SATELLITE DOPPLER STATIONS IN THE JAPANESE ANTARCTIC RESEARCH REGION

(1) AROUND SYOWA STATION BY JARE-21

Kazuo SHIBUYA[1] and Kiyoshi ITO[2]

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

[2]Regional Observation Center for Earthquake Prediction,
Faculty of Science, Kyoto University,
Nasahara 944, Takatsuki 569

1. Introduction

The two-wave NNSS receiver was utilized for the first time in 1979 by the 20th Japanese Antarctic Research Expedition (JARE-20) during the oversnow 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 until 1985 around Syowa Station, Mizuho Plateau and the Sør Rondane Mountains. Except geodetic control survey in outcrop areas, coordinates of the

satellite Doppler stations in the ice sheet change with time by the ice sheet flow and ablation/accumulation of snow. The stations may be lost or re-surveyed with the same station name in a few years' elapse time. It is thus necessary to keep the record of the data summary in order to avoid later confusion. We adopted the following format for the data log.

2. Data Format

Figure 1 shows the log format. STATION NAME is to be given by each JARE during the survey. Usually a pair of route name and the successive location number constitute the station name. LOCATION is the area name such as East Ongul Island, Mizuho Plateau etc. DOPPLER NO is to be given like 80012, which means the observation number 12 made in 1980. This can be used as the code number for data exchange. 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 JMR-1 are to be processed using SP-2G program by JMR Instruments Inc. (1982) for the point-positioning of the station. The default values for a set of prepared parameters are found to be adequate for the data acquired in the Antarctic region (Shibuya, 1985). SATELLITE-DERIVED COORDINATES are output from SP-2G program after 2 to 3 iterative phase adjustment and the geodetic coordinates are obtained on the WGS-72 Standard Ellipsoid. The coordinates of the antenna phase center are to be catalogued without any coordinate transform and offset

reduction. If any reduction is applied, it should be explained and illustrated in detail in GROUND SURVEY DATA AND REMARKS because the circumstances of the station might change with time.

3. Stations by JARE-21

JARE-21 (1978-1981) made the satellite Doppler positioning at the astronomical point of Syowa Station. JMR-1 antenna was placed over the station mark (brass disk). In the seismic explosion experiments on Mizuho Plateau, 27 seismic stations were installed along the traverse route from Syowa Station to Mizuho Station (Route S-H-Z). The seismic station was located close to the traverse pole and/or route pole (Ikami et al., 1984). For ST1 - ST7, JMR-1 antenna was placed on the snow surface. For ST8 - ST26, it was placed on the roof of the oversnow vehicle. No mark was reserved at the antenna location but the offset between the electric phase center of the antenna over the seismic station and the traverse (route) pole was measured by using a hand-bearing compass and footage. A large green-painted wooden box was installed to contain the seismic recorder and batteries and it was deposited at the seismic station. This may give the station locality for later re-surveying. Several stations have only 3-5 satellite passes and the uncertainty of the positioning may be larger than the values indicated by ESTIMATE OF VARIANCE-COVARIANCE MATRIX.

References

Ikami, A., Ito, K., Kaminuma, K. and Shibuya, K. (1984): The results of explosion seismic experiments operated between Syowa and Mizuho Stations, East Antarctica, Mem. Natl Inst. Polar Res., Ser. C (Earth Sci.), 15, 60p.

JMR Insturuments Inc. (1982): SP-2G Satellite Positioning Program, Catsworth, Cal., 16pp (JMR Document 2003505-8).

Members of the Yamato-Belgica Traverse Party (1981): Dai-20-ji Nankyoku Chiiki Kansokutai Yamato Berujika ryokô hôkoku (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.

Shibuya, K. (1985): Performance experiment of an NNSS positioning in and around Syowa Station, East Antarctica, J. Phys. Earth, 33, 453-483.

SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
STAMPING ON MARK		
JARE NUMBER	TYPE OF STATION MARK	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
OBSERVED BY	SATELLITES OBSERVED	PERIOD OF OCCUPATION

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE

Φ	λ	h
X	Y	Z

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE				STD. DEV(LATITUDE) =
LONGITUDE				STD. DEV(LONGITUDE) =
HEIGHT				STD. DEV(HEIGHT) =

GROUND SURVEY DATA AND REMARKS

Fig 1. Data log format.

SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
Syowa Station	East Ongul Island	80001
STAMPING ON MARK: brass disk by JARE-1		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: astronomical point at Syowa Station	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	0.49 m	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30110 30130,30140,30190,30200	PERIOD OF OCCUPATION: $116^d\ 14^h$ - $128^d\ 09^h$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
192	2946	WGS-72	15° - 75°

ϕ	λ	h
69°00'19.179"S	39°34'51.394"E	56.07 m
X	**Y**	**Z**
1766411.12	1460313.07	-5932236.56

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.06	0.02	-0.01	STD. DEV(LATITUDE) = 0.25
LONGITUDE	0.02	0.11	0.01	STD. DEV(LONGITUDE) = 0.32
HEIGHT	-0.01	0.01	0.09	STD. DEV(HEIGHT) = 0.30

GROUND SURVEY DATA AND REMARKS

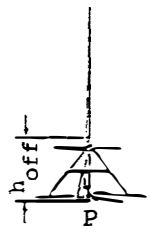
1. Above coordinates are of the antenna phase center and not reduced to the station mark of the astronomical point.

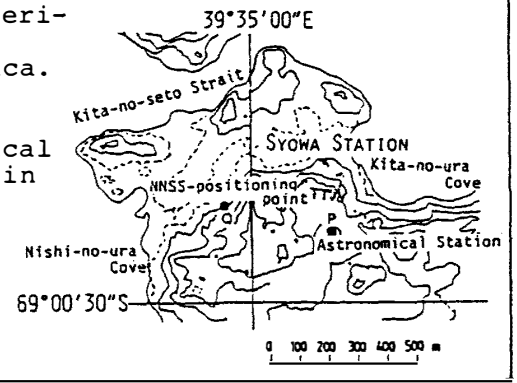
2. The height of the station mark above m.s.l. is 29.18 m.

3. References

K. Shibuya (1985): Performance experiment of an NNSS positioning in and around Syowa Station, East Antarctica. J. Phys. Earth, 33, 453-483.

K. Shibuya (1986): Glacio-geophysical implication of an NNSS positioning in and around Syowa Station, East Antarctica. to be published in J. Geodynamics.





SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST1	Route S-H-Z on Mizuho Plateau	80002
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: none	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	0.5±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30190, 30200,30140,30130,30110,	PERIOD OF OCCUPATION: $294^{d}\ 14^{h}$ - $295^{d}\ 04^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
13	284	WGS-72	15° - 75°

Φ	λ	h
69°01'48.207"S	40°03'14.334"E	593.50m
X	**Y**	**Z**
1752470.28	1473313.02	-5933726.21

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

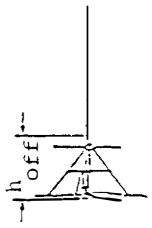
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.56	0.06	-0.25	STD. DEV(LATITUDE) = 0.75
LONGITUDE	0.06	0.90	0.18	STD. DEV(LONGITUDE)= 0.95
HEIGHT	-0.25	0.18	1.01	STD. DEV(HEIGHT) = 1.01

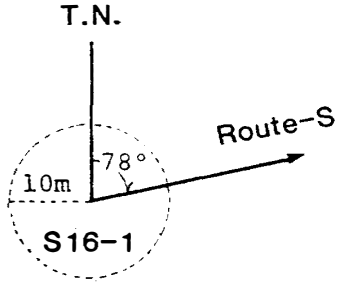
GROUND SURVEY DATA AND REMARKS

1. S16-1 is the route station name.
   ST1 is the seismic station name.
   ST1 was within 10 m from S16-1,
   though the offset was not measured.
   There is no corresponding traverse
   station.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.

2. A wooden box was installed at ST1.

3. Above coordinates are of the antenna
   phase center and not reduced to S16-1.





SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST2	Route S-H-Z on Mizuho Plateau	80003

STAMPING ON MARK
no mark reserved, see remarks

JARE NUMBER	TYPE OF STATION MARK
JARE-21	close to the route pole, see remarks.

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	0.5±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30140,30200,30110,30130	$295^{d}\ 05^{h}$ - $295^{d}\ 09^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
6	116	WGS-72	15° - 75°

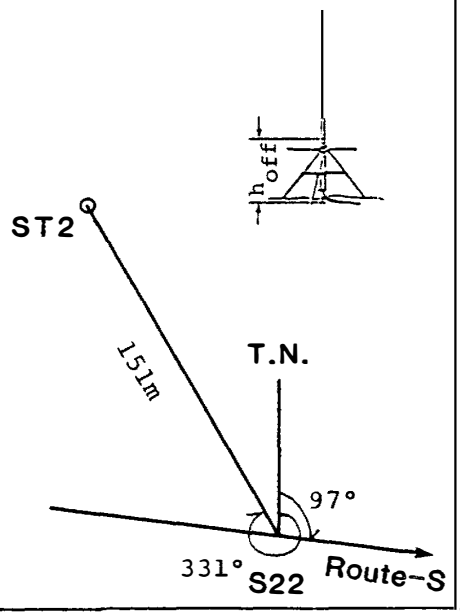
Φ	λ	h
69°01'35.052"S	40°18'47.186"E	791.02m
X	**Y**	**Z**
1746133.35	1481515.65	-5933764.74

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	2.24	0.84	0.26	STD. DEV(LATITUDE) = 1.50
LONGITUDE	0.84	3.84	0.05	STD. DEV(LONGITUDE)= 1.96
HEIGHT	0.26	0.05	1.83	STD. DEV(HEIGHT) = 1.35

GROUND SURVEY DATA AND REMARKS

1. S22 is the route station name.
   ST2 is the seismic stastion name.
   There is no corresponding traverse station.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res., Ser. C, 15, 1984.
2. h_{off}= 0.5 m
3. A wooden box was installed at ST2.
4. Above coordinates are of the antenna phase center and not reduced to S22.
5. ST2 can be reduced to S22.
   See right figure.



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST3	Route S-H-Z on Mizuho Plateau	80004
STAMPING ON MARK: no mark reserved, see remarks		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the route pole, see remarks	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	0.5±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30130	PERIOD OF OCCUPATION: $295^{d}\ 10^{h}$ - $295^{d}\ 14^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
3	72	WGS-72	15° - 75°

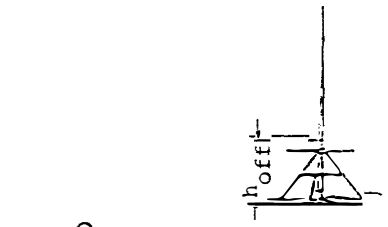
Φ	λ	h
69°02'33.249"S	40°34'32.275"E	957.97m
X	**Y**	**Z**
1738093.05	1488444.12	-5934565.95

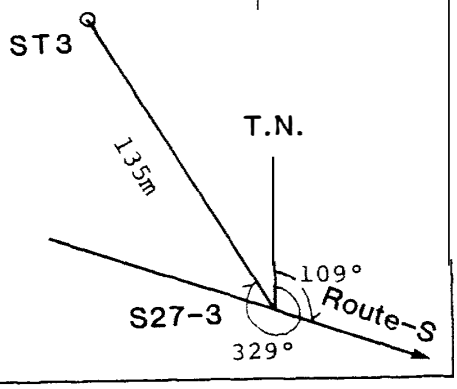
ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.98	0.21	0.00	STD. DEV(LATITUDE) = 0.99
LONGITUDE	0.21	2.74	0.96	STD. DEV(LONGITUDE)= 1.66
HEIGHT	0.00	0.96	1.72	STD. DEV(HEIGHT) = 1.31

GROUND SURVEY DATA AND REMARKS

1. S27-3 is the route station name.
   ST3 is the seismic station name.
   There is no corresponding traverse station.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res., Ser. C, 15, 1984.
2. h_{off} = 0.5 m
3. A wooden box was installed at ST3.
4. Above coordinates are of the antenna phase center and not reduced to S27-3.
5. ST3 can be reduced to S27-3.
   See right figure.





SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST4	Route S-H-Z on Mizuho Plateau	80005
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	0.5±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30200 30140,30110,30130,30190	PERIOD OF OCCUPATION: $295^{d}\ 16^{h}$ - $297^{d}\ 04^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
28	601	WGS-72	15° - 75°

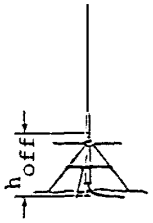
Φ	λ	h
69°05'06.748"S	40°47'17.750"E	1065.61 m
X	**Y**	**Z**
1729222.47	1492006.79	-5936366.32

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

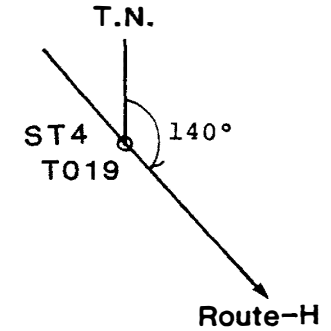
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.31	0.13	-0.08	STD. DEV(LATITUDE) = 0.55
LONGITUDE	0.13	0.53	0.01	STD. DEV(LONGITUDE)= 0.73
HEIGHT	-0.08	0.01	0.47	STD. DEV(HEIGHT) = 0.68

GROUND SURVEY DATA AND REMARKS

1. H17 is the route station name.
   T019 is the traverse station name.
   ST4 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 0.5 m
3. A wooden box was installed at ST4.
4. Above coordinates are of the antenna phase center and not reduced to the snow surface.



Route Station H17



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST5	Route S-H-Z on Mizuho Plateau	80006

STAMPING ON MARK: no mark reserved

JARE NUMBER	TYPE OF STATION MARK
JARE-21	traverse pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	0.5±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30110,30140	$297^d\ 07^h$ - $297^d\ 10^h$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
3	66	WGS-72	15° - 75°

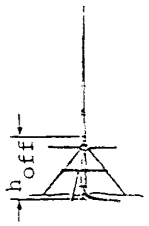
Φ	λ	h
69° 08'39.908"S	40°56'38.515"E	1162.49m
X	**Y**	**Z**
1720523.77	1492680.34	-5938811.91

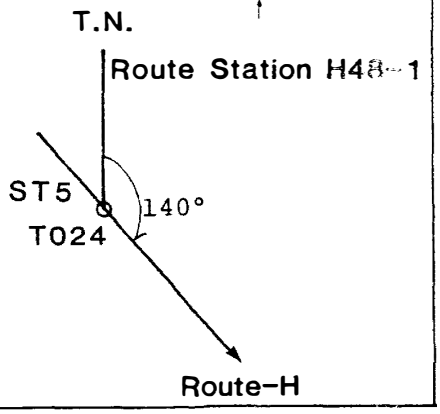
ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	2.47	4.32	0.71	STD. DEV(LATITUDE) = 1.57
LONGITUDE	4.32	9.20	1.32	STD. DEV(LONGITUDE)= 3.03
HEIGHT	0.71	1.32	0.56	STD. DEV(HEIGHT) = 0.75

GROUND SURVEY DATA AND REMARKS

1. H48-1 is the route station name.
   T024 is the traverse station name.
   ST5 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 0.5 m
3. A wooden box was installed at ST5.
4. Above coordinates are of the antenna phase center and not reduced to the snow surface.





SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST6	Route S-H-Z on Mizuho Plateau	80007
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	0.5±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30140,30130,30190	PERIOD OF OCCUPATION: $297^{d}\ 11^{h}$ - $297^{d}\ 15^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
3	59	WGS-72	15° - 75°

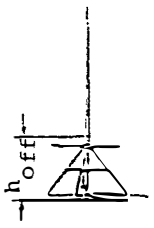
Φ	λ	h
69°12'47.345"S	41°06'44.165"E	1242.01^{m}
X	**Y**	**Z**
1710754.34	1493031.30	-5941612.09

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	3.61	5.87	2.04	STD. DEV(LATITUDE) = 1.90
LONGITUDE	5.87	15.4	4.42	STD. DEV(LONGITUDE)= 3.93
HEIGHT	2.04	4.42	2.62	STD. DEV(HEIGHT) = 1.62

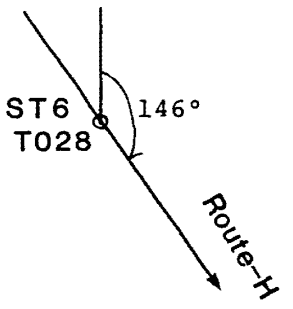
GROUND SURVEY DATA AND REMARKS

1. H74-1 is the route station name.
   T028 is the traverse station name.
   ST6 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 0.5 m
3. A wooden box was installed at ST6.
4. Above coordinates are of the antenna phase center and not reduced to the snow surface.



Route Station H74-1

T.N.



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST7	Route S-H-Z on Mizuho Plateau	80008

STAMPING ON MARK
no mark reserved

JARE NUMBER	TYPE OF STATION MARK
JARE-21	traverse pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	0.5±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30200 30190,30140,30130,30110	$297^{d}\ 16^{h}$ - $298^{d}\ 04^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
12	270	WGS-72	15° - 75°

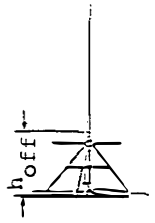
Φ	λ	h
69°16'12.970"S	41°16'03.299"E	1315.03 m
X	**Y**	**Z**
1702241.08	1493749.75	-5943939.10

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

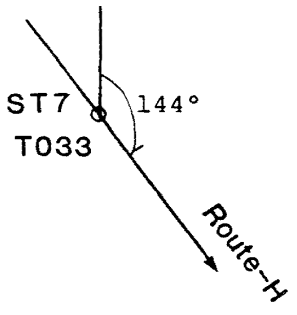
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.93	0.24	-0.28	STD. DEV(LATITUDE) = 0.97
LONGITUDE	0.24	1.43	0.12	STD. DEV(LONGITUDE)= 1.20
HEIGHT	-0.28	0.12	1.56	STD. DEV(HEIGHT) = 1.25

GROUND SURVEY DATA AND REMARKS

1. H93 is the route station name.
   T033 is the traverse station name.
   ST7 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 0.5 m
3. A wooden box was installed at ST7.
4. Above coordinates are of the antenna phase center and not reduced to the snow surface.



Route Station H93



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST8	Route S-H-Z on Mizuho Plateau	80009
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30110,30140	PERIOD OF OCCUPATION: $298^{d}\ 06^{h}$ - $298^{d}\ 14^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
5	96	WGS-72	15° - 75°

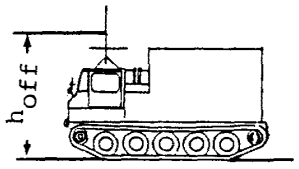
Φ	λ	h
69°20'28.240"S	41°26'52.154"E	1365.71 m
X	**Y**	**Z**
1691999.49	1494209.87	-5946782.35

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

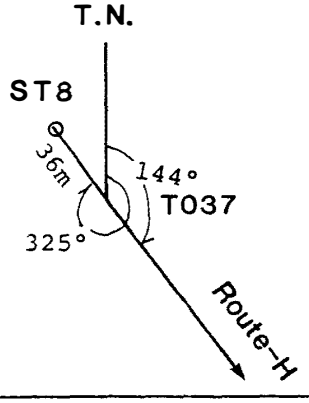
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	2.53	3.61	-0.66	STD. DEV(LATITUDE) = 1.59
LONGITUDE	3.61	6.07	-1.12	STD. DEV(LONGITUDE)= 2.46
HEIGHT	-0.66	-1.12	0.72	STD. DEV(HEIGHT) = 0.85

GROUND SURVEY DATA AND REMARKS

1. H113-1 is the route station name.
   T037 is the traverse station name.
   ST8 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST8.
4. Above coordinates are of the antenna phase center and not reduced to T037.
5. ST8 can be reduced to T037.
   See right figure.



Route Station H113-1



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST9	Route S-H-Z on Mizuho Plateau	80010

STAMPING ON MARK
no mark reserved

JARE NUMBER	TYPE OF STATION MARK
JARE-21	close to the route pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30190,30110,30140,30200	$298^{d}\ 15^{h}$ - $299^{d}\ 03^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
9	212	WGS-72	15° - 75°

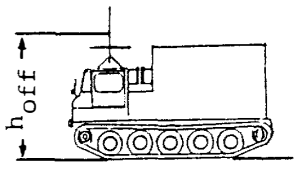
Φ	λ	h
69°25'50.636"S	41°38'04.152"E	1425.25m
X	**Y**	**Z**
1680148.03	1493514.65	-5950356.11

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	1.14	0.72	0.06	STD. DEV(LATITUDE) = 1.07
LONGITUDE	0.72	2.67	0.49	STD. DEV(LONGITUDE)= 1.63
HEIGHT	0.06	0.49	1.44	STD. DEV(HEIGHT) = 1.20

GROUND SURVEY DATA AND REMARKS

1. H139 is the route station name.
   ST9 is the seismic station name.
   There is no corresponding traverse station.
   See JARE Data Rep., No. 28., 1975.
   See Mem. Natl Inst. Polar Res., Ser. C, 15, 1984.

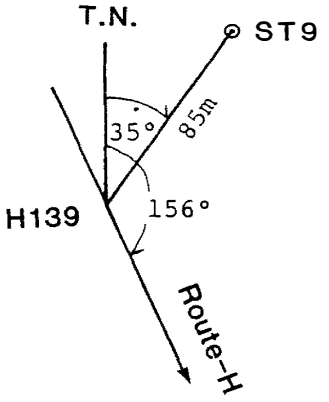


2. h_{off}= 2.9 m

3. A wooden box was installed at ST9.

4. Above coordinates are of the antenna phase center and not reduced to H139.

5. ST9 can be reduced to H139.
   See right figure.



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST10	Route S-H-Z on Mizuho Plateau	80011

STAMPING ON MARK
no mark reserved

JARE NUMBER	TYPE OF STATION MARK
JARE-21	close to the traverse pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30110,30200,30140,30130	$299^{d}\ 05^{h}$ - $299^{d}\ 10^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
5	117	WGS-72	15° - 86°

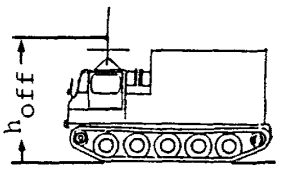
Φ	λ	h
69°29'55.865"S	41°46'32.344"E	1492.70m
X	**Y**	**Z**
1671172.72	1492923.41	-5953085.49

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

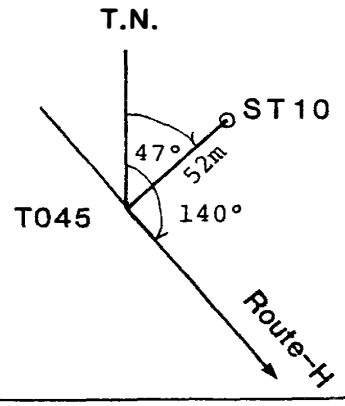
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	1.88	0.22	-0.09	STD. DEV(LATITUDE) = 1.37
LONGITUDE	0.22	4.79	2.13	STD. DEV(LONGITUDE)= 2.19
HEIGHT	-0.09	2.13	3.72	STD. DEV(HEIGHT) = 1.93

GROUND SURVEY DATA AND REMARKS

1. H155 is the route station name.
   T045 is the traverse station name.
   ST10 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST10.
4. Above coordinates are of the antenna phase center and not reduced to T045.
5. ST10 can be reduced to T045.
   See right figure.



Route Station H155



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST11	Route S-H-Z on Mizuho Plateau	80012
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30130,30140,30190	PERIOD OF OCCUPATION: $299^d\ 10^h$ - $299^d\ 12^h$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
3	62	WGS-72	15° - 75°

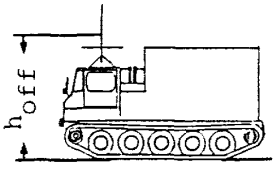
Φ	λ	h
69°34'02.968"S	41°56'21.005"E	1565.16m
X	**Y**	**Z**
1661586.55	1492907.93	-5955831.47

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

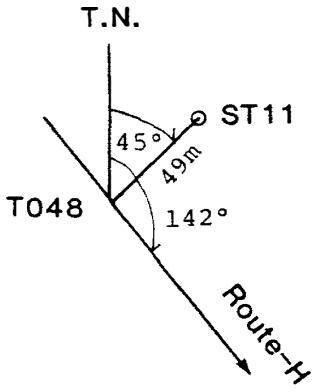
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	3.13	-1.29	-3.02	STD. DEV(LATITUDE) = 1.77
LONGITUDE	-1.29	3.59	3.45	STD. DEV(LONGITUDE)= 1.89
HEIGHT	-3.02	3.45	10.5	STD. DEV(HEIGHT) = 3.23

GROUND SURVEY DATA AND REMARKS

1. H174 is the route station name.
   T048 is the traverse station name.
   ST11 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST11.
4. Above coordinates are of the antenna phase center and not reduced to T048.
5. ST11 can be reduced to T048.
   See right figure.



Route Station H174



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST12	Route S-H-Z on Mizuho Plateau	80013
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30200,30110,30140,30130	PERIOD OF OCCUPATION: $300^{d}\ 07^{h}$ - $300^{d}\ 10^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
5	107	WGS-72	15° - 75°

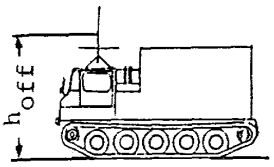
Φ	λ	h
69°38'16.997"S	42°07'7.829"E	1579.45m
X	**Y**	**Z**
1651426.26	1493164.87	-5958589.08

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

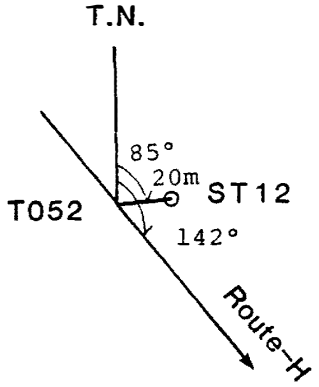
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	1.32	0.48	-0.00	STD. DEV(LATITUDE) = 1.15
LONGITUDE	-0.48	2.32	0.38	STD. DEV(LONGITUDE)= 1.52
HEIGHT	-0.00	0.38	1.99	STD. DEV(HEIGHT) = 1.41

GROUND SURVEY DATA AND REMARKS

1. H194 is the route station name.
   T052 is the traverse station name.
   ST12 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST12.
4. Above coordinates are of the antenna phase center and not reduced to T052.
5. ST12 can be reduced to T052.
   See right figure.



Route Station H194



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST13	Route S-H-Z on Mizuho Plateau	80014
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30190,30130	PERIOD OF OCCUPATION: $300^{d}\ 12^{h}$ - $300^{d}\ 16^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
4	88	WGS-72	15° - 75°

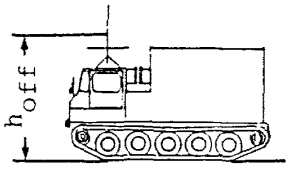
Φ	λ	h
69°42'30.414"S	42°16'58.285"E	1647.87 m
X	**Y**	**Z**
1641713.27	1492946.48	-5961381.84

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

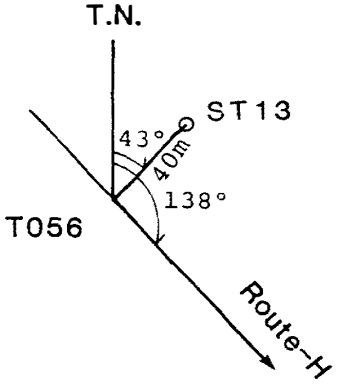
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.47	0.12	0.01	STD. DEV(LATITUDE) = 0.69
LONGITUDE	0.12	1.18	0.39	STD. DEV(LONGITUDE)= 1.09
HEIGHT	0.01	0.39	0.79	STD. DEV(HEIGHT) = 0.89

GROUND SURVEY DATA AND REMARKS

1. H213 is the route station name.
   T056 is the traverse station name.
   ST13 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST13.
4. Above coordinates are of the antenna phase center and not reduced to T056.
5. ST13 can be reduced to T056.
   See right figure.



Route Station H213



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST14	Route S-H-Z on Mizuho Plateau	80015

STAMPING ON MARK
no mark reserved

JARE NUMBER	TYPE OF STATION MARK
JARE-21	close to the traverse pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30110 30140,30190,30200,30130	$299^{d}\ 16^{h}$ - $300^{d}\ 04^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
15	327	WGS-72	15° -75°

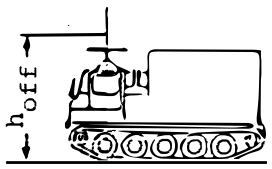
Φ	λ	h
69°46'22.566"S	42°26'27.152"E	1697.82^{m}
X	**Y**	**Z**
1632620.47	1492924.63	-5963920.43

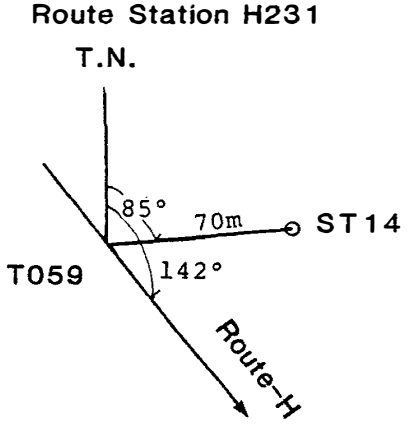
ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.93	0.29	-0.23	STD. DEV(LATITUDE) = 0.96
LONGITUDE	0.29	1.68	0.34	STD. DEV(LONGITUDE)= 1.30
HEIGHT	-0.23	0.34	1.51	STD. DEV(HEIGHT) = 1.23

GROUND SURVEY DATA AND REMARKS

1. H231 is the route station name.
   T059 is the traverse station name.
   ST14 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST14.
4. Above coordinates are of the antenna phase center and not reduced to T059.
5. ST14 can be reduced to T059.
   See right figure.





SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST 15	Route S-H-Z on Mizuho Plateau	80016

STAMPING ON MARK: no mark reserved

JARE NUMBER	TYPE OF STATION MARK
JARE-21	close to the traverse pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30200 30190,30110,30140,30130,	$300^{d}\ 17^{h}$ - $301^{d}\ 05^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
18	387	WGS-72	15° - 75°

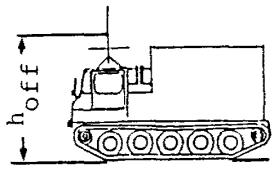
Φ	λ	h
69°51'14.673"S	42°37'34.776"E	1776.24 m
X	**Y**	**Z**
1621546.68	1492464.29	-5967118.53

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

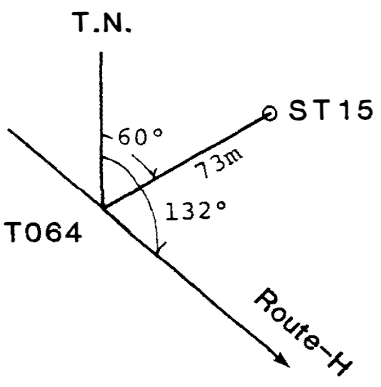
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.63	0.19	-0.15	STD. DEV(LATITUDE) = 0.80
LONGITUDE	0.19	1.40	0.36	STD. DEV(LONGITUDE)= 1.18
HEIGHT	-0.15	0.36	1.16	STD. DEV(HEIGHT) = 1.08

GROUND SURVEY DATA AND REMARKS

1. H253 is the route station name.
   T064 is the traverse station name.
   ST15 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST15.
4. Above coordinates are of the antenna phase center and not reduced to T064.
5. ST15 can be reduced to T064.
   See right figure.



Route Station H253



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST16	Route S-H-Z on Mizuho Plateau	80017

STAMPING ON MARK	
no mark reserved	

JARE NUMBER	TYPE OF STATION MARK
JARE-21	close to the traverse pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30140,30200,30110	$301^{d}\ 05^{h}$ - $301^{d}\ 08^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
3	60	WGS-72	15° - 75°

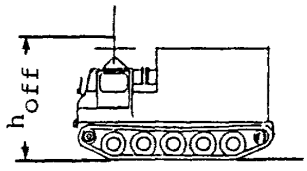
Φ	λ	h
69°55'07.791"S	42°48'28.357"E	1814.57m
X	**Y**	**Z**
1611841.09	1492992.87	-5969639.46

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

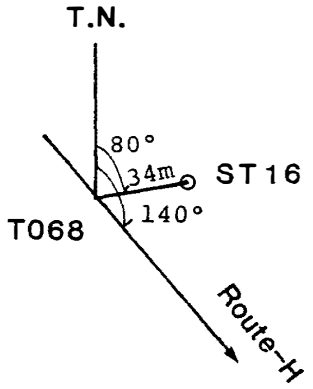
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	4.74	1.06	0.38	STD. DEV(LATITUDE) = 2.18
LONGITUDE	1.06	5.50	-0.05	STD. DEV(LONGITUDE)= 2.35
HEIGHT	0.38	-0.05	4.69	STD. DEV(HEIGHT) = 2.16

GROUND SURVEY DATA AND REMARKS

1. H272 is the route station name.
   T068 is the traverse station name.
   ST16 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST16.
4. Above coordinates are of the antenna phase center and not reduced to T068.
5. ST16 can be reduced to T068.
   See right figure.



Route Station H272



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST17	Route S-H-Z on Mizuho Plateau	80018
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the route pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30140,30130,30200,30110, 30190	PERIOD OF OCCUPATION: $301^{d}\ 09^{h}$ - $303^{d}\ 05^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
48	965	WGS-72	15° - 75°

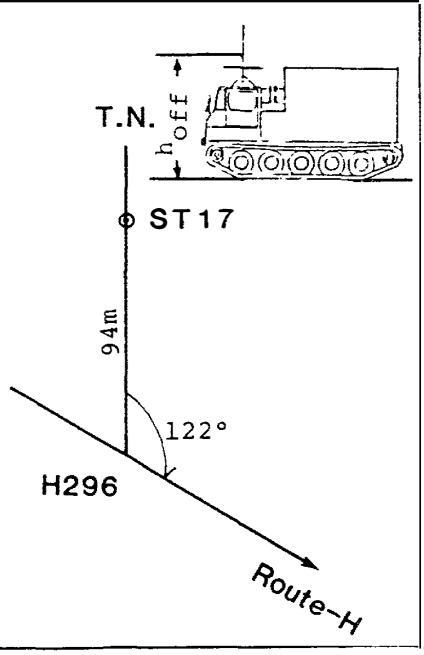
Φ	λ	h
70°00'00.300"S	43°00'36.588"E	1907.07m
X	**Y**	**Z**
1600354.28	1492885.33	-5972833.59

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.36	0.13	-0.07	STD. DEV(LATITUDE) = 0.60
LONGITUDE	0.13	0.67	0.09	STD. DEV(LONGITUDE)= 0.82
HEIGHT	-0.07	0.09	0.57	STD. DEV(HEIGHT) = 0.75

GROUND SURVEY DATA AND REMARKS

1. H296 is the route station name.
   ST17 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST17.
4. Above coordinates are of the antenna phase center and not reduced to H296.
5. ST 17 can be reduced to H296.
   See right figure.



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST18	Route S-H-Z on Mizuho Plateau	80019

STAMPING ON MARK
no mark reserved

JARE NUMBER	TYPE OF STATION MARK
JARE-21	close to the traverse pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30130 30190,30200,30140,30110,	$303^{d}\ 11^{h}$ - $304^{d}\ 02^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
18	370	WGS-72	15° - 75°

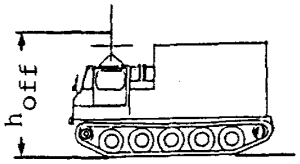
Φ	λ	h
70°02'13.589"S	43°09'36.969"E	1961.16m
X	**Y**	**Z**
1593618.68	1494429.34	-5974296.32

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

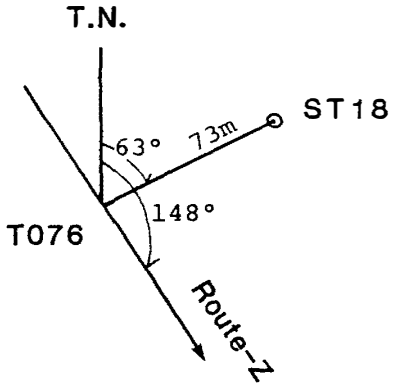
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.29	0.06	-0.10	STD. DEV(LATITUDE) = 0.54
LONGITUDE	0.06	0.55	0.14	STD. DEV(LONGITUDE)= 0.74
HEIGHT	-0.10	0.14	0.59	STD. DEV(HEIGHT) = 0.77

GROUND SURVEY DATA AND REMARKS

1. Z2 is the route station name.
   T076 is the traverse station name.
   ST18 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST18.
4. Above coordinates are of the antenna phase center and not reduced to T076.
5. ST18 can be reduced to T076.
   See right figure.



Route Station Z2



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST19	Route S-H-Z on Mizuho Plateau	80020
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30200,30110	PERIOD OF OCCUPATION: $304^{d}\ 06^{h}$ - $304^{d}\ 09^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
3	58	WGS-72	15° - 75°

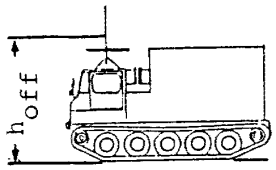
Φ	λ	h
70°06'16.008"S	43°17'50.718"E	2008.93m
X	**Y**	**Z**
1584906.88	1493406.03	-5976902.72

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

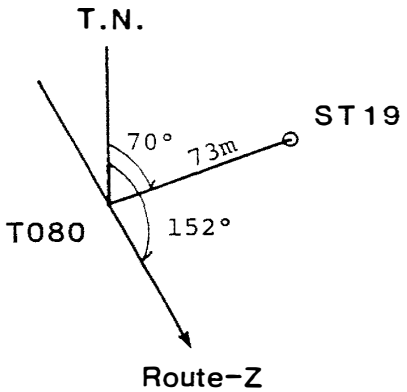
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	14.3	22.6	2.14	STD. DEV(LATITUDE) = 3.78
LONGITUDE	22.6	42.9	3.72	STD. DEV(LONGITUDE)= 6.55
HEIGHT	2.14	3.72	2.81	STD. DEV(HEIGHT) = 1.68

GROUND SURVEY DATA AND REMARKS

1. Z11-1 is the route station name.
   T080 is the traverse station name.
   ST19 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST19.
4. Above coordinates are of the antenna phase center and not reduced to T080.
5. ST19 can be reduced to T080.
   See right figure.



Route Station Z11-1



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST20	Route S-H-Z on Mizuho Plateau	80021
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30110,30190,30130,30200	PERIOD OF OCCUPATION: $304^{d}\ 10^{h}$ - $304^{d}\ 14^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
4	87	WGS-72	15° - 75°

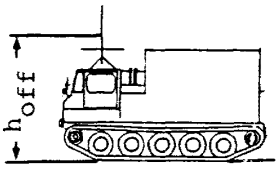
Φ	λ	h
70°11'23.638"S	43°26'22.889"E	2033.05m
X	**Y**	**Z**
1574686.82	1491175.02	-5980164.04

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

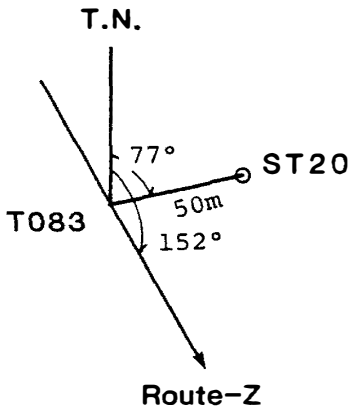
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	2.78	0.31	-0.84	STD. DEV(LATITUDE) = 1.67
LONGITUDE	0.31	4.71	0.89	STD. DEV(LONGITUDE)= 2.17
HEIGHT	-0.84	0.89	4.29	STD. DEV(HEIGHT) = 2.07

GROUND SURVEY DATA AND REMARKS

1. Z22-1 is the route station name.
   T083 is the traverse station name.
   ST20 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST20.
4. Above coordinates are of the antenna phase center and not reduced to T083.
5. ST20 can be reduced to T083.
   See right figure.



Route Station Z22-1



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST21	Route S-H-Z on Mizuho Plateau	80022

STAMPING ON MARK
no mark reserved

JARE NUMBER	TYPE OF STATION MARK
JARE-21	close to the traverse pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30110,30190,30200,30130	$304^{d}\ 15^{h}$ - $305^{d}\ 04^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
12	246	WGS-72	15° - 75°

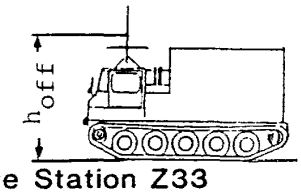
Φ	λ	h
70°16'06.990"S	43°34'18.672"E	2097.19m
X	**Y**	**Z**
1565269.77	1489120.68	-5983195.65

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

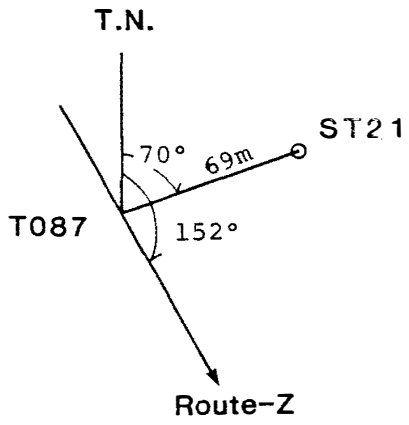
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	1.10	0.55	-0.16	STD. DEV(LATITUDE) = 1.05
LONGITUDE	0.55	1.96	0.22	STD. DEV(LONGITUDE)= 1.40
HEIGHT	-0.16	0.22	1.43	STD. DEV(HEIGHT) = 1.20

GROUND SURVEY DATA AND REMARKS

1. Z33 is the route station name.
   T087 is the traverse station name.
   ST21 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST21.
4. Above coordinates are of the antenna phase center and not reduced to T087.
5. ST21 can be reduced to T087.
   See right figure.



Route Station Z33



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST22	Route S-H-Z on Mizuho Plateau	80023
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30190,30200,30130	PERIOD OF OCCUPATION: $305^{d}\ 06^{h}$ - $305^{d}\ 10^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
5	99	WGS-72	15° - 75°

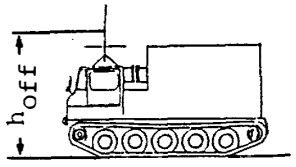
Φ	λ	h
70°20'23.556"S	43°41'38.572"E	2121.66m
X	**Y**	**Z**
1556681.93	1487288.19	-5985899.30

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

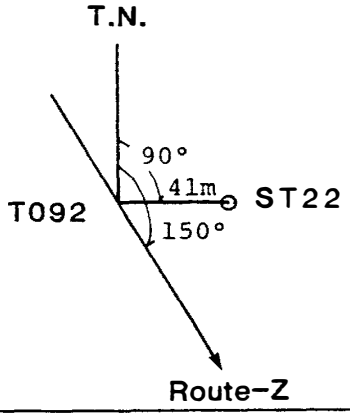
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	7.00	0.22	-7.08	STD. DEV(LATITUDE) = 2.65
LONGITUDE	0.22	4.50	-0.09	STD. DEV(LONGITUDE)= 2.12
HEIGHT	-7.08	-0.09	14.9	STD. DEV(HEIGHT) = 3.86

GROUND SURVEY DATA AND REMARKS

1. Z42-1 is the route station name.
   T092 is the traverse station name.
   ST22 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST22.
4. Above coordinates are of the antenna phase center and not reduced to T092.
5. ST22 can be reduced to T092.
   See right figure.



Route Station Z42-1



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST23	Route S-H-Z on Mizuho Plateau	80024

STAMPING ON MARK: no mark reserved

JARE NUMBER	TYPE OF STATION MARK
JARE-21	close to the traverse pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30200 30110,30190,30140,30130,	$305^{d}\ 11^{h}$ - $305^{d}\ 20^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
13	270	WGS-72	15° - 75°

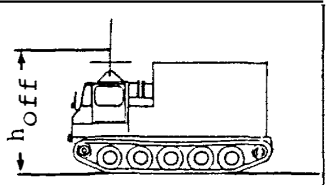
Φ	λ	h
70°24'29.018"S	43°48'39.445"E	2149.48m
X	**Y**	**Z**
1548478.41	1485505.95	-5988481.42

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

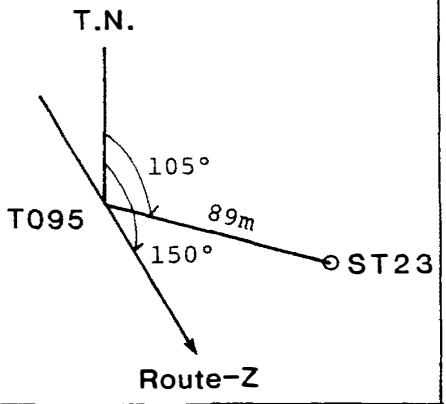
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	1.08	0.58	-0.03	STD. DEV(LATITUDE) = 1.04
LONGITUDE	0.58	2.38	0.44	STD. DEV(LONGITUDE)= 1.54
HEIGHT	-0.03	0.44	1.42	STD. DEV(HEIGHT) = 1.19

GROUND SURVEY DATA AND REMARKS

1. Z60-1 is the route station name.
   T095 is the traverse station name.
   ST23 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST23.
4. Above coordinates are of the antenna phase center and not reduced to T095.
5. ST23 can be reduced to T095.
   See right figure.



Route Station Z60-1



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST24	Route S-H-Z on Mizuho Plateau	80025
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30130,30190,30140,30110	PERIOD OF OCCUPATION: $306^{d}\ 18^{h}$ - $307^{d}\ 03^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
11	237	WGS-72	15° - 75°

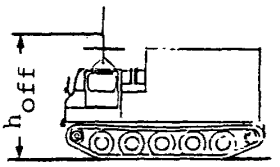
Φ	λ	h
70°28'50.288"S	43°56'34.270"E	2189.18 m
X	**Y**	**Z**
1539568.54	1483779.33	-5991229.99

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

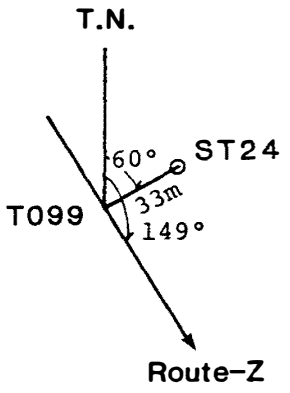
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.39	0.14	-0.13	STD. DEV(LATITUDE) = 0.63
LONGITUDE	0.14	0.79	0.17	STD. DEV(LONGITUDE)= 0.89
HEIGHT	-0.13	0.17	0.77	STD. DEV(HEIGHT) = 0.88

GROUND SURVEY DATA AND REMARKS

1. Z75 is the route station name.
   T099 is the traverse station name.
   ST24 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST24.
4. Above coordinates are of the antenna phase center and not reduced to T099.
5. ST24 can be reduced to T099.
   See right figure.



Route Station Z75



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST25	Route S-H-Z on Mizuho Plateau	80026

STAMPING ON MARK
no mark reserved

JARE NUMBER	TYPE OF STATION MARK
JARE-21	close to the traverse pole

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY	**SATELLITES OBSERVED**	**PERIOD OF OCCUPATION**
K. ITO	30110,30130,30140	$307^{d}\ 06^{h}$ - $307^{d}\ 09^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
3	67	WGS-72	15° - 75°

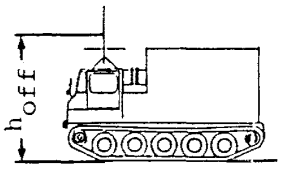
Φ	λ	h
70°33'11.563"S	44°04'58.507"E	2198.67 m
X	**Y**	**Z**
1530453.62	1482228.25	-5993940.52

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

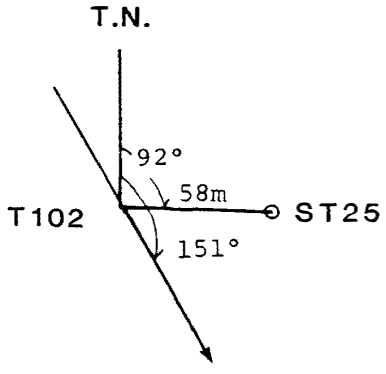
	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.79	0.64	0.27	STD. DEV(LATITUDE) = 0.89
LONGITUDE	0.64	3.03	0.90	STD. DEV(LONGITUDE)= 1.74
HEIGHT	0.27	0.90	0.89	STD. DEV(HEIGHT) = 0.94

GROUND SURVEY DATA AND REMARKS

1. Z85 is the route station name.
   T102 is the traverse station name.
   ST25 is the seismic station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST25.
4. Above coordinates are of the antenna phase center and not reduced to T102.
5. ST25 can be reduced to T102.
   See right figure.



Route Station Z85



SUMMARY OF JARE SATELLITE-OBSERVED STATION

STATION NAME/LOCAL NUMBER	LOCATION	DOPPLER NO.
ST26	Route S-H-Z on Mizuho Plateau	80027
STAMPING ON MARK: no mark reserved		
JARE NUMBER: JARE-21	TYPE OF STATION MARK: close to the traverse pole	

DOPPLER OBSERVATIONS

EQUIPMENT/SERIAL NO.	HEIGHT OF TRACKING EQUIPMENT REFERENCE POINT ABOVE STATION MARK	TRACKING EQUIPMENT REFERENCE POINT
JMR-1 20M01483	2.9±0.1m above snow surface	antenna phase center
OBSERVED BY: K. ITO	SATELLITES OBSERVED: 30190,30130,30200	PERIOD OF OCCUPATION: $307^{d}\ 10^{h}$ - $307^{d}\ 13^{h}$

SATELLITE-DERIVED COORDINATES

PASSES ACCEPTED	DEGREE OF FREEDOM	ELLIPSOID	ELEVATION ANGLE RANGE
5	117	WGS-72	15° - 75°

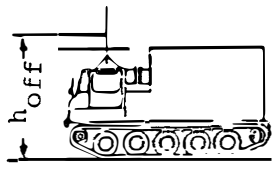
Φ	λ	h
70°37'25.662"S	44°10'38.139"E	2221.71m
X	**Y**	**Z**
1522687.84	1479573.88	-5996580.39

ESTIMATE OF VARIANCE-COVARIANCE MATRIX (METERS)

	LATITUDE	LONGITUDE	HEIGHT	
LATITUDE	0.47	-0.03	-0.11	STD. DEV(LATITUDE) = 0.69
LONGITUDE	-0.03	1.09	0.45	STD. DEV(LONGITUDE)= 1.04
HEIGHT	-0.11	0.45	1.01	STD. DEV(HEIGHT) = 1.00

GROUND SURVEY DATA AND REMARKS

1. Z94 is the route station name.
   T106 is the traverse station name.
   ST26 is the traverse station name.
   See JARE Data Rep., No. 28, 1975.
   See Mem. Natl Inst. Polar Res.,
   Ser. C, 15, 1984.
2. h_{off}= 2.9 m
3. A wooden box was installed at ST26.
4. Above coordinates are of the antenna phase center and not reduced to T106.
5. ST26 can be reduced to T106.
   See right figure.



Route Station Z94