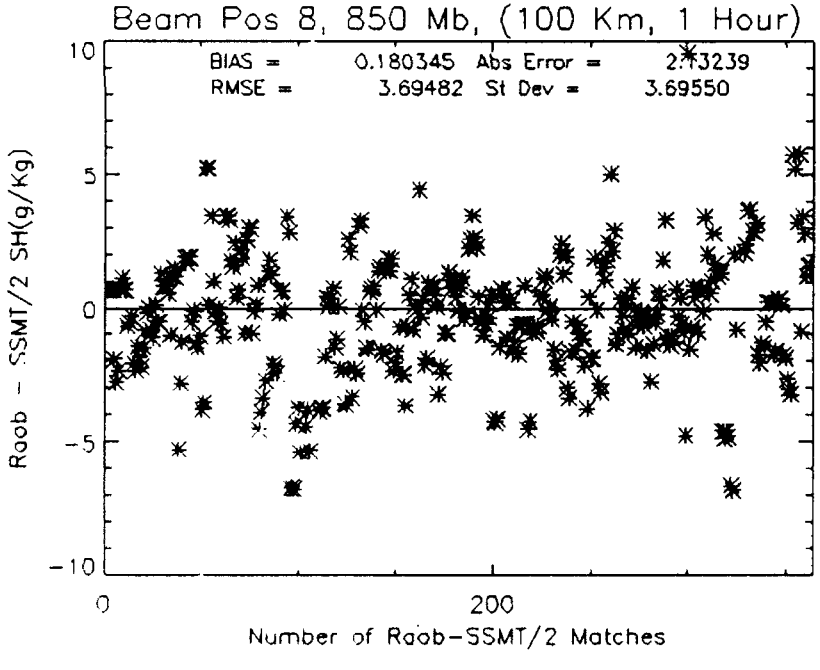

Beam Pos 22, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.844315 Abs Error = 2.25775
RMSE = 2.97412 St Dev = 2.86381
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

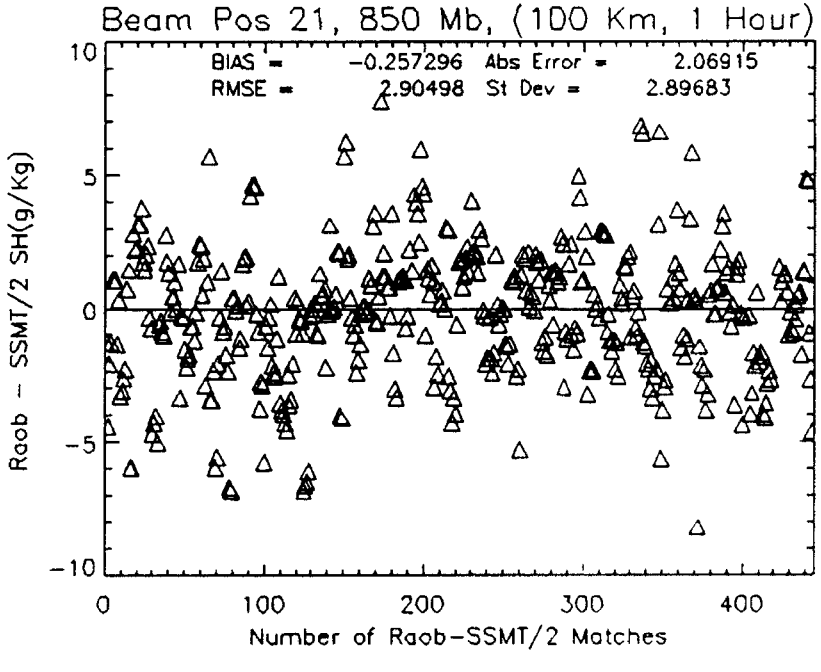

Beam Pos 8, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.225893 Abs Error = 2.07025
RMSE = 3.15076 St Dev = 3.16152
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

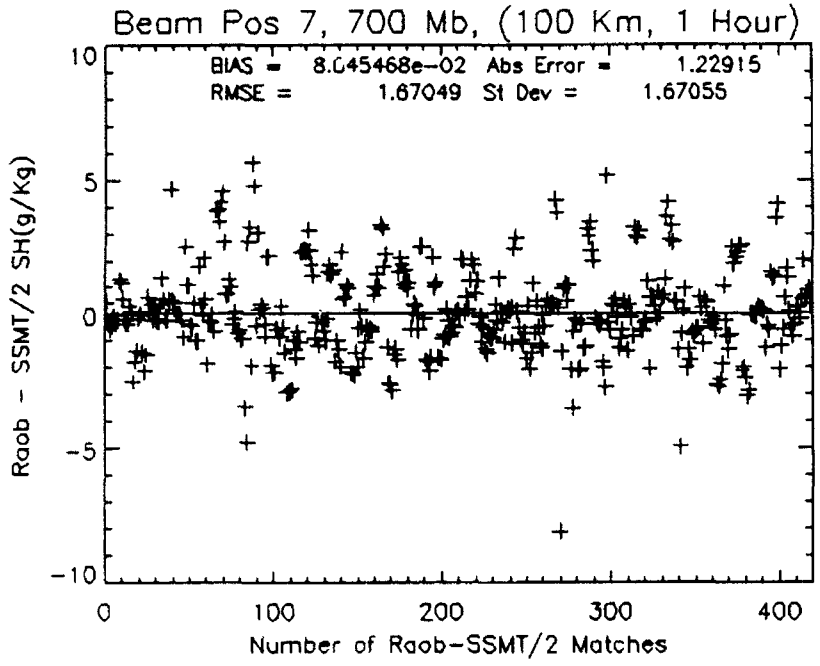

Beam Pos 21, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.855344 Abs Error = 2.15925
RMSE = 3.03654 St Dev = 2.92550
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

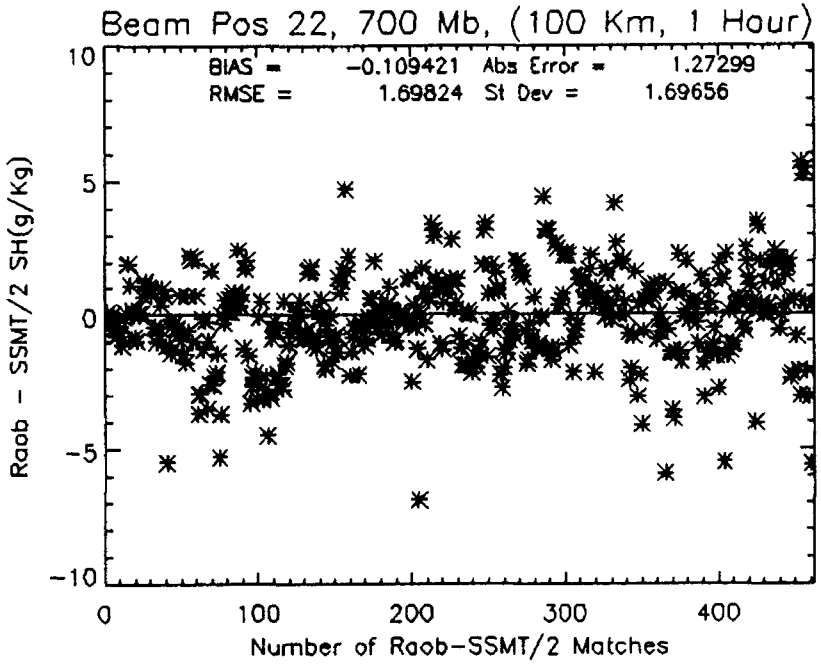

Beam Pos 7, 850 Mb, (100 Km, 1 Hour)
BIAS = 0.188651 Abs Error = 1.99494
RMSE = 3.57039 St Dev = 3.57012
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

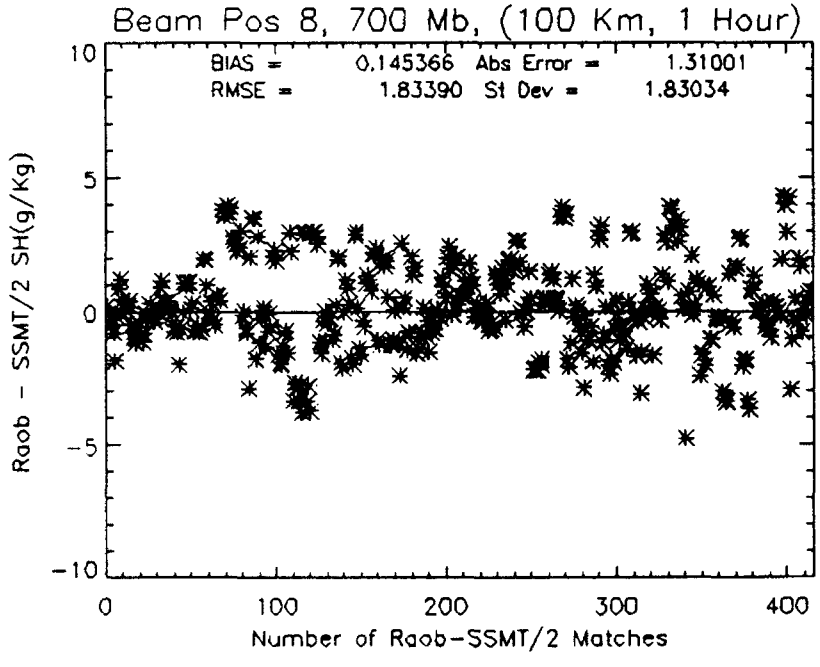

Beam Pos 22, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.247441 Abs Error = 1.94304
RMSE = 2.67092 St Dev = 2.66240
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

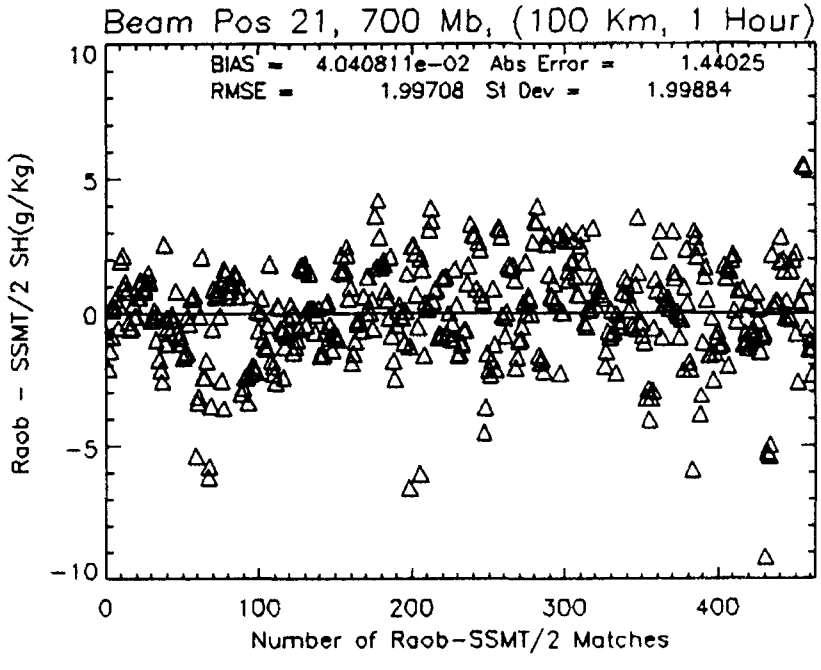

Beam Pos 8, 850 Mb, (100 Km, 1 Hour)
BIAS = 0.180345 Abs Error = 2.13239
RMSE = 3.69482 St Dev = 3.69550
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 21, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.257296 Abs Error = 2.06915
RMSE = 2.90498 St Dev = 2.89683
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 7, 700 Mb, (100 Km, 1 Hour)
BIAS = 8.045468e-02 Abs Error = 1.22915
RMSE = 1.67049 St Dev = 1.67055
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 22, 700 Mb, (100 Km, 1 Hour)
BIAS = -0.109421 Abs Error = 1.27299
RMSE = 1.69824 St Dev = 1.69656
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 8, 700 Mb, (100 Km, 1 Hour)
BIAS = 0.145366 Abs Error = 1.31001
RMSE = 1.83390 St Dev = 1.83034
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

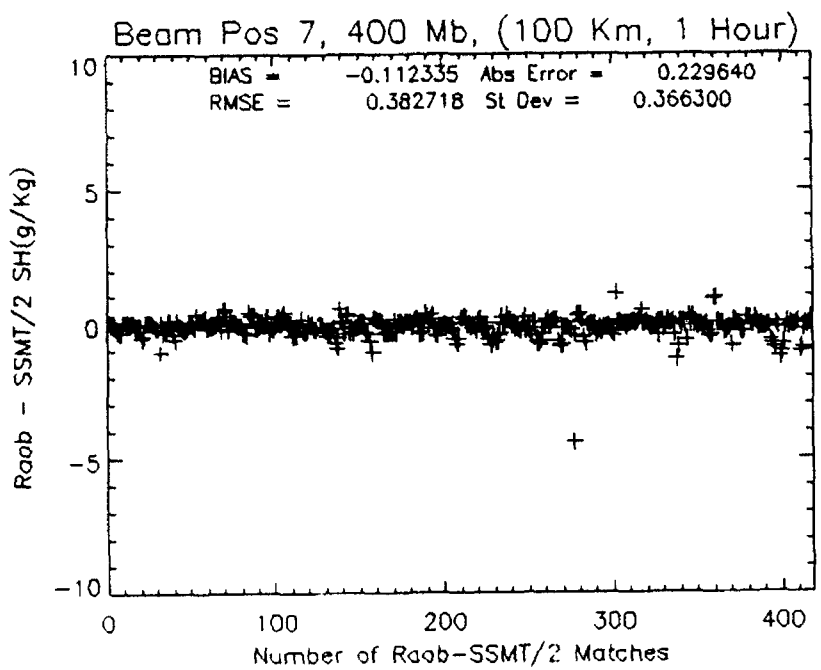

Beam Pos 21, 700 Mb, (100 Km, 1 Hour)
BIAS = 4.040811e-02 Abs Error = 1.44025
RMSE = 1.99708 St Dev = 1.99884
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

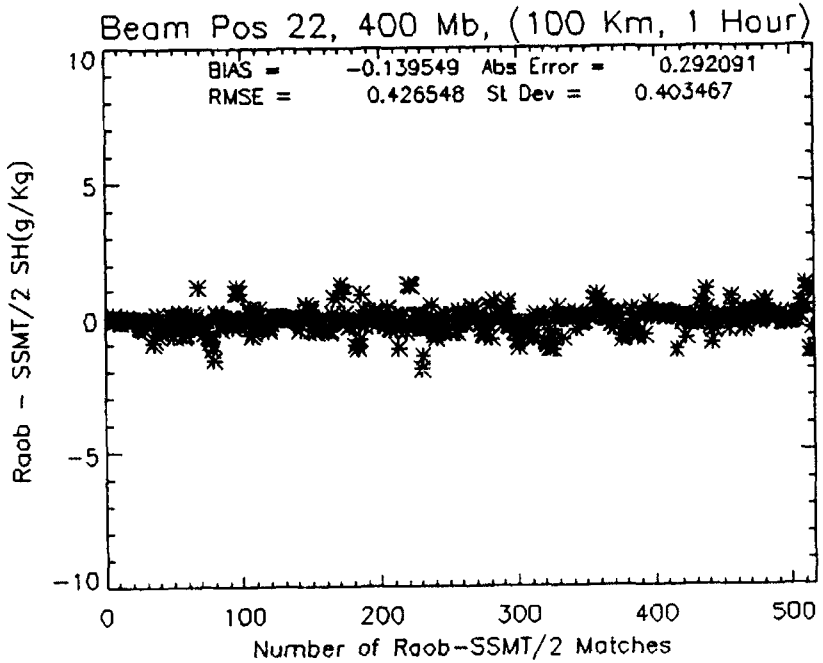
Beam Pos 22, 500 Mb, (100 Km, 1 Hour)
BIAS = -0.105471 Abs Error = 0.563908
RMSE = 0.798193 St Dev = 0.791955
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

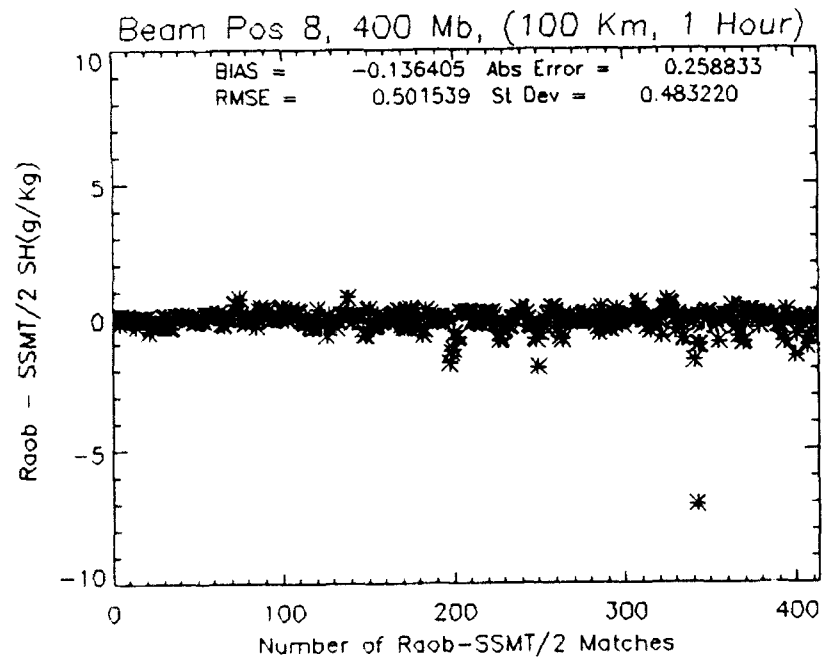
Beam Pos 21, 500 Mb, (100 Km, 1 Hour)
BIAS = -0.197029 Abs Error = 0.686577
RMSE = 0.975086 St Dev = 0.955934
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

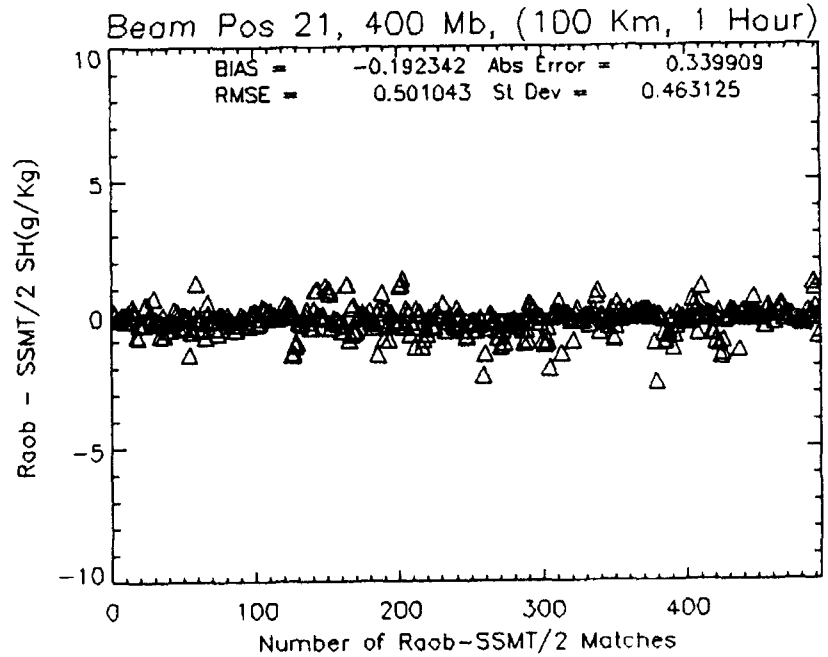
Beam Pos 7, 500 Mb, (100 Km, 1 Hour)
BIAS = -0.152575 Abs Error = 0.520223
RMSE = 0.880526 St Dev = 0.868176
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

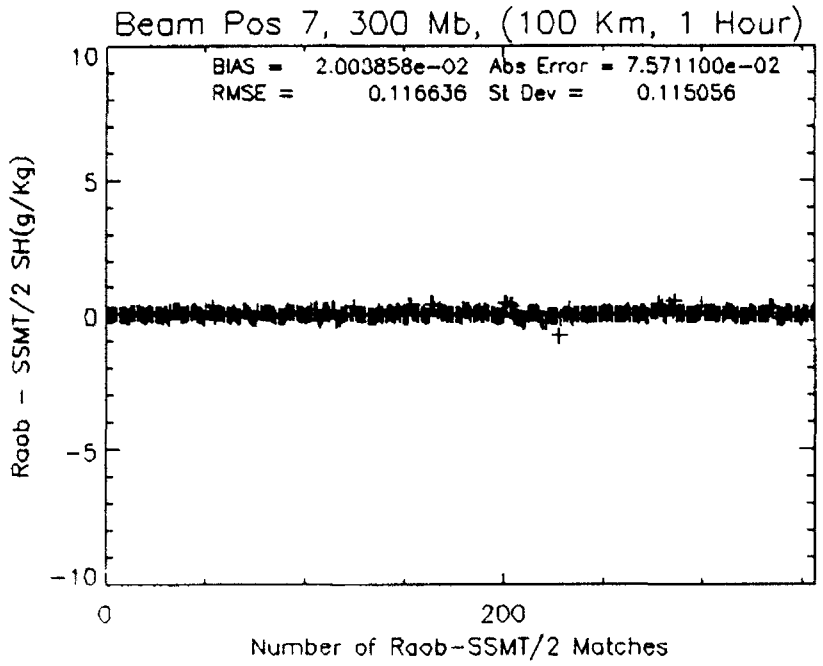
Beam Pos 8, 500 Mb, (100 Km, 1 Hour)
BIAS = -0.172024 Abs Error = 0.629833
RMSE = 1.20806 St Dev = 1.19710
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

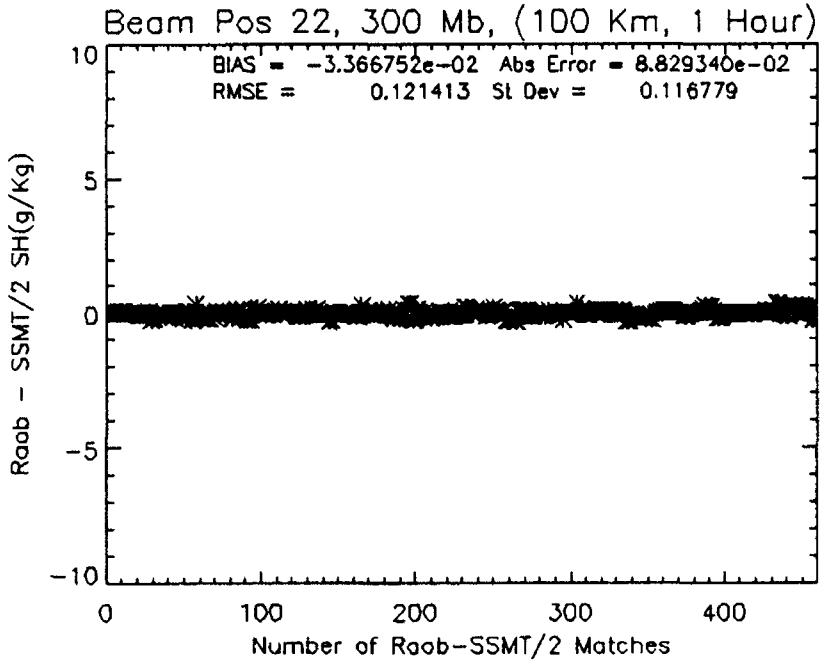

Beam Pos 7, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.112335 Abs Error = 0.229640
RMSE = 0.382718 St Dev = 0.366300
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

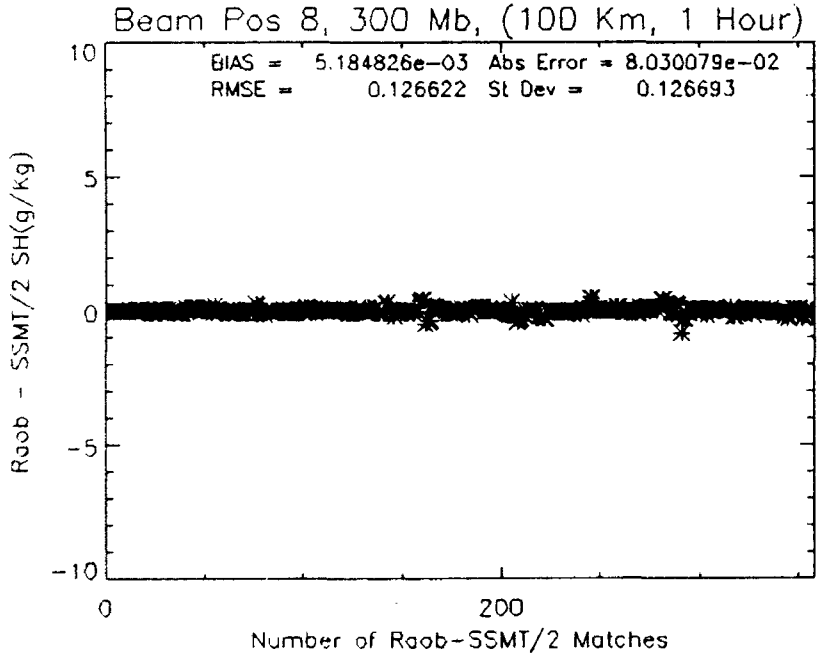

Beam Pos 22, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.139549 Abs Error = 0.292091
RMSE = 0.426548 St Dev = 0.403467
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

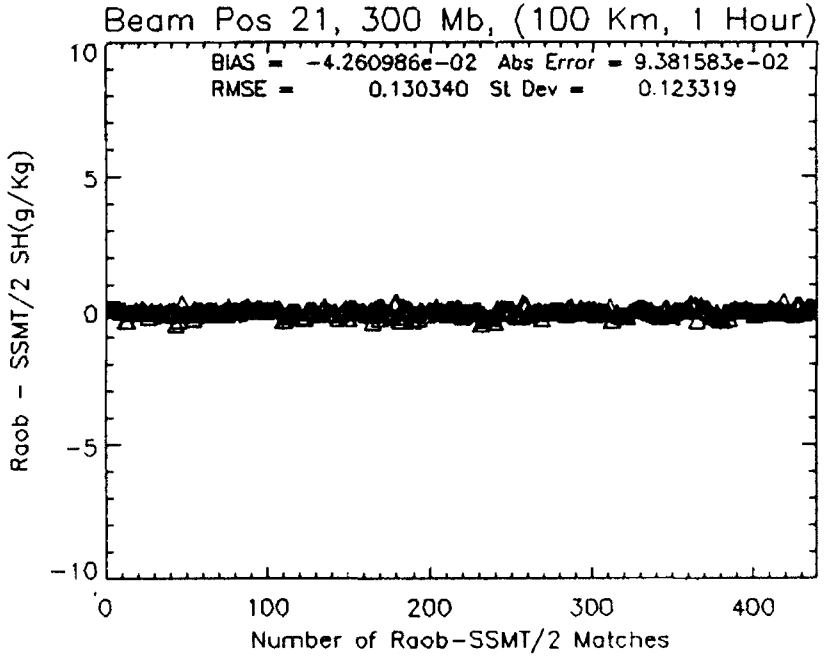

Beam Pos 8, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.136405 Abs Error = 0.258833
RMSE = 0.501539 St Dev = 0.483220
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

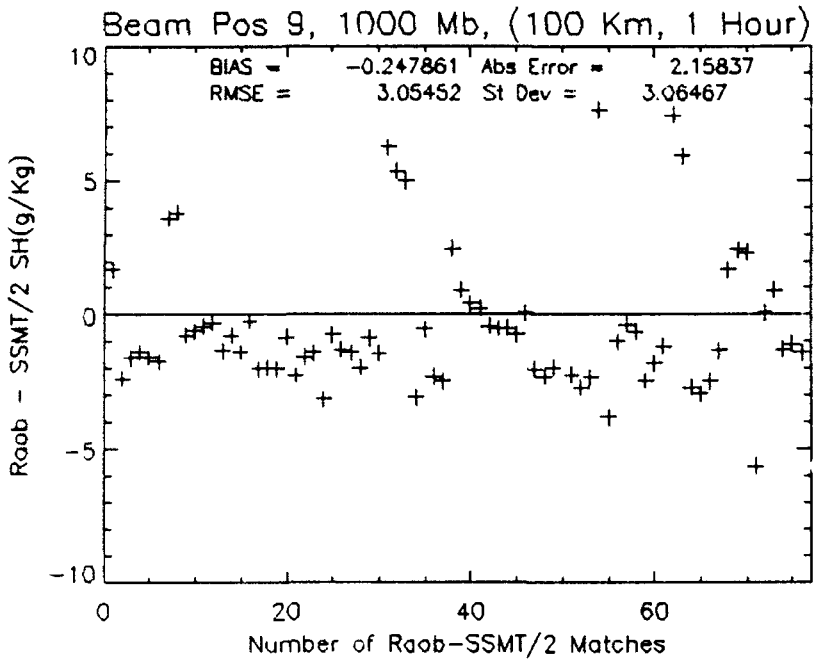

Beam Pos 21, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.192342 Abs Error = 0.339909
RMSE = 0.501043 St Dev = 0.463125
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

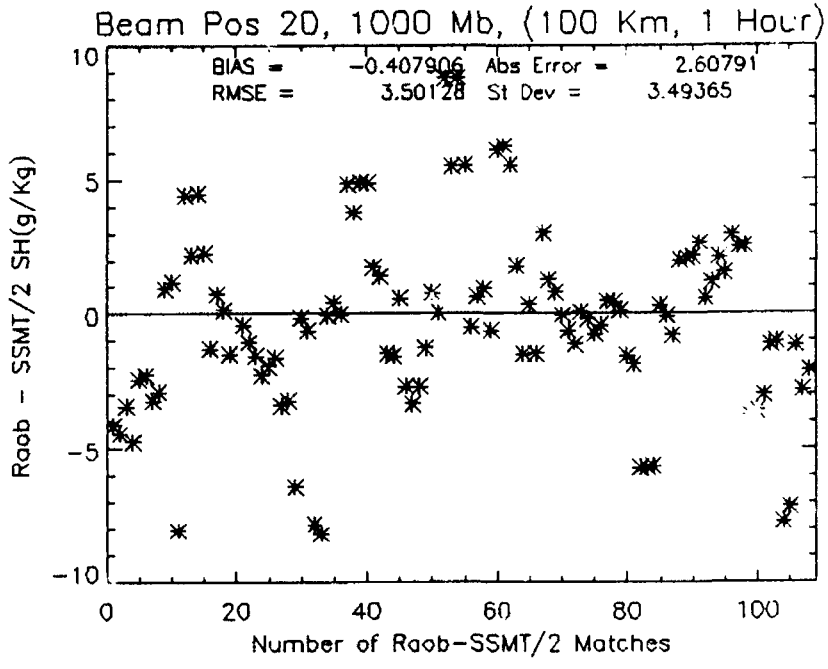

Beam Pos 7, 300 Mb, (100 Km, 1 Hour)
BIAS = 2.003858e-02 Abs Error = 7.571100e-02
RMSE = 0.116636 St Dev = 0.115056
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

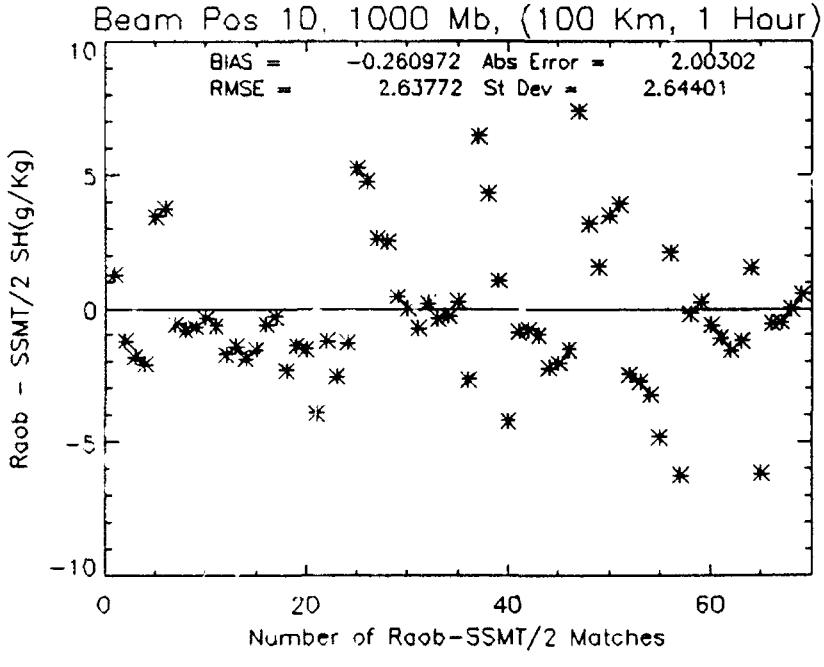

Beam Pos 22, 300 Mb, (100 Km, 1 Hour)
BIAS = -3.366752e-02 Abs Error = 8.829340e-02
RMSE = 0.121413 St Dev = 0.116779
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

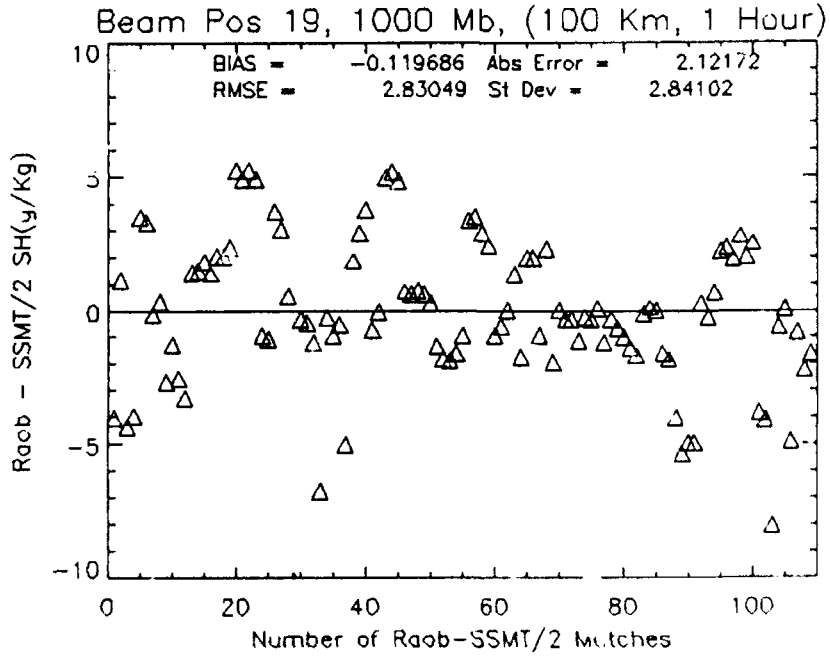

Beam Pos 8, 300 Mb, (100 Km, 1 Hour)
BIAS = 5.184826e-03 Abs Error = 8.030079e-02
RMSE = 0.126622 St Dev = 0.126693
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 21, 300 Mb, (100 Km, 1 Hour)
BIAS = -4.260986e-02 Abs Error = 9.381583e-02
RMSE = 0.130340 St Dev = 0.123319
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 9, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.247861 Abs Error = 2.15837
RMSE = 3.05452 St Dev = 3.06467
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 20, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.407906 Abs Error = 2.60791
RMSE = 3.50128 St Dev = 3.49365
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 10, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.260972 Abs Error = 2.00302
RMSE = 2.63772 St Dev = 2.64401
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

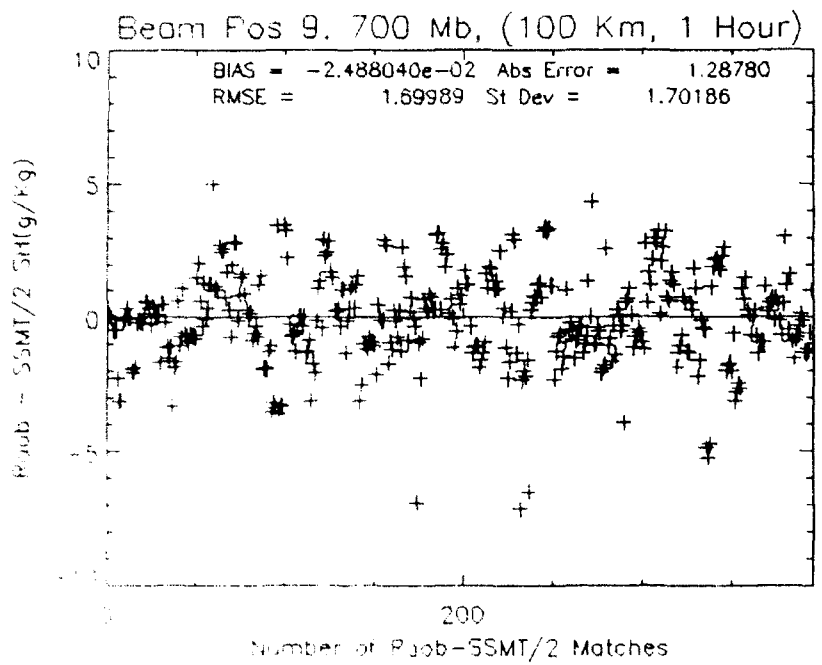

Beam Pos 19, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.119686 Abs Error = 2.12172
RMSE = 2.83049 St Dev = 2.84102
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

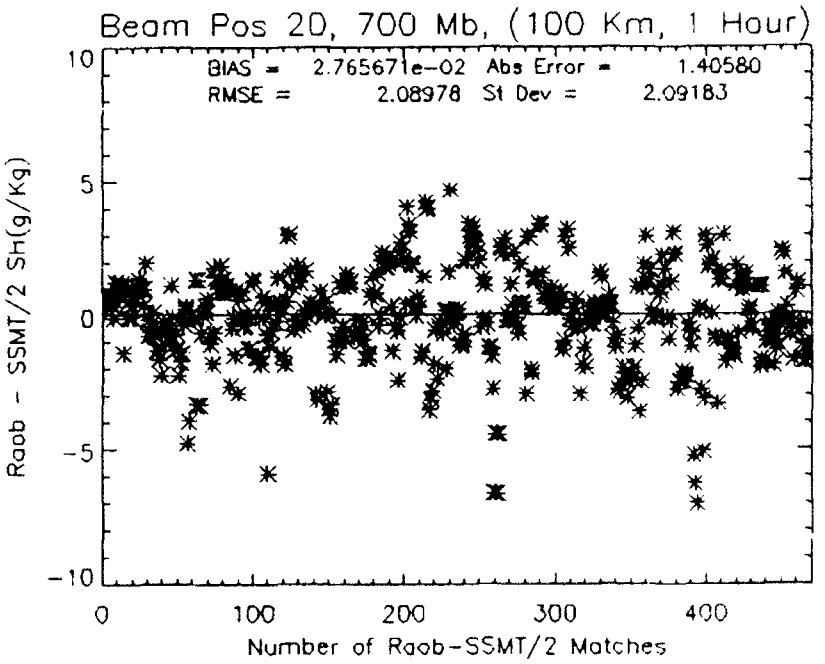
Beam Pos 20, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.413252 Abs Error = 2.09189
RMSE = 2.70314 St Dev = 2.67440
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

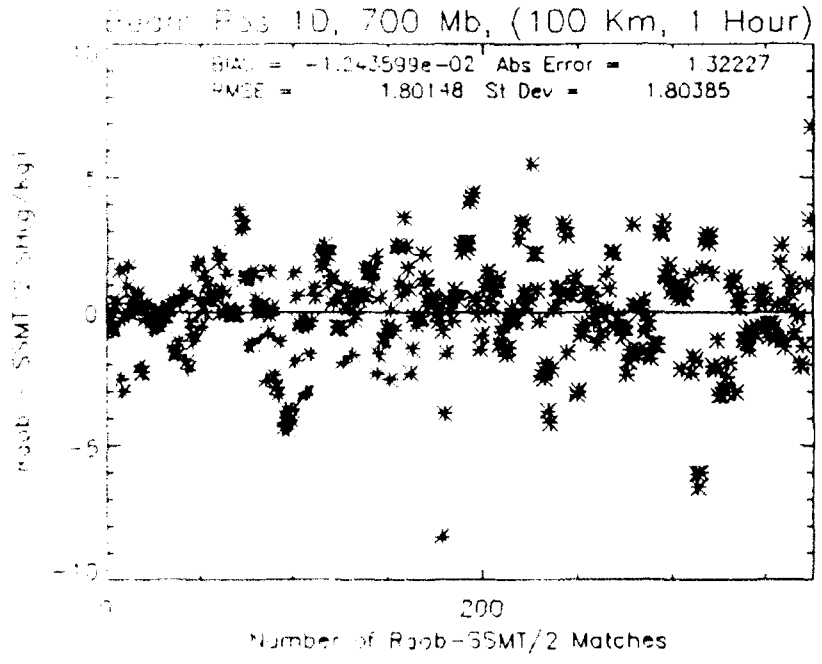
Beam Pos 19, 350 Mb, (100 Km, 1 Hour)
BIAS = -0.365041 Abs Error = 2.10404
RMSE = 2.74537 St Dev = 2.72427
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

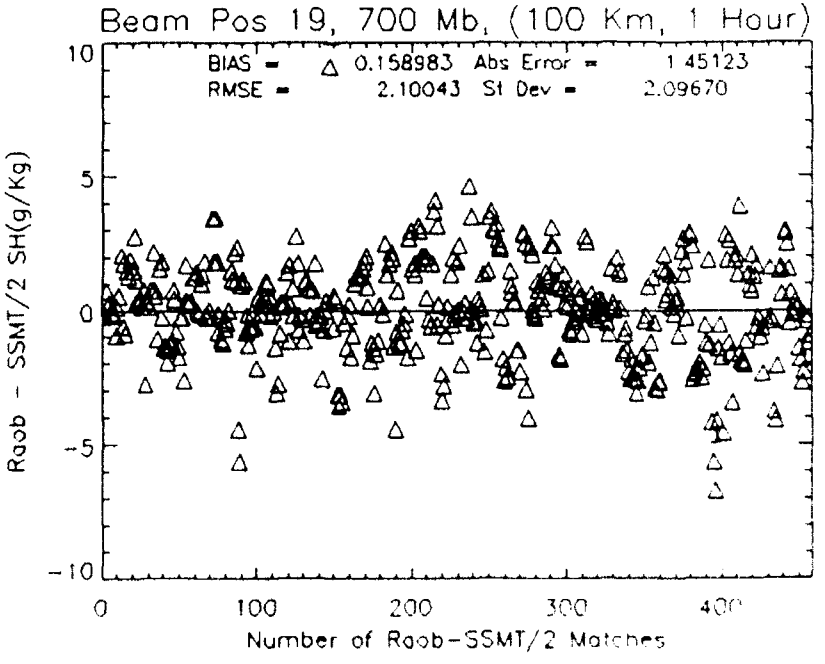
Beam Pos 9, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.328650 Abs Error = 2.22158
RMSE = 3.48195 St Dev = 3.47162
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

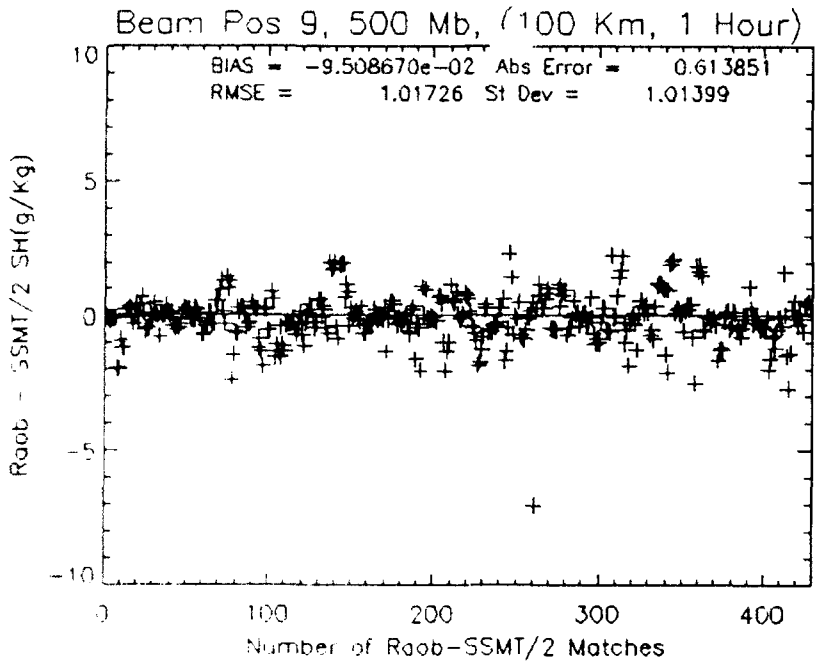
Beam Pos 10, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.592459 Abs Error = 2.14853
RMSE = 2.82894 St Dev = 2.77055
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

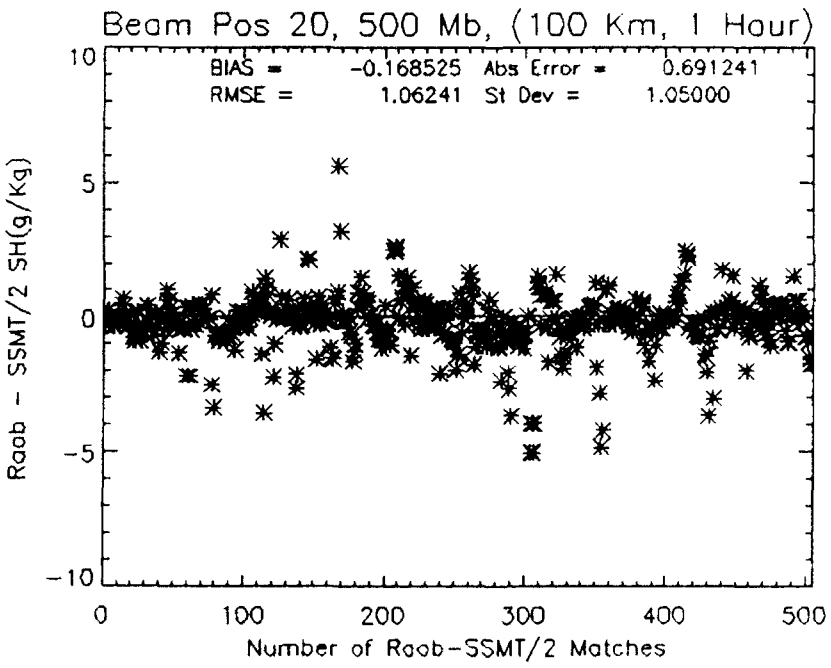

Beam Pos 9, 700 Mb, (100 Km, 1 Hour)
BIAS = -2.488040e-02 Abs Error = 1.28780
RMSE = 1.69989 St Dev = 1.70186
10
5
0
200
Number of Raob-SSMT/2 Matches

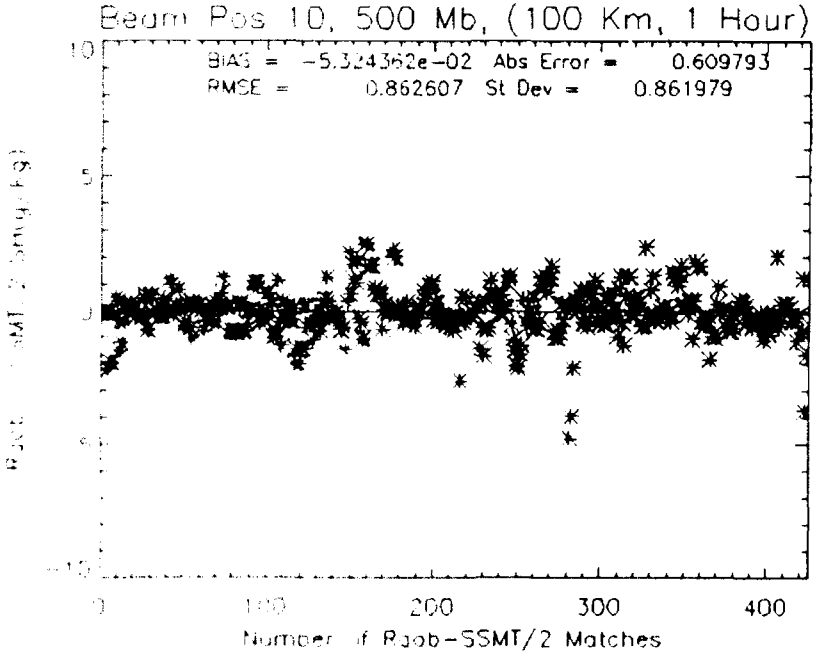

Beam Pos 20, 700 Mb, (100 Km, 1 Hour)
BIAS = 2.765671e-02 Abs Error = 1.40580
RMSE = 2.08978 St Dev = 2.09183
Raob - SSMT/2 Sh(g/Kg)
10
5
0
-5
-10
0
100
200
300
400
Number of Raob-SSMT/2 Matches

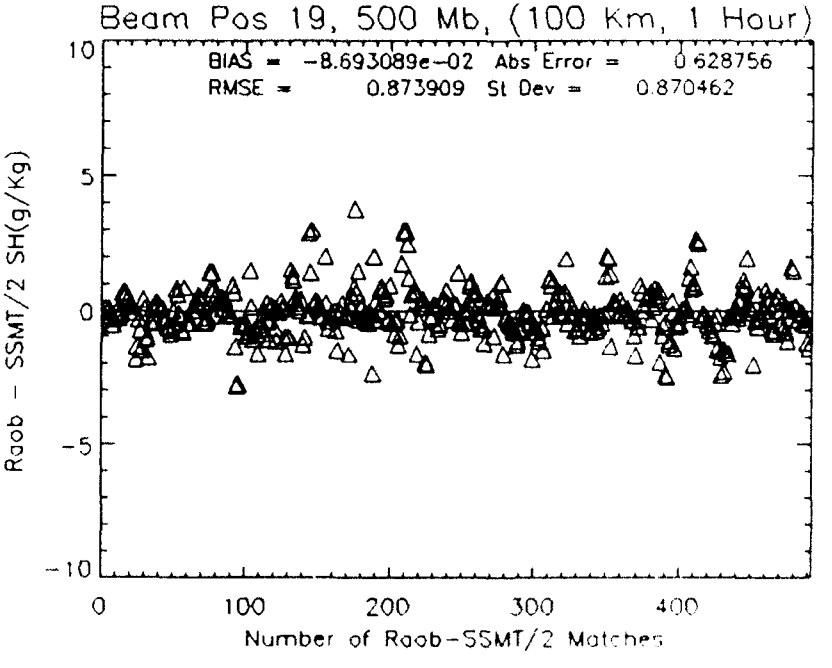

Beam Pos 10, 700 Mb, (100 Km, 1 Hour)
200
Number of Raob-SSMT/2 Matches

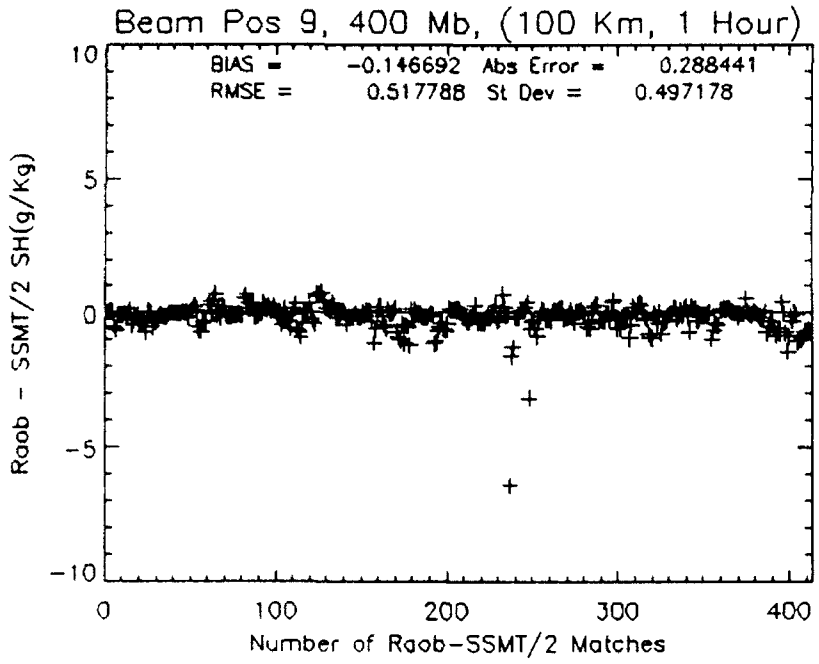

Beam Pos 19, 700 Mb, (100 Km, 1 Hour)
BIAS = 0.158983 Abs Error = 1.45123
RMSE = 2.10043 St Dev = 2.09670
Raob - SSMT/2 SH(g/Kg)
10
5
0
-5
-10
0
100
200
300
400
Number of Raob-SSMT/2 Matches

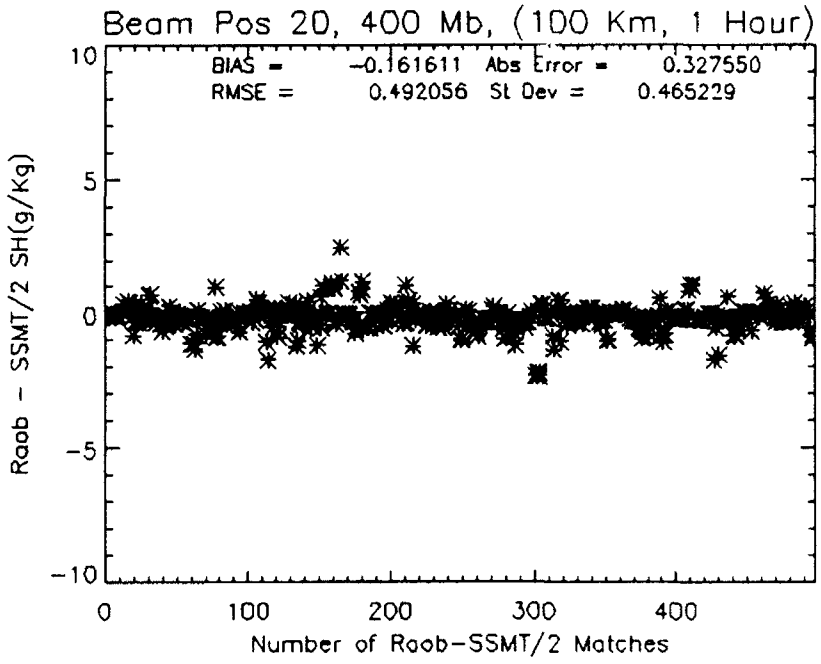

Beam Pos 9, 500 Mb, (100 Km, 1 Hour)
BIAS = -9.508670e-02 Abs Error = 0.613851
RMSE = 1.01726 St Dev = 1.01399
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

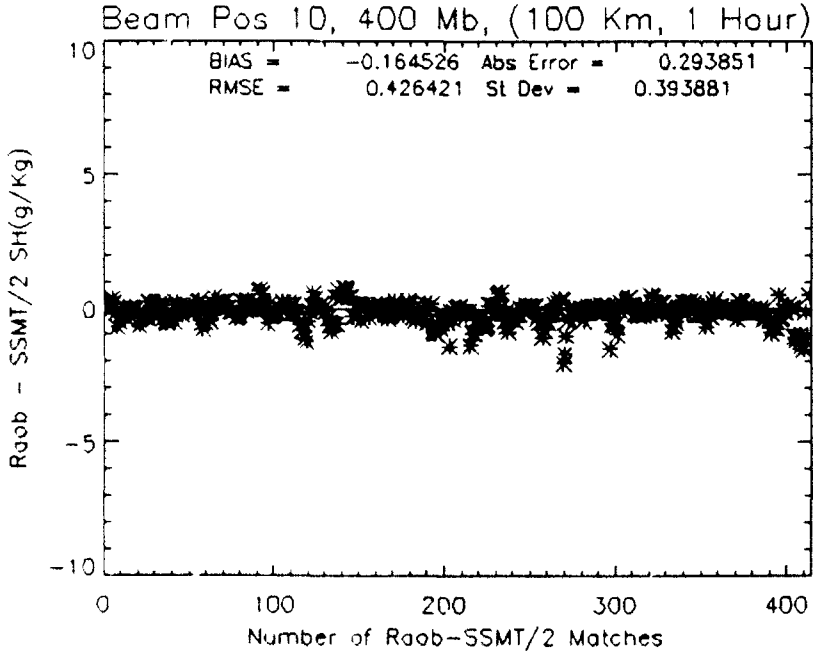

Beam Pos 20, 500 Mb, (100 Km, 1 Hour)
BIAS = -0.168525 Abs Error = 0.691241
RMSE = 1.06241 St Dev = 1.05000
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

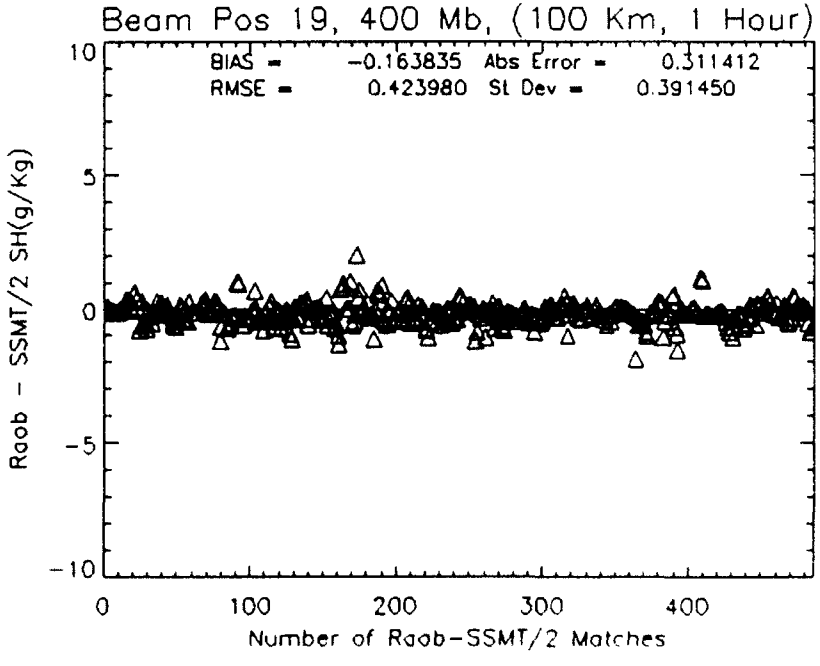

Beam Pos 10, 500 Mb, (100 Km, 1 Hour)
BIAS = -5.324362e-02 Abs Error = 0.609793
RMSE = 0.862607 St Dev = 0.861979
Number of Raob-SSMT/2 Matches

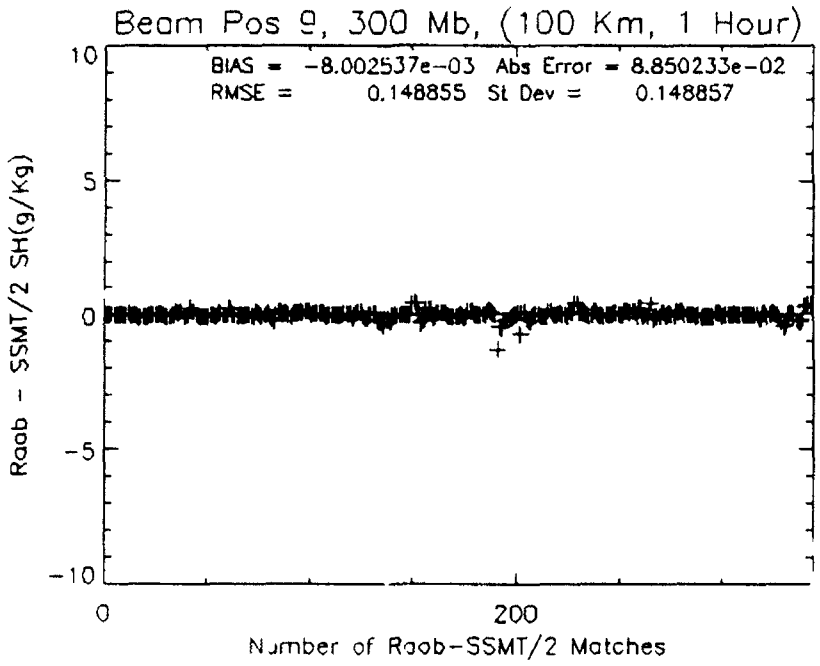

Beam Pos 19, 500 Mb, (100 Km, 1 Hour)
BIAS = -8.693089e-02 Abs Error = 0.628756
RMSE = 0.873909 St Dev = 0.870462
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

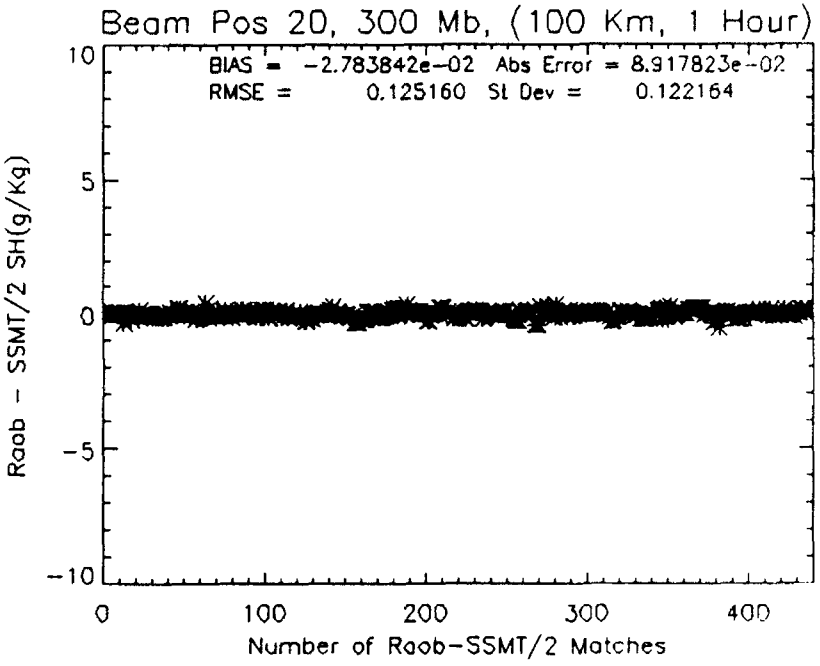

Beam Pos 9, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.146692 Abs Error = 0.288441
RMSE = 0.517788 St Dev = 0.497178
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

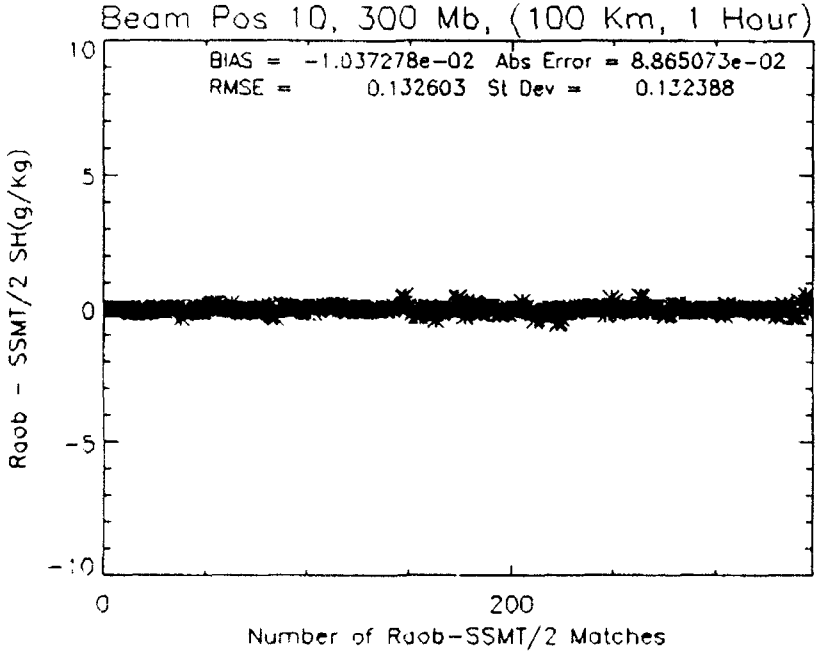

Beam Pos 20, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.161611 Abs Error = 0.327550
RMSE = 0.492056 St Dev = 0.465229
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

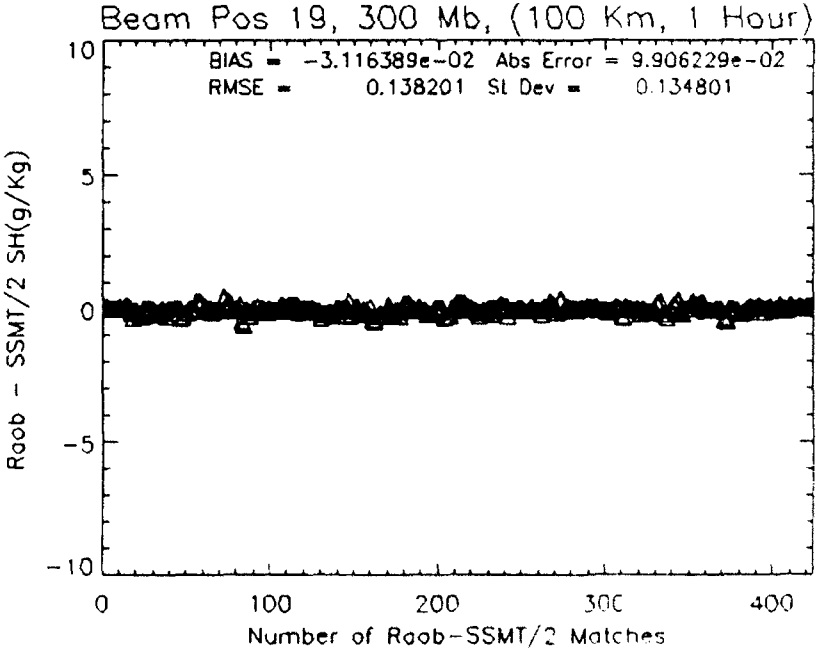

Beam Pos 10, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.164526 Abs Error = 0.293851
RMSE = 0.426421 St Dev = 0.393881
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

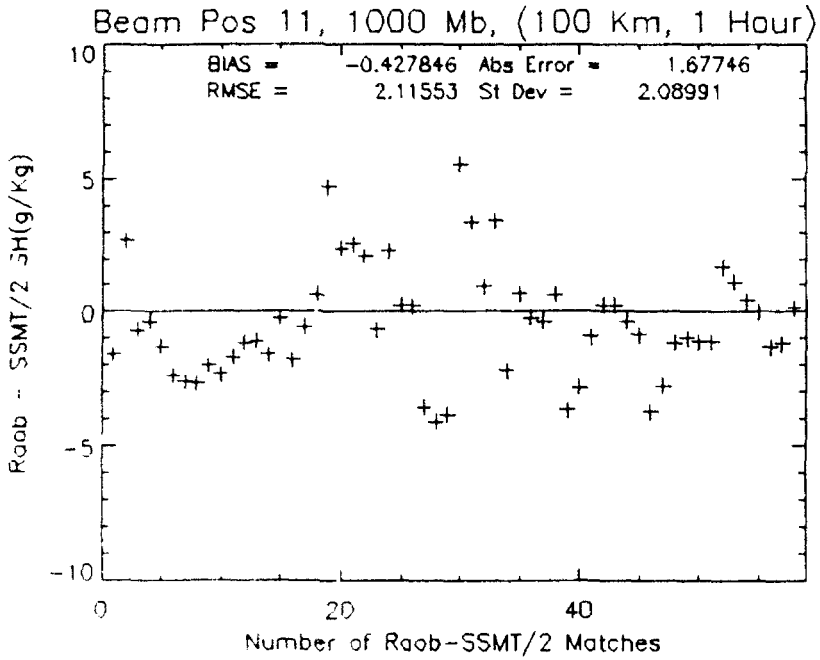

Beam Pos 19, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.163835 Abs Error = 0.311412
RMSE = 0.423980 St Dev = 0.391450
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

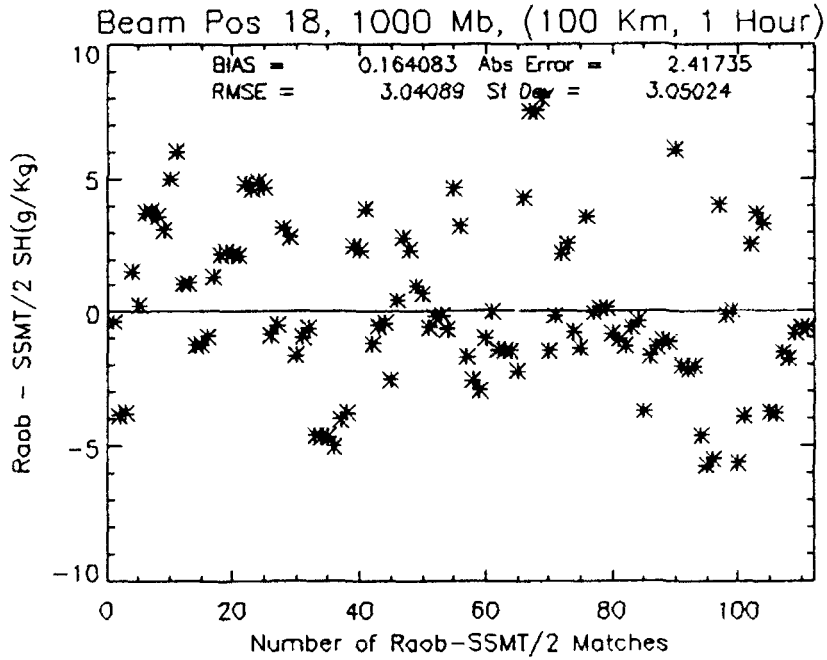

Beam Pos 9, 300 Mb, (100 Km, 1 Hour)
BIAS = -8.002537e-03 Abs Error = 8.850233e-02
RMSE = 0.148855 St Dev = 0.148857
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

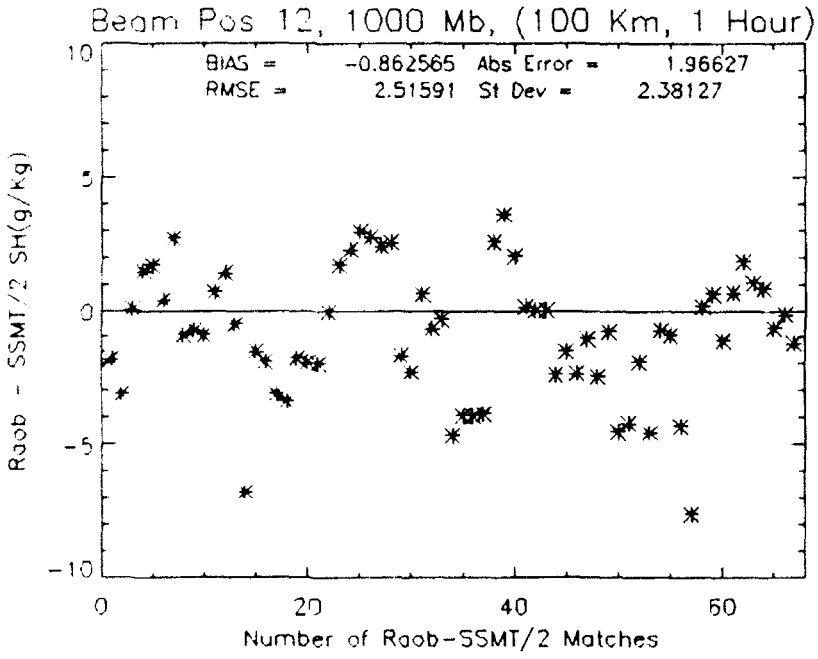

Beam Pos 20, 300 Mb, (100 Km, 1 Hour)
BIAS = -2.783842e-02 Abs Error = 8.917823e-02
RMSE = 0.125160 St Dev = 0.122164
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

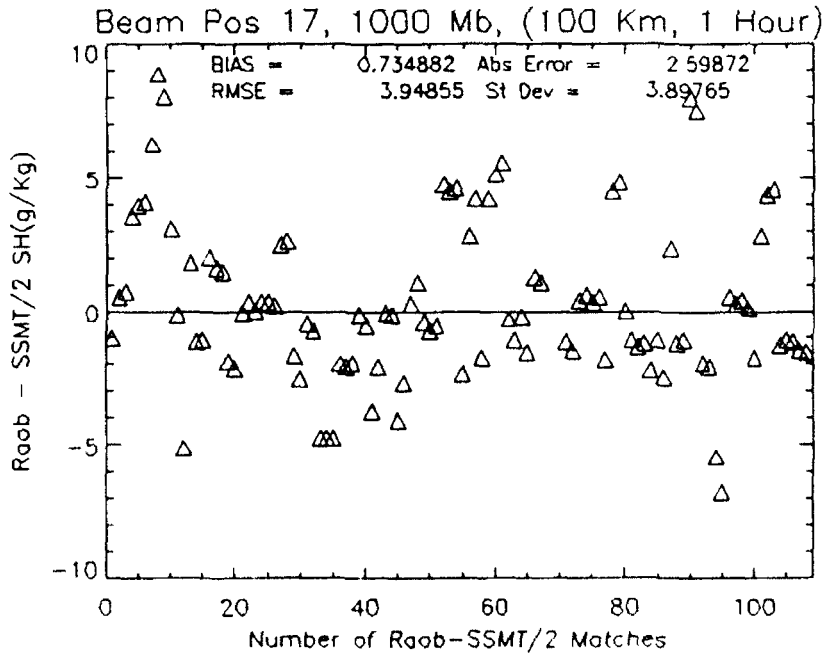

Beam Pos 10, 300 Mb, (100 Km, 1 Hour)
BIAS = -1.037278e-02 Abs Error = 8.865073e-02
RMSE = 0.132603 St Dev = 0.132388
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

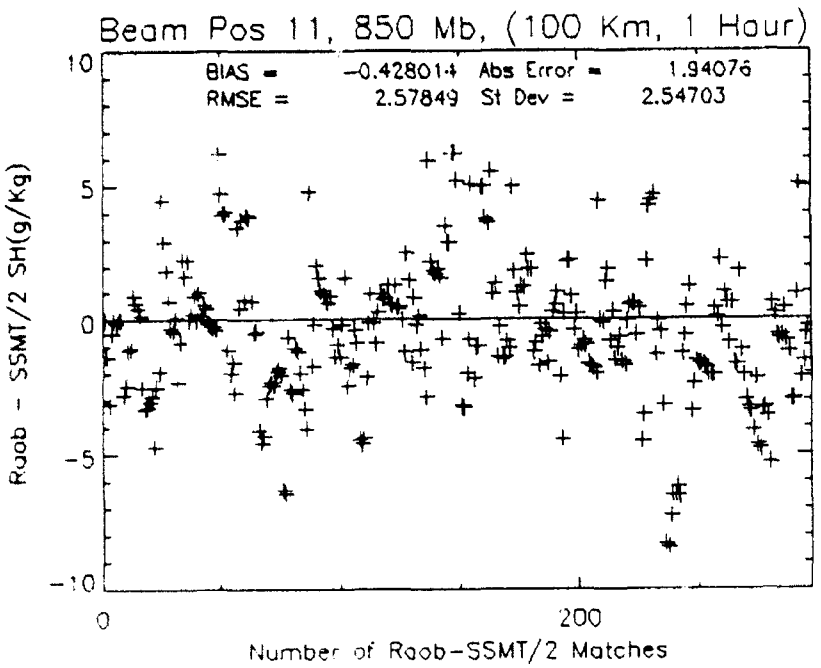

Beam Pos 19, 300 Mb, (100 Km, 1 Hour)
BIAS = -3.116389e-02 Abs Error = 9.906229e-02
RMSE = 0.138201 St Dev = 0.134801
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

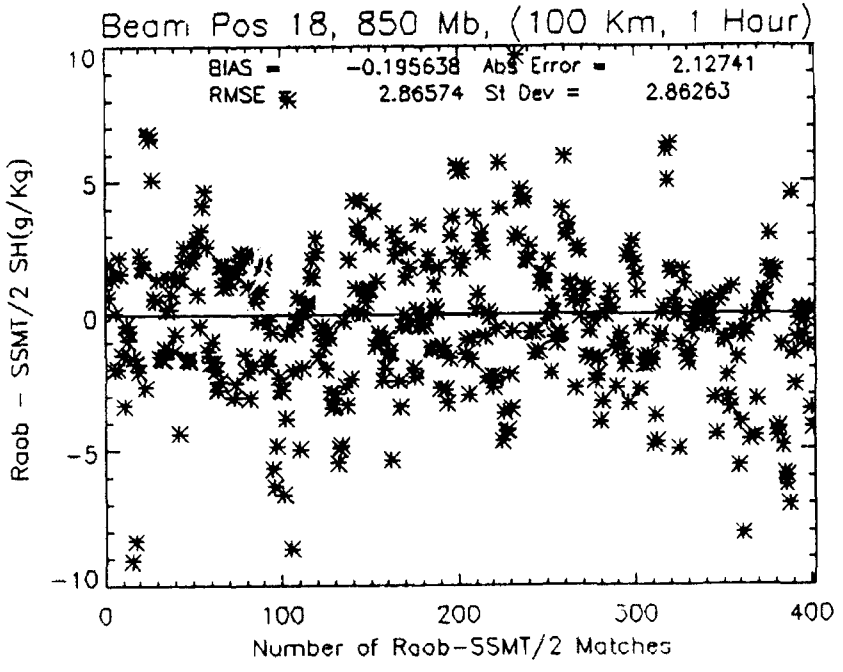

Beam Pos 11, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.427846 Abs Error = 1.67746
RMSE = 2.11553 St Dev = 2.08991
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

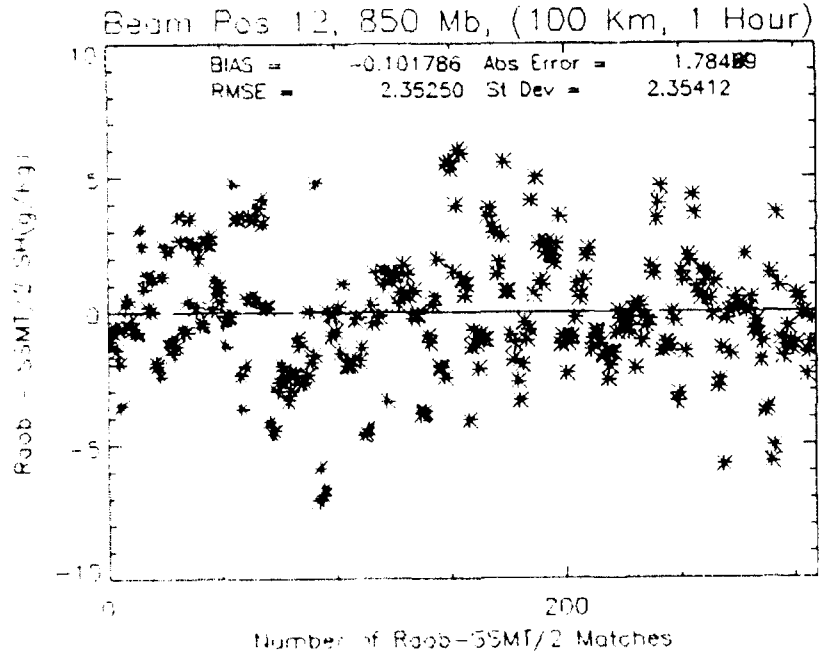

Beam Pos 18, 1000 Mb, (100 Km, 1 Hour)
BIAS = 0.164083 Abs Error = 2.41735
RMSE = 3.04089 St Dev = 3.05024
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

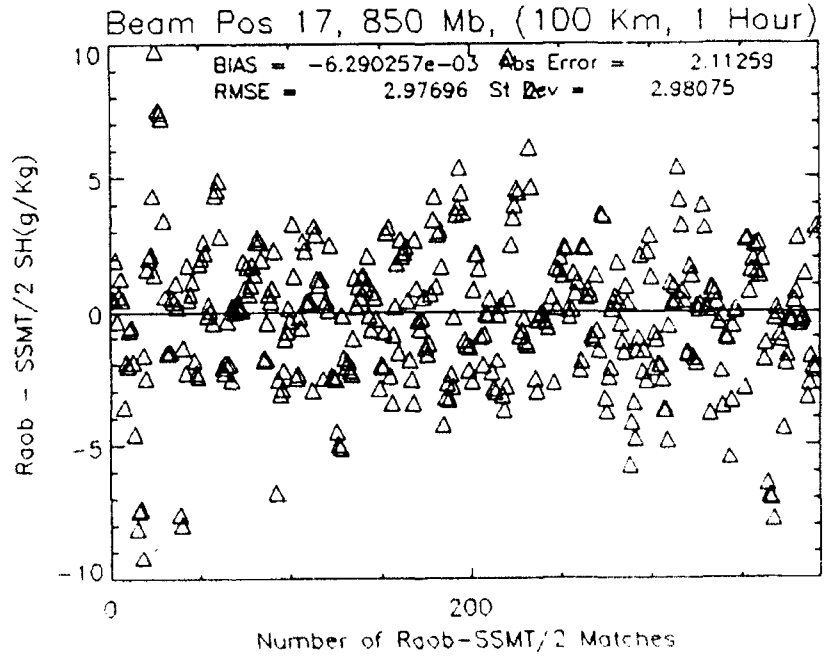

Beam Pos 12, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.862565 Abs Error = 1.96627
RMSE = 2.51591 St Dev = 2.38127
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 17, 1000 Mb, (100 Km, 1 Hour)
BIAS = 0.734882 Abs Error = 2.59872
RMSE = 3.94855 St Dev = 3.89765
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 11, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.428014 Abs Error = 1.94076
RMSE = 2.57849 St Dev = 2.54703
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 18, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.195638 Abs Error = 2.12741
RMSE = 2.86574 St Dev = 2.86263
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 12, 850 Mb, (100 Km, 1 Hour)
BIAS = -0.101786 Abs Error = 1.78489
RMSE = 2.35250 St Dev = 2.35412
Number of Raob-SSMT/2 Matches

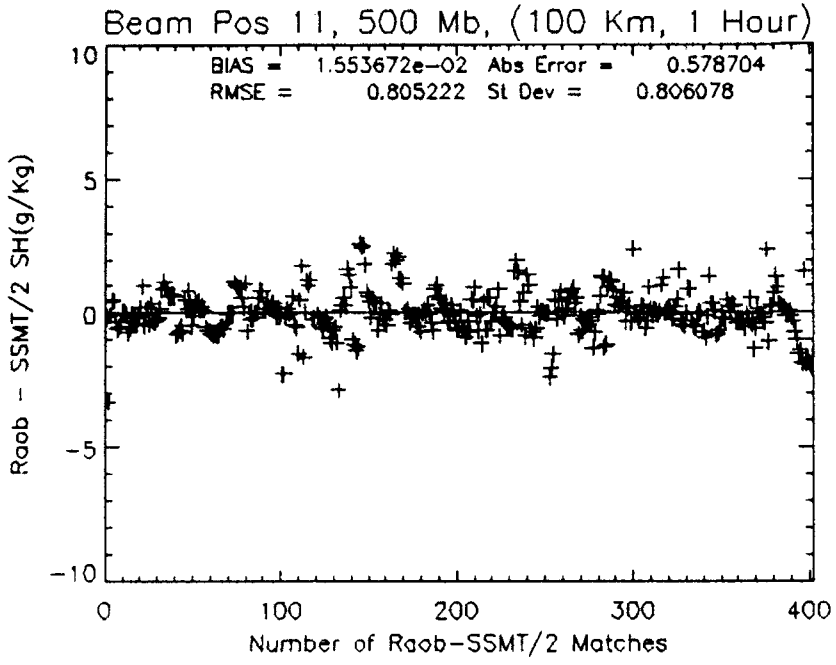

Beam Pos 17, 850 Mb, (100 Km, 1 Hour)
BIAS = -6.290257e-03 Abs Error = 2.11259
RMSE = 2.97696 St Dev = 2.98075
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

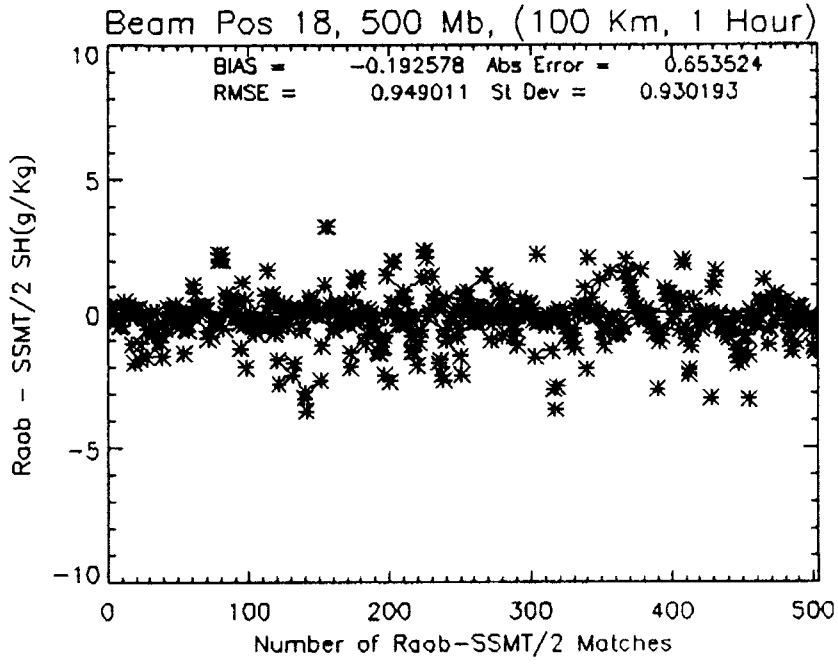
Beam Pos 18, 700 Mb, (100 Km, 1 Hour)
BIAS = -2.427008e-02 Abs Error = 1.37789
RMSE = 1.93270 St Dev = 1.93472
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

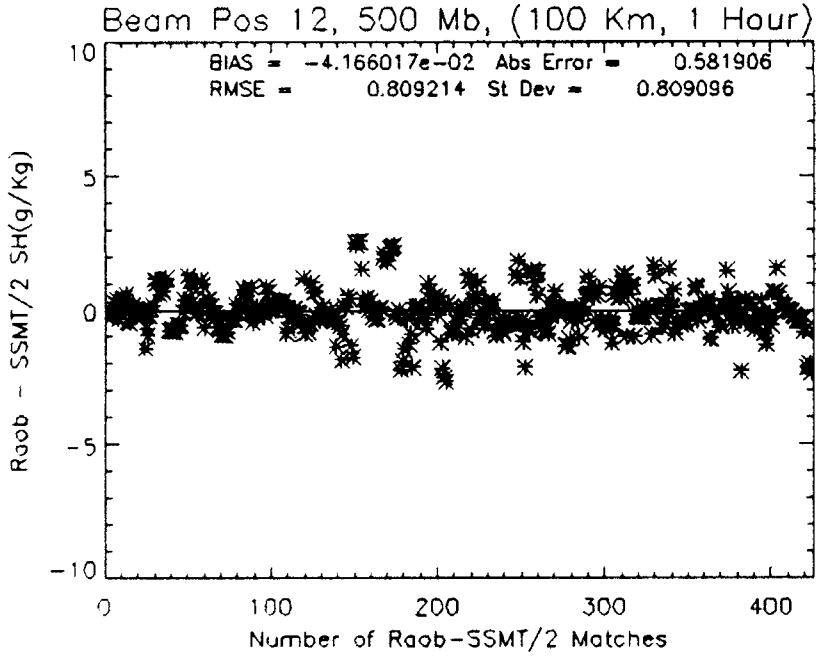
Beam Pos 17, 700 Mb, (100 Km, 1 Hour)
BIAS = 0.114248 Abs Error = 1.34901
RMSE = 1.90688 St Dev = 1.90564
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

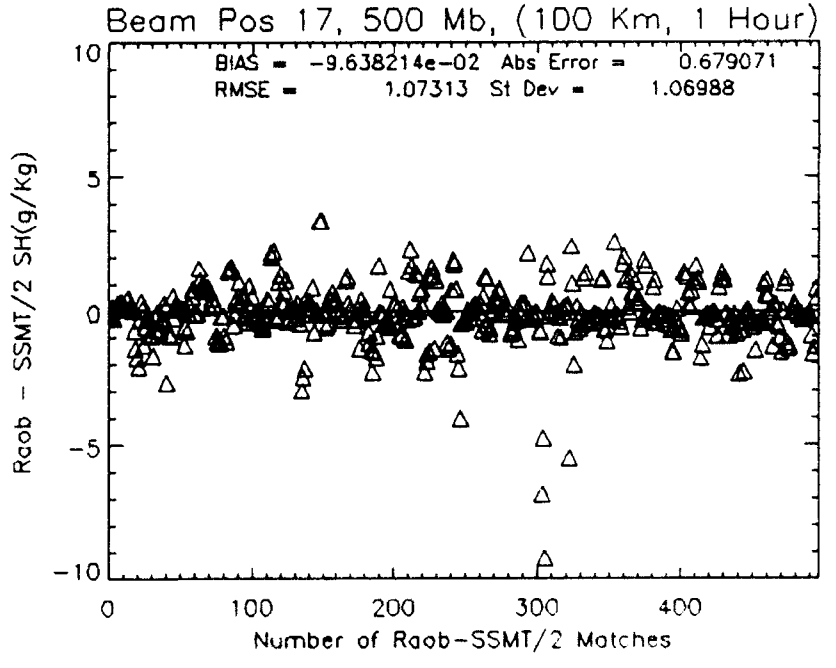
Beam Pos 11, 700 Mb, (100 Km, 1 Hour)
BIAS = 0.172999 Abs Error = 1.11305
RMSE = 1.56881 St Dev = 1.56154
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Beam Pos 12, 700 Mb, (100 Km, 1 Hour)
BIAS = 0.220009 Abs Error = 1.11353
RMSE = 1.43729 St Dev = 1.42236
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches


Beam Pos 11, 500 Mb, (100 Km, 1 Hour)
BIAS = 1.553672e-02 Abs Error = 0.578704
RMSE = 0.805222 St Dev = 0.806078
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 18, 500 Mb, (100 Km, 1 Hour)
BIAS = -0.192578 Abs Error = 0.653524
RMSE = 0.949011 St Dev = 0.930193
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 12, 500 Mb, (100 Km, 1 Hour)
BIAS = -4.166017e-02 Abs Error = 0.581906
RMSE = 0.809214 St Dev = 0.809096
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

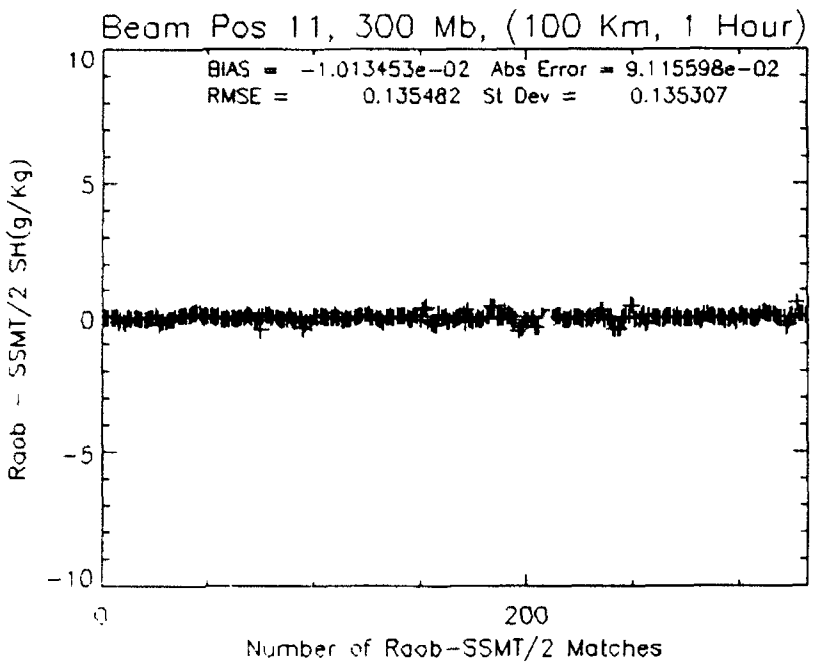

Beam Pos 17, 500 Mb, (100 Km, 1 Hour)
BIAS = -9.638214e-02 Abs Error = 0.679071
RMSE = 1.07313 St Dev = 1.06988
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

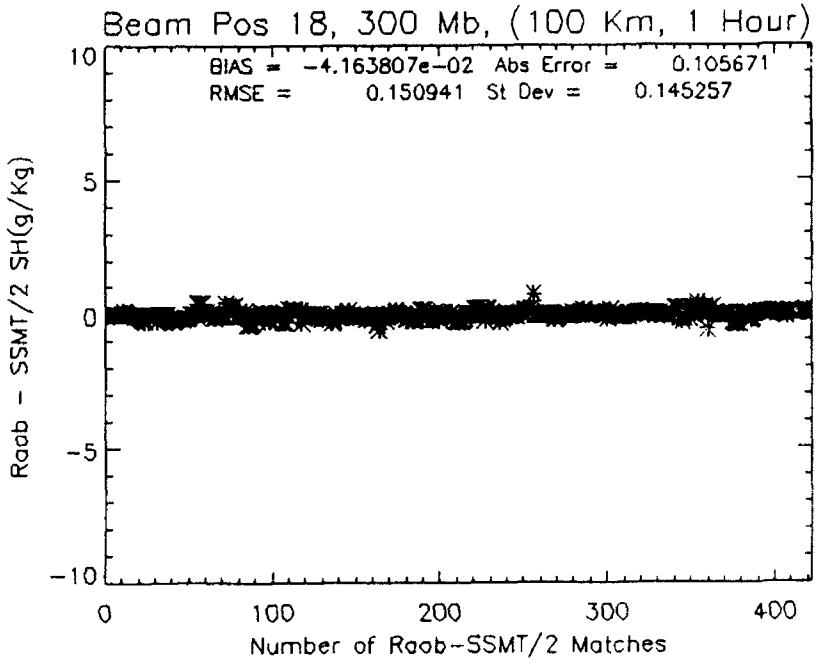
Beam Pos 18, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.194743 Abs Error = 0.334292
RMSE = 0.475657 St Dev = 0.434408
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

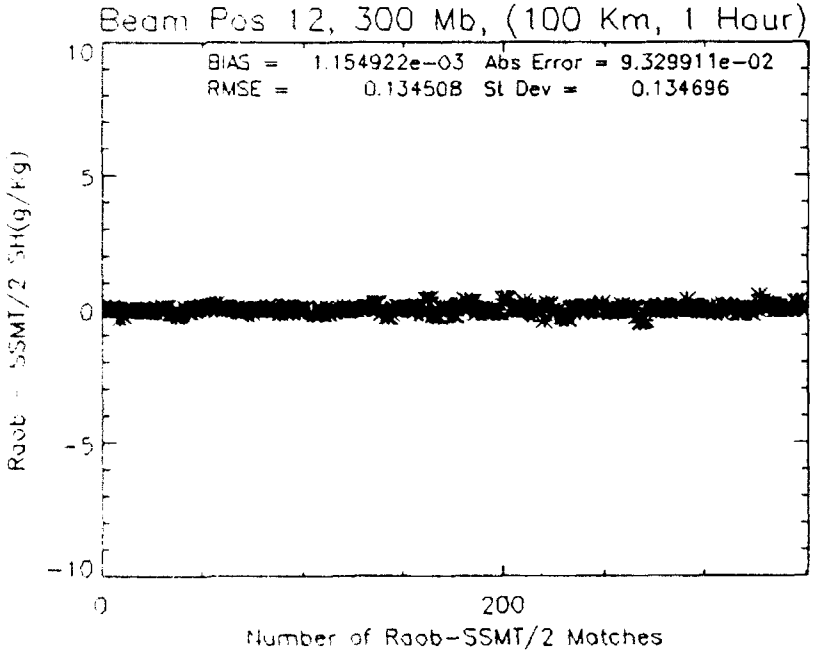
Beam Pos 17, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.136268 Abs Error = 0.332256
RMSE = 0.495440 St Dev = 0.476829
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

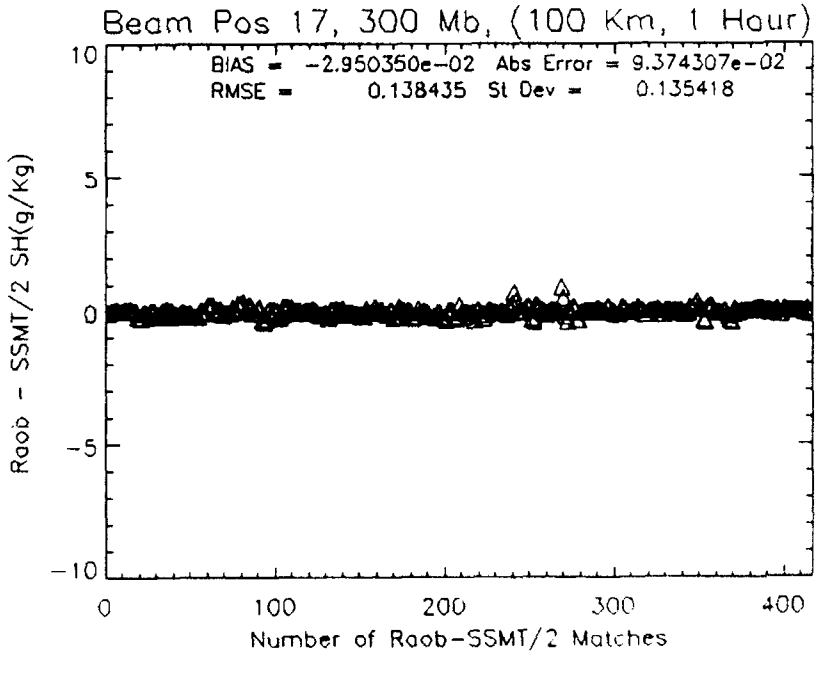
Beam Pos 11, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.178635 Abs Error = 0.295345
RMSE = 0.429339 St Dev = 0.390913
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

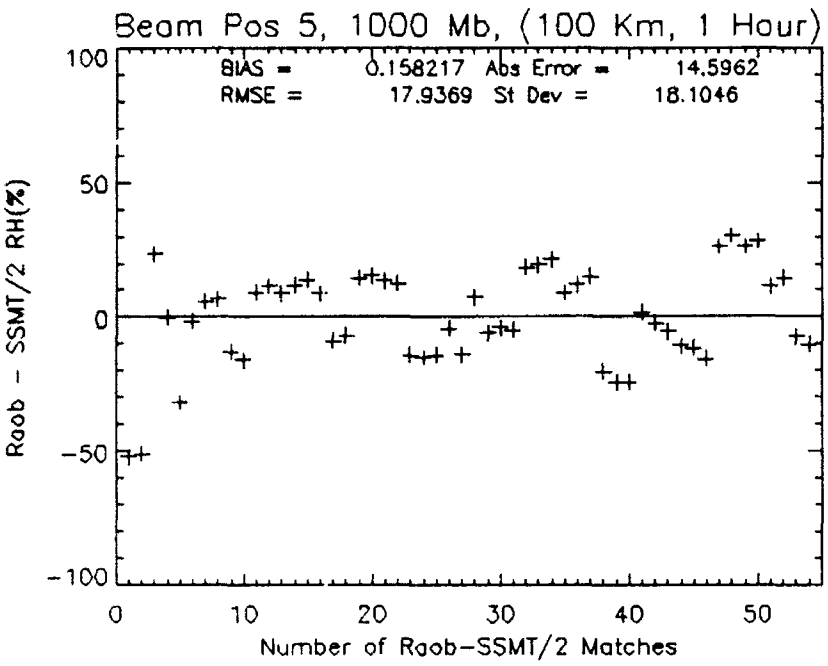
Beam Pos 12, 400 Mb, (100 Km, 1 Hour)
BIAS -0.155783 Abs Error = 0.271513
RMSE = 0.383129 St Dev = 0.350454
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

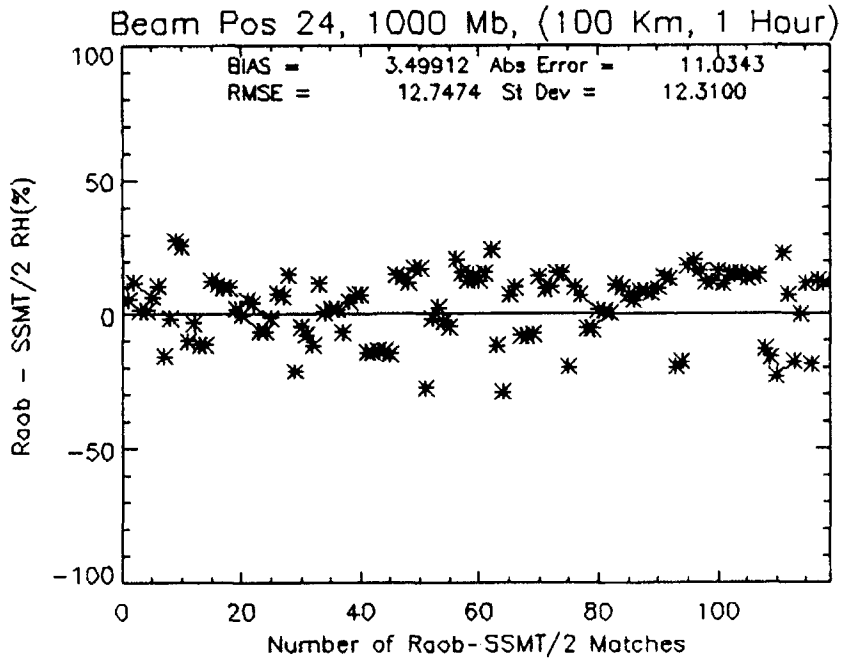

Beam Pos 11, 300 Mb, (100 Km, 1 Hour)
BIAS = -1.013453e-02 Abs Error = 9.115598e-02
RMSE = 0.135482 St Dev = 0.135307
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

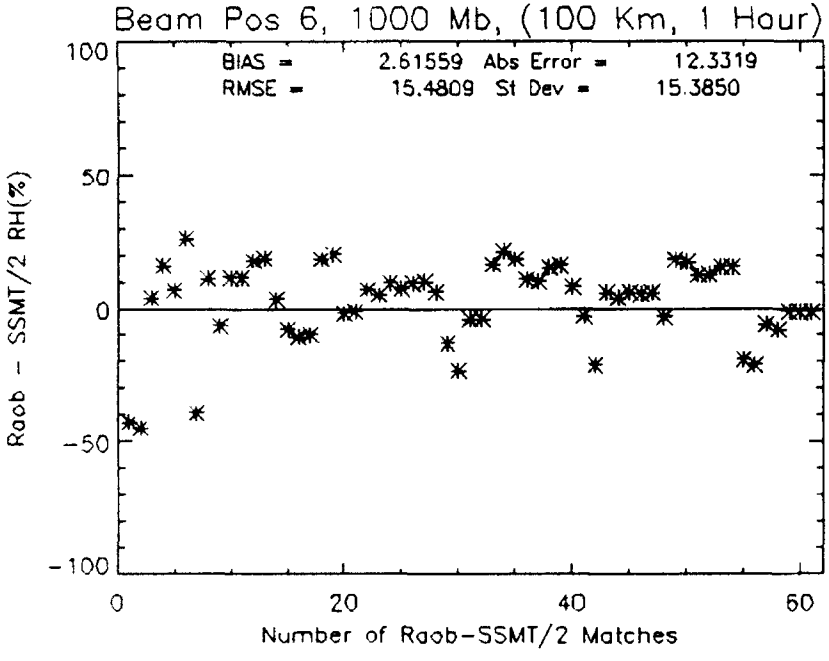

Beam Pos 18, 300 Mb, (100 Km, 1 Hour)
BIAS = -4.163807e-02 Abs Error = 0.105671
RMSE = 0.150941 St Dev = 0.145257
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

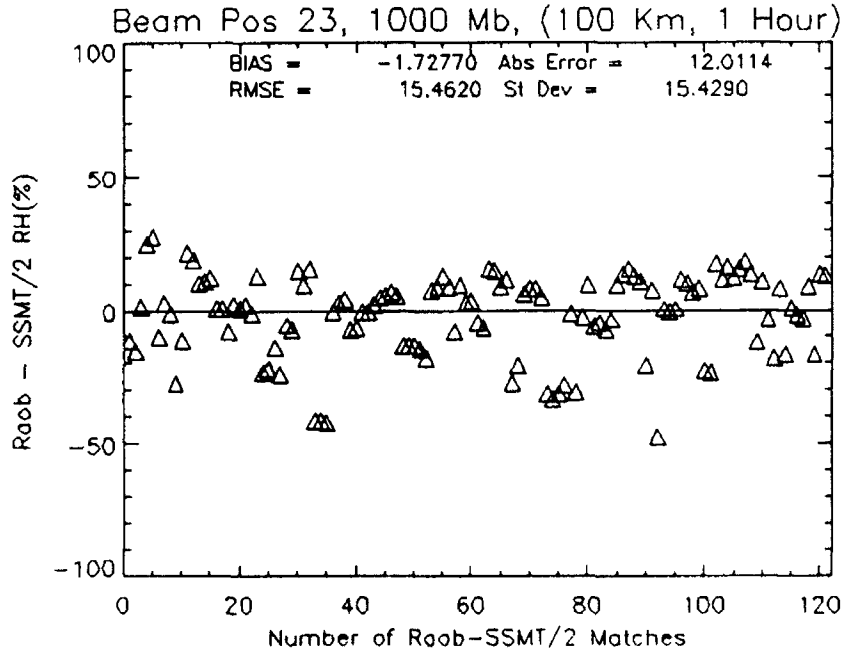

Beam Pos 12, 300 Mb, (100 Km, 1 Hour)
BIAS = 1.154922e-03 Abs Error = 9.329911e-02
RMSE = 0.134508 St Dev = 0.134696
Number of Raob-SSMT/2 Matches


Beam Pos 17, 300 Mb, (100 Km, 1 Hour)
BIAS = -2.950350e-02 Abs Error = 9.374307e-02
RMSE = 0.138435 St Dev = 0.135418
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 5, 1000 Mb, (100 Km, 1 Hour)
BIAS = 0.158217 Abs Error = 14.5962
RMSE = 17.9369 St Dev = 18.1046
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 24, 1000 Mb, (100 Km, 1 Hour)
BIAS = 3.49912 Abs Error = 11.0343
RMSE = 12.7474 St Dev = 12.3100
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 6, 1000 Mb, (100 Km, 1 Hour)
BIAS = 2.61559 Abs Error = 12.3319
RMSE = 15.4809 St Dev = 15.3850
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

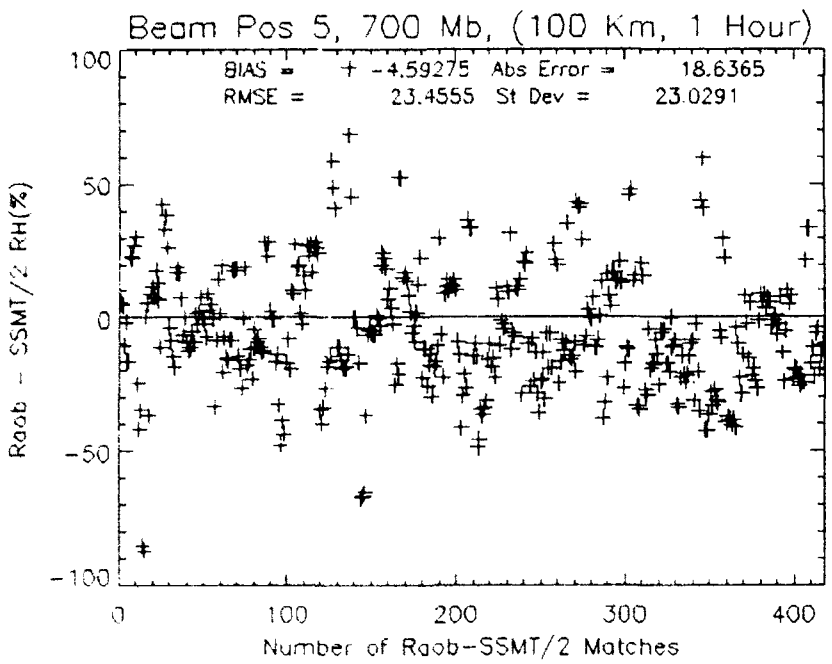

Beam Pos 23, 1000 Mb, (100 Km, 1 Hour)
BIAS = -1.72770 Abs Error = 12.0114
RMSE = 15.4620 St Dev = 15.4290
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

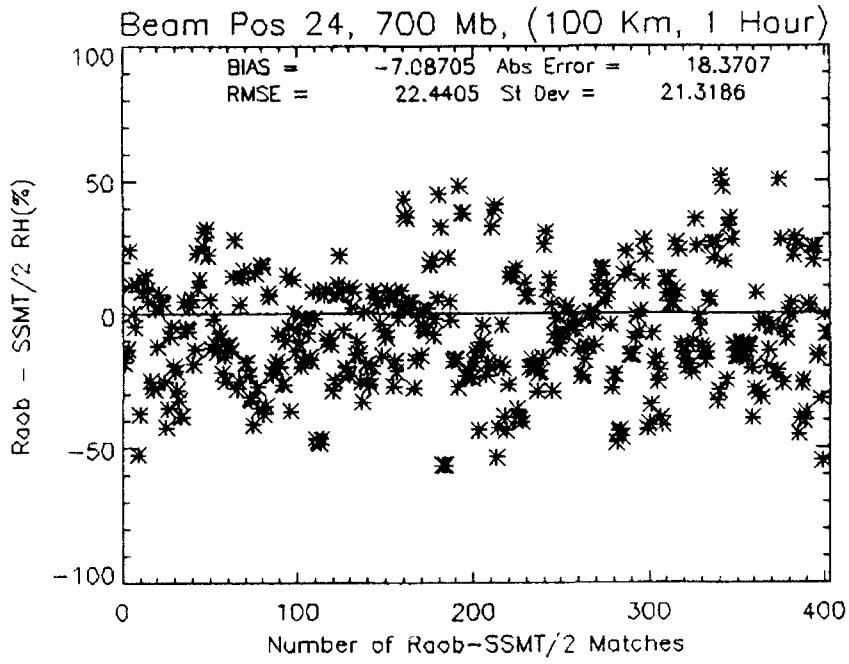
Beam Pos 24, 850 Mb, (100 Km, 1 Hour)
BIAS = -4.13532 Abs Error = 19.3854
RMSE = 24.0604 St Dev = 23.7325
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

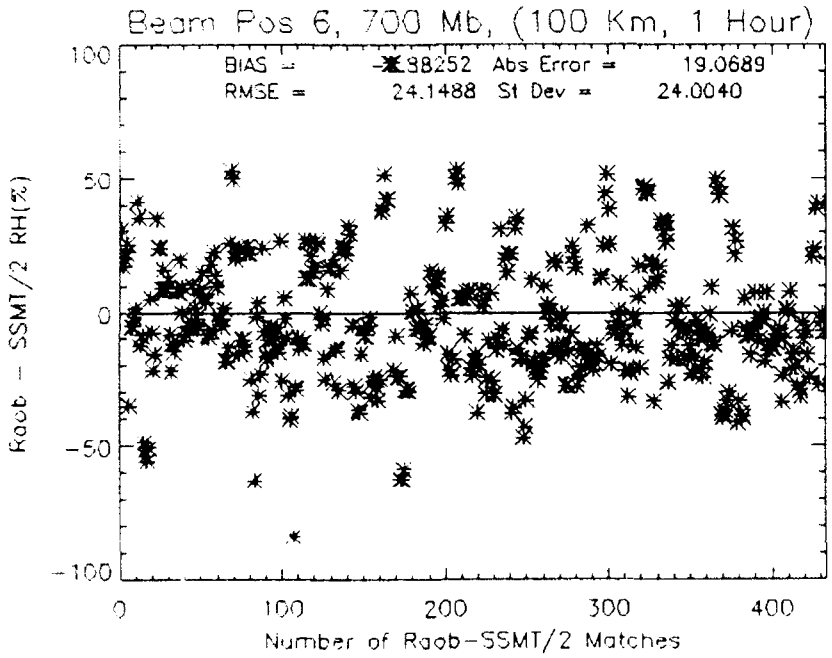
Beam Pos 23, 850 Mb, (100 Km, 1 Hour)
BIAS = -4.28507 Abs Error = 17.3231
RMSE = 22.0100 St Dev = 21.6138
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

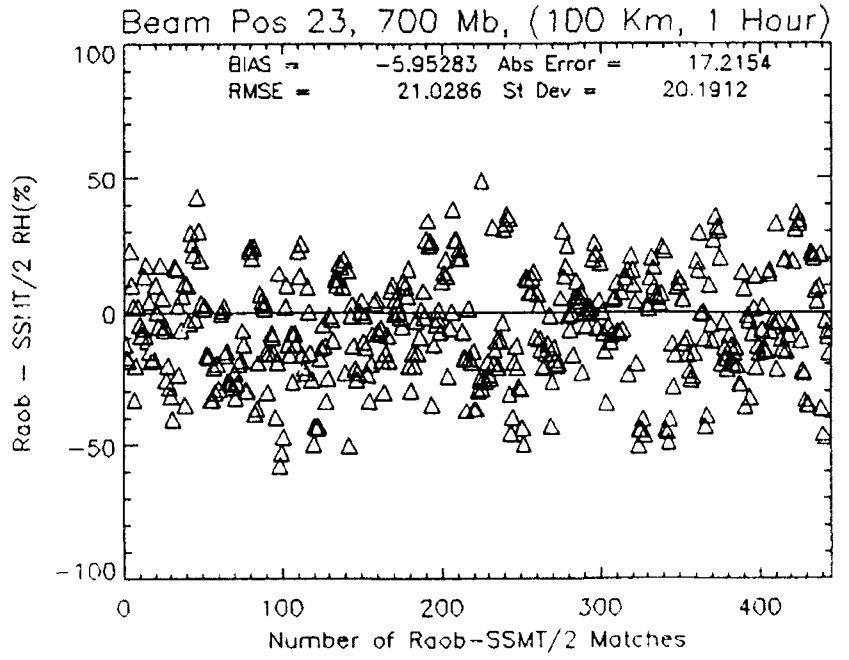
Beam Pos 5, 850 Mb, (100 Km, 1 Hour)
BIAS = -7.42727 Abs Error = 19.1174
RMSE = 23.7046 St Dev = 22.5432
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

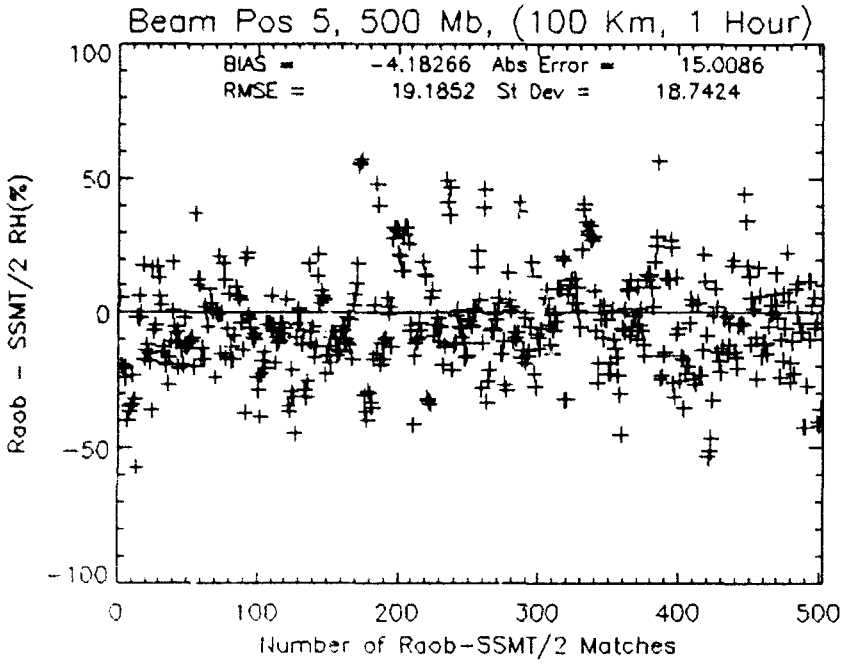
Beam Pos 6, 850 Mb, (100 Km, 1 Hour)
BIAS = -6.22113 Abs Error = 19.3842
RMSE = 24.5312 St Dev = 23.7605
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

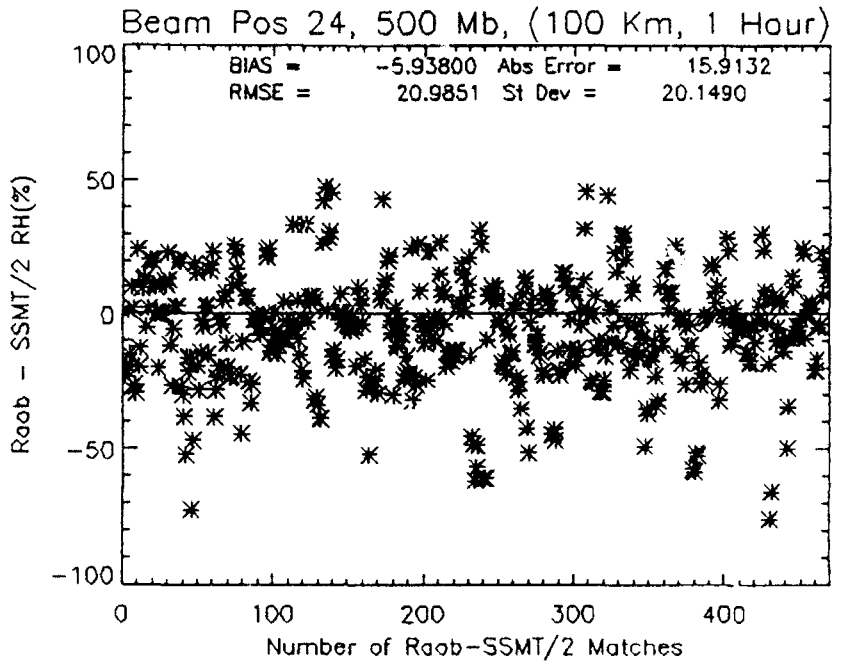

Beam Pos 5, 700 Mb, (100 Km, 1 Hour)
BIAS = -4.59275 Abs Error = 18.6365
RMSE = 23.4555 St Dev = 23.0291
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

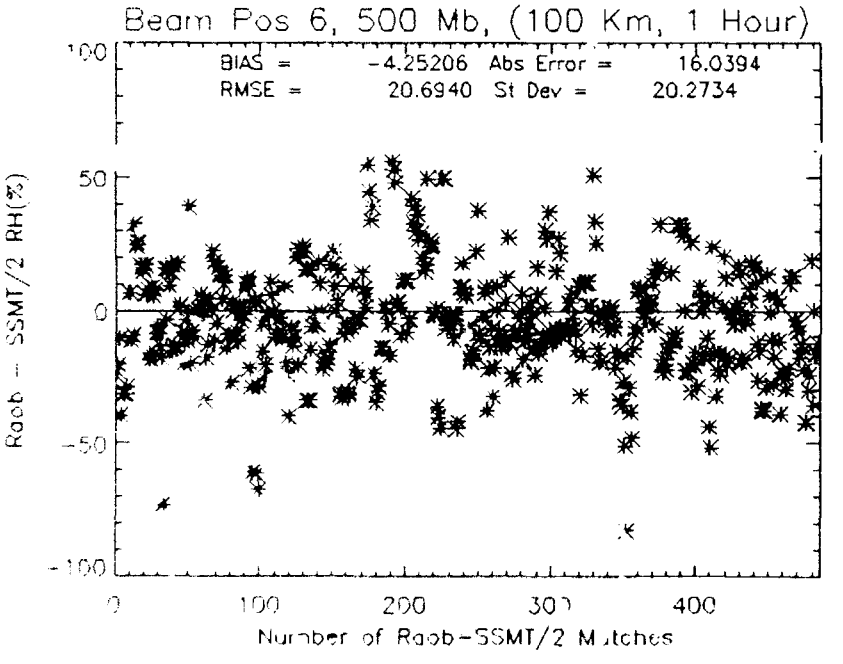

Beam Pos 24, 700 Mb, (100 Km, 1 Hour)
BIAS = -7.08705 Abs Error = 18.3707
RMSE = 22.4405 St Dev = 21.3186
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

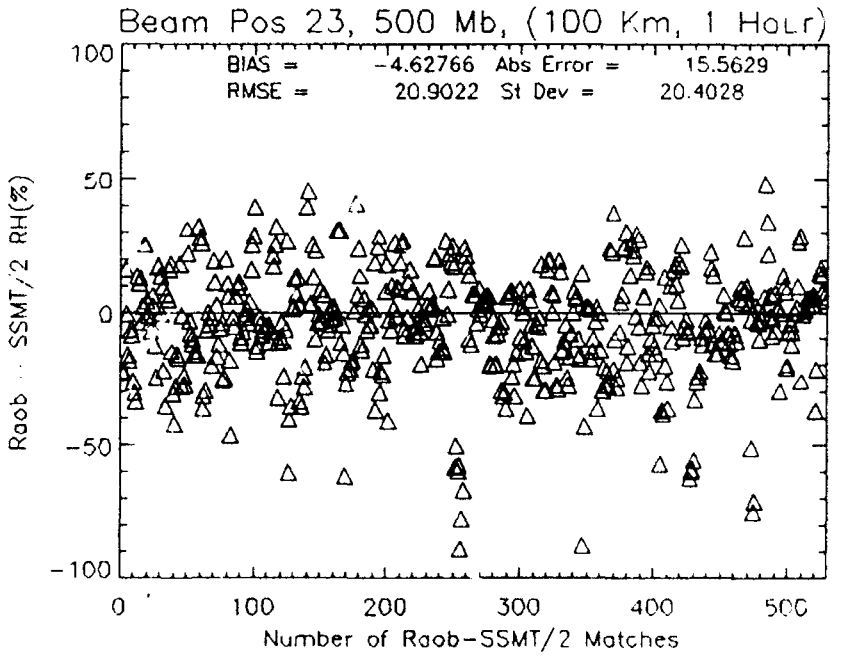

Beam Pos 6, 700 Mb, (100 Km, 1 Hour)
BIAS = -3.38252 Abs Error = 19.0689
RMSE = 24.1488 St Dev = 24.0040
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

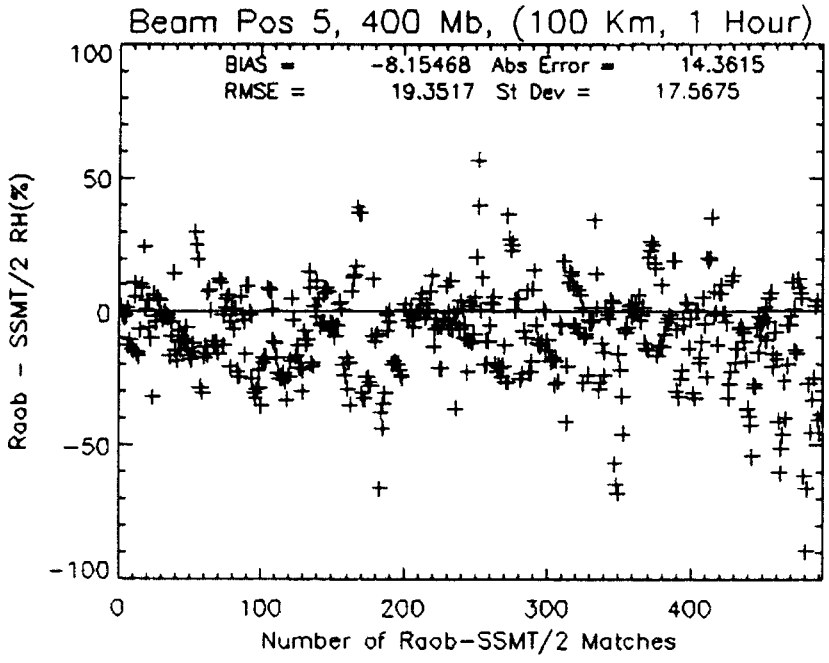

Beam Pos 23, 700 Mb, (100 Km, 1 Hour)
BIAS = -5.95283 Abs Error = 17.2154
RMSE = 21.0286 St Dev = 20.1912
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

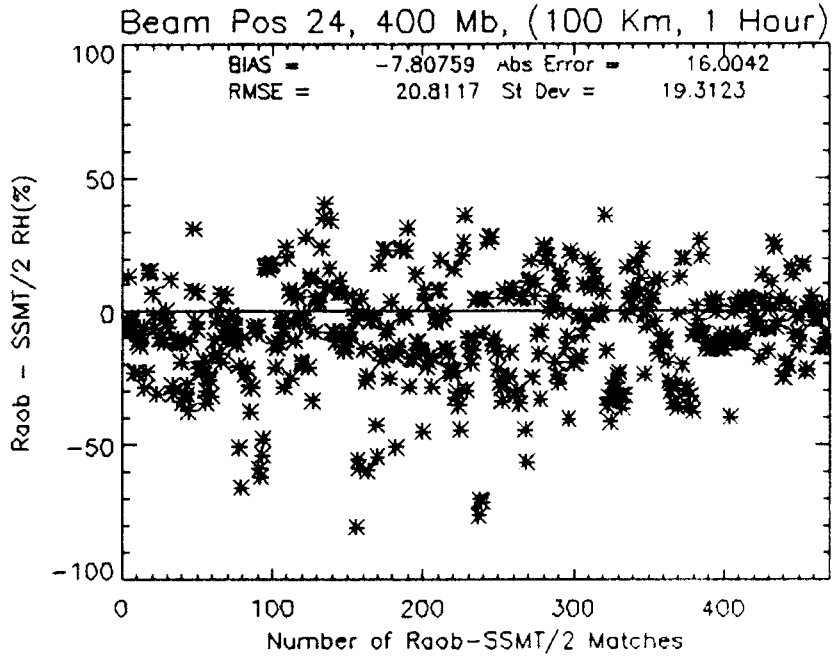

Beam Pos 5, 500 Mb, (100 Km, 1 Hour)
BIAS = -4.18266 Abs Error = 15.0086
RMSE = 19.1852 St Dev = 18.7424
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

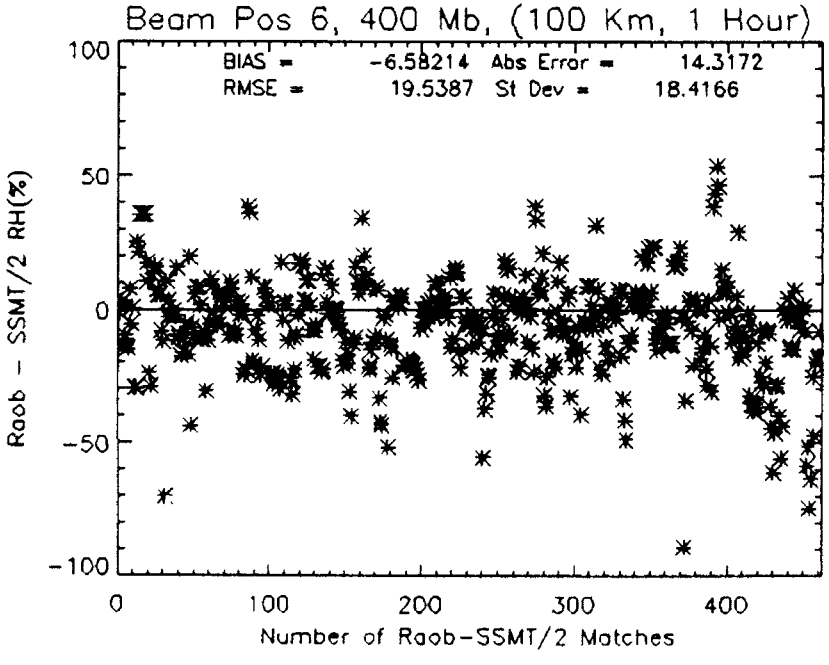

Beam Pos 24, 500 Mb, (100 Km, 1 Hour)
BIAS = -5.93800 Abs Error = 15.9132
RMSE = 20.9851 St Dev = 20.1490
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

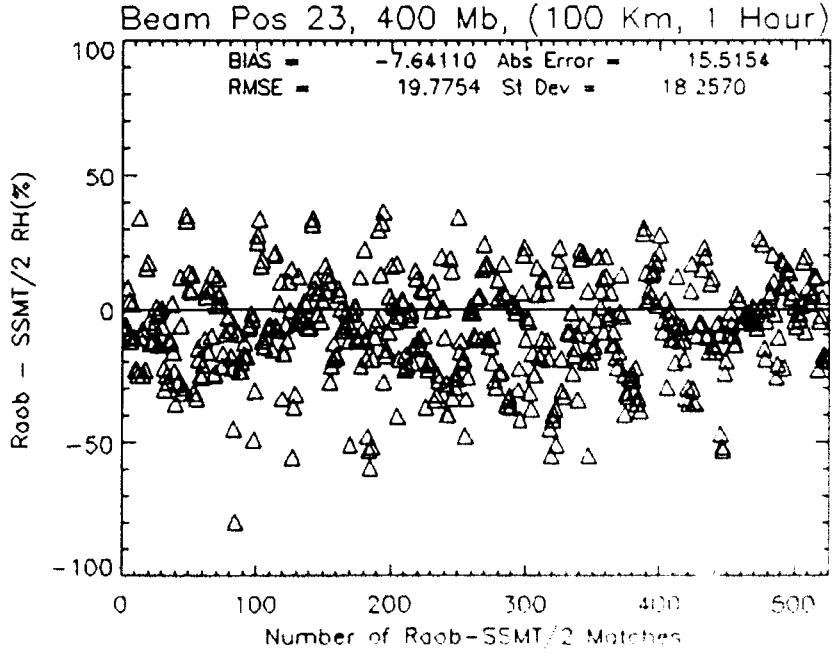

Beam Pos 6, 500 Mb, (100 Km, 1 Hour)
BIAS = -4.25206 Abs Error = 16.0394
RMSE = 20.6940 St Dev = 20.2734
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 23, 500 Mb, (100 Km, 1 Hour)
BIAS = -4.62766 Abs Error = 15.5629
RMSE = 20.9022 St Dev = 20.4028
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 5, 400 Mb, (100 Km, 1 Hour)
BIAS = -8.15468 Abs Error = 14.3615
RMSE = 19.3517 St Dev = 17.5675
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 24, 400 Mb, (100 Km, 1 Hour)
BIAS = -7.80759 Abs Error = 16.0042
RMSE = 20.8117 St Dev = 19.3123
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 6, 400 Mb, (100 Km, 1 Hour)
BIAS = -6.58214 Abs Error = 14.3172
RMSE = 19.5387 St Dev = 18.4166
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

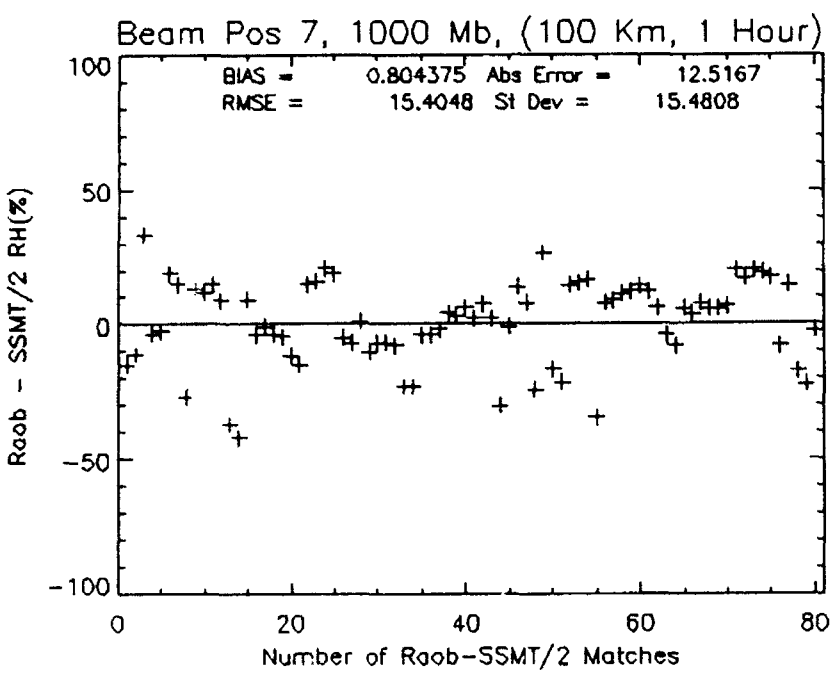

Beam Pos 23, 400 Mb, (100 Km, 1 Hour)
BIAS = -7.64110 Abs Error = 15.5154
RMSE = 19.7754 St Dev = 18.2570
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

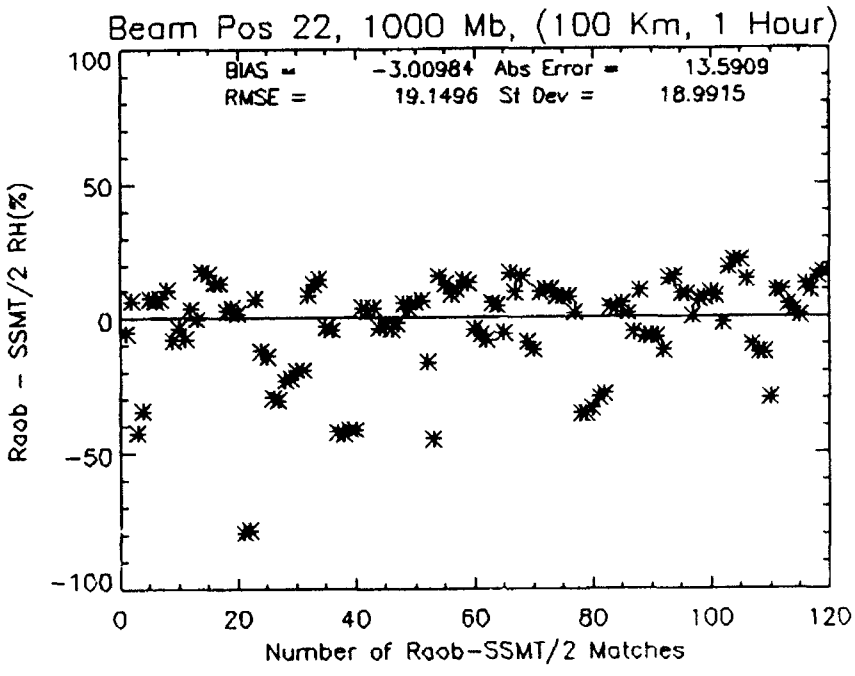
Beam Pos 24, 300 Mb, (100 Km, 1 Hour)
BIAS = -6.62377 Abs Error = 13.5623
RMSE = 17.2590 St Dev = 15.9590
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
100
50
0
-50
-100
0
200

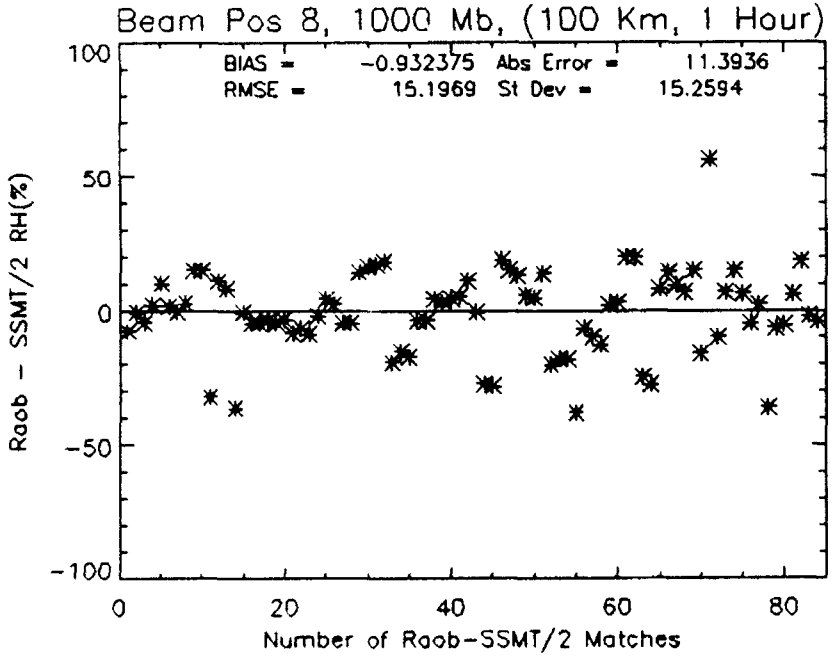
Beam Pos 23, 300 Mb, (100 Km, 1 Hour)
BIAS = -7.19301 Abs Error = 15.0522
RMSE = 19.1814 St Dev = 17.8016
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
100
50
0
-50
-100
0
100
200
300
400

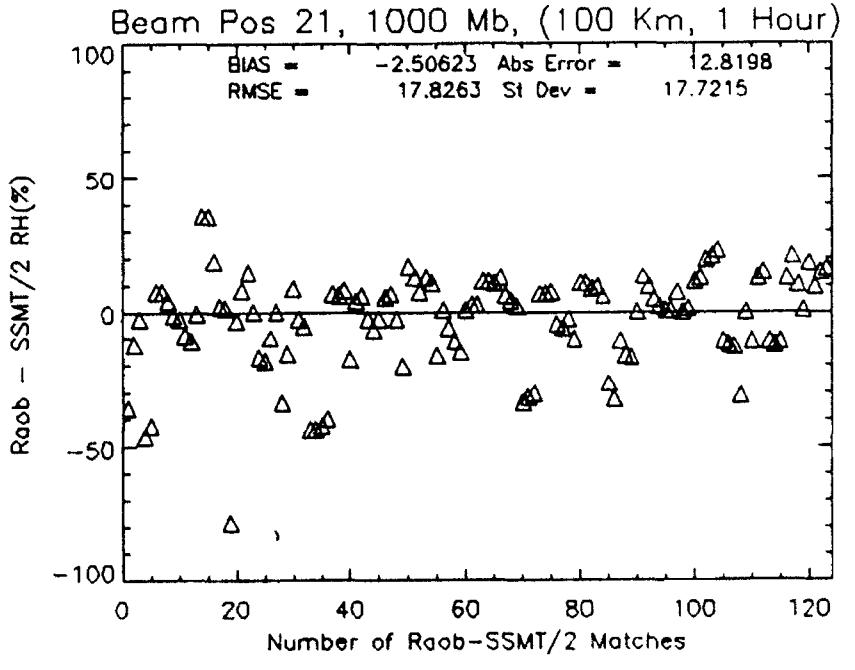
Beam Pos 5, 300 Mb, (100 Km, 1 Hour)
BIAS = 0.998106 Abs Error = 13.6068
RMSE = 17.3715 St Dev = 17.3634
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
100
50
0
-50
-100
0
100
200
300
400

Beam Pos 6, 300 Mb, (100 Km, 1 Hour)
BIAS = 2.59699 Abs Error = 12.9096
RMSE = 16.3101 St Dev = 16.1227
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
100
50
0
-50
-100
0
200

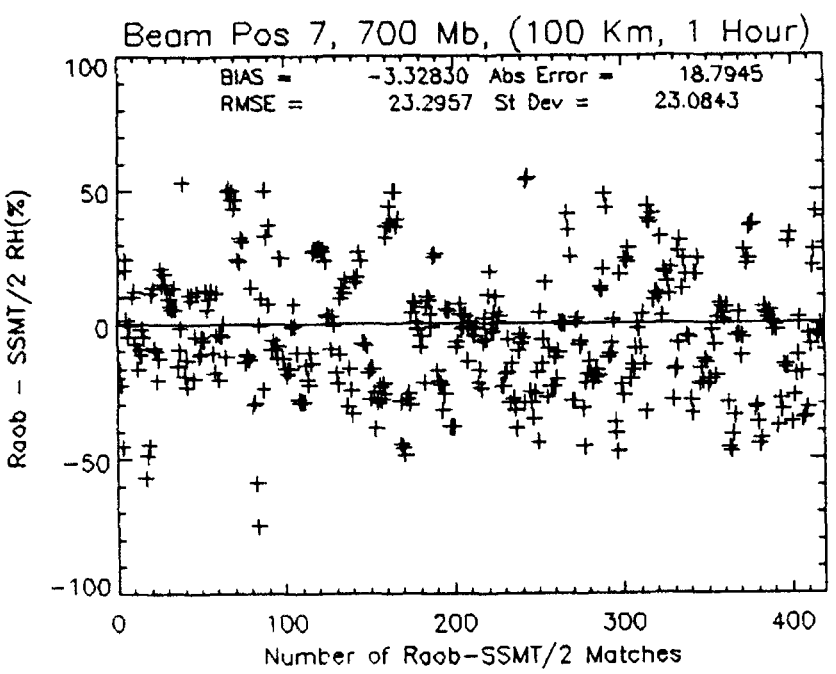

Beam Pos 7, 1000 Mb, (100 Km, 1 Hour)
BIAS = 0.804375 Abs Error = 12.5167
RMSE = 15.4048 St Dev = 15.4808
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

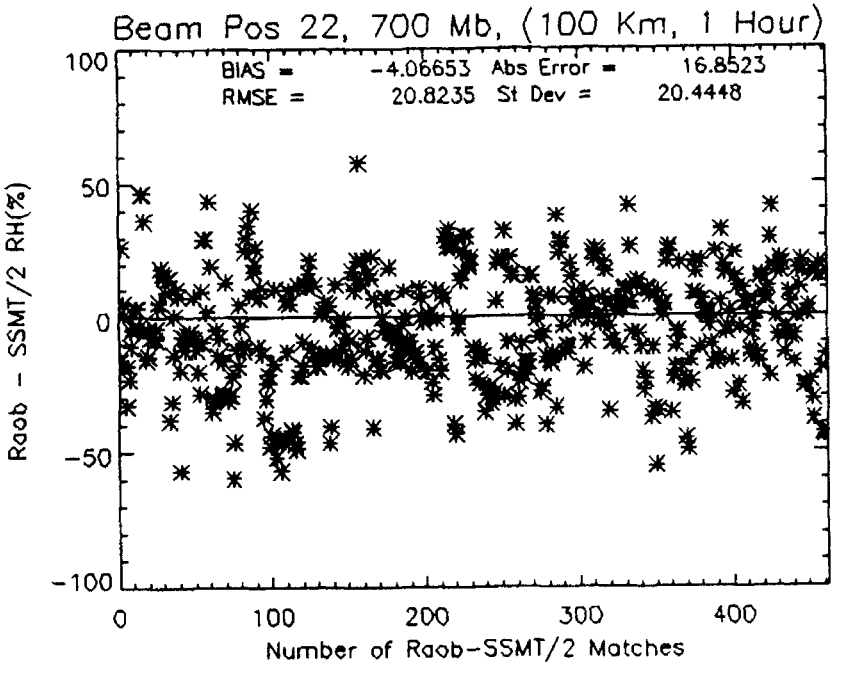

Beam Pos 22, 1000 Mb, (100 Km, 1 Hour)
BIAS = -3.00984 Abs Error = 13.5909
RMSE = 19.1496 St Dev = 18.9915
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

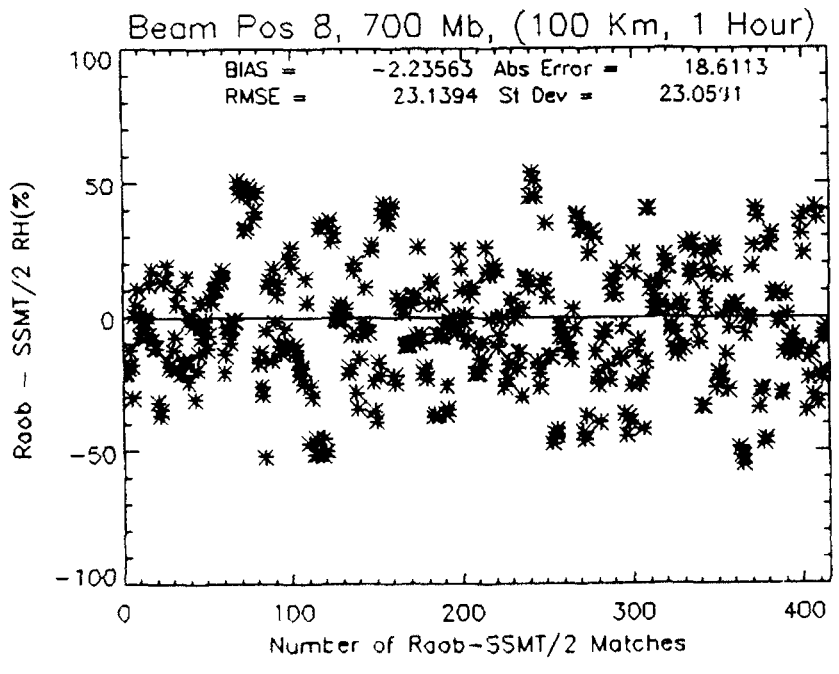

Beam Pos 8, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.932375 Abs Error = 11.3936
RMSE = 15.1969 St Dev = 15.2594
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

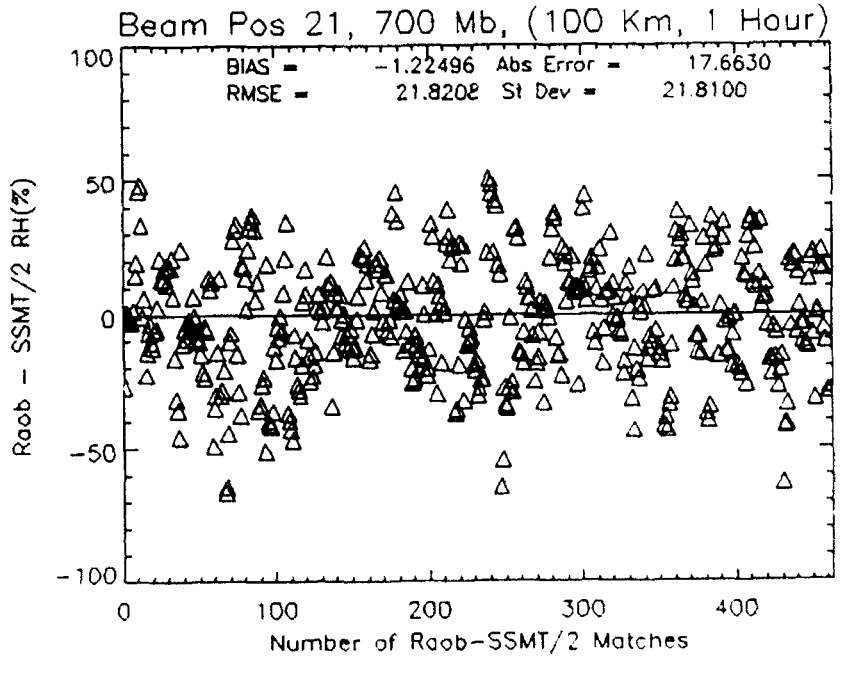

Beam Pos 21, 1000 Mb, (100 Km, 1 Hour)
BIAS = -2.50623 Abs Error = 12.8198
RMSE = 17.8263 St Dev = 17.7215
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

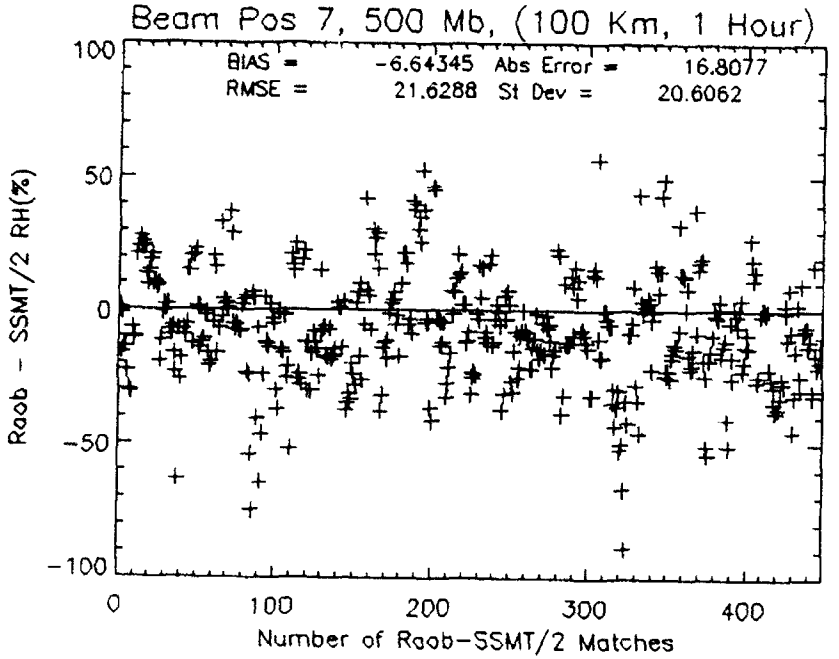
Beam Pos 22, 850 Mb, (100 Km, 1 Hour)
BIAS = -4.86310 Abs Error = 18.4325
RMSE = 23.0962 St Dev = 23.2177
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Beam Pos 21, 850 Mb, (100 Km, 1 Hour)
BIAS = -5.13191 Abs Error = 19.8942
RMSE = 24.3801 St Dev = 24.4621
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Beam Pos 7, 850 Mb, (100 Km, 1 Hour)
BIAS = -4.50197 Abs Error = 19.9547
RMSE = 24.8672 St Dev = 24.4886
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Beam Pos 8, 850 Mb, (100 Km, 1 Hour)
BIAS = -3.92382 Abs Error = 19.2604
RMSE = 24.5835 St Dev = 24.3018
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

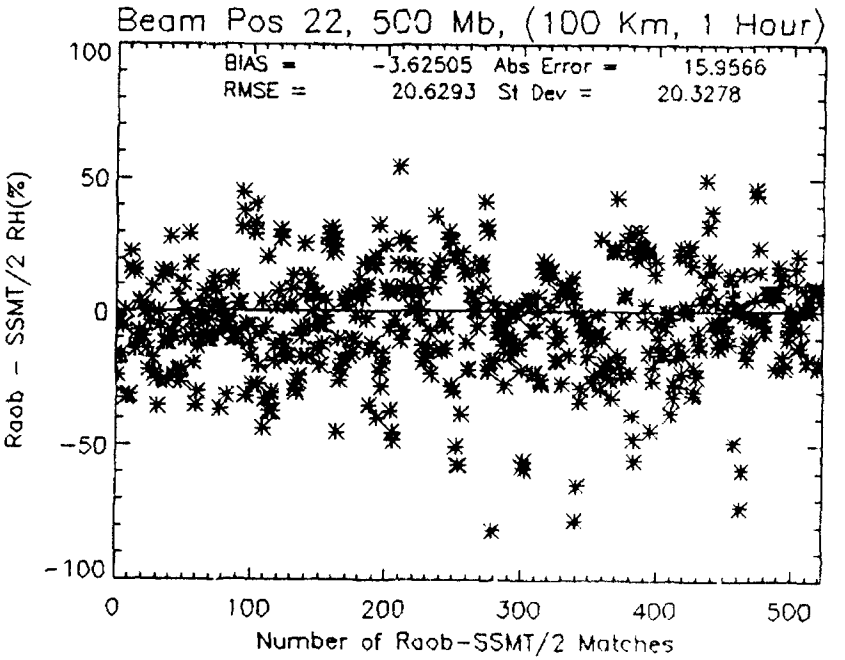

Beam Pos 7, 700 Mb, (100 Km, 1 Hour)
BIAS = -3.32830 Abs Error = 18.7945
RMSE = 23.2957 St Dev = 23.0843
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

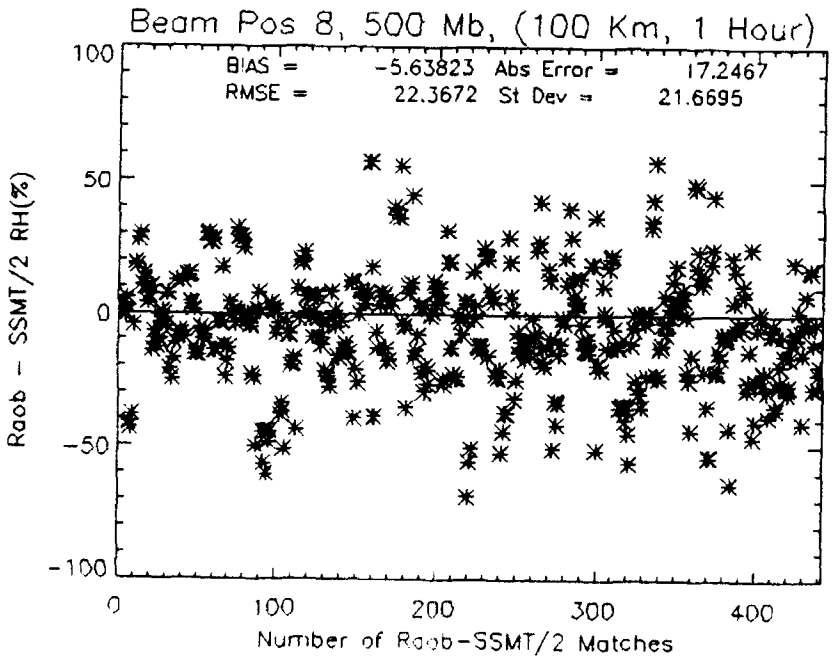

Beam Pos 22, 700 Mb, (100 Km, 1 Hour)
BIAS = -4.06653 Abs Error = 16.8523
RMSE = 20.8235 St Dev = 20.4448
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

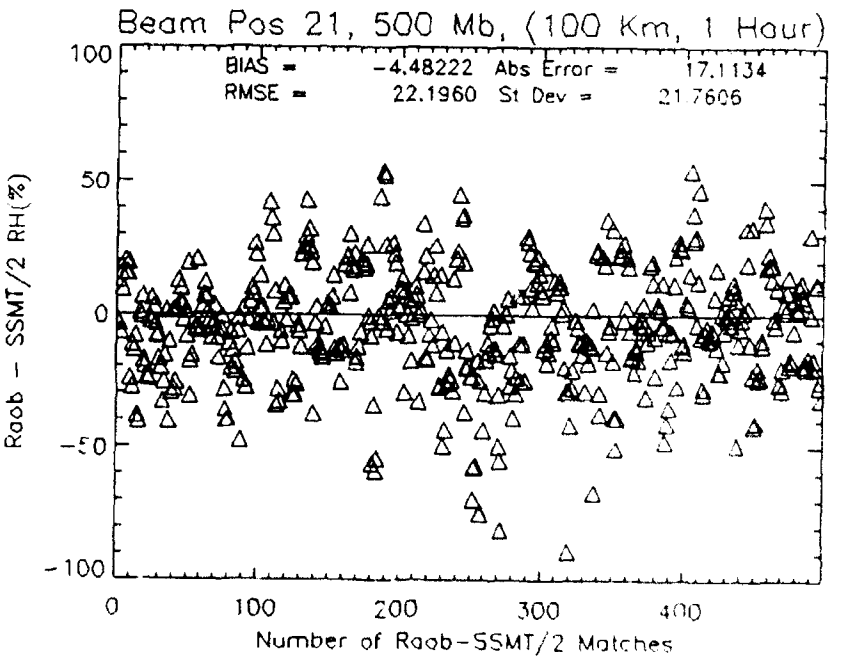

Beam Pos 8, 700 Mb, (100 Km, 1 Hour)
BIAS = -2.23563 Abs Error = 18.6113
RMSE = 23.1394 St Dev = 23.0511
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

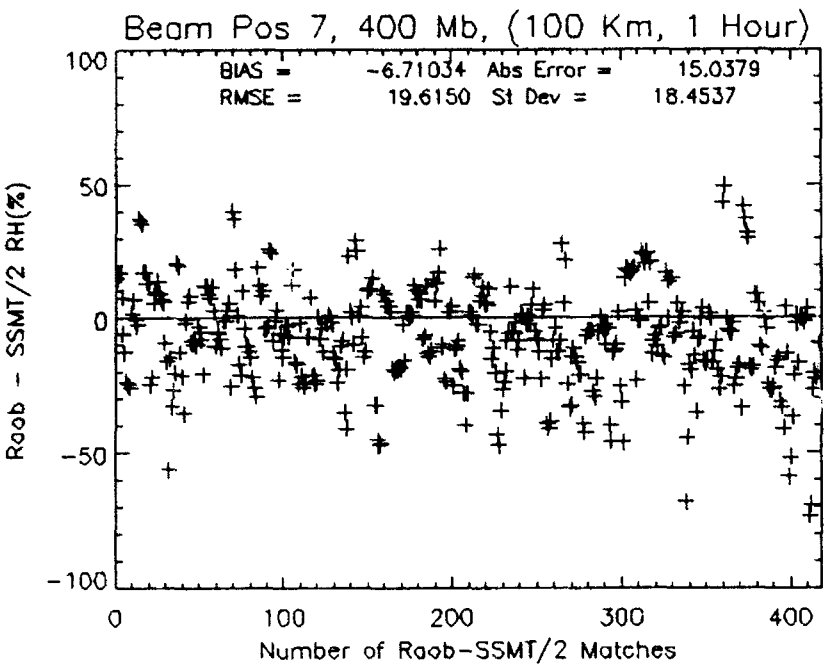

Beam Pos 21, 700 Mb, (100 Km, 1 Hour)
BIAS = -1.22496 Abs Error = 17.6630
RMSE = 21.8208 St Dev = 21.8100
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

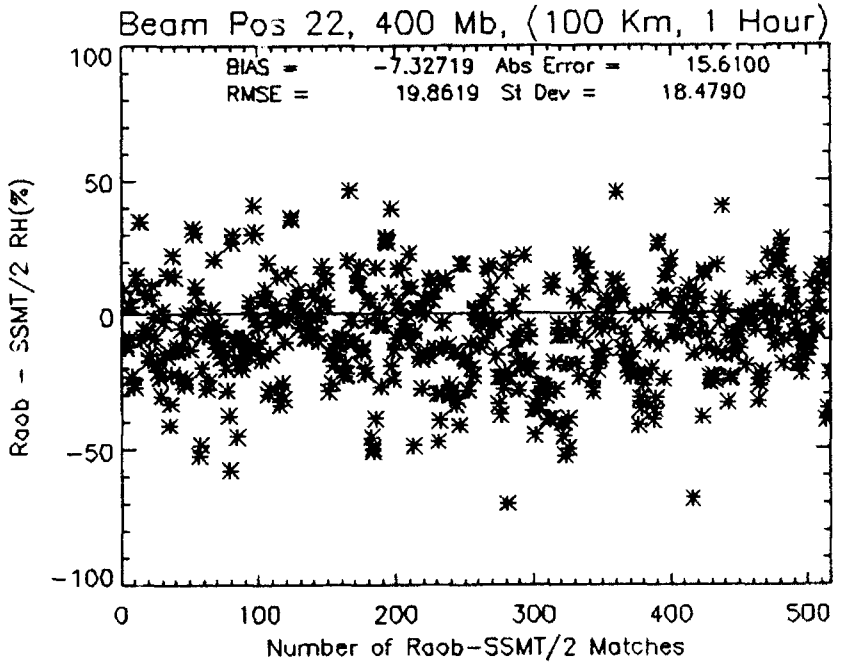

Beam Pos 7, 500 Mb, (100 Km, 1 Hour)
BIAS = -6.64345 Abs Error = 16.8077
RMSE = 21.6288 St Dev = 20.6062
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

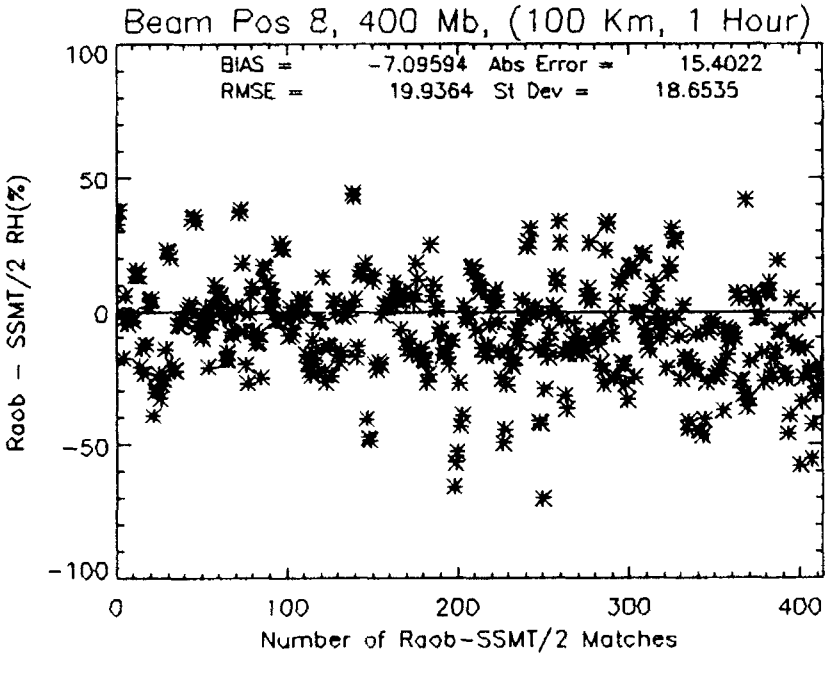

Beam Pos 22, 500 Mb, (100 Km, 1 Hour)
BIAS = -3.62505 Abs Error = 15.9566
RMSE = 20.6293 St Dev = 20.3278
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

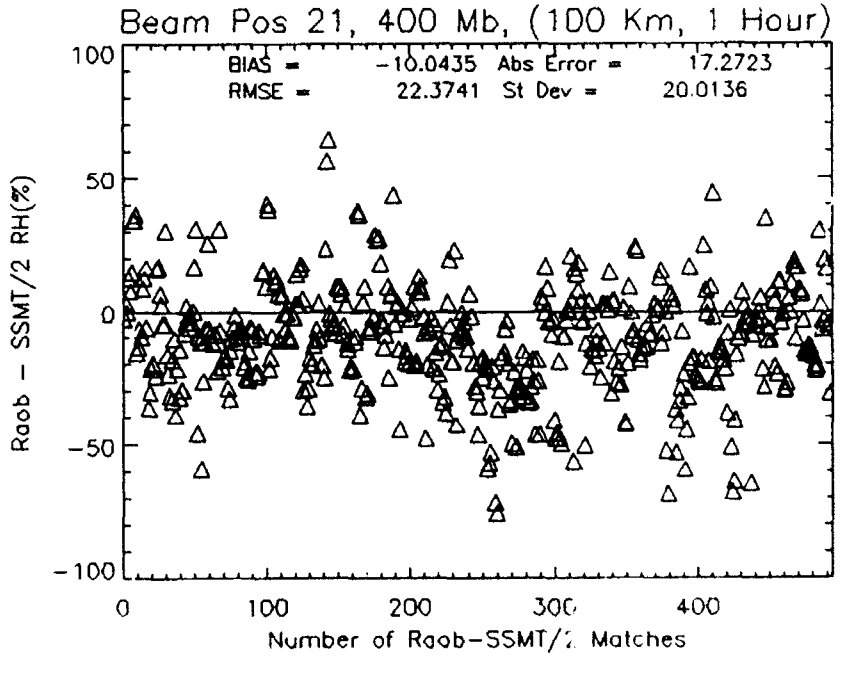

Beam Pos 8, 500 Mb, (100 Km, 1 Hour)
BIAS = -5.63823 Abs Error = 17.2467
RMSE = 22.3672 St Dev = 21.6695
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

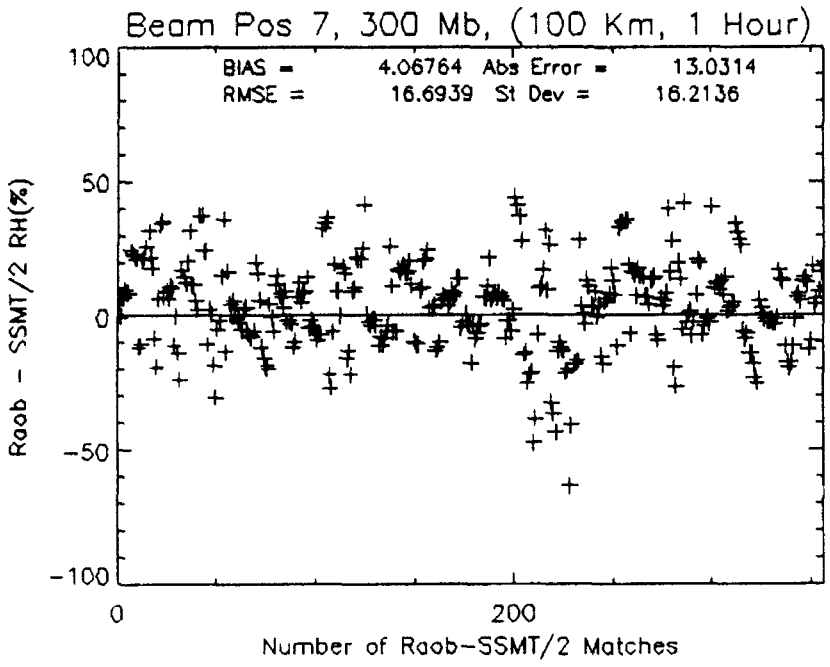

Beam Pos 21, 500 Mb, (100 Km, 1 Hour)
BIAS = -4.48222 Abs Error = 17.1134
RMSE = 22.1960 St Dev = 21.7606
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

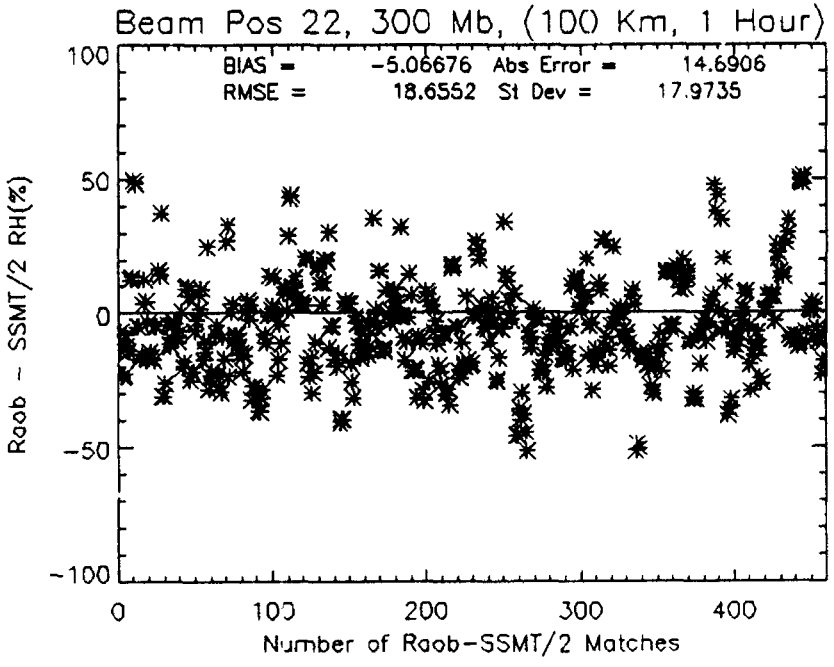

Beam Pos 7, 400 Mb, (100 Km, 1 Hour)
BIAS = -6.71034 Abs Error = 15.0379
RMSE = 19.6150 St Dev = 18.4537
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

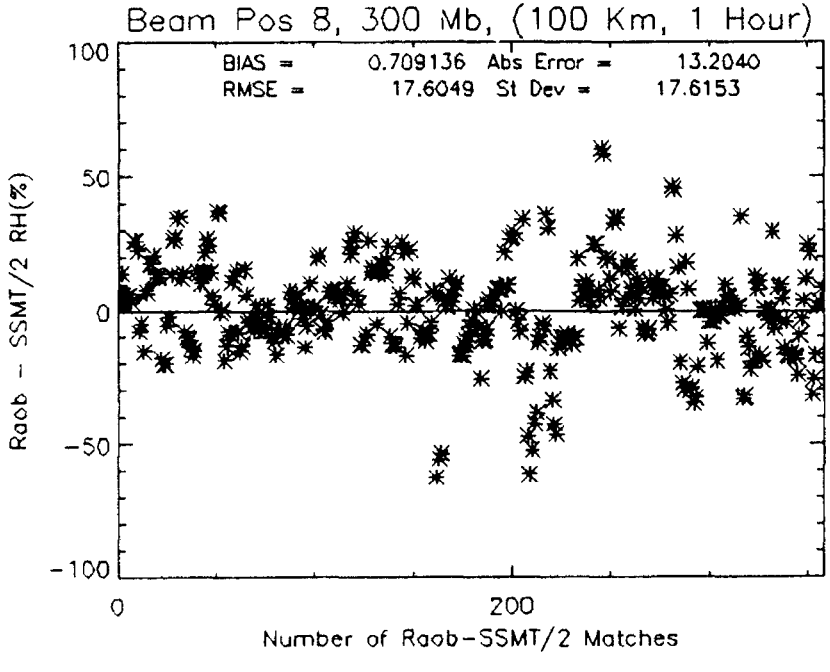

Beam Pos 22, 400 Mb, (100 Km, 1 Hour)
BIAS = -7.32719 Abs Error = 15.6100
RMSE = 19.8619 St Dev = 18.4790
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

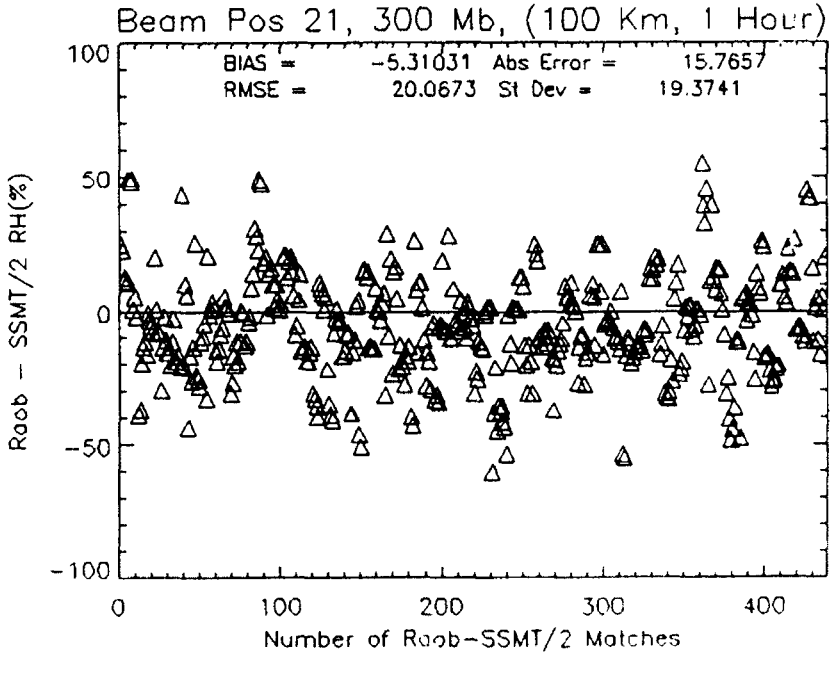

Beam Pos 8, 400 Mb, (100 Km, 1 Hour)
BIAS = -7.09594 Abs Error = 15.4022
RMSE = 19.9364 St Dev = 18.6535
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 21, 400 Mb, (100 Km, 1 Hour)
BIAS = -10.0435 Abs Error = 17.2723
RMSE = 22.3741 St Dev = 20.0136
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 7, 300 Mb, (100 Km, 1 Hour)
BIAS = 4.06764 Abs Error = 13.0314
RMSE = 16.6939 St Dev = 16.2136
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 22, 300 Mb, (100 Km, 1 Hour)
BIAS = -5.06676 Abs Error = 14.6906
RMSE = 18.6552 St Dev = 17.9735
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 8, 300 Mb, (100 Km, 1 Hour)
BIAS = 0.709136 Abs Error = 13.2040
RMSE = 17.6049 St Dev = 17.6153
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

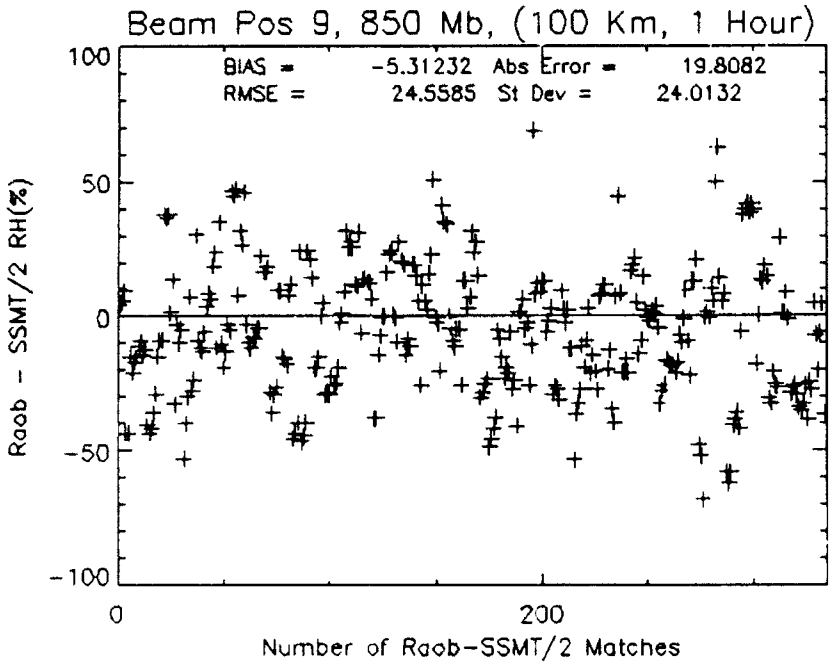

Beam Pos 21, 300 Mb, (100 Km, 1 Hour)
BIAS = -5.31031 Abs Error = 15.7657
RMSE = 20.0673 St Dev = 19.3741
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

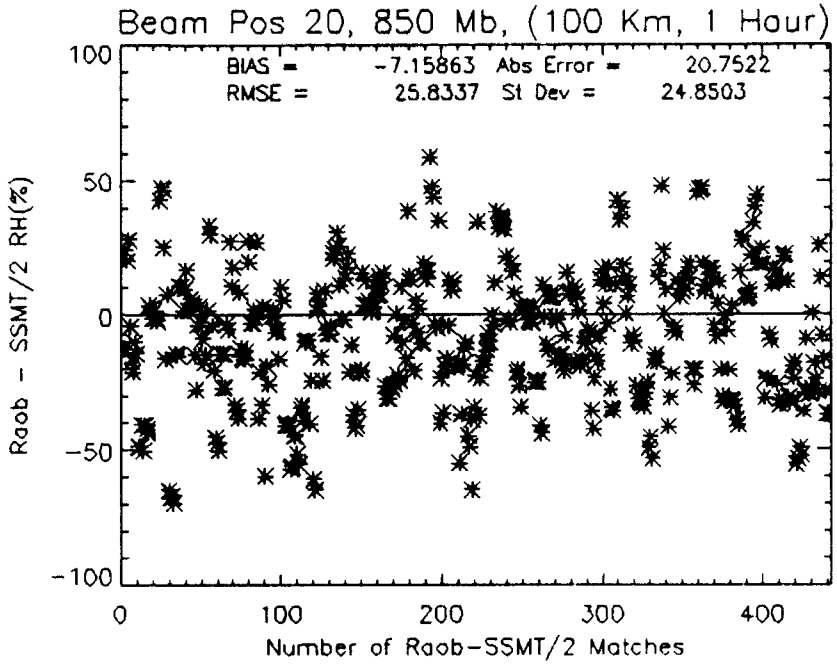
Beam Pos 20, 1000 Mb, (100 Km, 1 Hour)
BIAS = -3.90734 Abs Error = 12.9701
RMSE = 18.3593 St Dev = 18.0223
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

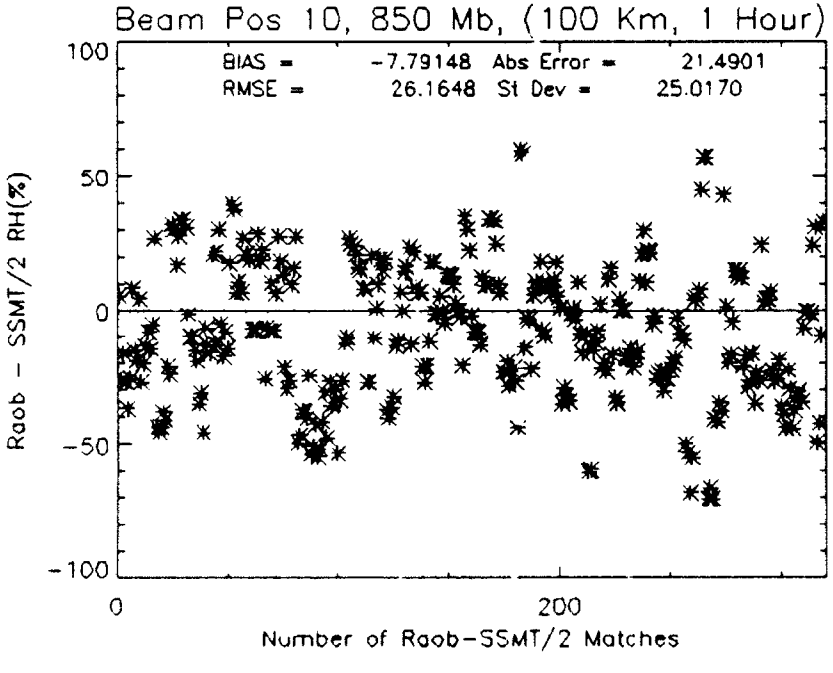
Beam Pos 19, 1000 Mb, (100 Km, 1 Hour)
BIAS = -9.955443e-02 Abs Error = 12.7247
RMSE = 17.6863 St Dev = 17.7677
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

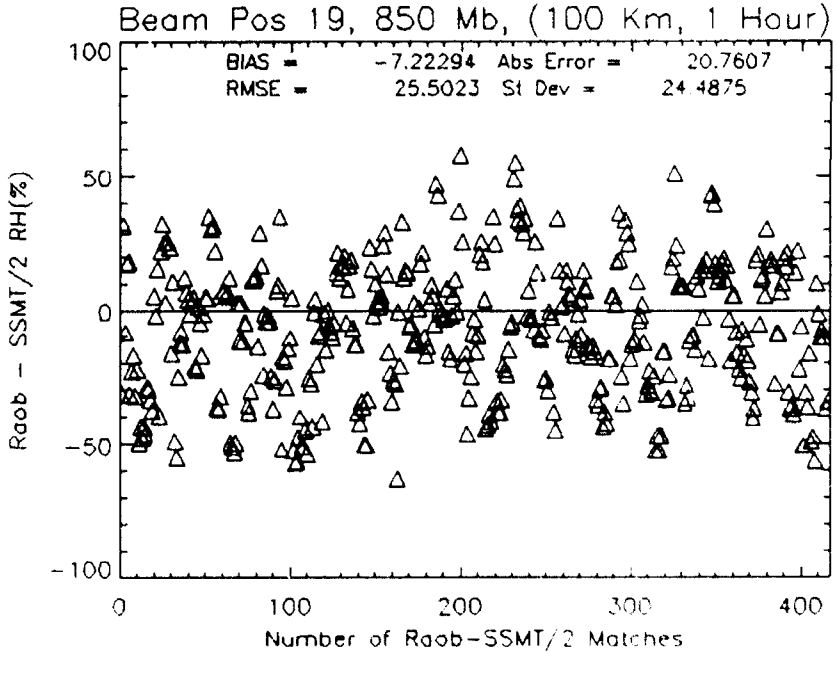
Beam Pos 9, 1000 Mb, (100 Km, 1 Hour)
BIAS = 0.959701 Abs Error = 11.5945
RMSE = 15.2737 St Dev = 15.3449
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Beam Pos 10, 1000 Mb, (100 Km, 1 Hour)
BIAS = 1.47859 Abs Error = 12.8773
RMSE = 15.9723 St Dev = 16.0202
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 9, 850 Mb, (100 Km, 1 Hour)
BIAS = -5.31232 Abs Error = 19.8082
RMSE = 24.5585 St Dev = 24.0132
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 20, 850 Mb, (100 Km, 1 Hour)
BIAS = -7.15863 Abs Error = 20.7522
RMSE = 25.8337 St Dev = 24.8503
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 10, 850 Mb, (100 Km, 1 Hour)
BIAS = -7.79148 Abs Error = 21.4901
RMSE = 26.1648 St Dev = 25.0170
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 19, 850 Mb, (100 Km, 1 Hour)
BIAS = -7.22294 Abs Error = 20.7607
RMSE = 25.5023 St Dev = 24.4875
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Beam Pos 20, 700 Mb, (100 Km, 1 Hour)
BIAS = -2.11166 Abs Error = 18.5375
RMSE = 22.7877 St Dev = 22.7139
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Beam Pos 19, 700 Mb, (100 Km, 1 Hour)
BIAS = -2.10134 Abs Error = 19.0083
RMSE = 23.5174 St Dev = 23.4490
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Beam Pos 9, 700 Mb, (100 Km, 1 Hour)
BIAS = -4.69065 Abs Error = 18.2924
RMSE = 22.9164 St Dev = 22.4597
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

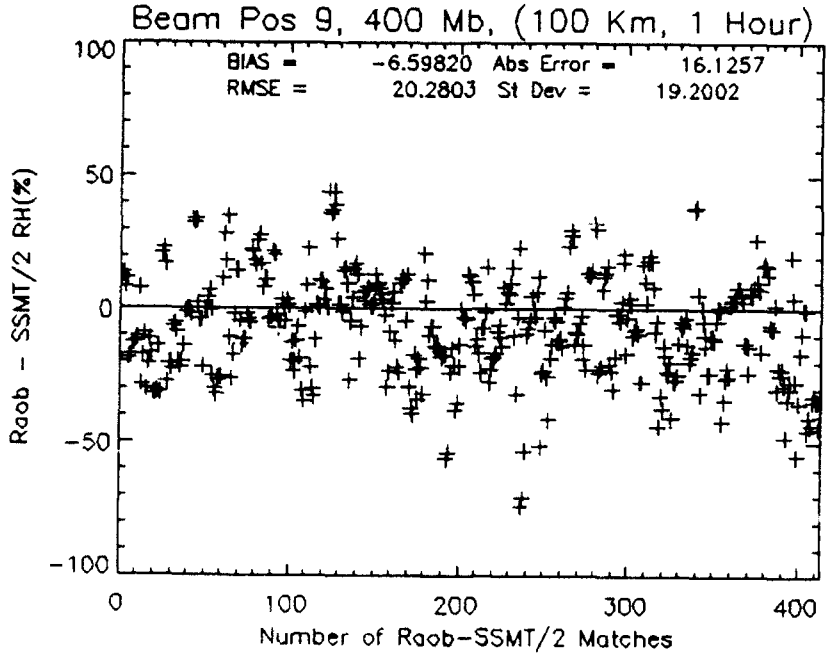
Beam Pos 10, 700 Mb, (100 Km, 1 Hour)
BIAS = -6.41235 Abs Error = 18.8059
RMSE = 24.0704 St Dev = 23.2317
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

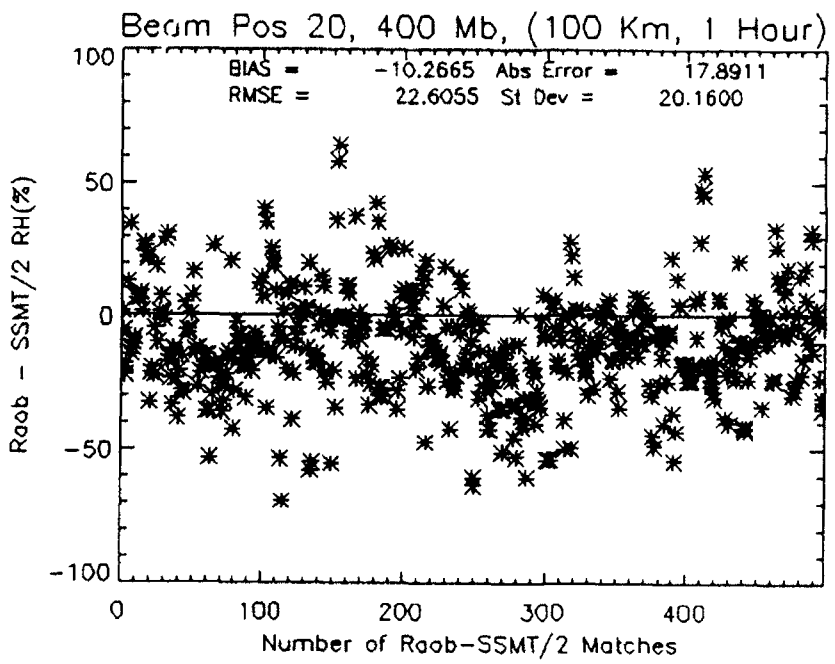
Beam Pos 20, 500 Mb, (100 Km, 1 Hour)
BIAS = -5.21449 Abs Error = 17.9804
RMSE = 23.3728 St Dev = 22.8063
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

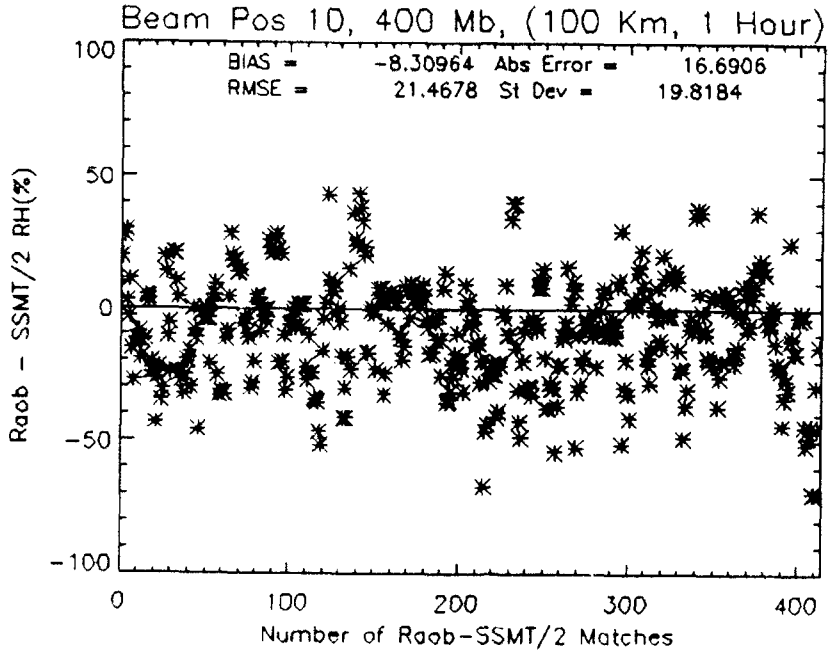
Beam Pos 19, 500 Mb, (100 Km, 1 Hour)
BIAS = -5.32189 Abs Error = 17.3501
RMSE = 22.7152 St Dev = 22.1055
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

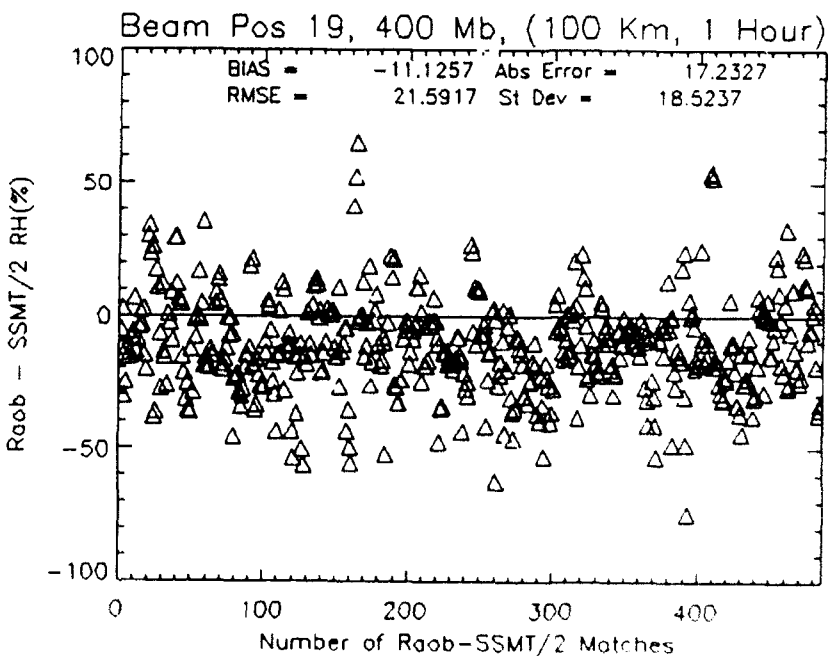
Beam Pos 9, 500 Mb, (100 Km, 1 Hour)
BIAS = -2.32316 Abs Error = 16.1341
RMSE = 21.0393 St Dev = 20.9351
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Beam Pos 10, 500 Mb, (100 Km, 1 Hour)
BIAS = -2.26498 Abs Error = 17.3182
RMSE = 22.5177 St Dev = 22.4299
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

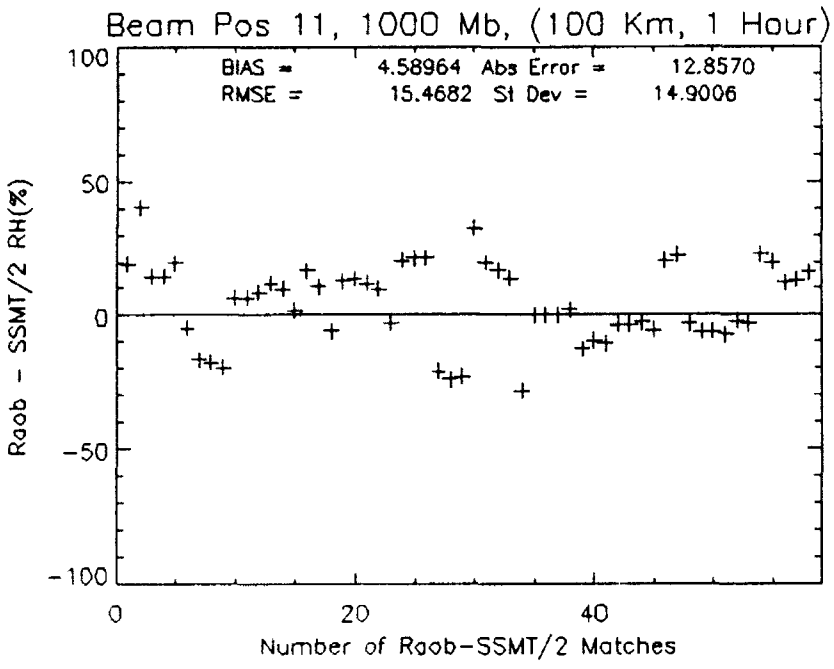

Beam Pos 9, 400 Mb, (100 Km, 1 Hour)
BIAS = -6.59820 Abs Error = 16.1257
RMSE = 20.2803 St Dev = 19.2002
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

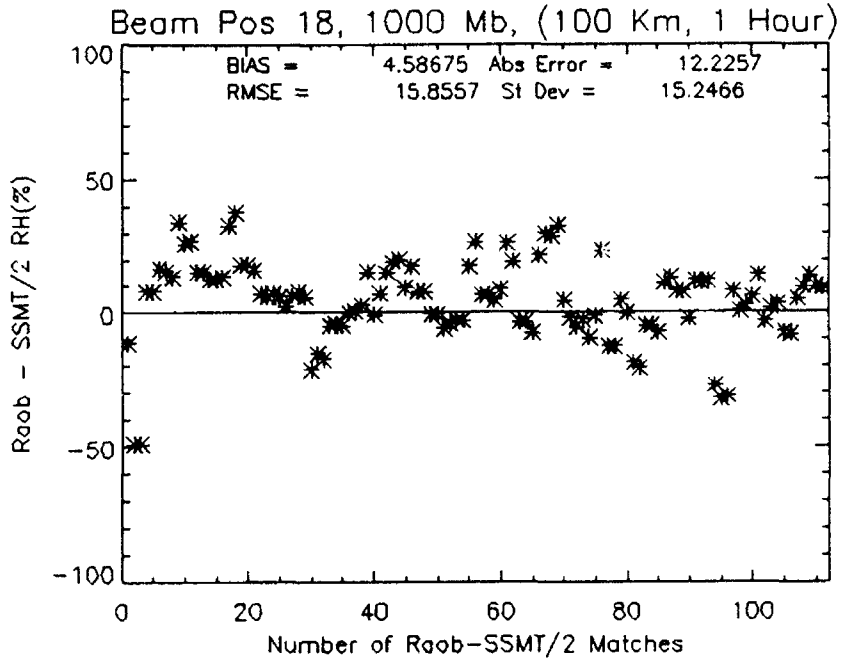

Beam Pos 20, 400 Mb, (100 Km, 1 Hour)
BIAS = -10.2665 Abs Error = 17.8911
RMSE = 22.6055 St Dev = 20.1600
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

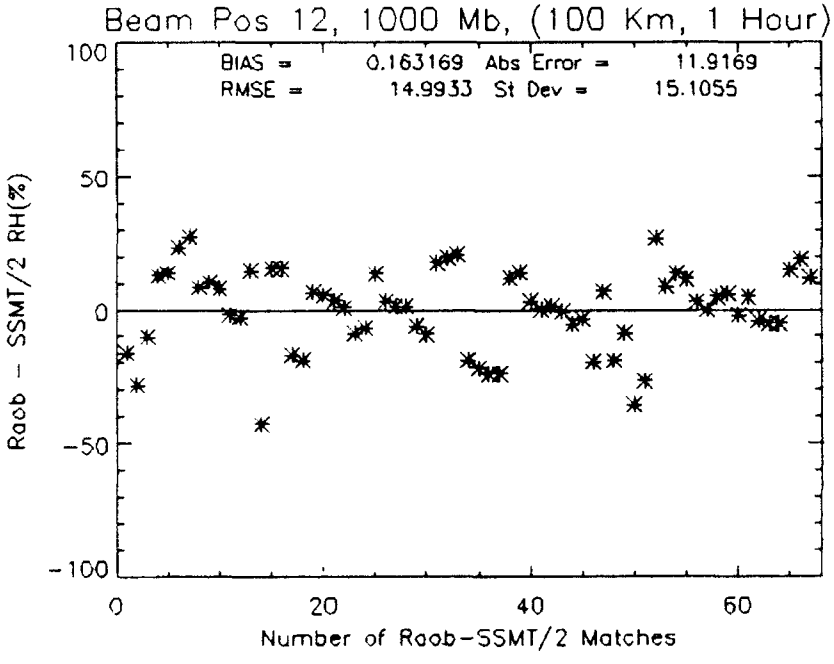

Beam Pos 10, 400 Mb, (100 Km, 1 Hour)
BIAS = -8.30964 Abs Error = 16.6906
RMSE = 21.4678 St Dev = 19.8184
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

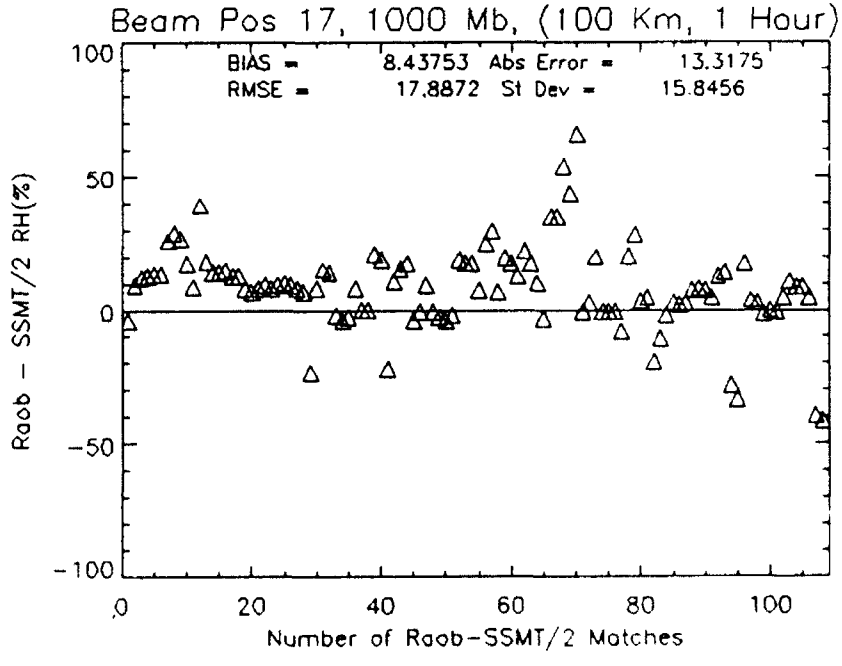

Beam Pos 19, 400 Mb, (100 Km, 1 Hour)
BIAS = -11.1257 Abs Error = 17.2327
RMSE = 21.5917 St Dev = 18.5237
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Beam Pos 20, 300 Mb, (100 Km, 1 Hour)
BIAS = -3.75486 Abs Error = 14.9864
RMSE = 19.0064 St Dev = 18.6531
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Beam Pos 19, 300 Mb, (100 Km, 1 Hour)
BIAS = -3.43227 Abs Error = 15.9842
RMSE = 20.2916 St Dev = 20.0229
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Beam Pos 9, 300 Mb, (100 Km, 1 Hour)
BIAS = -2.63393 Abs Error = 13.8249
RMSE = 18.4241 St Dev = 18.2615
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
Beam Pos 10, 300 Mb, (100 Km, 1 Hour)
BIAS = -1.89075 Abs Error = 14.5057
RMSE = 18.7224 St Dev = 18.6536
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 11, 1000 Mb, (100 Km, 1 Hour)
BIAS = 4.58964 Abs Error = 12.8570
RMSE = 15.4682 St Dev = 14.9006
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 18, 1000 Mb, (100 Km, 1 Hour)
BIAS = 4.58675 Abs Error = 12.2257
RMSE = 15.8557 St Dev = 15.2466
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 12, 1000 Mb, (100 Km, 1 Hour)
BIAS = 0.163169 Abs Error = 11.9169
RMSE = 14.9933 St Dev = 15.1055
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

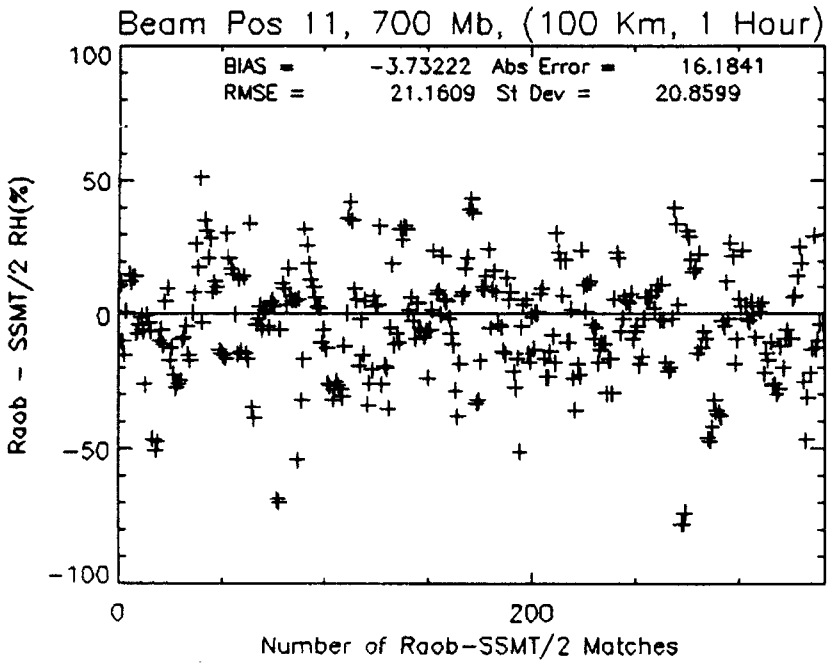

Beam Pos 17, 1000 Mb, (100 Km, 1 Hour)
BIAS = 8.43753 Abs Error = 13.3175
RMSE = 17.8872 St Dev = 15.8456
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

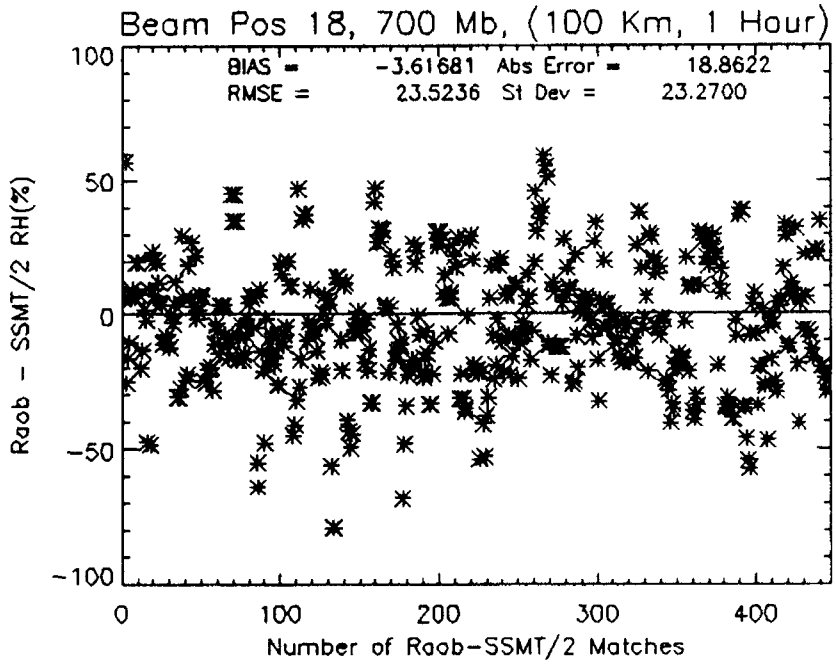
Beam Pos 18, 850 Mb, (100 Km, 1 Hour)
BIAS = -6.48829 Abs Error = 20.0579
RMSE = 24.8636 St Dev = 24.0320
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
100
50
0
-50
-100
0
100
200
300
400

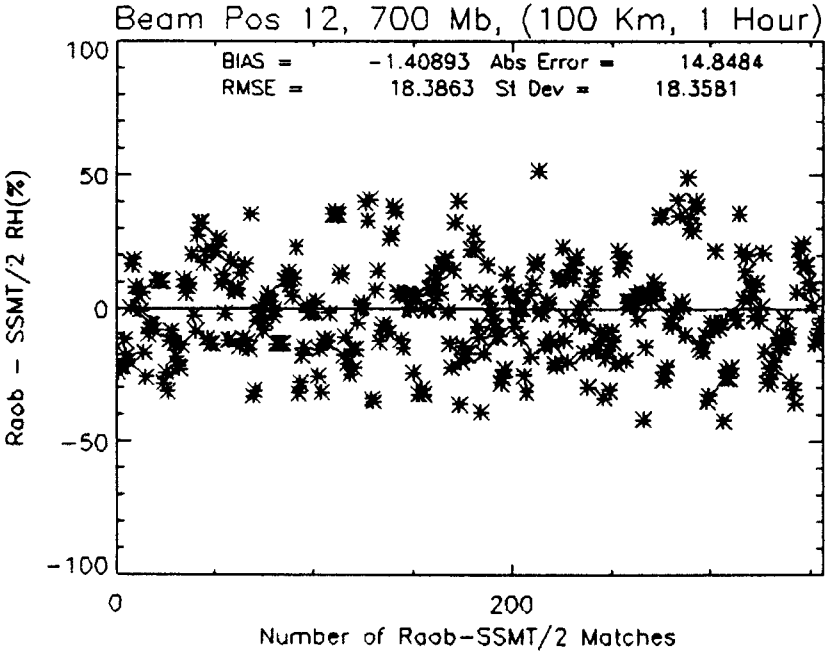
Beam Pos 17, 850 Mb, (100 Km, 1 Hour)
BIAS = -4.13056 Abs Error = 19.8563
RMSE = 24.7712 St Dev = 24.4555
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
100
50
0
-50
-100
0
200

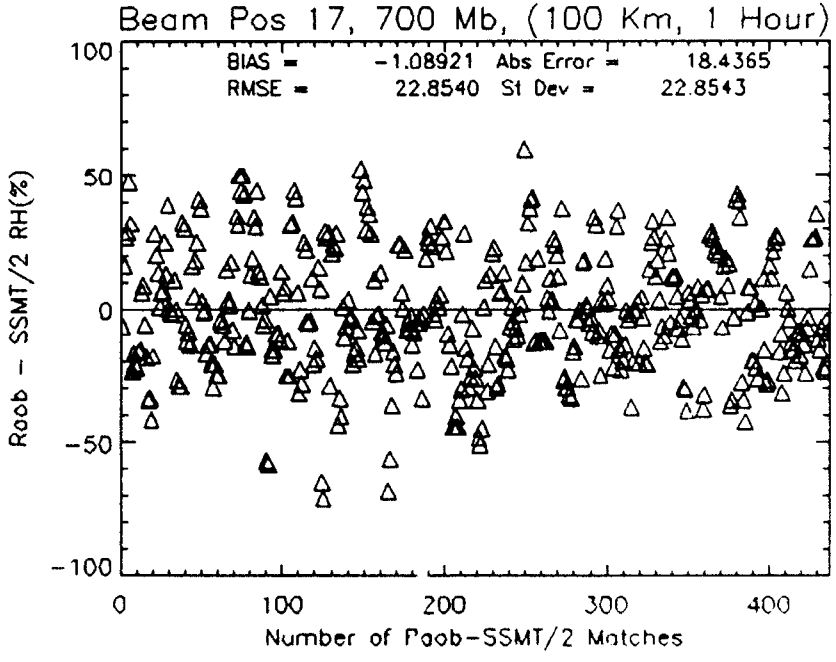
Beam Pos 11, 850 Mb, (100 Km, 1 Hour)
BIAS = -7.63317 Abs Error = 20.8898
RMSE = 25.5173 St Dev = 24.3901
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
100
50
0
-50
-100
0
200

Beam Pos 12, 850 Mb, (100 Km, 1 Hour)
BIAS = -3.33599 Abs Error = 18.9347
RMSE = 22.9434 St Dev = 22.7365
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches
100
50
0
-50
-100
0
200


Beam Pos 11, 700 Mb, (100 Km, 1 Hour)
BIAS = -3.73222 Abs Error = 16.1841
RMSE = 21.1609 St Dev = 20.8599
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 18, 700 Mb, (100 Km, 1 Hour)
BIAS = -3.61681 Abs Error = 18.8622
RMSE = 23.5236 St Dev = 23.2700
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 12, 700 Mb, (100 Km, 1 Hour)
BIAS = -1.40893 Abs Error = 14.8484
RMSE = 18.3863 St Dev = 18.3581
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

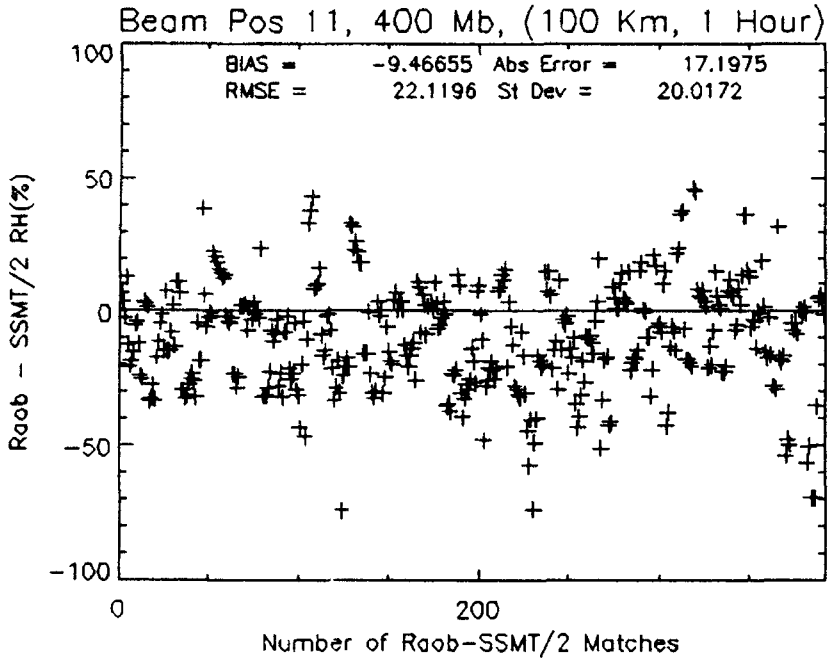

Beam Pos 17, 700 Mb, (100 Km, 1 Hour)
BIAS = -1.08921 Abs Error = 18.4365
RMSE = 22.8540 St Dev = 22.8543
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

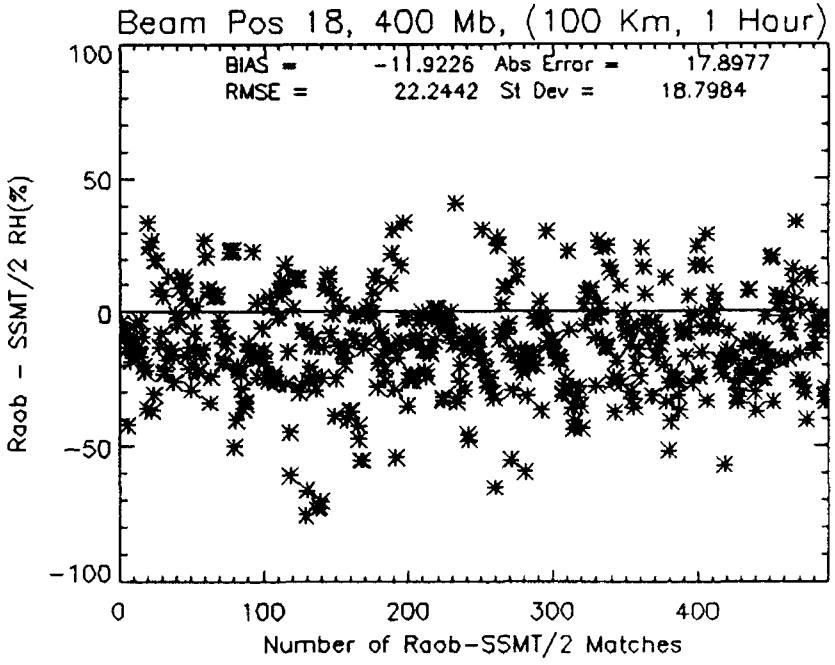
Beam Pos 11, 500 Mb, (100 Km, 1 Hour)
BIAS = -0.526418 Abs Error = 16.6155
RMSE = 21.3867 St Dev = 21.4069
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

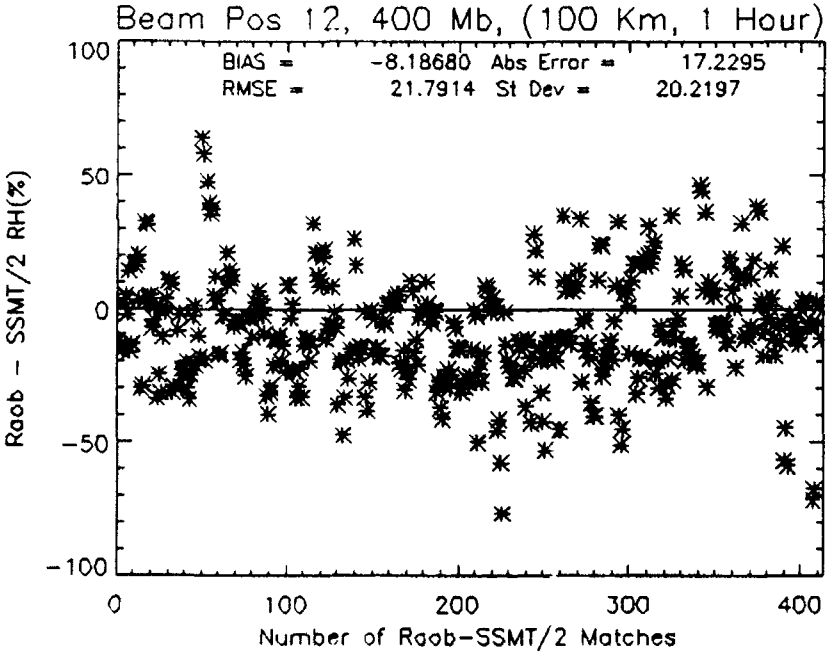
Beam Pos 12, 500 Mb, (100 Km, 1 Hour)
BIAS = -2.27074 Abs Error = 17.1567
RMSE = 22.2213 St Dev = 22.1311
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

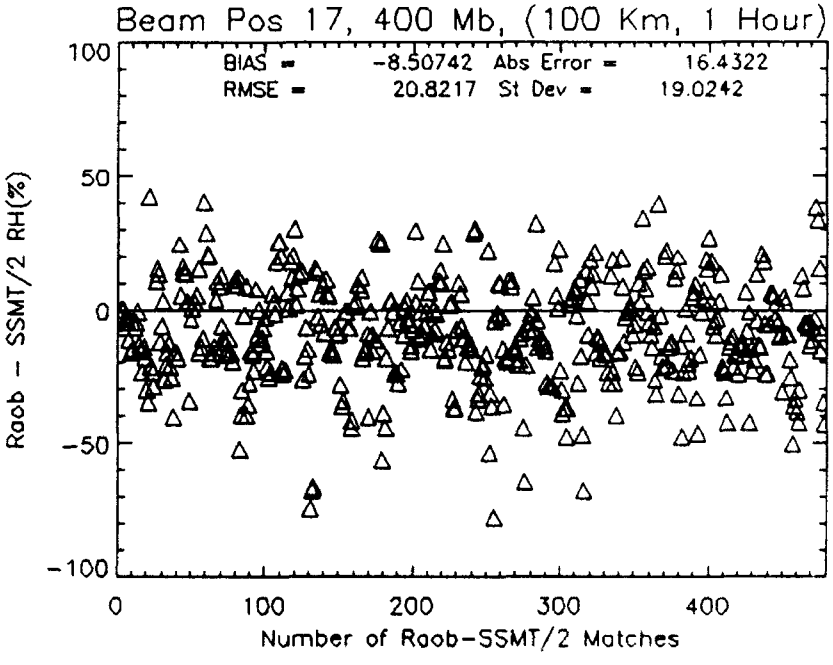
Beam Pos 17, 500 Mb, (100 Km, 1 Hour)
BIAS = -3.37971 Abs Error = 16.4825
RMSE = 20.9956 St Dev = 20.7428
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

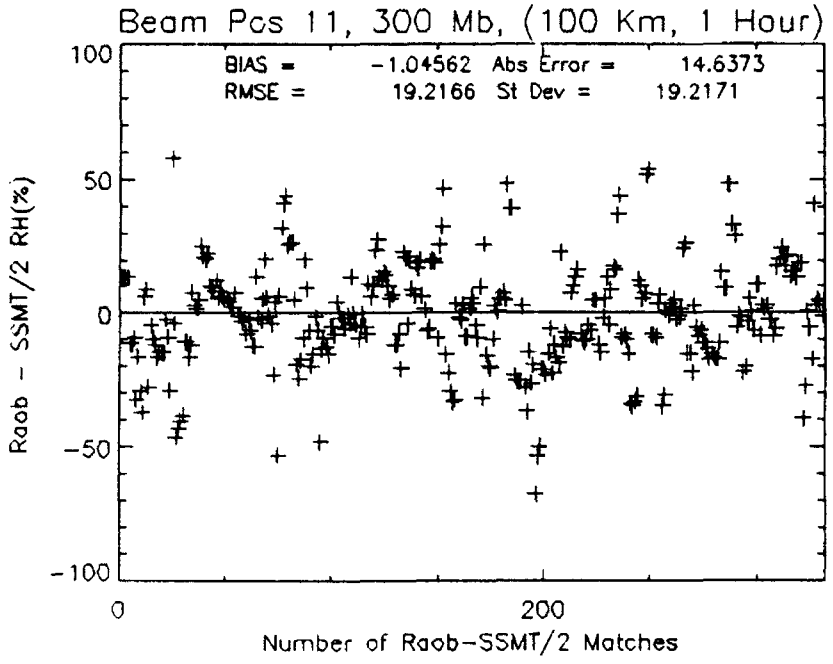
Beam Pos 18, 500 Mb, (100 Km, 1 Hour)
BIAS = -6.13090 Abs Error = 16.4930
RMSE = 21.7547 St Dev = 20.8937
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

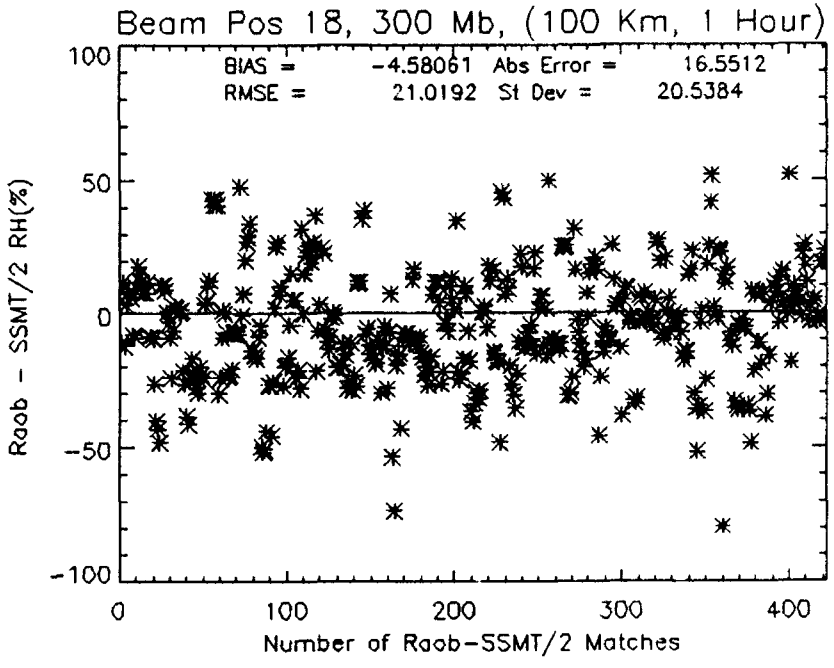

Beam Pos 11, 400 Mb, (100 Km, 1 Hour)
BIAS = -9.46655 Abs Error = 17.1975
RMSE = 22.1196 St Dev = 20.0172
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

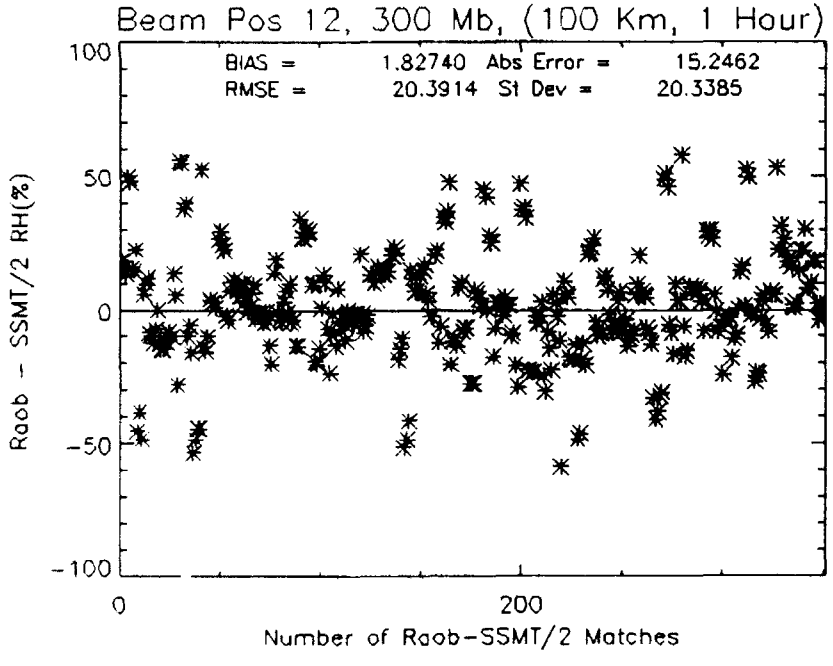

Beam Pos 18, 400 Mb, (100 Km, 1 Hour)
BIAS = -11.9226 Abs Error = 17.8977
RMSE = 22.2442 St Dev = 18.7984
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

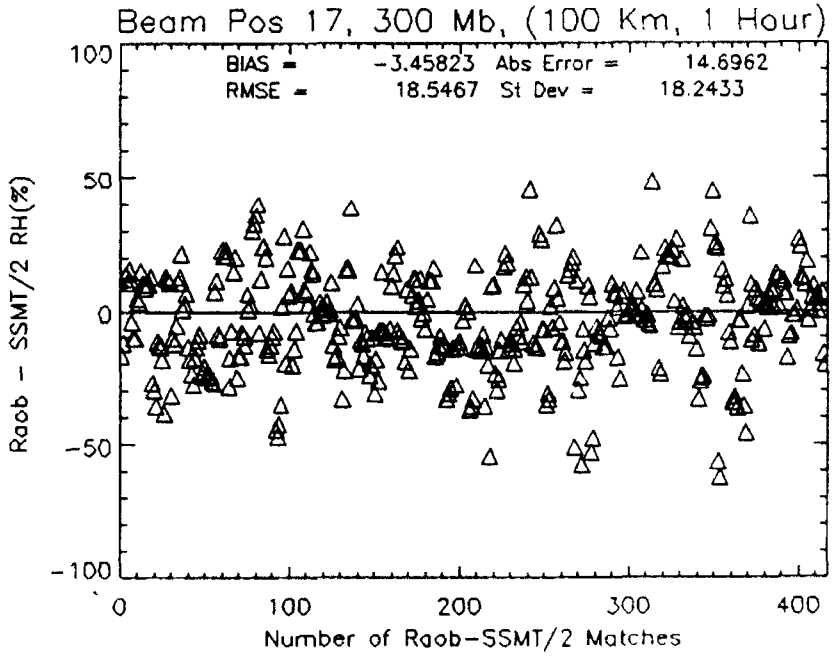

Beam Pos 12, 400 Mb, (100 Km, 1 Hour)
BIAS = -8.18680 Abs Error = 17.2295
RMSE = 21.7914 St Dev = 20.2197
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

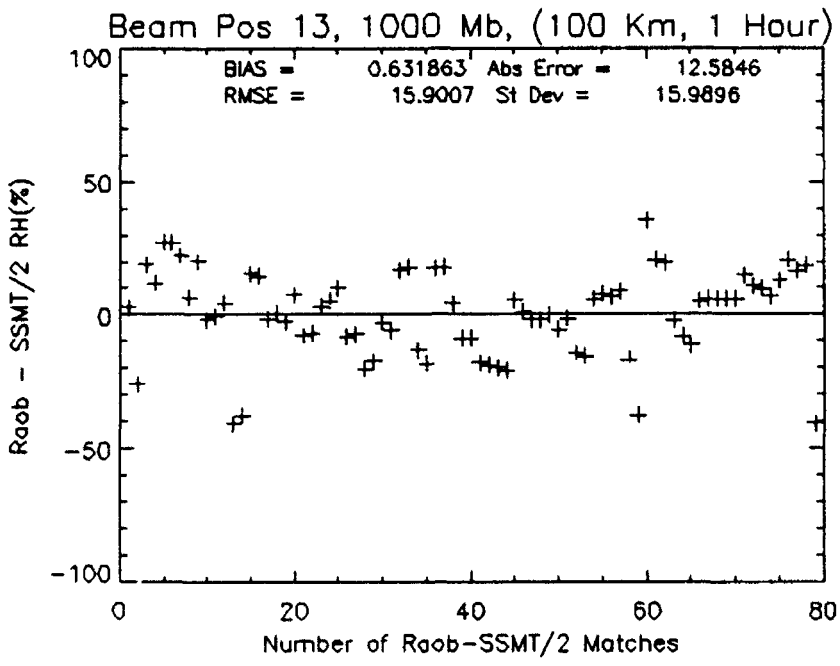

Beam Pos 17, 400 Mb, (100 Km, 1 Hour)
BIAS = -8.50742 Abs Error = 16.4322
RMSE = 20.8217 St Dev = 19.0242
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

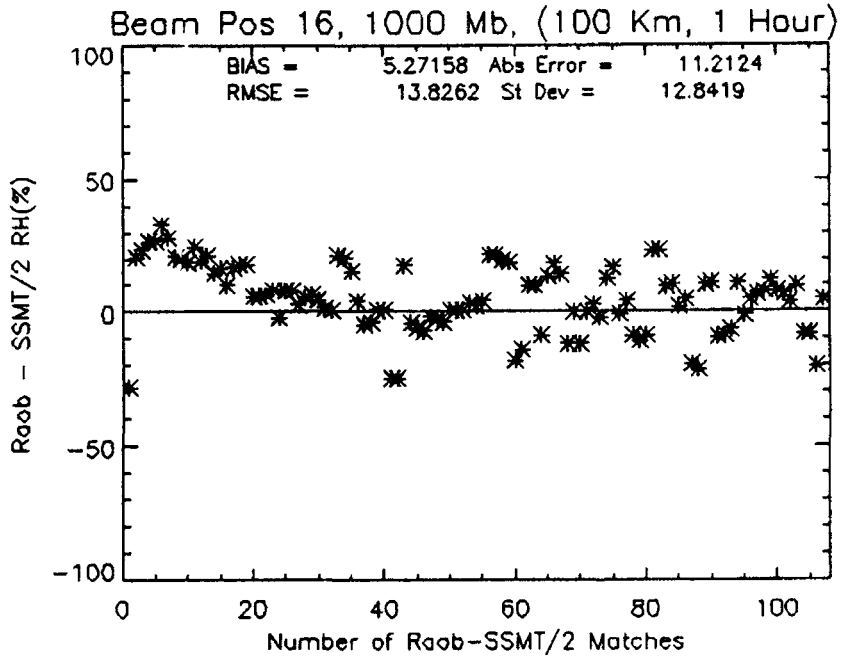

Beam Pos 11, 300 Mb, (100 Km, 1 Hour)
BIAS = -1.04562 Abs Error = 14.6373
RMSE = 19.2166 St Dev = 19.2171
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

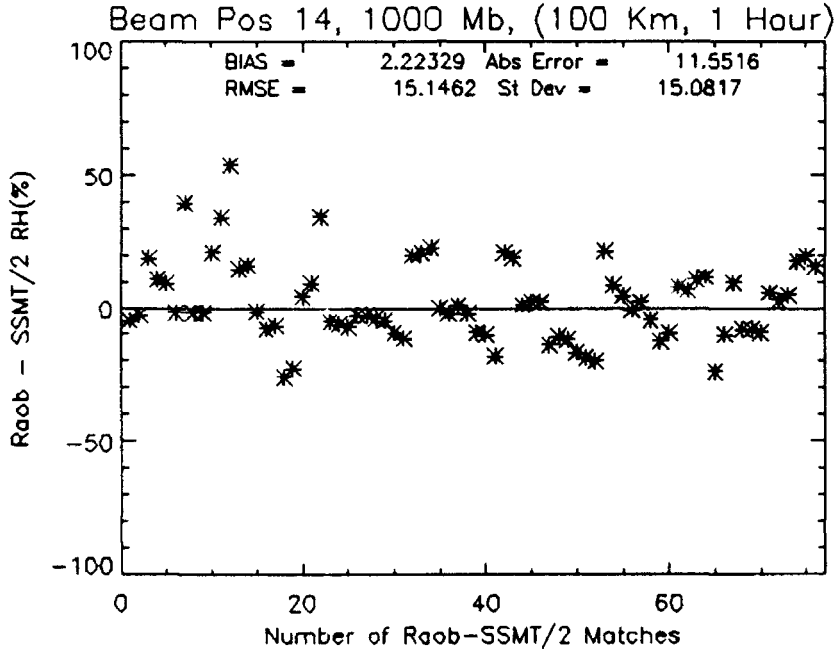

Beam Pos 18, 300 Mb, (100 Km, 1 Hour)
BIAS = -4.58061 Abs Error = 16.5512
RMSE = 21.0192 St Dev = 20.5384
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

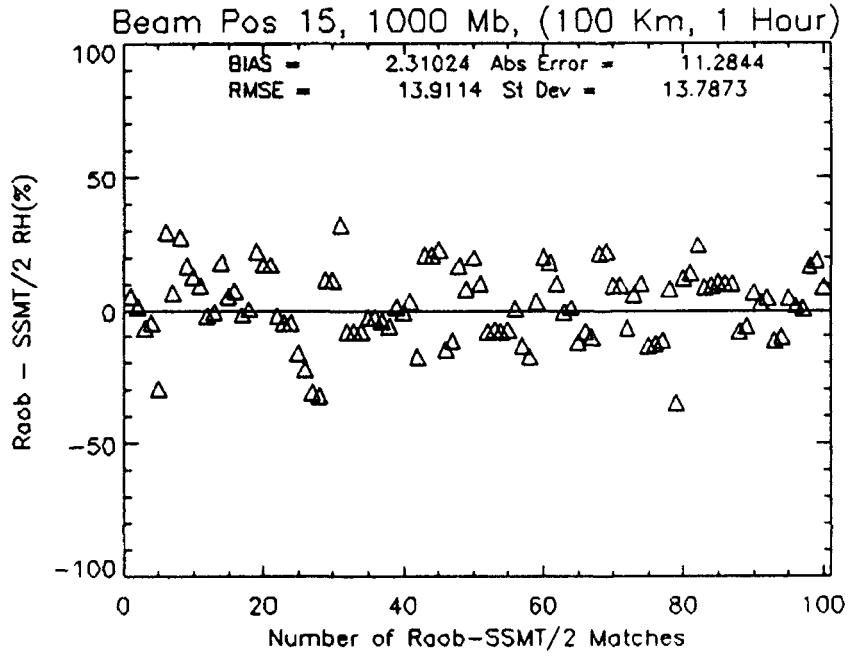

Beam Pos 12, 300 Mb, (100 Km, 1 Hour)
BIAS = 1.82740 Abs Error = 15.2462
RMSE = 20.3914 St Dev = 20.3385
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

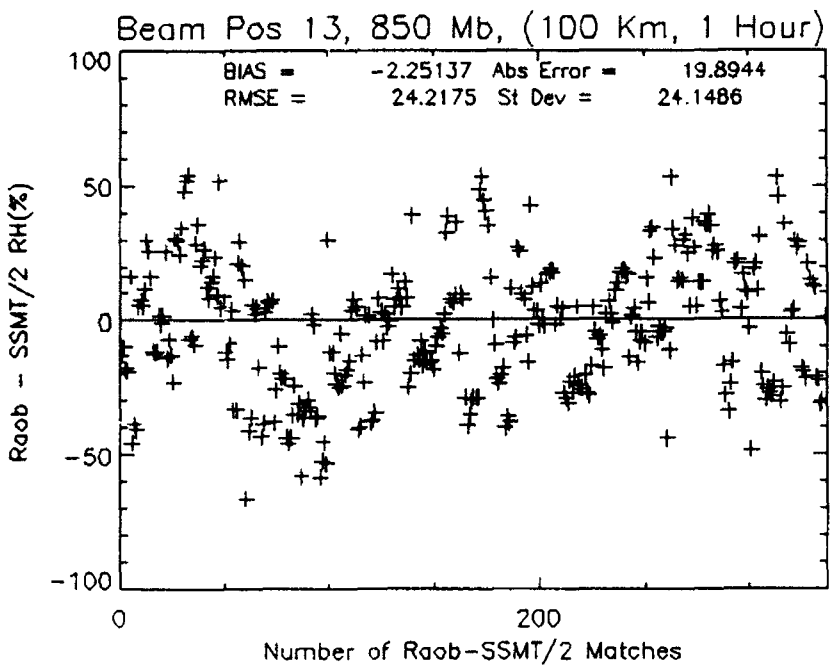

Beam Pos 17, 300 Mb, (100 Km, 1 Hour)
BIAS = -3.45823 Abs Error = 14.6962
RMSE = 18.5467 St Dev = 18.2433
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

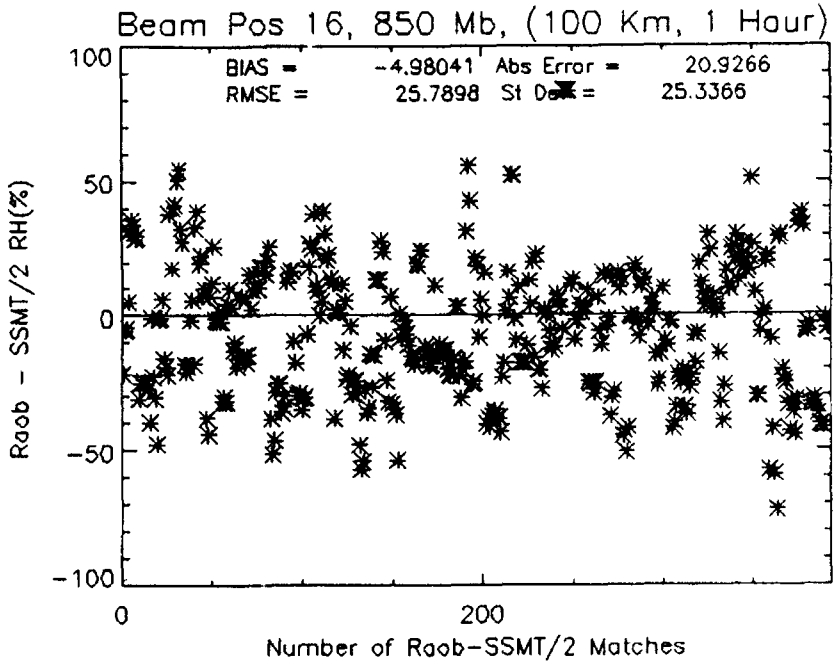

Beam Pos 13, 1000 Mb, (100 Km, 1 Hour)
BIAS = 0.631863 Abs Error = 12.5846
RMSE = 15.9007 St Dev = 15.9896
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

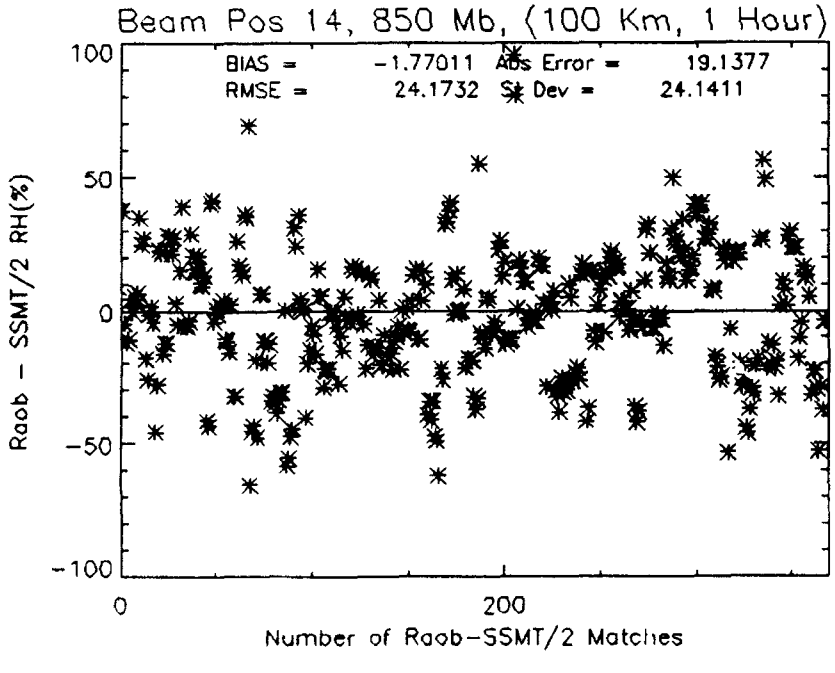

Beam Pos 16, 1000 Mb, (100 Km, 1 Hour)
BIAS = 5.27158 Abs Error = 11.2124
RMSE = 13.8262 St Dev = 12.8419
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

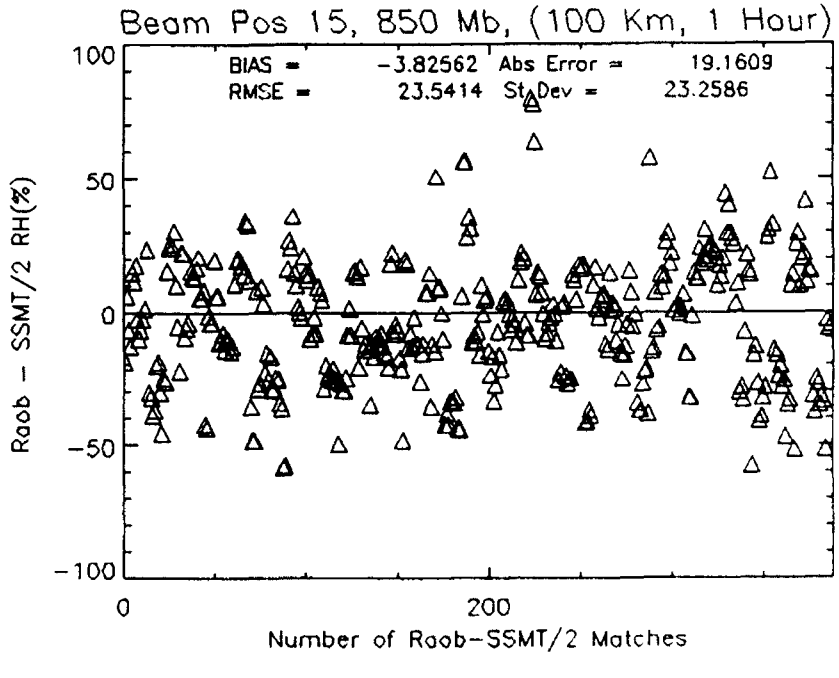

Beam Pos 14, 1000 Mb, (100 Km, 1 Hour)
BIAS = 2.22329 Abs Error = 11.5516
RMSE = 15.1462 St Dev = 15.0817
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 15, 1000 Mb, (100 Km, 1 Hour)
BIAS = 2.31024 Abs Error = 11.2844
RMSE = 13.9114 St Dev = 13.7873
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 13, 850 Mb, (100 Km, 1 Hour)
BIAS = -2.25137 Abs Error = 19.8944
RMSE = 24.2175 St Dev = 24.1486
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 16, 850 Mb, (100 Km, 1 Hour)
BIAS = -4.98041 Abs Error = 20.9266
RMSE = 25.7898 St Dev = 25.3366
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 14, 850 Mb, (100 Km, 1 Hour)
BIAS = -1.77011 Abs Error = 19.1377
RMSE = 24.1732 St Dev = 24.1411
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 15, 850 Mb, (100 Km, 1 Hour)
BIAS = -3.82562 Abs Error = 19.1609
RMSE = 23.5414 St Dev = 23.2586
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Beam Pos 16, 700 Mb, (100 Km, 1 Hour)
BIAS = -0.345889 Abs Error = 17.6212
RMSE = 21.6982 St Dev = 21.7208
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Beam Pos 15, 700 Mb, (100 Km, 1 Hour)
BIAS = -2.82620 Abs Error = 17.5694
RMSE = 21.8212 St Dev = 21.6632
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Beam Pos 13, 700 Mb, (100 Km, 1 Hour)
BIAS = -2.36004 Abs Error = 16.3449
RMSE = 20.2866 St Dev = 20.1747
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

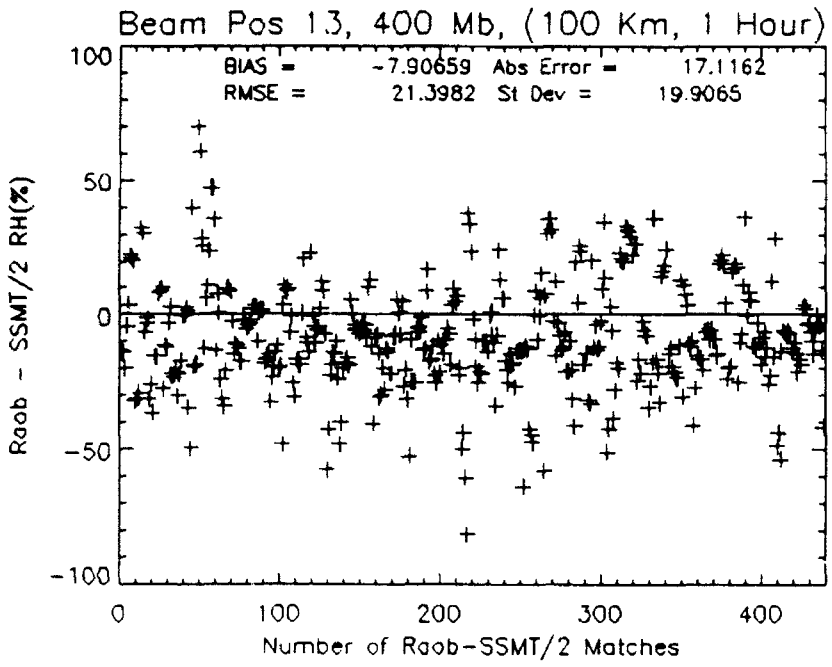
Beam Pos 14, 700 Mb, (100 Km, 1 Hour)
BIAS = -1.58023 Abs Error = 17.4141
RMSE = 21.5094 St Dev = 21.4773
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

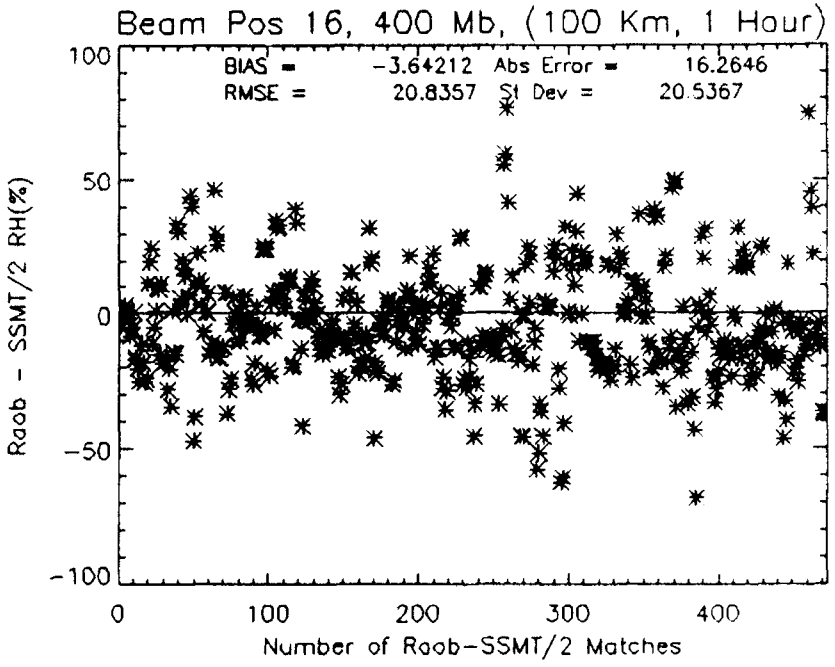
Beam Pos 16, 500 Mb, (100 Km, 1 Hour)
BIAS = 0.654819 Abs Error = 15.4872
RMSE = 19.3491 St Dev = 19.3579
Raob - SSMT/2 RH(%)
Number of Raob-SSM./2 Matches

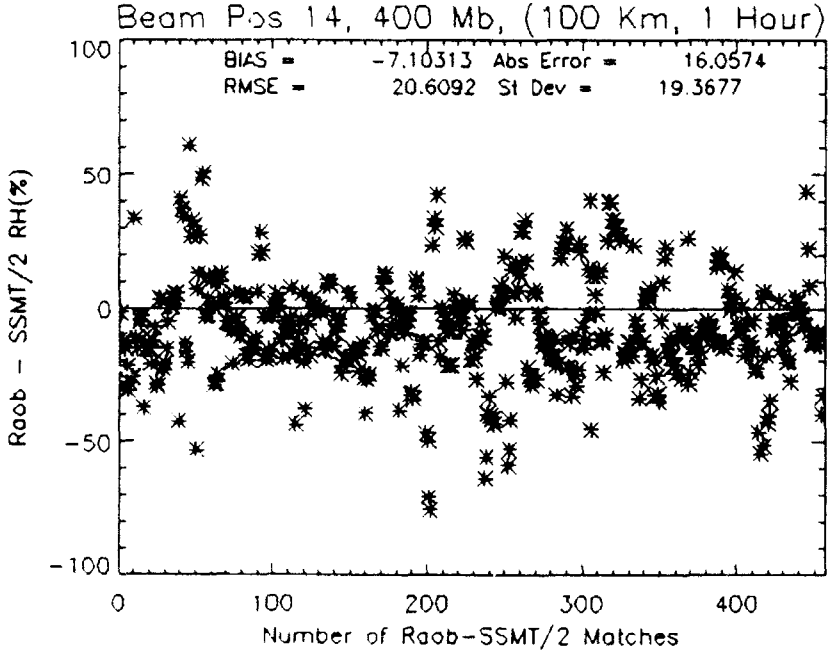
Beam Pos 15, 500 Mb, (100 Km, 1 Hour)
BIAS = -5.56634 Abs Error = 15.2538
RMSE = 19.5208 St Dev = 18.7298
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

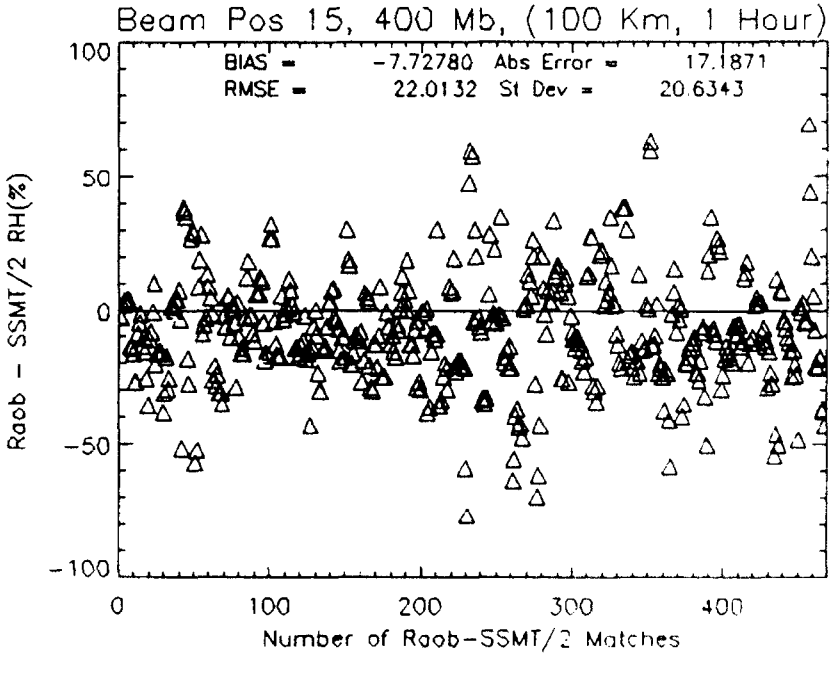
Beam Pos 13, 500 Mb, (100 Km, 1 Hour)
BIAS = -4.18894 Abs Error = 17.1197
RMSE = 22.1042 St Dev = 21.7277
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

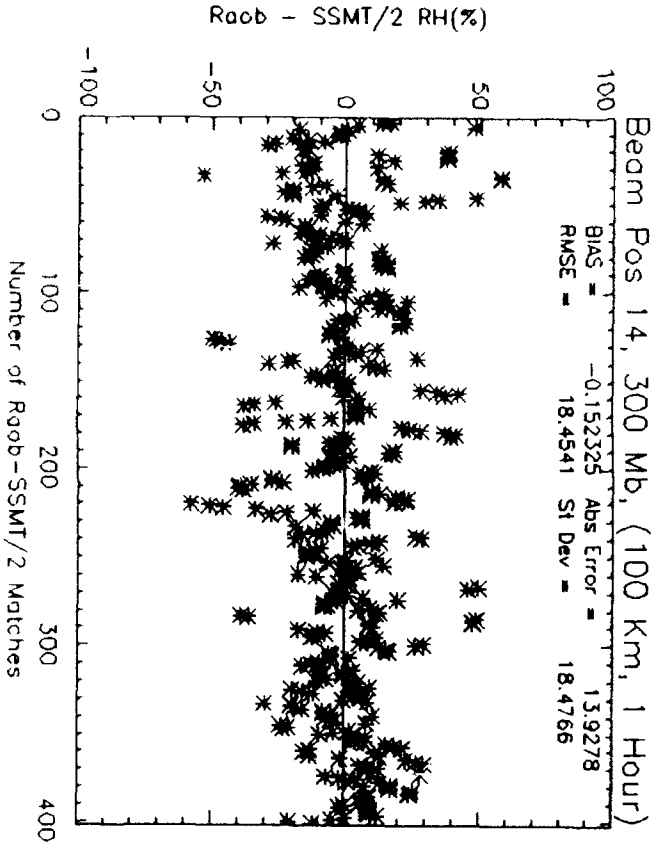
Beam Pos 14, 500 Mb, (100 Km, 1 Hour)
BIAS = -3.17223 Abs Error = 14.8291
RMSE = 19.5569 St Dev = 19.3183
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

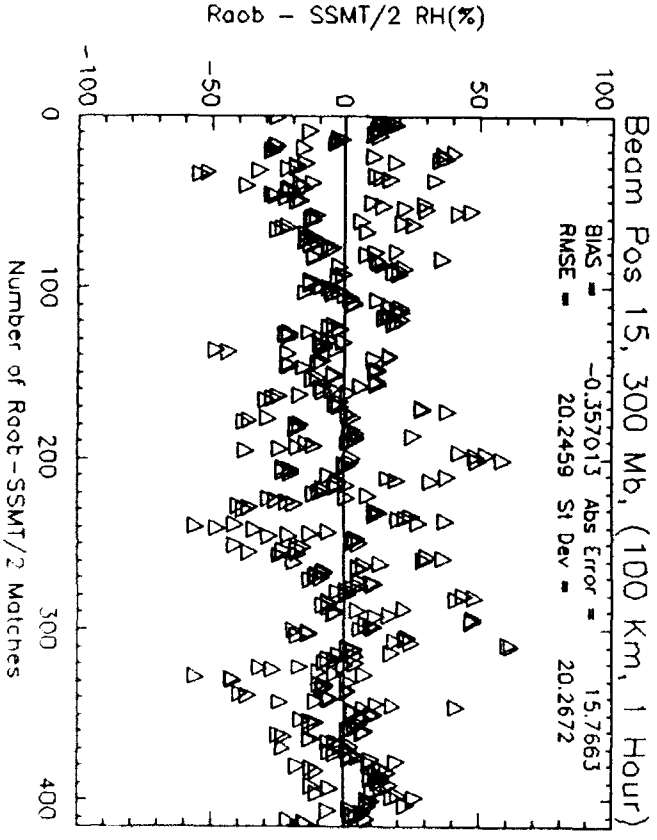

Beam Pos 13, 400 Mb, (100 Km, 1 Hour)
BIAS = -7.90659 Abs Error = 17.1162
RMSE = 21.3982 St Dev = 19.9065
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

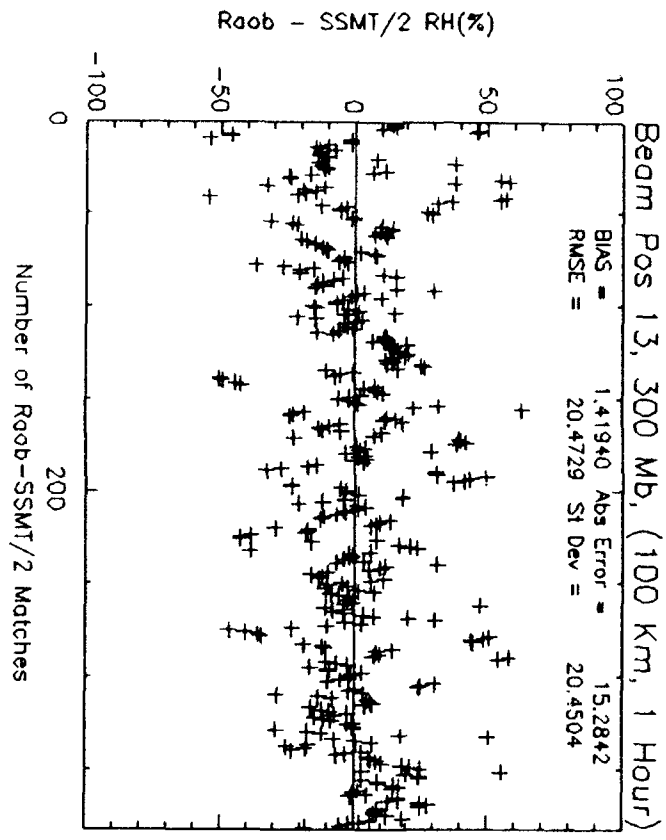

Beam Pos 16, 400 Mb, (100 Km, 1 Hour)
BIAS = -3.64212 Abs Error = 16.2646
RMSE = 20.8357 St Dev = 20.5367
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Beam Pos 14, 400 Mb, (100 Km, 1 Hour)
BIAS = -7.10313 Abs Error = 16.0574
RMSE = 20.6092 St Dev = 19.3677
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

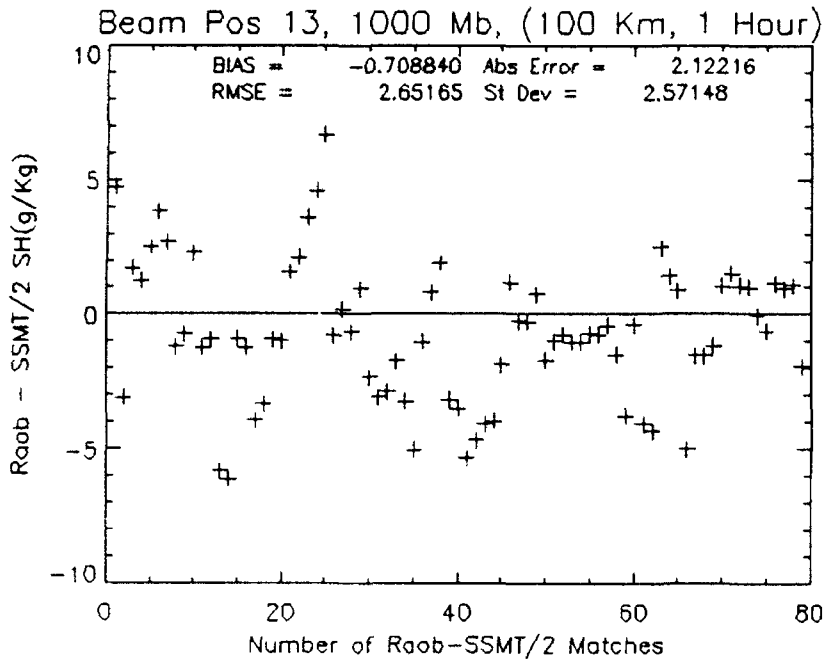

Beam Pos 15, 400 Mb, (100 Km, 1 Hour)
BIAS = -7.72780 Abs Error = 17.1871
RMSE = 22.0132 St Dev = 20.6343
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

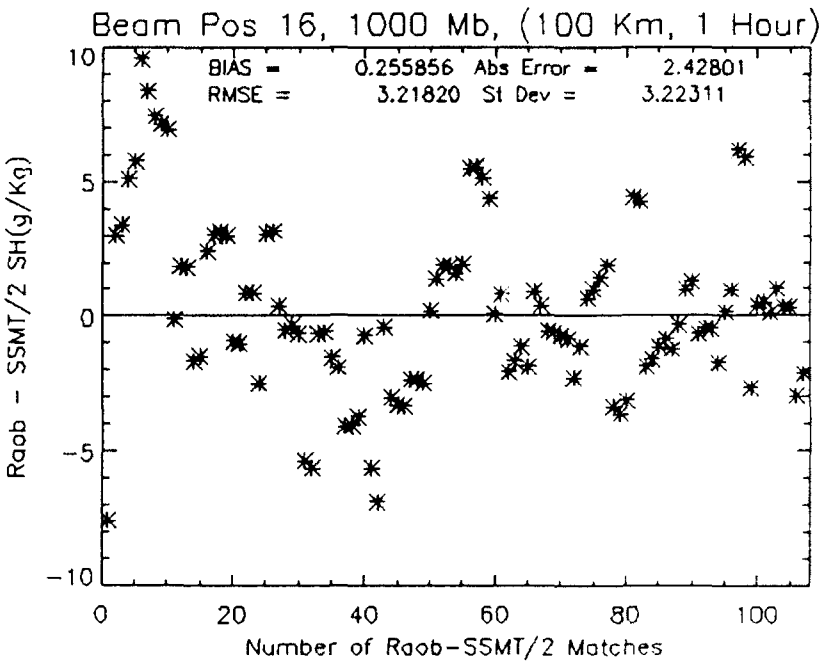

Beam Pos 13, 300 Mb, (100 Km, 1 Hour)
Raob - SSMT/2 RH(%)
BIAS = 1.41940 Abs Error = 15.2842
RMSE = 20.4729 St Dev = 20.4504
Number of Raob-SSMT/2 Matches

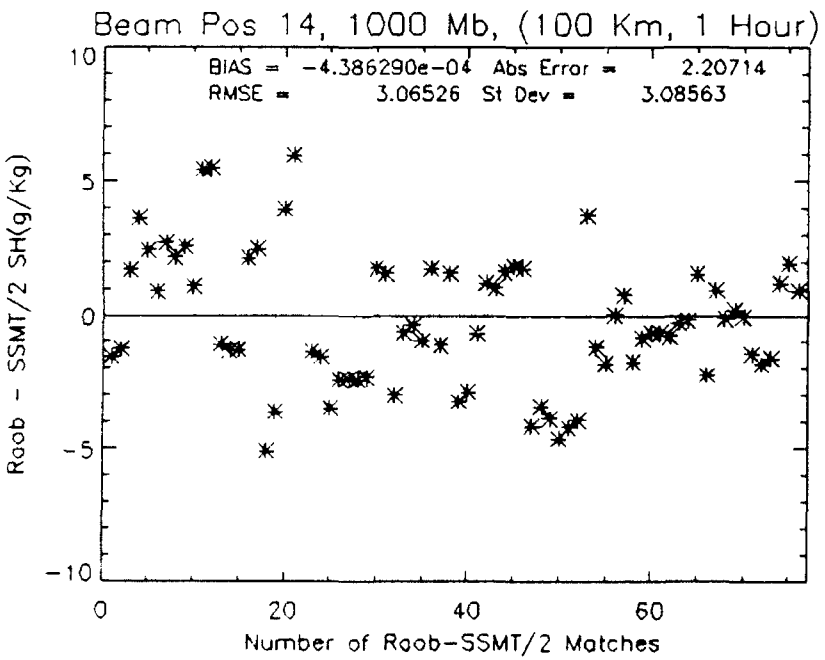

Beam Pos 14, 300 Mb, (100 Km, 1 Hour)
Raob - SSMT/2 RH(%)
BIAS = -0.152325 Abs Error = 13.9278
RMSE = 18.4541 St Dev = 18.4766
Number of Raob-SSMT/2 Matches

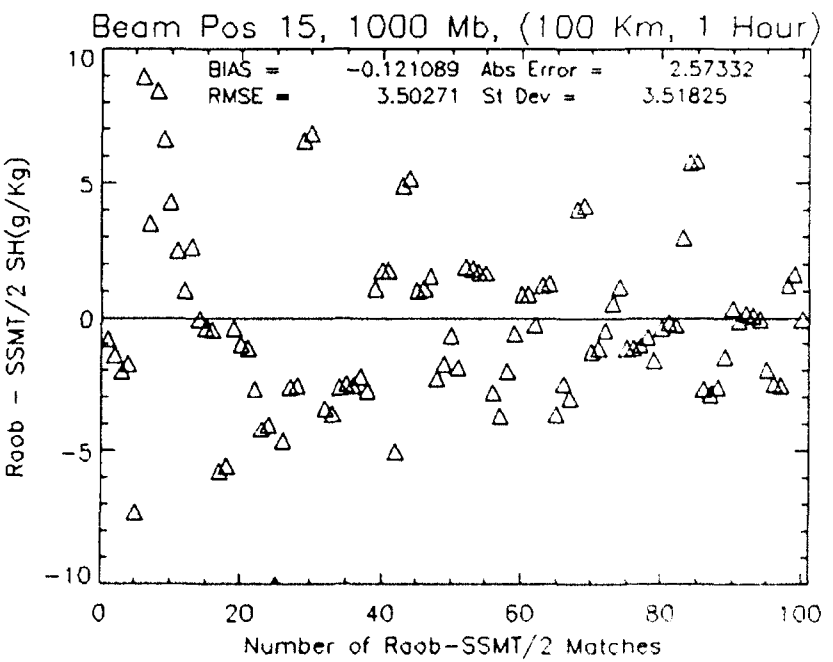

Beam Pos 16, 300 Mb, (100 Km, 1 Hour)
Raob - SSMT/2 RH(%)
BIAS = -0.875962 Abs Error = 15.3992
RMSE = 19.8588 St Dev = 19.8633
Number of Raob-SSMT/2 Matches

Beam Pos 15, 300 Mb, (100 Km, 1 Hour)
Raob - SSMT/2 RH(%)
BIAS = -0.357013 Abs Error = 15.7663
RMSE = 20.2459 St Dev = 20.2672
Number of Raob-SSMT/2 Matches


Beam Pos 13, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.708840 Abs Error = 2.12216
RMSE = 2.65165 St Dev = 2.57148
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 16, 1000 Mb, (100 Km, 1 Hour)
BIAS = 0.255856 Abs Error = 2.42801
RMSE = 3.21820 St Dev = 3.22311
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 14, 1000 Mb, (100 Km, 1 Hour)
BIAS = -4.386290e-04 Abs Error = 2.20714
RMSE = 3.06526 St Dev = 3.08563
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

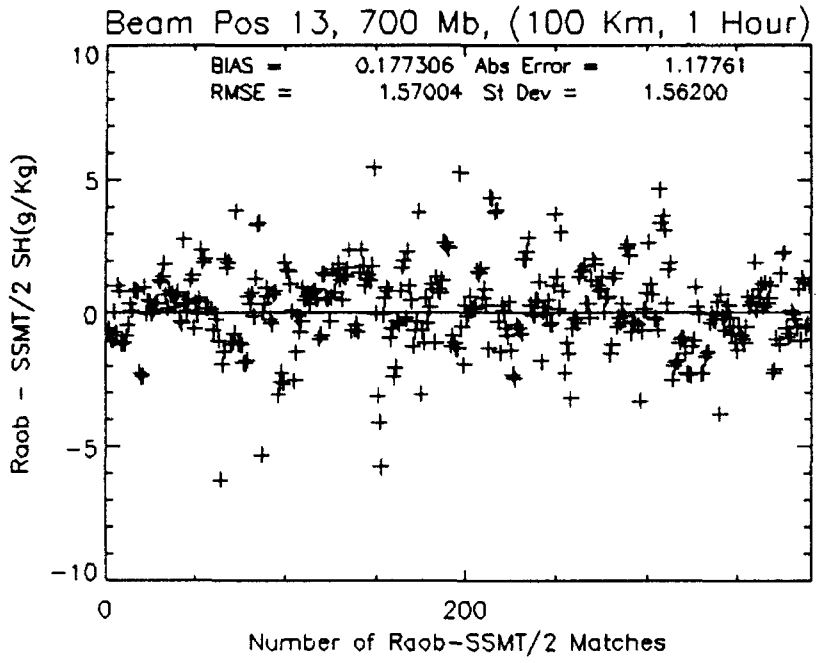

Beam Pos 15, 1000 Mb, (100 Km, 1 Hour)
BIAS = -0.121089 Abs Error = 2.57332
RMSE = 3.50271 St Dev = 3.51825
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

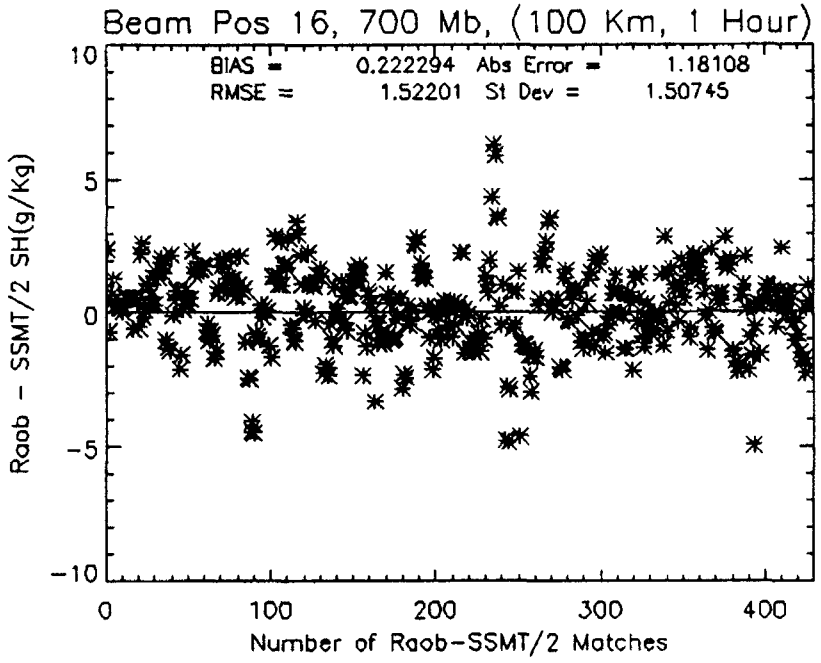
Beam Pos 16, 850 Mb, (100 Km, 1 Hour)
BIAS = 7.028003e-03 Abs Error = 2.04039
RMSE = 2.90367 St Dev = 2.90737
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

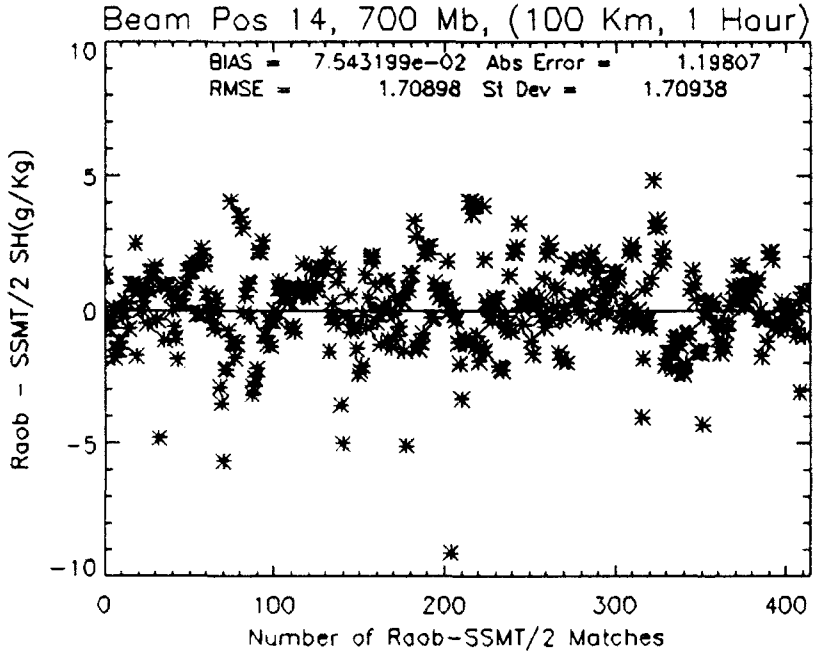
Beam Pos 15, 850 Mb, (100 Km, 1 Hour)
BIAS = -2.408046e-02 Abs Error = 1.91372
RMSE = 2.69043 St Dev = 2.69381
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

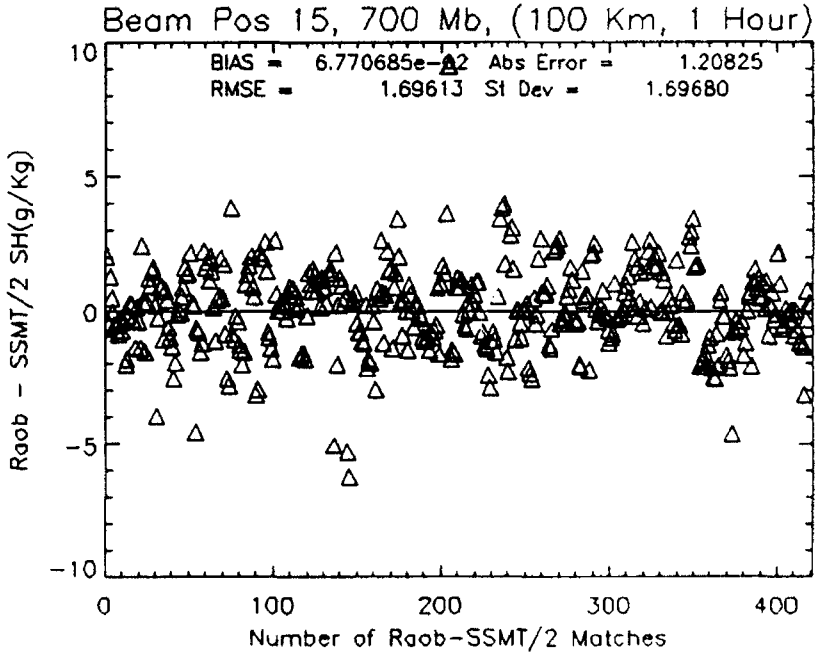
Beam Pos 13, 850 Mb, (100 Km, 1 Hour)
BIAS = 5.598365e-03 Abs Error = 1.84108
RMSE = 2.44954 St Dev = 2.45318
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

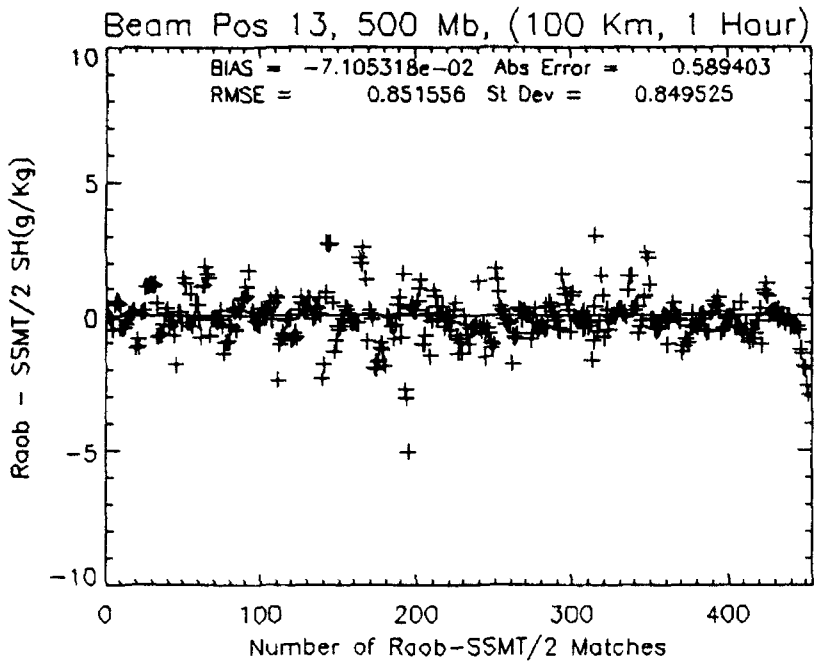
Beam Pos 14, 850 Mb, (100 Km, 1 Hour)
BIAS = 6.898995e-02 Abs Error = 1.82979
RMSE = 2.56227 St Dev = 2.56483
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

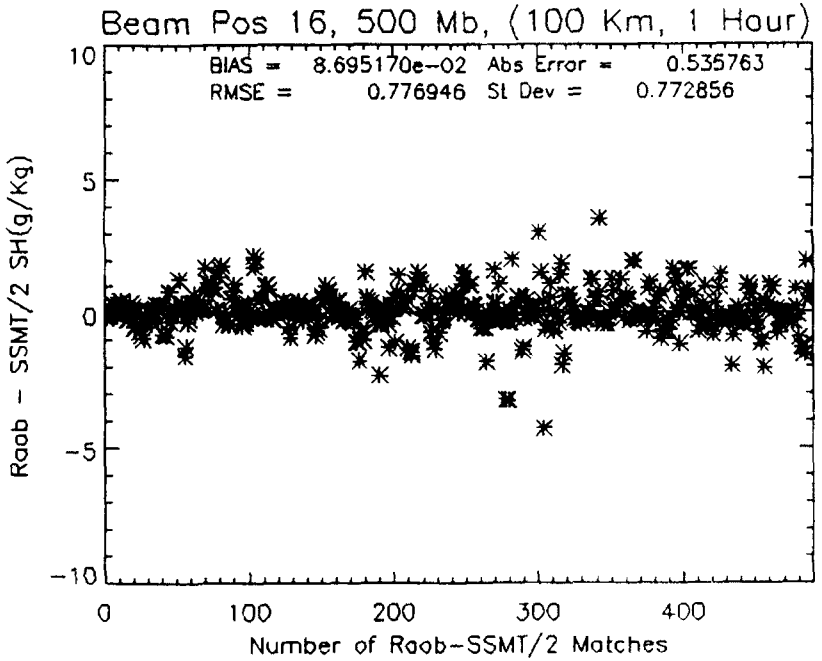

Beam Pos 13, 700 Mb, (100 Km, 1 Hour)
BIAS = 0.177306 Abs Error = 1.17761
RMSE = 1.57004 St Dev = 1.56200
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

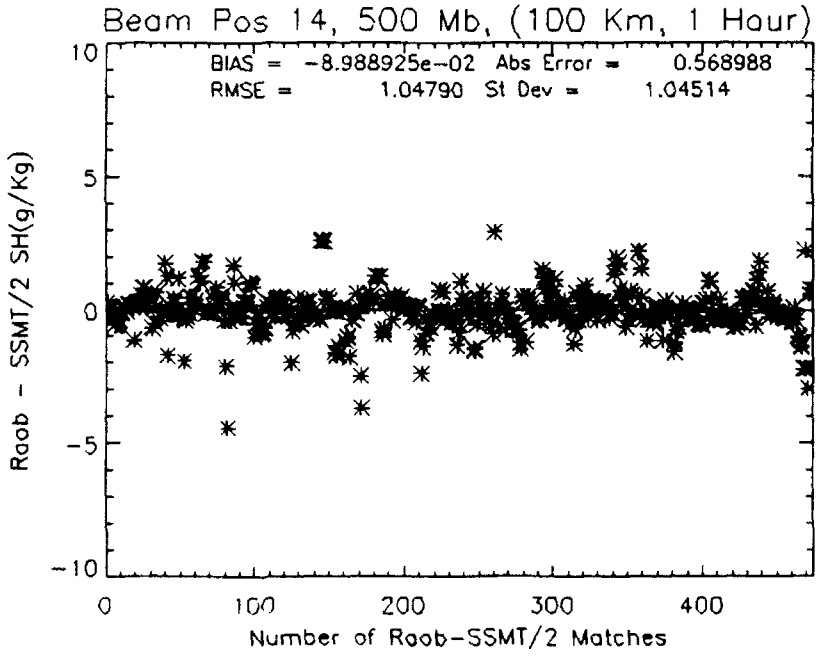

Beam Pos 16, 700 Mb, (100 Km, 1 Hour)
BIAS = 0.222294 Abs Error = 1.18108
RMSE = 1.52201 St Dev = 1.50745
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

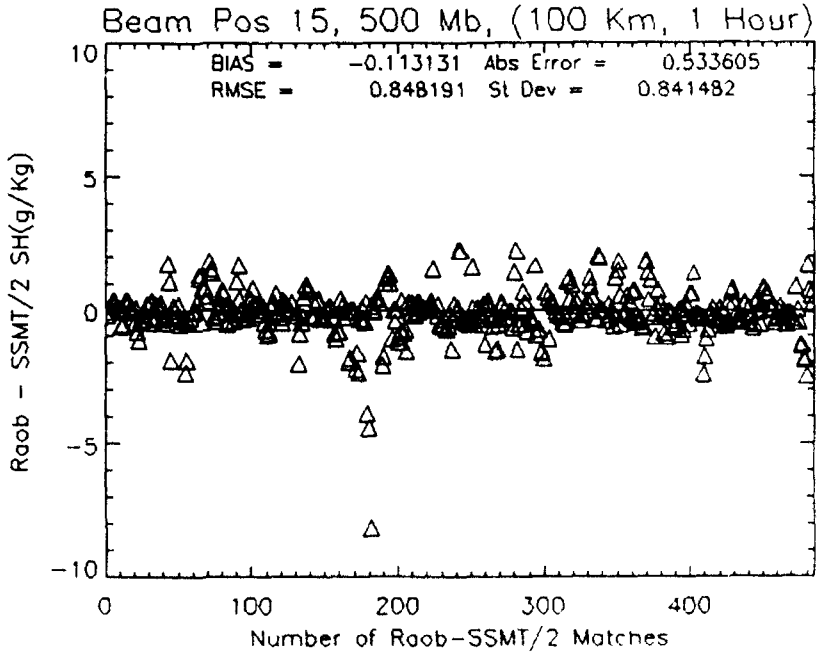

Beam Pos 14, 700 Mb, (100 Km, 1 Hour)
BIAS = 7.543199e-02 Abs Error = 1.19807
RMSE = 1.70898 St Dev = 1.70938
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

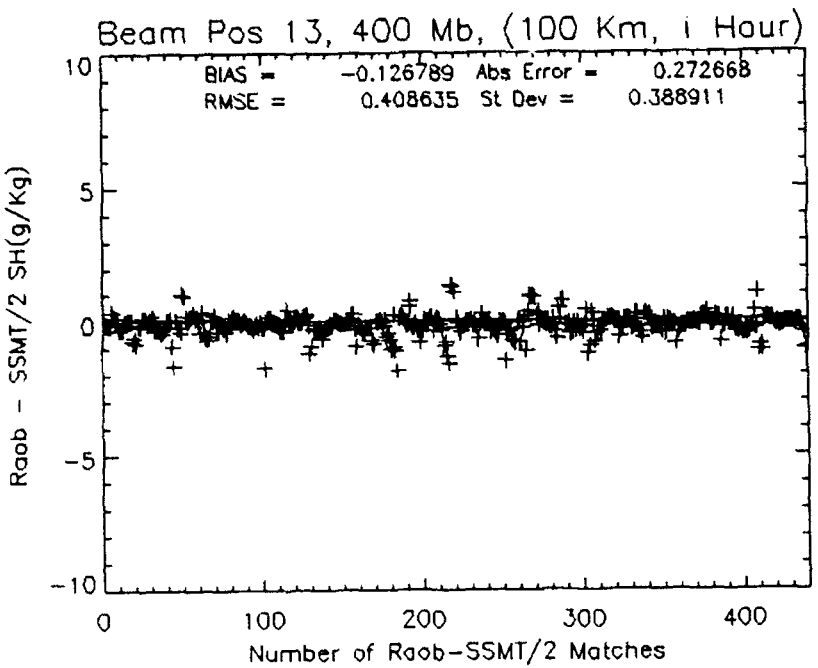

Beam Pos 15, 700 Mb, (100 Km, 1 Hour)
BIAS = 6.770685e-02 Abs Error = 1.20825
RMSE = 1.69613 St Dev = 1.69680
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

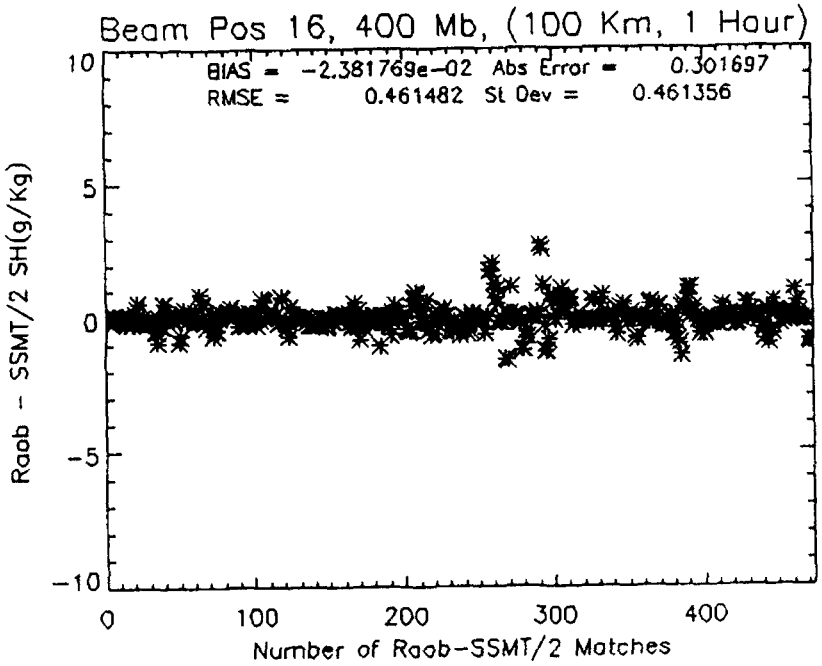

Beam Pos 13, 500 Mb, (100 Km, 1 Hour)
BIAS = -7.105318e-02 Abs Error = 0.589403
RMSE = 0.851556 St Dev = 0.849525
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

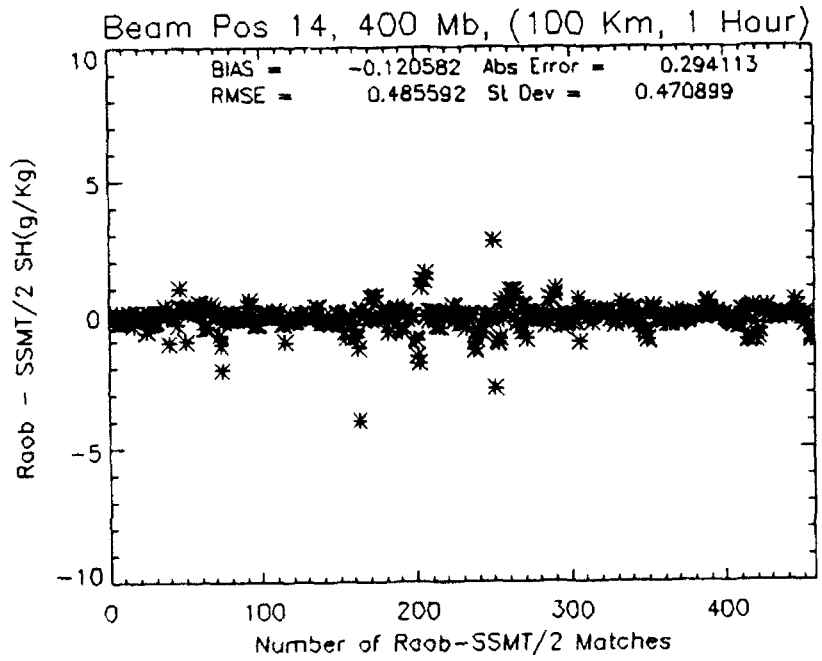

Beam Pos 16, 500 Mb, (100 Km, 1 Hour)
BIAS = 8.695170e-02 Abs Error = 0.535763
RMSE = 0.776946 St Dev = 0.772856
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

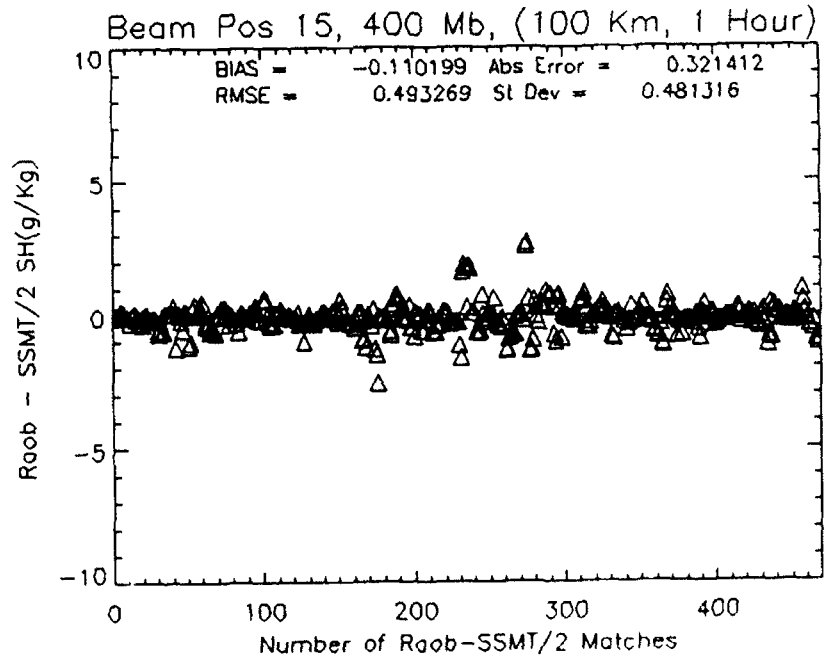

Beam Pos 14, 500 Mb, (100 Km, 1 Hour)
BIAS = -8.988925e-02 Abs Error = 0.568988
RMSE = 1.04790 St Dev = 1.04514
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

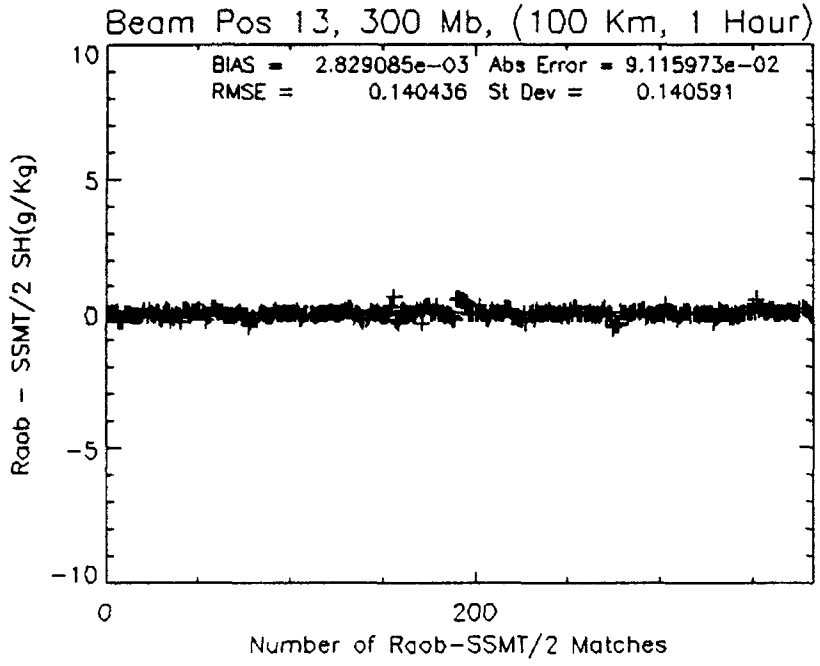

Beam Pos 15, 500 Mb, (100 Km, 1 Hour)
BIAS = -0.113131 Abs Error = 0.533605
RMSE = 0.848191 St Dev = 0.841482
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

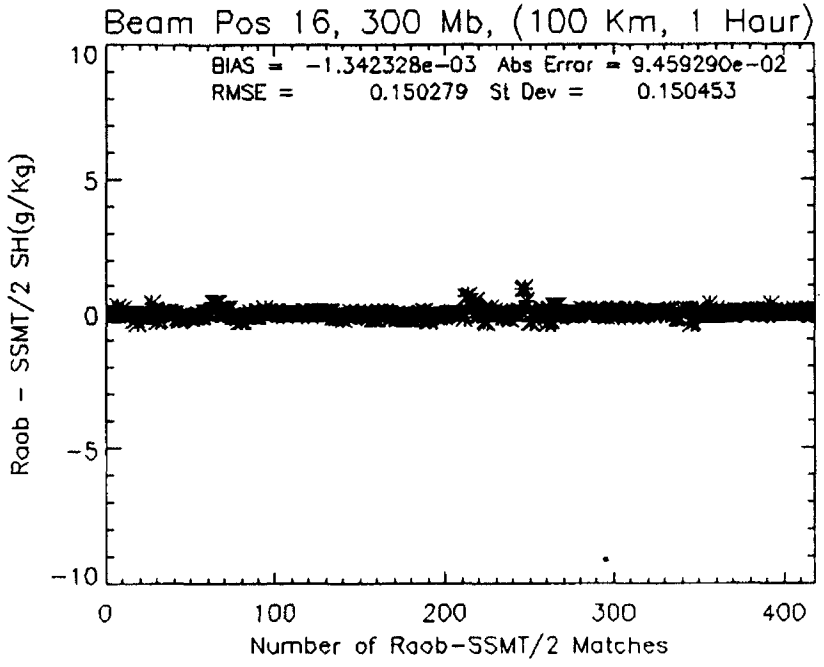

Beam Pos 13, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.126789 Abs Error = 0.272668
RMSE = 0.408635 St Dev = 0.388911
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

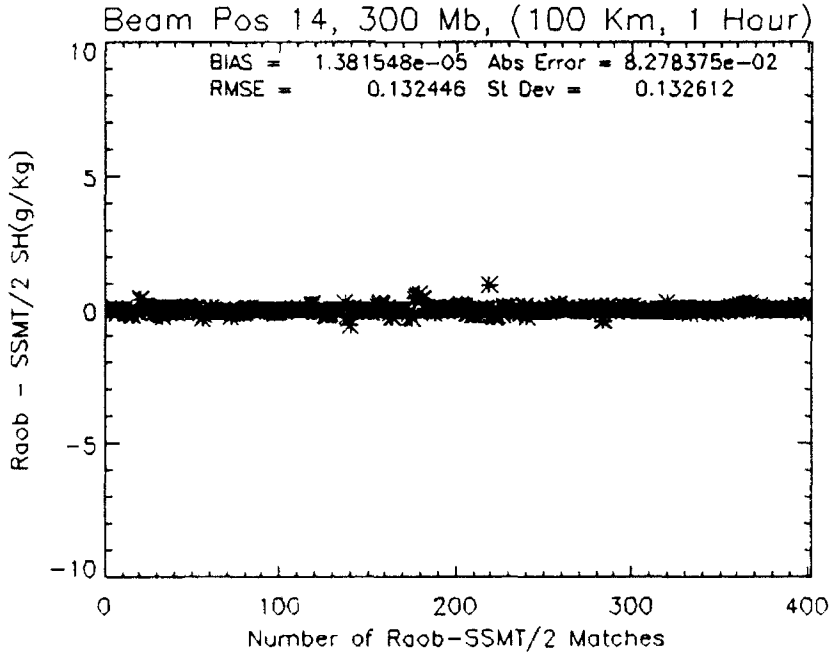

Beam Pos 16, 400 Mb, (100 Km, 1 Hour)
BIAS = -2.381769e-02 Abs Error = 0.301697
RMSE = 0.461482 St Dev = 0.461356
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

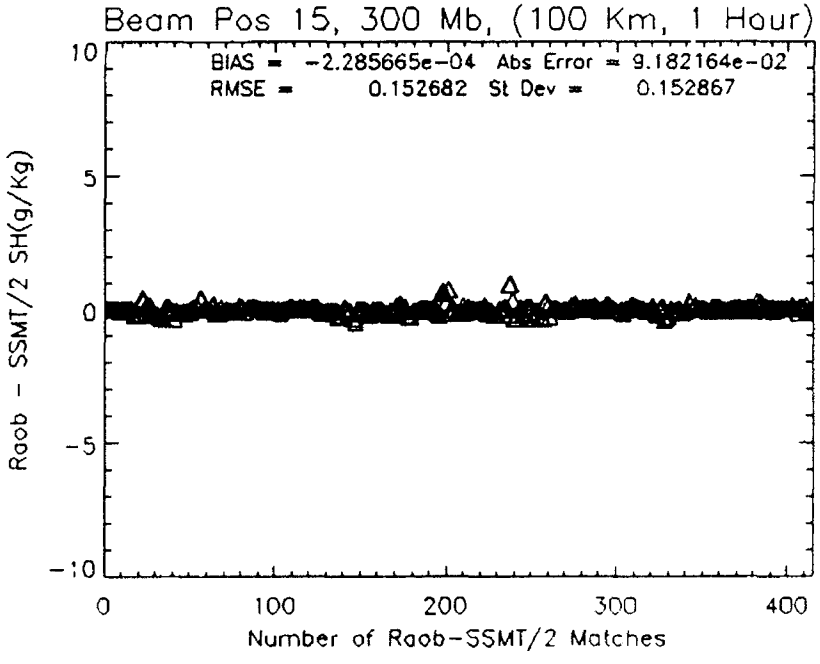

Beam Pos 14, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.120582 Abs Error = 0.294113
RMSE = 0.485592 St Dev = 0.470899
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 15, 400 Mb, (100 Km, 1 Hour)
BIAS = -0.110199 Abs Error = 0.321412
RMSE = 0.493269 St Dev = 0.481316
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

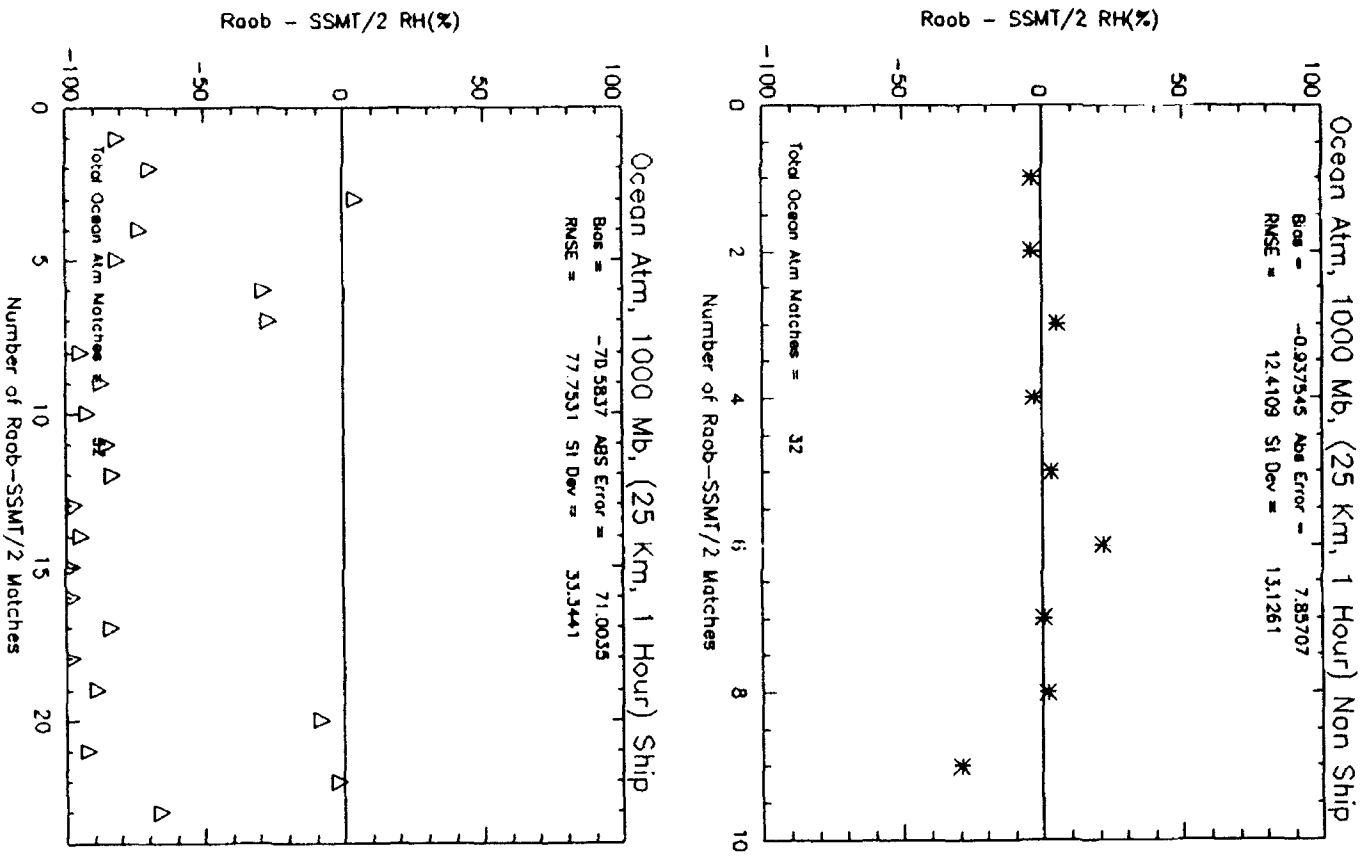

Beam Pos 13, 300 Mb, (100 Km, 1 Hour)
BIAS = 2.829085e-03 Abs Error = 9.115973e-02
RMSE = 0.140436 St Dev = 0.140591
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 16, 300 Mb, (100 Km, 1 Hour)
BIAS = -1.342328e-03 Abs Error = 9.459290e-02
RMSE = 0.150279 St Dev = 0.150453
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

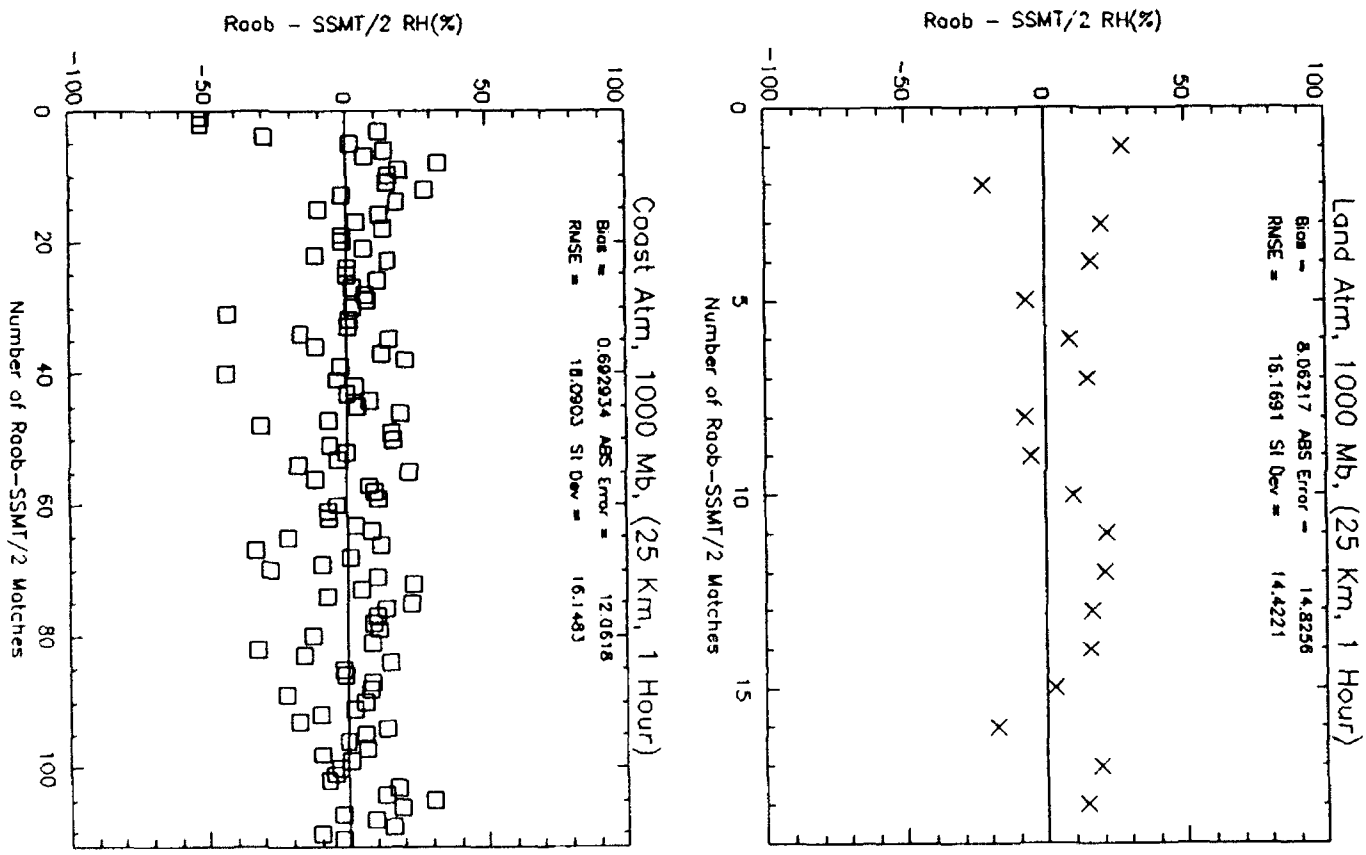

Beam Pos 14, 300 Mb, (100 Km, 1 Hour)
BIAS = 1.381548e-05 Abs Error = 8.278375e-02
RMSE = 0.132446 St Dev = 0.132612
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Beam Pos 15, 300 Mb, (100 Km, 1 Hour)
BIAS = -2.285665e-04 Abs Error = 9.182164e-02
RMSE = 0.152682 St Dev = 0.152867
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

Appendix I. For variable spatial co-location criteria, land and ship observations are plotted separately with the quantity (Radiosonde - SSM/T-2) RH and Q plotted on the ordinate, and the index of the co-locations on the abscissa. Each four-plot panel represents one atmospheric level. In addition, the plots are stratified by atmosphere type. The co-location criteria are annotated at the top of the plots.


Ocean Atm, 1000 Mb, (25 Km, 1 Hour) Non Ship
Raob - SSMT/2 RH(%)
Bias = -0.937545 Abs Error = 7.85707
RMSE = 12.4109 St Dev = 13.1261
Total Ocean Atm Matches = 32
Number of Raob-SSMT/2 Matches

Ocean Atm, 1000 Mb, (25 Km, 1 Hour) Ship
Raob - SSMT/2 RH(%)
Bias = -70.5837 ABS Error = 71.0035
RMSE = 77.7531 St Dev = 33.3441
Total Ocean Atm Matches = 42
Number of Raob-SSMT/2 Matches


Land Atm, 1000 Mb, (25 Km, 1 Hour)
Raob - SSMT/2 RH(%)
Bias = 8.06217 ABS Error = 14.8256
RMSE = 16.1691 St Dev = 14.4221
Number of Raob-SSMT/2 Matches

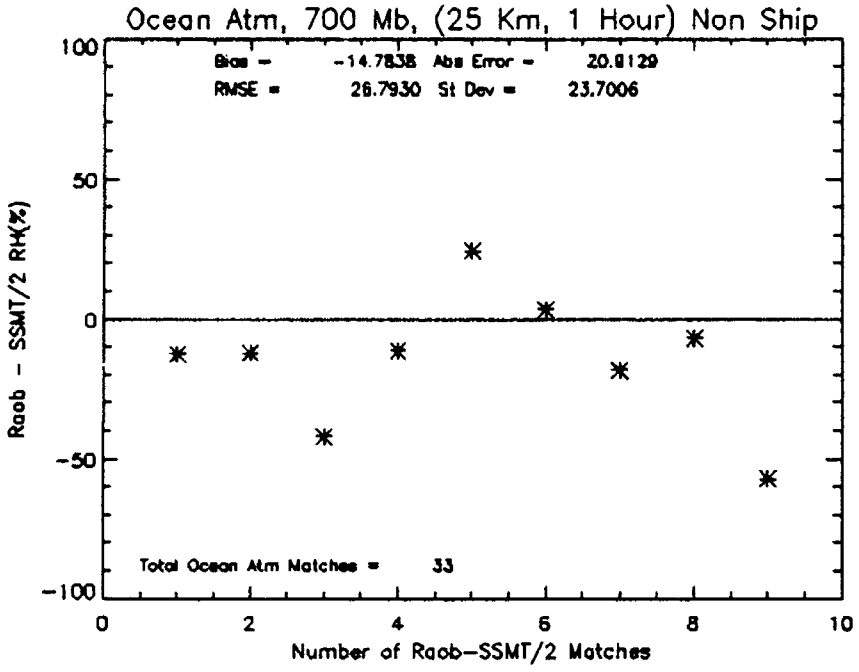
Coast Atm, 1000 Mb, (25 Km, 1 Hour)
Raob - SSMT/2 RH(%)
Bias = 0.692934 ABS Error = 12.0618
RMSE = 18.0903 St Dev = 16.1483
Number of Raob-SSMT/2 Matches

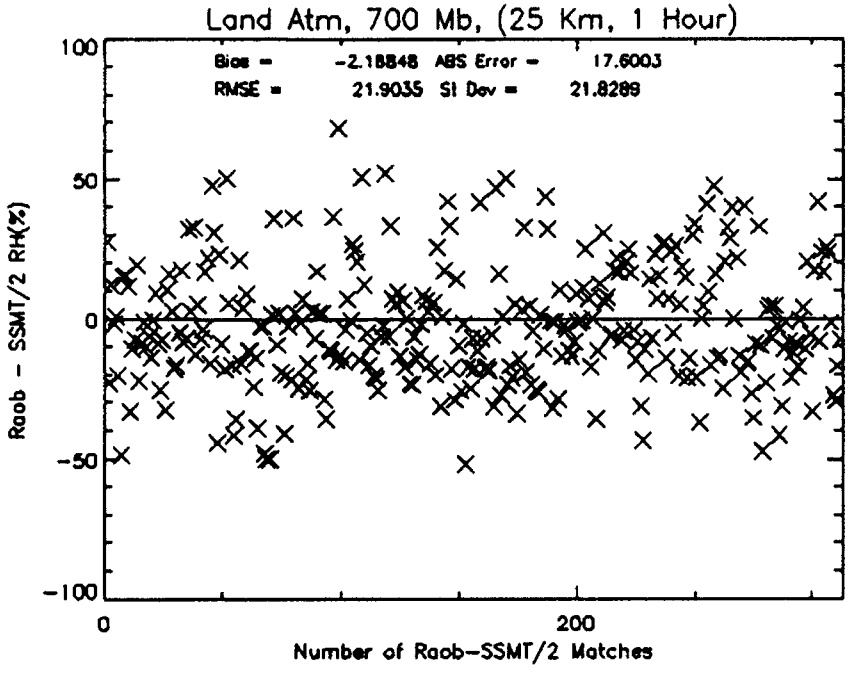
Land Atm, 850 Mb, (25 Km, 1 Hour)
Bias = -4.40817 ABS Error = 19.6425
RMSE = 24.1479 St Dev = 23.7677
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

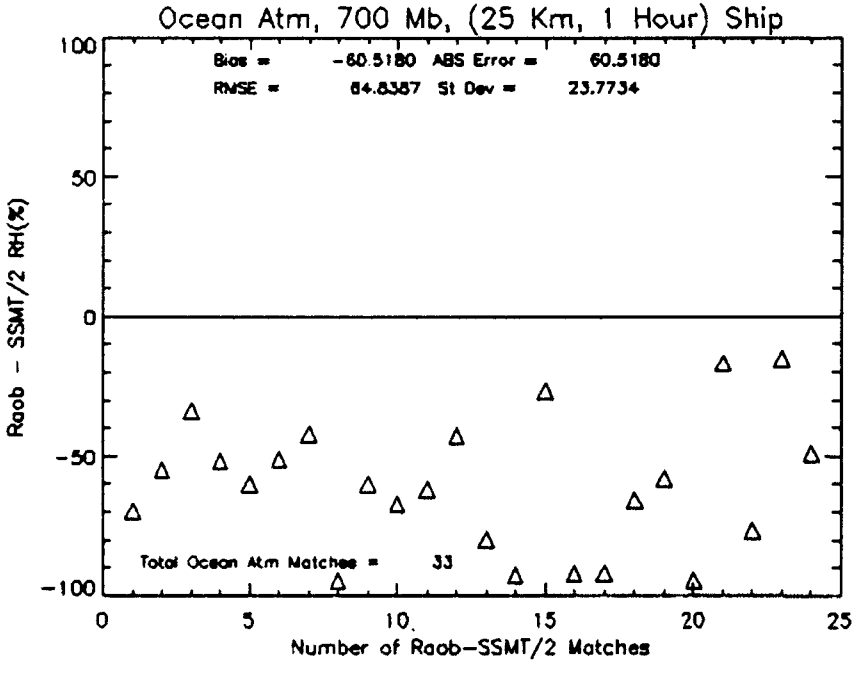
Coast Atm, 850 Mb, (25 Km, 1 Hour)
Bias = -7.23808 ABS Error = 19.2298
RMSE = 24.0099 St Dev = 22.9374
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

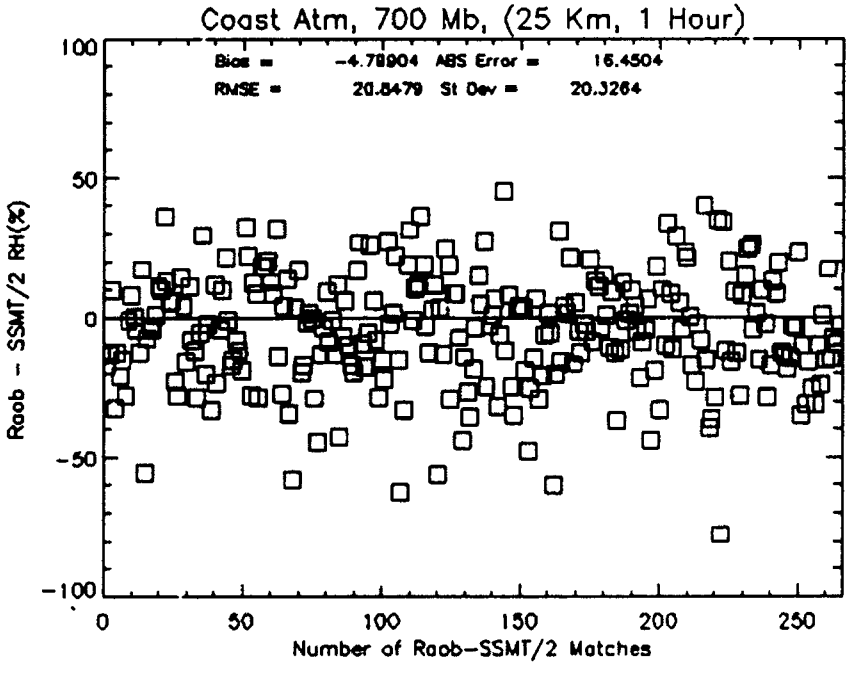
Ocean Atm, 850 Mb, (25 Km, 1 Hour) Non Ship
Bias = -11.1139 Abs Error = 12.6214
RMSE = 14.0576 St Dev = 9.13009
Total Ocean Atm Matches = 33
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

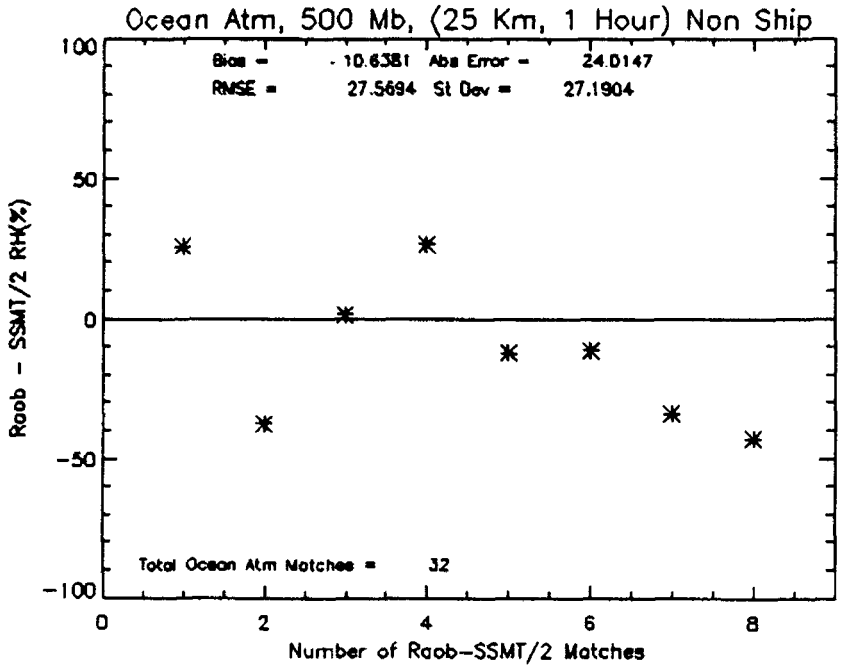
Ocean Atm, 350 Mb, (25 Km, 1 Hour) Ship
Bias = -66.4417 ABS Error = 66.4417
RMSE = 73.1892 St Dev = 31.3548
Total Ocean Atm Matches = 45
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

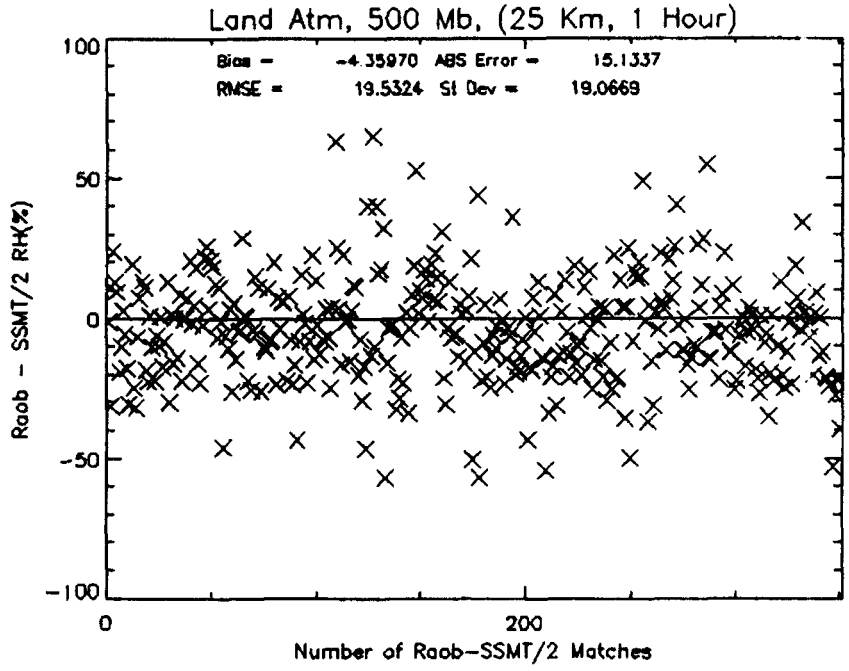

Ocean Atm, 700 Mb, (25 Km, 1 Hour) Non Ship
Bias = -14.7838 Abs Error = 20.8129
RMSE = 26.7930 St Dev = 23.7006
Total Ocean Atm Matches = 33
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

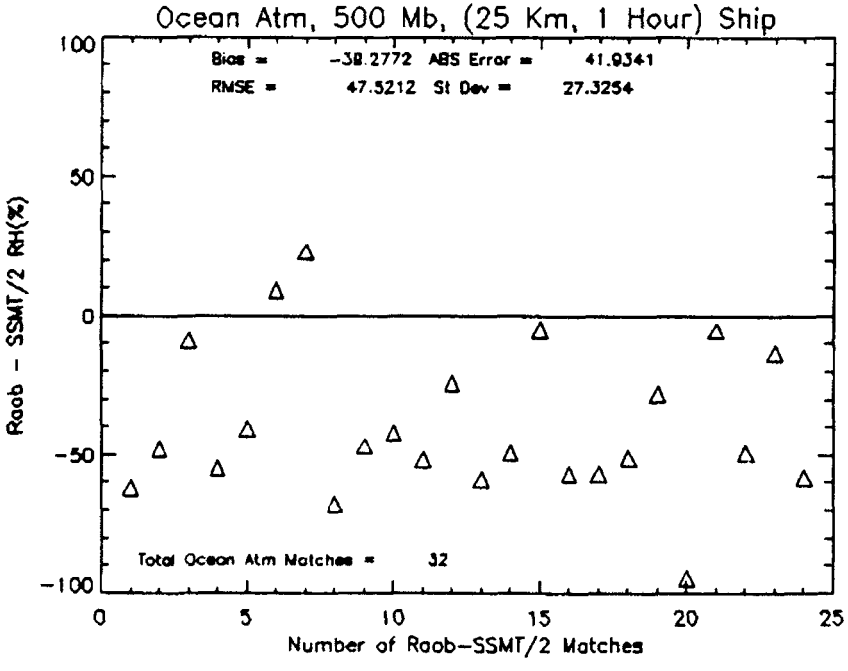

Land Atm, 700 Mb, (25 Km, 1 Hour)
Bias = -2.18848 ABS Error = 17.6003
RMSE = 21.9035 St Dev = 21.8289
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

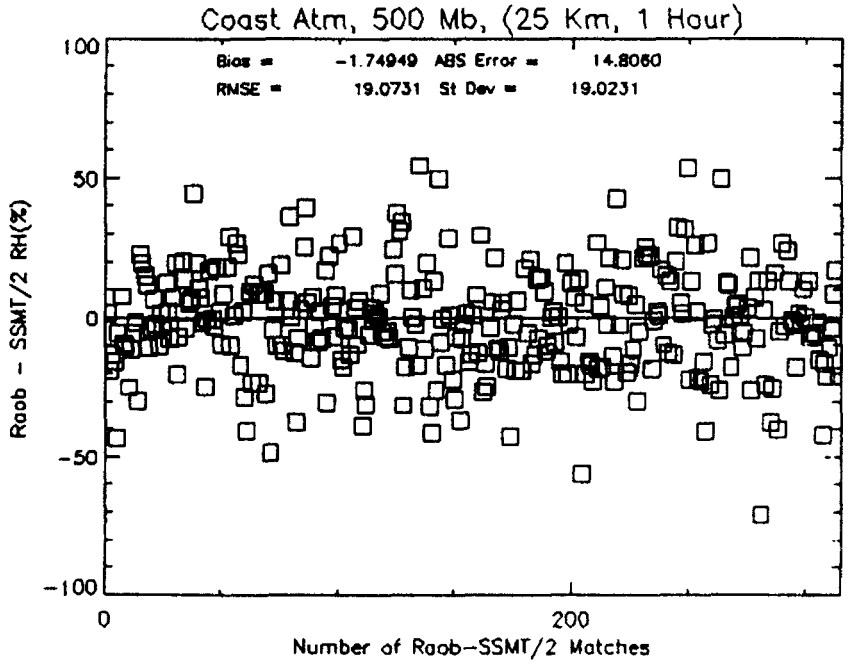

Ocean Atm, 700 Mb, (25 Km, 1 Hour) Ship
Bias = -60.5180 ABS Error = 60.5180
RMSE = 64.8387 St Dev = 23.7734
Total Ocean Atm Matches = 33
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

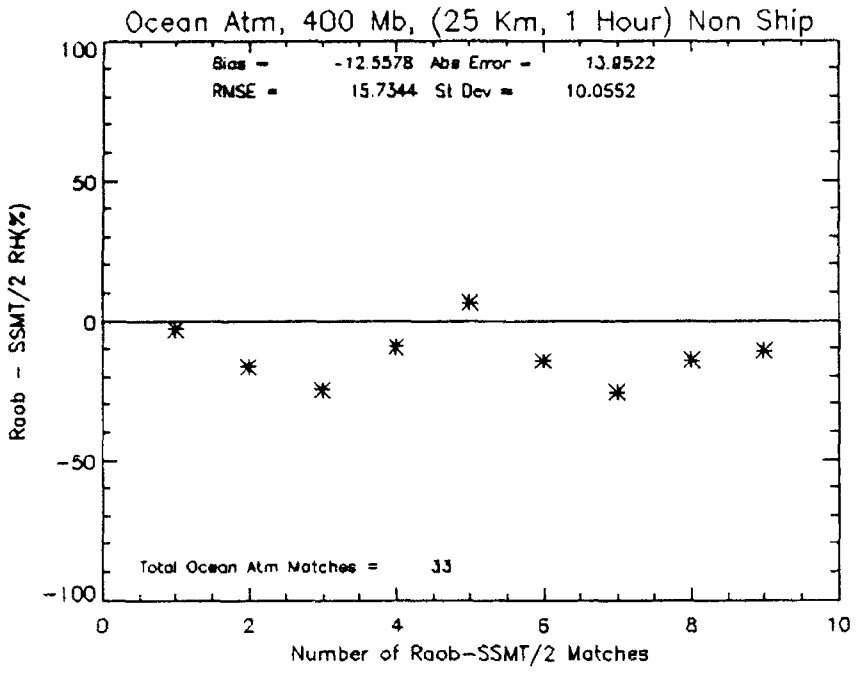

Coast Atm, 700 Mb, (25 Km, 1 Hour)
Bias = -4.78904 ABS Error = 16.4504
RMSE = 20.8479 St Dev = 20.3264
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

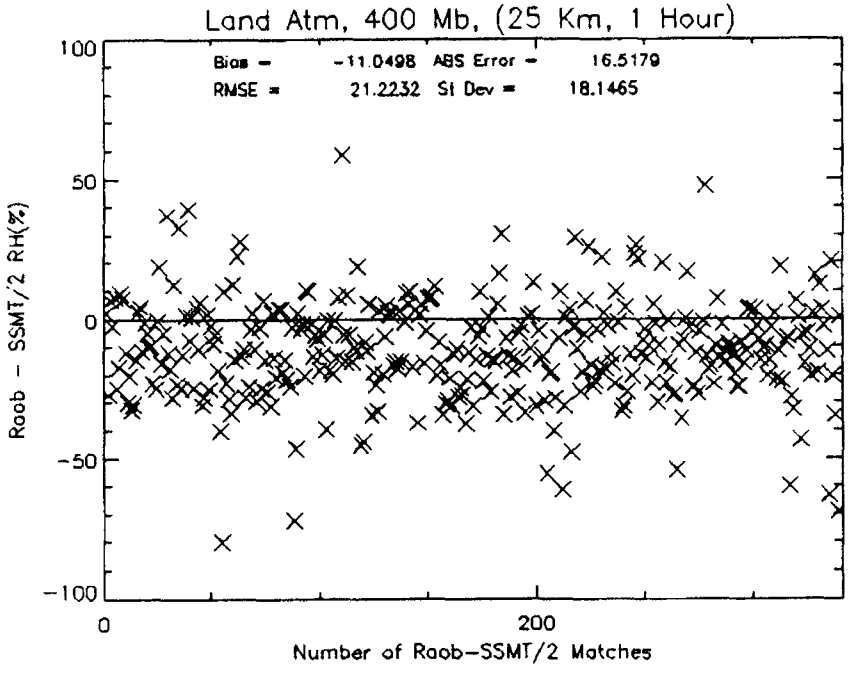

Ocean Atm, 500 Mb, (25 Km, 1 Hour) Non Ship
Bias = -10.6381 Abs Error = 24.0147
RMSE = 27.5694 St Dev = 27.1904
Total Ocean Atm Matches = 32
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

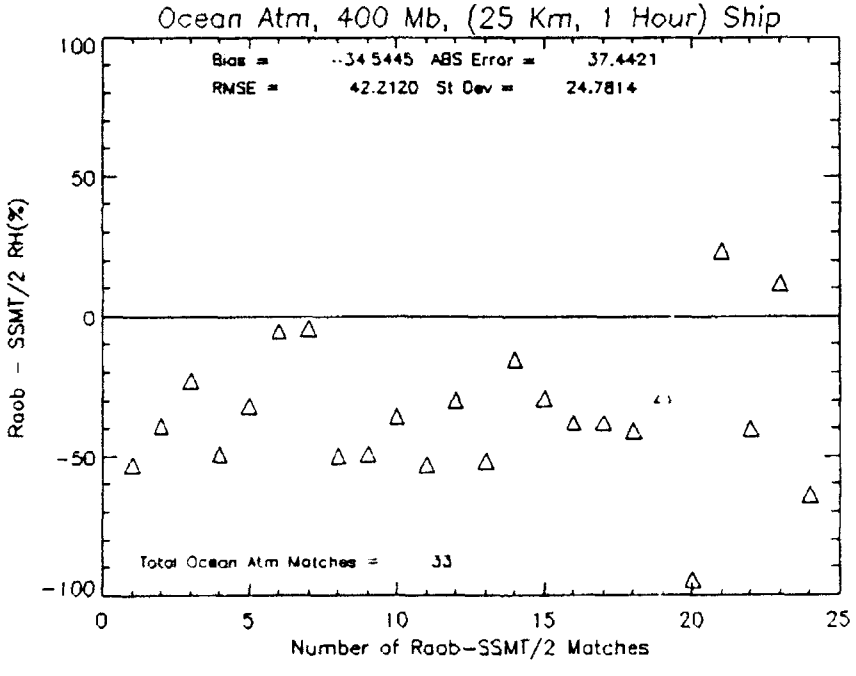

Land Atm, 500 Mb, (25 Km, 1 Hour)
Bias = -4.35970 ABS Error = 15.1337
RMSE = 19.5324 St Dev = 19.0669
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

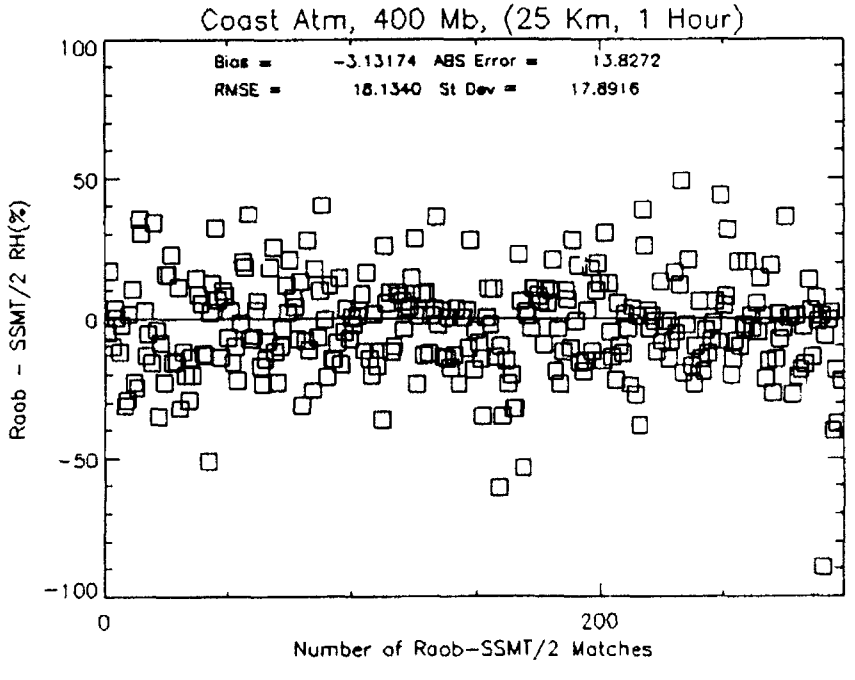

Ocean Atm, 500 Mb, (25 Km, 1 Hour) Ship
Bias = -38.2772 ABS Error = 41.9341
RMSE = 47.5212 St Dev = 27.3254
Total Ocean Atm Matches = 32
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Coast Atm, 500 Mb, (25 Km, 1 Hour)
Bias = -1.74949 ABS Error = 14.8060
RMSE = 19.0731 St Dev = 19.0231
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm, 400 Mb, (25 Km, 1 Hour) Non Ship
Bias = -12.5578 Abs Error = 13.8522
RMSE = 15.7344 St Dev = 10.0552
Total Ocean Atm Matches = 33
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Land Atm, 400 Mb, (25 Km, 1 Hour)
Bias = -11.0498 ABS Error = 16.5179
RMSE = 21.2232 St Dev = 18.1465
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm, 400 Mb, (25 Km, 1 Hour) Ship
Bias = -34.5445 ABS Error = 37.4421
RMSE = 42.2120 St Dev = 24.7814
Total Ocean Atm Matches = 33
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Coast Atm, 400 Mb, (25 Km, 1 Hour)
Bias = -3.13174 ABS Error = 13.8272
RMSE = 18.1340 St Dev = 17.8916
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Land Atm, 300 Mb, (25 Km, 1 Hour)
Bias = -2.15807 ABS Error = 14.8813
RMSE = 18.9521 St Dev = 18.8607
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Coast Atm, 300 Mb, (25 Km, 1 Hour)
Bias = 0.989301 ABS Error = 13.7765
RMSE = 17.9098 St Dev = 17.9184
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm, 300 Mb, (25 Km, 1 Hour) Non Ship
Bias = -10.7269 Abs Error = 15.8788
RMSE = 19.3016 St Dev = 17.0197
Total Ocean Atm Matches = 32
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

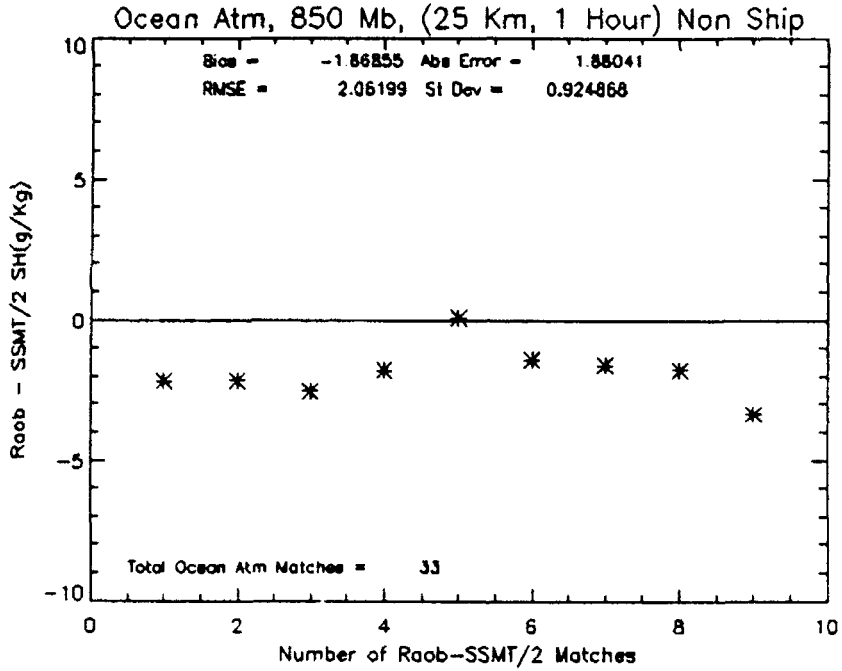
Ocean Atm, 300 Mb, (25 Km, 1 Hour) Ship
Bias = -20.4705 ABS Error = 24.8331
RMSE = 27.2565 St Dev = 18.4479
Total Ocean Atm Matches = 32
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

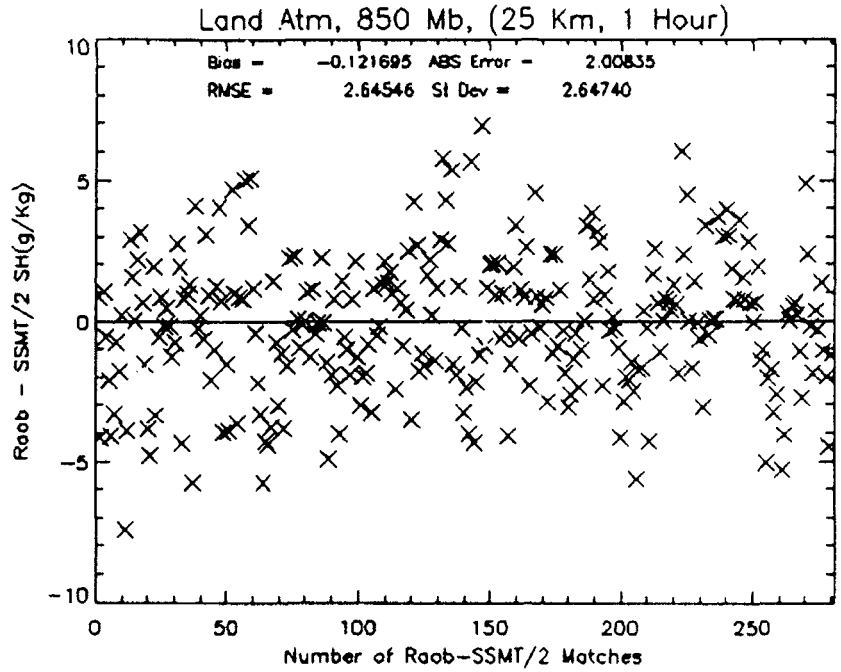
Land Atm, 1000 Mb, (25 Km, 1 Hour)
Bias = -0.684163 ABS Error = 1.45162
RMSE = 2.14896 St Dev = 2.09620
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

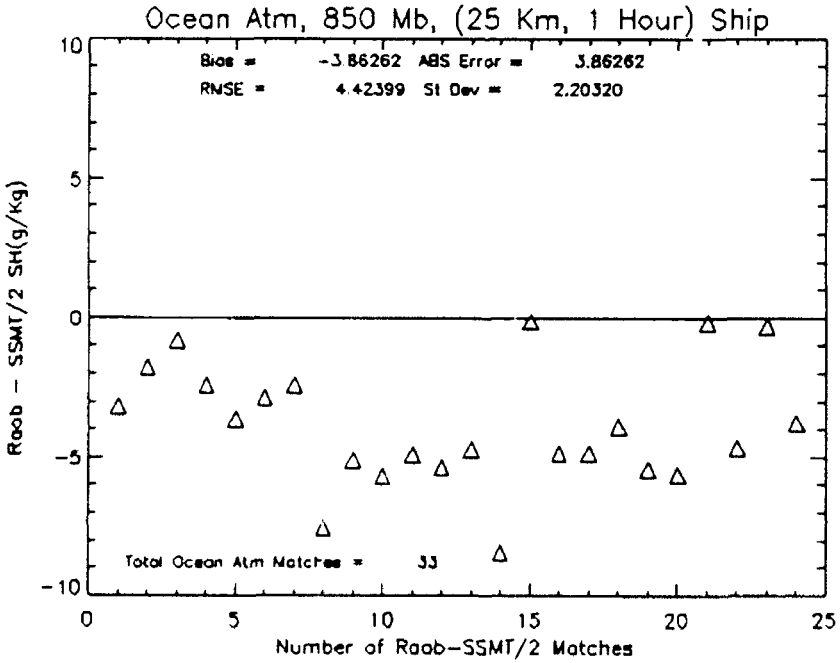
Coast Atm, 1000 Mb, (25 Km, 1 Hour)
Bias = 2.639970e-02 ABS Error = 2.13530
RMSE = 2.91633 St Dev = 2.92984
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

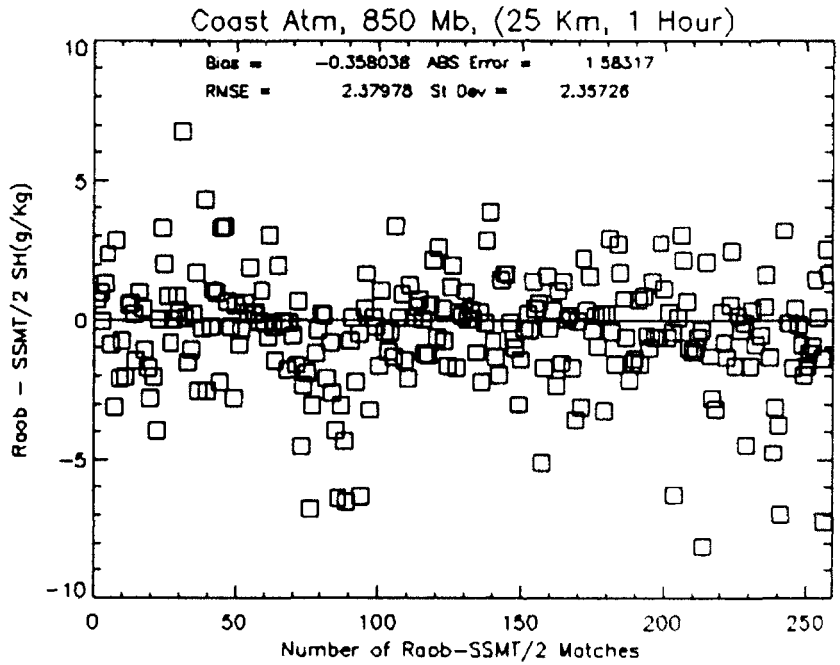
Ocean Atm, 1000 Mb, (25 Km, 1 Hour) Non Ship
Bias = -1.17618 Abs Error = 2.42674
RMSE = 3.26070 St Dev = 3.22566
Total Ocean Atm Matches = 32
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

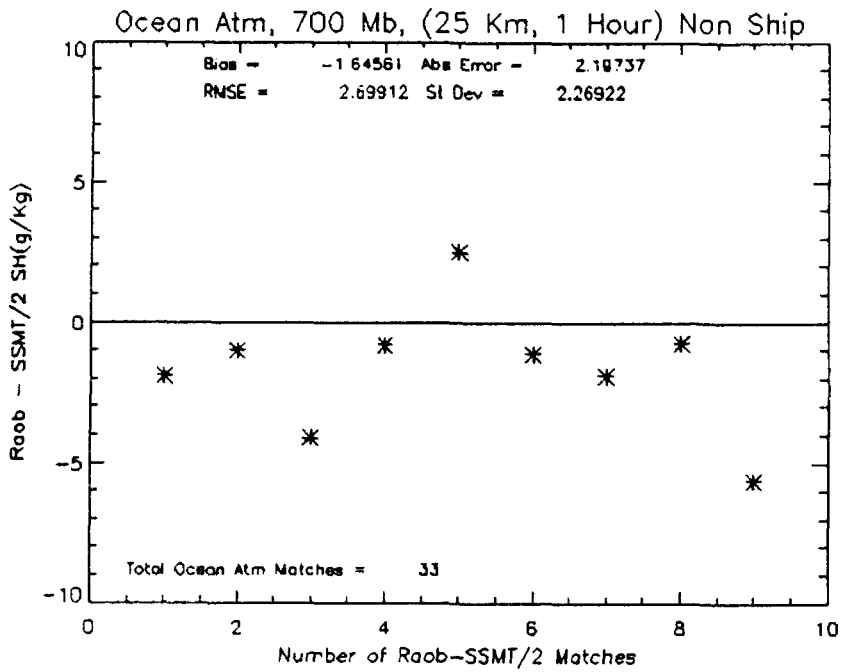
Ocean Atm, 1000 Mb, (25 Km, 1 Hour) Ship
Bias = -5.17394 ABS Error = 5.18871
RMSE = 5.74381 St Dev = 2.55039
Total Ocean Atm Matches = 32
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

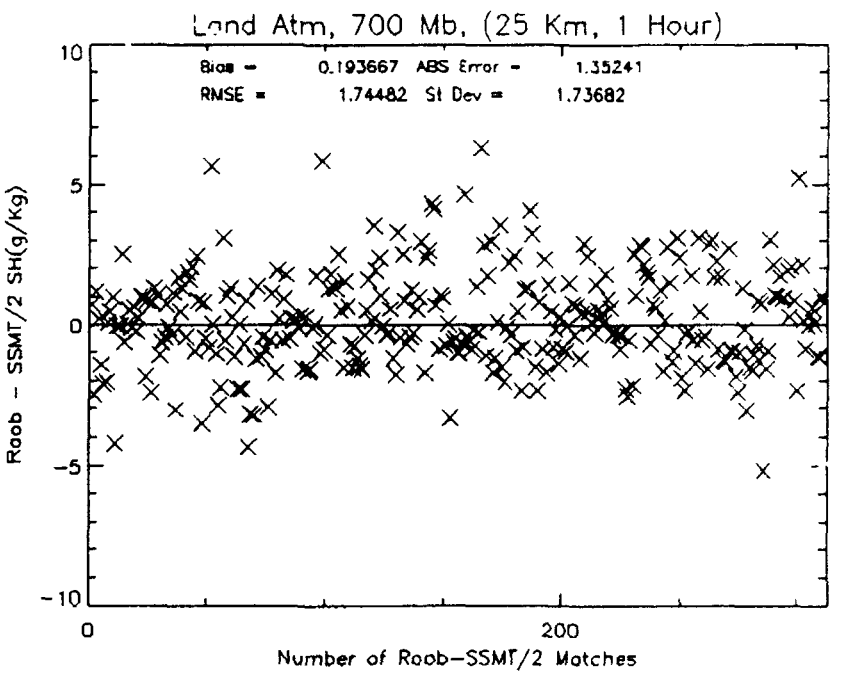

Ocean Atm, 850 Mb, (25 Km, 1 Hour) Non Ship
Bias = -1.86855 Abs Error = 1.88041
RMSE = 2.06199 St Dev = 0.924868
Total Ocean Atm Matches = 33
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

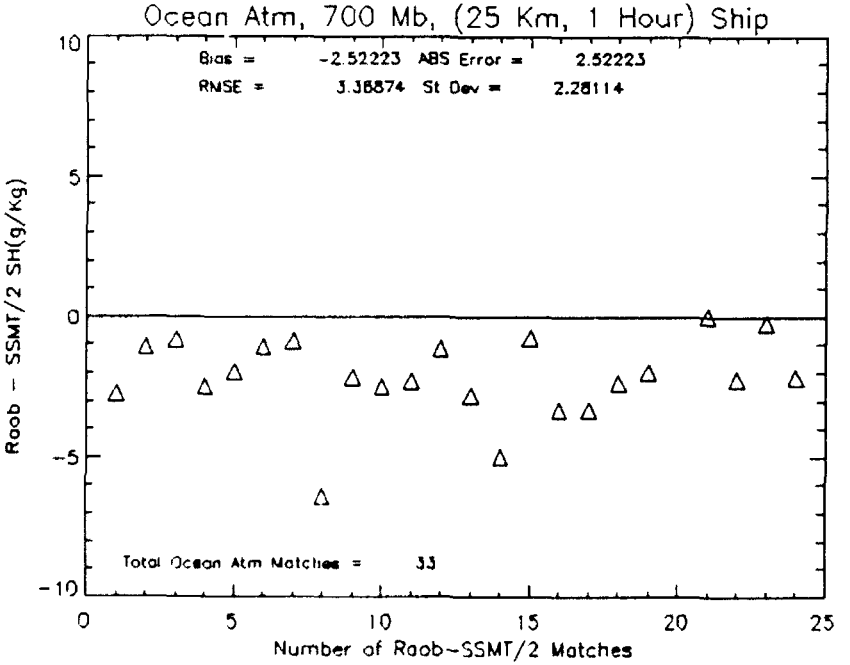

Land Atm, 850 Mb, (25 Km, 1 Hour)
Bias = -0.121695 ABS Error = 2.00835
RMSE = 2.64546 St Dev = 2.64740
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

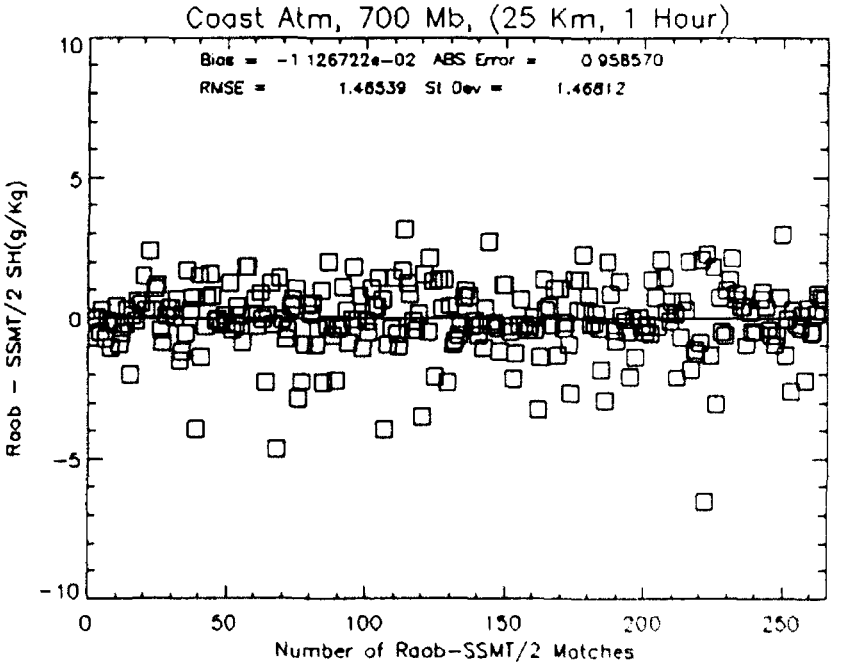

Ocean Atm, 850 Mb, (25 Km, 1 Hour) Ship
Bias = -3.86262 ABS Error = 3.86262
RMSE = 4.42399 St Dev = 2.20320
Total Ocean Atm Matches = 33
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

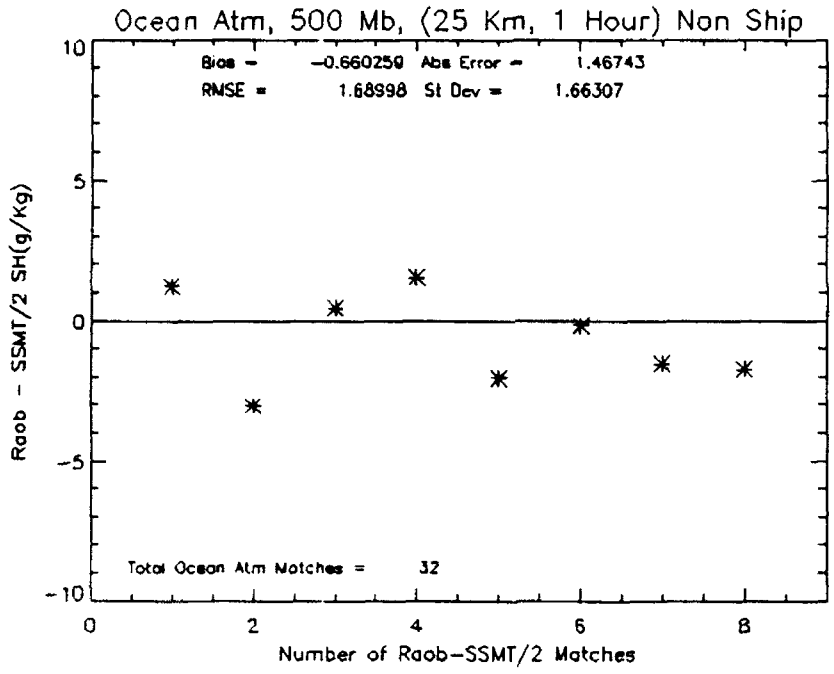

Coast Atm, 850 Mb, (25 Km, 1 Hour)
Bias = -0.358038 ABS Error = 1.58317
RMSE = 2.37978 St Dev = 2.35726
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

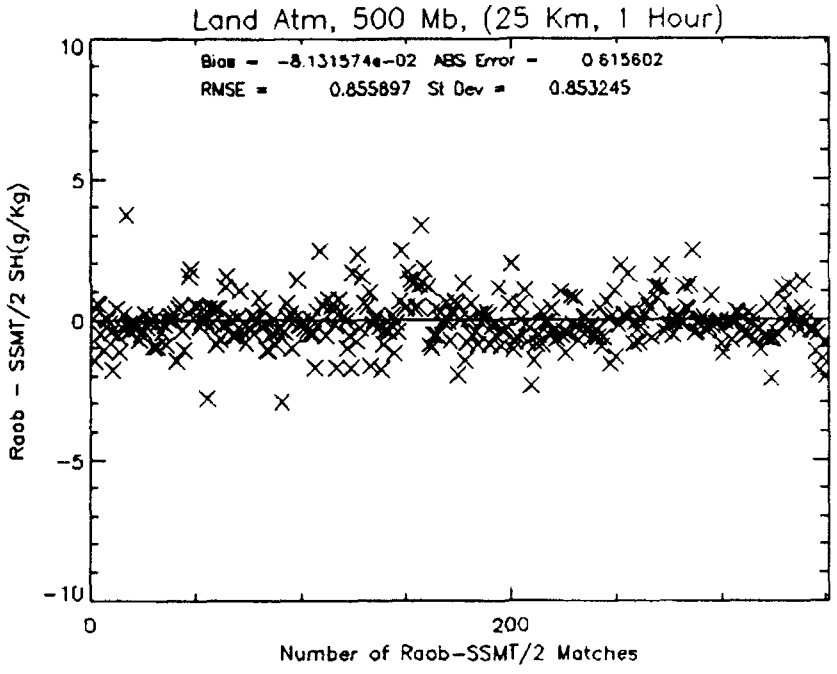

Ocean Atm, 700 Mb, (25 Km, 1 Hour) Non Ship
Bias = -1.64561 Abs Error = 2.19737
RMSE = 2.69912 St Dev = 2.26922
Total Ocean Atm Matches = 33
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

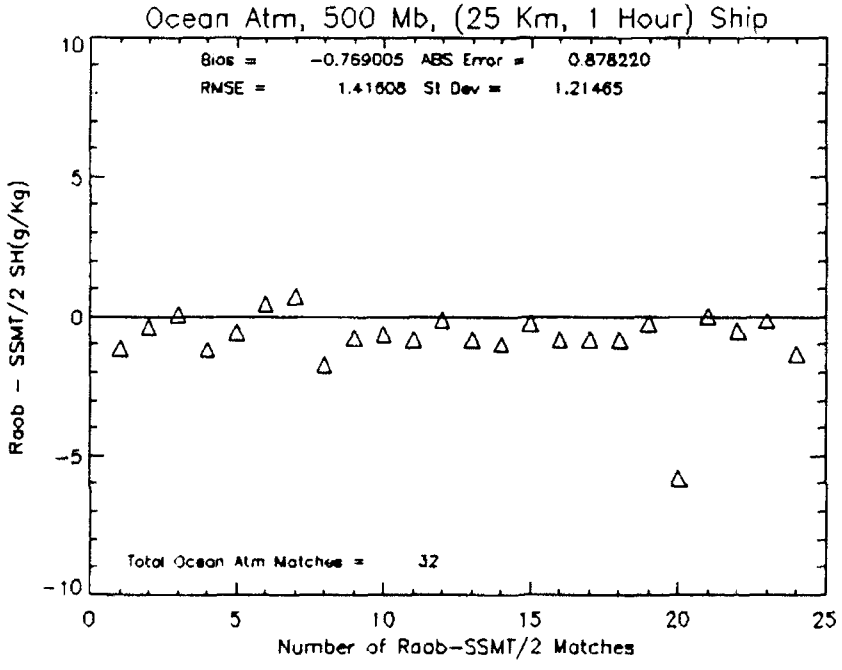

Land Atm, 700 Mb, (25 Km, 1 Hour)
Bias = 0.193667 ABS Error = 1.35241
RMSE = 1.74482 St Dev = 1.73682
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

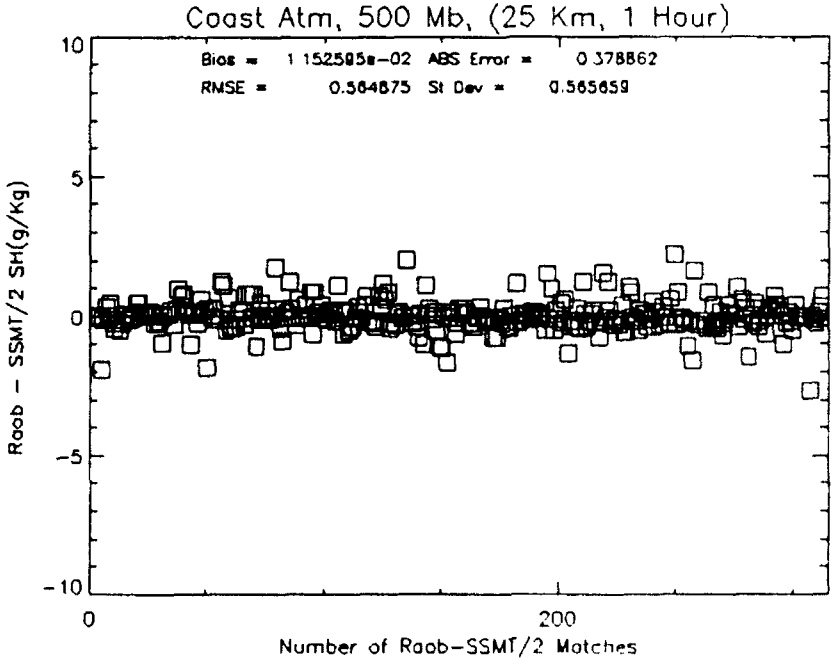

Ocean Atm, 700 Mb, (25 Km, 1 Hour) Ship
Bias = -2.52223 ABS Error = 2.52223
RMSE = 3.38874 St Dev = 2.28114
Total Ocean Atm Matches = 33
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

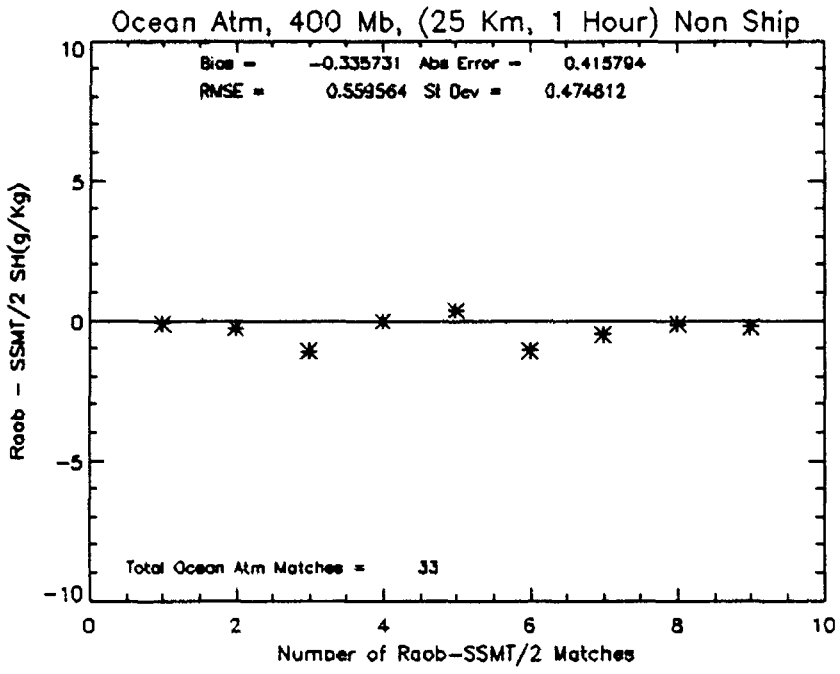

Coast Atm, 700 Mb, (25 Km, 1 Hour)
Bias = -1.126722e-02 ABS Error = 0.958570
RMSE = 1.46539 St Dev = 1.46812
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

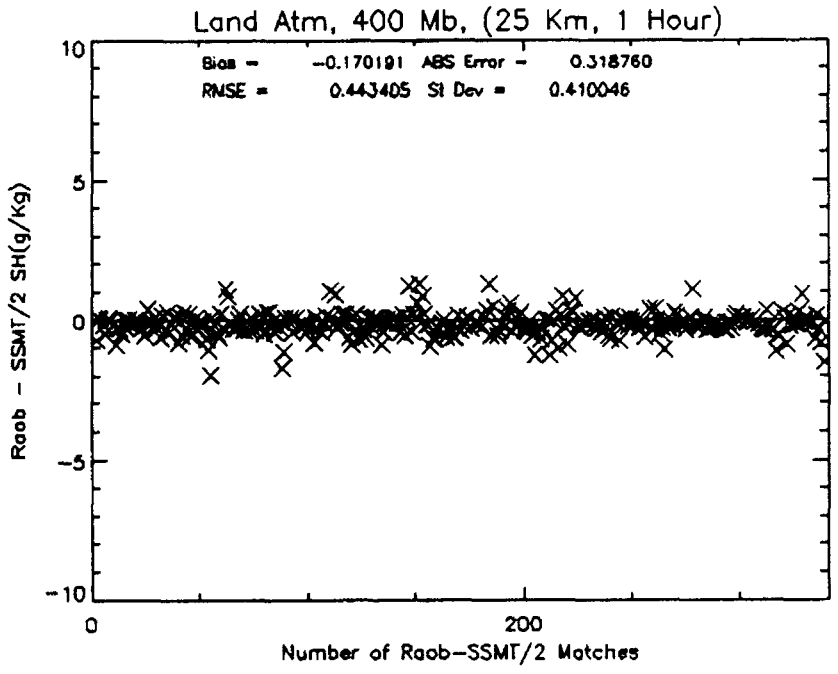

Ocean Atm, 500 Mb, (25 Km, 1 Hour) Non Ship
Bias = -0.660259 Abs Error = 1.46743
RMSE = 1.68998 St Dev = 1.66307
Total Ocean Atm Matches = 32
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

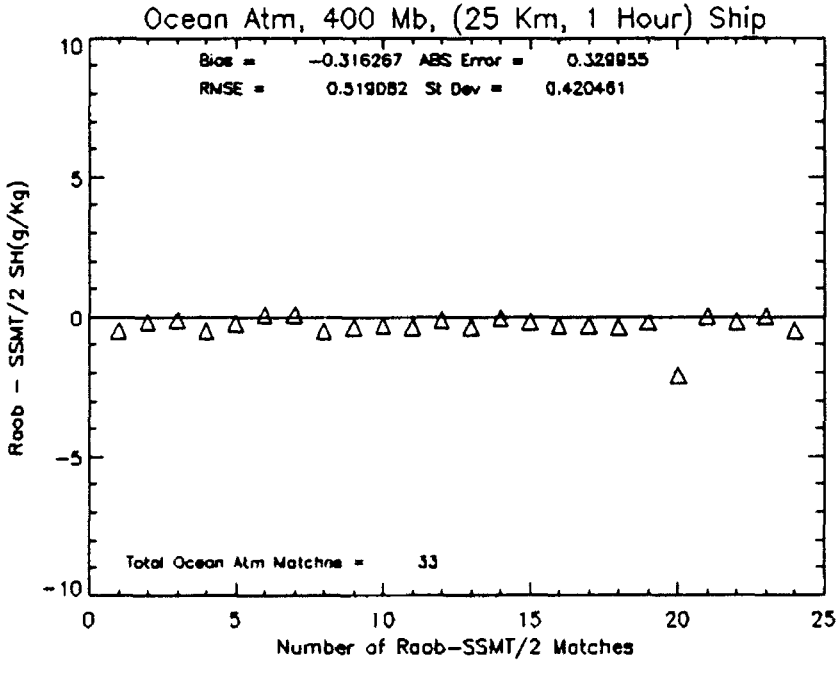

Land Atm, 500 Mb, (25 Km, 1 Hour)
Bias = -8.131574e-02 ABS Error = 0.615602
RMSE = 0.855897 St Dev = 0.853245
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

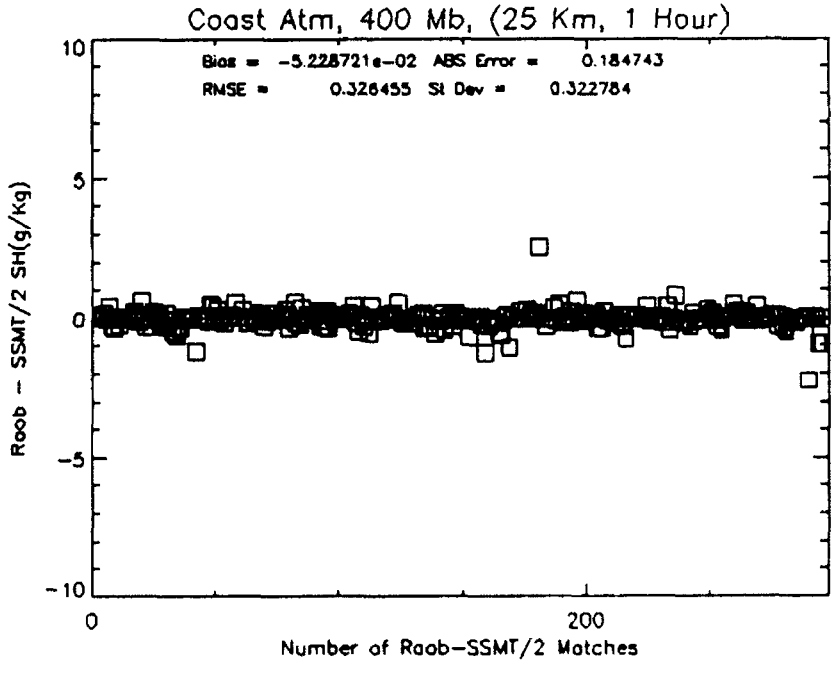

Ocean Atm, 500 Mb, (25 Km, 1 Hour) Ship
Bias = -0.769005 ABS Error = 0.878220
RMSE = 1.41608 St Dev = 1.21465
Total Ocean Atm Matches = 32
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

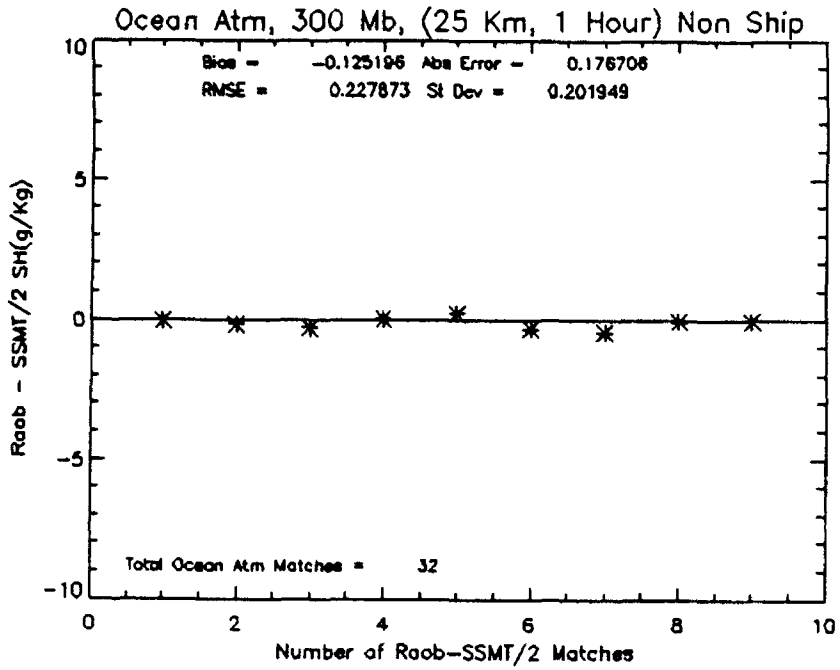

Coast Atm, 500 Mb, (25 Km, 1 Hour)
Bias = 1.152585e-02 ABS Error = 0.378862
RMSE = 0.564875 St Dev = 0.565659
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

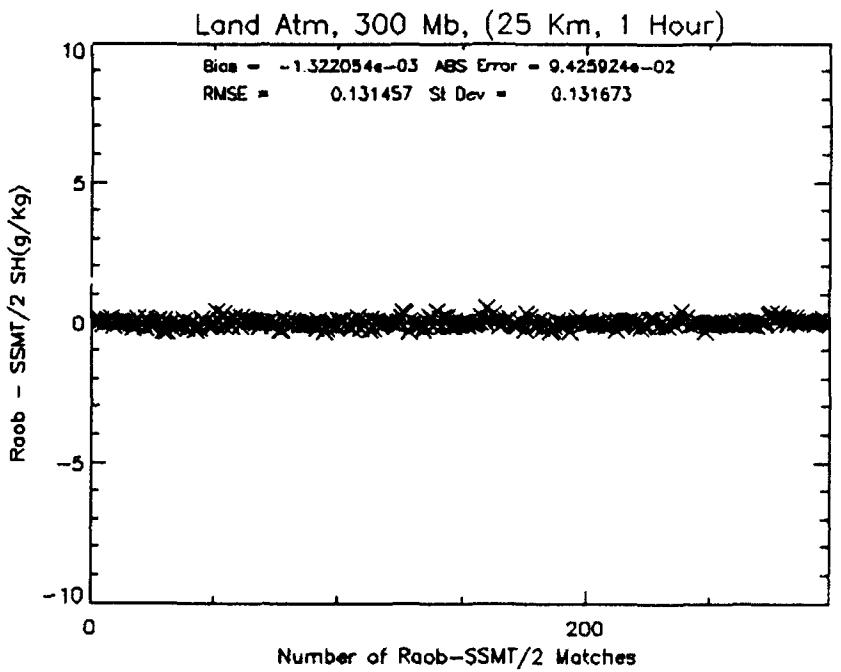

Ocean Atm, 400 Mb, (25 Km, 1 Hour) Non Ship
Bias = -0.335731 Abs Error = 0.415794
RMSE = 0.559564 St Dev = 0.474812
Total Ocean Atm Matches = 33
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

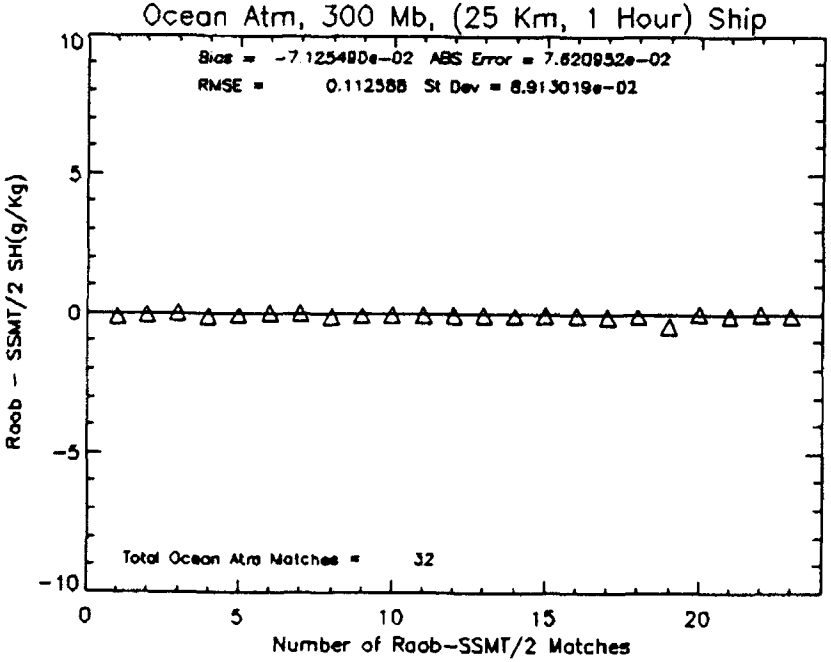

Land Atm, 400 Mb, (25 Km, 1 Hour)
Bias = -0.170191 ABS Error = 0.318760
RMSE = 0.443405 St Dev = 0.410046
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

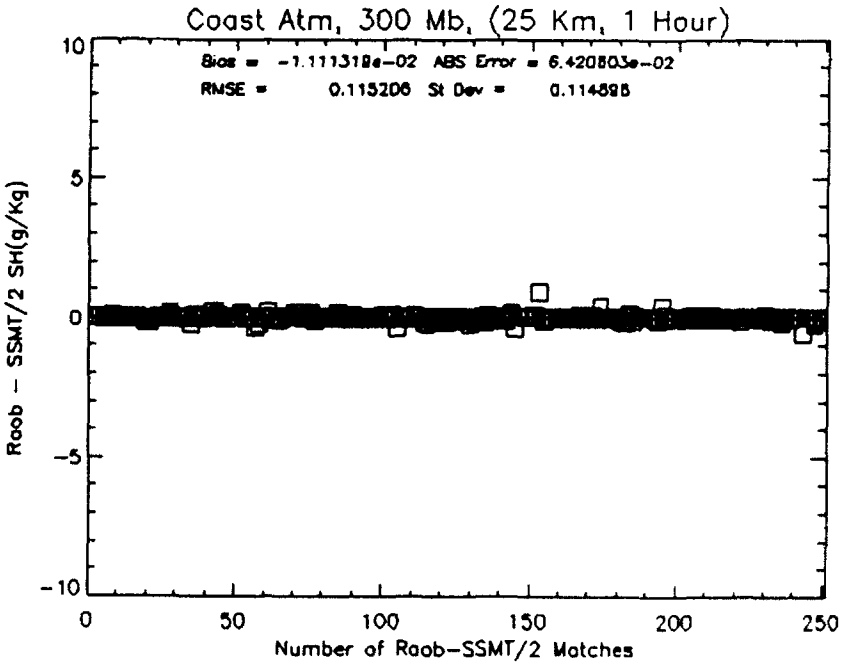

Ocean Atm, 400 Mb, (25 Km, 1 Hour) Ship
Bias = -0.316267 ABS Error = 0.329855
RMSE = 0.519082 St Dev = 0.420461
Total Ocean Atm Matches = 33
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

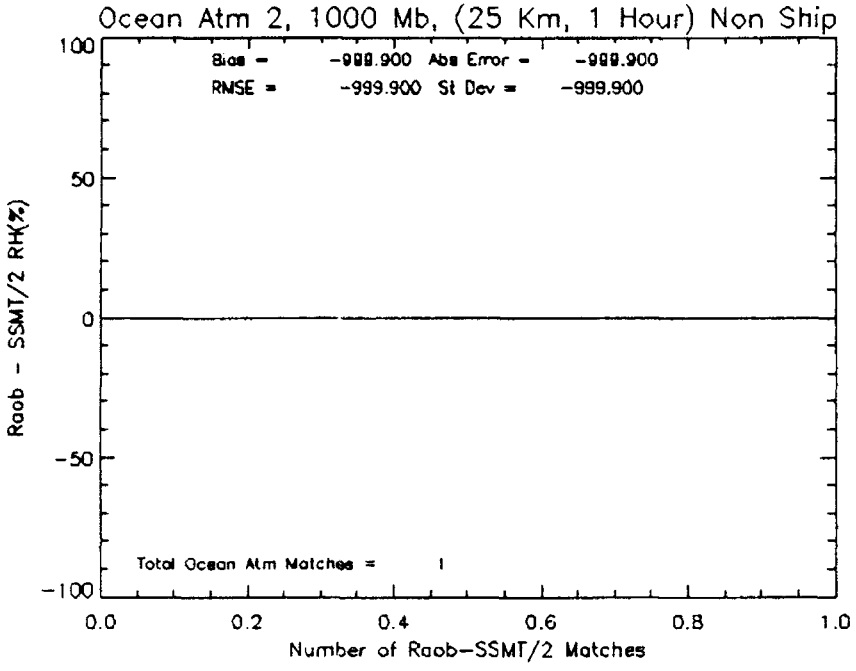

Coast Atm, 400 Mb, (25 Km, 1 Hour)
Bias = -5.228721e-02 ABS Error = 0.184743
RMSE = 0.326455 St Dev = 0.322784
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

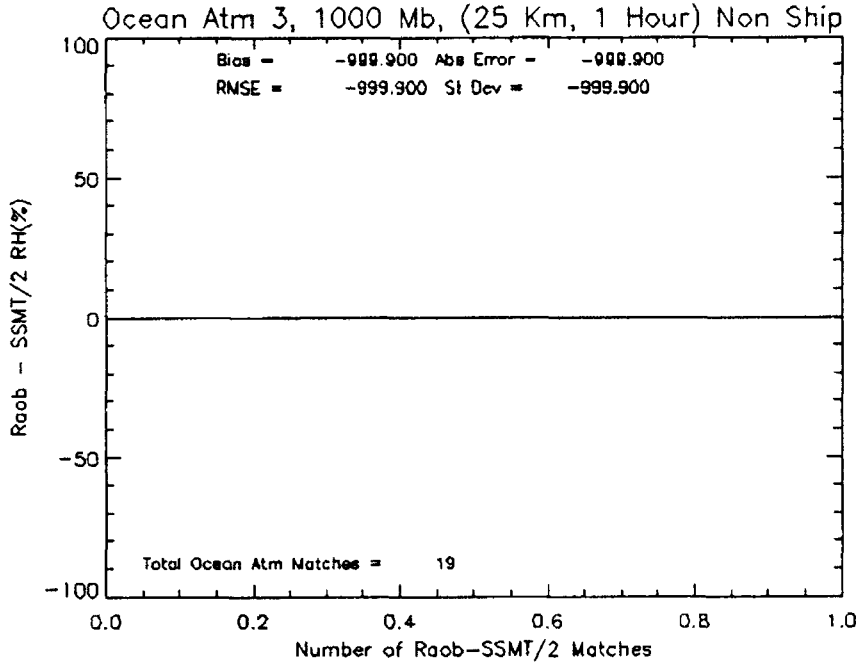

Ocean Atm, 300 Mb, (25 Km, 1 Hour) Non Ship
Bias = -0.125196 Abs Error = 0.176706
RMSE = 0.227873 St Dev = 0.201949
Total Ocean Atm Matches = 32
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

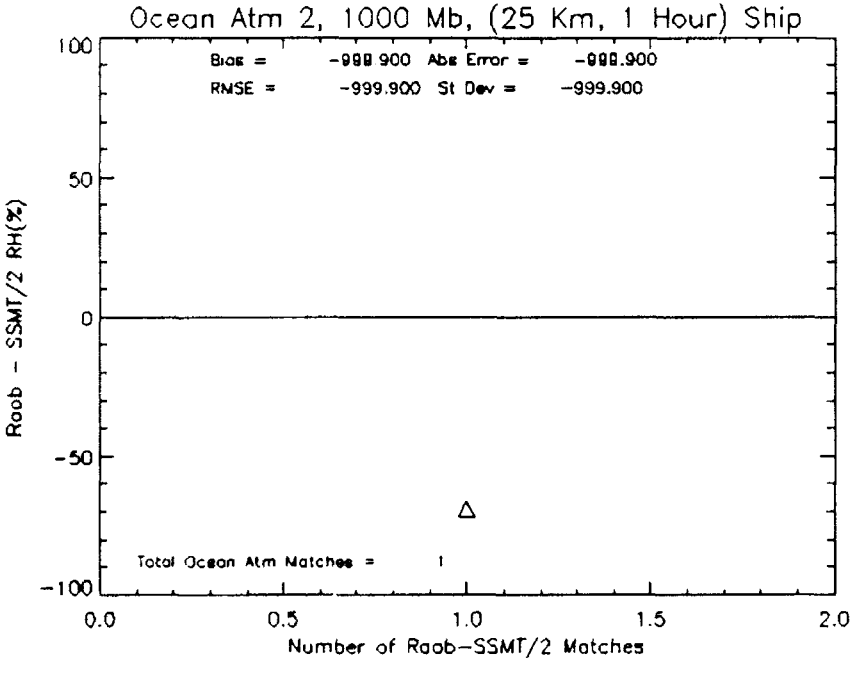

Land Atm, 300 Mb, (25 Km, 1 Hour)
Bias = -1.322054e-03 ABS Error = 9.425924e-02
RMSE = 0.131457 St Dev = 0.131673
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

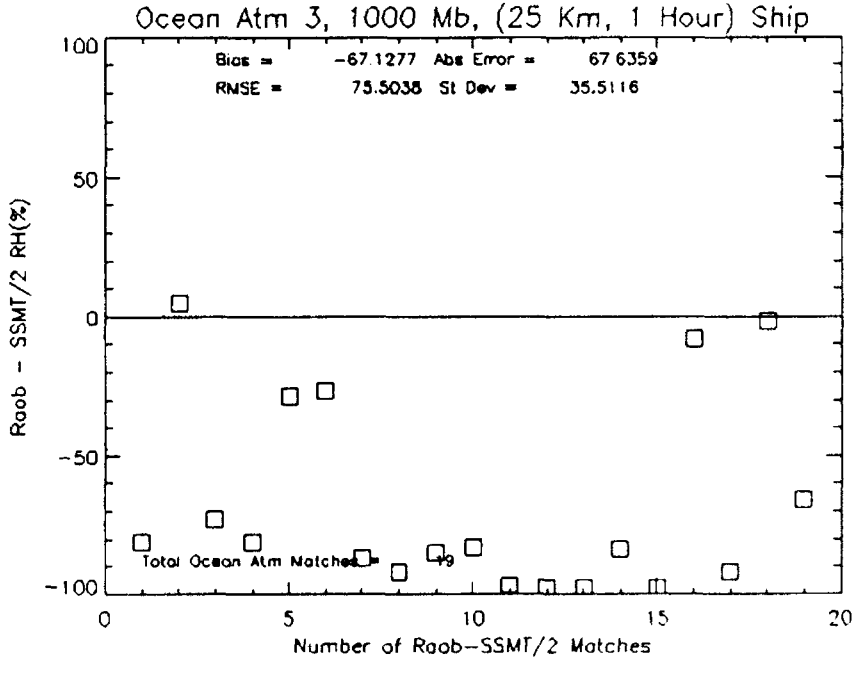

Ocean Atm, 300 Mb, (25 Km, 1 Hour) Ship
Bias = -7.125480e-02 ABS Error = 7.620952e-02
RMSE = 0.112588 St Dev = 8.913019e-02
Total Ocean Atm Matches = 32
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

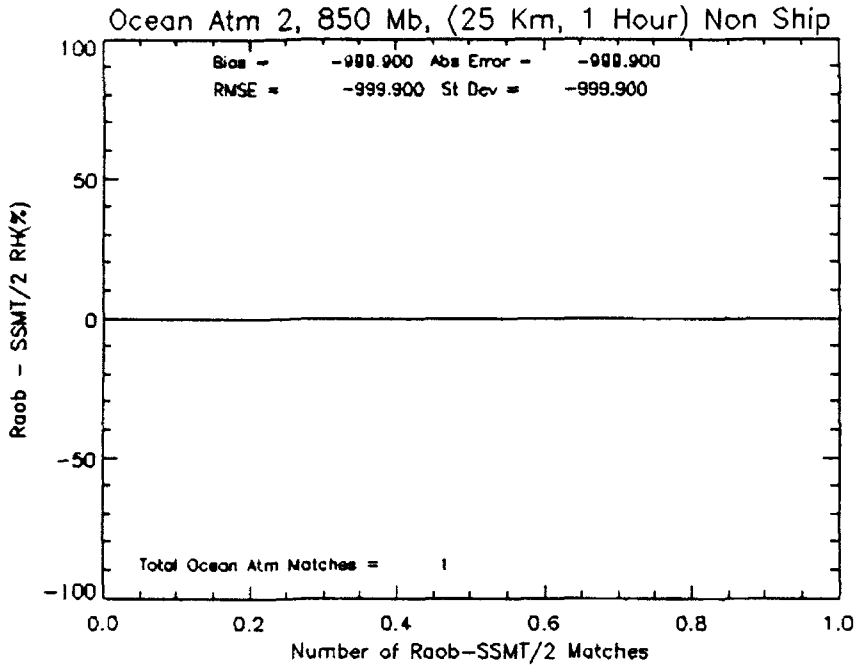

Coast Atm, 300 Mb, (25 Km, 1 Hour)
Bias = -1.111318e-02 ABS Error = 6.420803e-02
RMSE = 0.115206 St Dev = 0.114698
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

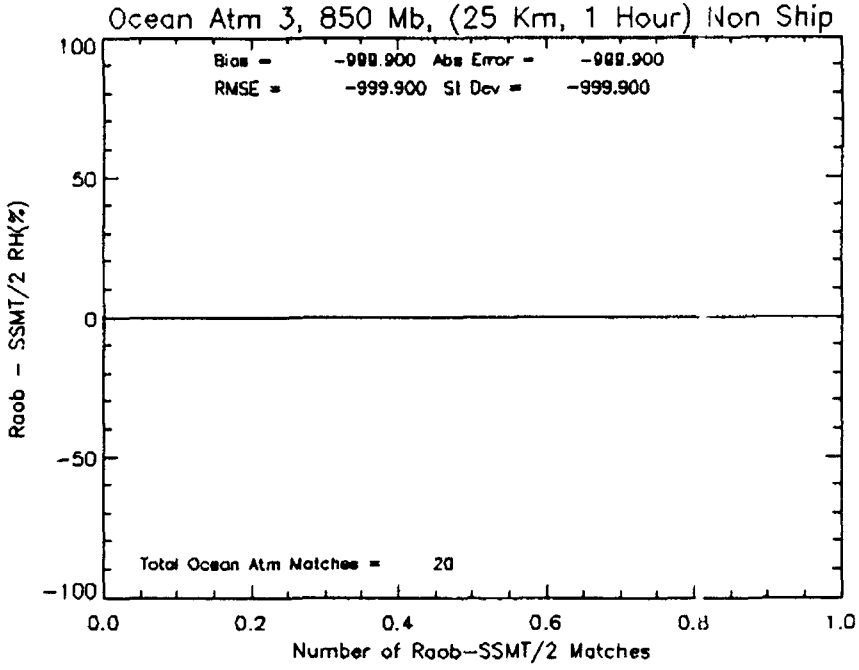

Ocean Atm 2, 1000 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

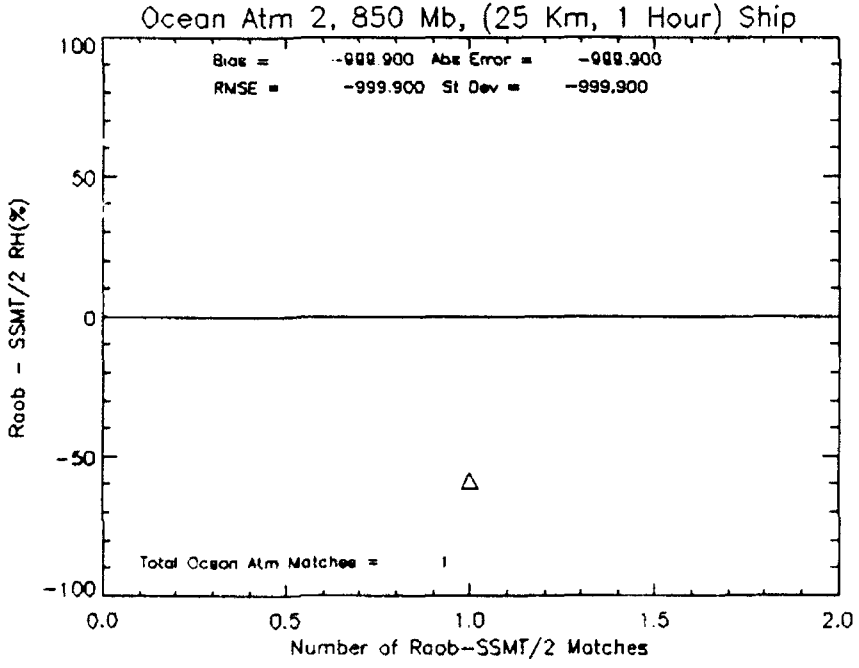

Ocean Atm 3, 1000 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 19
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

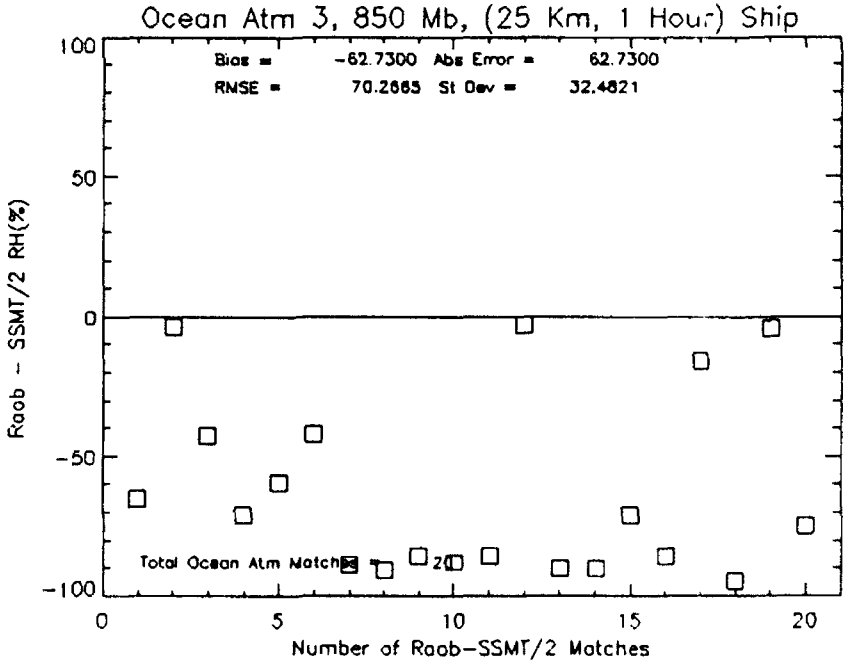

Ocean Atm 2, 1000 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

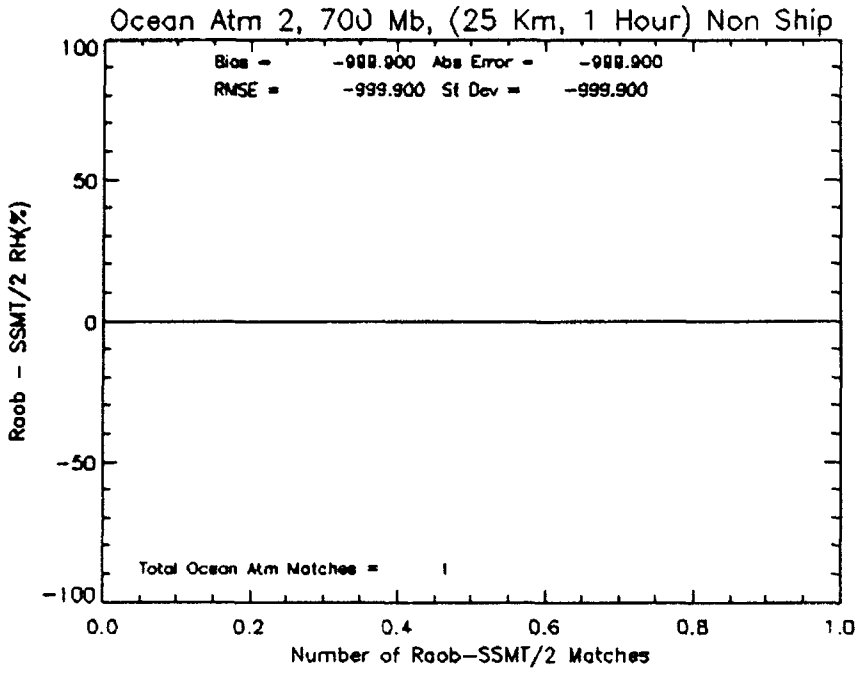

Ocean Atm 3, 1000 Mb, (25 Km, 1 Hour) Ship
Bias = -67.1277 Abs Error = 67.6359
RMSE = 75.5038 St Dev = 35.5116
Total Ocean Atm Matches = 19
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

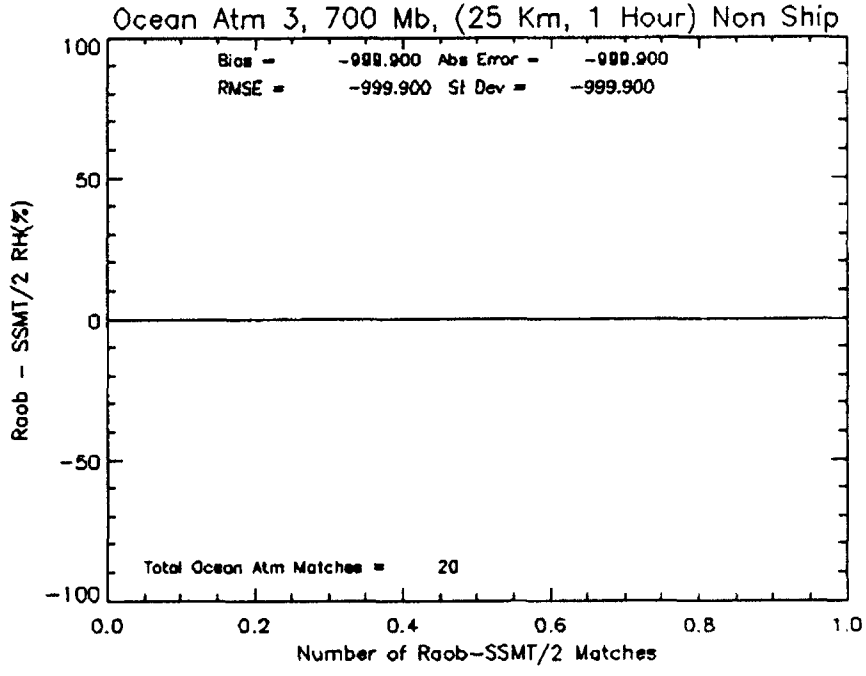

Ocean Atm 2, 850 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

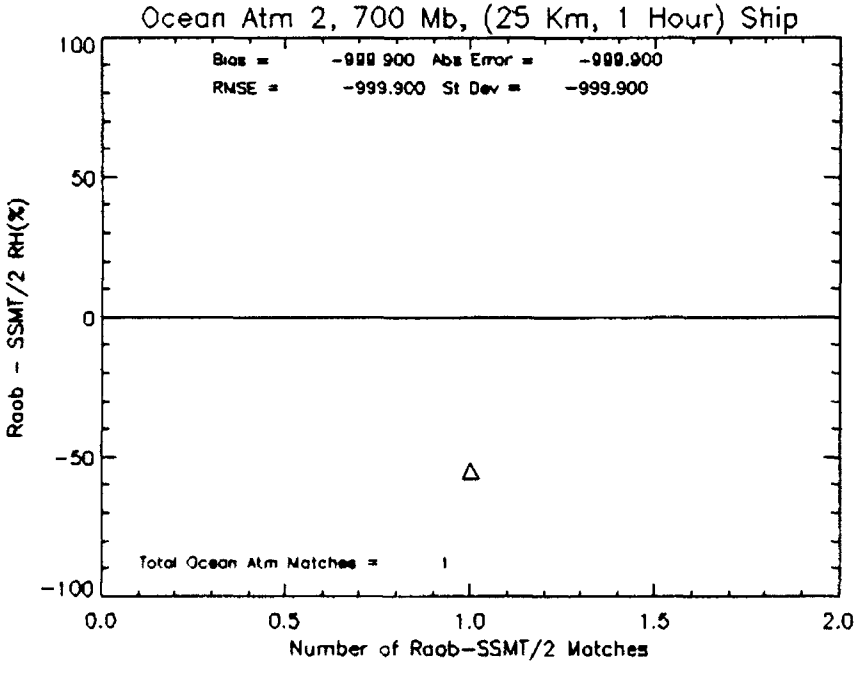

Ocean Atm 3, 850 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 20
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

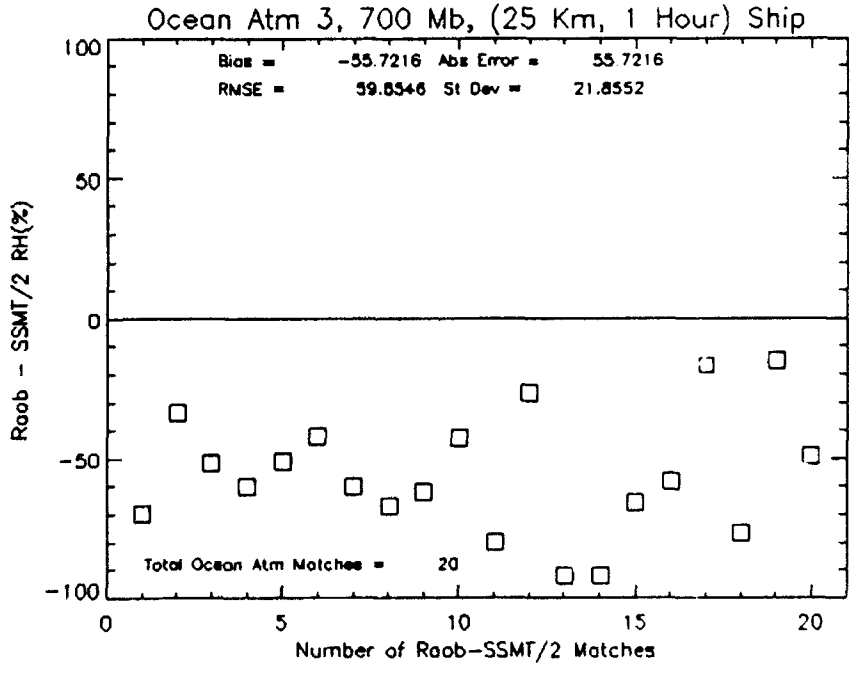

Ocean Atm 2, 850 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 850 Mb, (25 Km, 1 Hour) Ship
Bias = -62.7300 Abs Error = 62.7300
RMSE = 70.2665 St Dev = 32.4821
Total Ocean Atm Matches = 20
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 700 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 700 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 20
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 700 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 700 Mb, (25 Km, 1 Hour) Ship
Bias = -55.7216 Abs Error = 55.7216
RMSE = 59.8546 St Dev = 21.8552
Total Ocean Atm Matches = 20
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 3, 500 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 20
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 3, 500 Mb, (25 Km, 1 Hour) Ship
Bias = -34.1326 Abs Error = 37.3209
RMSE = 42.3346 St Dev = 25.6942
Total Ocean Atm Matches = 20
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 2, 500 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

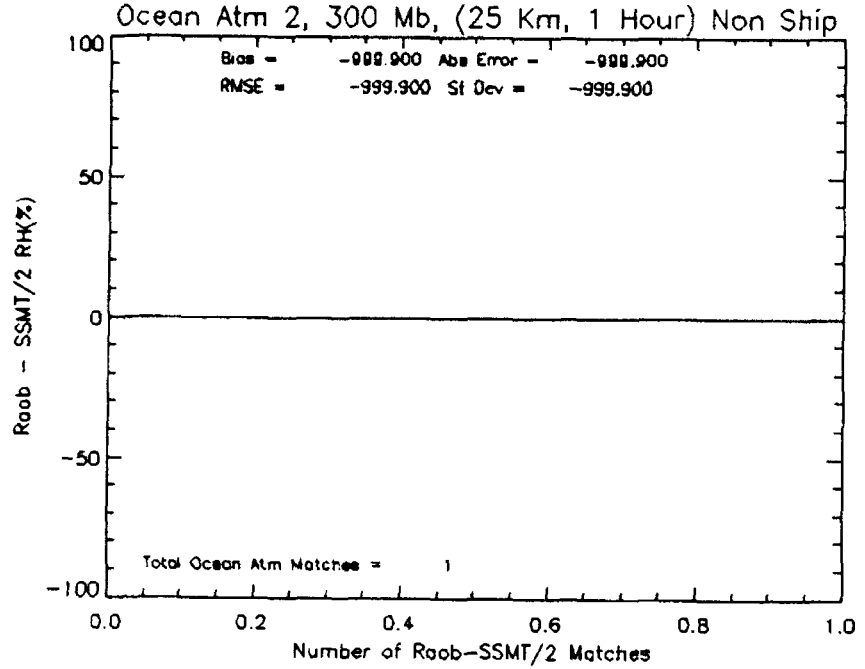
Ocean Atm 2, 500 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

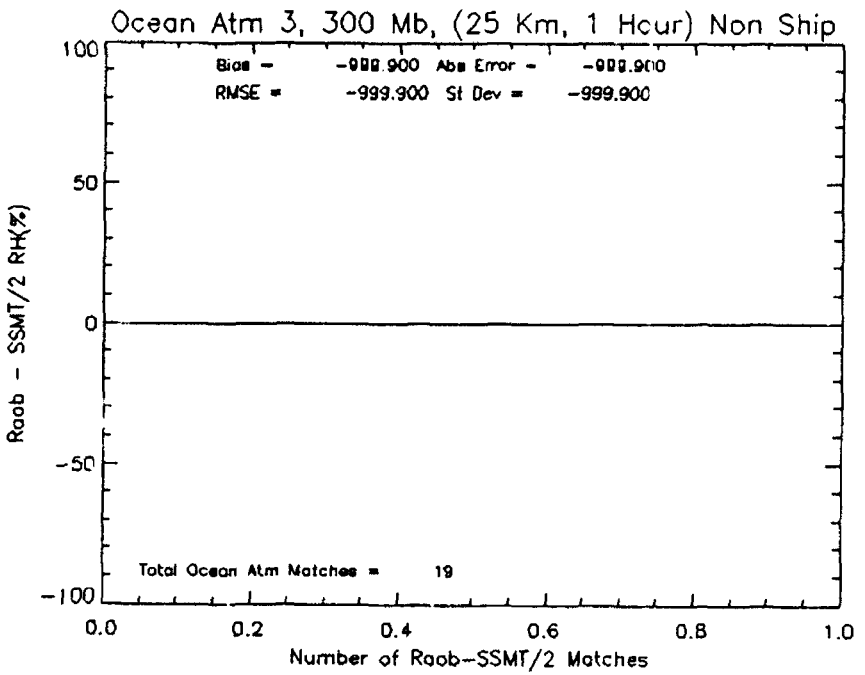
Ocean Atm 3, 400 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 Sl Dev = -999.900
Total Ocean Atm Matches = 20
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

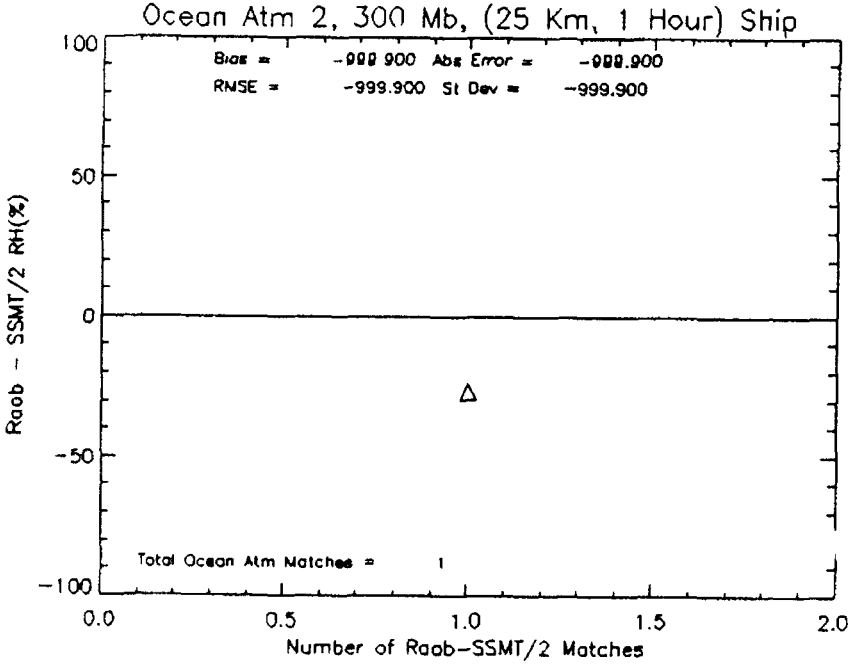
Ocean Atm 3, 400 Mb, (25 Km, 1 Hour) Ship
Bias = -31.5034 Abs Error = 34.9805
RMSE = 38.4015 Sl Dev = 22.5297
Total Ocean Atm Matches = 20
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

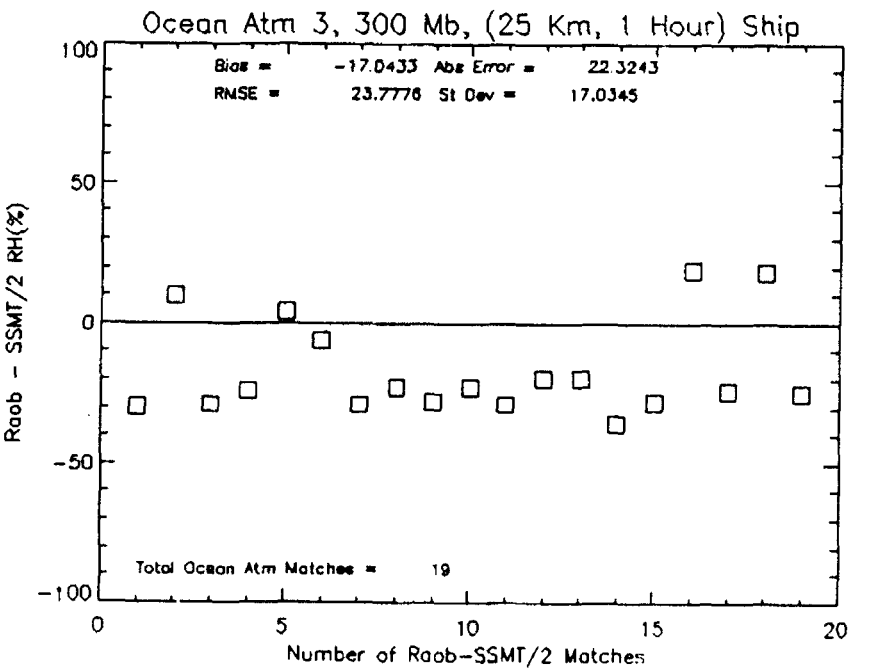
Ocean Atm 2, 400 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 Sl Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 2, 400 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 Sl Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 300 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 300 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 19
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 300 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

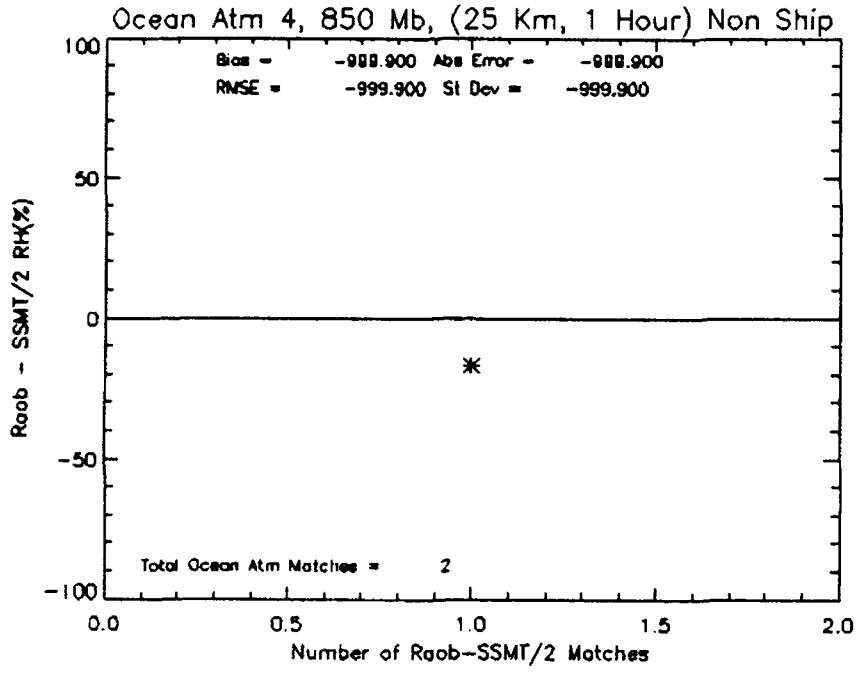

Ocean Atm 3, 300 Mb, (25 Km, 1 Hour) Ship
Bias = -17.0433 Abs Error = 22.3243
RMSE = 23.7776 St Dev = 17.0345
Total Ocean Atm Matches = 19
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

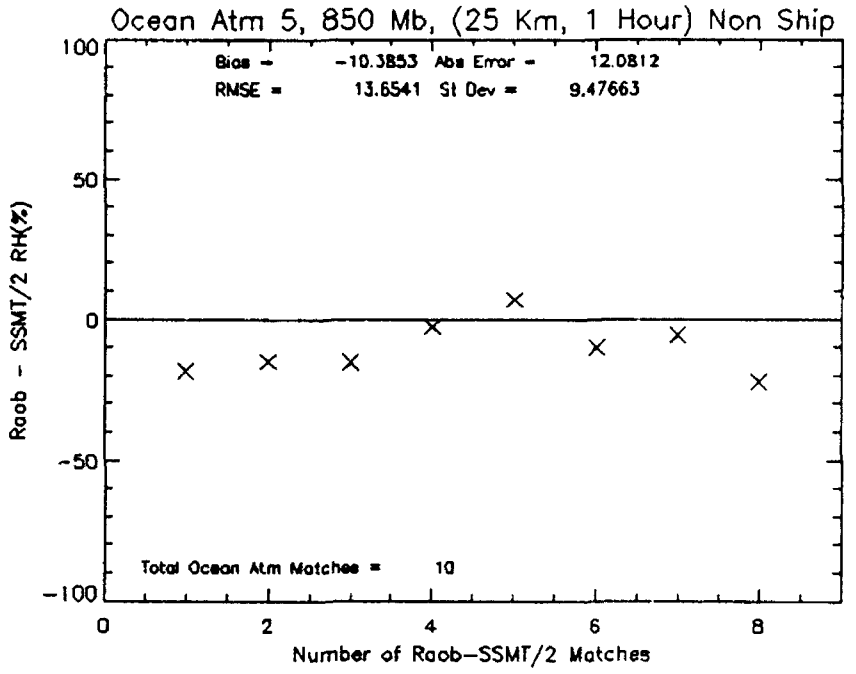
Ocean Atm 5, 1000 Mb, (25 Km, 1 Hour) Non Ship
Bias = -0.615780 Abs Error = 8.40074
RMSE = 13.1050 St Dev = 13.9944
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

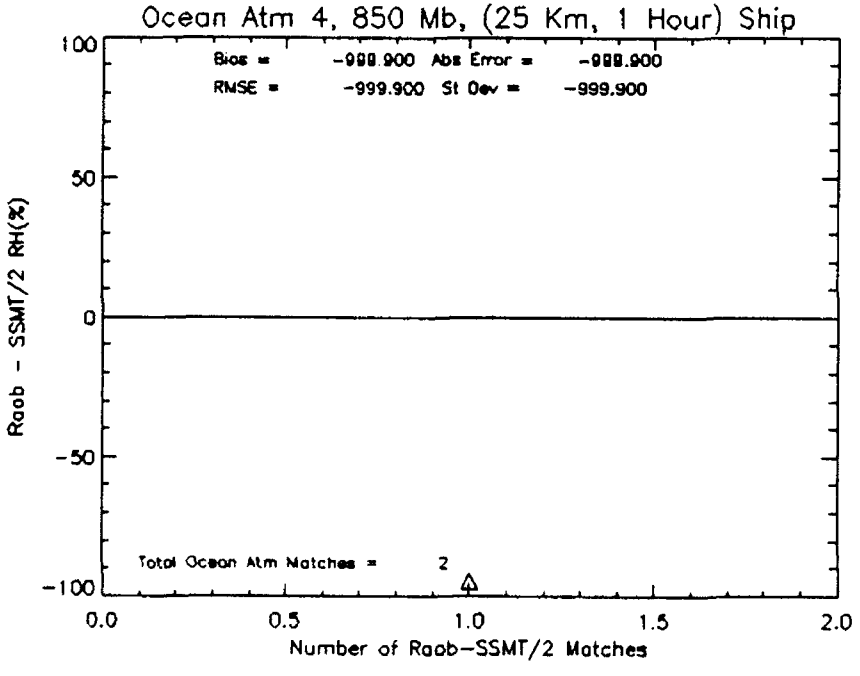
Ocean Atm 5, 1000 Mb, (25 Km, 1 Hour) Ship
Bias = -92.0000 Abs Error = 92.0000
RMSE = 92.0459 St Dev = 4.24264
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

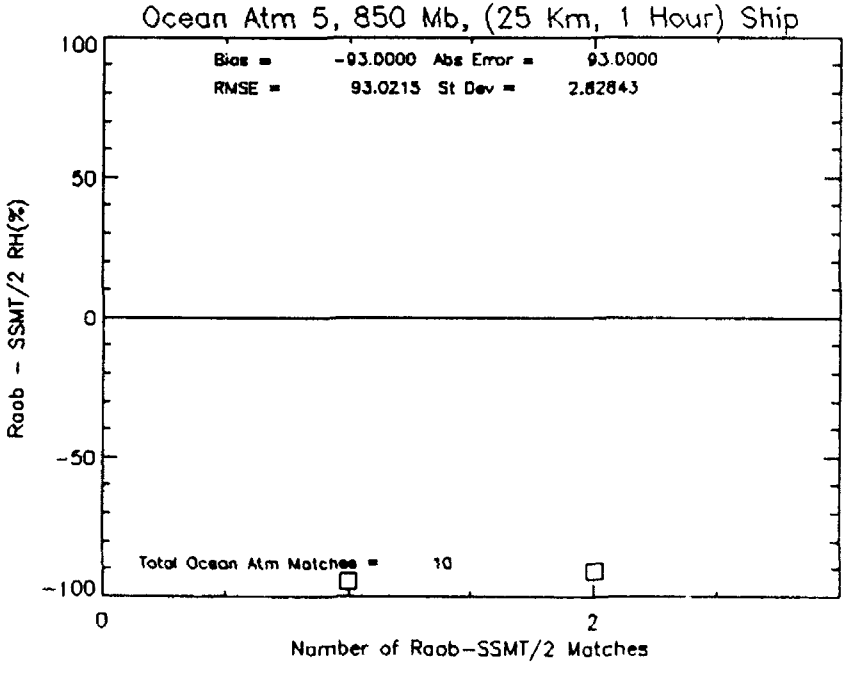
Ocean Atm 4, 1000 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

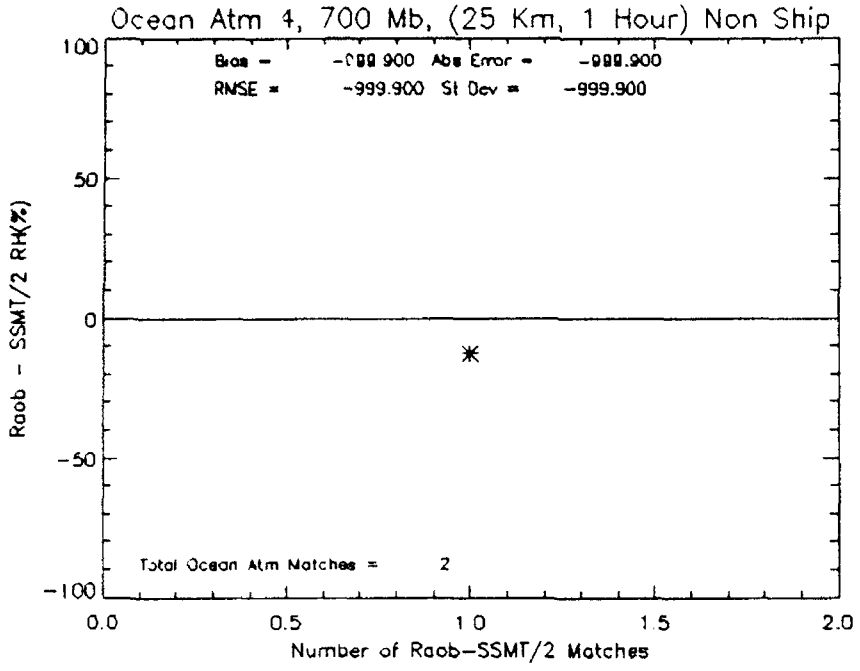
Ocean Atm 4, 1000 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

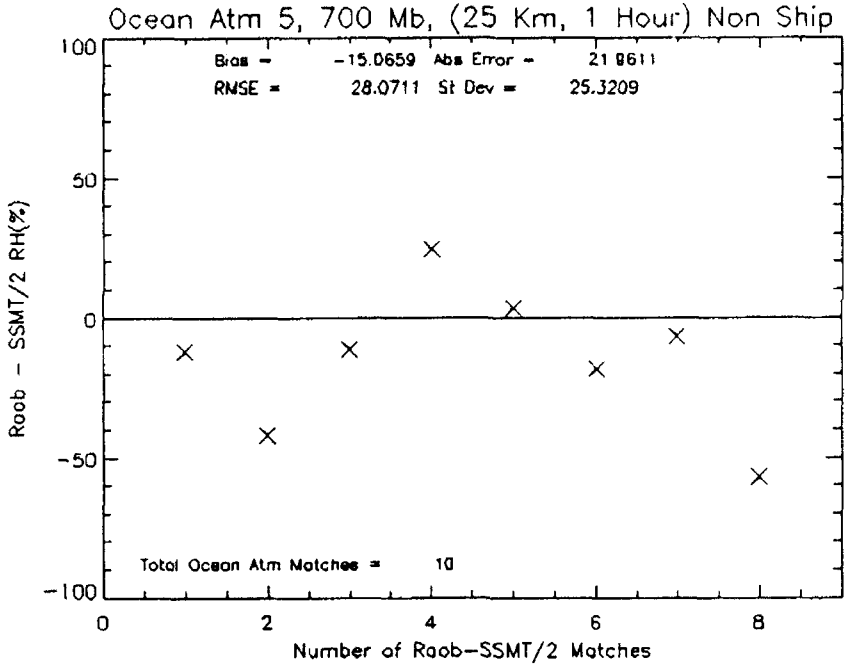

Ocean Atm 4, 850 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

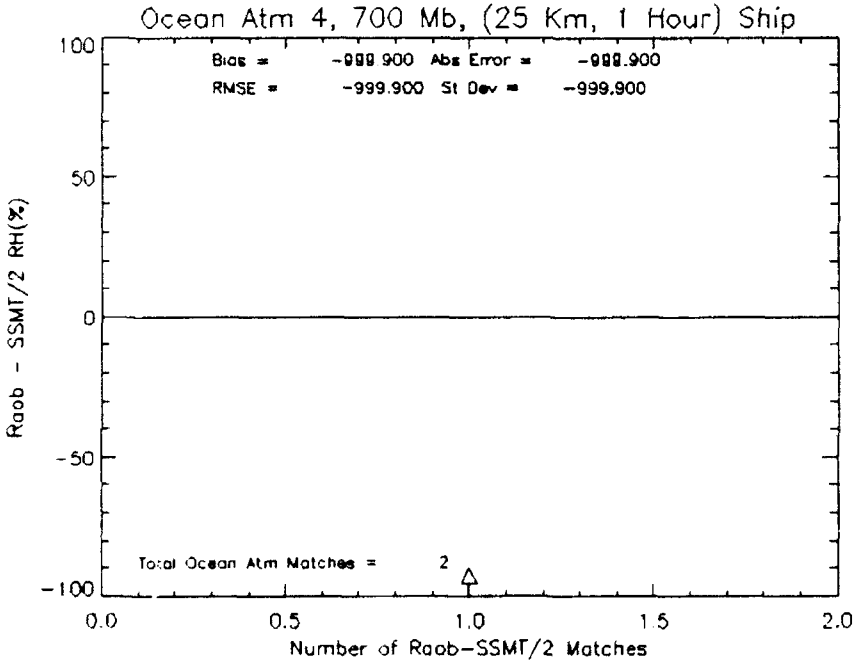

Ocean Atm 5, 850 Mb, (25 Km, 1 Hour) Non Ship
Bias = -10.3853 Abs Error = 12.0812
RMSE = 13.6541 St Dev = 9.47663
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

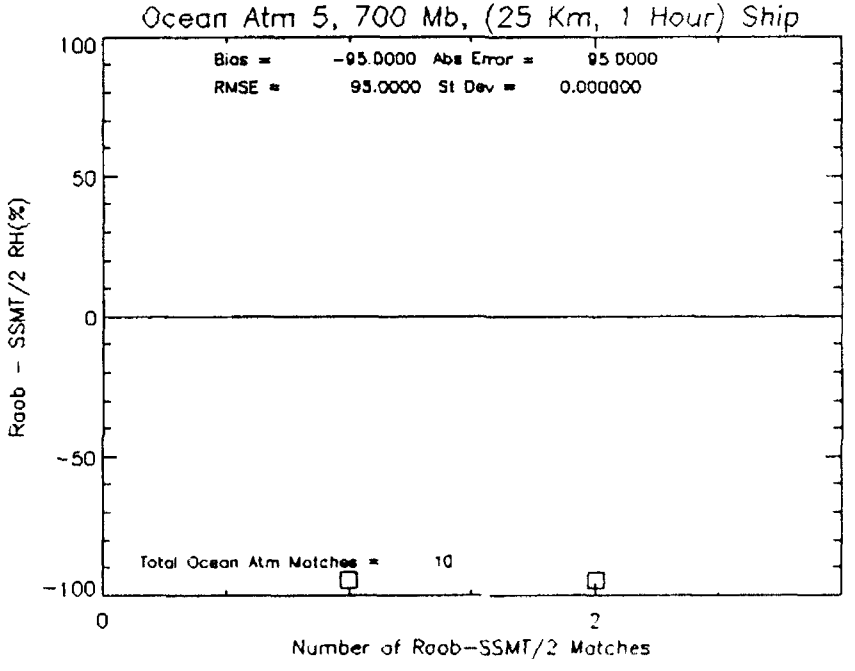

Ocean Atm 4, 850 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

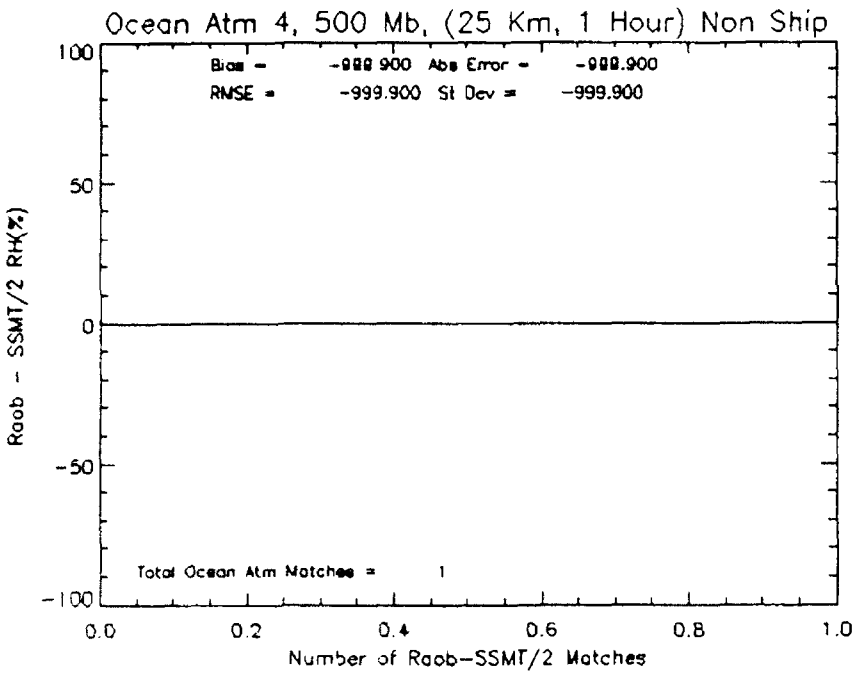

Ocean Atm 5, 850 Mb, (25 Km, 1 Hour) Ship
Bias = -93.0000 Abs Error = 93.0000
RMSE = 93.0215 St Dev = 2.82843
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

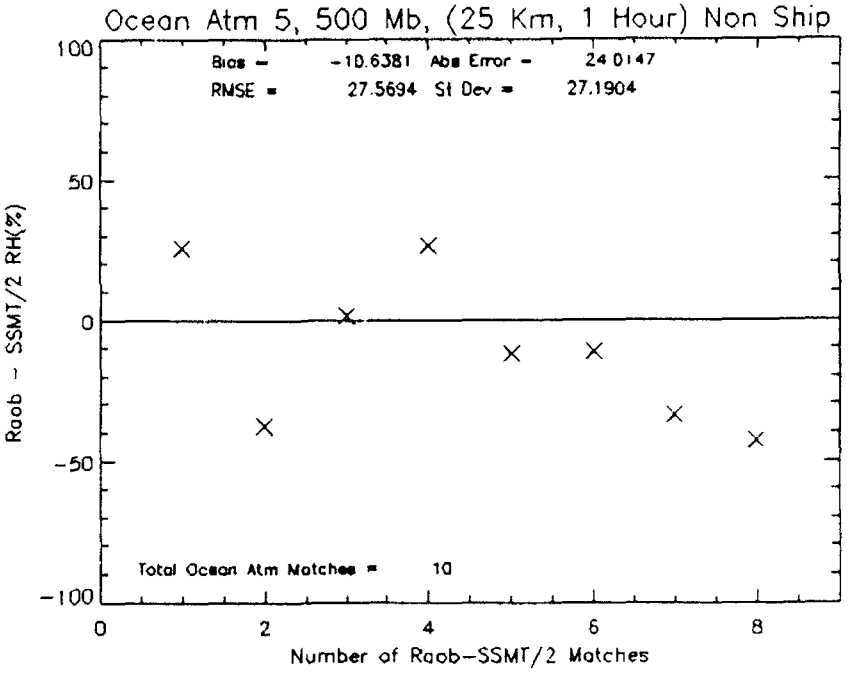

Ocean Atm 4, 700 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

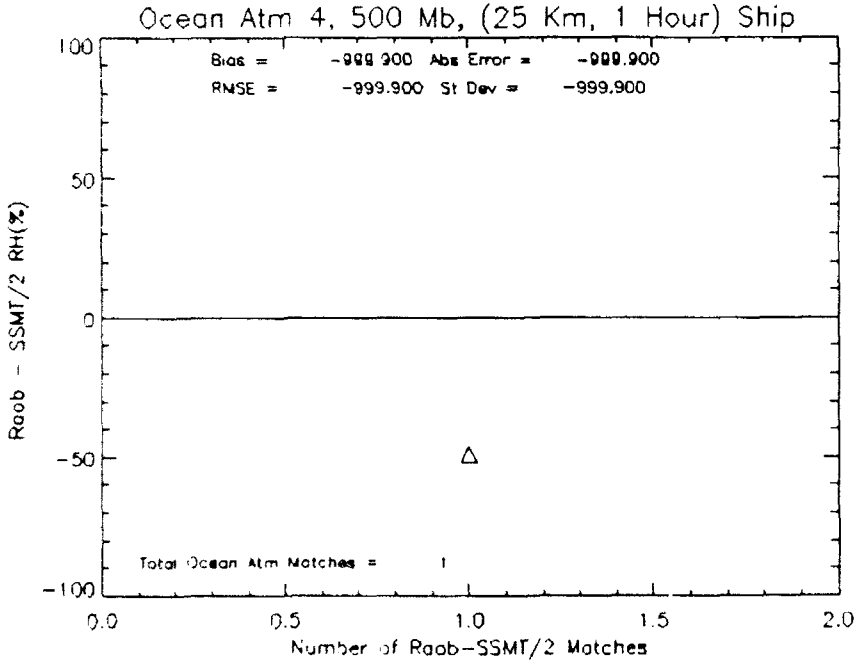

Ocean Atm 5, 700 Mb, (25 Km, 1 Hour) Non Ship
Bias = -15.0659 Abs Error = 21.9611
RMSE = 28.0711 St Dev = 25.3209
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

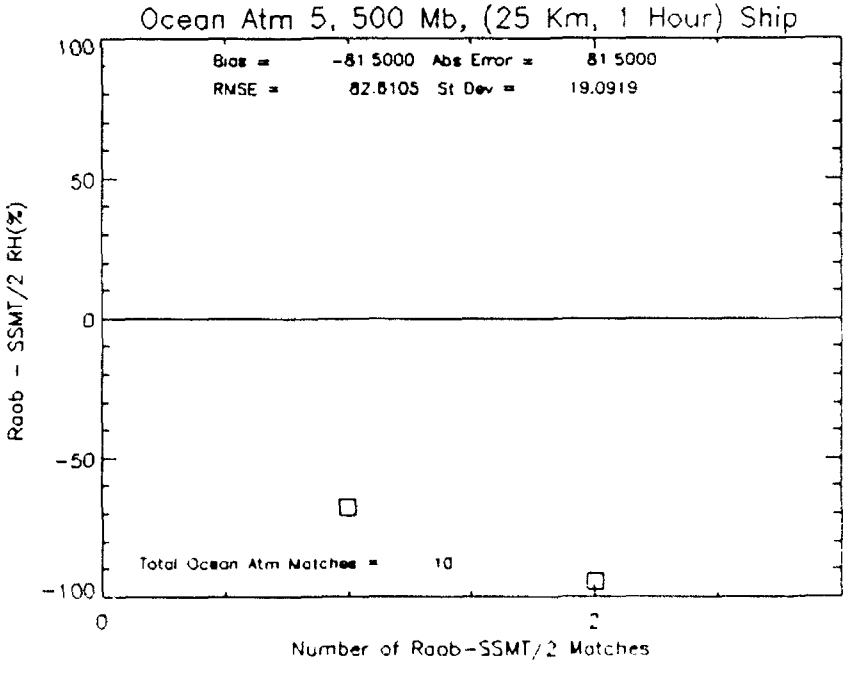

Ocean Atm 4, 700 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 700 Mb, (25 Km, 1 Hour) Ship
Bias = -95.0000 Abs Error = 95.0000
RMSE = 95.0000 St Dev = 0.000000
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 4, 500 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 500 Mb, (25 Km, 1 Hour) Non Ship
Bias = -10.6381 Abs Error = 24.0147
RMSE = 27.5694 St Dev = 27.1904
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 4, 500 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 500 Mb, (25 Km, 1 Hour) Ship
Bias = -81.5000 Abs Error = 81.5000
RMSE = 82.8105 St Dev = 19.0919
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 5, 400 Mb, (25 Km, 1 Hour) Non Ship
Bias = -13.7437 Abs Error = 15.3124
RMSE = 16.6535 St Dev = 10.0541
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 5, 400 Mb, (25 Km, 1 Hour) Ship
Bias = -72.5000 Abs Error = 72.5000
RMSE = 73.9111 St Dev = 31.8198
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 4, 400 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

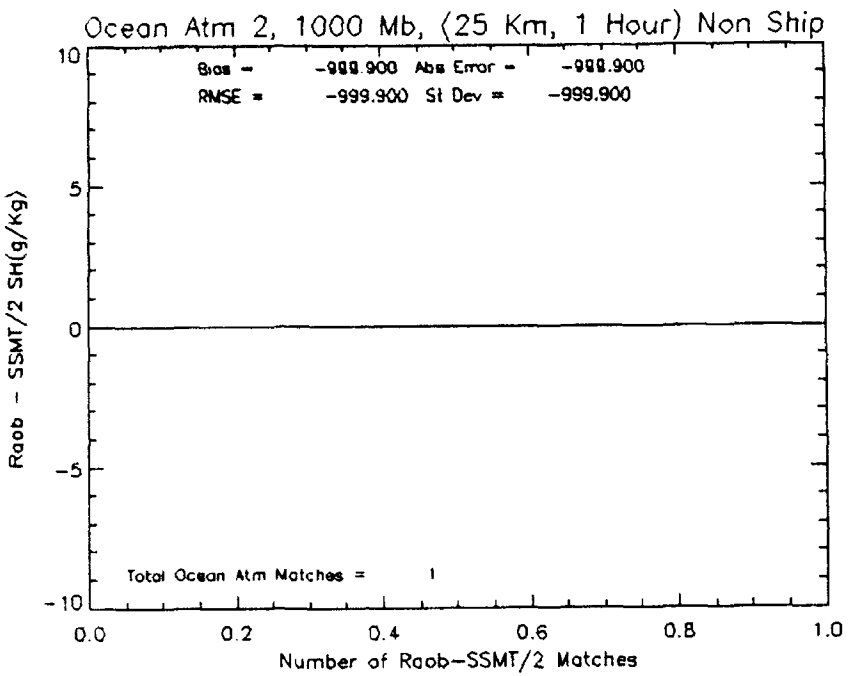
Ocean Atm 4, 400 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

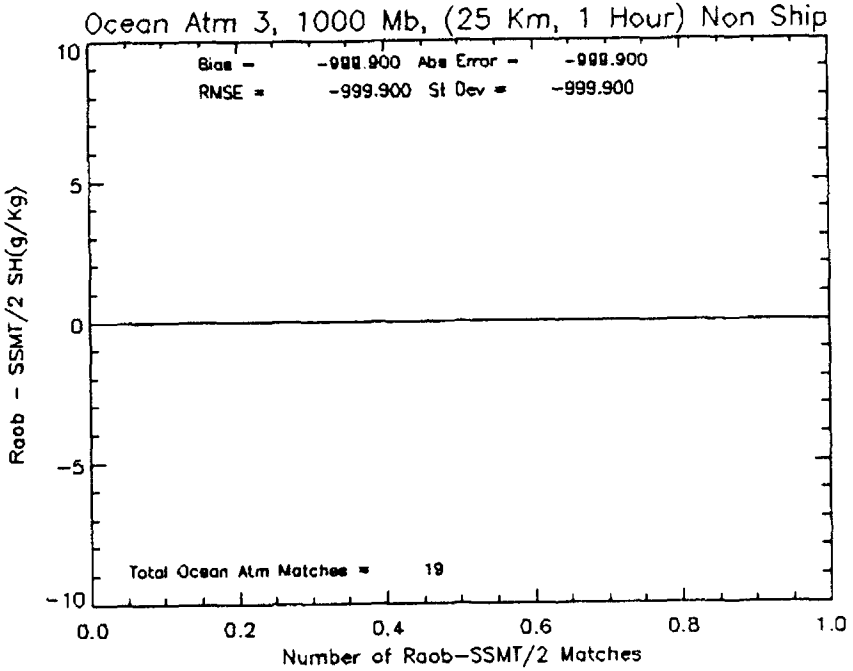
Ocean Atm 5, 300 Mb, (25 Km, 1 Hour) Non Ship
Bias = -11.1826 Abs Error = 17.0910
RMSE = 20.3188 St Dev = 18.1360
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

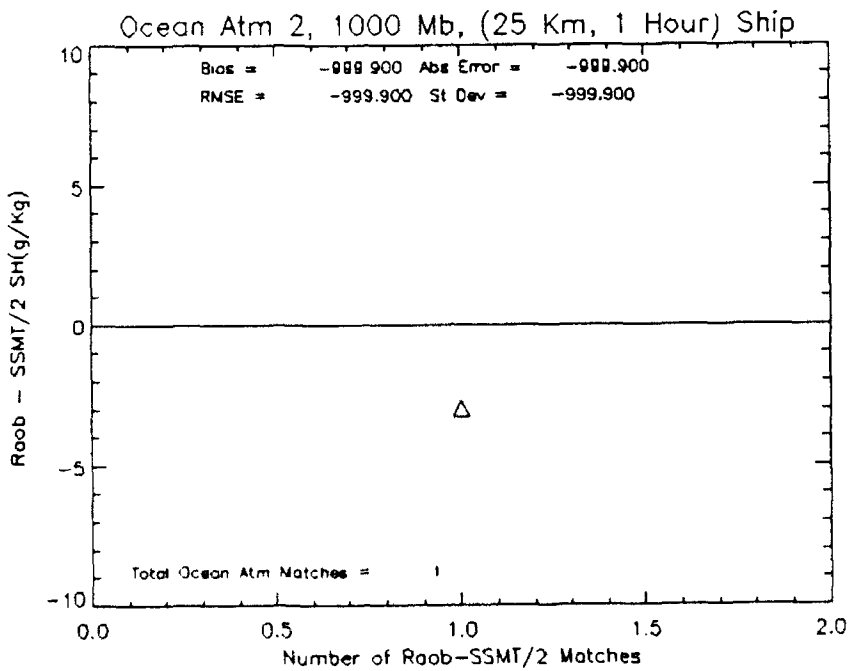
Ocean Atm 5, 300 Mb, (25 Km, 1 Hour) Ship
Bias = -48.5000 Abs Error = 48.5000
RMSE = 50.8211 St Dev = 20.5061
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

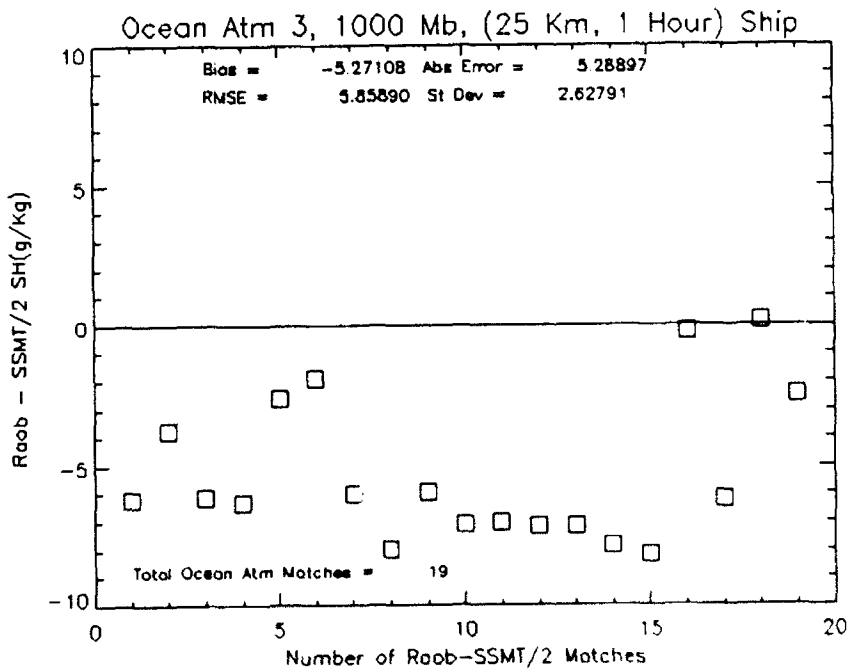
Ocean Atm 4, 300 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

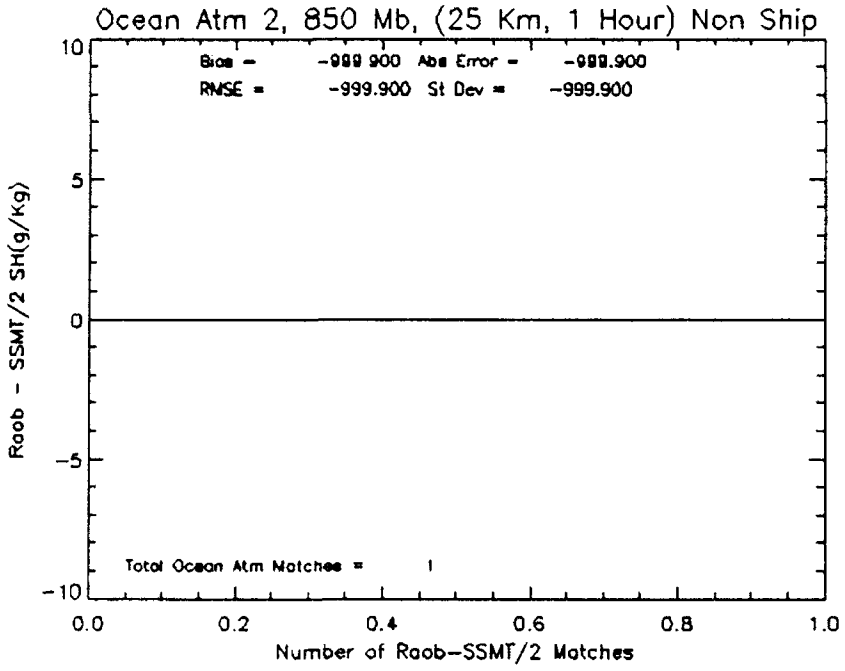
Ocean Atm 4, 300 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

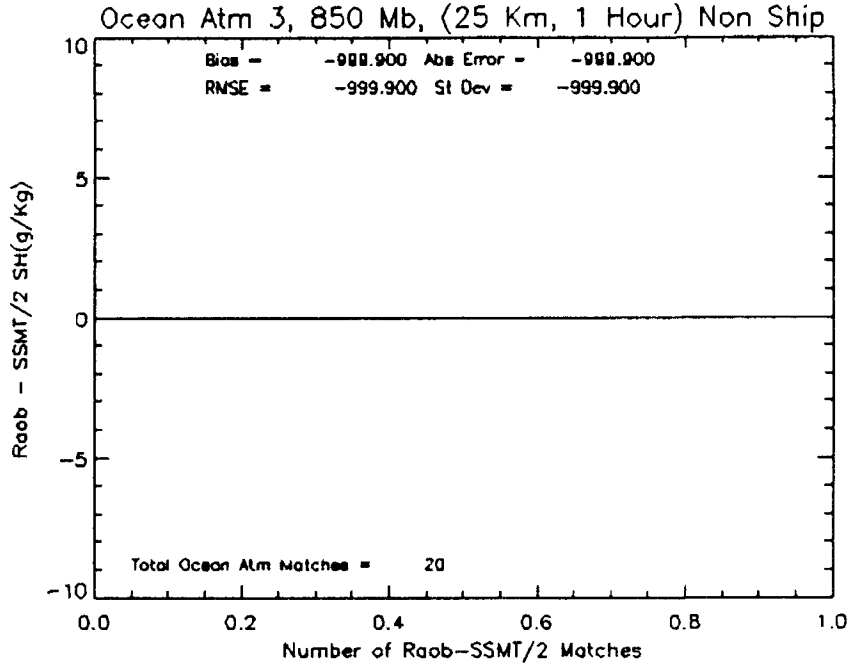

Ocean Atm 2, 1000 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

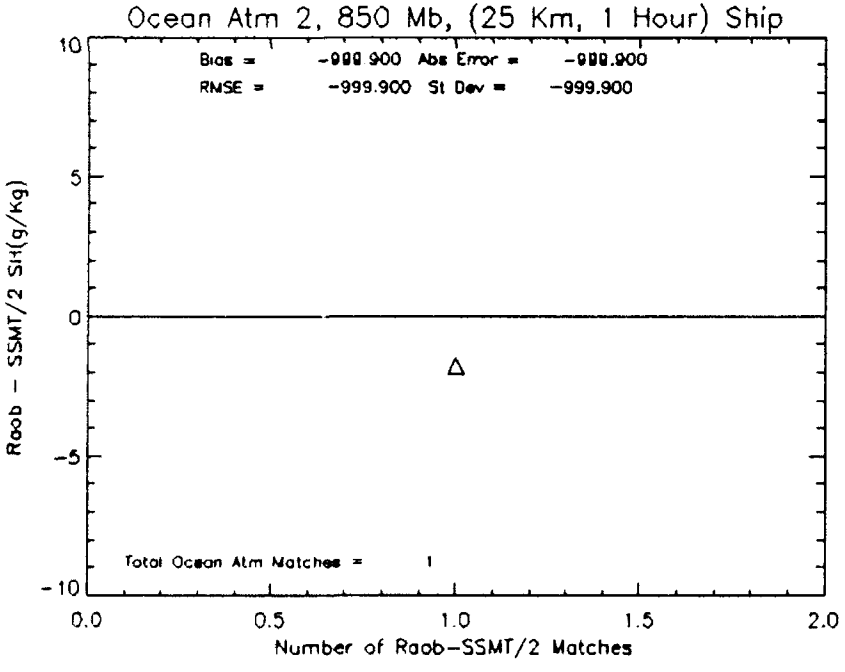

Ocean Atm 3, 1000 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 19
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

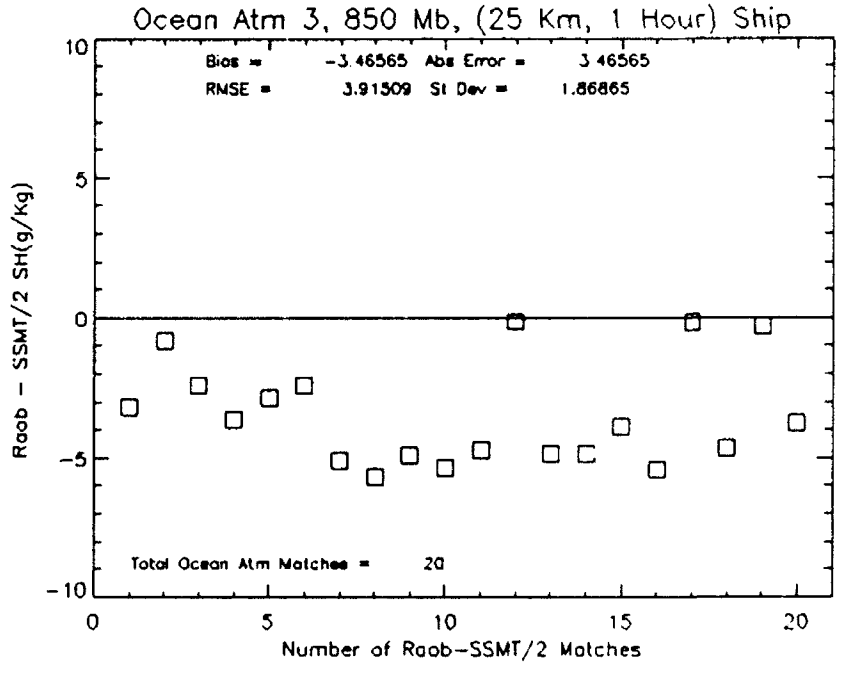

Ocean Atm 2, 1000 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

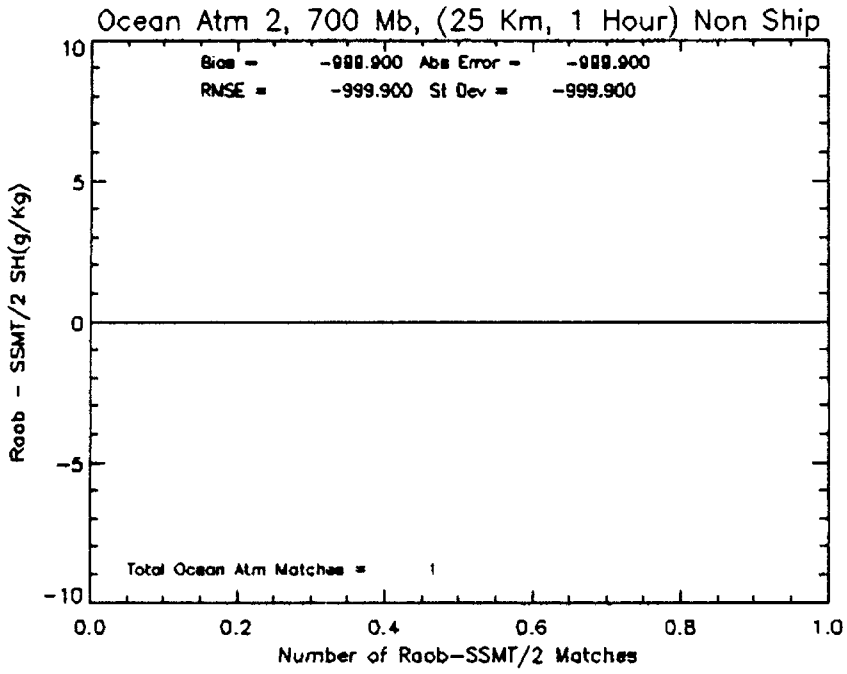

Ocean Atm 3, 1000 Mb, (25 Km, 1 Hour) Ship
Bias = -5.27108 Abs Error = 5.28897
RMSE = 5.65890 St Dev = 2.62791
Total Ocean Atm Matches = 19
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

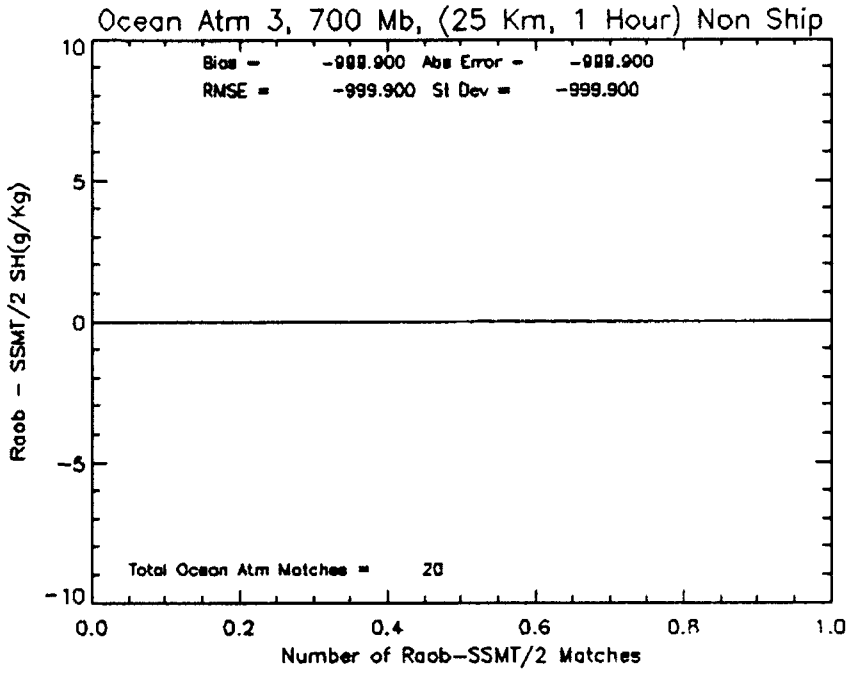

Ocean Atm 2, 850 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

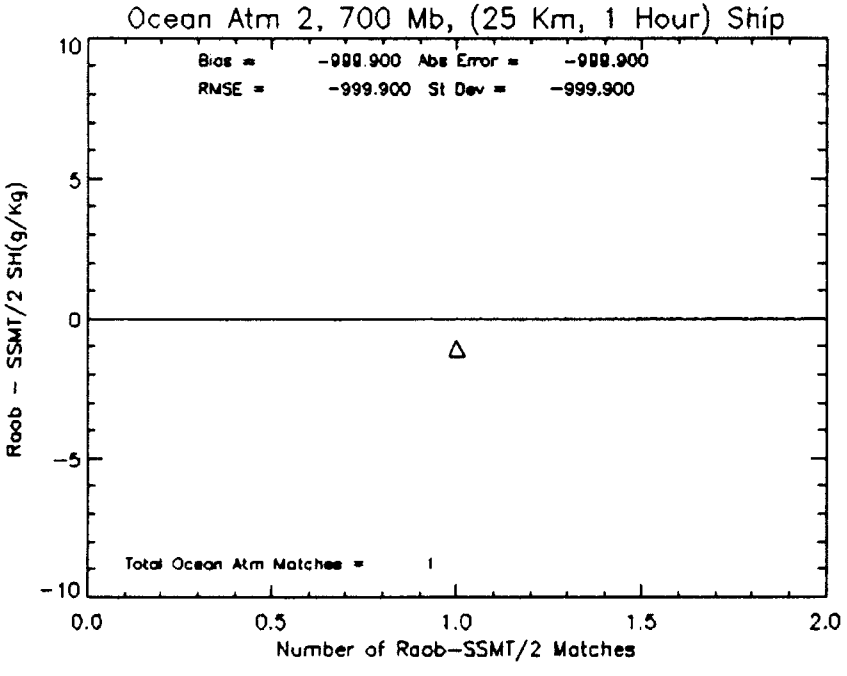

Ocean Atm 3, 850 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 20
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

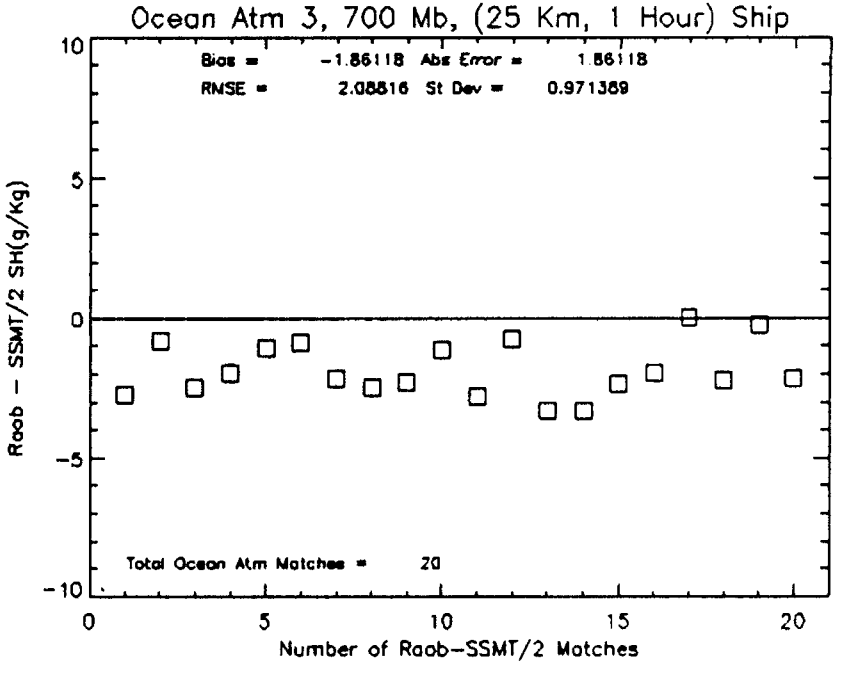

Ocean Atm 2, 850 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

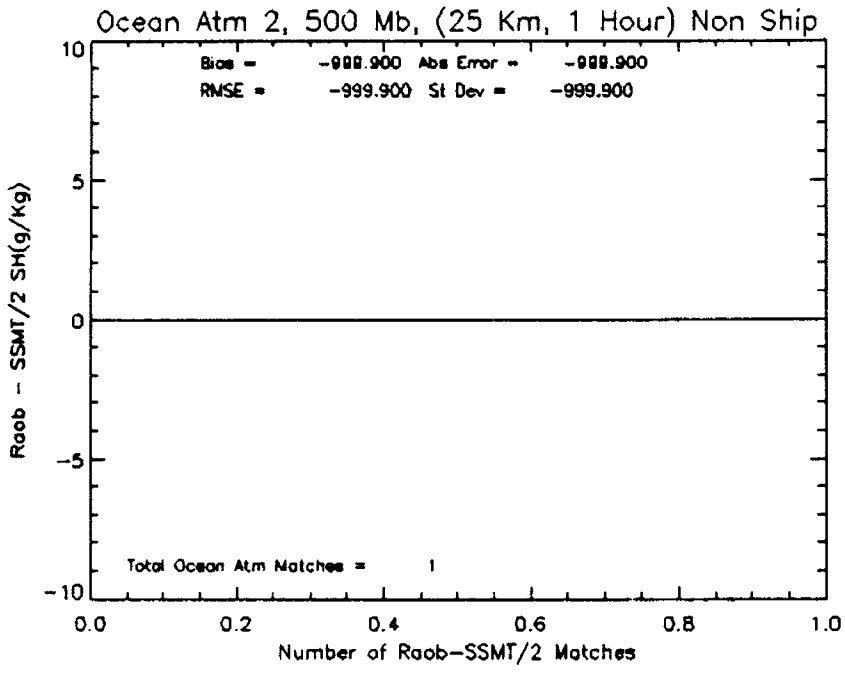

Ocean Atm 3, 850 Mb, (25 Km, 1 Hour) Ship
Bias = -3.46565 Abs Error = 3.46565
RMSE = 3.91509 St Dev = 1.86865
Total Ocean Atm Matches = 20
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

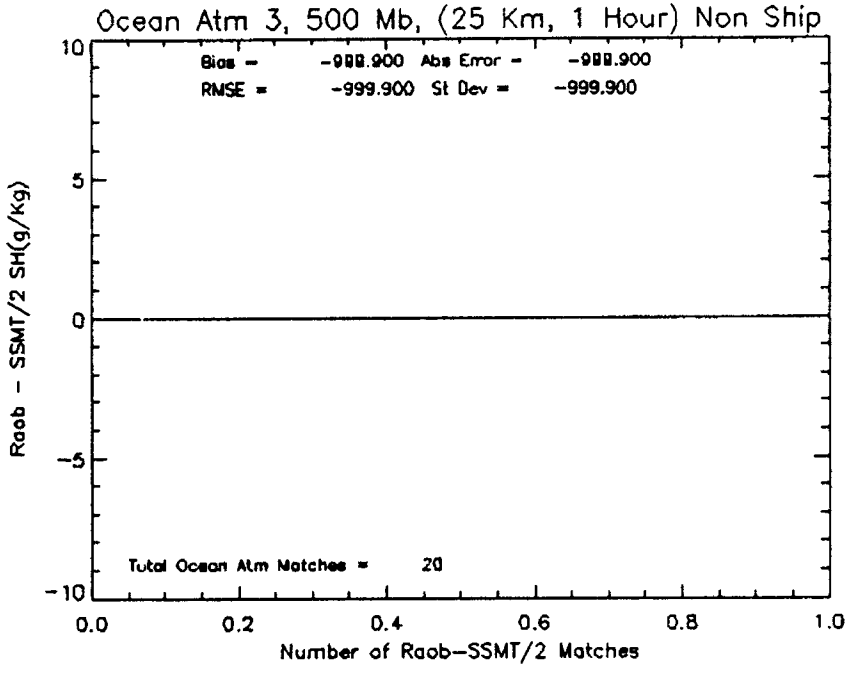

Ocean Atm 2, 700 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

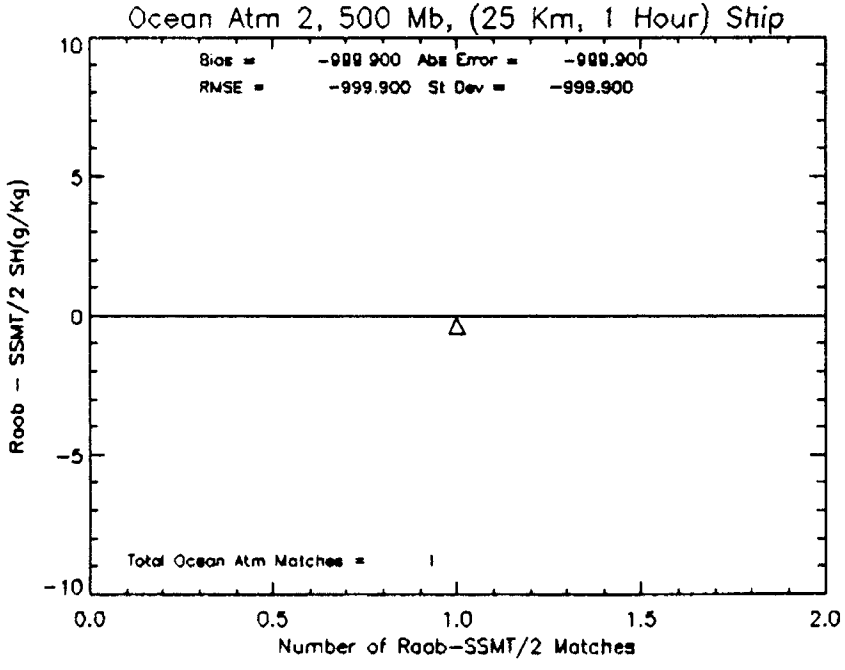

Ocean Atm 3, 700 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 20
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

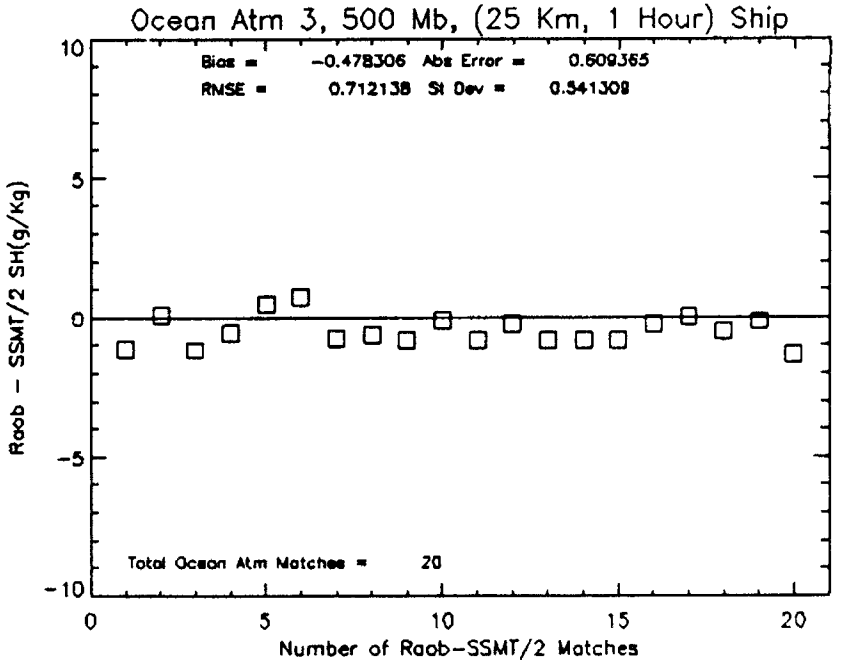

Ocean Atm 2, 700 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

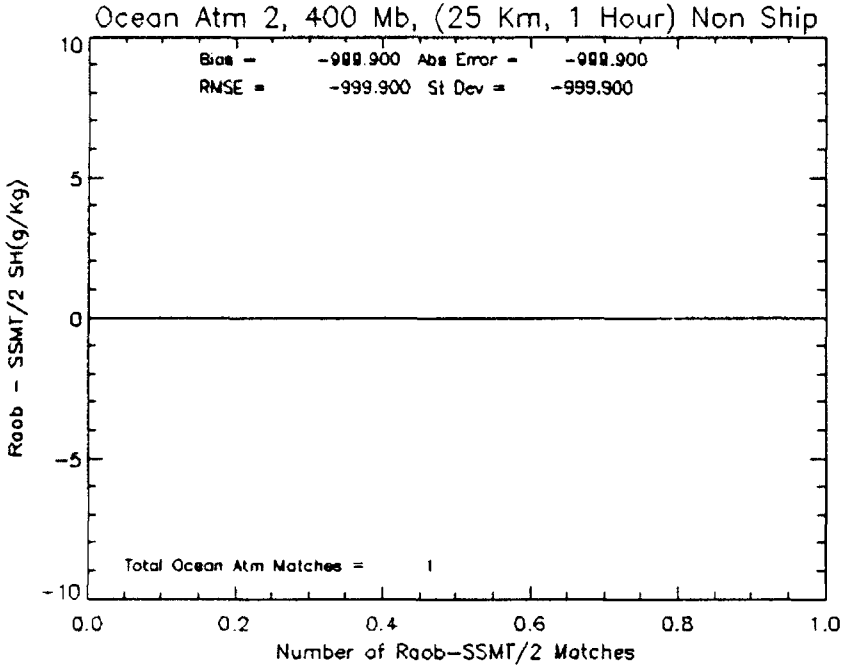

Ocean Atm 3, 700 Mb, (25 Km, 1 Hour) Ship
Bias = -1.86118 Abs Error = 1.86118
RMSE = 2.08816 St Dev = 0.971369
Total Ocean Atm Matches = 20
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

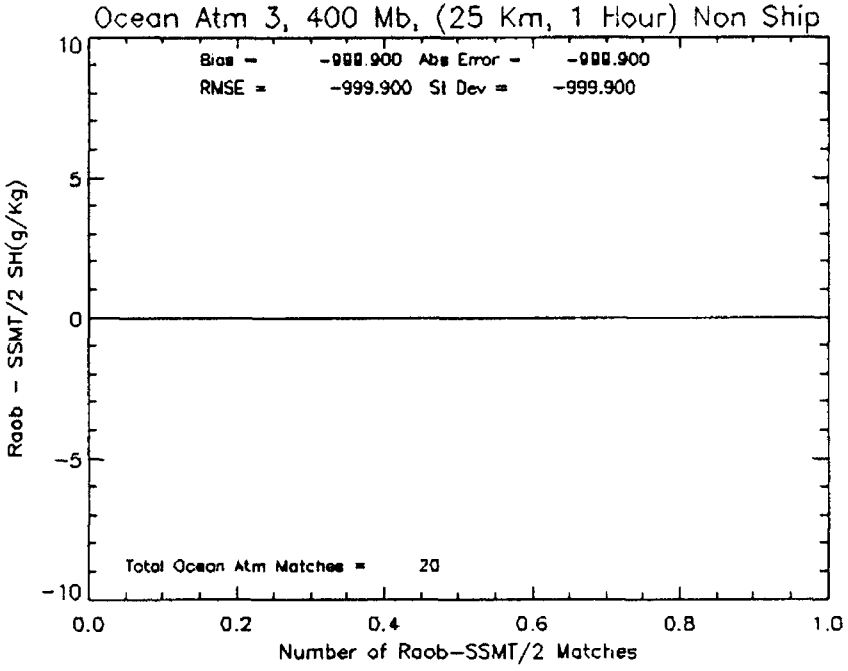

Ocean Atm 2, 500 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

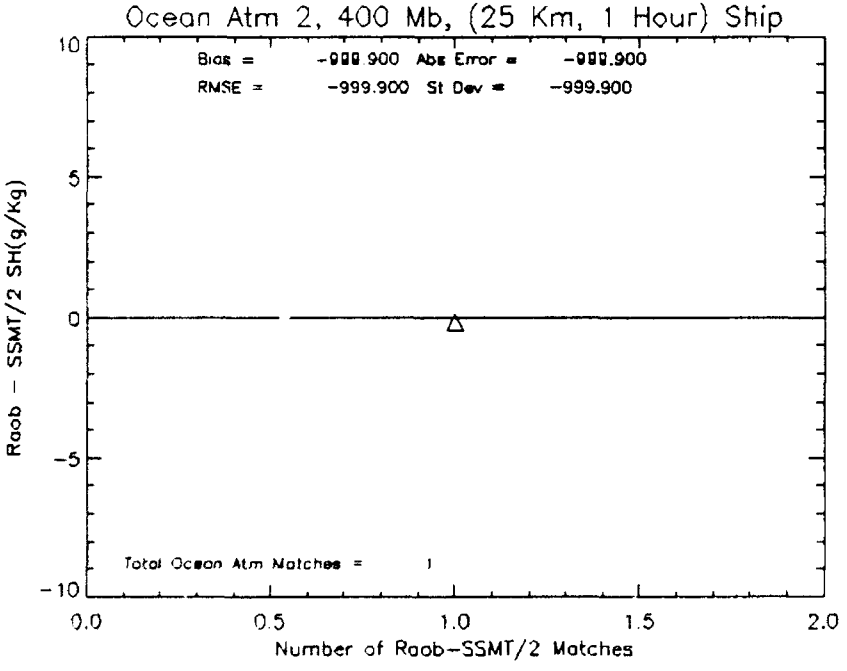

Ocean Atm 3, 500 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 20
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

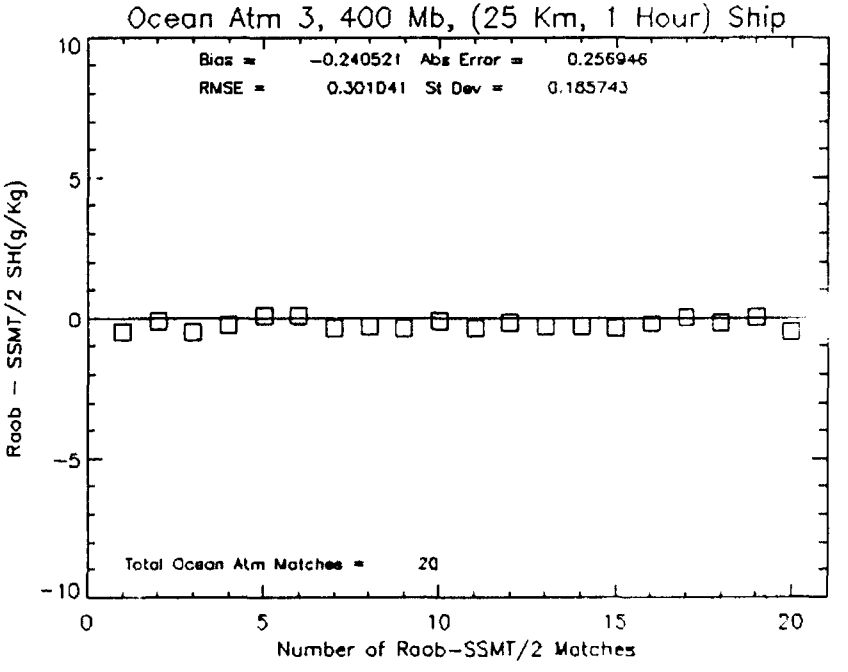

Ocean Atm 2, 500 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

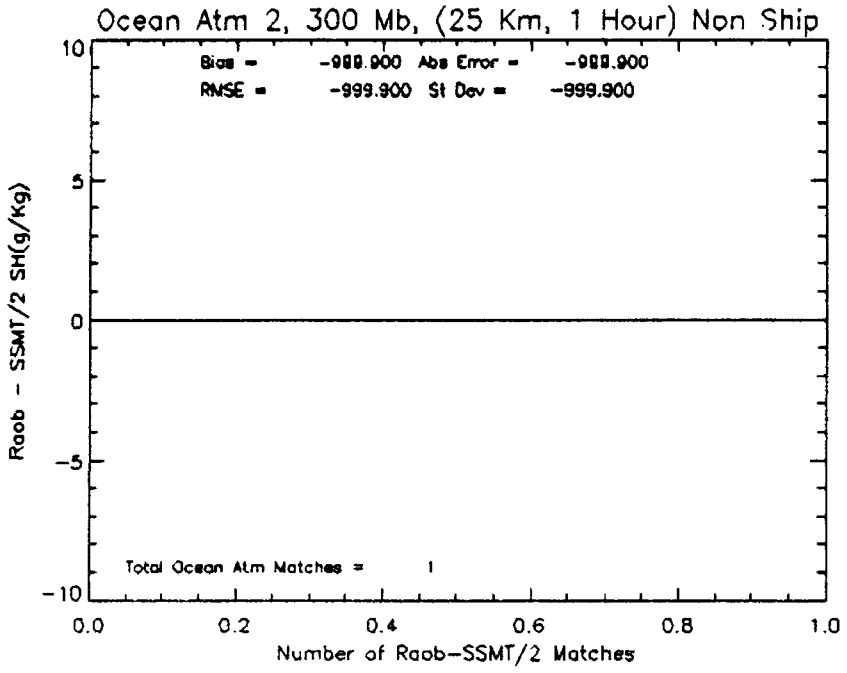

Ocean Atm 3, 500 Mb, (25 Km, 1 Hour) Ship
Bias = -0.478306 Abs Error = 0.609365
RMSE = 0.712138 St Dev = 0.541309
Total Ocean Atm Matches = 20
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

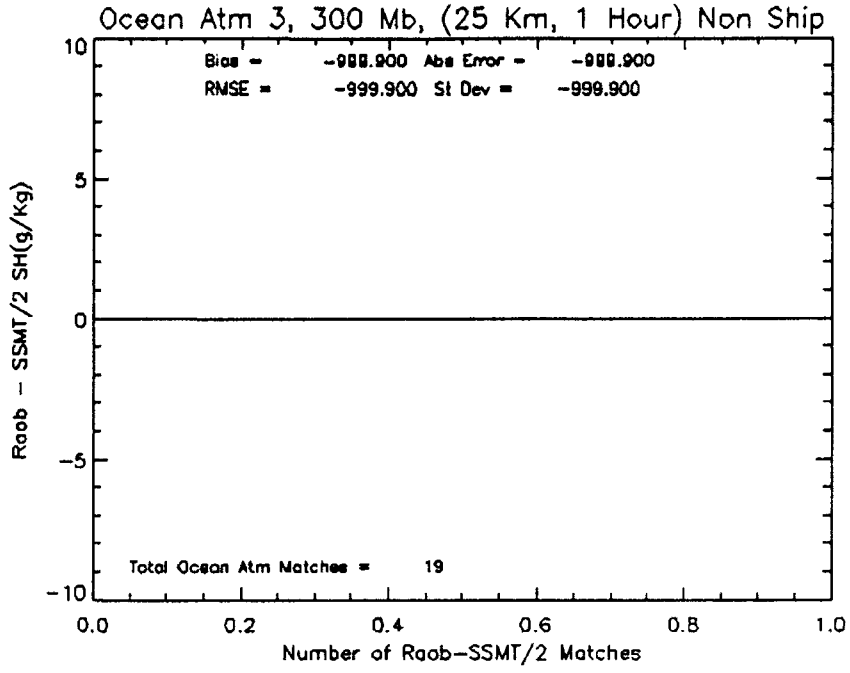

Ocean Atm 2, 400 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

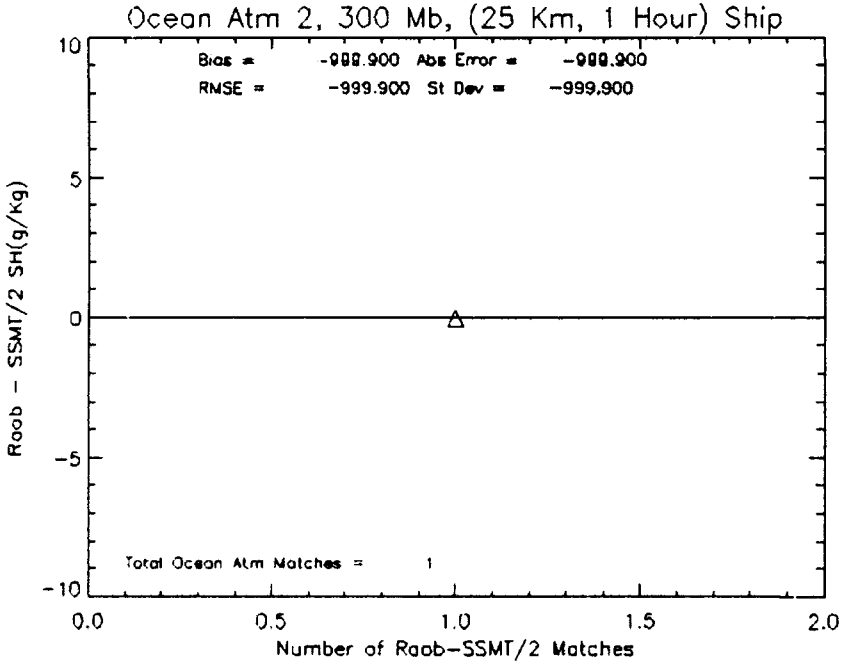

Ocean Atm 3, 400 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 20
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

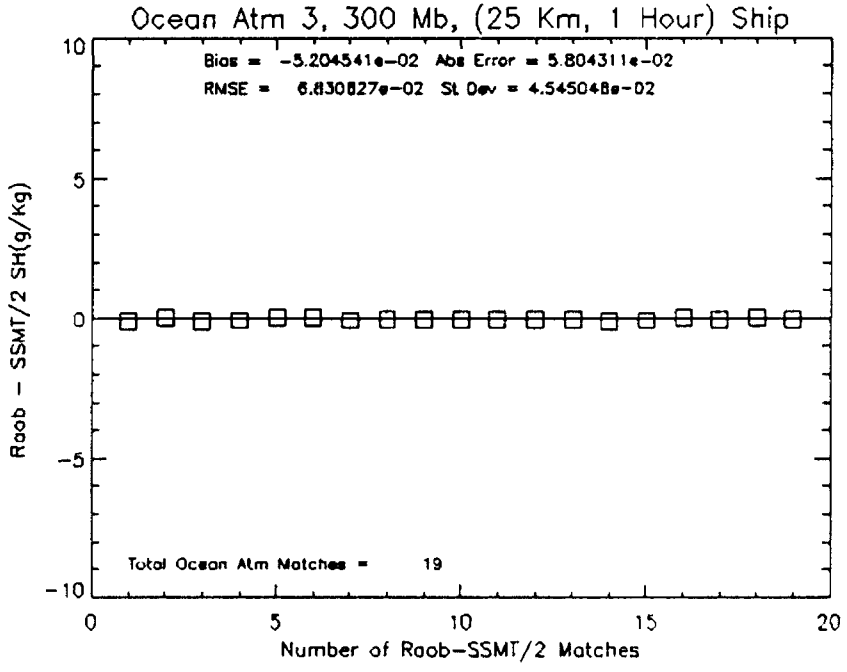

Ocean Atm 2, 400 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 400 Mb, (25 Km, 1 Hour) Ship
Bias = -0.240521 Abs Error = 0.256946
RMSE = 0.301041 St Dev = 0.165743
Total Ocean Atm Matches = 20
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 300 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 300 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 19
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 300 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 300 Mb, (25 Km, 1 Hour) Ship
Bias = -5.204541e-02 Abs Error = 5.804311e-02
RMSE = 6.830827e-02 St Dev = 4.545048e-02
Total Ocean Atm Matches = 19
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

Ocean Atm 5, 1000 Mb, (25 Km, 1 Hour) Non Ship
Bias = -1.22575 Abs Error = 2.63263
RMSE = 3.44750 St Dev = 3.44471
Total Ocean Atm Matches = 10
Roob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Ocean Atm 5, 1000 Mb, (25 Km, 1 Hour) Ship
Bias = -4.78500 Abs Error = 4.78500
RMSE = 5.40890 St Dev = 3.54261
Total Ocean Atm Matches = 10
Roob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Ocean Atm 4, 1000 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Roob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

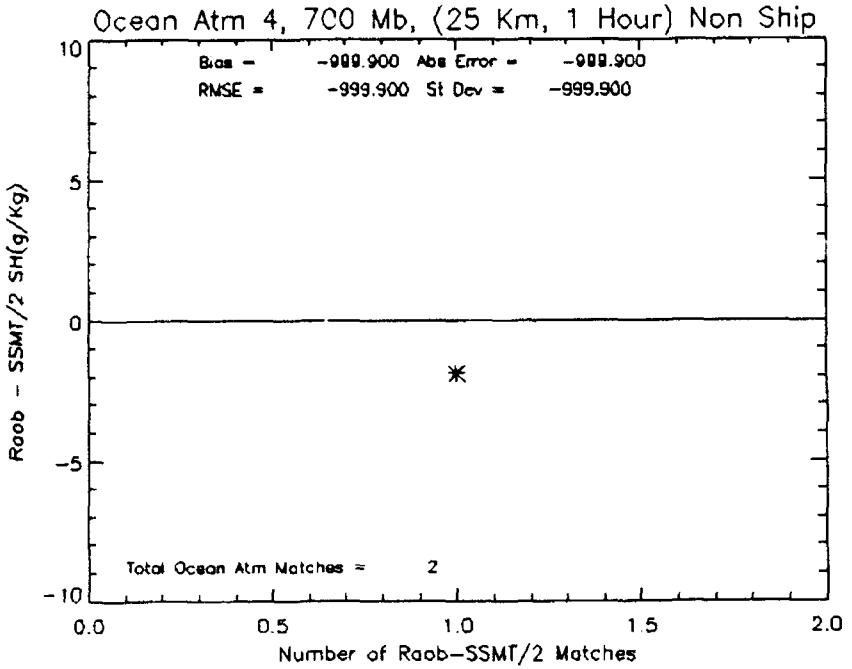
Ocean Atm 4, 1000 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Roob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

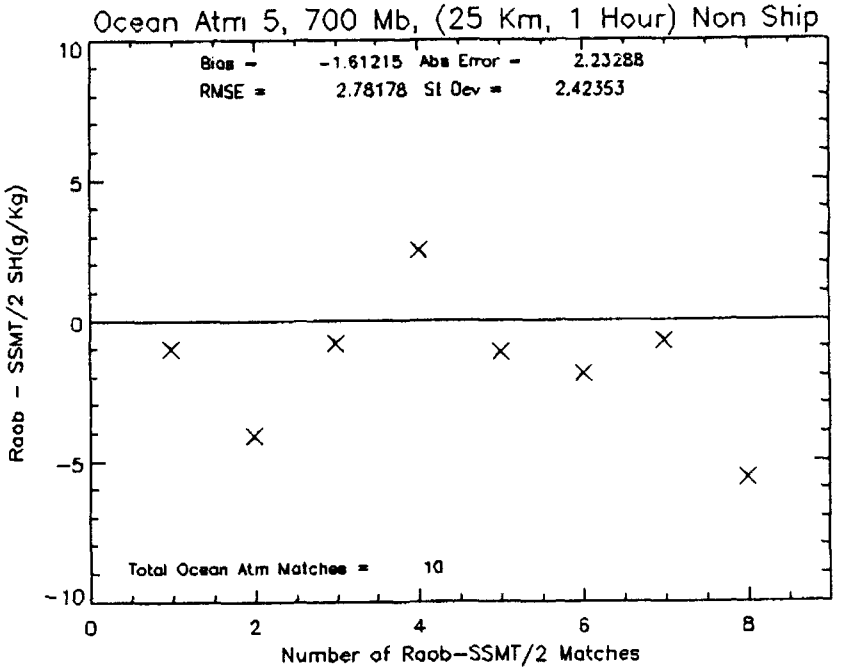
Ocean Atm 5, 850 Mb, (25 Km, 1 Hour) Non Ship
Bias = -1.82755 Abs Error = 1.84089
RMSE = 2.04455 St Dev = 0.979943
Total Ocean Atm Matches = 10
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

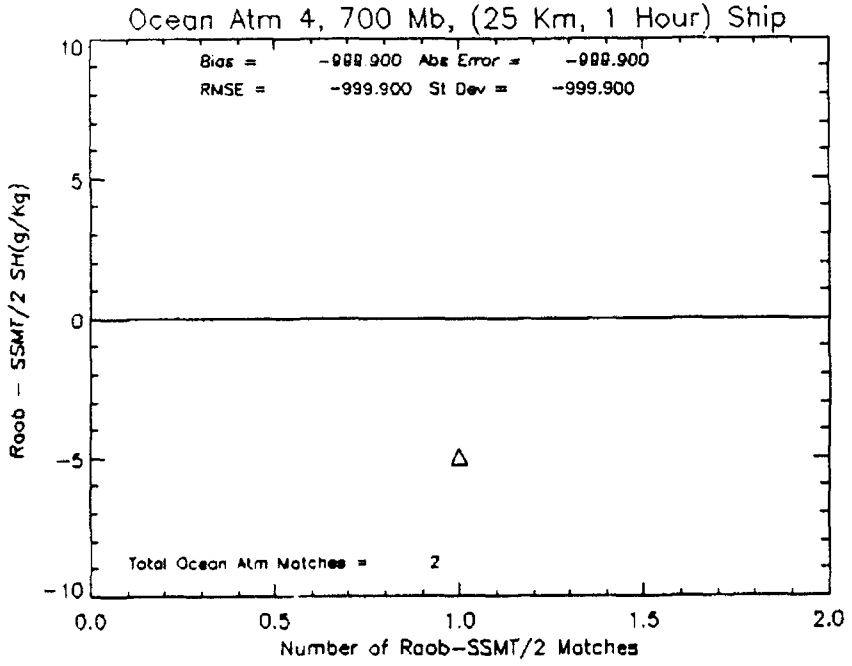
Ocean Atm 5, 850 Mb, (25 Km, 1 Hour) Ship
Bias = -6.58500 Abs Error = 6.58500
RMSE = 6.83679 St Dev = 1.37686
Total Ocean Atm Matches = 10
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

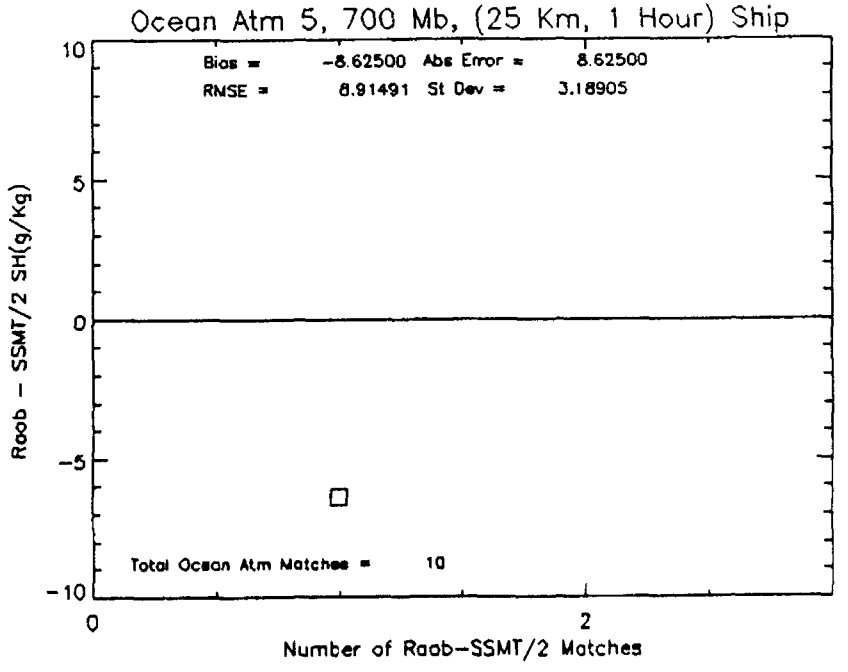
Ocean Atm 4, 850 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

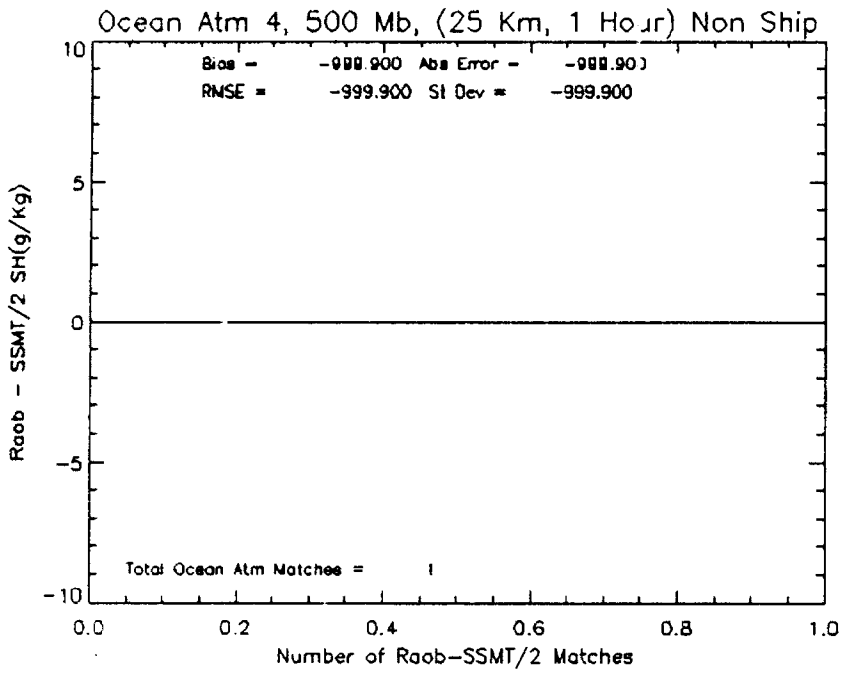
Ocean Atm 4, 850 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

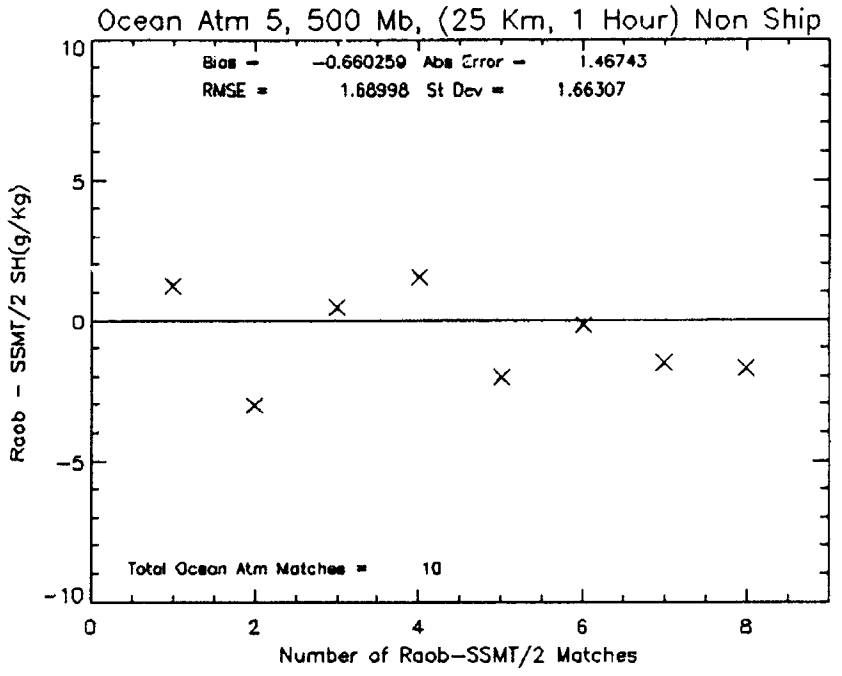

Ocean Atm 4, 700 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

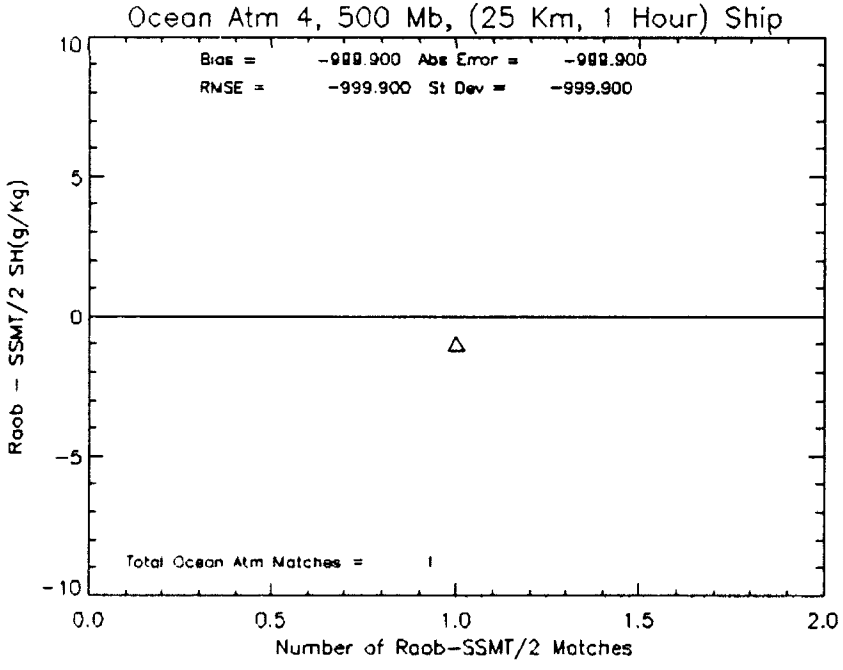

Ocean Atm 5, 700 Mb, (25 Km, 1 Hour) Non Ship
Bias = -1.61215 Abs Error = 2.23288
RMSE = 2.78178 St Dev = 2.42353
Total Ocean Atm Matches = 10
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

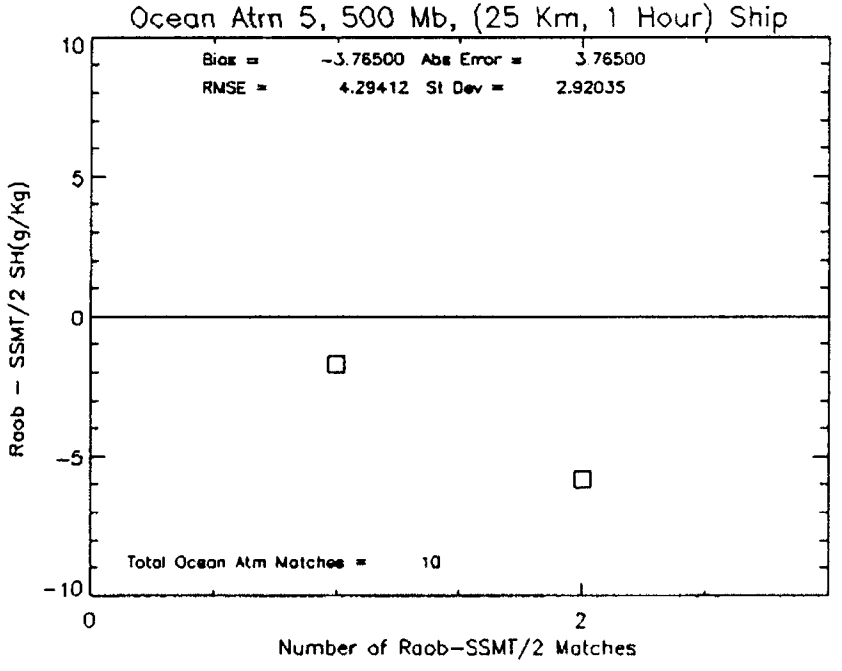

Ocean Atm 4, 700 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

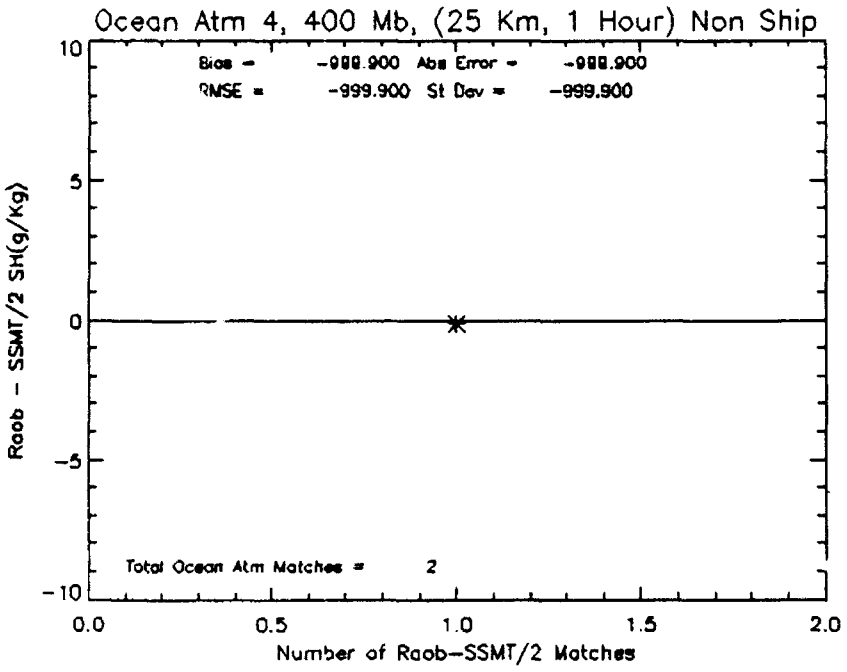

Ocean Atm 5, 700 Mb, (25 Km, 1 Hour) Ship
Bias = -8.62500 Abs Error = 8.62500
RMSE = 8.91491 St Dev = 3.18905
Total Ocean Atm Matches = 10
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

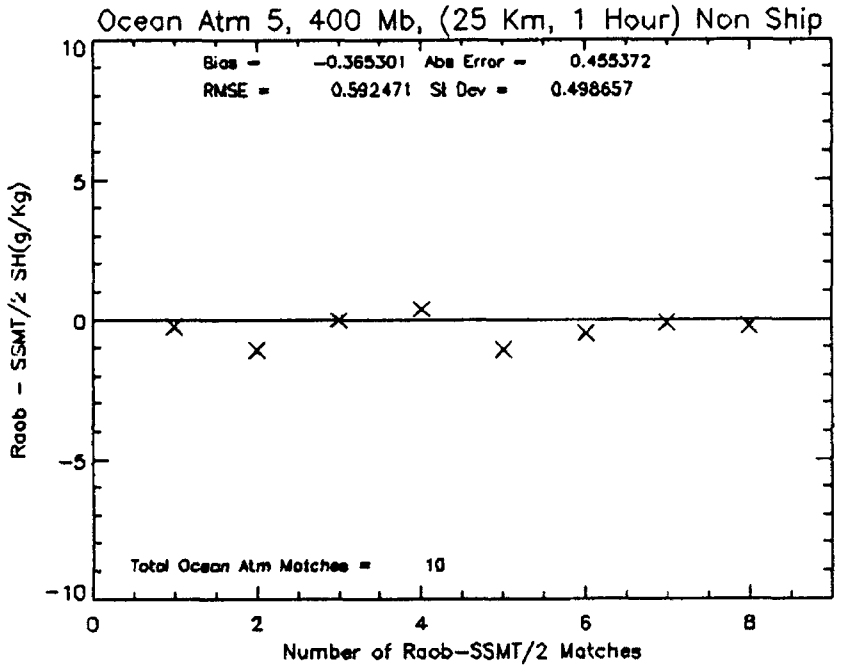

Ocean Atm 4, 500 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

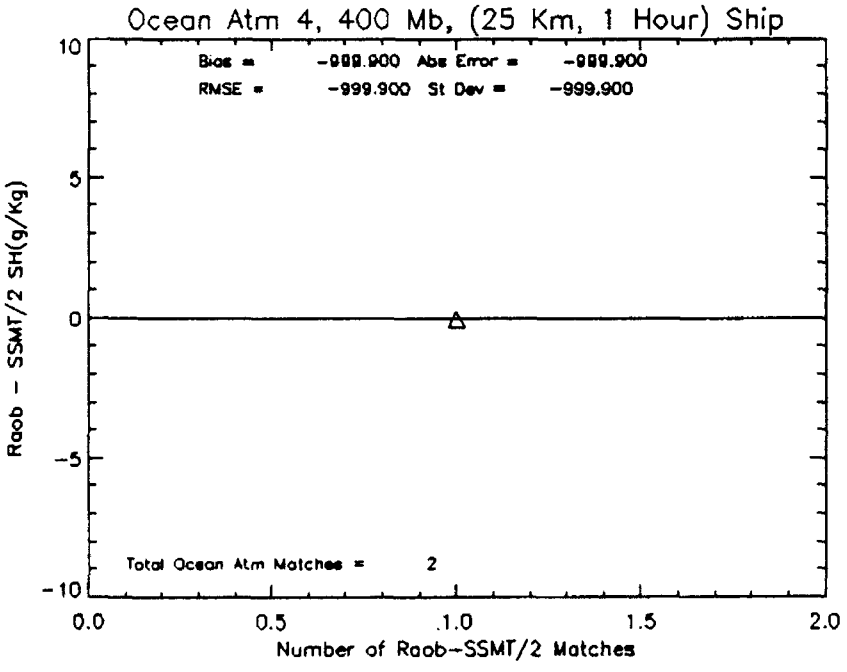

Ocean Atm 5, 500 Mb, (25 Km, 1 Hour) Non Ship
Bias = -0.660259 Abs Error = 1.46743
RMSE = 1.68998 St Dev = 1.66307
Total Ocean Atm Matches = 10
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

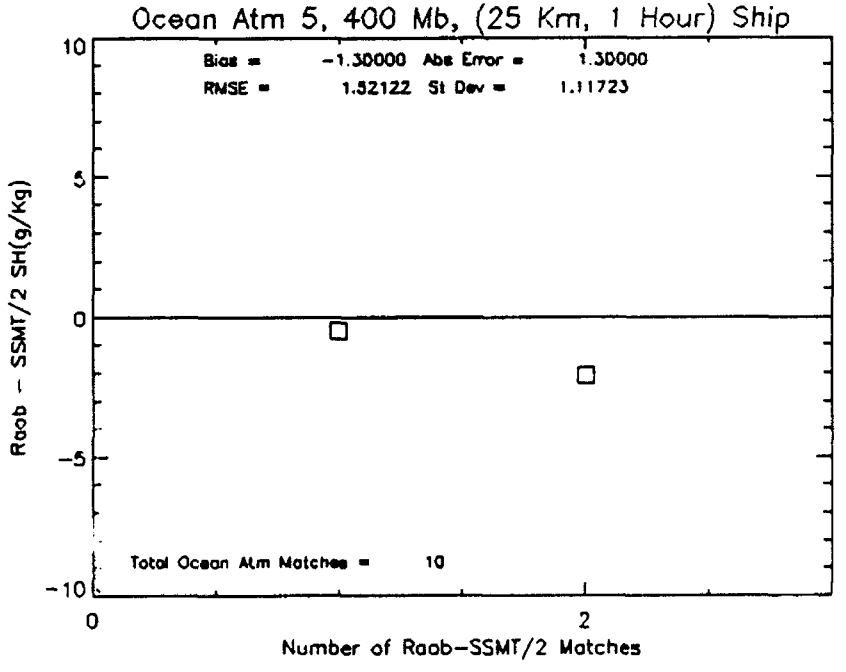

Ocean Atm 4, 500 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

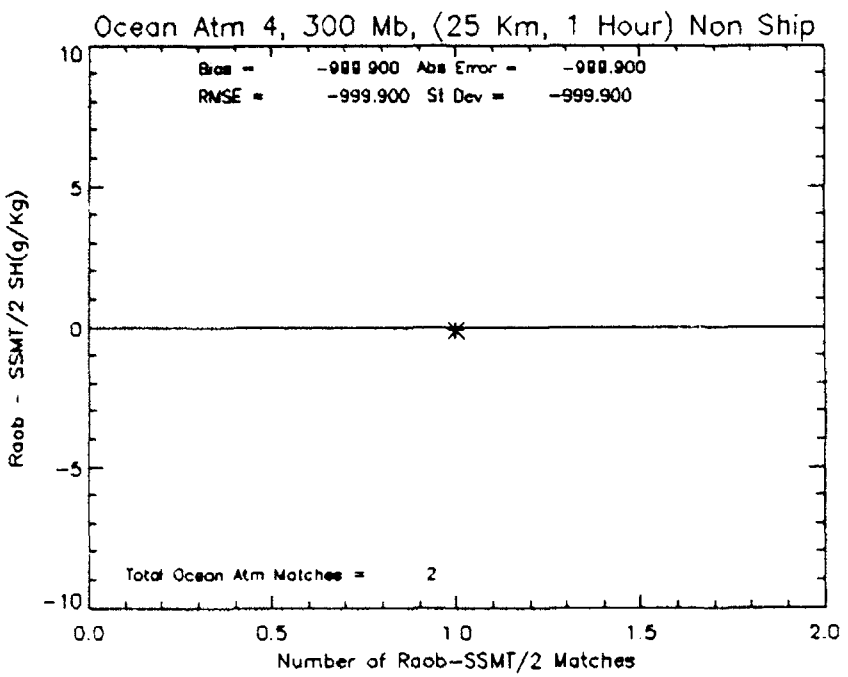

Ocean Atm 5, 500 Mb, (25 Km, 1 Hour) Ship
Bias = -3.76500 Abs Error = 3.76500
RMSE = 4.29412 St Dev = 2.92035
Total Ocean Atm Matches = 10
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

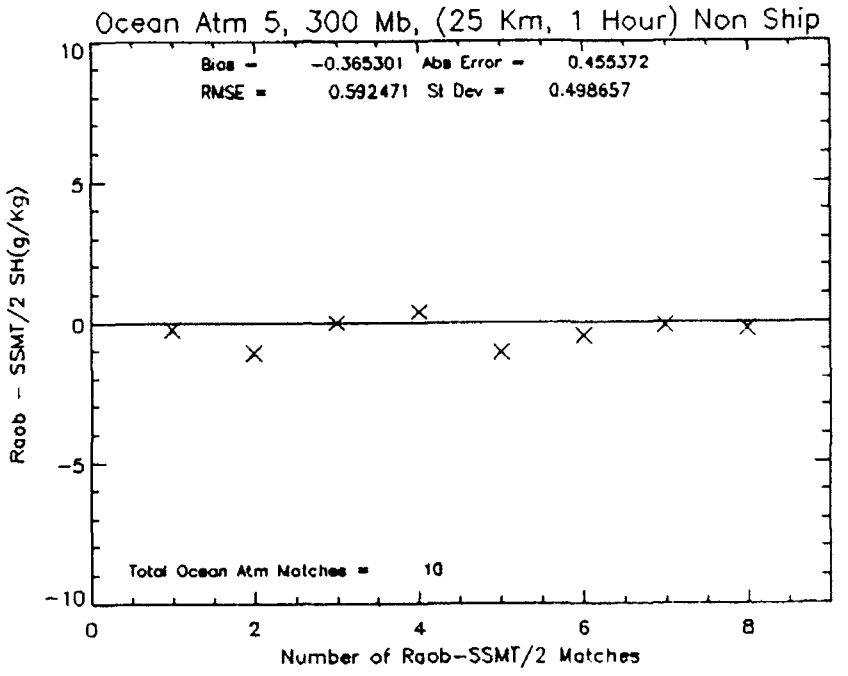

Ocean Atm 4, 400 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

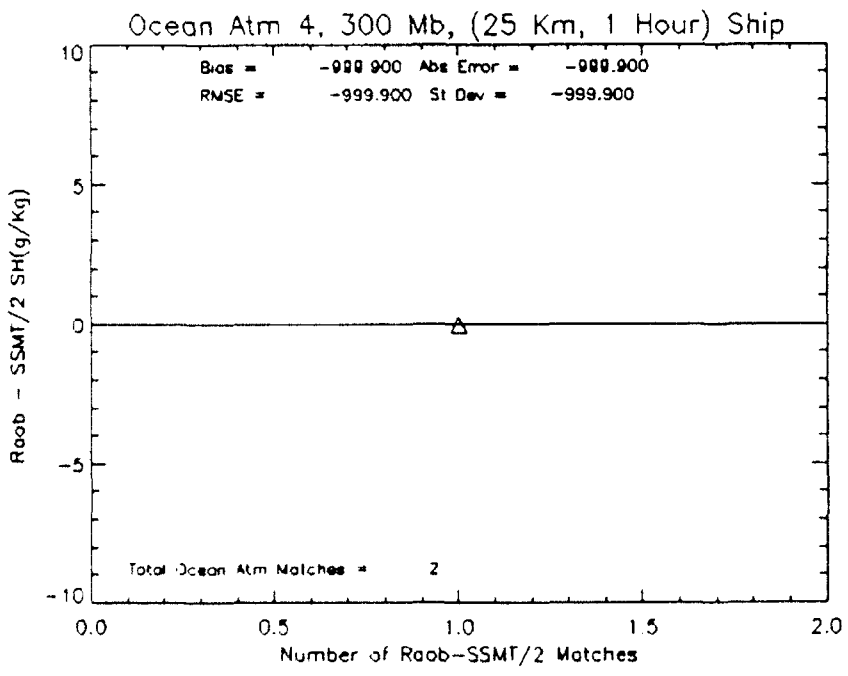

Ocean Atm 5, 400 Mb, (25 Km, 1 Hour) Non Ship
Bias = -0.365301 Abs Error = 0.455372
RMSE = 0.592471 St Dev = 0.498657
Total Ocean Atm Matches = 10
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

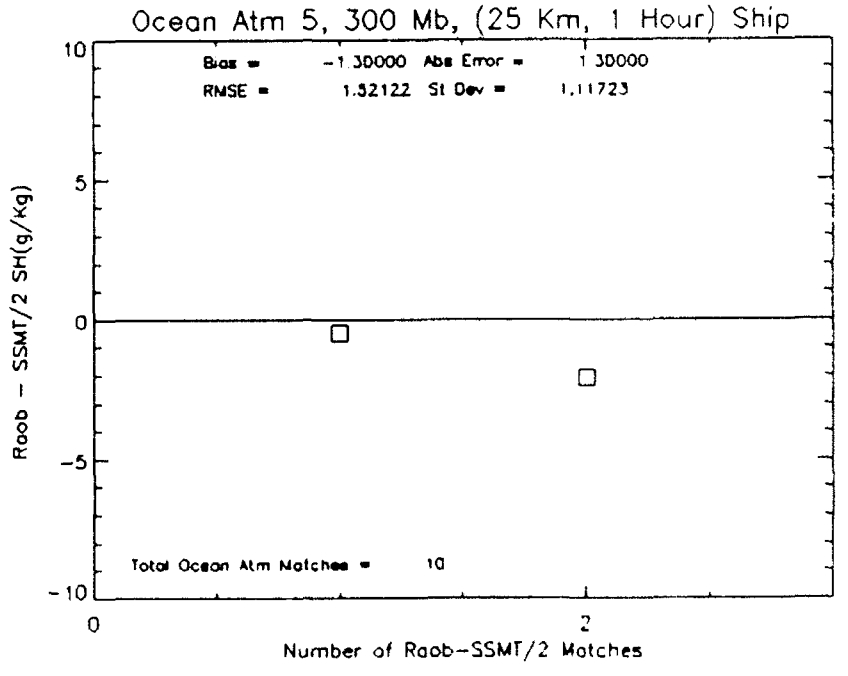

Ocean Atm 4, 400 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

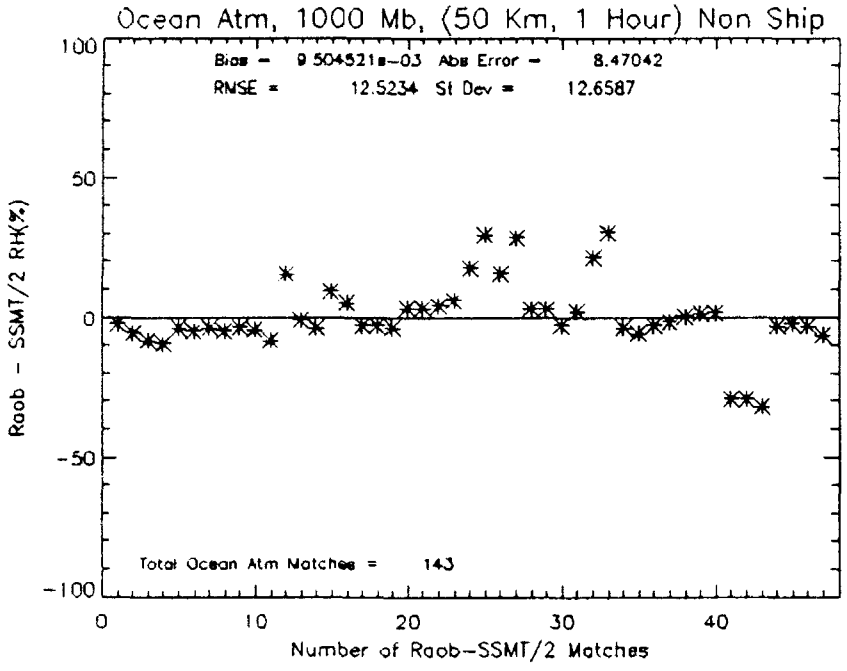

Ocean Atm 5, 400 Mb, (25 Km, 1 Hour) Ship
Bias = -1.30000 Abs Error = 1.30000
RMSE = 1.52122 St Dev = 1.11723
Total Ocean Atm Matches = 10
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

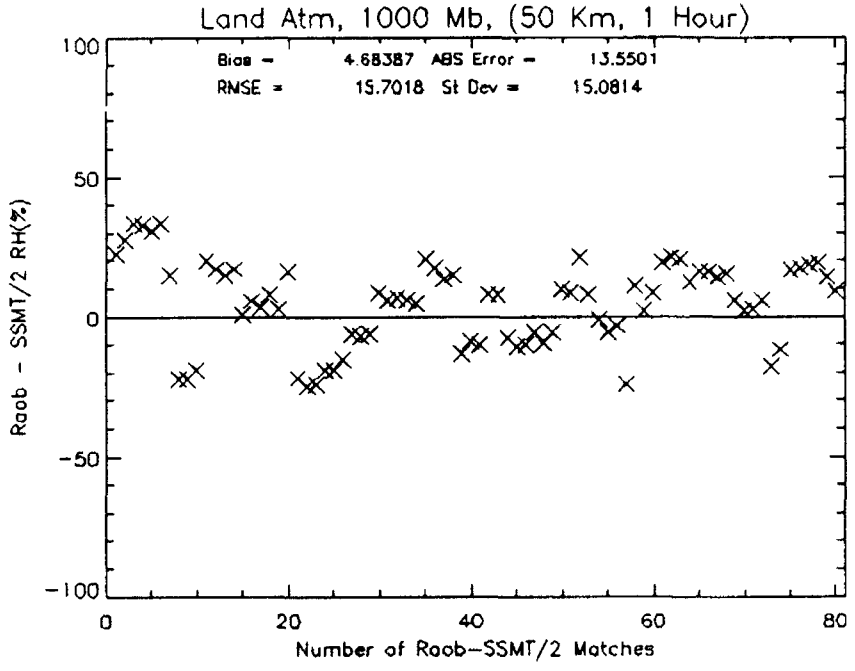

Ocean Atm 4, 300 Mb, (25 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

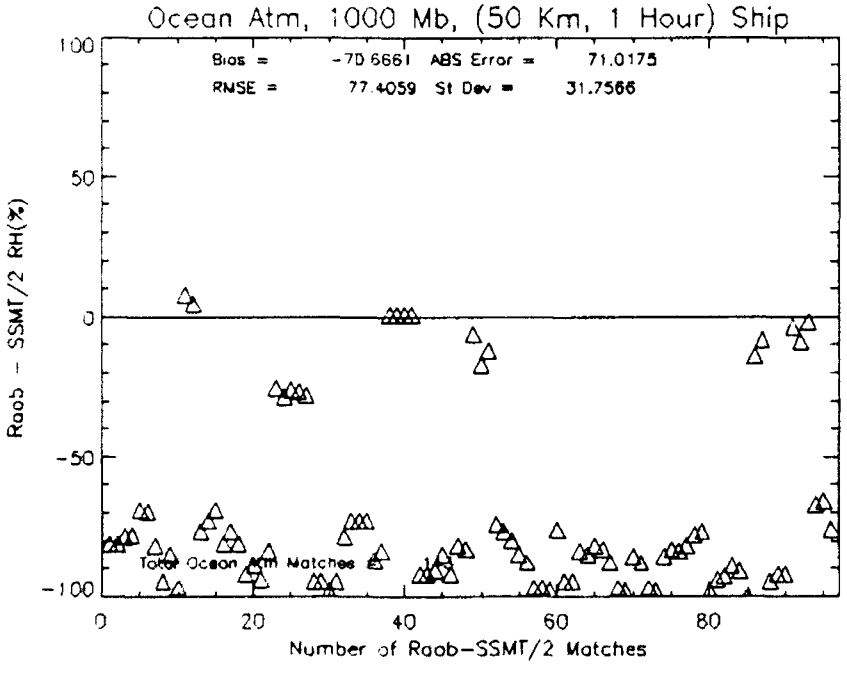

Ocean Atm 5, 300 Mb, (25 Km, 1 Hour) Non Ship
Bias = -0.365301 Abs Error = 0.455372
RMSE = 0.592471 St Dev = 0.498657
Total Ocean Atm Matches = 10
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

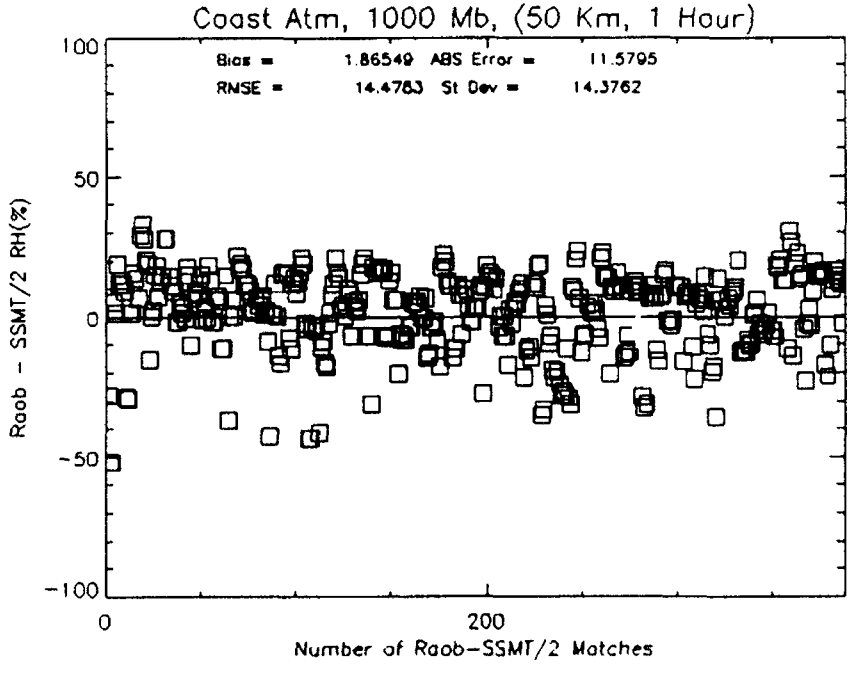

Ocean Atm 4, 300 Mb, (25 Km, 1 Hour) Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 2
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

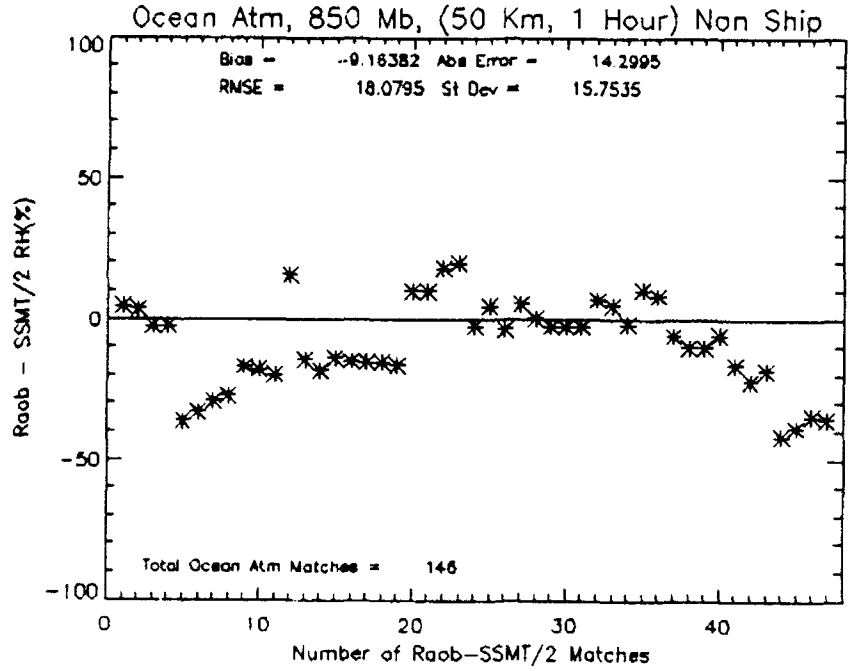

Ocean Atm 5, 300 Mb, (25 Km, 1 Hour) Ship
Bias = -1.30000 Abs Error = 1.30000
RMSE = 1.52122 St Dev = 1.11723
Total Ocean Atm Matches = 10
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

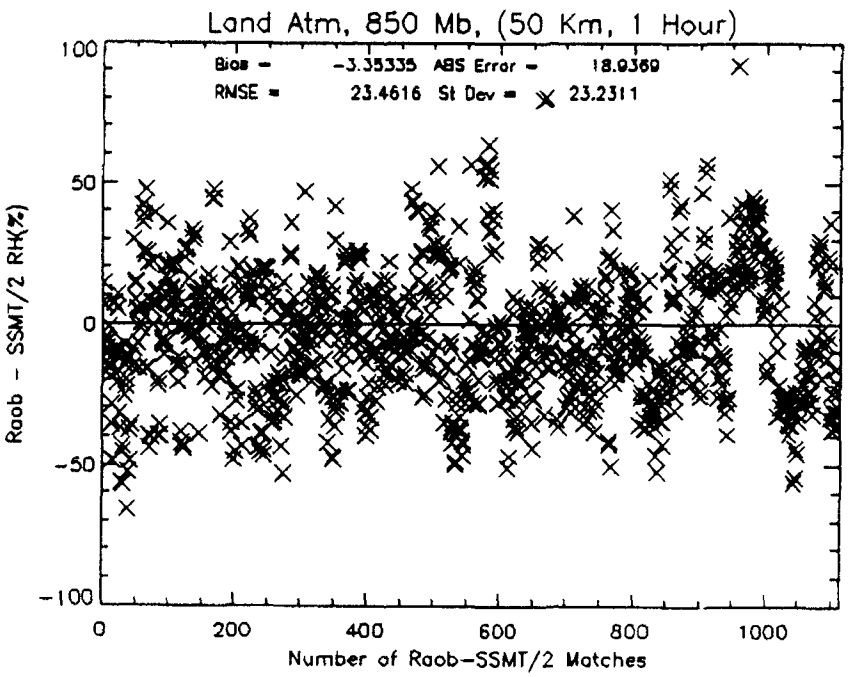

Ocean Atm, 1000 Mb, (50 Km, 1 Hour) Non Ship
Bias = 9.504521e-03 Abs Error = 8.47042
RMSE = 12.5234 St Dev = 12.6587
Total Ocean Atm Matches = 143
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

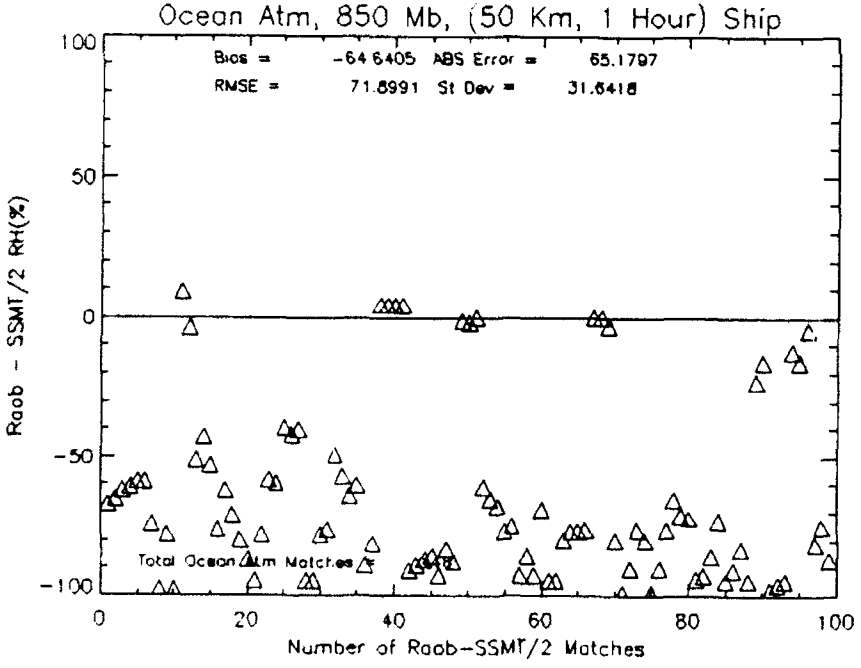

Land Atm, 1000 Mb, (50 Km, 1 Hour)
Bias = 4.68387 ABS Error = 13.5501
RMSE = 15.7018 St Dev = 15.0814
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

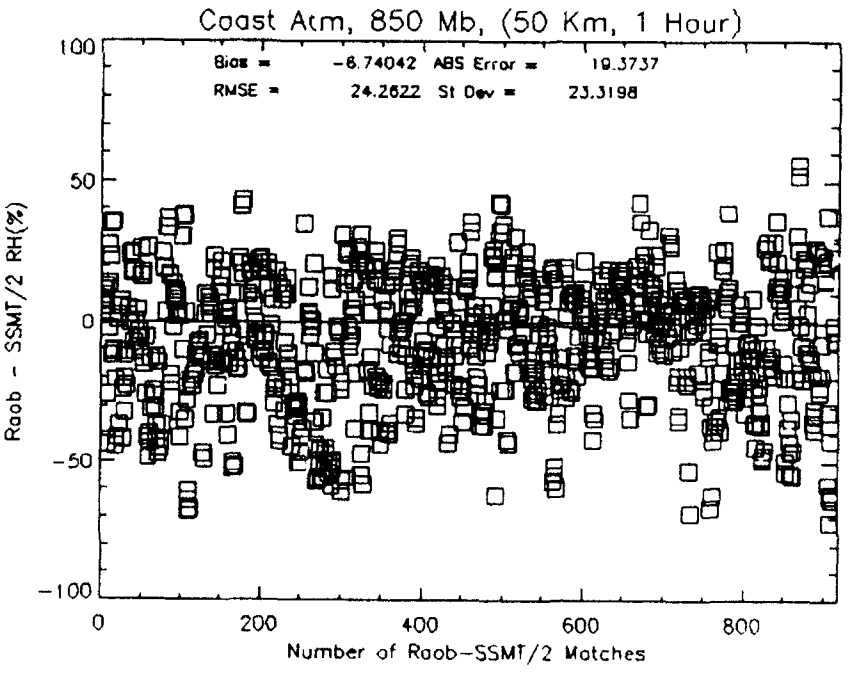

Ocean Atm, 1000 Mb, (50 Km, 1 Hour) Ship
Bias = -70.6661 ABS Error = 71.0175
RMSE = 77.4059 St Dev = 31.7566
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

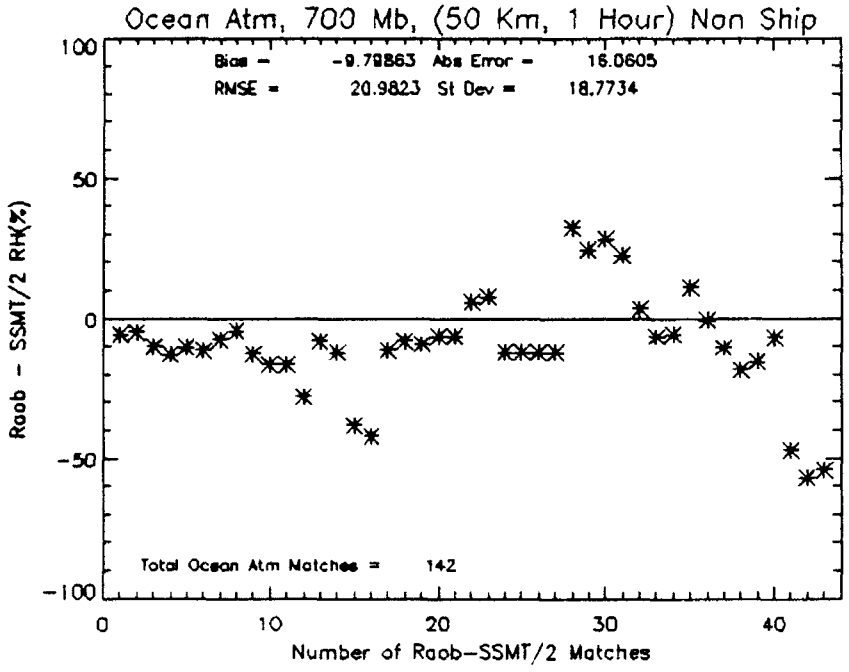

Coast Atm, 1000 Mb, (50 Km, 1 Hour)
Bias = 1.86549 ABS Error = 11.5795
RMSE = 14.4783 St Dev = 14.3762
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

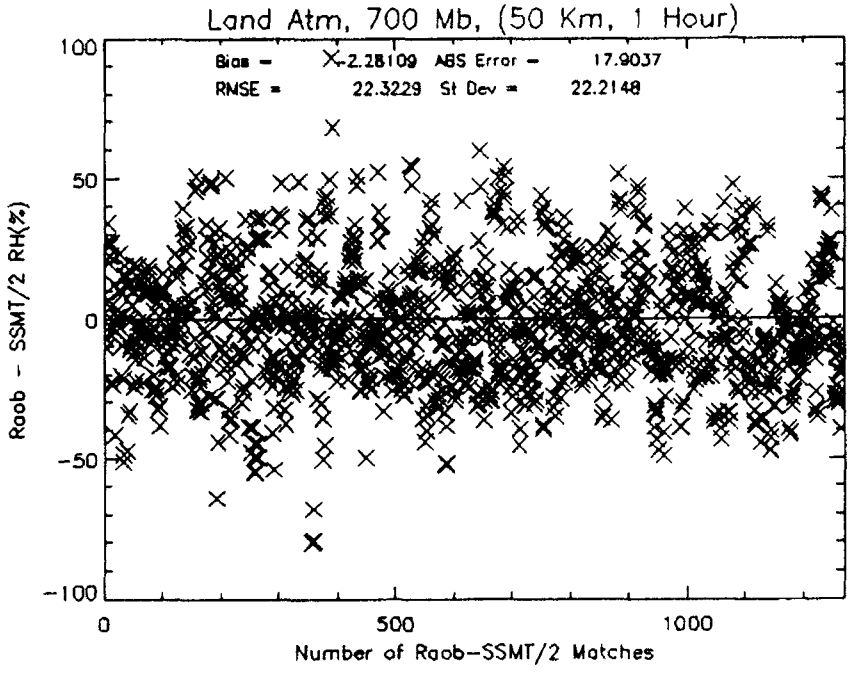

Ocean Atm, 850 Mb, (50 Km, 1 Hour) Non Ship
Bias = -9.16382 Abs Error = 14.2995
RMSE = 18.0795 St Dev = 15.7535
Total Ocean Atm Matches = 146
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

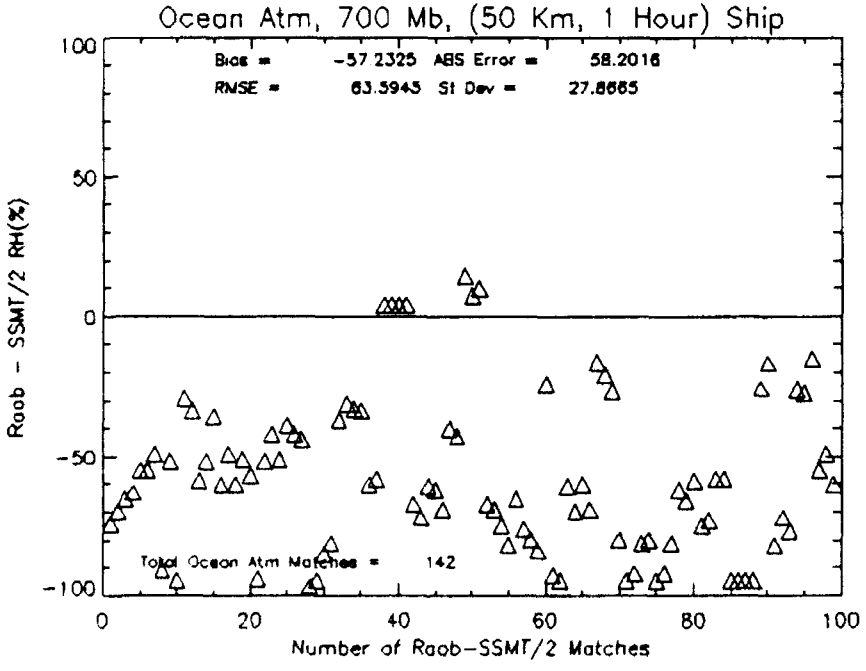

Land Atm, 850 Mb, (50 Km, 1 Hour)
Bias = -3.35335 ABS Error = 18.9369
RMSE = 23.4616 St Dev = 23.2311
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

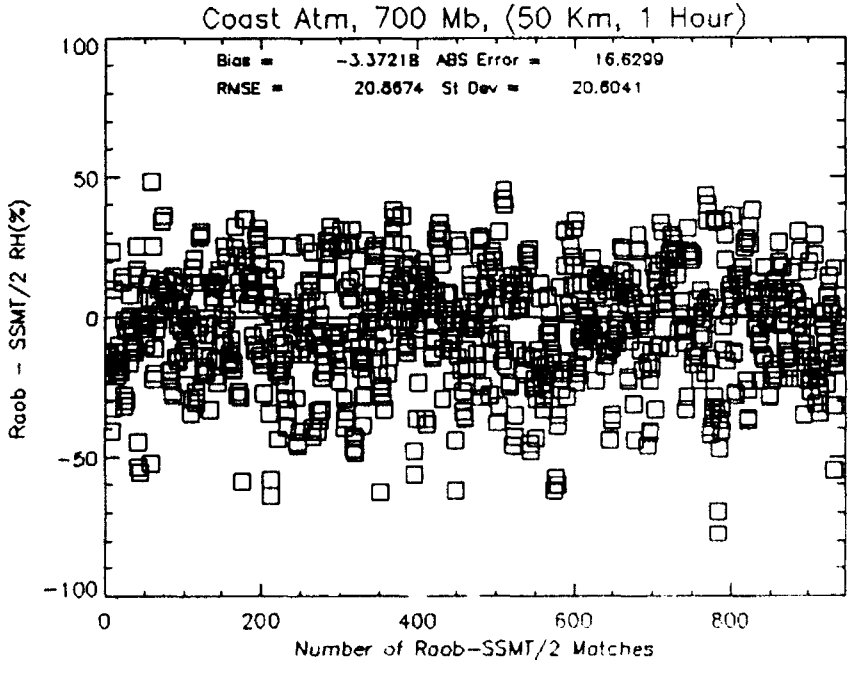

Ocean Atm, 850 Mb, (50 Km, 1 Hour) Ship
Bias = -64.6405 ABS Error = 65.1797
RMSE = 71.8991 St Dev = 31.6418
Total Ocean Atm Matches
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Coast Atm, 850 Mb, (50 Km, 1 Hour)
Bias = -6.74042 ABS Error = 19.3737
RMSE = 24.2622 St Dev = 23.3198
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm, 700 Mb, (50 Km, 1 Hour) Non Ship
Bias = -9.78863 Abs Error = 16.0605
RMSE = 20.9823 St Dev = 18.7734
Total Ocean Atm Matches = 142
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Land Atm, 700 Mb, (50 Km, 1 Hour)
Bias = -2.28109 ABS Error = 17.9037
RMSE = 22.3229 St Dev = 22.2148
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm, 700 Mb, (50 Km, 1 Hour) Ship
Bias = -57.2325 ABS Error = 58.2016
RMSE = 63.5945 St Dev = 27.8665
Total Ocean Atm Matches = 142
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Coast Atm, 700 Mb, (50 Km, 1 Hour)
Bias = -3.37218 ABS Error = 16.6299
RMSE = 20.8674 St Dev = 20.6041
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Land Atm, 500 Mb, (50 Km, 1 Hour)
Bias = -4.65634 ABS Error = 15.4054
RMSE = 20.2490 St Dev = 19.7133
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Coast Atm, 500 Mb, (50 Km, 1 Hour)
Bias = -1.83819 ABS Error = 15.3832
RMSE = 19.7169 St Dev = 19.6400
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm, 500 Mb, (50 Km, 1 Hour) Non Ship
Bias = -9.53147 Abs Error = 20.2302
RMSE = 24.4635 St Dev = 22.8173
Total Ocean Atm Matches = 139
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm, 500 Mb, (50 Km, 1 Hour) Ship
Bias = -42.1351 ABS Error = 43.9239
RMSE = 48.9844 St Dev = 25.1091
Total Ocean Atm Matches = 139
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Land Atm, 400 Mb, (50 Km, 1 Hour)
Bias = -9.84392 ABS Error = 16.0487
RMSE = 20.6939 St Dev = 18.2093
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Coast Atm, 400 Mb, (50 Km, 1 Hour)
Bias = -2.80871 ABS Error = 14.5056
RMSE = 18.5399 St Dev = 18.3190
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm, 400 Mb, (50 Km, 1 Hour) Non Ship
Bias = -9.52260 Abs Error = 14.3630
RMSE = 16.9433 St Dev = 14.1800
Total Ocean Atm Matches = 142
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm, 400 Mb, (50 Km, 1 Hour) Ship
Bias = -35.4094 ABS Error = 37.4981
RMSE = 42.2391 St Dev = 23.1459
Total Ocean Atm Matches = 142
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Land Atm, 300 Mb, (50 Km, 1 Hour)
Bias = -2.31610 ABS Error = 14.7710
RMSE = 18.9987 St Dev = 18.8648
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Coast Atm, 300 Mb, (50 Km, 1 Hour)
Bias = 1.46499 ABS Error = 13.7604
RMSE = 17.8004 St Dev = 17.7502
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm, 300 Mb, (50 Km, 1 Hour) Non Ship
Bias = -13.2788 Abs Error = 17.4600
RMSE = 21.0773 St Dev = 16.5824
Total Ocean Atm Matches = 135
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm, 300 Mb, (50 Km, 1 Hour) Ship
Bias = -21.4339 ABS Error = 25.5870
RMSE = 28.0707 St Dev = 16.2211
Total Ocean Atm Matches = 135
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Land Atm, 1000 Mb, (50 Km, 1 Hour)
Bias = -1.21205 ABS Error = 1.77028
RMSE = 2.22393 St Dev = 1.87638
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Coast Atm, 1000 Mb, (50 Km, 1 Hour)
Bias = 3.70839E-02 ABS Error = 1.99105
RMSE = 2.68706 St Dev = 2.69028
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Ocean Atm, 1000 Mb, (50 Km, 1 Hour) Non Ship
Bias = -0.408996 Abs Error = 2.21660
RMSE = 2.99585 St Dev = 2.99988
Total Ocean Atm Matches = 143
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

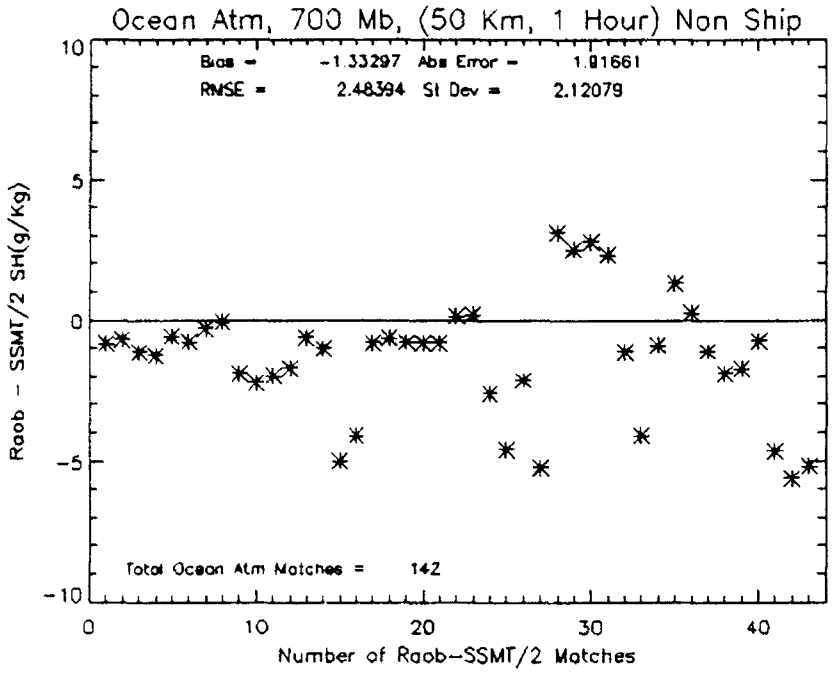
Ocean Atm, 1000 Mb, (50 Km, 1 Hour) Ship
Bias = -4.80318 ABS Error = 4.83137
RMSE = 5.38383 St Dev = 2.44486
Total Ocean Atm Matches = 143
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

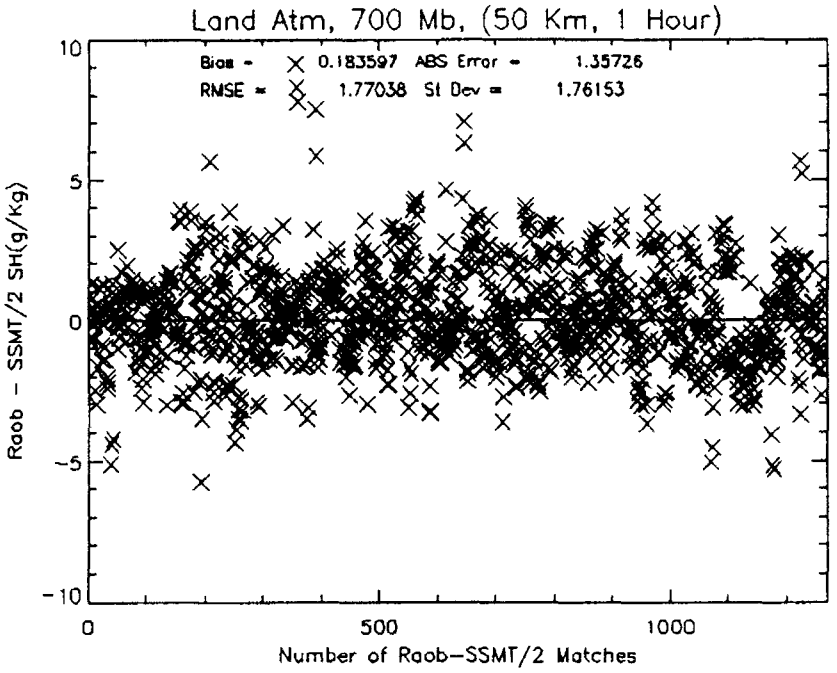
Land Atm, 850 Mb, (50 Km, 1 Hour)
Bias = 3.903545e-02 ABS Error = 2.05602
RMSE = 2.98413 St Dev = 2.98522
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

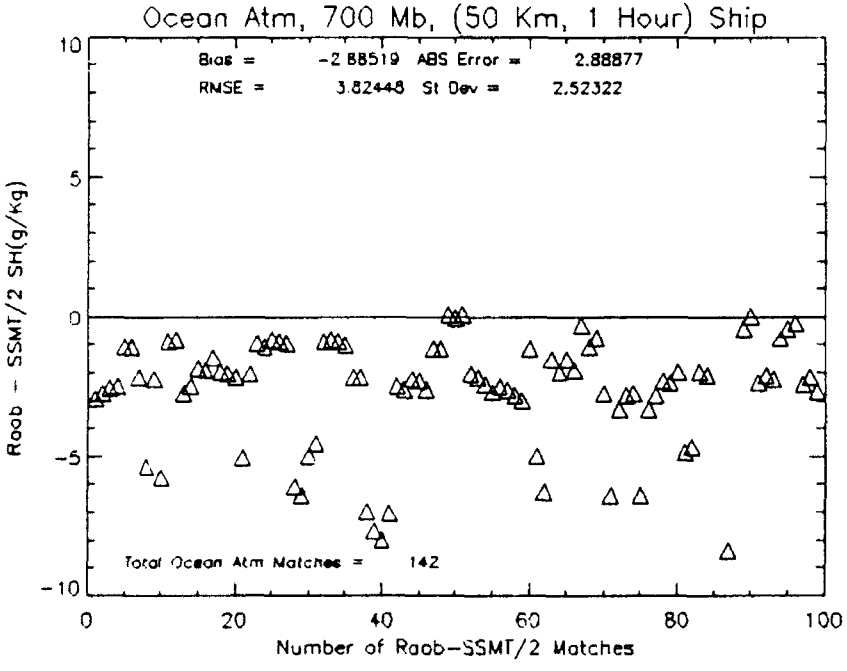
Coast Atm, 850 Mb, (50 Km, 1 Hour)
Bias = -0.289518 ABS Error = 1.82359
RMSE = 2.34642 St Dev = 2.32976
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

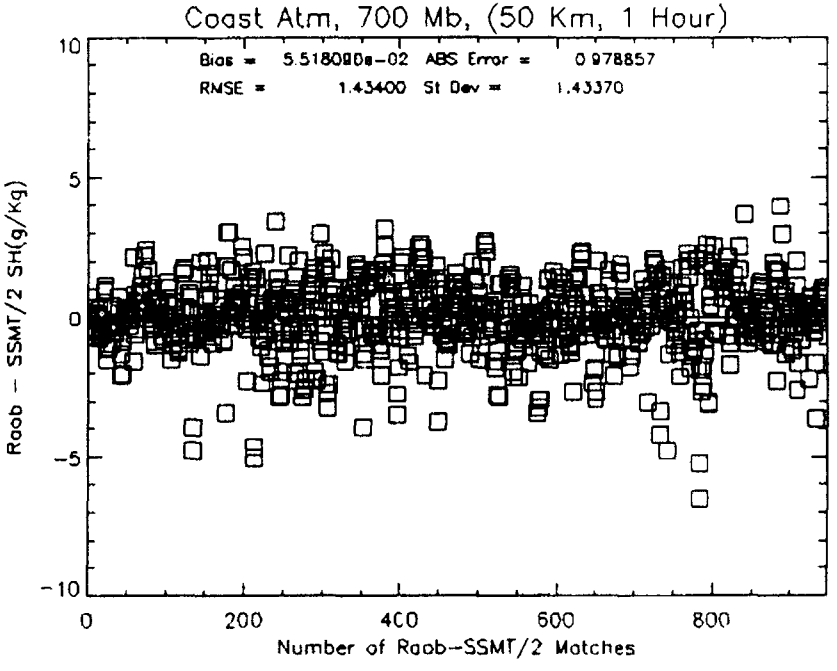
Ocean Atm, 850 Mb, (50 Km, 1 Hour) Non Ship
Bias = -1.58048 Abs Error = 2.01409
RMSE = 2.64324 St Dev = 2.13401
Total Ocean Atm Matches = 146
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Ocean Atm, 850 Mb, (50 Km, 1 Hour) Ship
Bias = -4.06816 ABS Error = 4.06821
RMSE = 4.39228 St Dev = 2.14132
Total Ocean Atm Matches = 146
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches


Ocean Atm, 700 Mb, (50 Km, 1 Hour) Non Ship
Bias = -1.33297 Abs Error = 1.81661
RMSE = 2.48394 St Dev = 2.12079
Total Ocean Atm Matches = 142
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Land Atm, 700 Mb, (50 Km, 1 Hour)
Bias = 0.183597 ABS Error = 1.35726
RMSE = 1.77038 St Dev = 1.76153
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm, 700 Mb, (50 Km, 1 Hour) Ship
Bias = -2.88519 ABS Error = 2.88877
RMSE = 3.82448 St Dev = 2.52322
Total Ocean Atm Matches = 142
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Coast Atm, 700 Mb, (50 Km, 1 Hour)
Bias = 5.518008e-02 ABS Error = 0.978857
RMSE = 1.43400 St Dev = 1.43370
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

Land Atm, 500 Mb, (50 Km, 1 Hour)
Bias = -8.153042e-02 ABS Error = 0.592871
RMSE = 0.827134 St Dev = 0.823393
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Coast Atm, 500 Mb, (50 Km, 1 Hour)
Bias = 2.147740e-04 ABS Error = 0.406220
RMSE = 0.610222 St Dev = 0.610499
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Ocean Atm, 500 Mb, (50 Km, 1 Hour) Non Ship
Bias = -0.568030 Abs Error = 1.30291
RMSE = 1.63724 St Dev = 1.55510
Total Ocean Atm Matches = 139
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

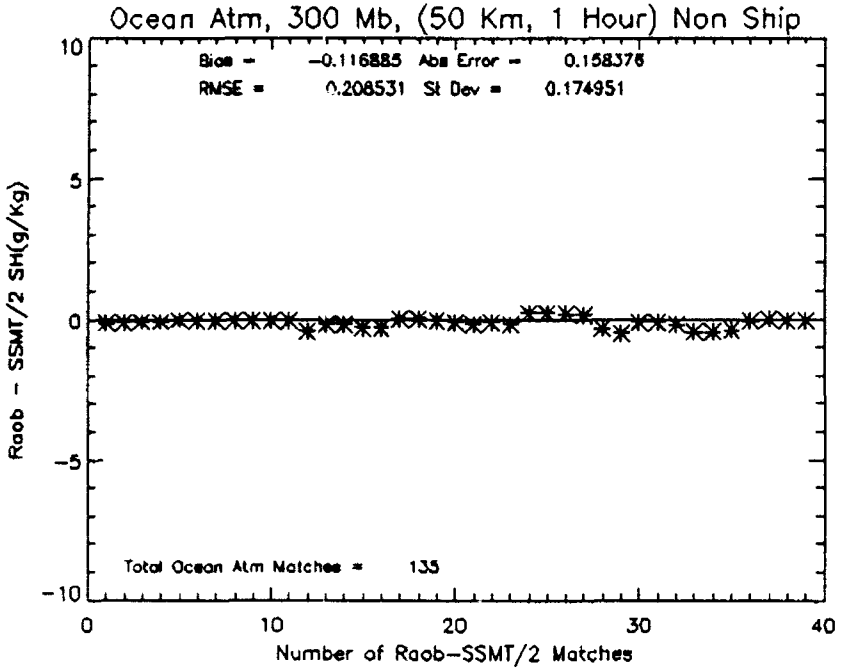
Ocean Atm, 500 Mb, (50 Km, 1 Hour) Ship
Bias = -0.960812 ABS Error = 1.02227
RMSE = 1.49284 St Dev = 1.14810
Total Ocean Atm Matches = 139
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

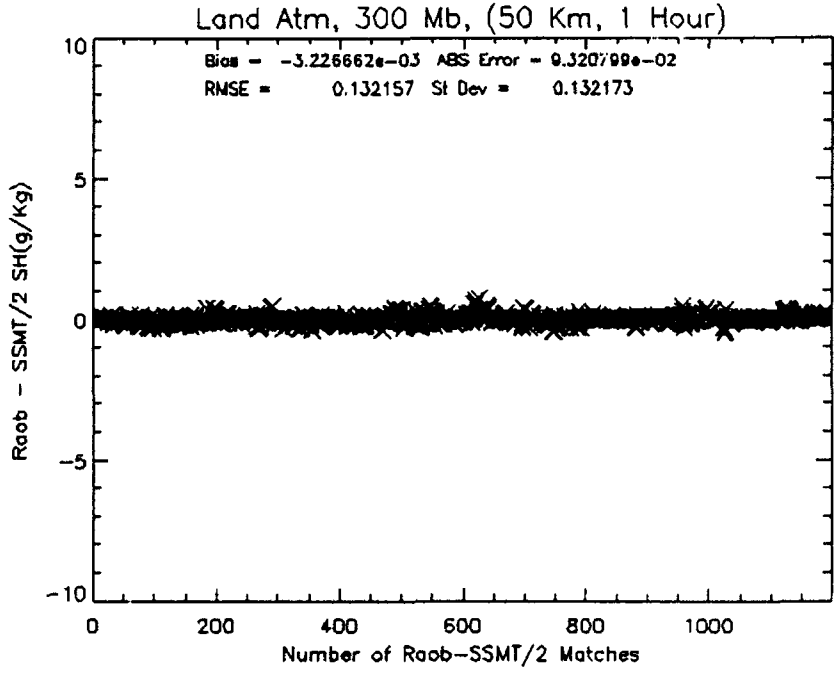
Land Atm, 400 Mb, (50 Km, 1 Hour)
Bias = -0.141858 ABS Error = 0.305871
RMSE = 0.432196 St Dev = 0.408401
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

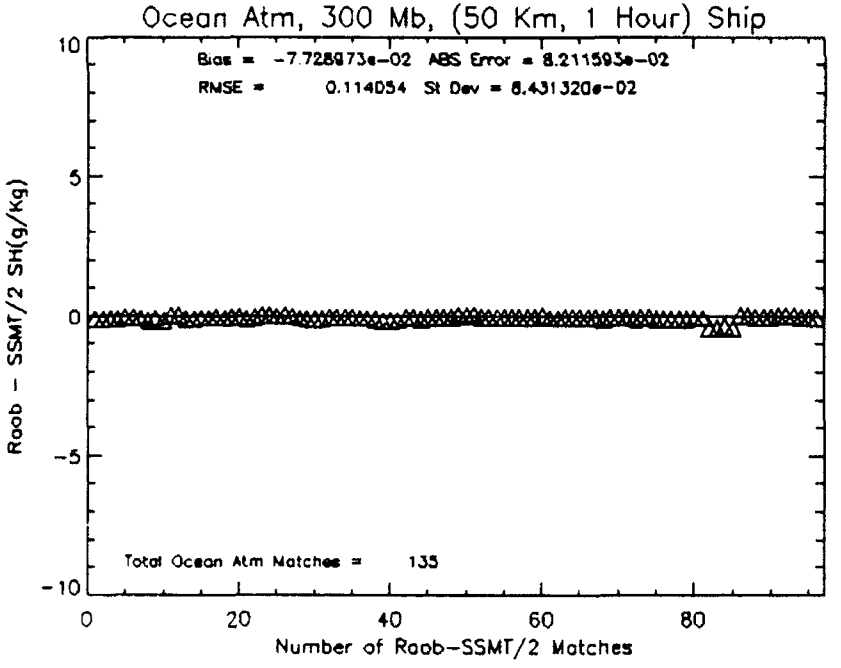
Coast Atm, 400 Mb, (50 Km, 1 Hour)
Bias = -5.936304e-02 ABS Error = 0.190965
RMSE = 0.318800 St Dev = 0.313373
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

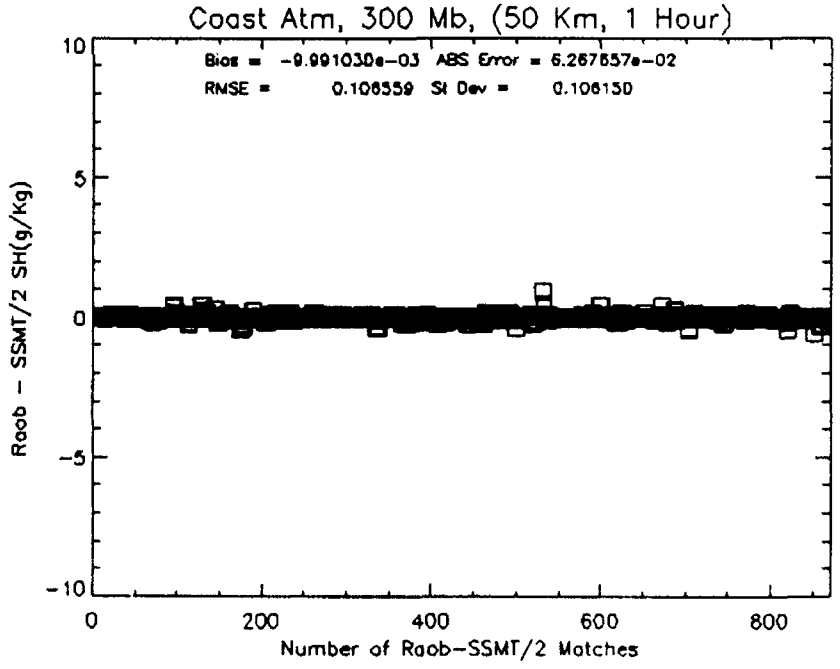
Ocean Atm, 400 Mb, (50 Km, 1 Hour) Non Ship
Bias = -0.198767 Abs Error = 0.364226
RMSE = 0.519472 St Dev = 0.485620
Total Ocean Atm Matches = 142
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

Ocean Atm, 400 Mb, (50 Km, 1 Hour) Ship
Bias = -0.334045 ABS Error = 0.340844
RMSE = 0.494314 St Dev = 0.368217
Total Ocean Atm Matches = 142
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches


Ocean Atm, 300 Mb, (50 Km, 1 Hour) Non Ship
Bias = -0.116885 Abs Error = 0.158376
RMSE = 0.208531 St Dev = 0.174951
Total Ocean Atm Matches = 135
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Land Atm, 300 Mb, (50 Km, 1 Hour)
Bias = -3.226662e-03 ABS Error = 9.320799e-02
RMSE = 0.132157 St Dev = 0.132173
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm, 300 Mb, (50 Km, 1 Hour) Ship
Bias = -7.728973e-02 ABS Error = 8.211595e-02
RMSE = 0.114054 St Dev = 8.431320e-02
Total Ocean Atm Matches = 135
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

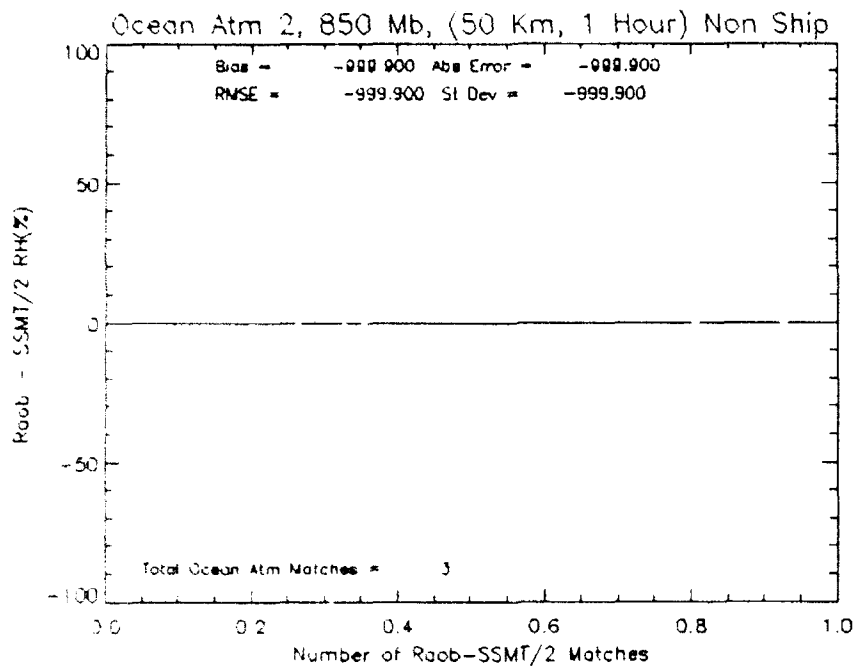

Coast Atm, 300 Mb, (50 Km, 1 Hour)
Bias = -9.991030e-03 ABS Error = 6.267657e-02
RMSE = 0.106559 St Dev = 0.106150
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

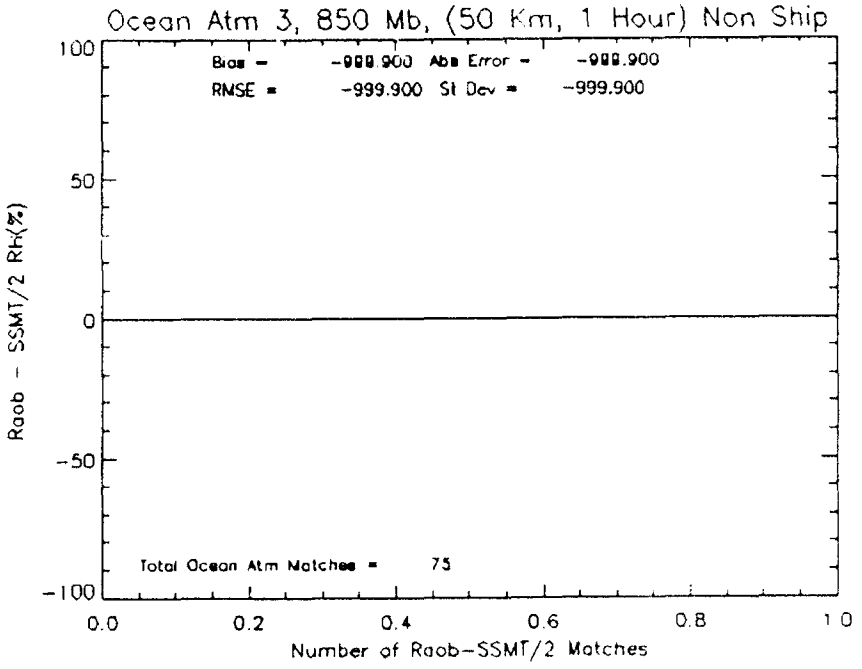
Ocean Atm 3, 1000 Mb, (50 Km, 1 Hour) Non Ship
Bias = -888.900 Abs Error = -888.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 72
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

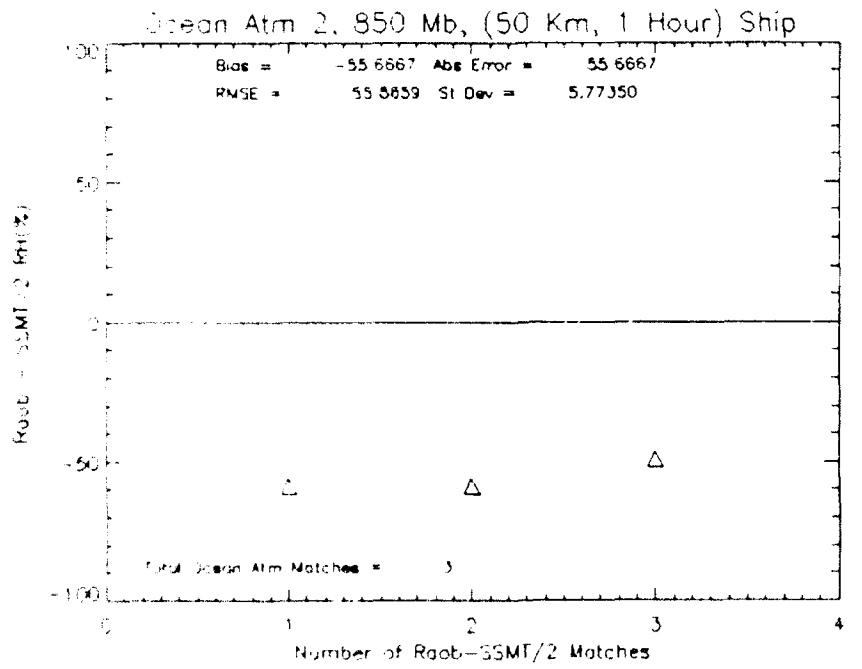
Ocean Atm 3, 1000 Mb, (50 Km, 1 Hour) Ship
Bias = -68.2939 Abs Error = 68.6454
RMSE = 73.8089 St Dev = 30.4649
Total Ocean Atm Matches = 72
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

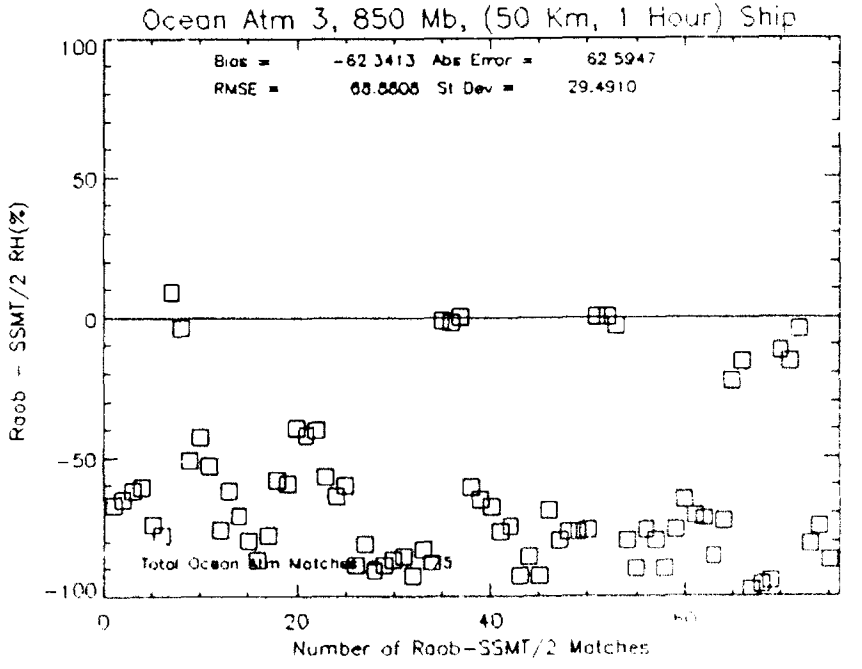
Ocean Atm 2, 1000 Mb, (50 Km, 1 Hour) Non Ship
Bias = -888.900 Abs Error = -888.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 2, 1000 Mb, (50 Km, 1 Hour) Ship
Bias = -72.6667 Abs Error = 72.6667
RMSE = 72.8037 St Dev = 5.50757
Total Ocean Atm Matches = 3
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 850 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 850 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 75
Raob - SSMT/2 Rh(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 850 Mb, (50 Km, 1 Hour) Ship
Bias = -55.6667 Abs Error = 55.6667
RMSE = 55.8659 St Dev = 5.77350
Total Ocean Atm Matches = 3
Number of Raob-SSMT/2 Matches

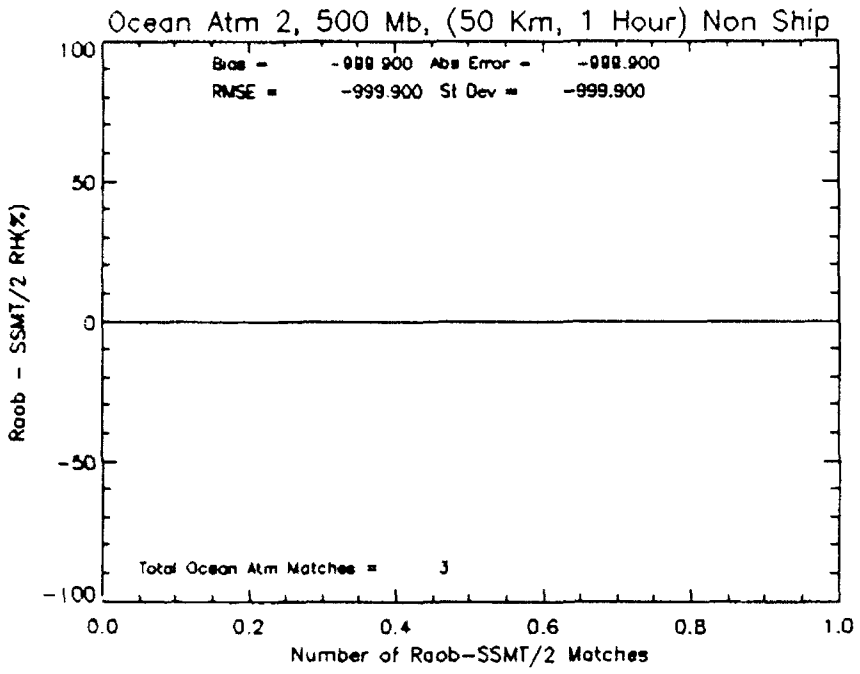

Ocean Atm 3, 850 Mb, (50 Km, 1 Hour) Ship
Bias = -62.3413 Abs Error = 62.5947
RMSE = 68.8808 St Dev = 29.4910
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

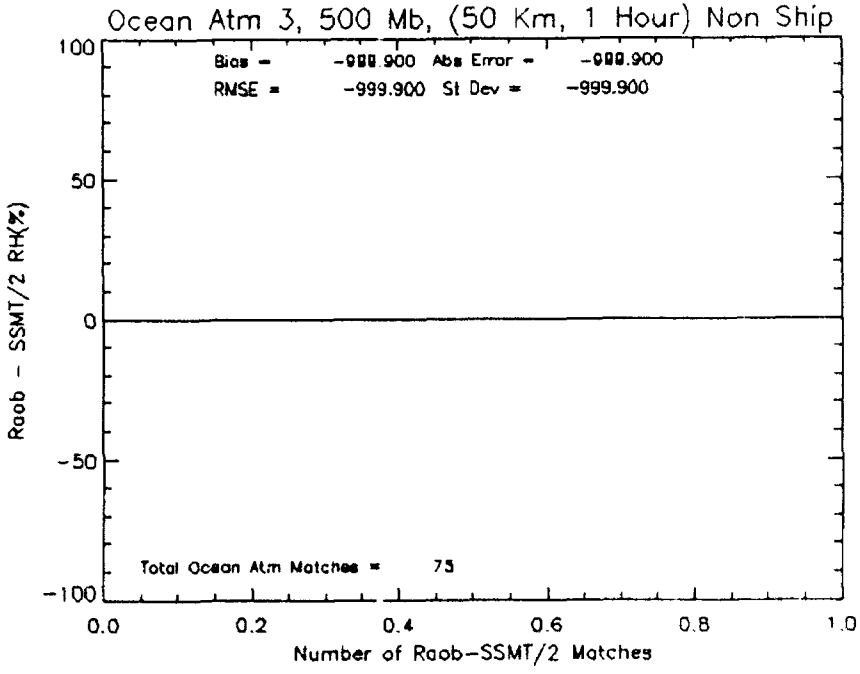
Ocean Atm 3, 700 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 75
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

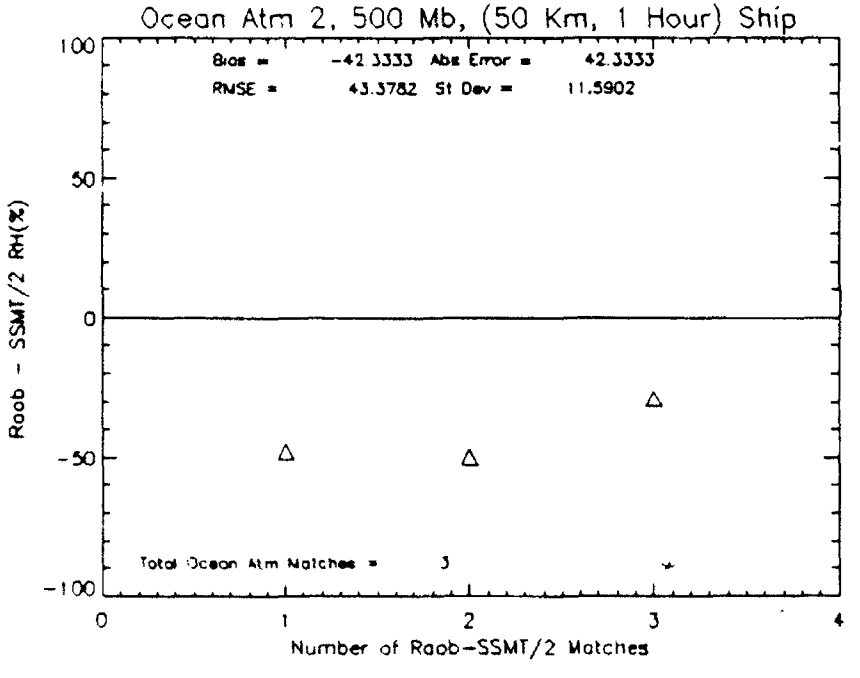
Ocean Atm 3, 700 Mb, (50 Km, 1 Hour) Ship
Bias = -53.2268 Abs Error = 54.0528
RMSE = 57.9368 St Dev = 23.0360
Total Ocean Atm Matches = 75
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

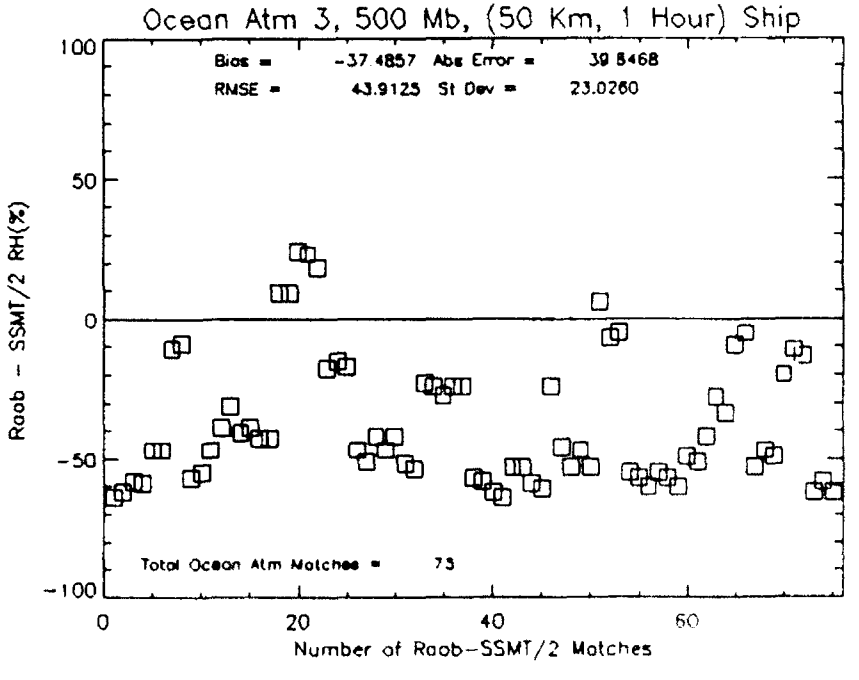
Ocean Atm 2, 700 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

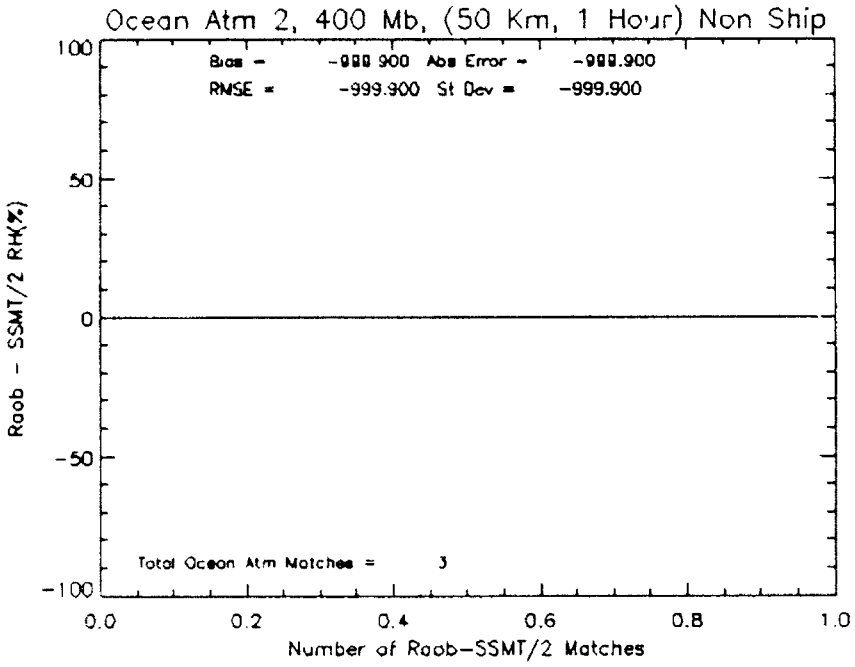
Ocean Atm 2, 700 Mb, (50 Km, 1 Hour) Ship
Bias = -48.0000 Abs Error = 48.0000
RMSE = 49.7293 St Dev = 10.3923
Total Ocean Atm Matches = 3
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

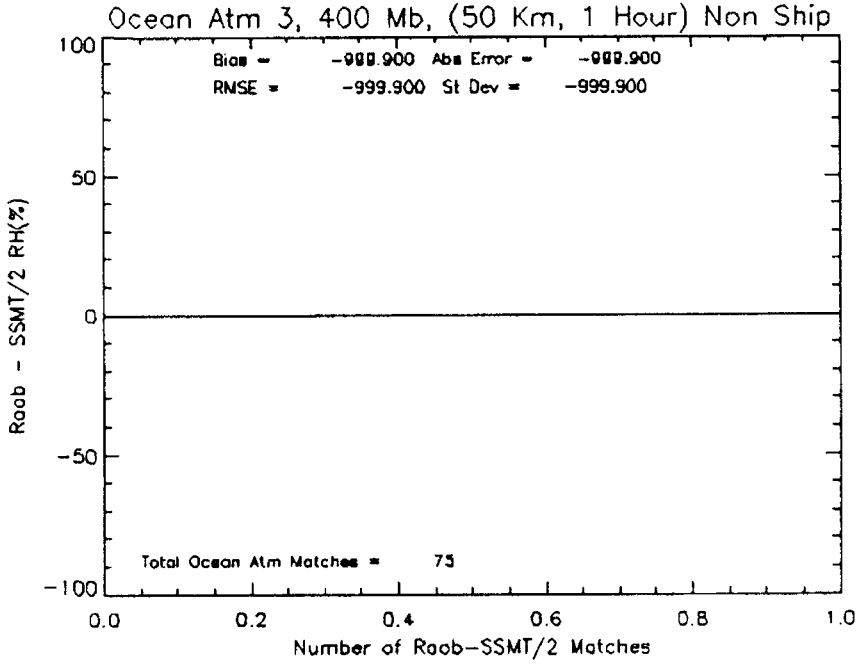

Ocean Atm 2, 500 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

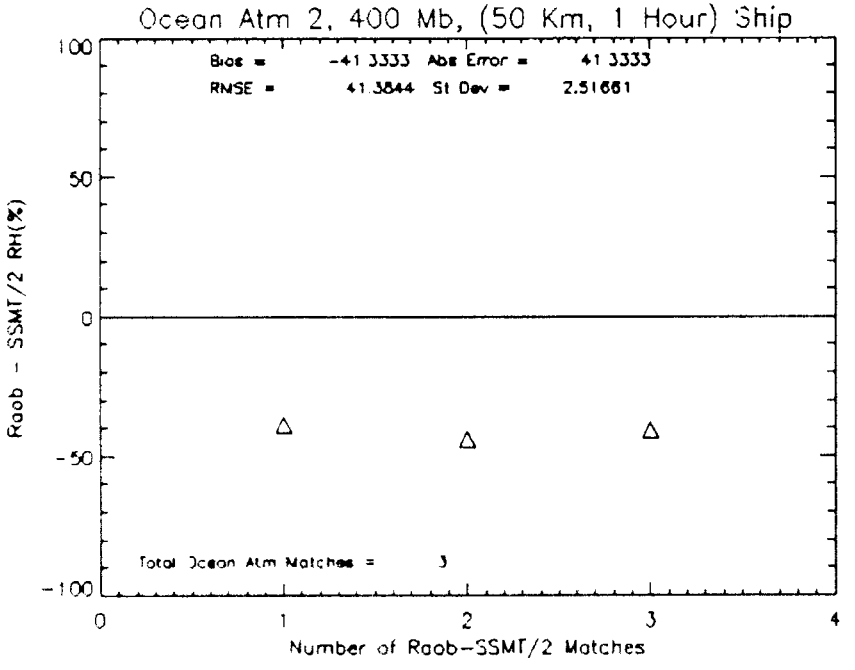

Ocean Atm 3, 500 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 75
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

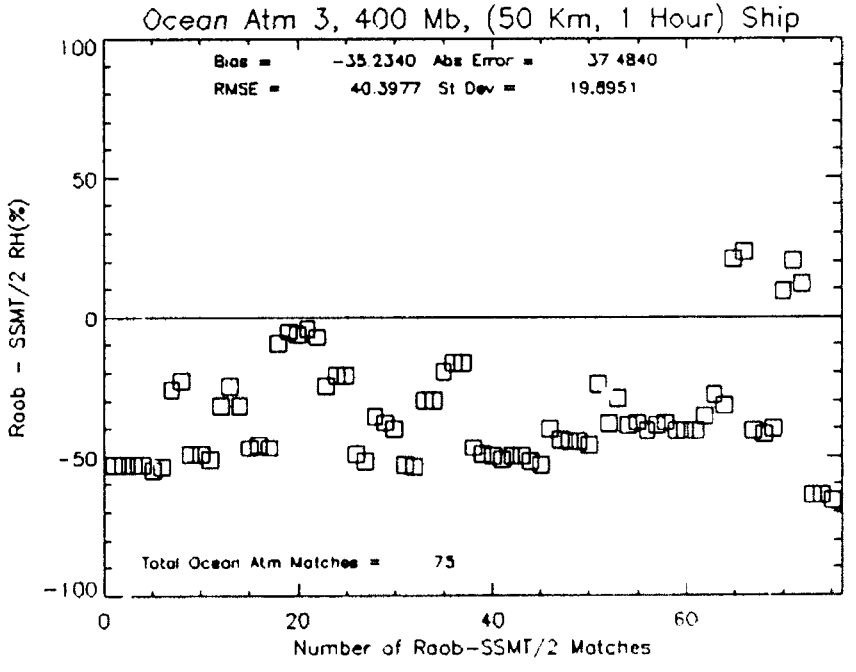

Ocean Atm 2, 500 Mb, (50 Km, 1 Hour) Ship
Bias = -42.3333 Abs Error = 42.3333
RMSE = 43.3782 St Dev = 11.5902
Total Ocean Atm Matches = 3
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 500 Mb, (50 Km, 1 Hour) Ship
Bias = -37.4857 Abs Error = 39.8468
RMSE = 43.9125 St Dev = 23.0260
Total Ocean Atm Matches = 75
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 400 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 400 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 75
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 400 Mb, (50 Km, 1 Hour) Ship
Bias = -41.3333 Abs Error = 41.3333
RMSE = 41.3844 St Dev = 2.51661
Total Ocean Atm Matches = 3
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

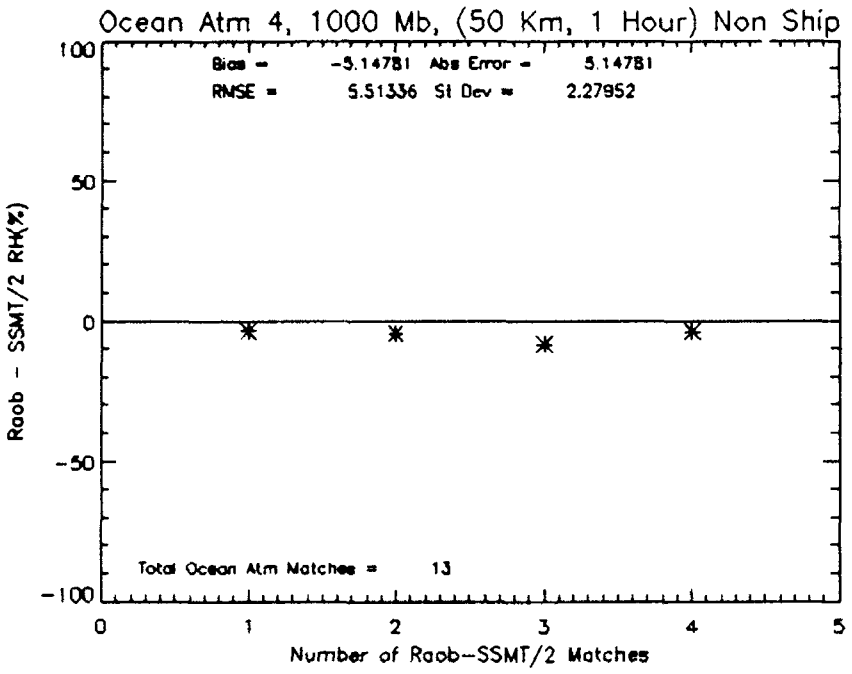

Ocean Atm 3, 400 Mb, (50 Km, 1 Hour) Ship
Bias = -35.2340 Abs Error = 37.4840
RMSE = 40.3977 St Dev = 19.8951
Total Ocean Atm Matches = 75
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

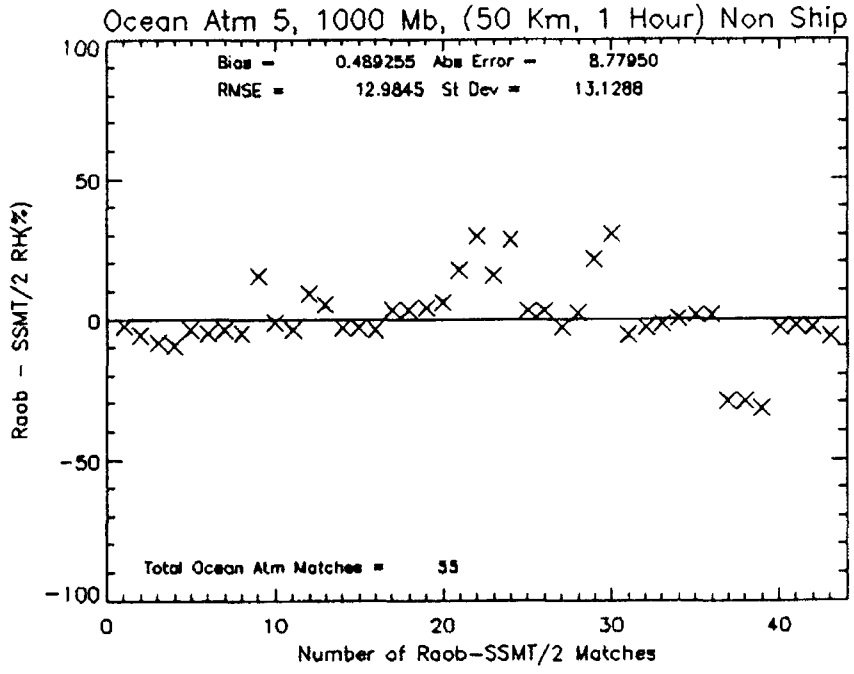
Ocean Atm 3, 300 Mb, (50 Km, 1 Hour) Non Ship
Bias = -888.900 Abs Error = -888.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 72
Rsob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

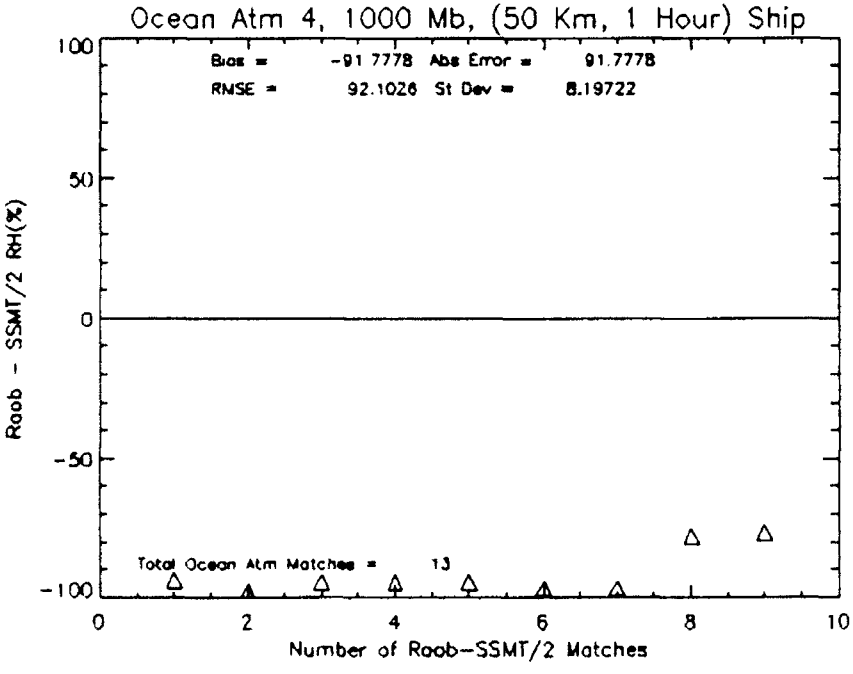
Ocean Atm 3, 300 Mb, (50 Km, 1 Hour) Ship
Bias = -18.1198 Abs Error = 23.6573
RMSE = 24.7632 St Dev = 17.0000
Total Ocean Atm Matches = 72
Rsob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

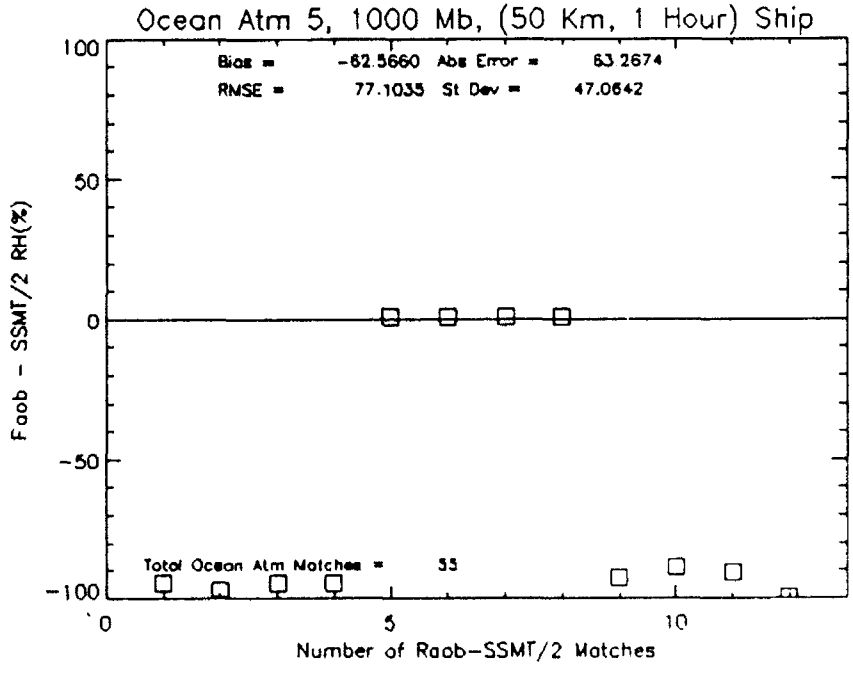
Ocean Atm 2, 300 Mb, (50 Km, 1 Hour) Non Ship
Bias = -888.900 Abs Error = -888.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Rsob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 2, 300 Mb, (50 Km, 1 Hour) Ship
Bias = -27.6667 Abs Error = 27.6667
RMSE = 27.7789 St Dev = 3.05505
Total Ocean Atm Matches = 3
Rsob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 4, 1000 Mb, (50 Km, 1 Hour) Non Ship
Bias = -5.14781 Abs Error = 5.14781
RMSE = 5.51336 St Dev = 2.27952
Total Ocean Atm Matches = 13
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 1000 Mb, (50 Km, 1 Hour) Non Ship
Bias = 0.489255 Abs Error = 8.77950
RMSE = 12.9845 St Dev = 13.1288
Total Ocean Atm Matches = 55
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 4, 1000 Mb, (50 Km, 1 Hour) Ship
Bias = -91.7778 Abs Error = 91.7778
RMSE = 92.1026 St Dev = 8.19722
Total Ocean Atm Matches = 13
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 1000 Mb, (50 Km, 1 Hour) Ship
Bias = -62.5660 Abs Error = 63.2674
RMSE = 77.1035 St Dev = 47.0642
Total Ocean Atm Matches = 55
Faob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 5, 850 Mb, (50 Km, 1 Hour) Non Ship
Bias = -8.68764 Abs Error = 14.3111
RMSE = 18.2697 St Dev = 16.2566
Total Ocean Atm Matches = 33
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 5, 850 Mb, (50 Km, 1 Hour) Ship
Bias = -61.0678 Abs Error = 63.8322
RMSE = 78.8787 St Dev = 46.4304
Total Ocean Atm Matches = 33
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

Ocean Atm 4, 850 Mb, (50 Km, 1 Hour) Non Ship
Bias = -14.1752 Abs Error = 14.1752
RMSE = 15.8919 St Dev = 8.29586
Total Ocean Atm Matches = 13
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

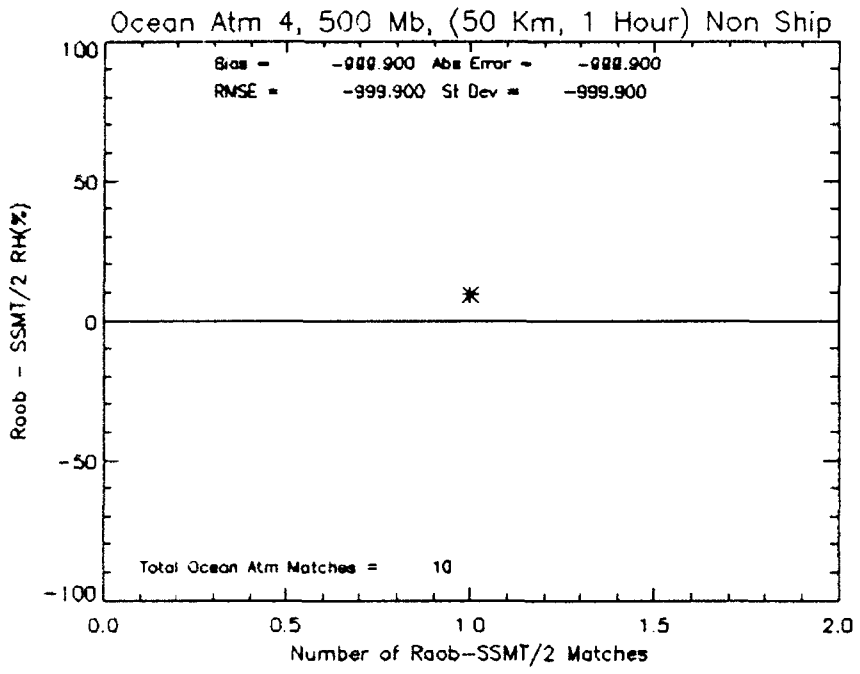
Ocean Atm 4, 850 Mb, (50 Km, 1 Hour) Ship
Bias = -91.5556 Abs Error = 91.5556
RMSE = 91.9070 St Dev = 8.51832
Total Ocean Atm Matches = 13
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

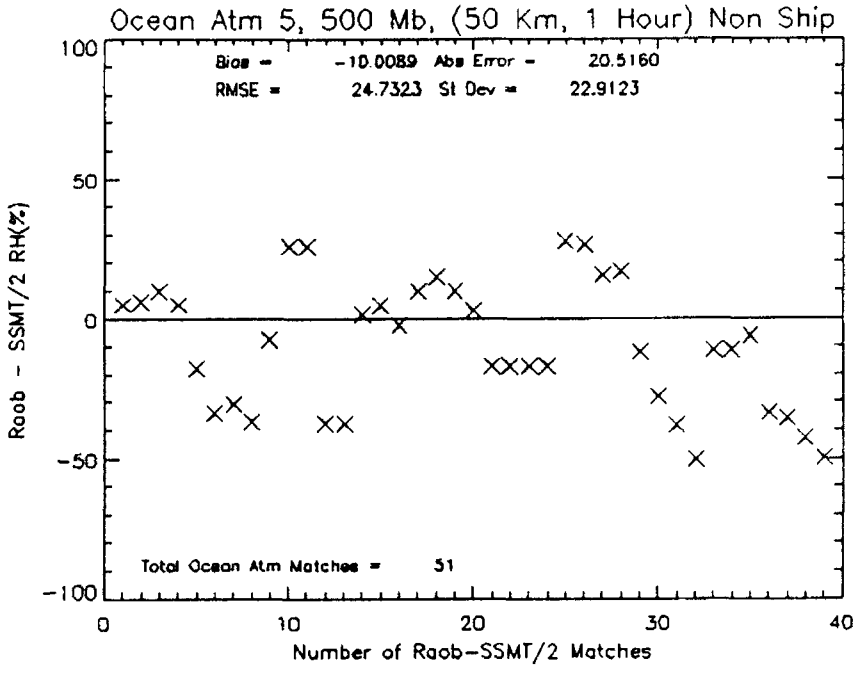
Ocean Atm 5, 700 Mb, (50 Km, 1 Hour) Non Ship
Bias = -9.48551 Abs Error = 16.3897
RMSE = 21.5988 St Dev = 19.6582
Total Ocean Atm Matches = 31
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

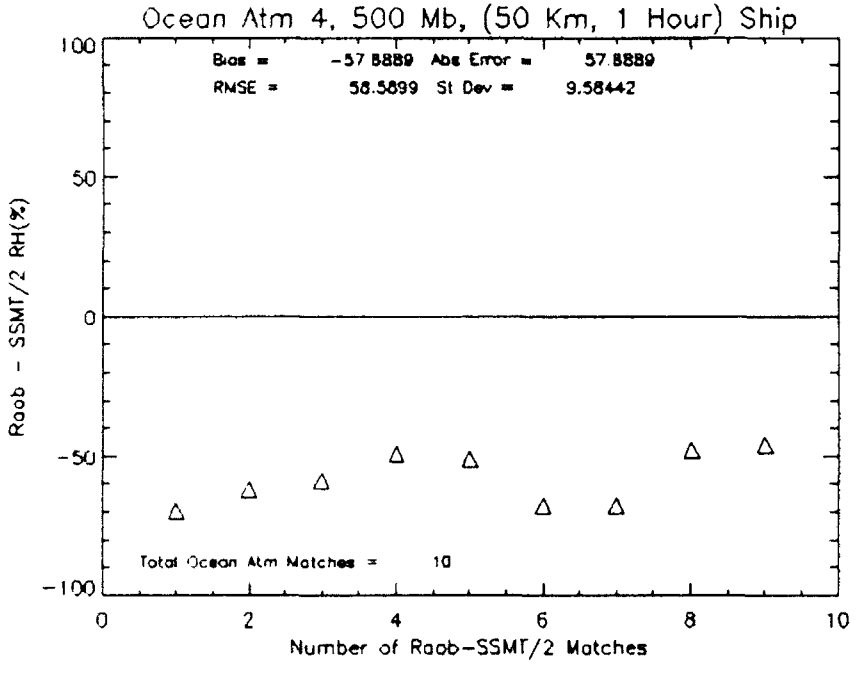
Ocean Atm 5, 700 Mb, (50 Km, 1 Hour) Ship
Bias = -61.7506 Abs Error = 64.5827
RMSE = 77.4124 St Dev = 48.7615
Total Ocean Atm Matches = 31
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

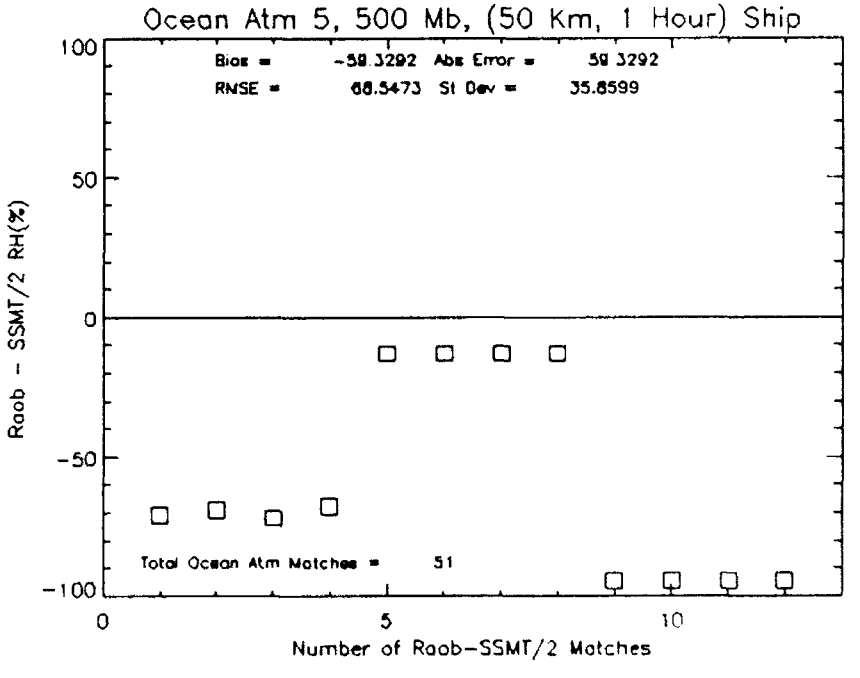
Ocean Atm 4, 700 Mb, (50 Km, 1 Hour) Non Ship
Bias = -12.8515 Abs Error = 12.8515
RMSE = 13.5752 St Dev = 5.04971
Total Ocean Atm Matches = 13
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

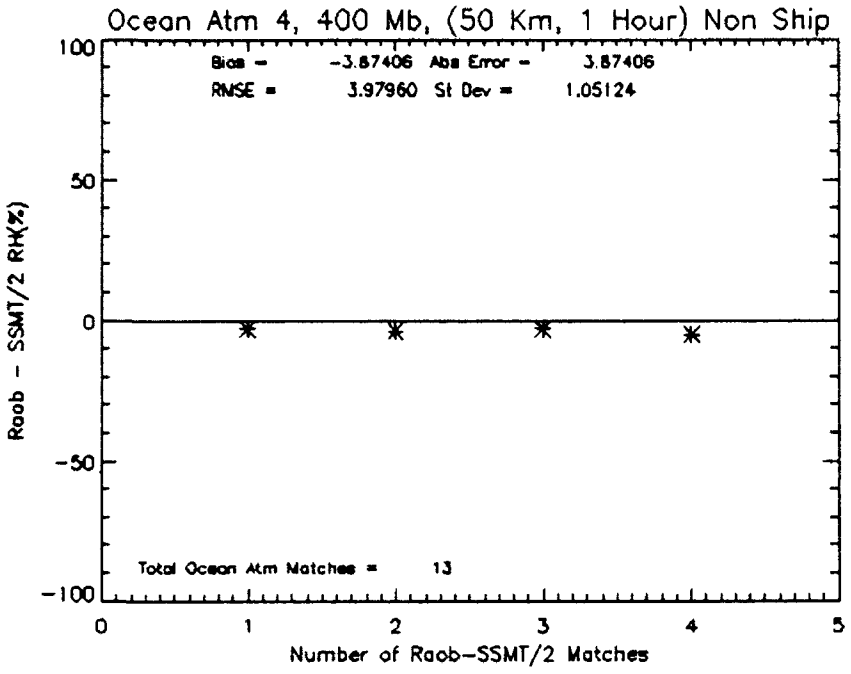
Ocean Atm 4, 700 Mb, (50 Km, 1 Hour) Ship
Bias = -87.3333 Abs Error = 87.3333
RMSE = 87.7496 St Dev = 9.05539
Total Ocean Atm Matches = 13
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

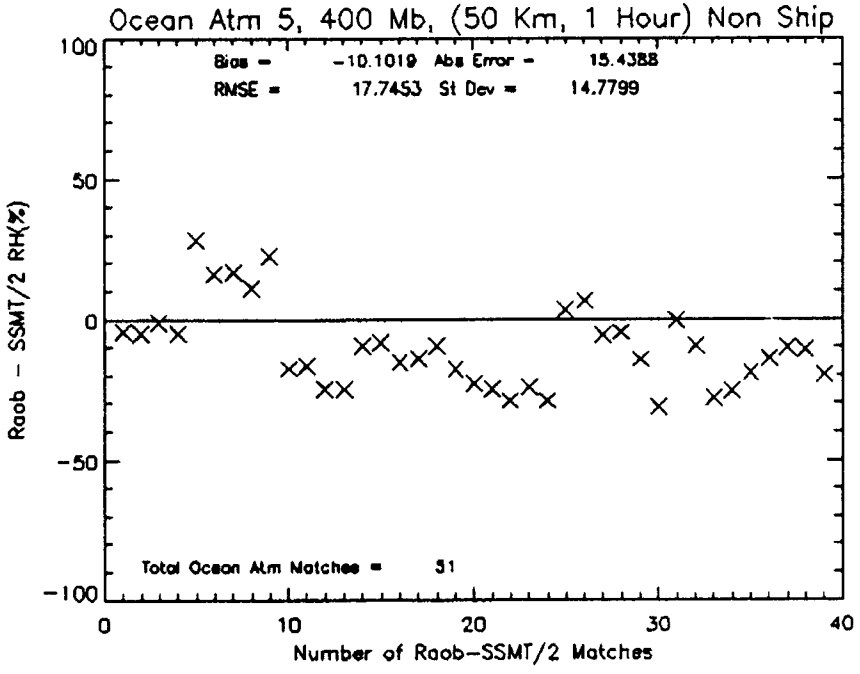

Ocean Atm 4, 500 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

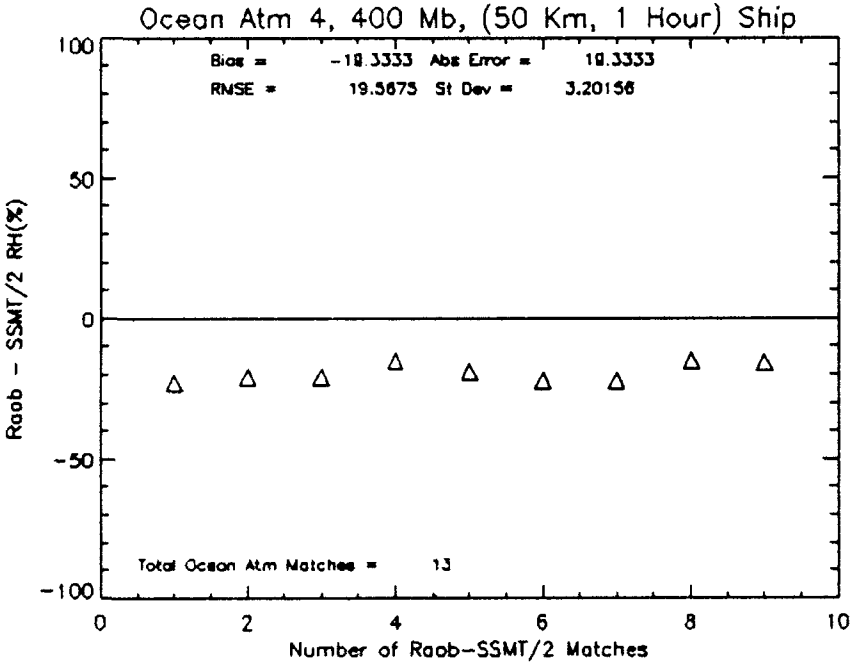

Ocean Atm 5, 500 Mb, (50 Km, 1 Hour) Non Ship
Bias = -10.0089 Abs Error = 20.5160
RMSE = 24.7323 St Dev = 22.9123
Total Ocean Atm Matches = 51
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

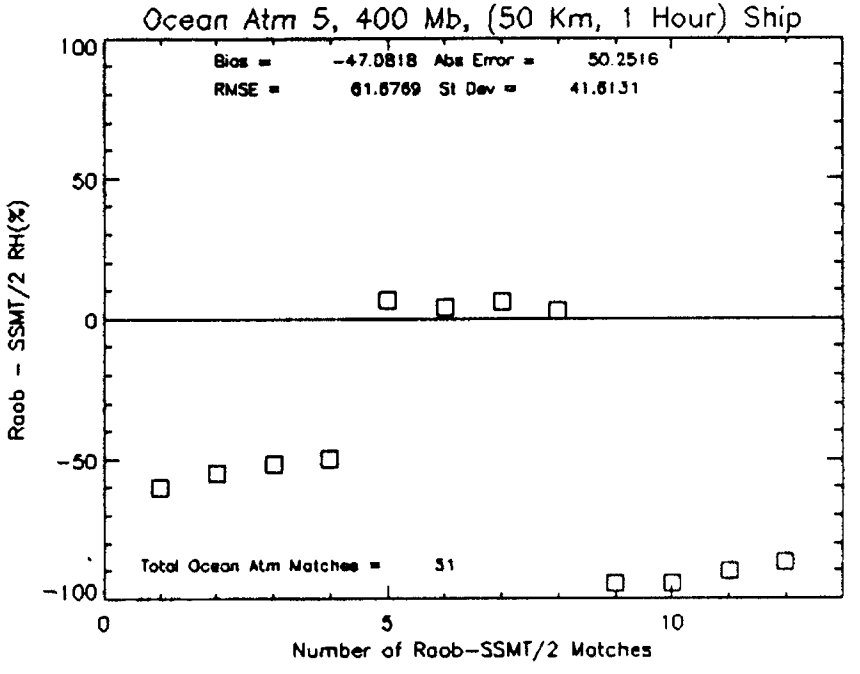

Ocean Atm 4, 500 Mb, (50 Km, 1 Hour) Ship
Bias = -57.8889 Abs Error = 57.8889
RMSE = 58.5699 St Dev = 9.58442
Total Ocean Atm Matches = 10
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

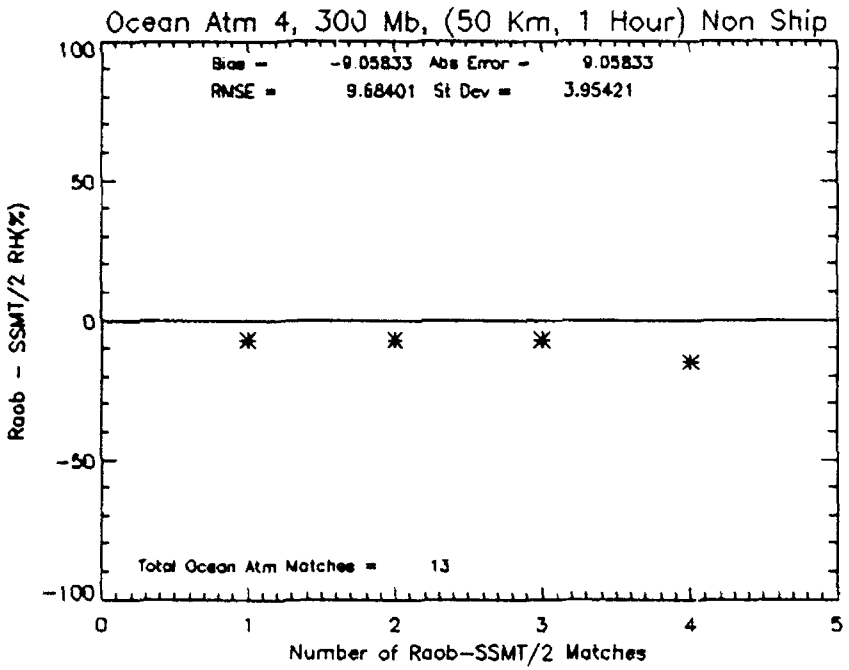

Ocean Atm 5, 500 Mb, (50 Km, 1 Hour) Ship
Bias = -59.3292 Abs Error = 59.3292
RMSE = 68.5473 St Dev = 35.8599
Total Ocean Atm Matches = 51
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

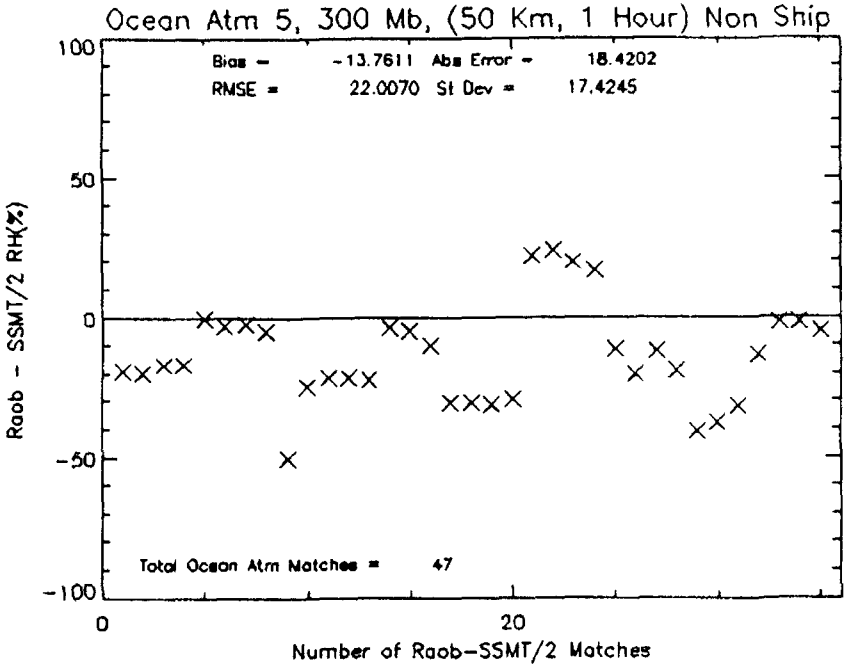

Ocean Atm 4, 400 Mb, (50 Km, 1 Hour) Non Ship
Bias = -3.87406 Abs Error = 3.87406
RMSE = 3.97960 St Dev = 1.05124
Total Ocean Atm Matches = 13
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

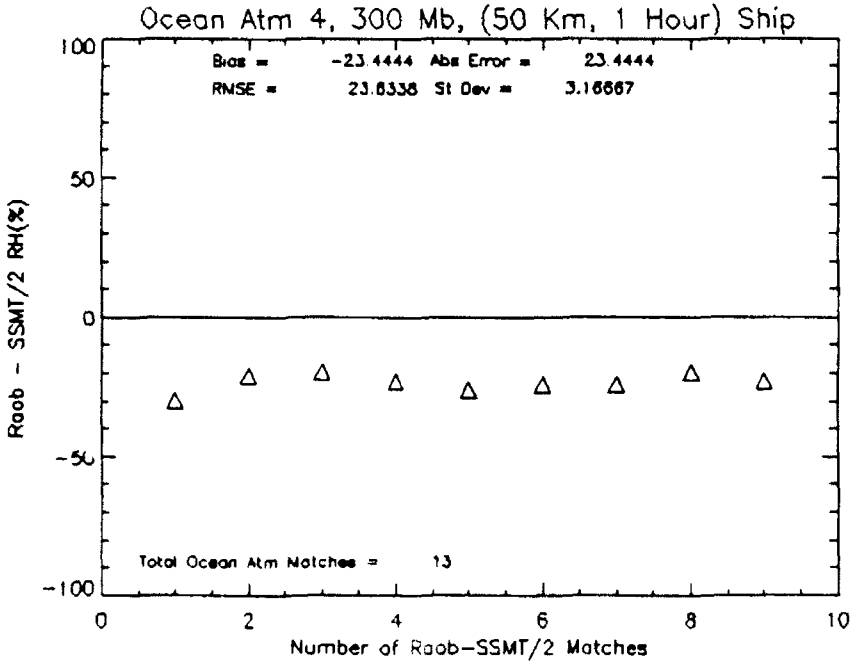

Ocean Atm 5, 400 Mb, (50 Km, 1 Hour) Non Ship
Bias = -10.1019 Abs Error = 15.4388
RMSE = 17.7453 St Dev = 14.7799
Total Ocean Atm Matches = 51
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

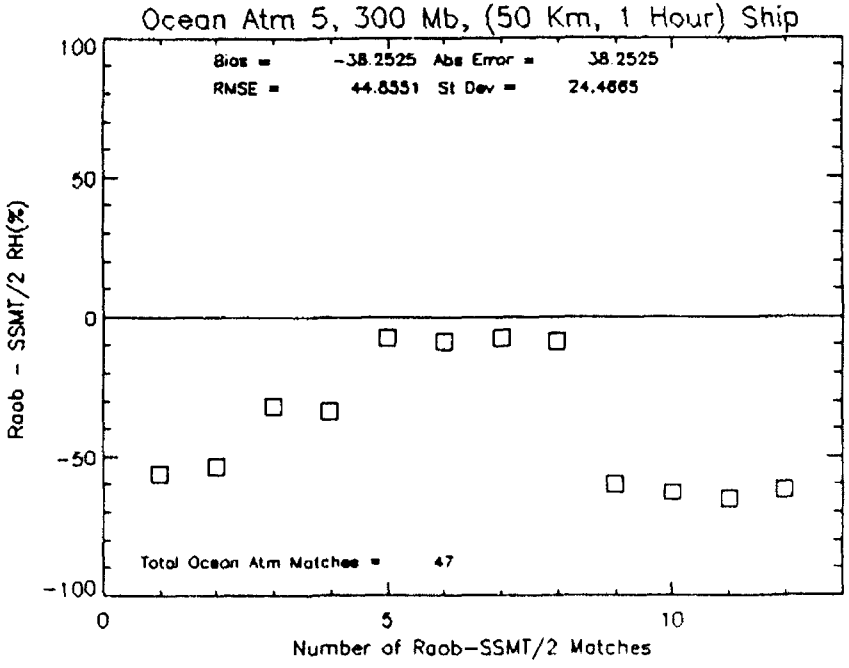

Ocean Atm 4, 400 Mb, (50 Km, 1 Hour) Ship
Bias = -18.3333 Abs Error = 18.3333
RMSE = 19.5675 St Dev = 3.20156
Total Ocean Atm Matches = 13
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

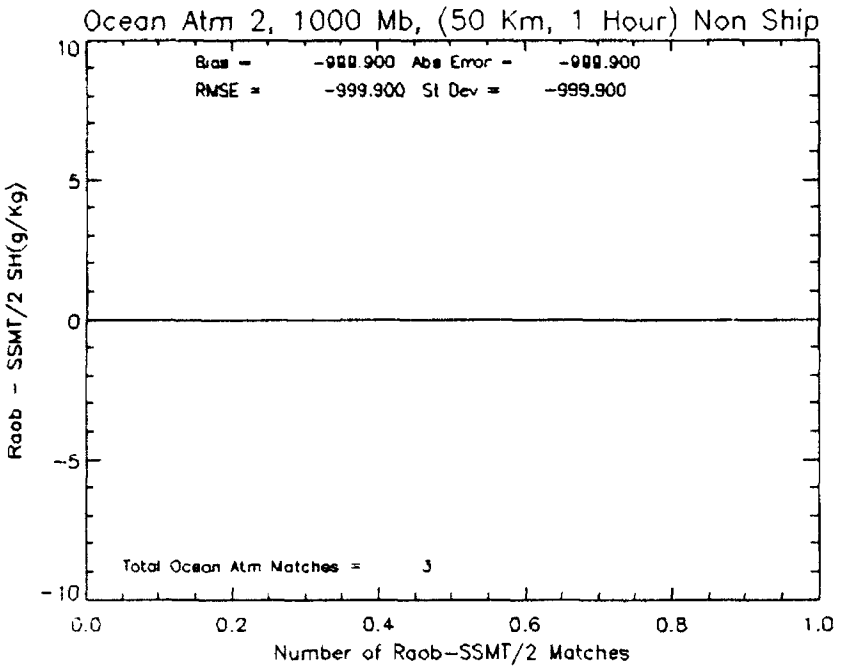

Ocean Atm 5, 400 Mb, (50 Km, 1 Hour) Ship
Bias = -47.0818 Abs Error = 50.2516
RMSE = 61.6769 St Dev = 41.6131
Total Ocean Atm Matches = 51
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

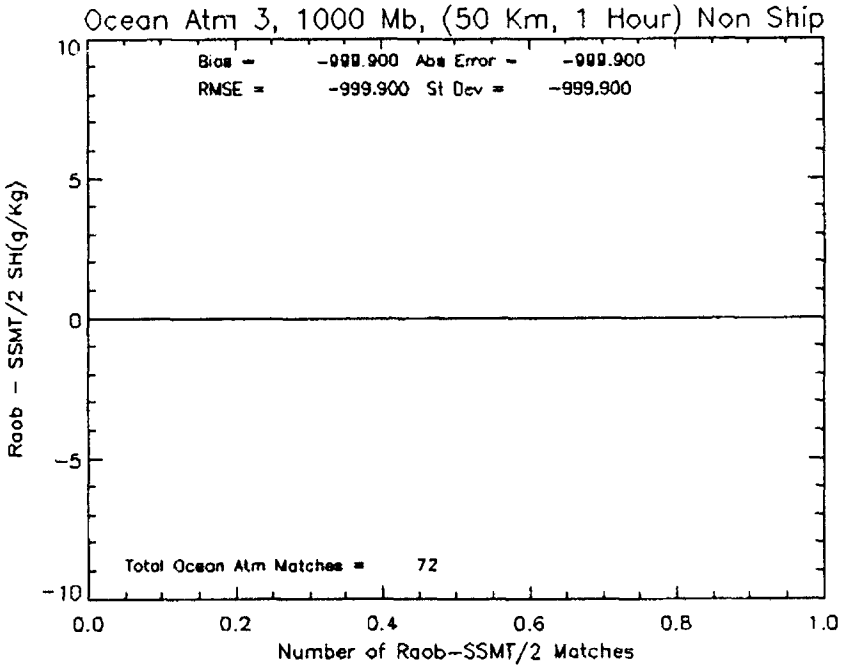

Ocean Atm 4, 300 Mb, (50 Km, 1 Hour) Non Ship
Bias = -9.05833 Abs Error = 9.05833
RMSE = 9.68401 St Dev = 3.95421
Total Ocean Atm Matches = 13
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

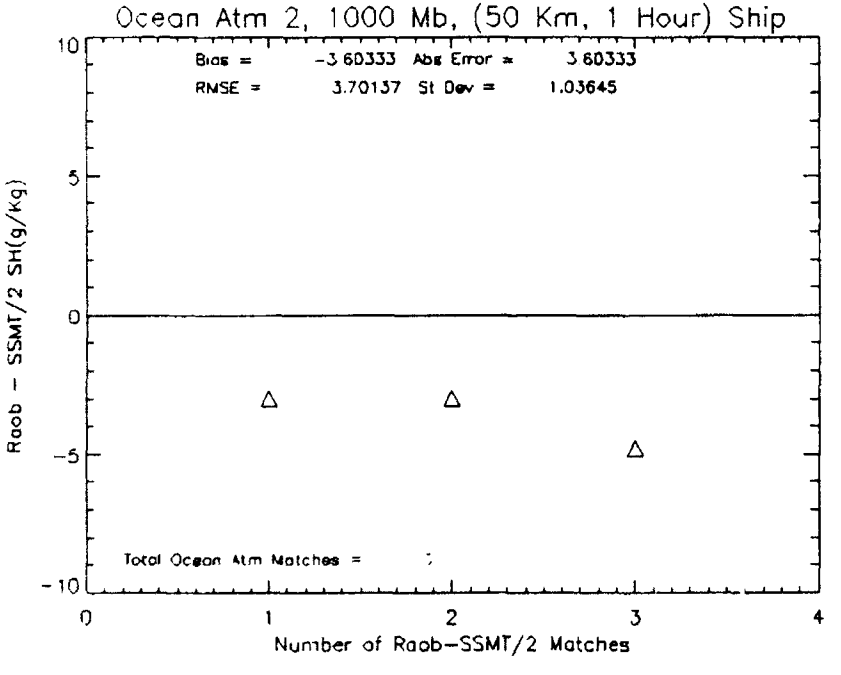

Ocean Atm 5, 300 Mb, (50 Km, 1 Hour) Non Ship
Bias = -13.7611 Abs Error = 18.4202
RMSE = 22.0070 St Dev = 17.4245
Total Ocean Atm Matches = 47
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

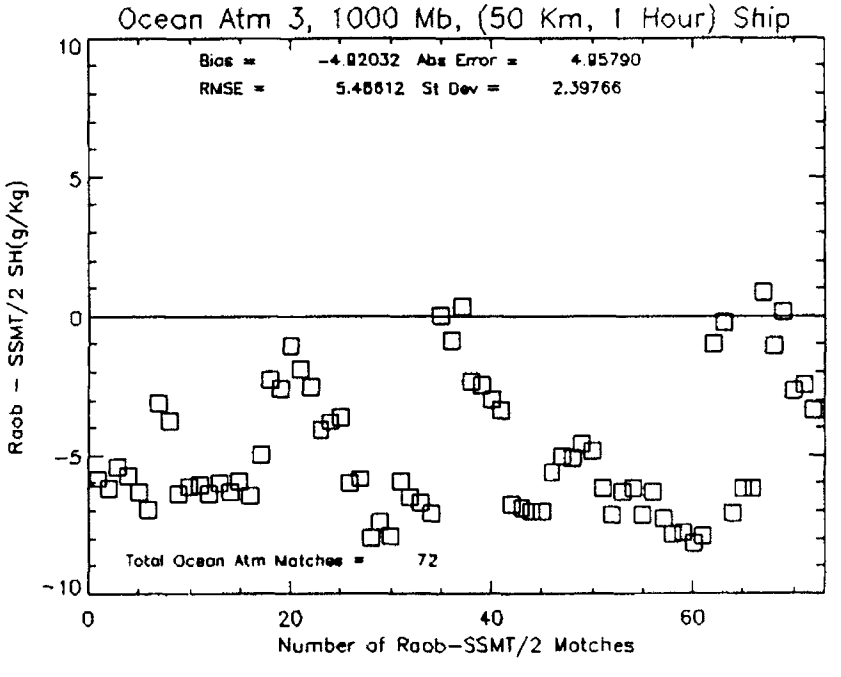

Ocean Atm 4, 300 Mb, (50 Km, 1 Hour) Ship
Bias = -23.4444 Abs Error = 23.4444
RMSE = 23.8338 St Dev = 3.16667
Total Ocean Atm Matches = 13
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

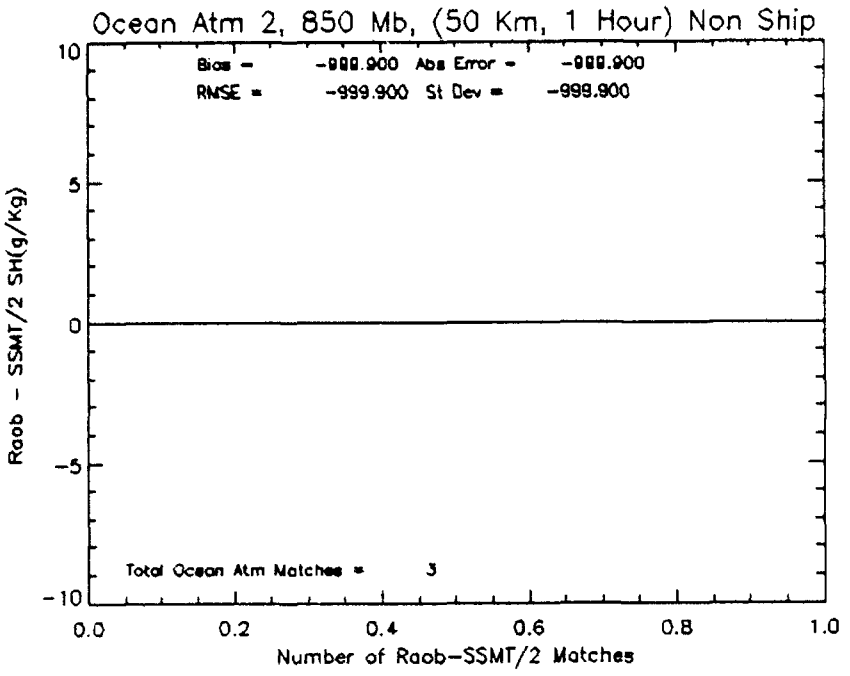

Ocean Atm 5, 300 Mb, (50 Km, 1 Hour) Ship
Bias = -38.2525 Abs Error = 38.2525
RMSE = 44.8551 St Dev = 24.4665
Total Ocean Atm Matches = 47
Raob - SSMT/2 RH(%)
Number of Raob-SSMT/2 Matches

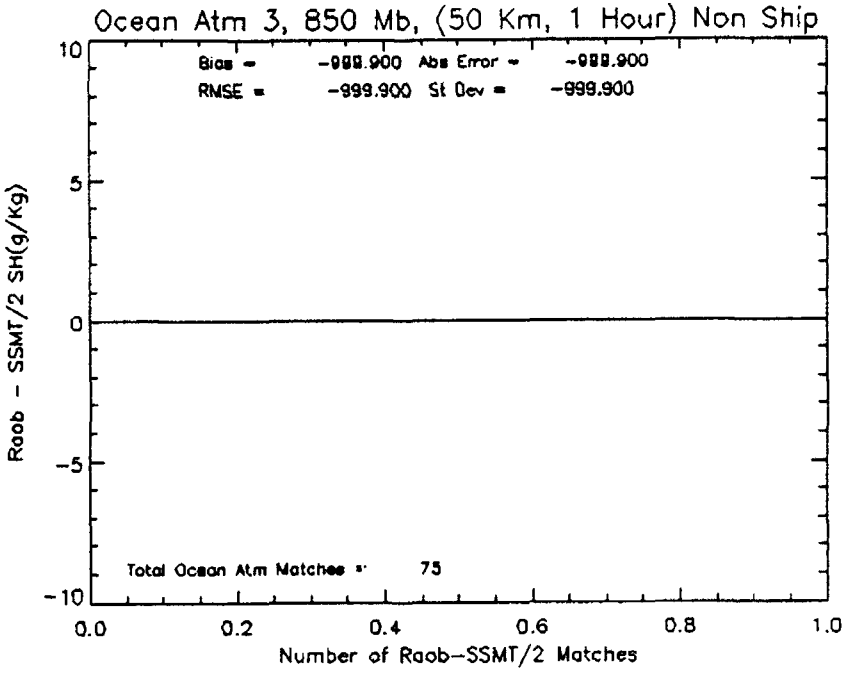

Ocean Atm 2, 1000 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

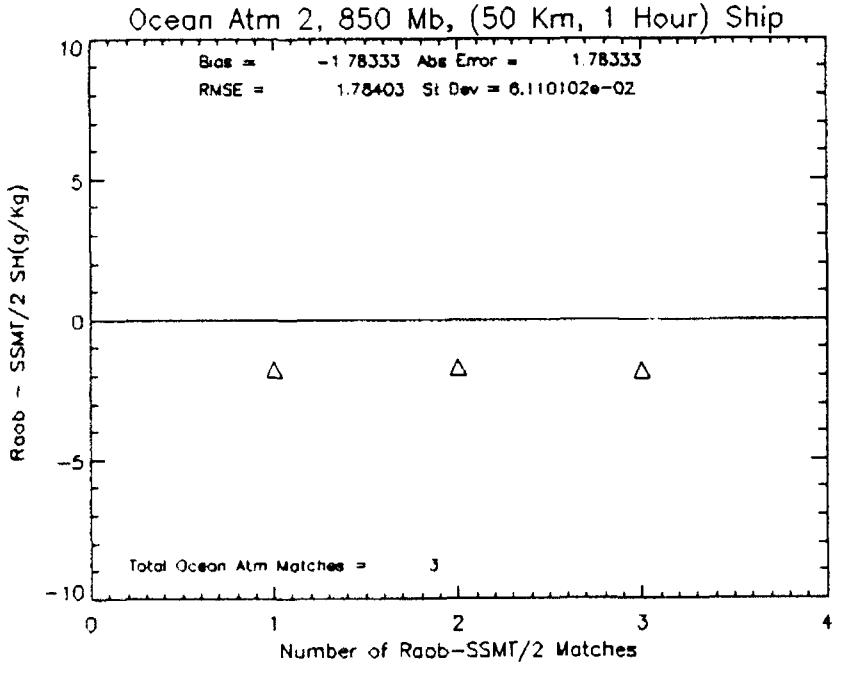

Ocean Atm 3, 1000 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 72
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

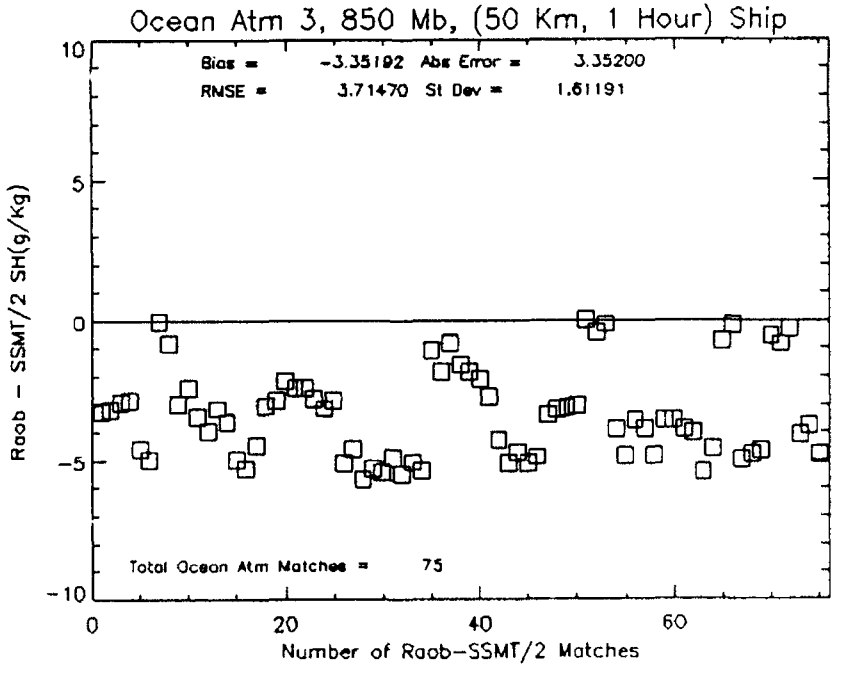

Ocean Atm 2, 1000 Mb, (50 Km, 1 Hour) Ship
Bias = -3.60333 Abs Error = 3.60333
RMSE = 3.70137 St Dev = 1.03645
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

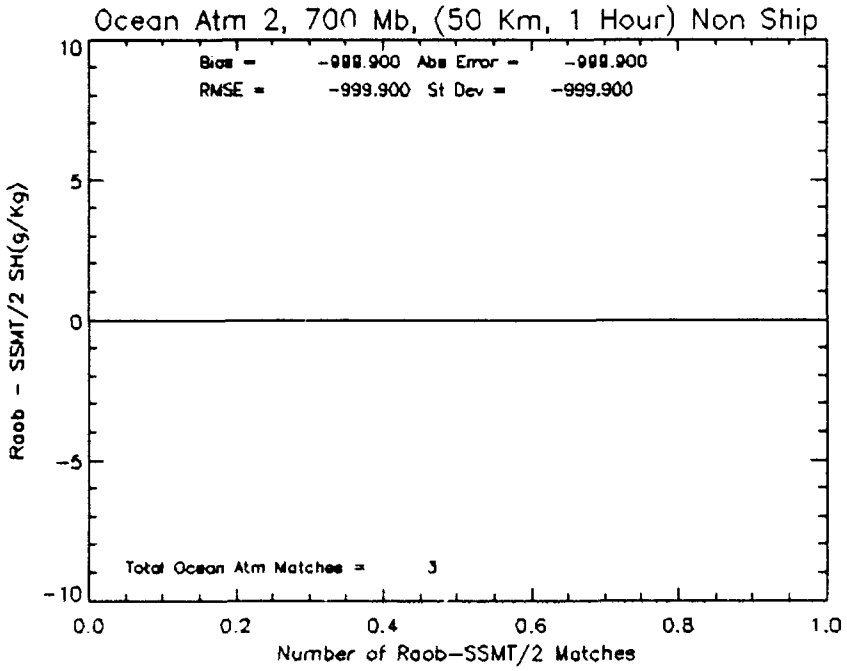

Ocean Atm 3, 1000 Mb, (50 Km, 1 Hour) Ship
Bias = -4.82032 Abs Error = 4.85790
RMSE = 5.48612 St Dev = 2.39766
Total Ocean Atm Matches = 72
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

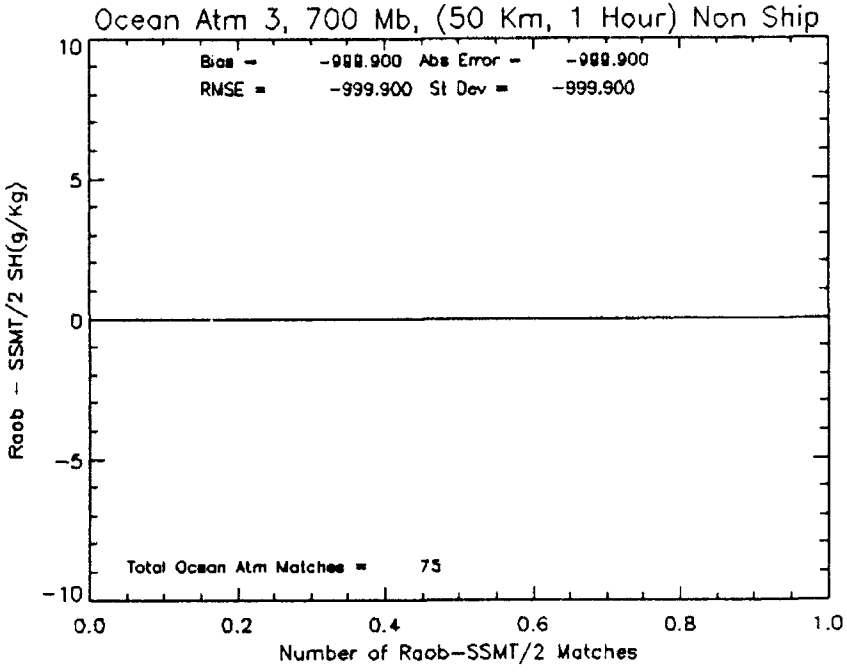

Ocean Atm 2, 850 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

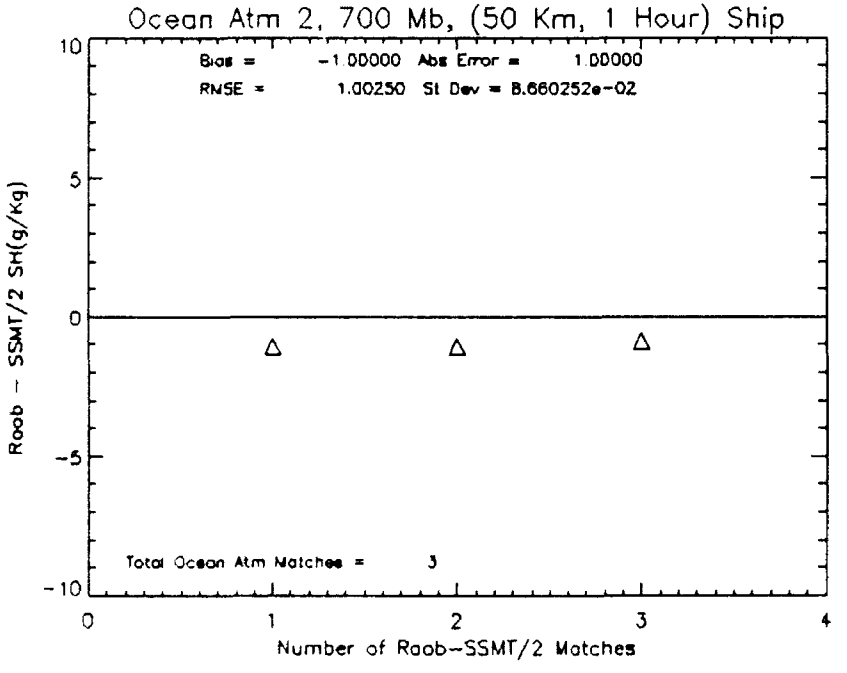

Ocean Atm 3, 850 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 75
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

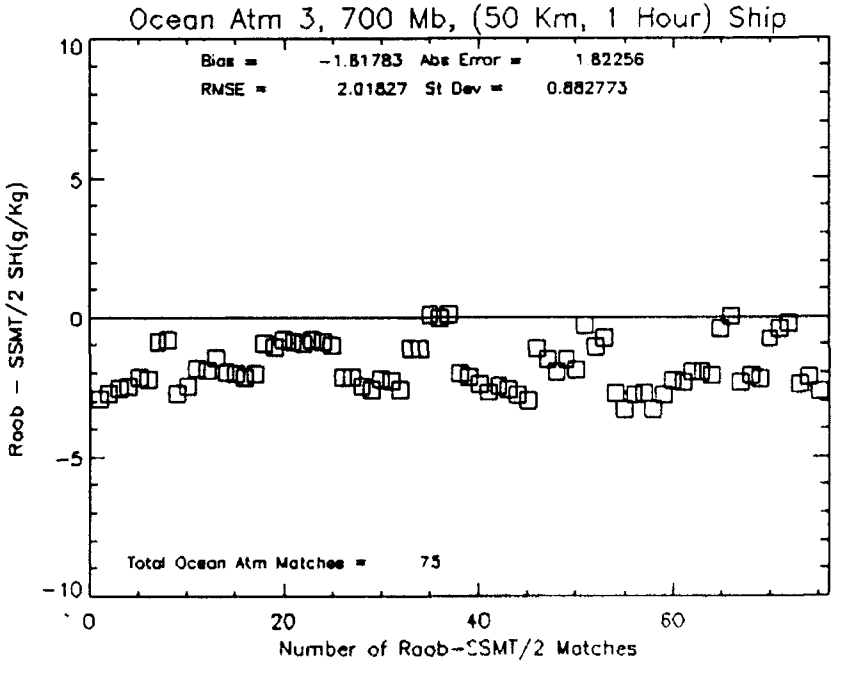

Ocean Atm 2, 850 Mb, (50 Km, 1 Hour) Ship
Bias = -1.78333 Abs Error = 1.78333
RMSE = 1.78403 St Dev = 6.110102e-02
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 3, 850 Mb, (50 Km, 1 Hour) Ship
Bias = -3.35192 Abs Error = 3.35200
RMSE = 3.71470 St Dev = 1.61191
Total Ocean Atm Matches = 75
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 2, 700 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

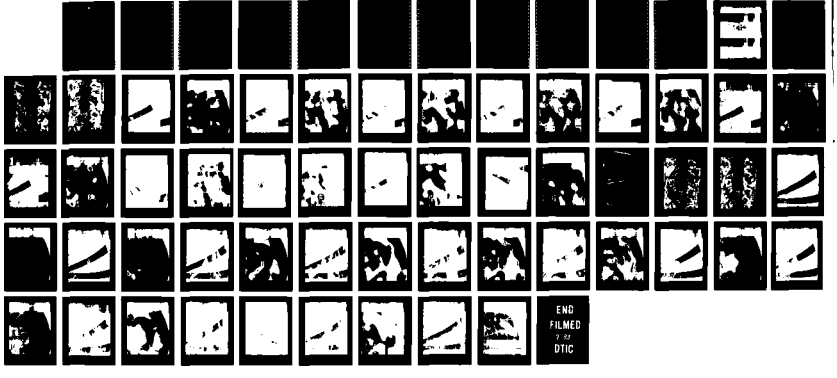

Ocean Atm 3, 700 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 75
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

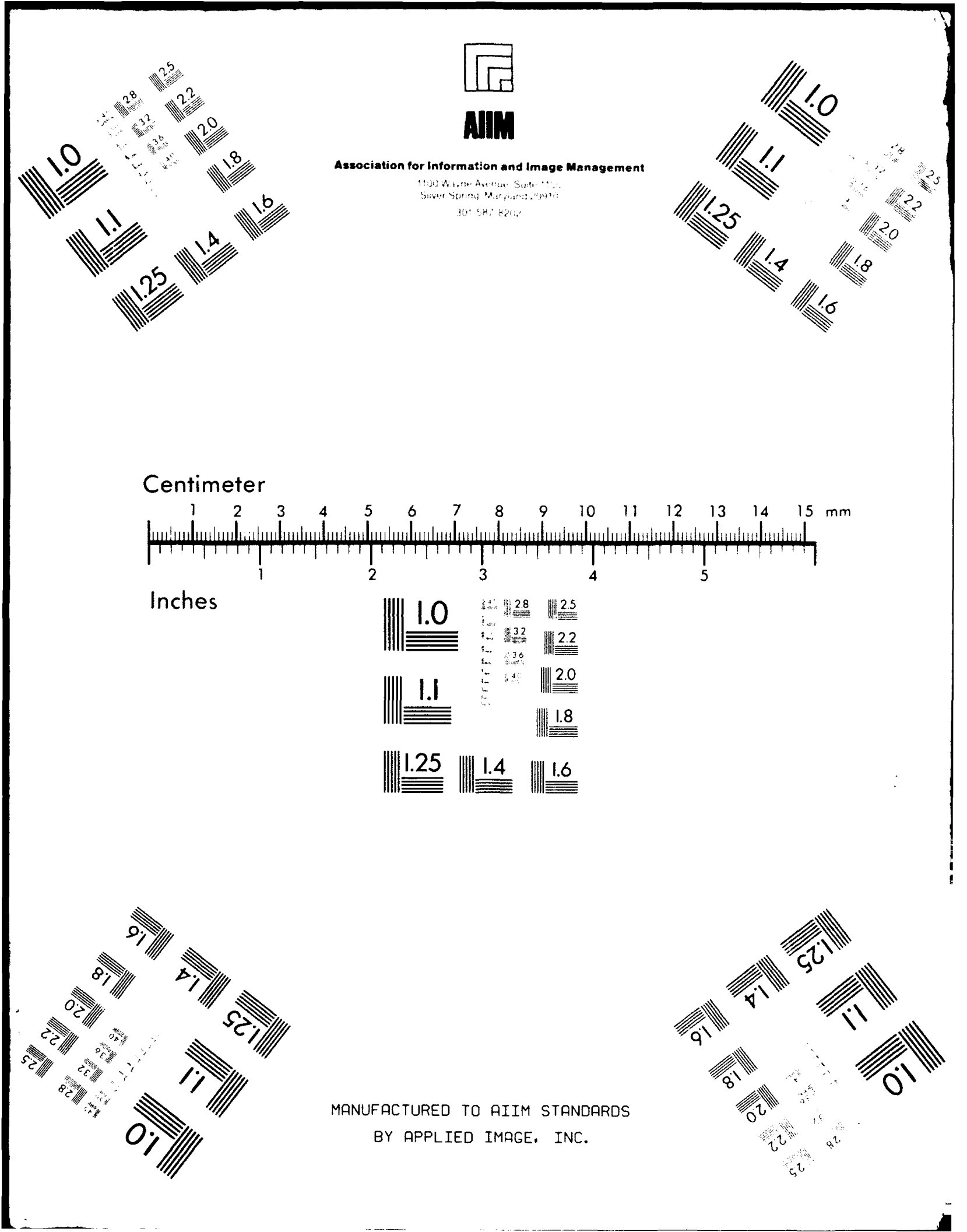

Ocean Atm 2, 700 Mb, (50 Km, 1 Hour) Ship
Bias = -1.00000 Abs Error = 1.00000
RMSE = 1.00250 St Dev = 8.660252e-02
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

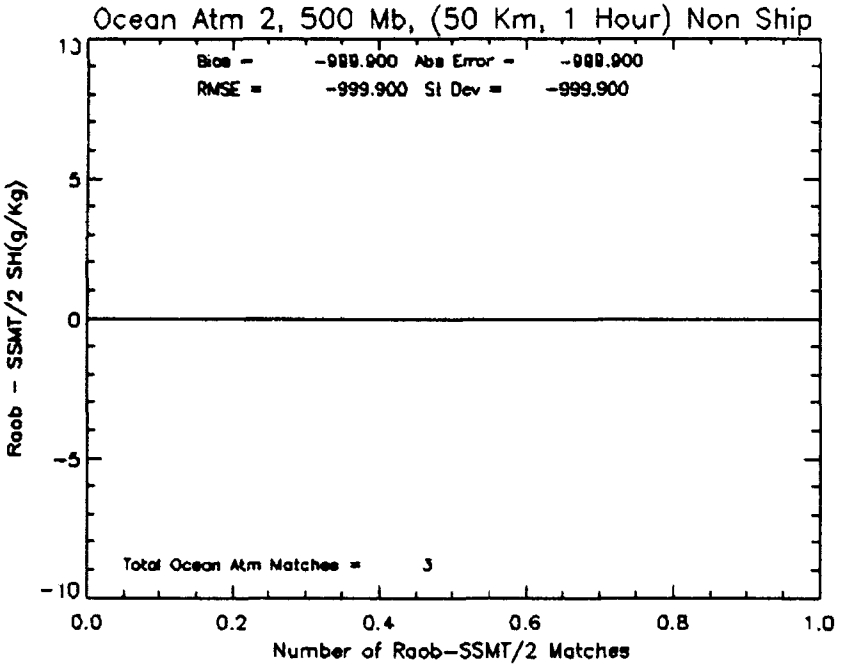

Ocean Atm 3, 700 Mb, (50 Km, 1 Hour) Ship
Bias = -1.81783 Abs Error = 1.82256
RMSE = 2.01827 St Dev = 0.882773
Total Ocean Atm Matches = 75
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

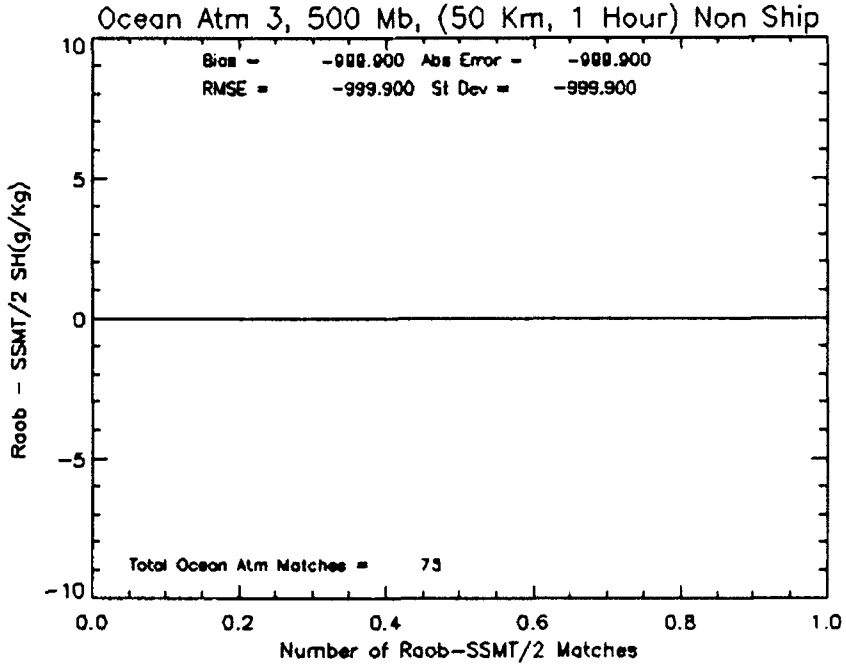
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LAB HANSCOM AFB MA Y FALCONE ET AL. 29 OCT 92
PL-TR-92-2293 XC-SMC

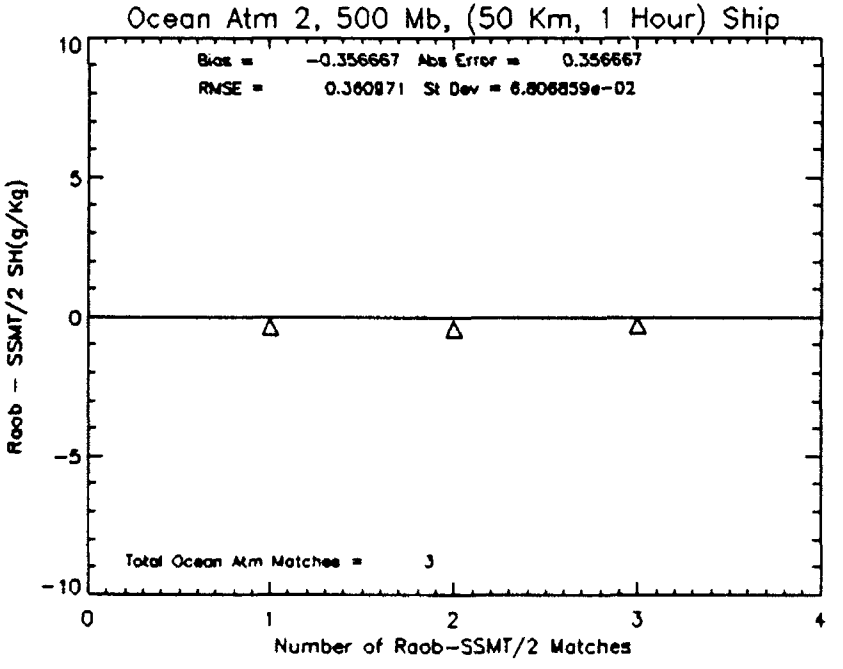
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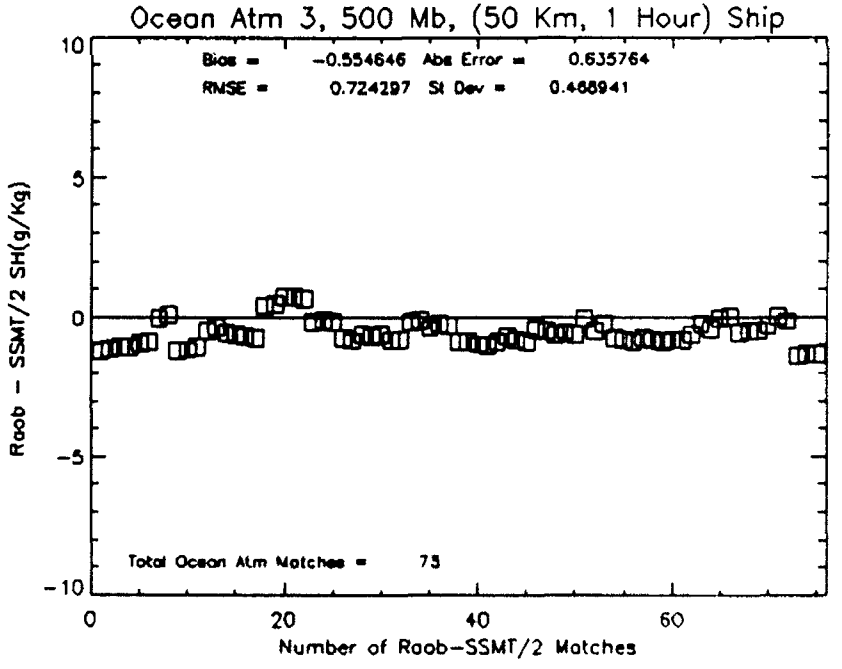


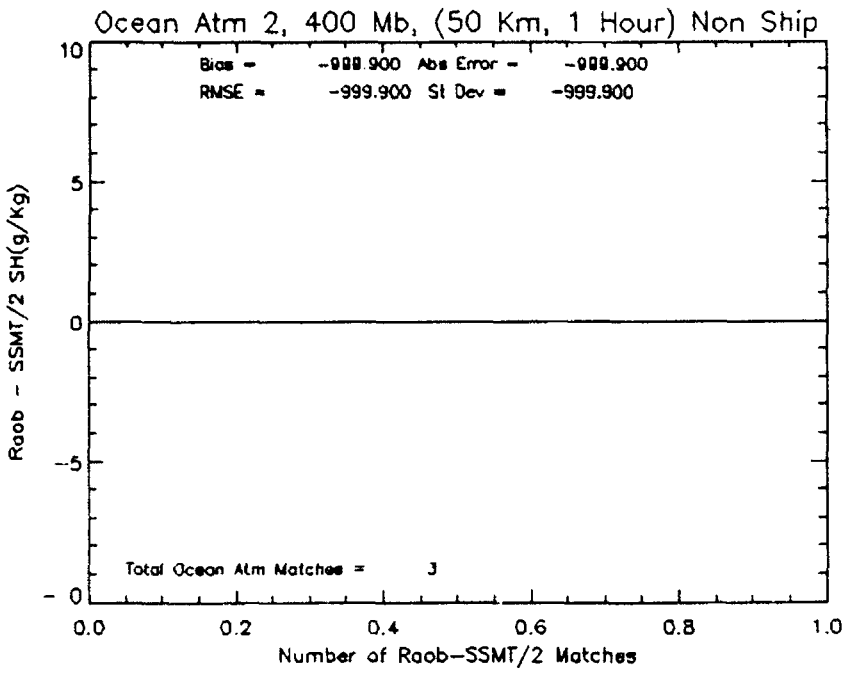

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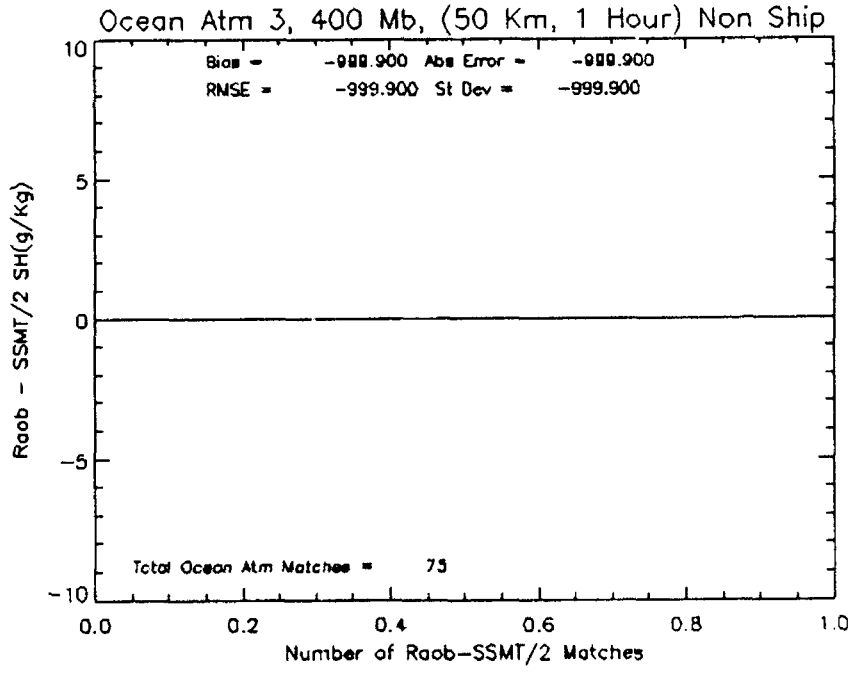

Ocean Atm 2, 500 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

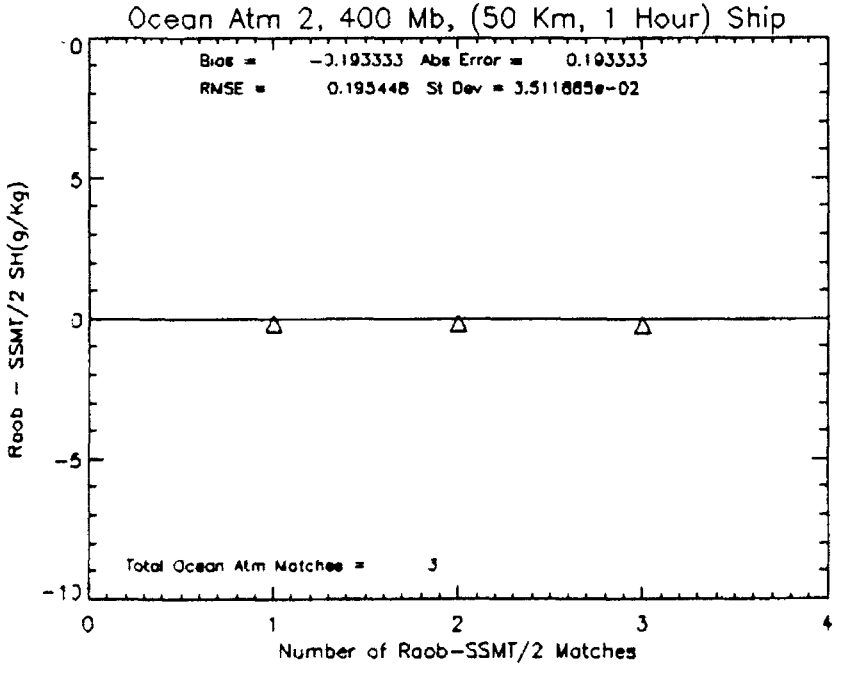

Ocean Atm 3, 500 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 75
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

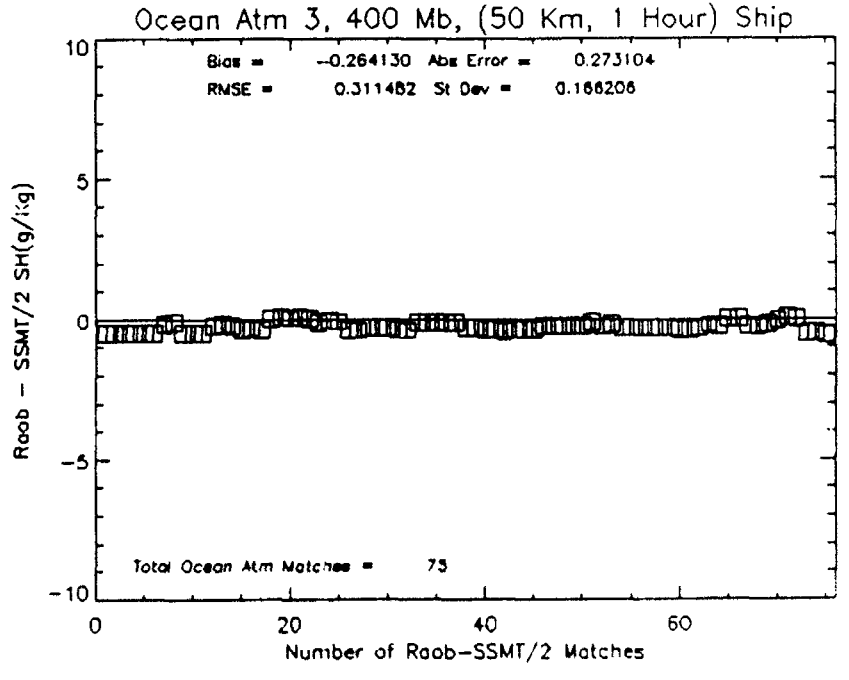

Ocean Atm 2, 500 Mb, (50 Km, 1 Hour) Ship
Bias = -0.356667 Abs Error = 0.356667
RMSE = 0.360871 St Dev = 6.806859e-02
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

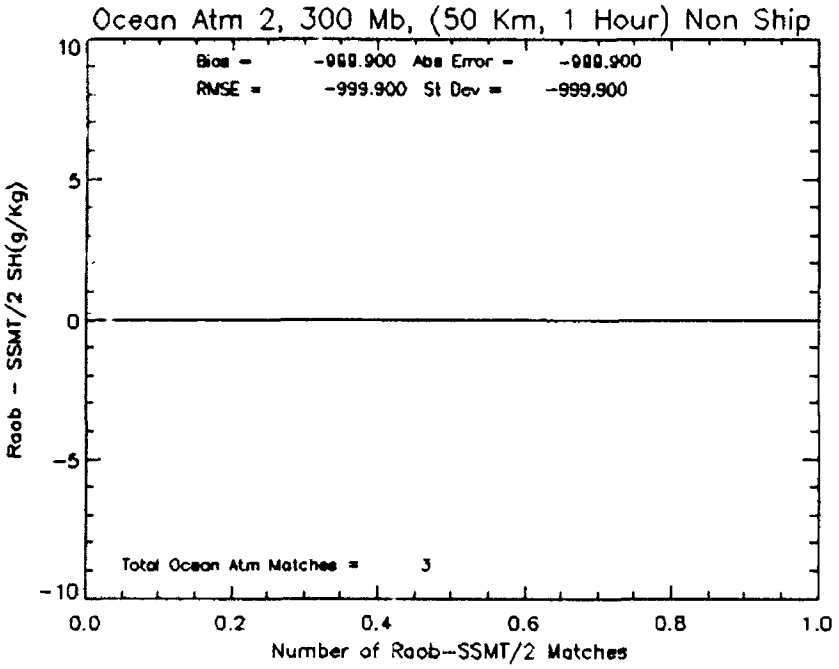

Ocean Atm 3, 500 Mb, (50 Km, 1 Hour) Ship
Bias = -0.554646 Abs Error = 0.635764
RMSE = 0.724297 St Dev = 0.466941
Total Ocean Atm Matches = 75
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

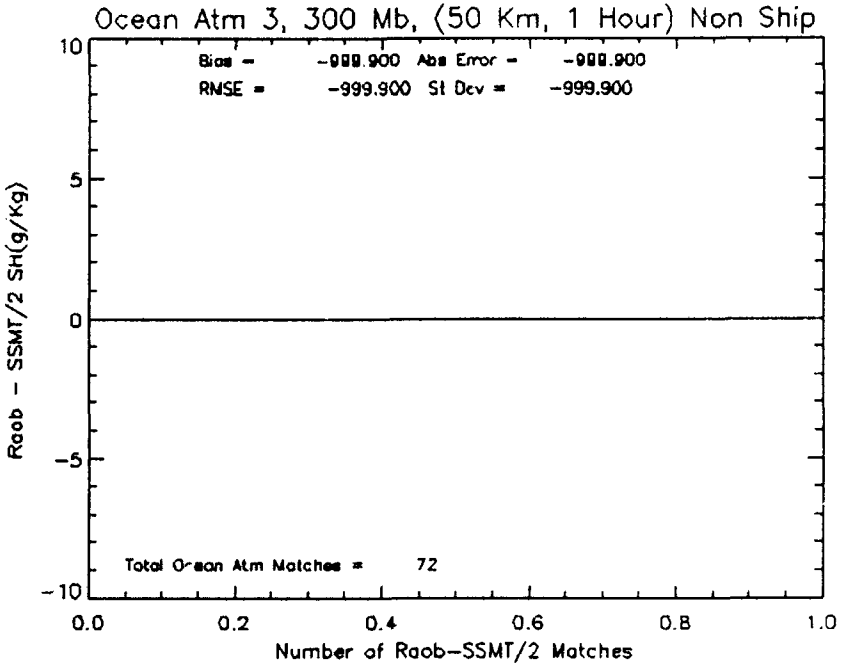

Ocean Atm 2, 400 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

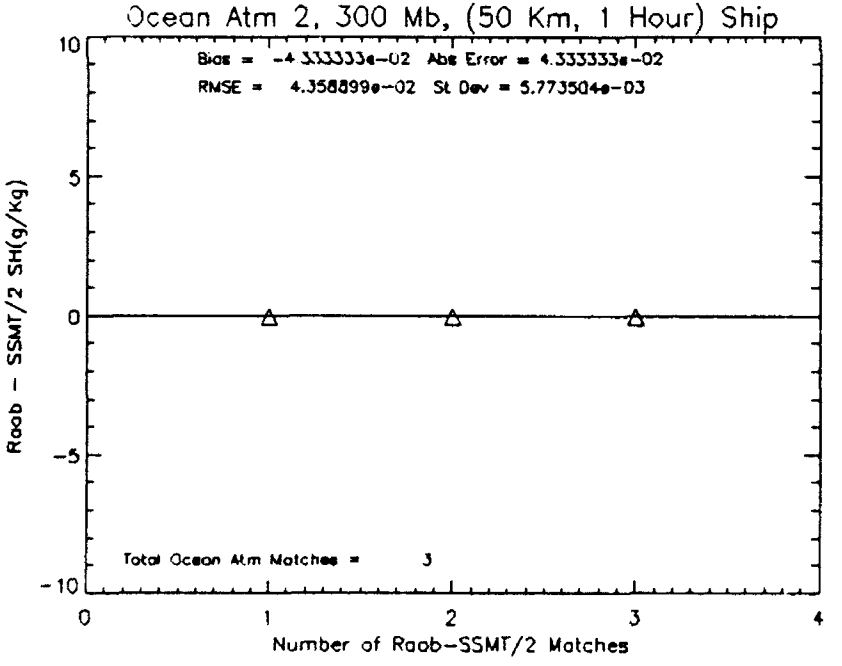

Ocean Atm 3, 400 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 75
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

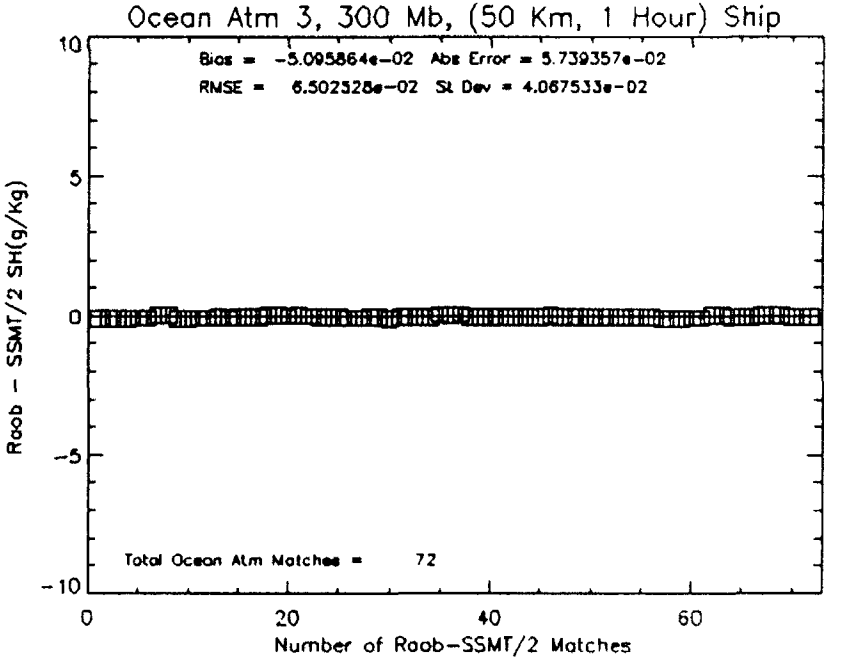

Ocean Atm 2, 400 Mb, (50 Km, 1 Hour) Ship
Bias = -0.193333 Abs Error = 0.193333
RMSE = 0.195448 St Dev = 3.511885e-02
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

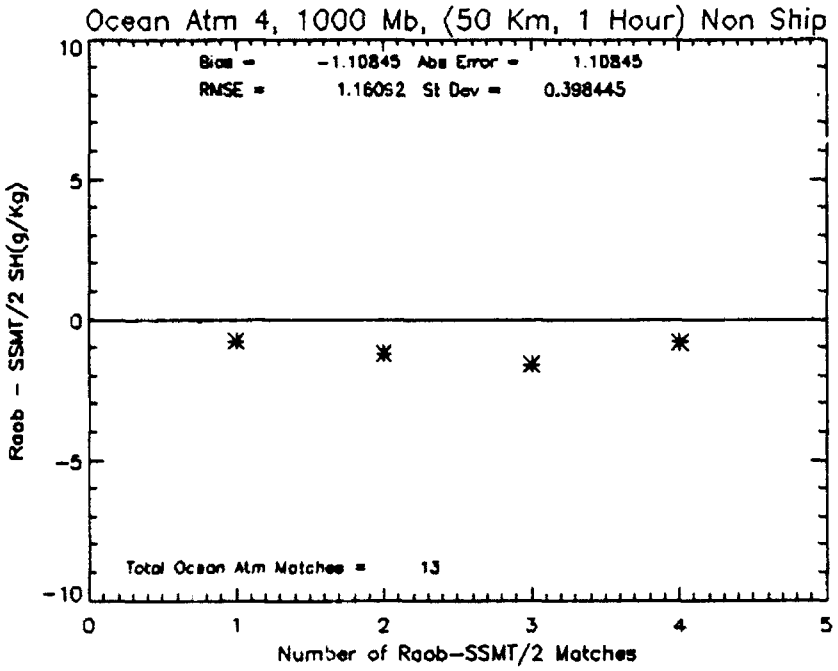

Ocean Atm 3, 400 Mb, (50 Km, 1 Hour) Ship
Bias = -0.264130 Abs Error = 0.273104
RMSE = 0.311482 St Dev = 0.166206
Total Ocean Atm Matches = 75
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

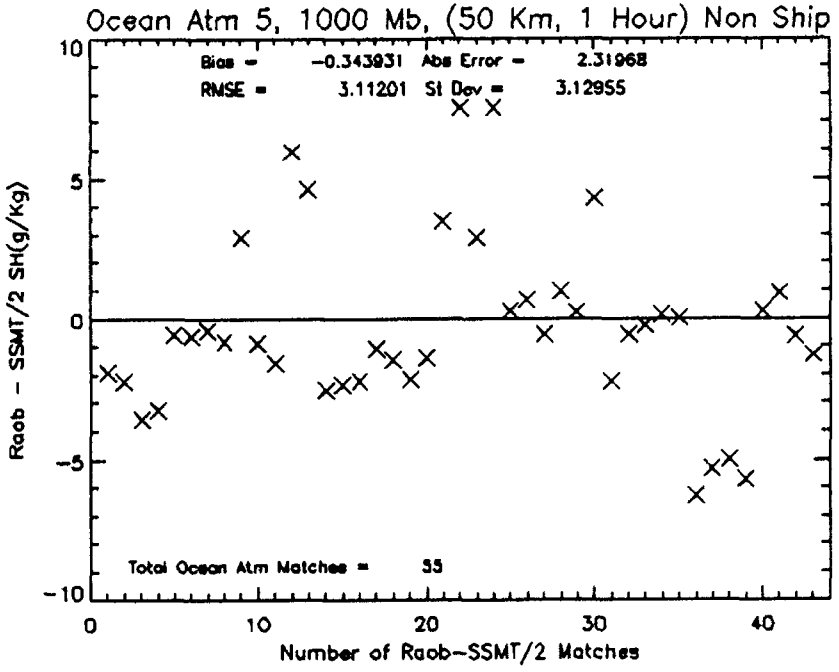

Ocean Atm 2, 300 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

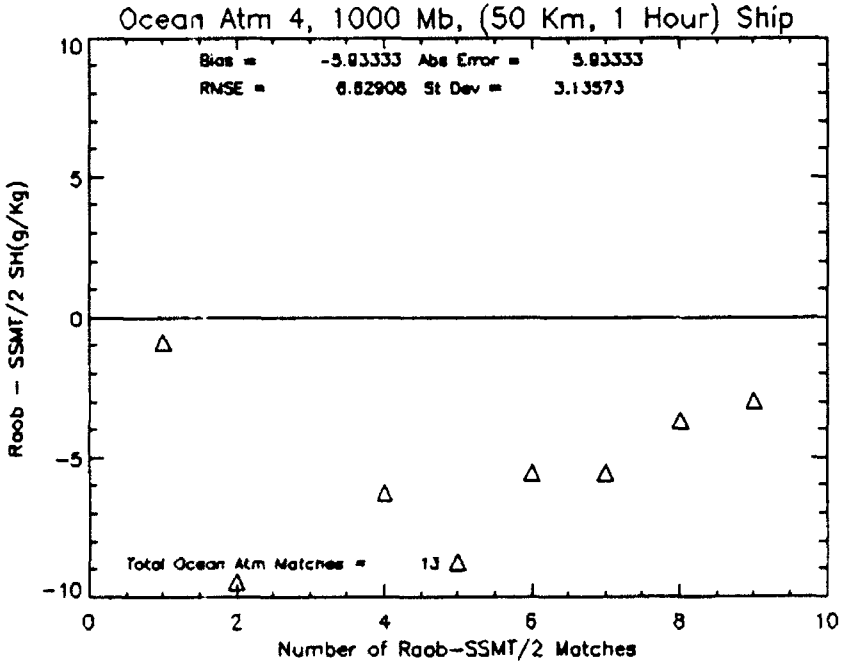

Ocean Atm 3, 300 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 72
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

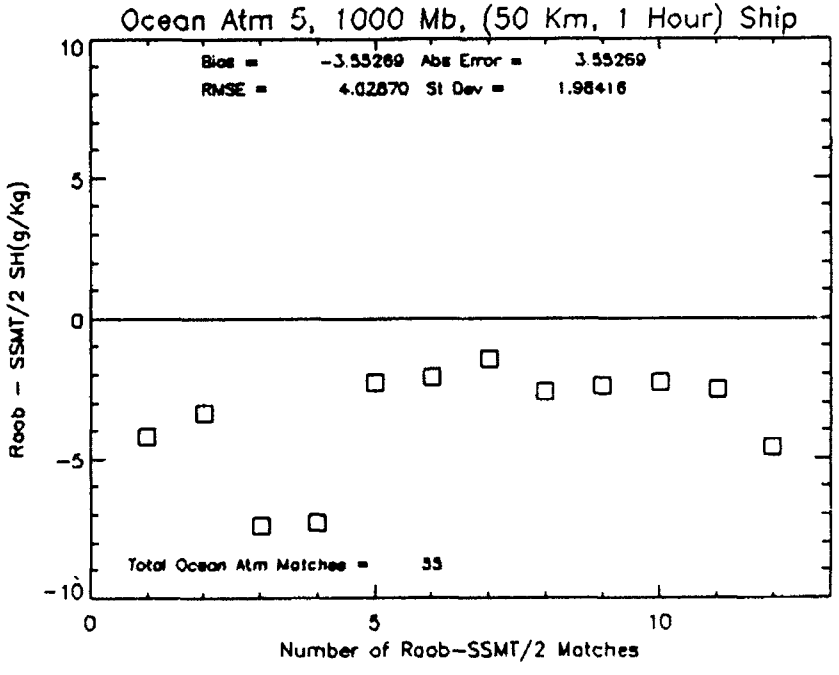

Ocean Atm 2, 300 Mb, (50 Km, 1 Hour) Ship
Bias = -4.333333e-02 Abs Error = 4.333333e-02
RMSE = 4.358899e-02 St Dev = 5.773504e-03
Total Ocean Atm Matches = 3
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

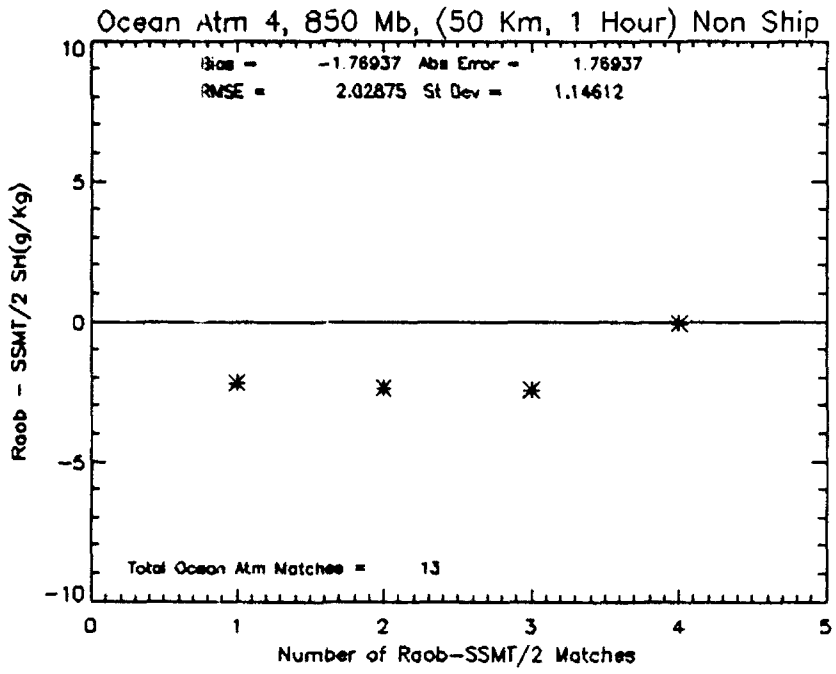

Ocean Atm 3, 300 Mb, (50 Km, 1 Hour) Ship
Bias = -5.095864e-02 Abs Error = 5.739357e-02
RMSE = 6.502528e-02 St Dev = 4.067533e-02
Total Ocean Atm Matches = 72
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

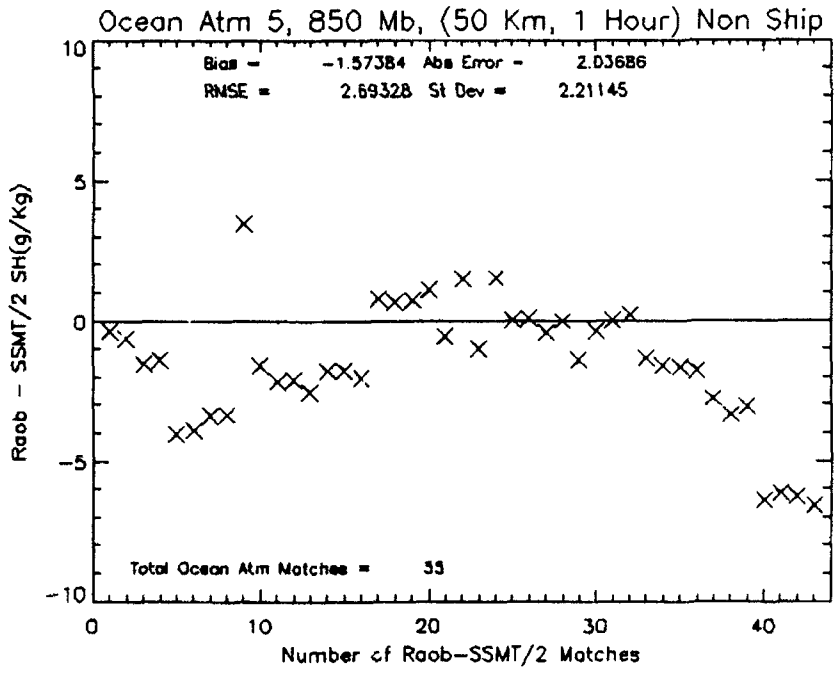

Ocean Atm 4, 1000 Mb, (50 Km, 1 Hour) Non Ship
Bias = -1.10845 Abs Error = 1.10845
RMSE = 1.16092 St Dev = 0.398445
Total Ocean Atm Matches = 13
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

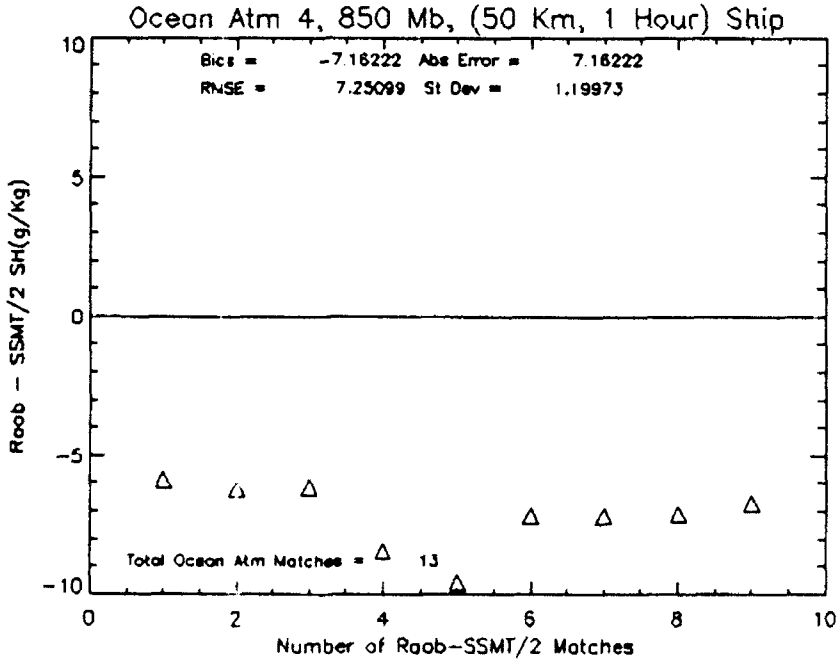

Ocean Atm 5, 1000 Mb, (50 Km, 1 Hour) Non Ship
Bias = -0.343931 Abs Error = 2.31968
RMSE = 3.11201 St Dev = 3.12955
Total Ocean Atm Matches = 55
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

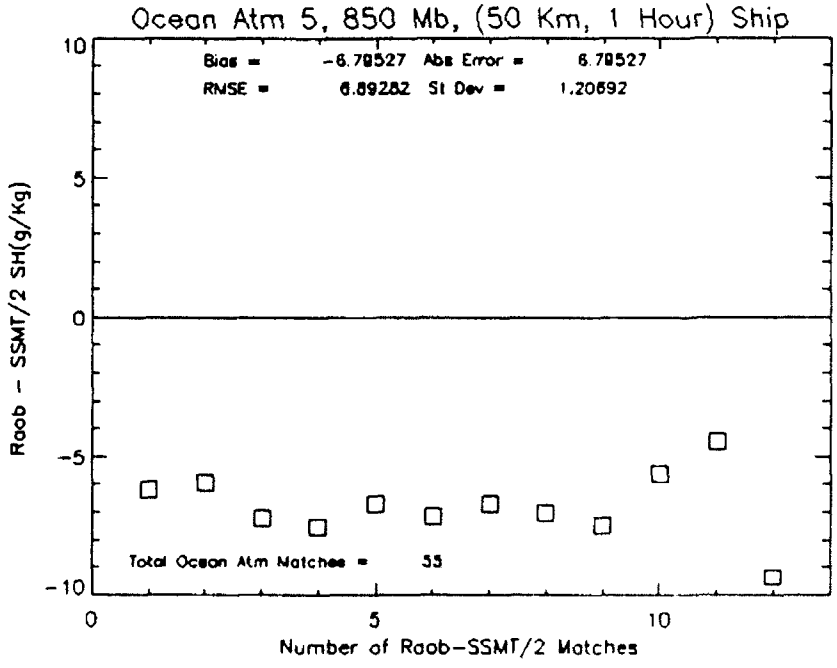

Ocean Atm 4, 1000 Mb, (50 Km, 1 Hour) Ship
Bias = -5.83333 Abs Error = 5.83333
RMSE = 6.82908 St Dev = 3.13573
Total Ocean Atm Matches = 13
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

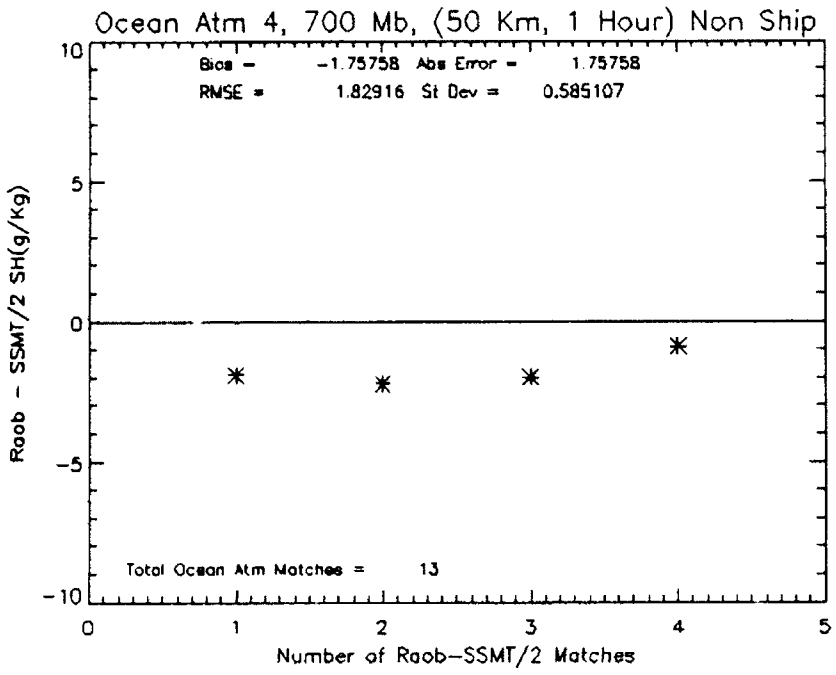

Ocean Atm 5, 1000 Mb, (50 Km, 1 Hour) Ship
Bias = -3.55269 Abs Error = 3.55269
RMSE = 4.02870 St Dev = 1.98416
Total Ocean Atm Matches = 55
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

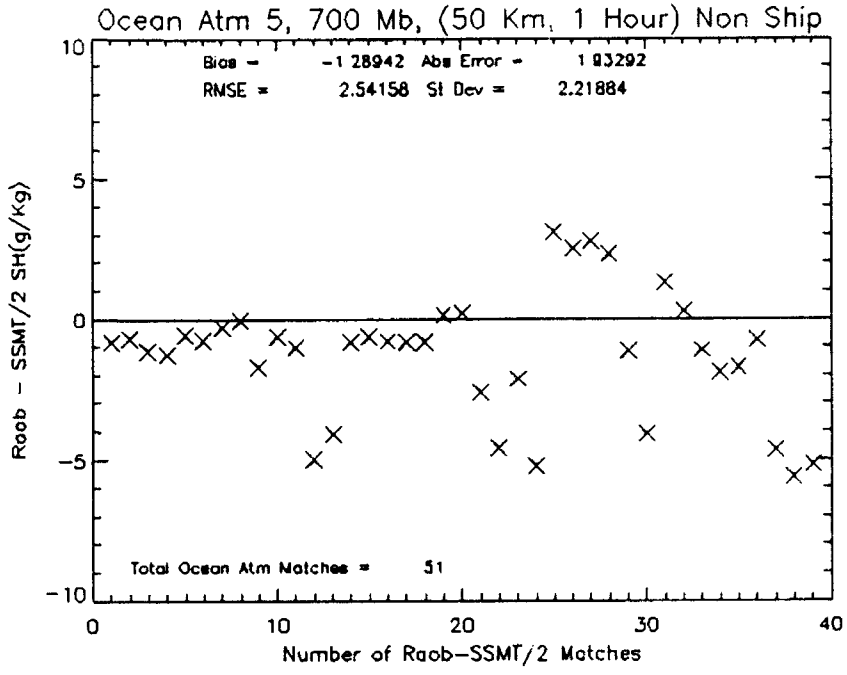

Ocean Atm 4, 850 Mb, (50 Km, 1 Hour) Non Ship
Bias = -1.76937 Abs Error = 1.76937
RMSE = 2.02875 St Dev = 1.14612
Total Ocean Atm Matches = 13
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

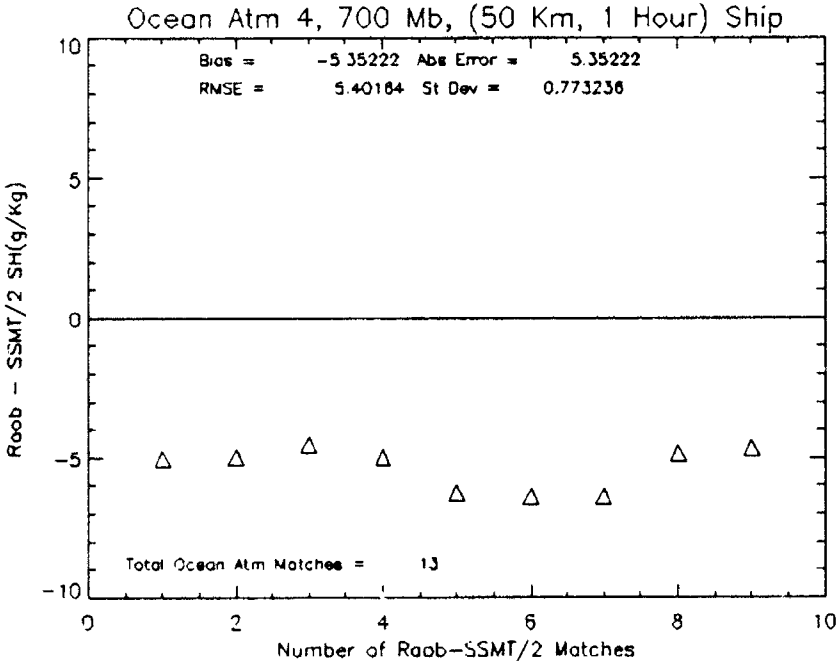

Ocean Atm 5, 850 Mb, (50 Km, 1 Hour) Non Ship
Bias = -1.57384 Abs Error = 2.03686
RMSE = 2.69328 St Dev = 2.21145
Total Ocean Atm Matches = 55
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

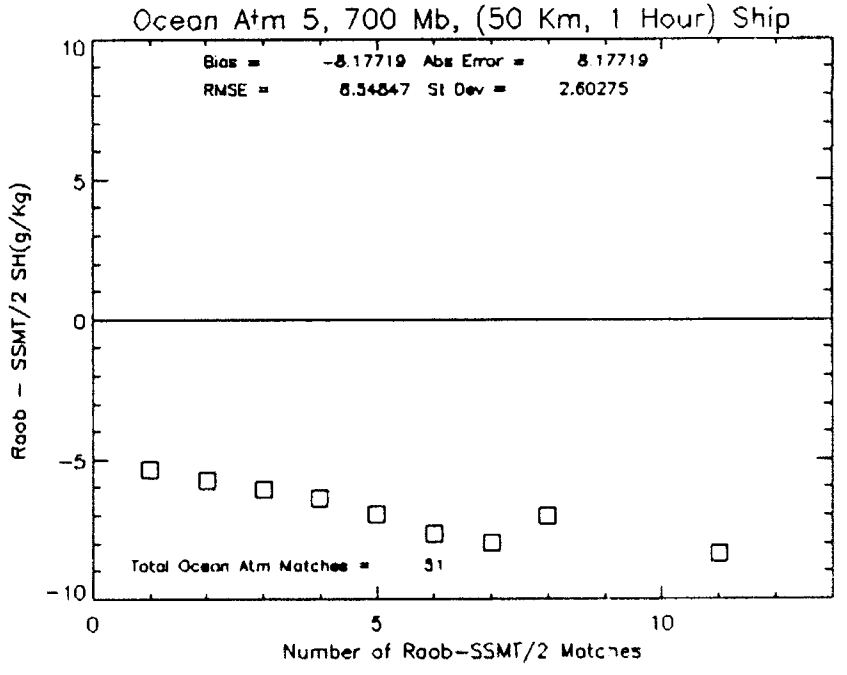

Ocean Atm 4, 850 Mb, (50 Km, 1 Hour) Ship
Bias = -7.16222 Abs Error = 7.16222
RMSE = 7.25099 St Dev = 1.19973
Total Ocean Atm Matches = 13
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 850 Mb, (50 Km, 1 Hour) Ship
Bias = -6.78527 Abs Error = 6.78527
RMSE = 6.89282 St Dev = 1.20692
Total Ocean Atm Matches = 55
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 4, 700 Mb, (50 Km, 1 Hour) Non Ship
Bias = -1.75758 Abs Error = 1.75758
RMSE = 1.82916 St Dev = 0.585107
Total Ocean Atm Matches = 13
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 700 Mb, (50 Km, 1 Hour) Non Ship
Bias = -1.28942 Abs Error = 1.93292
RMSE = 2.54158 St Dev = 2.21884
Total Ocean Atm Matches = 51
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 4, 700 Mb, (50 Km, 1 Hour) Ship
Bias = -5.35222 Abs Error = 5.35222
RMSE = 5.40164 St Dev = 0.773236
Total Ocean Atm Matches = 13
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

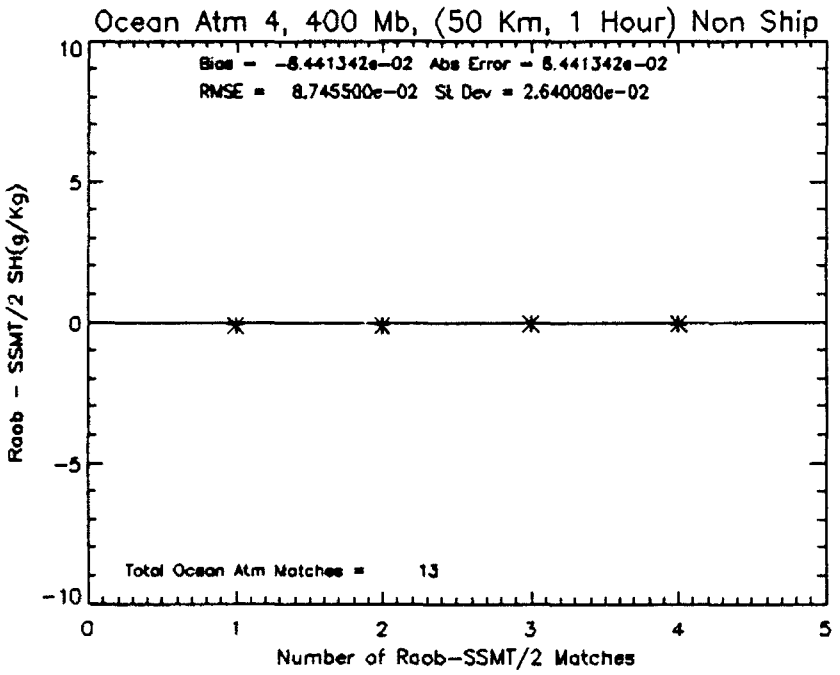

Ocean Atm 5, 700 Mb, (50 Km, 1 Hour) Ship
Bias = -8.17719 Abs Error = 8.17719
RMSE = 8.54847 St Dev = 2.60275
Total Ocean Atm Matches = 51
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

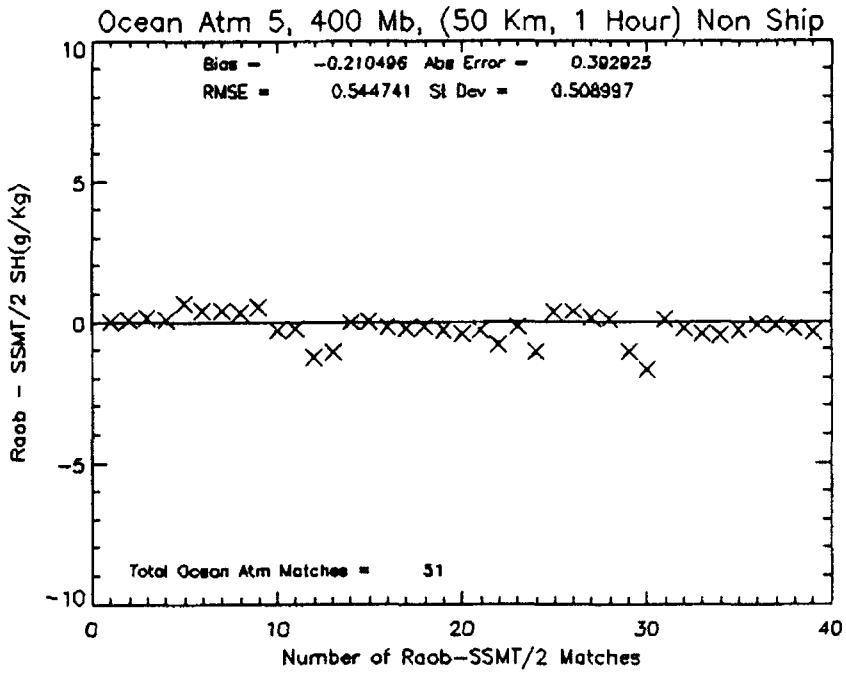
Ocean Atm 5, 500 Mb, (50 Km, 1 Hour) Non Ship
Bias = -0.594945 Abs Error = 1.32397
RMSE = 1.65630 St Dev = 1.56596
Total Ocean Atm Matches = 51
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

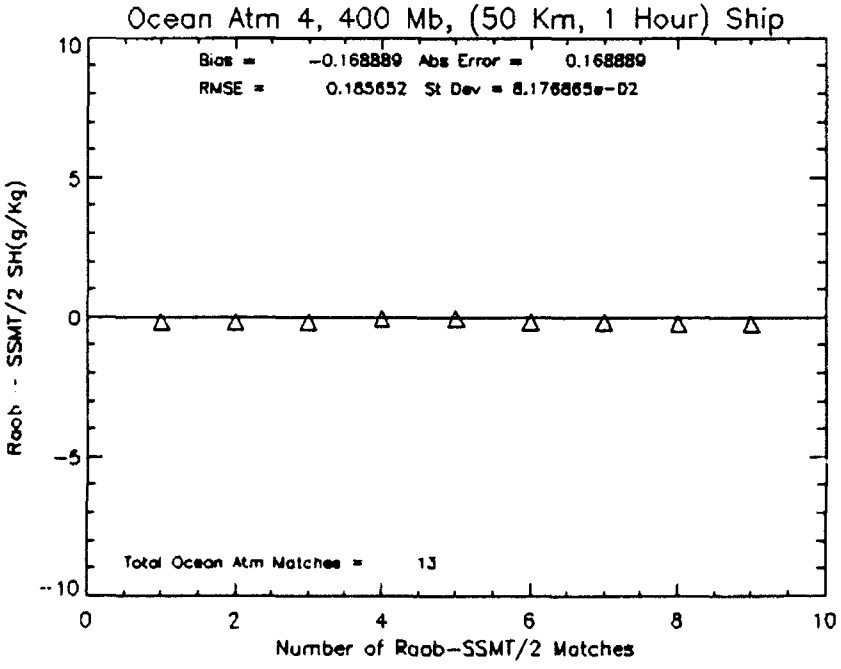
Ocean Atm 5, 500 Mb, (50 Km, 1 Hour) Ship
Bias = -3.20183 Abs Error = 3.20183
RMSE = 3.82959 St Dev = 1.78612
Total Ocean Atm Matches = 51
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

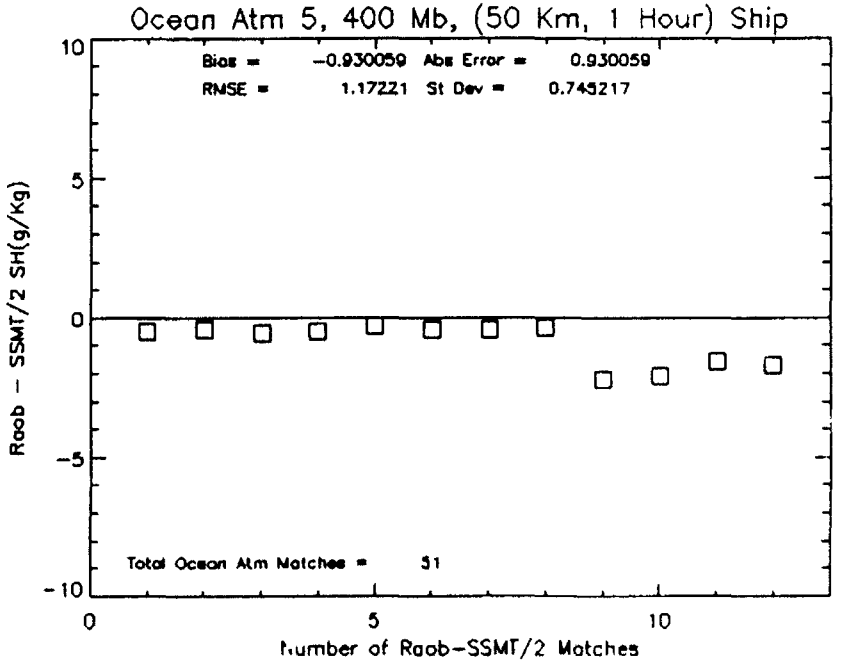
Ocean Atm 4, 500 Mb, (50 Km, 1 Hour) Non Ship
Bias = -999.900 Abs Error = -999.900
RMSE = -999.900 St Dev = -999.900
Total Ocean Atm Matches = 1Q
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

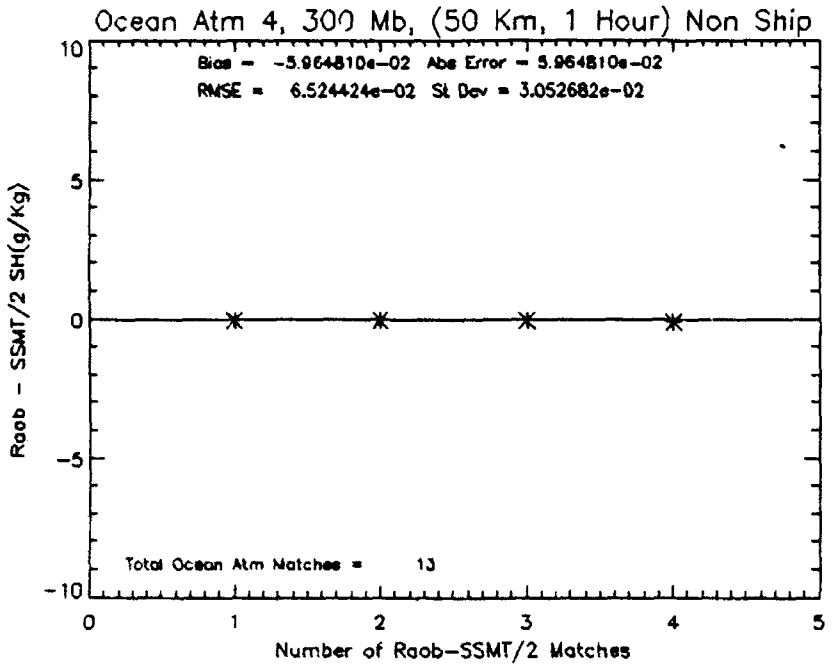
Ocean Atm 4, 500 Mb, (50 Km, 1 Hour) Ship
Bias = -1.55889 Abs Error = 1.55889
RMSE = 1.58890 St Dev = 0.326016
Total Ocean Atm Matches = 1Q
Raob - SSMT/2 SH(g/kg)
Number of Raob-SSMT/2 Matches

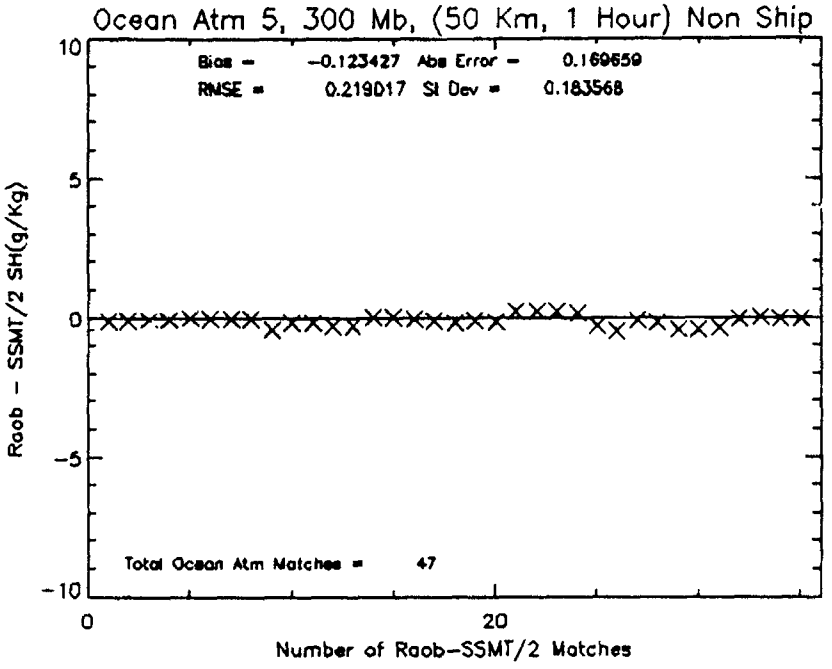

Ocean Atm 4, 400 Mb, (50 Km, 1 Hour) Non Ship
Bias = -8.441342e-02 Abs Error = 8.441342e-02
RMSE = 8.745500e-02 St Dev = 2.640080e-02
Total Ocean Atm Matches = 13
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

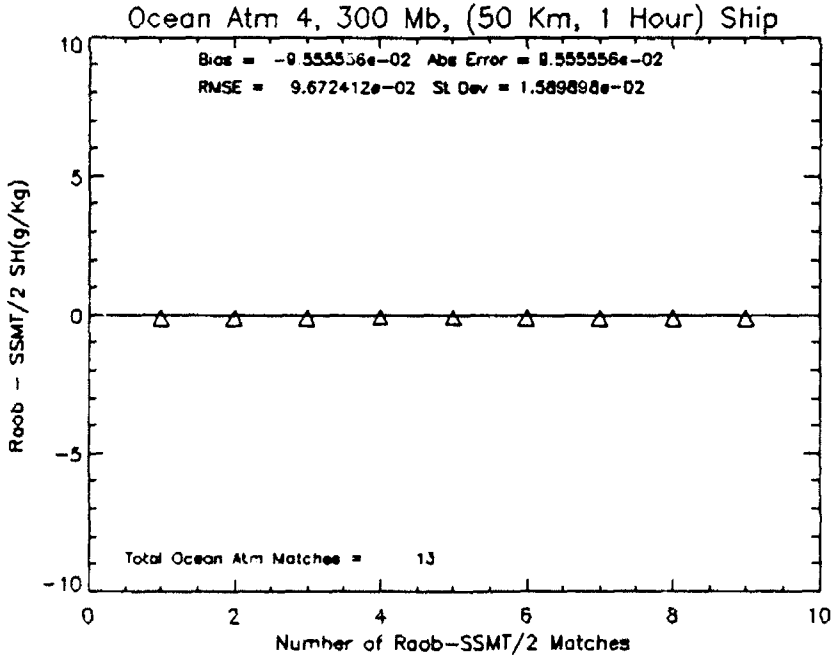

Ocean Atm 5, 400 Mb, (50 Km, 1 Hour) Non Ship
Bias = -0.210496 Abs Error = 0.392925
RMSE = 0.544741 St Dev = 0.508997
Total Ocean Atm Matches = 51
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

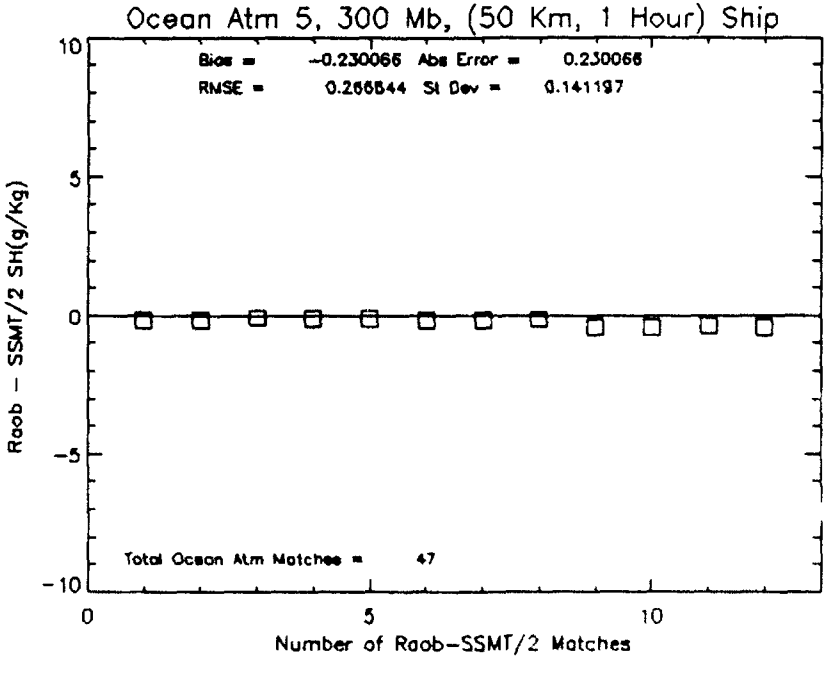

Ocean Atm 4, 400 Mb, (50 Km, 1 Hour) Ship
Bias = -0.168889 Abs Error = 0.168889
RMSE = 0.185652 St Dev = 8.176865e-02
Total Ocean Atm Matches = 13
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 400 Mb, (50 Km, 1 Hour) Ship
Bias = -0.930059 Abs Error = 0.930059
RMSE = 1.17221 St Dev = 0.745217
Total Ocean Atm Matches = 51
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 4, 300 Mb, (50 Km, 1 Hour) Non Ship
Bias = -5.964810e-02 Abs Error = 5.964810e-02
RMSE = 6.524424e-02 St Dev = 3.052682e-02
Total Ocean Atm Matches = 13
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 300 Mb, (50 Km, 1 Hour) Non Ship
Bias = -0.123427 Abs Error = 0.169659
RMSE = 0.219017 St Dev = 0.183568
Total Ocean Atm Matches = 47
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 4, 300 Mb, (50 Km, 1 Hour) Ship
Bias = -9.555556e-02 Abs Error = 9.555556e-02
RMSE = 9.672412e-02 St Dev = 1.589898e-02
Total Ocean Atm Matches = 13
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches


Ocean Atm 5, 300 Mb, (50 Km, 1 Hour) Ship
Bias = -0.230066 Abs Error = 0.230066
RMSE = 0.266844 St Dev = 0.141197
Total Ocean Atm Matches = 47
Raob - SSMT/2 SH(g/Kg)
Number of Raob-SSMT/2 Matches

Appendix J. SSM/T-2 channel TB imagery and HIRAS model-generated fields.

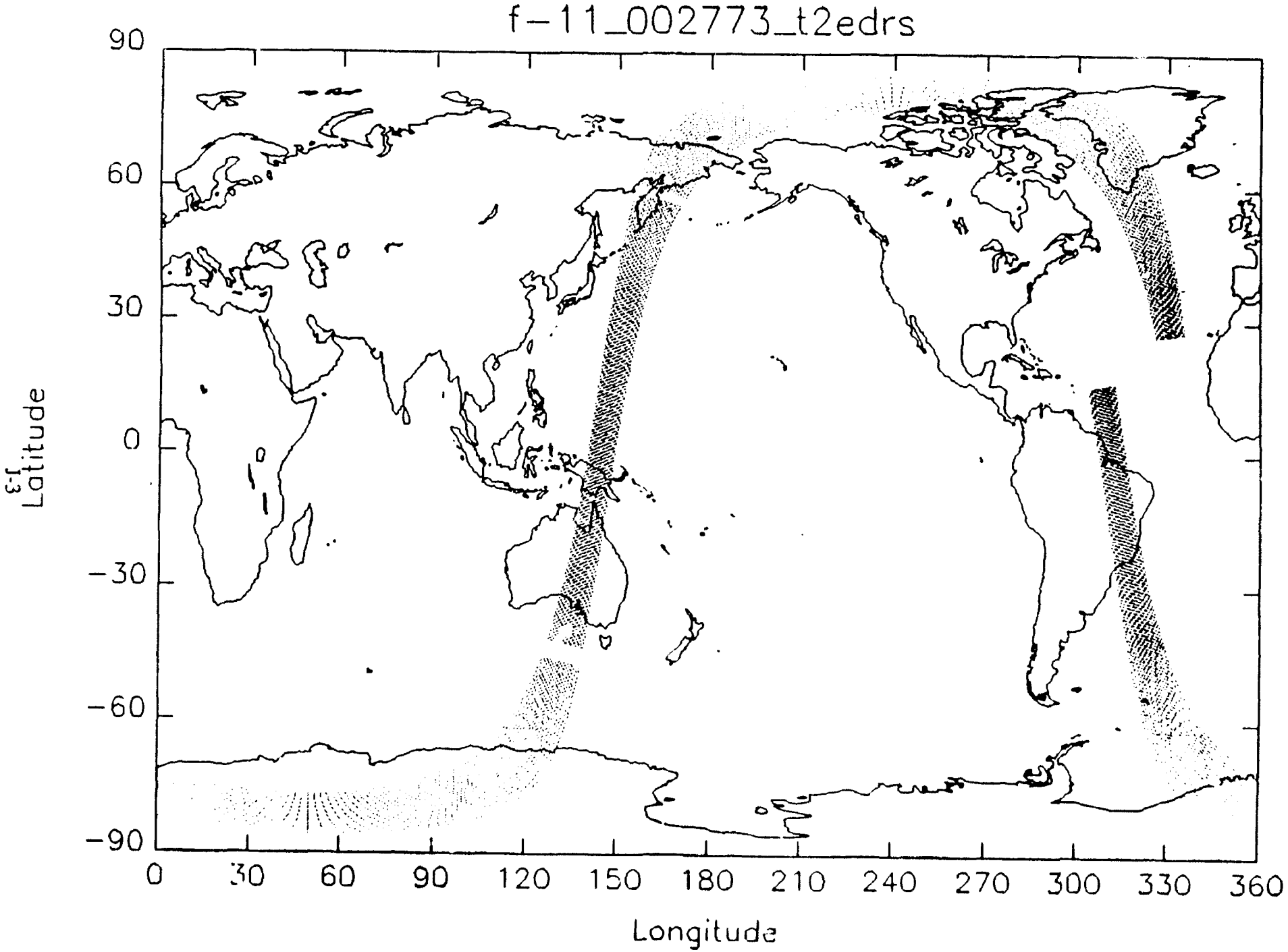
Key for RH color table

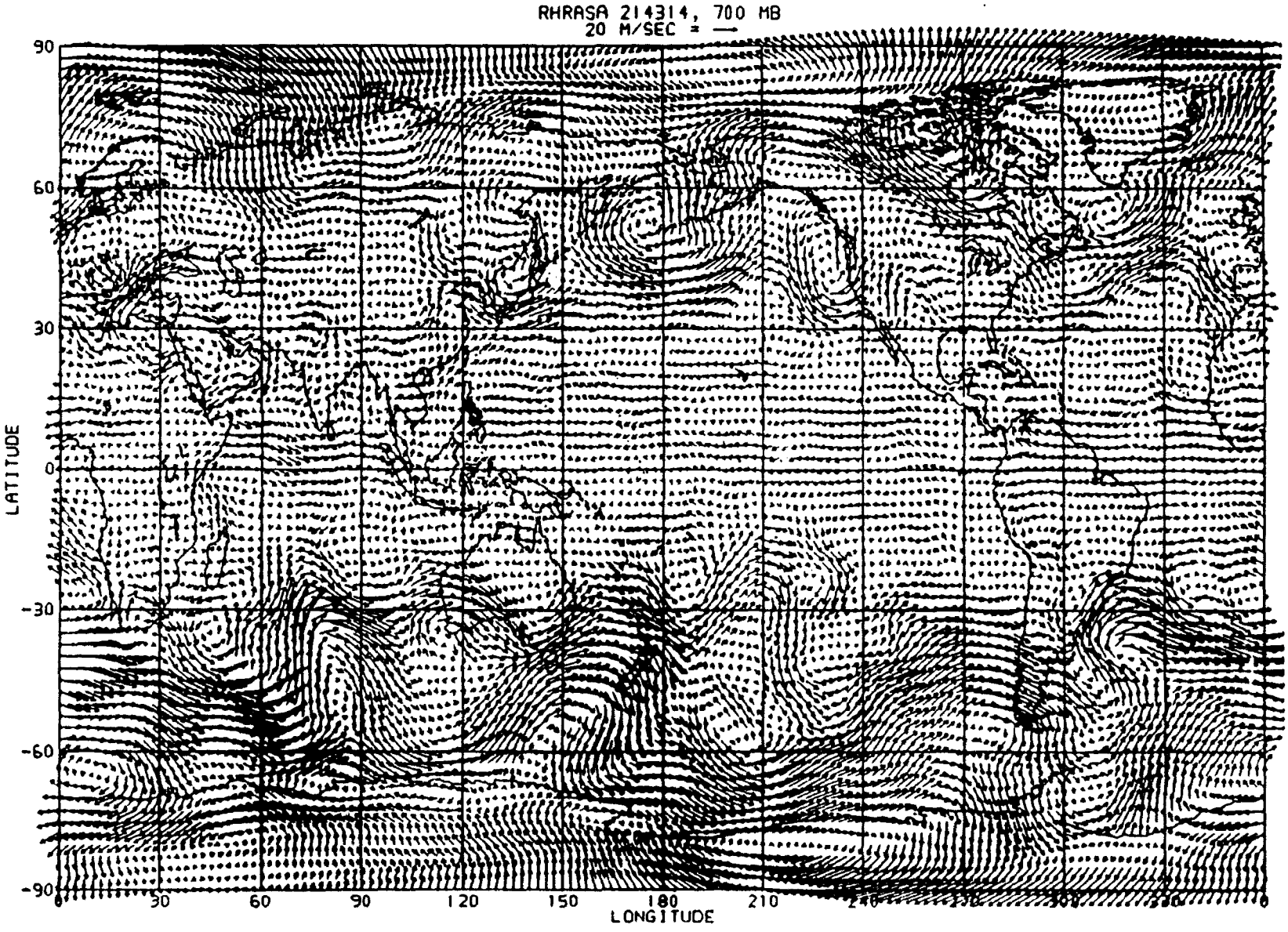
White = 100%; Red shades range from 95 - 80%; Yellow shades range from 80 - 60%; Green shades range from 50 - 35%; Blue shades range from 30 - 10%; Magenta shades range from 10 - 0%

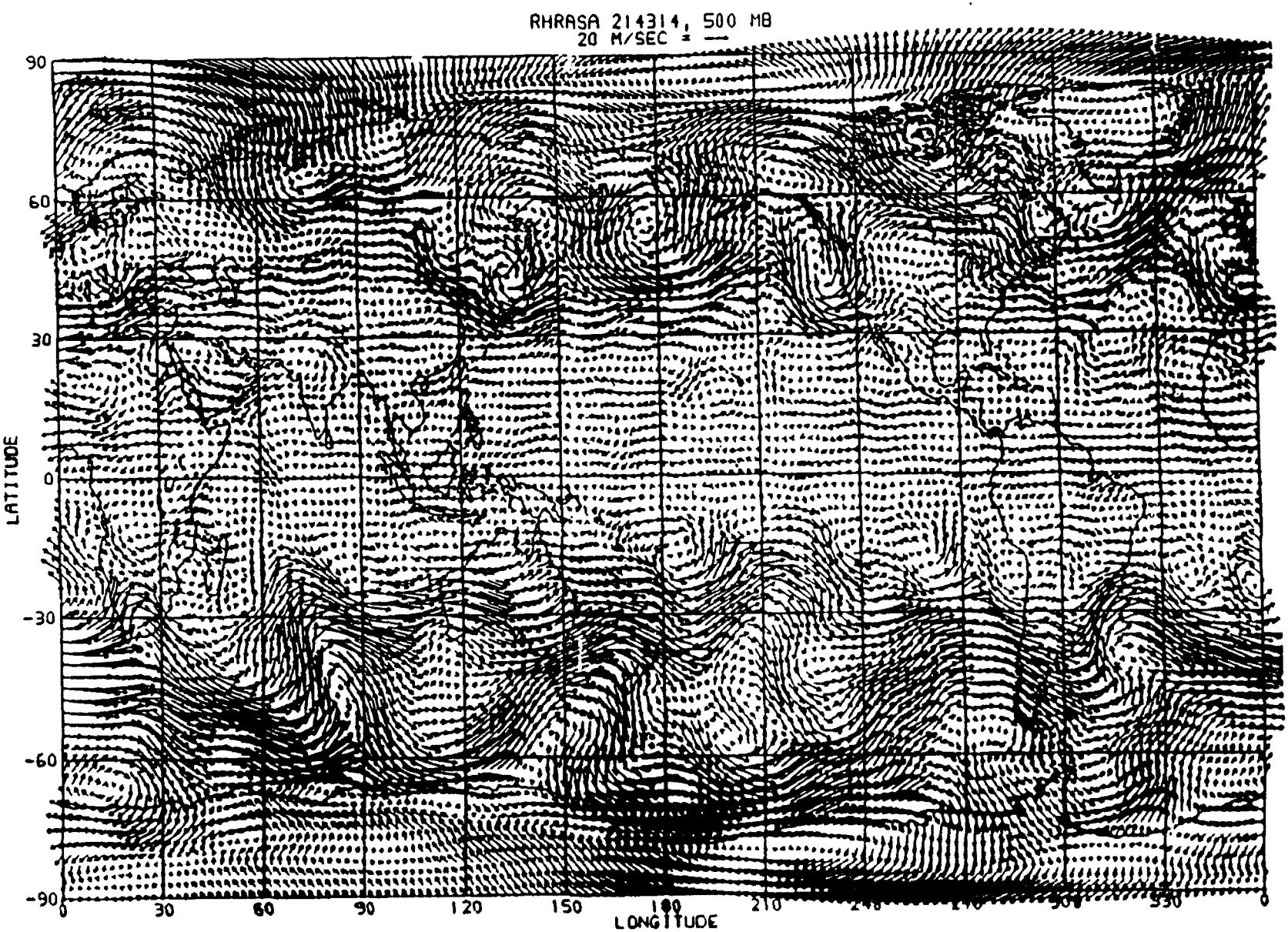
Key for Q color table

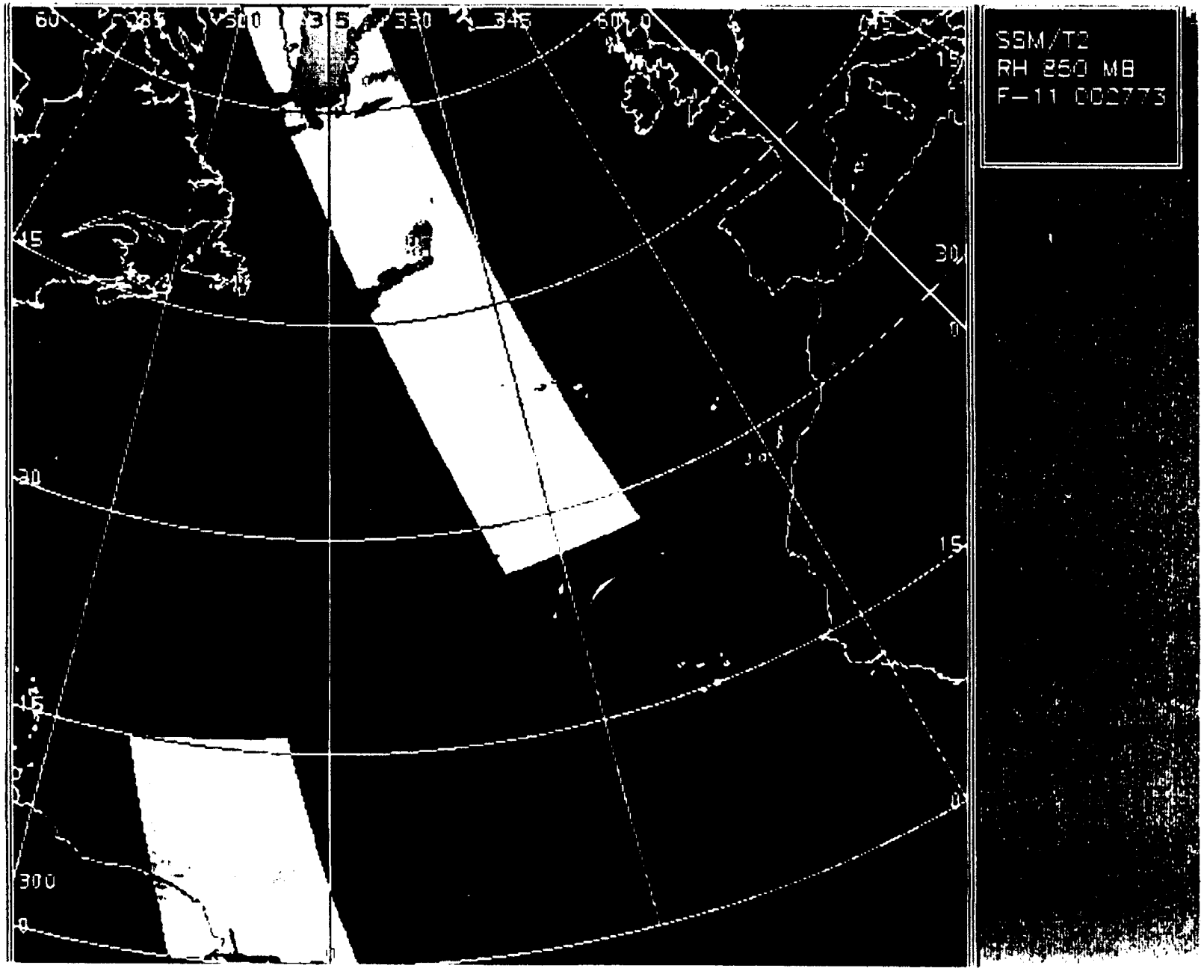
White = 15 g/kg; Red shades range from 14 - 12 g/kg; Yellow shades range from 12 - 8 g/kg; Green shades range from 7 - 5 g/kg; Blue shades range from 5 - 2 g/kg; Magenta shades range from 2 - 0 g/kg.

Color Table
for
Color Table
for

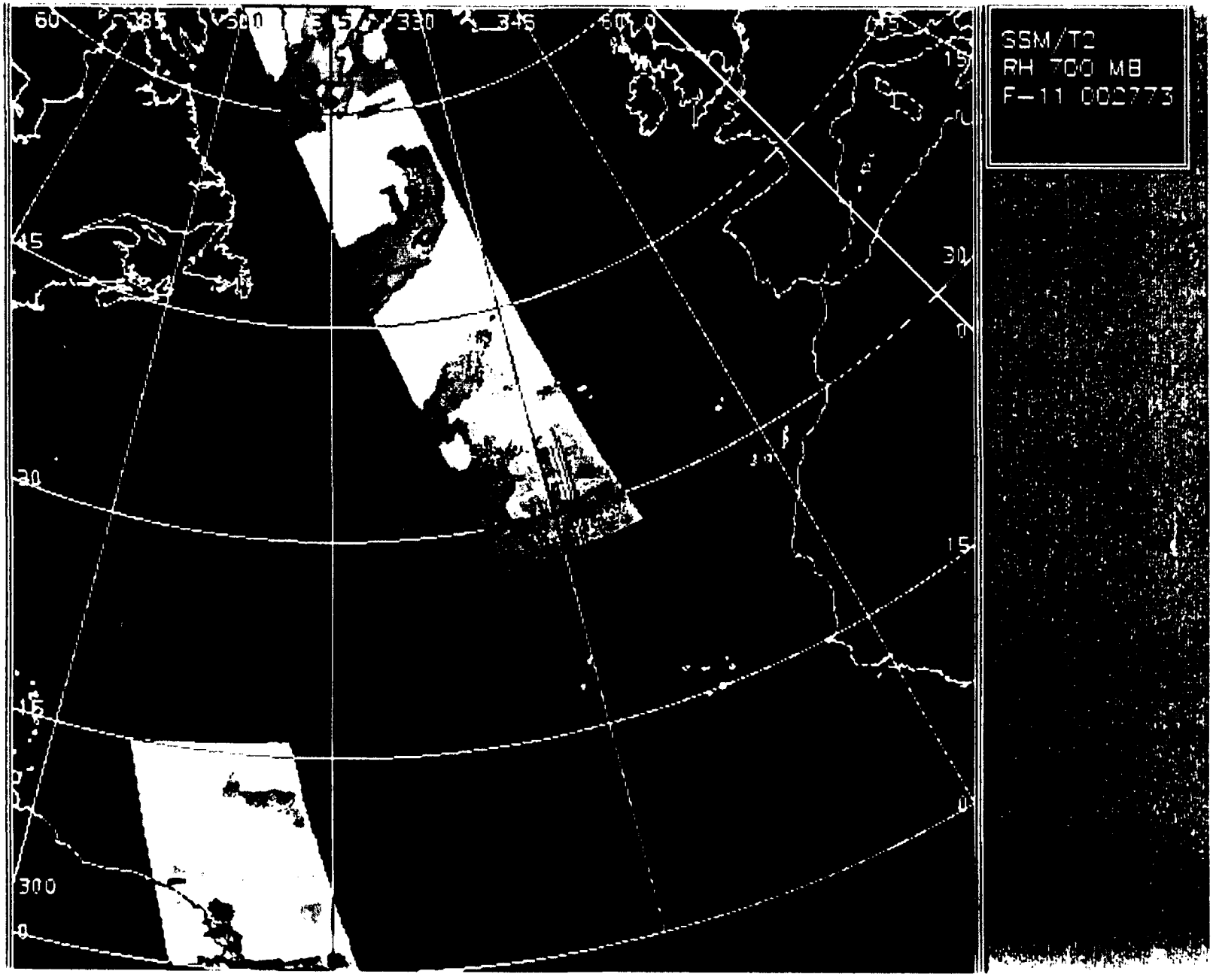

f-11_002773_t2edrs
90
60
30
0
-30
-60
-90
Latitude
0
30
60
90
120
150
180
210
240
270
300
330
360
Longitude


RHRASA 214314, 700 MB
20 M/SEC = —
90
60
30
0
-30
-60
-90
LATITUDE
30
60
90
120
150
180
210
LONGITUDE


RHRASA 214314, 500 MB
20 M/SEC = —
90
60
30
0
-30
-60
-90
LATITUDE
0
30
60
90
120
150
180
210
LONGITUDE


SSM/T2
RH 250 MB
F-11 002773
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30
15
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300
345
330

HIRAS
RH 250 MB
PHASE
60
300
330
345
30
300

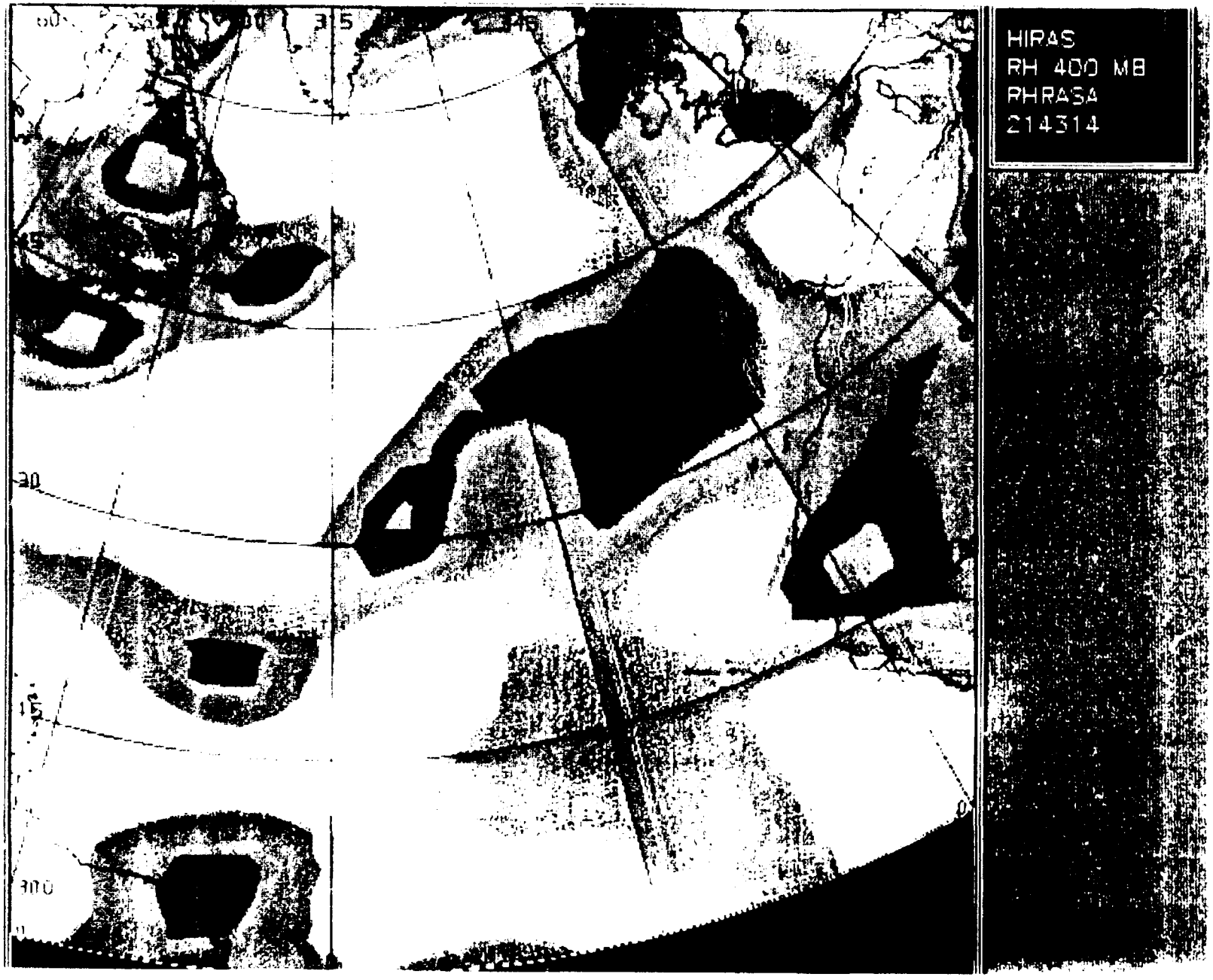

SSM/T2
RH 700 MB
F-11 002773
60
45
30
15
0
300
330
345
15
30
45
60

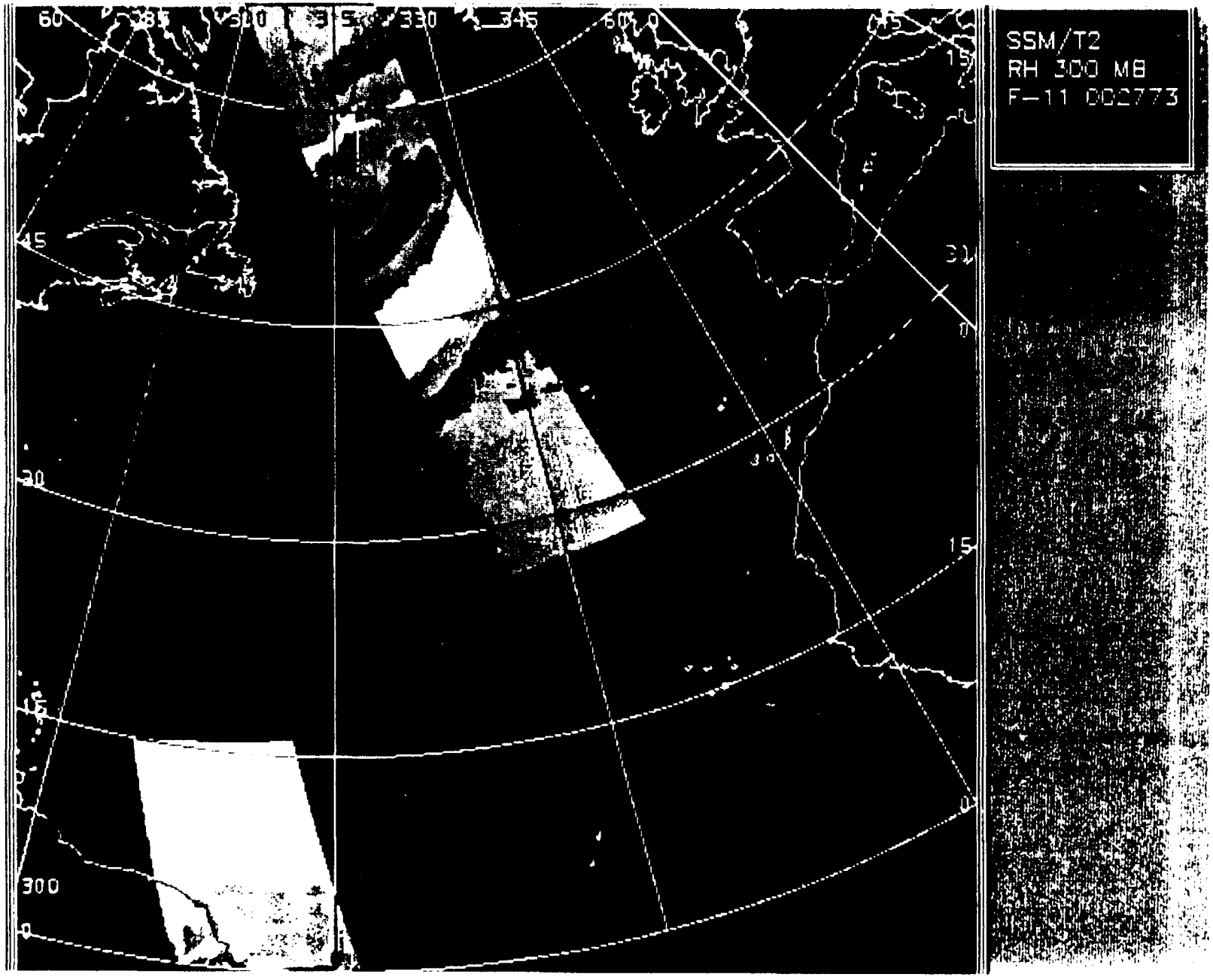
HIRAS
RH 700 MB
60
30
300

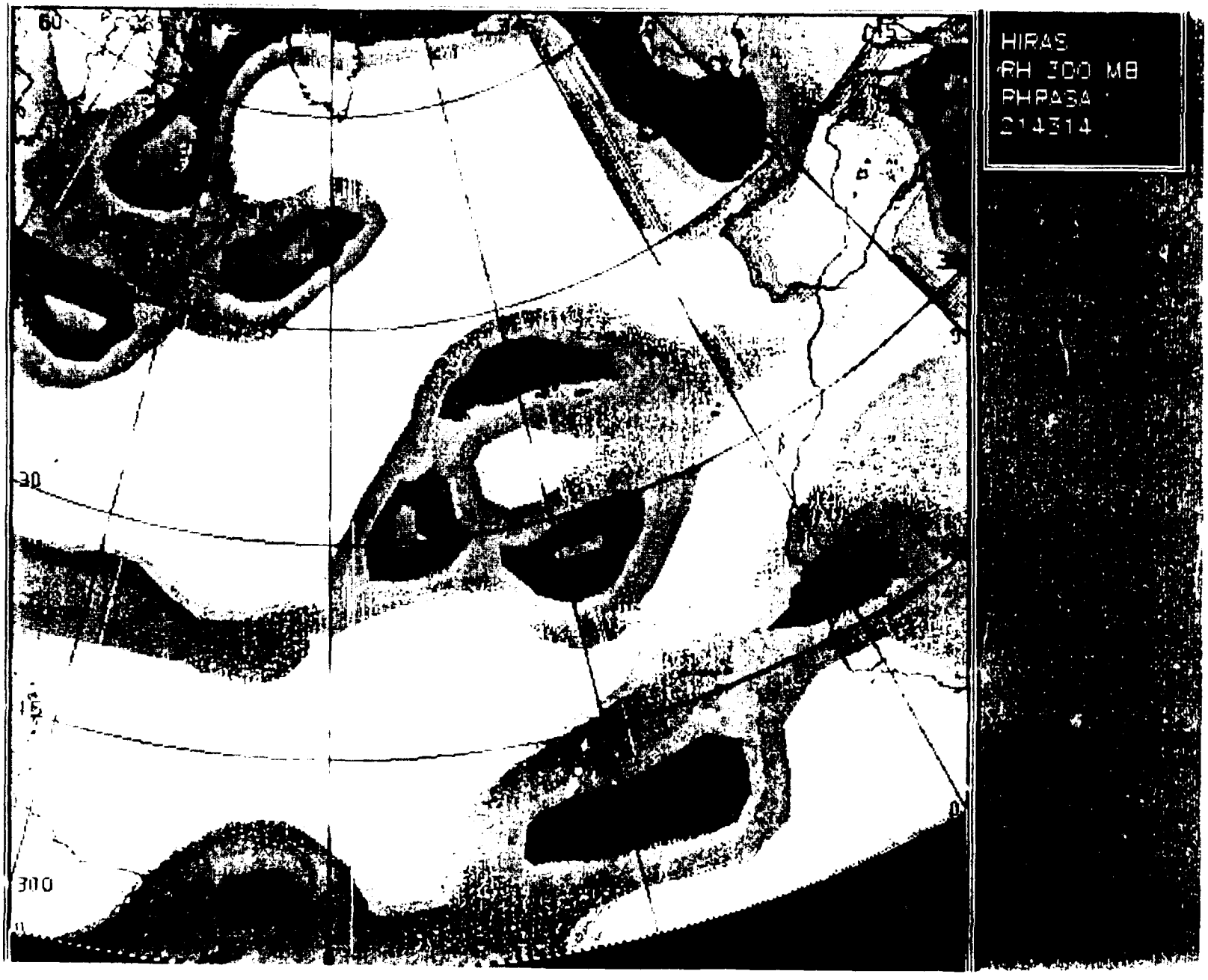
SSM/T2
RH 500 MB
F-11 00:27:23
60
45
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15
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300
315
330
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360
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225
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255
270
285

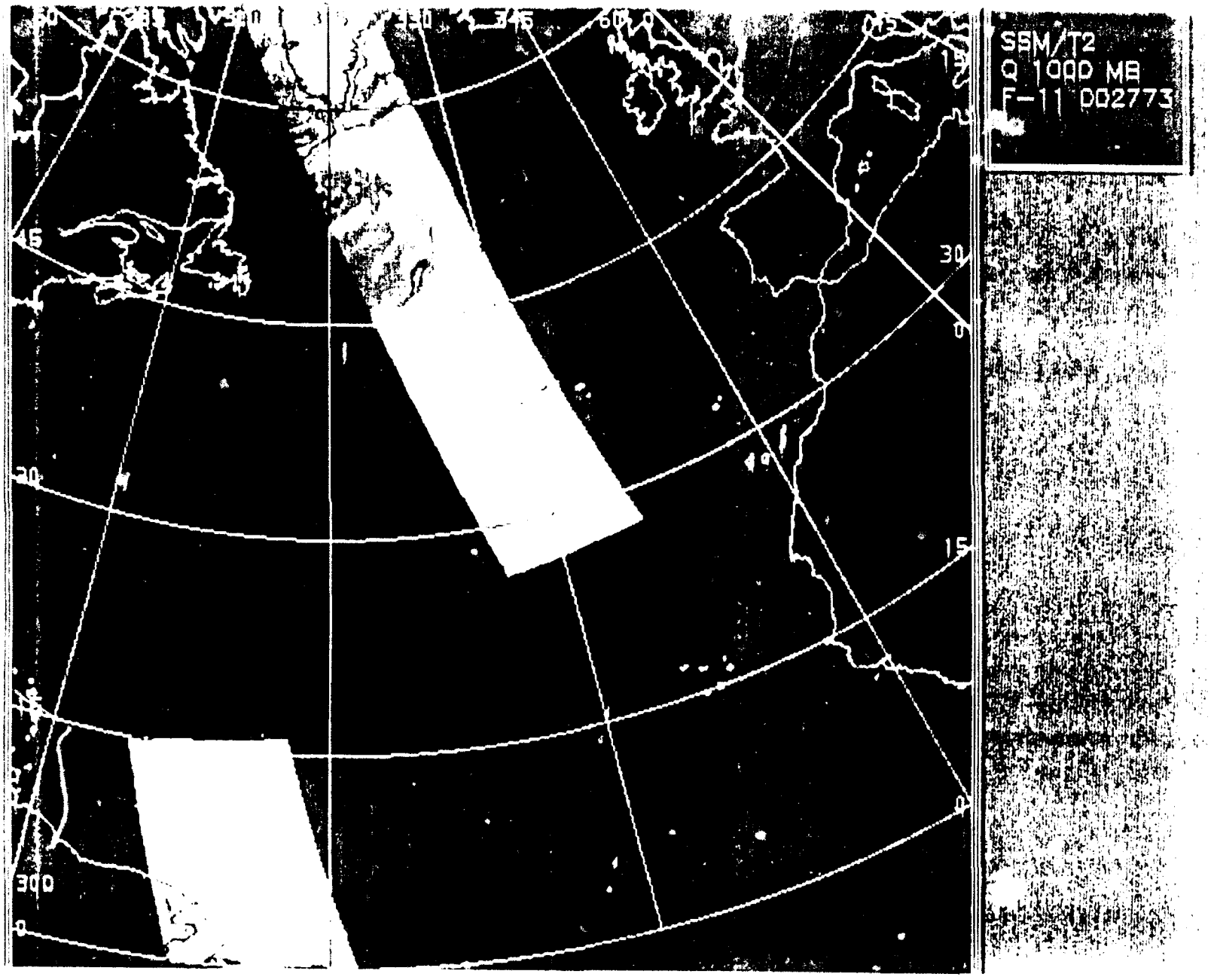

HIRAS
RH 500 MB
RHPASA
214314
60
30
15
300

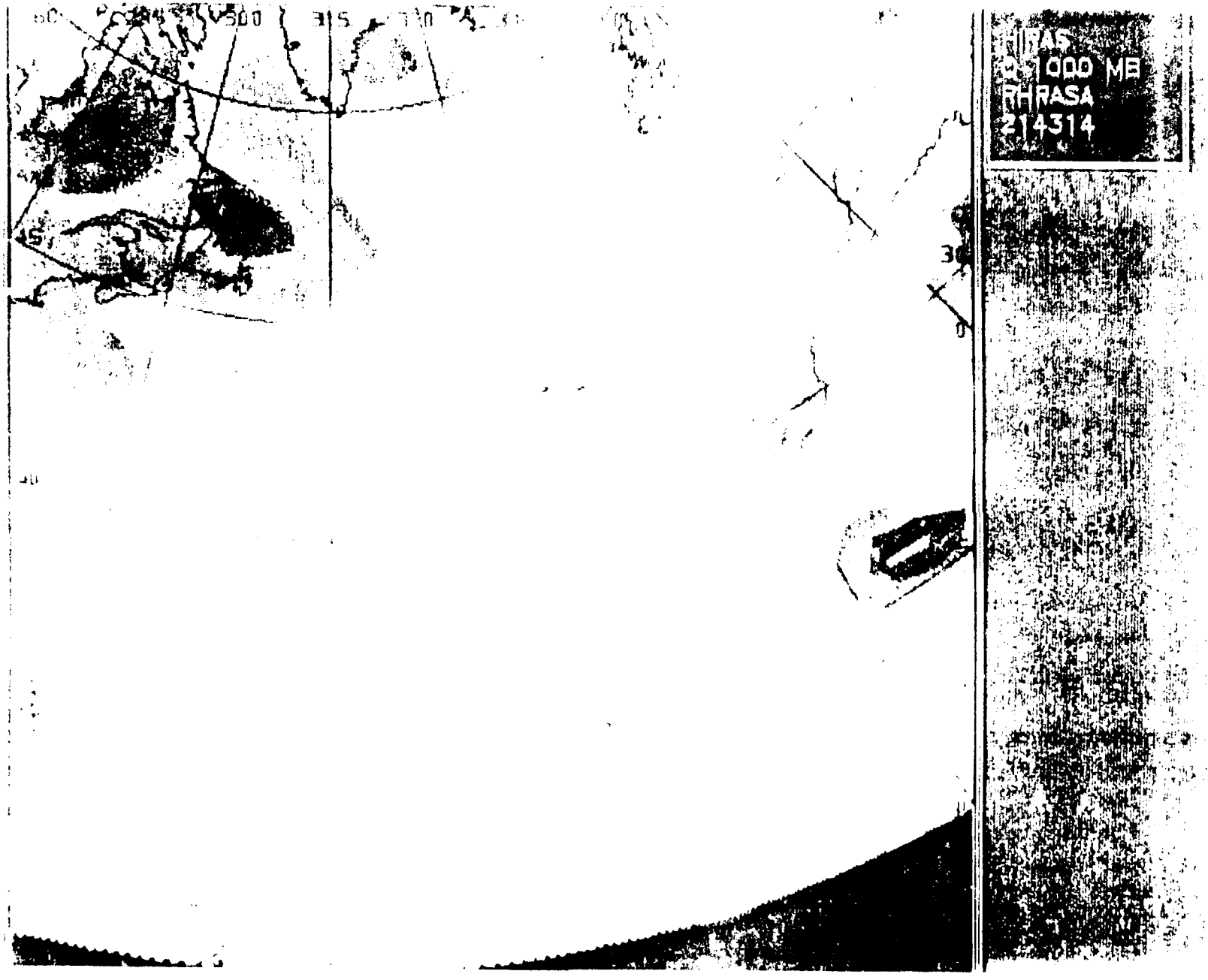
SSM/T2
RH 400 MB
F-11 002773
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0
315
330
345
30
15
0
300

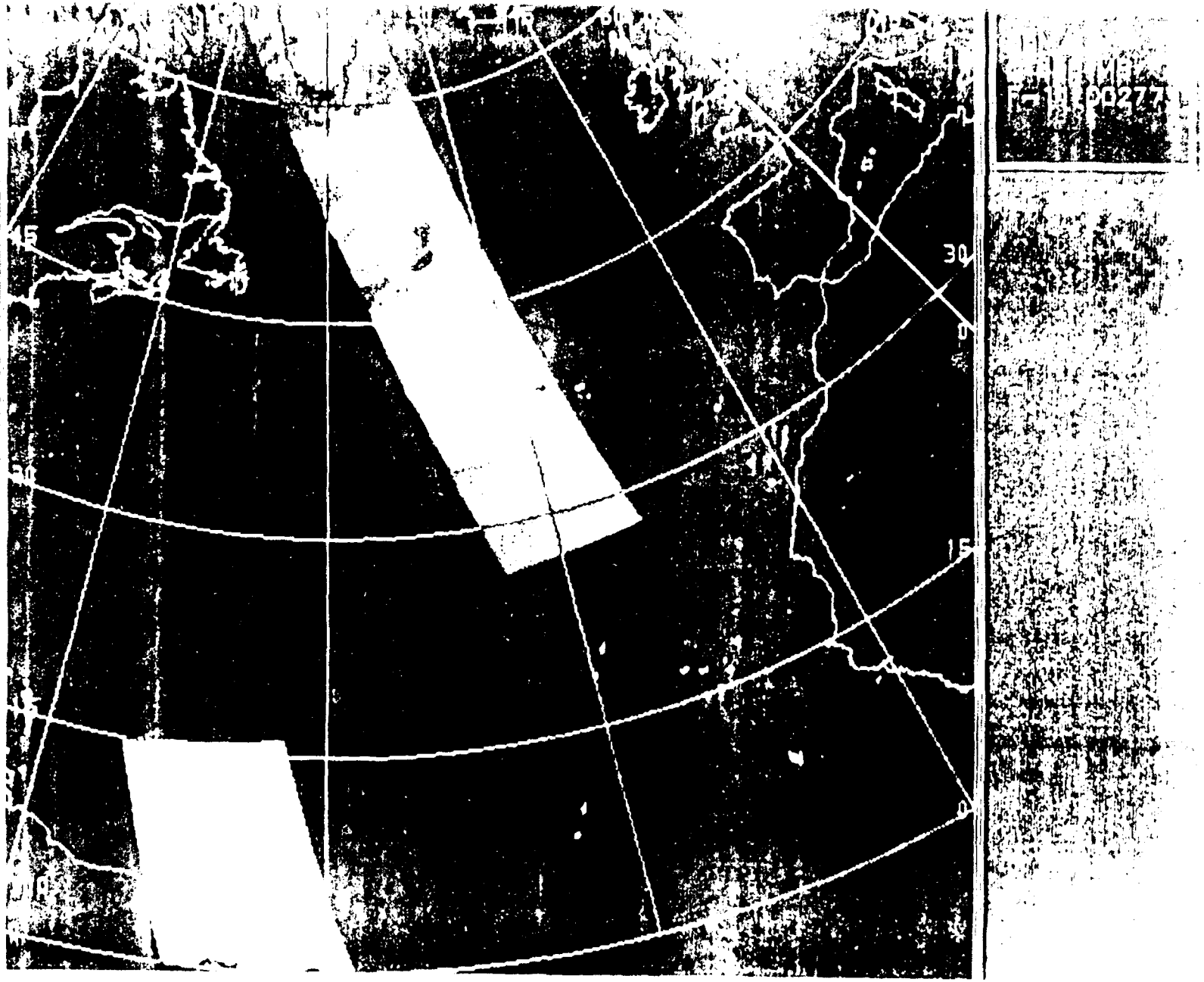

HIRAS
RH 400 MB
RHRASA
214314

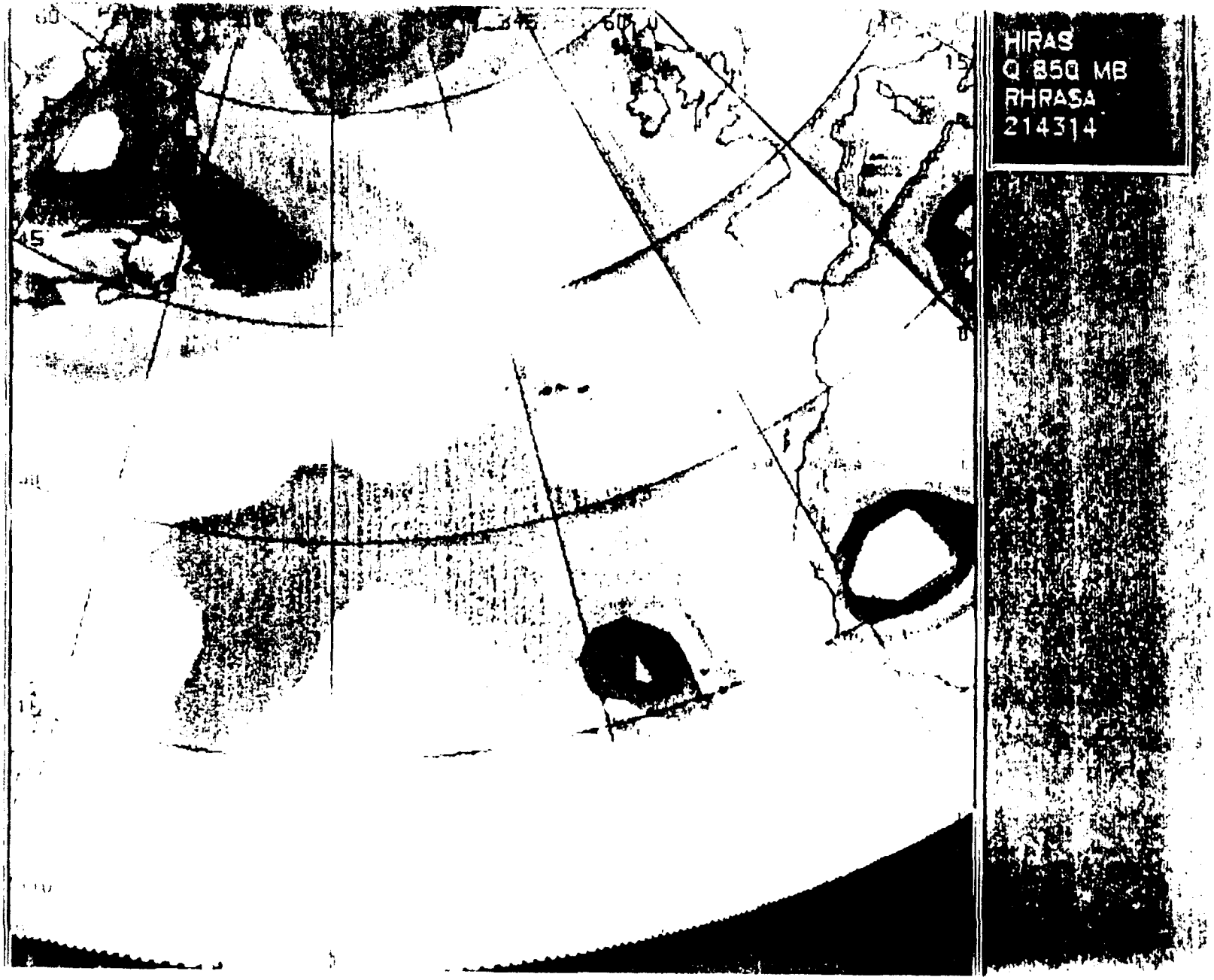

SSM/T2
RH 300 MB
F-11 002773
60
45
30
15
0
300
330
345


60
30
15
310
HIRAS
RH 300 MB
PHASA
214314


SSM/T2
Q 100D MB
F-11 002773
60
45
30
15
0
300


1000 MB
RHRASA
21431


15
30
15


HIRAS
Q 850 MB
RHRASA
214314

SSM/I
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45
30
15
330
345

HR4S
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RHR454
214314

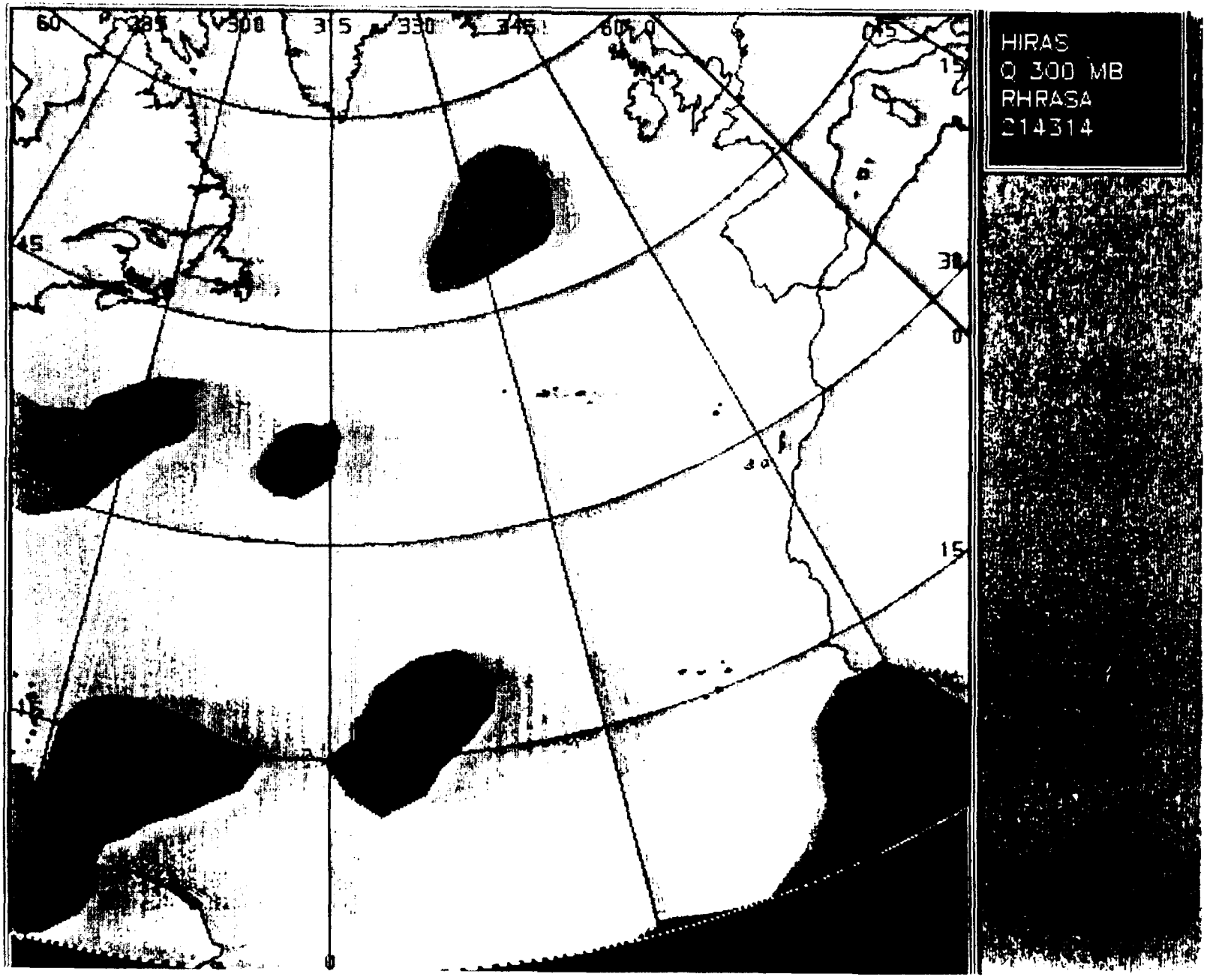
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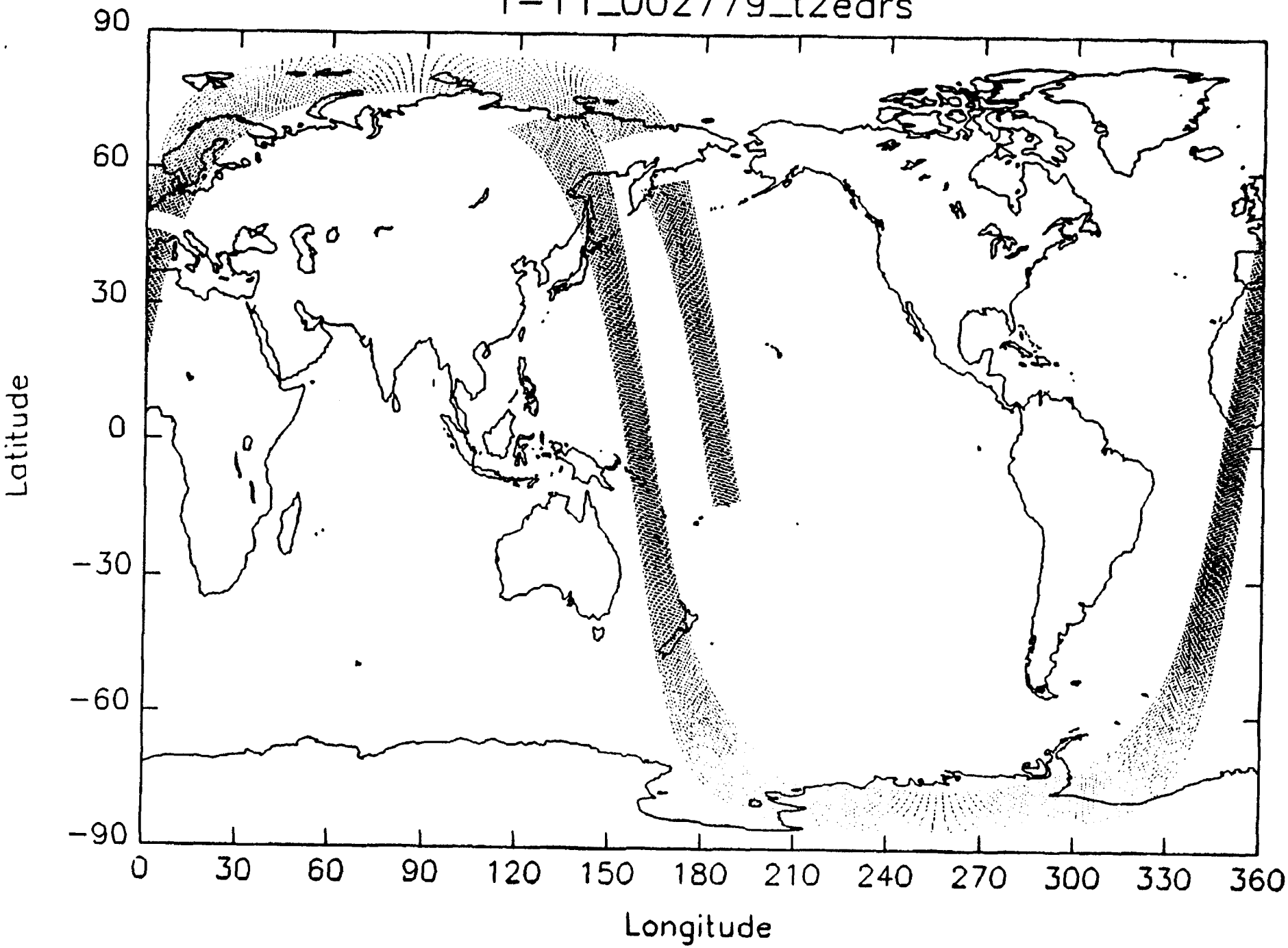

HIRAS
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RHR&SA
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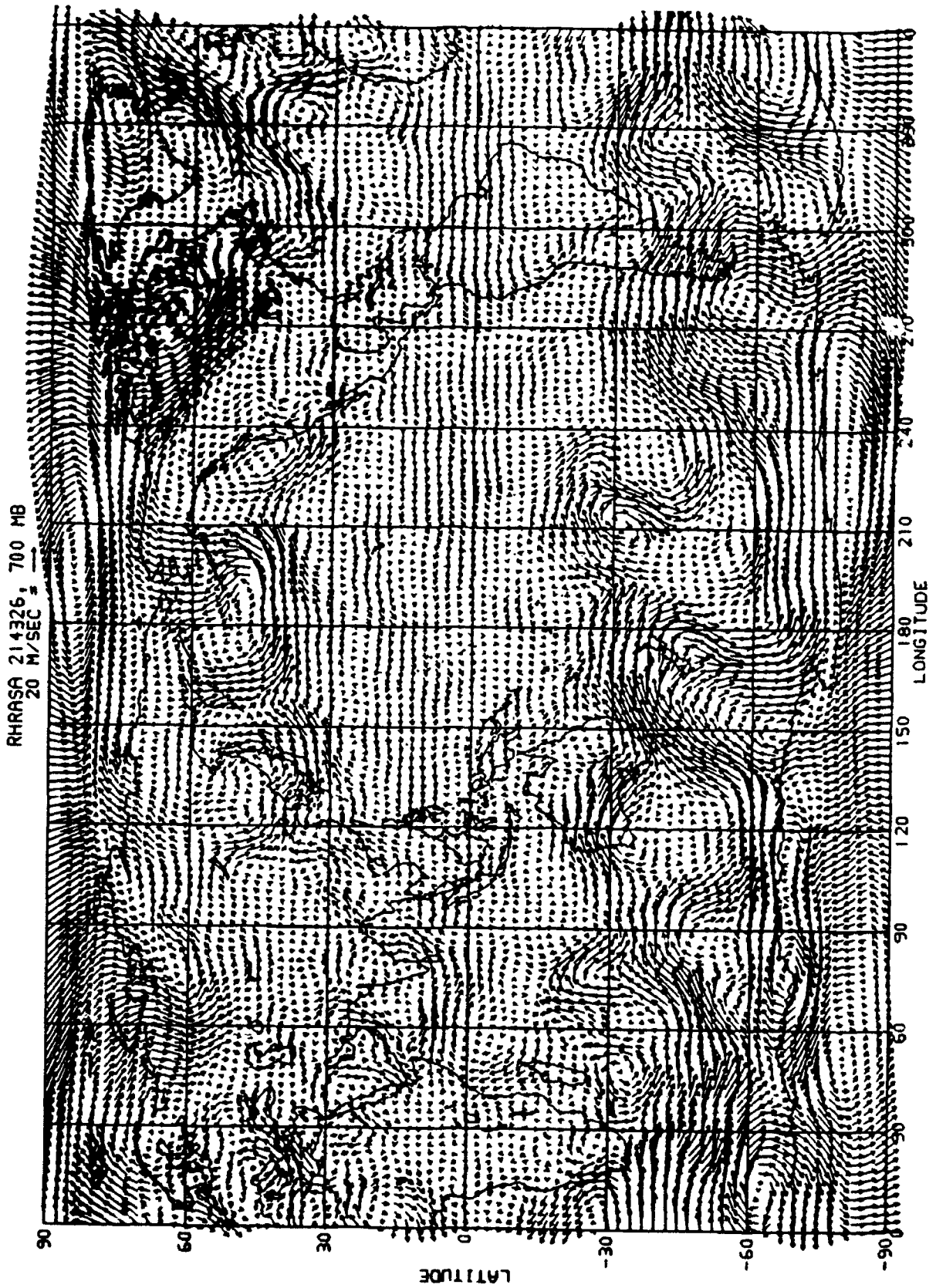
SSM/T2
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F-11 OCT--3
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135
120
105
90
75

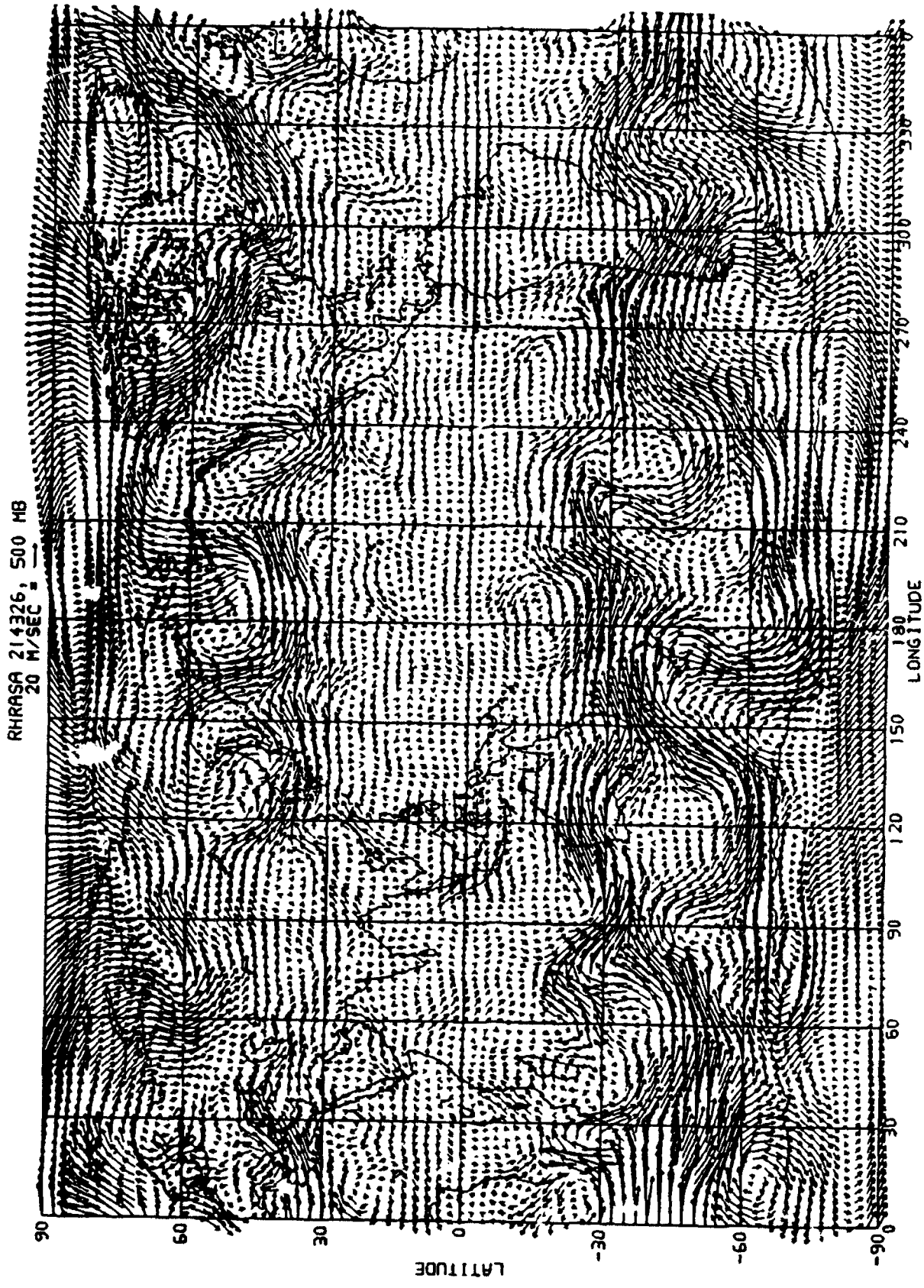

300
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345
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45
HIRAS
Q 400 MB
RHRASA
214314

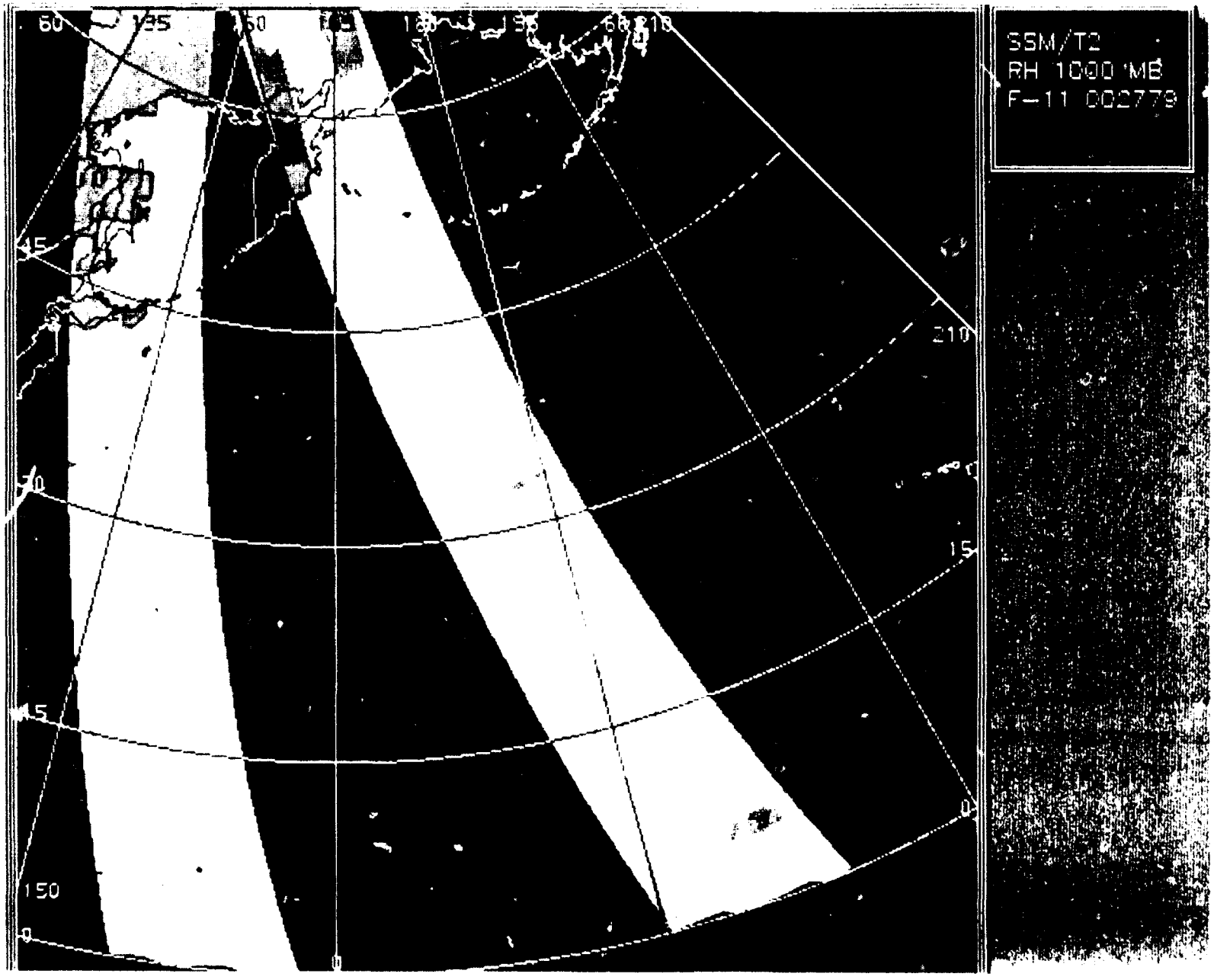
90
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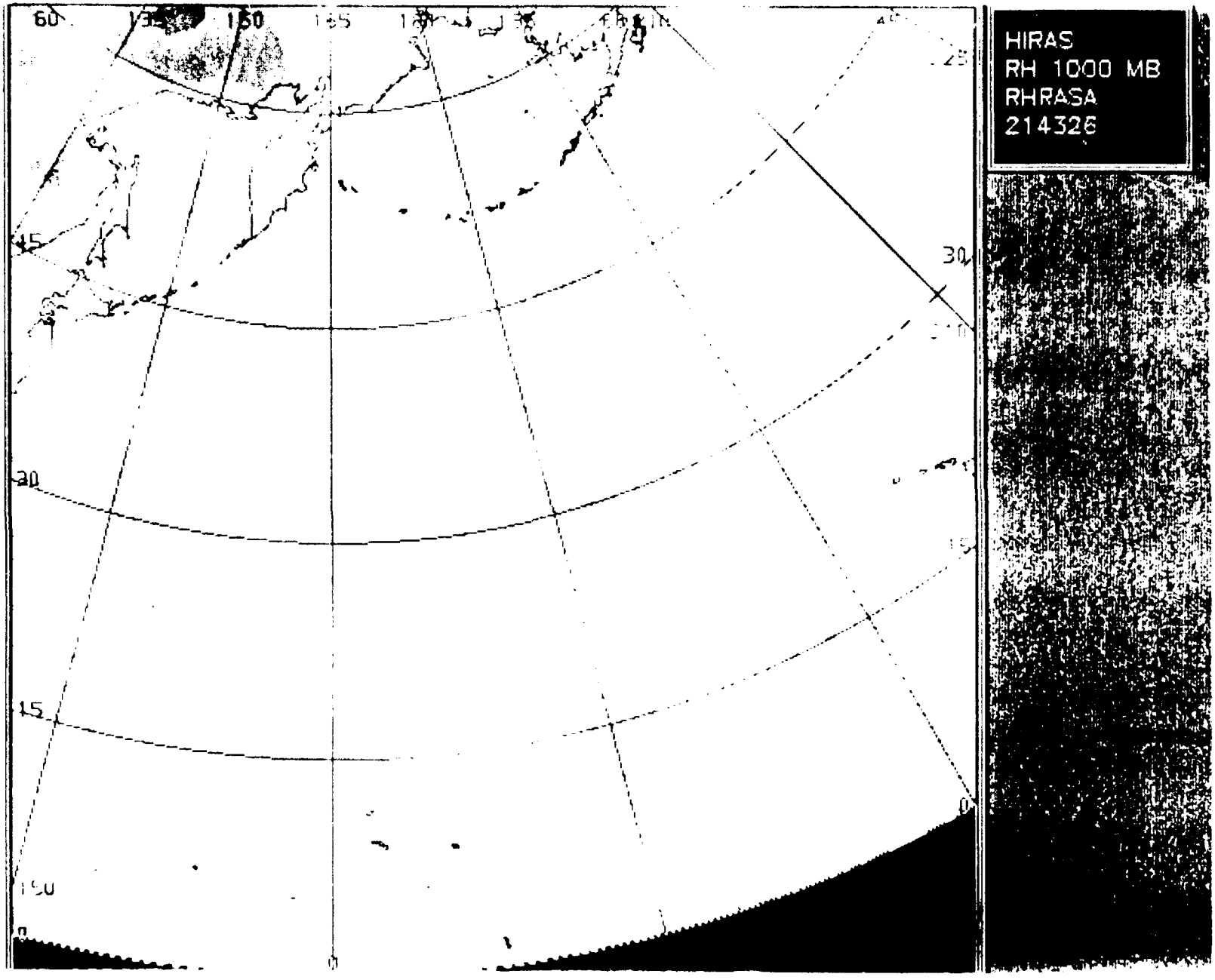

HIRAS
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RHRASA
214314
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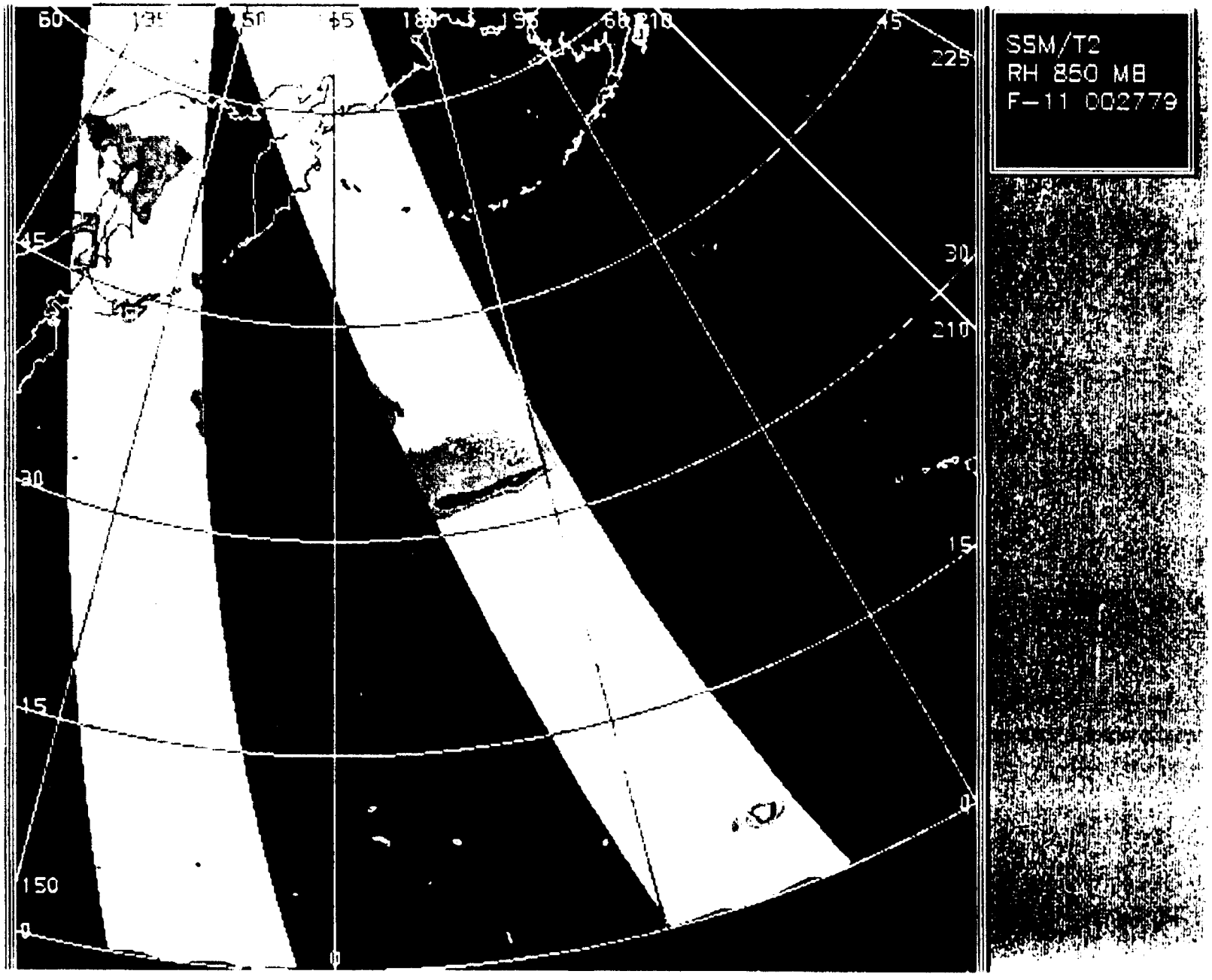

f-11_002779_t2edrs
90
60
30
0
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Latitude
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300
330
360
Longitude

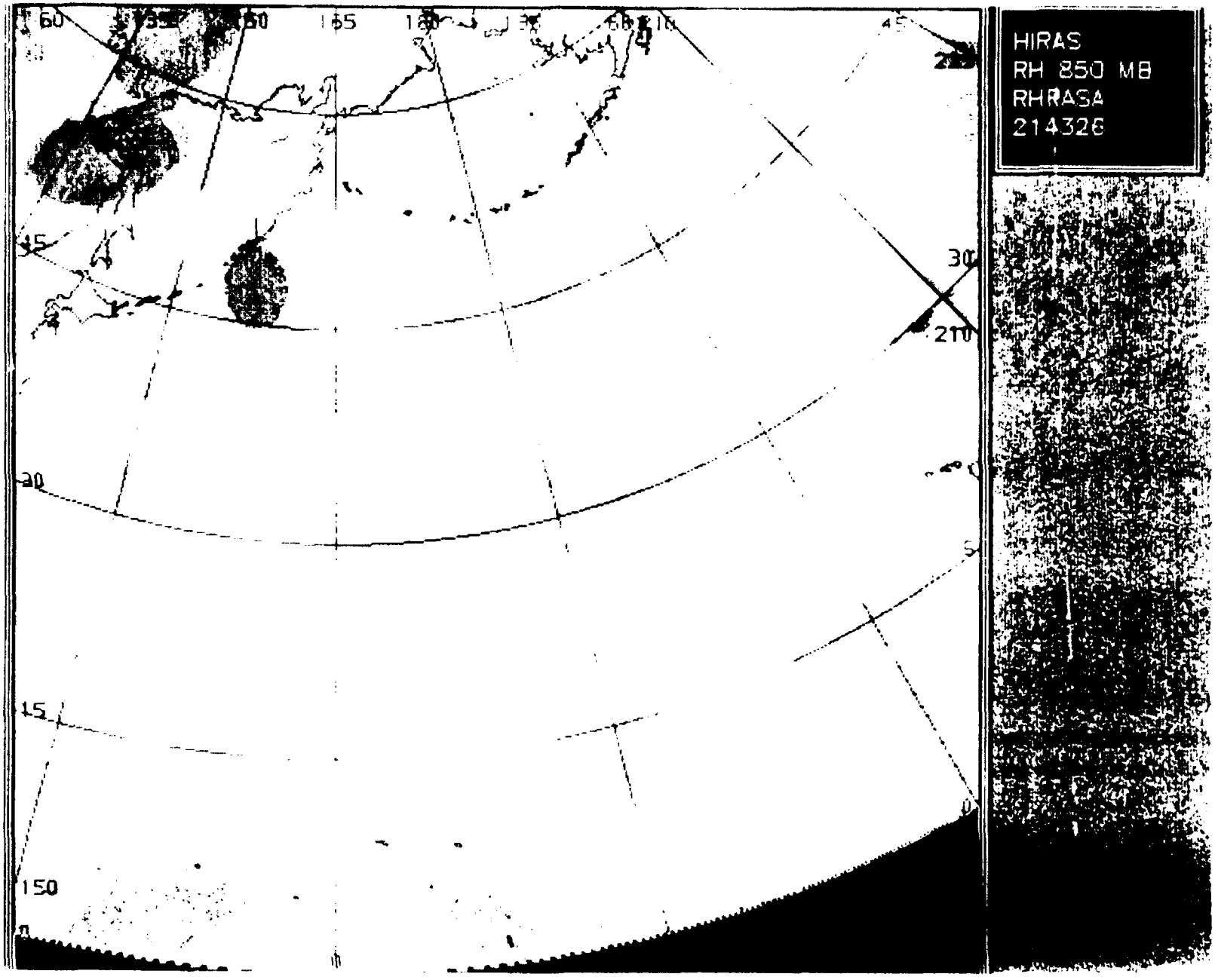

RHRASA 214326, 700 MB
20 M/SEC = →
LONGITUDE
LATITUDE
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0
-30
-60
-90
60
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120
150
180
210
240
270
300
330

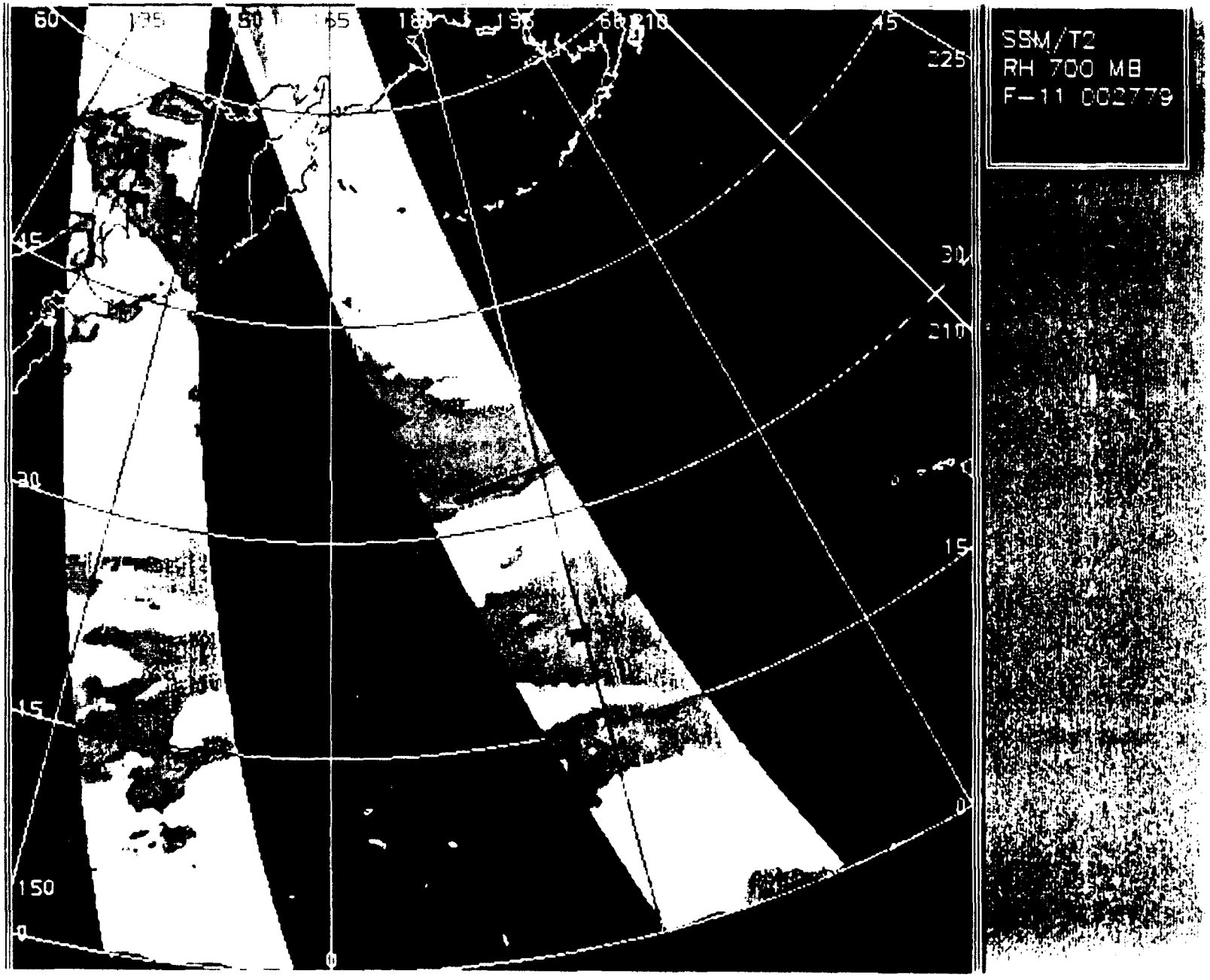

RHRASA 214326; 500 MB
20 M/SEC = —
90
60
30
0
-30
-60
-90
LATITUDE
0
30
60
90
120
150
180
210
240
270
300
330
LONGITUDE

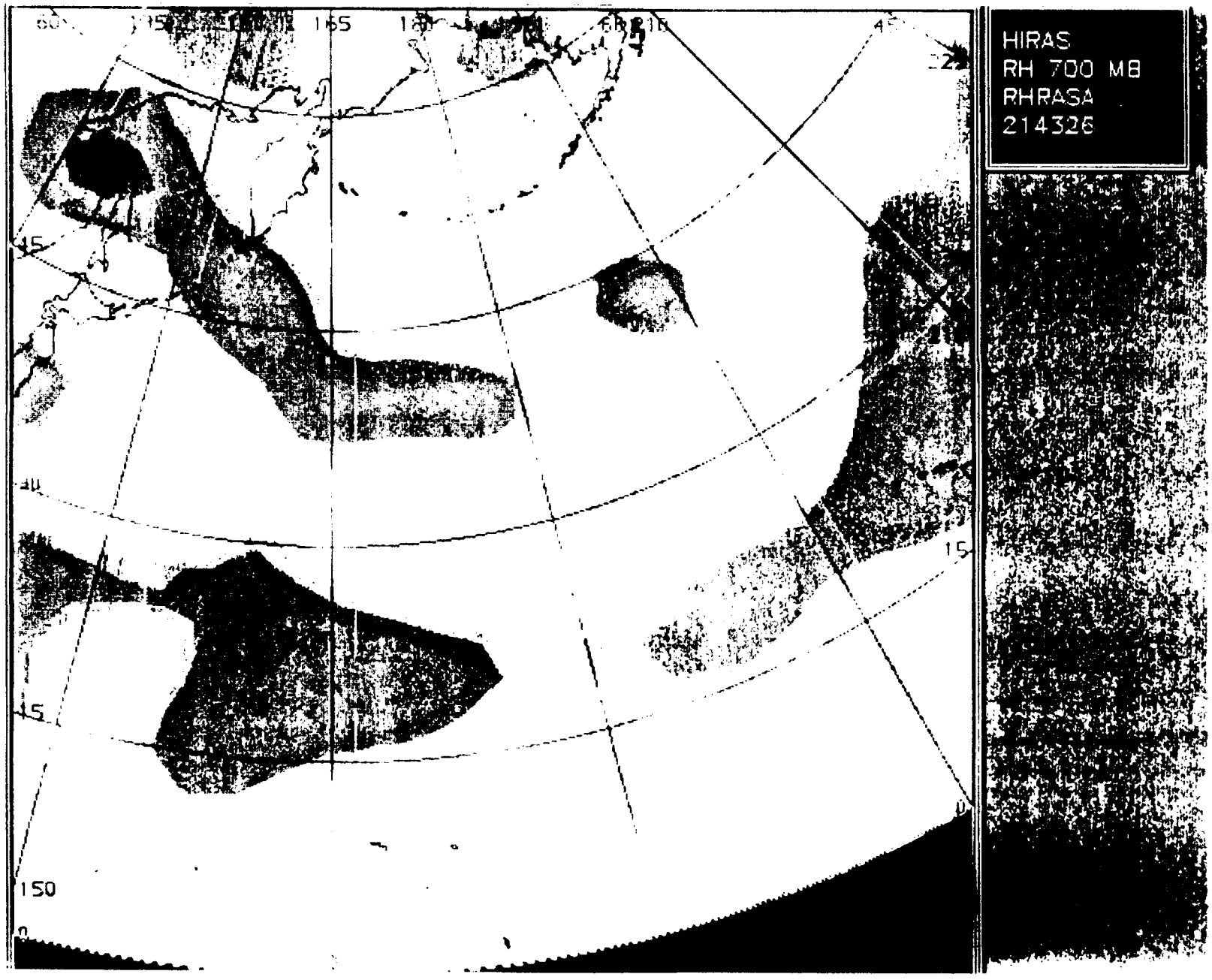

SSM/T2
RH 1000 MB
F-11 002779
60
45
30
15
0
150
210


HIRAS
RH 1000 MB
RHRASA
214326
60
30
15
30
15
0


SSM/T2
RH 850 MB
F-11 002779
60
45
30
15
0
150
225
210

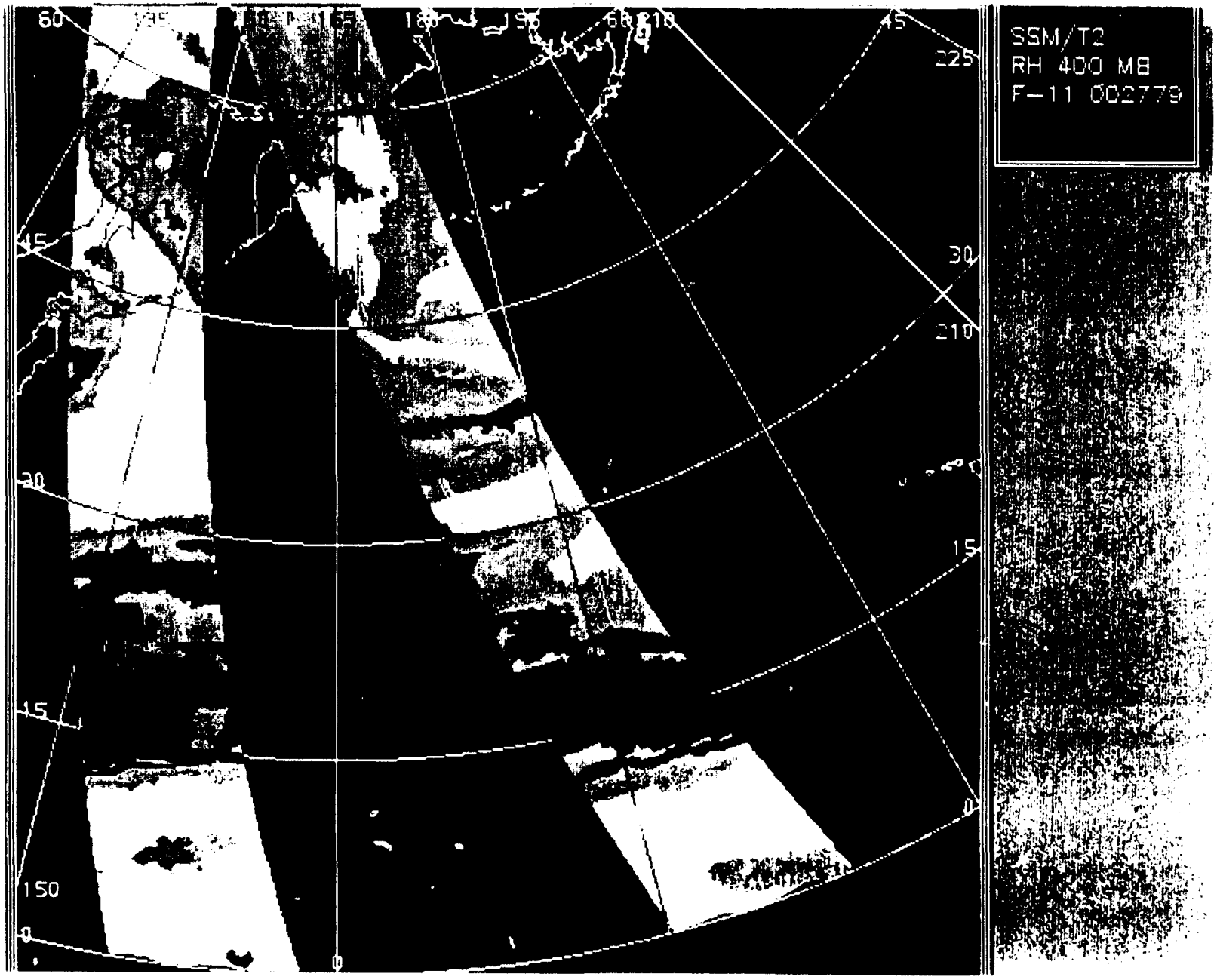

HIRAS
RH 850 MB
RHRASA
214326
60
55
50
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210
20
15
150

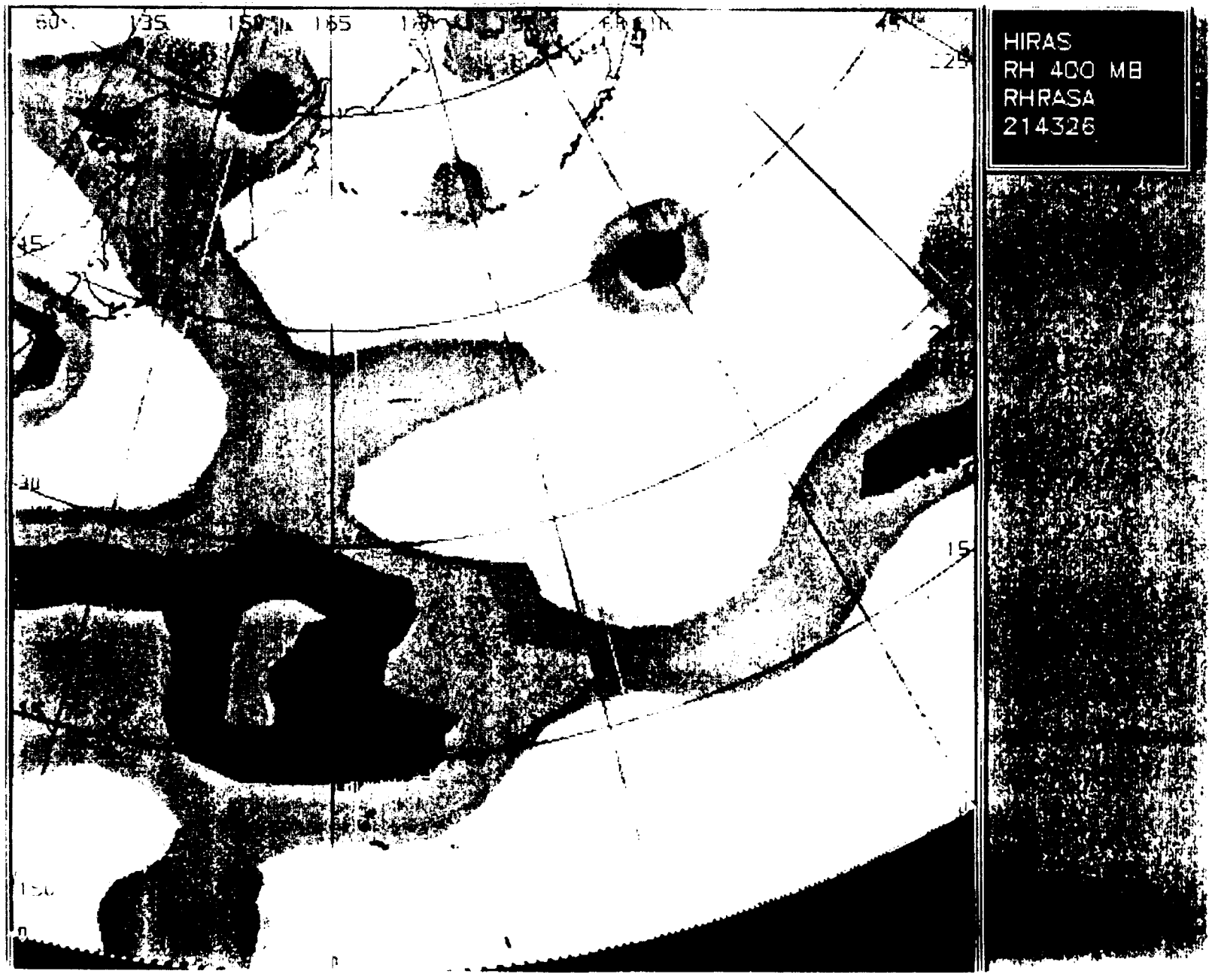

SSM/T2
RH 700 MB
F-11 002779
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180
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225

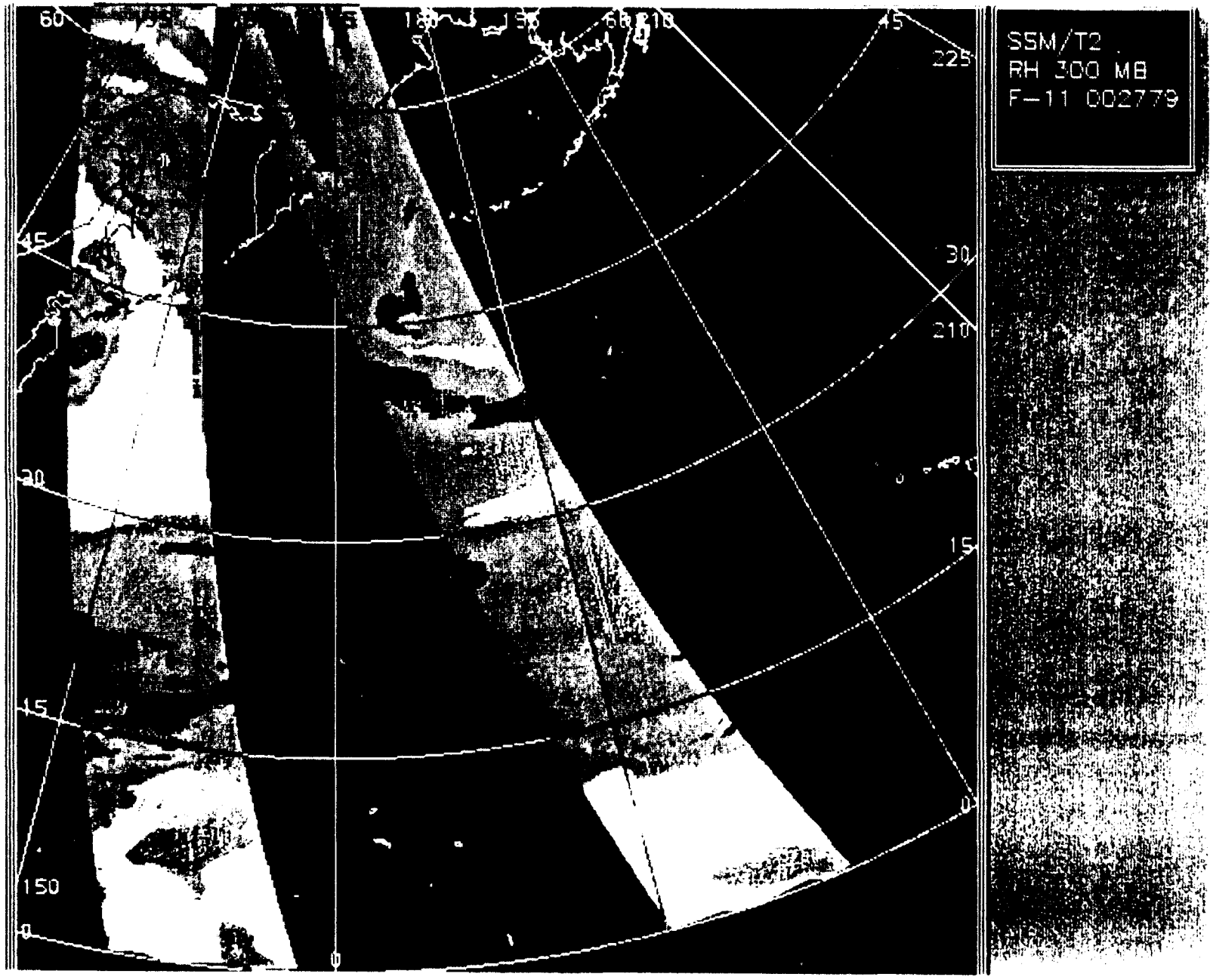

HIRAS
RH 700 MB
RHRASA
214326
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30
45
150

SSM/T2
RH 500 MB
F-11 002778

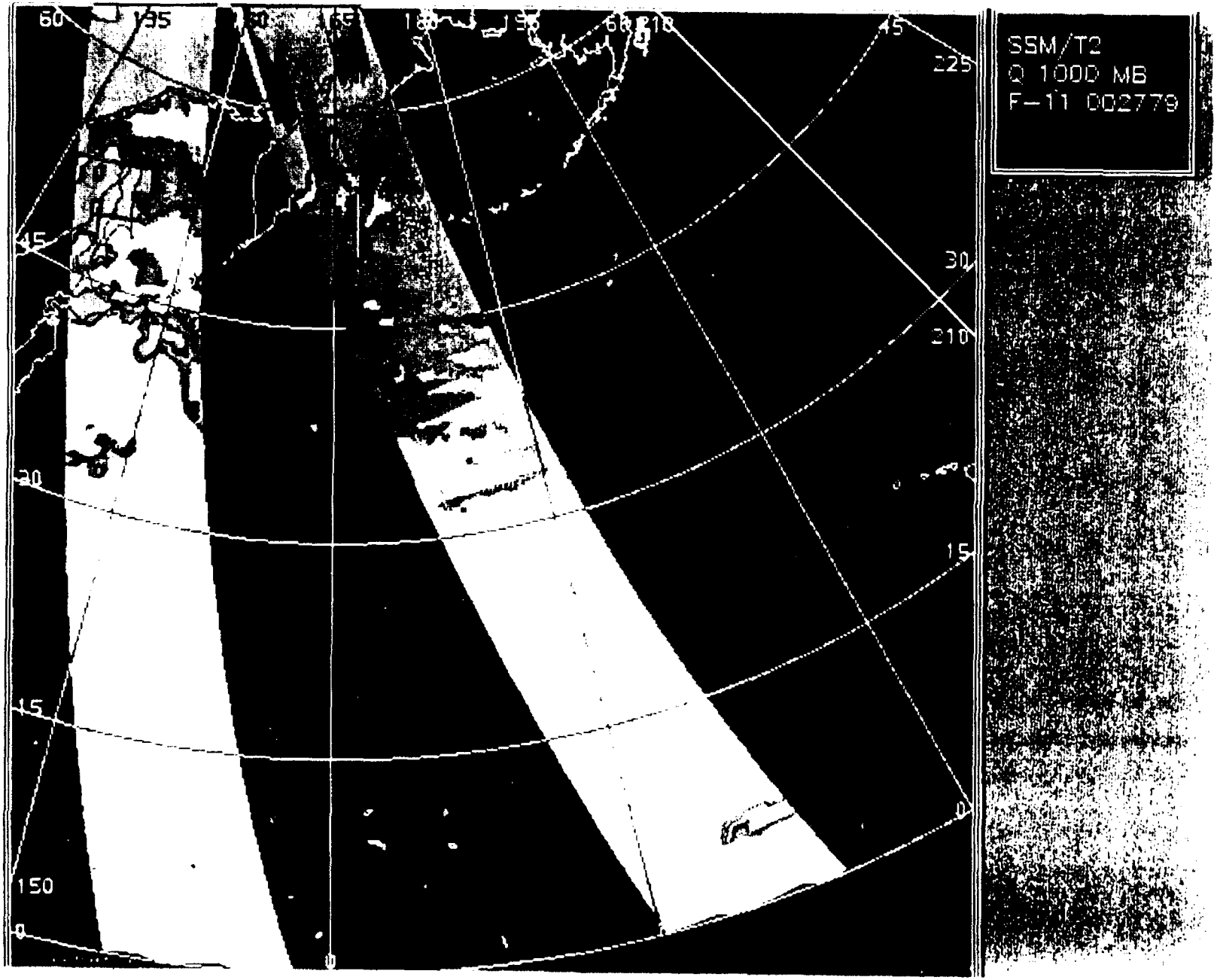

HIRAS
RH 600 MB
RHR43A
214326
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165
225
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15
30
150

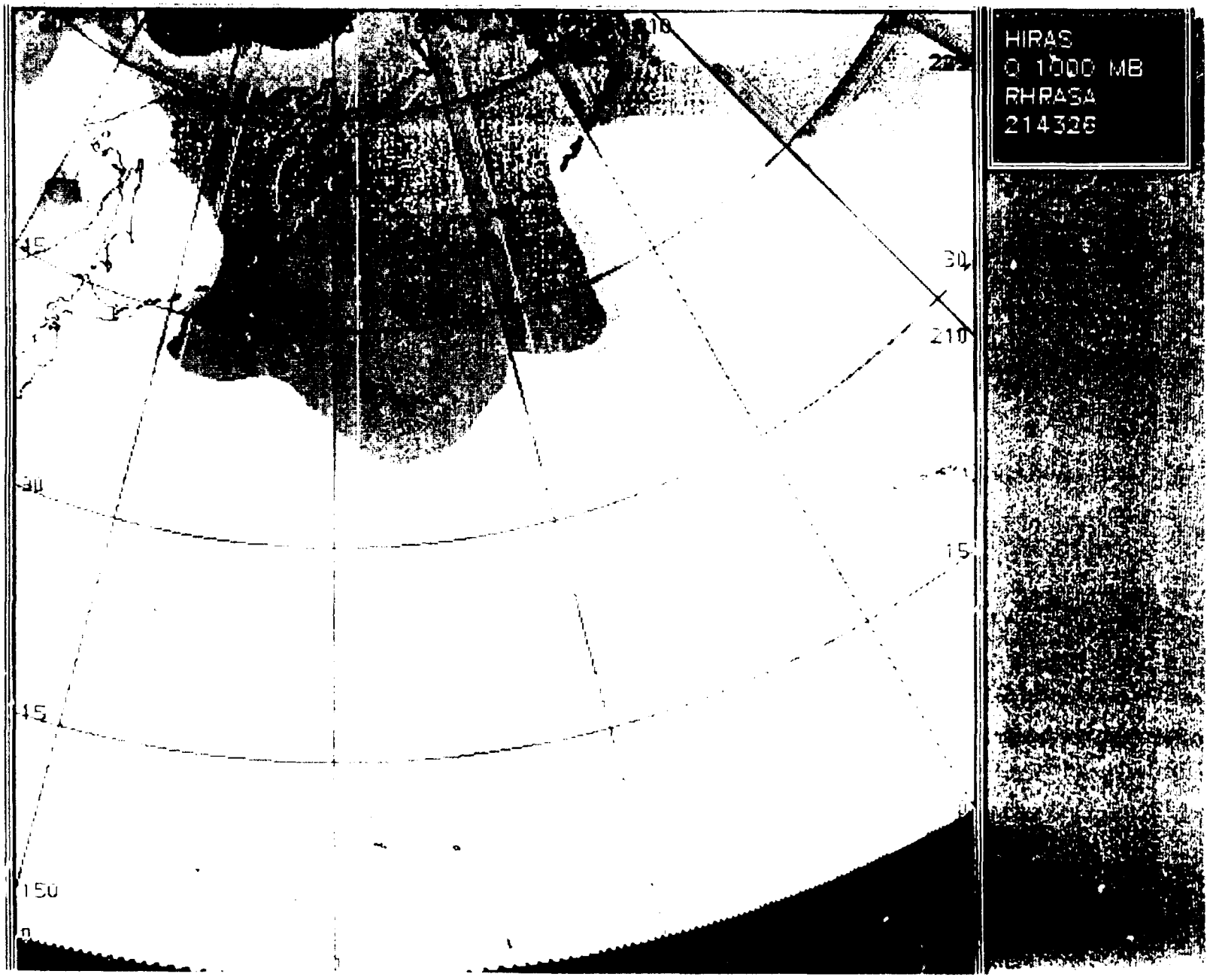

SSM/T2
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F-11 002779
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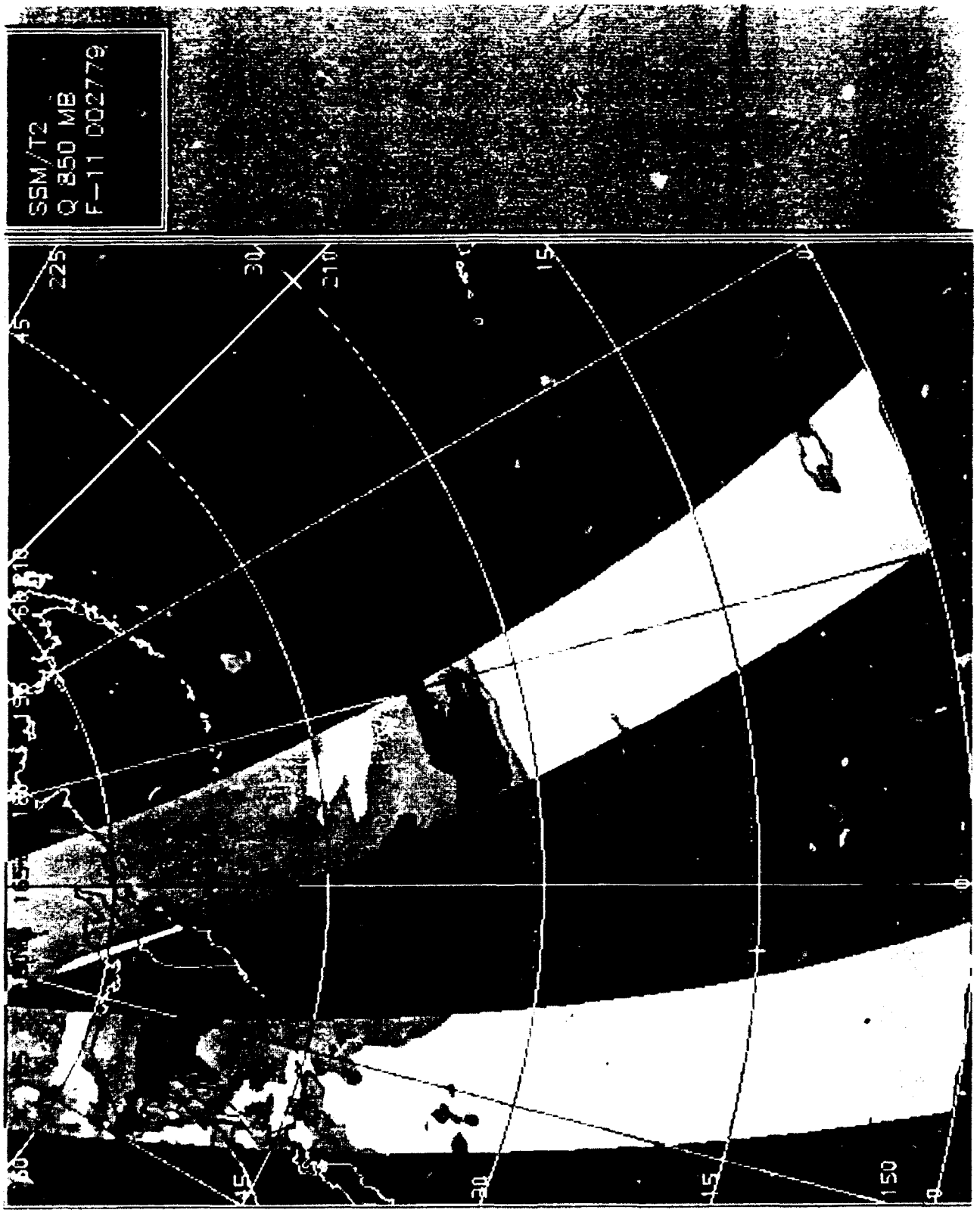

HIRAS
RH 400 MB
RHRASA
214326


SSM/T2
RH 300 MB
F-11 002779
60
45
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0
225
210
150

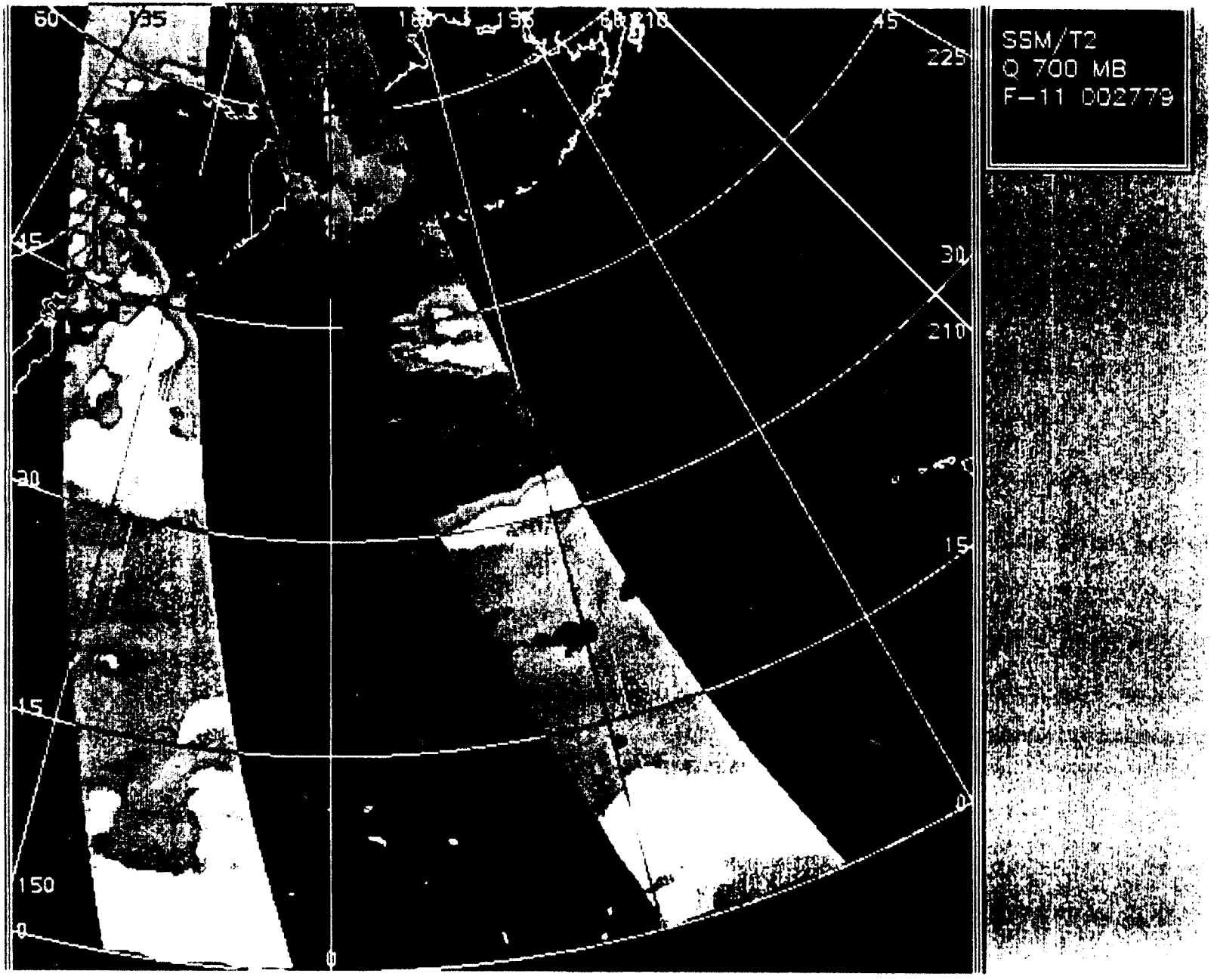

HIRAS
RH 300 MB
RHRASA
214326

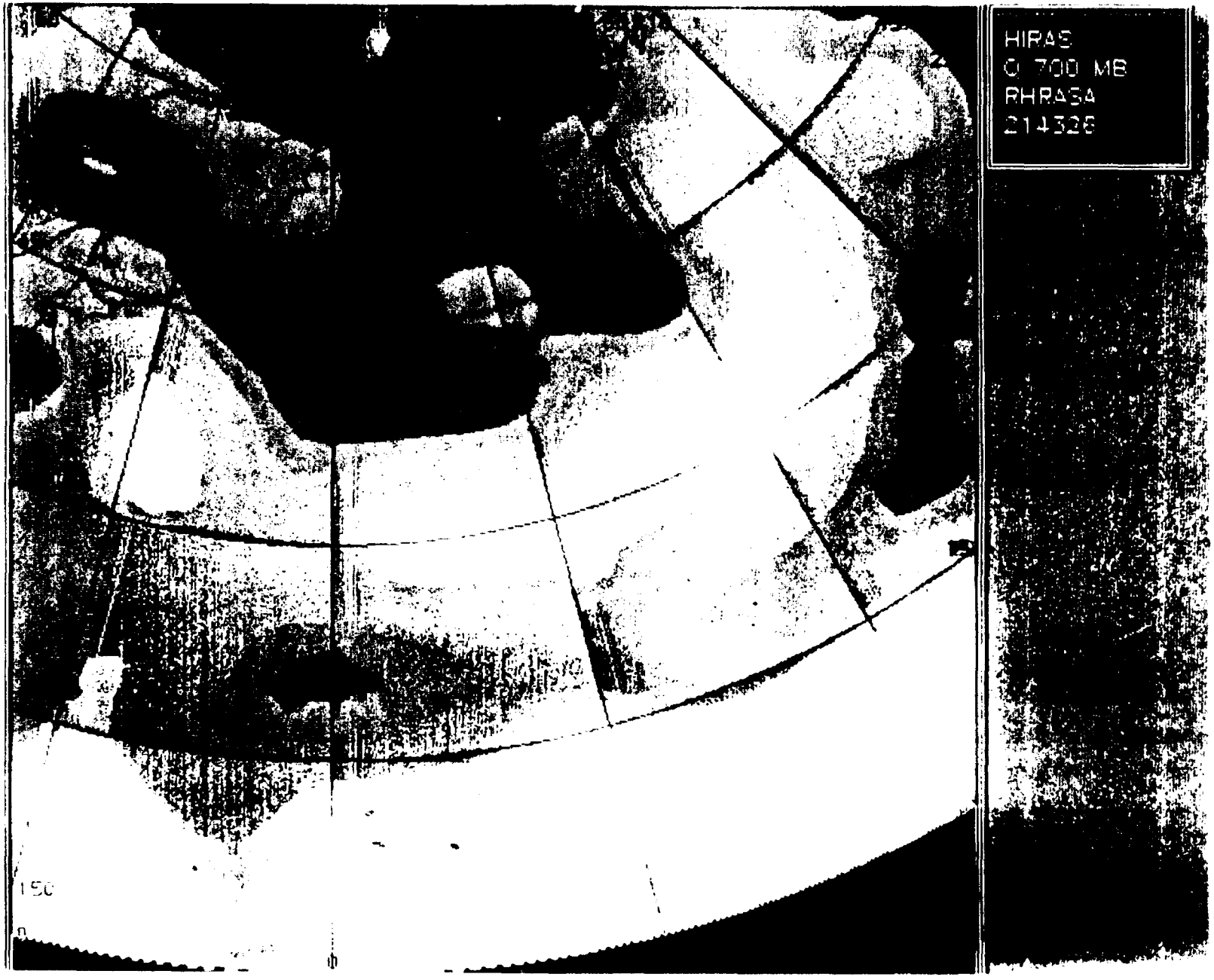

SSM/T2
Q 1000 MB
F-11 002779
60
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225
210
195
180
150

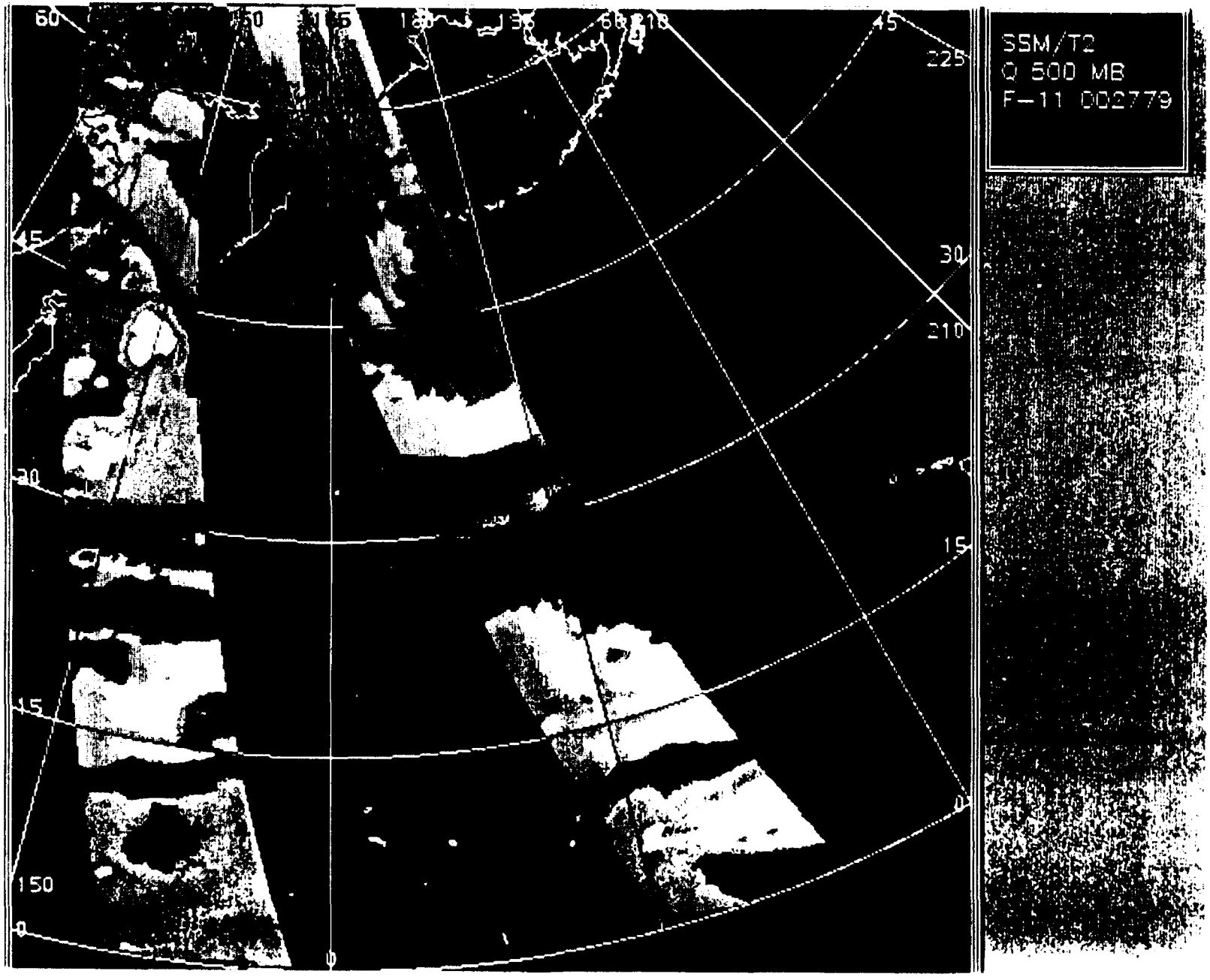

HIRAS
Q 1000 MB
RHRASA
214326
210
30
15
30
15
150
0


SSM/T2
Q 850 MB
F-11 002779

HIRAS
Q 850 MB
RHRASA
214326
60
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45
150

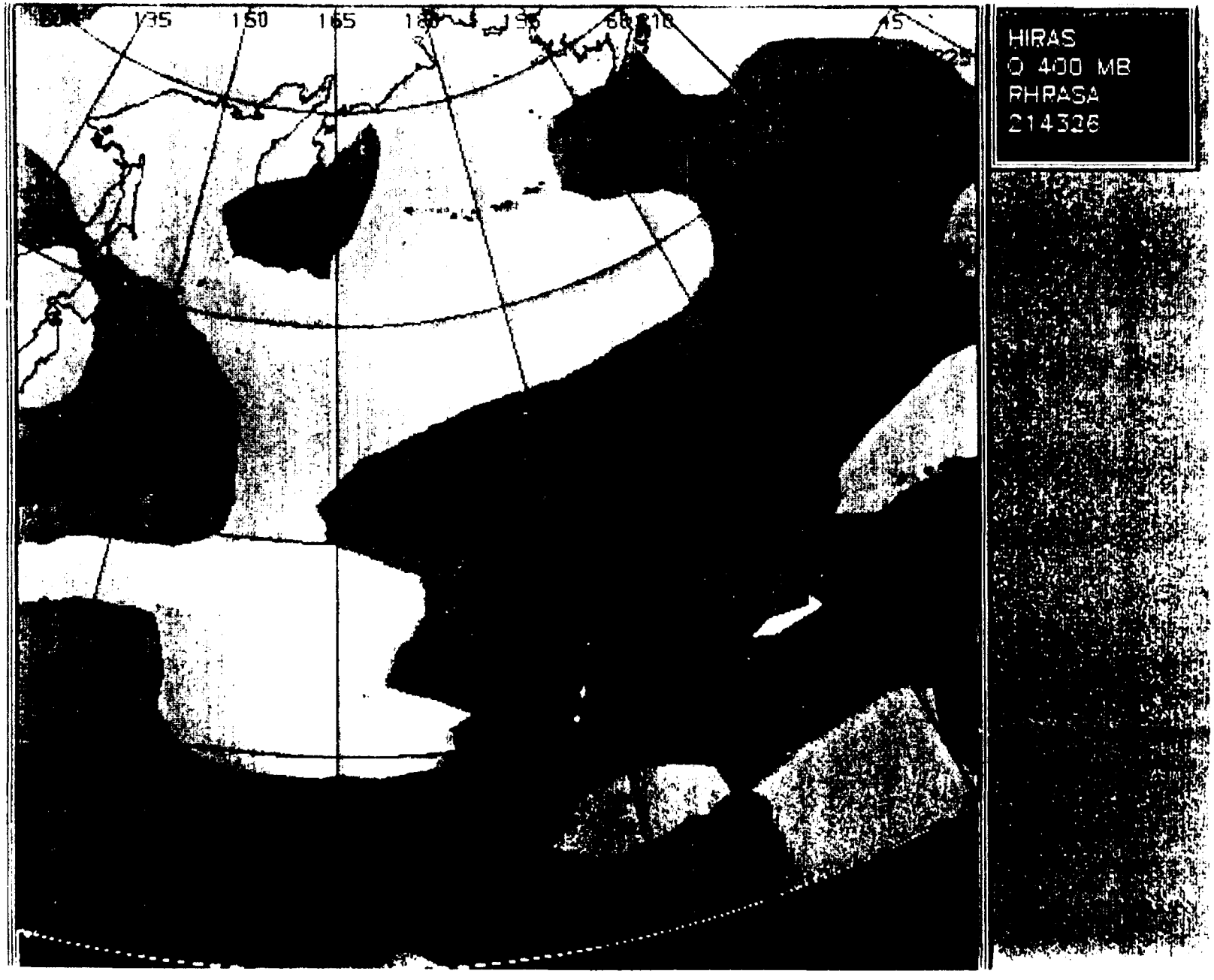

SSM/T2
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F-11 002779
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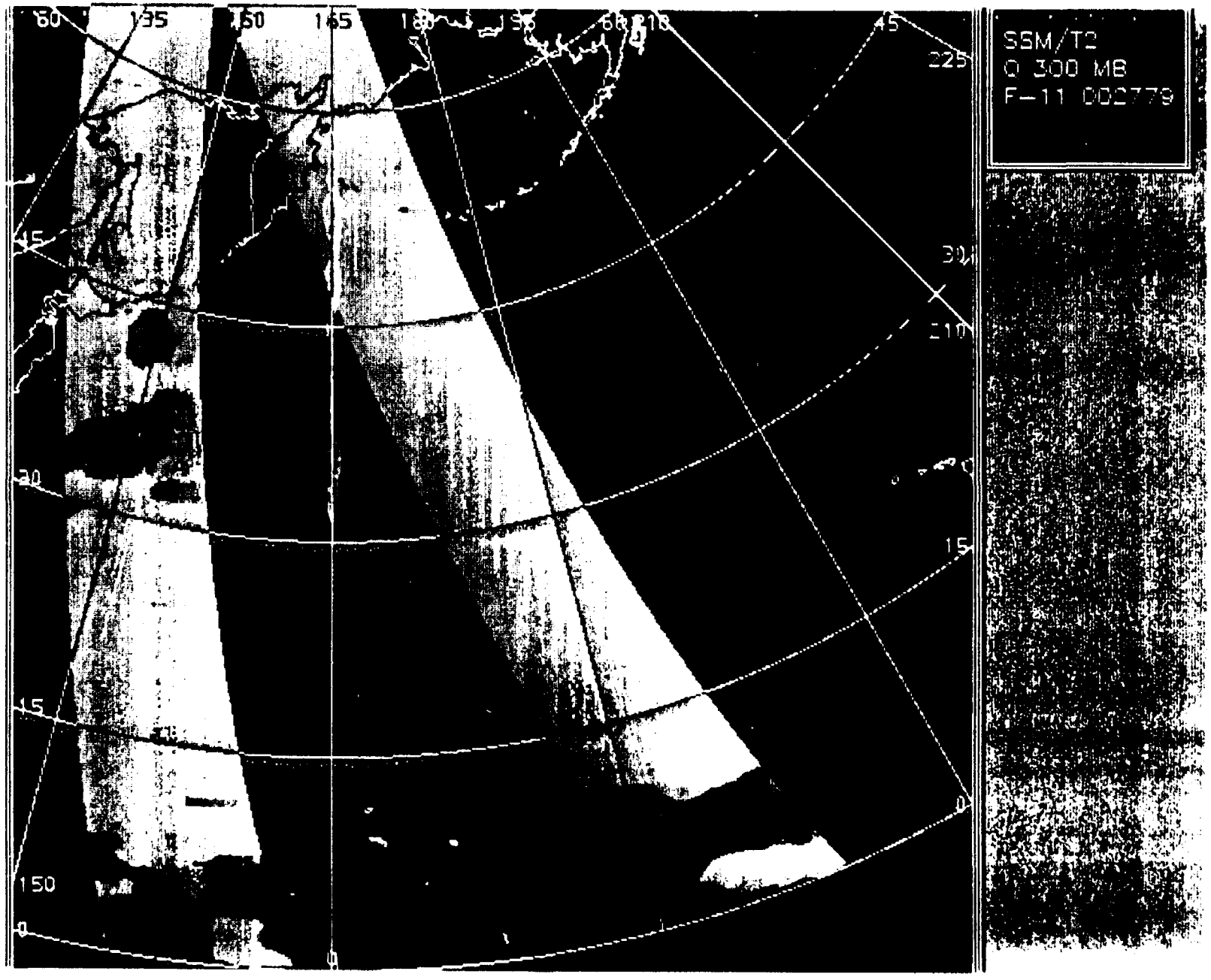

HIRAS
G 700 MB
RHRASA
214326
150


SSM/T2
Q 500 MB
F-11 002779
60
45
30
15
0
150
210
225

HRAE
500 MB

SSM/T2
Q 400 MB
F-11 002779
60
45
30
15
0
150
225
210
195
180
165


HIRAS
Q 400 MB
RHRASA
214326


SSM/T2
Q 300 MB
F-11 002779
60
135
150
165
180
225
45
30
210
15
0
150

HIRAS
Q 700 MB
RH@54
21 4526