

D815.14

2432

Ad 712 058

NWL TECHNICAL REPORT TR-2432
July 1970

LIBRARY

U.S. NAVY

U.S. NAVAL WEAPONS LABORATORY

POLAR MOTION DETERMINATIONS BY U.S. NAVY DOPPLER SATELLITE OBSERVATIONS

R. J. Anderle

20070122015

U. S. NAVAL WEAPONS LABORATORY
DAHLGREN, VIRGINIA



U. S. NAVAL WEAPONS LABORATORY

Dahlgren, Virginia

22448

Steven N. Anastasion, Capt., USN
Commander

Bernard Smith
Technical Director

NWL Technical Report TR-2432
JULY 1970

POLAR MOTION DETERMINATIONS BY
U.S. NAVY DOPPLER SATELLITE OBSERVATIONS

R. J. Anderle

Warfare Analysis Department

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED.

Best Available Copy

FOREWORD

The axis of rotation of the earth is not fixed in the earth; the imaginary point where the axis intersects the earth's crust describes a roughly circular motion, five to ten meters in radius, with a period of 400 days. This "Chandler Wobble" has been precisely measured by astronomical techniques for many years. In 1969, U.S. Navy scientists found that the motion could be determined with the use of Doppler observations of an artificial earth satellite. This report reviews the results obtained during the past year. It was prepared in response to an invitation by Professor P. Melchior to discuss the results during meetings of the Commission on the Rotation of the Earth at the Brighton General Assembly of the International Astronomical Union in August 1970.

The satellite orbits upon which these results are based were computed under the direction of Steve J. Smith using computer programs prepared largely by Treva B. Daniels. Larry Beuglass collaborated with the author in determining the position of the pole from these data with the able assistance of V. Louise Brooks. We are particularly grateful to Charles J. Cohen for his technical guidance in all aspects of the satellite geodesy program.

RELEASED BY:

Ralph A. Niemann

RALPH A. NIEMANN, Head
Warfare Analysis Department

22 July 1970

ABSTRACT

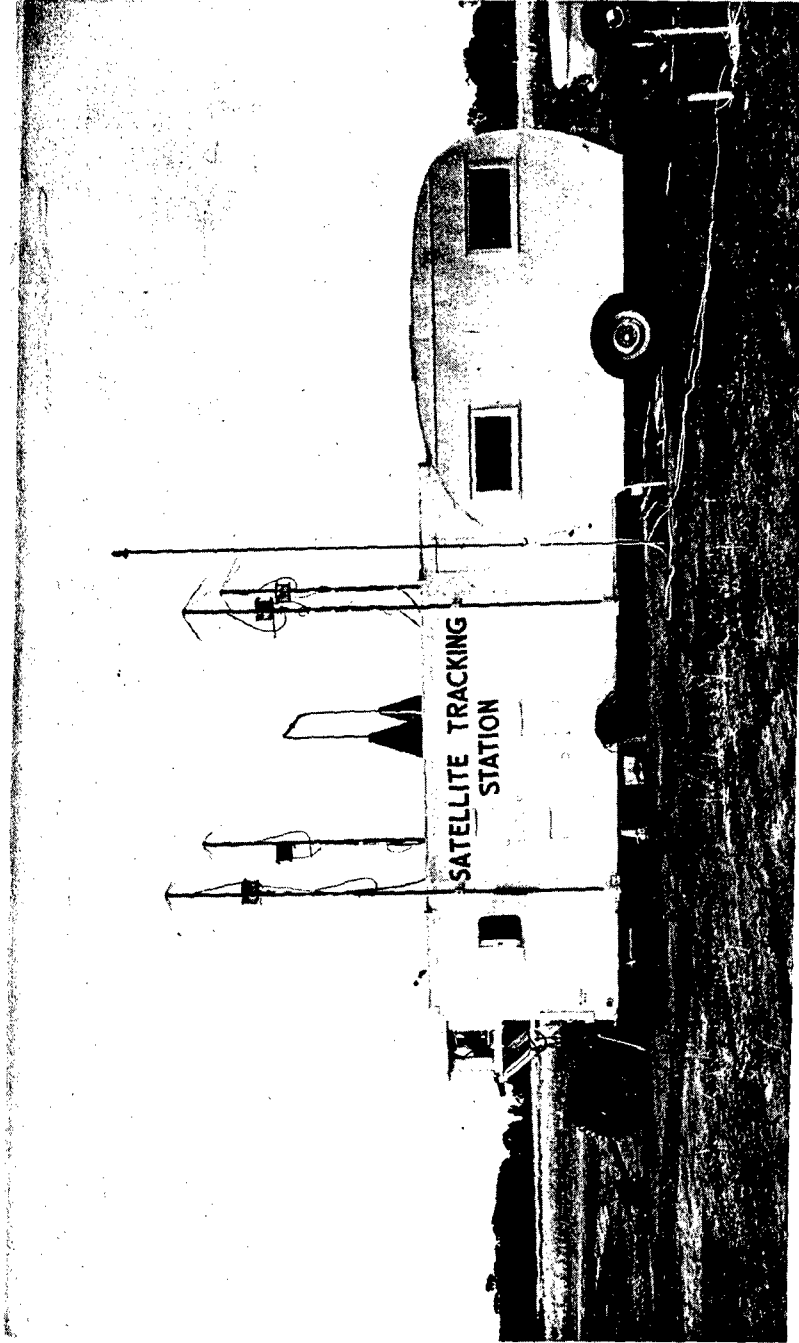
The irregular motion of the earth's axis of rotation, known as Chandler Wobble, has been determined on the basis of Doppler observations of Navy Navigation Satellites. Measurement precisions of about 0.5 meters have been obtained for averaging times of six days. Agreement with astronomical determinations is better than one meter over the last two years. The discrepancies are no larger than differences between results for different groups of observatories as reported by the Bureau International de L'Heure and by the International Polar Motion Service.

INTRODUCTION

Doppler satellite observations have been used in the development and operation of the Navy Navigation Satellite System (Kershner, 1967) since the launch of the Transit 1B satellite in 1960. The usefulness of such observations for geodetic applications, indicated in 1963 (Anderle and Oesterwinter), was exploited in succeeding years (Anderle 1967). During the course of these geodetic operations, it was found that the relation between the earth's geographic pole and the earth's instantaneous spin axis could be obtained as a by-product of this work (Anderle and Beuglass, 1970 a,b). The use of Doppler observations for such determinations of the position of the pole is described below. It should be emphasized that the determination is made from intermediate output of the geodetic operations at minimum cost; improved computational procedures applied to the original observational data would produce somewhat more accurate values for the position of the pole. A considerable improvement in results is evident over the course of the last three years as a result of computational changes designed to improve geodetic operations. Changes in computational procedures specifically designed to improve polar motion results are also being made.

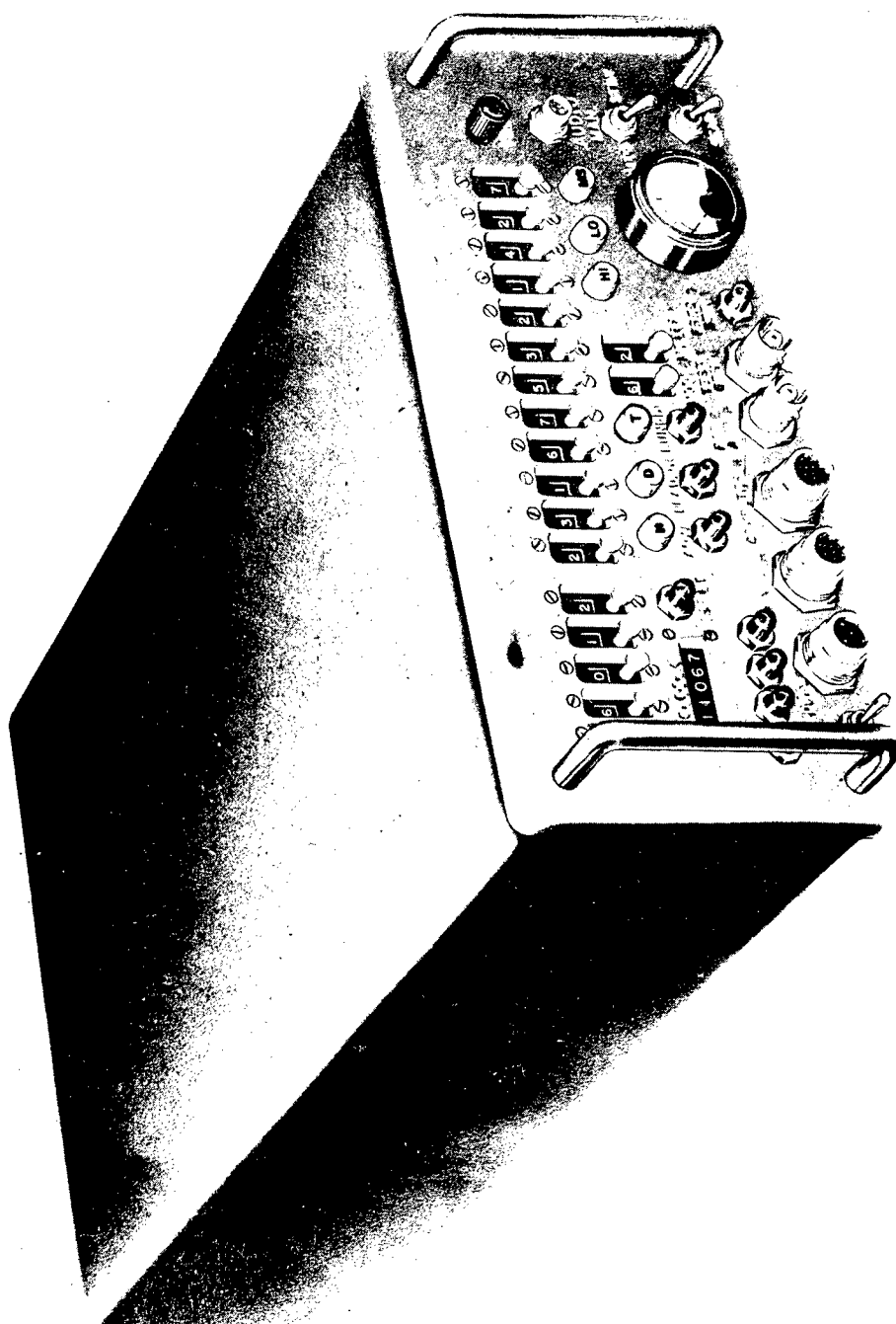
OBSERVING EQUIPMENT

Thirteen semi-permanent satellite observing stations have been used to obtain Doppler data for geodetic applications; but at any given time, observations may also be received from a dozen mobile or cooperating stations. For the sake of consistency, the polar motion results reported to date primarily reflect the observations made at the 13 geodetic stations. While details of the design of the Doppler equipment varies from station to station, the measurements obtained are essentially the same. The Howard County, Maryland, station is one of the most elaborate sites. It includes two complete stations which permits controlled tests of modifications to the equipment. The Applied Physics Laboratory of Johns Hopkins University, which has responsibility for the technical operation of the observing net, operates a control center also located at Howard County, Maryland. The control center receives the observations from all sites daily by teletype and advises the stations of the quality of the observations. The operation and logistic support for the field stations is the responsibility of the Doppler Satellite Office at the Pacific Missile Range (PMR), California. The majority of the sites are actually operated by the faculty and students of the New Mexico State University under contract to PMR. Figure (1) shows one of the mobile vans used in operations such as determining the position of LORAN navigation beacons. The van is the most compact equipment used to date in such geodetic operations. New equipment, designated GEOCEIVERS, are now in production. The equipment, shown in figure (2), weighs under 100 pounds, exclusive of the power source. This equipment will produce data which are different in form, but equivalent in accuracy, to those from the current system. But, since the equipment has not been used in polar motion calculations to date, its data format will not be discussed here.



DOPPLER MOBILE VANS

Figure (1)



MOCK-UP OF GEOCEIVER

Figure (2)

Each station is capable of receiving on at least four frequencies which are approximately 150, 162, 324 and 400 Mhz. Polar motion results have been based on observations of the Navy navigation satellites which transmit at about 150 and 400 Mhz. The receiving stations combine these signals by analog means to obtain a signal which is free of first order ionospheric refraction effects (Newton 1967). The combined signal is then mixed with a reference signal and the time required to count a preset number of beats between the frequencies is measured. The measurements, started each four seconds of time and lasting almost a second, are automatically punched on teletype tape. The time at which satellite time pulses are received are interspersed among these measurements at two minute intervals for use in synchronizing the ground station clocks. The 300 or so observations are preceded by a manually punched header message which includes calibration constants and identifies the station, satellite, date, and hour. The entire message is transmitted by teletype to the control center shortly after the pass is completed. The control center transfers the data from paper tape to magnetic tape for use in the computers.

GEODETTIC COMPUTATIONS

The satellite observations are transmitted from the control center in Maryland to the computational facility at the Naval Weapons Laboratory, Dahlgren, Virginia, every 24 hours over a telephone line in a magnetic tape-to-magnetic tape transmission. It is convenient for the geodetic computations to compute the orbit of any selected satellite every second day based on 48 hours of observations. This interval is long enough to permit a determination of the position of mobile observing stations but short enough to maintain a regular check of the performance of the equipment. The raw observations are converted to frequency measurements, and various calibration, filtering and aggregating operations are performed (Anderle, 1965). The time pulses received from the satellite by the Howard County observing station are used to calibrate the epoch and rate of the satellite clock against UTC; the calibrated clock transmissions are then used to synchronize the clocks at the other observing stations. The filtering process eliminates observations which are bad due to loss of lock of the satellite signal or transmission errors; the filtering also detects entire passes which show systematic errors. Finally, groups of eight filtered observations are aggregated in an averaging process to obtain about 40 observations of frequency with associated standard errors for each satellite pass for use in the orbit refinement. In the least squares orbit determination, the earth's gravity field and the coordinates of the fifteen base stations are fixed at values obtained in a general geodetic solution. Changes in these parameters were made in recent years on:

Gravity Field

20 Feb 1967
-
18 Apr 1968
13 Feb 1970*

Station Coordinates

20 Feb 1967
19 Jan 1968
-
-

Unknowns in the solution are the six orbit constants, a drag scaling factor, the coordinates of each mobile observing station, and a frequency and frequency drift bias for each pass. The orbit computation is done by a 10th order Cowell integration and includes effects of lunar-solar gravitational attraction, effect of land tides on the potential (but not on station position), effect of nominal solar radiation pressure, effect of tropospheric refraction for a nominal atmosphere, and the effect of earth's precession and nutation. Extrapolated values for the polar motion and variation in earth's rotation are used. The accuracy of this computed orbit is estimated to be about 10 meters (Anderle, Malyevac and Green 1969) in an earth-fixed coordinate frame. A significant bias in right ascension of the satellite is present because the conversion from UTC to UT-1 time is done using poorly extrapolated values for the difference; however, the longitude of the satellite relative to longitude of the stations is not subject to errors in the difference. Upon completion of the least squares solution for orbit constants and the other parameters described above, the final satellite orbit is used to obtain a measure of the quality of the solution. For this purpose, the orbit and the data obtained on each satellite pass is used to make a least squares solution for frequency bias and for two components of station position: one component is parallel to the satellite velocity vector at closest approach of the satellite to the station while the other component is parallel to the sight line from the station to the satellite at the same time. The standard deviation in these quantities obtained during a month is plotted in figure (3) versus elevation angle to the satellite at closest approach. The graph shows that the errors for passes at high elevation angles are two meters and seven meters in the slant range and tangential directions, respectively, while the errors at low elevation angles are about twice as large due to the greater distance from the station to the satellite and higher residual refraction errors. These errors are a composite of the errors in satellite position, errors in station position, and instrumentation errors. In 1969, it was found that errors in the assumed position of the pole can be found by analysis of these tangential errors.

*For satellite 1967-34A and 1968-12A; 3 Feb and 6 Feb for satellite 1967-92A and 1967-48A, respectively.

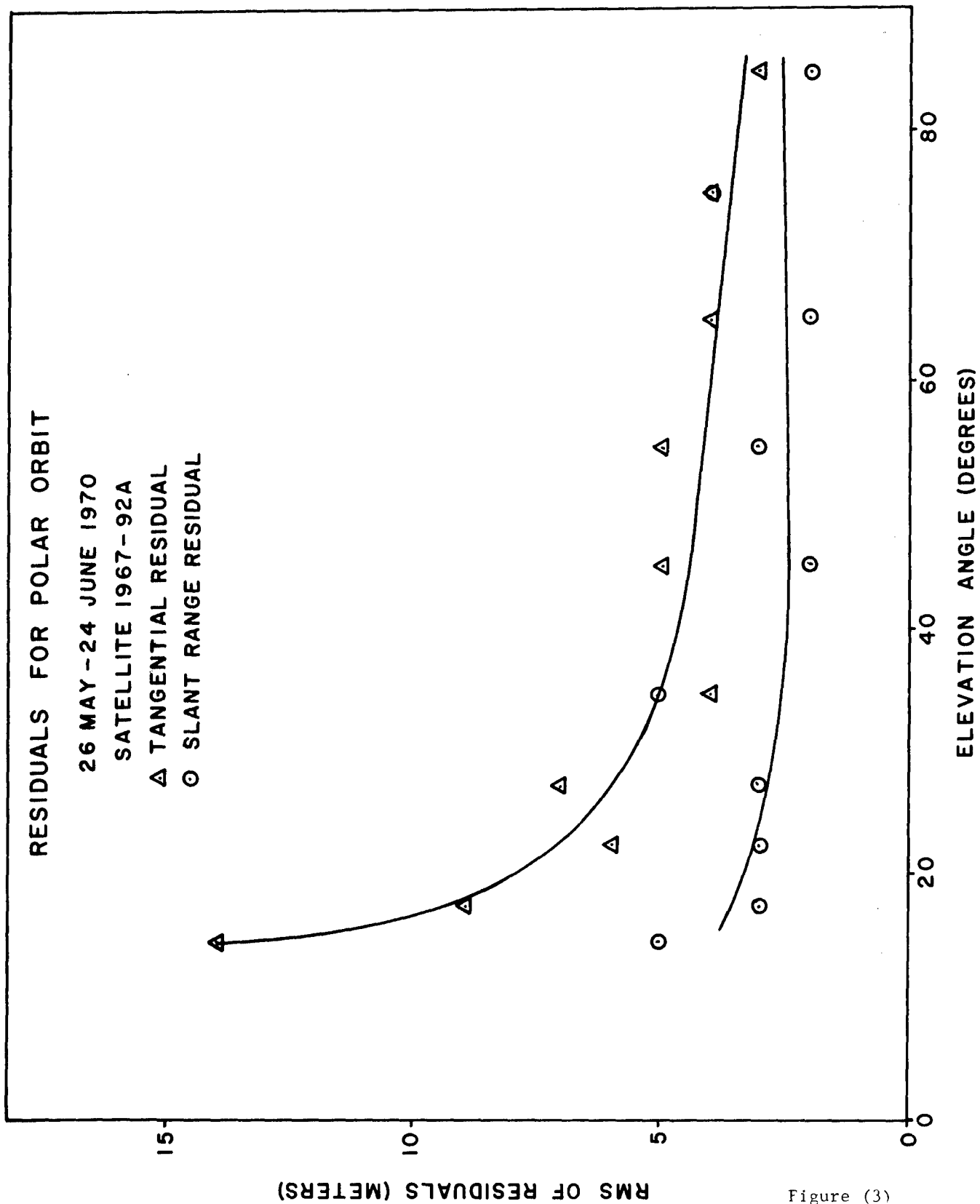


Figure (3)

POLE POSITION COMPUTATIONS

The tangential component of the error in the computed satellite orbit determined from each pass of the satellite over each observing station during a two day span is shown in figure (4). The figure shows a sinusoidal error of about 5 meters amplitude with a 24 hour period which was due to the use of an incorrect pole position in the computations. The way this effect arises for a satellite in a polar orbit is shown by the diagrams in figure (5): Assume the true pole is on the spin axis, and assuming that the true pole and the assumed pole lie in the plane of the orbit at some instant of time, as shown in the left side of the figure. Then there will be a tangential error in the computed satellite position (or navigated station position) for any station lying in the orbit plane; six hours later, the assumed pole will have rotated 90 degrees, as shown on the right hand side of the figure, so that there will be zero error in the tangential direction. Thus an error with a 24 hour period is introduced which cannot be absorbed in the solution for orbit constants. The pole position computation consists of the solution for the phase and amplitude of this error and conversion of these quantities to pole position displacement (figure (6)). Such a solution ignores the information on pole position which is contained in the errors in the slant range direction. The slant range errors yield weaker information on pole position because of low sensitivity of slant range to pole position error for stations at low latitudes or for satellite passes at high elevation angle. Until the middle of 1970, the solution for the phase and amplitude of the tangential error also included a constant and a linear term in the least squares solution. The four parameters were used on the theory that imperfect distribution of observations, together with an error in the pole position, may have yielded erroneous values for the mean anomaly and mean motion of the satellite in the fit of orbit constants. Under this assumption, it was necessary to solve for the four parameters using the observations made in the same 48 hour span considered in the orbit fit. It was subsequently found that solutions for the two periodic coefficients based on each 24 hours of observations gave results equivalent to the four parameter solutions based on 48 hours of data. Since more frequent solutions are desirable, future solutions for pole position will probably be based on 24 hours of observations regardless of the time span of data used in the original orbit fit. As shown in figure (3), the accuracy of determination of the tangential errors varies with elevation angle to the satellite at closest approach. The accuracy also varies with the size of the random error of the original frequency observations. Therefore each observation used in the two or four parameter solution is weighted inversely according to the empirical formula $(.004^2 + \sigma^2) (6 + 2 \times 10^{-6} (80 - \varphi)^3)^2$ where σ is the random error in the frequency observations in Hz per 108 Mhz and φ is the elevation angle in degrees. The standard error of each solution for pole position is computed from the residuals of fit and covariance of the solution for the nominal weighting of the observations. The standard error of the corrected pole position is about a meter on the average. Means and standard deviations of solutions made in five or six day intervals are also obtained in order to express the results in more compact form.

ALONG TRACK RESIDUALS
17 And 18 January 1969
Satellite 1967-48A

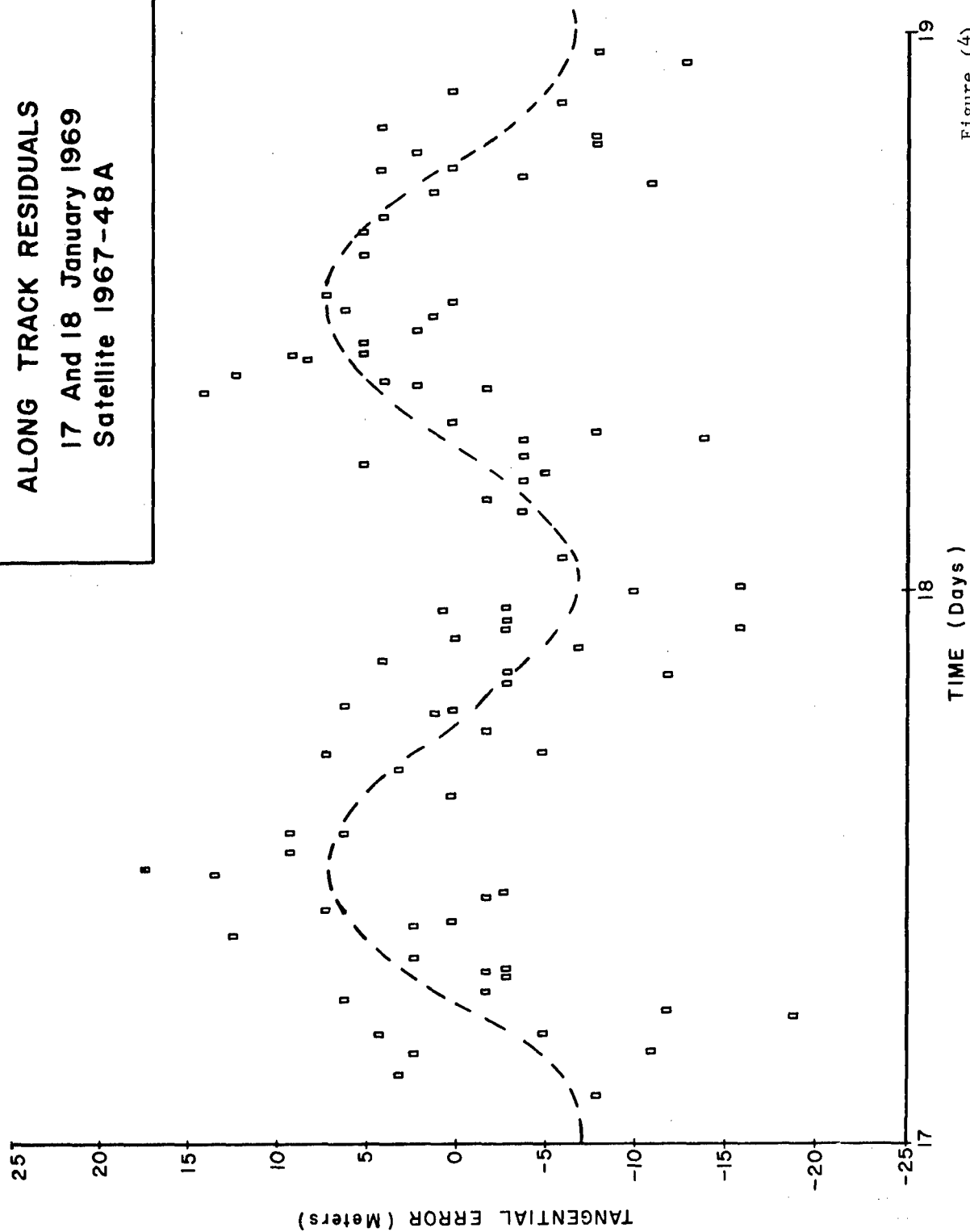


Figure (4)

OBSERVED POLE POSITION

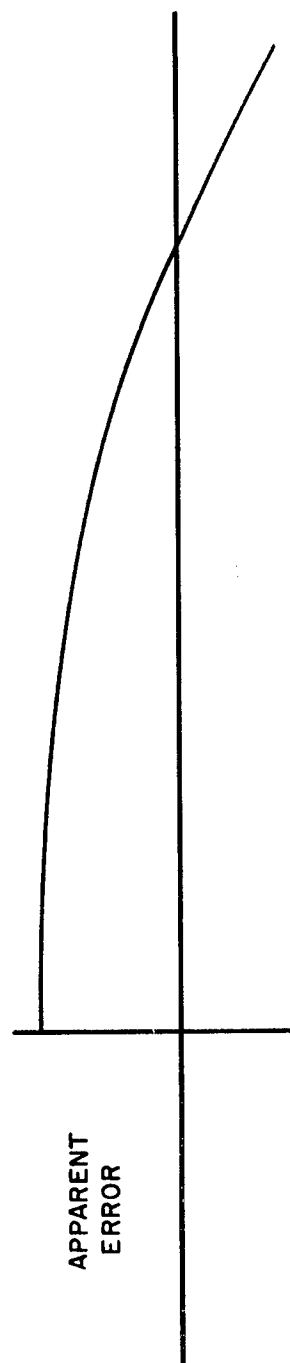
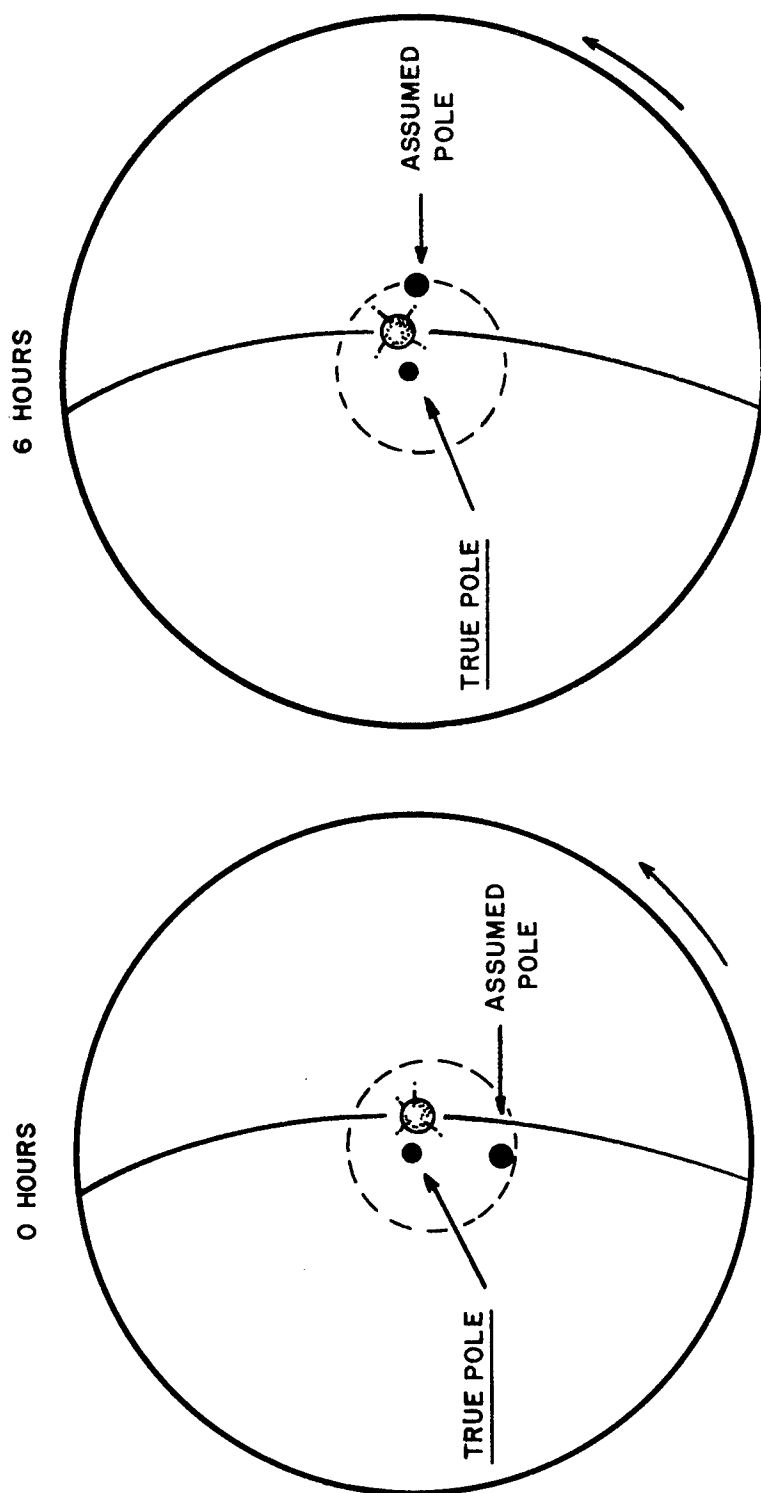


Figure (5)

POLE POSITION COMPUTATION

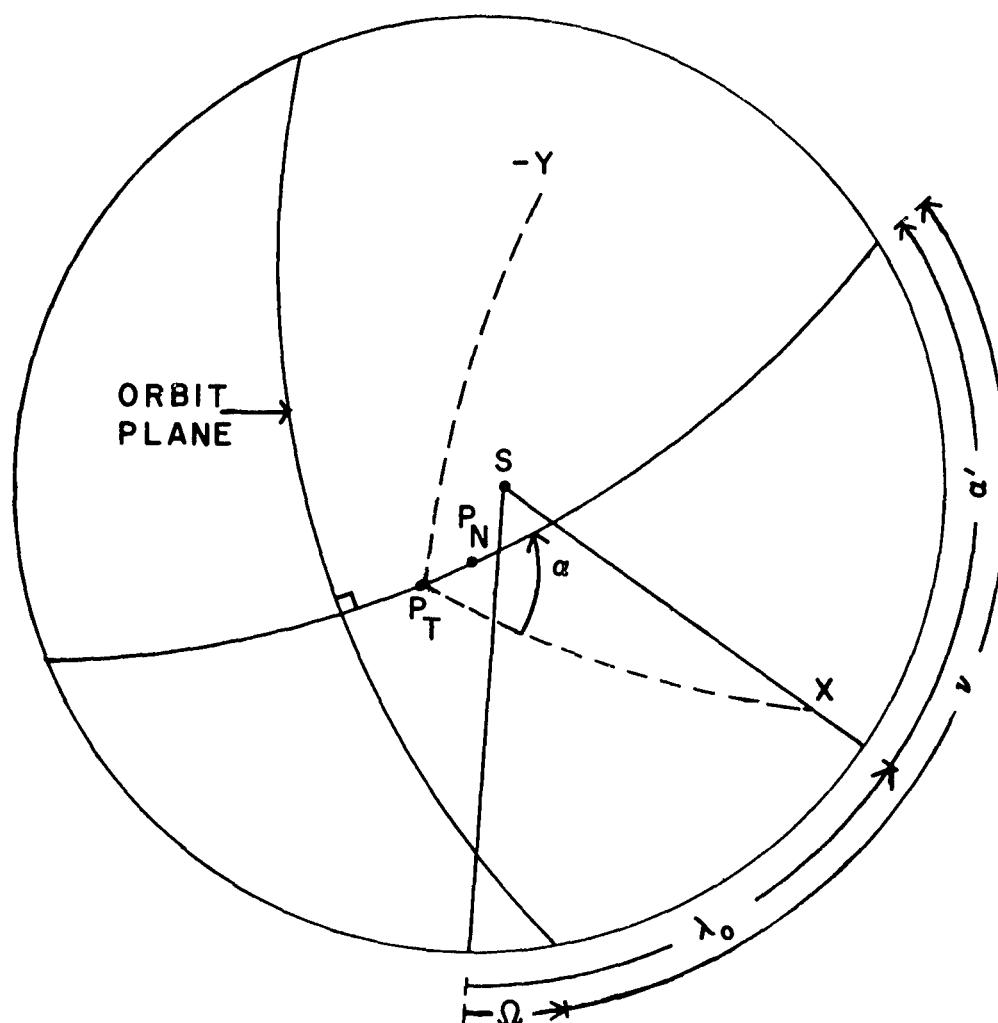
$$\text{ERROR} = A \cos \lambda + B \sin \lambda$$

λ = HOUR ANGLE OF GREENWICH

P_N = NOMINAL POLE POSITION

P_T = TRUE POLE POSITION

$\overline{P_N P_T}$ IS NORMAL TO ORBIT PLANE WHEN $\lambda_0 = \tan^{-1} \frac{A}{-B}$



S = SPIN AXIS

Ω ~ RIGHT ASCENSION OF NODE

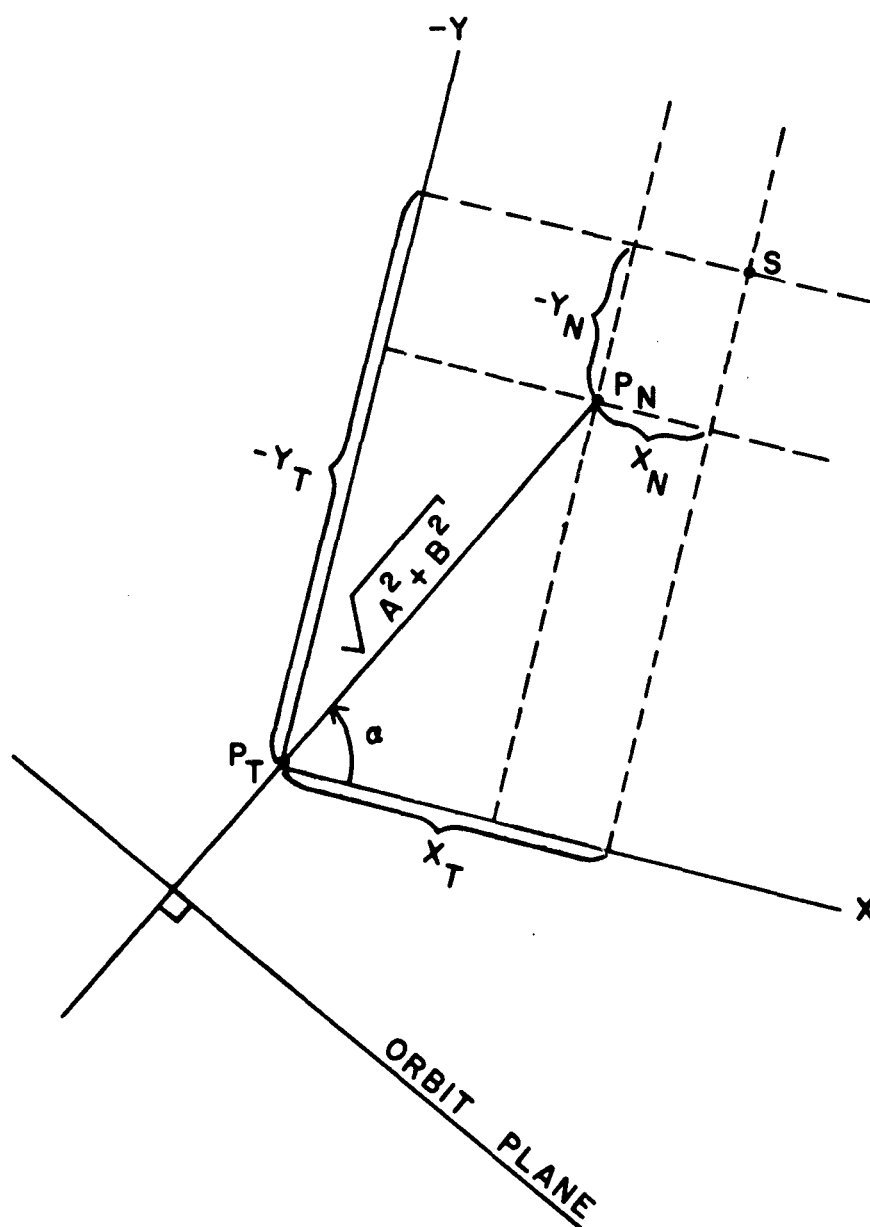
$\alpha' \sim \alpha$

$\nu \sim 90^\circ$

so $\alpha \sim \Omega - \lambda_0 + 90^\circ$

Figure (6a)

DETAIL OF POLE POSITION COMPUTATION



$$X_T = X_N + \sqrt{A^2 + B^2} \cos \alpha$$

$$Y_T = Y_N - \sqrt{A^2 + B^2} \sin \alpha$$

Figure (6b)

ERROR SOURCES

Consideration has been given to the following sources of error in the pole positions computed from Doppler observations of artificial earth satellites:

1. Origin of the coordinate system.
2. Errors in UTC-UT1.
3. Changes in station distribution.
4. Other computational errors.

An attempt was made to refer the coordinates of the Doppler observing stations to the CIO pole through BIH values for the instantaneous pole position at various points during the period 1961-1967 (Anderle and Beuglass 1970a). However, recent Doppler solutions for the position of the pole based on these coordinates show a bias with respect to IPMS and BIH results, particularly in the Y direction. Therefore the following arbitrary corrections must be added to the coordinates reported by the Dahlgren Polar Motion Service to achieve consistency with astronomic results:

$$X_{IPMS} - X_{DAHLGREN} = 0.0 \text{ M}$$

$$Y_{IPMS} - Y_{DAHLGREN} = 2.0 \text{ M}$$

The values for UTC-UT1 used in the Doppler calculations have at best contained significant errors of extrapolation and at worst ignored the (UT2-UT1) correction. In principle, this error should simply yield a different orbit plane in inertial space, leaving earth fixed computations, (including pole position computations) unaffected. Numerical experiments with gross errors in UTC-UT1 have substantiated this theory. While the reference orbits include data from varying numbers of observing stations, pole position calculations have been based on residuals from these orbits for a group of thirteen stations. Only one station in this network has been changed in recent years (Hawaii was moved to Wake). Experiments conducted omitting data from subsets of the station net have shown that (1) significant changes could be made to the station net without biasing the results but that (2) deleting a selected set of four stations from the net would seriously bias the results (Anderle and Beuglass 1970b). Therefore, effects of any future changes in the net will have to be tested. Experiments showed that the adoption of a new gravity field for the computations in February 1970 produced a bias in the pole position of about a meter. The bias may result from readjustment of the first order gravity terms which also produces a diurnal effect on the residuals. All reported results have been corrected for this bias, but the value of the bias is uncertain to few tenths of meters as shown by the results for the following test cases:

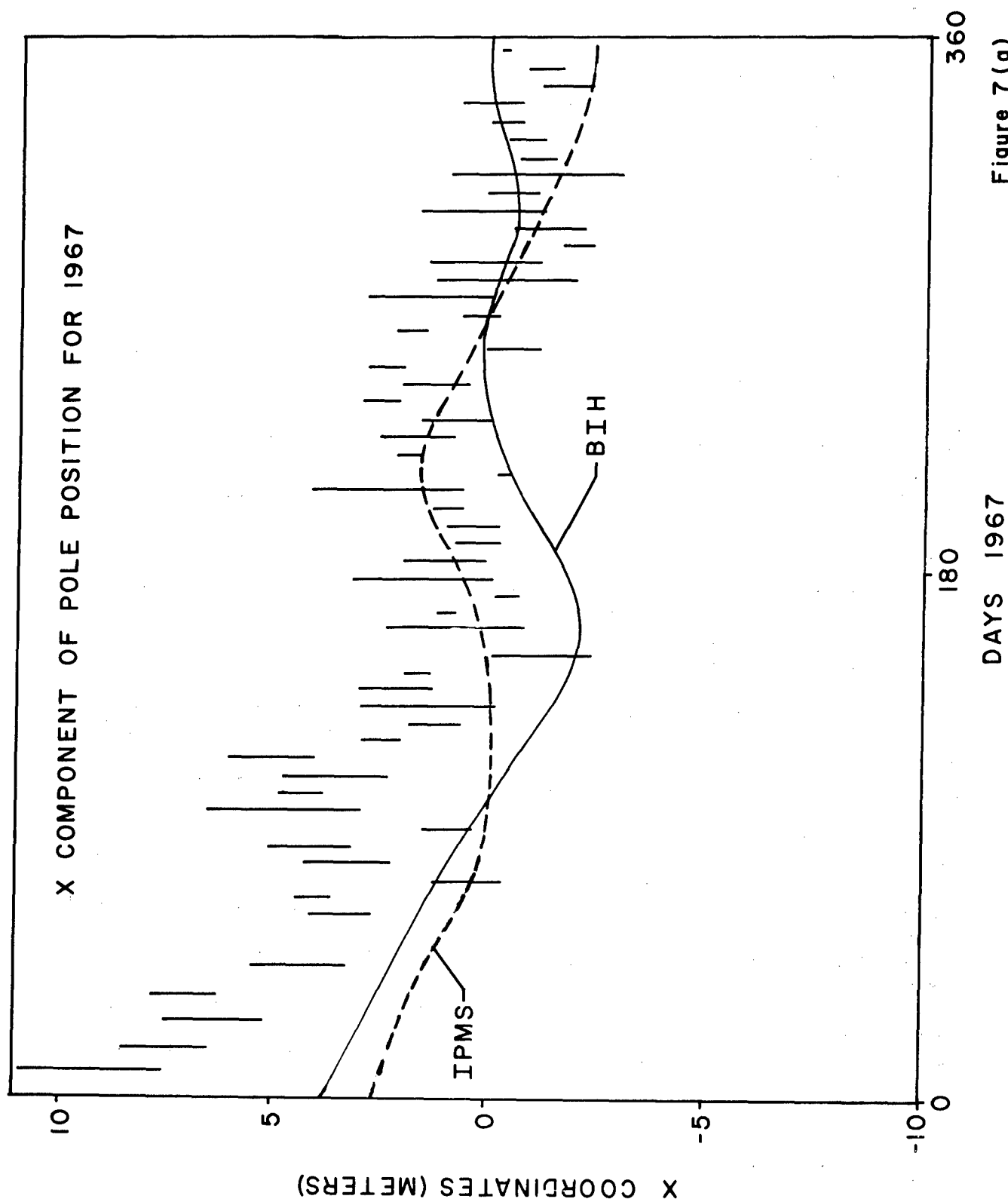
	<u>New* Minus Old</u>	
	<u>X</u>	<u>Y</u>
Day 46 1969	-0.1 M	0.5 M
Day 154 1969	-0.6	-0.2
Day 258 1969	-0.3	-0.1
Day 328 1969	0.2	-0.5
Day 50 1970	1.0	0.2
	—	—
Mean	0.0	0.0
Std Dev	.5	.3
Std Error	.3	.1

Effects on pole position of earlier changes in the gravity field have not been evaluated. However, the earlier results are subject to larger random errors and possible biases due to a variety of deficiencies in the orbit computation program which were corrected in mid-1968.

POLE POSITION RESULTS

The pole positions computed from the results of each orbit computation available from January 1967 through mid 1970 are tabulated in Appendix A. Means and standard errors of results obtained within six day spans are also shown on the tables. The values for the Y coordinates were found to be about two meters lower than the astronomic results. Since the origin of the coordinate system is relatively arbitrary, this bias was corrected before the results were plotted in figures (7) and (8). Starting in mid 1968, the agreement between the Doppler and Astronomic results is about as good as the agreement between the BIH and IPMS results. The agreement for 1969 is especially striking. The Doppler biases in 1967 and early 1968 are probably due to poorer computational techniques used in computing the satellites orbits. The Doppler results for the X coordinate in 1969 are in much better agreement with the IPMS data than the BIH data. However in other places, such as for the Y coordinate in 1967, the Doppler results seem to reflect the trends in the BIH data better than those in the IPMS data. The path of the pole for 1969 determined on the basis of the Doppler observations is shown in figure (9) along with that obtained by the BIH and the IPMS. The ellipses show the standard error of the Doppler observations. The diameter of the Doppler curve in the X - direction is larger than that of the IPMS which in turn is larger than that of the BIH.

*After bias correction



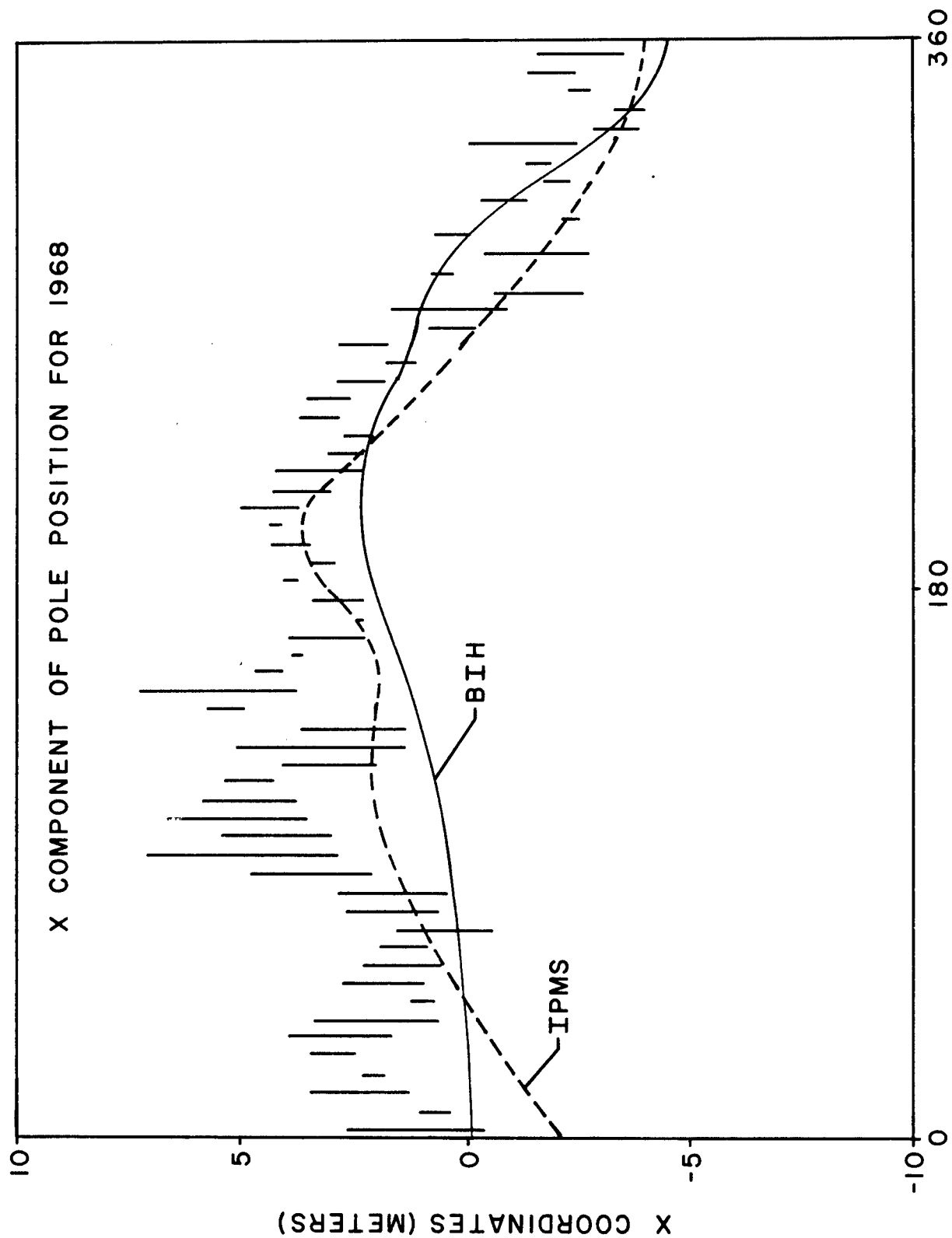
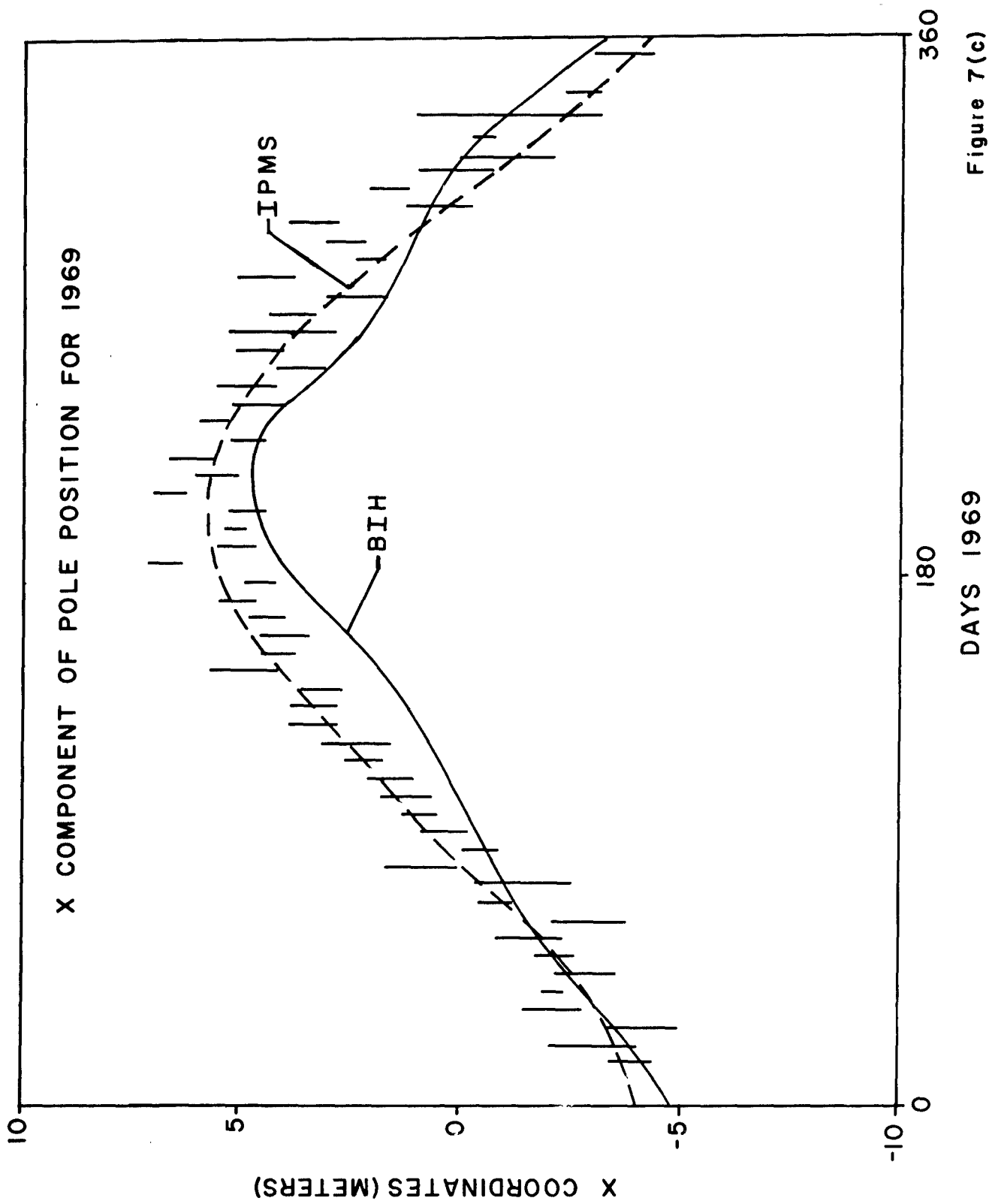


Figure 7 (b)



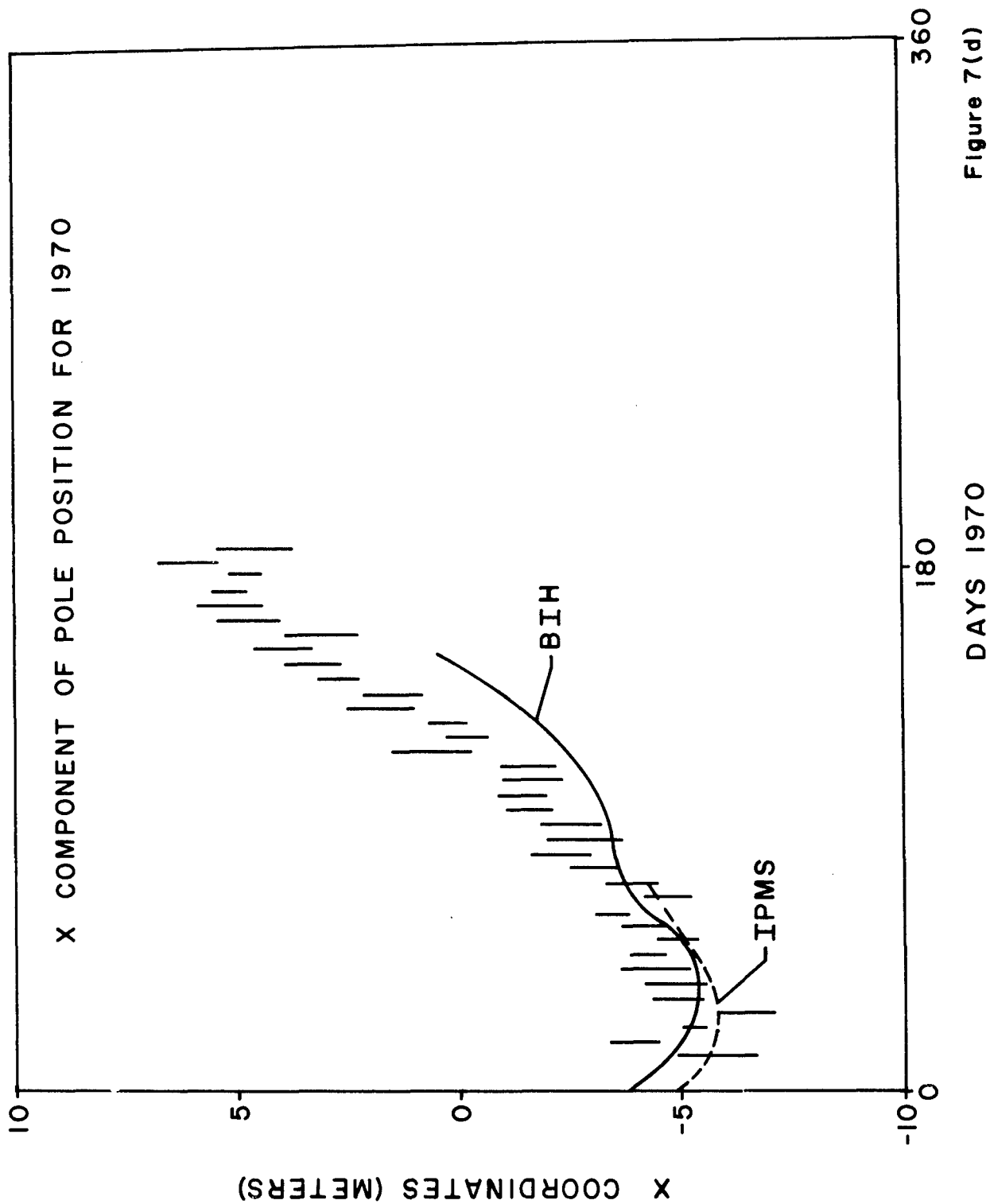
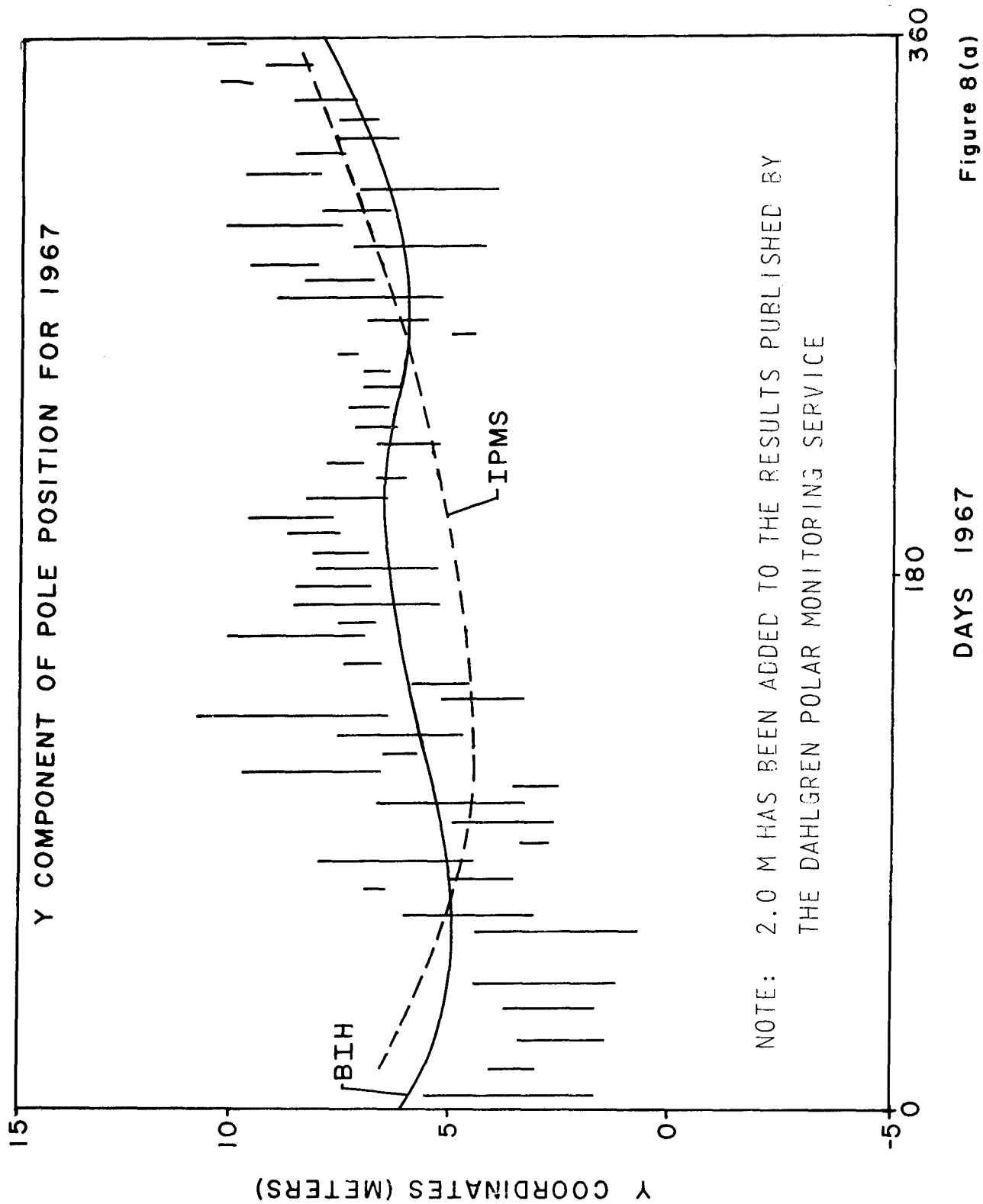


Figure 7(d)



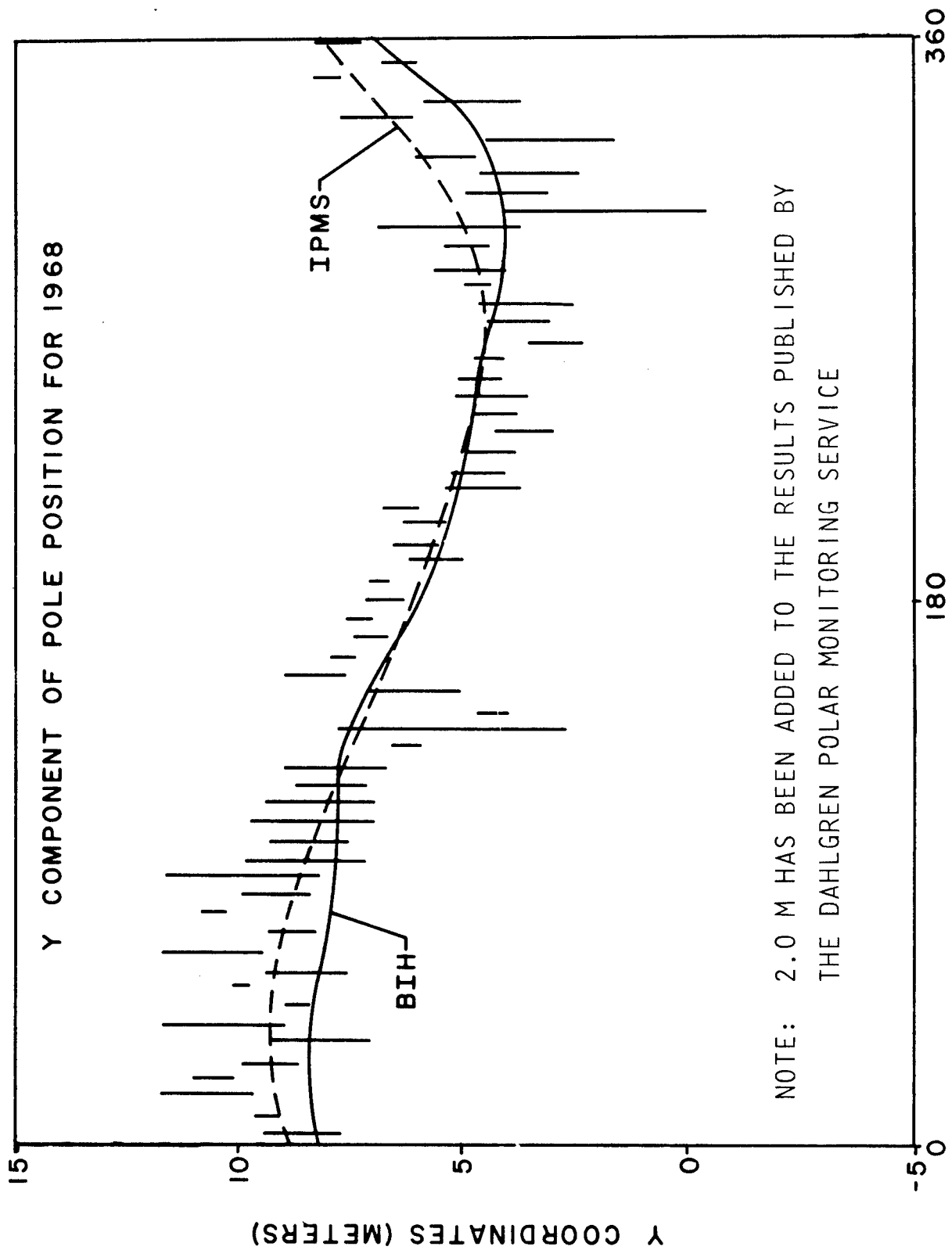


Figure 8(b)

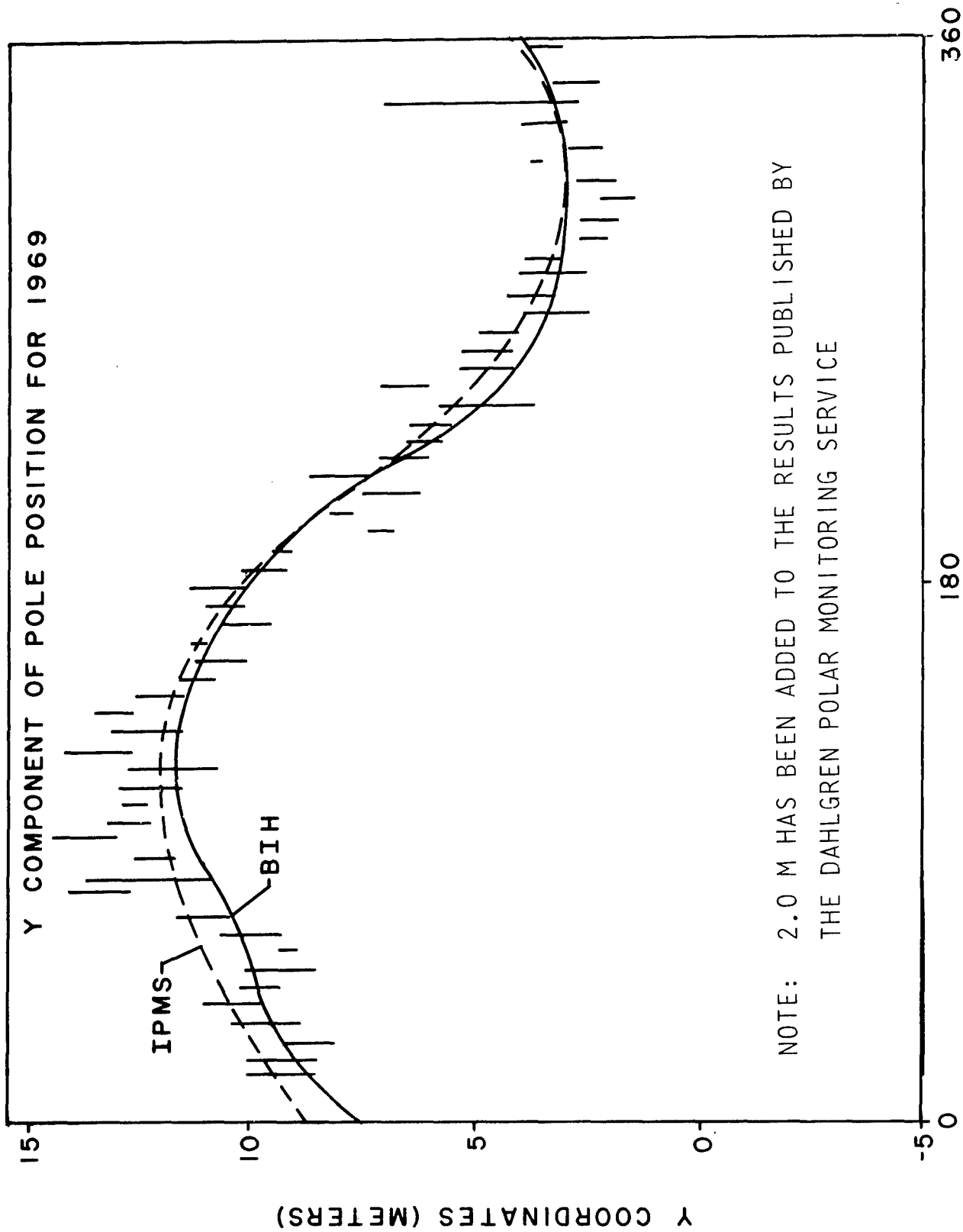


Figure 8 (c)

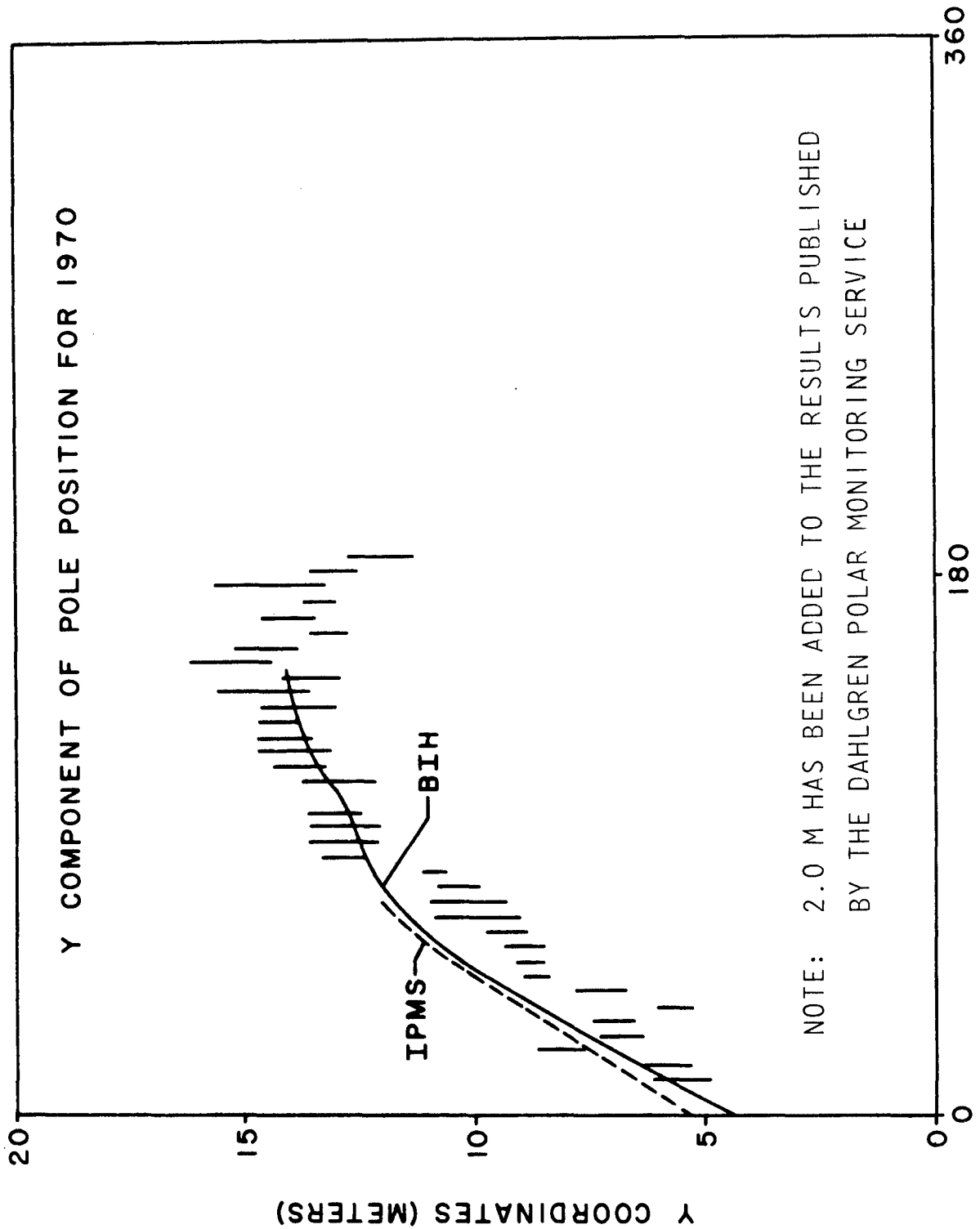


Figure 8 (d)

POLAR MOTION FOR 1969

BASED ON DOPPLER OBSERVATIONS OF SATELLITES 1967 48A AND 1967 92A

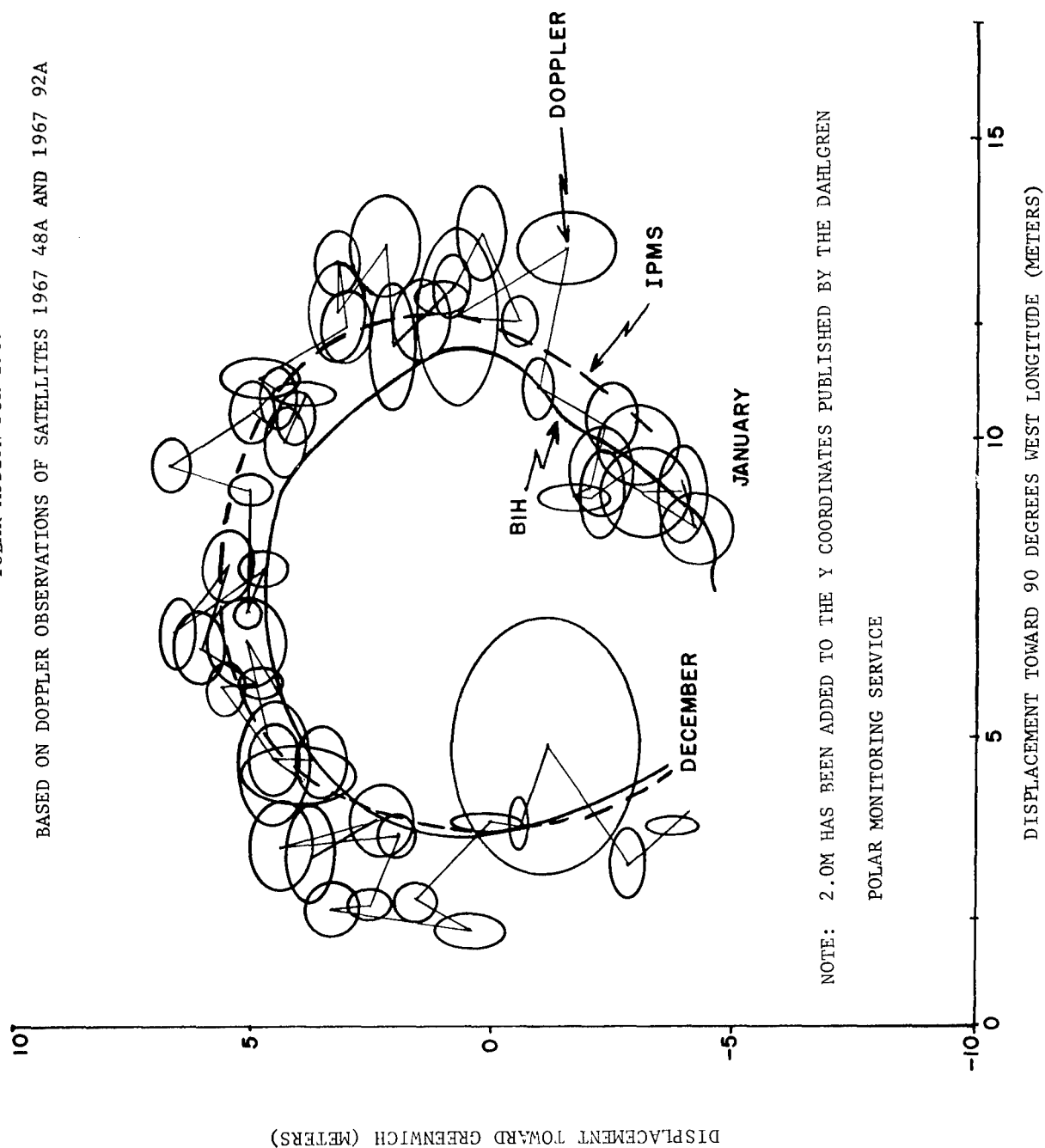


Figure (9)

SUMMARY

The irregular motion of the earth's axis of rotation, known as Chandler Wobble, has been determined on the basis of Doppler observations of Navy Navigation Satellites. Measurement precisions of about 0.5 meters have been obtained for averaging times of six days. Agreement with astronomical determinations is better than one meter over the last two years. The discrepancies are no larger than differences between results for different groups of observatories as reported by the Bureau International de L'Heure and by the International Polar Motion Service.

REFERENCES

1. Anderle, Richard J. and Claus Oesterwinter, "A Preliminary Potential for the Earth from Doppler Observations on Satellites", presented at COSFAR Meeting, June 1963.
2. Anderle, Richard J., "Doppler observations on the ANNA 1B Satellite", Transactions, American Geophysical Union, Vol 46, No 2, 385-387, June 1965.
3. Anderle, Richard J., "Geodetic Parameter Set NWL 5E 6 Based on Doppler Satellite Observations", in Use of Artificial Satellites for Geodesy, Vo. 2 G. Veis ed, University of Athens, 1967 p 197-220.
4. Anderle, R. J., C. A. Malyevac and H. L. Green, Jr., "Effect of Neglected Gravity Coefficients on Computed Satellite Orbits and Geodetic Parameters", Journal of Spacecraft and Rockets, Vol 6 No 8, p 951-954 Aug 1969.
5. Anderle, Richard J. and Larry K. Beuglass, "Doppler Satellite Observations of Polar Motion", Bulletin Geodesique, No. 96, p 125-141, June 1970a.
6. Anderle, Richard J. and Larry K. Beuglass, "Polar Motion for 1967 and 1968 Derived from Doppler Satellite Observations", preprint of paper presented at 51st Annual Meeting of the American Geophysical Union, April 1970b.
7. Kershner, Richard B., "Status of the Navy Navigation Satellite System", in Practical Space Applications, Vol 21, American astronautical Society, 1967.
8. Newton, Robert R., "The Navy Navigation Satellite System", in Space Research VII, North-Holland, 1967.

APPENDIX A

Table 1

TABLE 1

REPORT 0 REVISION 0
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1967	X METERS	Y METERS	X METERS	Y METERS	
	1 2	4.47	5.97	1.76	1.91	1966-76A
	3 4	9.27	1.69	1.71	1.85	
	5 6	9.74	4.15	1.74	1.78	
	7 8	7.48	1.00	2.78	2.98	
	9 10	14.98	-5.16	2.00	2.54	
MEAN	1 10	9.19	1.53	2.00	2.21	
STD DEV	1 10	3.84	4.23			
STD ERR	1 10	1.72	1.89			
	11 12	7.51	-0.66	1.86	1.89	
	13 14	5.70	1.63	1.83	1.84	
	15 16	5.49	2.14	1.43	1.52	
	17 18	7.76	2.33	1.56	1.46	
	19 20	10.92	2.15	1.41	1.41	
MEAN	11 20	7.48	1.52	1.62	1.62	
STD DEV	11 20	2.18	1.25			
STD ERR	11 20	0.98	0.56			
	21 22	9.62	1.65	1.55	1.47	
	23 24	7.82	1.85	1.75	1.66	
	25 26	6.77	-0.73	2.25	2.18	
	27 28	3.95	-2.95	2.32	2.13	
	29 30	3.55	2.06	1.53	1.48	
MEAN	21 30	6.34	0.38	1.88	1.78	
STD DEV	21 30	2.58	2.17			
STD ERR	21 30	1.15	0.97			
	31 32	4.93	-2.25	1.93	1.97	
	33 34	7.66	1.73	1.55	1.44	
	35 36	5.68	0.78	1.24	1.16	
	37 38	7.53	-0.24	1.56	1.42	
	39 40	9.15	3.37	1.67	1.56	
MEAN	31 40	6.99	0.68	1.59	1.51	
STD DEV	31 40	1.69	2.11			
STD ERR	31 40	0.75	0.94			
	41 42	8.65	6.47	1.86	1.77	
	43 44	3.52	-0.33	1.53	1.44	
	45 46	2.86	-2.18	1.61	1.52	
	47 48	2.54	-2.20	1.92	1.78	
	49 50	4.69	2.46	1.78	1.67	
MEAN	41 50	4.45	0.84	1.74	1.64	
STD DEV	41 50	2.49	3.68			
STD ERR	41 50	1.11	1.64			

REPORT 0 REVISION 0
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE 1966-76A
DAYS 1967		X METERS	Y METERS	X METERS	Y METERS	
	59 60	2.17	0.06	2.17	2.31	
	61 62	2.89	-.11	1.92	1.95	
	63 64	2.48	-1.93	2.22	2.20	
	65 66	4.85	3.76	1.76	1.93	
	67 68	4.49	0.44	1.56	1.53	
MEAN	59 68	3.38	0.44	1.93	1.98	
STD DEV	59 68	1.22	2.07			
STD ERR	59 68	0.54	0.92			
	69 70	4.44	2.05	1.94	1.96	
	71 72	3.25	5.54	1.88	2.00	
	73 74	1.99	4.88	1.81	1.90	
	75 76	-.66	4.83	1.86	1.88	
	77 78	0.17	4.46	1.95	1.96	
MEAN	69 78	1.84	4.35	1.89	1.94	
STD DEV	69 78	2.11	1.34			
STD ERR	69 78	0.94	0.60			
	79 80	2.61	2.56	1.94	1.96	
	81 82	1.95	0.99	1.61	1.69	
	83 84	5.33	3.10	1.52	1.75	
	85 86	4.11	2.77	1.70	2.04	
	87 88	5.86	7.70	2.33	2.37	
MEAN	79 88	3.97	3.42	1.82	1.96	
STD DEV	79 88	1.69	2.52			
STD ERR	79 88	0.75	1.13			
	89 90	2.53	1.96	2.04	2.30	
	91 92	1.19	0.84	1.65	1.75	
	93 94	-.13	0.66	1.48	1.70	
	95 96	1.77	1.60	1.97	2.21	
	97 98	2.79	0.72	1.86	2.01	
MEAN	89 98	1.63	1.16	1.80	1.99	
STD DEV	89 98	1.17	0.59			
STD ERR	89 98	0.52	0.26			
	99 100	3.01	0.39	1.77	2.02	
	101 102	8.32	4.01	1.83	2.20	
	103 104	4.39	6.43	1.69	1.93	
	105 106	3.49	1.54	1.83	2.25	
	107 108	5.19	0.87	1.86	2.30	
MEAN	99 108	4.88	2.65	1.80	2.14	
STD DEV	99 108	2.10	2.53			
STD ERR	99 108	0.94	1.13			

REPORT 0 REVISION 0
DAHLGREN POLAR MONITORING SERVICE

		DAYS 1967		POLE POSITION		STANDARD ERROR		SATELLITE 1966-76A
				X METERS	Y METERS	X METERS	Y METERS	
		109	110	1.46	0.48	1.64	1.92	
		111	112	3.48	2.26	1.52	1.83	
		113	114	5.66	0.58	1.76	2.16	
		115	116	4.36	2.98	1.90	2.32	
		117	118	6.90	6.82	2.11	2.53	
MEAN		109	118	4.37	2.62	1.79	2.15	
STD DEV		109	118	2.08	2.58			
STD ERR		109	118	0.93	1.15			
		119	120	3.93	8.63	1.81	2.05	
		121	122	1.91	4.87	1.71	2.21	
		123	124	2.34	4.04	1.71	2.35	
		125	126	3.31	3.41	1.99	2.67	
		127	128	2.26	1.53	1.77	2.08	
MEAN		119	128	2.75	4.50	1.80	2.27	
STD DEV		119	128	0.84	2.62			
STD ERR		119	128	0.38	1.17			
		129	130	0.51	4.31	1.72	2.22	
		131	132	0.93	6.53	1.61	2.06	
		133	134	1.77	10.85	1.43	1.66	
		135	136	-1.47	5.84	1.51	1.82	
		137	138	3.96	3.05	1.68	1.93	
MEAN		129	138	1.14	6.12	1.59	1.94	
STD DEV		129	138	1.97	2.97			
STD ERR		129	138	0.88	1.33			
		139	140	3.70	4.15	1.84	2.12	
		141	142	2.05	1.66	2.23	2.46	
		143	144	0.64	0.99	2.13	2.37	
		145	146	1.44	2.05	2.09	2.51	
		147	148	1.36	2.90	1.93	2.24	
MEAN		139	148	1.84	2.35	2.04	2.34	
STD DEV		139	148	1.15	1.22			
STD ERR		139	148	0.52	0.55			
		149	150	2.17	4.35	2.24	2.71	
		151	152	0.67	5.50	2.03	2.39	
		153	154	-3.09	4.97	2.23	2.62	
		155	156	-1.07	4.48	1.83	2.04	
		157	158	1.06	1.18	1.96	2.24	
MEAN		149	158	-0.05	4.10	2.06	2.40	
STD DEV		149	158	2.06	1.69			
STD ERR		149	158	0.92	0.76			

REPORT 0 REVISION 0
DAHLGREN POLAR MONITORING SERVICE

	DAYS 1967		PCLE POSITION		STANDARD ERROR		SATELLITE
			X METERS	Y METERS	X METERS	Y METERS	
	159	160	2.43	4.82	1.62	2.06	59
	161	162	-.74	8.00	1.72	1.92	59
MEAN	159	161	0.84	6.41	1.67	1.99	
STD DEV	159	161	2.24	2.25	0.07	0.10	
STD ERR	159	161	1.58	1.59			
	163	164	1.34	5.10	1.90	2.27	59
	165	166	1.11	5.83	1.56	1.85	59
	167	168	0.63	4.39	1.51	1.68	59
MEAN	163	167	1.03	5.11	1.66	1.93	
STD DEV	163	167	0.36	0.72	0.21	0.30	
STD ERR	163	167	0.21	0.41			
	169	170	-.67	2.44	1.57	1.73	59
	171	172	0.18	4.08	1.85	2.17	59
	173	174	-.60	8.07	1.88	2.27	59
MEAN	169	173	-.36	4.86	1.76	2.06	
STD DEV	169	173	0.47	2.90	0.17	0.29	
STD ERR	169	173	0.27	1.67			
	175	176	-.77	7.04	1.36	1.60	59
	177	178	0.88	5.19	1.35	1.68	59
	179	180	4.65	4.31	1.92	2.07	59
MEAN	175	179	1.59	5.51	1.55	1.79	
STD DEV	175	179	2.78	1.39	0.33	0.25	
STD ERR	175	179	1.61	0.80			

REPORT 0 REVISION C
DAHLGREN POLAR MONITORING SERVICE

	DAYS 1967		PCLE POSITION		STANDARD ERROR		SATELLITE
			X METERS	Y METERS	X METERS	Y METERS	
	181	182	0.58	1.83	1.71	2.05	59
	183	184	2.91	5.92	1.72	1.87	59
	185	186	-.21	5.84	1.62	1.95	59
MEAN	181	185	1.09	4.53	1.68	1.96	
STD DEV	181	185	1.62	2.34	0.05	0.09	
STD ERR	181	185	0.94	1.35			
	187	188	-.55	6.65	1.41	1.61	59
	189	190	0.28	4.60	1.77	1.89	59
	191	192	1.21	5.24	1.74	2.20	59
MEAN	187	191	0.31	5.50	1.64	1.90	
STD DEV	187	191	0.88	1.05	0.20	0.29	
STD ERR	187	191	0.51	0.61			
	193	194	-.74	6.14	1.36	1.50	59
	195	196	1.04	7.25	1.33	1.42	59
	197	198	0.99	5.18	1.71	1.90	59
MEAN	193	197	0.43	6.19	1.47	1.61	
STD DEV	193	197	1.01	1.03	0.21	0.26	
STD ERR	193	197	0.58	0.60			
	199	200	1.50	7.97	1.90	2.08	59
	201	202	1.15	4.59	1.48	1.57	59
	203	204	0.43	6.96	1.36	1.56	59
MEAN	199	203	1.02	6.50	1.58	1.74	
STD DEV	199	203	0.55	1.73	0.29	0.30	
STD ERR	199	203	0.32	1.00			

REPORT 0 REVISION 0
DAHLGREN POLAR MONITORING SERVICE

		DAYS 1967		PCLE POSITION		STANDARD ERROR		SATELLITE
				X METERS	Y METERS	X METERS	Y METERS	
		205	206	3.09	6.64	1.50	1.87	59
		207	208	5.04	3.35	1.84	2.14	59
		209	210	-0.87	5.87	1.56	1.64	59
MEAN		205	209	2.42	5.29	1.63	1.88	
STD DEV		205	209	3.01	1.72	0.18	0.25	
STD ERR		205	209	1.74	0.99			
		211	212	-0.50	4.26	1.90	1.91	59
		213	214	-0.08	4.23	1.78	1.67	59
		215	216	-0.30	4.63	1.49	1.58	59
MEAN		211	215	-0.29	4.37	1.73	1.72	
STD DEV		211	215	0.21	0.22	0.21	0.17	
STD ERR		211	215	0.12	0.13			
		217	218	1.64	5.10	1.61	1.52	59
		219	220	2.45	6.11	1.55	1.46	59
		221	222	1.70	4.87	1.03	1.05	59
MEAN		217	221	1.93	5.36	1.40	1.34	
STD DEV		217	221	0.46	0.66	0.32	0.26	
STD ERR		217	221	0.26	0.38			
		223	224	3.41	4.17	1.19	1.32	59
		225	226	1.11	2.62	1.35	1.32	59
		227	228	0.68	5.21	1.32	1.37	59
MEAN		223	227	1.73	4.00	1.29	1.34	
STD DEV		223	227	1.47	1.30	0.09	0.03	
STD ERR		223	227	0.85	0.75			

REPORT 0 REVISION 0
DAHLGREN POLAR MONITORING SERVICE

	DAYS	1967	PCLE POSITION		STANDARD ERROR		SATELLITE
			X METERS	Y METERS	X METERS	Y METERS	
	229	230	1.72	5.14	1.14	1.10	59
	231	232	1.54	3.69	1.27	1.18	59
	233	234	-0.73	5.24	1.15	1.13	59
MEAN	229	233	0.84	4.69	1.19	1.14	
STD DEV	229	233	1.36	0.87	0.07	0.04	
STD ERR	229	233	0.79	0.50			
	235	236	3.40	4.46	1.25	1.16	59
	237	238	2.30	5.71	1.20	1.14	59
	239	240	2.09	4.36	1.30	1.20	59
MEAN	235	239	2.60	4.84	1.25	1.17	
STD DEV	235	239	0.70	0.75	0.05	0.03	
STD ERR	235	239	0.41	0.43			
	241	242	2.03	5.45	1.15	1.14	59
	243	244	-0.22	4.40	1.55	1.48	59
	245	246	2.13	4.22	1.34	1.23	59
MEAN	241	245	1.31	4.69	1.35	1.28	
STD DEV	241	245	1.33	0.67	0.20	0.17	
STD ERR	241	245	0.77	0.38			
	247	248	2.96	4.89	1.24	1.22	59
	249	250	2.82	4.63	1.04	1.14	59
	251	252	1.68	4.36	1.02	0.93	59
MEAN	247	251	2.49	4.63	1.10	1.10	
STD DEV	247	251	0.70	0.26	0.12	0.15	
STD ERR	247	251	0.40	0.15			

REPORT 0 REVISION C
DAHLGREN POLAR MONITORING SERVICE

		PCLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1967	X METERS	Y METERS	X METERS	Y METERS	
	253 254	0.64	5.76	1.53	1.47	59
	255 256	-.55	4.88	1.62	1.64	59
	257 258	-1.50	5.53	2.16	2.11	59
MEAN	253 257	-.47	5.39	1.77	1.74	
STD DEV	253 257	1.07	0.46	0.34	0.33	
STD ERR	253 257	0.62	0.26			
	259 260	1.20	2.29	2.22	2.22	59
	261 262	2.22	2.88	1.85	1.81	59
	263 264	2.27	3.07	1.84	1.85	59
MEAN	259 263	1.90	2.74	1.97	1.96	
STD DEV	259 263	0.60	0.41	0.22	0.23	
STD ERR	259 263	0.35	0.23			
	265 266	0.50	5.48	1.81	1.72	59
	267 268	0.87	3.70	2.11	1.97	59
	269 270	-.52	3.22	2.45	2.45	59
MEAN	265 269	0.28	4.13	2.13	2.05	
STD DEV	265 269	0.72	1.19	0.32	0.37	
STD ERR	265 269	0.42	0.69			
	271 272	1.24	1.36	2.22	2.05	59
	273 274	-.86	5.82	2.20	2.16	59
	275 276	4.06	7.83	2.50	2.46	59
MEAN	271 275	1.48	5.01	2.31	2.23	
STD DEV	271 275	2.47	3.31	0.17	0.21	
STD ERR	271 275	1.43	1.91			

REPORT 0 REVISION C
DAHLGREN POLAR MONITORING SERVICE

	DAYS 1967		PCLE POSITION		STANDARD ERROR		SATELLITE
			X METERS	Y METERS	X METERS	Y METERS	
	277	278	-1.45	6.35	2.39	2.52	59
	279	280	-2.26	3.70	2.59	2.42	59
	281	282	2.86	6.52	2.33	2.36	59
MEAN	277	281	-.28	5.52	2.44	2.43	
STD DEV	277	281	2.75	1.58	0.14	0.08	
STD ERR	277	281	1.59	0.91			
	283	284	2.38	5.81	2.15	2.19	59
	285	286	-2.01	6.06	2.33	2.30	59
	287	288	0.16	8.32	2.51	2.60	59
MEAN	283	287	0.18	6.73	2.33	2.36	
STD DEV	283	287	2.20	1.38	0.18	0.21	
STD ERR	283	287	1.27	0.80			
	289	290	-2.59	6.25	2.38	2.55	59
	291	292	-1.75	1.08	2.66	2.78	59
	293	294	-1.49	3.34	2.46	2.61	59
MEAN	289	293	-1.94	3.56	2.50	2.65	
STD DEV	289	293	0.57	2.59	0.15	0.12	
STD ERR	289	293	0.33	1.49			
	295	296	-2.92	4.18	2.56	2.76	59
	297	298	-.67	7.30	2.19	2.40	59
	299	300	-.33	8.62	1.99	2.13	59
MEAN	295	299	-1.31	6.70	2.25	2.43	
STD DEV	295	299	1.41	2.28	0.29	0.32	
STD ERR	295	299	0.81	1.32			

REPORT 0 REVISION 0
DAHLGREN POLAR MONITORING SERVICE

		PCLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1967	X METERS	Y METERS	X METERS	Y METERS		
	301	302	-2.56	3.77	2.26	2.39	59
	303	304	1.30	5.75	2.52	3.07	59
	305	306	2.06	6.28	2.32	2.60	59
MEAN	301	305	0.27	5.26	2.36	2.69	
STD DEV	301	305	2.48	1.33	0.14	0.35	
STD ERR	301	305	1.43	0.77			
	307	308	-1.20	0.66	2.19	2.59	59
	309	310	0.65	3.36	2.09	2.45	59
	311	312	-0.72	6.32	2.27	2.69	59
MEAN	307	311	-0.42	3.44	2.19	2.57	
STD DEV	307	311	0.96	2.83	0.09	0.12	
STD ERR	307	311	0.55	1.64			
	313	314	-3.75	6.11	2.26	2.65	59
	315	316	-1.98	8.49	2.63	3.01	59
	317	318	2.81	5.87	2.11	2.32	59
MEAN	313	317	-0.97	6.83	2.33	2.66	
STD DEV	313	317	3.40	1.45	0.27	0.35	
STD ERR	313	317	1.96	0.84			
	319	320	-1.67	5.05	1.98	2.60	59
	321	322	-0.57	7.02	1.82	2.19	59
	323	324	-0.70	6.09	1.99	2.44	59
MEAN	319	323	-0.98	6.05	1.93	2.41	
STD DEV	319	323	0.60	0.99	0.10	0.21	
STD ERR	319	323	0.35	0.57			

REPORT 0 REVISION C
DAHLGREN POLAR MONITORING SERVICE

	DAYS 1967		PCLE POSITION		STANDARD ERROR		SATELLITE
			X METERS	Y METERS	X METERS	Y METERS	
	325	326	-0.09	5.62	2.04	2.52	59
	327	328	-0.66	5.92	1.81	2.39	59
	329	330	-1.43	3.77	2.08	2.50	59
MEAN	325	329	-0.72	5.10	1.97	2.47	
STD DEV	325	329	0.67	1.16	0.14	0.07	
STD ERR	325	329	0.39	0.67			
	331	332	-0.38	5.56	1.93	2.38	59
	333	334	-0.79	5.09	1.67	1.90	59
	335	336	0.31	4.51	1.51	1.75	59
MEAN	331	335	-0.29	5.05	1.70	2.01	
STD DEV	331	335	0.55	0.53	0.21	0.33	
STD ERR	331	335	0.32	0.30			
	337	338	-0.94	5.67	1.67	2.11	59
	339	340	-0.19	7.11	1.84	2.26	59
	341	342	1.42	4.97	2.21	2.75	59
MEAN	337	341	0.10	5.91	1.91	2.37	
STD DEV	337	341	1.20	1.09	0.28	0.33	
STD ERR	337	341	0.70	0.63			
	343	344	-0.64	7.31	1.53	1.88	59
	345	346	-2.55	8.91	1.37	1.71	59
	347	348	-1.70	7.29	1.40	1.78	59
MEAN	343	347	-1.63	7.84	1.43	1.79	
STD DEV	343	347	0.96	0.93	0.08	0.09	
STD ERR	343	347	0.55	0.54			

REPORT 0 REVISION 0
DAHLGREN POLAR MONITORING SERVICE

	DAYS	1967	X METERS	Y METERS	X METERS	Y METERS	SATELLITE
	349	350	-.58	5.65	1.79	2.16	59
	351	352	-1.88	6.78	1.49	1.76	59
	353	354	-.88	7.46	1.35	1.67	59
MEAN	349	353	-1.12	6.63	1.54	1.87	
STD DEV	349	353	0.68	0.91	0.23	0.26	
STD ERR	349	353	0.39	0.53			
	355	356	-.25	7.34	1.15	1.33	59
	357	358	-.33	8.23	1.35	1.54	59
	359	360	-.10	9.03	2.16	2.38	59
MEAN	355	359	-.23	8.20	1.55	1.75	
STD DEV	355	359	0.11	0.84	0.54	0.56	
STD ERR	355	359	0.07	0.49			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1968	X METERS	Y METERS	X METERS	Y METERS	
	1 2	1.20	5.09	1.43	1.63	59
	3 4	0.51	8.17	1.23	1.31	59
	5 6	4.02	6.20	1.98	2.25	59
MEAN	1 5	1.11	6.49	1.55	1.73	
STD DEV	1 5	2.66	1.56	0.39	0.48	
STD ERR	1 5	1.54	0.90			
	7 8	0.42	7.95	0.97	1.04	59
	9 10	1.34	6.83	0.89	0.94	59
	11 12	0.37	7.11	1.12	1.23	59
MEAN	7 11	0.71	7.30	0.99	1.07	
STD DEV	7 11	0.54	0.58	0.12	0.15	
STD ERR	7 11	0.31	0.34			
	13 14	1.85	7.57	1.28	1.37	59
	15 16	4.42	10.83	1.60	1.65	59
	17 18	0.85	7.65	1.96	1.85	59
MEAN	13 17	2.37	8.68	1.61	1.62	
STD DEV	13 17	1.84	1.86	0.34	0.24	
STD ERR	13 17	1.06	1.07			
	19 20	1.78	8.81	1.41	1.44	59
	21 22	2.40	8.97	1.73	1.61	59
	23 24	1.93	7.48	1.49	1.44	59
MEAN	19 23	2.04	8.42	1.54	1.50	
STD DEV	19 23	0.32	0.82	0.17	0.10	
STD ERR	19 23	0.19	0.47			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		PØLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1968	X METERS	Y METERS	X METERS	Y METERS	
	25 26	2,21	5,76	1,46	1,39	59
	27 28	2,88	7,77	1,44	1,35	59
	29 30	3,77	8,03	1,57	1,42	59
MEAN	25 29	2,95	7,19	1,49	1,38	
STD DEV	25 29	0,78	1,24	0,07	0,03	
STD ERR	25 29	0,45	0,72			
	33 34	1,67	7,15	1,60	1,44	59
	35 36	3,92	4,78	1,73	1,56	59
MEAN	33 35	2,79	5,96	1,66	1,50	
STD DEV	33 35	1,60	1,68	0,09	0,08	
STD ERR	33 35	1,13	1,19			
	37 38	4,10	10,73	1,89	1,70	59
	39 40	2,46	5,61	1,25	1,20	59
	41 42	2,56	8,12	1,32	1,18	59
MEAN	37 41	2,00	8,15	1,49	1,36	
STD DEV	37 41	2,36	2,56	0,35	0,29	
STD ERR	37 41	1,36	1,48			
	43 44	1,19	6,53	1,13	1,05	59
	45 46	0,53	6,34	1,33	1,26	59
	47 48	1,19	6,98	1,15	1,07	59
MEAN	43 47	0,97	6,62	1,20	1,13	
STD DEV	43 47	0,38	0,33	0,11	0,12	
STD ERR	43 47	0,22	0,19			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

			POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1968		X METERS	Y METERS	X METERS	Y METERS	
	49	50	2,92	8,32	1,35	1,29	59
	51	52	2,48	7,78	1,26	1,22	59
	53	54	0,12	7,63	1,17	1,03	59
MEAN	49	53	1,84	7,91	1,26	1,18	
STD DEV	49	53	1,50	0,36	0,09	0,14	
STD ERR	49	53	0,87	0,21			
	55	56	2,03	7,63	1,24	1,23	59
	57	58	1,26	6,93	1,04	0,93	59
	59	60	2,53	4,41	1,34	1,25	59
MEAN	55	59	1,43	6,32	1,21	1,14	
STD DEV	55	59	1,49	1,69	0,15	0,18	
STD ERR	55	59	0,86	0,98			
	61	62	2,24	10,30	1,40	1,25	59
	63	64	0,44	8,35	1,16	1,08	59
	65	66	1,47	6,60	1,20	1,16	59
MEAN	61	65	1,38	8,42	1,25	1,17	
STD DEV	61	65	0,90	1,85	0,13	0,08	
STD ERR	61	65	0,52	1,07			
	67	68	1,39	6,05	1,32	1,27	59
	69	70	0,51	6,35	1,20	1,22	59
	71	72	2,21	7,84	1,16	1,08	59
MEAN	67	71	0,44	6,75	1,23	1,19	
STD DEV	67	71	1,80	0,96	0,08	0,10	
STD ERR	67	71	1,04	0,55			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1968	X METERS	Y METERS	X METERS	Y METERS	
	73 74	3.49	8.91	1.44	1.50	59
	75 76	1.28	8.33	1.17	1.09	59
	77 78	0.10	8.04	1.06	0.98	59
MEAN	73 77	1.62	8.43	1.23	1.19	
STD DEV	73 77	1.72	0.44	0.20	0.28	
STD ERR	73 77	0.99	0.25			
	79 80	0.22	6.07	1.95	1.81	59
	81 82	0.71	6.28	2.06	2.04	59
	83 84	3.95	8.65	2.09	1.99	59
MEAN	79 83	1.63	7.00	2.04	1.95	
STD DEV	79 83	2.03	1.43	0.07	0.12	
STD ERR	79 83	1.17	0.83			
	85 86	5.29	11.39	2.49	2.18	59
	87 88	4.19	6.44	1.84	1.91	59
	89 90	0.87	5.62	1.57	1.55	59
MEAN	85 89	3.45	7.82	1.96	1.88	
STD DEV	85 89	2.30	3.12	0.47	0.32	
STD ERR	85 89	1.33	1.80			
	91 92	1.11	6.09	2.07	2.13	59
	93 94	8.40	4.62	2.20	2.58	59
	95 96	5.38	9.32	2.52	2.39	59
MEAN	91 95	4.97	6.68	2.26	2.37	
STD DEV	91 95	3.66	2.40	0.23	0.23	
STD ERR	91 95	2.11	1.39			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS	
	97 98	6.32	7.08	2.02	2.05	59
	99 100	3.75	7.54	2.01	2.13	59
	101 102	2.46	4.56	2.22	2.48	59
MEAN	97 101	4.17	6.39	2.08	2.22	
STD DEV	97 101	1.97	1.60	0.12	0.23	
STD ERR	97 101	1.14	0.92			
	103 104	2.27	8.39	2.11	2.02	59
	105 106	5.44	3.65	2.76	3.06	59
	107 108	7.55	6.75	2.17	2.39	59
MEAN	103 107	5.09	6.26	2.35	2.49	
STD DEV	103 107	2.66	2.40	0.36	0.53	
STD ERR	103 107	1.54	1.39			
	109 110	6.02	8.54	2.45	2.43	59
	111 112	5.59	5.38	2.32	2.49	59
	113 114	2.85	4.43	2.47	2.54	59
MEAN	109 113	4.82	6.12	2.41	2.49	
STD DEV	109 113	1.72	2.15	0.08	0.05	
STD ERR	109 113	0.99	1.24			
	115 116	3.85	6.70	2.55	2.98	59
	117 118	5.68	4.09	2.75	3.05	59
	119 120	4.95	6.89	2.22	2.63	59
MEAN	115 119	4.82	5.89	2.51	2.89	
STD DEV	115 119	0.92	1.57	0.27	0.23	
STD ERR	115 119	0.53	0.90			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1968	X METERS	Y METERS	X METERS	Y METERS	
	121 122	2.35	4.62	2.40	2.70	59
	123 124	1.70	4.45	2.32	2.60	59
	125 126	5.06	8.33	2.58	3.10	59
MEAN	121 125	3.04	5.80	2.43	2.80	
STD DEV	121 125	1.78	2.19	0.14	0.26	
STD ERR	121 125	1.03	1.27			
	127 128	4.06	4.45	2.58	2.93	59
	129 130	5.97	3.55	2.73	3.00	59
	131 132	4.35	4.51	2.56	3.21	59
MEAN	127 131	3.23	4.17	2.62	3.05	
STD DEV	127 131	3.25	0.54	0.10	0.15	
STD ERR	127 131	1.87	0.31			
	133 134	0.27	6.06	2.56	2.95	59
	135 136	4.22	5.30	2.01	2.75	59
	137 138	3.12	-1.94	2.76	3.39	59
MEAN	133 137	2.54	3.14	2.44	3.03	
STD DEV	133 137	2.04	4.41	0.39	0.33	
STD ERR	133 137	1.18	2.55			
	139 140	6.16	1.60	2.36	2.74	59
	141 142	5.01	2.66	2.15	2.63	59
	143 144	4.92	2.44	2.63	2.96	59
MEAN	139 143	5.36	2.23	2.38	2.78	
STD DEV	139 143	0.69	0.56	0.24	0.17	
STD ERR	139 143	0.40	0.32			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

	DAYS 1968		POLE POSITION		STANDARD ERROR		SATELLITE
			X METERS	Y METERS	X METERS	Y METERS	
	145	146	8.05	1.82	2.85	3.67	59
	147	148	2.19	5.09	0.90	1.09	59
	149	150	6.41	5.21	1.29	1.59	59
MEAN	145	149	5.55	4.04	1.68	2.12	
STD DEV	145	149	3.02	1.92	1.03	1.37	
STD ERR	145	149	1.75	1.11			
	151	152	4.80	7.47	1.08	1.30	59
	153	154	4.49	5.70	0.90	1.13	59
	155	156	3.87	4.96	1.35	1.56	59
MEAN	151	155	4.39	6.04	1.11	1.33	
STD DEV	151	155	0.47	1.29	0.23	0.22	
STD ERR	151	155	0.27	0.74			
	157	158	3.74	6.19	0.95	1.23	59
	159	160	3.71	5.20	0.97	1.18	59
	161	162	3.86	5.38	1.08	1.33	59
MEAN	157	161	3.77	5.59	1.00	1.25	
STD DEV	157	161	0.08	0.53	0.07	0.07	
STD ERR	157	161	0.05	0.30			
	163	164	2.77	5.59	1.10	1.28	59
	165	166	4.72	5.00	1.06	1.28	59
	167	168	1.91	4.35	0.95	1.16	59
MEAN	163	167	3.13	4.98	1.04	1.24	
STD DEV	163	167	1.44	0.62	0.08	0.07	
STD ERR	163	167	0.83	0.36			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1968	X METERS	Y METERS	X METERS	Y METERS	
	169 170	2,28	5,03	0.97	1,09	59
	171 172	2,39	5,77	1.11	1,33	59
	173 174	2,35	4,93	0.92	1,24	59
MEAN	169 173	2,34	5,24	1.00	1,22	
STD DEV	169 173	0,06	0,46	0.10	0,12	
STD ERR	169 173	0,03	0,26			
	175 176	2,16	5,40	0.97	1,12	59
	177 178	3,83	4,07	0.93	1,03	59
	179 180	2,56	4,74	0.89	1,08	59
MEAN	175 179	2,85	4,74	0.93	1,07	
STD DEV	175 179	0,87	0,67	0.04	0,05	
STD ERR	175 179	0,50	0,38			
	181 182	3,78	5,21	0.88	1,01	59
	183 184	4,18	4,63	0.94	1,04	59
	185 186	3,80	4,59	1.08	1,27	59
MEAN	181 185	3,92	4,81	0.96	1,11	
STD DEV	181 185	0,23	0,35	0.10	0,14	
STD ERR	181 185	0,13	0,20			
	187 188	3,60	3,90	0.91	1,02	59
	189 190	3,22	4,31	0.80	0,92	59
	191 192	2,75	2,32	0.98	1,06	59
MEAN	187 191	3,19	3,51	0.90	1,00	
STD DEV	187 191	0,43	1,05	0.09	0,07	
STD ERR	187 191	0,25	0,61			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1968	X METERS	Y METERS	X METERS	Y METERS	
	193 194	4.72	3.29	0.86	0.91	59
	195 196	3.41	3.56	0.83	0.88	59
	197 198	3.63	4.98	0.80	0.85	59
MEAN	193 197	3.92	3.95	0.83	0.88	
STD DEV	193 197	0.70	0.91	0.03	0.03	
STD ERR	193 197	0.40	0.52			
	199 200	4.04	4.75	0.94	1.01	59
	201 202	4.33	3.44	0.86	0.88	59
	203 204	4.38	3.14	0.94	0.95	59
MEAN	199 203	4.25	3.78	0.91	0.94	
STD DEV	199 203	0.18	0.85	0.04	0.06	
STD ERR	199 203	0.10	0.49			
	205 206	5.55	4.86	1.05	1.07	59
	207 208	3.57	3.57	0.99	0.92	59
	209 210	4.07	4.34	0.93	0.96	59
MEAN	205 209	4.40	4.26	0.99	0.98	
STD DEV	205 209	1.03	0.65	0.06	0.07	
STD ERR	205 209	0.60	0.38			
	211 212	3.07	2.98	1.02	1.01	59
	213 214	3.08	3.60	0.94	0.97	59
	215 216	4.89	0.66	0.93	0.91	59
MEAN	211 215	3.68	2.42	0.96	0.96	
STD DEV	211 215	1.05	1.55	0.05	0.05	
STD ERR	211 215	0.61	0.90			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS	
	217 218	5.09	1.91	1.18	1.13	59
	219 220	2.45	1.98	1.06	1.01	59
	221 222	2.28	3.76	1.08	1.06	59
MEAN	217 221	3.27	2.55	1.11	1.07	
STD DEV	217 221	1.58	1.05	0.07	0.06	
STD ERR	217 221	0.91	0.61			
	223 224	2.04	1.21	0.98	0.92	59
	225 226	2.88	2.48	1.09	1.02	59
	227 228	3.28	3.23	0.86	0.86	59
MEAN	223 227	2.73	2.30	0.98	0.94	
STD DEV	223 227	0.63	1.02	0.11	0.08	
STD ERR	223 227	0.36	0.59			
	229 230	3.00	1.75	1.24	1.04	59
	231 232	2.12	0.53	1.11	1.07	59
	233 234	2.11	2.61	0.89	0.84	59
MEAN	229 233	2.41	1.63	1.08	0.98	
STD DEV	229 233	0.51	1.05	0.18	0.13	
STD ERR	229 233	0.30	0.60			
	235 236	2.47	1.35	0.99	0.95	59
	237 238	3.73	2.08	0.95	0.87	59
	239 240	3.71	3.11	0.92	0.88	59
MEAN	235 239	3.30	2.18	0.95	0.90	
STD DEV	235 239	0.72	0.89	0.03	0.04	
STD ERR	235 239	0.42	0.51			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		DAYS 1968		POLE POSITION		STANDARD ERROR		SATELLITE
		X METERS	Y METERS	X METERS	Y METERS			
		241	242	2.93	3.52	0.97	0.97	59
		243	244	4.02	2.41	0.99	0.99	59
		245	246	2.41	0.79	0.98	0.93	59
MEAN		241	245	3.12	2.24	0.98	0.96	
STD DEV		241	245	0.82	1.37	0.01	0.03	
STD ERR		241	245	0.47	0.79			
		247	248	1.78	3.60	0.91	0.87	59
		249	250	1.98	1.59	0.98	0.99	59
		251	252	3.35	2.56	1.02	1.02	59
MEAN		247	251	2.37	2.58	0.97	0.96	
STD DEV		247	251	0.86	1.00	0.06	0.08	
STD ERR		247	251	0.49	0.58			
		253	254	1.91	2.50	0.94	0.91	59
		255	256	0.90	2.80	0.96	0.96	59
		257	258	1.55	1.66	0.91	0.88	59
MEAN		253	257	1.45	2.32	0.94	0.92	
STD DEV		253	257	0.51	0.59	0.03	0.04	
STD ERR		253	257	0.30	0.34			
		259	260	2.59	0.63	1.02	0.99	59
		261	262	1.30	0.10	1.05	1.12	59
		263	264	3.00	2.04	0.89	0.95	59
MEAN		259	263	2.30	0.92	0.99	1.02	
STD DEV		259	263	0.89	1.00	0.08	0.09	
STD ERR		259	263	0.51	0.58			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS	
	265 266	0.91	2.33	0.97	1.12	59
	267 268	1.68	2.26	1.16	1.30	59
	269 270	0.66	0.32	1.10	1.11	59
MEAN	265 269	0.30	1.64	1.08	1.18	
STD DEV	265 269	0.86	1.14	0.09	0.11	
STD ERR	265 269	0.49	0.66			
	271 272	1.10	1.37	0.92	1.01	59
	273 274	1.56	1.52	0.98	1.11	59
	275 276	2.81	2.92	0.85	0.92	59
MEAN	271 275	0.39	1.36	0.92	1.02	
STD DEV	271 275	2.23	1.65	0.06	0.10	
STD ERR	271 275	1.29	0.96			
	277 278	1.65	2.82	1.26	1.39	59
	279 280	3.32	2.65	1.03	1.16	59
	281 282	0.19	2.25	1.07	1.29	59
MEAN	277 281	1.59	2.57	1.12	1.28	
STD DEV	277 281	1.76	0.29	0.12	0.12	
STD ERR	277 281	1.01	0.17			
	283 284	0.41	2.85	0.98	1.25	59
	285 286	0.96	3.95	1.00	1.45	59
	287 288	0.30	1.48	1.07	1.45	59
MEAN	283 287	0.56	2.76	1.02	1.38	
STD DEV	283 287	0.35	1.24	0.05	0.12	
STD ERR	283 287	0.20	0.72			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1968	X METERS	Y METERS	X METERS	Y METERS		
	289	290	1.68	3.23	1.05	1.30	59
	291	292	3.83	1.90	1.06	1.23	59
	293	294	1.15	3.33	0.97	1.11	59
MEAN	289	293	1.56	2.82	1.03	1.21	
STD DEV	289	293	1.99	0.80	0.05	0.10	
STD ERR	289	293	1.15	0.46			
	295	296	1.40	2.62	1.06	1.25	59
	297	298	0.82	0.62	1.27	1.83	59
	299	300	0.53	6.34	0.99	1.51	59
MEAN	295	299	0.32	3.19	1.11	1.53	
STD DEV	295	299	0.63	2.90	0.15	0.29	
STD ERR	295	299	0.37	1.68			
	301	302	2.60	4.28	1.05	1.49	59
	303	304	2.36	1.98	1.23	1.77	59
	305	306	2.09	3.02	0.93	1.39	59
MEAN	301	305	2.35	1.24	1.07	1.55	
STD DEV	301	305	0.25	3.95	0.15	0.20	
STD ERR	301	305	0.15	2.28			
	307	308	1.29	0.56	1.27	1.60	59
	309	310	1.87	1.37	1.06	1.26	59
	311	312	1.43	3.86	0.93	1.25	59
MEAN	307	311	1.86	1.93	1.09	1.37	
STD DEV	307	311	0.88	1.72	0.17	0.20	
STD ERR	307	311	0.51	0.99			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1968	X METERS	Y METERS	X METERS	Y METERS	
	313 314	1.91	1.91	0.91	1.15	59
	315 316	2.57	1.55	1.05	1.36	59
	317 318	1.96	3.04	0.89	1.18	59
MEAN	313 317	1.81	1.47	0.95	1.23	
STD DEV	313 317	0.84	1.83	0.09	0.12	
STD ERR	313 317	0.48	1.06			
	319 320	1.16	4.15	1.07	1.34	59
	321 322	1.60	3.58	0.86	1.09	59
	323 324	2.03	2.05	0.93	1.17	59
MEAN	319 323	1.60	3.26	0.95	1.20	
STD DEV	319 323	0.43	1.09	0.11	0.13	
STD ERR	319 323	0.25	0.63			
	325 326	0.98	1.83	0.88	1.07	59
	327 328	2.86	1.32	0.95	1.19	59
	329 330	1.86	3.76	0.88	1.03	59
MEAN	325 329	1.25	0.87	0.90	1.10	
STD DEV	325 329	1.99	2.52	0.04	0.09	
STD ERR	325 329	1.15	1.45			
	331 332	2.74	3.25	1.11	1.37	59
	333 334	2.98	5.90	0.88	1.09	59
	335 336	4.29	5.13	1.28	1.32	59
MEAN	331 335	3.34	4.76	1.09	1.26	
STD DEV	331 335	0.83	1.36	0.20	0.15	
STD ERR	331 335	0.48	0.79			

REPORT 1 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		DAYS 1969		POLE POSITION		STANDARD ERROR		SATELLITE
		X METERS	Y METERS	X METERS	Y METERS			
		337	338	3,53	1,35	1.11	1,34	59
		339	340	4,19	1,62	1.19	1,41	59
		341	342	3,18	4,99	1.24	1,37	59
MEAN		337	341	3,63	2,65	1.18	1,38	
STD DEV		337	341	0,51	2,03	0.07	0,04	
STD ERR		337	341	0,29	1,17			
		343	344	2,15	6,21	1.39	1,54	59
		345	346	2,63	5,43	1.09	1,23	59
		347	348	2,83	5,56	1.19	1,36	59
MEAN		343	347	2,54	5,74	1.22	1,38	
STD DEV		343	347	0,35	0,42	0.15	0,16	
STD ERR		343	347	0,20	0,24			
		349	350	2,66	3,86	1.13	1,29	59
		351	352	1,99	3,85	1.06	1,10	59
		353	354	1,94	5,10	0.87	0,98	59
MEAN		349	353	1,87	4,27	1.02	1,12	
STD DEV		349	353	0,84	0,72	0.13	0,16	
STD ERR		349	353	0,48	0,42			
		355	356	4,37	5,01	0.99	1,08	59
		357	358	1,68	6,79	1.05	1,11	59
		359	360	1,54	5,32	1.32	1,47	59
MEAN		355	359	2,53	5,71	1.12	1,22	
STD DEV		355	359	1,59	0,95	0.17	0,22	
STD ERR		355	359	0,92	0,55			
		361	362	2,40	5,98	1.14	1,18	59
		363	364	2,50	5,92	0.98	0,98	59
MEAN		361	363	2,45	5,95	1.06	1,08	
STD DEV		361	363	0,07	0,04	0.11	0,14	
STD ERR		361	363	0,05	0,03			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		DAYS 1969		POLE POSITION		STANDARD ERROR		SATELLITE
		X METERS	Y METERS	X METERS	Y METERS			
		15	16	-5.24	6.20	1.14	1.05	59
		16	17	-3.74	5.77	1.52	1.66	60
		17	18	-2.88	6.99	0.95	0.90	59
		18	19	-3.78	9.38	1.17	1.26	60
MEAN		15	18	-3.91	7.08	1.19	1.22	
STD DEV		15	18	0.98	1.61	0.24	0.33	
STD ERR		15	18	0.49	0.81			
		19	20	-0.29	5.52	1.00	0.96	59
		20	21	-5.85	4.45	1.14	1.27	60
		21	22	-5.98	7.19	1.19	1.21	59
		22	23	-3.17	9.46	1.17	1.25	60
		23	24	-1.11	8.95	1.12	1.16	59
		24	25	-2.04	7.05	1.20	1.26	60
MEAN		19	24	-3.07	7.10	1.14	1.18	
STD DEV		19	24	2.40	1.92	0.07	0.12	
STD ERR		19	24	0.98	0.79			
		25	26	-1.14	4.96	1.01	1.06	59
		26	27	-2.56	7.64	1.06	1.15	60
		27	28	-4.25	7.42	1.33	1.36	59
		28	29	-5.58	6.76	1.43	1.43	60
		29	30	-5.19	7.82	1.17	1.14	59
		30	31	-6.44	4.28	1.26	1.44	60
MEAN		25	30	-4.19	6.48	1.21	1.26	
STD DEV		25	30	2.00	1.50	0.16	0.17	
STD ERR		25	30	0.82	0.61			
		31	32	-2.14	6.77	0.89	0.89	59
		32	33	-4.18	4.50	1.34	1.54	60
		33	34	0.27	10.06	1.29	1.27	59
		34	35	-3.14	7.71	1.14	1.26	60
		35	36	-1.20	8.80	0.97	0.95	59
		36	37	-2.80	7.18	1.17	1.33	60
MEAN		31	36	-2.20	7.50	1.13	1.21	
STD DEV		31	36	1.57	1.89	0.18	0.24	
STD ERR		31	36	0.64	0.77			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS		
	37	38	- .43	10.27	1.72	1.72	59
	38	39	-3.42	8.62	1.38	1.54	60
	39	40	-1.51	9.44	1.47	1.51	59
	40	41	-2.73	8.77	1.31	1.58	60
	41	42	-3.57	6.56	1.26	1.33	59
	42	43	-3.05	5.70	1.51	1.67	60
MEAN	37	42	-2.45	8.23	1.44	1.56	
STD DEV	37	42	1.23	1.75	0.17	0.14	
STD ERR	37	42	0.50	0.71			
	43	44	-2.56	8.22	1.20	1.27	59
	44	45	-3.01	5.93	1.43	1.63	60
	45	46	- .95	7.48	1.17	1.19	59
	46	47	-4.49	7.75	1.21	1.39	60
	47	48	-1.43	7.75	1.31	1.24	59
	48	49	-5.17	8.47	1.35	1.52	60
MEAN	43	48	-2.93	7.60	1.28	1.37	
STD DEV	43	48	1.66	0.89	0.10	0.17	
STD ERR	43	48	0.68	0.36			
	49	50	-3.71	7.51	1.32	1.32	59
	50	51	- .61	9.79	1.49	1.73	60
	51	52	-2.56	7.84	1.14	1.06	59
	52	53	-2.83	7.12	1.70	2.04	60
	53	54	-1.45	5.13	1.09	0.98	59
	54	55	-2.17	5.23	1.46	1.85	60
MEAN	49	54	-2.22	7.10	1.37	1.50	
STD DEV	49	54	1.09	1.75	0.23	0.44	
STD ERR	49	54	0.44	0.71			
	55	56	-1.00	6.63	1.12	1.17	59
	56	57	0.51	7.73	1.68	1.85	60
	57	58	-4.89	7.28	1.11	1.05	59
	58	59	- .45	6.26	1.51	1.70	60
	59	60	-1.79	6.97	1.43	1.53	59
	60	61	-2.28	7.12	1.73	1.91	60
MEAN	55	60	-1.65	7.00	1.43	1.53	
STD DEV	55	60	1.87	0.51	0.27	0.36	
STD ERR	55	60	0.76	0.21			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS	
	61 62	-1.26	10.06	1.58	1.65	59
	62 63	-3.12	6.70	1.17	1.24	60
	63 64	-3.77	7.97	1.44	1.53	59
	64 65	-6.64	6.15	3.03	4.68	60
	65 66	-1.53	7.09	1.39	1.48	59
	66 67	-1.58	9.43	1.41	1.66	60
MEAN	61 66	-2.98	7.90	1.67	2.04	
STD DEV	61 66	2.05	1.56	0.68	1.30	
STD ERR	61 66	0.84	0.64			
	67 68	-1.79	7.09	1.08	1.12	59
	68 69	-1.78	9.22	1.26	1.46	60
	69 70	-.03	9.73	1.49	1.51	59
	70 71	-1.45	8.51	1.29	1.53	60
	71 72	-.06	10.68	1.28	1.33	59
	72 73	-.21	7.98	1.40	1.68	60
MEAN	67 72	-.89	8.87	1.30	1.44	
STD DEV	67 72	0.87	1.28	0.14	0.19	
STD ERR	67 72	0.36	0.52			
	74 75	2.03	11.69	1.75	1.96	60
	75 76	-2.94	9.11	1.22	1.30	59
	76 77	-.11	11.12	1.39	1.60	60
	77 78	-3.15	12.40	1.69	1.83	59
	78 79	-3.38	11.71	1.71	1.94	60
MEAN	74 78	-1.51	11.21	1.55	1.73	
STD DEV	74 78	2.38	1.26	0.23	0.28	
STD ERR	74 78	1.07	0.56			
	79 80	-1.48	9.41	1.72	1.80	59
	80 81	-.14	7.73	1.43	1.53	60
	81 82	-.11	10.23	1.22	1.36	59
	82 83	2.57	17.17	1.76	1.94	60
	83 84	3.61	8.23	1.17	1.38	59
	84 85	0.26	7.62	1.56	1.61	60
MEAN	79 84	0.78	10.06	1.48	1.60	
STD DEV	79 84	1.91	3.63	0.25	0.23	
STD ERR	79 84	0.78	1.48			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS		
	85	86	1.00	10.17	1.47	1.69	59
	86	87	-.93	10.70	1.15	1.28	60
	87	88	-1.52	11.01	1.37	1.60	59
	88	89	0.25	8.26	1.47	1.66	60
	89	90	-.67	9.75	1.32	1.62	59
	90	91	-1.27	10.11	1.89	2.01	60
MEAN	85	90	-.52	10.00	1.44	1.64	
STD DEV	85	90	0.97	0.96	0.25	0.23	
STD ERR	85	90	0.39	0.39			
	91	92	-1.61	13.40	1.80	2.89	59
	92	93	1.31	11.61	1.14	1.27	60
	93	94	1.44	11.61	1.16	1.32	59
	94	95	-.14	7.94	1.27	1.33	60
	95	96	1.28	12.55	1.24	1.39	59
	96	97	-.55	11.55	1.48	1.63	60
MEAN	91	96	0.29	11.44	1.35	1.64	
STD DEV	91	96	1.25	1.87	0.25	0.63	
STD ERR	91	96	0.51	0.76			
	97	98	1.67	12.08	1.30	1.60	59
	98	99	0.97	11.30	1.51	1.69	60
	99	100	-.49	10.43	1.19	1.30	59
	100	101	0.13	10.18	1.05	1.15	60
	101	102	2.07	8.42	1.05	1.20	59
	102	103	0.99	11.04	1.28	1.38	60
MEAN	97	102	0.89	10.57	1.23	1.39	
STD DEV	97	102	0.95	1.25	0.17	0.22	
STD ERR	97	102	0.39	0.51			
	103	104	1.08	9.65	1.11	1.21	59
	104	105	0.33	10.32	1.04	1.16	60
	105	106	2.84	9.82	1.35	1.44	59
	106	107	-1.05	10.77	1.11	1.19	60
	107	108	1.62	10.76	0.95	1.04	59
	108	109	2.10	10.98	1.16	1.22	60
MEAN	103	108	1.15	10.38	1.12	1.21	
STD DEV	103	108	1.38	0.55	0.13	0.13	
STD ERR	103	108	0.56	0.22			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS	
109	110	0.97	12.05	1.36	1.61	59
110	111	1.28	8.53	1.18	1.25	60
111	112	-0.59	9.76	1.14	1.42	59
112	113	2.95	8.25	1.26	1.40	60
113	114	2.09	11.97	1.37	1.51	59
114	115	2.58	9.59	1.01	1.07	60
MEAN	109	114	1.55	10.02	1.22	1.38
STD DEV	109	114	1.29	1.64	0.14	0.19
STD ERR	109	114	0.53	0.67		
	115	116	1.42	11.21	1.14	1.26
	116	117	2.17	10.37	1.55	1.66
	117	118	2.16	9.28	1.10	1.25
	118	119	2.71	9.52	1.06	1.05
	119	120	0.73	4.67	1.51	2.49
	120	121	3.75	12.40	1.16	1.25
MEAN	115	120	2.16	9.57	1.25	1.49
STD DEV	115	120	1.04	2.66	0.22	0.53
STD ERR	115	120	0.43	1.09		
	121	122	-0.63	10.34	1.20	1.41
	122	123	2.36	10.00	1.05	1.03
	123	124	1.97	14.34	1.51	1.74
	124	125	2.54	10.03	1.39	1.29
	125	126	5.67	13.10	1.41	1.72
	126	127	2.02	9.54	1.32	1.37
MEAN	121	126	2.32	11.22	1.31	1.43
STD DEV	121	126	2.01	1.99	0.17	0.27
STD ERR	121	126	0.82	0.81		
	127	128	2.28	8.80	1.30	1.69
	128	129	2.45	9.14	0.90	0.93
	129	130	2.75	11.39	1.12	1.34
	130	131	4.96	9.70	1.00	1.09
	131	132	2.26	13.44	1.24	1.47
	132	133	5.21	8.19	1.10	1.14
MEAN	127	132	3.32	10.11	1.11	1.28
STD DEV	127	132	1.38	1.96	0.15	0.28
STD ERR	127	132	0.56	0.80		

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS	
133	134	2.49	9.70	1.36	1.71	59
134	135	2.31	11.33	0.97	0.98	60
135	136	1.86	12.11	1.24	1.43	59
136	137	3.92	10.73	1.03	1.09	60
137	138	4.28	12.39	1.54	1.78	59
138	139	5.03	9.58	0.84	0.87	60
MEAN	133	138	3.31	10.97	1.16	1.31
STD DEV	133	138	1.27	1.19	0.26	0.39
STD ERR	133	138	0.52	0.48		
	139	140	3.21	11.97	1.14	1.29
	140	141	3.38	9.92	1.04	1.05
	141	142	2.73	10.90	1.00	1.20
	142	143	3.68	9.49	1.09	1.06
	143	144	1.17	9.18	0.94	1.09
	144	145	4.63	7.86	0.96	0.96
MEAN	139	144	3.13	9.89	1.03	1.11
STD DEV	139	144	1.15	1.42	0.08	0.12
STD ERR	139	144	0.47	0.58		
	145	146	3.58	9.14	1.12	1.24
	146	147	6.61	7.94	0.99	0.99
	147	148	3.10	10.19	1.19	1.26
	148	149	4.53	8.52	1.00	1.04
	150	151	6.78	9.13	1.01	1.04
MEAN	145	150	4.92	8.98	1.06	1.11
STD DEV	145	150	1.70	0.84	0.09	0.13
STD ERR	145	150	0.76	0.37		
	151	152	3.52	9.24	0.98	1.09
	152	153	4.92	7.09	0.93	0.94
	153	154	4.63	9.69	0.92	1.06
	154	155	4.05	7.15	0.98	0.96
	155	156	2.62	7.88	0.93	1.05
	156	157	5.19	8.90	0.93	0.95
MEAN	151	156	4.15	8.32	0.94	1.01
STD DEV	151	156	0.96	1.11	0.03	0.07
STD ERR	151	156	0.39	0.45		

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS		
	157	158	3.11	9.04	1.08	1.28	59
	158	159	3.91	8.53	1.06	1.08	60
	159	160	3.24	8.49	1.01	1.18	59
	160	161	5.10	8.73	1.04	1.08	60
	161	162	6.20	9.69	1.44	1.69	59
	162	163	2.52	8.07	1.08	1.07	60
MEAN	157	162	4.01	8.76	1.12	1.23	
STD DEV	157	162	1.39	0.56	0.16	0.24	
STD ERR	157	162	0.57	0.23			
	163	164	3.07	7.66	1.06	1.22	59
	164	165	4.72	6.34	1.24	1.22	60
	165	166	3.92	8.88	1.04	1.18	59
	166	167	5.96	8.03	1.28	1.22	60
	167	168	3.99	9.98	1.46	1.59	59
	168	169	4.72	6.65	1.03	1.06	60
MEAN	163	168	4.40	7.92	1.18	1.25	
STD DEV	163	168	0.98	1.37	0.17	0.18	
STD ERR	163	168	0.40	0.56			
	169	170	4.68	8.28	1.28	1.34	59
	170	171	4.94	7.47	0.97	0.97	60
	171	172	6.12	8.14	1.02	1.17	59
	172	173	5.16	8.14	1.17	1.17	60
	173	174	6.01	7.86	1.05	1.21	59
	174	175	3.41	10.75	1.27	1.26	60
MEAN	169	174	5.05	8.44	1.13	1.19	
STD DEV	169	174	0.99	1.17	0.13	0.12	
STD ERR	169	174	0.40	0.48			
	175	176	4.84	9.68	0.98	1.09	59
	176	177	5.51	6.74	0.89	0.89	60
	177	178	3.99	8.91	1.19	1.34	59
	178	179	3.21	9.03	1.10	1.10	60
	179	180	5.02	10.29	1.16	1.23	59
	180	181	4.76	7.41	1.01	1.02	60
MEAN	175	180	4.55	8.68	1.05	1.11	
STD DEV	175	180	0.82	1.35	0.12	0.16	
STD ERR	175	180	0.34	0.55			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS		
	181	182	6.90	8.02	1.10	1.14	59
	182	183	6.46	9.43	1.25	1.35	60
	183	184	6.76	7.49	1.13	1.21	59
	184	185	5.06	6.46	1.09	1.14	60
	185	186	7.93	7.45	1.06	1.10	59
	186	187	7.54	6.29	1.13	1.20	60
MEAN	181	186	6.74	7.52	1.13	1.19	
STD DEV	181	186	0.97	1.14	0.07	0.09	
STD ERR	181	186	0.40	0.47			
	187	188	4.14	6.14	1.01	1.04	59
	188	189	6.46	7.82	1.05	1.09	60
	189	190	3.97	7.89	1.11	1.14	59
	190	191	6.00	6.71	1.04	1.10	60
	191	192	4.94	7.02	1.10	1.14	59
	192	193	5.12	6.96	1.14	1.20	60
MEAN	187	192	5.10	7.09	1.07	1.12	
STD DEV	187	192	0.99	0.67	0.05	0.05	
STD ERR	187	192	0.40	0.27			
	193	194	4.70	5.38	1.15	1.22	59
	194	195	4.65	4.50	1.02	1.07	60
	195	196	4.99	5.46	1.55	1.61	59
	196	197	5.76	4.38	1.33	1.39	60
	197	198	4.76	4.91	1.17	1.21	59
	198	199	5.98	5.58	1.05	1.19	60
MEAN	193	198	5.14	5.03	1.21	1.28	
STD DEV	193	198	0.58	0.52	0.20	0.19	
STD ERR	193	198	0.24	0.21			
	199	200	4.33	5.39	1.02	1.01	59
	200	201	5.62	5.20	0.98	1.08	60
	201	202	4.61	5.56	1.09	1.15	59
	202	203	3.11	7.31	1.42	2.32	60
	203	204	5.56	5.66	1.04	0.95	59
	204	205	5.87	5.44	0.93	1.05	60
MEAN	199	204	4.85	5.76	1.08	1.26	
STD DEV	199	204	1.05	0.78	0.18	0.52	
STD ERR	199	204	0.43	0.32			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		DAYS 1969		POLE POSITION		STANDARD ERROR		SATELLITE
				X METERS	Y METERS	X METERS	Y METERS	
		205	206	6.04	5.54	1.06	1.09	59
		206	207	6.52	5.40	0.96	0.97	60
		207	208	7.80	5.50	1.03	0.99	59
		209	210	5.69	4.38	1.01	0.97	59
		210	211	7.12	2.55	1.06	1.20	60
MEAN		205	210	6.63	4.67	1.00	1.04	
STD DEV		205	210	0.84	1.28	0.08	0.10	
STD ERR		205	210	0.38	0.57			
		211	212	4.08	7.02	0.97	0.93	59
		212	213	5.97	4.81	0.96	1.05	60
		213	214	7.16	7.91	1.06	1.04	59
		214	215	5.23	3.93	1.15	1.28	60
		215	216	6.20	5.12	0.96	1.00	59
		216	217	4.55	6.12	1.09	1.12	60
MEAN		211	216	5.53	5.82	1.03	1.08	
STD DEV		211	216	1.14	1.48	0.09	0.13	
STD ERR		211	216	0.46	0.60			
		217	218	6.56	4.76	0.92	0.93	59
		218	219	5.51	6.14	1.10	1.28	60
		219	220	7.28	2.51	1.05	1.08	59
		220	221	4.16	4.34	1.20	1.41	60
		221	222	7.44	5.52	0.99	1.02	59
		222	223	5.91	3.26	1.00	1.20	60
MEAN		217	222	6.14	4.42	1.04	1.15	
STD DEV		217	222	1.23	1.36	0.10	0.18	
STD ERR		217	222	0.50	0.56			
		223	224	4.44	4.89	1.01	1.04	59
		224	225	6.28	4.23	1.03	1.21	60
		225	226	4.05	3.21	0.92	0.96	59
		226	227	5.30	3.43	1.14	1.28	60
		227	228	3.77	4.11	1.11	1.13	59
		228	229	5.26	3.19	0.96	0.95	60
MEAN		223	228	4.85	3.84	1.01	1.09	
STD DEV		223	228	0.94	0.68	0.11	0.13	
STD ERR		223	228	0.38	0.28			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		DAYS 1969		POLE POSITION		STANDARD ERROR		SATELLITE
				X METERS	Y METERS	X METERS	Y METERS	
		229	230	5.14	4.52	0.92	0.99	59
		230	231	6.52	2.69	0.95	1.05	60
		231	232	6.71	2.48	1.06	1.11	59
		232	233	5.52	3.35	1.00	1.12	60
		233	234	4.92	5.19	0.98	1.06	59
		234	235	5.09	4.29	1.11	1.27	60
MEAN		229	234	5.65	3.75	1.00	1.10	
STD DEV		229	234	0.78	1.08	0.07	0.10	
STD ERR		229	234	0.32	0.44			
		235	236	3.51	1.21	1.34	1.63	59
		236	237	4.93	5.27	1.40	1.60	60
		237	238	4.52	2.96	1.03	1.09	59
		238	239	2.33	1.96	1.63	2.83	60
		239	240	6.71	3.21	1.13	1.19	59
		240	241	5.55	4.87	1.23	1.46	60
MEAN		235	240	4.59	2.52	1.29	1.63	
STD DEV		235	240	1.54	2.58	0.21	0.63	
STD ERR		235	240	0.63	1.05			
		241	242	5.29	5.04	0.91	0.89	59
		242	243	3.22	3.69	1.11	1.27	60
		243	244	4.02	7.00	2.37	2.41	59
		244	245	4.00	3.40	2.10	3.65	60
		245	246	6.20	2.50	0.99	1.06	59
		246	247	8.30	5.42	2.87	3.36	60
MEAN		241	246	5.17	4.51	1.72	2.11	
STD DEV		241	246	1.86	1.63	0.83	1.21	
STD ERR		241	246	0.76	0.66			
		247	248	2.54	1.24	1.32	1.40	59
		248	249	5.58	2.80	0.87	0.99	60
		249	250	4.94	1.03	1.04	1.12	59
		250	251	2.52	3.28	1.10	1.22	60
		251	252	3.37	1.81	1.02	1.06	59
		252	253	2.94	4.95	0.90	1.02	60
MEAN		247	252	3.65	2.52	1.04	1.13	
STD DEV		247	252	1.30	1.48	0.16	0.15	
STD ERR		247	252	0.53	0.60			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS	
	253 254	4.88	3.43	0.95	1.03	59
	254 255	3.96	3.12	1.07	1.18	60
	255 256	6.78	4.63	1.03	1.14	59
	256 257	3.88	1.43	1.02	1.20	60
	257 258	3.10	1.48	0.96	1.06	59
	258 259	4.89	1.29	1.03	1.18	60
MEAN	253 258	4.58	2.56	1.01	1.13	
STD DEV	253 258	1.27	1.37	0.05	0.07	
STD ERR	253 258	0.52	0.56			
	259 260	1.04	2.77	1.30	1.32	59
	261 262	3.16	2.42	1.10	1.23	59
	262 263	7.50	0.57	1.16	1.30	60
	263 264	2.53	2.90	1.18	1.29	59
	264 265	6.12	2.81	1.15	1.30	60
MEAN	259 264	4.07	2.29	1.18	1.29	
STD DEV	259 264	2.66	0.98	0.07	0.03	
STD ERR	259 264	1.19	0.44			
	265 266	3.99	2.26	1.20	1.29	59
	266 267	3.96	0.69	1.26	1.38	60
	267 268	3.94	2.45	1.08	1.20	59
	268 269	4.72	2.86	1.32	1.52	60
	269 270	1.48	-1.28	1.38	1.53	59
	270 271	5.01	-1.23	1.39	1.60	60
MEAN	265 270	3.35	0.96	1.27	1.42	
STD DEV	265 270	1.25	1.87	0.12	0.16	
STD ERR	265 270	0.51	0.76			
	271 272	-0.79	0.67	1.09	1.23	59
	272 273	2.76	3.82	1.22	1.30	60
	273 274	2.91	1.40	1.14	1.21	59
	274 275	3.62	2.03	1.15	1.23	60
	275 276	2.11	2.02	1.06	1.13	59
	276 277	3.55	-0.56	1.07	1.15	60
MEAN	271 276	2.36	1.56	1.12	1.21	
STD DEV	271 276	1.64	1.47	0.06	0.06	
STD ERR	271 276	0.67	0.60			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

	DAYS 1969		POLE POSITION		STANDARD ERROR		SATELLITE
			X METERS	Y METERS	X METERS	Y METERS	
	278	279	3.25	0.83	1.05	1.06	60
	280	281	5.23	-0.02	0.78	0.87	60
	282	283	4.91	2.44	0.91	1.07	60
MEAN	278	282	4.46	1.08	0.91	1.00	
STD DEV	278	282	1.06	1.25	0.14	0.11	
STD ERR	278	282	0.61	0.72			
	284	285	2.45	1.19	0.95	0.99	60
	286	287	1.39	0.67	0.81	0.84	60
	288	289	2.30	1.97	0.88	0.94	60
MEAN	284	288	2.05	1.28	0.88	0.92	
STD DEV	284	288	0.57	0.65	0.07	0.08	
STD ERR	284	288	0.33	0.38			
	290	291	3.24	0.62	0.82	0.89	60
	292	293	1.78	-0.29	0.83	0.93	60
	294	295	2.82	0.02	0.90	0.97	60
MEAN	290	294	2.61	0.12	0.85	0.93	
STD DEV	290	294	0.75	0.46	0.04	0.04	
STD ERR	290	294	0.43	0.27			
	296	297	3.79	0.11	0.87	0.92	60
	298	299	4.09	-0.74	1.00	0.99	60
	300	301	2.28	0.74	0.91	0.87	60
MEAN	296	300	3.39	0.04	0.93	0.93	
STD DEV	296	300	0.97	0.74	0.07	0.06	
STD ERR	296	300	0.56	0.43			

REPORT 2 REVISION 1
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1969	X METERS	Y METERS	X METERS	Y METERS	
	302 303	0.31	-1.05	1.00	0.94	60
	304 305	-1.70	-1.99	0.85	0.88	60
	306 307	1.80	0.07	0.94	0.90	60
MEAN	302 306	0.47	-1.32	0.93	0.91	
STD DEV	302 306	1.26	0.58	0.08	0.03	
STD ERR	302 306	0.73	0.34			
	308 309	2.50	-1.43	0.90	0.82	60
	310 311	1.16	0.15	0.95	0.89	60
	312 313	1.24	0.82	0.95	0.90	60
MEAN	308 312	1.64	0.18	0.93	0.87	
STD DEV	308 312	0.75	0.63	0.03	0.04	
STD ERR	308 312	0.43	0.36			
	314 315	1.74	1.40	0.85	0.79	60
	316 317	-1.60	1.77	0.98	0.91	60
	318 319	-1.83	1.40	1.02	0.87	60
MEAN	314 318	0.10	1.52	0.95	0.86	
STD DEV	314 318	1.42	0.21	0.09	0.06	
STD ERR	314 318	0.82	0.12			
	320 321	-2.11	0.82	1.05	0.95	60

REPORT 3 REVISION 2
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1970	X METERS	Y METERS	X METERS	Y METERS		
	12	12	-8.21	2.87	1.32	1.46	1967-92A
	13	13	-5.76	4.21	1.35	1.47	1967-92A
	14	14	-4.14	2.31	1.17	1.32	1967-92A
	15	15	-4.82	5.08	1.20	1.31	1967-92A
MEAN	13		-5.73	3.62	1.26	1.39	
STD DEV	13		1.78	1.26	0.09	0.09	
STD ERR	13		0.89	0.63			
	16	16	-5.26	2.27	1.40	1.47	1967-92A
	17	17	-2.84	4.71	1.52	1.54	1967-92A
	18	18	-2.58	4.31	1.45	1.59	1967-92A
	19	19	-4.76	5.06	1.12	1.19	1967-92A
	20	20	-3.85	3.22	1.53	1.58	1967-92A
MEAN	18		-3.86	3.91	1.40	1.48	
STD DEV	18		1.17	1.15	0.17	0.17	
STD ERR	18		0.52	0.51			
	21	21	-5.80	5.95	1.14	1.23	1967-92A
	22	22	-5.20	4.92	1.31	1.41	1967-92A
	23	23	-5.53	5.76	1.33	1.39	1967-92A
	24	24	-4.38	6.82	1.37	1.42	1967-92A
	25	25	-5.30	8.02	1.37	1.42	1967-92A
MEAN	23		-5.24	6.29	1.30	1.38	
STD DEV	23		0.54	1.18	0.10	0.08	
STD ERR	23		0.24	0.53			
	26	26	-5.71	4.94	1.08	1.21	1967-92A
	27	27	-4.39	5.82	1.37	1.33	1967-92A
	28	28	-7.08	4.58	1.42	1.47	1967-92A
	29	29	-7.36	5.97	1.54	1.58	1967-92A
	30	30	-7.47	3.48	1.62	1.92	1967-92A
MEAN	28		-6.40	4.96	1.41	1.50	
STD DEV	28		1.33	1.01	0.20	0.27	
STD ERR	28		0.59	0.45			

REPORT 3 REVISION 2
DAHLGREN POLAR MONITORING SERVICE

	DAYS	1970	PCLE POSITION		STANDARD ERROR		SATELLITE
			X METERS	Y METERS	X METERS	Y METERS	
	31	31	-3.13	5.89	1.39	1.51	1967-92A
	32	32	-5.19	5.24	1.62	1.67	1967-92A
	33	33	-5.35	6.16	1.77	1.62	1967-92A
	34	34	-4.40	4.06	1.06	1.21	1967-92A
	35	35	-6.24	4.08	1.40	1.39	1967-92A
MEAN	33		-4.86	5.08	1.45	1.48	
STD DEV	33		1.17	0.99	0.27	0.18	
STD ERR	33		0.52	0.44			
	36	36	-5.92	3.84	1.36	1.48	1967-92A
	37	37	-4.93	4.47	1.23	1.26	1967-92A
	38	38	-6.02	4.57	1.13	1.21	1967-92A
	39	39	-6.08	4.21	1.35	1.40	1967-92A
	40	40	-5.86	2.03	1.68	1.92	1967-48A
	40	40	-1.10	4.44	2.23	2.68	1967-34A
	40	40	-3.78	2.72	1.48	1.50	1967-92A
MEAN	38		-4.81	3.75	1.49	1.64	
STD DEV	38		1.84	0.99	0.37	0.51	
STD ERR	38		0.70	0.38			
	41	41	-4.75	0.48	1.49	1.65	1967-34A
	42	42	-4.25	7.79	2.31	2.40	1967-34A
	43	43	-6.49	7.14	1.18	1.31	1967-48A
	44	44	-8.11	8.58	1.21	1.41	1967-48A
	45	45	-2.76	4.44	1.33	1.41	1967-48A
	41	41	-4.08	4.42	1.11	1.23	1967-92A
	42	42	-6.70	4.90	1.27	1.33	1967-92A
	43	43	-4.84	3.39	1.44	1.67	1967-34A
	44	44	-3.07	3.45	1.96	2.19	1967-34A
	45	45	-2.35	5.07	1.57	1.51	1967-34A
	43	43	-5.61	6.25	1.31	1.52	1967-92A
	44	44	-5.51	6.46	1.30	1.56	1967-92A
	45	45	3.97	5.90	1.77	2.07	1968-12A
	45	45	-6.40	6.75	1.41	1.64	1967-92A
MEAN	43		-4.35	5.36	1.48	1.64	
STD DEV	43		2.90	2.10	0.33	0.35	
STD ERR	43		0.78	0.56			

REPORT 3 REVISION 2
DAHLGREN POLAR MONITORING SERVICE

DAYS	1970	PCLE POSITION		STANDARD ERROR		SATELLITE
		X METERS	Y METERS	X METERS	Y METERS	
46	46	-7.48	7.36	1.36	1.39	1967-48A
47	47	-3.28	5.81	1.09	1.25	1967-48A
48	48	-4.67	6.80	1.13	1.25	1967-48A
49	49	-3.29	7.08	1.57	1.70	1967-34A
50	50	-4.99	6.66	1.14	1.32	1967-48A
46	46	-4.41	7.63	1.84	2.03	1967-34A
47	47	-2.02	5.87	1.50	1.61	1967-34A
48	48	-3.65	8.28	1.61	1.71	1967-34A
49	49	-1.69	3.88	1.70	2.13	1968-12A
50	50	-2.67	7.90	1.45	1.72	1967-34A
46	46	-6.57	8.02	1.62	1.81	1968-12A
47	47	-2.93	5.93	1.70	1.98	1968-12A
48	48	-7.27	9.04	1.74	1.91	1968-12A
49	49	-4.88	6.73	1.42	1.71	1967-92A
50	50	-4.20	7.40	1.64	1.74	1968-12A
46	46	-3.83	4.25	1.58	1.51	1967-92A
47	47	-3.27	6.42	1.26	1.42	1967-92A
48	48	-3.63	5.69	1.38	1.66	1967-92A
50	50	-4.85	6.97	1.34	1.62	1967-92A
MEAN	48	-4.19	6.72	1.48	1.66	
STD DEV	48	1.60	1.30	0.22	0.26	
STD ERR	48	0.37	0.30			

51	51	-5.77	8.12	1.53	1.80	1967-48A
52	52	-4.01	7.54	1.17	1.28	1967-48A
53	53	-6.65	8.69	1.06	1.22	1967-48A
54	54	-5.52	8.24	1.20	1.45	1967-48A
55	55	-4.04	7.42	1.06	1.20	1967-48A
51	51	-4.49	5.13	1.30	1.45	1967-34A
52	52	-5.66	8.49	1.42	1.71	1967-34A
53	53	-4.21	8.15	1.78	2.00	1967-34A
54	54	-5.93	8.41	1.16	1.28	1967-34A
55	55	-4.44	5.00	1.57	1.65	1967-34A
51	51	-2.36	8.18	1.74	2.02	1968-12A
52	52	-3.78	7.75	1.86	2.09	1968-12A
53	53	-2.75	3.94	1.39	1.73	1968-12A
54	54	-7.33	6.25	1.43	1.76	1968-12A
55	55	-1.11	5.07	1.23	1.49	1968-12A
51	51	-6.46	5.56	1.09	1.23	1967-92A
52	52	-4.22	5.08	1.03	1.31	1967-92A
53	53	-4.82	7.25	1.15	1.39	1967-92A
54	54	-5.29	5.00	1.43	1.69	1967-92A
55	55	-9.81	8.20	1.22	1.48	1967-92A
MEAN	53	-4.88	6.87	1.34	1.56	
STD DEV	53	2.01	1.55	0.25	0.28	
STD ERR	53	0.45	0.35			

REPORT 3 REVISION 2
DAHLGREN POLAR MONITORING SERVICE

		PCLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1970	X METERS	Y METERS	X METERS	Y METERS	
56	56	-3.28	7.10	1.28	1.32	1967-48A
57	57	-2.99	5.31	1.40	1.59	1967-48A
58	58	-5.80	7.84	1.46	1.54	1967-48A
59	59	-3.98	6.12	1.40	1.58	1967-48A
60	60	-3.96	4.56	1.21	1.42	1967-48A
56	56	-5.06	10.13	1.45	1.53	1967-34A
57	57	-3.30	4.42	1.99	2.16	1967-34A
58	58	-3.48	10.30	1.36	1.56	1967-34A
59	59	-0.87	10.62	2.19	2.10	1967-34A
60	60	-3.59	7.27	1.75	1.93	1967-34A
56	56	-6.11	6.62	1.82	2.09	1968-12A
57	57	-2.78	6.95	1.64	1.87	1968-12A
58	58	-7.74	4.28	2.19	2.16	1968-12A
59	59	1.47	6.38	2.36	3.14	1968-12A
60	60	-7.05	8.01	1.60	1.78	1968-12A
56	56	-3.12	6.59	1.21	1.30	1967-92A
57	57	-5.89	7.77	1.26	1.61	1967-92A
58	58	-4.32	7.45	1.10	1.28	1967-92A
59	59	-4.40	7.44	0.97	1.27	1967-92A
60	60	-6.25	4.72	1.28	1.42	1967-92A
MEAN	58	-4.13	7.00	1.55	1.73	
STD DEV	58	2.12	1.87	0.39	0.45	
STD ERR	58	0.47	0.42			
61	61	-1.66	7.17	1.22	1.34	1967-48A
62	62	-3.37	9.23	1.28	1.37	1967-48A
63	63	-4.33	7.41	1.64	1.51	1967-48A
64	64	-3.60	10.51	0.99	1.11	1967-48A
65	65	-4.39	7.03	1.37	1.61	1967-92A
61	61	-3.11	6.93	2.33	2.19	1967-34A
62	62	-0.74	4.31	1.87	2.23	1967-34A
63	63	-2.06	7.68	1.43	1.75	1967-34A
64	64	-3.64	7.71	1.42	1.72	1967-92A
61	61	-4.64	9.17	1.84	2.24	1968-12A
62	62	-4.97	5.86	1.55	1.68	1968-12A
63	63	-1.91	8.67	1.48	1.82	1968-12A
61	61	-2.32	8.44	1.29	1.48	1967-92A
62	62	-5.52	6.16	1.51	1.49	1967-92A
63	63	-5.25	4.05	1.57	1.85	1967-92A
MEAN	63	-3.43	7.36	1.52	1.69	
STD DEV	63	1.44	1.77	0.32	0.34	
STD ERR	63	0.37	0.46			

REPORT 3 REVISION 2
DAHLGREN POLAR MONITORING SERVICE

		PCLE POSITION		STANDARD ERROR		SATELLITE
DAYS	1970	X METERS	Y METERS	X METERS	Y METERS	
66	66	-5.91	5.55	1.46	1.68	1967-48A
67	67	-3.48	9.03	1.39	1.69	1967-48A
68	68	-7.42	13.94	1.65	1.88	1967-48A
69	69	-4.73	7.95	1.20	1.31	1967-92A
70	70	-3.54	7.98	1.08	1.44	1967-92A
66	66	-3.50	5.76	1.32	1.67	1967-92A
67	67	-4.60	6.16	1.73	1.87	1967-92A
68	68	-4.06	7.92	1.12	1.35	1967-92A
MEAN	68	-4.66	8.04	1.37	1.61	
STD DEV	68	1.39	2.69	0.24	0.22	
STD ERR	68	0.49	0.95			
71	71	-5.43	9.10	1.22	1.48	1967-92A
72	72	-3.78	5.69	1.21	1.64	1967-92A
73	73	-4.58	9.62	1.22	1.62	1967-92A
74	74	-1.95	6.87	1.47	1.65	1967-92A
75	75	-3.54	10.07	1.10	1.41	1967-92A
MEAN	73	-3.85	8.27	1.24	1.56	
STD DEV	73	1.30	1.89	0.13	0.11	
STD ERR	73	0.58	0.85			
76	76	-2.23	8.23	1.75	2.02	1967-92A
77	77	-4.78	8.75	1.07	1.44	1967-92A
78	78	-2.26	8.93	1.14	1.36	1967-92A
79	79	-3.64	9.46	1.42	1.76	1967-92A
80	80	-2.10	6.67	1.28	1.43	1967-92A
MEAN	78	-3.00	8.41	1.33	1.60	
STD DEV	78	1.17	1.07	0.27	0.28	
STD ERR	78	0.53	0.48			
81	81	-1.51	8.98	1.16	1.54	1967-92A
82	82	-0.89	8.06	1.09	1.41	1967-92A
83	83	-2.31	8.98	1.44	1.73	1967-92A
84	84	-1.85	9.66	0.97	1.06	1967-92A
85	85	-4.73	9.07	1.28	1.35	1967-92A
MEAN	83	-2.26	8.95	1.19	1.42	
STD DEV	83	1.48	0.57	0.18	0.25	
STD ERR	83	0.66	0.26			

REPORT 3 REVISION 2
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1970	X METERS	Y METERS	X METERS	Y METERS		
	86	86	-2.52	11.06	1.18	1.38	1967-92A
	87	87	-4.86	10.11	1.39	1.58	1967-92A
	88	88	-.83	12.29	1.06	1.35	1967-92A
	89	89	-4.71	11.15	1.33	1.61	1967-92A
	90	90	-1.17	9.88	1.16	1.27	1967-92A
MEAN	88		-2.82	10.90	1.22	1.44	
STD DEV	88		1.90	0.96	0.13	0.15	
STD ERR	88		0.85	0.43			
	91	91	-2.21	11.73	1.22	1.37	1967-92A
	92	92	-1.90	12.47	1.75	1.89	1967-92A
	93	93	-4.37	11.02	1.11	1.28	1967-92A
	94	94	-.51	11.00	1.16	1.19	1967-92A
	95	95	-3.49	8.19	1.21	1.51	1967-92A
MEAN	93		-2.50	10.88	1.29	1.45	
STD DEV	93		1.49	1.62	0.26	0.27	
STD ERR	93		0.67	0.73			
	96	96	-1.42	8.95	1.21	1.39	1967-92A
	97	97	-1.77	11.84	1.15	1.38	1967-92A
	98	98	-.81	9.15	1.15	1.32	1967-92A
	99	99	-3.32	11.55	1.38	1.61	1967-92A
	100	100	-.40	12.94	1.49	1.63	1967-92A
MEAN	98		-1.54	10.89	1.28	1.47	
STD DEV	98		1.13	1.76	0.15	0.14	
STD ERR	98		0.50	0.79			
	101	101	-1.34	11.58	1.55	1.94	1967-92A
	102	102	-.26	10.37	1.34	1.61	1967-92A
	103	103	-1.93	11.58	1.18	1.34	1967-92A
	104	104	-.30	9.16	1.24	1.37	1967-92A
	105	105	-3.19	12.93	1.26	1.55	1967-92A
MEAN	103		-1.41	11.12	1.31	1.56	
STD DEV	103		1.22	1.42	0.15	0.24	
STD ERR	103		0.55	0.64			

REPORT 3 REVISION 2
DAHLGREN POLAR MONITORING SERVICE

	DAYS	1970	POLE POSITION		STANDARD ERROR		SATELLITE
			X METERS	Y METERS	X METERS	Y METERS	
	106	106	0.69	13.06	1.40	1.52	1967-92A
	107	107	-2.39	13.31	1.26	1.55	1967-92A
	108	108	-1.01	12.69	1.61	1.66	1967-92A
	109	109	-2.74	10.56	1.40	1.59	1967-92A
	110	110	-2.73	14.97	1.08	1.22	1967-92A
MEAN	108		-1.64	12.92	1.35	1.51	
STD DEV	108		1.48	1.58	0.20	0.17	
STD ERR	108		0.66	0.71			
	111	111	-2.05	9.11	1.37	1.68	1967-92A
	112	112	-2.44	11.00	1.03	1.21	1967-92A
	113	113	-1.68	13.49	1.08	1.26	1967-92A
	114	114	0.81	9.34	1.29	1.39	1967-92A
	115	115	-2.36	12.21	1.35	1.66	1967-92A
MEAN	113		-1.54	11.03	1.22	1.44	
STD DEV	113		1.35	1.87	0.16	0.22	
STD ERR	113		0.60	0.84			
	116	116	1.08	10.27	1.26	1.40	1967-92A
	117	117	0.44	13.29	1.39	1.54	1967-92A
	118	118	-0.46	12.84	0.98	1.12	1967-92A
	119	119	-1.54	12.11	0.97	1.12	1967-92A
	120	120	3.79	10.77	1.31	1.51	1967-92A
MEAN	118		0.66	11.86	1.18	1.34	
STD DEV	118		2.01	1.30	0.20	0.20	
STD ERR	118		0.90	0.58			
	121	121	-1.69	13.73	1.17	1.37	1967-92A
	122	122	0.43	11.29	1.15	1.29	1967-92A
	123	123	0.47	11.14	1.12	1.27	1967-92A
	124	124	-0.75	13.76	1.09	1.30	1967-92A
	125	125	0.64	9.75	1.01	1.20	1967-92A
MEAN	123		-0.18	11.94	1.11	1.29	
STD DEV	123		1.01	1.76	0.06	0.06	
STD ERR	123		0.45	0.79			

REPORT 3,4 REVISION 2
DAHLGREN POLAR MONITORING SERVICE

		POLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1970	X METERS	Y METERS	X METERS	Y METERS		
	126	126	-0.25	13.92	0.92	1.10	1967-92A
	127	127	0.48	11.39	1.15	1.15	1967-92A
	128	128	-1.03	12.99	1.73	1.67	1967-92A
	129	129	0.63	11.43	1.20	1.30	1967-92A
	130	130	1.50	10.93	1.16	1.36	1967-92A
MEAN	128		0.27	12.13	1.23	1.32	
STD DEV	128		0.96	1.27	0.30	0.22	
STD ERR	128		0.43	0.57			
	131	131	3.14	12.77	0.92	1.05	1967-92A
	132	132	1.74	10.74	1.27	1.48	1967-92A
	133	133	-0.58	13.38	0.97	1.05	1967-92A
	134	134	3.64	11.81	1.23	1.39	1967-92A
	135	135	0.94	12.80	1.25	1.36	1967-92A
MEAN	133		1.78	12.30	1.13	1.27	
STD DEV	133		1.70	1.04	0.17	0.20	
STD ERR	133		0.76	0.46			
	136	136	1.91	10.32	1.39	1.56	1967-92A
	137	137	0.73	12.04	1.17	1.21	1967-92A
	138	138	2.21	11.56	1.27	1.33	1967-92A
	139	139	-0.58	10.53	0.76	0.88	1967-92A
	140	140	3.11	14.82	1.43	1.58	1967-92A
MEAN	138		1.48	11.86	1.20	1.31	
STD DEV	138		1.43	1.80	0.27	0.29	
STD ERR	138		0.64	0.81			
	141	141	2.51	13.14	0.91	1.03	1967-92A
	142	142	3.82	14.29	1.14	1.45	1967-92A
	143	143	3.45	9.65	1.31	1.49	1967-92A
	144	144	1.52	15.08	1.15	1.29	1967-92A
	145	145	2.17	10.98	1.09	1.23	1967-92A
MEAN	143		2.69	12.63	1.12	1.30	
STD DEV	143		0.94	2.27	0.14	0.18	
STD ERR	143		0.42	1.02			

REPORT 4,5,6 REVISION 2
DAHLGREN POLAR MONITORING SERVICE

		PCLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1970	X METERS	Y METERS	X METERS	Y METERS		
	146	146	2.88	12.14	1.43	1.52	1967-92A
	147	147	1.72	11.65	1.50	1.80	1967-92A
	148	148	5.34	10.43	1.13	1.17	1967-92A
	149	149	2.46	13.57	1.05	1.20	1967-92A
	150	150	4.10	10.10	1.41	1.39	1967-92A
MEAN	148		3.30	11.58	1.30	1.42	
STD DEV	148		1.43	1.40	0.20	0.26	
STD ERR	148		0.64	0.62			
	151	151	3.33	13.81	1.20	1.32	1967-92A
	152	152	6.35	10.78	1.73	1.67	1967-92A
	153	153	3.73	15.46	1.02	1.11	1967-92A
	154	154	3.56	11.50	1.38	1.60	1967-92A
	155	155	2.70	15.16	1.07	1.15	1967-92A
MEAN	153		3.94	13.34	1.28	1.37	
STD DEV	153		1.41	2.12	0.29	0.26	
STD ERR	153		0.63	0.95			
	156	156	3.90	12.80	1.32	1.51	1967-92A
	157	157	4.45	11.30	0.93	1.04	1967-92A
	158	158	2.76	13.50	1.04	1.15	1967-92A
	159	159	4.26	10.92	1.03	1.21	1967-92A
	160	160	0.05	14.26	1.63	1.76	1967-92A
MEAN	158		3.08	12.56	1.19	1.34	
STD DEV	158		1.82	1.42	0.28	0.30	
STD ERR	158		0.81	0.64			
	161	161	5.85	10.17	1.33	1.49	1967-92A
	162	162	2.57	11.37	1.39	1.50	1967-92A
	163	163	5.72	11.36	1.53	1.63	1967-92A
	164	164	5.69	10.52	1.36	1.52	1967-92A
	165	165	3.59	12.58	1.16	1.25	1967-92A
MEAN	163		4.69	11.20	1.36	1.48	
STD DEV	163		1.51	0.93	0.14	0.14	
STD ERR	163		0.68	0.42			

REPORT 6 REVISION 2
DAHLGREN POLAR MONITORING SERVICE

		PCLE POSITION		STANDARD ERROR		SATELLITE	
DAYS	1970	X METERS	Y METERS	X METERS	Y METERS		
	166	166	5.02	13.11	1.56	1.70	1967-92A
	167	167	5.28	12.75	1.03	1.23	1967-92A
	168	168	3.77	12.70	1.29	1.48	1967-92A
	169	169	3.80	11.94	1.50	1.54	1967-92A
	170	170	7.79	9.88	1.68	1.73	1967-92A
MEAN	168		5.13	12.08	1.41	1.54	
STD DEV	168		1.64	1.30	0.25	0.20	
STD ERR	168		0.73	0.58			
	171	171	4.57	12.30	0.90	0.97	1967-92A
	172	172	5.71	11.41	1.49	1.55	1967-92A
	173	173	3.91	10.27	0.94	1.07	1967-92A
	174	174	5.31	11.10	1.21	1.38	1967-92A
	175	175	6.17	11.89	0.97	1.07	1967-92A
MEAN	173		5.13	11.39	1.10	1.21	
STD DEV	173		0.90	0.78	0.25	0.25	
STD ERR	173		0.40	0.35			
	178	178	5.47	10.43	1.06	1.05	1967-92A
	179	179	4.58	14.65	1.07	1.28	1967-92A
	180	180	4.35	12.24	1.08	1.22	1967-92A
MEAN	179		4.80	12.44	1.07	1.18	
STD DEV	179		0.59	2.12	0.01	0.12	
STD ERR	179		0.34	1.22			
	181	181	4.52	9.87	1.32	1.61	1967-92A
	182	182	6.64	10.63	1.35	1.34	1967-92A
	183	183	5.41	13.01	1.84	1.94	1967-92A
	184	184	8.34	10.86	1.05	0.98	1967-92A
	185	185	5.42	10.95	1.53	1.54	1967-92A
MEAN	183		6.07	11.06	1.42	1.48	
STD DEV	183		1.48	1.17	0.29	0.36	
STD ERR	183		0.66	0.52			
	186	186	6.14	10.22	1.43	1.49	1967-92A
	187	187	3.52	11.93	1.31	1.25	1967-92A
	188	188	5.86	8.53	1.60	1.76	1967-92A
	189	189	2.80	9.63	0.93	0.98	1967-92A
MEAN	187		4.58	10.08	1.32	1.37	
STD DEV	187		1.67	1.42	0.29	0.33	
STD ERR	187		0.83	0.71			

APPENDIX B

DISTRIBUTION

DISTRIBUTION

Naval Air Systems Command	
Department of the Navy	
Washington, D. C. 20360	
Attn: Mr. T. F. Griffin (Code 538)	1
Attn: Mr. J. Kay (Code 5382)	1
Attn: Mr. P. Kuldell	1
Attn: Technical Library	1
Special Projects Office	
Department of the Navy	
Washington, D. C. 20360	
Attn: Technical Library	1
Naval Oceanographic Office	
Washington, D. C. 20390	
Attn: Mr. D. K. Jenkins	1
Attn: Mr. A. Campbell	1
Attn: Mr. J. Reshew	1
Attn: Mr. E. Diehlman	1
National Aeronautics & Space Administration	
400 Maryland Avenue, S. W.	
Washington, D. C. 20546	
Attn: Mr. Jerry Rosenberg	1
Attn: Mr. Glenn A. Reiff	1
Attn: Technical Library	1
National Aeronautics & Space Administration	
Scientific & Technical Information Facility	
Attn: NASA Representative (S-AK/DL)	
P. O. Box 5700	
Bethesda, Maryland 20014	
National Aeronautics & Space Administration	
Goddard Space Flight Center	
Greenbelt, Maryland 20771	
Attn: Mr. John Berbert	1
Attn: Dr. J. W. Siry	1
Attn: Technical Library	1
National Aeronautics & Space Administration	
Langley Research Center	
Langley, Virginia 23365	
Attn: Technical Library	1

DISTRIBUTION (CONTINUED)

National Aeronautics & Space Administration
Rendezvous Analysis Branch
Office of Flight Operations
Manned Spacecraft Center
Houston, Texas
Attn: Alan J. Moore

1

National Aeronautics & Space Administration
Lewis Flight Propulsion Laboratory
Cleveland, Ohio 44121
Attn: Technical Library

1

Military Airlift Command
F. E. Warren AFB, Wyoming 82003
Attn: Capt Larry D. Beers

Commander
Military Airlift Command
Scott AFB, Illinois 62226
Attn: J. Hinely
Attn: MAXPGA

1

1

SAMSO (SMTGA)
Norton AFB, California 92409
Attn: Col. Lindell

1

Navy Space Systems Activity
Air Force Unit Post Office
Los Angeles, California 90024

1

Hq. USAF (AFRDDG)
Science & Technology Division
Pentagon, Washington, D. C. 20360
Attn: Col. William Lake

1

Dept. of the Air Force
Assistant Chief of Staff, Intelligence
Mr. Marcus A. Rosenbaum, AFNINCB
4B 139 Pentagon
Washington, D. C. 20360

1

Secretary of the Air Force for Space Systems
ABSAFSS
4C-1000 Pentagon, Washington, D. C. 20360
Attn: Maj. Schow

1

DISTRIBUTION (CONTINUED)

Applied Physics Laboratory	
The Johns Hopkins University	
8621 Georgia Avenue	
Silver Spring, Maryland 20910	
Attn: Dr. R. B. Kershner	1
Attn: Dr. H. Black	1
Attn: Dr. R. R. Newton	1
Attn: Dr. S. M. Yionoulis	1
Attn: Mr. P. E. P. White	1
Attn: Mr. Charles Dannel	1
Attn: Technical Library	1
Central Intelligence Agency	
Washington, D. C. 20505	
Attn: Mr. R. M. Harding	1
Attn: Mr. Henry Lutz	1
Defense Documentation Center	
Cameron Station	
Alexandria, Virginia 22314	20
Commanding General	
Aberdeen Proving Ground	
Aberdeen, Maryland 21005	
Attn: Ballistics Research Laboratories	1
Attn: Technical Information Section	1
Attn: Development and Proof Services	1
U. S. Navy Astronautics Group	
Point Mugu, California 93041	
Attn: Code AG33	1
Attn: Code SPM00	1
Attn: Mr. Campbell	1
Commander Pacific Missile Range	
Point Mugu, California 93041	
Attn: Code 330 - Mark Jones	1
Attn: Code 3274, Box 8 - M. A. Bondelid	1
Commander	
U. S. Naval Missile Center (N23)	
NAS Point Mugu, California 93041	
Attn: Technical Library	1

DISTRIBUTION (CONTINUED)

Aeronautical Chart & Information Center USAF, Second & Arsenal Streets St. Louis, Missouri 63118 Attn: ACDEG	6
Aeronautical Chart & Information Center Detachment #1 1221 S. Fern Street Arlington, Virginia 22202	1
Director Defense Intelligence Agency Washington, D. C. 20360 Attn: Mr. C. F. Gilchrist Attn: Mr. P. M. Schwimmer Attn: Col. L. Knipling Attn: Mr. Doyle Frederick	1 1 1 1
U. S. Army Engineers Topographic Laboratory Research Institute for Geodetic Sciences 701 Prince Street Alexandria, Virginia 22314	1
U. S. Army Engineers Topographic Laboratory Ft. Belvoir, Virginia 22060 Attn: L. A. Gambino	1
U. S. Topographic Command 6500 Brooks Lane Washington, D. C. 20315 Attn: Mr. John McCall - Code 92000 Attn: Code 14201 Attn: Code 14560 Attn: Mrs. I. Fischer Attn: Mr. George Dudley Attn: Mr. C. Born Attn: Mr. E. H. Rutscheidt Attn: Mr. R. Peat	1 1 1 1 1 1 1 1
Oceanographer of the Navy The Madison Bldg. 732 N. Washington Street Alexandria, Va. 22314	1

DISTRIBUTION (CONTINUED)

Chief of Naval Operations OP761 Room 50768 The Pentagon Washington, D. C. 20350	1
Naval Ordnance Systems Command Department of the Navy Washington, D. C. 20360	1
Institute for Defense Analysis 400 Army-Navy Drive Arlington, Virginia 22202 Attn: Technical Library	1
Director National Security Agency Fort George G. Meade, Maryland 20755 Attn: R312	1
Air Force Systems Command, Code SCGRH Andrews Air Force Base Washington, D. C. 20331	1
U. S. Coast & Geodetic Survey Geodetic Laboratory Institute for Earth Sciences Washington Science Center Rockville, Maryland 20850 Attn: Dr. H. Schmid Attn: Mr. B. Chovitz	1 1
Chief of Naval Research Department of the Navy Washington, D. C. 20360	1
U. S. Naval Observatory Washington, D. C. 20390 Attn: Dr. Raynor L. Duncombe Attn: Dr. Glen Hall	1 3
Director Naval Research Laboratory Washington, D. C. 20360 Attn: Code 4130 Attn: R. Easton Attn: Fred Raymond	1 1 1

DISTRIBUTION (CONTINUED)

Commander U. S. Naval Ordnance Laboratory White Oak, Maryland 20390 Attn: Technical Library	1
Naval Ship Systems Command Department of the Navy Washington, D. C. 20360 Attn: Technical Library	1
Director Naval Ship Research & Development Center Washington, D. C. 20007 Attn: Technical Library	1
Superintendent U. S. Naval Postgraduate School Monterey, California 93940 Attn: Library, Technical Reports Section	1
Commander U. S. Naval Ordnance Test Station China Lake, California 93555 Attn: Technical Library	1
Superintendent U. S. Naval Academy Annapolis, Maryland 21402 Attn: Technical Library	1
National Science Foundation 1951 Constitution Avenue, N. W. Washington, D. C. 20550 Attn: Dr. E. R. Dyer, Jr. Attn: Engineering Division Attn: Attn: Mathematical Sciences Division	1 1 1
Director National Bureau of Standards Washington, D. C. 20360 Attn: Technical Library	1
Commanding Officer Naval Applied Science Laboratory Attn: Code 9510 Flushing & Washington Avenue Brooklyn, New York 11251	1

DISTRIBUTION (CONTINUED)

Hq., Ballistic Systems Division
Trageting Branch
Guidance & Control Division
Norton AFB, California 92409
Attn: Capt L. B. Thompson
SAMSO(SMQNI-2) - Space & Missile Systems Organization 1

Hq., National Range Division
Patrick Air Force Base, Florida 32925
Attn: Code NRPPS 1
Attn: Maj. Mike Mitchell 1
AFETR(ETEG)
Patrick AFB, Fla. 32925

Commanding Officer
U. S. Naval Space Surveillance System
Dahlgren, Virginia 22448 1

Smithsonian Astrophysical Observatory
60 Garden Street
Cambridge, Massachusetts 02138
Attn: Dr. Fred L. Whipple 1
Attn: Dr. C. Lundquist 1
Attn: Mr. E. M. Gaposchkin 1

Mr. W. M. Kaula
Institute of Geophysics & Planetary Physics
University of California
Los Angeles, California 90024 1

The Ohio State University
Department of Geodetic Science
164 W. Nineteenth Avenue
Columbus, Ohio 43210
Attn: Dr. Ivan I. Mueller 1
Attn: Dr. U. A. Uotila 1
Attn: Dr. R. Rapp 1

C. Byron Winn
Colorado State University
Fort Collins, Colorado 80521 1

Aerospace Corporation
2400 East El Segundo Boulevard
El Segundo, California 90245
Attn: Mr. Richard Farrer 1
Attn: Mr. Len Wong 1

DISTRIBUTION (CONTINUED)

Radio Corporation of America Locust Corner Princeton, New Jersey 98540 Attn: Dr. Lowell Krawitz	1
Radio Corporation of America 9430 Lanham Severn Rd. Seabrook, Md. 20801 Attn: Mr. H. C. Parker	1
TRW Systems One Space Park Redondo Beach, California 90278 Attn: Mr. Duane V. Olinger	1
Massachusetts Institute of Technology Computer Center Cambridge, Massachusetts 02139 Attn: Technical Library Attn: Dr. C. C. Counselman, Bldg. 54	1
Dr. Irwin I. Shapiro Lincoln Laboratory Massachusetts Institute of Technology 244 Wood Street Lexington, Mass. 02173	1
Dr. John D. Nicolaides Department of Aero-Space Engineering Notre Dame University Notre Dame, Indiana 46556	1
Directorate of Military Survey Feltham, England Attn: John Racolence	1
Directorate of Ordnance Southampton, England Attn: Brig. John Kelsey	1
Hawaii Institute of Geophysics University of Hawaii Honolulu, Hawaii 96822 Attn: Dr. Mohammad Asadvllah Khan Attn: Mr. K. I. Daugherty	1 1

DISTRIBUTION (CONTINUED)

Purdue University
Lafayette, Indiana
Attn: Prof L. A. Kivioja

1

Yale University Observatory
135 Prospect Street
New Haven, Connecticut 06520
Attn: Prof. G. M. Clemence
Attn: Dr. Jay Lieske
Attn: Dr. Boris Garfinkel
Attn: Technical Library

1
1
1
1
1

Cincinnati Observatory
Observatory Place
Cincinnati, Ohio 45201
Attn: Prof. Paul Herget
Attn: Eugene Rabe
Attn: Technical Library

1
1
1

University of California at Los Angeles
Dept. of Engineering, Astrodynamics
Los Angeles, California 90024
Attn: Prof. Samuel Herrick
4731 Boelter Hall

1

Jet Propulsion Laboratory
4800 Oak Grove Drive, Mail Stop 156-220
Pasadena, California 91109
Attn: Dr. Charles Lawson
Attn: Dr. J. Derral Mulholland
Attn: Dr. Roger Broucke
Attn: Dr. William G. Melbourne
Attn: Mr. Carleton B. Solloway
Attn: Technical Library
Attn: Dr. Douglas A. O'Handley
Attn: Dr. Fred Peters

1
1
1
1
1
1
1
1

Prof. V. G. Szehehely
Taylor Hall, Dept. of Aerospace Eng.
University of Texas
Austin, Texas 78712

1

Space Technology Laboratories, Inc.
5739 Arbor Vitae Street
Los Angeles, California 90045

1

DISTRIBUTION (CONTINUED)

UNIVAC

Division of Sperry Rand Corporation
Box 500
Blue Bell, Pa. 19422

1

The RAND Corporation
1700 Main Street
Santa Monica, California 90406
Attn: Mr. R. T. Gabler

1

Applied Research Department
AVCO Manufacturing Corporation
Lawrence, Massachusetts 01842

1

Lockheed Aircraft Corporation
Sunnyvale, California 94086
Attn: Technical Library

1

General Electric Corp.
Missile & Space Vehicle Dept.
Valley Forge Space Technology Center
P. O. Box 8555
Philadelphia, Pa.

1

Texas Instrument Inc.
Box 6015
Dallas, Texas 75222
Attn: W. E. Chrisman, Jr.

1

Computer Usage Development Corp.
7315 Wisconsin Avenue N. W.
Washington, D. C. 20014

1

Autonetics
3370 Mira Loma Avenue
Anaheim, California 92803
Attn: Mr. Ken Gow
Building 231, Dept. 247

1

Computer Sciences Corp.
8121 Georgia Avenue
Silver Spring, Maryland 20910

1

Computer Sciences Corp.
650 N. Sepulveda Blvd.
El Segundo, California 90245
Attn: Dr. Robert Baker

1

DISTRIBUTION (CONTINUED)

System Development Corporation 2500 Colorado Avenue Santa Monica, California 90406 Attn: Technical Library	1
Itek Corporation Third Avenue Burlington, Massachusetts 01803	1
Douglas Space Center 5301 Bolsa Avenue Huntington Beach, California 92647 Attn: Helen A. Holman A3-813, E610	1
Douglas Aircraft Co., Inc. Missile & Space Systems Division Santa Monica, California 90406 Attn: Mr. J. C. Walker Dept. A830, Group BBEO Delivery Station 8	1
International Business Machines Corp. Watson Laboratory 612 W. 116th Street New York, N. Y. 10027 Attn: Dr. W. J. Eckert	1
General Electric Co. 1 River Road Schenectady, N. Y.	1
Mr. John Hinely Air Photographic and Charting Service Orlando Air Force Base, Florida 32813	1
USSR Academy of Sciences 20 Vavilova Street Moscow G-242, USSR Attn: Prof. A. G. Massevitch	1
Batelle Institute 505 King Columbus, Ohio Attn: Mr. George Mourad	1

DISTRIBUTION (CONTINUED)

Institute of Theoretical Astronomy Academy of Sciences of the USSR Mendeleevskaya Liniya, 1 Leningrad, V-164, USSR Attn: Dr. V. A. Brumberg	1
Attn: Dr. G. A. Chebotarev	1
Attn: Dr. N. A. Budnikova	1
Attn: Dr. Sh. G. Sharaf	1
 Dr. Giorgio E. O. Giacaglia Instituto de Pesquisas Matematica Caixa Postal 8174 - B Sao Paulo S. P. Brazil	 1
 Prof. Yusuke Hagihara Tokyo Imperial University Observatory Tokyo, Japan	 1
 Geophysical Institute University of Tokyo, Bunkyo-ku, Tokyo, Japan Attn: Dr. Hitoshi Hakeuchi	 1
Attn: Dr. Gen-ichiro Hori	1
 Dr. Desmond G. King-Hele Ministry of Aviation Space Department Royal Aircraft Establishment Farnborough, Hants, England	 1
 Prof. P. Muller Observatoire de Meudon Seine et Oise France	 1
 Dr. K. Arnold Geodatisches Institut Potsdam, E. Germany (German Democratic Republic)	 1
 Dr. J. Kovalevsky Bureau des Longitudes 3 Rue Mazarine Paris 6e, France	 1
 Dr. Y. Kozai Tokyo Astronomical Observatory Tokyo, Japan	 1

DISTRIBUTION (CONTINUED)

Dr. A. E. Roy Department of Astronomy Glasgow University Glasgow, Scotland	1
Dr. Ian Halliday Dominion Observatory Ottawa, Canada	1
Royal Greenwich Observatory Herstmonceux Castle, Sussex, England Attn: Mr. D. H. Saddler Dr. G. A. Wilkins	1 1
Prof. Dr. Karl Ramsayer Institut fur Flugnavigation Der Technischen Hobschschule Stuttgart, Germany	1
Dr. O. Weber Deutsche Forschungssanstalt fur Luft-und Raumfahrt Flughafen 33 Braunschweig, Germany	1
Laboratory of Astronomy Athens University Athens, Greece Attn: Dr. Gregory Antonacopoulos Attn: Dr. Charalabos Fragakis	1 1
Dr. Willem Baarda Geodetic Institute of the Delft Technological University Delft, Netherlands	1
Dr. Paul-Louis Baetsle Universite Libre de Bruxelles et ecole Royale Militaire, Bruxelles, Belgium	1
Dr. F. Barlier Observatoire De Paris Meudon, France	1
Dr. Berard Bruins Technological University Julianalaan 134, Delft Netherlands	1

DISTRIBUTION (CONTINUED)

Royal Institute of Technology Stockholm 70 Sweden	1
Observatoire Royal De Belgique Bruxelles 18 Belgium	
Attn: Dr. P. Melchior	10
Attn: Dr. Henri Devehogne	1
Attn: Dr. Paul Paquet	1
Dr. Konstantinos Adraktas Research Division Doxiadix Associates Athens, Greece	1
Dr. Lyssimahos Mavridis Department of Geodetic Astronomy University of Thessaloniki Thessaloniki, Greece	1
Greek Geodetic and Geophysic Commission Athens, Greece	
Attn: Dr. George Spiliotopoulos	1
Attn: Dr. Nicolas Pierrakeas	1
Dr. John Xanthakis Research and Computing Center Academy of Athens 44 Panapistimiou Street Athens, Greece	1
Radio Research Station Slough, Buckinghamshire, England Attn: Dr. J. A. Ratcliffe	1
Prof. S. K. Runcorn Physics Department The University Newcastle-Upon-Tyne, 1 England	1
Dr. Henri Marcel Dufour Institut Geographique National Paris, France	1

DISTRIBUTION (CONTINUED)

Astronomical Institute National Observatory of Athens Athens, Greece	
Attn: Dr. Demetrius Elias	1
Attn: Dr. Photios Karapiperis	1
Attn: Dr. Constantinos Chassapis	1
 Dr. Jean Evangelidis Invite-Firecteur du quotidien "Dimokratiki Allagi" Greece	 1
 Dr. Michael Frangopoulos Ministry of Public Works National Technical University Athens, Greece	 1
 Dr. Apostolos Frangos Scientific Rockets Research Group on Space Athens, Greece	 1
 Dr. Joseph Hewitt Royal Radar Establishment Malvern Woreschester, England	 1
 Dr. Reino Hirvonen Finnish Institute of Technology Abrahaminkatu 1-5, Helsinki Finland	 1
 Dr. Elvin Kejlsoe Geodetic Institute Copenhagen, Denmark	 1
 Dr. Stanislaw Krynski Institute of Geodesy and Cartography Warsaw, Poland	 1
 Dr. Karl Ledersteger Technische Hochschule Wien, Austria	 1
 Dr. Eugen Kuntz Technische Hochschule Karlsruhe, Germany	 1

DISTRIBUTION (CONTINUED)

Dr. Jean-Jacques Levallois Association Internationale de Geodesie Secrtaire general Paris, France	1
Dr. Wilfried Loescher Wild Heerbrugg AG Heerbrugg, Switzerland	1
Dr. Jacques Loopts Institut Geographique Militaire, Bruxelles, Belgique	1
Dr. Antonio Marussi University of Trieste Trieste, Italy	1
Dr. Olav Mathisen Geographical Survey of Norway Oslo, Norway	1
Dr. Corrado Mazzon Italian Commission of Geodesy Institute di Geodesia Politecnico Milano, Italy	1
Dr. George Nikolitsas School of Agriculture Athens, Greece	1
Dr. Liisi Oterma Astronomia Optika Institutio de Universitate do Turku Turku, Finland	1
Dr. Galin Popovici Academia Republicei Populve Romine Bucharest Observatory Bucharest, Rumania	1
Geodatisches Institut der Technischen Hochschule Stuttgart, Germany	1
Dr. Rafael Sanchez National University of Tucuman Aycucho 482, Tucuman Argentina	1

DISTRIBUTION (CONTINUED)

Dr. Joie Turroja University of Madrid Madrid, Spain	1
Dr. Rasa Vodusek University of Ljubljana Trg Revolucije 11, Ljubljana Yugoslavia	1
Deutsche Forschungsanstalt fur Luft-und Raumfahrt (DEL), Germany	1
Dr. Jack Weightman Geodetic Office Ministry of Defense London, England	1
Technical University of Berlin Hardenbergstr. 34, Berlin-Charlottenburg Germany	
Attn: Dr. Helmut Moritz	1
Attn: Dr. Karl Zeiske	1
Attn: Dr. Reinhard Schlichting	1
Centre Spatial De Bretigny Boite Postale N° 4 Bretigny 1 Orge 91 France	
Attn: Dr. M. Lefebvre	1
Dr. B. Guinot Bureau International De L'Heure 61, Avenue de L'Observatoire 75 - Paris (14eme) France	10
Dr. Shigeru Yumi Director Central Bureau of the IPMS International Latitude Observatory Mizusawa-shi, Iwate-ken Japan	10

DISTRIBUTION (CONTINUED)

Dr. D. E. Smylie
Department of Geophysics
The University of British Columbia
Vancouver 8, Canada 1

Alton B. Moody
Western Geophysical Company
8100 Westpark Drive
P. O. Box 2469
Houston, Texas 77001 1

Dr. G. Hartmann
Max-Planck-Institut Für Aeronomie
Abteilung Für Weltraumphysik
3411 Linda/Harz
Postfach 70
Germany 1

Professor John Danby
North Carolina State University
Raleigh, North Carolina 27607 1

Local:
KA 100
MAM 1
MAL 6
KR 1
KXZ 1

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author)

U. S. Naval Weapons Laboratory
Dahlgren, Virginia

2a. REPORT SECURITY CLASSIFICATION

UNCLASSIFIED

2b. GROUP

3. REPORT TITLE

POLAR MOTION DETERMINATIONS BY U. S. NAVY DOPPLER SATELLITE OBSERVATIONS

4. DESCRIPTIVE NOTES (Type of report and, inclusive dates)

5. AUTHOR(S) (First name, middle initial, last name)

R. J. Anderle

6. REPORT DATE

July 1970

7a. TOTAL NO. OF PAGES

95

7b. NO. OF REFS

8a. CONTRACT OR GRANT NO.

b. PROJECT NO.

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)

TR-2432

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. DISTRIBUTION STATEMENT

Distribution of this document is unlimited.

11. SUPPLEMENTARY NOTES

12. SPONSORING MILITARY ACTIVITY

13. ABSTRACT

The irregular motion of the earth's axis of rotation, know as Chandler Wobble, has been determined on the basis of Doppler observations of Navy Navigation Satellites. Measurement precisions of about 0.5 meters have been obtained for averaging times of six days. Agreement with astronomical determinations is better than one meter over the last two years. The discrepancies are no longer than differences between results for different groups of observatories as reported by the Bureau International de L'Heure and the International Polar Motion Service.

U. S. Naval Weapons Laboratory (NWL TR-2432) POLAR MOTION DETERMINATIONS BY U.S. NAVY DOPPLER SATELLITE OBSERVATIONS, by R. J. Anderle, July 1970, 95 pages. UNCLASSIFIED REPORT The irregular motion of the earth's axis of rotation, known as Chandler Wobble, has been determined on the basis of Doppler observations of Navy Navigation Satellites. Measurement precisions of about 0.5 meters have been obtained for averaging times of six days. Agreement with astronomical determinations is better than one meter over the last two years. The discrepancies are no longer than differences between results for different groups of observatories as reported by the Bureau International de L'Heure and by the <u>International Polar Motion Service</u>.	1. Satellites - Doppler position finding 2. Satellites - Polar orbits I. Anderle, R. J. UNCLASSIFIED CARD	U. S. Naval Weapons Laboratory (NWL TR-2432) POLAR MOTION DETERMINATIONS BY U.S. NAVY DOPPLER SATELLITE OBSERVATIONS, by R. J. Anderle, July 1970, 95 pages. UNCLASSIFIED REPORT The irregular motion of the earth's axis of rotation, known as Chandler Wobble, has been determined on the basis of Doppler observations of Navy Navigation Satellites. Measurement precisions of about 0.5 meters have been obtained for averaging times of six days. Agreement with astronomical determinations is better than one meter over the last two years. The discrepancies are no longer than differences between results for different groups of observatories as reported by the Bureau International de L'Heure and by the <u>International Polar Motion Service</u>.	1. Satellites - Doppler position finding 2. Satellites - Polar orbits I. Anderle, R. J. UNCLASSIFIED CARD	U. S. Naval Weapons Laboratory (NWL TR-2432) POLAR MOTION DETERMINATIONS BY U.S. NAVY DOPPLER SATELLITE OBSERVATIONS, by R. J. Anderle, July 1970, 95 pages. UNCLASSIFIED REPORT The irregular motion of the earth's axis of rotation, known as Chandler Wobble, has been determined on the basis of Doppler observations of Navy Navigation Satellites. Measurement precisions of about 0.5 meters have been obtained for averaging times of six days. Agreement with astronomical determinations is better than one meter over the last two years. The discrepancies are no longer than differences between results for different groups of observatories as reported by the Bureau International de L'Heure and by the <u>International Polar Motion Service</u>.	1. Satellites - Doppler position finding 2. Satellites - Polar orbits I. Anderle, R. J. UNCLASSIFIED CARD
---	---	---	---	---	---