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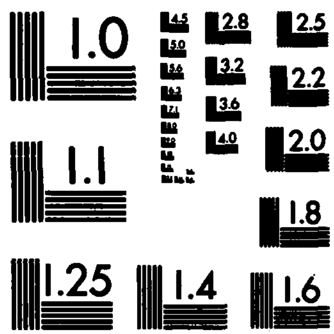

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High Resolution Stratospheric Winds From Chemical Smoke Trail Experiments at White Sands Missile Range and Wallops Island

ANTONIO F. QUESADA

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AERONOMY DIVISION PROJECT 6687
AIR FORCE GEOPHYSICS LABORATORY
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Alva T. Stair, Jr.

DR. ALVA T. STAIR, Jr
Chief Scientist

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This report describes some recent improvements in the hardware and software used to measure photographic images of chemical smoke trails. It also presents measurements of winds and windshears for five experiments conducted at White Sands Missile Range and Wallops Island from 1973 to 1978. In addition, it discusses sources of error in the measurements and suggests means of reducing the errors to improve the vertical resolution of the wind and windshear profiles.

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Preface

The author wishes to thank Mr. C.A. Trowbridge, who conducted the film measurements and was responsible for much of the data reduction. He also thanks Ms. P.M. Bench for the preparation of the wind hodographs.

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Contents

Illustrations

High Resolution Stratospheric Winds From Chemical Smoke Trail Experiments at White Sands Missile Range and Wallops Island

1. INTRODUCTION

During the past several years, the Air Force Geophysics Laboratory (AFGL), Aeronomy Division (LKD) has conducted a number of rocket experiments for the purpose of releasing in a controlled manner a thick trail of titanium tetrachloride to make high resolution measurements of stratospheric winds and windshears. The measurements show jagged wind profiles consistent with the view that turbulence in the stratosphere occurs in thin layers that form randomly. There are structural features in the wind field, corresponding to high spatial frequencies, that lead to high shears over short vertical distances. These, in turn, are responsible for the onset of instabilities that grow into flattened turbulent regions, accounting for some of the vertical transport of tracers or pollutants injected into the stratosphere. Zones of intermittent mixing are thus created which, in the course of time, have an effect analogous to a diffusion process with a characteristic diffusion parameter. The present report is concerned with a general description of improved technique used to reduce and analyze the raw photographic data. It also presents the wind and windshear data gathered in the course of five rocket flights for which the triangulation has been found to be both consistent and reproducible. Finally, the report contains

(Received for publication 29 July 1982)

a discussion of some possible means of improving the accuracy and resolution of stratospheric winds computed from smoke trail data. The transport problem has been addressed by Dewan.[1]

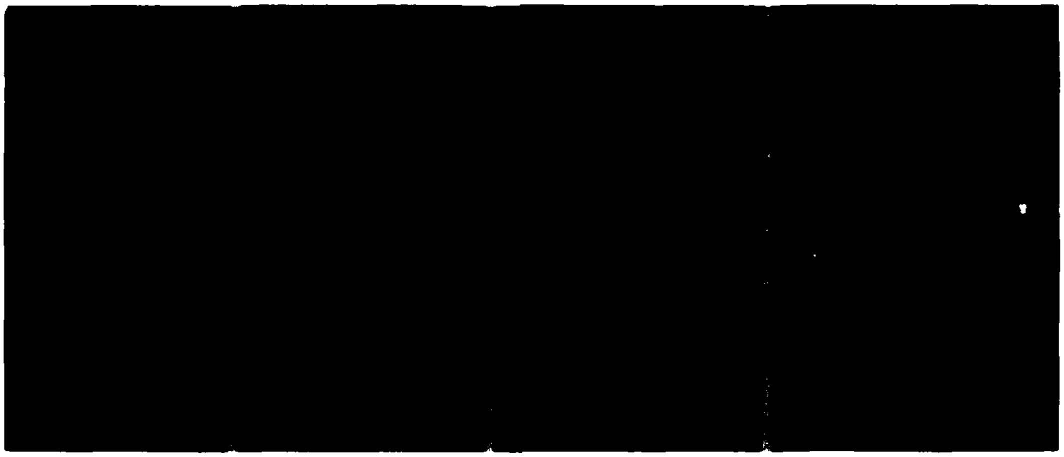
2. COLLECTION OF RAW DATA

Chemical vapor or smoke trails dispensed from rockets have been used for over two decades to serve as visible tracers of atmospheric wind speed and direction. For stratospheric altitudes AFGL/LKD utilizes a mixture of titanium tetrachloride and water-methanol solution to form a thick trail that follows the motions of the wind field, and remains well defined for periods of several minutes. At later times the spreading of the trail may be used to estimate the magnitude and altitude dependence of the molecular diffusion coefficient. Details of payload configuration, and vapor release hardware are given by Vickery[2] and by Stokes et al.[3] The trails are photographed at regular intervals from the time of their injection into the ambient air until they drift out of the field of view of the cameras, or have become too tenuous to be photographed. In most cases this happens some fifteen minutes after the chemical smoke is vented from the rocket. Figure 1 shows the evolution of one trail (Trail "20 MAY") photographed from a triangulation station located about 25 km northwest of the launching site. The cameras are located at two or more ground stations chosen, when possible, to optimize the geometrical factors that influence the accuracy of the triangulation procedure that, subsequently, will reconstruct the successive positions of each point on the trail. We shall not dwell here on the characteristics of the cameras, the film, the exposure sequence or the film development needed to obtain negatives with sufficiently high contrast and low granularity to allow the triangulation to have a vertical resolution of 10 meters or better. These characteristics were listed in an earlier report by Quesada and Trowbridge.[4] In the following sections we shall describe changes and

1. Dewan, E.M. (1981) Turbulent vertical transport due to thin intermittent mixing layers in the stratosphere and other stable fluids, Science **211**(No. 4486):1041-1042.
2. Vickery, W.K. (1975) Techniques for Depositing Visible Smoke Trails in the Stratosphere for Measurements of Winds and Turbulence, AFCRL-TR-75-0221, ADA013792.
3. Stokes, C.S., Murphy, W.J., and Smith, E.W. (1974) Experimental and Flight Evaluation of the Titanium Tetrachloride, Water-Methanol System for the Production of Smoke Trails, AFCRL-TR-74-0496, ADA006126.
4. Quesada, A.F., and Trowbridge, C.A. (1976) Analysis of Smoke Trail Photographs to Determine Stratospheric Winds and Shears, AFGL-TR-76-0243, ADA035504.

improvements introduced into the measurement of the trail and star background images, and in the triangulation procedure since publication of the report just referenced.

LAUNCH TIME (T_0) : 09 29 UT
APOGEE: 53.16 KM at T_0+119 s



T_0+128 s +158 s +218 s +308 s

Figure 1. Evolution of Trail "20 MAY". Launched at Wallops Island on 20 May 1978, and photographed from Triangulation site near Pocomoke City, Maryland

2.1 Camera Orientation

Precise wind measurements depend on the accuracy with which the orientation of the camera is determined. To observe the motion of segments of a trail at a 50-km range at 10-meter intervals, we cannot tolerate angular errors that exceed 0.005 degree. Fortunately, when considerable pointing errors exist, their presence becomes apparent during the triangulation and velocity determination. They produce abrupt discontinuities in the trail position, and excessively large wind shears. Pointing errors are introduced by a variety of causes; for example, wind gusts that momentarily jar the cameras, accidental operator contact with the camera mount, differential expansion of the mount due to uneven heating, misidentification of dim stars in the calibration frames, film stretching due to malfunction of the film processor, and so on. Optimization procedures may be applied to reduce errors of this type, but they generally produce slightly different wind fields, and we no longer use them. Vector procedures are used to determine the camera orientation and focal length from photographs of stars in the field of view of the cameras. They are described in various reports.[5,6] The vector procedures relate the star image positions in the film plane to their equatorial coordinates (right ascension and declination). The computations require knowing the time at which the calibration photograph was exposed and the camera site location on the Earth's surface (latitude, longitude, and height above mean sea level). These are taken from geodetic survey information with a target accuracy of 10 meters. Camera azimuth, elevation and horizontal tilt, and the precise focal length of the lens are determined with standard deviations consistent with the desired triangulation accuracy. For the cameras employed at the WSMR and Wallops Island experiments, standard deviations of 0.005 degree for the angles, and 0.01 cm for the focal lengths were routinely computed when 12 to 15 stars were used to determine the camera parameters. These deviations, translated to spatial positions, produce errors of the order of 5 meters at the (typically) 50-km range that separates the cameras from the center section of a stratospheric smoke trail.

2.2 Film Measurements

In principle, it is possible to use pairs of photographic negatives taken simultaneously from two separate ground stations to reconstruct the spatial location of the trail at the instant it was photographed. To do so, we must know the geographical location of the site and the orientation of each camera. The orientation of the cameras is usually defined by giving the azimuths and elevations of the optical axes. In addition, we must know the focal length of the lenses. In practice there are many pitfalls which may introduce small but unacceptable errors in the triangulation. Some have been discussed by Trowbridge,[7] together with means to minimize or compensate for their effects. The basic principle is to measure very accurately the coordinates of closely spaced points on the center-line of the trail image. To establish a reference coordinate system common to all photographs, fiducial marks are recorded on every frame when the trail is photographed. Since several hundred to a few thousand coordinate pairs must be measured on each frame, a semiautomatic, computer controlled densitometric system was designed and built to measure, digitize, and record these coordinates on magnetic tape. The instrument and the

5. Quesada, A.F. (1971) Application of Vector and Matrix Methods to Triangulation of Chemical Releases in the Upper Atmosphere, AFCRL-71-0233, AD729448.

6. Quesada, A.F. (1975) Vector Evaluation of Triangulation Camera Parameters From Star Photographs, AFCRL-TR-75-0451, ADA019655.

7. Trowbridge, C.A. (1982) Identification of Requirements for Atmospheric Data, AFGL-TR-82-0015, ADA113640.

software needed to make it operational were described by Trowbridge and Andrus.[8] Recently, a series of modifications was needed to reestablish the operational status of the instrument, many of whose digital components were over 10 years old and could not be replaced or repaired when they malfunctioned. The instrument is a video based system with an encoded stage that transports the film, and upon command from the computer aligns the optic axis of the video camera with any point of the photographic negative under examination. Electronics for processing the input signals were designed to provide adjustable operating ranges of approximately 0.5, 1.0, 1.5, and 3.0 optical density units (D). These ranges may be shifted to cover any portion of the total useful range (4D) of the densitometer. The system, shown diagrammatically in Figure 2, is unique in that gross alignment of features to be measured may be accomplished using distances and densities from the off-axis video. Fine positioning and measurement of the densities of desired features are performed on the video axis as the film is aligned with the axis by the moving stage. Thus, effects of field curvature, distortion, and system photometric nonuniformity (vignetting) are essentially removed. Final coordinate information is obtained only from the extremely accurate stage drive and encoders. The maximum error is less than 10 μm over a 150-mm total displacement, with repeatability and precision better than 2 μm.

The digitization procedure begins with the alignment of the film frame on the scanner, using two fiducial markers to set one axis of the film coordinate system perpendicular to one axis of the scanning system. A third fiducial is then used to determine one point of the second axis of the film coordinate net, whose center coincides with the camera optical axis. The trail digitization proper starts with the introduction of a trail "skeleton," that is, a series of guide points widely spaced along the trail image which are entered manually using a joy-stick control to transport the film to the desired positions. These points provide starting and ending points for the curve following software of the computer system, and allow both accurate determination of the coordinates of the trail axis, and motion in the proper direction along the trail, with minimal operator intervention. Proper direction along the trail is crucial, particularly at late times when very frequently the trail image shows closed loops that must be traversed in the correct direction, in order to avoid serious discontinuities in the triangulation.

Star calibration photographs require long exposures (2 min) and each star image is a narrow arc segment on the film, resulting from the Earth's rotation during the exposure time. The coordinates of the center point of each track (corresponding to a time midway between the beginning and end of the exposure) are found by

8. Trowbridge, C.A., and Andrus, W.S. (1978) An Automated Coordinate Measuring System for Smoke Trail Photographs, AFGL-TR-78-0231, ADA062485.

first digitizing and storing coordinates and densities measured on the axis of the arc. Density and position information are then transferred to the computer, which identifies the end points of the axial arc and calculates the position of its center. Star tracks have been found to provide star locations with a higher precision than obtained from the point images produced by short exposures.

2.3 Trail Position and Horizontal Velocity Measurements

The triangulation program uses the coordinates of the trail centerline as viewed from two sites, the site geodetic coordinates, and each camera orientation which, as explained previously, is derived from the star calibration photographs. In principle, this is sufficient to reconstruct the spatial location of the trail. We have implemented the vector-matrix techniques described in References 5 and 6 to create a software package that improves significantly the ease and speed of the triangulation. In practice, computational problems, such as described by Trowbridge et al,[9] may degrade the accuracy of the results over short sections of the trail and reduce the vertical resolution by a factor of approximately 2. One reason is that the trails generally have no features that can be uniquely identified on photographs taken simultaneously from widely separated locations. Triangulation is, therefore, performed using an iterative approach that minimizes discrepancies in the dihedral angle computed from each site to a given point on the trail. The quantity which is minimized, and serves as a figure of merit, is the angular mismatch between the normals to the dihedral planes, each of which is defined by the common line through the two observation sites and the lines-of-sight to the points that we wish to match. The spatial position of the trail (altitude, latitude and longitude) is determined, assuming a spherical Earth, from the intersection (or near intersection) of the line-of-sight vectors for points that have been matched. The data are stored for later use by the computer program that calculates the horizontal velocities from trail positions corresponding to known time intervals.

Improvements in the triangulation procedure were obtained by a change in the dihedral angle tolerances that resulted in point matching with a much higher accuracy. With tigher tolerances, about 50 percent of the digitized points are discarded during the triangulation. This means that the altitude resolution finally obtained is somewhat less than 10 m, although the raw data were digitized with about a 5-m resolution. Measures of "goodness of fit" for the triangulation other than control over the dihedral angle mismatch, such as average film plane mismatch and average separation vector, have also been improved by a factor of 10. There is also excellent agreement between the velocity profiles calculated from triangulation site number 1 against site number 2, or the reverse pairing.[7]

9. Trowbridge, C.A., Kofsky, I.L., and Johnson, R.H. (1978) Recording and Analysis of Optical Data From Stratospheric Dynamics Experiments, AFGL-TR-78-0015, ADA054013.

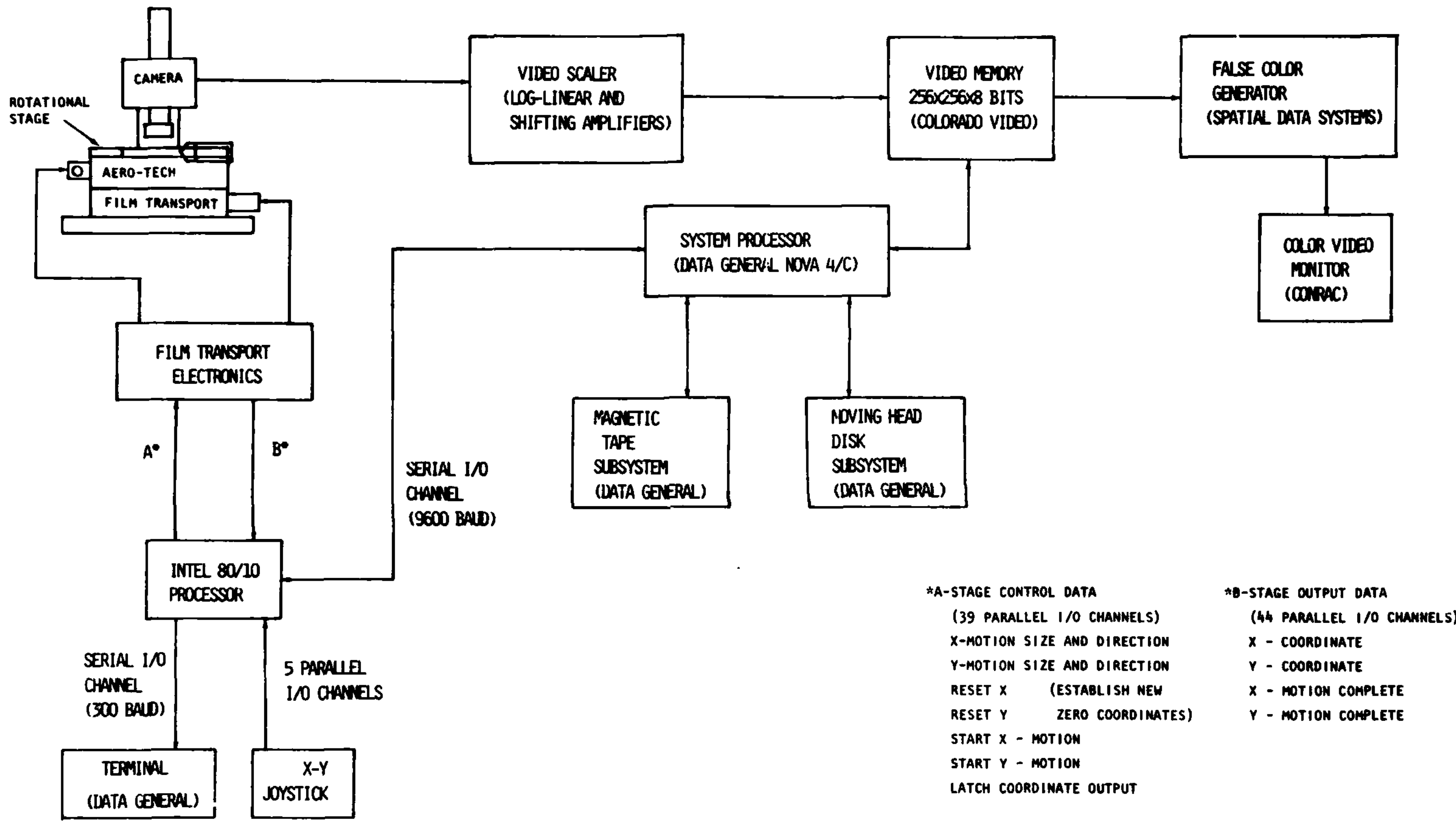


Figure 2. Block Diagram of the Coordinate Measuring System

Further study of the change in the triangulation procedure, that is, insisting that the dihedral angular mismatch be extremely small, has shown that it very effectively preserves trail continuity. The larger values of dihedral angle mismatch previously tolerated permitted an accumulation of error to occur, and grow up to a limit. This was followed by several consecutive mismatches, and then again by error buildup. The resulting sawtooth error generated small discontinuities (and occasionally larger ones) that proved to be troublesome when the shears were computed. Owing to the smaller percentage of matches obtained when a tight dihedral angle tolerance is introduced, some resolution is lost. We have estimated that in order to maintain an average 10-m vertical resolution, the raw data must be digitized at intervals of about 12 μm (on the film plane) for a 50-km range. The exact value depends on the degree of distortion of the trail induced by the wind field. By reducing the separation between consecutive scans to 12 μm, we will substantially increase the time required to digitize each frame. A possible reduction in the digitization workload has been suggested in Reference 7. It requires digitizing the films from one site at the nominal 10-m resolution, and the other site at a higher resolution.

With introduction of the change in the triangulation procedure, the major source of error for determining trail positions is the precision with which the camera orientation can be measured. Better measurements can be made if one records the start and end times of the exposure with an accuracy of 0.1 second. An increase in the number of stars used (currently 10 to 15) and a finer digitizing interval (typically 20 μm) could also contribute to more precise camera orientation parameters.

The next step of the smoke trail method is to determine winds from the point trail positions. The trail position data from the triangulation are interpolated at equal altitude intervals by either a cubic polynomial or a cubic spline. Then, a least-squares analysis of position versus time is introduced to derive average horizontal velocities. Ordinarily, we can use a sequence of 4 to 6 frames spanning an interval of about 2 to 3 minutes. Minor changes were made to the velocity routines to correct inconsistencies on the assignment of the time separation for sequential trail positions. The velocity values were unaffected by the change, but the uncertainty associated with each velocity was reduced by nearly a factor of 2.

3. WIND AND WINDSHEAR RESULTS

The wind measurements which will be presented in this section were made from raw data collected from 1973 to 1978. In Appendix A, we list the trails and star calibrations whose images were digitized. For the trails, some features of the smoke release are indicated. Some of the trails consist of up to 10 segments. By breaking up the trail in this manner, we can unambiguously identify common points on different views of the trail, and thus facilitate the operation of the triangulation package. Although the rocket vehicle and the smoke release mechanism after 1973 were selected to cover the altitude range 15 to 50 km, it is often impossible to use the entire length of the trail. For example, sometimes the camera viewing angles are optimum for the lower sections of the trail, but are much less adequate for the upper portions, whose images show multiple overlapping of segments or extreme foreshortening that obliterates structural details, or does not permit triangulation with the required resolution.

The following pages contain the results of our measurements in graphical form. In Appendix B we list a typical output of the triangulation and wind programs. A complete data file for all trails is available on magnetic tape.

For the winds, we have computed the East-West, North-South components, and the resultant wind speed. We have also computed some hodographs. In the shear diagrams we have displayed the values of

$$S = \sqrt{\left(\frac{V_{E-W}}{\Delta z}\right)^2 + \left(\frac{V_{N-S}}{\Delta z}\right)^2}$$

as a function of altitude.

We note that, in general, a hodograph covering an altitude interval of many kilometers in the stratosphere, is usually of limited value, because of the convoluted nature of the curve traced by the tip of the vector wind. This is well illustrated in Figure 20, where altitude ranges from 18 to 33 km. On the other hand, if the altitude interval extends over a few kilometers, as in Figure 19, the hodograph can be very informative.

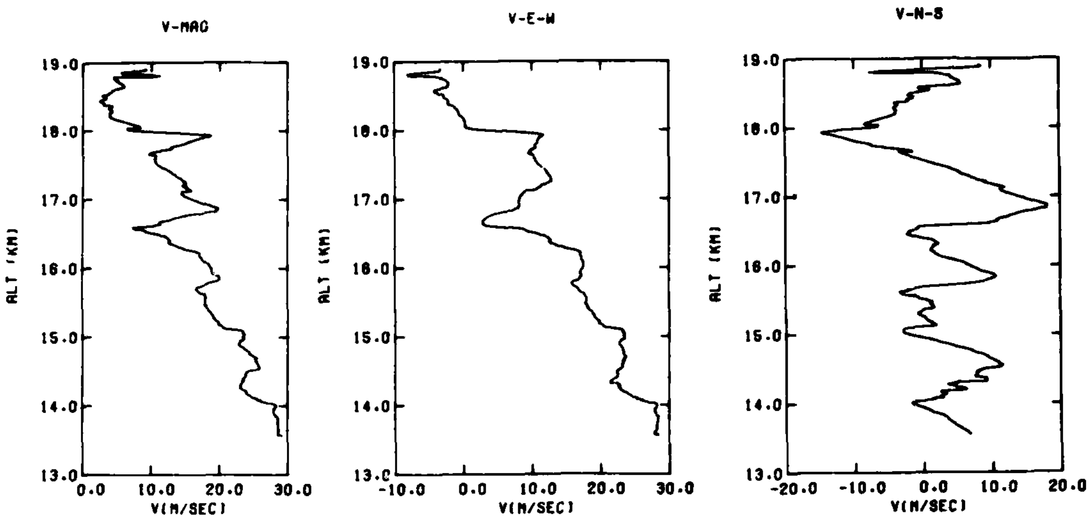


Figure 3. Wind vs Altitude for Trail "FLORA". Rocket launched at WSMR on 4 June 1973 at 1230 UT

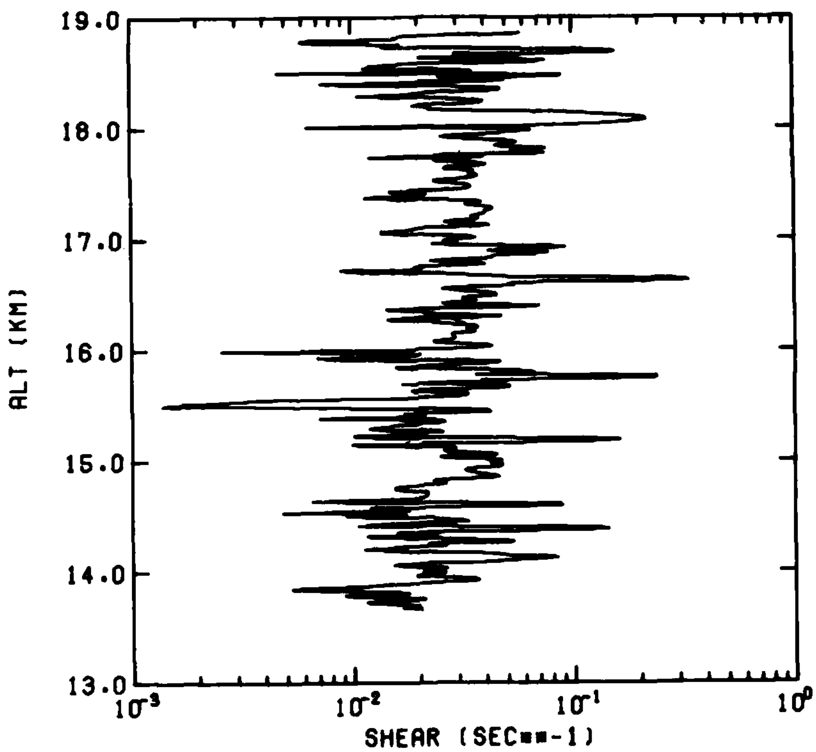


Figure 4. Windshear vs Altitude for Trail "FLORA"

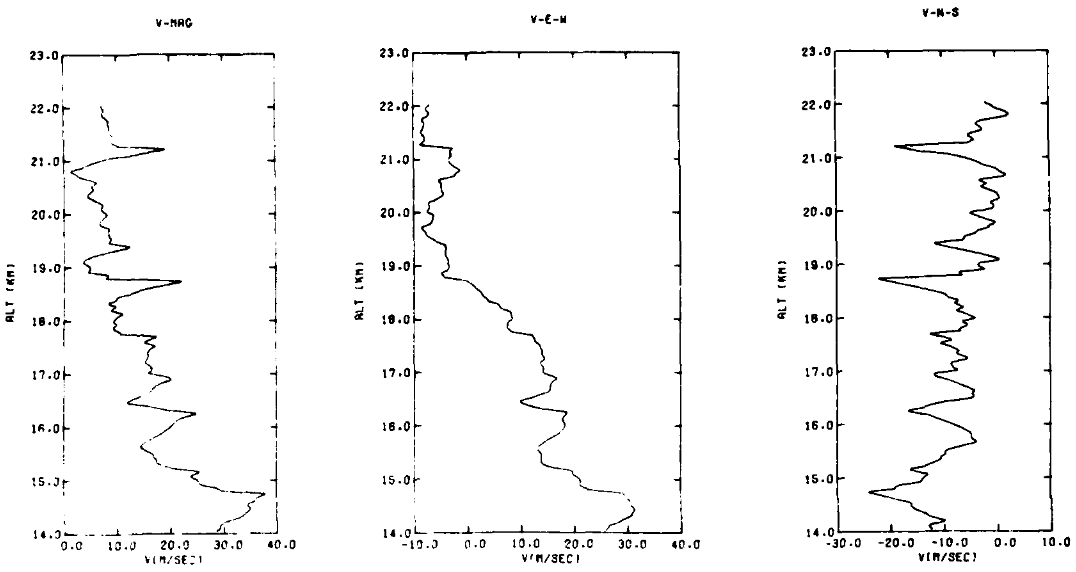


Figure 5. Wind vs Altitude for Trail "IRIS". Rocket launched from WSMR on 6 June 1973 at 1200 UT

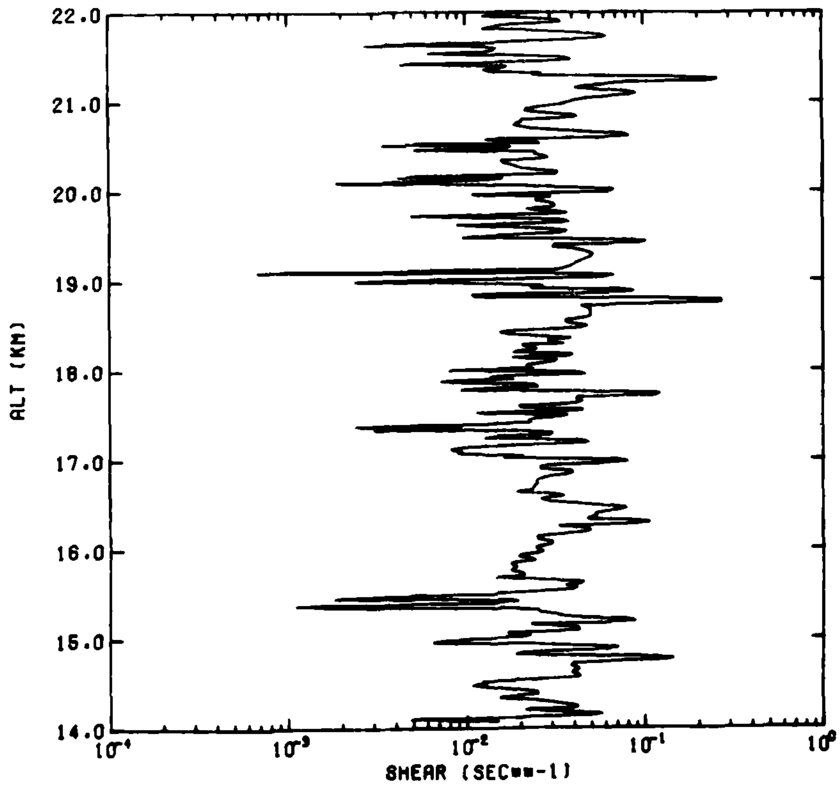


Figure 6. Windshear vs Altitude for Trail "IRIS"

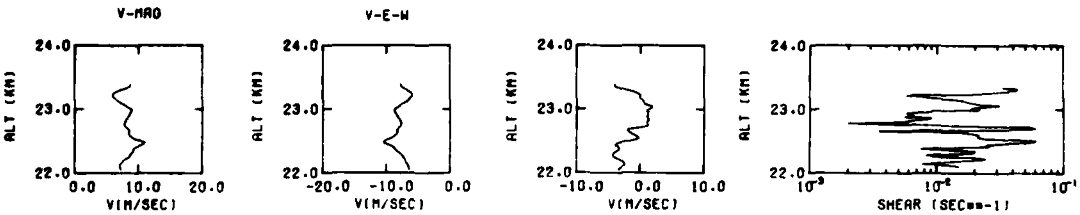


Figure 7. Wind and Windshear for Upper Section of Trail "IRIS"

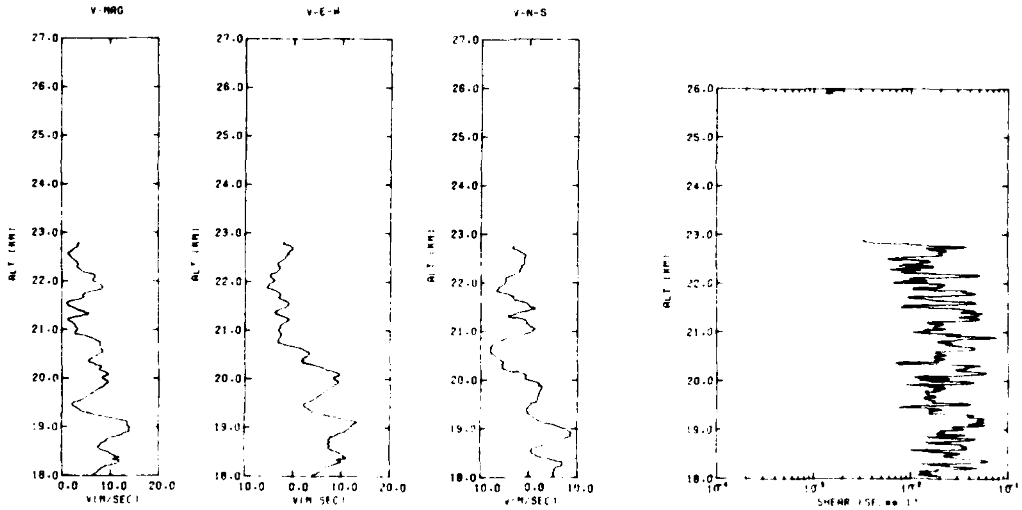


Figure 8. Wind and Windshear vs Altitude for Lower Section of Trail "22 APRIL". Rocket launched from WSMR on 22 April 1977 at 1215 UT

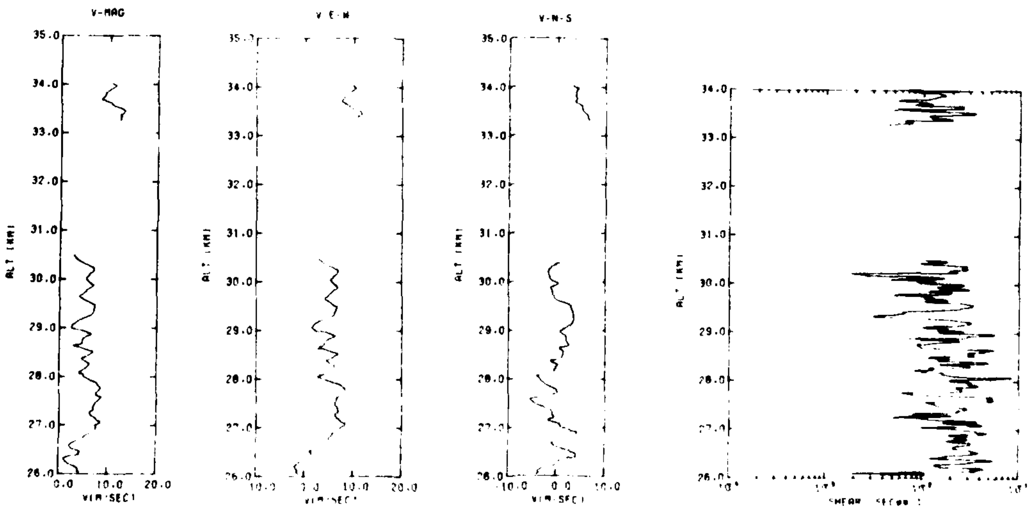


Figure 9. Wind and Windshear vs Altitude for Midsection of Trail "22 APRIL"

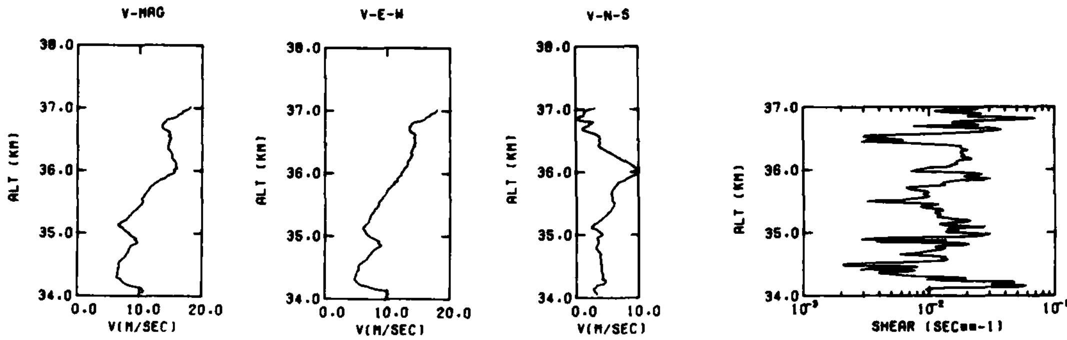


Figure 10. Wind and Windshear vs Altitude for Upper Section of Trail "22 APRIL"

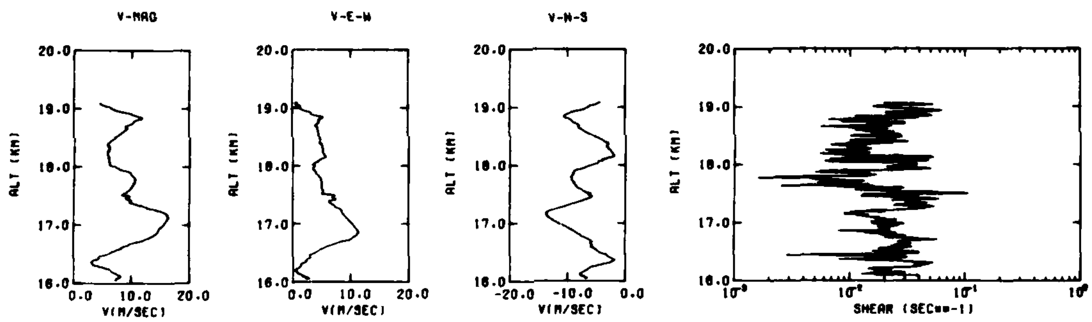


Figure 11. Wind and Windshear vs Altitude for Lower Section of Trail "20 MAY". Rocket launched from Wallops Island on 20 May 1978 at 0929 UT

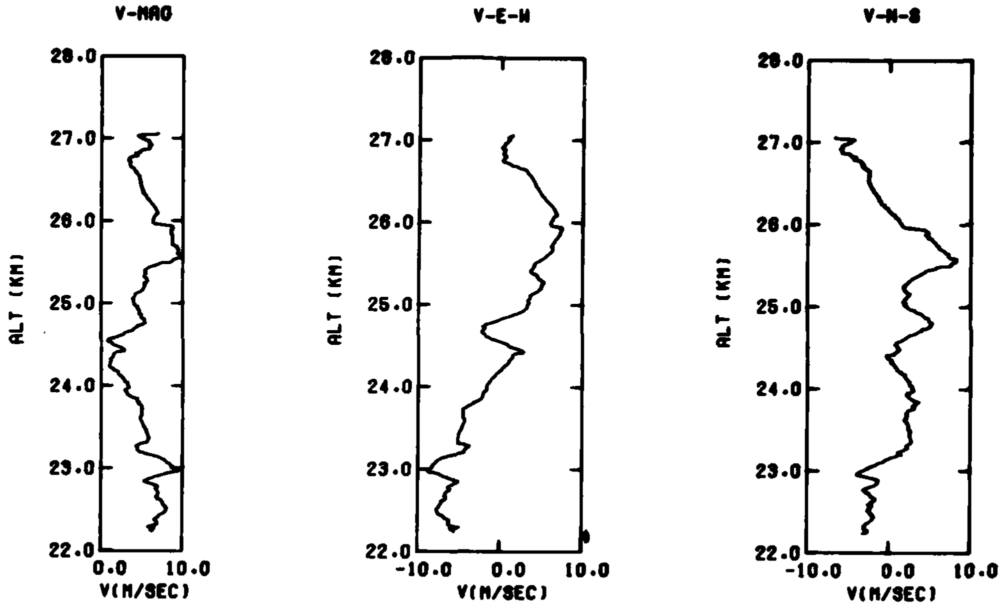


Figure 12. Wind vs Altitude for Mid-lower Section of Trail "20 MAY"

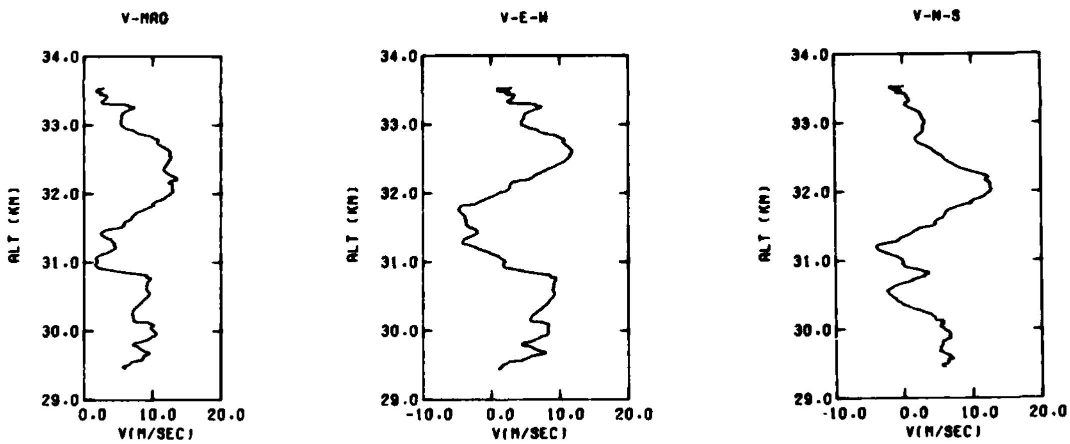


Figure 13. Wind vs Altitude for Mid-upper Section of Trail "20 MAY"

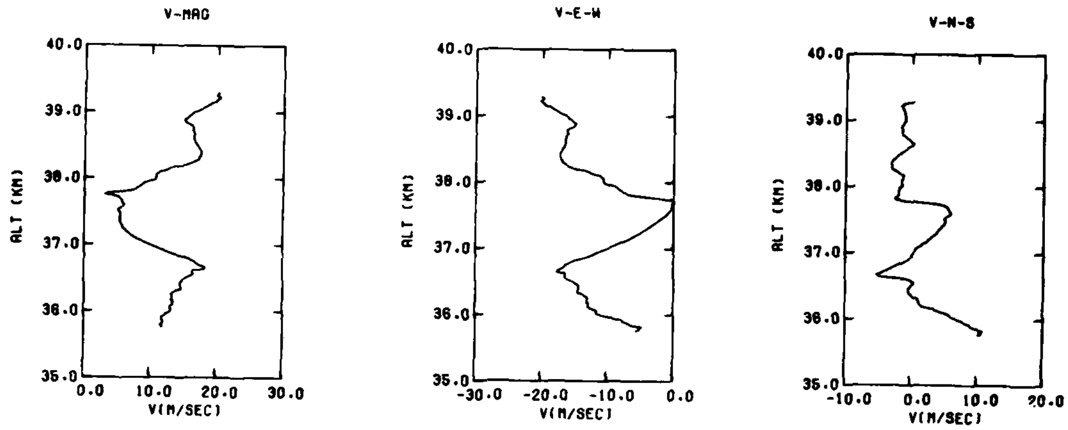


Figure 14. Wind vs Altitude for Upper Section of Trail "20 MAY"

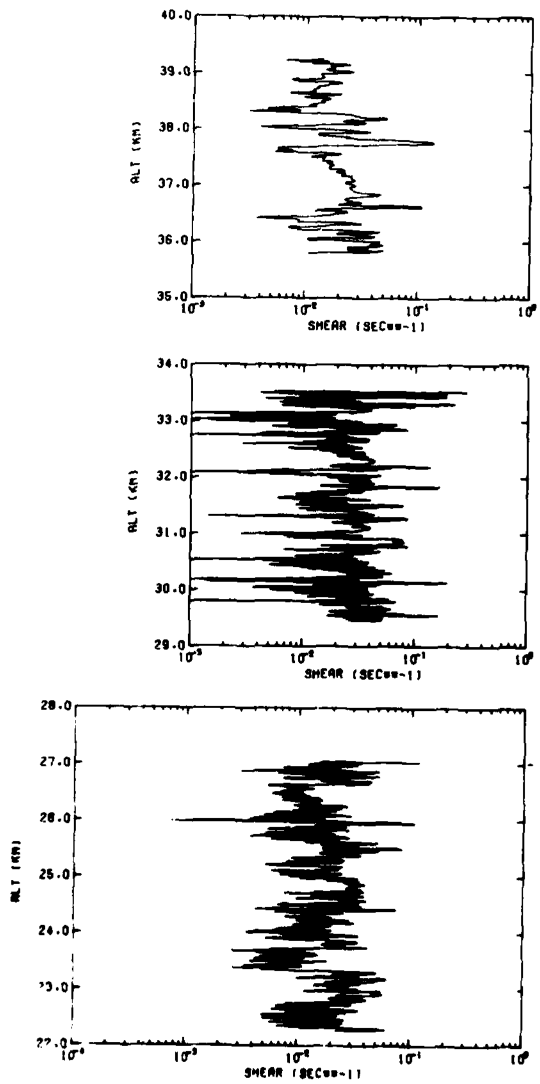


Figure 15. Windshear vs Altitude for Mid- and Upper Sections of Trail "20 MAY"

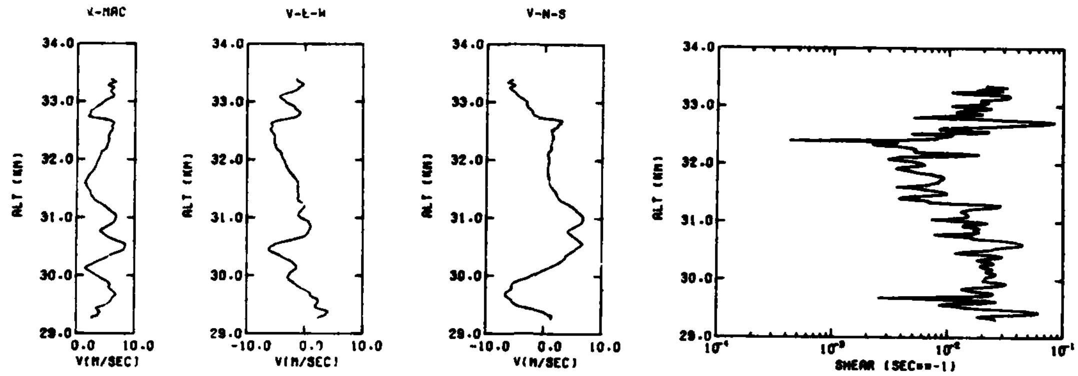


Figure 16. Wind and Windshear vs Altitude for Trail "22 MAY". Rocket launched from Wallops Island on 22 May 1978 at 0927 UT

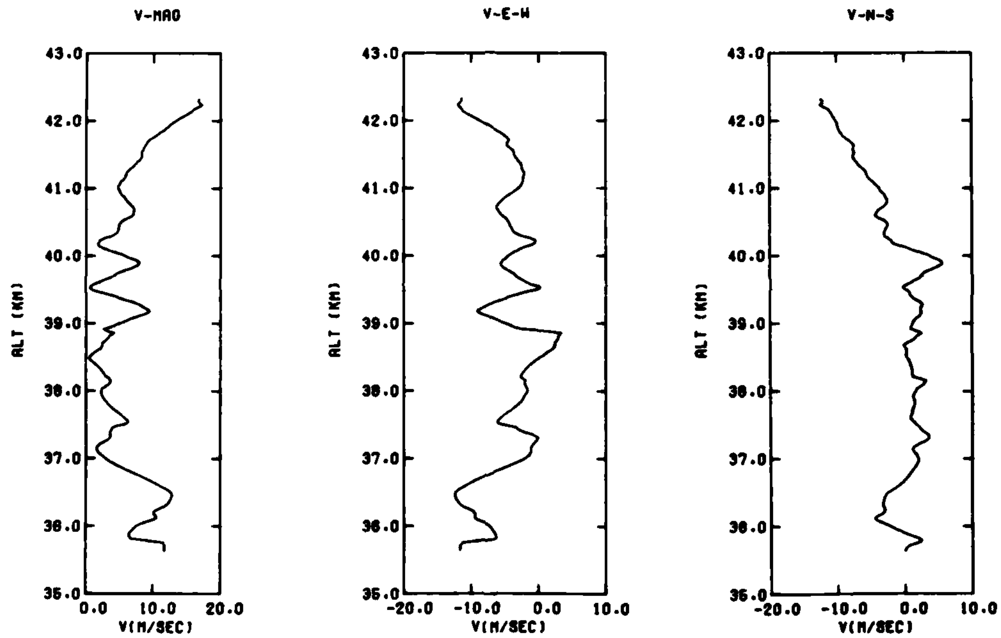


Figure 17. Wind vs Altitude for Upper Section of Trail "22 MAY"

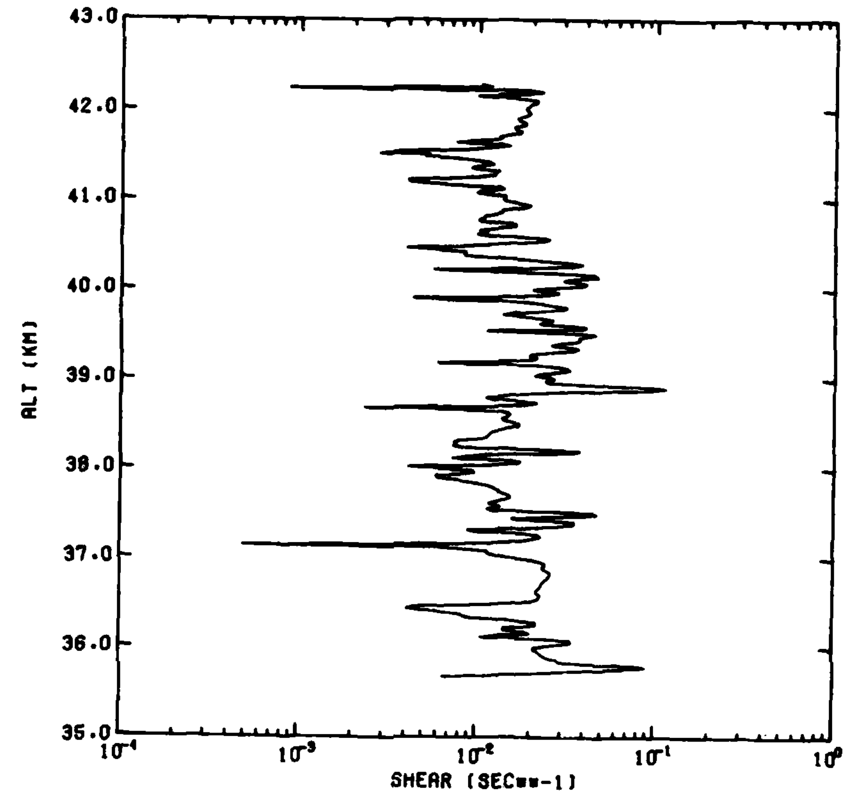


Figure 18. Windshear vs Altitude for Upper Section of Trail "22 MAY"

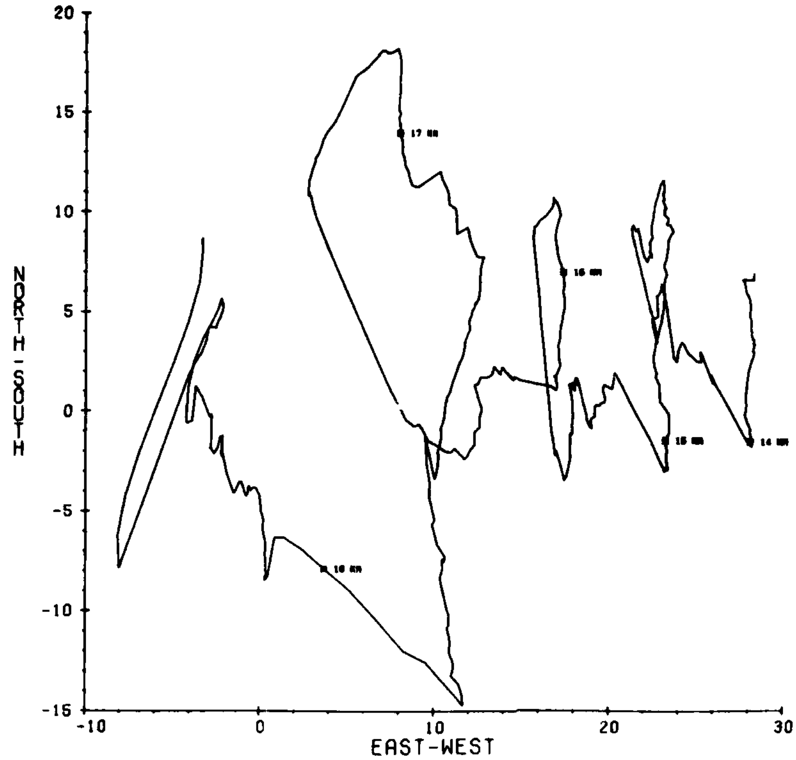


Figure 19. Hodograph for Trail "FLORA"

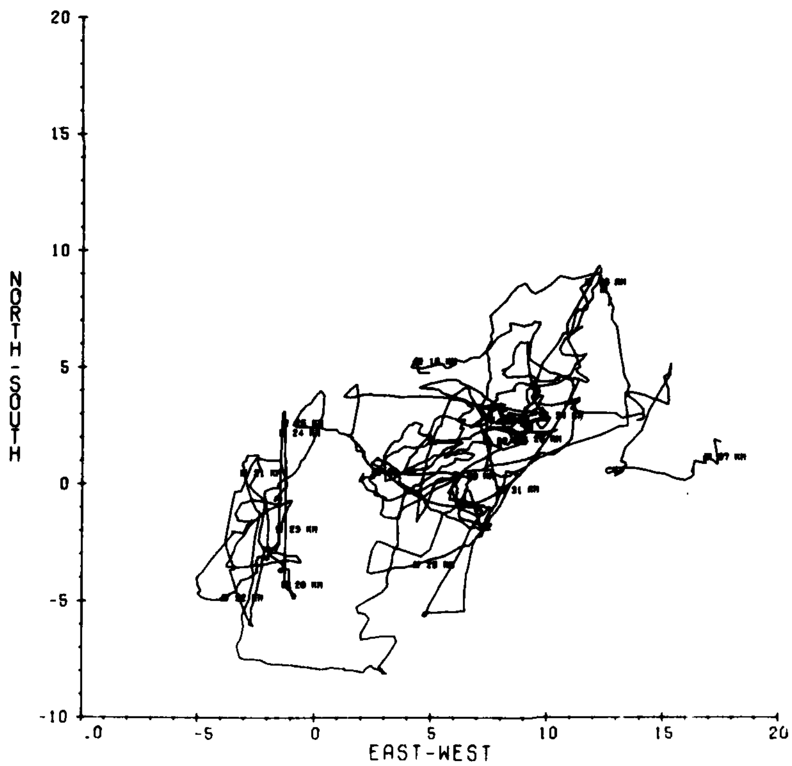


Figure 20. Hodograph for Trail "22 APRIL"

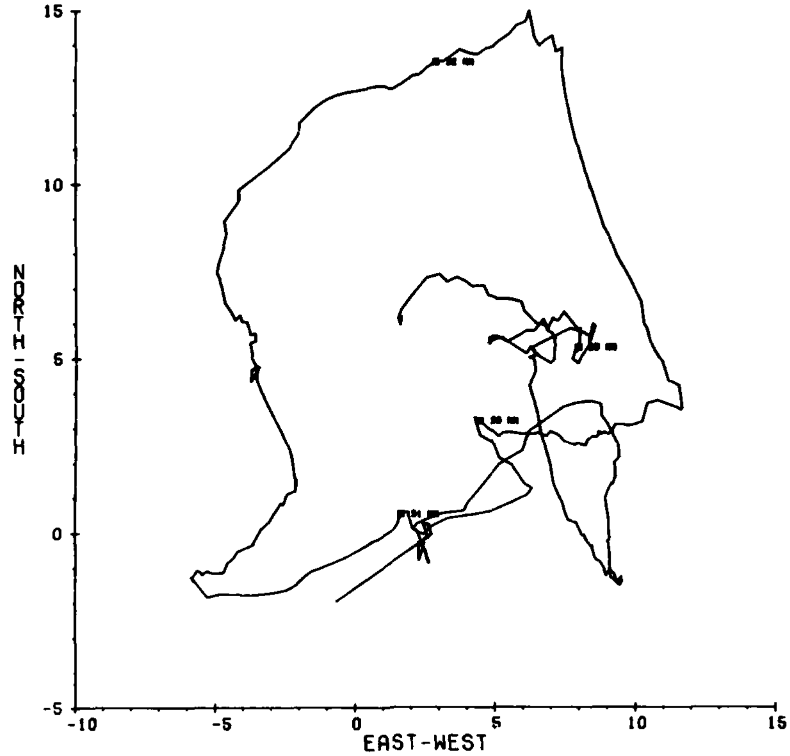


Figure 21. Hodograph for Trail "20 MAY"

4. DISCUSSION

Measurements of stratospheric winds and windshears with high vertical resolution show that the dynamic structure of the stratosphere is very complex. A salient feature is the presence, in nearly every case, of a variety of motions corresponding to scales of tens of meters, and varying in relatively short times, superimposed on longer time and spatial motions that represent the response to such factors as tidal forces and diurnal heating. The fine scale motions are particularly apparent when a comparison is made of simultaneous, or nearly simultaneous, soundings of the stratosphere by means of techniques that have widely different vertical resolution. Figures 22, 23, and 24 show smoke trail measurements done during an earlier programe at WSMR, and rawinsonde profiles at essentially the same time. Lack of total agreement between the rawinsonde and the smoothed smoke trail profiles is to be expected because of time differentials, and the impossibility of matching the paths of the rawinsonde balloon and the smoke trail rocket. The comparison shows, however, that gross structural features of the wind field persist over time intervals of minutes and horizontal distances of kilometers.

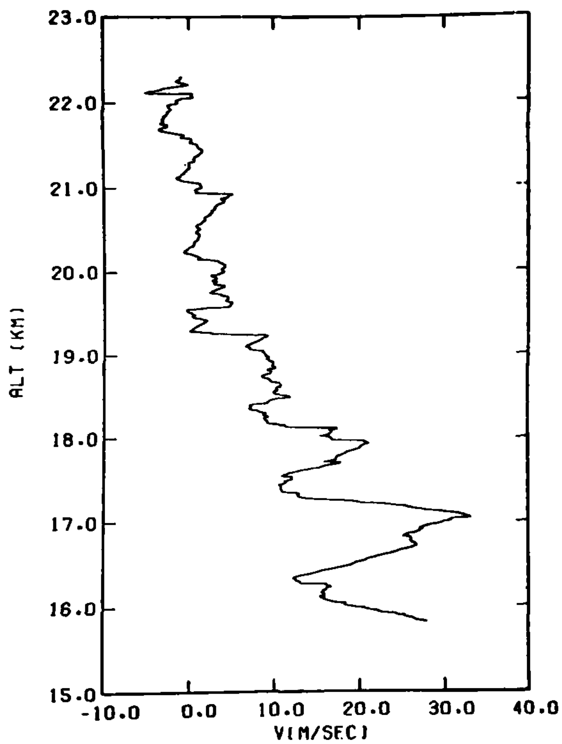


Figure 22. Easterly Velocity Profile Determined From Release "APPOLON" by the Smoke Trail Method

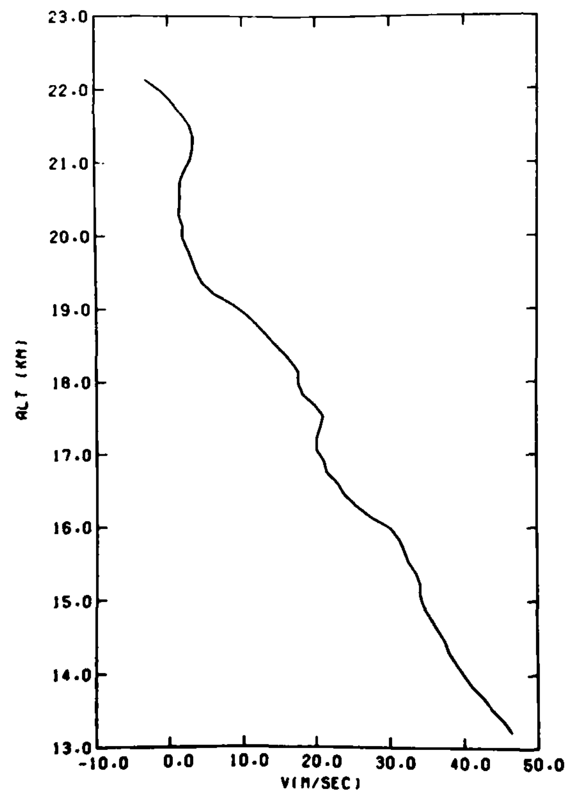


Figure 23. Easterly Velocity Profile at Time of "APPOLON" Determined by Rawinsonde Tracking

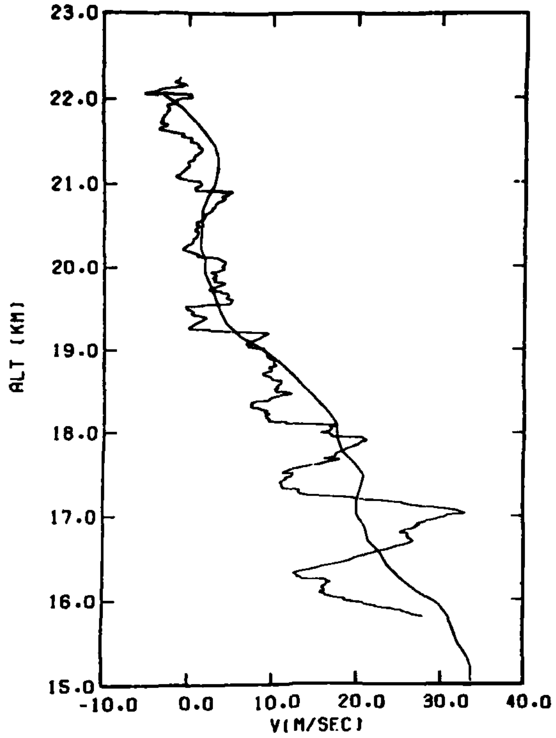


Figure 24. Superposition of Figures 22 and 23 to Compare Altitude Resolution

One dash for the trail of 20 May 1978 was redigitized using a raster increment of 12 μm (rather than the more common 48 μm), in order to determine whether the denser positional data would improve the accuracy and vertical resolution of the winds. When the triangulation results were scrutinized, it was clear that the average altitude increment had been reduced by approximately a factor of 3. However, no improvement was observed in the standard deviation of the resultant winds. It was evident that improper pairing of points from each site was responsible for discontinuities in the triangulation that led to spurious shears. Repeating the triangulation with a tigher tolerance for the dihedral angle did not improve the results. We have concluded that the appearance of artificially high shears is often caused by attempts to reduce data with a resolution finer than the natural limit imposed by the precision with which the camera orientation and focal length are computed. For the measurements given in this report, this limit lies between 10 and 15 meters. On the other hand, smoke trails afford in practice, as our measurements demonstrate, a technique for the determination of horizontal winds at intervals of 10 meters with a standard deviation in the velocity that averages 50 cm per sec. These numbers apply to large sections of the trails. There are sometimes short intervals along the trails where the measurements are not that good. Loss of vertical resolution by a factor of 2, and wind velocities with errors exceeding 1 m per sec occur when the trail is embedded in a wind field that aligns a short section of it with a line-of-sight from one of the cameras. In such cases, there is a one-to-many point correspondence for the images recorded at each of two sites, and vertical resolution as well as wind velocity are correspondingly degraded. In principle, it is possible to refine the measurements of the trail images to provide sampling of the wind field at vertical intervals of 2 meters, and have the granularity of the film set the limit for the fine scale structure. To realize this improvement, however, it would be necessary to increase the accuracy of the camera orientation and focal length determination, which at present, limits the resolution to no better than about 10 meters. Obtaining higher accuracy for the camera parameters does not appear unsurmountable. We estimate, for example, that a factor of 2 in vertical resolution can be gained by increasing the accuracy in timing the beginning and end of a star calibration exposure to 0.1 sec, and reducing the error in synchronization of cameras at different sites to a comparable value. At present both of these timing errors vary between 1/2 and 1 sec.

Further analysis of the data presented in this report is in progress. It will contribute to the study of statistical properties of stratospheric wind fields, and will form the basis for forthcoming reports.

References

1. Dewan, E.M. (1981) Turbulent vertical transport due to thin intermittent mixing layers in the stratosphere and other stable fluids, Science 211(No. 4486):1041-1042.
2. Vickery, W.K. (1975) Techniques for Depositing Visible Smoke Trails in the Stratosphere for Measurements of Winds and Turbulence, AFCRL-TR-75-0221, ADA013792.
3. Stokes, C.S., Murphy, W.J., and Smith, E.W. (1974) Experimental and Flight Evaluation of the Titanium Tetrachloride, Water-Methanol System for the Production of Smoke Trails, AFCRL-TR-74-0496, ADA006126.
4. Quesada, A.F., and Trowbridge, C.A. (1976) Analysis of Smoke Trail Photographs to Determine Stratospheric Winds and Shears, AFGL-TR-76-0243, ADA035504.
5. Quesada, A.F. (1971) Application of Vector and Matrix Methods to Triangulation of Chemical Releases in the Upper Atmosphere, AFCRL-71-0233, AD729448.
6. Quesada, A.F. (1975) Vector Evaluation of Triangulation Camera Parameters From Star Photographs, AFCRL-TR-75-0451, ADA019655.
7. Trowbridge, C.A. (1982) Identification of Requirements for Atmospheric Data, AFGL-TR-82-0015, ADA113640.
8. Trowbridge, C.A., and Andrus, W.S. (1978) An Automated Coordinate Measuring System for Smoke Trail Photographs, AFGL-TR-78-0231, ADA062485.
9. Trowbridge, C.A., Kofsky, I.L., and Johnson, R.H. (1978) Recording and Analysis of Optical Data From Stratospheric Dynamics Experiments, AFGL-TR-78-0015, ADA054013.

Appendix A

Summary of Data Digitized

Summary of Data Digitized

Event Name or Date	Frame	Site	Data
FLORA	14	Seehorn	Single Trail
4 Jun 73	17	Seehorn	13-19 km
	19	Seehorn	
	21	Seehorn	
	23	Seehorn	
	14	Hotel	
	17	Hotel	
	19	Hotel	
	21	Hotel	
IRIS	65	Seehorn	Single Trail
6 Jun 73	66	Seehorn	14-23 km
	67	Seehorn	
	68	Seehorn	
	65	Hotel	
	66	Hotel	
	67	Hotel	
	68	Hotel	

Event Name or Date	Frame	Site	Data
22 Apr 77	81	T5	Dashed Trail 18-37 km
	82	T5	
	83	T5	
	84	T5	
	81	Two Buttes	
	82	Two Buttes	
	83	Two Buttes	
	84	Two Buttes	
	85	Two Buttes	
20 May 78	2	Pocomoke	Dashed Trail 16-44 km
	3	Pocomoke	
	4	Pocomoke	
	5	Pocomoke	
	6	Pocomoke	
	7	Pocomoke	
	8	Pocomoke	
	9	Pocomoke	
20 May 78	2	Wachapreague	
	3	Wachapreague	
	4	Wachapreague	
	5	Wachapreague	
	6	Wachapreague	
	7	Wachapreague	
	8	Wachapreague	
	9	Wachapreague	
20 May 78	4	Pocomoke	High Resolution Scans of Dash 3 - Maximum Increment = 12 μm
	5	Pocomoke	
	6	Pocomoke	
	7	Pocomoke	
	4	Wachapreague	
	5	Wachapreague	
	6	Wachapreague	
	7	Wachapreague	
22 May 78	41	Pocomoke	Dashed Trail 29-42 km
	42	Pocomoke	
	43	Pocomoke	
	44	Pocomoke	
	45	Pocomoke	
	46	Pocomoke	
	47	Pocomoke	
	41	Wachapreague	
	42	Wachapreague	
	43	Wachapreague	
	44	Wachapreague	
	45	Wachapreague	
	46	Wachapreague	
	47	Wachapreague	

Summary of Star Frames Digitized

Event Name or Date	Frame	Site	Maximum Error (Along Star Track)
FLORA 4 Jun 73	9 11	Hotel Seehorn	± 24 μm
IRIS 6 Jun 73	63 63	Hotel Seehorn	± 20 μm
22 Apr 77	99 99	T5 Two Buttes	± 24 μm
20 May 78 22 May 78	1 20 1	Wachapreague Wachapreague Pocomoke	± 20 μm

Appendix B

Output of Position and Velocity Programs for Trail "IRIS"

The following pages contain a fraction of the output of the position program and the entire output of the velocity program for trail "IRIS."

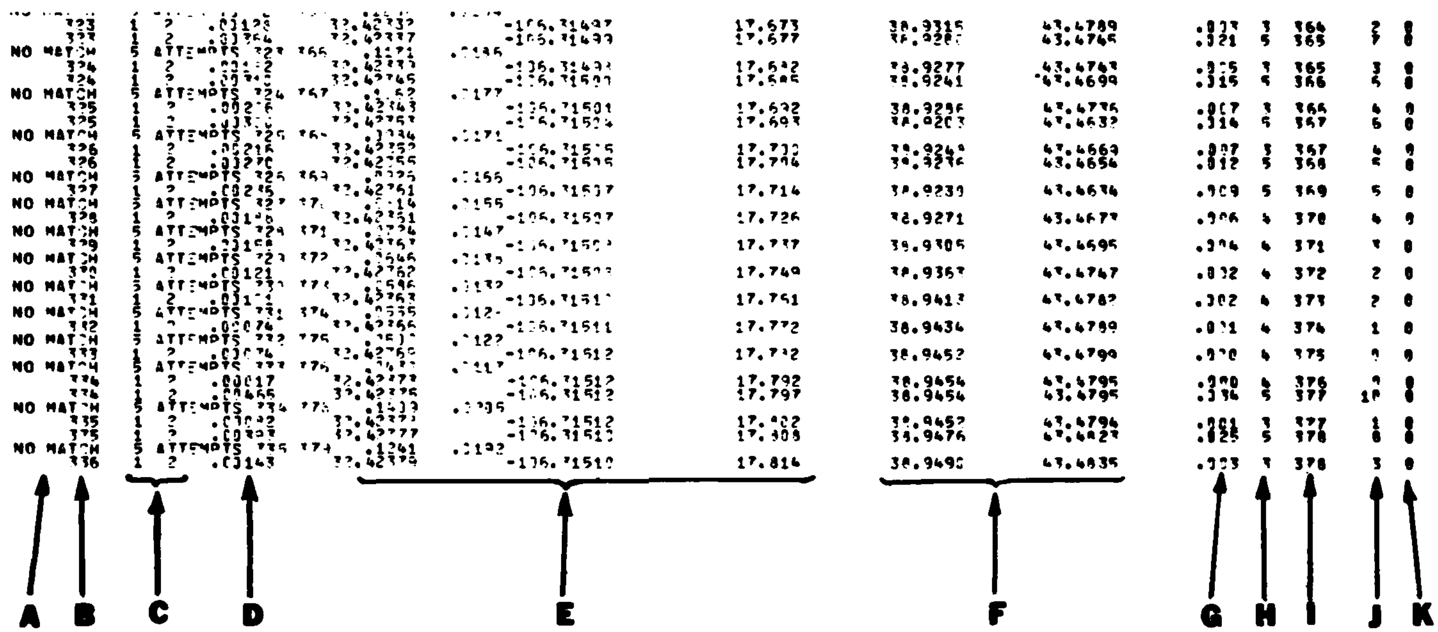
Part I. Sample Output of the Triangulation Program

The listing of the position program displays the following information:

A. First Entry — If a match is found for a point belonging to site 1, it is blank. If no match is found the program writes a shortened line that begins with the words "NO MATCH" and then the number of points on the file corresponding to site 2 that it tried for a match "(#) ATTEMPTS". This is followed by the point numbers for which the best match could be established when the program examined in succession points from the file for site 2. The match, however, does not lead to a dihedral error within tolerance, and is rejected. Next the program writes the separation vector (meters) corresponding to this best match and the dihedral angular discrepancy in radians × 1,000,000.

B. Second Entry — The point number on the file of film plane coordinates corresponding to site 1 that is to be matched to some point on the file for site 2.

C.	Third and Fourth Entries	Site numbers. The triangulation program uses two sites at a time, but if more than two stations were active and provided photographic data one can use, for example, site 1 and site 2, or, site 1 and site 3, and so on.
D.	Fifth Entry	Numerical value of discrepancy (centimeters) when the point on site 1 which has just been matched is projected on the film plane of site 2.
E.	Sixth, Seventh and Eighth Entries	Latitude and longitude (degrees) and altitude (kilometers) above mean sea level for the point on the trail for which a match has just been established.
F.	Ninth and Tenth Entries	Ranges to each site (kilometers) for the point on the trail whose coordinates are given in E.
G.	Eleventh Entry	Figure of merit for the present match. It represents the dihedral angular error (radians) × 1,000,000.
H.	Twelfth Entry	Number of points for file 2 that were tried before a match is found. If the first attempt leads to a dihedral angle within tolerance, the program does not jump to the next point, but rather tries a few neighboring points from site 2 to determine whether they result in smaller dihedral discrepancies, and then takes as a match the pairing with minimum dihedral error.
I.	Thirteenth Entry	Number of the point on file from site 2 that matched the point on file from site 1 whose number is listed in B.
J.	Fourteenth Entry	Magnitude (meters) of closure error of lines-of-sight from the 2 stations, that is, length of vector perpendicular to both line-of-sight vectors.
K.	Fifteenth Entry	Flag used to identify printing sequence selected for each line of output.


A
B
C
D
E
F
G
H
I
J
K

```
NO. OF FRAMES, MAX S VECTOR, MAX DIMED FIGURE OF MERIT      4      .015      .8000E-08

                                                    IRIS  06JUN73SHORN  32.75876396N. LAT.-106.48671229W. LONG.
                                                  1349.0CMETERS
   .563511  -1.959544
 .17498033E+06
-.15260383E+06-.51496279E+06 .34317597E+06
 -1.85956      .56961  -1.85956
   FOCAL LENGTH = 17.903 CM

   AZ         EL          TILT
154.57715  16.17737     .21745
  2.69748     .23235     .33398

                                     RIGHT ASCENSION OF CAMERA =  -1.134
                                     DECLINATION OF CAMERA = -35.517
                                     ROTATION OF THE FILM PLANE =    .217

                         AZIMUTH = 154.577          ELEVATION = 16.177          SIDEREAL TIME = 1.308

                             SIEHORN   F965          111.11  06/06/73  IRIS

                                                    574 NPTS

                                                    IRIS  06JUN73HOTEL  32.72917222N. LAT.-106.21349618W. LONG.
                                                  1219.0CMETERS
   .563148  -1.953775
 .12191193E+06
-.14939387E+06-.51592538E+06 .34292.79E+06
 -1.95379      .56315  -1.85379
   FOCAL LENGTH = 17.933 CM

   AZ         EL          TILT
197.61992  21.21573    -.44552
  3.44912     .37329    -.33779

                                     RIGHT ASCENSION OF CAMERA = -51.109
                                     DECLINATION OF CAMERA = -33.555
                                     ROTATION OF THE FILM PLANE =   -.445

                         AZIMUTH =-162.390          ELEVATION = 21.215          SIDEREAL TIME = 1.308

                             HOTEL   F965          111.11  06/06/73  IRIS

                                                    573 NPTS
```

STEHORN F255 111.11 06/05/73 IPIS

HOTEL F255 111.11 06/06/73 IFIS

NO MATCH	532	ATTEMPTS	1	1	.9559	.1329								
NO MATCH	5	ATTEMPTS	3	1	.5519	.1393								
NO MATCH	7	ATTEMPTS	3	1	.2719	.1277								
NO MATCH	3	ATTEMPTS	4	1	.9093	.1159								
5	1	2	.00171		32.41451		-136.31482	14.012	37.9913	42.6925	.005	3	1	3	0
NO MATCH	5	ATTEMPTS	5	2	.3672	.3138								
6	1	2	.00216		32.41355		-136.31481	14.015	37.9876	42.5993	.007	3	1	6	0
6	1	2	.00262		32.41355		-136.31490	14.021	37.9895	42.5920	.311	5	2	5	0
NO MATCH	5	ATTEMPTS	6	3	.3575	.3157								
7	1	2	.00160		32.41470		-136.31477	14.030	37.9874	42.6912	.305	4	3	3	0
NO MATCH	5	ATTEMPTS	7	4	.3557	.3137								
8	1	2	.00075		32.41375		-136.31475	14.040	37.9853	42.6904	.001	4	4	1	0
8	1	2	.00192		32.41374		-136.31474	14.042	37.9867	42.5921	.006	3	5	4	0
8	1	2	.00748		32.41589		-136.31491	14.038	37.9721	42.5748	.019	5	6	7	1
NO MATCH	5	ATTEMPTS	8	7	.3455	.3126								
9	1	2	.03027		32.41330		-136.31480	14.043	37.9629	42.5658	.030	4	7	0	0
9	1	2	.03494		32.41331		-136.31491	14.047	37.9685	42.6621	.339	5	8	10	0
NO MATCH	5	ATTEMPTS	9	9	.3331	.3167								
10	1	2	.00094		32.41910		-136.31479	14.051	37.9547	42.6581	.001	3	8	1	0
10	1	2	.00237		32.41599		-136.31473	14.050	37.9667	42.6031	.097	3	9	4	0
NO MATCH	5	ATTEMPTS	10	10	.3574	.3133								
11	1	2	.00070		32.41232		-136.31462	14.073	37.9779	42.6896	.101	4	10	1	0
NO MATCH	5	ATTEMPTS	11	11	.3513	.3119								
12	1	2	.00015		32.41337		-136.31463	14.092	37.9747	42.5955	.030	4	11	0	0
12	1	2	.03439		32.41335		-136.31462	14.098	37.9783	42.6895	.338	5	12	12	0
NO MATCH	5	ATTEMPTS	12	13	.1534	.3205								
13	1	2	.00021		32.41300		-136.31460	14.092	37.9737	42.5962	.001	3	12	1	0
13	1	2	.03394		32.41301		-136.31453	14.097	37.9747	42.6974	.025	5	13	9	0
NO MATCH	5	ATTEMPTS	13	14	.1234	.3134								
14	1	2	.00172		32.41306		-136.31453	14.112	37.9705	42.6840	.005	3	13	3	0
14	1	2	.03205		32.41322		-136.31455	[illegible]	37.9755	42.6909	.314	5	14	6	0
NO MATCH	5	ATTEMPTS	14	15	.3477	.3157								
15	1	2	.01152		32.41335		-136.31445	14.122	37.9845	42.7047	.004	4	15	3	0
NO MATCH	5	ATTEMPTS	15	16	.3746	.3145								
16	1	2	.00095		32.41325		-136.31452	14.123	37.9576	42.6744	.301	4	16	2	0
NO MATCH	5	ATTEMPTS	16	17	.3434	.3119								
17	1	2	.03321		32.41326		-136.31446	14.135	37.9596	42.6795	.300	4	17	8	0
17	1	2	.03469		32.41331		-136.31449	14.139	37.9560	42.6751	.035	5	18	9	0
NO MATCH	5	ATTEMPTS	17	17	[illegible]	.3193								
18	1	2	.03143		32.41343		-136.31444	14.140	37.9443	42.6554	.003	3	18	3	0
18	1	2	.00324		32.41339		-136.31441	14.147	37.9495	42.6723	.317	5	19	6	0
NO MATCH	5	ATTEMPTS	18	20	.1122	.3170								
19	1	2	.03135		32.41349		-136.31435	14.155	37.9409	42.6567	.306	4	20	3	0
NO MATCH	5	ATTEMPTS	19	21	.0579	.3138								
20	1	2	.03063		32.41252		-136.31430	14.165	37.9401	42.6692	.001	4	21	1	0
NO MATCH	5	ATTEMPTS	20	22	.3443	.3112								
21	1	2	.00035		32.41337		-136.31425	14.178	37.9453	42.5768	.070	5	22	8	0
21	1	2	.03423		32.41342		-136.31420	14.186	37.9542	42.6980	.029	5	23	9	0
NO MATCH	5	ATTEMPTS	21	24	.1251	.0139								
22	1	2	.03190		32.41954		-136.31417	14.189	37.9422	42.5783	.006	3	23	4	0
22	1	2	.30270		32.41947		-136.31412	14.196	37.9512	42.6895	.012	5	24	5	0
NO MATCH	5	ATTEMPTS	22	25	.3673	.0157								
23	1	2	.03176		32.41947		-136.31409	14.207	37.9541	42.5943	.105	4	25	3	0
23	1	2	.03331		32.41349		-136.31409	14.207	37.9520	42.5917	.315	5	26	6	0
23	1	2	.00610		32.41945		-136.31407	14.210	37.9565	42.6977	.137	5	27	8	0
23	1	2	.03436		32.41932		-136.31407	14.217	37.9708	42.7151	.339	5	28	10	0
NO MATCH	5	ATTEMPTS	23	29	.1432	.3205								
24	1	2	.03049		32.41333		-136.31393	14.222	37.9713	42.7155	.320	3	28	1	0
24	1	2	.03415		32.41326		-136.31396	14.229	37.9779	42.7238	.320	5	29	4	0
NO MATCH	5	ATTEMPTS	24	30	.3596	.3140								
25	1	2	.03120		32.41323		-136.31396	14.235	37.9803	42.7255	.302	3	29	2	0
25	1	2	.03122		32.41330		-136.31396	14.239	37.9794	42.7247	.302	3	30	2	0
25	1	2	.03216		32.41321		-136.31392	14.242	37.9935	42.7164	.008	3	31	4	0
NO MATCH	5	ATTEMPTS	25	32	.0746	.0145								
26	1	2	.03145		32.41317		-136.31393	14.258	38.0077	42.7555	.006	4	32	3	0
26	1	2	.00302		32.41305		-136.31398	14.250	38.0093	42.7573	.315	5	33	6	0
26	1	2	.03339		32.41307		-136.31394	14.265	38.0184	42.7590	.326	5	34	9	0
NO MATCH	5	ATTEMPTS	26	35	.1146	.3163								
27	1	2	.03156		32.41311		-136.31393	14.270	38.0174	42.7581	.304	3	34	3	0
27	1	2	[illegible]		32.41333		-136.31373	14.279	38.0264	42.7733	.315	5	35	6	0
NO MATCH	5	ATTEMPTS	27	36	[illegible]	.3157								
28	1	2	[illegible]		[illegible]		[illegible]	[illegible]	38.0247	42.7735	[illegible]	4	36	4	0

NO MATCH	5	ATTEMPTS	23	37	.1734	.1144									
23	1	2	.03072		32.41933		-106.31369	14.237	38.0286	42.7786	.031	4	37	1	0.
NO MATCH	5	ATTEMPTS	23	39	.0472	.0116									
30	1	2	.00037		32.41937		-106.31365	14.337	38.0192	42.7795	[illegible]	5	38	[illegible]	[illegible]
30	1	2	.01440		32.41912		-106.31365	14.312	38.0179	42.7779	.032	5	39	[illegible]	[illegible]
NO MATCH	5	ATTEMPTS	31	40	.3502	.0113									
31	1	2	.01032		32.41915		-106.31364	14.321	38.0253	42.7954	[illegible]	3	40	[illegible]	[illegible]
31	1	2	.00146		32.41923		-106.31363	14.323	38.0270	42.7985	[illegible]	[illegible]	41	[illegible]	[illegible]
41	1	2	.03236		32.41977		-106.31360	14.326	38.0326	42.7969	.010	4	42	5	0
NO MATCH	5	ATTEMPTS	31	43	.3431	.0153									
32	1	2	.03219		32.41893		-106.31358	14.341	38.0462	42.8004	.037	4	43	4	0
NO MATCH	5	ATTEMPTS	32	44	.3723	.0163									
33	1	2	.00150		32.41930		-106.31356	14.356	38.0609	42.8237	.004	4	44	3	0
NO MATCH	5	ATTEMPTS	33	45	.3645	.0135									
34	1	2	.00030		32.41978		-106.31354	14.368	38.0663	42.8295	.002	4	45	2	0
NO MATCH	5	ATTEMPTS	34	46	.1523	.0122									
35	1	2	.03041		32.41483		-106.31356	14.391	38.0764	42.8390	.001	4	46	1	0
NO MATCH	5	ATTEMPTS	35	47	.0493	.0118									
36	1	2	.00044		32.41475		-106.31357	14.392	38.0785	42.8386	.098	4	47	0	0
NO MATCH	5	ATTEMPTS	36	48	.0427	.0109									
37	1	2	.00012		32.41967		-106.31356	14.406	38.0909	42.8511	.000	4	48	0	0
NO MATCH	5	ATTEMPTS	37	49	.0497	.0133									
38	1	2	.00011		32.41471		-106.31362	14.416	38.0927	42.8409	[illegible]	4	49	[illegible]	[illegible]
38	1	2	.00432		32.41872		-106.31362	14.421	38.0926	42.9487	.034	5	50	10	0
NO MATCH	5	ATTEMPTS	39	51	.1537	.0212									
39	1	2	.00010		32.41466		-106.31364	14.430	38.1026	42.8567	.008	3	50	0	0
NO MATCH	5	ATTEMPTS	39	51	.0434	.0137									
40	1	2	.00029		32.41978		-106.31399	14.438	38.0981	42.8495	[illegible]	5	51	[illegible]	[illegible]
40	1	2	.01453		32.41975		-106.31368	14.443	38.0991	42.8507	.033	5	52	[illegible]	[illegible]
NO MATCH	5	ATTEMPTS	40	53	.1413	.0205									
41	1	2	.03058		32.41474		-106.31369	14.449	38.1013	42.8530	.031	3	52	1	0
NO MATCH	5	ATTEMPTS	41	53	.0473	.0116									
42	1	2	.00342		32.41872		-106.31371	14.460	38.1000	42.8581	.000	4	53	0	0
42	1	2	.01344		32.41341		-106.31375	14.461	38.1004	42.8479	.024	5	54	6	0
NO MATCH	5	ATTEMPTS	42	55	.1196	.0194									
43	1	2	.00117		32.41975		-106.31377	14.455	38.1089	42.8563	.302	3	55	[illegible]	[illegible]
43	1	2	.00362		32.41577		-106.31376	14.474	38.1099	42.8555	.321	5	55	7	0
NO MATCH	5	ATTEMPTS	43	56	.0752	.0145									
44	1	2	.00078		32.41962		-106.31381	14.495	38.1294	42.8712	.001	3	55	1	0
44	1	2	.00244		32.41964		-106.31391	14.488	38.1289	42.8786	.010	5	56	4	0
NO MATCH	5	ATTEMPTS	44	57	.0541	.0124									
45	1	2	.01141		32.41457		-106.31389	14.500	38.1421	42.8785	.103	3	57	3	0
45	1	2	.01645		32.41453		-106.31390	14.503	38.1405	42.8764	.335	5	58	4	0
NO MATCH	5	ATTEMPTS	45	59	.0933	.0199									
46	1	2	.00036		32.41344		-106.31395	14.514	38.1615	42.8934	.000	3	58	[illegible]	0
46	1	2	.00354		32.41344		-106.31395	14.518	38.1622	42.8962	.020	5	59	7	0
NO MATCH	5	ATTEMPTS	45	63	.0765	.0148									
47	1	2	.01077		32.41929		-106.31409	14.530	38.1633	42.9112	.101	3	59	1	0
47	1	2	.00259		32.41836		-106.31403	14.531	38.1771	42.9034	.011	5	60	6	0
NO MATCH	5	ATTEMPTS	47	61	.0532	.0123									
48	1	2	.01048		32.41927		-106.31405	14.537	38.1884	42.9125	.010	3	60	1	0
48	1	2	.01346		32.41947		-106.31409	14.541	38.1902	42.9140	.021	5	61	7	0
NO MATCH	5	ATTEMPTS	49	62	.0432	.0152									
49	1	2	.01267		32.41921		-106.31406	14.544	38.1975	42.9206	.111	5	61	5	0
NO MATCH	5	ATTEMPTS	49	62	.0503	.0131									
50	1	2	.00163		32.41915		-106.31412	14.556	38.2165	42.9376	.004	3	61	3	0
50	1	2	.03182		32.41916		-106.31416	14.556	38.2083	42.9255	.005	3	62	3	1
50	1	2	.00237		32.41327		-106.31421	14.553	38.1986	42.9127	.313	5	63	6	1
NO MATCH	5	ATTEMPTS	50	64	.3678	.0139									
51	1	2	.03141		32.41943		-106.31431	14.557	38.1869	42.8979	.303	3	64	3	0
NO MATCH	5	ATTEMPTS	51	65	.0670	.0139									
52	1	2	.03154		32.41945		-106.31439	14.567	38.1895	42.8939	.004	4	65	3	0
NO MATCH	5	ATTEMPTS	52	66	.0747	.0146									
53	1	2	.03217		32.41354		-106.31451	14.575	38.1957	42.8827	.008	4	66	4	0
NO MATCH	5	ATTEMPTS	53	67	.0311	.0152									
54	1	2	.00245		32.41350		-106.31456	14.588	38.1957	42.8886	.010	5	67	5	0
NO MATCH	5	ATTEMPTS	54	68	.0530	.0159									
55	1	2	.00249		32.41344		-106.31459	14.597	38.2047	42.8987	.019	[illegible]	67	[illegible]	[illegible]
55	1	2	.00253		32.41952		-106.31462	14.599	38.1987	42.8579	.010	5	68	5	0
NO MATCH	5	ATTEMPTS	55	69	.0869	.0158									
56	1	2	.03236		32.41949		-106.31464	14.612	38.2070	42.8945	.009	5	69	5	0
NO MATCH	5	ATTEMPTS	56	70	.0643	.0140									
57	1	2	.03137		32.41346		-106.31473	14.623	38.2157	42.8988	.006	4	70	4	0

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NO MATCH  5 ATTEMPTS  57   71    .0773     .0145
   58     1   2   .03136   32.41343  -106.31475   14.636   38.2237   42.9037   .006  4   71   4  0
NO MATCH  5 ATTEMPTS  58   72    .0744     .0149
   59     1   2   .03133   32.41353  -106.31473   14.647   38.2299   42.9059   .006  4   72   4  0
NO MATCH  5 ATTEMPTS  59   73    .0751     .0147
   60     1   2   .03176   32.41342  -106.31491   14.659   38.2346   42.9098   .005  4   73   3  0
NO MATCH  5 ATTEMPTS  60   74    .0733     .0145
   61     1   2   .03170   32.41348  -106.31437   14.668   38.2333   42.9051   .005  4   74   3  0
NO MATCH  5 ATTEMPTS  61   75    .0599     .0141
   62     1   2   .03150   32.41343  -106.31483   14.680   38.2378   42.9076   .004  4   75   3  0
NO MATCH  5 ATTEMPTS  62   76    .0567     .0136
   63     1   2   .03115   32.41343  -106.31491   14.691   38.2418   42.9103   .002  4   76   2  0
NO MATCH  5 ATTEMPTS  63   77    .0630     .0134
   64     1   2   .03118   32.41357  -106.31497   14.700   38.2382   42.9027   .002  4   77   2  0
NO MATCH  5 ATTEMPTS  64   78    .0534     .0129
   65     1   2   .03074   32.41359  -106.31499   14.711   38.2406   42.9041   .001  4   78   1  0
NO MATCH  5 ATTEMPTS  65   79    .0529     .0127
   66     1   2   .03091   32.41359  -106.31503   14.722   38.2460   42.9063   .001  4   79   1  0
NO MATCH  5 ATTEMPTS  66   80    .0515     .0121
   67     1   2   .03018   32.41350  -106.31502   14.733   38.2476   42.9081   .000  4   80   0  0
NO MATCH  5 ATTEMPTS  67   81    .0429     .0113
   68     1   2   .03031   32.41368  -106.31504   14.742   38.2434   42.9026   .000  4   81   0  0
   68     1   2   .03476   32.41431  -106.31509   14.743   38.2329   42.8995   .037  5   82  19  0
NO MATCH  5 ATTEMPTS  68   83    .1450     .0204
   69     1   2   .03039   32.41477  -106.31510   14.750   38.2382   42.8938   .000  3   82   0  0
   69     1   2   .03476   32.41477  -106.31509   14.755   38.2404   42.8965   .031  5   83   9  0
NO MATCH  5 ATTEMPTS  69   84    .1331     .0202
   70     1   2   .03371   32.41473  -106.31517   14.753   38.2474   42.9021   .001  3   83   1  0
   70     1   2   .03623   32.41379  -106.31512   14.766   38.2426   42.8961   .029  5   84   9  0
NO MATCH  5 ATTEMPTS  70   85    .1325     .0195
   71     1   2   .03374   32.41376  -106.31514   14.774   38.2495   42.9017   .001  3   84   1  0
   71     1   2   .03470   32.41370  -106.31514   14.779   38.2482   42.9001   .026  5   85   8  0
NO MATCH  5 ATTEMPTS  71   86    .1287     .0192
   72     1   2   .03124   32.41377  -106.31515   14.785   38.2520   42.9032   .002  3   85   2  0
   72     1   2   .03369   32.41324  -106.31517   14.788   38.2472   42.8972   .022  5   86   7  0
NO MATCH  5 ATTEMPTS  72   87    .1273     .0193
   73     1   2   .03154   32.41334  -106.31513   14.794   38.2495   42.8998   .004  3   86   3  0
   73     1   2   .03320   32.41347  -106.31514   14.798   38.2462   42.8974   .017  5   87   6  0
NO MATCH  5 ATTEMPTS  73   89    .1231     .0175
   74     1   2   .03146   32.41337  -106.31513   14.806   38.2551   42.9030   .006  3   87   4  0
   74     1   2   .03313   32.41391  -106.31523   14.808   38.2489   42.8942   .016  5   88   6  0
NO MATCH  5 ATTEMPTS  74   89    .1213     .0171
   75     1   2   .03223   32.41391  -106.31523   14.814   38.2502   42.8960   .008  3   88   4  0
   75     1   2   .03258   32.41332  -106.31522   14.819   38.2513   42.8972   .011  5   89   5  0
NO MATCH  5 ATTEMPTS  75   90    .0338     .0150
   76     1   2   .03132   32.41338  -106.31522   14.829   38.2490   42.8949   .006  4   90   4  0
NO MATCH  5 ATTEMPTS  76   91    .0732     .0150
   77     1   2   .03173   32.41317  -106.31527   14.837   38.2434   42.8862   .005  4   91   3  0
NO MATCH  5 ATTEMPTS  77   92    .0733     .0145
   78     1   2   .03142   32.41017  -106.31531   14.845   38.2374   42.8778   .003  4   92   3  0
NO MATCH  5 ATTEMPTS  78   93    .0532     .0134
   79     1   2   .03056   32.41025  -106.31530   14.853   38.2321   42.8729   .001  4   93   1  0
NO MATCH  5 ATTEMPTS  79   94    .2436     .0113
   80     1   2   .03077   32.41335  -106.31533   14.860   38.2212   42.8526   .000  4   94   0  0
   80     1   2   .03456   32.41045  -106.31532   14.863   38.2165   42.8567   .033  5   95   9  0
NO MATCH  5 ATTEMPTS  80   96    .1477     .0202
   81     1   2   .03345   32.41366  -106.31532   14.869   38.2171   42.8572   .001  3   95   1  0
   81     1   2   .03472   32.41359  -106.31533   14.873   38.2147   42.8542   .026  5   96   9  0
NO MATCH  5 ATTEMPTS  81   97    .1246     .0139
   82     1   2   .03147   32.41053  -106.31532   14.878   38.2138   42.8536   .005  3   96   3  0
   82     1   2   .03370   32.41956  -106.31531   14.883   38.2148   42.8547   .017  5   97   7  0
NO MATCH  5 ATTEMPTS  82   98    .1152     .0178
   83     1   2   .00279   32.41359  -106.31533   14.897   38.2107   42.8515   .009  5   97   5  0
   83     1   2   .03240   32.41359  -106.31529   14.902   38.2119   42.8527   .009  5   98   5  0
NO MATCH  5 ATTEMPTS  83   99    .0388     .0155
   84     1   2   .03152   32.41365  -106.31529   14.902   38.2092   42.8506   .004  4   99   3  0
NO MATCH  5 ATTEMPTS  84  100    .0632     .0141
   85     1   2   .03129   32.41378  -106.31533   14.910   38.2035   42.8439   .002  4  100   2  0
NO MATCH  5 ATTEMPTS  85  101    .0532     .0123
   86     1   2   .03033   32.41373  -106.31527   14.922   38.2087   42.8501   .000  4  101   0  0
NO MATCH  5 ATTEMPTS  86  102    .0422     .0117
   87     1   2   .03026   32.41343  -106.31525   14.936   38.2101   42.8601   .000  4  102   0  0
   87     1   2   .03447   32.41341  -106.31533   14.935   38.2064   42.8456   .038  5  103  10  0
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NO MATCH	5	ATTEMPTS	87	114	.1432	.0216							
88	1	2	.00342	32.41345	-106.31523	14.949	38.2024	42.9424	.008	3	103	1	0
88	1	2	.00336	32.41335	-106.31524	14.945	38.2046	42.9451	.025	5	104	8	0
NO MATCH	5	ATTEMPTS	88	105	[illegible]	[illegible]							
89	1	2	.00170	32.41344	-106.31528	14.953	38.2084	42.9482	.003	3	104	2	0
89	1	2	.00352	32.41346	-106.31523	14.957	38.2083	42.9440	.020	5	105	7	0
NO MATCH	5	ATTEMPTS	89	106	.1159	.0142							
90	1	2	.00145	32.41331	-106.31530	14.965	38.2168	42.8549	.003	3	105	3	0
90	1	2	.00361	32.41349	-106.31533	14.968	38.2109	42.8475	.020	5	106	7	0
NO MATCH	5	ATTEMPTS	90	107	.1125	.0179							
91	1	2	.00177	32.41392	-106.31535	14.977	38.2211	42.8557	.003	3	106	2	0
91	1	2	.00340	32.41345	-106.31535	14.981	38.2195	42.8541	.019	5	107	7	0
NO MATCH	5	ATTEMPTS	91	109	.1115	.0179							
92	1	2	.00145	32.41335	-106.31536	14.987	38.2220	42.8559	.006	3	107	3	0
92	1	2	.00303	32.41339	-106.31536	14.991	38.2208	42.8543	.014	5	108	6	0
NO MATCH	5	ATTEMPTS	92	109	.1166	.0175							
93	1	2	.00245	32.42044	-106.31541	14.996	38.2039	42.8351	.010	5	109	9	0
NO MATCH	5	ATTEMPTS	93	110	.0936	.0163							
94	1	2	.00203	32.42027	-106.31547	15.000	38.1875	42.8157	.007	4	110	4	0
NO MATCH	5	ATTEMPTS	94	111	.0749	.0145							
95	1	2	.00222	32.42011	-106.31552	15.012	38.2086	42.8327	.008	3	110	4	0
95	1	2	.00257	32.42012	-106.31552	15.017	38.2096	42.8340	.011	5	111	5	0
NO MATCH	5	ATTEMPTS	95	112	.0875	.0155							
96	1	2	.00197	32.42001	-106.31555	15.022	38.2232	42.8449	.006	3	111	4	0
NO MATCH	5	ATTEMPTS	96	112	.0734	.0142							
97	1	2	.00228	32.41345	-106.31560	15.036	38.2463	42.8618	.008	5	111	4	0
97	1	2	.00236	32.41391	-106.31557	15.042	38.2511	42.8703	.009	5	112	5	0
NO MATCH	5	ATTEMPTS	97	113	[illegible]	.0159							
98	1	2	.00225	32.41372	-106.31561	15.052	38.2560	42.8423	.008	5	112	4	0
98	1	2	.00245	32.41382	-106.31565	15.053	38.2555	42.8692	.013	5	113	6	0
NO MATCH	5	ATTEMPTS	98	114	.0973	.0167							
99	1	2	.00135	32.41375	-106.31569	15.062	38.2672	42.8786	.006	3	113	4	0
99	1	2	.00239	32.41331	-106.31570	15.065	38.2624	42.8727	.014	5	114	6	0
NO MATCH	5	ATTEMPTS	99	115	.1157	.0174							
100	1	2	.00265	32.41377	-106.31572	15.072	38.2694	42.8793	.007	3	114	4	0
100	1	2	.00349	32.41940	-106.31575	15.074	38.2577	42.8638	.015	5	115	6	0
NO MATCH	5	ATTEMPTS	100	116	.0249	.0163							
101	1	2	.00227	32.41935	-106.31578	15.079	38.2600	42.8656	.008	5	115	4	0
101	1	2	.00251	32.41391	-106.31577	15.084	38.2611	42.8669	.010	5	116	5	0
NO MATCH	5	ATTEMPTS	101	117	.0315	.0152							
102	1	2	.00240	32.41398	-106.31582	15.093	38.2583	42.8610	.009	5	117	5	0
NO MATCH	5	ATTEMPTS	102	118	.0930	.0159							
103	1	2	.00133	32.41934	-106.31587	15.104	38.2779	42.8750	.006	3	117	4	0
103	1	2	[illegible]	32.41373	-106.31590	15.106	38.2705	42.8680	.015	5	118	6	0
NO MATCH	5	ATTEMPTS	103	119	.1115	.0171							
104	1	2	.00181	32.41935	-106.31593	15.115	38.2810	42.8761	.005	3	118	3	0
104	1	2	.00317	32.41930	-106.31594	15.119	38.2785	42.8731	.015	5	119	6	0
NO MATCH	5	ATTEMPTS	104	120	.1195	.0176							
105	1	2	.00237	32.41938	-106.31595	15.126	38.2940	42.8775	.007	3	119	4	0
105	1	2	.00307	32.42032	-106.31601	15.126	38.2711	42.8615	.015	5	120	6	1
NO MATCH	5	ATTEMPTS	105	121	.1272	.0175							
106	1	2	.00278	32.41379	-106.31602	15.133	38.2765	42.8659	.007	3	120	4	0
106	1	2	.00312	32.42011	-106.31607	15.134	38.2660	42.8528	.015	5	121	6	0
NO MATCH	5	ATTEMPTS	106	122	.0932	.0153							
107	1	2	.00115	32.42035	-106.31609	15.142	38.2762	42.8609	.005	3	121	3	0
107	1	2	.00234	32.42036	-106.31609	15.148	38.2772	42.8622	.014	5	122	6	0
NO MATCH	5	ATTEMPTS	107	123	.1264	.0157							
108	1	2	.00238	32.42005	-106.31609	15.154	38.2795	42.8641	.009	5	122	5	0
108	1	2	.00244	32.42010	-106.31609	15.159	38.2794	42.8639	.010	5	123	5	0
NO MATCH	5	ATTEMPTS	108	124	.0962	.0156							
109	1	2	.00251	32.42022	-106.31617	15.165	38.2697	42.8494	.010	5	124	5	0
NO MATCH	5	ATTEMPTS	109	125	.1018	.0161							
110	1	2	.00237	32.42029	-106.31622	15.174	38.2681	42.8450	.009	5	125	5	0
NO MATCH	5	ATTEMPTS	110	126	.0946	.0136							
111	1	2	.00024	32.42027	-106.31622	15.177	38.2708	42.8466	.000	3	125	0	0
111	1	2	.00463	32.42031	-106.31623	15.181	38.2676	42.8435	.035	5	126	9	0
NO MATCH	5	ATTEMPTS	111	127	.1517	.0208							
112	1	2	.00040	32.42030	-106.31624	15.178	38.2730	42.8479	.000	3	126	1	0
112	1	2	.01456	32.42039	-106.31629	15.190	38.2636	42.8363	.033	5	127	9	0
NO MATCH	5	ATTEMPTS	112	128	.1437	.0231							
113	1	2	.00075	32.42041	-106.31623	15.196	38.2660	42.8381	.001	3	127	1	0
113	1	2	.00433	32.42040	-106.31629	15.201	38.2670	42.8394	.026	5	128	8	0
NO MATCH	5	ATTEMPTS	113	129	.1270	.0191							

	114	1	2	.00111		32.42076		-106.31673	15.219	38.2740	42.8451	.302	3	129	2	0
	114	1	2	.00333		32.42139		-106.31630	15.213	38.2727	42.8435	.324	5	129	9	0
NO MATCH		5	ATTEMPTS	114	130	.1311	.3133									
	115	1	2	.00119		32.42233		-106.31671	15.213	38.2766	42.8455	.333	3	129	2	0
	115	1	2	.00352		32.42147		-106.31632	15.223	38.2730	42.8421	.320	5	130	7	0
NO MATCH		5	ATTEMPTS	115	131	.1144	.3141									
	116	1	2	.00237		32.42347		-106.31531	15.228	38.2707	42.8432	.007	3	130	4	0
	116	1	2	.00234		32.42352		-106.31633	15.231	38.2671	42.8358	.013	5	131	6	0
NO MATCH		5	ATTEMPTS	116	132	.0952	.3155									
	117	1	2	.00228		32.42357		-106.31633	15.241	38.2665	42.8348	.008	5	132	4	0
NO MATCH		5	ATTEMPTS	117	133	.0433	.3156									
	118	1	2	.00233		32.42355		-106.31637	15.253	38.2731	42.8385	.009	5	133	5	0
NO MATCH		5	ATTEMPTS	118	134	.0739	.3152									
	119	1	2	.00175		32.42351		-106.31635	15.262	38.2827	42.8487	.005	4	134	3	0
NO MATCH		5	ATTEMPTS	119	135	.0727	.3144									
	120	1	2	.00116		32.42352		-106.31636	15.274	38.2740	42.8396	.002	4	135	2	0
NO MATCH		5	ATTEMPTS	120	136	.0573	.3124									
	121	1	2	.00064		32.42357		-106.31637	15.283	38.2728	42.8370	.001	4	136	1	0
NO MATCH		5	ATTEMPTS	121	137	.0463	.3115									
	122	1	2	.00013		32.42354		-106.31575	15.295	38.2753	42.8405	.330	4	137	7	0
	122	1	2	.00195		32.42372		-106.31636	15.296	38.2723	42.8369	.336	3	138	4	0
NO MATCH		5	ATTEMPTS	122	139	.0732	.3145									
	123	1	2	.00115		32.42377		-106.31635	15.305	38.2709	42.8362	.002	4	139	2	0
NO MATCH		5	ATTEMPTS	123	140	.0547	.3125									
	124	1	2	.00042		32.42374		-106.31632	15.318	38.2774	42.8439	.000	4	140	0	0
NO MATCH		5	ATTEMPTS	124	141	.0427	.3111									
	125	1	2	.00015		32.42373		-106.31630	15.330	38.2831	42.8499	.000	4	141	0	0
	125	1	2	.00494		32.42331		-106.31577	15.332	38.2760	42.8411	.330	5	142	17	0
NO MATCH		5	ATTEMPTS	125	143	.1445	.3204									
	126	1	2	.00047		32.42031		-106.31634	15.339	38.2784	42.8430	.008	3	142	1	0
	126	1	2	.00416		32.42275		-106.31630	15.346	38.2852	42.8515	.028	5	143	9	0
NO MATCH		5	ATTEMPTS	126	144	.1325	.3195									
	127	1	2	.00115		32.42075		-106.31633	15.352	38.2876	42.8534	.002	3	143	2	0
	127	1	2	.00376		32.42332		-106.31632	15.356	38.2840	42.8493	.025	5	144	6	0
NO MATCH		5	ATTEMPTS	127	145	.1135	.3190									
	128	1	2	.00173		32.42394		-106.31571	15.361	38.2832	42.8583	.305	3	144	7	0
	128	1	2	.00290		32.42379		-106.31623	15.368	38.2900	42.8569	.314	5	145	6	0
NO MATCH		5	ATTEMPTS	128	146	.0958	.3157									
	129	1	2	.00241		32.42379		-106.31629	15.374	38.2924	42.8587	.009	5	145	5	0
	129	1	2	.00244		32.42392		-106.31624	15.379	38.2911	42.8572	.010	5	146	5	0
NO MATCH		5	ATTEMPTS	129	147	.0957	.3157									
	130	1	2	.00152		32.42393		-106.31629	15.389	38.2895	42.8548	.036	4	147	4	0
NO MATCH		5	ATTEMPTS	130	148	.0731	.3145									
	131	1	2	.00115		32.42093		-106.31629	15.398	38.2970	42.8527	.302	4	148	2	0
NO MATCH		5	ATTEMPTS	131	149	.0564	.3124									
	132	1	2	.01053		32.42034		-106.31628	15.409	38.2904	42.8560	.001	4	149	1	0
NO MATCH		5	ATTEMPTS	132	150	.0468	.3116									
	133	1	2	.00031		32.42035		-106.31626	15.420	38.2934	42.8593	.000	4	150	0	0
	133	1	2	.03474		32.42095		-106.31625	15.426	38.2957	42.8621	.336	5	151	10	0
NO MATCH		5	ATTEMPTS	133	152	.1473	.3296									
	134	1	2	.00047		32.42033		-106.31526	15.433	38.2996	42.8653	.300	3	151	1	0
	134	1	2	.00494		32.42095		-106.31625	15.437	38.2995	42.8651	.030	5	152	9	0
NO MATCH		5	ATTEMPTS	134	153	.1352	.3197									
	135	1	2	.00097		32.42095		-106.31626	15.443	38.3019	42.8670	.032	3	152	2	0
	135	1	2	.00305		32.42037		-106.31626	15.448	38.3018	42.8669	.324	5	153	8	0
NO MATCH		5	ATTEMPTS	135	154	.1211	.3196									
	136	1	2	.01136		32.42336		-106.31624	15.455	38.3057	42.8701	.003	3	153	2	0
	136	1	2	.01345		32.42398		-106.31626	15.460	38.3056	42.8700	.019	5	154	7	0
NO MATCH		5	ATTEMPTS	136	155	.1394	.3177									
	137	1	2	.00274		32.42170		-106.31625	15.465	38.3068	42.8693	.307	3	154	4	0
	137	1	2	.00275		32.42171		-106.31625	15.470	38.3059	42.8707	.312	5	155	5	0
NO MATCH		5	ATTEMPTS	137	156	.1945	.3155									
	138	1	2	.00244		32.42105		-106.31627	15.480	38.3063	42.8694	.010	5	156	5	0
NO MATCH		5	ATTEMPTS	138	157	.1556	.3157									
	139	1	2	.00198		32.42190		-106.31629	15.491	38.3074	42.8697	.006	4	157	4	0
NO MATCH		5	ATTEMPTS	139	158	.1759	.3148									
	140	1	2	.00146		32.42113		-106.31629	15.500	38.3058	42.8674	.013	4	158	3	0
NO MATCH		5	ATTEMPTS	140	159	.0554	.3137									
	141	1	2	.00038		32.42121		-106.31630	15.509	38.3015	42.8623	.001	4	159	1	0
NO MATCH		5	ATTEMPTS	141	160	.0523	.3122									
	142	1	2	.00021		32.42126		-106.31629	15.519	38.3006	42.8615	.000	4	160	0	0
NO MATCH		5	ATTEMPTS	142	161	.0402	.3107									
	143	1	2	.00031		32.42126		-106.31629	15.538	38.3041	42.8640	.000	4	161	0	0

Part II. Sample Output of Velocity Program.

The columns of the velocity program are labeled, with the exception of columns 7 and 9, that list the errors in the velocity components in meters per second to within the nearest decimeter per second.

The difference between columns 2 and 1 represents the time elapsed (in seconds) between the first and last trail position files used to compute the velocity.

Column 3 is the altitude in kilometers.

Columns 4 and 5 give the azimuth and magnitude of the velocity vector. For example, an azimuth of 90 degrees and magnitude of 20 meters would correspond to a wind of 20 m/sec blowing from West to East.

Columns 6 and 7 list the East-West component of the wind and its standard error.

Columns 8 and 9 give the North-South component of the wind and its standard error.

The last column indicates the number of frames that were used to compute the wind, that is, through how many points a least-squares straight line was fitted, whose slope is the wind at that altitude.

TIME SECS	TIME SECS	ALT KM	AZ DEG	VEL M/S	VEW M/S		VNS M/S		NP
40.	95.	16.9600	127.35	19.2	15.2	.2	-11.6	.3	4
40.	95.	16.9800	128.04	18.4	14.5	.3	-11.4	.4	4
40.	.5.	17.0000	115.65	15.4	13.9	.1	-6.7	.2	4
40.	95.	17.0200	117.38	15.7	13.9	.0	-7.2	.1	4
40.	95.	17.0400	119.32	16.4	14.3	.1	-6.0	.1	4
40.	95.	17.0600	11[illegible]	16.3	14.2	.0	-8.1	.1	4
40.	95.	17.0800	11[illegible]	16.5	14.3	.0	-[illegible].2	.1	4
40.	95.	17.1000	120.45	16.5	14.2	.0	-8.3	.1	4
40.	95.	17.1200	122.18	16.6	14.0	.0	-8.8	.1	4
40.	95.	17.1400	121.36	16.2	13.[illegible]	.[illegible]	-6.4	.2	4
40.	95.	17.1600	120.23	15.8	13.7	.0	-[illegible].0	.1	4
40.	.5.	17.1800	122.3[illegible]	16.0	13.5	.0	-8.6	.1	4
40.	95.	17.2000	115.23	15.1	13.7	.0	-6.4	.2	4
40.	95.	17.2200	112.48	15.3	14.2	.0	-5.9	.1	4
40.	95.	17.2400	106.[illegible]2	15.5	14.6	.0	-5.0	.2	4
40.	.5.	17.2600	110.25	15.6	14.7	.0	-5.4	.1	4
40.	95.	17.2800	112.94	15.7	14.5	.1	-6.1	.0	4
40.	95.	17.3000	114.27	15.7	14.3	.0	-6.6	.1	4
40.	95.	17.3200	117.15	15.9	14.1	.0	-7.2	.1	4
40.	95.	17.3400	119.[illegible]5	16.0	14.0	.0	-7.[illegible]	.1	4
40.	.5.	17.3600	117.58	15.9	14.1	.0	-7.3	.3	4
40.	95.	17.3800	115.52	15.6	14.1	.0	-6.7	.0	4
40.	95.	17.4000	116.92	15.8	14.1	.[illegible]	-7.2	.1	4
40.	95.	17.4200	11[illegible].37	15.9	13.9	.1	-7.7	.1	4
40.	.5.	17.4400	128.25	16.1	13.[illegible]	.1	-[illegible].1	.0	4
40.	95.	17.4600	121.98	16.1	13.7	.0	-8.5	.1	4
40.	95.	17.4800	122.96	16.4	13.8	.0	-8.9	.0	4
40.	95.	17.5000	125.4[illegible]	16.7	13.6	.[illegible]	-9.7	.1	4
40.	95.	17.5200	128.18	17.3	13.6	.1	-10.7	.4	4
40.	.5.	17.5400	12[illegible].57	17.6	13.6	.1	-11.2	1.0	4
40.	95.	17.5600	123.11	15.4	12.9	.0	-8.4	.3	4
40.	95.	17.5800	123.25	15.[illegible]	12.6	.[illegible]	-6.3	.1	4
40.	95.	17.6000	123.[illegible]4	15.3	12.7	.1	-8.5	.0	4
40.	.5.	17.6200	125.10	15.5	12.7	.1	-[illegible]	.2	4
40.	95.	17.6400	128.67	16.2	12.6	.2	-10.1	.3	4
40.	95.	17.6600	130.37	16.5	12.4	.4	-10.8	.2	4
40.	95.	17.6800	133.75	16.9	12.2	.6	-11.7	.[illegible]	4
40.	95.	17.7000	135.78	17.7	12.3	.[illegible]	-12.7	1.3	4
40.	.5.	17.7200	137.49	17.9	12.1	.9	-13.2	1.7	4
40.	95.	17.7400	127.34	10.6	8.4	.0	-6.5	.1	4
40.	95.	17.7600	129.12	10.5	8.1	.[illegible]	-6.6	.1	4
40.	95.	17.7800	130.53	10.7	8.2	.1	-7.0	.1	4
40.	5.	17.[illegible]000	131.[illegible]3	10.6	7.[illegible]	.1	-7.1	.3	4
40.	95.	17.8200	129.31	9.8	7.5	.0	-6.3	.2	4
40.	95.	17.8400	129.32	9.6	7.4	.0	-6.2	.1	4
40.	95.	17.8600	124.63	9.1	7.4	.0	-5.2	.2	4
40.	95.	17.8800	125.71	9.2	7.5	.0	-5.4	.1	4
40.	.5.	17.9000	127.38	9.6	7.6	.0	-5.9	.0	4
40.	95.	17.9200	128.[illegible]	9.8	7.6	.0	-6.1	.1	4
40.	95.	17.9400	130.48	10.1	7.7	.[illegible]	-6.6	.1	4
40.	95.	17.9600	129.51	9.9	7.7	.1	-6.3	.5	4
40.	.5.	17.[illegible]800	112.51	[illegible]	[illegible].2	.1	-3.4	.2	4
40.	95.	18.0000	114.55	9.3	8.5	.0	-3.9	.1	4
40.	95.	18.0200	118.00	9.6	8.5	.0	-4.6	.1	4
40.	95.	18.0400	1[illegible].67	9.6	[illegible].3	.1	-4.[illegible]	.0	4
40.	95.	18.0600	122.43	9.7	8.2	.1	-5.2	.1	4
40.	.5.	18.0800	124.57	10.1	8.3	.0	-5.7	.1	4
40.	95.	18.1000	127.77	10.3	8.1	.[illegible]	-6.3	.1	4
40.	95.	18.1200	13[illegible].[illegible]7	10.7	[illegible].2	.1	-6.9	.1	4
40.	95.	18.1400	133.30	11.3	8.2	.[illegible]	-7.8	.5	4
40.	.5.	18.1600	136.20	11.3	7.[illegible]	.3	-[illegible].1	.6	4
40.	95.	18.1800	131.85	8.7	6.5	.0	-5.8	.1	4
40.	95.	18.2000	134.50	8.8	6.3	.1	-6.2	.1	4
40.	95.	18.2200	137.11	9.0	6.2	.1	-6.6	.0	4
40.	95.	18.2400	139.28	9.2	6.0	.1	-6.[illegible]	.1	4
40.	.5.	18.2600	141.44	9.6	5.9	.3	-7.5	.3	4
40.	95.	18.2800	144.47	10.0	5.8	.4	-8.1	.5	4
40.	95.	18.3000	145.73	9.6	5.4	.4	-[illegible]	.4	4
40.	95.	18.3200	147.74	7.6	4.1	.1	-6.4	.2	4
40.	.5.	18.3400	151.[illegible]	[illegible].3	3.[illegible]	.1	-7.3	.3	4
40.	95.	18.3600	155.14	9.2	3.9	.3	-8.4	.3	4
40.	95.	18.3800	157.31	9.6	3.7	.6	-8.9	.2	4
40.	95.	18.4000	[illegible]59.15	10.1	3.6	.6	-9.4	.0	4

TIME SECS	TIME SECS	ALT KM	AZ DEG	VEL M/S	VEW M/S		VNS M/S		NP
40.	5.	15.5000	125.22	[illegible]	13.7	.0	-9.7	.1	4
40.	95.	15.5200	123.46	16.2	13.5	.0	-9.0	.1	4
40.	95.	15.5400	120.73	16.2	13.3	.0	-9.2	.2	4
40.	95.	15.5600	122.24	15.5	13.1	.0	-8.3	.2	4
40.	95.	15.5800	117.72	14.9	13.2	.0	-6.9	.1	4
40.	95.	15.6000	116.52	14.8	13.2	.0	-6.6	.1	4
40.	95.	15.6200	113.72	14.6	13.4	.0	-5.9	.0	4
40.	95.	15.6400	110.67	14.4	13.5	.0	-5.1	.1	4
40.	95.	15.6600	103.48	14.4	14.0	.0	-3.3	.1	4
40.	.5.	15.6800	105.60	14.7	14.2	.1	-4.0	.1	4
40.	95.	15.7000	105.68	15.0	14.4	.0	-4.0	.0	4
40.	95.	15.7200	106.33	15.4	14.8	.0	-4.3	.1	4
40.	95.	15.7400	107.75	15.6	15.1	.0	-4.8	.1	4
40.	95.	15.7600	107.[illegible]1	16.1	15.3	.0	-4.[illegible]	.1	4
40.	95.	15.7800	107.13	16.5	15.8	.0	-4.9	.1	4
40.	95.	15.8000	106.36	16.8	16.1	.0	-4.7	.1	4
40.	95.	15.8200	106.[illegible]	17.2	16.4	.[illegible]	-5.0	.1	4
40.	95.	15.8400	105.59	17.6	16.9	.0	-4.8	.1	4
40.	.5.	15.8600	106.30	17.9	17.1	.0	-5.0	.1	4
40.	95.	15.8800	107.53	18.2	17.4	.0	-5.5	.1	4
40.	95.	15.9000	108.75	18.6	17.6	.0	-6.0	.1	4
40.	95.	15.9200	109.72	18.9	17.[illegible]	.0	-6.4	.1	4
40.	95.	15.9400	110.35	19.1	17.9	.1	-6.5	.1	4
40.	95.	15.9600	111.60	19.3	18.0	.1	-7.1	.0	4
40.	95.	15.9800	112.70	19.7	18.2	.0	-7.6	.1	4
40.	95.	16.0000	114.[illegible]	20.0	18.2	.1	-8.2	.1	4
40.	95.	16.0200	115.29	20.2	18.2	.1	-8.6	.1	4
40.	.5.	16.0400	116.51	20.3	18.2	.1	-9.1	.1	4
40.	95.	16.0600	117.92	20.5	18.1	.1	-9.6	.1	4
40.	95.	16.0800	119.32	20.7	17.9	.1	-10.3	.0	4
40.	95.	16.1000	121.42	20.9	17.[illegible]	.2	-10.9	.0	4
40.	95.	16.1200	122.40	21.2	17.[illegible]	.1	-11.3	.1	4
40.	95.	16.1400	123.60	21.3	17.8	.1	-11.8	.0	4
40.	95.	16.1600	124.56	21.7	17.9	.1	-12.3	.0	4
40.	95.	16.1800	125.29	22.2	18.1	.1	-12.6	.2	4
40.	95.	16.2000	126.85	22.8	18.3	.1	-13.7	.3	4
40.	.5.	16.2200	12[illegible].53	23.7	18.5	.1	-14.7	.4	4
40.	95.	16.2400	130.06	24.4	18.5	.5	-15.9	.3	4
40.	95.	16.2600	131.76	24.8	19.5	1.[illegible]	-16.6	.9	4
40.	95.	16.2800	133.[illegible]	25.6	18.7	1.1	-17.5	1.0	4
40.	95.	16.3000	134.30	20.4	14.6	.1	-14.2	.3	4
40.	95.	16.3200	134.96	19.2	13.6	.3	-13.6	.3	4
40.	95.	16.3400	136.10	18.8	13.0	.3	-13.5	.4	4
40.	95.	16.3600	136.11	17.5	12.1	.2	-12.6	.3	4
40.	95.	16.3800	136.34	16.5	11.4	.2	-11.9	.4	4
40.	.5.	16.4000	135.61	15.4	10.8	.1	-11.0	.4	4
40.	95.	16.4200	134.95	14.4	10.2	.1	-10.2	.2	4
40.	95.	16.4400	132.57	13.4	9.9	.0	-9.1	.2	4
40.	95.	16.4600	127.12	12.1	9.6	.0	-7.3	.1	4
40.	5.	16.4800	11[illegible].31	11.5	10.1	.0	-5.6	.2	4
40.	95.	16.5000	111.06	11.9	11.1	.0	-4.3	.2	4
40.	95.	16.5200	112.61	12.6	11.6	.1	-4.7	.1	4
40.	95.	16.5400	107.66	13.1	12.5	.2	-4.0	.2	4
40.	95.	16.5600	108.69	13.6	12.[illegible]	.1	-4.4	.1	4
40.	.5.	16.5800	109.73	14.2	13.3	.1	-4.8	.0	4
40.	95.	16.6000	109.[illegible]8	14.6	13.8	.1	-4.8	.1	4
40.	95.	16.6200	104.95	15.6	15.1	.1	-3.9	.2	4
40.	95.	16.6400	105.33	15.8	15.3	.1	-4.2	.1	4
40.	.5.	16.6600	106.51	16.1	15.4	.0	-4.6	.1	4
40.	95.	16.6800	108.44	16.3	15.5	.0	-5.2	.1	4
40.	95.	16.7000	109.71	16.6	15.6	.0	-5.6	.0	4
40.	95.	16.7200	111.15	16.6	15.5	.1	-6.0	.1	4
40.	95.	16.7400	113.30	16.8	15.4	.2	-6.7	.1	4
40.	5.	16.7600	114.34	17.1	15.5	.2	-7.0	.1	4
40.	95.	16.7800	115.74	17.4	15.6	.2	-7.5	.0	4
40.	95.	16.8000	117.[illegible]	17.6	15.6	.2	-8.0	.1	4
40.	95.	16.8200	118.36	18.1	15.9	.2	-8.6	.1	4
40.	.5.	16.8400	[illegible]	[illegible]	15.[illegible]	.2	-[illegible].1	.1	4
40.	95.	16.8600	121.39	19.1	16.3	.1	-9.8	.1	4
40.	95.	16.8800	122.95	20.0	16.9	.1	-10.8	.1	4
40.	95.	16.9000	124.43	20.2	16.7	.1	-11.4	.2	4
40.	95.	16.9200	126.25	20.4	16.4	.2	-12.0	.1	4
40.	95.	16.9400	126.42	19.1	15.4	.1	-11.4	.1	4

TIME SECS	TIME SECS	ALT KM	AZ DEG	VEL M/S	VEW M/S		VNS M/S		NR
40.	70.	14.0400	115.01	27.9	25.3	.0	-11.6	.5	3
40.	70.	14.0600	116.06	28.9	25.9	.0	-12.7	.2	3
40.	70.	14.0800	115.[illegible]7	29.4	26.5	.0	-12.[illegible]	.1	3
40.	95.	14.1000	116.14	29.2	26.3	.1	-12.9	.1	4
40.	95.	14.1200	116.19	29.3	26.3	.0	-12.9	.2	4
40.	95.	14.1400	114.76	29.2	26.6	.1	-12.2	.1	4
40.	95.	14.1600	112.56	29.3	27.1	.1	-11.2	.2	4
40.	95.	14.1800	108.50	29.8	28.3	.0	-9.5	.3	4
40.	95.	14.2000	109.37	30.8	28.3	.1	-9.9	.0	4
40.	95.	14.2200	110.40	30.5	28.5	.0	-10.6	.1	4
40.	95.	14.2400	111.58	31.1	28.9	.1	-11.4	.1	4
40.	95.	14.2600	112.5[illegible]	31.[illegible]	29.4	.1	-12.2	.1	4
40.	95.	14.2800	113.46	32.3	29.6	.1	-12.8	.2	4
40.	95.	14.3000	113.42	32.9	30.2	.0	-13.1	.2	4
40.	95.	14.3200	113.66	33.6	30.[illegible]	.0	-13.5	.1	4
40.	95.	14.3400	113.88	33.6	30.8	.1	-13.6	.0	4
40.	95.	14.3600	114.28	33.9	30.9	.1	-13.9	.1	4
40.	95.	14.3800	114.30	33.9	30.8	.1	-14.3	.1	4
40.	95.	14.4000	115.31	34.6	31.2	.1	-15.1	.1	4
40.	95.	14.4200	116.10	34.8	31.3	.1	-15.3	.1	4
40.	95.	14.4400	116.74	35.0	31.3	.0	-15.7	.1	4
40.	95.	14.4600	117.29	35.1	31.2	.1	-16.1	.1	4
40.	95.	14.4800	117.7[illegible]	34.9	30.9	.0	-16.3	.1	4
40.	95.	14.5000	117.65	34.[illegible]	30.[illegible]	.1	-16.1	.1	4
40.	95.	14.5200	117.65	34.3	30.3	.0	-15.[illegible]	.2	4
40.	95.	14.5400	118.43	34.3	30.2	.1	-16.3	.0	4
40.	95.	14.5600	119.00	34.6	30.3	.1	-16.8	.1	4
40.	95.	14.5800	120.42	35.4	30.5	.1	-17.9	.5	4
40.	95.	14.6000	121.71	35.8	30.5	.0	-18.8	.6	4
40.	95.	14.6200	122.[illegible]6	36.0	30.3	.6	-19.5	.7	4
40.	95.	14.6400	124.16	36.0	29.8	.5	-20.2	.3	4
40.	95.	14.6600	125.30	36.1	29.5	1.0	-20.9	.5	4
40.	95.	14.6800	126.63	36.7	29.5	1.0	-21.9	.5	4
40.	95.	14.7000	127.82	37.3	29.4	1.1	-22.[illegible]	.7	4
40.	95.	14.7200	128.28	37.4	29.4	1.3	-23.2	1.0	4
40.	95.	14.7400	129.64	37.8	29.2	1.4	-24.2	1.2	4
40.	95.	14.7600	130.33	38.5	29.1	1.4	-25.2	1.4	4
40.	95.	14.7800	130.32	30.1	23.0	.1	-19.5	.2	4
40.	95.	14.8000	130.47	[illegible]	22.7	.1	-1[illegible].4	.2	4
40.	95.	14.8200	130.46	29.2	22.2	.0	-18.9	.1	4
40.	95.	14.8400	130.67	28.9	21.9	.0	-18.9	.2	4
40.	95.	14.8600	131.[illegible]7	28.9	21.7	.1	-1[illegible].0	.2	4
40.	95.	14.8800	130.[illegible]9	27.7	21.2	.1	-17.[illegible]	.6	4
40.	95.	14.9000	128.80	26.9	20.9	.0	-16.8	.6	4
40.	95.	14.9200	124.17	25.3	21.0	.0	-14.2	.1	4
40.	95.	14.9600	123.39	25.5	21.2	.[illegible]	-14.2	.1	4
40.	95.	14.[illegible]600	123.81	25.5	21.2	.0	-14.2	.1	4
40.	95.	1[illegible]00	123.32	25.3	21.2	.0	-13.[illegible]	.2	4
40.	95.	15.0000	123.16	25.2	21.1	.1	-13.8	.2	4
40.	95.	15.0200	123.37	25.0	20.9	.1	-13.8	.3	4
40.	95.	15.0400	122.71	24.6	2[illegible].7	.1	-13.3	.4	4
40.	95.	15.0600	121.00	23.6	20.1	.1	-12.4	.1	4
40.	95.	15.0800	123.55	23.9	20.0	.1	-13.2	.3	4
40.	95.	15.1000	125.11	24.0	19.7	.0	-13.8	.3	4
40.	95.	15.1200	127.21	24.7	19.7	.3	-14.9	.2	4
40.	95.	15.1400	128.81	25.2	19.6	.5	-15.8	.4	4
40.	95.	15.1600	12[illegible]	25.6	1[illegible].7	.6	-16.3	.3	4
40.	95.	15.1800	130.9[illegible]	25.9	19.6	.7	-17.0	.7	4
40.	95.	15.2000	130.75	22.7	17.2	.4	-14.8	.5	4
40.	95.	15.2200	[illegible]	20.4	15.7	.1	-13.0	.1	4
40.	95.	15.2400	131.20	20.5	15.4	.2	-13.5	.2	4
40.	95.	15.2600	130.44	19.1	14.5	.1	-12.4	.3	4
40.	95.	15.2800	129.87	18.7	14.3	.1	-12.0	.1	4
40.	95.	15.3000	13[illegible].22	18.2	13.9	.[illegible]	-11.7	.2	4
40.	95.	15.3200	123.11	17.8	13.8	.0	-11.2	.3	4
40.	95.	15.3400	126.0[illegible]	17.3	13.[illegible]	.0	-10.3	.1	4
40.	95.	15.3600	125.50	17.4	13.9	.0	-10.4	.1	4
40.	95.	15.3800	127.26	17.4	13.9	.0	-10.5	.1	4
40.	95.	15.4000	127.[illegible]4	17.5	13.[illegible]	.0	-10.7	.2	4
40.	95.	15.4200	125.02	17.1	13.8	.0	-10.0	.2	4
40.	95.	15.4400	124.19	16.7	13.8	.0	-9.4	.1	4
40.	95.	15.4600	124.43	16.8	13.8	.0	-9.6	.1	4
40.	95.	15.4800	125.5[illegible]	17.0	13.[illegible]	.0	-9.[illegible]	.1	4

TIME SECS	TIME SECS	ALT KM	AZ DEG	VEL M/S	VEW M/S		VNS M/S		NP
40.	95.	18.4200	160.98	9.8	3.2	.6	-9.3	.2	4
40.	95.	18.4400	162.73	9.9	2.9	.6	-9.5	.3	4
40.	95.	18.4600	164.15	10.2	2.6	.6	-9.6	.5	4
40.	95.	18.4800	165.76	11.2	2.8	.6	-10.6	.9	4
40.	95.	18.5000	167.30	11.9	2.6	.7	-11.6	1.0	4
40.	95.	18.5200	168.54	13.2	2.6	1.2	-12.9	1.3	4
40.	95.	18.5400	170.48	13.6	2.2	1.4	-13.4	.9	4
40.	95.	18.5600	172.43	13.9	1.8	1.9	-13.8	1.1	4
40.	95.	18.5800	173.65	14.0	1.6	1.6	-14.7	1.4	4
40.	95.	18.6000	174.67	15.7	1.5	2.0	-15.6	1.9	4
40.	95.	18.6200	175.72	16.7	1.2	1.9	-16.6	2.3	4
40.	95.	18.6400	176.65	17.7	1.0	1.6	-17.7	2.4	4
40.	95.	18.6600	177.47	18.6	.8	1.6	-18.6	2.6	4
40.	95.	18.6800	178.31	19.5	.6	1.7	-19.5	3.2	4
40.	95.	18.7000	179.09	20.6	.3	1.4	-20.6	3.7	4
40.	95.	18.7200	179.86	21.5	.1	1.2	-21.5	3.6	4
40.	95.	18.7400	180.42	22.2	-.3	1.0	-22.2	3.9	4
40.	95.	18.7600	181.61	22.3	-.6	.9	-22.0	4.0	4
40.	95.	18.7800	215.13	7.7	-4.4	.0	-6.3	.1	4
40.	95.	18.8000	215.37	7.8	-4.5	.0	-6.3	.1	4
40.	95.	18.8200	213.11	8.1	-4.4	.1	-6.6	.1	4
40.	95.	18.8400	212.45	8.3	-4.4	.1	-7.0	.1	4
40.	95.	18.8600	214.61	8.5	-4.8	.2	-7.0	.6	4
40.	95.	18.8800	220.26	8.3	-5.4	.1	-6.3	.5	4
40.	95.	18.9000	250.51	4.3	-4.1	.3	-1.4	.3	4
40.	95.	18.9200	241.30	4.4	-3.9	.1	-2.1	.1	4
40.	95.	18.9400	231.7	4.7	-3.7	.1	-2.9	.1	4
40.	95.	18.9600	227.11	4.8	-3.5	.1	-3.3	.1	4
40.	95.	18.9800	225.59	4.8	-3.5	.1	-3.4	.1	4
40.	95.	19.0000	223.51	4.9	-3.4	.0	-3.6	.0	4
40.	95.	19.0200	224.74	4.8	-3.4	.0	-3.4	.1	4
40.	95.	19.0400	229.70	4.6	-3.5	.0	-3.0	.2	4
40.	95.	19.0600	240.19	4.2	-3.8	.0	-1.7	.2	4
40.	95.	19.0800	267.14	3.6	-3.4	.1	1.1	.2	4
40.	95.	19.1000	279.75	3.5	-3.5	.1	.6	.2	4
40.	95.	19.1200	270.36	3.6	-3.6	.1	.0	.2	4
40.	95.	19.1400	260.76	3.8	-3.7	.1	-.6	.2	4
40.	95.	19.1600	250.49	4.1	-3.8	.2	-1.4	.2	4
40.	95.	19.1800	241.51	4.5	-4.0	.2	-2.1	.2	4
40.	95.	19.2000	234.20	5.0	-4.1	.2	-2.9	.2	4
40.	95.	19.2200	227.54	5.6	-4.1	.3	-3.8	.1	4
40.	95.	19.2400	221.08	6.3	-4.2	.2	-4.7	.1	4
40.	95.	19.2600	216.78	7.0	-4.2	.2	-5.6	.1	4
40.	95.	19.2800	212.50	7.8	-4.2	.2	-6.6	.2	4
40.	95.	19.3000	209.74	8.7	-4.1	.1	-7.7	.2	4
40.	95.	19.3200	204.95	9.6	-4.0	.1	-8.7	.1	4
40.	95.	19.3400	202.24	10.4	-4.0	.2	-9.7	.2	4
40.	95.	19.3600	201.43	11.2	-4.1	.4	-10.4	.3	4
40.	95.	19.3800	199.36	12.0	-4.1	.4	-11.3	1.2	4
40.	95.	19.4000	199.49	12.5	-4.2	.3	-11.8	1.2	4
40.	95.	19.4200	199.57	12.7	-4.2	.3	-11.9	1.2	4
40.	95.	19.4400	221.4	8.6	-5.6	.0	-6.5	.1	4
40.	95.	19.4600	224.08	8.4	-5.8	.0	-6.0	.1	4
40.	95.	19.4800	224.5	8.5	-6.8	.0	-6.8	.0	4
40.	95.	19.5000	226.63	8.6	-6.2	.1	-5.9	.1	4
40.	95.	19.5200	225.59	9.0	-6.4	.1	-6.3	.2	4
40.	95.	19.5400	232.26	8.9	-7.1	.1	-5.4	.1	4
40.	95.	19.5600	236.90	9.0	-7.4	.1	-5.2	.2	4
40.	95.	19.5800	242.45	8.6	-7.6	.0	-4.0	.1	4
40.	95.	19.6000	244.24	8.5	-7.6	.0	-3.7	.0	4
40.	95.	19.6200	244.65	8.5	-7.7	.0	-3.6	.0	4
40.	95.	19.6400	245.59	8.5	-7.8	.0	-3.6	.1	4
40.	95.	19.6600	249.40	8.6	-8.0	.0	-3.1	.1	4
40.	95.	19.6800	260.35	8.4	-8.3	.0	-1.4	.1	4
40.	95.	19.7000	260.63	8.5	-8.4	.0	-1.4	.0	4
40.	95.	19.7200	261.22	8.6	-8.5	.0	-1.8	.0	4
40.	95.	19.7400	259.84	8.8	-9.6	.0	-1.5	.1	4
40.	95.	19.7600	265.37	8.1	-8.0	.1	-.7	.5	4
40.	95.	19.7800	272.55	6.9	-6.9	.1	.3	.2	4
40.	95.	19.8000	267.69	6.8	-6.6	.1	-.3	.1	4
40.	95.	19.8200	262.49	6.7	-6.6	.1	-.9	.1	4
40.	95.	19.8400	257.43	6.8	-6.6	.1	-1.5	.1	4
40.	95.	19.8600	252.32	6.9	-6.5	.1	-2.1	.1	4

TIME SECS	TIME SECS	ALT KM	AZ DEG	VEL M/S	VEW M/S		VNS M/S		NP
40.	95.	[illegible]	245.[illegible]	6.9	-6.3	.1	-2.8	.1	4
40.	95.	[illegible]	243.2[illegible]	7.2	-6.5	.1	-3.3	.0	4
40.	95.	19.9200	239.91	7.4	-6.4	.1	-3.7	.1	4
40.	95.	19.9400	237.27	7.7	-6.4	.1	-4.1	.1	4
40.	95.	19.9600	231.17	7.9	-6.1	.2	-4.9	.1	4
40.	95.	19.9800	227.38	8.2	-6.0	.1	-5.6	.5	4
40.	95.	20.0000	244.[illegible]1	6.2	-7.4	.0	-3.5	.1	4
40.	95.	20.0200	250.19	6.1	-7.6	.0	-2.8	.1	4
40.	95.	20.0400	266.14	7.5	-7.5	.0	-.5	.1	4
40.	95.	20.0600	266.19	7.3	-7.3	.0	-.5	.1	4
40.	95.	20.0800	264.5[illegible]	7.2	-7.1	.0	-.7	.1	4
40.	95.	20.1000	267.48	6.9	-6.9	.0	-.2	.1	4
40.	95.	20.1200	266.72	7.1	-7.1	.0	-.4	.1	4
40.	95.	20.1400	263.65	7.2	-7.1	.[illegible]	-.6	.0	4
40.	95.	20.1600	260.52	7.3	-7.2	.0	-1.2	.0	4
40.	95.	20.1800	259.64	7.4	-7.3	.0	-1.3	.2	4
40.	95.	20.2000	268.35	7.2	-7.2	.0	-.2	.0	4
40.	95.	20.2200	272.15	6.8	-6.8	.1	.3	.1	4
40.	95.	20.2400	277.27	6.2	-6.2	.1	.8	.1	4
40.	95.	20.2600	276.16	5.[illegible]	-5.7	.1	.6	.0	4
40.	95.	20.2800	274.19	5.4	-5.4	.1	.4	.1	4
40.	95.	20.3000	273.[illegible]2	5.2	-5.2	.1	.3	.1	4
40.	95.	20.3200	273.79	4.7	-4.7	.1	.3	.0	4
40.	95.	20.3400	274.70	4.4	-4.4	.0	.4	.1	4
40.	95.	20.3600	267.62	4.3	-4.3	.0	-.2	.1	4
40.	95.	20.3800	260.[illegible]3	4.5	-4.5	.1	-.8	.1	4
40.	95.	20.4000	253.44	4.9	-4.7	.1	-1.4	.0	4
40.	95.	20.4200	249.[illegible]1	5.1	-4.8	.0	-1.8	.1	4
40.	95.	20.4400	244.41	5.3	-4.[illegible]	.1	-2.3	.2	4
40.	95.	20.4600	240.00	5.5	-4.8	.0	-2.8	.1	4
40.	95.	20.4800	234.57	5.9	-4.8	.0	-3.4	.7	4
40.	95.	20.5000	254.[illegible]	5.1	-4.9	.0	-1.3	.0	4
40.	95.	20.5200	250.24	5.2	-4.9	.0	-1.[illegible]	.1	4
40.	95.	20.5400	244.[illegible]	5.4	-4.8	.0	-2.3	.1	4
40.	95.	20.5600	239.94	5.7	-4.9	.0	-2.8	.1	4
40.	95.	20.5800	235.31	6.0	-4.9	.1	-3.4	.1	4
40.	95.	20.6000	234.[illegible]1	6.3	-5.1	.2	-3.6	.6	4
40.	95.	20.6200	261.[illegible]	6.1	-6.0	.1	-.9	.5	4
40.	95.	20.6400	284.79	4.9	-4.7	.1	1.3	.1	4
40.	95.	20.6600	291.35	4.2	-3.9	.1	1.6	.1	4
40.	95.	20.6800	303.29	3.6	-3.[illegible]	.2	2.0	.0	4
60.	95.	20.7000	308.07	2.7	-2.1	.0	1.6	.0	3
60.	95.	20.7200	2[illegible].34	2.6	-2.3	.1	1.3	.1	3
60.	95.	20.7400	285.58	2.4	-2.3	.1	.7	.0	3
60.	95.	20.7600	284.11	2.1	-2.1	.0	.5	.1	3
60.	95.	20.7800	27[illegible]	1.7	-1.7	.0	.2	.0	3
60.	95.	20.8000	[illegible].72	1.3	-1.3	.0	-.0	.0	3
60.	95.	20.8200	250.22	1.2	-1.1	.0	-.3	.0	3
60.	95.	20.8400	233.18	2.2	-1.7	.1	-1.3	.1	3
60.	95.	20.8600	223.4[illegible]	3.1	-2.[illegible]	.[illegible]	-2.2	.0	3
60.	95.	20.8800	221.90	3.6	-2.4	.0	-2.7	.0	3
60.	95.	20.9000	220.37	4.0	-2.6	.1	-3.0	.1	3
60.	95.	20.9200	220.33	4.4	-2.9	.1	-3.4	.0	3
60.	95.	20.9400	218.78	4.9	-3.1	.0	-3.[illegible]	.1	3
60.	95.	20.9600	217.35	5.4	-3.2	.0	-4.3	.1	3
60.	95.	20.9800	214.25	6.0	-3.4	.1	-4.[illegible]	.2	3
60.	95.	21.0000	209.43	6.7	-3.3	.1	-5.8	.2	3
60.	95.	21.0200	207.47	7.3	-3.4	.1	-6.5	.2	3
60.	95.	21.0400	203.[illegible]	[illegible]	-3.3	.0	-7.3	.2	3
60.	95.	21.0600	200.78	8.9	-3.2	.2	-[illegible].3	.0	3
60.	95.	21.0800	197.26	10.0	-2.9	.3	-9.6	.0	3
60.	95.	21.1000	193.26	12.0	-2.8	.5	-11.7	.4	3
60.	95.	21.1200	191.31	14.2	-2.9	.5	-13.9	.3	3
60.	95.	21.1400	192.50	15.3	-3.3	.4	-15.0	1.0	3
60.	95.	21.1600	191.21	15.[illegible]	-3.1	.5	-15.6	1.1	3
60.	95.	21.1800	190.57	16.9	-3.1	.5	-16.6	1.1	3
60.	95.	21.2000	189.71	17.6	-3.0	.5	-17.3	1.2	3
60.	95.	21.2200	187.63	19.[illegible]	-2.5	.6	-19.[illegible]	1.2	3
60.	95.	21.2400	180.73	20.8	-2.5	.7	-20.7	1.[illegible]	3
60.	95.	21.2600	239.50	10.2	-8.7	.0	-5.2	.0	3
60.	95.	21.2800	238.74	10.2	-8.8	.0	-5.3	.2	3
60.	95.	21.3000	237.90	10.4	-8.8	.0	-5.5	.3	3
60.	95.	21.3200	245.70	9.2	-8.4	.0	-3.8	.1	3

TIME SECS	TIME SECS	ALT KM	AZ DEG	VEL M/S	VEW M/S		VNS M/S		NP
60.	95.	21.3400	243.13	9.0	-8.0	.0	-4.1	.1	3
60.	95.	21.3600	243.37	8.8	-7.9	.0	-4.0	.1	3
60.	95.	21.3800	240.46	9.0	-7.8	.0	-4.4	.1	3
60.	95.	21.4000	23[illegible]	9.2	-7.[illegible]	.0	-4.7	.0	3
60.	95.	21.4200	236.41	9.4	-7.9	.0	-5.2	.1	3
60.	95.	21.4400	23[illegible]	9.4	-7.8	.0	-5.2	.2	3
60.	95.	21.4600	241.51	9.2	-8.1	.0	-4.4	.0	3
60.	95.	21.4800	242.55	9.4	-8.3	.0	-4.3	.2	3
60.	95.	21.5000	250.[illegible]	9.2	-[illegible].7	.0	-3.0	.2	3
60.	95.	21.5200	256.34	8.7	-8.5	.0	-2.1	.0	3
60.	95.	21.5400	254.57	8.6	-8.3	.0	-2.3	.1	3
60.	95.	21.5600	253.03	8.7	-8.3	.0	-2.6	.1	3
60.	95.	21.5800	251.36	8.6	-8.2	.0	-2.0	.0	3
60.	95.	21.6000	249.34	8.6	-8.1	.0	-3.1	.1	3
60.	95.	21.6200	246.84	8.7	-8.0	.0	-3.4	.1	3
60.	95.	21.6400	245.74	8.7	-8.0	.0	-3.6	.0	3
60.	95.	21.6600	245.30	8.7	-7.9	.0	-3.6	.1	3
60.	95.	21.6800	24[illegible].34	8.4	-7.9	.0	-2.9	.1	3
60.	95.	21.7000	252.98	8.3	-7.9	.0	-2.4	.1	3
60.	95.	21.7200	254.54	8.4	-8.1	.0	-2.2	.1	3
60.	95.	21.7400	271.23	8.5	-8.5	.0	.2	.0	3
60.	95.	21.7600	270.22	8.5	-8.4	.0	.[illegible]	.2	3
60.	95.	21.7800	282.62	8.4	-8.2	.0	1.9	.0	3
60.	95.	21.8000	290.21	8.0	-7.5	.0	2.8	.0	3
60.	95.	21.8200	2[illegible]0.[illegible]1	7.[illegible]	-7.3	.0	2.6	.2	3
60.	95.	21.8400	287.48	7.6	-7.2	.0	2.3	.1	3
60.	95.	21.8600	2[illegible]6.[illegible]1	7.3	-7.0	.0	2.1	.0	3
60.	95.	21.8800	285.17	7.2	-7.0	.0	1.9	.0	3
60.	95.	21.9000	279.30	7.2	-7.1	.[illegible]	1.2	.0	3
60.	95.	21.9200	272.35	7.4	-7.4	.1	.3	.2	3
60.	95.	21.9400	26[illegible].35	7.[illegible]	-7.[illegible]	.1	-.3	.1	3
60.	95.	21.9600	267.00	7.7	-7.7	.1	-.3	.0	3
60.	95.	21.9800	264.56	7.5	-7.4	.1	-.7	.0	3
60.	95.	22.0000	264.44	7.4	-7.3	.0	-.7	.1	3
60.	95.	22.0200	258.25	7.2	-7.0	.0	-1.5	.0	3
60.	95.	22.0400	251.35	7.1	-6.7	.0	-2.3	.0	3
60.	95.	22.0600	247.17	7.1	-6.6	.0	-2.8	.0	3
60.	95.	22.0800	240.23	7.3	-6.4	.0	-3.6	.3	3
60.	95.	22.1000	247.79	7.1	-6.6	.0	-2.7	.2	3
60.	95.	22.1200	251.[illegible]	6.9	-6.6	.0	-2.2	.1	3
60.	95.	22.1400	249.79	7.2	-6.8	.0	-2.5	.1	3
60.	95.	22.1600	250.70	7.4	-7.0	.0	-2.4	.0	3
60.	95.	22.1800	240.61	7.5	-7.0	.0	-2.7	.1	3
60.	95.	22.2000	247.35	7.7	-7.1	.0	-3.0	.1	3
60.	95.	22.2200	244.54	7.[illegible]	-7.1	.0	-3.4	.1	3
60.	95.	22.2400	241.[illegible]3	8.4	-7.3	.0	-4.0	.1	3
60.	95.	22.2600	239.[illegible]0	8.7	-7.5	.0	-4.5	.1	3
60.	95.	22.2800	241.00	8.6	-7.5	.0	-4.2	.1	3
60.	95.	22.3000	240.[illegible]7	[illegible]	-7.7	.0	-4.3	.1	3
60.	95.	22.3200	243.18	9.1	-8.1	.0	-4.1	.2	3
60.	95.	22.3400	246.30	9.1	-8.3	.0	-3.6	.1	3
60.	95.	22.3600	249.25	9.3	-8.7	.0	-3.3	.2	3
60.	95.	22.3800	249.79	9.3	-8.7	.0	-3.2	.1	3
60.	95.	22.4000	250.14	9.4	-8.8	.1	-3.2	.1	3
60.	95.	22.4200	248.07	9.7	-9.0	.1	-3.6	.1	3
60.	95.	22.4400	248.27	10.4	-9.7	.1	-3.9	.1	3
60.	95.	22.4600	246.[illegible]0	11.1	-10.2	.0	-4.5	.3	3
60.	95.	22.4800	256.17	10.[illegible]	-10.6	.0	-2.6	.2	3
60.	95.	22.5000	258.09	10.9	-10.7	.1	-2.3	.4	3
60.	95.	22.5200	270.40	9.7	-9.7	.0	.1	.2	3
60.	95.	22.5400	269.69	9.3	-9.[illegible]	.0	-.1	.1	3
60.	95.	22.5600	266.74	9.2	-9.1	.0	-.5	.1	3
60.	95.	22.5800	266.40	8.6	-8.5	.0	-.5	.1	3
60.	95.	22.6000	262.54	8.5	-8.5	.0	-1.1	.1	3
60.	95.	22.6200	260.24	8.5	-8.3	.0	-1.4	.1	3
60.	95.	22.6400	257.48	8.4	-8.2	.0	-1.8	.0	3
60.	95.	22.6600	256.42	8.5	-8.3	.0	-2.0	.1	3
60.	95.	22.6800	253.91	8.5	-8.2	.0	-2.4	.1	3
60.	95.	22.7000	261.27	8.5	-8.4	.1	-1.3	.3	3
60.	95.	22.7200	279.50	7.[illegible]	-7.7	.0	1.3	.1	3
60.	95.	22.7400	280.00	7.8	-7.6	.0	1.4	.1	3
60.	95.	22.7600	277.85	7.8	-7.7	.0	1.1	.1	3
60.	95.	22.7800	276.94	7.8	-7.7	.0	.9	.1	3

TIME SECS	TIME SECS	ALT KM	AZ DEG	VEL M/S	VEW M/S		VNS M/S		NP
60.	95.	22.8000	278.09	7.8	-7.7	.0	1.1	.3	3
60.	95.	22.8200	279.52	7.[illegible]	-7.[illegible]	.0	1.3	.1	3
60.	95.	22.8400	278.61	8.1	-8.0	.0	1.2	.1	3
60.	95.	22.8600	277.33	8.3	-8.2	.0	1.1	.1	3
60.	95.	22.8800	276.33	8.4	-8.3	.0	1.0	.2	3
60.	95.	22.9000	278.2[illegible]	8.6	-8.4	.0	.[illegible]	.2	3
60.	95.	22.9200	280.27	8.5	-8.4	.0	1.5	.0	3
60.	95.	22.9400	277.51	8.7	-8.7	.0	1.1	.2	3
60.	95.	22.9600	278.54	8.[illegible]	-8.7	.0	1.0	.1	3
60.	95.	22.9800	277.32	8.8	-8.8	.0	1.2	.1	3
60.	95.	23.0000	274.5[illegible]	9.1	-9.1	.0	.7	.0	3
60.	95.	23.0200	287.17	8.6	-8.2	.0	2.5	.2	3
60.	95.	23.0400	284.09	8.2	-8.0	.0	2.[illegible]	.1	3
60.	95.	23.0600	276.09	7.9	-7.9	.0	.9	.1	3
60.	95.	23.0800	273.75	7.7	-7.7	.0	.5	.1	3
60.	95.	23.1000	274.09	7.2	-7.2	.0	.5	.1	3
60.	95.	23.1200	274.74	6.9	-6.9	.0	.6	.1	3
60.	95.	23.1400	273.[illegible]7	6.5	-6.5	.0	.4	.2	3
60.	95.	23.1600	270.71	6.4	-6.4	.0	.1	.1	3
60.	95.	23.1800	267.40	6.3	-6.3	.0	-.3	.1	3
60.	95.	23.2000	271.49	6.0	-6.0	.0	.2	.1	3
60.	95.	23.2200	271.39	5.8	-5.8	.0	.2	.1	3
60.	95.	23.2400	265.41	5.9	-5.9	.0	-.2	.0	3
60.	95.	23.2600	264.[illegible]2	6.3	-6.2	.0	-.6	.1	3
60.	95.	23.2800	260.57	6.5	-6.4	.0	-1.1	.1	3
60.	95.	23.3000	255.25	7.0	-6.8	.0	-1.8	.0	3
60.	95.	23.3200	248.66	7.7	-7.2	.0	-2.6	.0	3
60.	95.	23.3400	243.94	8.4	-7.5	.0	-3.7	.0	3
60.	95.	23.3600	243.17	8.6	-7.7	.0	-3.9	.1	3
60.	95.	23.3800	241.29	9.0	-7.9	.0	-4.3	.1	3

ALTS= 468 V-E ERROR = .1550 V-N ERROR = .2576

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