

# Ground Cloud Dispersion Measurements During the Titan IV A-17 Mission (7 November 1997) at Cape Canaveral Air Station

20 February 1999

Assembled by

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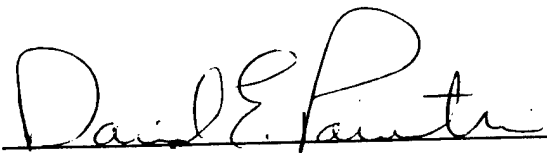
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A handwritten signature in black ink, reading "David E. Painter". The signature is written in a cursive style with a large, looped "P" and "A".

David E. Painter, Capt, USAF  
Chief, Titan Systems and  
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## Preface

The Air Force Space and Missile Systems Center's Launch Programs Office (SMC/CL) is sponsoring the Atmospheric Dispersion Model Validation Program (MVP). This program is collecting launch cloud dispersion data that will be used to determine the accuracy of atmospheric dispersion models, such as REEDM, in predicting toxic hazard corridors at the launch ranges. This report presents launch cloud dispersion and meteorological measurements performed during the Titan IVA-17 launch at Cape Canaveral Air Station on 7 November 1997.

An MVP Integrated Product Team (IPT) led by Capt. Bill Kempf (SMC/CLTE) is directing the MVP effort. Dr. Bart Lundblad of The Aerospace Corporation's Environmental Systems Directorate (ESD) is the MVP technical manager. This report was prepared by Mr. Norm Keegan (ESD) and Dr. Lundblad from materials contributed by personnel participating in the A-17 launch cloud dispersion measurements.

Infrared imagery measurements were made of the launch cloud by Ms. Karen Foster, Mr. Gary Harper, Mr. Brian Kasper, Mr. Luis Ortega, Dr. Don Stone, and Mr. Jess Valero of The Aerospace Corporation's Environmental Monitoring and Technology Department (EMTD). Mr. Doug Schulthess of Aerospace's Eastern Range Directorate coordinated camera site selection and logistical support. Also assisting imagery operations were Mr. John Ligda and Mr. Richard Reyes of the Aerospace Eastern Range Directorate. Ms. Foster digitized the imagery data for analysis by Dr. Robert Abernathy (EMTD). The description of the cloud imagery results was prepared by Dr. Abernathy.

The meteorological data displayed in this report was provided by Mr. Randy Evans of the NASA Applied Meteorology Unit.

The Titan IVA-17 mission was the thirteenth Titan IV launch for which usable launch cloud dispersion data was collected by MVP. The previous missions were K-7, K-23, K-19, K-21, K-15, K-16, K-22, K-2, K-13, B-24, B-33, and A-18.

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## Executive Summary

This report presents plume imagery documenting the development and dispersion of the Titan IVA-17 launch ground cloud at Cape Canaveral Air Station (CCAS). The launch occurred on 7 November 1997 at 2105 EST. The report also presents pertinent meteorological data taken from towers, 915 MHz radars, and rawinsonde balloons.

The imaging team used infrared cameras at four locations around the launch site (LC-41) to track the trajectory and time evolution of the vehicle's exhaust ground cloud for 9.5 min following launch. Meteorological data were collected to improve understanding of cloud dispersion and to use as input during model simulations and evaluations. Rawinsonde balloon data from shortly before launch, radar data from shortly before and after launch, and meteorological tower data from shortly before and after launch were collected and archived. These data and similar data on other Titan IV launches (past and future) will be used to determine the accuracy of atmospheric dispersion models such as the Rocket Exhaust Effluent Diffusion Model (REEDM) in predicting toxic hazard corridors (THCs) at the USAF Eastern and Western Ranges. These THCs assess the risk of exposing the public to HCl exhaust from solid rocket motors or hypergolic propellant vapors accidentally released during launch operations.

Analysis of imagery data from the first 9.5 min following launch yielded information on cloud rise and dispersion. The imagery showed that the middle of the launch cloud stabilized at an altitude of 1192 m AGL by 4.25 min after launch. REEDM 7.08 predicted that the middle of the launch cloud would stabilize at 947 m AGL at 4.65 min after launch. The middle of the actual launch cloud therefore stabilized 26% higher than predicted by REEDM 7.08. Analysis of the imagery also showed that the rising cloud had an air entrainment coefficient (ratio of increase in diameter to increase in altitude) of 0.33 (REEDM 7.08 default value is 0.64). The initial cloud radius extrapolated from the imagery was 168 m. (REEDM 7.08 default value is 72 m). REEDM 7.08 predictions for bearing, speed, and stabilization height were closer to the observed values when REEDM was initialized with the imagery-derived for the initial radius and the entrainment coefficient rather than with the default values.

## 1. Introduction

Launch vehicles that employ solid propellant rocket motors release exhaust ground clouds containing large quantities of hydrogen chloride (HCl) into the launch areas at Cape Canaveral Air Station (CCAS) and Vandenberg Air Force Base (VAFB). Large quantities of hazardous liquid fuels and oxidizers could also be released as a result of propellant transfer accidents or launch vehicle failures. The Air Force uses atmospheric dispersion models to predict the downwind diffusion and concentration of toxic launch clouds. Collection of launch cloud data is required to test and validate the performance of these dispersion models.

The Air Force range safety organizations at Patrick Air Force Base (45 SW/SE) and VAFB (30 SW/SE) are responsible for assuring that launches occur only when meteorological conditions will not expose nearby public areas to hazardous levels of launch exhausts and propellant vapors. Predictions of toxic hazard corridors that extend into public areas can lead to costly launch delays. The use of non-validated models requires the use of conservative launch criteria. The development and validation of more accurate atmospheric dispersion models is expected to increase launch opportunities and significantly reduce launch costs. The Space and Missile Systems Center's Launch Programs Office (SMC/CL) established the Atmospheric Dispersion Model Validation Program (MVP) to collect launch cloud data and to use the data to test and validate current and future atmospheric dispersion models at the ranges.

The MVP effort involves the collection of data during Titan IV launches at CCAS and VAFB to characterize HCl launch cloud rise, growth, and stabilization, as well as launch cloud transport and diffusion. These data, along with data collected during tracer gas releases, will be used to determine the capability of the Rocket Exhaust Effluent Diffusion Model (REEDM) for predicting toxic hazard corridors at the ranges. REEDM is used at CCAS and VAFB to predict the locations of toxic hazard corridors in support of launch operations. It is applied to large heated sources of toxic air emissions such as nominal launches, catastrophic failure fireballs, and inadvertent ignitions of solid rocket motors. It uses launch vehicle and meteorological data to generate ground-level concentration isopleths of HCl, hydrazine fuels, nitrogen dioxide, and other toxic launch emissions. Launch holds may occur when REEDM toxic concentration predictions exceed adopted exposure standards. REEDM is a unique and complex model based on relatively simple modeling physics. It has a long development history with the Air Force and NASA, but has never been fully validated. Validation of REEDM has been identified as a range safety priority.

The MVP has been organized and is being directed by the MVP Integrated Product Team (IPT). SMC/CL is serving as the IPT leader, while The Aerospace Corporation's Environmental Systems Directorate serves as the IPT technical manager. The IPT consists of personnel with expertise in atmospheric dispersion modeling, meteorology, and atmospheric dispersion field studies. MVP participants include personnel from SMC, 30 SW, 45 SW, Armstrong Laboratory, The Aerospace Corporation, NASA, NOAA, and contractors. Key functions include program planning, field data collection, data review and compilation, range coordination, and model validation.

This report presents the results of measurements performed at CCAS during the Titan IVA-17 launch on 7 November 1997 at 2105 EST. Infrared camera imagery of the ground cloud was collected from four locations to monitor the cloud's growth, stabilization, and trajectory. The imagery results are presented in Section 2. REEDM predictions of ground cloud stabilization heights and surface concentrations are presented in Appendix A. Measurements of meteorological data are tabulated in Appendix B.

Analysis of the quantitative imagery determined the ground cloud's rise rate, stabilization height, expansion rate, bearing, and speed. The imagery-derived cloud stabilization height (middle of cloud) was 1192 m AGL. This is 26 % higher than the 947 m AGL height predicted by REEDM 7.08 (based on T-0.6 rawinsonde sounding). The measured cloud entrainment coefficient was 0.33, while the default value used in REEDM 7.08 is 0.64. Extrapolation of the imagery-derived sphere equivalent radius to ground level gives an initial cloud radius of 168 m (default value in REEDM 7.08 is 72 m). REEDM 7.08 predictions for cloud bearing, speed, and stabilization height were closer to the observed values when REEDM was initialized with the imagery-derived values for the initial cloud radius and the entrainment coefficient rather than the default values. The imagery results presented in this, as well as other MVP reports, will allow the accuracy of REEDM and other launch range atmospheric dispersion models to be determined over the range of possible meteorological conditions.

## **2. Imagery of the Titan IV A-17 Ground Cloud**

[The material in this section was contributed by R. N. Abernathy, B. P. Kasper, and K. L. Foster of the Surveillance Technology Department of The Aerospace Corporation's Space and Environment Technology Center.]

### **2.1 Background**

On 7 November 1997, the Titan IV A-17 mission was successfully launched from Space Launch Complex 41 (SLC-41) at Cape Canaveral Air Station (CCAS) at 21:05 EST (02:05 GMT). This section describes the quantitative exhaust cloud imagery data collected by each of four imagery sites during the 9.50 min immediately following the launch from SLC-41. This section also describes the data acquisition hardware and analysis software. The two-dimensional cloud images obtained by the various imagery sites were combined to produce stereoscopic 3-D information. This analysis yielded the cloud's rise rate, stabilization height, expansion rate, speed, and bearing during the first 0.25 to 9.50 min after launch.

The quantitative imagery-derived ground cloud data are reported here in several graphical formats to facilitate comparison with REEDM predictions (Appendix A) and rawinsonde sounding data (Appendix B). For clarity, this section includes some data from the appendices. It is apparent from review of this section, that these data are useful for validating current and future dispersion models.

The purpose of this report was to document the quality and quantity of the A-17 exhaust cloud imagery data available for validating dispersion models. To facilitate the comparison of these data to individual dispersion model runs, the imagery-derived A-17 exhaust cloud imagery data are available as comma-separated-variable files providing time and position for various ground cloud features. When collected, the raw visible imagery data are archived on VCR tapes. The raw infrared (IR) imagery is archived on DAT. The selected IR images analyzed for this report are also archived on magneto-optical disks as digital image files.

### **2.2 Introduction**

This section summarizes the results of quantitative IR imagery of the exhaust cloud from the Titan IV A-17 launch from SLC-41 at CCAS on 7 November 1997 at 21:05 EST (02:05 GMT). Personnel from The Aerospace Corporation's Surveillance Technology Department (STD) supported this launch with the deployment of four complete platforms of the Titan IV dedicated Visible and IR Imaging System (VIRIS). For the A-17 evening launch, the IR imagery permitted the post-launch quantitative analysis of the ground cloud's movement and growth as a function of time.

The imagery sites chosen for the A-17 launch were

- on the road across from UCS-4  
(northwest of SLC-41),
- at the sixth bollard along the northeast edge of the pond at Press Site  
(west of SLC-41),
- at static test road viewing site (STR)  
(southwest of SLC-41), and
- on a rise in the road to the east of SLC-34  
(south-southeast of SLC-41).

UCS stands for Universal Camera Site. Each site recorded only IR imagery of the exhaust cloud since it was too dark for visible imagery.

The IR imagery was digitized by the AGEMA scanner at 13 bits by an internal A/D converter. Due to a bug in the acquisition program, only the least-significant six bits (i.e., the intensity was “folded” to six bits of intensity) were stored to hard disk. In addition, the acquisition program averaged 7 images of the cloud with 5 unrelated images. As a result of this second error, the analyst had to subtract previous or subsequent images to reveal cloud details. Luckily, the 5 unrelated images were identical and were completely eliminated by image subtraction. In addition, the image subtraction removed some of the elevation-dependent atmospheric radiance gradient. Interestingly, the “folded” and background-subtracted imagery revealed all of the ground cloud with a single intensity span. Normally, one can only view a portion of the 13 bits of intensity spanned by the ground cloud and the elevation-dependent atmospheric radiance. A down side to the image subtraction was that the exhaust cloud was in all imagery subsequent to launch. Therefore, the processed images can contain both positive and negative images of the ground cloud when subsequent imagery serves as background. By wise selection of the images, the positive and negative exhaust cloud images had minimal overlap and posed little difficulty for image interpretation.

Quantitative analysis of the IR imagery for the first 9.50 min after launch documented the cloud’s rise rate, stabilization height, expansion rate, bearing, and speed without recourse to other data. The “ground cloud” is defined as the lower and more concentrated portion of the rocket’s exhaust cloud that can diffuse to the ground. The “launch column” or contrail is defined as the trail of the rapidly moving rocket that extends above the more spherical “ground cloud.”

The T-0.6 h rawinsonde pre-launch meteorology data are documented in Appendix B and referenced in this section. Those rawinsonde wind data were used to run the “normal launch” REEDM version 7.08 predictions. The complete output for the T-0.6 h REEDM version 7.08 “default” predictions are documented in Appendix A and referenced in this section.

## **2.3 Field Deployment**

### **2.3.1 Planning**

The Aerospace Corporation's participants are listed in various teams below (members of the imaging teams for A-17 are indicated with asterisks):

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| K. L. Foster*                          | (Press Site Pond)  |
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| B. P. Kasper* (Field Crew Team Leader) | (East of SLC-34)   |
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### **2.3.2 Equipment**

The equipment at each site included all the hardware and software necessary to record and document the launch, to communicate between sites, and to supply backup power in case of an outage at the fixed power distribution points. The VIRIS consists of an array of three full and one back-up (excluding the IR imager) cloud tracking systems and was designed and fabricated at the request of Space Launch Operations, Systems Engineering Directorate, at The Aerospace Corporation. Each full tracking system consists of coaligned visible (CCD) and infrared (IR = 8–12  $\mu\text{m}$ ) imagers, mounted on an azimuth- and elevation-encoding tripod, with an associated data acquisition and display console. The combination of visible and IR imagers permits cloud tracking in both daylight and darkness. The unique capabilities built into the VCR hardware include digital insertion of imager azimuth (AZ), elevation (EL), time, and GPS location. The system electronics is integrated in a single package, which has been ruggedized for field use. Pre-wiring of this package makes deployment of these imager systems straightforward, usually requiring less than 45 min for instrumentation at a site to become fully operational.

For the Titan IV A-17 mission, the operators at each site set the FOV of the visible imager using the adjustable 10 to 110 mm electronic zoom lens. They also selected the best lens for the IR imager. A fourth AGEMA IR imager was borrowed from another program to support this mission. All operators rotated the tripod head to keep the ground cloud within the FOV as it moved from the launch pad. Table 1 documents the FOV used by each imagery site for the A-17 mission.

Table 1. Field of View (FOV) for Imagery Sites during A-17 Mission

| Imagery Site       | Imager Type<br>(Visible or IR) | FOV(horizontal)<br>(degrees) | FOV(vertical)<br>(degrees) |
|--------------------|--------------------------------|------------------------------|----------------------------|
| East of UCS-4      | AGEMA Infrared                 | 40.85                        | 20.59                      |
| Pond at Press Site | AGEMA Infrared                 | 41.45                        | 19.88                      |
| Static Test Road   | AGEMA Infrared                 | 40.80                        | 20.81                      |
| East of SLC-34     | AGEMA Infrared                 | 40.69                        | 21.03                      |

All four imaging systems deployed for the Titan IV A-17 mission were capable of total autonomy. Each VIRIS has an on-board differential-ready Xyberion GPS receiver that can be used to document each imager's position with moderate spatial resolution. Typically, 35 m is the precision in the horizontal plane and 100 m is the precision in the vertical plane. For the A-17 imagery sites, a Trimble differential GPS provided more accurate GPS data (5 m resolution) for each of the surveyed camera sites. Gasoline-powered AC generators (Honda Ex1000) are insurance against loss or absence of facility power. The Stirling cooler option for the AGEMA 900 series IR imager was chosen so that liquid nitrogen would not be required at the sites. Each unit is transportable in a standard utility wagon (e.g., Ford Explorer).

The AZ/EL angle encoder for all imager systems was calibrated using reference objects (e.g., SLC-41) within the field of view of the imager. When reference objects are not part of the geodetic survey database, the GPS location uncertainty is the dominant term in their positional accuracy. Imager pixelation and operator error in edge detection contribute as well to the error in defining the cloud boundary. The  $0.07^\circ$  step-size in the tripod angle encoders is a third source of error. The analysis accuracy is determined either by the availability of optimal references for AZ/EL calibration or by the step size for the tripod angle encoder. Typically the VIRIS system provides  $0.1^\circ$  accuracy in both elevation and azimuth.

## 2.4 Processing of Imagery Data

The processing of the imagery data requires several transformations that are performed upon return to The Aerospace Corporation:

1. Digitizing frames of the visible imagery (i.e., daylight launches).
2. Measuring the pixel locations of the reference sites within each image (i.e., FOV and angular calibration).
3. Measuring the pixel locations of cloud features in digitized images.
4. Converting pixel locations to azimuth and elevation readings.
5. Calculating cloud characteristics (i.e., position in Cartesian coordinates relative to the launch pad).

The processing requires the use of specialized hardware and software. When used, visible images of the cloud are digitized at precise times, beginning with time intervals of 15 s, then 30 s, then 1 min as the cloud evolves. The AGEMA 900 IR imagers produce digital images every 15 s in the field. A set of digitized images is selected for specific times following the launch and from each of the available imagery sites. Time, AZ, and EL are tabulated for each set. A setup file is created for each of these sets, containing all relevant information necessary to compute the cloud geometry using the imagery. The Aerospace program's **PLMTRACK** and **PLMVOL** are run to digitize the x, y, and z coordinates of cloud features and to estimate the volume of the exhaust cloud, respectively. These programs report the x and y coordinates relative to the launch pad and the z coordinate as height above MSL. We converted the height MSL to height above ground level (AGL) by subtracting the 7 m MSL for the height of SLC-41. This allows direct comparison of the imagery-derived data to REEDM's output.

**PLMTRACK** is a software program developed and maintained in the Surveillance Technology Department (STD) of The Aerospace Corporation by Brian P. Kasper. It is designed to analyze pairs of cloud images synchronized in time. In various versions, **PLMTRACK** has used the linear and rigorous (i.e., trigonometric) methods of interpreting pixels as AZ and EL and vice versa. **PLMTRACK** provides an absolute method of triangulating the position of the ground cloud without making any assumptions regarding the position of the ground cloud. This report presents the rigorous, trigonometric **PLMTRACK** results.

When using the **PLMTRACK Line Method**, the operator selects the location of a particular cloud feature in the images from the two imager sites by moving a screen pointer to the desired feature in each image and clicking a mouse button. **PLMTRACK** then calculates the point of nearest approach to the two rays defined by the selected points. The three-dimensional location of this feature is then written to a data file.

Another implementation of **PLMTRACK** is illustrated in Figure 1. When using the **PLMTRACK Box Method**, the operator draws a rectangle about the ground cloud in the images from the two sites

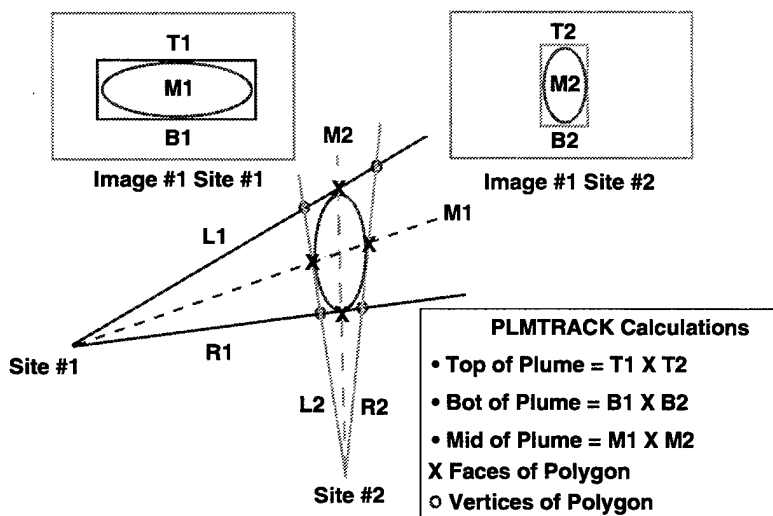


Figure 1. Implementation of the PLMTRACK "box" method with two imagers.

by moving a screen pointer to the extreme corners of the desired rectangles and clicking a mouse button. **PLMTRACK** then calculates the closest approach for various rays as illustrated in Figure 1 and described below. The top of the cloud is defined by rays determining T1 and T2 (i.e., T1 x T2); the bottom is determined by rays defining B1 and B2 (i.e., B1 x B2); and the middle is defined by the geometric mean of top and bottom (i.e., M1 x M2). To define the “faces” of the “box,” the points of closest approach for ray M1 with L2 and R2 (the left and right tangents to the cloud from Imager 2) are defined (i.e., M1 x L2 and M1 x R2). A similar procedure is used to define the points of closest approach for M2 with L1 and R1, yielding M2 x R1 and M2 x L1. In addition to the centers of the faces of the “box,” the intersects of the left and right rays document the four vertices for the XY polygon. Thus, eleven points are defined for the six-faced “box” surrounding the cloud (a point in the center of each of the six faces, four vertices for the XY polygon, plus a middle point for the “box”). These eleven sets of x, y, and z coordinates are written to a file.

When multiple imagery sites are viewing the cloud simultaneously, a multi-sided polygon method (documented in Figure 2) has been employed as a way to document the maximum extent of the cloud (i.e., a ground-plane projection) for all sets of images. With four imagers, there are redundant determinations of the top, middle, and bottom of the cloud by each pairing of imagery sites using **PLMTRACK**. The horizontal extent of the cloud is determined by defining the rays from each imager that are tangential to the widest part of the cloud as seen from that site. Projection of these

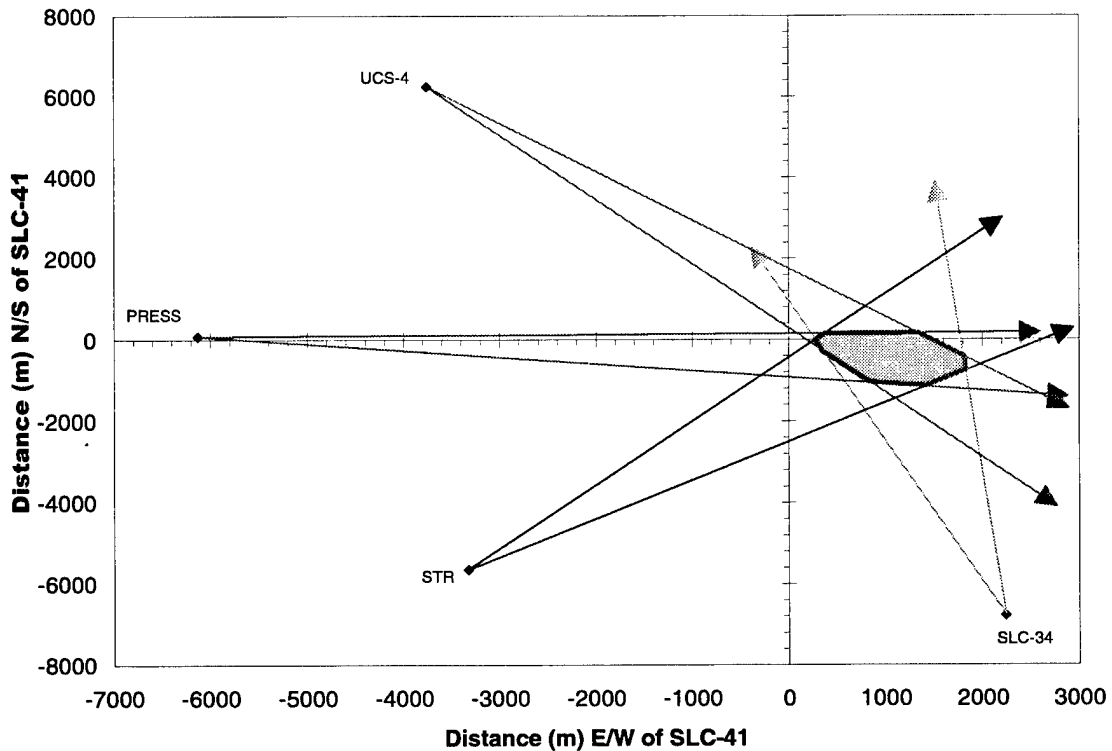


Figure 2. Comparison of the A-17 cloud extent derived from the polygon analysis and from the PLMVOL analysis (i.e., shaded area within the polygon). The imager positions and rays are actual A-17 data for T+02:15 (mm:ss) after launch.

extreme rays for each imager on the x-y ground plane forms a polygon that bounds all material in the cloud at all altitudes, as shown in Figure 2. Thus, when an aircraft is flown against the ground cloud (i.e., K-15,<sup>2</sup> K-16,<sup>3</sup> K-22,<sup>4</sup> and K-23,<sup>5</sup> missions), one expects to see aircraft HCl sampling "hits" fall within this polygon, regardless of the sampling altitude. When the polygon area is combined with the mean cloud height (i.e., the difference between the top and the bottom of the cloud), one can obtain an upper bound for cloud volume. As illustrated in Figure 2 (a ground projection of the cloud's extent), the shaded area within the polygon documents the extent of the cloud derived from **PLMVOL** analysis. There is excellent agreement between **PLMTRACK** and **PLMVOL** results.

The utility of the polygon method has been documented in previous reports for the K-152 and K-235 missions. In those reports, the polygons from imagery were correlated with aircraft's HCl measurements of cloud dimensions and average HCl concentrations for the Titan IV launch cloud. After correcting for Geomet time response, these datasets established that HCl concentrations detectable by an aircraft-based Geomet total HCl detector were mostly contained by the six-sided polygon areas for the first 10 to 20 min after launch. The K-15 and K-23 data established that the imagery-derived position and extent of the visible cloud correlates with the measurable HCl concentrations. A similar treatment is possible with the A-17 imagery (without aircraft data) and allows a mapping of the growth and position of the cloud over time.

Brian P. Kasper also created and maintains the **PLMVOL** program at The Aerospace Corporation. **PLMVOL** provides a convenient way of triangulating all of the volume elements that could be occupied by an object using imagery from two (or more) sites. Like **PLMTRACK**, **PLMVOL** uses a rigorous (i.e., trigonometric) method<sup>1</sup> of interpreting pixels as AZ and EL and vice versa. For the A-17 mission, the **PLMVOL** algorithm provided an absolute method of triangulating the position and volume of the ground cloud. The analyst outlined the edge of the ground cloud in simultaneously acquired images from the four sites. **PLMVOL** determined all of the pixels that were within the outlines in each image and projected the rays for all of those pixels into space. **PLMVOL** defined volume elements in space and determined which volume elements were intercepted by the projected rays from all imagery sites. These intersected volume elements could be occupied by the ground cloud. **PLMVOL** reports the x,y,z coordinates for all "occupied" volume elements. The coordinates are relative to a reference (i.e., SLC-41 for x and y and mean sea level for z). **PLMVOL** calculates the total volume (i.e., sum of all occupied volume elements), the sphere-equivalent radius, and the mean altitude for the ground cloud (i.e., mean position of all occupied volume elements). For facile comparison to REEDM, this report uses altitude relative to SLC-41 pad (i.e., AGL) rather than MSL in all plots.

The **PLMVOL** approach is illustrated by Figure 3 for simultaneous images of the Titan IV K-23 normal launch cloud from three sites. We used the K-23 images to illustrate **PLMVOL** since that cloud had a complicated shape, and the imagery was not folded. The **PLMVOL**-derived reconstructed cloud is shown from a perspective similar to the middle image in Figure 3, but can be viewed from any perspective.

**PLMVOL** analysis of the A-17 imagery was possible between 0.25 and 9.50 min after the launch. In addition to the ground track, the rise rate, the stabilization height, and the extent that could also be derived from **PLMTRACK** analysis, **PLMVOL** provided volumetric data and altitude-dependent extent.

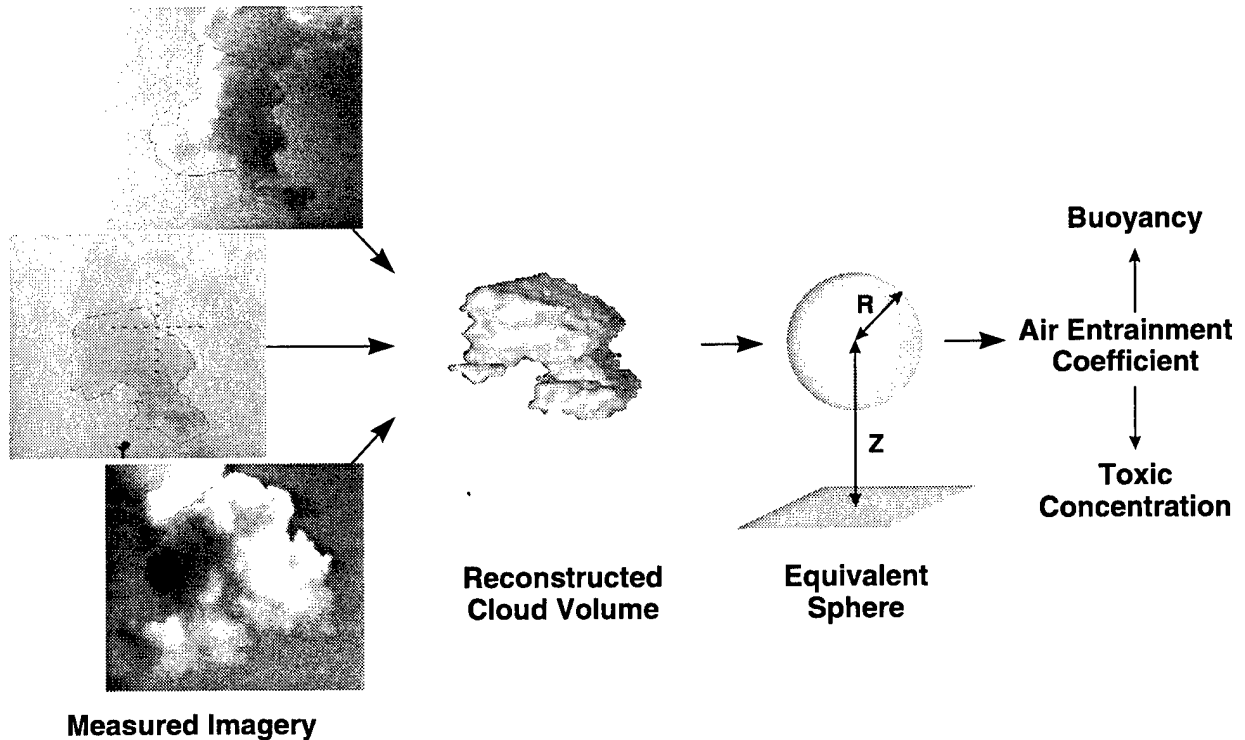


Figure 3. PLMVOL approach illustrated by Titan IV K-23 ground cloud images.

## 2.5 Results and Discussion

### 2.5.1. Correlation of Ground Cloud Bearing with Wind Direction

Figure 4 presents the imagery-derived cloud bearing and the T-0.6 h REEDM version 7.08 predicted ground cloud bearings as arrows originating from the launch pad and as text. The darkly bordered two REEDM 7.08 predictions (i.e., default and tuned runs that use 0 m as the initial cloud height). Figure 4 also documents the rawinsonde wind directions at the imagery-derived heights for the top, middle, and bottom of the stabilized ground cloud. The rawinsonde wind bearings are illustrated with narrow arrows originating from the rawinsonde release site and in a narrowly bordered text box. Lastly, Figure 4 documents the locations of SLC-41 launch pad, the rawinsonde release site, and the four imager sites (UCS-4, Press, STR, and SLC-34) used by The Aerospace Corporation for the A-17 mission. All directions are reported in rawinsonde convention [defined fully in Subsection 2.5.4]. Briefly, the arrows indicate the direction the cloud would move for a wind coming from the reported angle (clockwise from north).

As illustrated in Figure 4, there is reasonably good agreement between the imagery-derived cloud bearing, the REEDM version 7.08 predicted cloud bearing, and the rawinsonde wind directions at the equivalent heights. The quantitative imagery documented a cloud bearing of  $293^\circ$  by PLMVOL analysis (i.e., wide arrow in Figure 4) during the first 9.50 minutes after launch. REEDM version 7.08 predicted a shift in cloud bearing during rise:  $281^\circ$  at 13.0 m altitude to  $299^\circ$  at 893 m AGL. REEDM version 7.08 predicted the cloud's bearing as  $299^\circ$  (i.e., medium arrow in Figure 4) to the maximum cloud concentration at the predicted stabilization height (i.e., 947 m AGL). This is almost identical to the predicted cloud bearing of  $298^\circ$  to the maximum cloud concentration at ground level.

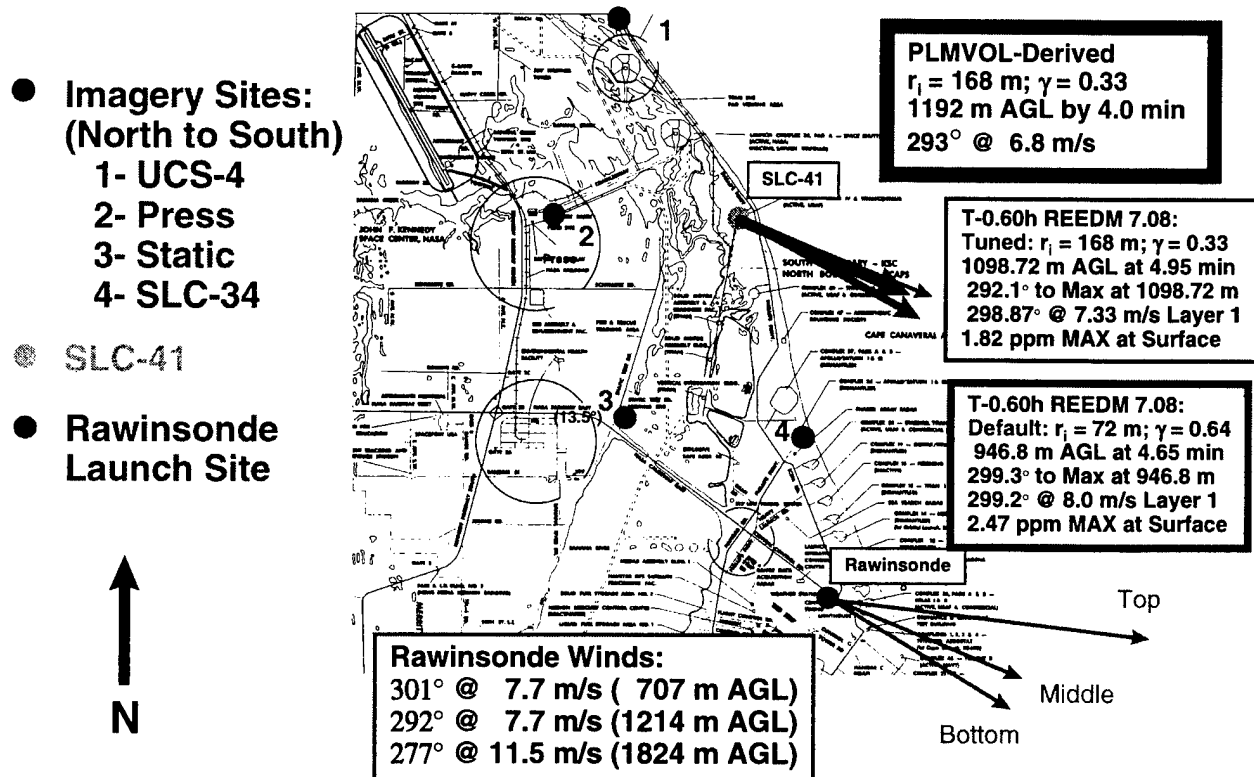


Figure 4. A map documenting the imagery sites, the rawinsonde release site, the A-17 ground cloud's bearing (derived from infrared imagery), the T-0.6 h REEDM Version 7.08 predictions for the ground cloud's bearing ( at stabilization height), and the 01:32 GMT (T-0.6 h) rawinsonde wind directions at the imagery-derived cloud stabilization heights (i.e., bottom, middle and top of the ground cloud).

After stabilization, REEDM predicts a 299° cloud bearing at 947 m AGL (based upon the average wind in the first mixing layer). At ground level, the cloud's predicted bearing was 298° after stabilization. There are negligible differences in the predicted bearings at the stabilization height and at ground level due to almost negligible wind shear between the stabilization height and the ground. This is consistent with the imagery and with the T-0.6 h rawinsonde data. Figure 4 also presents the rawinsonde-derived wind directions (301°, 292°, and 277°) associated with the rawinsonde sounding heights (707, 1214, and 1824 m AGL) nearest the bottom, middle, and top of the stabilized ground cloud, respectively. These wind directions are from the T-0.6 h rawinsonde data and at the indicated sounding heights, which are closest to imagery-derived stabilization heights of 781, 1192, and 1775 m AGL for the bottom, middle, and top of the ground cloud, respectively.

Figures 5 through 9 document background-subtracted IR images for T+0.25 min, T+1.25 min, T+2.25 min, T+6.00 min, and T+7.00 min as recorded from (clockwise) UCS-4, Press, SLC-34, and STR sites. These images have the intensity "folded" to only 6 bits and include PLMVOL outlines and reflections. The outlines document the extent of the ground cloud in each perspective. The reflections are the centers of the intercepted volume elements reflected back into the image. For a perfect calibration, the reflections would be scattered throughout the outline. If the calibration were bad, PLMVOL's "reflected" rays would not fill a portion of the cloud outline. Therefore, these images document a good calibration of the imagery.

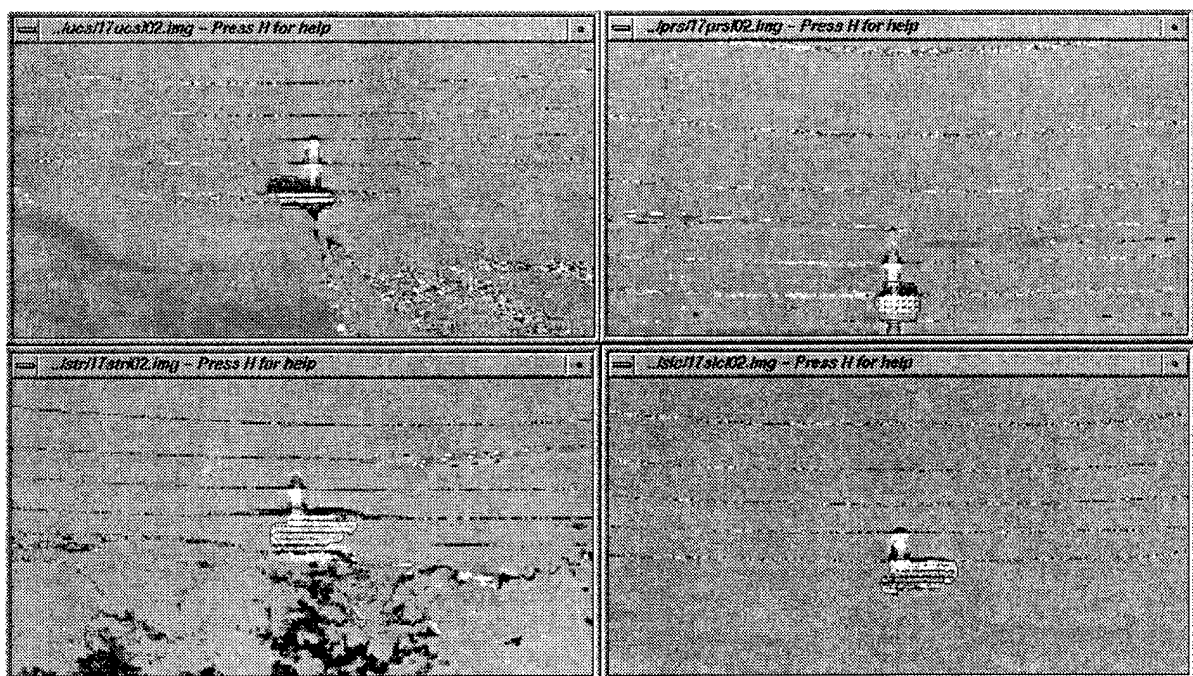


Figure 5. PLMVOL Reflection in T+0.25 min imagery from UCS-4, Press, STR, and SLC-34.

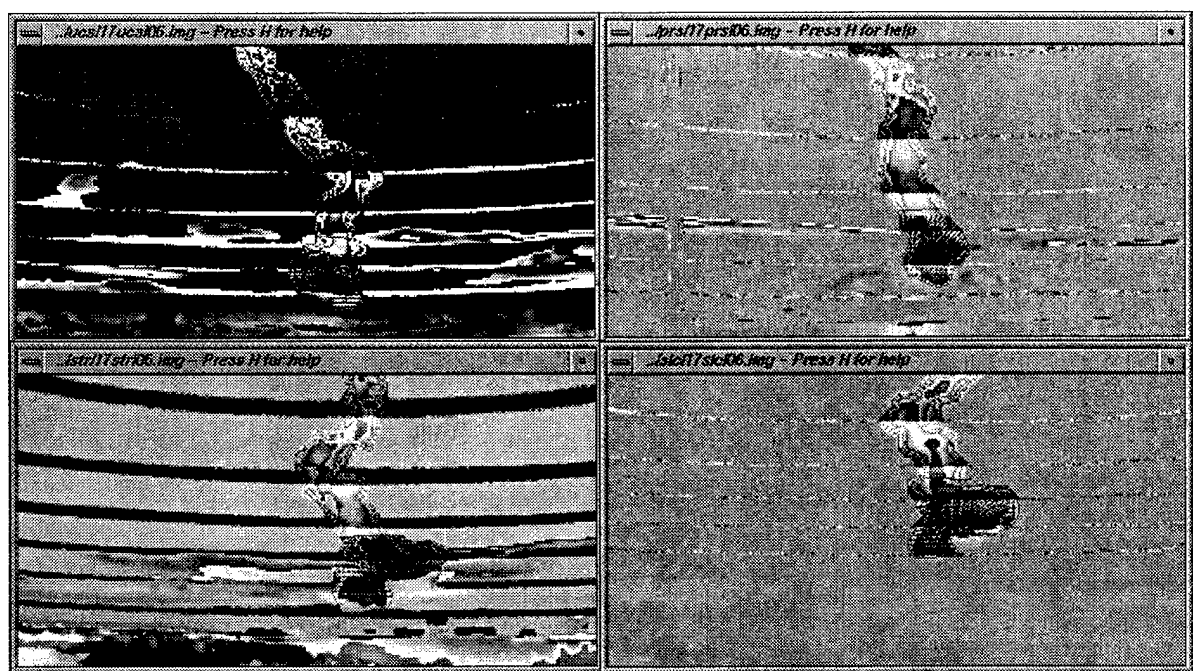


Figure 6. PLMVOL Reflection in T+1.25 min imagery from UCS-4, Press, STR, and SLC-34.

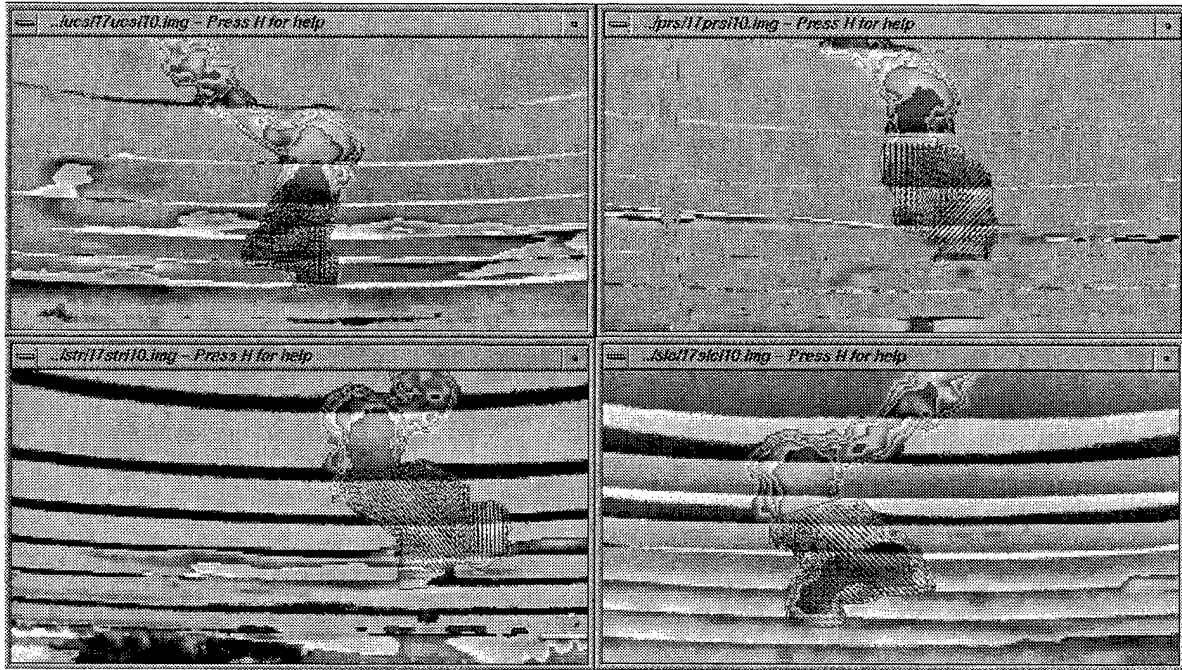


Figure 7. PLMVOL Reflection in T+2.25 min Imagery from UCS-4, Press, STR, and SLC-34.

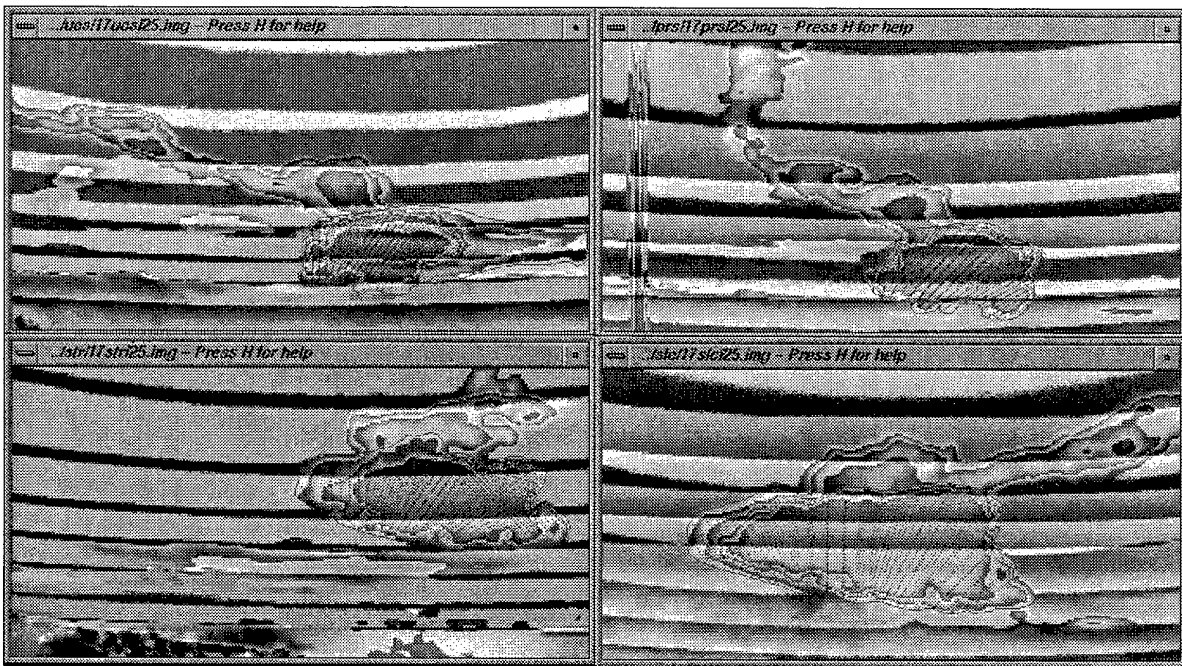


Figure 8. PLMVOL Reflection in T+6.00 imagery from UCS-4, Press, STR, and SLC-34.

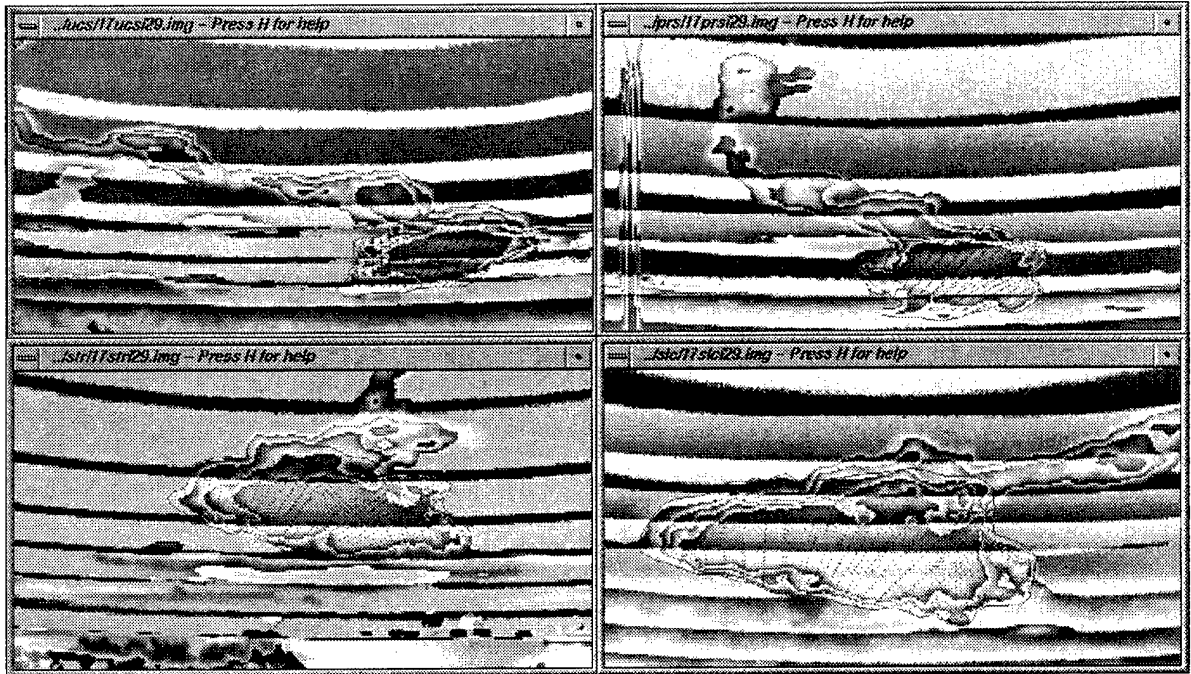


Figure 9. PLMVOL Reflection in T+7.00 min imagery from UCS-4, Press, STR, and SLC-34.

In Figure 5, the northwestern (USC-4) and southern (SLC-34) perspectives document asymmetry in the cloud's initial shape with a lobe to the east (i.e., left from UCS-4 and right from SLC-34 perspectives). This outcropping of exhaust resulted from ejection of exhaust to the east from the exhaust duct on SLC-41 pad. For Press and STR sites, there is a reflection of the ground cloud observable in the water between the sites and SLC-41. Narrow intensity bands document folding of the intensity at various elevations and about the launch cloud. The analyst drew the outlines after reviewing all available imagery and included only the portion of the cloud believed to be the ground cloud and launch column consumed by the rising ground cloud.

### 2.5.2. Cloud Rise Times and Stabilization Heights

Figures 10 through 12 present the imagery-derived, time-dependent altitude for the “bottom,” the “middle,” and the “top” of the ground cloud based upon **PLMVOL** analysis. In these plots, all data are plotted as height in meters above SLC-41 (i.e., m Above Ground Level). The analyst used **PLMVOL** to process imagery from all four sites simultaneously. Therefore, the plots in Figures 10 through 12 report only one result for each set of images. These data document the stabilization height for the bottom, the center, and the top of the ground cloud.

A polynomial fit is used when the cloud is tracked through stabilization. A polynomial fit is a convenient method to permit the representation of cloud overshoot and subsequent damped oscillation around the stabilization height. To be consistent with REEDM, stabilization time and height refer to the first maximum in polynomial fits. REEDM predicts that the cloud goes through damped oscillatory motion with a period of  $2\pi/S^{1/2}$ , where  $S$  is the static stability parameter [Ref. 6, Eq. (7)]<sup>6</sup>. Sensitivity of REEDM predictions to input parameters has been examined by Womack.

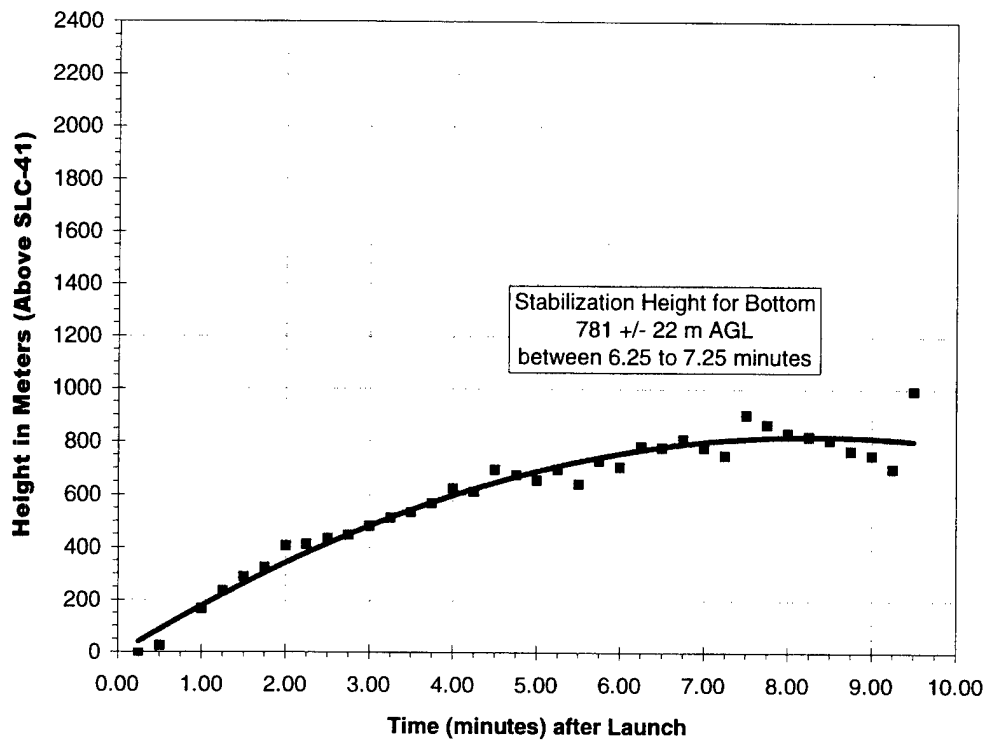


Figure 10. Cloud rise for the bottom of the A-17 cloud (PLMVOL analysis).

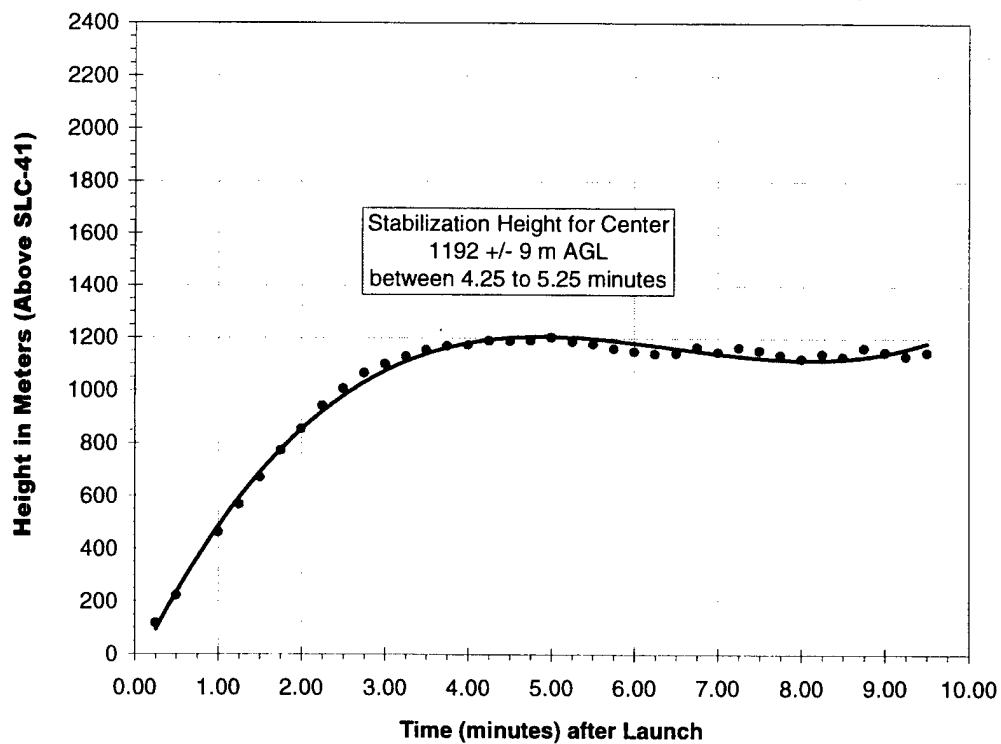


Figure 11. Cloud rise for the middle of the A-17 cloud (PLMVOL analysis).

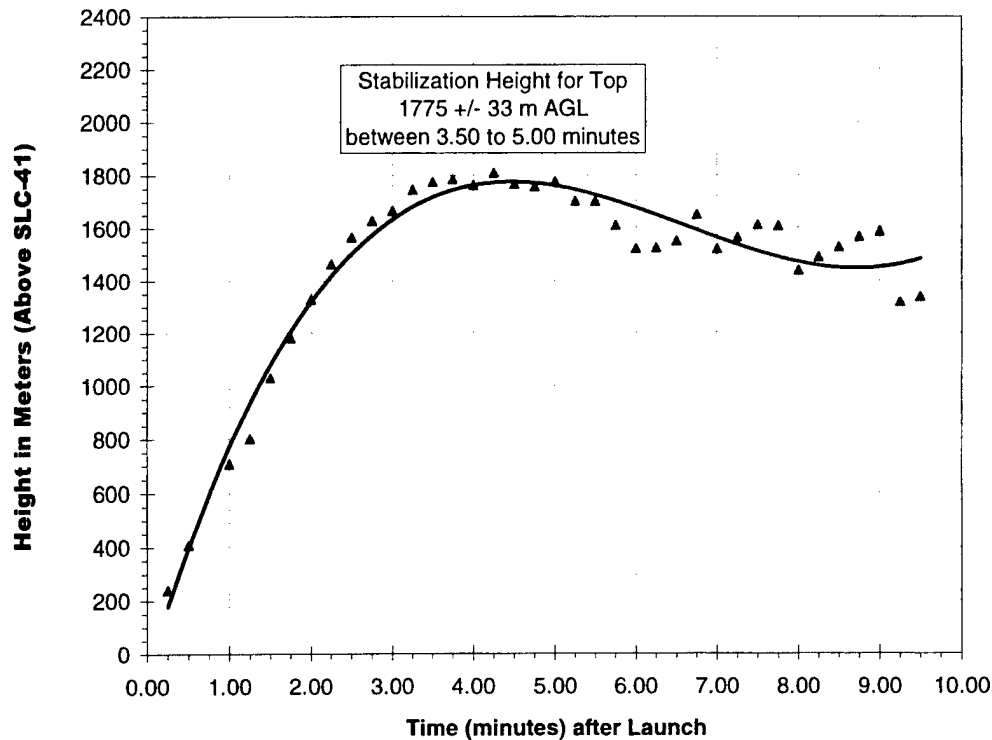


Figure 12. Cloud rise for the top of the A-17 cloud (PLMVOL analysis).

### 2.5.3. Comparison of REEDM Prediction to Imagery Data—Rise Rate

Figure 13 presents the **PLMVOL**-derived heights for the ground cloud's top, middle, and bottom plotted as a function of time following the launch. For comparison, Figure 13 includes the predicted curves for the middle of the cloud based upon two T-0.6 h REEDM modeling runs. It is apparent that the "tuned" REEDM run more closely models the imagery-derived rise curve than the "default" REEDM run. The "tuned" run uses the imagery-derived values of 168 m for the initial radius, 0 m for the initial height, and 0.33 for the entrainment coefficient. The "default" REEDM run uses the default values of 72 m for the initial radius, 0 m for the initial height, and 0.64 for the entrainment coefficient. In both cases, one would obtain a higher value for the stabilization height by setting the initial height equal to the initial radius (i.e., 72 m for the default run and 168 m for the tuned run). This would raise the stabilization height accordingly and, therefore, provide an even better fit to the observed rise curve for the center of the ground cloud.

### 2.5.4. Comparison of REEDM Prediction to Imagery Data—Bearing and Speed

Figures 14 and 15 document the imagery-derived cloud bearing and speed, respectively. These figures document the results derived from **PLMVOL** analysis. The **PLMVOL** "center" is a weighted average based upon the locations of all intersected (i.e., "occupied") volume elements reported by **PLMVOL**.

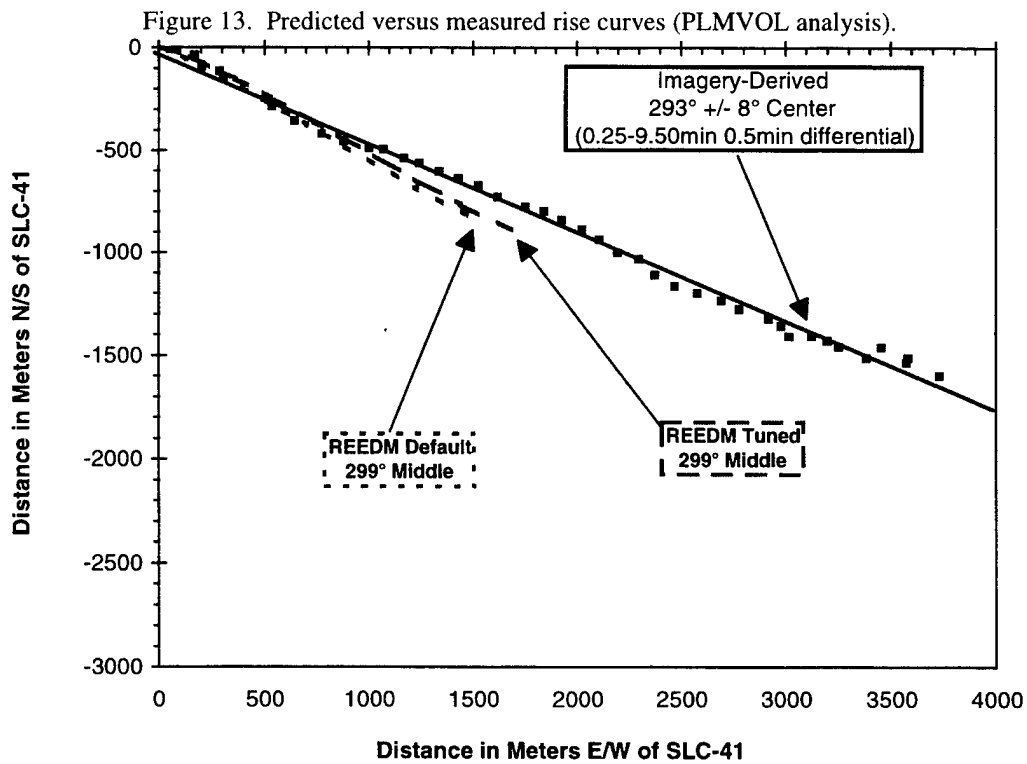
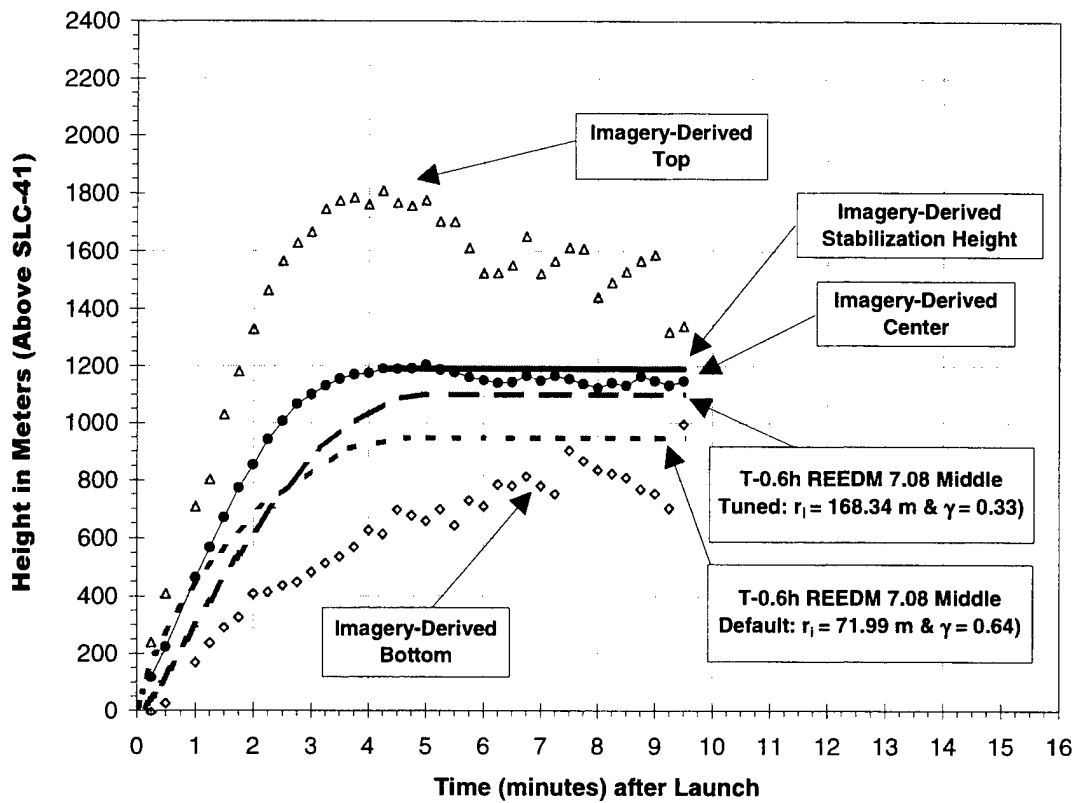


Figure 14. Predicted and measured bearings (PLMVOL analysis).

In this report, the angles conform to the convention of rawinsonde wind vectors (the angle from which the wind originates that would push the cloud into its imaged position). Thus, the angles are related by

$$J = 180 + F,$$

where  $\vartheta$  is the equivalent rawinsonde wind angle and  $\Phi$  is the measured polar angle of the cloud relative to SLC-41 and clockwise of true north. For example, when the cloud is due east of SLC-41,  $\Phi$  is  $90^\circ$  and  $\vartheta$  is  $270^\circ$ .

Figure 14 plots the Cartesian coordinates for the ground cloud between 0.25 and 9.50 min after launch. The **PLMVOL** results are for the center of the cloud and document a bearing of  $293^\circ$ . **PLMVOL** analysis uses a detailed outline about the ground cloud and uses imagery from all available sites simultaneously. The text box provides the average ( $293^\circ$ ) and standard deviation ( $8^\circ$ ) for a moving 0.5-min differential speed between **PLMVOL** data points (i.e., x,y data). For comparison, Figure 14 includes the predictions for both the “tuned” and “default” REEDM version 7.08 runs. The predictions stop at stabilization while the **PLMVOL** data continues past stabilization. It is apparent that there is reasonably good agreement between the predicted and measured bearings.

Figure 15 is a distance versus time plot and documents the **PLMVOL**-derived cloud speed as well as REEDM version 7.08 “tuned” and “default” predictions. The text box also documents the 1-min differential speed for the ground cloud during the 9.50 min of available imagery. The differential treatment documents an average (6.8 m/s) and a standard deviation (1.0 m/s) for the cloud’s center speed. It is apparent that there is reasonably good agreement between the predicted and measured speeds.

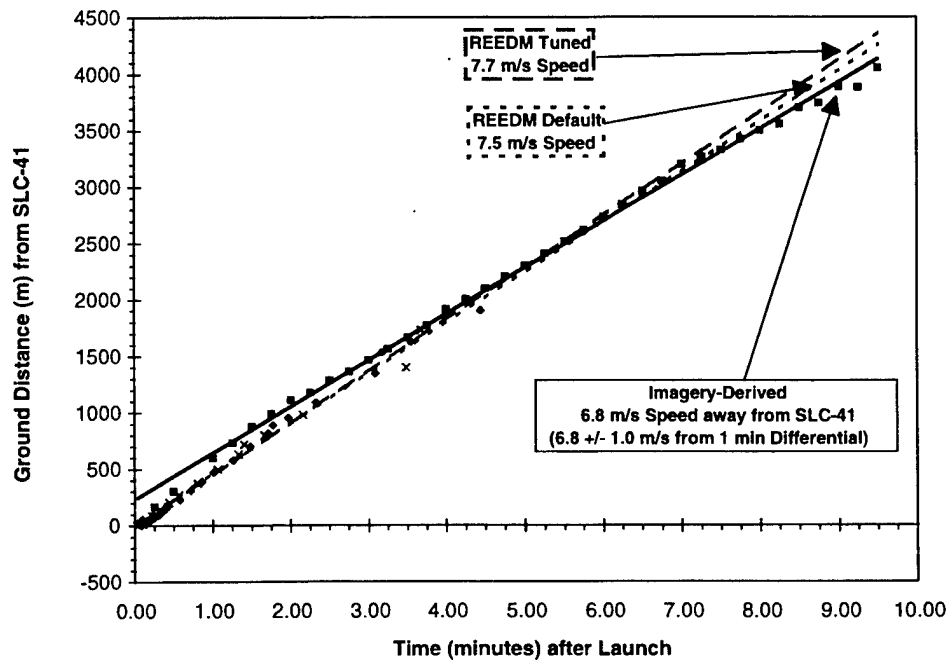


Figure 15. Predicted and measured cloud speed (**PLMVOL** analysis).

Figure 16 documents **PLMVOL** results as an increase in cloud volume with time. Figure 17 conveys the same **PLMVOL** results as an increase in the cloud's sphere-equivalent radius (SER) with altitude. The SER is the radius of a sphere that has the same volume as measured by **PLMVOL**. The initial slope of a fit to SER plotted against altitude is, by definition, the entrainment coefficient used by REEDM. Therefore, Figure 17 documents a measured entrainment coefficient of 0.33 with 0.974  $R^2$  during the first 2.0 min of rise (i.e., 0.31 for first 1.75 min with 0.975  $R^2$  and 0.36 for first 2.25 min with 0.966  $R^2$ ). These values are comparable to the imagery-derived entrainment coefficients for the 34D-9 abort cloud (i.e., 0.35), for three Titan IVA launches (i.e., 0.35 for K23, 0.37 for K19, and 0.39 for A18), and for two Titan IVB launch (i.e., 0.35 for B24 and 0.39 for B33). The average of all of the imagery-derived values (0.36 with a standard deviation of only 0.02) is substantially smaller than REEDM's default value of 0.64. Likewise, the average value for the initial radius (i.e., 179 m with a standard deviation of 20 m) is substantially larger than REEDM's default value of 72m.

### 2.5.5. Comparison of REEDM Prediction to Imagery Data -- Summary Table

Table 2 summarizes the imagery derived, the T-0.6 h rawinsonde measured, and the T-0.6 h REEDM predicted data for the A-17 ground cloud. Several conclusions can be derived from review of the contents of this table and from the discussions in previous sections of this chapter:

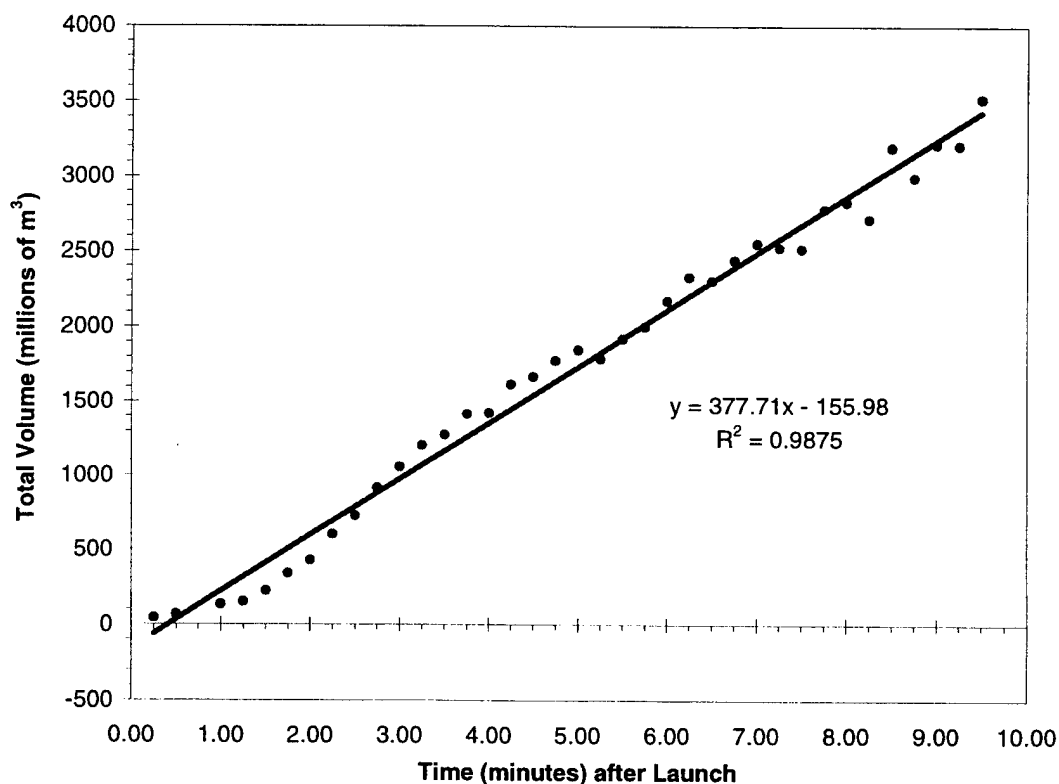


Figure 16. Cloud volume versus time (PLMVOL analysis).

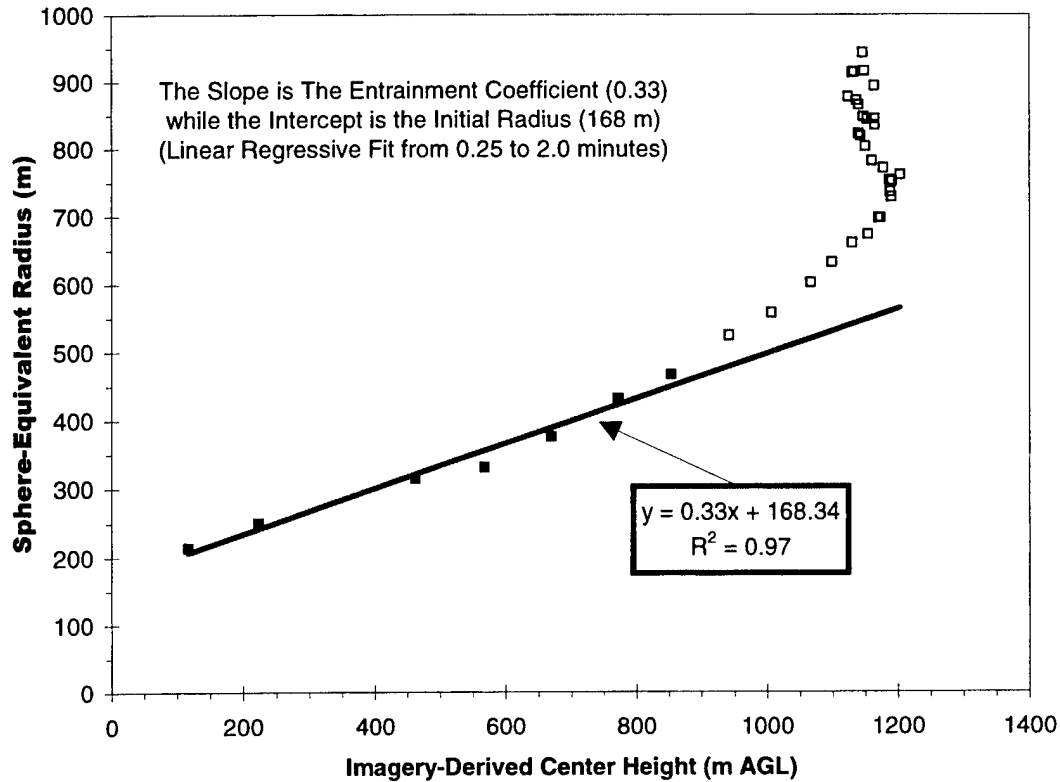


Figure 17. Sphere-equivalent radius versus altitude (PLMVOL analysis).

- The imagery-derived stabilization height (1192 m AGL) is 26% higher than the “default” REEDM prediction (947 m AGL) and only 8% higher than the “tuned” REEDM prediction (1099 m AGL);
- The imagery-derived bearing ( $293^\circ \pm 8^\circ$ ) and speed ( $6.8 \pm 1.0$  m/s) are in fair agreement with the T-0.6 h rawinsonde winds ( $292^\circ$  and 7.7 m/s), with the T-0.6 h REEDM Version 7.08 “default” predictions ( $299^\circ$  and 7.5 m/s) and with the T-0.6 h REEDM Version 7.08 “tuned” predictions ( $292^\circ$  and 7.7 m/s);
- The imagery-derived entrainment coefficient (0.33) is 39% smaller than REEDM’s default value (0.64);
- The imagery-derived extrapolated initial cloud radius (168 m) is 133% larger than REEDM’s default value (72m); and
- The predicted ground concentration drops from 2.5 ppm for the “default” REEDM run to 1.8 ppm for the “tuned” REEDM run.

Table 2. Summary of A-17 Ground Cloud Data Derived from Infrared Imagery, T-0.6h Rawinsonde Sounding Data, & T-0.6h REEDM Version 7.08 Predictions.

| Attribute            | Feature       | Imagery<br>(IR only) | Rawinsonde<br>(T – 0.60 h) | REEDM 7.08<br>(Default) | REEDM 7.08<br>(Tuned) |
|----------------------|---------------|----------------------|----------------------------|-------------------------|-----------------------|
| Stabilization Height | Top           | 1775                 |                            | 1671                    | 1519                  |
| Meters Above SLC-41  | Middle        | 1192                 |                            | 947                     | 1099                  |
| (SLC-41 = 7 m MSL)   | Bottom        | 781                  |                            | 300                     | 707                   |
| Stabilization Time   | Top           | 3.50                 |                            |                         |                       |
| Minutes After Launch | Middle        | 4.25                 |                            | 4.65                    | 4.95                  |
|                      | Bottom        | 6.25                 |                            |                         |                       |
| Bearing (deg)        | Top           | 297                  | 277                        |                         |                       |
| (rawinsonde)         | Middle        | 293                  | 292                        | 299                     | 299                   |
| at Specified Levels  | Bottom        | 293                  | 301                        |                         |                       |
| Bearing (deg)        | After Stab.   | 293                  |                            | 299                     | 299                   |
| (rawinsonde)         | To Max.       | 293                  |                            | 299                     | 292                   |
| During Time Interval | During Rise   | 293                  |                            | 281–299                 | 281–299               |
| Speed (m/s)          | Top           | 7.7±3.3              | 11.5                       |                         |                       |
| (along trajectory)   | Middle        | 6.8±1.0              | 7.7                        | 8.0                     | 7.3                   |
| at Specified Levels  | Bottom        | 8.7±2.1              | 7.7                        |                         |                       |
| Speed (m/s)          | After Stab.   | 6.8±1.0              |                            | 8.0                     | 7.3                   |
| (along trajectory)   | To Max.       | 6.8±1.0              |                            |                         |                       |
| During Time Interval | During Rise   | 6.8±1.0              |                            | 7.5                     | 7.7                   |
| Entrainment Coeff.   | During Rise   |                      |                            | 0.64                    | 0.33                  |
| Initial Radius (m)   | At Height = 0 | 168                  |                            | 72                      | 168                   |
| Initial Height (m)   | At t = 0      | 0                    |                            | 0                       | 0                     |
| Rise Rate (time)     | During Rise   | Linear               |                            | 2 <sup>nd</sup> Order   | Linear                |
| Max Ground HCl (ppm) | Surface       |                      |                            | 2.5                     | 1.8                   |

We ran REEDM Version 7.08 in the research mode using the imagery-derived initial radius (168 m), an initial height equal to 0 m (the REEDM default), and the imagery-derived entrainment coefficient (0.33). This “tuned” research run was a better fit to the imagery-derived data. The predicted stabilization heights for the bottom, middle, and top of the cloud jumped from 299, 947, and 1672 m (i.e., the results of the normal run using the REEDM “default” settings) to 707, 1099, and 1519 m for the “tuned” research run. The predicted vertical extent of the cloud decreased by 41% while the predicted stabilization height increased by 16% by changing these two REEDM parameters. These differences shift the predicted ground-level HCl concentrations from 2.5 ppm for the “default” run to 1.8 ppm for the “tuned” run. Fortunately, there is imagery data for the vertical extent (994 m) of the cloud and its stabilization height (1192 m AGL) for the A-17 mission. The “tuned” run predicts a more accurate extent (i.e., 812 m is only 18 % smaller than the imagery-derived extent) and a more accurate stabilization height (i.e., 1099 m is only 8% lower than the imagery-derived stabilization height). In contrast, the default run’s predictions were too big for the vertical extent (1373 m is 38% larger than the imagery-derived extent) and too low for the stabilization height (i.e., 947 m AGL is 21% lower than the imagery-derived stabilization height). One obtains proportionately higher stabi-

## 2.6 Summary and Conclusions

The Titan IV A-17 mission was launched successfully from the Eastern Range (SLC-41) at 2105 EST (0205 GMT) on 7 November 1997. Personnel from The Aerospace Corporation imaged the ground cloud for 9.50 min after the launch from four camera sites. When combined with the AZ/EL readings and the IRIG-B time data, the quantitative imagery documented the rise, stabilization, growth, speed, and bearing of the ground cloud. This quantitative imagery data for the A-17 ground cloud will be useful for tuning current and future dispersion models.

The definition of the A-17 exhaust cloud's geometric features was complicated by its three-dimensional shape (i.e., not spherical). However, the imagery successfully documented this complex shape as the cloud evolved (i.e., asymmetric ejection from the exhaust duct, rapid rise of the hot ground cloud, and continued dispersion after reaching its stabilization height).

Analysis of the imagery data presented in this report has focused on determining parameters that are directly comparable to REEDM predictions. The imagery-derived cloud bearing and speed were similar to T-0.6h rawinsonde winds and to T-0.6h REEDM version 7.08 predictions. However, the imagery documented several differences between the ground cloud and REEDM predictions:

- The imagery-derived stabilization height (1192 m AGL) is 26% higher than the “default” REEDM prediction (947 m AGL) and only 8% higher than the “tuned” REEDM prediction (1099 m AGL);
- The imagery-derived bearing ( $293^{\circ} \pm 8^{\circ}$ ) and speed ( $6.8 \pm 1.0$  m/s) are in fair agreement with the T-0.6 h rawinsonde winds ( $292^{\circ}$  and 7.7 m/s), with the T-0.6 h REEDM Version 7.08 “default” predictions ( $299^{\circ}$  and 7.5 m/s) and with the T-0.6 h REEDM Version 7.08 “tuned” predictions ( $292^{\circ}$  and 7.7 m/s);
- The imagery-derived entrainment coefficient (0.33) is 39% smaller than REEDM's default value (0.64);
- The imagery-derived extrapolated initial cloud radius (168 m) is 133% larger than REEDM's default value (72m); and
- The predicted ground concentration drops from 2.5 ppm for the “default” REEDM run to 1.8 ppm for the “tuned” REEDM run.

The Aerospace Corporation has imaged 14 Titan IVA and 2 Titan IVB launches as part of the Model Validation Program. The available imagery documents that the default REEDM runs often underestimate the stabilization height of the ground cloud. Such overly conservative REEDM predictions can result in unnecessary launch holds at a considerable cost to the Air Force. The available imagery documents a larger initial radius and a smaller entrainment coefficient than the current default values used by REEDM version 7.08. Titan IV A and B exhaust cloud data are needed to validate and to tune current and future dispersion models for both ranges (Vandenberg AFB and CCAS) and for the various meteorological conditions associated with round-the-clock and year-round launch schedules.

## References

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6. J. R. Bjorklund, "User's Manual for the REEDM Version 7 (Rocket Exhaust Effluent Diffusion Model) Computer Program," Vol. I, TR-90-157-01, AF Systems Command, Patrick AFB, FL (April 1990).
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## Appendix A—REEDM Version 7.08 Predictions for the A-17 Mission

[The material in this section was contributed by R. N. Abernathy of the Surveillance Technology Department of The Aerospace Corporation's Space and Environment Technology Center]

This Appendix includes REEDM version 7.08 runs for impact at both the surface (0 m AGL, 7 m MSL) and stabilization height (predicted by REEDM). We include the plots of the rawinsonde meteorological data, the predicted maximum concentration versus downwind distance, and the predicted concentration isopleths overlayed on a range map. These plots are followed by the detailed REEDM report for that run.

### Stabilization Height Predictions

The following figures and table are the REEDM version 7.08 output for the stabilization height run. These predictions were compared with actual A-17 ground cloud observations in Section 2 for the quantitative imagery. The first page of the REEDM output is its listing of errors and is not included in this appendix.

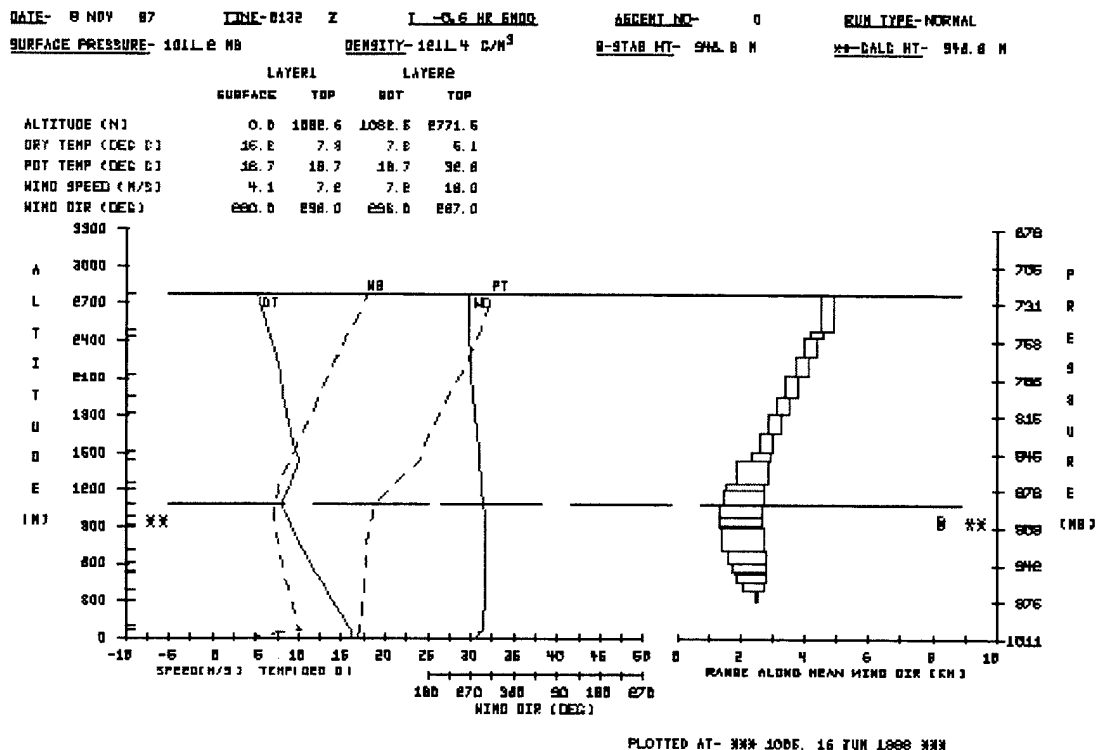


Figure 1A. Meteorological Output Plot from REEDM Version 7.08 for A-17 Mission Using T-0.6h Rawinsonde Data.

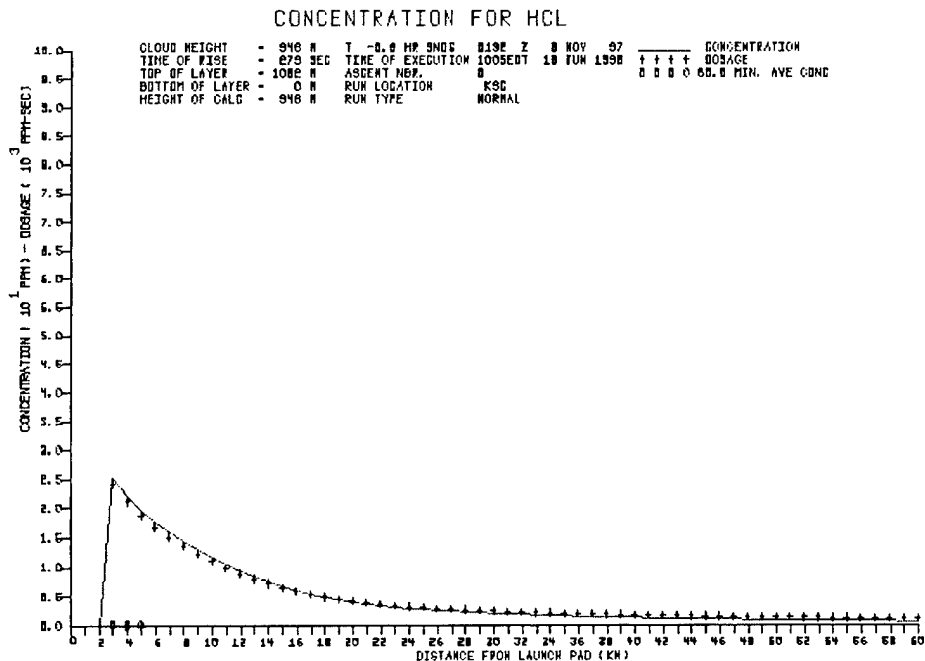


Figure 2A. HCL Stabilization Height Concentration Predictions from REEDM Version 7.08 for A-17 Mission Using T-0.6h Rawinsonde Data.

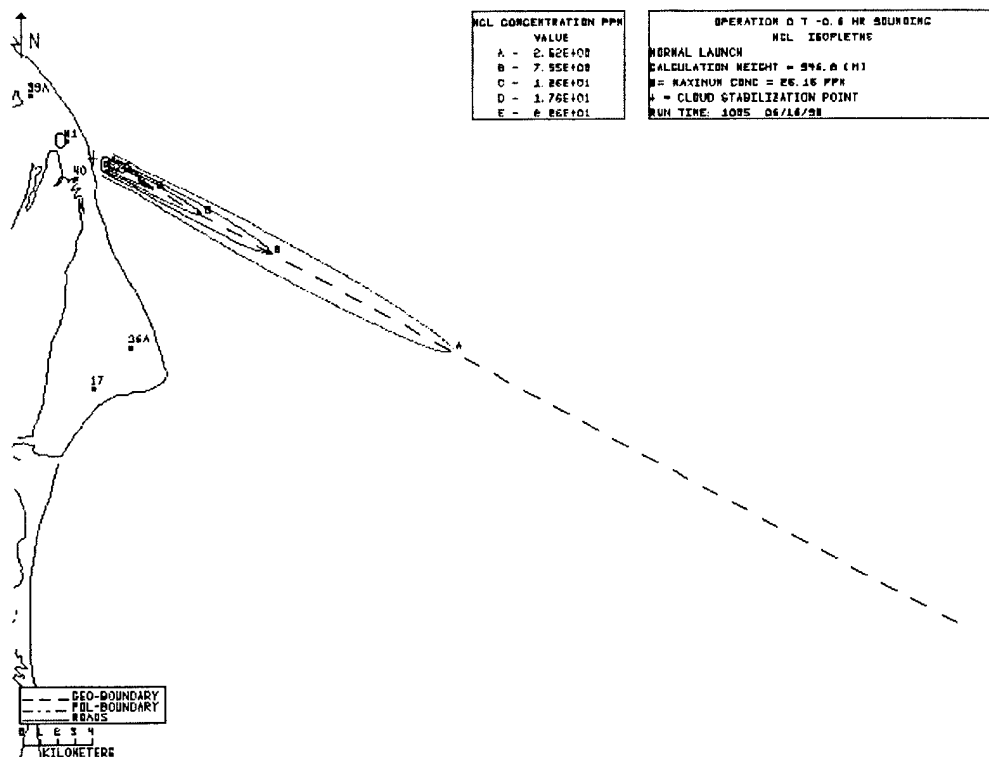


Figure 3A. HCL Stabilization Height Concentration Isopleth Predictions from REEDM Version 7.08 for A-17 Mission Using T-0.6h Rawinsonde Data.

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1 *****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE    2
      VERSION 7.08 AT KSC
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      RAWINSONDE ASCENT NUMBER      0, 0132  Z  8 NOV  97  T  -0.6 HR
*****

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----- PROGRAM OPTIONS -----

|                                                                   |                        |
|-------------------------------------------------------------------|------------------------|
| MODEL                                                             | CONCENTRATION          |
| RUN TYPE                                                          | OPERATIONAL            |
| WIND-FIELD TERRAIN EFFECTS MODEL                                  | NONE                   |
| LAUNCH VEHICLE                                                    | TITAN IV               |
| LAUNCH TYPE                                                       | NORMAL                 |
| LAUNCH COMPLEX NUMBER                                             | 41                     |
| TURBULENCE PARAMETERS ARE DETERMINED FROM                         | CLIMATOLOGICAL DATA    |
| SURFACE CHEMISTRY MODEL                                           | absorption coefficient |
| SPECIES SURFACE FACTOR                                            | HCL 0.000              |
| CLOUD SHAPE                                                       | ELLIPTICAL             |
| CALCULATION HEIGHT                                                | STABILIZATION          |
| PROPELLANT TEMPERATURE (DEG. C)                                   | 22.86                  |
| CONCENTRATION AVERAGING TIME (SEC.)                               | 3600.00                |
| mixing layer reflection coefficient (RNG- 0 TO 1,no reflection=0) | 1.0000                 |
| DIFFUSION COEFFICIENTS                                            | LATERAL 1.0000         |
|                                                                   | VERTICAL 1.0000        |
| VEHICLE AIR ENTRAINMENT PARAMETER                                 | GAMMAE 0.6400          |
| DOWNWIND EXPANSION DISTANCE (METERS)                              | LATERAL 100.00         |
|                                                                   | VERTICAL 100.00        |

----- DATA FILES -----

|                 | INPUT FILES  |              |
|-----------------|--------------|--------------|
| RAWINSONDE FILE |              | a17a0132.raw |
| DATA BASE FILE  |              | rdmbase.ksc  |
|                 | OUTPUT FILES |              |
| PRINT FILE      |              | a17ah000.stb |
| PLOT FILE       |              | a17ah000.stp |

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1*****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE    3
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----- METEOROLOGICAL RAWINSONDE DATA -----

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RAWINSONDE MSS/MSS
TIME- 0132 Z DATE- 08 NOV 97
ASCENT NUMBER      0

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----- T -0.6 HR SOUNDING -----

| MET.<br>LEV.<br>NO. | MSL<br>(FT) | ALTITUDE<br>GND<br>(FT) | GND<br>(M) | WIND<br>DIR<br>(DEG) | WIND<br>SPEED<br>(M/S) | (KTS) | AIR<br>TEMP<br>(DEG C) | PTEMP<br>(DEG C) | DPTEMP | AIR<br>PRESS<br>(MB) | AIR<br>RH<br>(%) | H<br>M | INT-<br>ERP |
|---------------------|-------------|-------------------------|------------|----------------------|------------------------|-------|------------------------|------------------|--------|----------------------|------------------|--------|-------------|
| 1                   | 16          | 0.0                     | 0.0        | 280                  | 4.1                    | 8.0   | 16.2                   | 16.7             | 11.2   | 1011.2               | 72.0             |        |             |
| 2                   | 59          | 42.6                    | 13.0       | 283                  | 5.4                    | 10.4  | 16.2                   | 16.8             | 11.2   | 1009.7               | 72.2             | **     |             |
| 3                   | 101         | 85.2                    | 26.0       | 286                  | 6.6                    | 12.8  | 16.1                   | 16.9             | 11.1   | 1008.1               | 72.2             | **     |             |
| 4                   | 144         | 127.8                   | 39.0       | 288                  | 7.8                    | 15.2  | 16.1                   | 17.0             | 11.1   | 1006.6               | 72.2             | **     |             |
| 5                   | 186         | 170.4                   | 51.9       | 291                  | 9.1                    | 17.6  | 16.0                   | 17.1             | 11.0   | 1005.0               | 72.2             | **     |             |
| 6                   | 229         | 213.0                   | 64.9       | 294                  | 10.3                   | 20.0  | 16.0                   | 17.1             | 11.0   | 1003.5               | 72.0             |        |             |
| 7                   | 278         | 262.0                   | 79.9       | 295                  | 10.0                   | 19.5  | 15.9                   | 17.1             | 10.9   | 1001.7               | 72.4             | **     |             |
| 8                   | 327         | 311.0                   | 94.8       | 295                  | 9.8                    | 19.0  | 15.7                   | 17.1             | 10.8   | 1000.0               | 73.0             |        |             |
| 9                   | 495         | 479.3                   | 146.1      | 296                  | 9.6                    | 18.7  | 15.3                   | 17.2             | 10.7   | 994.0                | 74.3             | **     |             |
| 10                  | 664         | 647.5                   | 197.4      | 297                  | 9.5                    | 18.4  | 14.9                   | 17.3             | 10.7   | 988.0                | 76.0             | **     |             |
| 11                  | 832         | 815.8                   | 248.6      | 298                  | 9.3                    | 18.1  | 14.4                   | 17.4             | 10.6   | 982.0                | 77.7             | **     |             |
| 12                  | 1000        | 984.0                   | 299.9      | 299                  | 9.2                    | 17.8  | 14.0                   | 17.4             | 10.5   | 976.1                | 79.0             |        |             |
| 13                  | 1271        | 1255.0                  | 382.5      | 299                  | 8.7                    | 17.0  | 13.3                   | 17.6             | 10.5   | 966.7                | 83.0             |        |             |
| 14                  | 1510        | 1494.0                  | 455.4      | 300                  | 8.5                    | 16.5  | 12.6                   | 17.6             | 10.5   | 958.3                | 87.1             | **     |             |
| 15                  | 1749        | 1733.0                  | 528.2      | 300                  | 8.2                    | 16.0  | 11.9                   | 17.6             | 10.5   | 950.0                | 91.0             |        |             |
| 16                  | 1802        | 1786.0                  | 544.4      | 300                  | 8.2                    | 16.0  | 11.8                   | 17.7             | 10.5   | 948.3                | 92.0             |        |             |
| 17                  | 2000        | 1984.0                  | 604.7      | 300                  | 8.1                    | 15.8  | 11.3                   | 17.7             | 10.1   | 941.5                | 92.0             |        |             |
| 18                  | 2337        | 2321.0                  | 707.4      | 301                  | 7.7                    | 15.0  | 10.4                   | 17.8             | 9.4    | 930.0                | 93.0             |        |             |
| 19                  | 2947        | 2931.0                  | 893.4      | 299                  | 7.2                    | 14.0  | 9.1                    | 18.2             | 8.1    | 909.5                | 94.0             |        |             |
| 20                  | 3000        | 2984.0                  | 909.5      | 299                  | 7.2                    | 14.0  | 9.0                    | 18.3             | 8.0    | 907.7                | 94.0             |        |             |
| 21                  | 3227        | 3211.0                  | 978.7      | 298                  | 7.2                    | 14.0  | 8.5                    | 18.5             | 7.7    | 900.0                | 95.0             |        |             |
| 22                  | 3568        | 3552.0                  | 1082.6     | 296                  | 7.2                    | 14.0  | 7.8                    | 18.7             | 7.2    | 889.0                | 96.0             | *      |             |
| 23                  | 4000        | 3984.0                  | 1214.3     | 292                  | 7.7                    | 14.9  | 8.7                    | 20.6             | 0.9    | 875.0                | 61.0             |        |             |
| 24                  | 4162        | 4146.0                  | 1263.7     | 291                  | 7.7                    | 15.0  | 9.0                    | 21.3             | -1.5   | 869.8                | 48.0             |        |             |
| 25                  | 4781        | 4765.0                  | 1452.4     | 286                  | 9.3                    | 18.0  | 10.0                   | 24.1             | -5.0   | 850.0                | 34.0             |        |             |
| 26                  | 5000        | 4984.0                  | 1519.1     | 285                  | 9.5                    | 18.4  | 9.6                    | 24.4             | -5.3   | 843.4                | 35.0             |        |             |
| 27                  | 5500        | 5484.0                  | 1671.5     | 281                  | 10.5                   | 20.4  | 9.0                    | 25.4             | -5.9   | 828.1                | 34.9             | **     |             |
| 28                  | 6000        | 5984.0                  | 1823.9     | 277                  | 11.5                   | 22.4  | 8.5                    | 26.3             | -6.5   | 813.0                | 34.0             |        |             |
| 29                  | 6426        | 6410.0                  | 1953.8     | 274                  | 12.3                   | 24.0  | 8.1                    | 27.3             | -7.1   | 800.0                | 33.0             |        |             |
| 30                  | 7000        | 6984.0                  | 2128.7     | 270                  | 13.5                   | 26.3  | 7.9                    | 28.8             | -7.6   | 783.6                | 32.0             |        |             |
| 31                  | 7500        | 7484.0                  | 2281.1     | 269                  | 14.5                   | 28.2  | 7.3                    | 29.8             | -8.2   | 769.2                | 33.2             | **     |             |
| 32                  | 8000        | 7984.0                  | 2433.5     | 267                  | 15.5                   | 30.1  | 6.7                    | 30.8             | -8.8   | 755.2                | 32.0             |        |             |
| 33                  | 8170        | 8154.0                  | 2485.3     | 267                  | 15.9                   | 31.0  | 6.5                    | 31.1             | -9.1   | 750.0                | 32.0             |        |             |
| 34                  | 9109        | 9093.0                  | 2771.5     | 267                  | 18.0                   | 35.0  | 5.1                    | 32.6             | -10.3  | 724.7                | 32.0             |        |             |

\* - INDICATES THE CALCULATED TOP OF THE SURFACE MIXING LAYER

\*\* - INDICATES THAT DATA IS LINEARLY INTERPOLATED FROM INPUT METEOROLOGY

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1 *****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE    4
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      RAWINSONDE ASCENT NUMBER      0, 0132   Z  8 NOV   97   T  -0.6 HR
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----- METEOROLOGICAL RAWINSONDE DATA -----

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SURFACE AIR DENSITY (GM/M**3)                      1211.43
DEFAULT CALCULATED MIXING LAYER HEIGHT (M)           1082.65
CLOUD COVER IN TENTHS OF CELESTIAL DOME              0.0
CLOUD CEILING (M)                                    9999.0

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----- PLUME RISE DATA -----

```

EXHAUST RATE OF MATERIAL INTO GRN CLD-   (GRAMS/SEC)      4.21733E+06
TOTAL GROUND CLD MATERIAL-               (GRAMS)          3.96943E+07
HEAT OUTPUT PER GRAM-                   (CALORIES)         1555.6
VEHICLE RISE HEIGHT DEFINING GROUND CLD- (M)              199.9
VEHICLE RISE TIME PARAMETERS-            (TK=(A*Z**B)+C)  A=      0.8677
                                           B=      0.4500
                                           C=      0.0000
EXHAUST RATE OF MATERIAL INTO CONTRAIL-   (GRAMS/SEC)      4.21733E+06
CONTRAIL HEAT OUTPUT PER GRAM-            (CALORIES)         1555.6

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*****

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----- EXHAUST CLOUD -----

| MET.<br>LAYER<br>NO. | TOP<br>OF LAYER<br>(METERS) | CLOUD<br>RISE TIME<br>(SECONDS) | CLOUD<br>RISE RANGE<br>(METERS) | CLOUD<br>RISE BEARING<br>(DEGREES) | STABILIZED<br>CLOUD RANGE<br>(METERS) | STABILIZED<br>CLOUD BEARING<br>(DEGREES) |
|----------------------|-----------------------------|---------------------------------|---------------------------------|------------------------------------|---------------------------------------|------------------------------------------|
| 1                    | 13.0                        | 1.8                             | 4.0                             | 100.8                              | 0.0                                   | 0.0                                      |
| 2                    | 26.0                        | 2.8                             | 11.5                            | 102.1                              | 0.0                                   | 0.0                                      |
| 3                    | 39.0                        | 3.8                             | 18.0                            | 103.4                              | 0.0                                   | 0.0                                      |
| 4                    | 51.9                        | 4.8                             | 25.5                            | 104.9                              | 0.0                                   | 0.0                                      |
| 5                    | 64.9                        | 5.7                             | 34.3                            | 106.6                              | 0.0                                   | 0.0                                      |
| 6                    | 79.9                        | 6.9                             | 45.3                            | 108.3                              | 0.0                                   | 0.0                                      |
| 7                    | 94.8                        | 8.2                             | 57.6                            | 109.6                              | 0.0                                   | 0.0                                      |
| 8                    | 146.1                       | 13.2                            | 87.9                            | 111.6                              | 0.0                                   | 0.0                                      |
| 9                    | 197.4                       | 19.1                            | 140.3                           | 113.2                              | 0.0                                   | 0.0                                      |
| 10                   | 248.6                       | 26.1                            | 201.3                           | 114.4                              | 0.0                                   | 0.0                                      |
| 11                   | 299.9                       | 34.0                            | 270.2                           | 115.3                              | 0.0                                   | 0.0                                      |
| 12                   | 382.5                       | 48.5                            | 372.2                           | 116.3                              | 2437.3                                | 118.6                                    |
| 13                   | 455.4                       | 63.3                            | 500.6                           | 117.0                              | 2361.4                                | 118.8                                    |
| 14                   | 528.2                       | 79.8                            | 633.3                           | 117.5                              | 2300.1                                | 119.1                                    |
| 15                   | 544.4                       | 83.8                            | 718.2                           | 117.8                              | 2326.9                                | 119.3                                    |
| 16                   | 604.7                       | 99.3                            | 798.1                           | 118.0                              | 2269.6                                | 119.3                                    |
| 17                   | 707.4                       | 129.3                           | 981.8                           | 118.4                              | 2169.3                                | 119.6                                    |
| 18                   | 893.4                       | 208.6                           | 1399.6                          | 119.1                              | 1926.7                                | 119.3                                    |
| 19                   | 909.5                       | 220.3                           | 1732.0                          | 119.1                              | 2157.0                                | 119.1                                    |
| 20                   | 978.7                       | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 21                   | 1082.6                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 22                   | 1214.3                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 23                   | 1263.7                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 24                   | 1452.4                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 25                   | 1519.1                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 26                   | 1671.5                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 27                   | 1823.9                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 28                   | 1953.8                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 29                   | 2128.7                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 30                   | 2281.1                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 31                   | 2433.5                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 32                   | 2485.3                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 33                   | 2771.5                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |

\* - INDICATES CLOUD STABILIZATION TIME WAS USED

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1*****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE    6
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*****

```

----- EXHAUST CLOUD -----

CHEMICAL SPECIES = HCL

| MET.<br>LAYER<br>NO. | TOP<br>OF LAYER<br>(METERS) | LAYER<br>SOURCE<br>STRENGTH<br>(GRAMS) | CLOUD<br>UPDRAFT<br>VELOCITY<br>(M/S) | CLOUD<br>RADIUS<br>(METERS) | STD. DEVIATION<br>ALONGWIND<br>(METERS) | MATERIAL DIST.<br>CROSSWIND<br>(METERS) |
|----------------------|-----------------------------|----------------------------------------|---------------------------------------|-----------------------------|-----------------------------------------|-----------------------------------------|
| 1                    | 13.0                        | 0.00000E+00                            | 11.5                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 2                    | 26.0                        | 0.00000E+00                            | 13.4                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 3                    | 39.0                        | 0.00000E+00                            | 13.6                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 4                    | 51.9                        | 0.00000E+00                            | 13.3                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 5                    | 64.9                        | 0.00000E+00                            | 12.8                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 6                    | 79.9                        | 0.00000E+00                            | 12.1                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 7                    | 94.8                        | 0.00000E+00                            | 11.4                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 8                    | 146.1                       | 0.00000E+00                            | 9.4                                   | 0.0                         | 0.0                                     | 0.0                                     |
| 9                    | 197.4                       | 0.00000E+00                            | 7.9                                   | 0.0                         | 0.0                                     | 0.0                                     |
| 10                   | 248.6                       | 0.00000E+00                            | 6.9                                   | 0.0                         | 0.0                                     | 0.0                                     |
| 11                   | 299.9                       | 0.00000E+00                            | 6.1                                   | 0.0                         | 0.0                                     | 0.0                                     |
| 12                   | 382.5                       | 5.32352E+04                            | 5.3                                   | 20.3                        | 9.4                                     | 9.4                                     |
| 13                   | 455.4                       | 3.40015E+05                            | 4.7                                   | 331.5                       | 154.5                                   | 154.5                                   |
| 14                   | 528.2                       | 6.18797E+05                            | 4.2                                   | 446.7                       | 208.2                                   | 208.2                                   |
| 15                   | 544.4                       | 1.70843E+05                            | 4.1                                   | 497.8                       | 231.9                                   | 231.9                                   |
| 16                   | 604.7                       | 7.33920E+05                            | 3.7                                   | 534.1                       | 248.9                                   | 248.9                                   |
| 17                   | 707.4                       | 1.54277E+06                            | 3.1                                   | 594.1                       | 276.8                                   | 276.8                                   |
| 18                   | 893.4                       | 3.39962E+06                            | 1.5                                   | 657.2                       | 306.2                                   | 306.2                                   |
| 19                   | 909.5                       | 3.14576E+05                            | 1.3                                   | 675.4                       | 314.7                                   | 314.7                                   |
| 20                   | 978.7 *                     | 1.59094E+06                            | 0.0                                   | 677.3                       | 315.6                                   | 315.6                                   |
| 21                   | 1082.6 *                    | 2.73687E+06                            | 0.0                                   | 670.8                       | 312.6                                   | 312.6                                   |
| 22                   | 1214.3 *                    | 3.17219E+06                            | 0.0                                   | 638.6                       | 297.6                                   | 297.6                                   |
| 23                   | 1263.7 *                    | 1.06109E+06                            | 0.0                                   | 593.2                       | 276.4                                   | 276.4                                   |
| 24                   | 1452.4 *                    | 3.12286E+06                            | 0.0                                   | 497.0                       | 231.6                                   | 231.6                                   |
| 25                   | 1519.1 *                    | 6.61100E+05                            | 0.0                                   | 308.4                       | 143.7                                   | 143.7                                   |
| 26                   | 1671.5 *                    | 8.94115E+05                            | 0.0                                   | 220.6                       | 102.8                                   | 102.8                                   |
| 27                   | 1823.9 *                    | 8.17373E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 28                   | 1953.8 *                    | 6.67215E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 29                   | 2128.7 *                    | 8.61534E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 30                   | 2281.1 *                    | 7.19226E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 31                   | 2433.5 *                    | 6.93253E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 32                   | 2485.3 *                    | 2.30241E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 33                   | 2771.5 *                    | 1.22659E+06                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |

\* - INDICATES CLOUD STABILIZATION TIME WAS USED

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1*****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE    7
      VERSION 7.08 AT KSC
      1005 EDT 16 JUN 1998
      launch time: 2105 EST 07 NOV 1997
      RAWINSONDE ASCENT NUMBER      0, 0132  Z  8 NOV  97  T  -0.6 HR
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----- CLOUD STABILIZATION -----

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CALCULATION HEIGHT          (METERS)          946.82
STABILIZATION HEIGHT        (METERS)          946.82
STABILIZATION TIME          (SECS)           279.27
FIRST MIXING LAYER HEIGHT-   (METERS)          TOP = 1082.65
                                BASE=      0.00
SECOND SELECTED LAYER HEIGHT- (METERS)          TOP = 2771.55
                                BASE= 1082.65
SIGMAR(AZ) AT THE SURFACE    (DEGREES)         5.4936
SIGMER(EL) AT THE SURFACE    (DEGREES)         3.6919

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| MET.<br>LAYER<br>NO. | WIND<br>SPEED<br>(M/SEC) | WIND<br>SPEED<br>SHEAR<br>(M/SEC) | WIND<br>DIRECTION<br>(DEG) | WIND<br>DIRECTION<br>SHEAR<br>(DEG) | SIGMA OF<br>AZI ANG<br>(DEG) | SIGMA OF<br>ELE ANG<br>(DEG) |
|----------------------|--------------------------|-----------------------------------|----------------------------|-------------------------------------|------------------------------|------------------------------|
| 1                    | 4.95                     | 1.23                              | 281.40                     | 2.80                                | 4.7661                       | 3.6919                       |
| 2                    | 5.97                     | 1.23                              | 284.20                     | 2.80                                | 3.8775                       | 3.6919                       |
| 3                    | 7.20                     | 1.23                              | 287.00                     | 2.80                                | 3.7041                       | 3.6919                       |
| 4                    | 8.44                     | 1.23                              | 289.80                     | 2.80                                | 3.6919                       | 3.6919                       |
| 5                    | 9.67                     | 1.23                              | 292.60                     | 2.80                                | 3.6919                       | 3.6919                       |
| 6                    | 10.16                    | 0.26                              | 294.25                     | 0.50                                | 3.6919                       | 3.6919                       |
| 7                    | 9.90                     | 0.26                              | 294.75                     | 0.50                                | 3.6919                       | 3.6919                       |
| 8                    | 9.70                     | -0.15                             | 295.50                     | 1.00                                | 3.5937                       | 3.5937                       |
| 9                    | 9.54                     | -0.15                             | 296.50                     | 1.00                                | 3.4252                       | 3.4252                       |
| 10                   | 9.39                     | -0.15                             | 297.50                     | 1.00                                | 3.2847                       | 3.2847                       |
| 11                   | 9.23                     | -0.15                             | 298.50                     | 1.00                                | 3.1228                       | 3.1228                       |
| 12                   | 8.95                     | -0.41                             | 299.00                     | 0.00                                | 2.9246                       | 2.9246                       |
| 13                   | 8.62                     | -0.26                             | 299.25                     | 0.50                                | 2.7184                       | 2.7184                       |
| 14                   | 8.36                     | -0.26                             | 299.75                     | 0.50                                | 2.5577                       | 2.5577                       |
| 15                   | 8.23                     | 0.00                              | 300.00                     | 0.00                                | 2.4443                       | 2.4443                       |
| 16                   | 8.18                     | -0.10                             | 300.00                     | 0.00                                | 2.2802                       | 2.2802                       |
| 17                   | 7.92                     | -0.41                             | 300.50                     | 1.00                                | 1.9709                       | 1.9709                       |
| 18                   | 7.46                     | -0.51                             | 300.00                     | -2.00                               | 1.6348                       | 1.6348                       |
| 19                   | 7.20                     | 0.00                              | 299.00                     | 0.00                                | 1.4379                       | 1.4379                       |
| 20                   | 7.20                     | 0.00                              | 298.50                     | -1.00                               | 1.2609                       | 1.2609                       |
| 21                   | 7.20                     | 0.00                              | 297.00                     | -2.00                               | 1.0712                       | 1.0712                       |
| 22                   | 7.43                     | 0.46                              | 294.00                     | -4.00                               | 1.0000                       | 1.0000                       |
| 23                   | 7.69                     | 0.05                              | 291.50                     | -1.00                               | 1.0000                       | 1.0000                       |
| 24                   | 8.49                     | 1.54                              | 288.50                     | -5.00                               | 1.0000                       | 1.0000                       |
| 25                   | 9.36                     | 0.21                              | 285.50                     | -1.00                               | 1.0000                       | 1.0000                       |
| 26                   | 9.98                     | 1.03                              | 283.00                     | -4.00                               | 1.0000                       | 1.0000                       |
| 27                   | 11.01                    | 1.03                              | 279.00                     | -4.00                               | 1.0000                       | 1.0000                       |
| 28                   | 11.94                    | 0.82                              | 275.50                     | -3.00                               | 1.0000                       | 1.0000                       |
| 29                   | 12.94                    | 1.18                              | 272.00                     | -4.00                               | 1.0000                       | 1.0000                       |
| 30                   | 14.02                    | 0.98                              | 269.25                     | -1.50                               | 1.0000                       | 1.0000                       |

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1*****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE    8
      VERSION 7.08 AT KSC
      1005 EDT 16 JUN 1998
      launch time: 2105 EST 07 NOV 1997
      RAWINSONDE ASCENT NUMBER      0, 0132    Z  8 NOV   97   T  -0.6 HR
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----- CALCULATED METEOROLOGICAL LAYER PARAMETERS -----

| MET.<br>LAYER<br>NO. | WIND<br>SPEED<br>(M/SEC) | WIND<br>SPEED<br>SHEAR<br>(M/SEC) | WIND<br>DIRECTION<br>(DEG) | WIND<br>DIRECTION<br>SHEAR<br>(DEG) | SIGMA OF<br>AZI ANG<br>(DEG) | SIGMA OF<br>ELE ANG<br>(DEG) |
|----------------------|--------------------------|-----------------------------------|----------------------------|-------------------------------------|------------------------------|------------------------------|
| 31                   | 15.00                    | 0.98                              | 267.75                     | -1.50                               | 1.0000                       | 1.0000                       |
| 32                   | 15.72                    | 0.46                              | 267.00                     | 0.00                                | 1.0000                       | 1.0000                       |
| 33                   | 16.98                    | 2.06                              | 267.00                     | 0.00                                | 1.0000                       | 1.0000                       |

ALTITUDE RANGE USED IN COMPUTING TRANSITION LAYER AVERAGES  
IS 197.4 TO 2771.5 METERS.

TRANSITION LAYER NUMBER- 1

| VALUE<br>AT | HEIGHT<br>(METERS) | TEMP.<br>(DEG K) | WIND<br>SPEED<br>(M/SEC) | WIND<br>SPEED<br>SHEAR<br>(M/SEC) | WIND<br>DIR.<br>(DEG) | WIND<br>DIR.<br>SHEAR<br>(DEG) | SIGMA<br>AZI.<br>(DEG) | SIGMA<br>ELE.<br>(DEG) |
|-------------|--------------------|------------------|--------------------------|-----------------------------------|-----------------------|--------------------------------|------------------------|------------------------|
| TOP-        | 1082.65            | 291.90           | 7.20                     |                                   | 296.00                |                                | 1.0000                 | 1.0000                 |
| LAYER-      |                    |                  | 8.04                     | 0.74                              | 299.16                | 1.38                           | 2.1008                 | 2.1008                 |
| BOTTOM-     | 0.00               | 289.86           | 4.12                     |                                   | 280.00                |                                | 5.4936                 | 3.6919                 |

TRANSITION LAYER NUMBER- 2

| VALUE<br>AT | HEIGHT<br>(METERS) | TEMP.<br>(DEG K) | WIND<br>SPEED<br>(M/SEC) | WIND<br>SPEED<br>SHEAR<br>(M/SEC) | WIND<br>DIR.<br>(DEG) | WIND<br>DIR.<br>SHEAR<br>(DEG) | SIGMA<br>AZI.<br>(DEG) | SIGMA<br>ELE.<br>(DEG) |
|-------------|--------------------|------------------|--------------------------|-----------------------------------|-----------------------|--------------------------------|------------------------|------------------------|
| TOP-        | 2771.55            | 305.74           | 18.01                    |                                   | 267.00                |                                | 1.0000                 | 1.0000                 |
| LAYER-      |                    |                  | 12.12                    | 3.33                              | 274.57                | 8.14                           | 1.0000                 | 1.0000                 |
| BOTTOM-     | 1082.65            | 291.90           | 7.20                     |                                   | 296.00                |                                | 1.0000                 | 1.0000                 |

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1*****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE    9
      VERSION 7.08 AT KSC
      1005 EDT 16 JUN 1998
      launch time: 2105 EST 07 NOV 1997
      RAWINSONDE ASCENT NUMBER      0, 0132    Z  8 NOV   97   T  -0.6 HR
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----- MAXIMUM CENTERLINE CALCULATIONS -----

\*\* DECAY COEFFICIENT (1/SEC) = 0.00000E+00 \*\*

CONCENTRATION OF HCL AT A HEIGHT OF 946.8 METERS  
 DOWNWIND FROM A TITAN IV NORMAL LAUNCH  
 CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

| RANGE<br>FROM PAD<br>(METERS) | BEARING<br>FROM PAD<br>(DEGREES) | PEAK<br>CONCEN-<br>TRATION<br>(PPM) | CLOUD<br>ARRIVAL<br>TIME<br>(MIN) | CLOUD<br>DEPARTURE<br>TIME<br>(MIN) |
|-------------------------------|----------------------------------|-------------------------------------|-----------------------------------|-------------------------------------|
| 3000.0051                     | 119.2659                         | 25.1542                             | 4.0147                            | 7.7211                              |
| 4000.0288                     | 119.3777                         | 22.0962                             | 3.8257                            | 9.7964                              |
| 5000.0000                     | 119.1429                         | 19.6682                             | 5.8178                            | 11.8739                             |
| 6000.0015                     | 119.1972                         | 17.6732                             | 7.8754                            | 13.9538                             |
| 7000.0000                     | 119.1677                         | 15.9303                             | 9.9289                            | 16.0359                             |
| 8000.0005                     | 119.1455                         | 14.3550                             | 11.9786                           | 18.1202                             |
| 9000.0010                     | 119.1283                         | 12.9174                             | 14.0246                           | 20.2067                             |
| 10000.0029                    | 119.1145                         | 11.6028                             | 16.0445                           | 22.2953                             |
| 11000.0059                    | 119.1032                         | 10.4041                             | 18.0596                           | 24.3859                             |
| 12000.0098                    | 119.2328                         | 9.3177                              | 20.0746                           | 26.4784                             |
| 13000.0088                    | 119.2273                         | 8.3408                              | 22.0896                           | 28.5729                             |
| 14000.0078                    | 119.2225                         | 7.4684                              | 24.1045                           | 30.6691                             |
| 15000.0078                    | 119.2184                         | 6.6949                              | 26.1194                           | 32.7670                             |
| 16000.0068                    | 119.2147                         | 6.0136                              | 28.1343                           | 34.8666                             |
| 17000.0059                    | 119.2115                         | 5.4167                              | 30.1492                           | 36.9677                             |
| 18000.0059                    | 119.2087                         | 4.8957                              | 32.1641                           | 39.0703                             |
| 19000.0059                    | 119.2062                         | 4.4423                              | 34.1790                           | 41.1742                             |
| 20000.0059                    | 119.2039                         | 4.0483                              | 36.1939                           | 43.2795                             |
| 21000.0059                    | 119.2018                         | 3.7060                              | 38.2087                           | 45.3860                             |
| 22000.0059                    | 119.1999                         | 3.4081                              | 40.2236                           | 47.4937                             |
| 23000.0059                    | 119.1982                         | 3.1484                              | 42.2385                           | 49.6025                             |
| 24000.0039                    | 119.1966                         | 2.9212                              | 44.2533                           | 51.7124                             |
| 25000.0039                    | 119.1952                         | 2.7215                              | 46.2682                           | 53.8232                             |
| 26000.0039                    | 119.1938                         | 2.5450                              | 48.2830                           | 55.9349                             |
| 27000.0039                    | 119.1926                         | 2.3881                              | 50.2979                           | 58.0475                             |
| 28000.0039                    | 119.1915                         | 2.2478                              | 52.3127                           | 60.1609                             |
| 29000.0039                    | 119.1904                         | 2.1216                              | 54.3276                           | 62.2751                             |
| 30000.0039                    | 119.1894                         | 2.0072                              | 56.3424                           | 64.3900                             |
| 31000.0039                    | 119.1885                         | 1.9030                              | 58.3572                           | 66.5055                             |
| 32000.0039                    | 119.1876                         | 1.8076                              | 60.3721                           | 68.6218                             |
| 33000.0039                    | 119.1868                         | 1.7198                              | 62.3869                           | 70.7386                             |
| 34000.0039                    | 119.1860                         | 1.6386                              | 64.4018                           | 72.8559                             |
| 35000.0039                    | 119.1852                         | 1.5633                              | 66.4166                           | 74.9738                             |
| 36000.0039                    | 119.1846                         | 1.4932                              | 68.4314                           | 77.0922                             |
| 37000.0039                    | 119.1839                         | 1.4277                              | 70.4463                           | 79.2111                             |

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1*****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE 10
      VERSION 7.08 AT KSC
      1005 EDT 16 JUN 1998
      launch time: 2105 EST 07 NOV 1997
      RAWINSONDE ASCENT NUMBER      0, 0132  Z  8 NOV  97  T  -0.6 HR
*****

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----- MAXIMUM CENTERLINE CALCULATIONS -----

\*\* DECAY COEFFICIENT (1/SEC) = 0.00000E+00 \*\*

CONCENTRATION OF HCL AT A HEIGHT OF 946.8 METERS  
 DOWNWIND FROM A TITAN IV NORMAL LAUNCH  
 CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

| RANGE<br>FROM PAD<br>(METERS) | BEARING<br>FROM PAD<br>(DEGREES) | PEAK<br>CONCEN-<br>TRATION<br>(PPM) | CLOUD<br>ARRIVAL<br>TIME<br>(MIN) | CLOUD<br>DEPARTURE<br>TIME<br>(MIN) |
|-------------------------------|----------------------------------|-------------------------------------|-----------------------------------|-------------------------------------|
| 38000.0039                    | 119.1833                         | 1.3664                              | 72.4611                           | 81.3305                             |
| 39000.0039                    | 119.1827                         | 1.3089                              | 74.4759                           | 83.4502                             |
| 40000.0039                    | 119.1821                         | 1.2549                              | 76.4908                           | 85.5704                             |
| 41000.0039                    | 119.1816                         | 1.2041                              | 78.5056                           | 87.6909                             |
| 42000.0039                    | 119.1811                         | 1.1562                              | 80.5204                           | 89.8118                             |
| 43000.0039                    | 119.1806                         | 1.1111                              | 82.5353                           | 91.9330                             |
| 44000.0039                    | 119.1802                         | 1.0684                              | 84.5501                           | 94.0545                             |
| 45000.0039                    | 119.1797                         | 1.0281                              | 86.5649                           | 96.1764                             |
| 46000.0039                    | 119.1793                         | 0.9899                              | 88.5798                           | 98.2985                             |
| 47000.0039                    | 119.1789                         | 0.9538                              | 90.5946                           | 100.4209                            |
| 48000.0039                    | 119.1785                         | 0.9195                              | 92.6094                           | 102.5436                            |
| 49000.0039                    | 119.1781                         | 0.8870                              | 94.6242                           | 104.6665                            |
| 50000.0039                    | 119.1778                         | 0.8562                              | 96.6391                           | 106.7896                            |
| 51000.0039                    | 119.1775                         | 0.8268                              | 98.6539                           | 108.9130                            |
| 52000.0039                    | 119.1771                         | 0.7989                              | 100.6687                          | 111.0366                            |
| 53000.0039                    | 119.1768                         | 0.7724                              | 102.6835                          | 113.1603                            |
| 54000.0039                    | 119.1765                         | 0.7471                              | 104.6984                          | 115.2843                            |
| 55000.0039                    | 119.1762                         | 0.7230                              | 106.7132                          | 117.4085                            |
| 56000.0039                    | 119.1759                         | 0.7000                              | 108.7280                          | 119.5328                            |
| 57000.0039                    | 119.1757                         | 0.6781                              | 110.7429                          | 121.6573                            |
| 58000.0039                    | 119.1754                         | 0.6571                              | 112.7577                          | 123.7819                            |
| 59000.0000                    | 119.1751                         | 0.6371                              | 114.7725                          | 125.9068                            |
| 60000.0000                    | 119.1749                         | 0.6180                              | 116.7873                          | 128.0317                            |

|                                          | RANGE  | BEARING |
|------------------------------------------|--------|---------|
| 25.154 IS THE MAXIMUM PEAK CONCENTRATION | 3000.0 | 119.3   |

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1*****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE 11
      VERSION 7.08 AT KSC
      1005 EDT 16 JUN 1998
      launch time: 2105 EST 07 NOV 1997
      RAWINSONDE ASCENT NUMBER      0, 0132  Z  8 NOV  97  T  -0.6 HR
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----- MAXIMUM CENTERLINE CALCULATIONS -----

\*\* DECAY COEFFICIENT (1/SEC) = 0.00000E+00 \*\*

CONCENTRATION OF HCL AT A HEIGHT OF 946.8 METERS  
 DOWNWIND FROM A TITAN IV NORMAL LAUNCH  
 CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

| 60.0 MIN.  |           |         |         |           |
|------------|-----------|---------|---------|-----------|
| RANGE      | BEARING   | MEAN    | CLOUD   | CLOUD     |
| FROM PAD   | FROM PAD  | CONCEN- | ARRIVAL | DEPARTURE |
| (METERS)   | (DEGREES) | TRATION | TIME    | TIME      |
|            |           | (PPM)   | (MIN)   | (MIN)     |
| 3000.0051  | 119.2659  | 0.6852  | 4.0147  | 7.7211    |
| 4000.0288  | 119.3777  | 0.5999  | 3.8257  | 9.7964    |
| 5000.0000  | 119.1429  | 0.5343  | 5.8178  | 11.8739   |
| 6000.0015  | 119.1972  | 0.4808  | 7.8754  | 13.9538   |
| 7000.0000  | 119.1677  | 0.4339  | 9.9289  | 16.0359   |
| 8000.0005  | 119.1455  | 0.3914  | 11.9786 | 18.1202   |
| 9000.0010  | 119.1283  | 0.3531  | 14.0246 | 20.2067   |
| 10000.0029 | 119.1145  | 0.3186  | 16.0445 | 22.2953   |
| 11000.0059 | 119.1032  | 0.2877  | 18.0596 | 24.3859   |
| 12000.0098 | 119.2328  | 0.2602  | 20.0746 | 26.4784   |
| 13000.0088 | 119.2273  | 0.2357  | 22.0896 | 28.5729   |
| 14000.0078 | 119.2225  | 0.2140  | 24.1045 | 30.6691   |
| 15000.0078 | 119.2184  | 0.1949  | 26.1194 | 32.7670   |
| 16000.0068 | 119.2147  | 0.1781  | 28.1343 | 34.8666   |
| 17000.0059 | 119.2115  | 0.1634  | 30.1492 | 36.9677   |
| 18000.0059 | 119.2087  | 0.1505  | 32.1641 | 39.0703   |
| 19000.0059 | 119.2062  | 0.1393  | 34.1790 | 41.1742   |
| 20000.0059 | 119.2039  | 0.1296  | 36.1939 | 43.2795   |
| 21000.0059 | 119.2018  | 0.1211  | 38.2087 | 45.3860   |
| 22000.0059 | 119.1999  | 0.1138  | 40.2236 | 47.4937   |
| 23000.0059 | 119.1982  | 0.1075  | 42.2385 | 49.6025   |
| 24000.0039 | 119.1966  | 0.1019  | 44.2533 | 51.7124   |
| 25000.0039 | 119.1952  | 0.0971  | 46.2682 | 53.8232   |
| 26000.0039 | 119.1938  | 0.0928  | 48.2830 | 55.9349   |
| 27000.0039 | 119.1926  | 0.0891  | 50.2979 | 58.0475   |
| 28000.0039 | 119.1915  | 0.0857  | 52.3127 | 60.1609   |
| 29000.0039 | 119.1904  | 0.0827  | 54.3276 | 62.2751   |
| 30000.0039 | 119.1894  | 0.0800  | 56.3424 | 64.3900   |
| 31000.0039 | 119.1885  | 0.0775  | 58.3572 | 66.5055   |
| 32000.0039 | 119.1876  | 0.0752  | 60.3721 | 68.6218   |
| 33000.0039 | 119.1868  | 0.0731  | 62.3869 | 70.7386   |
| 34000.0039 | 119.1860  | 0.0712  | 64.4018 | 72.8559   |
| 35000.0039 | 119.1852  | 0.0694  | 66.4166 | 74.9738   |
| 36000.0039 | 119.1846  | 0.0676  | 68.4314 | 77.0922   |

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1 *****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE 12
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*****

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----- MAXIMUM CENTERLINE CALCULATIONS -----

\*\* DECAY COEFFICIENT (1/SEC) = 0.00000E+00 \*\*

CONCENTRATION OF HCL AT A HEIGHT OF 946.8 METERS  
 DOWNWIND FROM A TITAN IV NORMAL LAUNCH  
 CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

| 60.0 MIN.                     |                                  |                                     |                                   |                                     |
|-------------------------------|----------------------------------|-------------------------------------|-----------------------------------|-------------------------------------|
| RANGE<br>FROM PAD<br>(METERS) | BEARING<br>FROM PAD<br>(DEGREES) | MEAN<br>CONCEN-<br>TRATION<br>(PPM) | CLOUD<br>ARRIVAL<br>TIME<br>(MIN) | CLOUD<br>DEPARTURE<br>TIME<br>(MIN) |
| 37000.0039                    | 119.1839                         | 0.0660                              | 70.4463                           | 79.2111                             |
| 38000.0039                    | 119.1833                         | 0.0645                              | 72.4611                           | 81.3305                             |
| 39000.0039                    | 119.1827                         | 0.0630                              | 74.4759                           | 83.4502                             |
| 40000.0039                    | 119.1821                         | 0.0616                              | 76.4908                           | 85.5704                             |
| 41000.0039                    | 119.1816                         | 0.0603                              | 78.5056                           | 87.6909                             |
| 42000.0039                    | 119.1811                         | 0.0590                              | 80.5204                           | 89.8118                             |
| 43000.0039                    | 119.1806                         | 0.0578                              | 82.5353                           | 91.9330                             |
| 44000.0039                    | 119.1802                         | 0.0566                              | 84.5501                           | 94.0545                             |
| 45000.0039                    | 119.1797                         | 0.0555                              | 86.5649                           | 96.1764                             |
| 46000.0039                    | 119.1793                         | 0.0544                              | 88.5798                           | 98.2985                             |
| 47000.0039                    | 119.1789                         | 0.0534                              | 90.5946                           | 100.4209                            |
| 48000.0039                    | 119.1785                         | 0.0524                              | 92.6094                           | 102.5436                            |
| 49000.0039                    | 119.1781                         | 0.0514                              | 94.6242                           | 104.6665                            |
| 50000.0039                    | 119.1778                         | 0.0505                              | 96.6391                           | 106.7896                            |
| 51000.0039                    | 119.1775                         | 0.0496                              | 98.6539                           | 108.9130                            |
| 52000.0039                    | 119.1771                         | 0.0487                              | 100.6687                          | 111.0366                            |
| 53000.0039                    | 119.1768                         | 0.0479                              | 102.6835                          | 113.1603                            |
| 54000.0039                    | 119.1765                         | 0.0471                              | 104.6984                          | 115.2843                            |
| 55000.0039                    | 119.1762                         | 0.0463                              | 106.7132                          | 117.4085                            |
| 56000.0039                    | 119.1759                         | 0.0456                              | 108.7280                          | 119.5328                            |
| 57000.0039                    | 119.1757                         | 0.0449                              | 110.7429                          | 121.6573                            |
| 58000.0039                    | 119.1754                         | 0.0441                              | 112.7577                          | 123.7819                            |
| 59000.0000                    | 119.1751                         | 0.0435                              | 114.7725                          | 125.9068                            |
| 60000.0000                    | 119.1749                         | 0.0428                              | 116.7873                          | 128.0317                            |

|                                                   | RANGE  | BEARING |
|---------------------------------------------------|--------|---------|
| 0.685 IS THE MAXIMUM 60.0 MIN. MEAN CONCENTRATION | 3000.0 | 119.3   |

\*\*\* REEDM HAS TERMINATED

## Surface Impact Predictions

This section includes the REEDM version 7.08 output for the surface impact run. For the surface impact run, we included the plots of the rawinsonde meteorological data, the predicted maximum concentration versus downwind distance, and the predicted concentration isopleths overlayed on a range map. The rawinsonde meteorological data is identical to the data plotted in Figure 1 for the stabilization height run. Lastly this section includes the detailed REEDM report for this run. The first page of the REEDM output is its listing of errors and is not included in this appendix.

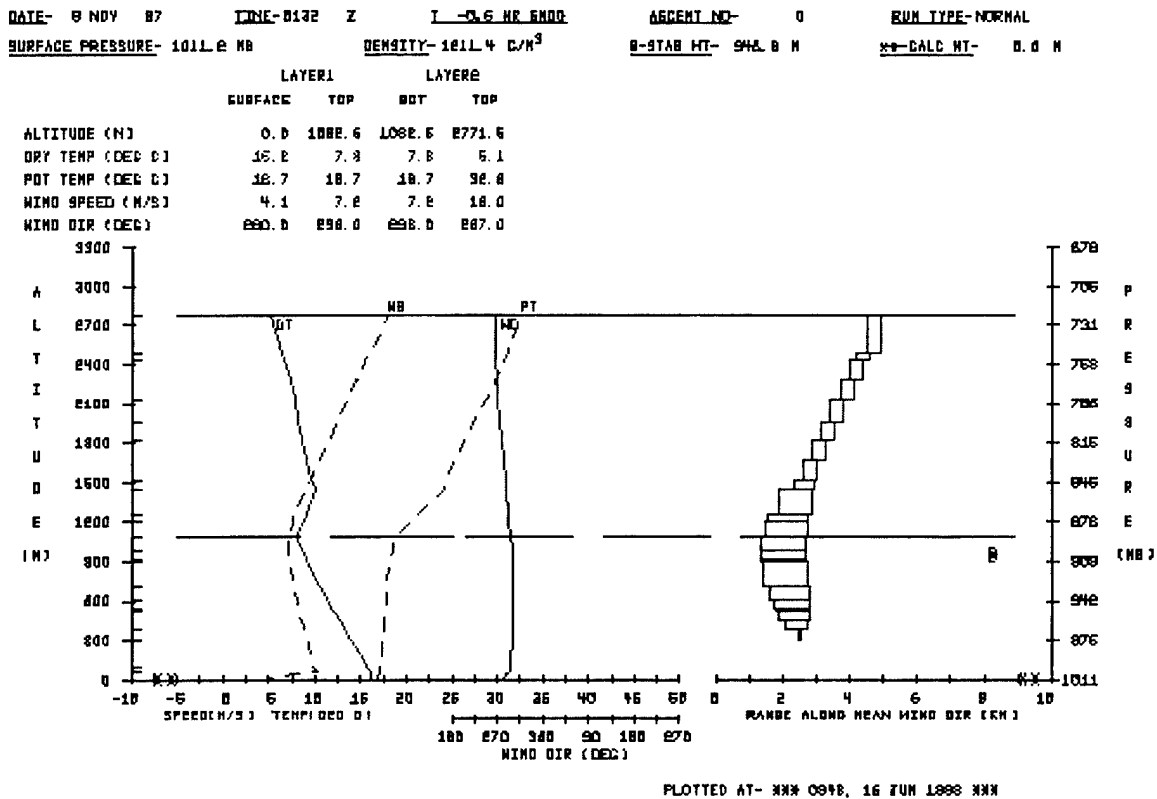


Figure 4A. Meteorological output plot from REEDM Version 7.08 for A-17 mission Using T-0.6h rawinsonde data.

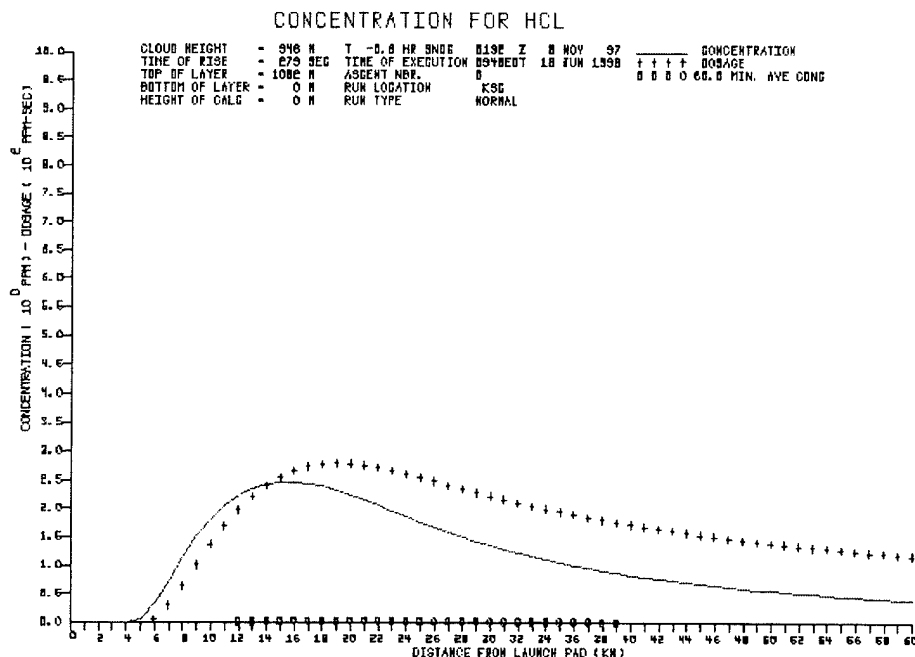


Figure 5A. HCL surface height concentration predictions from REEDM Version 7.08 for A-17 mission using T-0.6h rawinsonde data.

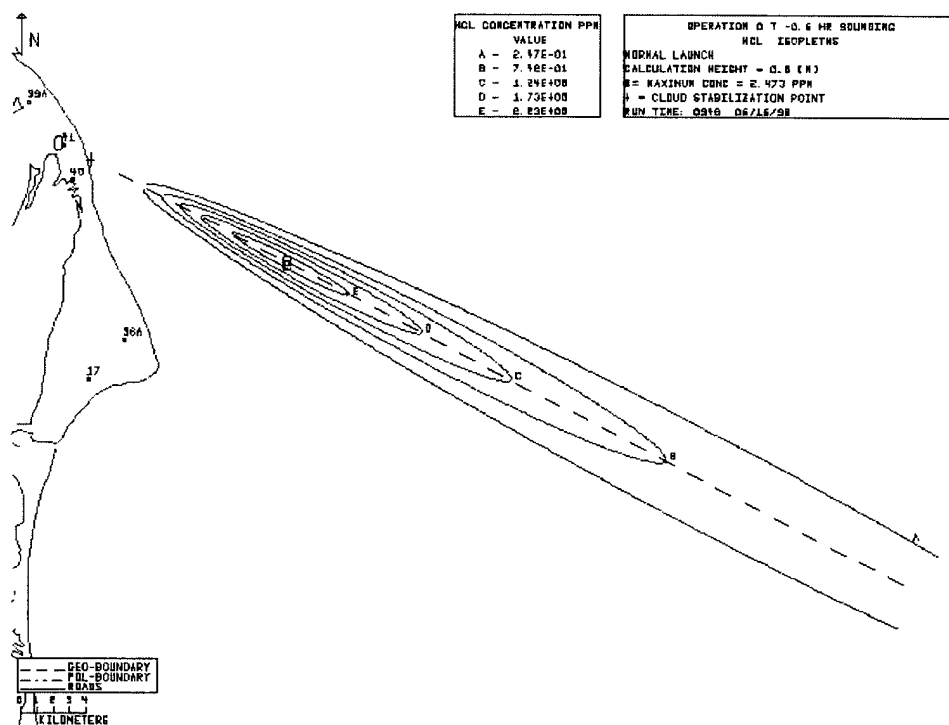


Figure 6A. HCL surface height concentration isopleth predictions from REEDM Version 7.08 for A-17 mission using T-0.6h rawinsonde data.

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*****

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----- PROGRAM OPTIONS -----

|                                                                   |                        |
|-------------------------------------------------------------------|------------------------|
| MODEL                                                             | CONCENTRATION          |
| RUN TYPE                                                          | OPERATIONAL            |
| WIND-FIELD TERRAIN EFFECTS MODEL                                  | NONE                   |
| LAUNCH VEHICLE                                                    | TITAN IV               |
| LAUNCH TYPE                                                       | NORMAL                 |
| LAUNCH COMPLEX NUMBER                                             | 41                     |
| TURBULENCE PARAMETERS ARE DETERMINED FROM                         | CLIMATOLOGICAL DATA    |
| SURFACE CHEMISTRY MODEL                                           | absorption coefficient |
| SPECIES SURFACE FACTOR                                            | HCL 0.000              |
| CLOUD SHAPE                                                       | ELLIPTICAL             |
| CALCULATION HEIGHT                                                | SURFACE                |
| PROPELLANT TEMPERATURE (DEG. C)                                   | 22.86                  |
| CONCENTRATION AVERAGING TIME (SEC.)                               | 3600.00                |
| mixing layer reflection coefficient (RNG- 0 TO 1,no reflection=0) | 1.0000                 |
| DIFFUSION COEFFICIENTS                                            | LATERAL 1.0000         |
|                                                                   | VERTICAL 1.0000        |
| VEHICLE AIR ENTRAINMENT PARAMETER                                 | GAMMAE 0.6400          |
| DOWNWIND EXPANSION DISTANCE (METERS)                              | LATERAL 100.00         |
|                                                                   | VERTICAL 100.00        |

----- DATA FILES -----

| INPUT FILES     |              |
|-----------------|--------------|
| RAWINSONDE FILE | a17a0132.raw |
| DATA BASE FILE  | rdmbase.ksc  |
| OUTPUT FILES    |              |
| PRINT FILE      | u17ah000.sur |
| PLOT FILE       | u17ah000.sup |

1\*\*\*\*\*  
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RAWINSONDE ASCENT NUMBER 0, 0132 Z 8 NOV 97 T -0.6 HR  
\*\*\*\*\*

----- METEOROLOGICAL RAWINSONDE DATA -----

RAWINSONDE MSS/MSS  
TIME- 0132 Z DATE- 08 NOV 97  
ASCENT NUMBER 0

----- T -0.6 HR SOUNDING -----

| MET.<br>LEV.<br>NO. | MSL<br>(FT) | ALTITUDE<br>GND<br>(FT) | GND<br>(M) | WIND<br>DIR<br>(DEG) | WIND<br>SPEED<br>(M/S) | WIND<br>(KTS) | AIR<br>TEMP<br>(DEG C) | PTEMP<br>(DEG C) | DPTEMP | AIR<br>PRESS<br>(MB) | AIR<br>RH<br>(%) | H<br>M | INT-<br>ERP |
|---------------------|-------------|-------------------------|------------|----------------------|------------------------|---------------|------------------------|------------------|--------|----------------------|------------------|--------|-------------|
| 1                   | 16          | 0.0                     | 0.0        | 280                  | 4.1                    | 8.0           | 16.2                   | 16.7             | 11.2   | 1011.2               | 72.0             |        |             |
| 2                   | 59          | 42.6                    | 13.0       | 283                  | 5.4                    | 10.4          | 16.2                   | 16.8             | 11.2   | 1009.7               | 72.2             | **     |             |
| 3                   | 101         | 85.2                    | 26.0       | 286                  | 6.6                    | 12.8          | 16.1                   | 16.9             | 11.1   | 1008.1               | 72.2             | **     |             |
| 4                   | 144         | 127.8                   | 39.0       | 288                  | 7.8                    | 15.2          | 16.1                   | 17.0             | 11.1   | 1006.6               | 72.2             | **     |             |
| 5                   | 186         | 170.4                   | 51.9       | 291                  | 9.1                    | 17.6          | 16.0                   | 17.1             | 11.0   | 1005.0               | 72.2             | **     |             |
| 6                   | 229         | 213.0                   | 64.9       | 294                  | 10.3                   | 20.0          | 16.0                   | 17.1             | 11.0   | 1003.5               | 72.0             |        |             |
| 7                   | 278         | 262.0                   | 79.9       | 295                  | 10.0                   | 19.5          | 15.9                   | 17.1             | 10.9   | 1001.7               | 72.4             | **     |             |
| 8                   | 327         | 311.0                   | 94.8       | 295                  | 9.8                    | 19.0          | 15.7                   | 17.1             | 10.8   | 1000.0               | 73.0             |        |             |
| 9                   | 495         | 479.3                   | 146.1      | 296                  | 9.6                    | 18.7          | 15.3                   | 17.2             | 10.7   | 994.0                | 74.3             | **     |             |
| 10                  | 664         | 647.5                   | 197.4      | 297                  | 9.5                    | 18.4          | 14.9                   | 17.3             | 10.7   | 988.0                | 76.0             | **     |             |
| 11                  | 832         | 815.8                   | 248.6      | 298                  | 9.3                    | 18.1          | 14.4                   | 17.4             | 10.6   | 982.0                | 77.7             | **     |             |
| 12                  | 1000        | 984.0                   | 299.9      | 299                  | 9.2                    | 17.8          | 14.0                   | 17.4             | 10.5   | 976.1                | 79.0             |        |             |
| 13                  | 1271        | 1255.0                  | 382.5      | 299                  | 8.7                    | 17.0          | 13.3                   | 17.6             | 10.5   | 966.7                | 83.0             |        |             |
| 14                  | 1510        | 1494.0                  | 455.4      | 300                  | 8.5                    | 16.5          | 12.6                   | 17.6             | 10.5   | 958.3                | 87.1             | **     |             |
| 15                  | 1749        | 1733.0                  | 528.2      | 300                  | 8.2                    | 16.0          | 11.9                   | 17.6             | 10.5   | 950.0                | 91.0             |        |             |
| 16                  | 1802        | 1786.0                  | 544.4      | 300                  | 8.2                    | 16.0          | 11.8                   | 17.7             | 10.5   | 948.3                | 92.0             |        |             |
| 17                  | 2000        | 1984.0                  | 604.7      | 300                  | 8.1                    | 15.8          | 11.3                   | 17.7             | 10.1   | 941.5                | 92.0             |        |             |
| 18                  | 2337        | 2321.0                  | 707.4      | 301                  | 7.7                    | 15.0          | 10.4                   | 17.8             | 9.4    | 930.0                | 93.0             |        |             |
| 19                  | 2947        | 2931.0                  | 893.4      | 299                  | 7.2                    | 14.0          | 9.1                    | 18.2             | 8.1    | 909.5                | 94.0             |        |             |
| 20                  | 3000        | 2984.0                  | 909.5      | 299                  | 7.2                    | 14.0          | 9.0                    | 18.3             | 8.0    | 907.7                | 94.0             |        |             |
| 21                  | 3227        | 3211.0                  | 978.7      | 298                  | 7.2                    | 14.0          | 8.5                    | 18.5             | 7.7    | 900.0                | 95.0             |        |             |
| 22                  | 3568        | 3552.0                  | 1082.6     | 296                  | 7.2                    | 14.0          | 7.8                    | 18.7             | 7.2    | 889.0                | 96.0             | *      |             |
| 23                  | 4000        | 3984.0                  | 1214.3     | 292                  | 7.7                    | 14.9          | 8.7                    | 20.6             | 0.9    | 875.0                | 61.0             |        |             |
| 24                  | 4162        | 4146.0                  | 1263.7     | 291                  | 7.7                    | 15.0          | 9.0                    | 21.3             | -1.5   | 869.8                | 48.0             |        |             |
| 25                  | 4781        | 4765.0                  | 1452.4     | 286                  | 9.3                    | 18.0          | 10.0                   | 24.1             | -5.0   | 850.0                | 34.0             |        |             |
| 26                  | 5000        | 4984.0                  | 1519.1     | 285                  | 9.5                    | 18.4          | 9.6                    | 24.4             | -5.3   | 843.4                | 35.0             |        |             |
| 27                  | 5500        | 5484.0                  | 1671.5     | 281                  | 10.5                   | 20.4          | 9.0                    | 25.4             | -5.9   | 828.1                | 34.9             | **     |             |
| 28                  | 6000        | 5984.0                  | 1823.9     | 277                  | 11.5                   | 22.4          | 8.5                    | 26.3             | -6.5   | 813.0                | 34.0             |        |             |
| 29                  | 6426        | 6410.0                  | 1953.8     | 274                  | 12.3                   | 24.0          | 8.1                    | 27.3             | -7.1   | 800.0                | 33.0             |        |             |
| 30                  | 7000        | 6984.0                  | 2128.7     | 270                  | 13.5                   | 26.3          | 7.9                    | 28.8             | -7.6   | 783.6                | 32.0             |        |             |
| 31                  | 7500        | 7484.0                  | 2281.1     | 269                  | 14.5                   | 28.2          | 7.3                    | 29.8             | -8.2   | 769.2                | 33.2             | **     |             |
| 32                  | 8000        | 7984.0                  | 2433.5     | 267                  | 15.5                   | 30.1          | 6.7                    | 30.8             | -8.8   | 755.2                | 32.0             |        |             |
| 33                  | 8170        | 8154.0                  | 2485.3     | 267                  | 15.9                   | 31.0          | 6.5                    | 31.1             | -9.1   | 750.0                | 32.0             |        |             |
| 34                  | 9109        | 9093.0                  | 2771.5     | 267                  | 18.0                   | 35.0          | 5.1                    | 32.6             | -10.3  | 724.7                | 32.0             |        |             |

\* - INDICATES THE CALCULATED TOP OF THE SURFACE MIXING LAYER

\*\* - INDICATES THAT DATA IS LINEARLY INTERPOLATED FROM INPUT METEOROLOGY

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*****

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----- METEOROLOGICAL RAWINSONDE DATA -----

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SURFACE AIR DENSITY (GM/M**3)                      1211.43
DEFAULT CALCULATED MIXING LAYER HEIGHT (M)           1082.65
CLOUD COVER IN TENTHS OF CELESTIAL DOME              0.0
CLOUD CEILING (M)                                    9999.0

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----- PLUME RISE DATA -----

```

EXHAUST RATE OF MATERIAL INTO GRN CLD-    (GRAMS/SEC)      4.21733E+06
TOTAL GROUND CLD MATERIAL-                (GRAMS)          3.96943E+07
HEAT OUTPUT PER GRAM-                     (CALORIES)        1555.6
VEHICLE RISE HEIGHT DEFINING GROUND CLD-  (M)              199.9
VEHICLE RISE TIME PARAMETERS-             (TK=(A*Z**B)+C)  A=      0.8677
                                                    B=      0.4500
                                                    C=      0.0000
EXHAUST RATE OF MATERIAL INTO CONTRAIL-   (GRAMS/SEC)      4.21733E+06
CONTRAIL HEAT OUTPUT PER GRAM-            (CALORIES)        1555.6

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----- EXHAUST CLOUD -----

| MET.<br>LAYER<br>NO. | TOP<br>OF LAYER<br>(METERS) | CLOUD<br>RISE TIME<br>(SECONDS) | CLOUD<br>RISE RANGE<br>(METERS) | CLOUD<br>RISE BEARING<br>(DEGREES) | STABILIZED<br>CLOUD RANGE<br>(METERS) | STABILIZED<br>CLOUD BEARING<br>(DEGREES) |
|----------------------|-----------------------------|---------------------------------|---------------------------------|------------------------------------|---------------------------------------|------------------------------------------|
| 1                    | 13.0                        | 1.8                             | 4.0                             | 100.8                              | 0.0                                   | 0.0                                      |
| 2                    | 26.0                        | 2.8                             | 11.5                            | 102.1                              | 0.0                                   | 0.0                                      |
| 3                    | 39.0                        | 3.8                             | 18.0                            | 103.4                              | 0.0                                   | 0.0                                      |
| 4                    | 51.9                        | 4.8                             | 25.5                            | 104.9                              | 0.0                                   | 0.0                                      |
| 5                    | 64.9                        | 5.7                             | 34.3                            | 106.6                              | 0.0                                   | 0.0                                      |
| 6                    | 79.9                        | 6.9                             | 45.3                            | 108.3                              | 0.0                                   | 0.0                                      |
| 7                    | 94.8                        | 8.2                             | 57.6                            | 109.6                              | 0.0                                   | 0.0                                      |
| 8                    | 146.1                       | 13.2                            | 87.9                            | 111.6                              | 0.0                                   | 0.0                                      |
| 9                    | 197.4                       | 19.1                            | 140.3                           | 113.2                              | 0.0                                   | 0.0                                      |
| 10                   | 248.6                       | 26.1                            | 201.3                           | 114.4                              | 0.0                                   | 0.0                                      |
| 11                   | 299.9                       | 34.0                            | 270.2                           | 115.3                              | 0.0                                   | 0.0                                      |
| 12                   | 382.5                       | 48.5                            | 372.2                           | 116.3                              | 2437.3                                | 118.6                                    |
| 13                   | 455.4                       | 63.3                            | 500.6                           | 117.0                              | 2361.4                                | 118.8                                    |
| 14                   | 528.2                       | 79.8                            | 633.3                           | 117.5                              | 2300.1                                | 119.1                                    |
| 15                   | 544.4                       | 83.8                            | 718.2                           | 117.8                              | 2326.9                                | 119.3                                    |
| 16                   | 604.7                       | 99.3                            | 798.1                           | 118.0                              | 2269.6                                | 119.3                                    |
| 17                   | 707.4                       | 129.3                           | 981.8                           | 118.4                              | 2169.3                                | 119.6                                    |
| 18                   | 893.4                       | 208.6                           | 1399.6                          | 119.1                              | 1926.7                                | 119.3                                    |
| 19                   | 909.5                       | 220.3                           | 1732.0                          | 119.1                              | 2157.0                                | 119.1                                    |
| 20                   | 978.7                       | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 21                   | 1082.6                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 22                   | 1214.3                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 23                   | 1263.7                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 24                   | 1452.4                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 25                   | 1519.1                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 26                   | 1671.5                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 27                   | 1823.9                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 28                   | 1953.8                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 29                   | 2128.7                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 30                   | 2281.1                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 31                   | 2433.5                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 32                   | 2485.3                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |
| 33                   | 2771.5                      | 279.3 *                         | 2199.0                          | 119.1                              | 2199.0                                | 119.1                                    |

\* - INDICATES CLOUD STABILIZATION TIME WAS USED

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*****

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----- EXHAUST CLOUD -----

CHEMICAL SPECIES = HCL

| MET.<br>LAYER<br>NO. | TOP<br>OF LAYER<br>(METERS) | LAYER<br>SOURCE<br>STRENGTH<br>(GRAMS) | CLOUD<br>UPDRAFT<br>VELOCITY<br>(M/S) | CLOUD<br>RADIUS<br>(METERS) | STD. DEVIATION<br>ALONGWIND<br>(METERS) | MATERIAL DIST.<br>CROSSWIND<br>(METERS) |
|----------------------|-----------------------------|----------------------------------------|---------------------------------------|-----------------------------|-----------------------------------------|-----------------------------------------|
| 1                    | 13.0                        | 0.00000E+00                            | 11.5                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 2                    | 26.0                        | 0.00000E+00                            | 13.4                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 3                    | 39.0                        | 0.00000E+00                            | 13.6                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 4                    | 51.9                        | 0.00000E+00                            | 13.3                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 5                    | 64.9                        | 0.00000E+00                            | 12.8                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 6                    | 79.9                        | 0.00000E+00                            | 12.1                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 7                    | 94.8                        | 0.00000E+00                            | 11.4                                  | 0.0                         | 0.0                                     | 0.0                                     |
| 8                    | 146.1                       | 0.00000E+00                            | 9.4                                   | 0.0                         | 0.0                                     | 0.0                                     |
| 9                    | 197.4                       | 0.00000E+00                            | 7.9                                   | 0.0                         | 0.0                                     | 0.0                                     |
| 10                   | 248.6                       | 0.00000E+00                            | 6.9                                   | 0.0                         | 0.0                                     | 0.0                                     |
| 11                   | 299.9                       | 0.00000E+00                            | 6.1                                   | 0.0                         | 0.0                                     | 0.0                                     |
| 12                   | 382.5                       | 5.32352E+04                            | 5.3                                   | 20.3                        | 9.4                                     | 9.4                                     |
| 13                   | 455.4                       | 3.40015E+05                            | 4.7                                   | 331.5                       | 154.5                                   | 154.5                                   |
| 14                   | 528.2                       | 6.18797E+05                            | 4.2                                   | 446.7                       | 208.2                                   | 208.2                                   |
| 15                   | 544.4                       | 1.70843E+05                            | 4.1                                   | 497.8                       | 231.9                                   | 231.9                                   |
| 16                   | 604.7                       | 7.33920E+05                            | 3.7                                   | 534.1                       | 248.9                                   | 248.9                                   |
| 17                   | 707.4                       | 1.54277E+06                            | 3.1                                   | 594.1                       | 276.8                                   | 276.8                                   |
| 18                   | 893.4                       | 3.39962E+06                            | 1.5                                   | 657.2                       | 306.2                                   | 306.2                                   |
| 19                   | 909.5                       | 3.14576E+05                            | 1.3                                   | 675.4                       | 314.7                                   | 314.7                                   |
| 20                   | 978.7 *                     | 1.59094E+06                            | 0.0                                   | 677.3                       | 315.6                                   | 315.6                                   |
| 21                   | 1082.6 *                    | 2.73687E+06                            | 0.0                                   | 670.8                       | 312.6                                   | 312.6                                   |
| 22                   | 1214.3 *                    | 3.17219E+06                            | 0.0                                   | 638.6                       | 297.6                                   | 297.6                                   |
| 23                   | 1263.7 *                    | 1.06109E+06                            | 0.0                                   | 593.2                       | 276.4                                   | 276.4                                   |
| 24                   | 1452.4 *                    | 3.12286E+06                            | 0.0                                   | 497.0                       | 231.6                                   | 231.6                                   |
| 25                   | 1519.1 *                    | 6.61100E+05                            | 0.0                                   | 308.4                       | 143.7                                   | 143.7                                   |
| 26                   | 1671.5 *                    | 8.94115E+05                            | 0.0                                   | 220.6                       | 102.8                                   | 102.8                                   |
| 27                   | 1823.9 *                    | 8.17373E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 28                   | 1953.8 *                    | 6.67215E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 29                   | 2128.7 *                    | 8.61534E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 30                   | 2281.1 *                    | 7.19226E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 31                   | 2433.5 *                    | 6.93253E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 32                   | 2485.3 *                    | 2.30241E+05                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |
| 33                   | 2771.5 *                    | 1.22659E+06                            | 0.0                                   | 199.9                       | 93.2                                    | 93.2                                    |

\* - INDICATES CLOUD STABILIZATION TIME WAS USED

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1*****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE    7
      VERSION 7.08 AT KSC
      0948 EDT 16 JUN 1998
      launch time: 2105 EST 07 NOV 1997
      RAWINSONDE ASCENT NUMBER      0, 0132  Z  8 NOV  97  T  -0.6 HR
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----- CLOUD STABILIZATION -----

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CALCULATION HEIGHT          (METERS)          0.00
STABILIZATION HEIGHT        (METERS)          946.82
STABILIZATION TIME          (SECS)            279.27
FIRST MIXING LAYER HEIGHT-   (METERS)          TOP = 1082.65
                                   BASE=      0.00
SECOND SELECTED LAYER HEIGHT- (METERS)          TOP = 2771.55
                                   BASE= 1082.65
SIGMAR(AZ) AT THE SURFACE    (DEGREES)          5.4936
SIGMER(EL) AT THE SURFACE    (DEGREES)          3.6919

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| MET.<br>LAYER<br>NO. | WIND<br>SPEED<br>(M/SEC) | WIND<br>SPEED<br>SHEAR<br>(M/SEC) | WIND<br>DIRECTION<br>(DEG) | WIND<br>DIRECTION<br>SHEAR<br>(DEG) | SIGMA OF<br>AZI ANG<br>(DEG) | SIGMA OF<br>ELE ANG<br>(DEG) |
|----------------------|--------------------------|-----------------------------------|----------------------------|-------------------------------------|------------------------------|------------------------------|
| 1                    | 4.95                     | 1.23                              | 281.40                     | 2.80                                | 4.7661                       | 3.6919                       |
| 2                    | 5.97                     | 1.23                              | 284.20                     | 2.80                                | 3.8775                       | 3.6919                       |
| 3                    | 7.20                     | 1.23                              | 287.00                     | 2.80                                | 3.7041                       | 3.6919                       |
| 4                    | 8.44                     | 1.23                              | 289.80                     | 2.80                                | 3.6919                       | 3.6919                       |
| 5                    | 9.67                     | 1.23                              | 292.60                     | 2.80                                | 3.6919                       | 3.6919                       |
| 6                    | 10.16                    | 0.26                              | 294.25                     | 0.50                                | 3.6919                       | 3.6919                       |
| 7                    | 9.90                     | 0.26                              | 294.75                     | 0.50                                | 3.6919                       | 3.6919                       |
| 8                    | 9.70                     | -0.15                             | 295.50                     | 1.00                                | 3.5937                       | 3.5937                       |
| 9                    | 9.54                     | -0.15                             | 296.50                     | 1.00                                | 3.4252                       | 3.4252                       |
| 10                   | 9.39                     | -0.15                             | 297.50                     | 1.00                                | 3.2847                       | 3.2847                       |
| 11                   | 9.23                     | -0.15                             | 298.50                     | 1.00                                | 3.1228                       | 3.1228                       |
| 12                   | 8.95                     | -0.41                             | 299.00                     | 0.00                                | 2.9246                       | 2.9246                       |
| 13                   | 8.62                     | -0.26                             | 299.25                     | 0.50                                | 2.7184                       | 2.7184                       |
| 14                   | 8.36                     | -0.26                             | 299.75                     | 0.50                                | 2.5577                       | 2.5577                       |
| 15                   | 8.23                     | 0.00                              | 300.00                     | 0.00                                | 2.4443                       | 2.4443                       |
| 16                   | 8.18                     | -0.10                             | 300.00                     | 0.00                                | 2.2802                       | 2.2802                       |
| 17                   | 7.92                     | -0.41                             | 300.50                     | 1.00                                | 1.9709                       | 1.9709                       |
| 18                   | 7.46                     | -0.51                             | 300.00                     | -2.00                               | 1.6348                       | 1.6348                       |
| 19                   | 7.20                     | 0.00                              | 299.00                     | 0.00                                | 1.4379                       | 1.4379                       |
| 20                   | 7.20                     | 0.00                              | 298.50                     | -1.00                               | 1.2609                       | 1.2609                       |
| 21                   | 7.20                     | 0.00                              | 297.00                     | -2.00                               | 1.0712                       | 1.0712                       |
| 22                   | 7.43                     | 0.46                              | 294.00                     | -4.00                               | 1.0000                       | 1.0000                       |
| 23                   | 7.69                     | 0.05                              | 291.50                     | -1.00                               | 1.0000                       | 1.0000                       |
| 24                   | 8.49                     | 1.54                              | 288.50                     | -5.00                               | 1.0000                       | 1.0000                       |
| 25                   | 9.36                     | 0.21                              | 285.50                     | -1.00                               | 1.0000                       | 1.0000                       |
| 26                   | 9.98                     | 1.03                              | 283.00                     | -4.00                               | 1.0000                       | 1.0000                       |
| 27                   | 11.01                    | 1.03                              | 279.00                     | -4.00                               | 1.0000                       | 1.0000                       |
| 28                   | 11.94                    | 0.82                              | 275.50                     | -3.00                               | 1.0000                       | 1.0000                       |
| 29                   | 12.94                    | 1.18                              | 272.00                     | -4.00                               | 1.0000                       | 1.0000                       |
| 30                   | 14.02                    | 0.98                              | 269.25                     | -1.50                               | 1.0000                       | 1.0000                       |

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      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE      8
      VERSION 7.08 AT KSC
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      RAWINSONDE ASCENT NUMBER      0, 0132  Z  8 NOV  97  T  -0.6 HR
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----- CALCULATED METEOROLOGICAL LAYER PARAMETERS -----

| MET.<br>LAYER<br>NO. | WIND<br>SPEED<br>(M/SEC) | WIND<br>SPEED<br>SHEAR<br>(M/SEC) | WIND<br>DIRECTION<br>(DEG) | WIND<br>DIRECTION<br>SHEAR<br>(DEG) | SIGMA OF<br>AZI ANG<br>(DEG) | SIGMA OF<br>ELE ANG<br>(DEG) |
|----------------------|--------------------------|-----------------------------------|----------------------------|-------------------------------------|------------------------------|------------------------------|
| 31                   | 15.00                    | 0.98                              | 267.75                     | -1.50                               | 1.0000                       | 1.0000                       |
| 32                   | 15.72                    | 0.46                              | 267.00                     | 0.00                                | 1.0000                       | 1.0000                       |
| 33                   | 16.98                    | 2.06                              | 267.00                     | 0.00                                | 1.0000                       | 1.0000                       |

ALTITUDE RANGE USED IN COMPUTING TRANSITION LAYER AVERAGES  
IS 0.0 TO 1671.5 METERS.

TRANSITION LAYER NUMBER- 1

| VALUE<br>AT | HEIGHT<br>(METERS) | TEMP.<br>(DEG K) | WIND<br>SPEED<br>(M/SEC) | WIND<br>SPEED<br>SHEAR<br>(M/SEC) | WIND<br>DIR.<br>(DEG) | WIND<br>DIR.<br>SHEAR<br>(DEG) | SIGMA<br>AZI.<br>(DEG) | SIGMA<br>ELE.<br>(DEG) |
|-------------|--------------------|------------------|--------------------------|-----------------------------------|-----------------------|--------------------------------|------------------------|------------------------|
| TOP-        | 1082.65            | 291.90           | 7.20                     |                                   | 296.00                |                                | 1.0000                 | 1.0000                 |
| LAYER-      |                    |                  | 8.19                     | 0.99                              | 298.07                | 2.69                           | 2.3866                 | 2.3723                 |
| BOTTOM-     | 0.00               | 289.86           | 4.12                     |                                   | 280.00                |                                | 5.4936                 | 3.6919                 |

TRANSITION LAYER NUMBER- 2

| VALUE<br>AT | HEIGHT<br>(METERS) | TEMP.<br>(DEG K) | WIND<br>SPEED<br>(M/SEC) | WIND<br>SPEED<br>SHEAR<br>(M/SEC) | WIND<br>DIR.<br>(DEG) | WIND<br>DIR.<br>SHEAR<br>(DEG) | SIGMA<br>AZI.<br>(DEG) | SIGMA<br>ELE.<br>(DEG) |
|-------------|--------------------|------------------|--------------------------|-----------------------------------|-----------------------|--------------------------------|------------------------|------------------------|
| TOP-        | 2771.55            | 305.74           | 18.01                    |                                   | 267.00                |                                | 1.0000                 | 1.0000                 |
| LAYER-      |                    |                  | 8.65                     | 1.12                              | 287.77                | 4.79                           | 1.0000                 | 1.0000                 |
| BOTTOM-     | 1082.65            | 291.90           | 7.20                     |                                   | 296.00                |                                | 1.0000                 | 1.0000                 |

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      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE    9
      VERSION 7.08 AT KSC
      0948 EDT 16 JUN 1998
      launch time: 2105 EST 07 NOV 1997
      RAWINSONDE ASCENT NUMBER      0, 0132  Z  8 NOV  97  T  -0.6 HR
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----- MAXIMUM CENTERLINE CALCULATIONS -----

\*\* DECAY COEFFICIENT (1/SEC) = 0.00000E+00 \*\*

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS  
 DOWNWIND FROM A TITAN IV NORMAL LAUNCH  
 CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

| RANGE<br>FROM PAD<br>(METERS) | BEARING<br>FROM PAD<br>(DEGREES) | PEAK<br>CONCEN-<br>TRATION<br>(PPM) | CLOUD<br>ARRIVAL<br>TIME<br>(MIN) | CLOUD<br>DEPARTURE<br>TIME<br>(MIN) |
|-------------------------------|----------------------------------|-------------------------------------|-----------------------------------|-------------------------------------|
| 5000.0771                     | 118.3876                         | 0.0612                              | 5.7198                            | 11.0884                             |
| 6000.0771                     | 118.3600                         | 0.3364                              | 7.7304                            | 13.7964                             |
| 7000.0396                     | 118.2621                         | 0.7278                              | 9.7345                            | 15.8472                             |
| 8000.0835                     | 118.3311                         | 1.1417                              | 11.7138                           | 17.9017                             |
| 9000.0605                     | 118.2800                         | 1.5164                              | 13.6748                           | 19.9596                             |
| 10000.0439                    | 118.2392                         | 1.8227                              | 15.6357                           | 22.0207                             |
| 11000.0313                    | 118.2058                         | 2.0596                              | 17.5966                           | 24.0849                             |
| 12000.1328                    | 118.3387                         | 2.2353                              | 19.5574                           | 26.1521                             |
| 13000.1230                    | 118.3180                         | 2.3584                              | 21.5183                           | 28.2219                             |
| 14000.1143                    | 118.3002                         | 2.4352                              | 23.4791                           | 30.2944                             |
| 15000.1064                    | 118.2848                         | 2.4716                              | 25.4399                           | 32.3692                             |
| 16000.0996                    | 118.2713                         | 2.4733                              | 27.4006                           | 34.4462                             |
| 17000.0938                    | 118.2594                         | 2.4460                              | 29.3614                           | 36.5253                             |
| 18000.0879                    | 118.2488                         | 2.3952                              | 31.3222                           | 38.6063                             |
| 19000.0840                    | 118.2393                         | 2.3264                              | 33.2829                           | 40.6890                             |
| 20000.0801                    | 118.2308                         | 2.2444                              | 35.2436                           | 42.7734                             |
| 21000.0762                    | 118.2231                         | 2.1536                              | 37.2044                           | 44.8593                             |
| 22000.0723                    | 118.2161                         | 2.0578                              | 39.1651                           | 46.9465                             |
| 23000.0684                    | 118.2097                         | 1.9597                              | 41.1259                           | 49.0351                             |
| 24000.0664                    | 118.2038                         | 1.8619                              | 43.0866                           | 51.1248                             |
| 25000.0645                    | 118.1985                         | 1.7660                              | 45.0473                           | 53.2156                             |
| 26000.0605                    | 118.1935                         | 1.6733                              | 47.0081                           | 55.3074                             |
| 27000.0586                    | 118.1889                         | 1.5846                              | 48.9688                           | 57.4001                             |
| 28000.0566                    | 118.1846                         | 1.5005                              | 50.9295                           | 59.4937                             |
| 29000.0547                    | 118.1806                         | 1.4212                              | 52.8902                           | 61.5881                             |
| 30000.0527                    | 118.1769                         | 1.3467                              | 54.8510                           | 63.6832                             |
| 31000.0508                    | 118.1734                         | 1.2770                              | 56.8117                           | 65.7791                             |
| 32000.0488                    | 118.1701                         | 1.2118                              | 58.7724                           | 67.8755                             |
| 33000.0469                    | 118.1671                         | 1.1509                              | 60.7331                           | 69.9726                             |
| 34000.0469                    | 118.1642                         | 1.0942                              | 62.6938                           | 72.0702                             |
| 35000.0469                    | 118.1615                         | 1.0412                              | 64.6546                           | 74.1683                             |
| 36000.0430                    | 118.1589                         | 0.9918                              | 66.6153                           | 76.2669                             |
| 37000.0430                    | 118.1565                         | 0.9457                              | 68.5760                           | 78.3660                             |
| 38000.0430                    | 118.1542                         | 0.9025                              | 70.5367                           | 80.4654                             |
| 39000.0391                    | 118.1520                         | 0.8621                              | 72.4974                           | 82.5653                             |

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      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE 10
      VERSION 7.08 AT KSC
      0948 EDT 16 JUN 1998
      launch time: 2105 EST 07 NOV 1997
      RAWINSONDE ASCENT NUMBER      0, 0132  Z  8 NOV  97  T  -0.6 HR
*****

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----- MAXIMUM CENTERLINE CALCULATIONS -----

\*\* DECAY COEFFICIENT (1/SEC) = 0.00000E+00 \*\*

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS  
 DOWNWIND FROM A TITAN IV NORMAL LAUNCH  
 CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

| RANGE<br>FROM PAD<br>(METERS) | BEARING<br>FROM PAD<br>(DEGREES) | PEAK<br>CONCEN-<br>TRATION<br>(PPM) | CLOUD<br>ARRIVAL<br>TIME<br>(MIN) | CLOUD<br>DEPARTURE<br>TIME<br>(MIN) |
|-------------------------------|----------------------------------|-------------------------------------|-----------------------------------|-------------------------------------|
| 40000.0391                    | 118.1499                         | 0.8243                              | 74.4581                           | 84.6655                             |
| 41000.0391                    | 118.1479                         | 0.7888                              | 76.4189                           | 86.7661                             |
| 42000.0391                    | 118.1461                         | 0.7555                              | 78.3796                           | 88.8670                             |
| 43000.0352                    | 118.1443                         | 0.7242                              | 80.3403                           | 90.9682                             |
| 44000.0352                    | 118.1426                         | 0.6947                              | 82.3010                           | 93.0697                             |
| 45000.0352                    | 118.1409                         | 0.6670                              | 84.2617                           | 95.1714                             |
| 46000.0352                    | 118.1394                         | 0.6408                              | 86.2224                           | 97.2734                             |
| 47000.0352                    | 118.1379                         | 0.6162                              | 88.1831                           | 99.3757                             |
| 48000.0313                    | 118.1364                         | 0.5929                              | 90.1438                           | 101.4782                            |
| 49000.0313                    | 118.1350                         | 0.5709                              | 92.1046                           | 103.5808                            |
| 50000.0313                    | 118.1337                         | 0.5500                              | 94.0653                           | 105.6837                            |
| 51000.0313                    | 118.1325                         | 0.5302                              | 96.0260                           | 107.7868                            |
| 52000.0313                    | 118.1312                         | 0.5115                              | 97.9867                           | 109.8901                            |
| 53000.0313                    | 118.1301                         | 0.4937                              | 99.9474                           | 111.9935                            |
| 54000.0313                    | 118.1289                         | 0.4769                              | 101.9081                          | 114.0971                            |
| 55000.0273                    | 118.1278                         | 0.4608                              | 103.8688                          | 116.2009                            |
| 56000.0273                    | 118.1268                         | 0.4456                              | 105.8295                          | 118.3048                            |
| 57000.0273                    | 118.1258                         | 0.4310                              | 107.7902                          | 120.4088                            |
| 58000.0273                    | 118.1248                         | 0.4172                              | 109.7509                          | 122.5130                            |
| 59000.0273                    | 118.1239                         | 0.4040                              | 111.7117                          | 124.6173                            |
| 60000.0273                    | 118.1229                         | 0.3914                              | 113.6724                          | 126.7217                            |

|                                         | RANGE   | BEARING |
|-----------------------------------------|---------|---------|
| 2.473 IS THE MAXIMUM PEAK CONCENTRATION | 16000.1 | 118.3   |

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      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE 11
      VERSION 7.08 AT KSC
      0948 EDT 16 JUN 1998
      launch time: 2105 EST 07 NOV 1997
      RAWINSONDE ASCENT NUMBER      0, 0132  Z  8 NOV  97  T  -0.6 HR
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----- MAXIMUM CENTERLINE CALCULATIONS -----

\*\* DECAY COEFFICIENT (1/SEC) = 0.00000E+00 \*\*

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS  
 DOWNWIND FROM A TITAN IV NORMAL LAUNCH  
 CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

| 60.0 MIN.                     |                                  |                                     |                                   |                                     |
|-------------------------------|----------------------------------|-------------------------------------|-----------------------------------|-------------------------------------|
| RANGE<br>FROM PAD<br>(METERS) | BEARING<br>FROM PAD<br>(DEGREES) | MEAN<br>CONCEN-<br>TRATION<br>(PPM) | CLOUD<br>ARRIVAL<br>TIME<br>(MIN) | CLOUD<br>DEPARTURE<br>TIME<br>(MIN) |
| 6000.0771                     | 118.3600                         | 0.0030                              | 7.7304                            | 13.7964                             |
| 7000.0396                     | 118.2621                         | 0.0096                              | 9.7345                            | 15.8472                             |
| 8000.0835                     | 118.3311                         | 0.0190                              | 11.7138                           | 17.9017                             |
| 9000.0605                     | 118.2800                         | 0.0294                              | 13.6748                           | 19.9596                             |
| 10000.0439                    | 118.2392                         | 0.0393                              | 15.6357                           | 22.0207                             |
| 11000.1445                    | 118.3632                         | 0.0483                              | 17.5966                           | 24.0849                             |
| 12000.1328                    | 118.3387                         | 0.0561                              | 19.5574                           | 26.1521                             |
| 13000.1230                    | 118.3180                         | 0.0627                              | 21.5183                           | 28.2219                             |
| 14000.1143                    | 118.3002                         | 0.0681                              | 23.4791                           | 30.2944                             |
| 15000.1064                    | 118.2848                         | 0.0723                              | 25.4399                           | 32.3692                             |
| 16000.0996                    | 118.2713                         | 0.0754                              | 27.4006                           | 34.4462                             |
| 17000.0938                    | 118.2594                         | 0.0775                              | 29.3614                           | 36.5253                             |
| 18000.0879                    | 118.2488                         | 0.0786                              | 31.3222                           | 38.6063                             |
| 19000.0840                    | 118.2393                         | 0.0790                              | 33.2829                           | 40.6890                             |
| 20000.0801                    | 118.2308                         | 0.0788                              | 35.2436                           | 42.7734                             |
| 21000.0762                    | 118.2231                         | 0.0780                              | 37.2044                           | 44.8593                             |
| 22000.0723                    | 118.2161                         | 0.0769                              | 39.1651                           | 46.9465                             |
| 23000.0684                    | 118.2097                         | 0.0755                              | 41.1259                           | 49.0351                             |
| 24000.0664                    | 118.2038                         | 0.0739                              | 43.0866                           | 51.1248                             |
| 25000.0645                    | 118.1985                         | 0.0721                              | 45.0473                           | 53.2156                             |
| 26000.0605                    | 118.1935                         | 0.0703                              | 47.0081                           | 55.3074                             |
| 27000.0586                    | 118.1889                         | 0.0685                              | 48.9688                           | 57.4001                             |
| 28000.0566                    | 118.1846                         | 0.0666                              | 50.9295                           | 59.4937                             |
| 29000.0547                    | 118.1806                         | 0.0648                              | 52.8902                           | 61.5881                             |
| 30000.0527                    | 118.1769                         | 0.0631                              | 54.8510                           | 63.6832                             |
| 31000.0508                    | 118.1734                         | 0.0614                              | 56.8117                           | 65.7791                             |
| 32000.0488                    | 118.1701                         | 0.0598                              | 58.7724                           | 67.8755                             |
| 33000.0469                    | 118.1671                         | 0.0582                              | 60.7331                           | 69.9726                             |
| 34000.0469                    | 118.1642                         | 0.0567                              | 62.6938                           | 72.0702                             |
| 35000.0469                    | 118.1615                         | 0.0553                              | 64.6546                           | 74.1683                             |
| 36000.0430                    | 118.1589                         | 0.0539                              | 66.6153                           | 76.2669                             |
| 37000.0430                    | 118.1565                         | 0.0526                              | 68.5760                           | 78.3660                             |
| 38000.0430                    | 118.1542                         | 0.0514                              | 70.5367                           | 80.4654                             |
| 39000.0391                    | 118.1520                         | 0.0502                              | 72.4974                           | 82.5653                             |

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1*****
      ROCKET EXHAUST EFFLUENT DIFFUSION MODEL REEDM          PAGE 12
      VERSION 7.08 AT KSC
      0948 EDT 16 JUN 1998
      launch time: 2105 EST 07 NOV 1997
      RAWINSONDE ASCENT NUMBER      0, 0132  Z  8 NOV  97  T  -0.6 HR
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----- MAXIMUM CENTERLINE CALCULATIONS -----

\*\* DECAY COEFFICIENT (1/SEC) = 0.00000E+00 \*\*

CONCENTRATION OF HCL AT A HEIGHT OF 0.0 METERS  
 DOWNWIND FROM A TITAN IV NORMAL LAUNCH  
 CALCULATIONS APPLY TO THE LAYER BETWEEN 0.0 AND 1082.6 METERS

| RANGE<br>FROM PAD<br>(METERS) | BEARING<br>FROM PAD<br>(DEGREES) | 60.0 MIN.<br>MEAN<br>CONCENTRATION<br>(PPM) | CLOUD<br>ARRIVAL<br>TIME<br>(MIN) | CLOUD<br>DEPARTURE<br>TIME<br>(MIN) |
|-------------------------------|----------------------------------|---------------------------------------------|-----------------------------------|-------------------------------------|
|                               |                                  |                                             |                                   |                                     |
| 40000.0391                    | 118.1499                         | 0.0491                                      | 74.4581                           | 84.6655                             |
| 41000.0391                    | 118.1479                         | 0.0480                                      | 76.4189                           | 86.7661                             |
| 42000.0391                    | 118.1461                         | 0.0470                                      | 78.3796                           | 88.8670                             |
| 43000.0352                    | 118.1443                         | 0.0460                                      | 80.3403                           | 90.9682                             |
| 44000.0352                    | 118.1426                         | 0.0450                                      | 82.3010                           | 93.0697                             |
| 45000.0352                    | 118.1409                         | 0.0441                                      | 84.2617                           | 95.1714                             |
| 46000.0352                    | 118.1394                         | 0.0433                                      | 86.2224                           | 97.2734                             |
| 47000.0352                    | 118.1379                         | 0.0424                                      | 88.1831                           | 99.3757                             |
| 48000.0313                    | 118.1364                         | 0.0416                                      | 90.1438                           | 101.4782                            |
| 49000.0313                    | 118.1350                         | 0.0408                                      | 92.1046                           | 103.5808                            |
| 50000.0313                    | 118.1337                         | 0.0401                                      | 94.0653                           | 105.6837                            |
| 51000.0313                    | 118.1325                         | 0.0393                                      | 96.0260                           | 107.7868                            |
| 52000.0313                    | 118.1312                         | 0.0386                                      | 97.9867                           | 109.8901                            |
| 53000.0313                    | 118.1301                         | 0.0380                                      | 99.9474                           | 111.9935                            |
| 54000.0313                    | 118.1289                         | 0.0373                                      | 101.9081                          | 114.0971                            |
| 55000.0273                    | 118.1278                         | 0.0367                                      | 103.8688                          | 116.2009                            |
| 56000.0273                    | 118.1268                         | 0.0361                                      | 105.8295                          | 118.3048                            |
| 57000.0273                    | 118.1258                         | 0.0355                                      | 107.7902                          | 120.4088                            |
| 58000.0273                    | 118.1248                         | 0.0349                                      | 109.7509                          | 122.5130                            |
| 59000.0273                    | 118.1239                         | 0.0344                                      | 111.7117                          | 124.6173                            |
| 60000.0273                    | 118.1229                         | 0.0338                                      | 113.6724                          | 126.7217                            |

|                                                   | RANGE   | BEARING |
|---------------------------------------------------|---------|---------|
| 0.079 IS THE MAXIMUM 60.0 MIN. MEAN CONCENTRATION | 19000.1 | 118.2   |

\*\*\* REEDM HAS TERMINATED

## **Appendix B—Meteorological Data for Launch of Titan IVA-17**

This appendix contains three types of meteorological data recorded before and after the Titan IVA-17 launch at Cape Canaveral Air Station. The launch occurred at 2105 EST on 7 November 1997 (0205Z on 8 November 1997).

### **Rawinsonde Data**

This vertical meteorological data file was provided by a rawinsonde balloon released from CCAS at 0132Z (T-33 minutes).

### **915-MHz Radar Profiler Data**

These vertical meteorological data files were provided by five 915-MHz radar profilers located on and near CCAS. The data are 10-min averages of windspeed and direction that begin at 0150Z and end at 0215Z.

### **Meteorological Tower Data**

These data files were provided by a series of meteorological towers located on and adjacent to CCAS. The data are averaged over 5 min. The first entry is at 0205Z and the last entry is at 0215Z. Data are taken at the elevation (Z) above tower base, and includes wind direction (DIR), windspeed (SPD) in knots, temperature (T) in °F, and dewpoint (TD) in °F.

# Rawinsonde File

RS013120132

TEST NBR A0597 WS7

1500

RAWINSONDE MSS/MSS

CAPE CANAVERAL AFS, FLORIDA

0132Z 08 NOV 97

| ALT<br>GEOMFT | DIR<br>DEG | SPD<br>KTS | SHR<br>/SEC | TEMP<br>DEG C | DPT<br>DEG C | PRESS<br>MBS | RH<br>PCT | ABHUM<br>G/M3 | DENSITY<br>G/M3 | I/R<br>N | V/S<br>KTS | VPS<br>MBS | PW<br>MM |
|---------------|------------|------------|-------------|---------------|--------------|--------------|-----------|---------------|-----------------|----------|------------|------------|----------|
| 16            | 280        | 8.0        | .000        | 16.2          | 11.2         | 1011.20      | 72        | 9.95          | 1211.43         | 330      | 665        | 13.28      | 0        |
| 1000          | 299        | 17.8       | .018        | 14.0          | 10.5         | 976.13       | 79        | 9.58          | 1178.42         | 321      | 662        | 12.69      | 3        |
| 2000          | 300        | 15.8       | .003        | 11.3          | 10.1         | 941.46       | 92        | 9.41          | 1147.40         | 314      | 659        | 12.35      | 6        |
| 3000          | 299        | 14.0       | .003        | 9.0           | 8.0          | 907.71       | 94        | 8.27          | 1115.79         | 300      | 656        | 10.77      | 8        |
| 4000          | 292        | 14.9       | .003        | 8.7           | .9           | 874.96       | 61        | 5.20          | 1078.45         | 273      | 655        | 6.76       | 11       |
| 5000          | 285        | 18.4       | .007        | 9.6           | -5.3         | 843.44       | 35        | 3.16          | 1037.46         | 251      | 656        | 4.12       | 12       |
| 6000          | 277        | 22.4       | .008        | 8.5           | -6.5         | 813.01       | 34        | 2.89          | 1003.90         | 242      | 655        | 3.75       | 13       |
| 7000          | 270        | 26.3       | .008        | 7.9           | -7.6         | 783.58       | 32        | 2.65          | 969.69          | 233      | 654        | 3.44       | 13       |
| 8000          | 267        | 30.1       | .007        | 6.7           | -8.8         | 755.15       | 32        | 2.44          | 938.53          | 224      | 653        | 3.15       | 14       |
| 9000          | 267        | 34.0       | .007        | 5.3           | -10.2        | 727.63       | 32        | 2.19          | 909.09          | 216      | 651        | 2.82       | 15       |
| 10000         | 265        | 39.1       | .009        | 4.1           | -11.4        | 700.97       | 31        | 2.00          | 879.74          | 209      | 649        | 2.56       | 16       |
| 11000         | 262        | 43.8       | .009        | 4.6           | -11.5        | 675.24       | 30        | 1.97          | 845.77          | 201      | 650        | 2.53       | 16       |
| 12000         | 259        | 45.3       | .004        | 2.1           | -12.8        | 650.40       | 32        | 1.80          | 821.98          | 195      | 647        | 2.28       | 17       |
| 13000         | 259        | 45.2       | .001        | -.2           | -14.8        | 626.26       | 32        | 1.54          | 798.31          | 188      | 644        | 1.94       | 17       |
| 14000         | 259        | 45.2       | .001        | -2.8          | -16.9        | 602.82       | 33        | 1.31          | 775.87          | 181      | 641        | 1.63       | 18       |
| 15000         | 260        | 46.2       | .002        | -5.5          | -19.2        | 580.02       | 33        | 1.08          | 754.29          | 175      | 638        | 1.34       | 18       |
| 16000         | 261        | 48.1       | .003        | -8.1          | -21.1        | 557.89       | 34        | .92           | 732.68          | 169      | 635        | 1.13       | 18       |
| 17000         | 261        | 49.9       | .003        | -10.5         | -22.8        | 536.39       | 36        | .80           | 711.05          | 164      | 632        | .98        | 19       |
| 18000         | 262        | 51.2       | .003        | -13.2         | -25.0        | 515.52       | 36        | .67           | 690.59          | 158      | 629        | .80        | 19       |
| 19000         | 263        | 52.3       | .002        | -15.7         | -27.2        | 495.27       | 36        | .55           | 669.87          | 153      | 626        | .66        | 19       |
| 20000         | 264        | 53.5       | .003        | -18.5         | -29.0        | 475.62       | 39        | .47           | 650.33          | 148      | 622        | .55        | 19       |
| 21000         | 264        | 54.9       | .003        | -21.2         | -30.9        | 456.55       | 41        | .40           | 630.99          | 143      | 619        | .46        | 19       |
| 22000         | 264        | 56.4       | .003        | -23.6         | -33.4        | 438.05       | 40        | .32           | 611.47          | 138      | 616        | .36        | 19       |
| 23000         | 264        | 58.0       | .003        | -26.3         | -35.4        | 420.14       | 41        | .26           | 592.68          | 134      | 613        | .29        | 19       |
| 24000         | 264        | 60.1       | .004        | -28.9         | -37.7        | 402.77       | 42        | .21           | 574.44          | 129      | 609        | .23        | 19       |
| 25000         | 265        | 63.3       | .005        | -31.0         | -40.0        | 385.96       | 40        | .16           | 555.12          | 125      | 607        | .18        | 20       |
| 26000         | 266        | 67.9       | .008        | -31.4         | -41.6        | 369.77       | 36        | .14           | 532.88          | 120      | 606        | .16        | 20       |
| 27000         | 267        | 74.2       | .011        | -32.8         | -42.8        | 354.21       | 36        | .12           | 513.32          | 115      | 604        | .14        | 20       |
| 28000         | 268        | 81.7       | .013        | -33.3         | -43.5        | 339.24       | 35        | .11           | 492.68          | 111      | 604        | .13        | 20       |
| 29000         | 270        | 87.3       | .010        | -34.4         | -44.4        | 324.86       | 35        | .10           | 473.93          | 106      | 602        | .12        | 20       |
| 30000         | 272        | 90.7       | .007        | -35.3         | -45.2        | 311.05       | 35        | .10           | 455.58          | 102      | 601        | .11        | 20       |
| 31000         | 999        | 999.0      | .999        | -36.5         | -46.3        | 297.76       | 35        | .09           | 438.20          | 98       | 600        | .09        | 20       |
| 32000         | 999        | 999.0      | .999        | -38.9         | -48.9        | 284.94       | 33        | .06           | 423.71          | 95       | 597        | .07        | 20       |
| TERMINATION   |            | 32304      | GEOPFT      | 9846          | GEOPM        | 279.9        | MBS       |               |                 |          |            |            |          |
| TROPOPAUSE    |            | 0          | FEET        | .00           | MB           | .0           | C         | .0            | C               |          |            |            |          |

## MANDATORY LEVELS

| GEOPFT | DIR | KTS | TEMP | DPT  | PRESS  | RH |
|--------|-----|-----|------|------|--------|----|
| 327    | 295 | 19  | 15.7 | 10.8 | 1000.0 | 73 |
| 1749   | 300 | 16  | 11.9 | 10.5 | 950.0  | 91 |
| 3227   | 298 | 14  | 8.5  | 7.7  | 900.0  | 95 |
| 4781   | 286 | 18  | 10.0 | -5.0 | 850.0  | 34 |
| 6426   | 274 | 24  | 8.1  | -7.1 | 800.0  | 33 |
| 8170   | 267 | 31  | 6.5  | -9.1 | 750.0  | 32 |

|       |     |    |       |       |       |    |
|-------|-----|----|-------|-------|-------|----|
| 10018 | 265 | 39 | 4.0   | -11.4 | 700.0 | 31 |
| 11992 | 259 | 45 | 2.1   | -12.9 | 650.0 | 32 |
| 14092 | 259 | 45 | -3.1  | -17.1 | 600.0 | 33 |
| 16327 | 261 | 49 | -8.9  | -21.7 | 550.0 | 34 |
| 18720 | 263 | 52 | -15.1 | -26.7 | 500.0 | 36 |
| 21298 | 264 | 55 | -22.1 | -31.8 | 450.0 | 41 |
| 24100 | 264 | 61 | -29.3 | -38.1 | 400.0 | 42 |
| 27203 | 267 | 76 | -33.2 | -43.1 | 350.0 | 36 |
| 30739 | 272 | 92 | -36.3 | -46.0 | 300.0 | 35 |

SIGNIFICANT LEVELS

| GEOMFT | DIR | KTS | TEMP | DPT | PRESS | IR | RH |
|--------|-----|-----|------|-----|-------|----|----|
|--------|-----|-----|------|-----|-------|----|----|

|       |     |     |       |       |        |     |    |
|-------|-----|-----|-------|-------|--------|-----|----|
| 16    | 280 | 8   | 16.2  | 11.2  | 1011.2 | 330 | 72 |
| 229   | 294 | 20  | 16.0  | 11.0  | 1003.5 | 328 | 72 |
| 1271  | 299 | 17  | 13.3  | 10.5  | 966.7  | 320 | 83 |
| 1802  | 300 | 16  | 11.8  | 10.5  | 948.3  | 317 | 92 |
| 2337  | 301 | 15  | 10.4  | 9.4   | 930.0  | 309 | 93 |
| 2947  | 299 | 14  | 9.1   | 8.1   | 909.5  | 301 | 94 |
| 3568  | 296 | 14  | 7.8   | 7.2   | 889.0  | 294 | 96 |
| 4162  | 291 | 15  | 9.0   | -1.5  | 869.8  | 265 | 48 |
| 4772  | 287 | 17  | 10.0  | -5.0  | 850.5  | 253 | 34 |
| 9109  | 267 | 35  | 5.1   | -10.3 | 724.7  | 216 | 32 |
| 11004 | 262 | 44  | 4.6   | -11.5 | 675.1  | 201 | 30 |
| 21121 | 264 | 55  | -21.5 | -31.2 | 454.3  | 143 | 41 |
| 23185 | 264 | 58  | -26.8 | -35.9 | 416.9  | 133 | 42 |
| 24503 | 264 | 61  | -30.2 | -38.9 | 394.3  | 127 | 42 |
| 30979 | 272 | 93  | -36.4 | -46.2 | 298.0  | 98  | 35 |
| 31737 | 999 | 999 | -38.3 | -48.4 | 288.3  | 96  | 33 |
| 32401 | 999 | 999 | -39.8 | -49.7 | 279.9  | 94  | 33 |

TERMINATION

040 040

NNNN

# 915 Mhz Radar Files

DATE: 11/08/1997 SITE NAME: RWP0001  
 LATITUDE: 28.44 LONGITUDE: -80.58 ELEVATION: 10 ft  
 AZIMUTH 1: 174 AZIMUTH 2: 84  
 NYQUIST: 19.6 kts

| CTIMEZ | BTIMEZ | NM  | HGT     | WS    | WD   | RV1   | NS1 | SNR1 | RV2   | NS2 | SNR2 | VV    | NSV | NMN | SNRV |
|--------|--------|-----|---------|-------|------|-------|-----|------|-------|-----|------|-------|-----|-----|------|
| hhmmss | hhmmss | min | ft      | kts   | deg  | kts   | #   | db   | kts   | #   | db   | kts   | #   | #   | db   |
| 020050 | 015024 | 10  | 383.4   | 999.9 | 9999 | -5.5  | 4   | 3    | -4.3  | 5   | 14   | 0.1   | 7   | 5   | 12   |
| 020050 | 015024 | 10  | 699.1   | 999.9 | 9999 | -4.9  | 4   | 7    | -3.9  | 5   | 19   | -0.1  | 7   | 5   | 13   |
| 020050 | 015024 | 10  | 1014.8  | 999.9 | 9999 | -6.4  | 4   | 5    | -3.4  | 6   | 35   | 0.3   | 7   | 5   | 14   |
| 020050 | 015024 | 10  | 1330.5  | 999.9 | 9999 | -6.0  | 3   | 5    | -2.6  | 5   | 38   | -1.0  | 7   | 5   | 18   |
| 020050 | 015024 | 10  | 1646.3  | 999.9 | 9999 | -5.0  | 3   | 3    | -2.5  | 6   | 22   | -0.2  | 7   | 5   | 30   |
| 020050 | 015024 | 10  | 1962.0  | 14.6  | 316  | -4.8  | 8   | 6    | -3.7  | 6   | 16   | -0.2  | 7   | 5   | 26   |
| 020050 | 015024 | 10  | 2277.7  | 999.9 | 9999 | -4.8  | 5   | 4    | -3.9  | 4   | 30   | -0.2  | 7   | 5   | 16   |
| 020050 | 015024 | 10  | 2593.4  | 999.9 | 9999 | -5.6  | 4   | 0    | 2.5   | 2   | 7    | 0.0   | 5   | 5   | -6   |
| 020050 | 015024 | 10  | 2909.1  | 999.9 | 9999 | -7.8  | 3   | -5   | 9.2   | 3   | 7    | 0.0   | 7   | 5   | -7   |
| 020050 | 015024 | 10  | 3224.9  | 999.9 | 9999 | -2.3  | 6   | -9   | 10.2  | 3   | 10   | 0.0   | 8   | 5   | -3   |
| 020050 | 015024 | 10  | 3540.6  | 8.2   | 289  | -1.2  | 8   | 0    | -2.8  | 6   | -7   | 0.0   | 8   | 5   | 0    |
| 020050 | 015024 | 10  | 3856.3  | 9.3   | 281  | -1.0  | 8   | -4   | -3.4  | 6   | -5   | 0.0   | 8   | 5   | -5   |
| 020050 | 015024 | 10  | 4172.0  | 999.9 | 9999 | -2.0  | 8   | -7   | -4.1  | 4   | -9   | 14.7  | 3   | 5   | -17  |
| 020050 | 015024 | 10  | 4487.7  | 999.9 | 9999 | -3.1  | 8   | -12  | -4.7  | 3   | -17  | -0.8  | 3   | 5   | -18  |
| 020050 | 015024 | 10  | 4803.5  | 20.0  | 274  | -1.2  | 5   | -17  | -7.6  | 5   | -19  | 1.1   | 4   | 5   | -12  |
| 020050 | 015024 | 10  | 5119.2  | 12.8  | 291  | -2.2  | 5   | -18  | -4.4  | 5   | -17  | -16.6 | 2   | 5   | -18  |
| 020050 | 015024 | 10  | 5434.9  | 999.9 | 9999 | 2.8   | 4   | -17  | 10.4  | 4   | -18  | -3.5  | 3   | 5   | -4   |
| 020050 | 015024 | 10  | 5750.6  | 999.9 | 9999 | 4.1   | 4   | -17  | 12.4  | 3   | -9   | -17.7 | 3   | 5   | -19  |
| 020050 | 015024 | 10  | 6066.3  | 999.9 | 9999 | 2.8   | 3   | -20  | 16.7  | 4   | -20  | 5.0   | 2   | 5   | -19  |
| 020050 | 015024 | 10  | 6382.1  | 999.9 | 9999 | 3.4   | 3   | -16  | -6.1  | 2   | -18  | -11.8 | 4   | 5   | -17  |
| 020050 | 015024 | 10  | 6697.8  | 999.9 | 9999 | 6.8   | 4   | -17  | -10.7 | 2   | -14  | 18.6  | 4   | 5   | -20  |
| 020050 | 015024 | 10  | 7013.5  | 999.9 | 9999 | -0.4  | 3   | 7    | 10.0  | 2   | -18  | 10.2  | 3   | 5   | -18  |
| 020050 | 015024 | 10  | 7329.2  | 999.9 | 9999 | 11.9  | 3   | -19  | 14.3  | 3   | -18  | -4.9  | 3   | 5   | -19  |
| 020050 | 015024 | 10  | 7644.9  | 999.9 | 9999 | -2.6  | 2   | -18  | 4.2   | 2   | -18  | -11.9 | 2   | 5   | -19  |
| 020050 | 015024 | 10  | 7960.7  | 999.9 | 9999 | -2.0  | 4   | -20  | 4.1   | 3   | -15  | 13.8  | 3   | 5   | -19  |
| 020050 | 015024 | 10  | 8276.4  | 999.9 | 9999 | 3.3   | 2   | -12  | -17.3 | 2   | -17  | -17.0 | 4   | 5   | -15  |
| 020050 | 015024 | 10  | 8592.1  | 999.9 | 9999 | -4.9  | 3   | -20  | 6.4   | 3   | -18  | 5.0   | 3   | 5   | -17  |
| 020050 | 015024 | 10  | 8907.8  | 999.9 | 9999 | 11.2  | 3   | -14  | 14.1  | 3   | -19  | 6.2   | 3   | 5   | -19  |
| 020050 | 015024 | 10  | 9223.5  | 999.9 | 9999 | 16.6  | 3   | -18  | 16.0  | 2   | -18  | -13.7 | 3   | 5   | -17  |
| 020050 | 015024 | 10  | 9539.3  | 999.9 | 9999 | -7.2  | 2   | -18  | 11.8  | 2   | -17  | 6.7   | 3   | 5   | -16  |
| 020050 | 015024 | 10  | 9855.0  | 999.9 | 9999 | -17.5 | 3   | -19  | -1.3  | 2   | -20  | -6.4  | 3   | 5   | -16  |
| 020050 | 015024 | 10  | 10170.7 | 999.9 | 9999 | -16.3 | 4   | -16  | 10.0  | 3   | -15  | 11.5  | 3   | 5   | -17  |
|        |        |     |         |       |      |       |     |      |       |     |      |       |     |     |      |
| 021534 | 020528 | 9   | 383.4   | 999.9 | 9999 | -7.1  | 2   | 6    | -3.3  | 3   | 32   | 0.1   | 7   | 5   | 30   |
| 021534 | 020528 | 9   | 699.1   | 999.9 | 9999 | -12.4 | 3   | 16   | -4.0  | 4   | 35   | 0.1   | 7   | 5   | 32   |
| 021534 | 020528 | 9   | 1014.8  | 999.9 | 9999 | -17.0 | 3   | 22   | 4.3   | 3   | 30   | 0.2   | 7   | 5   | 25   |
| 021534 | 020528 | 9   | 1330.5  | 999.9 | 9999 | -14.0 | 4   | 23   | -4.3  | 3   | 29   | 0.0   | 7   | 5   | 34   |
| 021534 | 020528 | 9   | 1646.3  | 999.9 | 9999 | 0.0   | 2   | 13   | -5.7  | 3   | 29   | 0.0   | 6   | 5   | 26   |
| 021534 | 020528 | 9   | 1962.0  | 999.9 | 9999 | -4.7  | 4   | 7    | 8.9   | 2   | 19   | -0.4  | 6   | 5   | 22   |
| 021534 | 020528 | 9   | 2277.7  | 999.9 | 9999 | -5.3  | 3   | 6    | 7.5   | 2   | 13   | -0.9  | 5   | 5   | 14   |
| 021534 | 020528 | 9   | 2593.4  | 999.9 | 9999 | -6.3  | 3   | 23   | -0.7  | 2   | 14   | 0.6   | 6   | 5   | -1   |
| 021534 | 020528 | 9   | 2909.1  | 999.9 | 9999 | -4.7  | 2   | -5   | -1.5  | 3   | 5    | 0.2   | 8   | 5   | -12  |
| 021534 | 020528 | 9   | 3224.9  | 999.9 | 9999 | -0.9  | 4   | -11  | -1.3  | 3   | -11  | 0.0   | 8   | 5   | 3    |
| 021534 | 020528 | 9   | 3540.6  | 7.2   | 277  | -0.5  | 7   | -1   | -2.6  | 7   | 1    | 0.0   | 8   | 5   | 8    |
| 021534 | 020528 | 9   | 3856.3  | 10.3  | 282  | -1.0  | 7   | 2    | -3.5  | 6   | 3    | 0.2   | 8   | 5   | 8    |
| 021534 | 020528 | 9   | 4172.0  | 999.9 | 9999 | -2.6  | 7   | 0    | -3.8  | 4   | -1   | 0.3   | 8   | 5   | -4   |
| 021534 | 020528 | 9   | 4487.7  | 999.9 | 9999 | -3.0  | 6   | -7   | -4.5  | 4   | -10  | 0.4   | 3   | 5   | 31   |

|        |        |   |         |       |      |       |   |     |       |   |     |       |   |   |     |
|--------|--------|---|---------|-------|------|-------|---|-----|-------|---|-----|-------|---|---|-----|
| 021534 | 020528 | 9 | 4803.5  | 17.9  | 283  | -2.0  | 6 | 0   | -6.3  | 5 | -13 | 0.2   | 5 | 5 | 31  |
| 021534 | 020528 | 9 | 5119.2  | 17.7  | 297  | -3.5  | 5 | -7  | -5.4  | 6 | -11 | 0.3   | 6 | 5 | 14  |
| 021534 | 020528 | 9 | 5434.9  | 999.9 | 9999 | -3.2  | 4 | -15 | -6.8  | 5 | -13 | -5.4  | 2 | 5 | -20 |
| 021534 | 020528 | 9 | 5750.6  | 999.9 | 9999 | 17.4  | 3 | -16 | 16.5  | 3 | -12 | -1.3  | 3 | 5 | 18  |
| 021534 | 020528 | 9 | 6066.3  | 999.9 | 9999 | -11.3 | 3 | -12 | 12.7  | 3 | -12 | -12.2 | 2 | 5 | -16 |
| 021534 | 020528 | 9 | 6382.1  | 999.9 | 9999 | 17.8  | 3 | -17 | 14.9  | 2 | -19 | -1.7  | 3 | 5 | -7  |
| 021534 | 020528 | 9 | 6697.8  | 999.9 | 9999 | -12.4 | 2 | -11 | -6.6  | 3 | -19 | 11.8  | 4 | 5 | -6  |
| 021534 | 020528 | 9 | 7013.5  | 999.9 | 9999 | 15.1  | 2 | -18 | 18.3  | 2 | -16 | 10.7  | 2 | 5 | -14 |
| 021534 | 020528 | 9 | 7329.2  | 999.9 | 9999 | -10.0 | 2 | -18 | -9.3  | 3 | -17 | 11.1  | 3 | 5 | -18 |
| 021534 | 020528 | 9 | 7644.9  | 999.9 | 9999 | -13.5 | 2 | -20 | -13.4 | 2 | -20 | -15.4 | 2 | 5 | -19 |
| 021534 | 020528 | 9 | 7960.7  | 999.9 | 9999 | 4.8   | 3 | -19 | -18.3 | 3 | -17 | 15.7  | 3 | 5 | -19 |
| 021534 | 020528 | 9 | 8276.4  | 999.9 | 9999 | -11.8 | 2 | -18 | 8.2   | 4 | -18 | -18.3 | 3 | 5 | -19 |
| 021534 | 020528 | 9 | 8592.1  | 999.9 | 9999 | -9.2  | 2 | -18 | 4.7   | 2 | -15 | 12.6  | 3 | 5 | -17 |
| 021534 | 020528 | 9 | 8907.8  | 999.9 | 9999 | -17.3 | 2 | -18 | -3.0  | 2 | -18 | 13.4  | 3 | 5 | -17 |
| 021534 | 020528 | 9 | 9223.5  | 999.9 | 9999 | 11.4  | 3 | -15 | 10.8  | 2 | -18 | 5.9   | 4 | 5 | -18 |
| 021534 | 020528 | 9 | 9539.3  | 999.9 | 9999 | -9.6  | 2 | -2  | 10.3  | 3 | -19 | 6.6   | 3 | 5 | -16 |
| 021534 | 020528 | 9 | 9855.0  | 999.9 | 9999 | 1.9   | 3 | -19 | -8.1  | 2 | -18 | 2.1   | 3 | 5 | -19 |
| 021534 | 020528 | 9 | 10170.7 | 999.9 | 9999 | 16.3  | 3 | -18 | -17.2 | 2 | -18 | -11.7 | 2 | 5 | -17 |

DATE: 11/08/1997 SITE NAME: RWP0002  
 LATITUDE: 28.60 LONGITUDE: -80.59 ELEVATION: 10 ft  
 AZIMUTH 1: 2 AZIMUTH 2: 272  
 NYQUIST: 19.6 kts

| CTIMEZ | BTIMEZ | NM  | HGT    | WS    | WD   | RV1   | NS1 | SNR1 | RV2   | NS2 | SNR2 | VV    | NSV | NMN | SNR1 |
|--------|--------|-----|--------|-------|------|-------|-----|------|-------|-----|------|-------|-----|-----|------|
| hhmmss | hhmmss | min | ft     | kts   | deg  | kts   | #   | db   | kts   | #   | db   | kts   | #   | #   | db   |
| 020013 | 015017 | 9   | 383.4  | 999.9 | 9999 | 4.6   | 5   | 7    | 8.7   | 4   | 23   | 0.1   | 7   | 5   | 27   |
| 020013 | 015017 | 9   | 699.1  | 999.9 | 9999 | 4.8   | 4   | 8    | 6.0   | 3   | 21   | -0.2  | 7   | 5   | 36   |
| 020013 | 015017 | 9   | 1014.8 | 999.9 | 9999 | 4.7   | 6   | 7    | 12.9  | 2   | 15   | 0.0   | 7   | 5   | 23   |
| 020013 | 015017 | 9   | 1330.5 | 999.9 | 9999 | 5.1   | 7   | 13   | 9.4   | 4   | 22   | 0.4   | 7   | 5   | 32   |
| 020013 | 015017 | 9   | 1646.3 | 999.9 | 9999 | 3.3   | 3   | 9    | 10.7  | 4   | 20   | 0.9   | 7   | 5   | 26   |
| 020013 | 015017 | 9   | 1962.0 | 999.9 | 9999 | 1.4   | 7   | 12   | 11.8  | 4   | 17   | -0.8  | 6   | 5   | 32   |
| 020013 | 015017 | 9   | 2277.7 | 999.9 | 9999 | 0.8   | 6   | 1    | 1.0   | 4   | 0    | -0.1  | 8   | 5   | 18   |
| 020013 | 015017 | 9   | 2593.4 | 3.1   | 338  | 0.7   | 7   | -7   | 0.1   | 5   | 12   | -0.3  | 8   | 5   | 0    |
| 020013 | 015017 | 9   | 2909.1 | 3.1   | 188  | -1.0  | 6   | -11  | 0.3   | 5   | 2    | 0.1   | 7   | 5   | -7   |
| 020013 | 015017 | 9   | 3224.9 | 999.9 | 9999 | 0.0   | 5   | -10  | 3.8   | 2   | -14  | -0.3  | 8   | 5   | -12  |
| 020013 | 015017 | 9   | 3540.6 | 999.9 | 9999 | -0.5  | 5   | -13  | 3.0   | 4   | -14  | -0.1  | 8   | 5   | -1   |
| 020013 | 015017 | 9   | 3856.3 | 5.4   | 283  | 0.3   | 7   | -5   | 2.0   | 7   | -7   | 0.0   | 8   | 5   | 1    |
| 020013 | 015017 | 9   | 4172.0 | 8.7   | 293  | 1.0   | 7   | 3    | 2.9   | 7   | -2   | -0.2  | 8   | 5   | -5   |
| 020013 | 015017 | 9   | 4487.7 | 8.6   | 296  | 1.6   | 7   | -1   | 3.3   | 7   | -4   | 0.3   | 5   | 5   | -13  |
| 020013 | 015017 | 9   | 4803.5 | 12.2  | 303  | 2.5   | 7   | -12  | 4.1   | 7   | -5   | -12.8 | 2   | 5   | -12  |
| 020013 | 015017 | 9   | 5119.2 | 999.9 | 9999 | 2.7   | 4   | -16  | 5.4   | 4   | -17  | -0.9  | 3   | 5   | -15  |
| 020013 | 015017 | 9   | 5434.9 | 999.9 | 9999 | 2.9   | 5   | -16  | -4.5  | 3   | -19  | -10.2 | 2   | 5   | -20  |
| 020013 | 015017 | 9   | 5750.6 | 999.9 | 9999 | 11.5  | 2   | -15  | -17.4 | 2   | -19  | 10.8  | 3   | 5   | -17  |
| 020013 | 015017 | 9   | 6066.3 | 999.9 | 9999 | 17.7  | 3   | -11  | 3.5   | 2   | -19  | -3.6  | 3   | 5   | -20  |
| 020013 | 015017 | 9   | 6382.1 | 999.9 | 9999 | -3.3  | 2   | -18  | -8.4  | 3   | -16  | 7.6   | 3   | 5   | -17  |
| 020013 | 015017 | 9   | 6697.8 | 999.9 | 9999 | 19.3  | 2   | -18  | 14.6  | 3   | -15  | -1.3  | 3   | 5   | -17  |
| 020013 | 015017 | 9   | 7013.5 | 999.9 | 9999 | 2.2   | 2   | -19  | -2.6  | 2   | -20  | -5.5  | 2   | 5   | -18  |
| 020013 | 015017 | 9   | 7329.2 | 999.9 | 9999 | -9.9  | 4   | -18  | 11.9  | 3   | -18  | -10.0 | 3   | 5   | -17  |
| 020013 | 015017 | 9   | 7644.9 | 999.9 | 9999 | -14.3 | 3   | -17  | 11.8  | 2   | -15  | 7.7   | 3   | 5   | -18  |
| 020013 | 015017 | 9   | 7960.7 | 999.9 | 9999 | -14.6 | 2   | -16  | 7.3   | 2   | -16  | -5.8  | 2   | 5   | -15  |
| 020013 | 015017 | 9   | 8276.4 | 999.9 | 9999 | 6.7   | 3   | -19  | 3.2   | 3   | -17  | 13.5  | 2   | 5   | -16  |
| 020013 | 015017 | 9   | 8592.1 | 999.9 | 9999 | 13.7  | 2   | -16  | -10.2 | 3   | -18  | -16.8 | 3   | 5   | -20  |
| 020013 | 015017 | 9   | 8907.8 | 999.9 | 9999 | 16.2  | 3   | -18  | -13.2 | 3   | -18  | 10.2  | 3   | 5   | -18  |
| 020013 | 015017 | 9   | 9223.5 | 999.9 | 9999 | 4.7   | 3   | -18  | -0.2  | 2   | -20  | -14.6 | 4   | 5   | -20  |

|        |        |   |         |       |      |       |   |     |       |   |     |       |   |   |     |
|--------|--------|---|---------|-------|------|-------|---|-----|-------|---|-----|-------|---|---|-----|
| 020013 | 015017 | 9 | 9539.3  | 999.9 | 9999 | -5.3  | 3 | -18 | 7.4   | 3 | -19 | 2.9   | 3 | 5 | -21 |
| 020013 | 015017 | 9 | 9855.0  | 999.9 | 9999 | 0.1   | 2 | -20 | -11.4 | 3 | -19 | 4.5   | 3 | 5 | -19 |
| 020013 | 015017 | 9 | 10170.7 | 999.9 | 9999 | 4.5   | 2 | -17 | -4.4  | 2 | -19 | -8.2  | 3 | 5 | -18 |
| 021524 | 020520 | 9 | 383.4   | 999.9 | 9999 | 4.1   | 6 | 11  | 4.7   | 4 | 26  | -0.2  | 7 | 5 | 8   |
| 021524 | 020520 | 9 | 699.1   | 999.9 | 9999 | 4.3   | 5 | 17  | 4.9   | 3 | 27  | 0.1   | 5 | 5 | 4   |
| 021524 | 020520 | 9 | 1014.8  | 999.9 | 9999 | 4.1   | 7 | 15  | 4.2   | 3 | 8   | 0.0   | 8 | 5 | 11  |
| 021524 | 020520 | 9 | 1330.5  | 999.9 | 9999 | 4.8   | 6 | 21  | 6.1   | 3 | 20  | 0.6   | 7 | 5 | 8   |
| 021524 | 020520 | 9 | 1646.3  | 999.9 | 9999 | 5.2   | 5 | 21  | 10.2  | 3 | 18  | 0.1   | 6 | 5 | 7   |
| 021524 | 020520 | 9 | 1962.0  | 999.9 | 9999 | 4.6   | 4 | 4   | 4.5   | 2 | 22  | 0.7   | 7 | 5 | -1  |
| 021524 | 020520 | 9 | 2277.7  | 999.9 | 9999 | 2.4   | 5 | -9  | 14.4  | 3 | 8   | 0.0   | 8 | 5 | -6  |
| 021524 | 020520 | 9 | 2593.4  | 999.9 | 9999 | 1.1   | 7 | -11 | 7.7   | 4 | -7  | 0.0   | 8 | 5 | -7  |
| 021524 | 020520 | 9 | 2909.1  | 999.9 | 9999 | 0.6   | 7 | -10 | 6.3   | 4 | -11 | 0.2   | 7 | 5 | -13 |
| 021524 | 020520 | 9 | 3224.9  | 999.9 | 9999 | -0.3  | 4 | -13 | 6.2   | 4 | -18 | -0.1  | 7 | 5 | -15 |
| 021524 | 020520 | 9 | 3540.6  | 999.9 | 9999 | 1.4   | 6 | -16 | 1.9   | 2 | -20 | 0.0   | 8 | 5 | -4  |
| 021524 | 020520 | 9 | 3856.3  | 7.2   | 289  | 0.8   | 8 | -2  | 2.6   | 7 | -5  | 0.0   | 8 | 5 | -1  |
| 021524 | 020520 | 9 | 4172.0  | 9.7   | 290  | 1.1   | 8 | 1   | 3.6   | 7 | -4  | 0.0   | 8 | 5 | -9  |
| 021524 | 020520 | 9 | 4487.7  | 11.5  | 295  | 1.8   | 8 | -6  | 4.1   | 7 | -11 | 4.1   | 3 | 5 | -19 |
| 021524 | 020520 | 9 | 4803.5  | 999.9 | 9999 | 3.5   | 4 | -19 | 4.3   | 2 | -15 | 3.1   | 3 | 5 | -18 |
| 021524 | 020520 | 9 | 5119.2  | 999.9 | 9999 | -7.8  | 3 | -17 | 5.4   | 4 | -19 | -15.1 | 3 | 5 | -18 |
| 021524 | 020520 | 9 | 5434.9  | 999.9 | 9999 | -4.7  | 3 | -18 | 7.8   | 3 | -18 | 2.7   | 2 | 5 | -18 |
| 021524 | 020520 | 9 | 5750.6  | 999.9 | 9999 | -14.7 | 3 | -18 | 6.0   | 3 | -7  | 8.6   | 3 | 5 | -19 |
| 021524 | 020520 | 9 | 6066.3  | 999.9 | 9999 | 10.9  | 3 | -18 | 5.8   | 2 | -5  | -19.3 | 2 | 5 | -18 |
| 021524 | 020520 | 9 | 6382.1  | 999.9 | 9999 | -7.5  | 2 | -16 | 3.2   | 2 | -18 | -7.7  | 2 | 5 | -17 |
| 021524 | 020520 | 9 | 6697.8  | 999.9 | 9999 | 4.2   | 2 | -18 | -10.7 | 3 | -19 | -12.3 | 6 | 5 | -18 |
| 021524 | 020520 | 9 | 7013.5  | 999.9 | 9999 | 2.4   | 3 | 3   | 6.4   | 3 | -19 | -5.2  | 3 | 5 | -18 |
| 021524 | 020520 | 9 | 7329.2  | 999.9 | 9999 | 3.4   | 3 | 2   | -15.8 | 2 | -21 | -2.2  | 2 | 5 | -16 |
| 021524 | 020520 | 9 | 7644.9  | 999.9 | 9999 | -3.0  | 3 | -18 | -4.5  | 2 | -17 | 11.7  | 3 | 5 | -17 |
| 021524 | 020520 | 9 | 7960.7  | 999.9 | 9999 | -3.7  | 2 | -20 | 8.1   | 4 | -18 | -2.9  | 3 | 5 | -18 |
| 021524 | 020520 | 9 | 8276.4  | 999.9 | 9999 | -8.3  | 3 | -18 | 17.3  | 2 | -18 | 14.5  | 4 | 5 | -18 |
| 021524 | 020520 | 9 | 8592.1  | 999.9 | 9999 | -4.9  | 2 | -19 | 2.0   | 3 | -20 | -10.2 | 2 | 5 | -18 |
| 021524 | 020520 | 9 | 8907.8  | 999.9 | 9999 | -13.3 | 3 | -19 | 14.2  | 3 | -19 | 2.9   | 3 | 5 | -16 |
| 021524 | 020520 | 9 | 9223.5  | 999.9 | 9999 | 13.9  | 2 | -18 | 15.4  | 3 | -21 | 8.0   | 3 | 5 | -17 |
| 021524 | 020520 | 9 | 9539.3  | 999.9 | 9999 | 2.5   | 3 | -19 | 9.2   | 2 | -18 | -3.8  | 3 | 5 | -16 |
| 021524 | 020520 | 9 | 9855.0  | 999.9 | 9999 | -10.1 | 3 | -17 | -9.7  | 2 | -18 | 6.9   | 3 | 5 | -18 |
| 021524 | 020520 | 9 | 10170.7 | 999.9 | 9999 | 16.4  | 3 | -19 | 18.2  | 2 | -16 | 0.3   | 3 | 5 | -19 |

DATE: 11/08/1997 SITE NAME: RWP0003

LATITUDE: 28.56 LONGITUDE: -80.66 ELEVATION: 10 ft

AZIMUTH 1: 287 AZIMUTH 2: 17

NYQUIST: 19.6 kts

| CTIMEZ | BTIMEZ | NM  | HGT    | WS    | WD   | RV1 | NS1 | SNR1 | RV2  | NS2 | SNR2 | VV   | NSV | NMN | SNRV |
|--------|--------|-----|--------|-------|------|-----|-----|------|------|-----|------|------|-----|-----|------|
| hhmmss | hhmmss | min | ft     | kts   | deg  | kts | #   | db   | kts  | #   | db   | kts  | #   | #   | db   |
| 020153 | 015014 | 10  | 383.4  | 999.9 | 9999 | 3.5 | 4   | 28   | 2.2  | 5   | 20   | 0.2  | 5   | 5   | 26   |
| 020153 | 015014 | 10  | 699.1  | 999.9 | 9999 | 3.3 | 4   | 34   | 1.8  | 5   | 28   | 0.3  | 7   | 5   | 27   |
| 020153 | 015014 | 10  | 1014.8 | 999.9 | 9999 | 3.6 | 4   | 28   | 2.3  | 5   | 21   | 1.0  | 5   | 5   | 27   |
| 020153 | 015014 | 10  | 1330.5 | 999.9 | 9999 | 5.2 | 4   | 31   | 1.9  | 5   | 36   | 0.5  | 6   | 5   | 28   |
| 020153 | 015014 | 10  | 1646.3 | 999.9 | 9999 | 6.8 | 4   | 38   | 1.4  | 5   | 34   | 0.0  | 5   | 5   | 24   |
| 020153 | 015014 | 10  | 1962.0 | 999.9 | 9999 | 6.9 | 4   | 32   | 1.4  | 5   | 24   | 0.0  | 4   | 5   | 16   |
| 020153 | 015014 | 10  | 2277.7 | 999.9 | 9999 | 8.0 | 5   | 22   | 1.1  | 4   | 15   | 0.3  | 7   | 5   | 6    |
| 020153 | 015014 | 10  | 2593.4 | 19.4  | 291  | 7.5 | 6   | 10   | 0.5  | 5   | 6    | 0.0  | 8   | 5   | 1    |
| 020153 | 015014 | 10  | 2909.1 | 17.5  | 284  | 6.7 | 8   | 7    | -0.3 | 5   | 0    | 0.0  | 5   | 5   | -4   |
| 020153 | 015014 | 10  | 3224.9 | 19.2  | 278  | 6.9 | 7   | -4   | -1.5 | 5   | -6   | -0.4 | 6   | 5   | -7   |
| 020153 | 015014 | 10  | 3540.6 | 8.0   | 283  | 2.9 | 8   | 1    | -0.3 | 6   | -1   | -0.2 | 8   | 5   | 8    |

|        |        |    |         |       |      |       |    |     |       |    |     |       |    |   |     |
|--------|--------|----|---------|-------|------|-------|----|-----|-------|----|-----|-------|----|---|-----|
| 020153 | 015014 | 10 | 3856.3  | 8.6   | 278  | 3.5   | 8  | 9   | -0.2  | 7  | 9   | 0.2   | 7  | 5 | 5   |
| 020153 | 015014 | 10 | 4172.0  | 11.1  | 296  | 4.4   | 8  | 5   | 0.8   | 7  | 6   | 0.1   | 7  | 5 | -5  |
| 020153 | 015014 | 10 | 4487.7  | 12.8  | 301  | 4.9   | 8  | -4  | 1.2   | 7  | -3  | 0.0   | 7  | 5 | -13 |
| 020153 | 015014 | 10 | 4803.5  | 14.4  | 303  | 5.5   | 7  | -11 | 1.7   | 7  | -8  | 0.2   | 7  | 5 | -14 |
| 020153 | 015014 | 10 | 5119.2  | 21.0  | 295  | 7.9   | 8  | -13 | 0.9   | 5  | 16  | -0.1  | 5  | 5 | -12 |
| 020153 | 015014 | 10 | 5434.9  | 999.9 | 9999 | 8.1   | 7  | -13 | -0.6  | 4  | 19  | 7.8   | 4  | 5 | -20 |
| 020153 | 015014 | 10 | 5750.6  | 999.9 | 9999 | 9.5   | 5  | -16 | -0.8  | 4  | 8   | 18.1  | 2  | 5 | -18 |
| 020153 | 015014 | 10 | 6066.3  | 999.9 | 9999 | 7.8   | 5  | -15 | 13.3  | 3  | -18 | 4.9   | 3  | 5 | -17 |
| 020153 | 015014 | 10 | 6382.1  | 999.9 | 9999 | -6.1  | 3  | -18 | -0.5  | 2  | -7  | 0.9   | 4  | 5 | -17 |
| 020153 | 015014 | 10 | 6697.8  | 999.9 | 9999 | -8.8  | 2  | -19 | -15.1 | 2  | -19 | 11.7  | 2  | 5 | -18 |
| 020153 | 015014 | 10 | 7013.5  | 999.9 | 9999 | 8.4   | 3  | -18 | -2.8  | 3  | -19 | 12.2  | 3  | 5 | -17 |
| 020153 | 015014 | 10 | 7329.2  | 999.9 | 9999 | -3.0  | 3  | -18 | -7.2  | 3  | -17 | 8.6   | 2  | 5 | -18 |
| 020153 | 015014 | 10 | 7644.9  | 999.9 | 9999 | 14.3  | 2  | -20 | 8.9   | 3  | -18 | 17.8  | 2  | 5 | -18 |
| 020153 | 015014 | 10 | 7960.7  | 999.9 | 9999 | 6.0   | 2  | -17 | -17.9 | 2  | -20 | 4.4   | 2  | 5 | -17 |
| 020153 | 015014 | 10 | 8276.4  | 999.9 | 9999 | 16.1  | 2  | -16 | 8.4   | 2  | -16 | 14.6  | 2  | 5 | -16 |
| 020153 | 015014 | 10 | 8592.1  | 999.9 | 9999 | 12.4  | 4  | -17 | -7.7  | 2  | -17 | -4.7  | 2  | 5 | -21 |
| 020153 | 015014 | 10 | 8907.8  | 999.9 | 9999 | -15.6 | 4  | -17 | -2.8  | 3  | -20 | 8.1   | 2  | 5 | -17 |
| 020153 | 015014 | 10 | 9223.5  | 999.9 | 9999 | -2.9  | 3  | -19 | 12.3  | 2  | -19 | 4.2   | 3  | 5 | -19 |
| 020153 | 015014 | 10 | 9539.3  | 999.9 | 9999 | -6.5  | 2  | -18 | -2.2  | 2  | -19 | -4.0  | 3  | 5 | -18 |
| 020153 | 015014 | 10 | 9855.0  | 999.9 | 9999 | -2.0  | 2  | -19 | 9.1   | 2  | -19 | 6.5   | 2  | 5 | -17 |
| 020153 | 015014 | 10 | 10170.7 | 999.9 | 9999 | -12.5 | 3  | -17 | -15.5 | 2  | -20 | -17.0 | 3  | 5 | -17 |
|        |        |    |         |       |      |       |    |     |       |    |     |       |    |   |     |
| 021519 | 020144 | 13 | 383.4   | 999.9 | 9999 | 7.5   | 5  | 27  | 2.0   | 5  | 9   | -0.1  | 9  | 7 | 33  |
| 021519 | 020144 | 13 | 699.1   | 999.9 | 9999 | 3.3   | 5  | 31  | 3.1   | 3  | 40  | -0.1  | 10 | 7 | 36  |
| 021519 | 020144 | 13 | 1014.8  | 999.9 | 9999 | 4.8   | 6  | 19  | 2.8   | 6  | 35  | 0.0   | 9  | 7 | 34  |
| 021519 | 020144 | 13 | 1330.5  | 999.9 | 9999 | 4.0   | 6  | 23  | 2.6   | 4  | 16  | -0.3  | 8  | 7 | 44  |
| 021519 | 020144 | 13 | 1646.3  | 999.9 | 9999 | 6.4   | 8  | 16  | 3.3   | 6  | 30  | 0.0   | 9  | 7 | 33  |
| 021519 | 020144 | 13 | 1962.0  | 999.9 | 9999 | 8.4   | 7  | 19  | 4.7   | 4  | 33  | 0.0   | 9  | 7 | 27  |
| 021519 | 020144 | 13 | 2277.7  | 999.9 | 9999 | 7.3   | 6  | 7   | 3.1   | 6  | 22  | -0.1  | 10 | 7 | 12  |
| 021519 | 020144 | 13 | 2593.4  | 999.9 | 9999 | 8.0   | 8  | 5   | 1.3   | 6  | 10  | 0.0   | 9  | 7 | 10  |
| 021519 | 020144 | 13 | 2909.1  | 999.9 | 9999 | 7.9   | 9  | -2  | -1.8  | 6  | 4   | -0.2  | 9  | 7 | -2  |
| 021519 | 020144 | 13 | 3224.9  | 17.5  | 274  | 6.3   | 9  | -5  | -1.8  | 8  | 0   | -0.3  | 9  | 7 | -6  |
| 021519 | 020144 | 13 | 3540.6  | 10.5  | 275  | 3.7   | 10 | -4  | -1.1  | 9  | -4  | -0.3  | 11 | 7 | 5   |
| 021519 | 020144 | 13 | 3856.3  | 10.1  | 287  | 3.6   | 10 | 5   | -0.3  | 9  | 4   | -0.3  | 11 | 7 | 2   |
| 021519 | 020144 | 13 | 4172.0  | 12.1  | 297  | 4.3   | 10 | 2   | 0.5   | 10 | 2   | -0.2  | 11 | 7 | -7  |
| 021519 | 020144 | 13 | 4487.7  | 11.7  | 296  | 4.6   | 10 | -6  | 0.8   | 10 | -6  | 0.0   | 7  | 7 | 4   |
| 021519 | 020144 | 13 | 4803.5  | 999.9 | 9999 | 5.7   | 9  | -11 | -6.9  | 4  | -19 | -0.3  | 6  | 7 | 17  |
| 021519 | 020144 | 13 | 5119.2  | 999.9 | 9999 | 6.7   | 4  | -14 | -0.3  | 5  | 9   | -0.7  | 10 | 7 | 5   |
| 021519 | 020144 | 13 | 5434.9  | 19.4  | 273  | 7.3   | 8  | -11 | -1.8  | 8  | 25  | 2.7   | 5  | 7 | -3  |
| 021519 | 020144 | 13 | 5750.6  | 999.9 | 9999 | 10.0  | 6  | -13 | -2.2  | 6  | 16  | -12.2 | 3  | 7 | -15 |
| 021519 | 020144 | 13 | 6066.3  | 999.9 | 9999 | 8.4   | 6  | -10 | -2.6  | 5  | 8   | 14.8  | 4  | 7 | -12 |
| 021519 | 020144 | 13 | 6382.1  | 999.9 | 9999 | 17.3  | 3  | -19 | -3.5  | 4  | -8  | 11.4  | 4  | 7 | -18 |
| 021519 | 020144 | 13 | 6697.8  | 999.9 | 9999 | 10.0  | 4  | -18 | -2.8  | 3  | -8  | -11.3 | 4  | 7 | -17 |
| 021519 | 020144 | 13 | 7013.5  | 999.9 | 9999 | 7.9   | 4  | -16 | 10.7  | 3  | -18 | -11.6 | 4  | 7 | -18 |
| 021519 | 020144 | 13 | 7329.2  | 999.9 | 9999 | -16.9 | 4  | -18 | 9.6   | 3  | -16 | 4.9   | 4  | 7 | -18 |
| 021519 | 020144 | 13 | 7644.9  | 999.9 | 9999 | 4.6   | 3  | -16 | -3.7  | 3  | -12 | 6.1   | 5  | 7 | -4  |
| 021519 | 020144 | 13 | 7960.7  | 999.9 | 9999 | 3.8   | 3  | -18 | 11.6  | 3  | -8  | 9.7   | 3  | 7 | -18 |
| 021519 | 020144 | 13 | 8276.4  | 999.9 | 9999 | 3.8   | 2  | -17 | -14.9 | 4  | -18 | -6.7  | 4  | 7 | -17 |
| 021519 | 020144 | 13 | 8592.1  | 999.9 | 9999 | 3.0   | 3  | -17 | 12.6  | 3  | -9  | -11.2 | 4  | 7 | -16 |
| 021519 | 020144 | 13 | 8907.8  | 999.9 | 9999 | -8.2  | 3  | -20 | 17.7  | 5  | -18 | -16.6 | 3  | 7 | -17 |
| 021519 | 020144 | 13 | 9223.5  | 999.9 | 9999 | -16.6 | 3  | -14 | -7.4  | 3  | -20 | 6.7   | 3  | 7 | -17 |
| 021519 | 020144 | 13 | 9539.3  | 999.9 | 9999 | -12.8 | 4  | -17 | 2.4   | 4  | -20 | 16.9  | 3  | 7 | -17 |
| 021519 | 020144 | 13 | 9855.0  | 999.9 | 9999 | -18.5 | 3  | -18 | 7.7   | 4  | -18 | -3.2  | 4  | 7 | -18 |
| 021519 | 020144 | 13 | 10170.7 | 999.9 | 9999 | -14.0 | 3  | -19 | -13.2 | 4  | -19 | -13.4 | 2  | 7 | -17 |

DATE: 11/08/1997 SITE NAME: RWP0004  
 LATITUDE: 28.69 LONGITUDE: -80.72 ELEVATION: 10 ft  
 AZIMUTH 1: 130 AZIMUTH 2: 220  
 NYQUIST: 19.6 kts

| CTIMEZ<br>hhmmss | BTIMEZ<br>hhmmss | NM<br>min | HGT<br>ft | WS<br>kts | WD<br>deg | RV1<br>kts | NS1<br># | SNR1<br>db | RV2<br>kts | NS2<br># | SNR2<br>db | VV<br>kts | NSV<br># | NMN<br># | SNRV<br>db |
|------------------|------------------|-----------|-----------|-----------|-----------|------------|----------|------------|------------|----------|------------|-----------|----------|----------|------------|
| 020021           | 015029           | 9         | 383.4     | 999.9     | 9999      | -7.0       | 7        | 13         | -4.0       | 4        | 22         | -0.2      | 8        | 5        | 31         |
| 020021           | 015029           | 9         | 699.1     | 17.7      | 338       | -6.4       | 6        | 15         | -3.5       | 6        | 27         | -0.3      | 8        | 5        | 26         |
| 020021           | 015029           | 9         | 1014.8    | 18.1      | 331       | -7.1       | 7        | 15         | -3.0       | 5        | 23         | -0.6      | 7        | 5        | 40         |
| 020021           | 015029           | 9         | 1330.5    | 24.5      | 330       | -9.2       | 5        | 18         | -3.6       | 5        | 32         | -0.3      | 8        | 5        | 33         |
| 020021           | 015029           | 9         | 1646.3    | 999.9     | 9999      | -7.6       | 4        | 17         | -1.1       | 5        | 20         | 0.3       | 8        | 5        | 28         |
| 020021           | 015029           | 9         | 1962.0    | 999.9     | 9999      | -12.9      | 3        | 31         | -2.0       | 5        | 13         | -0.2      | 8        | 5        | 21         |
| 020021           | 015029           | 9         | 2277.7    | 999.9     | 9999      | -13.4      | 3        | 25         | -1.1       | 5        | 7          | -0.5      | 8        | 5        | 14         |
| 020021           | 015029           | 9         | 2593.4    | 999.9     | 9999      | -7.2       | 3        | -4         | 0.0        | 4        | -1         | -0.3      | 8        | 5        | 5          |
| 020021           | 015029           | 9         | 2909.1    | 999.9     | 9999      | -6.0       | 3        | -7         | 2.2        | 5        | -5         | 0.0       | 8        | 5        | 1          |
| 020021           | 015029           | 9         | 3224.9    | 999.9     | 9999      | -5.2       | 5        | -8         | -0.7       | 4        | -4         | -0.3      | 8        | 5        | 2          |
| 020021           | 015029           | 9         | 3540.6    | 10.9      | 285       | -3.6       | 7        | -9         | 1.9        | 6        | -10        | 0.2       | 8        | 5        | 1          |
| 020021           | 015029           | 9         | 3856.3    | 9.3       | 284       | -2.9       | 7        | 1          | 1.8        | 7        | -1         | 0.3       | 8        | 5        | 1          |
| 020021           | 015029           | 9         | 4172.0    | 11.5      | 289       | -3.7       | 7        | -1         | 2.0        | 7        | -1         | 0.5       | 8        | 5        | -6         |
| 020021           | 015029           | 9         | 4487.7    | 11.5      | 291       | -4.0       | 7        | -7         | 1.5        | 7        | -8         | 0.1       | 8        | 5        | -7         |
| 020021           | 015029           | 9         | 4803.5    | 14.2      | 306       | -4.9       | 7        | -11        | 0.9        | 7        | -9         | 0.6       | 8        | 5        | -3         |
| 020021           | 015029           | 9         | 5119.2    | 17.3      | 298       | -5.8       | 7        | -6         | 2.1        | 7        | -6         | 0.8       | 8        | 5        | -5         |
| 020021           | 015029           | 9         | 5434.9    | 17.9      | 288       | -6.4       | 7        | -5         | 2.7        | 7        | -7         | 0.3       | 4        | 5        | -12        |
| 020021           | 015029           | 9         | 5750.6    | 999.9     | 9999      | -7.3       | 6        | -11        | 2.1        | 4        | -13        | -0.6      | 4        | 5        | -15        |
| 020021           | 015029           | 9         | 6066.3    | 999.9     | 9999      | 9.2        | 4        | -18        | 15.7       | 3        | -17        | -16.3     | 3        | 5        | -20        |
| 020021           | 015029           | 9         | 6382.1    | 999.9     | 9999      | 7.4        | 3        | -18        | 13.5       | 2        | -15        | -1.5      | 3        | 5        | 1          |
| 020021           | 015029           | 9         | 6697.8    | 999.9     | 9999      | 11.6       | 3        | -17        | -6.0       | 2        | -18        | 6.4       | 3        | 5        | -17        |
| 020021           | 015029           | 9         | 7013.5    | 999.9     | 9999      | 12.9       | 2        | -16        | 16.9       | 2        | -15        | -7.4      | 3        | 5        | -18        |
| 020021           | 015029           | 9         | 7329.2    | 999.9     | 9999      | -8.2       | 2        | -16        | -11.6      | 2        | -17        | -12.1     | 3        | 5        | -18        |
| 020021           | 015029           | 9         | 7644.9    | 999.9     | 9999      | 3.8        | 2        | -20        | 12.1       | 3        | -18        | 3.6       | 3        | 5        | -17        |
| 020021           | 015029           | 9         | 7960.7    | 999.9     | 9999      | -9.7       | 3        | -17        | -5.8       | 2        | -17        | -6.1      | 4        | 5        | -20        |
| 020021           | 015029           | 9         | 8276.4    | 999.9     | 9999      | 13.4       | 4        | -20        | -16.5      | 3        | -18        | -13.8     | 3        | 5        | -20        |
| 020021           | 015029           | 9         | 8592.1    | 999.9     | 9999      | -6.5       | 3        | -18        | -5.8       | 3        | -18        | 14.1      | 4        | 5        | -19        |
| 020021           | 015029           | 9         | 8907.8    | 999.9     | 9999      | -5.9       | 3        | -19        | -7.5       | 2        | -18        | -7.5      | 3        | 5        | -18        |
| 020021           | 015029           | 9         | 9223.5    | 999.9     | 9999      | 13.2       | 3        | -18        | -17.3      | 3        | -18        | 15.6      | 2        | 5        | -17        |
| 020021           | 015029           | 9         | 9539.3    | 999.9     | 9999      | 13.3       | 3        | -17        | -9.9       | 3        | -19        | 4.7       | 3        | 5        | -17        |
| 020021           | 015029           | 9         | 9855.0    | 999.9     | 9999      | -15.0      | 2        | -19        | 5.6        | 2        | -17        | 13.1      | 2        | 5        | -18        |
| 020021           | 015029           | 9         | 10170.7   | 999.9     | 9999      | 16.5       | 3        | -19        | -5.3       | 4        | -17        | 6.5       | 2        | 5        | -18        |
| 021522           | 020521           | 9         | 383.4     | 999.9     | 9999      | -8.3       | 5        | 23         | -0.5       | 4        | 29         | 0.3       | 8        | 5        | 17         |
| 021522           | 020521           | 9         | 699.1     | 999.9     | 9999      | -6.6       | 4        | 21         | -0.9       | 5        | 27         | 0.2       | 8        | 5        | 27         |
| 021522           | 020521           | 9         | 1014.8    | 999.9     | 9999      | -7.5       | 5        | 25         | -0.5       | 4        | 21         | 0.0       | 8        | 5        | 18         |
| 021522           | 020521           | 9         | 1330.5    | 999.9     | 9999      | -9.2       | 4        | 26         | -1.4       | 5        | 31         | 0.0       | 8        | 5        | 29         |
| 021522           | 020521           | 9         | 1646.3    | 999.9     | 9999      | -11.1      | 4        | 36         | -1.5       | 4        | 28         | -0.7      | 7        | 5        | 41         |
| 021522           | 020521           | 9         | 1962.0    | 999.9     | 9999      | -11.3      | 4        | 32         | 1.0        | 5        | 11         | -0.6      | 8        | 5        | 31         |
| 021522           | 020521           | 9         | 2277.7    | 999.9     | 9999      | -0.3       | 3        | 2          | 0.5        | 5        | 7          | -0.2      | 8        | 5        | 22         |
| 021522           | 020521           | 9         | 2593.4    | 999.9     | 9999      | -7.1       | 5        | 4          | 0.2        | 4        | 5          | 0.0       | 8        | 5        | 11         |
| 021522           | 020521           | 9         | 2909.1    | 18.1      | 300       | -6.9       | 7        | -1         | 1.1        | 6        | -2         | 0.0       | 8        | 5        | 7          |
| 021522           | 020521           | 9         | 3224.9    | 17.7      | 292       | -6.6       | 8        | -3         | 2.0        | 7        | -2         | -0.1      | 8        | 5        | 1          |
| 021522           | 020521           | 9         | 3540.6    | 13.6      | 282       | -4.7       | 8        | -5         | 2.4        | 7        | -4         | -0.1      | 8        | 5        | 2          |
| 021522           | 020521           | 9         | 3856.3    | 9.5       | 276       | -3.0       | 8        | 1          | 2.0        | 7        | 0          | 0.0       | 8        | 5        | 3          |
| 021522           | 020521           | 9         | 4172.0    | 10.5      | 283       | -3.6       | 8        | 2          | 1.9        | 7        | 1          | 0.0       | 8        | 5        | -4         |
| 021522           | 020521           | 9         | 4487.7    | 11.5      | 300       | -4.0       | 8        | -4         | 1.2        | 7        | -4         | 0.4       | 8        | 5        | 1          |
| 021522           | 020521           | 9         | 4803.5    | 14.2      | 307       | -5.2       | 8        | -8         | 0.5        | 7        | -7         | 0.3       | 7        | 5        | -6         |
| 021522           | 020521           | 9         | 5119.2    | 16.9      | 304       | -6.3       | 8        | -9         | 0.8        | 7        | -10        | 0.1       | 8        | 5        | -10        |

|        |        |   |         |       |      |       |   |     |       |   |     |       |   |   |     |
|--------|--------|---|---------|-------|------|-------|---|-----|-------|---|-----|-------|---|---|-----|
| 021522 | 020521 | 9 | 5434.9  | 16.9  | 298  | -6.4  | 6 | -14 | 1.3   | 6 | 5   | 0.0   | 6 | 5 | -14 |
| 021522 | 020521 | 9 | 5750.6  | 18.7  | 278  | -6.9  | 5 | -15 | 3.1   | 6 | -13 | -0.8  | 5 | 5 | -15 |
| 021522 | 020521 | 9 | 6066.3  | 999.9 | 9999 | -9.7  | 2 | -15 | 2.7   | 5 | -16 | -2.0  | 3 | 5 | 0   |
| 021522 | 020521 | 9 | 6382.1  | 999.9 | 9999 | -10.0 | 2 | 2   | 2.8   | 2 | 4   | -18.6 | 2 | 5 | -20 |
| 021522 | 020521 | 9 | 6697.8  | 999.9 | 9999 | 11.0  | 3 | -6  | 3.1   | 3 | -6  | 9.1   | 3 | 5 | -18 |
| 021522 | 020521 | 9 | 7013.5  | 999.9 | 9999 | 7.0   | 3 | -18 | 1.8   | 3 | 22  | 5.9   | 3 | 5 | -19 |
| 021522 | 020521 | 9 | 7329.2  | 999.9 | 9999 | 12.3  | 3 | -15 | -18.1 | 2 | -18 | -12.9 | 3 | 5 | -19 |
| 021522 | 020521 | 9 | 7644.9  | 999.9 | 9999 | 14.4  | 2 | -18 | 3.7   | 3 | 23  | 2.1   | 2 | 5 | -17 |
| 021522 | 020521 | 9 | 7960.7  | 999.9 | 9999 | -14.2 | 3 | -11 | 5.9   | 3 | 13  | 14.8  | 2 | 5 | -16 |
| 021522 | 020521 | 9 | 8276.4  | 999.9 | 9999 | 9.6   | 3 | -15 | 3.2   | 3 | 2   | 9.5   | 3 | 5 | -18 |
| 021522 | 020521 | 9 | 8592.1  | 999.9 | 9999 | 11.1  | 5 | -18 | -15.5 | 3 | -14 | 8.4   | 2 | 5 | -17 |
| 021522 | 020521 | 9 | 8907.8  | 999.9 | 9999 | -14.9 | 4 | -17 | 7.4   | 4 | -18 | -13.2 | 4 | 5 | -18 |
| 021522 | 020521 | 9 | 9223.5  | 999.9 | 9999 | -16.9 | 3 | -16 | 7.0   | 2 | -17 | -16.0 | 2 | 5 | -19 |
| 021522 | 020521 | 9 | 9539.3  | 999.9 | 9999 | 5.7   | 3 | -18 | -14.4 | 3 | -16 | 8.0   | 2 | 5 | -17 |
| 021522 | 020521 | 9 | 9855.0  | 999.9 | 9999 | 5.5   | 2 | -18 | 5.2   | 3 | -19 | -3.7  | 4 | 5 | -16 |
| 021522 | 020521 | 9 | 10170.7 | 999.9 | 9999 | -11.1 | 5 | -16 | 9.5   | 3 | -17 | 15.1  | 4 | 5 | -18 |

DATE: 11/08/1997 SITE NAME: RWP0005

LATITUDE: 28.50 LONGITUDE: -80.79 ELEVATION: 10 ft

AZIMUTH 1: 43 AZIMUTH 2: 133

NYQUIST: 19.6 kts

| CTIMEZ | BTIMEZ | NM  | HGT     | WS    | WD   | RV1   | NS1 | SNR1 | RV2   | NS2 | SNR2 | VV    | NSV | NMN | SNRV |
|--------|--------|-----|---------|-------|------|-------|-----|------|-------|-----|------|-------|-----|-----|------|
| hhmmss | hhmmss | min | ft      | kts   | deg  | kts   | #   | db   | kts   | #   | db   | kts   | #   | #   | db   |
| 020029 | 015019 | 9   | 383.4   | 12.4  | 295  | -1.7  | 6   | 8    | -4.9  | 5   | -7   | -0.3  | 8   | 5   | 7    |
| 020029 | 015019 | 9   | 699.1   | 999.9 | 9999 | 1.0   | 6   | 33   | -6.8  | 3   | 16   | 0.1   | 8   | 5   | 26   |
| 020029 | 015019 | 9   | 1014.8  | 999.9 | 9999 | 1.0   | 5   | 24   | -7.7  | 3   | 30   | 0.5   | 8   | 5   | 42   |
| 020029 | 015019 | 9   | 1330.5  | 999.9 | 9999 | 4.8   | 4   | 31   | -10.6 | 4   | 27   | -0.9  | 5   | 5   | 46   |
| 020029 | 015019 | 9   | 1646.3  | 999.9 | 9999 | 2.0   | 4   | 20   | -11.4 | 4   | 32   | 0.0   | 5   | 5   | 41   |
| 020029 | 015019 | 9   | 1962.0  | 999.9 | 9999 | -1.9  | 5   | 22   | -2.7  | 4   | 13   | -0.1  | 5   | 5   | 30   |
| 020029 | 015019 | 9   | 2277.7  | 17.1  | 310  | -0.2  | 5   | 6    | -6.6  | 5   | -2   | 0.0   | 7   | 5   | 10   |
| 020029 | 015019 | 9   | 2593.4  | 999.9 | 9999 | -0.8  | 4   | -7   | -7.3  | 7   | 1    | 0.0   | 6   | 5   | -2   |
| 020029 | 015019 | 9   | 2909.1  | 999.9 | 9999 | -1.8  | 3   | -11  | -7.1  | 7   | 5    | 0.0   | 4   | 5   | -12  |
| 020029 | 015019 | 9   | 3224.9  | 999.9 | 9999 | -1.4  | 7   | -11  | -6.8  | 4   | -1   | 0.1   | 6   | 5   | -9   |
| 020029 | 015019 | 9   | 3540.6  | 999.9 | 9999 | -1.7  | 4   | -9   | -4.7  | 7   | -9   | 0.3   | 8   | 5   | -6   |
| 020029 | 015019 | 9   | 3856.3  | 11.1  | 303  | -0.4  | 6   | -6   | -3.9  | 8   | -8   | 0.3   | 8   | 5   | 4    |
| 020029 | 015019 | 9   | 4172.0  | 20.6  | 292  | 0.0   | 8   | -4   | -4.6  | 7   | -7   | 3.1   | 6   | 5   | 29   |
| 020029 | 015019 | 9   | 4487.7  | 999.9 | 9999 | -0.8  | 3   | -8   | -5.2  | 4   | -14  | -15.4 | 2   | 5   | -15  |
| 020029 | 015019 | 9   | 4803.5  | 999.9 | 9999 | -10.4 | 2   | -20  | 3.4   | 3   | -19  | 1.9   | 3   | 5   | 10   |
| 020029 | 015019 | 9   | 5119.2  | 999.9 | 9999 | -3.7  | 2   | -6   | 12.9  | 2   | -18  | 2.0   | 2   | 5   | -11  |
| 020029 | 015019 | 9   | 5434.9  | 999.9 | 9999 | -2.4  | 4   | -14  | 13.4  | 2   | -17  | 8.6   | 3   | 5   | -17  |
| 020029 | 015019 | 9   | 5750.6  | 999.9 | 9999 | -2.0  | 4   | -7   | 17.0  | 2   | -20  | -11.5 | 2   | 5   | -18  |
| 020029 | 015019 | 9   | 6066.3  | 999.9 | 9999 | 5.7   | 3   | -20  | -12.4 | 3   | -16  | -0.5  | 2   | 5   | -20  |
| 020029 | 015019 | 9   | 6382.1  | 999.9 | 9999 | -12.9 | 3   | -18  | 17.5  | 3   | -17  | 7.6   | 3   | 5   | -18  |
| 020029 | 015019 | 9   | 6697.8  | 999.9 | 9999 | 17.8  | 3   | -21  | -14.1 | 2   | -9   | -8.0  | 4   | 5   | -18  |
| 020029 | 015019 | 9   | 7013.5  | 999.9 | 9999 | -16.2 | 3   | -19  | 2.7   | 2   | -17  | -10.1 | 3   | 5   | -18  |
| 020029 | 015019 | 9   | 7329.2  | 999.9 | 9999 | 17.5  | 3   | -17  | 11.0  | 2   | -18  | -1.4  | 2   | 5   | -19  |
| 020029 | 015019 | 9   | 7644.9  | 999.9 | 9999 | -2.5  | 2   | -19  | -7.6  | 3   | -18  | 16.6  | 3   | 5   | -16  |
| 020029 | 015019 | 9   | 7960.7  | 999.9 | 9999 | -13.6 | 3   | -19  | 4.3   | 2   | -18  | -11.7 | 3   | 5   | -17  |
| 020029 | 015019 | 9   | 8276.4  | 999.9 | 9999 | -4.1  | 4   | -20  | 12.7  | 2   | -16  | -6.0  | 4   | 5   | -17  |
| 020029 | 015019 | 9   | 8592.1  | 999.9 | 9999 | 10.7  | 4   | -18  | 12.1  | 2   | -20  | -8.9  | 3   | 5   | -19  |
| 020029 | 015019 | 9   | 8907.8  | 999.9 | 9999 | -6.5  | 4   | -18  | 18.3  | 3   | -17  | 5.9   | 4   | 5   | -19  |
| 020029 | 015019 | 9   | 9223.5  | 999.9 | 9999 | -4.8  | 3   | -18  | 10.3  | 4   | -18  | -0.2  | 2   | 5   | -19  |
| 020029 | 015019 | 9   | 9539.3  | 999.9 | 9999 | 17.4  | 3   | -19  | 10.6  | 3   | -20  | -2.8  | 4   | 5   | -18  |
| 020029 | 015019 | 9   | 9855.0  | 999.9 | 9999 | 2.8   | 3   | -19  | 13.6  | 3   | -11  | -9.9  | 3   | 5   | -19  |
| 020029 | 015019 | 9   | 10170.7 | 999.9 | 9999 | -4.8  | 2   | 2    | 14.5  | 2   | -6   | -11.3 | 3   | 5   | -17  |

|        |        |   |         |       |      |       |   |     |       |   |     |       |   |   |     |
|--------|--------|---|---------|-------|------|-------|---|-----|-------|---|-----|-------|---|---|-----|
| 021510 | 020515 | 9 | 383.4   | 999.9 | 9999 | -2.6  | 5 | 23  | -9.0  | 3 | 24  | 0.0   | 4 | 5 | 29  |
| 021510 | 020515 | 9 | 699.1   | 999.9 | 9999 | 0.3   | 6 | 31  | -10.0 | 3 | 30  | 0.2   | 7 | 5 | 27  |
| 021510 | 020515 | 9 | 1014.8  | 999.9 | 9999 | 2.1   | 4 | 22  | -1.0  | 4 | 35  | 0.4   | 8 | 5 | 26  |
| 021510 | 020515 | 9 | 1330.5  | 999.9 | 9999 | 1.1   | 4 | 18  | -1.1  | 4 | 32  | 0.1   | 7 | 5 | 31  |
| 021510 | 020515 | 9 | 1646.3  | 999.9 | 9999 | 0.1   | 4 | 39  | -1.9  | 3 | 14  | 0.0   | 7 | 5 | 25  |
| 021510 | 020515 | 9 | 1962.0  | 999.9 | 9999 | 0.0   | 4 | 34  | -8.8  | 4 | 24  | 1.0   | 8 | 5 | 23  |
| 021510 | 020515 | 9 | 2277.7  | 999.9 | 9999 | 1.1   | 5 | 18  | -2.2  | 4 | 19  | 1.3   | 7 | 5 | 21  |
| 021510 | 020515 | 9 | 2593.4  | 10.7  | 306  | 0.1   | 6 | -1  | -3.4  | 5 | 3   | 0.7   | 7 | 5 | 6   |
| 021510 | 020515 | 9 | 2909.1  | 999.9 | 9999 | -2.0  | 5 | 11  | -6.2  | 4 | -8  | 0.8   | 4 | 5 | -11 |
| 021510 | 020515 | 9 | 3224.9  | 14.2  | 287  | -2.1  | 7 | -11 | -4.7  | 7 | -10 | 0.3   | 7 | 5 | -8  |
| 021510 | 020515 | 9 | 3540.6  | 11.7  | 297  | -0.9  | 8 | -7  | -4.0  | 8 | -5  | 0.3   | 8 | 5 | -3  |
| 021510 | 020515 | 9 | 3856.3  | 10.5  | 300  | -0.5  | 8 | -2  | -3.6  | 8 | -4  | 0.3   | 8 | 5 | -5  |
| 021510 | 020515 | 9 | 4172.0  | 13.8  | 297  | -0.3  | 8 | -4  | -4.0  | 8 | -7  | 1.2   | 7 | 5 | -17 |
| 021510 | 020515 | 9 | 4487.7  | 11.1  | 298  | -1.0  | 5 | -9  | -4.1  | 5 | -19 | 5.8   | 2 | 5 | -19 |
| 021510 | 020515 | 9 | 4803.5  | 999.9 | 9999 | -8.1  | 4 | -17 | -7.3  | 3 | -14 | 3.9   | 3 | 5 | -18 |
| 021510 | 020515 | 9 | 5119.2  | 999.9 | 9999 | -2.9  | 3 | -7  | 13.7  | 3 | -16 | -0.5  | 4 | 5 | -15 |
| 021510 | 020515 | 9 | 5434.9  | 999.9 | 9999 | -3.9  | 3 | -17 | 17.4  | 3 | -23 | 9.1   | 3 | 5 | -17 |
| 021510 | 020515 | 9 | 5750.6  | 999.9 | 9999 | -3.3  | 4 | -16 | 16.1  | 3 | -18 | -17.2 | 2 | 5 | -19 |
| 021510 | 020515 | 9 | 6066.3  | 999.9 | 9999 | 14.1  | 2 | -18 | 3.3   | 3 | -17 | 9.6   | 3 | 5 | -18 |
| 021510 | 020515 | 9 | 6382.1  | 999.9 | 9999 | 14.0  | 3 | -17 | -16.4 | 3 | -17 | 10.1  | 2 | 5 | -18 |
| 021510 | 020515 | 9 | 6697.8  | 999.9 | 9999 | 16.8  | 3 | -18 | 18.0  | 4 | -18 | 18.4  | 2 | 5 | -17 |
| 021510 | 020515 | 9 | 7013.5  | 999.9 | 9999 | -10.1 | 3 | -18 | 11.9  | 2 | -20 | -11.2 | 3 | 5 | -17 |
| 021510 | 020515 | 9 | 7329.2  | 999.9 | 9999 | -6.0  | 2 | -19 | -18.4 | 2 | -18 | 5.2   | 3 | 5 | -19 |
| 021510 | 020515 | 9 | 7644.9  | 999.9 | 9999 | -9.3  | 4 | -21 | 10.4  | 4 | -18 | -3.9  | 3 | 5 | -3  |
| 021510 | 020515 | 9 | 7960.7  | 999.9 | 9999 | -5.2  | 2 | -20 | -17.0 | 5 | -18 | 6.3   | 3 | 5 | -20 |
| 021510 | 020515 | 9 | 8276.4  | 999.9 | 9999 | -6.7  | 3 | -16 | -16.6 | 3 | -17 | -2.5  | 3 | 5 | 16  |
| 021510 | 020515 | 9 | 8592.1  | 999.9 | 9999 | -4.8  | 4 | -19 | -15.8 | 3 | -11 | -2.7  | 2 | 5 | 0   |
| 021510 | 020515 | 9 | 8907.8  | 999.9 | 9999 | -12.6 | 3 | -18 | -17.2 | 2 | -2  | -19.0 | 2 | 5 | -16 |
| 021510 | 020515 | 9 | 9223.5  | 999.9 | 9999 | 14.8  | 2 | -18 | -9.4  | 3 | -19 | -16.6 | 3 | 5 | -16 |
| 021510 | 020515 | 9 | 9539.3  | 999.9 | 9999 | 6.6   | 4 | -19 | 3.1   | 4 | -17 | -5.1  | 3 | 5 | -19 |
| 021510 | 020515 | 9 | 9855.0  | 999.9 | 9999 | 17.4  | 3 | -16 | 11.5  | 4 | 14  | -10.6 | 3 | 5 | -18 |
| 021510 | 020515 | 9 | 10170.7 | 999.9 | 9999 | -14.1 | 2 | -18 | 14.7  | 3 | 9   | 4.4   | 3 | 5 | -17 |

# **Meteorological Tower Data**

| DAY   | TIME  | LAT     | LON     | Z   | DIR | SPD  | T  | TD | TIDN |
|-------|-------|---------|---------|-----|-----|------|----|----|------|
| 97312 | 20500 | 28.4338 | 80.5734 | 6   |     |      | 60 |    | 1    |
| 97312 | 20500 | 28.4338 | 80.5734 | 12  | 295 | 2.9  |    |    | 1    |
| 97312 | 20500 | 28.4338 | 80.5734 | 54  | 267 | 7.0  | 60 |    | 1    |
| 97312 | 20500 | 28.4443 | 80.5621 | 6   |     |      | 60 | 52 | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 12  | 300 | 2.9  |    |    | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 54  | 302 | 6.0  | 60 | 52 | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 90  | 301 | 8.0  |    |    | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 162 | 302 | 8.9  |    |    | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 204 | 300 | 11.1 | 60 | 52 | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 6   |     |      | 59 | 52 | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 12  | 300 | 1.9  |    |    | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 54  | 301 | 5.1  | 60 | 53 | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 90  | 300 | 7.0  |    |    | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 162 | 302 | 8.0  |    |    | 2    |
| 97312 | 20500 | 28.4443 | 80.5621 | 204 | 288 | 8.9  | 60 | 52 | 2    |
| 97312 | 20500 | 28.4598 | 80.5267 | 6   |     |      | 59 |    | 3    |
| 97312 | 20500 | 28.4598 | 80.5267 | 12  | 303 | 6.0  |    |    | 3    |
| 97312 | 20500 | 28.4598 | 80.5267 | 54  | 296 | 7.0  |    |    | 3    |
| 97312 | 20500 | 28.4466 | 80.5652 | 6   |     |      |    |    | 17   |
| 97312 | 20500 | 28.7435 | 80.7005 | 6   |     |      | 61 | 54 | 19   |
| 97312 | 20500 | 28.7435 | 80.7005 | 54  | 324 | 14.0 |    |    | 19   |
| 97312 | 20500 | 28.7975 | 80.7378 | 6   |     |      | 61 | 53 | 22   |
| 97312 | 20500 | 28.7975 | 80.7378 | 54  | 305 | 13.0 |    |    | 22   |
| 97312 | 20500 | 28.4721 | 80.5393 | 6   |     |      |    |    | 36   |
| 97312 | 20500 | 28.4721 | 80.5393 | 90  | 311 | 8.9  |    |    | 36   |
| 97312 | 20500 | 28.5622 | 80.5785 | 6   |     |      |    |    | 40   |
| 97312 | 20500 | 28.5622 | 80.5785 | 54  | 301 | 11.1 |    |    | 40   |
| 97312 | 20500 | 28.5836 | 80.5842 | 6   |     |      |    |    | 41   |
| 97312 | 20500 | 28.5836 | 80.5842 | 54  | 291 | 9.9  |    |    | 41   |
| 97312 | 20500 | 28.5130 | 80.5613 | 6   |     |      | 63 | 58 | 61   |
| 97312 | 20500 | 28.5130 | 80.5613 | 12  | 301 | 2.9  |    |    | 61   |
| 97312 | 20500 | 28.5130 | 80.5613 | 54  | 299 | 6.0  | 59 | 51 | 61   |
| 97312 | 20500 | 28.5130 | 80.5613 | 162 | 301 | 9.9  |    |    | 61   |
| 97312 | 20500 | 28.5130 | 80.5613 | 204 | 306 | 11.1 | 60 | 52 | 61   |
| 97312 | 20500 | 28.5130 | 80.5613 | 6   |     |      | 59 | 52 | 62   |
| 97312 | 20500 | 28.5130 | 80.5613 | 12  | 293 | 2.9  |    |    | 62   |
| 97312 | 20500 | 28.5130 | 80.5613 | 54  | 293 | 6.0  | 60 | 53 | 62   |
| 97312 | 20500 | 28.5130 | 80.5613 | 162 | 296 | 8.9  |    |    | 62   |
| 97312 | 20500 | 28.5130 | 80.5613 | 204 | 298 | 9.9  | 59 | 56 | 62   |
| 97312 | 20500 | 28.5358 | 80.5747 | 6   |     |      | 60 |    | 108  |
| 97312 | 20500 | 28.5358 | 80.5747 | 12  | 298 | 5.1  |    |    | 108  |
| 97312 | 20500 | 28.5358 | 80.5747 | 54  | 293 | 8.0  | 60 |    | 108  |
| 97312 | 20500 | 28.6141 | 80.6203 | 6   |     |      | 56 |    | 112  |
| 97312 | 20500 | 28.6141 | 80.6203 | 12  | 292 | 1.9  |    |    | 112  |
| 97312 | 20500 | 28.6141 | 80.6203 | 54  | 292 | 6.0  | 58 |    | 112  |
| 97312 | 20500 | 28.4048 | 80.6519 | 6   |     |      | 62 | 55 | 300  |
| 97312 | 20500 | 28.4048 | 80.6519 | 54  | 294 | 8.9  |    |    | 300  |
| 97312 | 20500 | 28.4600 | 80.5711 | 6   |     |      | 58 |    | 303  |
| 97312 | 20500 | 28.4600 | 80.5711 | 12  | 297 | 1.9  |    |    | 303  |
| 97312 | 20500 | 28.4600 | 80.5711 | 54  | 294 | 6.0  | 59 |    | 303  |
| 97312 | 20500 | 28.6027 | 80.6414 | 6   |     |      | 59 |    | 311  |
| 97312 | 20500 | 28.6027 | 80.6414 | 12  | 302 | 2.9  |    |    | 311  |
| 97312 | 20500 | 28.6027 | 80.6414 | 54  | 261 | 1.0  | 59 |    | 311  |
| 97312 | 20500 | 28.6105 | 80.6069 | 6   |     |      |    |    | 393  |

|       |       |         |         |     |     |      |    |    |      |
|-------|-------|---------|---------|-----|-----|------|----|----|------|
| 97312 | 20500 | 28.6105 | 80.6069 | 60  | 291 | 8.9  | 59 | 53 | 393  |
| 97312 | 20500 | 28.6057 | 80.6016 | 6   |     |      | 58 | 52 | 394  |
| 97312 | 20500 | 28.6057 | 80.6016 | 60  | 294 | 8.9  | 58 | 52 | 394  |
| 97312 | 20500 | 28.6294 | 80.6235 | 6   |     |      |    |    | 397  |
| 97312 | 20500 | 28.6294 | 80.6235 | 60  | 292 | 8.9  | 58 | 52 | 397  |
| 97312 | 20500 | 28.6248 | 80.6182 | 6   |     |      | 58 | 52 | 398  |
| 97312 | 20500 | 28.6248 | 80.6182 | 60  | 292 | 8.9  | 58 | 52 | 398  |
| 97312 | 20500 | 28.4586 | 80.5923 | 6   |     |      | 60 |    | 403  |
| 97312 | 20500 | 28.4586 | 80.5923 | 12  | 305 | 5.1  |    |    | 403  |
| 97312 | 20500 | 28.4586 | 80.5923 | 54  | 298 | 8.0  | 60 |    | 403  |
| 97312 | 20500 | 28.6062 | 80.6739 | 6   |     |      | 57 |    | 412  |
| 97312 | 20500 | 28.6062 | 80.6739 | 12  | 291 | 1.0  |    |    | 412  |
| 97312 | 20500 | 28.6062 | 80.6739 | 54  | 298 | 5.1  | 58 |    | 412  |
| 97312 | 20500 | 28.6586 | 80.6998 | 6   |     |      | 58 |    | 415  |
| 97312 | 20500 | 28.6586 | 80.6998 | 12  | 275 | 1.0  |    |    | 415  |
| 97312 | 20500 | 28.6586 | 80.6998 | 54  | 300 | 2.9  | 58 |    | 415  |
| 97312 | 20500 | 28.7055 | 80.7265 | 6   |     |      | 61 | 55 | 418  |
| 97312 | 20500 | 28.7055 | 80.7265 | 54  | 305 | 7.0  |    |    | 418  |
| 97312 | 20500 | 28.7755 | 80.8043 | 6   |     |      | 61 | 56 | 421  |
| 97312 | 20500 | 28.7755 | 80.8043 | 54  | 289 | 11.1 |    |    | 421  |
| 97312 | 20500 | 28.5158 | 80.6400 | 6   |     |      | 59 |    | 506  |
| 97312 | 20500 | 28.5158 | 80.6400 | 12  | 295 | 4.1  |    |    | 506  |
| 97312 | 20500 | 28.5158 | 80.6400 | 54  | 302 | 6.0  | 60 |    | 506  |
| 97312 | 20500 | 28.5623 | 80.6694 | 6   |     |      | 58 |    | 509  |
| 97312 | 20500 | 28.5623 | 80.6694 | 12  | 318 | 2.9  |    |    | 509  |
| 97312 | 20500 | 28.5623 | 80.6694 | 54  | 310 | 5.1  | 59 |    | 509  |
| 97312 | 20500 | 28.5986 | 80.6817 | 6   |     |      |    |    | 511  |
| 97312 | 20500 | 28.5986 | 80.6817 | 30  | 300 | 8.0  |    |    | 511  |
| 97312 | 20500 | 28.6160 | 80.6930 | 6   |     |      | 61 | 52 | 512  |
| 97312 | 20500 | 28.6160 | 80.6930 | 30  | 301 | 8.0  |    |    | 512  |
| 97312 | 20500 | 28.6307 | 80.7027 | 6   |     |      |    |    | 513  |
| 97312 | 20500 | 28.6307 | 80.7027 | 30  | 304 | 8.0  |    |    | 513  |
| 97312 | 20500 | 28.6431 | 80.7482 | 6   |     |      | 58 |    | 714  |
| 97312 | 20500 | 28.6431 | 80.7482 | 12  | 318 | 2.9  |    |    | 714  |
| 97312 | 20500 | 28.6431 | 80.7482 | 54  | 302 | 6.0  | 58 |    | 714  |
| 97312 | 20500 | 28.4632 | 80.6702 | 6   |     |      | 58 |    | 803  |
| 97312 | 20500 | 28.4632 | 80.6702 | 12  | 299 | 1.0  |    |    | 803  |
| 97312 | 20500 | 28.4632 | 80.6702 | 54  | 297 | 2.9  | 59 |    | 803  |
| 97312 | 20500 | 28.5184 | 80.6962 | 6   |     |      | 69 |    | 805  |
| 97312 | 20500 | 28.5184 | 80.6962 | 12  | 293 | 4.1  |    |    | 805  |
| 97312 | 20500 | 28.5184 | 80.6962 | 54  | 287 | 7.0  | 59 |    | 805  |
| 97312 | 20500 | 28.7464 | 80.8707 | 6   |     |      | 57 | 52 | 819  |
| 97312 | 20500 | 28.7464 | 80.8707 | 54  | 294 | 5.1  |    |    | 819  |
| 97312 | 20500 | 28.4079 | 80.7604 | 6   |     |      | 58 | 53 | 1000 |
| 97312 | 20500 | 28.4079 | 80.7604 | 54  | 291 | 7.0  |    |    | 1000 |
| 97312 | 20500 | 28.5272 | 80.7742 | 6   |     |      | 59 | 54 | 1007 |
| 97312 | 20500 | 28.5272 | 80.7742 | 54  | 276 | 7.0  |    |    | 1007 |
| 97312 | 20500 | 28.6056 | 80.8248 | 6   |     |      | 60 | 52 | 1012 |
| 97312 | 20500 | 28.6056 | 80.8248 | 54  | 301 | 5.1  |    |    | 1012 |
| 97312 | 20500 | 28.5697 | 80.5864 | 6   |     |      | 60 | 55 | 1101 |
| 97312 | 20500 | 28.5697 | 80.5864 | 12  | 302 | 6.0  |    |    | 1101 |
| 97312 | 20500 | 28.5697 | 80.5864 | 54  | 295 | 12.1 | 60 | 53 | 1101 |
| 97312 | 20500 | 28.5697 | 80.5864 | 162 | 305 | 14.0 |    |    | 1101 |
| 97312 | 20500 | 28.5697 | 80.5864 | 204 | 302 | 14.0 | 59 | 51 | 1101 |
| 97312 | 20500 | 28.5697 | 80.5864 | 6   |     |      | 60 | 54 | 1102 |
| 97312 | 20500 | 28.5697 | 80.5864 | 12  | 303 | 5.1  |    |    | 1102 |
| 97312 | 20500 | 28.5697 | 80.5864 | 54  | 292 | 11.1 | 60 | 52 | 1102 |

|       |       |         |         |     |     |      |    |    |      |
|-------|-------|---------|---------|-----|-----|------|----|----|------|
| 97312 | 20500 | 28.5697 | 80.5864 | 162 | 298 | 12.1 |    |    | 1102 |
| 97312 | 20500 | 28.5697 | 80.5864 | 204 | 298 | 12.1 | 59 | 51 | 1102 |
| 97312 | 20500 | 28.4843 | 80.7856 | 6   |     |      | 59 | 53 | 1204 |
| 97312 | 20500 | 28.4843 | 80.7856 | 54  | 283 | 2.9  |    |    | 1204 |
| 97312 | 20500 | 28.6445 | 80.9034 | 6   |     |      |    |    | 1215 |
| 97312 | 20500 | 28.4114 | 80.9284 | 6   |     |      | 56 | 51 | 1500 |
| 97312 | 20500 | 28.4114 | 80.9284 | 54  | 280 | 4.1  |    |    | 1500 |
| 97312 | 20500 | 28.4475 | 80.8538 | 6   |     |      |    |    | 1502 |
| 97312 | 20500 | 28.4960 | 80.8843 | 6   |     |      |    |    | 1605 |
| 97312 | 20500 | 28.4960 | 80.8843 | 54  |     |      |    |    | 1605 |
| 97312 | 20500 | 28.5583 | 80.9132 | 6   |     |      |    |    | 1609 |
| 97312 | 20500 | 28.6173 | 80.9581 | 6   |     |      | 56 | 55 | 1612 |
| 97312 | 20500 | 28.6173 | 80.9581 | 54  | 266 | 5.1  |    |    | 1612 |
| 97312 | 20500 | 28.6762 | 80.9987 | 6   |     |      | 58 | 54 | 1617 |
| 97312 | 20500 | 28.6762 | 80.9987 | 54  | 305 | 7.0  |    |    | 1617 |
| 97312 | 20500 | 28.5231 | 81.0100 | 6   |     |      | 57 | 52 | 2008 |
| 97312 | 20500 | 28.5231 | 81.0100 | 54  | 274 | 5.1  |    |    | 2008 |
| 97312 | 20500 | 28.6489 | 81.0693 | 6   |     |      | 56 | 52 | 2016 |
| 97312 | 20500 | 28.6489 | 81.0693 | 54  | 298 | 6.0  |    |    | 2016 |
| 97312 | 20500 | 28.4417 | 81.0291 | 6   |     |      |    |    | 2202 |
| 97312 | 20500 | 28.4417 | 81.0291 | 54  |     |      |    |    | 2202 |
| 97312 | 20500 | 28.6256 | 80.6571 | 6   |     |      | 57 | 52 | 3131 |
| 97312 | 20500 | 28.6256 | 80.6571 | 12  | 292 | 2.9  |    |    | 3131 |
| 97312 | 20500 | 28.6256 | 80.6571 | 54  | 302 | 6.0  | 58 | 51 | 3131 |
| 97312 | 20500 | 28.6256 | 80.6571 | 162 | 296 | 11.1 |    |    | 3131 |
| 97312 | 20500 | 28.6256 | 80.6571 | 204 | 297 | 12.1 | 58 | 51 | 3131 |
| 97312 | 20500 | 28.6256 | 80.6571 | 295 | 302 | 14.0 |    |    | 3131 |
| 97312 | 20500 | 28.6256 | 80.6571 | 394 | 299 | 15.0 |    |    | 3131 |
| 97312 | 20500 | 28.6256 | 80.6571 | 492 | 294 | 15.9 | 57 | 51 | 3131 |
| 97312 | 20500 | 28.6256 | 80.6571 | 6   |     |      | 57 | 52 | 3132 |
| 97312 | 20500 | 28.6256 | 80.6571 | 12  | 296 | 2.9  |    |    | 3132 |
| 97312 | 20500 | 28.6256 | 80.6571 | 54  | 304 | 6.0  | 58 | 52 | 3132 |
| 97312 | 20500 | 28.6256 | 80.6571 | 162 | 304 | 11.1 |    |    | 3132 |
| 97312 | 20500 | 28.6256 | 80.6571 | 204 | 308 | 12.1 | 58 | 51 | 3132 |
| 97312 | 20500 | 28.6256 | 80.6571 | 295 | 305 | 14.0 |    |    | 3132 |
| 97312 | 20500 | 28.6256 | 80.6571 | 394 | 309 | 15.0 |    |    | 3132 |
| 97312 | 20500 | 28.6256 | 80.6571 | 492 | 310 | 11.1 | 56 | 50 | 3132 |
| 97312 | 20500 | 28.3932 | 80.8211 | 6   |     |      | 59 | 53 | 9001 |
| 97312 | 20500 | 28.3932 | 80.8211 | 54  | 294 | 6.0  |    |    | 9001 |
| 97312 | 20500 | 28.3382 | 80.7321 | 6   |     |      | 59 | 54 | 9404 |
| 97312 | 20500 | 28.3382 | 80.7321 | 54  | 290 | 4.1  |    |    | 9404 |

| DAY   | TIME  | LAT     | LON     | Z   | DIR | SPD  | T  | TD | TIDN |
|-------|-------|---------|---------|-----|-----|------|----|----|------|
| 97312 | 21000 | 28.4338 | 80.5734 | 6   |     |      | 59 |    | 1    |
| 97312 | 21000 | 28.4338 | 80.5734 | 12  | 287 | 2.9  |    |    | 1    |
| 97312 | 21000 | 28.4338 | 80.5734 | 54  | 266 | 8.0  | 60 |    | 1    |
| 97312 | 21000 | 28.4443 | 80.5621 | 6   |     |      | 60 | 52 | 2    |
| 97312 | 21000 | 28.4443 | 80.5621 | 12  | 301 | 2.9  |    |    | 2    |
| 97312 | 21000 | 28.4443 | 80.5621 | 54  | 307 | 7.0  | 60 | 52 | 2    |
| 97312 | 21000 | 28.4443 | 80.5621 | 90  | 307 | 8.9  |    |    | 2    |
| 97312 | 21000 | 28.4443 | 80.5621 | 162 | 306 | 11.1 |    |    | 2    |
| 97312 | 21000 | 28.4443 | 80.5621 | 204 | 305 | 12.1 | 60 | 52 | 2    |
| 97312 | 21000 | 28.4443 | 80.5621 | 6   |     |      | 59 | 52 | 2    |
| 97312 | 21000 | 28.4443 | 80.5621 | 12  | 300 | 2.9  |    |    | 2    |
| 97312 | 21000 | 28.4443 | 80.5621 | 54  | 304 | 6.0  | 60 | 53 | 2    |
| 97312 | 21000 | 28.4443 | 80.5621 | 90  | 305 | 8.0  |    |    | 2    |
| 97312 | 21000 | 28.4443 | 80.5621 | 162 | 305 | 9.9  |    |    | 2    |

|       |       |         |         |     |     |      |    |    |     |
|-------|-------|---------|---------|-----|-----|------|----|----|-----|
| 97312 | 21000 | 28.4443 | 80.5621 | 204 | 291 | 9.9  | 60 | 52 | 2   |
| 97312 | 21000 | 28.4598 | 80.5267 | 6   |     |      | 59 |    | 3   |
| 97312 | 21000 | 28.4598 | 80.5267 | 12  | 310 | 5.1  |    |    | 3   |
| 97312 | 21000 | 28.4598 | 80.5267 | 54  | 299 | 8.0  |    |    | 3   |
| 97312 | 21000 | 28.4466 | 80.5652 | 6   |     |      |    |    | 17  |
| 97312 | 21000 | 28.7435 | 80.7005 | 6   |     |      | 61 | 55 | 19  |
| 97312 | 21000 | 28.7435 | 80.7005 | 54  | 322 | 11.1 |    |    | 19  |
| 97312 | 21000 | 28.7975 | 80.7378 | 6   |     |      | 61 | 54 | 22  |
| 97312 | 21000 | 28.7975 | 80.7378 | 54  | 304 | 12.1 |    |    | 22  |
| 97312 | 21000 | 28.4721 | 80.5393 | 6   |     |      |    |    | 36  |
| 97312 | 21000 | 28.4721 | 80.5393 | 90  | 312 | 8.0  |    |    | 36  |
| 97312 | 21000 | 28.5622 | 80.5785 | 6   |     |      |    |    | 40  |
| 97312 | 21000 | 28.5622 | 80.5785 | 54  | 299 | 11.1 |    |    | 40  |
| 97312 | 21000 | 28.5836 | 80.5842 | 6   |     |      |    |    | 41  |
| 97312 | 21000 | 28.5836 | 80.5842 | 54  | 288 | 11.1 |    |    | 41  |
| 97312 | 21000 | 28.5130 | 80.5613 | 6   |     |      | 63 | 58 | 61  |
| 97312 | 21000 | 28.5130 | 80.5613 | 12  | 303 | 2.9  |    |    | 61  |
| 97312 | 21000 | 28.5130 | 80.5613 | 54  | 303 | 7.0  | 59 | 51 | 61  |
| 97312 | 21000 | 28.5130 | 80.5613 | 162 | 302 | 12.1 |    |    | 61  |
| 97312 | 21000 | 28.5130 | 80.5613 | 204 | 310 | 13.0 | 60 | 52 | 61  |
| 97312 | 21000 | 28.5130 | 80.5613 | 6   |     |      | 59 | 52 | 62  |
| 97312 | 21000 | 28.5130 | 80.5613 | 12  | 295 | 2.9  |    |    | 62  |
| 97312 | 21000 | 28.5130 | 80.5613 | 54  | 296 | 7.0  | 59 | 53 | 62  |
| 97312 | 21000 | 28.5130 | 80.5613 | 162 | 297 | 11.1 |    |    | 62  |
| 97312 | 21000 | 28.5130 | 80.5613 | 204 | 300 | 11.1 | 59 | 56 | 62  |
| 97312 | 21000 | 28.5358 | 80.5747 | 6   |     |      | 60 |    | 108 |
| 97312 | 21000 | 28.5358 | 80.5747 | 12  | 297 | 5.1  |    |    | 108 |
| 97312 | 21000 | 28.5358 | 80.5747 | 54  | 294 | 8.0  | 60 |    | 108 |
| 97312 | 21000 | 28.6141 | 80.6203 | 6   |     |      | 56 |    | 112 |
| 97312 | 21000 | 28.6141 | 80.6203 | 12  | 290 | 1.9  |    |    | 112 |
| 97312 | 21000 | 28.6141 | 80.6203 | 54  | 290 | 6.0  | 58 |    | 112 |
| 97312 | 21000 | 28.4048 | 80.6519 | 6   |     |      | 62 | 55 | 300 |
| 97312 | 21000 | 28.4048 | 80.6519 | 54  | 294 | 9.9  |    |    | 300 |
| 97312 | 21000 | 28.4600 | 80.5711 | 6   |     |      | 57 |    | 303 |
| 97312 | 21000 | 28.4600 | 80.5711 | 12  | 290 | 1.9  |    |    | 303 |
| 97312 | 21000 | 28.4600 | 80.5711 | 54  | 293 | 5.1  | 59 |    | 303 |
| 97312 | 21000 | 28.6027 | 80.6414 | 6   |     |      | 59 |    | 311 |
| 97312 | 21000 | 28.6027 | 80.6414 | 12  | 304 | 2.9  |    |    | 311 |
| 97312 | 21000 | 28.6027 | 80.6414 | 54  | 300 | 4.1  | 58 |    | 311 |
| 97312 | 21000 | 28.6105 | 80.6069 | 6   |     |      |    |    | 393 |
| 97312 | 21000 | 28.6105 | 80.6069 | 60  | 288 | 8.0  | 58 | 53 | 393 |
| 97312 | 21000 | 28.6057 | 80.6016 | 6   |     |      | 57 | 52 | 394 |
| 97312 | 21000 | 28.6057 | 80.6016 | 60  | 293 | 8.0  | 58 | 52 | 394 |
| 97312 | 21000 | 28.6294 | 80.6235 | 6   |     |      |    |    | 397 |
| 97312 | 21000 | 28.6294 | 80.6235 | 60  | 293 | 8.9  | 58 | 52 | 397 |
| 97312 | 21000 | 28.6248 | 80.6182 | 6   |     |      | 58 | 52 | 398 |
| 97312 | 21000 | 28.6248 | 80.6182 | 60  | 290 | 8.0  | 58 | 52 | 398 |
| 97312 | 21000 | 28.4586 | 80.5923 | 6   |     |      | 60 |    | 403 |
| 97312 | 21000 | 28.4586 | 80.5923 | 12  | 301 | 5.1  |    |    | 403 |
| 97312 | 21000 | 28.4586 | 80.5923 | 54  | 295 | 8.0  | 60 |    | 403 |
| 97312 | 21000 | 28.6062 | 80.6739 | 6   |     |      | 57 |    | 412 |
| 97312 | 21000 | 28.6062 | 80.6739 | 12  | 297 | 1.9  |    |    | 412 |
| 97312 | 21000 | 28.6062 | 80.6739 | 54  | 299 | 4.1  | 58 |    | 412 |
| 97312 | 21000 | 28.6586 | 80.6998 | 6   |     |      | 57 |    | 415 |
| 97312 | 21000 | 28.6586 | 80.6998 | 12  | 280 | 1.9  |    |    | 415 |
| 97312 | 21000 | 28.6586 | 80.6998 | 54  | 307 | 1.9  | 58 |    | 415 |
| 97312 | 21000 | 28.7055 | 80.7265 | 6   |     |      | 61 | 55 | 418 |

|       |       |         |         |     |     |      |    |    |      |
|-------|-------|---------|---------|-----|-----|------|----|----|------|
| 97312 | 21000 | 28.7055 | 80.7265 | 54  | 309 | 7.0  |    |    | 418  |
| 97312 | 21000 | 28.7755 | 80.8043 | 6   |     |      | 61 | 56 | 421  |
| 97312 | 21000 | 28.7755 | 80.8043 | 54  | 291 | 9.9  |    |    | 421  |
| 97312 | 21000 | 28.5158 | 80.6400 | 6   |     |      | 59 |    | 506  |
| 97312 | 21000 | 28.5158 | 80.6400 | 12  | 298 | 2.9  |    |    | 506  |
| 97312 | 21000 | 28.5158 | 80.6400 | 54  | 305 | 5.1  | 60 |    | 506  |
| 97312 | 21000 | 28.5623 | 80.6694 | 6   |     |      | 58 |    | 509  |
| 97312 | 21000 | 28.5623 | 80.6694 | 12  | 317 | 2.9  |    |    | 509  |
| 97312 | 21000 | 28.5623 | 80.6694 | 54  | 308 | 5.1  | 59 |    | 509  |
| 97312 | 21000 | 28.5986 | 80.6817 | 6   |     |      |    |    | 511  |
| 97312 | 21000 | 28.5986 | 80.6817 | 30  | 302 | 8.0  |    |    | 511  |
| 97312 | 21000 | 28.6160 | 80.6930 | 6   |     |      | 61 | 52 | 512  |
| 97312 | 21000 | 28.6160 | 80.6930 | 30  | 300 | 8.9  |    |    | 512  |
| 97312 | 21000 | 28.6307 | 80.7027 | 6   |     |      |    |    | 513  |
| 97312 | 21000 | 28.6307 | 80.7027 | 30  | 306 | 8.0  |    |    | 513  |
| 97312 | 21000 | 28.6431 | 80.7482 | 6   |     |      | 58 |    | 714  |
| 97312 | 21000 | 28.6431 | 80.7482 | 12  | 311 | 1.9  |    |    | 714  |
| 97312 | 21000 | 28.6431 | 80.7482 | 54  | 302 | 8.0  | 58 |    | 714  |
| 97312 | 21000 | 28.4632 | 80.6702 | 6   |     |      | 58 |    | 803  |
| 97312 | 21000 | 28.4632 | 80.6702 | 12  | 305 | 1.0  |    |    | 803  |
| 97312 | 21000 | 28.4632 | 80.6702 | 54  | 297 | 2.9  | 58 |    | 803  |
| 97312 | 21000 | 28.5184 | 80.6962 | 6   |     |      | 69 |    | 805  |
| 97312 | 21000 | 28.5184 | 80.6962 | 12  | 298 | 4.1  |    |    | 805  |
| 97312 | 21000 | 28.5184 | 80.6962 | 54  | 292 | 7.0  | 59 |    | 805  |
| 97312 | 21000 | 28.7464 | 80.8707 | 6   |     |      | 57 | 52 | 819  |
| 97312 | 21000 | 28.7464 | 80.8707 | 54  | 296 | 5.1  |    |    | 819  |
| 97312 | 21000 | 28.4079 | 80.7604 | 6   |     |      | 58 | 53 | 1000 |
| 97312 | 21000 | 28.4079 | 80.7604 | 54  | 291 | 8.0  |    |    | 1000 |
| 97312 | 21000 | 28.5272 | 80.7742 | 6   |     |      | 59 | 54 | 1007 |
| 97312 | 21000 | 28.5272 | 80.7742 | 54  | 279 | 8.0  |    |    | 1007 |
| 97312 | 21000 | 28.6056 | 80.8248 | 6   |     |      | 60 | 52 | 1012 |
| 97312 | 21000 | 28.6056 | 80.8248 | 54  | 297 | 2.9  |    |    | 1012 |
| 97312 | 21000 | 28.5697 | 80.5864 | 6   |     |      | 60 | 55 | 1101 |
| 97312 | 21000 | 28.5697 | 80.5864 | 12  | 301 | 6.0  |    |    | 1101 |
| 97312 | 21000 | 28.5697 | 80.5864 | 54  | 294 | 11.1 | 60 | 53 | 1101 |
| 97312 | 21000 | 28.5697 | 80.5864 | 162 | 304 | 13.0 |    |    | 1101 |
| 97312 | 21000 | 28.5697 | 80.5864 | 204 | 301 | 13.0 | 59 | 51 | 1101 |
| 97312 | 21000 | 28.5697 | 80.5864 | 6   |     |      | 60 | 54 | 1102 |
| 97312 | 21000 | 28.5697 | 80.5864 | 12  | 304 | 5.1  |    |    | 1102 |
| 97312 | 21000 | 28.5697 | 80.5864 | 54  | 290 | 9.9  | 60 | 52 | 1102 |
| 97312 | 21000 | 28.5697 | 80.5864 | 162 | 296 | 12.1 |    |    | 1102 |
| 97312 | 21000 | 28.5697 | 80.5864 | 204 | 297 | 12.1 | 59 | 51 | 1102 |
| 97312 | 21000 | 28.4843 | 80.7856 | 6   |     |      | 58 | 53 | 1204 |
| 97312 | 21000 | 28.4843 | 80.7856 | 54  | 279 | 2.9  |    |    | 1204 |
| 97312 | 21000 | 28.6445 | 80.9034 | 6   |     |      |    |    | 1215 |
| 97312 | 21000 | 28.4114 | 80.9284 | 6   |     |      | 56 | 51 | 1500 |
| 97312 | 21000 | 28.4114 | 80.9284 | 54  | 285 | 4.1  |    |    | 1500 |
| 97312 | 21000 | 28.4475 | 80.8538 | 6   |     |      |    |    | 1502 |
| 97312 | 21000 | 28.4960 | 80.8843 | 6   |     |      |    |    | 1605 |
| 97312 | 21000 | 28.4960 | 80.8843 | 54  |     |      |    |    | 1605 |
| 97312 | 21000 | 28.5583 | 80.9132 | 6   |     |      |    |    | 1609 |
| 97312 | 21000 | 28.6173 | 80.9581 | 6   |     |      | 56 | 55 | 1612 |
| 97312 | 21000 | 28.6173 | 80.9581 | 54  | 272 | 5.1  |    |    | 1612 |
| 97312 | 21000 | 28.6762 | 80.9987 | 6   |     |      | 58 | 54 | 1617 |
| 97312 | 21000 | 28.6762 | 80.9987 | 54  | 301 | 7.0  |    |    | 1617 |
| 97312 | 21000 | 28.5231 | 81.0100 | 6   |     |      | 57 | 52 | 2008 |
| 97312 | 21000 | 28.5231 | 81.0100 | 54  | 277 | 5.1  |    |    | 2008 |

|       |       |         |         |     |     |      |    |    |      |
|-------|-------|---------|---------|-----|-----|------|----|----|------|
| 97312 | 21000 | 28.6489 | 81.0693 | 6   |     |      | 55 | 52 | 2016 |
| 97312 | 21000 | 28.6489 | 81.0693 | 54  | 297 | 5.1  |    |    | 2016 |
| 97312 | 21000 | 28.4417 | 81.0291 | 6   |     |      |    |    | 2202 |
| 97312 | 21000 | 28.4417 | 81.0291 | 54  |     |      |    |    | 2202 |
| 97312 | 21000 | 28.6256 | 80.6571 | 6   |     |      | 56 | 51 | 3131 |
| 97312 | 21000 | 28.6256 | 80.6571 | 12  | 287 | 2.9  |    |    | 3131 |
| 97312 | 21000 | 28.6256 | 80.6571 | 54  | 299 | 6.0  | 57 | 51 | 3131 |
| 97312 | 21000 | 28.6256 | 80.6571 | 162 | 297 | 11.1 |    |    | 3131 |
| 97312 | 21000 | 28.6256 | 80.6571 | 204 | 296 | 12.1 | 58 | 51 | 3131 |
| 97312 | 21000 | 28.6256 | 80.6571 | 295 | 303 | 15.0 |    |    | 3131 |
| 97312 | 21000 | 28.6256 | 80.6571 | 394 | 299 | 15.9 |    |    | 3131 |
| 97312 | 21000 | 28.6256 | 80.6571 | 492 | 295 | 16.9 | 57 | 51 | 3131 |
| 97312 | 21000 | 28.6256 | 80.6571 | 6   |     |      | 57 | 52 | 3132 |
| 97312 | 21000 | 28.6256 | 80.6571 | 12  | 287 | 2.9  |    |    | 3132 |
| 97312 | 21000 | 28.6256 | 80.6571 | 54  | 302 | 6.0  | 58 | 52 | 3132 |
| 97312 | 21000 | 28.6256 | 80.6571 | 162 | 305 | 11.1 |    |    | 3132 |
| 97312 | 21000 | 28.6256 | 80.6571 | 204 | 308 | 12.1 | 58 | 51 | 3132 |
| 97312 | 21000 | 28.6256 | 80.6571 | 295 | 306 | 14.0 |    |    | 3132 |
| 97312 | 21000 | 28.6256 | 80.6571 | 394 | 310 | 15.9 |    |    | 3132 |
| 97312 | 21000 | 28.6256 | 80.6571 | 492 | 311 | 15.9 | 57 | 50 | 3132 |
| 97312 | 21000 | 28.3932 | 80.8211 | 6   |     |      | 59 | 53 | 9001 |
| 97312 | 21000 | 28.3932 | 80.8211 | 54  | 294 | 5.1  |    |    | 9001 |
| 97312 | 21000 | 28.3382 | 80.7321 | 6   |     |      | 59 | 54 | 9404 |
| 97312 | 21000 | 28.3382 | 80.7321 | 54  | 290 | 5.1  |    |    | 9404 |

| DAY   | TIME  | LAT     | LON     | Z   | DIR | SPD  | T  | TD | TIDN |
|-------|-------|---------|---------|-----|-----|------|----|----|------|
| 97312 | 21500 | 28.4338 | 80.5734 | 6   |     |      | 59 |    | 1    |
| 97312 | 21500 | 28.4338 | 80.5734 | 12  | 292 | 4.1  |    |    | 1    |
| 97312 | 21500 | 28.4338 | 80.5734 | 54  | 266 | 8.0  | 60 |    | 1    |
| 97312 | 21500 | 28.4443 | 80.5621 | 6   |     |      | 59 | 52 | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 12  | 309 | 2.9  |    |    | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 54  | 313 | 5.1  | 60 | 52 | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 90  | 311 | 8.0  |    |    | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 162 | 308 | 9.9  |    |    | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 204 | 308 | 11.1 | 59 | 52 | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 6   |     |      | 59 | 52 | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 12  | 310 | 2.9  |    |    | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 54  | 311 | 5.1  | 60 | 53 | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 90  | 308 | 7.0  |    |    | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 162 | 307 | 8.0  |    |    | 2    |
| 97312 | 21500 | 28.4443 | 80.5621 | 204 | 294 | 8.0  | 59 | 52 | 2    |
| 97312 | 21500 | 28.4598 | 80.5267 | 6   |     |      | 59 |    | 3    |
| 97312 | 21500 | 28.4598 | 80.5267 | 12  | 311 | 6.0  |    |    | 3    |
| 97312 | 21500 | 28.4598 | 80.5267 | 54  | 301 | 8.0  |    |    | 3    |
| 97312 | 21500 | 28.4466 | 80.5652 | 6   |     |      |    |    | 17   |
| 97312 | 21500 | 28.7435 | 80.7005 | 6   |     |      | 61 | 55 | 19   |
| 97312 | 21500 | 28.7435 | 80.7005 | 54  | 318 | 11.1 |    |    | 19   |
| 97312 | 21500 | 28.7975 | 80.7378 | 6   |     |      | 60 | 54 | 22   |
| 97312 | 21500 | 28.7975 | 80.7378 | 54  | 300 | 14.0 |    |    | 22   |
| 97312 | 21500 | 28.4721 | 80.5393 | 6   |     |      |    |    | 36   |
| 97312 | 21500 | 28.4721 | 80.5393 | 90  | 309 | 8.9  |    |    | 36   |
| 97312 | 21500 | 28.5622 | 80.5785 | 6   |     |      |    |    | 40   |
| 97312 | 21500 | 28.5622 | 80.5785 | 54  | 299 | 9.9  |    |    | 40   |
| 97312 | 21500 | 28.5836 | 80.5842 | 6   |     |      |    |    | 41   |
| 97312 | 21500 | 28.5836 | 80.5842 | 54  | 290 | 9.9  |    |    | 41   |
| 97312 | 21500 | 28.5130 | 80.5613 | 6   |     |      | 63 | 58 | 61   |
| 97312 | 21500 | 28.5130 | 80.5613 | 12  | 297 | 4.1  |    |    | 61   |

|       |       |         |         |     |     |      |    |    |     |
|-------|-------|---------|---------|-----|-----|------|----|----|-----|
| 97312 | 21500 | 28.5130 | 80.5613 | 54  | 300 | 7.0  | 59 | 51 | 61  |
| 97312 | 21500 | 28.5130 | 80.5613 | 162 | 299 | 11.1 |    |    | 61  |
| 97312 | 21500 | 28.5130 | 80.5613 | 204 | 308 | 13.0 | 59 | 52 | 61  |
| 97312 | 21500 | 28.5130 | 80.5613 | 6   |     |      | 59 | 52 | 62  |
| 97312 | 21500 | 28.5130 | 80.5613 | 12  | 289 | 2.9  |    |    | 62  |
| 97312 | 21500 | 28.5130 | 80.5613 | 54  | 294 | 6.0  | 59 | 53 | 62  |
| 97312 | 21500 | 28.5130 | 80.5613 | 162 | 294 | 9.9  |    |    | 62  |
| 97312 | 21500 | 28.5130 | 80.5613 | 204 | 300 | 11.1 | 59 | 56 | 62  |
| 97312 | 21500 | 28.5358 | 80.5747 | 6   |     |      | 60 |    | 108 |
| 97312 | 21500 | 28.5358 | 80.5747 | 12  | 294 | 4.1  |    |    | 108 |
| 97312 | 21500 | 28.5358 | 80.5747 | 54  | 292 | 8.0  | 60 |    | 108 |
| 97312 | 21500 | 28.6141 | 80.6203 | 6   |     |      | 56 |    | 112 |
| 97312 | 21500 | 28.6141 | 80.6203 | 12  | 294 | 1.9  |    |    | 112 |
| 97312 | 21500 | 28.6141 | 80.6203 | 54  | 291 | 6.0  | 57 |    | 112 |
| 97312 | 21500 | 28.4048 | 80.6519 | 6   |     |      | 61 | 55 | 300 |
| 97312 | 21500 | 28.4048 | 80.6519 | 54  | 294 | 11.1 |    |    | 300 |
| 97312 | 21500 | 28.4600 | 80.5711 | 6   |     |      | 57 |    | 303 |
| 97312 | 21500 | 28.4600 | 80.5711 | 12  | 303 | 1.9  |    |    | 303 |
| 97312 | 21500 | 28.4600 | 80.5711 | 54  | 295 | 5.1  | 59 |    | 303 |
| 97312 | 21500 | 28.6027 | 80.6414 | 6   |     |      | 59 |    | 311 |
| 97312 | 21500 | 28.6027 | 80.6414 | 12  | 304 | 4.1  |    |    | 311 |
| 97312 | 21500 | 28.6027 | 80.6414 | 54  | 307 | 7.0  | 58 |    | 311 |
| 97312 | 21500 | 28.6105 | 80.6069 | 6   |     |      |    |    | 393 |
| 97312 | 21500 | 28.6105 | 80.6069 | 60  | 287 | 8.0  | 58 | 53 | 393 |
| 97312 | 21500 | 28.6057 | 80.6016 | 6   |     |      | 57 | 52 | 394 |
| 97312 | 21500 | 28.6057 | 80.6016 | 60  | 293 | 8.0  | 58 | 52 | 394 |
| 97312 | 21500 | 28.6294 | 80.6235 | 6   |     |      |    |    | 397 |
| 97312 | 21500 | 28.6294 | 80.6235 | 60  | 292 | 7.0  | 58 | 52 | 397 |
| 97312 | 21500 | 28.6248 | 80.6182 | 6   |     |      | 57 | 52 | 398 |
| 97312 | 21500 | 28.6248 | 80.6182 | 60  | 290 | 8.0  | 58 | 52 | 398 |
| 97312 | 21500 | 28.4586 | 80.5923 | 6   |     |      | 60 |    | 403 |
| 97312 | 21500 | 28.4586 | 80.5923 | 12  | 308 | 5.1  |    |    | 403 |
| 97312 | 21500 | 28.4586 | 80.5923 | 54  | 300 | 8.9  | 60 |    | 403 |
| 97312 | 21500 | 28.6062 | 80.6739 | 6   |     |      | 57 |    | 412 |
| 97312 | 21500 | 28.6062 | 80.6739 | 12  | 294 | 1.0  |    |    | 412 |
| 97312 | 21500 | 28.6062 | 80.6739 | 54  | 299 | 5.1  | 58 |    | 412 |
| 97312 | 21500 | 28.6586 | 80.6998 | 6   |     |      | 57 |    | 415 |
| 97312 | 21500 | 28.6586 | 80.6998 | 12  | 269 | 1.9  |    |    | 415 |
| 97312 | 21500 | 28.6586 | 80.6998 | 54  | 295 | 2.9  | 57 |    | 415 |
| 97312 | 21500 | 28.7055 | 80.7265 | 6   |     |      | 61 | 54 | 418 |
| 97312 | 21500 | 28.7055 | 80.7265 | 54  | 310 | 8.0  |    |    | 418 |
| 97312 | 21500 | 28.7755 | 80.8043 | 6   |     |      | 60 | 56 | 421 |
| 97312 | 21500 | 28.7755 | 80.8043 | 54  | 292 | 11.1 |    |    | 421 |
| 97312 | 21500 | 28.5158 | 80.6400 | 6   |     |      | 59 |    | 506 |
| 97312 | 21500 | 28.5158 | 80.6400 | 12  | 296 | 2.9  |    |    | 506 |
| 97312 | 21500 | 28.5158 | 80.6400 | 54  | 308 | 4.1  | 59 |    | 506 |
| 97312 | 21500 | 28.5623 | 80.6694 | 6   |     |      | 58 |    | 509 |
| 97312 | 21500 | 28.5623 | 80.6694 | 12  | 317 | 4.1  |    |    | 509 |
| 97312 | 21500 | 28.5623 | 80.6694 | 54  | 308 | 6.0  | 58 |    | 509 |
| 97312 | 21500 | 28.5986 | 80.6817 | 6   |     |      |    |    | 511 |
| 97312 | 21500 | 28.5986 | 80.6817 | 30  | 301 | 8.0  |    |    | 511 |
| 97312 | 21500 | 28.6160 | 80.6930 | 6   |     |      | 61 | 52 | 512 |
| 97312 | 21500 | 28.6160 | 80.6930 | 30  | 300 | 8.0  |    |    | 512 |
| 97312 | 21500 | 28.6307 | 80.7027 | 6   |     |      |    |    | 513 |
| 97312 | 21500 | 28.6307 | 80.7027 | 30  | 307 | 8.0  |    |    | 513 |
| 97312 | 21500 | 28.6431 | 80.7482 | 6   |     |      | 58 |    | 714 |
| 97312 | 21500 | 28.6431 | 80.7482 | 12  | 310 | 2.9  |    |    | 714 |

|       |       |         |         |         |      |    |      |
|-------|-------|---------|---------|---------|------|----|------|
| 97312 | 21500 | 28.6431 | 80.7482 | 54 302  | 8.0  | 58 | 714  |
| 97312 | 21500 | 28.4632 | 80.6702 | 6       |      | 58 | 803  |
| 97312 | 21500 | 28.4632 | 80.6702 | 12 306  | 1.0  |    | 803  |
| 97312 | 21500 | 28.4632 | 80.6702 | 54 300  | 2.9  | 58 | 803  |
| 97312 | 21500 | 28.5184 | 80.6962 | 6       |      | 69 | 805  |
| 97312 | 21500 | 28.5184 | 80.6962 | 12 292  | 4.1  |    | 805  |
| 97312 | 21500 | 28.5184 | 80.6962 | 54 295  | 8.0  | 59 | 805  |
| 97312 | 21500 | 28.7464 | 80.8707 | 6       |      | 57 | 819  |
| 97312 | 21500 | 28.7464 | 80.8707 | 54 295  | 4.1  |    | 819  |
| 97312 | 21500 | 28.4079 | 80.7604 | 6       |      | 57 | 1000 |
| 97312 | 21500 | 28.4079 | 80.7604 | 54 296  | 7.0  |    | 1000 |
| 97312 | 21500 | 28.5272 | 80.7742 | 6       |      | 59 | 1007 |
| 97312 | 21500 | 28.5272 | 80.7742 | 54 278  | 7.0  |    | 1007 |
| 97312 | 21500 | 28.6056 | 80.8248 | 6       |      | 59 | 1012 |
| 97312 | 21500 | 28.6056 | 80.8248 | 54 288  | 4.1  |    | 1012 |
| 97312 | 21500 | 28.5697 | 80.5864 | 6       |      | 60 | 1101 |
| 97312 | 21500 | 28.5697 | 80.5864 | 12 303  | 6.0  |    | 1101 |
| 97312 | 21500 | 28.5697 | 80.5864 | 54 296  | 11.1 | 60 | 1101 |
| 97312 | 21500 | 28.5697 | 80.5864 | 162 304 | 12.1 |    | 1101 |
| 97312 | 21500 | 28.5697 | 80.5864 | 204 300 | 13.0 | 58 | 1101 |
| 97312 | 21500 | 28.5697 | 80.5864 | 6       |      | 60 | 1102 |
| 97312 | 21500 | 28.5697 | 80.5864 | 12 304  | 5.1  |    | 1102 |
| 97312 | 21500 | 28.5697 | 80.5864 | 54 292  | 9.9  | 60 | 1102 |
| 97312 | 21500 | 28.5697 | 80.5864 | 162 296 | 11.1 |    | 1102 |
| 97312 | 21500 | 28.5697 | 80.5864 | 204 297 | 11.1 | 58 | 1102 |
| 97312 | 21500 | 28.4843 | 80.7856 | 6       |      | 58 | 1204 |
| 97312 | 21500 | 28.4843 | 80.7856 | 54 273  | 4.1  |    | 1204 |
| 97312 | 21500 | 28.6445 | 80.9034 | 6       |      |    | 1215 |
| 97312 | 21500 | 28.4114 | 80.9284 | 6       |      | 56 | 1500 |
| 97312 | 21500 | 28.4114 | 80.9284 | 54 284  | 4.1  |    | 1500 |
| 97312 | 21500 | 28.4475 | 80.8538 | 6       |      |    | 1502 |
| 97312 | 21500 | 28.4960 | 80.8843 | 6       |      |    | 1605 |
| 97312 | 21500 | 28.4960 | 80.8843 | 54      |      |    | 1605 |
| 97312 | 21500 | 28.5583 | 80.9132 | 6       |      |    | 1609 |
| 97312 | 21500 | 28.6173 | 80.9581 | 6       |      | 56 | 1612 |
| 97312 | 21500 | 28.6173 | 80.9581 | 54 271  | 5.1  |    | 1612 |
| 97312 | 21500 | 28.6762 | 80.9987 | 6       |      | 58 | 1617 |
| 97312 | 21500 | 28.6762 | 80.9987 | 54 300  | 7.0  |    | 1617 |
| 97312 | 21500 | 28.5231 | 81.0100 | 6       |      | 57 | 2008 |
| 97312 | 21500 | 28.5231 | 81.0100 | 54 274  | 4.1  |    | 2008 |
| 97312 | 21500 | 28.6489 | 81.0693 | 6       |      | 55 | 2016 |
| 97312 | 21500 | 28.6489 | 81.0693 | 54 289  | 5.1  |    | 2016 |
| 97312 | 21500 | 28.4417 | 81.0291 | 6       |      |    | 2202 |
| 97312 | 21500 | 28.4417 | 81.0291 | 54      |      |    | 2202 |
| 97312 | 21500 | 28.6256 | 80.6571 | 6       |      | 56 | 3131 |
| 97312 | 21500 | 28.6256 | 80.6571 | 12 287  | 2.9  |    | 3131 |
| 97312 | 21500 | 28.6256 | 80.6571 | 54 299  | 6.0  | 57 | 3131 |
| 97312 | 21500 | 28.6256 | 80.6571 | 162 296 | 11.1 |    | 3131 |
| 97312 | 21500 | 28.6256 | 80.6571 | 204 297 | 12.1 | 58 | 3131 |
| 97312 | 21500 | 28.6256 | 80.6571 | 295 303 | 15.0 |    | 3131 |
| 97312 | 21500 | 28.6256 | 80.6571 | 394 300 | 16.9 |    | 3131 |
| 97312 | 21500 | 28.6256 | 80.6571 | 492 296 | 16.9 | 57 | 3131 |
| 97312 | 21500 | 28.6256 | 80.6571 | 6       |      | 57 | 3132 |
| 97312 | 21500 | 28.6256 | 80.6571 | 12 288  | 2.9  |    | 3132 |
| 97312 | 21500 | 28.6256 | 80.6571 | 54 302  | 6.0  | 57 | 3132 |
| 97312 | 21500 | 28.6256 | 80.6571 | 162 305 | 11.1 |    | 3132 |
| 97312 | 21500 | 28.6256 | 80.6571 | 204 308 | 12.1 | 58 | 3132 |

|       |       |         |         |         |      |    |    |      |
|-------|-------|---------|---------|---------|------|----|----|------|
| 97312 | 21500 | 28.6256 | 80.6571 | 295 306 | 15.0 |    |    | 3132 |
| 97312 | 21500 | 28.6256 | 80.6571 | 394 311 | 15.9 |    |    | 3132 |
| 97312 | 21500 | 28.6256 | 80.6571 | 492 312 | 15.9 | 56 | 50 | 3132 |
| 97312 | 21500 | 28.3932 | 80.8211 | 6       |      | 58 | 53 | 9001 |
| 97312 | 21500 | 28.3932 | 80.8211 | 54 298  | 6.0  |    |    | 9001 |
| 97312 | 21500 | 28.3382 | 80.7321 | 6       |      | 59 | 54 | 9404 |
| 97312 | 21500 | 28.3382 | 80.7321 | 54 291  | 4.1  |    |    | 9404 |