

SATELLITE DOPPLER STATIONS IN THE JAPANESE ANTARCTIC
RESEARCH REGION

(2) Around Asuka Station by JARE-28 in 1987

Kazuo SHIBUYA

National Institute of Polar Research
9-10, Kaga 1-chome, Itabashi-ku, Tokyo 173-8515

1. Introduction

A two-wave NNSS receiver was utilized for the first time in 1979 by the 20th Japanese Antarctic Research Expedition (JARE-20) during the over snow vehicle operation of the Yamato-Belgica traverse survey (Members of the Yamato-Belgica Traverse Party, 1981). Since then, more than 400 satellite Doppler stations were installed around Syowa Station, on Mizuho Plateau and in the Yamato Mountains region until 1985. Unlike a geodetic control point in outcrop areas, coordinates of the satellite Doppler stations on the ice sheet change with time because of the ice sheet flow and ablation/accumulation of snow. The station marks may be lost or the same station may be re-surveyed with different name after several years' elapse time. It is thus important to keep the record of the positioning summary in order to avoid later confusion.

In this report we summarize the obtained positioning results for selected route stations along the L-route between L0 point and Asuka Station, where the route map is shown in another part of this report (see Fig. 1 of Shibuya and Fukuda, 1999). Although the applied satellite positioning method gradually shifted to the Global Positioning System (GPS) with more precise positioning result and shorter occupation period at the observation site, its performance of the absolute positioning

was under experimental stage in 1987 because of limited number (up to 4-5) of satellite vehicles. In our traverse survey, GPS relative positioning was also made as illustrated by the mark "P" in the GROUND SURVEY DATA AND REMARKS. However its result is not included in this data report. This NNSS archive will still be useful because re-surveying is not yet done by any expeditions during these 11 years.

2. Outline of the Survey

The satellite Doppler surveys were made during the oversnow traverse operation of the JARE-28 Asuka wintering team during April 11–23 of 1987. JMR-1 and JMR-4A NNSS (Navy Navigation Satellite System) receivers (JMR Instruments Inc., 1981) were placed at six stations, L0, L47.5, L66, L90, and Asuka height datum pole on the ice sheet, and at the No. 25-01 geodetic mark at Seal Rock (Fig. 1). On the L-route, the antenna was located close to the traverse pole and/or the route bamboo pole. No mark was installed (reserved) at the antenna site but the offset between the electric phase center of the antenna and the traverse pole was measured by using a hand-bearing compass and a measure. A blue plastic tag was attached to the route pole with a red flag. This must give an indicator for later re-surveying.

3. Data Format

The sheet attached summarizes the results of the SP-2G and GP-1S program (JMR Instruments Inc., 1982) analyses, where we follow the data log format by Shibuya and Ito (1986) to catalogue the obtained data. In each data sheet, STATION NAME was given after the JARE route point. LOCATION indicates area name, in our cases, around Asuka Station in East Dronning Maud Land.

DOPPLER NO. was given like 87001B, which means the observation number 01 obtained in 1987 with the Broadcast ephemeris positioning. Likewise the last character P indicates Precise ephemeris positioning, while T indicates Translocation. This can be used as the code number for exchange of raw data. STAMPING ON MARK and JARE NUMBER are self explanatory. TYPE OF STATION MARK is to be noted case by case.

Doppler raw data acquired by the JMR-1 or the JMR-4A receiver were usually processed using the SP-2G program for point-positioning of the station. The default values for a set of prepared parameters have been found to be adequate for the data acquired in the Antarctic region (Shibuya, 1985). Convergent SATELLITE-DERIVED COORDINATES can be obtained after 2 to 3 iterative phase adjustment and the geodetic coordinates are given on the WGS84 ellipsoid (Defense Mapping Agency, 1987; $a = 6378137.0$ m, $1/f = 298.2572235630$). Translocation analysis was after the GP-1S program, and difference vectors of the station coordinates are obtained by taking the reference station described in the GROUND SURVEY DATA AND REMARKS as the tie-point. The coordinates of the antenna phase center are catalogued without any coordinate transform nor offset reduction. For further reduction, site sketch was illustrated in detail in GROUND SURVEY DATA AND REMARKS.

Acknowledgments

The author expresses his thanks to the Asuka wintering team of M. Ayukawa (leader), R. Sakai, T. Oosaka, S. Takahashi, K. Nozaki, T. Tomita and T. Takagi, for their support during wintering and field survey. K. Hori helped the author to prepare the manuscript.

References

- Defense Mapping Agency (1987): Department of Defense World Geodetic System 1984: Its definition and relationship with local geodetic system. DMA Tech. Rep., 8350.2, 110 p.
- JMR Instruments Inc. (1977): The JMR-1 Doppler Survey Set, Description and Application, Catsworth, Cal., 24 p. (JMR Document No. 73288-3).
- JMR Instruments Inc. (1982): SP-2G Satellite Positioning Program, Catsworth, Cal., 16p. (JMR Document No. 2003505-8).
- Members of the Yamato-Belgica Traverse Party (1981): Report of the Yamato-Belgica traverse by the 20th Japanese Antarctic Research Expedition in 1979-1980 field season. Nankyoku Shiryô (Antarct. Rec.), **73**, 210-245 (in Japanese with English abstract).
- Shibuya, K. (1985): Performance experiment of an NNSS positioning in and around Syowa Station, East Antarctica. J. Phys. Earth, **33**, 453-483.
- Shibuya, K. and Fukuda, Y. (1999): Gravity survey along the L- and AB-routes, East Dronning Maud Land, Antarctica. JARE Data Rep., **237** (Earth Sci. 5), 16-30.
- Shibuya, K. and Ito, K. (1986): Satellite Doppler stations in the Japanese Antarctic research region (1) Around Syowa Station by JARE-21. JARE Data Rep., **119** (Earth Sci. 3), 87-118.

SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER L0 point	LOCATION East Dronning Maud Land	DOPPLER NO. 87001P
STAMPING ON MARK Bamboo pole		
JARE NUMBER JARE-28	TYPE OF STATION MARK Red Flag and Plastic Tag	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-4A 60S12360	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.58 m above snow surface	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 200, 300, 480, 500	PERIOD OF OCCUPATION 106 ^d 16 ^h –109 ^d 06 ^h

SATELLITE-DERIVED COORDINATES

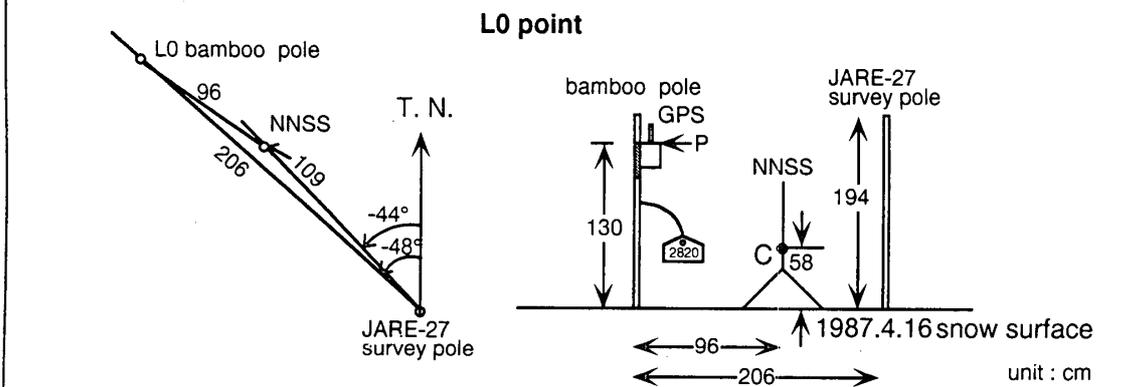
PASSES ACCEPTED 79	DEGREE OF FREEDOM N/A	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 7°
ϕ 70°27'15.272"S	λ 23°53'22.361"E	h 190.012 m	
X 1956937.538 m	Y 866768.163 m	Z -5988362.838 m	

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE	LONGITUDE	HEIGHT	
LATITUDE			STD, DEV(LATITUDE) = 1.0 m
LONGITUDE			STD, DEV(LONGITUDE) = 1.0 m
HEIGHT			STD, DEV (HEIGHT) = 1.5 m

GROUND SURVEY DATA AND REMARKS

1. Station number 81622 was assigned by DMAHTC/GSG, courtesy of M. Kumar.
2. Positioned to the electrical phase center of the antenna by precise ephemeris positioning.
3. Surface synoptic data were included for tropospheric correction.



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER L0 point	LOCATION East Dronning Maud Land	DOPPLER NO. 87001B
STAMPING ON MARK Bamboo pole		
JARE NUMBER JARE-28	TYPE OF STATION MARK Red Flag and Plastic Tag	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-4A 60S12360	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.58 m above snow surface	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 200, 300, 480, 500	PERIOD OF OCCUPATION 106 ^d 16 ^h —109 ^d 06 ^h

SATELLITE-DERIVED COORDINATES

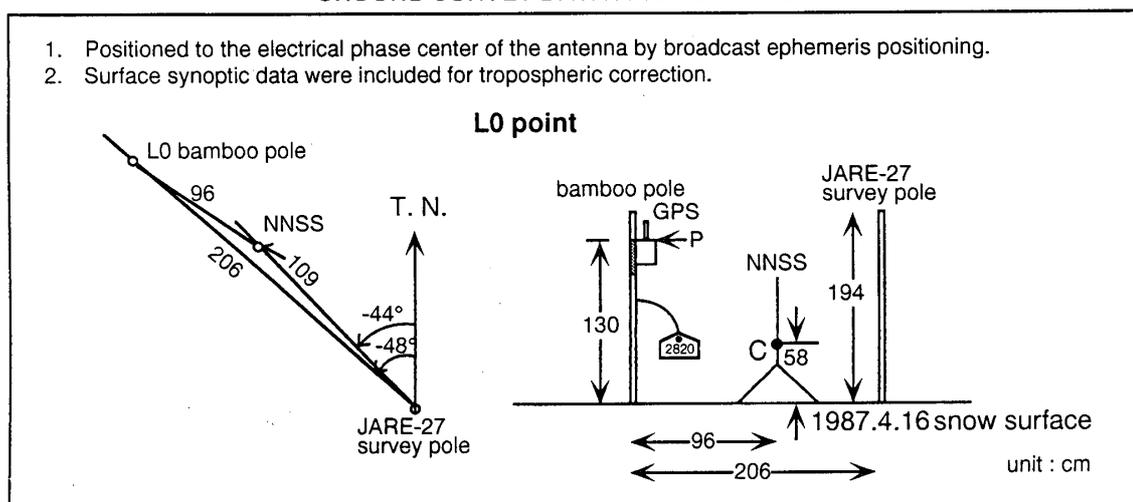
PASSES ACCEPTED 94	DEGREE OF FREEDOM 2136	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 15°
Φ 70°27'15.377"S	λ 23°53'21.661"E	h 190.78 m	
X 1956937.26 m	Y 866760.10 m	Z -5988362.98 m	

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE	STD, DEV(LATITUDE) = 0.19 m
LONGITUDE	STD, DEV(LONGITUDE) = 0.26 m
HEIGHT	STD, DEV (HEIGHT) = 0.24 m

GROUND SURVEY DATA AND REMARKS

1. Positioned to the electrical phase center of the antenna by broadcast ephemeris positioning.
2. Surface synoptic data were included for tropospheric correction.



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER L47.5 (30 mile point)	LOCATION East Dronning Maud Land	DOPPLER NO. 87006B
STAMPING ON MARK 3 m survey pole at the route hut		
JARE NUMBER JARE-28	TYPE OF STATION MARK Red Flag and Plastic Tag	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-4A 60S12360	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.61 m above snow surface	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 200, 300, 480, 500	PERIOD OF OCCUPATION 104 ^d 16 ^h —106 ^d 05 ^h

SATELLITE-DERIVED COORDINATES

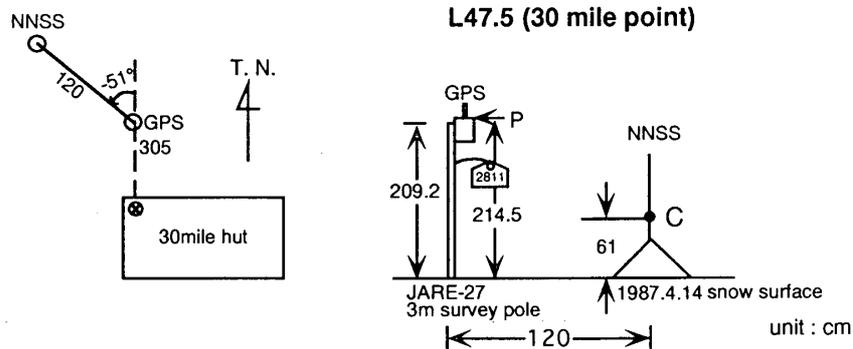
PASSES ACCEPTED 31	DEGREE OF FREEDOM 711	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 15°
ϕ 70°52'56.659"S	λ 23°54'57.402"E	h 412.48 m	
X 1915396.10 m	Y 849424.51 m	Z -6004385.49 m	

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE	LONGITUDE	HEIGHT	
LATITUDE			STD, DEV(LATITUDE) = 0.26 m
LONGITUDE			STD, DEV(LONGITUDE) = 0.38 m
HEIGHT			STD, DEV (HEIGHT) = 0.33 m

GROUND SURVEY DATA AND REMARKS

1. Positioned to the electrical phase center of the antenna by broadcast ephemeris positioning.
2. Surface synoptic data were included for tropospheric correction.



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER L47.5 (30 mile point)	LOCATION East Dronning Maud Land	DOPPLER NO. 87006T
STAMPING ON MARK 3 m survey pole at the route hut		
JARE NUMBER JARE-28	TYPE OF STATION MARK Red Flag and Plastic Tag	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-4A 60S12360	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.61 m above snow surface	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 200, 300, 480, 500	PERIOD OF OCCUPATION 104 ^d 17 ^h –105 ^d 22 ^h

SATELLITE-DERIVED COORDINATES

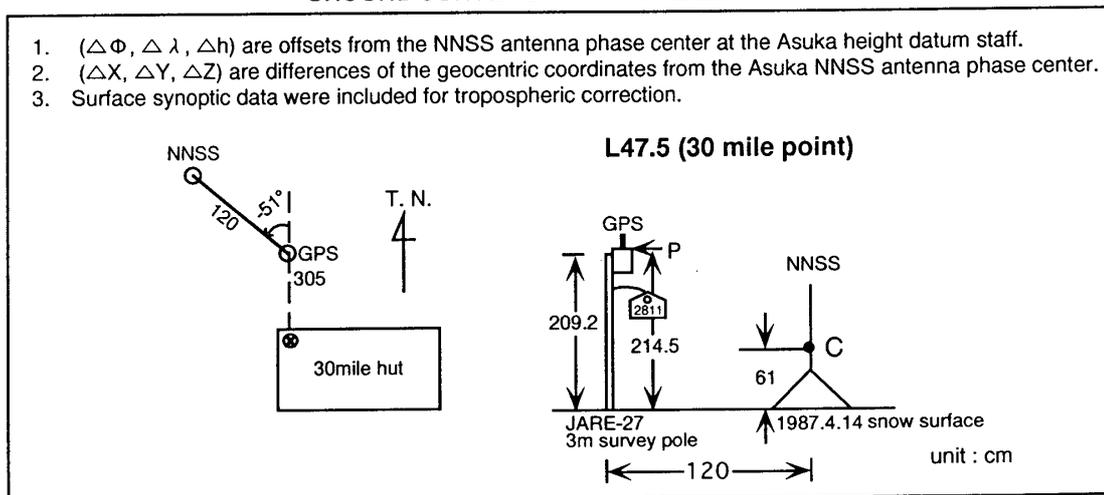
PASSES ACCEPTED 24	DEGREE OF FREEDOM 328	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 15°
$\Delta\Phi$ 38°32.409"	$\Delta\lambda$ -12°53.312"	Δh -568.76 m	
ΔX 64955.99 m	ΔY 20490.16 m	ΔZ 23633.22 m	

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE LONGITUDE HEIGHT	
LATITUDE	STD, DEV(LATITUDE) = 0.65 m
LONGITUDE	STD, DEV(LONGITUDE) = 0.77 m
HEIGHT	STD, DEV (HEIGHT) = 0.72 m

GROUND SURVEY DATA AND REMARKS

1. ($\Delta\Phi$, $\Delta\lambda$, Δh) are offsets from the NNSS antenna phase center at the Asuka height datum staff.
2. (ΔX , ΔY , ΔZ) are differences of the geocentric coordinates from the Asuka NNSS antenna phase center.
3. Surface synoptic data were included for tropospheric correction.



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER L66	LOCATION East Dronning Maud Land	DOPPLER NO. 87005B
STAMPING ON MARK 3 m survey pole		
JARE NUMBER JARE-28	TYPE OF STATION MARK Red Flag and Plastic Tag	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-4A 60S12360	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.59 m above snow surface	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 200, 300, 480, 500	PERIOD OF OCCUPATION 112 ^d 16 ^h –113 ^d 06 ^h

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED 26	DEGREE OF FREEDOM 537	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 15°
Φ 71°02'51.092"S	λ 23°55'36.249"E	h 535.06 m	
X 1899352.36 m	Y 842737.67 m	Z -6010510.44 m	

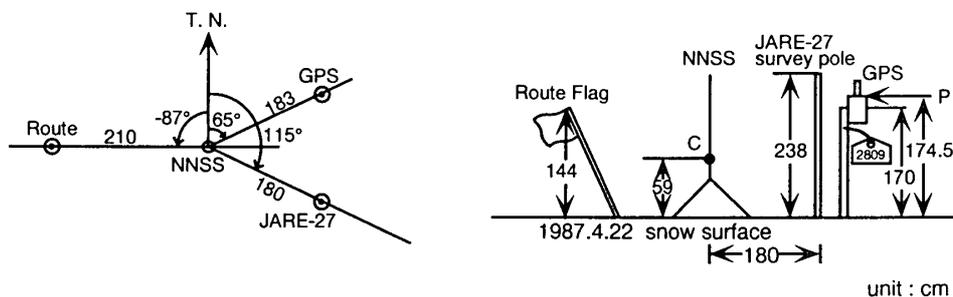
ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE	HEIGHT
LATITUDE	STD, DEV(LATITUDE) = 0.33 m
LONGITUDE	STD, DEV(LONGITUDE) = 0.49 m
HEIGHT	STD, DEV (HEIGHT) = 0.41 m

GROUND SURVEY DATA AND REMARKS

1. Positioned to the electrical phase center of the antenna by broadcast ephemeris positioning.
2. Surface synoptic data were included for tropospheric correction.

L66



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER L66	LOCATION East Dronning Maud Land	DOPPLER NO. 87005T
STAMPING ON MARK 3 m survey pole		
JARE NUMBER JARE-28	TYPE OF STATION MARK Red Flag and Plastic Tag	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-4A 60S12360	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.59 m above snow surface	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 200, 300, 480, 500	PERIOD OF OCCUPATION 112 ^d 16 ^h —113 ^d 06 ^h

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED 18	DEGREE OF FREEDOM 673	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 15°
$\Delta\Phi$ -28°37.844"	$\Delta\lambda$ -12°14.050"	Δh -444.80 m	
ΔX 48907.39 m	ΔY 13805.80 m	ΔZ 17505.65 m	

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE	STD, DEV(LATITUDE) = 0.47 m
LONGITUDE	STD, DEV(LONGITUDE) = 0.52 m
HEIGHT	STD, DEV (HEIGHT) = 0.44 m

GROUND SURVEY DATA AND REMARKS

1. ($\Delta\Phi$, $\Delta\lambda$, Δh) are offsets from the NNSS antenna phase center at the Asuka height datum staff.
 2. (ΔX , ΔY , ΔZ) are differences of the geocentric coordinates from the Asuka NNSS antenna phase center.
 3. Surface synoptic data were included for tropospheric correction.

L66

unit : cm

SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER L90	LOCATION East Dronning Maud Land	DOPPLER NO. 87004T
STAMPING ON MARK 3 m survey pole		
JARE NUMBER JARE-28	TYPE OF STATION MARK Red Flag and Plastic Tag	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-4A 60S12360	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.58 m above snow surface	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 300	PERIOD OF OCCUPATION 101 ^d 16 ^h –101 ^d 20 ^h

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED 3	DEGREE OF FREEDOM 104	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 15°
$\Delta\phi$ 15'45.255"	$\Delta\lambda$ -11'24.746"	Δh -276.44 m	
ΔX 28041.65 m	ΔY 5085.22 m	ΔZ 9611.04 m	

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE	STD, DEV(LATITUDE) = 0.89 m
LONGITUDE	STD, DEV(LONGITUDE) = 1.34 m
HEIGHT	STD, DEV (HEIGHT) = 1.25 m

GROUND SURVEY DATA AND REMARKS

1. ($\Delta\phi$, $\Delta\lambda$, Δh) are offsets from the NNSS antenna phase center at the Asuka height datum staff.

2. (ΔX , ΔY , ΔZ) are differences of the geocentric coordinates from the Asuka NNSS antenna phase center.

3. Surface synoptic data were included for tropospheric correction.

unit : cm

SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER Asuka Height Datum Staff	LOCATION East Dronning Maud Land	DOPPLER NO. 87002B
STAMPING ON MARK 3 m survey pole		
JARE NUMBER JARE-28	TYPE OF STATION MARK Red Flag and Plastic Tag	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-1	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.55 m above snow surface	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 200, 300, 480, 500	PERIOD OF OCCUPATION 105 ^d 22 ^h –109 ^d 06 ^h

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED 119	DEGREE OF FREEDOM 2718	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 15°
Φ 71°31'29.215"S	λ 24°07'50.108"E	h 980.27 m	
X 1850438.36 m	Y 828926.81 m	Z -6028019.30 m	

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE LONGITUDE HEIGHT	
LATITUDE	STD, DEV(LATITUDE) = 0.16 m
LONGITUDE	STD, DEV(LONGITUDE) = 0.21 m
HEIGHT	STD, DEV (HEIGHT) = 0.20 m

GROUND SURVEY DATA AND REMARKS

1. Positioned to the electrical phase center of the antenna by broadcast ephemeris positioning.
2. Surface synoptic data were included for tropospheric correction.

T. N.
NNSS
-167°
220
214
50
Height Datum Staff

Asuka Station

Height Datum Staff (Wood base 2 m below snow surface)

GPS P
109.5 115
1987.4.16 snow surface
55
220
unit : cm

SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER Asuka Height Datum Staff	LOCATION East Dronning Maud Land	DOPPLER NO. 87002T
STAMPING ON MARK 3 m survey pole		
JARE NUMBER JARE-28	TYPE OF STATION MARK Red Flag and Plastic Tag	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-1	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.55 m above snow surface	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 200, 300, 480, 500	PERIOD OF OCCUPATION 106 ^d 16 ^h —109 ^d 06 ^h

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED 46	DEGREE OF FREEDOM 1611	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 15°
$\Delta \Phi$ -1°4'13.804"	$\Delta \lambda$ +0°14'28.297"	Δh 788.61 m	
ΔX -106497.57 m	ΔY -37834.35 m	ΔZ -39655.10 m	

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE	STD, DEV(LATITUDE) = 0.49 m
LONGITUDE	STD, DEV(LONGITUDE) = 0.58 m
HEIGHT	STD, DEV (HEIGHT) = 0.46 m

GROUND SURVEY DATA AND REMARKS

1. ($\Delta \Phi$, $\Delta \lambda$, Δh) are offsets from the L0 point NNSS antenna phase center.
 2. (ΔX , ΔY , ΔZ) are differences of the geocentric coordinates from the L0 point NNSS antenna phase center.
 3. Surface synoptic data were included for tropospheric correction.

T. N.
-167°
NNSS
220
214
50
Height Datum Staff

Asuka Station
Height Datum Staff (Wood base 2 m below snow surface)
GPS
109.5
115
NNSS
C
55
1987.4.16 snow surface
220
unit : cm

SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER Seal Rock	LOCATION East Dronning Maud Land	DOPPLER NO. 87003B
STAMPING ON MARK No. 25-01 geodetic mark installed by JARE-25 (A. Itabashi) in 1984		
JARE NUMBER JARE-28	TYPE OF STATION MARK Bench Mark and No. 26-01 Gravity Mark 1 m apart	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-1	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.565 m above station mark	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 200, 300, 480, 500	PERIOD OF OCCUPATION 93 ^d 09 ^h —93 ^d 20 ^h

SATELLITE-DERIVED COORDINATES

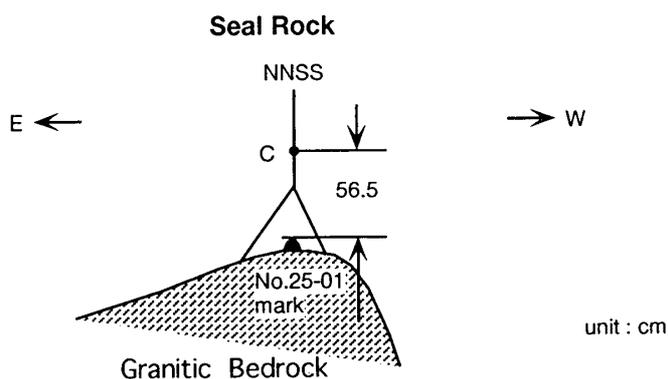
PASSES ACCEPTED 17	DEGREE OF FREEDOM 359	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 15°
Φ 71°31'29.779"S	λ 24°03'54.553"E	h 1000.46 m	
X 1851374.50 m	Y 826808.92 m	Z -6028043.99 m	

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE	LONGITUDE	HEIGHT	
LATITUDE			STD, DEV(LATITUDE) = 0.58 m
LONGITUDE			STD, DEV(LONGITUDE) = 0.82 m
HEIGHT			STD, DEV (HEIGHT) = 0.71 m

GROUND SURVEY DATA AND REMARKS

1. Positioned to the electrical phase center of the antenna by broadcast ephemeris positioning.
2. Surface synoptic data were included for tropospheric correction.



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER Seal Rock	LOCATION East Dronning Maud Land	DOPPLER NO. 87003T
STAMPING ON MARK No. 25-01 geodetic mark installed by JARE-25 (A. Itabashi) in 1984		
JARE NUMBER JARE-28	TYPE OF STATION MARK Bench Mark and No. 26-01 Gravity Mark 1 m apart	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO. JMR-1	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK 0.565 m above station mark	TRACKING EQUIPMENT REFERENCE POINT antenna phase center
OBSERVED BY K. Shibuya	SATELLITES OBSERVED 110, 130, 200, 330, 480, 500	PERIOD OF OCCUPATION 93 ^d 10 ^h –93 ^d 20 ^h

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED 13	DEGREE OF FREEDOM 452	ELLIPSOID WGS84	ELEVATION ANGLE RANGE 15°
$\Delta\phi$ -0.729"	$\Delta\lambda$ -3'55.718"	Δh 18.53 m	
ΔX 931.86 m	ΔY -2121.56 m	ΔZ -24.74 m	

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

LATITUDE	LONGITUDE	HEIGHT
LATITUDE	STD, DEV(LATITUDE) = 0.39 m	
LONGITUDE	STD, DEV(LONGITUDE) = 0.46 m	
HEIGHT	STD, DEV (HEIGHT) = 0.41 m	

GROUND SURVEY DATA AND REMARKS

1. ($\Delta\phi$, $\Delta\lambda$, Δh) are offsets from the NNSS antenna phase center at the Asuka height datum staff.
2. (ΔX , ΔY , ΔZ) are differences of the geocentric coordinates from the Asuka NNSS antenna phase center.
3. Surface synoptic data were included for tropospheric correction.

