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U. S. GEOLOGICAL SURVEY

THE 1992 BASIN & RANGE PROVINCE GPS SURVEY: 3. DATA PROCESSING AND RESULTS

by

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Introduction

An 825 km long surveying transect of the Basin & Range province was measured in October 1992 using GPS (Figure 1). This survey was part of the NASA Dynamics of the Solid Earth (DOSE) program, and NASA-supplied Turborogue receivers were used. The objective of the survey was to establish a first epoch network spanning the extending regime, that may be remeasured in the future to determine the magnitude and direction of present-day crustal extension. The network comprised 7 100 x 100 km, 10-point quadrilaterals that were each measured twice, on consecutive days. Details of the network points are given by Julian and Foulger (1994) and of the field survey by Foulger (1994). This report describes the data processing and discusses the quality of the final results.

The data were processed using a software system implemented at University of Durham, UK, and transferred to the U.S.G.S. at Menlo Park. The main processing routines are from the Bernese v. 3.2 Software with the addition of the GYPSY TURBOEDIT cycle slip detector, a post-processing network adjustment program NETADJ (Heki, 1992) and a menu-driven user interface written by K. Heki at University of Durham. The processing was conducted using a Sun4 computer.

The Data

Field measurements

Details of the field survey are given by Foulger (1994). Following the measurements, the data were taken to JPL and archived. They were supplied to the U.S.G.S. as RINEX files on EXABYTE tar tape, from which they were transferred to the Sun computer. These data are currently archived by Karen Wendt, and the field logs and original point descriptions are kept by Wayne Thatcher, both at the Branch of Earthquake Geology and Geophysics, U.S.G.S.

Observation data from a station of known location

The VLBI station Quincey is located approximately 80 km west of the most westerly station of our transect (Figure 1). It is continuously occupied by a Turborogue receiver. Observation data from this station were obtained from the Scripps Orbit and Permanent Array Center and processed along with data from the first two days of our survey.

The precise coordinates of Quincey

Coordinates were obtained from the Scripps Orbit and Permanent Array Center and NASA. The X, Y and Z coordinates from these two sources agreed to about 5 cm (X), 10 cm (Y) and 7 cm (Z). The coordinates provided by Scripps were subsequently used as coordinates of a fixed station in the data processing. The X, Y and Z coordinates in meters of Quincey are:

-2517230.9025 -4198595.1899 4076531.2717

The antenna offset of Quincey

The monument at Quincey is 0.163 m below the top of the antenna choke ring (information from the Scripps Orbit and Permanent Array Center).

The Turborogue phase center offsets

These are not known to better than about 1 cm. The values in use when data processing commenced, and supplied by JPL, are 0.79/2.64 cm (L1/L2) above the top of the antenna choke ring. Recent experiments show that these estimates may be in error by 1-1.5 cm, however, so later values may be revised (personal communication from JPL, 1993).

Broadcast orbit files

Broadcast orbits obtained from the Scripps Orbit and Permanent Array Center were used to supplement those recorded in the field.

Precise orbits

Precise orbits obtained from the Scripps Orbit and Permanent Array Center were used. These are in the ITRF91 coordinate system, and the results calculated here are therefore in that coordinate system.

Data preparation

Manipulation of the original RINEX files was necessary to standardize them regarding filenaming and to make them compatible with the Bernese translation programs. The specific operations performed are listed in Table 1.

Processing procedure

The same names were used for many different files, which are distinguished by the directories in which they are stored, e.g. the ionosphere and broadcast orbit files are named *ddd* (Table 1), but are stored in **bdat/ionos/** and **bdat/brdcst/** respectively.

The data were processed using a broadly standard procedure:

1. Translation of the RINEX observation files (**raw/***nnnnddds.yy***ol** files) into Bernese v 3.2 format (program RXOBV3). The file naming convention for the output files was *nnnn.ddds***h** for the header files and *nnnn.ddds* for the data files. The files were stored in directories **bdat/phase** and **bdat/prange**).
2. Translation of the RINEX navigation files (**raw/***nnnnddds.yy***n** files) into Bernese v 3.2 format (program RXNBV3). One file per day was created, containing all the broadcast messages for that day, with the naming convention **bdat/brdcst/***ddd.*
3. Scanning of the measured orbit files for outliers (program BRDTST). The naming convention of the cleaned output orbit message file was **bdat/brdcst/***ddd***.n** (n=new).
4. Scanning of the observation data files for outliers (program CODCHK).
5. Single point positioning using the pseudorange data, to calculate clock corrections and reasonable *a-priori* station location estimates (program CODSPP). The point positions read from the original RINEX files were stored in files **bdat/coordi/***ddd***.a** and used as *a-priori* positions. A 10^{o} cut-off angle was used and the troposphere modeled using a Saastamoinen model. One clock correction per epoch was estimated. RMS residuals of about 20 m for the point coordinates were generally obtained. The output files containing the calculated coordinates were named **bdat/coordi/***ddd***.c**. New minus *a-priori* coordinate differences were generally up to a few hundred meters.
6. Copies of the code and phase files were made prior to cycle slip correction, since that process edits the original data files.
7. Cycle slip detection (program TRBEDT). TRBEDT is not a Bernese v 3.2 program, but was written at JPL by Blewitt (1990) and forms part of the GYPSY software. It was adapted to the Bernese environment at University of Durham. It performs better than MAUPRP (see 10. below) with noisy data. It was used for the majority of the Basin & Range data. Default input options were used for all the data (see computer files) and the minimum cycle slip size screened for was 6. A few files could not be screened using TRBEDT (see Problems below),

and these were screened using MAUPRP (see 10. below). TRBEDT performed well, and in general all but about 3-4 small slips and a few outliers were removed or flagged in each day's data.

8. The data files were examined graphically for continuity and measurement time span (program SATGRA). Optimal single difference combinations were selected on the basis of maximizing the amount of single difference data and minimizing the line lengths for paired stations.
9. Formation of single difference files (program SNGDIF).
10. If cycle slip detection failed using TRBEDT it was conducted using program MAUPRP. A few files only were screened using MAUPRP (see Problems below). The minimum slip size screened for was 5. MAUPRP performed as well as TRBEDT for the data processed.
11. Translation of precise orbits, obtained from the Scripps Orbit and Permanent Array Center, into Bernese format tabular orbits (program PRETAB).
12. Formation of Bernese standard orbits from tabular orbits (program DEFSTD). All 8 unknowns in the orbit determination were solved for (six osculating elements, direct radiation pressure and y-bias). Three iterations were used. The RMS errors after modeling were generally about 0.2-0.3 m and occasionally up to 0.6 m.
13. Estimation of an ionosphere model (program IONEST). The ionosphere was modeled using the phase data as layer of electrons of varying thickness at a height of 350 km, and described by a polynomial of degree 2 (latitude), 3 (hour angle) and 3 (mixed coefficient). The RMS of the solution was generally about 0.2 - 0.5 m.
14. Pictorial examination of the ionosphere model to check the result (program IONGRA).
15. Estimation of the coordinates and ambiguities as floating point numbers (program GPSTRP, 311 option). GPSTRP is an adaptation of the Bernese program GPSEST which offers the option of modeling the troposphere as a polynomial function of time. The coordinate results of single point positioning (CODSPP) or the results calculated using GPSTRP for previous days were used as *a-priori* coordinates for all stations except a single fixed station. The coordinates of the fixed station should be accurate to 1 m or so with respect to the center of mass of the Earth to minimize systematic errors in the solution. For days 1 and 2 the precise coordinates of station Quincey were used. For subsequent days, the coordinates of a site previously estimated using GPSTRP were used for the fixed site. The data were processed in chronological order (i.e. the transect was processed from west to east) and precise fixed site coordinates were thereby propagated throughout the network. A satellite elevation cutoff of 20^{o} and a Saastamoinen troposphere model was used. The RMS of the single differences was generally about 0.0022 m where no cycle slips remained. A much larger RMS indicated cycle slips in the data.
16. The single difference residuals were browsed for each file processed, to look for outliers and

cycle slips smaller than the detection threshold set for TRBEDT and MAUPRP (see 7. above) (script BRES).

17. The times corresponding to the epochs where the uncorrected slips occurred were obtained by browsing the single difference files (program OBSFMT and script BVIEW).
18. The phase data files were edited to insert cycle slip flags by hand (program OBSFMT and script BVI).
19. The single difference files were reformed (program SNGDIF).
20. Steps 13. - 17. were repeated until the residuals were free of cycle slips.
21. The parameter estimation program was used to solve the L5 ambiguities (i.e. the L1-L2 ambiguities) (GPSTRP 511 option). The coordinates of all stations were fixed to the values calculated in the previous run of GPSTRP, and the ionospheric model calculated using IONEST was used. In most cases all of the L5 ambiguities were resolved.
22. The L5 residuals were browsed for cycle slips undetected in the previous program runs. Any slips or outliers observed were dealt with in the same way as before or marked in the phase files.
23. GPSTRP was rerun until the files were free of cycle slips.
24. GPSTRP was run to estimate the coordinates of the points and to solve the L1 and L2 ambiguities. Two methods were tested. The first used the GPSTRP 421 option (solving for the L1 ambiguities using the L5 ambiguities and holding the point coordinates fixed) followed by the GPSTRP 331 option (solving for remaining L1 ambiguities using those solved earlier, and simultaneously estimating the station coordinates). This method was used for the first four days of data, but was abandoned in favor of a second method which was found to give superior results. The second method uses the GPSTRP 321 option (solving for the L1 ambiguities using the L5 ambiguities, and simultaneously estimating the station coordinates). Each program run took about 1 hr in a Sun4 with 8 Mbytes of memory.
25. GPSTRP was rerun for both the ambiguity-free (311 option) and the ambiguity-fixed (321 option) cases, modeling the troposphere as the difference between the fixed station and the other stations expressed as a zenith delay polynomial of up to degree 1 with time for each station.
26. After processing each pair of days where the same quadrangle of points was measured (Foulger, 1994), network adjustments were performed for the ambiguity-fixed and ambiguity-free solutions with and without troposphere modeling, to calculate the repeatability of the results (program NETADJ). Additional checking of the data and reprocessing was conducted where the repeatabilities were consistently and significantly inferior to those obtained for the best days.

Problems

1. Several pieces of wrong information were disseminated to us at the commencement of the data processing effort, e.g. the phase centre offset of the Turborogue antenna and the antenna height at Quincey. The author recommends that such information be obtained independently from at least two sources before commencing data processing.
2. No precise orbits were available for PRN16 16th - 17th October because of bad transmitted L2 signals on those days. The data for PRN16 were therefore not used in the solutions for those days.
3. Anti-spoofing was turned on from UTH midnight on Fridays until UTH midnight on Sundays (16:00 Fridays - 16:00 Sundays PDT). During these times the P-code accuracy was severely degraded. The small quantities of data recorded during these periods were discarded. Satellite outages during the survey were minor and did not substantially affect the results (Table 2).
4. Some data from days 288 and 294 could not be processed by TRBEDT because of an unknown bug. The cycle slip detector MAUPRP was used for these data. MAUPRP operates on the single difference files and additional slips detected at the manual scanning stage were added to those files, rather than the zero-difference files as for TRBEDT-processed files.
5. Some data recorded in the field were not delivered by JPL. These data are:

point	start time	end time
d280	288:1828	289:0003
e300	291:0000	291:0026
g250	296:1930	297:0055
g200	296:1607	296:2240

6. The Turborogue receivers sometimes lost lock on several satellites simultaneously . This had the effect of introducing additional cycle slips and ambiguities that had to be calculated into the data (Table 3).
7. Sometimes a receiver recorded no data for the majority of the satellites. The existence of some data recorded by that receiver during these periods rules out the possibility of receiver power failure or file loss as a cause of this problem (e.g. Table 4).
8. For some days, a few L5 ambiguities could not be resolved even though the data were definitely clear of cycle slips. This is likely to be because of ionospheric turbulence.
9. The calculated coordinates of point b200 (p1t solution - see below) were:

day	lat	long	height
day 1	39 30 47.05596	-118 56 19.60470	1203.3523
day 2	39 30 47.05602	-118 56 19.60562	1203.1360
day 3	39 30 47.05593	-118 56 19.60571	1203.4281
day 4	39 30 47.05588	-118 56 19.60541	1203.4242

The calculated height for day 2 is 20-30 cm lower than that calculated for the other days. The data for day 2 were good and the calculated horizontal coordinates agree to within about 2 cm with the other days. The only explanation for the height discrepancy is error in the measured antenna height and this exemplifies the ability of repeated measurements to detect blunders of this kind. Had only one measurement been made, this blunder would have gone undetected until the second survey, and, had it been relatively small, it might have been interpreted as crustal deformation. Had two occupations been made, the blunder would have been detected but which was the wrong measurement would have been indeterminable and both days of data would have had to have been discarded. At least three occupations are necessary to identify such blunders. In this case, the data for day 2, point b200 were discarded.

Results

Ionospheric modeling.

The number of electrons in the modeled layer varied from about 1 - 30.E16 throughout the 24-hr long sessions and a fairly uniform pattern was observed from day to day (Figure 2). The highest electron content occurred during the period about 12.00-24.00 hrs and the lowest during the period 00.00-12.00 hrs. Ionospheric scintillations, or large changes in the electron content on the same time-scale as the measurement interval (30 s, for our survey), has the potential to disrupt the cycle-slip correction process, which may be a serious problem. The L5 ambiguity resolution process is a test of ionospheric smoothness, as that process uses the session ionosphere model calculated by IONEST, which describes the ionosphere as a low-degree polynomial. L5 ambiguity resolution will fail for many satellites if the ionosphere is not well-modeled using the assumption of smoothness. In the case of our survey, most of the L5 ambiguities could be resolved (see below), indicating that ionospheric scintillations were not a problem.

Ambiguity resolution.

L5 ambiguities.

Of the approximately 2100 L5 ambiguities, only about 10 (0.05%) could not be resolved.

L1 and L2 ambiguities.

The two methods of resolving L1 and L2 ambiguities applied to the first four days (the 421-331 method and the 321 method in GPSTRP) were compared by examining a) the percentage of ambiguities resolved, b) the average RMS of the single differences of the final solutions and c) the repeatabilities of the final coordinates. The 321 method performed substantially better according to all these tests (Table 5), and therefore was used for the whole survey.

Troposphere modeling

Amplitudes of the calculated tropospheric zenith delays for individual stations were typically up to 1-2 cm plus a few mm/hr. Examples are shown for three days in Figure 3.

Calculation of the final results

By processing each day of data independently, multiple estimates of all the point coordinates were obtained. These were combined by calculating final point coordinates that minimize the weighted root mean square (WRMS) of the individual estimates. This is known as network adjustment. The formal errors for the point coordinates were used to weight the coordinates. The WRMS is a statistically correct measurement of the repeatability which expresses the constancy of the results between separate, independent measurements from day to day. It is a measure of both random errors in the data and systematic errors that vary on a day to day basis. It cannot assess systematic errors that vary over periods longer than the measurement interval (up to 4 days in the case of this survey) or unmodelled systematic errors e.g. error in the assumed value of the velocity of light.

The formal errors of the coordinates are statistical measures of the scatter in the data and generally underestimate the true errors by a factor of several. It is common practice to multiply the formal errors by an empirically-determined factor to obtain values thought to be reasonable for the setting. In the case of this work, the formal errors were multiplied by the normal root mean square (NRMS) calculated in the network adjustment, to obtain scaled formal errors (SFE). The NRMS is the ratio of the repeatability (WRMS) to the formal error of the whole network. The SFE are thus a measure of the uncertainty in the point coordinate determinations based on a rigorous statistical combination of both the formal errors and the measurement repeatability.

Four different network adjusted coordinate solutions were calculated and studied. These solutions are:

	code
ambiguity-free	p1
ambiguity-free + troposphere modeling	p1t
ambiguity-fixed	p4
ambiguity-fixed + troposphere modeling	p4t

Comparison of the solutions

Solving for the L1 and L2 ambiguities : the p1 vs. the p4 solution

The repeatabilities of the seven quadrilaterals (pairs of measurement days - Foulger, 1994) were compared (Table 6). The ambiguity-fixed solutions were superior for three pairs of measurement days (days 1-2, 3-4 and 7-8), inferior for three (days 5-6, 9-10 and 11-12), and of equal quality for one (days 13-14). For the whole network (days 1-14), the overall repeatability was marginally superior for the ambiguity-fixed solution (0.6 cm compared with 0.7 cm). In the cases of the separate directional components (local north, east and up), however, both the repeatabilities and the scaled formal errors in all components were improved by solving for the ambiguities, as was the repeatability in the calculated baseline lengths (Figure 4, Table 7). Fixing the ambiguities thus improves the coordinate results somewhat.

Modeling the troposphere : the p1 vs. the p1t solution

The repeatabilities of the coordinates improved considerably for every pair of days except two (days 7-8 and 11-12) where no improvement was obtained (Table 6). For the whole network considerable improvement in repeatability (from 0.7 cm to 0.3 cm) was achieved. No improvement in the repeatability of the calculated baseline lengths was achieved however (Table 7). The scaled formal errors in the local horizontal directions improved substantially, whereas that in the up direction worsened somewhat (from 1.53 to 1.93 cm) (Figure 4, Table 7). This is a result of the high correlation of the up component with the troposphere, but the improvement in repeatability in the vertical (from 1.79 to 1.04 cm) shows that, despite this, the troposphere-modeled solution is superior in that direction also. These improvements can be traced to significant atmospheric corrections being derived for about half the observation days (days 1-6 and 13-14) for one or other solution or both.

Modeling the troposphere : the p4 vs. the p4t solution

The ambiguity-fixed solution showed very similar behavior to the ambiguity-free solution when the troposphere was modeled. The repeatability improved considerably for all pairs of days except days 7-8 where it remained the same. The repeatability of the whole network improved by a factor of two (from 0.6 to 0.3 cm). In the separate components, the repeatability worsened insignificantly in the north direction, improved insignificantly in the east and improved significantly in the vertical. The repeatability of the calculated baseline lengths remained the same. The scaled formal errors changed in a similar way to the ambiguity-free solution, and improved in the north and east components and worsened in the vertical component as a result of high correlation with the troposphere.

The best solutions

The ambiguity-fixed, troposphere-modeled (p4t) solution is the best obtained for the network. The overall repeatability is 0.3 cm, and in the north, east and up directions it is 0.24, 0.18 and 1.14 cm. The ambiguity-free, troposphere-modeled (p1t) solution is of similar overall quality (network repeatability 0.3 cm), similar repeatability in the north component (0.25 cm compared with 0.24 cm for the ambiguity-fixed, troposphere-modeled solution), considerably worse in the east component (0.42 compared with 0.18 cm) but slightly better in the vertical (1.04 compared with 1.14 cm).

For the ambiguity-free, troposphere modeled solution (p1t), point repeatabilities are shown graphically in Figures 5 and 6. Error ellipses showing 1σ scaled formal errors are presented in Figure 7. The NRMS for this solution is 6.9 (Table 6), and this is the factor by which the formal errors were multiplied to obtain the scaled formal errors shown in Figure 7. Note that a different scale is used for the horizontal view (Figure 7a) from the vertical sections (Figures 7b and 7c). Similar information is shown for the ambiguity-fixed, troposphere modeled solution (p4t) in Figures 8, 9 and 10. The NRMS for that solution is 8.6 (Table 6).

Conclusions

1. Fixing the L1 and L2 ambiguities produced some improvements in the quality of the calculated

point locations.

2. Modeling the troposphere produced major improvements in the quality of the calculated point locations.
3. In the horizontal directions, the best solution is an ambiguity-fixed, troposphere-modeled solution which gave an overall network repeatability of 0.3 cm.
4. In the vertical direction, the best solution was an ambiguity-free troposphere-modeled solution which gave a similar overall network repeatability to the ambiguity-fixed troposphere modeled solution.
5. After future surveys of the network, the first epoch solution best suited to detect horizontal motions is the ambiguity-fixed, troposphere-modeled solution. If vertical deformations are sought minor advantages would be obtained from using the ambiguity-free, troposphere-modeled solution.

Acknowledgments

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Heki, K., A network adjustment program for the Bernese Global Positioning System data analysis software, J. Geod. Soc. Japan, 38, 309-312, 1992.

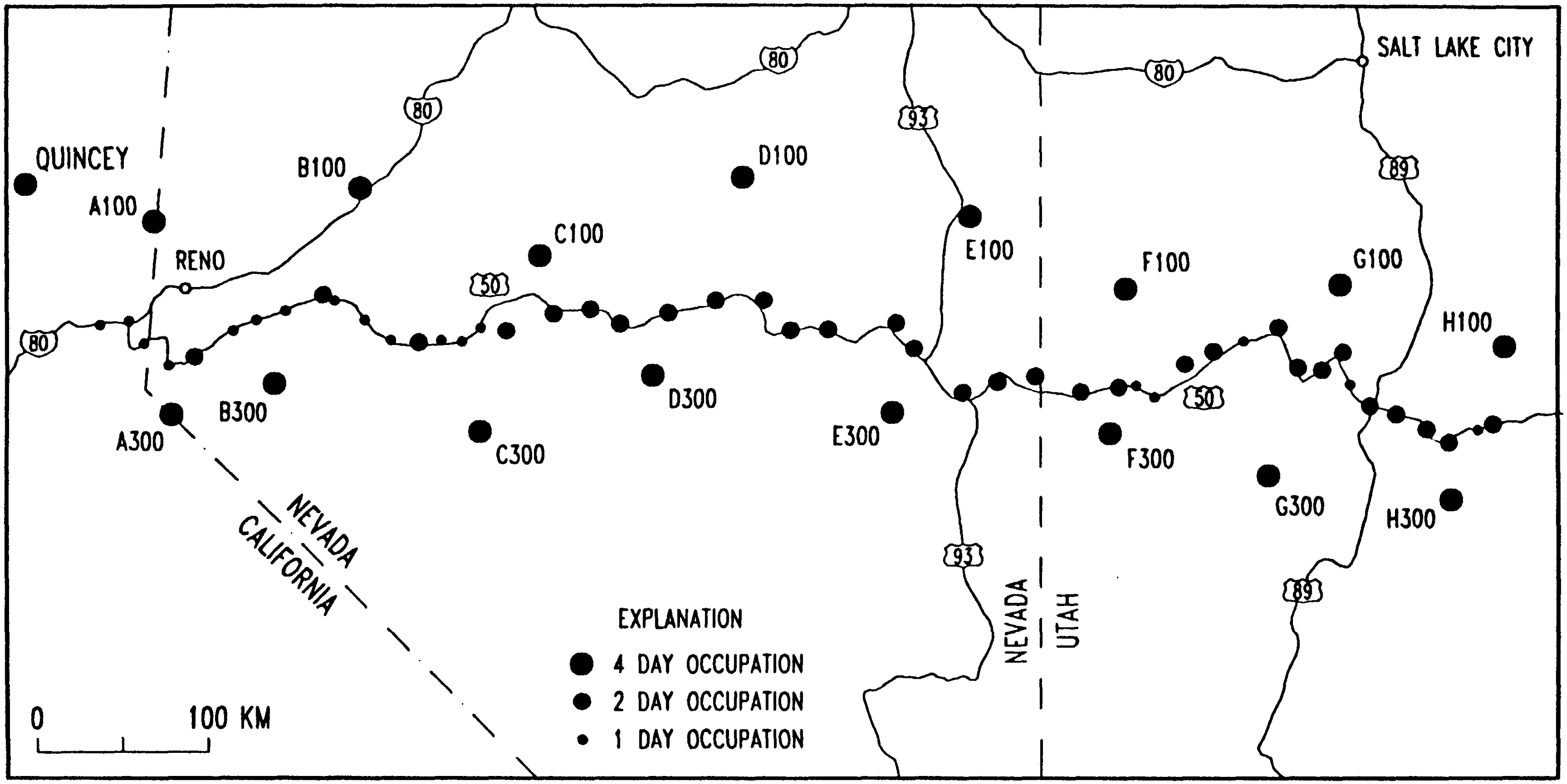

Fig. 1 Map showing the GPS network installed measured. Large dots : four occupations, medium dots : two occupations, small dots : one occupation. For full description of point codes, see Foulger (1994).

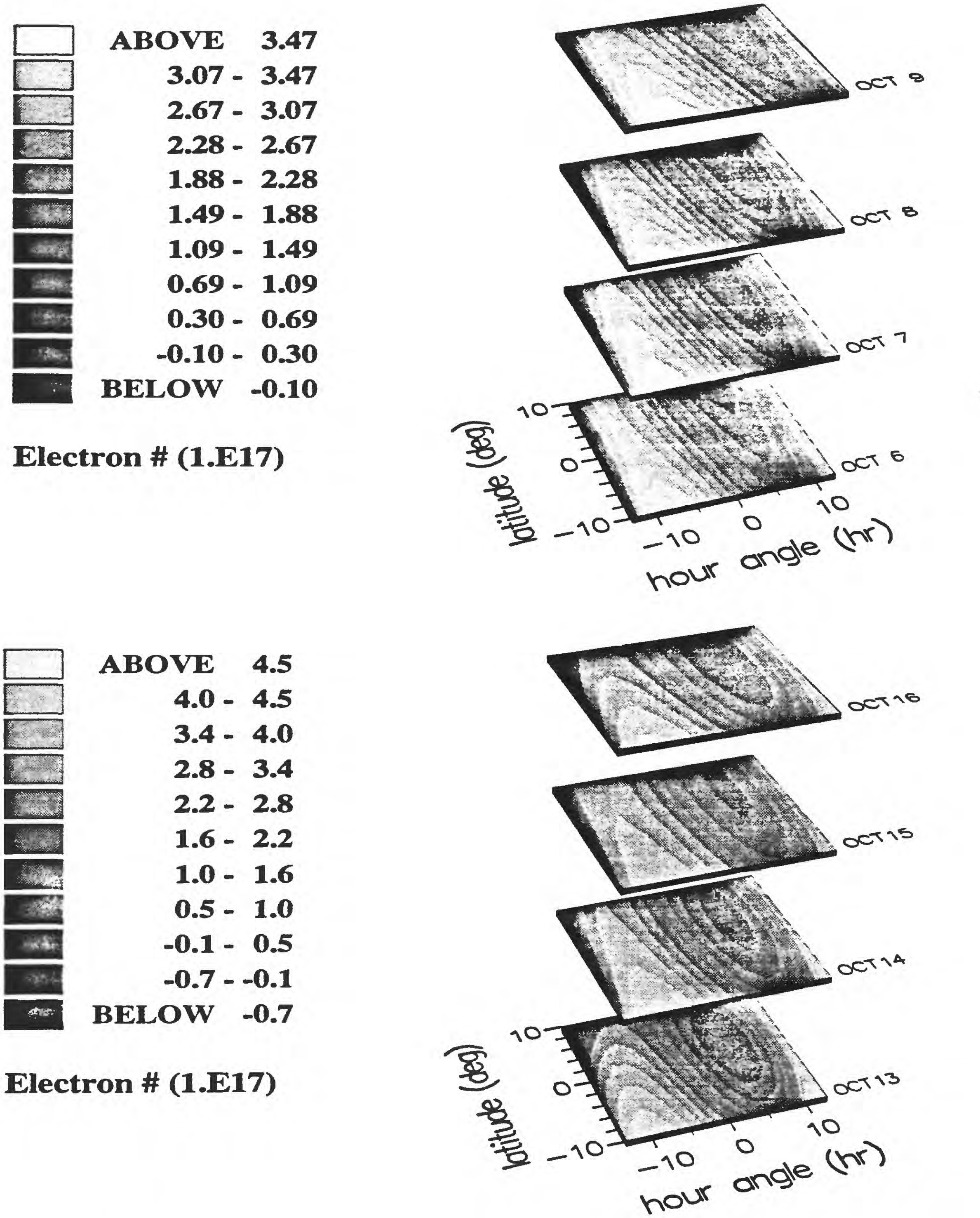

Fig. 2 Ionospheric models calculated for each survey day. (a) Oct .6th - Oct. 9th. (b) Oct. 13th - Oct. 16th.

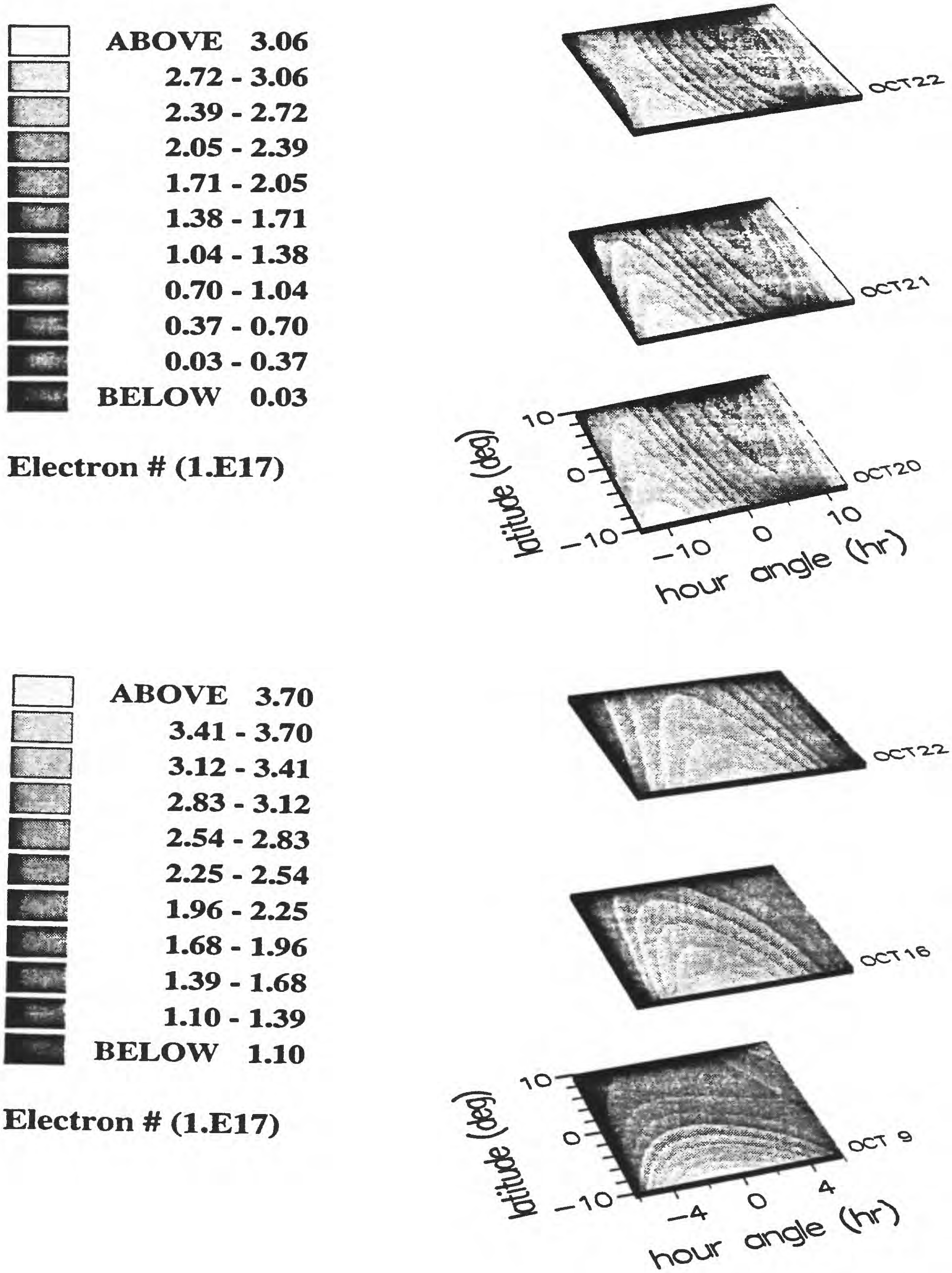

Fig. 2 (c) Oct. 20th - Oct. 22nd. (d) Oct. 9th, 16th and 22nd. Note different hour angle scale for (d).

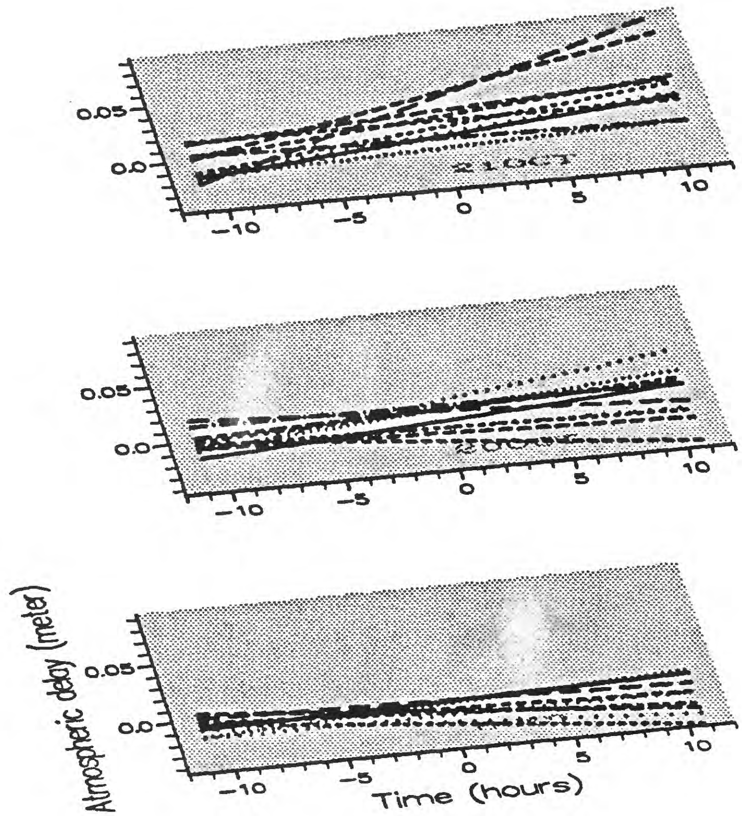

Fig. 3 Atmospheric delays as a function of time calculated for three example days of the survey, from bottom to top : Oct. 8th, Oct. 20th and Oct. 21st.

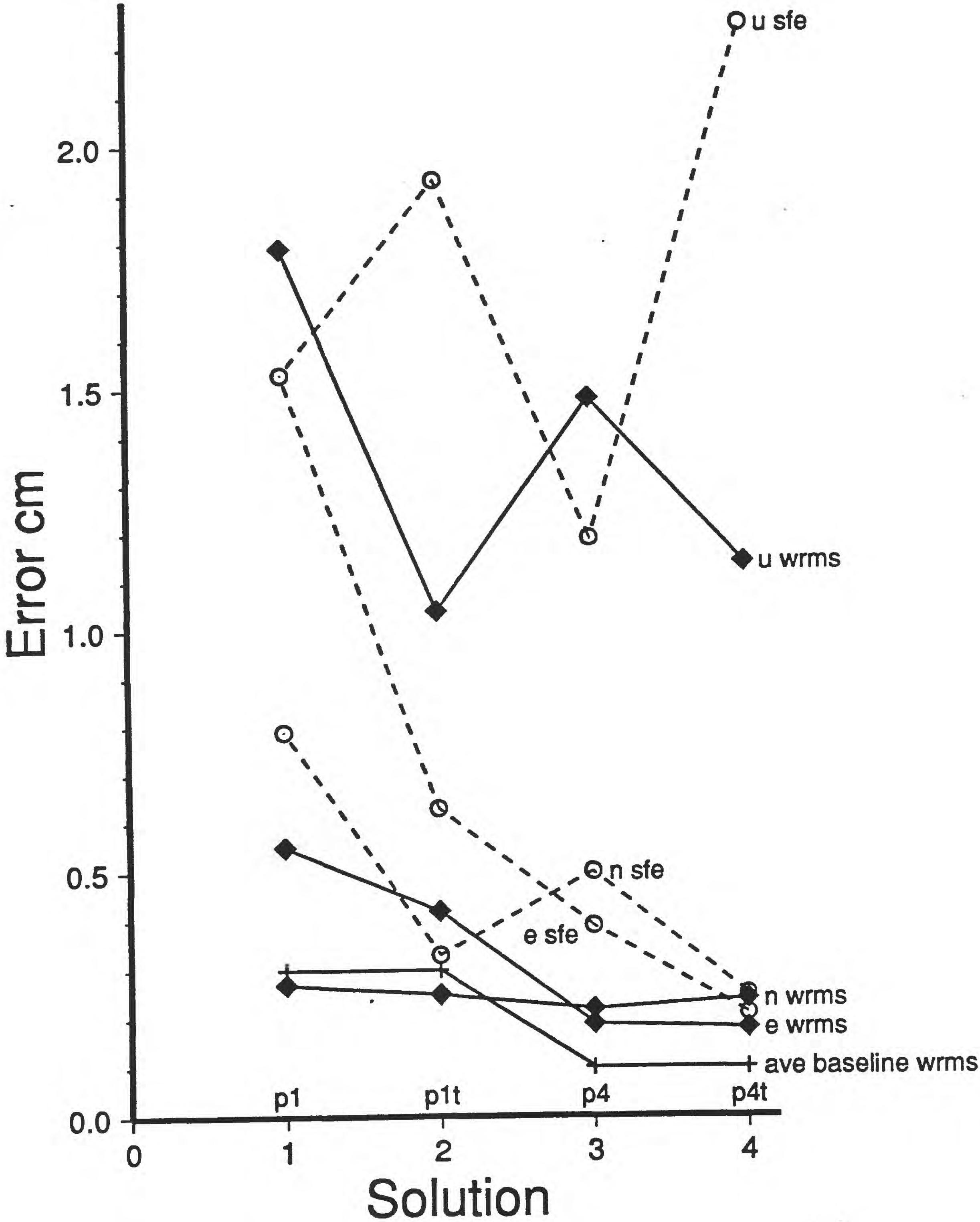

Fig. 4 Graphical representation of repeatabilities and scaled formal errors of components of the four final solutions calculated.

```
WRMS                     WRMS                     WRMS
 (cm)                     (cm)                     (cm)

  0- 2 |====================   0- 2 |====================   0- 2 |====================
  2- 4 |                       2- 4 |                       2- 4 |===
  4- 6 |                       4- 6 |                       4- 6 |
  6- 8 |                       6- 8 |                       6- 8 |
  8-10 |                       8-10 |                       8-10 |
 10-12 |                      10-12 |                      10-12 |
 12-14 |                      12-14 |                      12-14 |
 14-16 |                      14-16 |                      14-16 |
 16-18 |                      16-18 |                      16-18 |
 18-20 |                      18-20 |                      18-20 |
 20-   |                      20-   |                      20-   |
```

```
 wrms-baselines
0.0-0.5 |====================
0.5-1.0 |====================
1.0-1.5 |======
1.5-2.0 |
2.0-2.5 |
2.5-3.0 |
3.0-3.5 |
3.5-4.0 |
4.0-4.5 |
4.5-5.0 |
5.0-    |
```

Fig. 5 Ambiguity-free, troposphere modeled solution. Repeatabilities in cm (WRMS) against proportion of direct determinations for the north, east, and up components, and line lengths.

```
      WRMSs     n : 0.25cm     e : 0.42cm     u : 1.04cm
                                    North
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                ||| I
 West                    |    -@  -YYNQ$|||||||                         East
=========================|====-1--)%*U1)(zdefij-=============================
                         |      |  |J|hPQHFD|h|||
                         |            I||||  | -J
                         |            I        |
                  -------b-------     I
                         |            I
                         |            I
                         |            I
                         |            I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                    South          Window : +/- 10.0cm
```

<u>**Fig. 6a**</u> <u>Ambiguity-free, troposphere modeled solution. Variations about the mean in the horizontal for individual point position determinations.</u>

```
                                      Up
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                         |            I
                  -------b-------     I
                         |            I
                                    *-I      |
                                | -)$ I  -ehi-J
 West                          -1--&#%YJAHFD-|gj-                       East
==================================-^YUXVhz===================================
                                  -%JV1)(-
                                |    We*-
                               -@     I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                    Down           Window : +/- 10.0cm (E-W)
                                                            +/- 30.0cm (U-D)
```

```
a:a100 b:a200 c:a210 d:a230 e:a250 f:a280 g:a300 h:b100 i:b200 j:b300
k:a220 l:a270 m:a290 n:b210 o:b250 p:b280 q:c100 r:c200 s:c300 t:b220
u:b270 v:b290 w:c240 x:c260 y:c280 z:d100 A:d200 B:d300 C:c220 D:d220
E:d240 F:d260 G:d280 H:e100 J:e200 K:e300 L:e220 M:e240 N:e260 O:e280
P:f100 Q:f200 R:f300 S:f210 T:f230 U:f250 V:f290 W:g100 X:g200 Y:g300
Z:f220 !:f270 @:f280 #:g210 $:g230 %:g250 ^:g270 &:g290 *:g280 (:h100
):h200 1:h300 2:g220
```

Fig. 6b Ambiguity-free, troposphere modeled solution. Variations about the mean in the vertical for individual point position determinations.

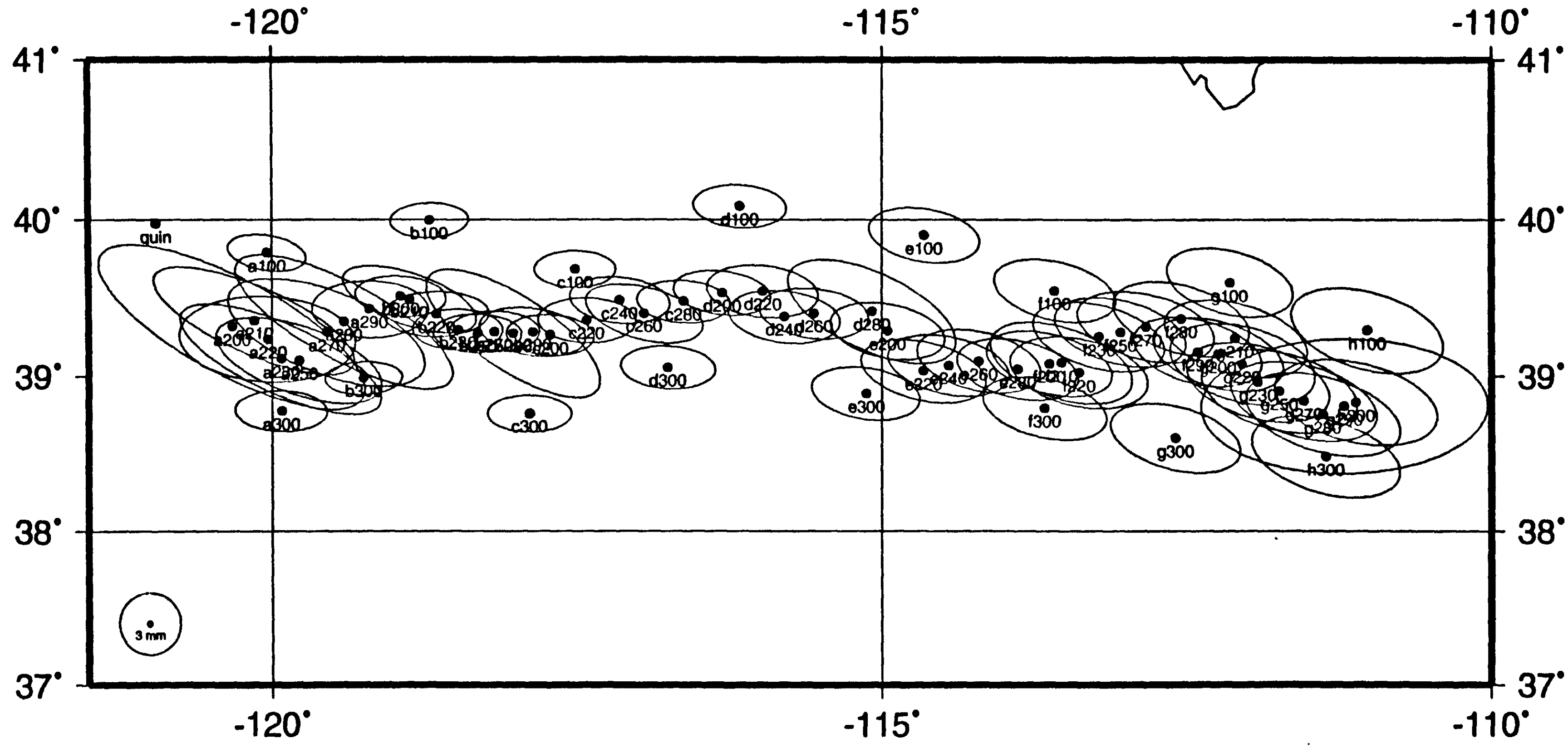

Fig. 7a Scaled formal error ellipses for the ambiguity-free, troposphere modeled (p1t) solution : horizontal components.

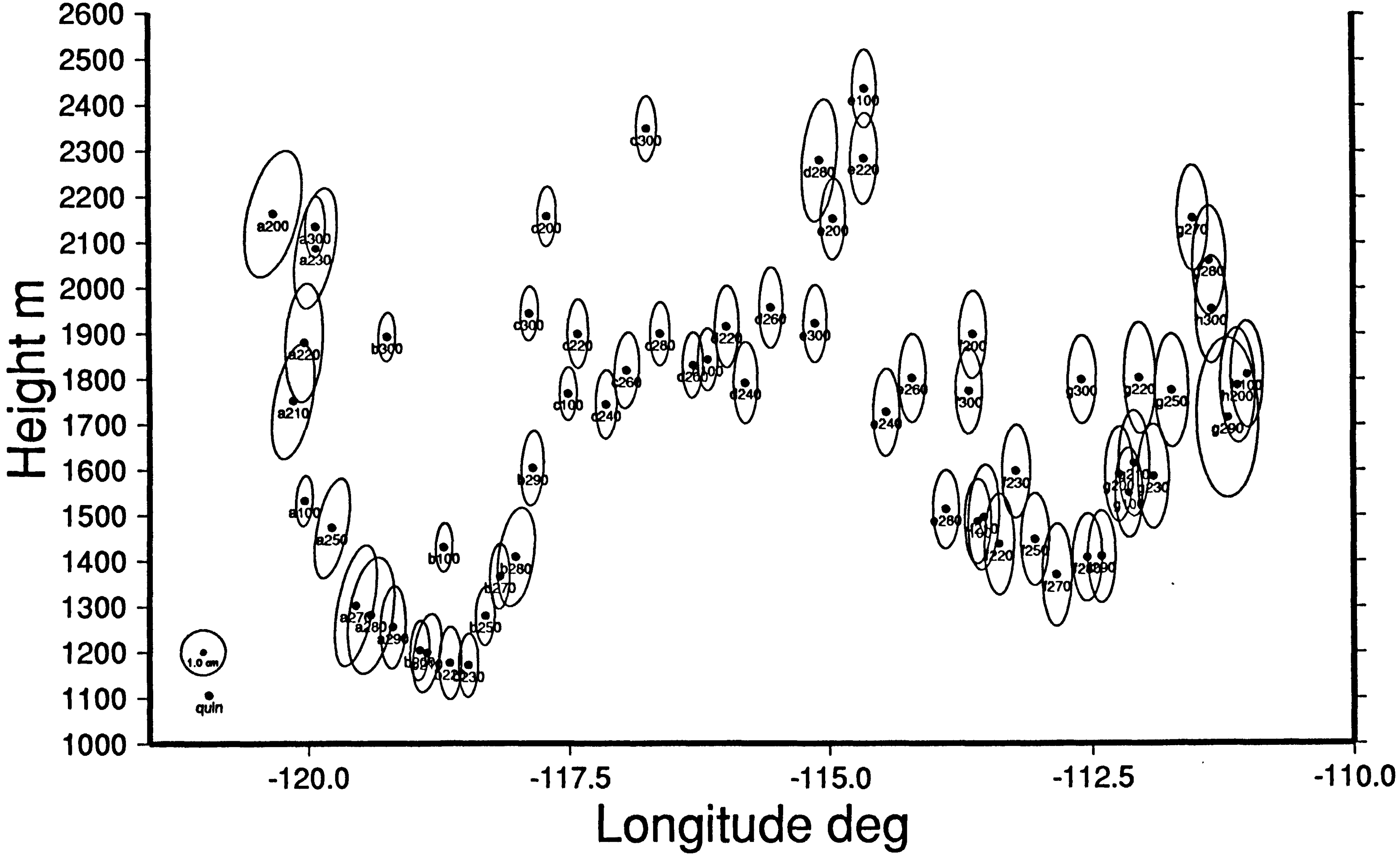

Fig. 7b Scaled formal error ellipses for the ambiguity-free, troposphere modeled (p1t) solution : Longitude vs. height.

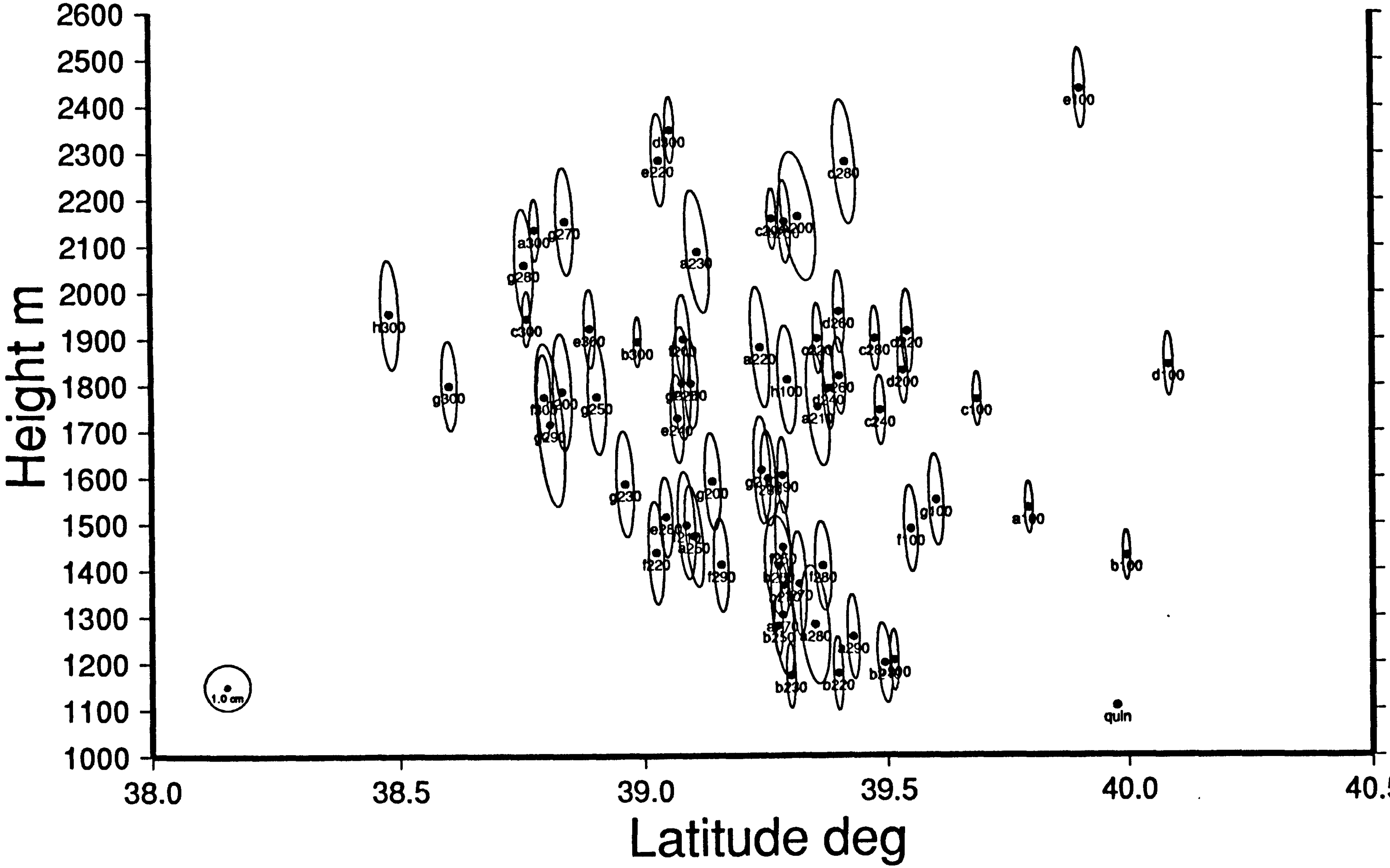

Fig. 7c Scaled formal error ellipses for the ambiguity-free, troposphere modeled (p1t) solution : Latitude vs. height.

WRMS (cm)

```
wrms-north
0- 2  |====================
2- 4  |
4- 6  |
6- 8  |
8-10  |
10-12 |
12-14 |
14-16 |
16-18 |
18-20 |
20-   |
```

WRMS (cm)

```
wrms-east
0- 2  |====================
2- 4  |
4- 6  |
6- 8  |
8-10  |
10-12 |
12-14 |
14-16 |
16-18 |
18-20 |
20-   |
```

WRMS (cm)

```
wrms-up
0- 2  |====================
2- 4  |=====
4- 6  |
6- 8  |
8-10  |
10-12 |
12-14 |
14-16 |
16-18 |
18-20 |
20-   |
```

```
wrms-baselines
0.0-0.5 |====================
0.5-1.0 |
1.0-1.5 |
1.5-2.0 |
2.0-2.5 |
2.5-3.0 |
3.0-3.5 |
3.5-4.0 |
4.0-4.5 |
4.5-5.0 |
5.0-    |
```

Fig. 8 Ambiguity-fixed, troposphere modeled solution. Repeatabilities in cm (WRMS) against proportion of direct determinations for the north, east, and up components, and line lengths.

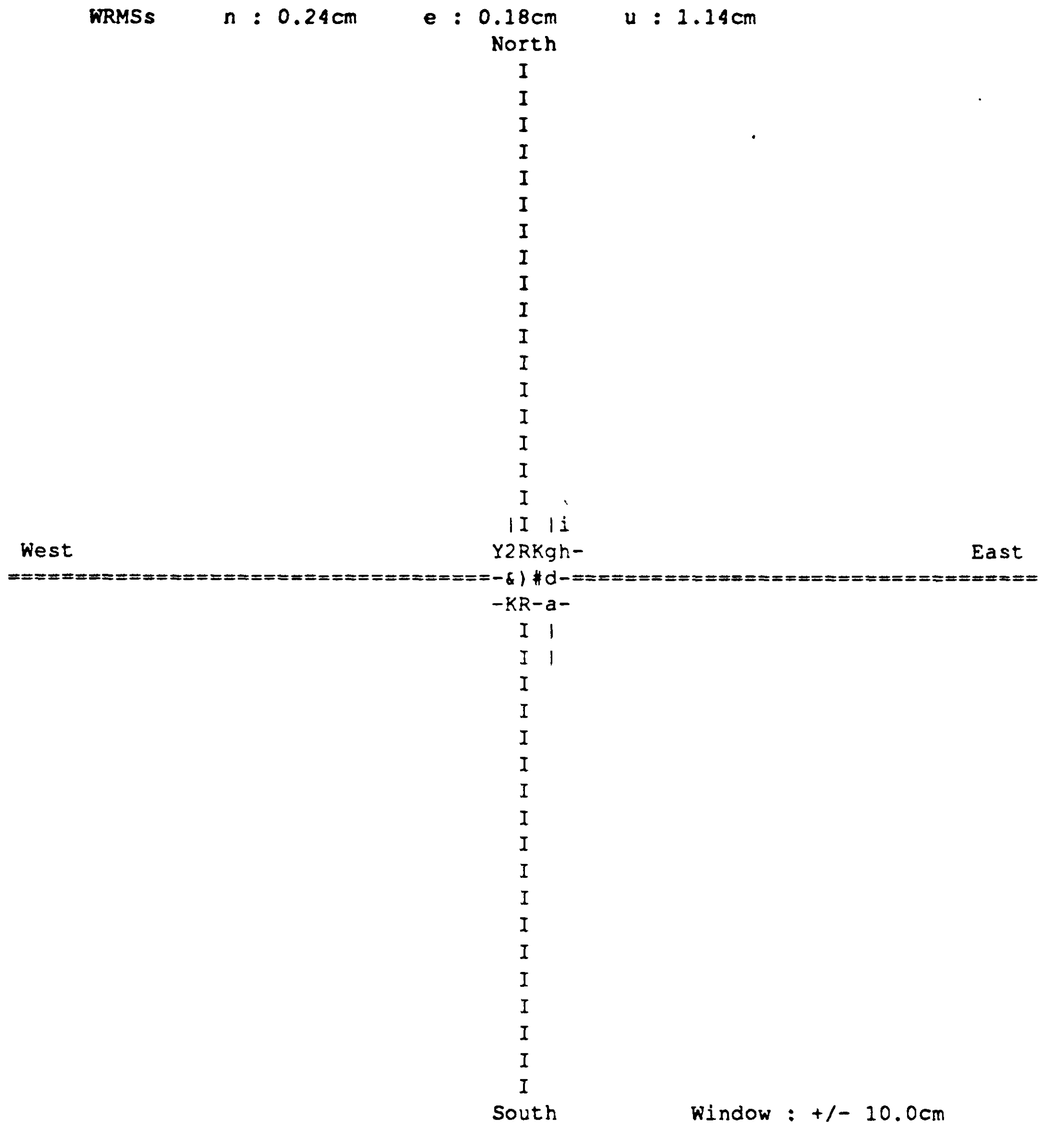

Fig. 9a Ambiguity-fixed, troposphere modeled solution. Variations about the mean in the horizontal for individual point position determinations.

```
                                      Up
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                     |I
                                    -LI
                                      J-
                                     (|-a-
 West                                21Q|                              East
===================================-&)U-=====================================
                                    Y1$#eh-
                                     2Y-gi
                                      I -f
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                      I
                                    Down          Window : +/- 10.0cm (E-W)
                                                           +/- 30.0cm (U-D)

a:a200 b:a210 c:a230 d:a250 e:a280 f:a300 g:b100 h:b200 i:b300 j:quin
k:a220 l:a270 m:a290 n:b210 o:b230 p:b250 q:b280 r:c200 s:c300 t:b220
u:b270 v:b290 w:c100 x:c220 y:c240 z:c260 A:c280 B:d100 C:d200 D:d300
E:d220 F:d240 G:d260 H:d280 J:e100 K:e200 L:e300 M:e220 N:e240 O:e260
P:e280 Q:f100 R:f200 S:f300 T:f210 U:f230 V:f280 W:g100 X:g200 Y:g300
Z:f220 !:f250 @:f270 #:f290 $:g210 %:g230 ^:g250 &:g270 *:g290 (:g280
):h100 1:h200 2:h300 3:g220
```

Fig. 9b Ambiguity-fixed, troposphere modeled solution. Variations about the mean in the vertical for individual point position determinations.

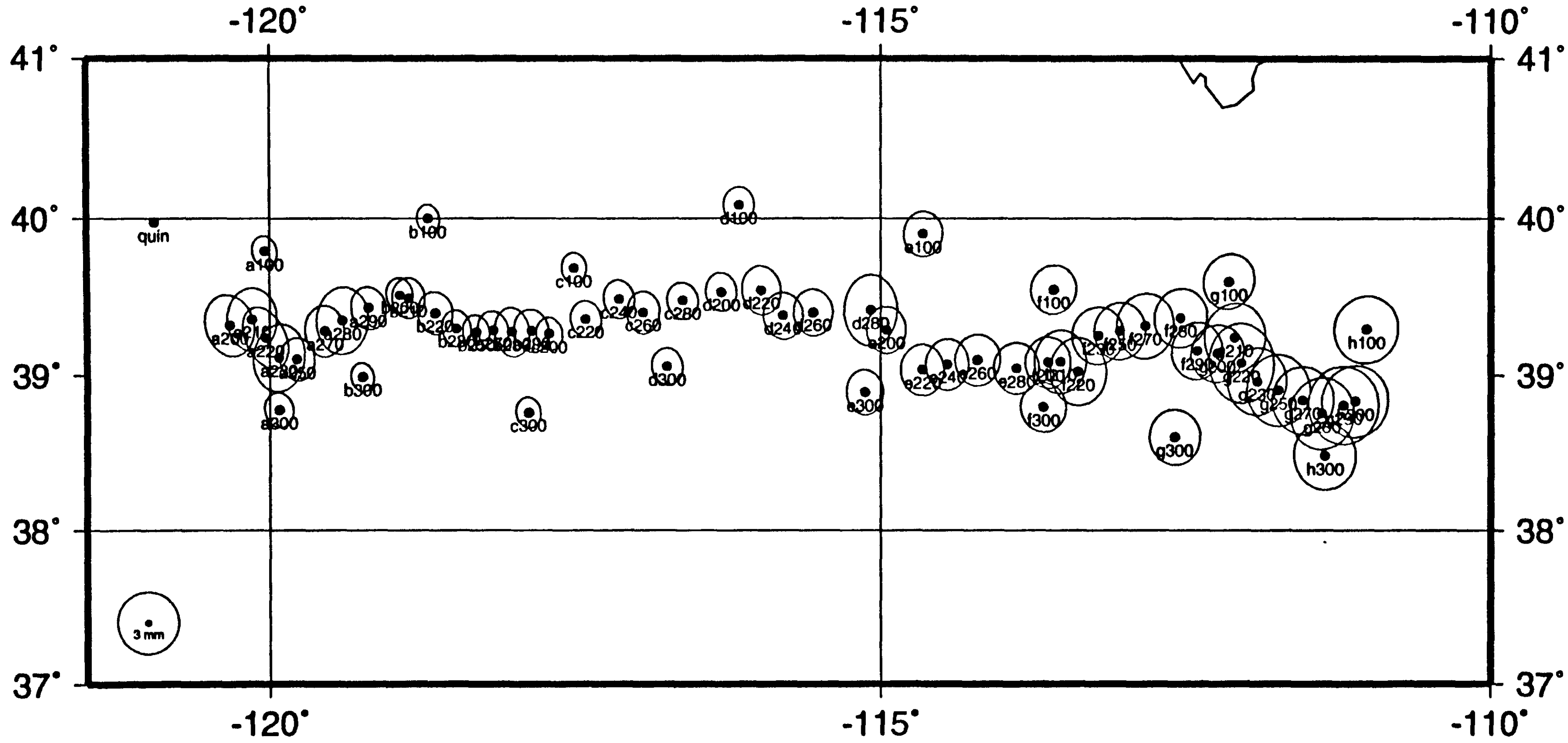

Fig. 10a Scaled formal error ellipses for the ambiguity-fixed, troposphere modeled (p1t) solution : horizontal components.

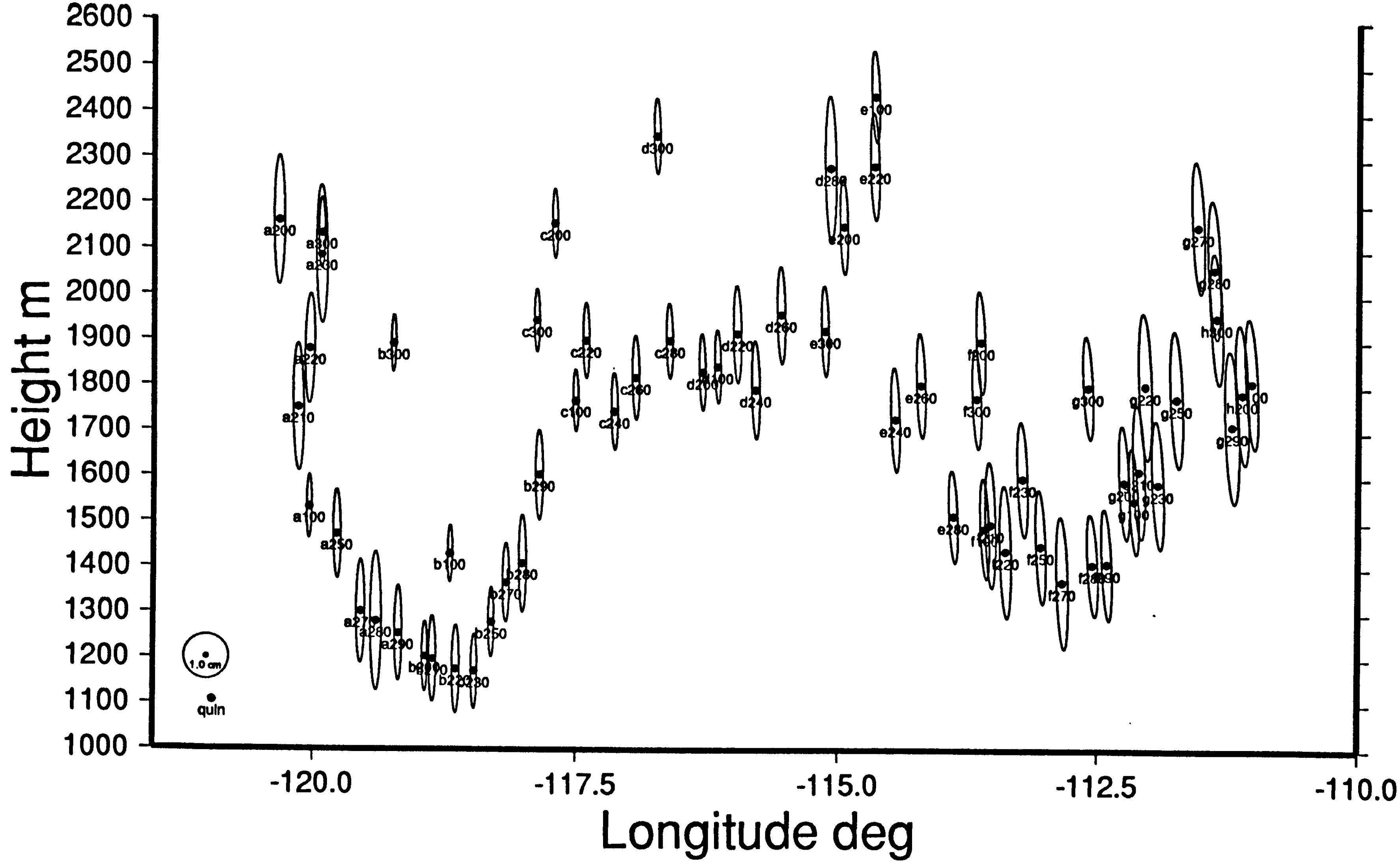

Fig. 10b Scaled formal error ellipses for the ambiguity-fixed, troposphere modeled (p1t) solution : Longitude vs. height.

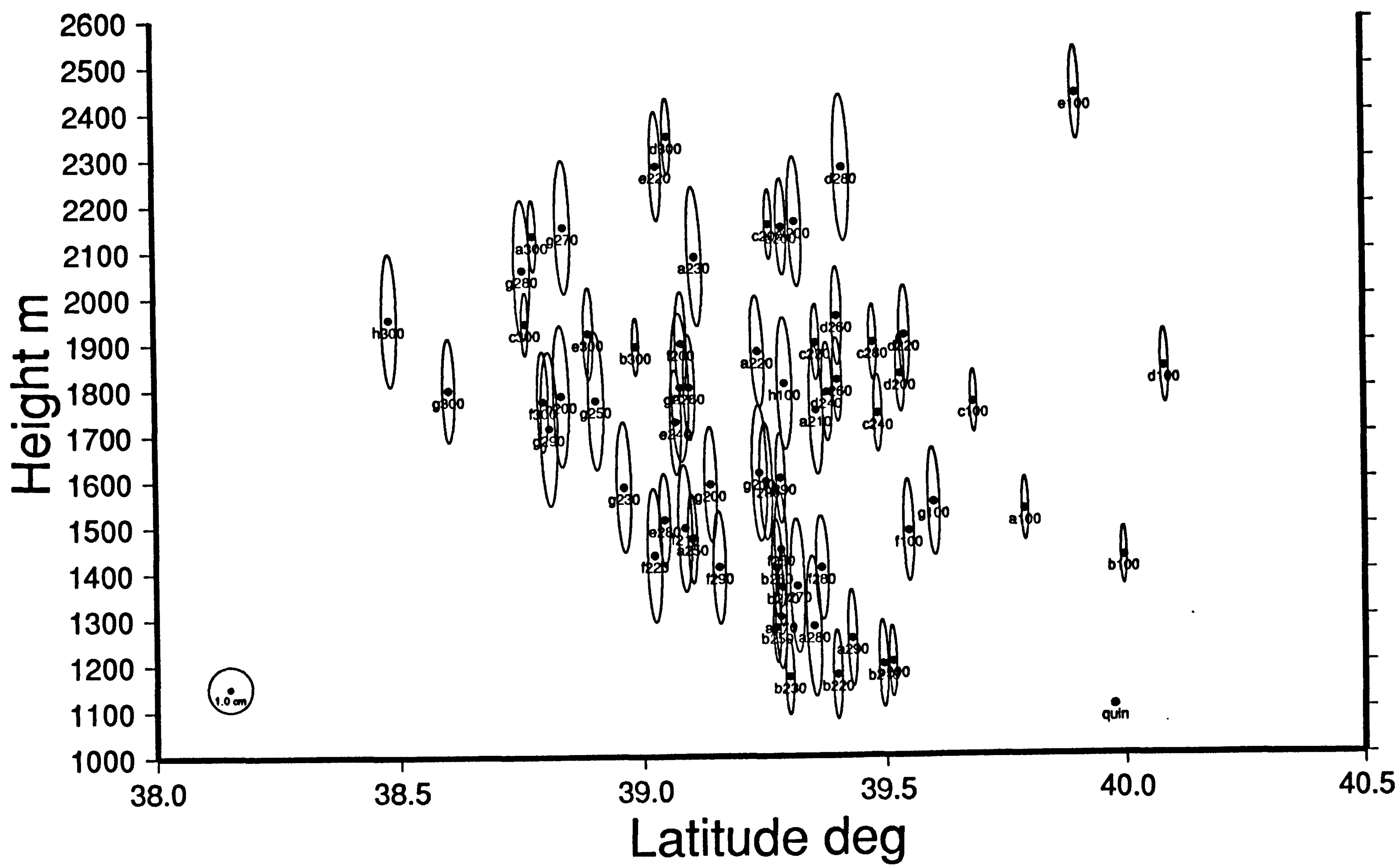

Fig. 10c Scaled formal error ellipses for the ambiguity-fixed, troposphere modeled (p1t) solution : Latitude vs. height.

Table 1 Manipulations of the original RINEX files supplied by JPL prior to translation.

1. The files acquired from the permanent tracking station Quincey were treated in the same way as the data collected as part of the Basin & Range field project, since they were also recorded using a Turborogue receiver and antenna.
2. The original data files were in compressed format and named **92oct*DD*br*nnnn*__r1.eph_z** (orbit files) and **92oct*DD*br*nnnn*__r1.rnx_z** (observation files). They were decompressed and renamed *nnnnddds.yy***n** (orbit files) and *nnnnddds.yy***o** (observation files) in order to conform with recommended practice. For example, file **92oct17brf100__r1.eph_z** was renamed **f1002911.92n**.

DD	=	day of month
nnnn	=	station code, e.g. f100
ddd	=	day of year
s	=	session number (generally 1 since we recorded only 1 daily session).
yy	=	year (92)
o	=	observation
l	=	lower case
h	=	header
n	=	navigation

3. The text of the observation files was converted to lower case, which is required by the Bernese v3.2 translation program (RXOBV3). This was done using the **dd** utility and the command:
cat *inputfile* **| dd conv=lcase >** *outputfile*
The output files were given the same name as the input files with an **l** appended, e.g. **e2802911.92o** became **e2802911.92ol**.
4. The data were processed in sessions lasting approximately 24 hours, from about day1:1500 hrs to day2:1500 hrs. The exact time windows were selected after examining the exact times that recording started at the stations for each day (Foulger, 1994, Figure 7). Where the data for a particular station spanned UHT midnight (which was most of the observation sessions), the observation files for day1 and day2 were concatenated by using the **cat** command to append the day2 *nnnnddds.yy***ol** file onto the day1 *nnnnddds.yy***ol** file.
4. The *nnnnddds.yy***ol** files were edited and the following operations performed:
a) The receiver type was changed from "rogue" to "turborogue"
b) The antenna type was set to "turborogue".
c) The true heights were inserted, calculated from the slant height measured in the field, adding 6.67 cm for the height of the choke ring.
d) Unwanted data (i.e. data not to be processed as part of the current session) were deleted from the beginning of the data block.
e) Any extra header in the middle of the file was deleted.
f) Any unwanted data were deleted from the end of the file.
g) The times of first and last epochs in the header were corrected where necessary.

Table 2 Reported satellite outages for the period of the Basin & Range survey.

Notice Advisory to NAVSTAR Users (NANUs) Issued during the 1992 calendar year

NANU NO.	SUBJECT LINE
244-92279	PRN13/SVN09 UNUSABLE DAY 279/0525-0526 UTC
245-92279	ANTI-SPOOF (A-S) TESTING
246-92280	PRN12/SVN10 UNUSABLE DAY 280/1500-1505 UTC
247-92281	PRN12/SVN10 UNUSABLE DAY 280/2205-2218 UTC
248-92281	PRN11/SVN08 USABLE DAY 280/1430 UTC
249-92283	PRN03/SVN11 UNUSABLE DAY 283/0540-0630 UTC
250-92287	PRN13/SVN09 UNUSABLE DAY 284/1041-1042 UTC
251-92287	PRN03/SVN11 UNUSABLE DAY 284/1724-1725 UTC
252-92287	PRN11/SVN08 UNUSABLE DAY 284/2204-2217 UTC
253-92287	PRN03/SVN11 UNUSABLE DAY 285/1239-1240 UTC
254-92287	ANTI-SPOOF (A-S) TESTING
255-92287	PRN13/SVN09 UNUSABLE DAY 287/1740-1741 UTC
256-92290	PRN02/SVN13 UNUSABLE DAY 290/0749 UTC UNTIL FURTHER NOTICE
257-92290	PRN02/SVN13 USABLE DAY 290/1737 UTC
258-92293	PRN12/SVN10 UNUSABLE DAY 290/1956-2009 UTC
259-92293	PRN03/SVN11 UNUSABLE DAY 291/0300-0317 UTC
260-92293	PRN13/SVN09 UNUSABLE DAY 292/1518-1531 UTC
261-92293	ANTI-SPOOF (A-S) TESTING
262-92293	PRN25/SVN25 SKED UNUSABLE DAY 296/2200 UTC FOR UP TO 12 HRS FOR MAINT.
263-92293	PRN11/SVN08 UNUSABLE DAY 293/1700-1714 UTC
264-92295	PRN12/SVN10 UNUSABLE DAY 294/2330-2331 UTC
265-92295	PRN12/SVN10 UNUSABLE DAY 295/2046-2058 UTC

Table 3 **Example of multiple simultaneous losses of lock (breaks) in a phase file.**

station : e280
number of epochs : 1124
reference epoch :1992-10-15 15:20:30 (289)
(| indicates positions of breaks, - indicates marked observations)

```
SVN                                                                                                      #rec #good #breaks
 3 I***|*******6-|*******************************************************2-                            I  778   745 2
12 I***|*******6---                                                ---|********************************9  560   504 2
13 I***|*****2---                                                                                      I  125    97 1
16 I                                                                                                   I    0     0 0
20 I***|*********|****************************--                                                 |******  550   537 3
24 I***|*********|**************4---                                                                   I  335   310 2
25 I7**|*******6-|*****3|**                                                     --|*********************  495   453 4
17 I      *****6-|*************************************************************************3           I  907   886 1
23 I                    -6***************************************************************************3--  887   849 0
21 I                                   --***************************************************************  720   705 0
28 I                                         -2*********************9*****************************2-   I  600   573 0
11 I                                                         --6****************************************  472   456 0
15 I                                                                               --*******************  223   212 0
14 I                                                                                               1****   45    45 0
```

Table 4 Example of missing data. For the period 293:1725 - 293:2047 only SV23 was recorded.

DOSE Basin & Range GPS Survey, Oct. 1992.

Survey: nevada92 station 1: g300
type of observation: phase zero difference
reference epoch : 1992-10-19 15:40:30.00 one character = 22.00 minutes
total number of observations: 12535

```
svn frq #obs
  2 13   883!                                       ********************      !
  3 13   273!   **         **                   **                           *!
 11 13  1022!              ************             ***********               !
 12 13   922!               *********                            *************!
 13 13   772!                             *                  *****************!
 14 13   900!                        ****************               *****     !
 15 13  1047!                   **************            **********          !
 16 13   547!    *                                  *******              *****!
 17 13   326!   **         ******                                             !
 18 13   768!                              ******************                 !
 19 13   858!                                ********************             !
 20 13   608!    *                 ********                             ******!
 21 13   593!              **************                                     !
 23 13   859!   ********************                                          !
 24 13   555!   **                                                ************!
 25 13   747!                  ****************                              *!
 28 13   855!              *********           ***********                    !
  epoch number   124        480 654 845 100811671385 1597  1865 2064 23012482697
```

Table 5 Comparison of the results of the 421-331 method and the 321 method for resolving L1 and L2 ambiguities and calculating final coordinates.

	% ambs resolved	RMS of sng diffs (s)	repeatability of coords (WRMS) (cm)
421-331 method	92	0.0095	1.9
321 method	99-100	0.0021	1.1

Table 6 WRMS (repeatability) from day to day of ambiguity-free (p1) and ambiguity-fixed (p4) solutions with and without tropospheric modeling (suffix t).

	p1	p1t	p4	p4t	# new occs
days 1-2	0.7	0.3	0.6	0.4	5
days 3-4	0.7	0.1	0.3	0.2	5
days 5-6	0.6	0.3	0.8	0.3	10
days 7-8	0.6	0.6	0.4	0.4	7
days 9-10	0.3	0.2	0.4	0.3	6
days 11-12	0.2	0.2	0.3	0.2	8
days 13-14	1.3	0.3	1.3	0.3	6
days 1-14 (wrms)	0.7	0.3	0.6	0.3	
days 1-14 (nrms)	16.3	6.9	16.9	8.6	

Table 7 Repeatabilities (WRMS) and scaled formal errors (SFE) for the four solutions studied. p1 : ambiguities free, p4 : ambiguities fixed, suffix t : troposphere modeled.

solution	n	e	u	bas
p1				
ave wrms of baseline lengths				0.3
wrms	0.27	0.55	1.79	
ave sfe	0.79	1.53	1.53	
p1t				
ave wrms of baseline lengths				0.3
wrms	0.25	0.42	1.04	
ave sfe	0.33	0.63	1.93	
p4				
ave wrms of baseline lengths				0.1
wrms	0.22	0.19	1.48	
ave sfe	0.50	0.39	1.19	
p4t				
ave wrms of baseline lengths				0.1
wrms	0.24	0.18	1.14	
ave sfe	0.25	0.21	2.25	

Appendix 1 Data : The ambiguity free, troposphere modeled solution (p1t)

List of coordinates (p1t)

```
Basin & Range 92     network adjustment solution  p1t   Thu Apr 14 19:09:51 1994
----------------------------------------------------------------------------------
local geodetic datum: ITRF91

num  station name          latitude          longitude        height   flag

  1  quin              39 58 28.39736   -120 56 39.92915   1105.7719    s
  2  a100              39 47 27.30521   -120  2 19.80910   1532.1984    s
  3  a200              39 19  4.62335   -120 19 29.78031   2162.0523    s
  4  a300              38 46 38.09883   -119 55 26.59997   2134.5084    s
  5  a210              39 21 27.81920   -120  8 31.87678   1750.7354    s
  6  a220              39 14 18.30671   -120  1 57.22576   1879.8994    s
  7  a230              39  6 38.96499   -119 55 21.70702   2087.1274    s
  8  a250              39  6  5.23701   -119 46 27.17288   1471.9237    s
  9  a270              39 16 55.96767   -119 33  0.99765   1301.9632    s
 10  a280              39 20 59.45224   -119 24 19.68052   1280.6424    s
 11  a290              39 25 44.71378   -119 11 36.56099   1254.2997    s
 12  b100              39 59 43.36785   -118 42 11.25119   1429.2610    s
 13  b200              39 30 47.05603   -118 56 19.60549   1203.3141    s
 14  b300              38 59 17.21947   -119 14 38.79867   1892.1156    s
 15  b210              39 29 36.07640   -118 52  2.80541   1197.8980    s
 16  b220              39 23 51.44315   -118 38 47.12769   1175.5952    s
 17  b230              39 17 55.86710   -118 28 19.30168   1171.0176    s
 18  b250              39 16 25.71728   -118 18 38.46758   1278.8806    s
 19  b270              39 17 10.11210   -118 10 22.01479   1365.5723    s
 20  b280              39 16 29.25202   -118  0 59.69077   1408.1216    s
 21  b290              39 17  1.73088   -117 51 33.13705   1603.2537    s
 22  c100              39 41  8.69478   -117 30 31.91887   1767.1601    s
 23  c200              39 15 49.37780   -117 42 42.08045   2156.5731    s
 24  c300              38 45 35.71950   -117 53  2.12100   1943.5943    s
 25  c220              39 21 27.51986   -117 24 41.43197   1899.1675    s
 26  c240              39 29 11.81460   -117  8 32.34652   1743.6388    s
 27  c260              39 24  7.90186   -116 56 30.12920   1817.9078    s
 28  c280              39 28 36.43387   -116 37 16.79338   1898.5439    s
 29  d100              40  5  1.05144   -116  9 39.09641   1842.4914    s
 30  d200              39 32  1.35894   -116 18 22.78651   1830.2986    s
 31  d300              39  3 22.17480   -116 44 44.34471   2347.8371    s
 32  d220              39 32 35.37216   -115 58 33.81019   1914.3730    s
 33  d240              39 22 49.99286   -115 47 56.61655   1791.4199    s
 34  d260              39 24  7.72783   -115 33 20.70406   1956.1208    s
 35  d280              39 24 54.71653   -115  4 53.59445   2278.5966    s
 36  e100              39 54  6.01115   -114 39  7.04340   2435.7628    s
 37  e200              39 17 22.86887   -114 57 12.49936   2150.9380    s
 38  e300              38 53 23.57578   -115  7 48.68239   1921.3184    s
 39  e220              39  1 58.70431   -114 39 28.42208   2283.8573    s
 40  e240              39  4  7.26851   -114 27 12.45922   1726.3596    s
 41  e260              39  5 48.62658   -114 12 15.27025   1801.7541    s
 42  e280              39  2 40.33551   -113 53 12.92598   1512.9561    s
 43  f100              39 32 54.55467   -113 35  5.33906   1486.9188    s
 44  f200              39  4 52.56806   -113 37 46.84644   1897.6766    s
 45  f300              38 47 41.08048   -113 40  0.30250   1773.2888    s
 46  f210              39  5 11.03780   -113 31 49.37222   1495.4928    s
 47  f220              39  1 25.64478   -113 23  5.21412   1436.6644    s
 48  f230              39 15 13.81116   -113 13 24.94662   1596.1171    s
 49  f250              39 16 58.60000   -113  2 45.00397   1447.6670    s
 50  f270              39 18 59.73732   -112 50 13.88319   1368.7982    s
 51  f280              39 22  1.18806   -112 32 44.18720   1407.8170    s
 52  f290              39  9 24.43559   -112 24 34.49156   1409.4885    s
 53  g100              39 36  2.62568   -112  8 51.06054   1549.1817    s
 54  g200              39  8 23.70208   -112 14 31.50863   1590.3027    s
 55  g300              38 36  8.40655   -112 35 37.24757   1799.0253    s
 56  g210              39 14 27.76023   -112  5 53.96412   1614.1346    s
 57  g220              39  4 42.37107   -112  2 29.57297   1802.1523    s
 58  g230              38 57 40.75149   -111 54 52.37146   1585.6041    s
 59  g250              38 54 15.70867   -111 44 17.98091   1774.3566    s
 60  g270              38 50 20.95147   -111 32 12.36486   2153.6491    s
 61  g280              38 45 17.71007   -111 22 51.69922   2060.4328    s
 62  g290              38 48 27.42129   -111 12 20.00331   1714.1562    s
 63  h100              39 17 35.75875   -111  1 13.35886   1809.9538    s
 64  h200              38 49 57.44427   -111  6 41.17693   1785.2446    s
 65  h300              38 28 58.08708   -111 21 32.40619   1952.8659    s
```

Coordinates and point scaled formal errors (plt)

#	station	n	x	dx	y	dy	z	dz	dn	de	du	n-e	e-u	u-n	x-y	y-z	z-x
			plt average position and scaled formal error (cm)									correlation					
1	quin	2	-251723090.25	0.01	-419859518.99	0.01	407653127.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2	a100	2	-245726825.28	0.49	-424945899.33	0.83	406115532.01	0.71	0.18	0.38	1.13	-0.28	0.18	-0.15	0.60	-0.91	-0.77
3	a200	2	-249559098.55	1.12	-426642794.54	2.56	402105721.30	1.59	0.81	1.30	2.82	-0.76	0.45	-0.47	0.36	-0.77	-0.75
4	a300	2	-248453866.84	0.63	-431655035.92	0.99	397440618.30	0.84	0.20	0.45	1.36	-0.05	0.09	-0.14	0.64	-0.93	-0.76
5	a210	1	-248040424.27	0.97	-427166953.46	2.20	402421302.37	1.48	0.53	0.98	2.59	-0.74	0.46	-0.50	0.52	-0.87	-0.79
6	a220	1	-247647663.50	1.23	-428375910.20	2.02	401404147.01	1.55	0.42	0.86	2.66	-0.09	0.16	-0.49	0.65	-0.94	-0.77
7	a230	1	-247280297.69	1.00	-429639690.77	2.27	400318755.90	1.53	0.54	0.98	2.69	-0.73	0.45	-0.51	0.54	-0.88	-0.80
8	a250	2	-246174941.38	0.81	-430294597.54	1.88	400199218.47	1.27	0.42	0.81	2.23	-0.56	0.51	-0.52	0.54	-0.91	-0.72
9	a270	1	-243859231.80	0.95	-430138610.26	2.29	401744129.51	1.56	0.53	0.96	2.71	-0.58	0.52	-0.49	0.55	-0.90	-0.74
10	a280	1	-242536864.51	1.05	-430337580.72	2.18	402323832.03	1.57	0.66	1.06	2.60	-0.77	0.33	-0.31	0.44	-0.79	-0.81
11	a290	1	-240669734.81	0.83	-430742716.11	1.35	403002201.54	1.14	0.28	0.57	1.85	-0.02	0.11	-0.25	0.66	-0.94	-0.76
12	b100	4	-235051147.94	0.51	-429274114.27	0.78	407851121.30	0.70	0.17	0.38	1.09	0.05	0.07	-0.12	0.58	-0.93	-0.71
13	b200	3	-238463716.47	0.60	-431286091.96	0.98	403718882.75	0.83	0.20	0.44	1.33	-0.13	0.13	-0.19	0.61	-0.93	-0.75
14	b300	4	-242586605.99	0.51	-433274011.20	0.79	399248212.95	0.69	0.16	0.38	1.09	0.07	0.10	-0.05	0.59	-0.93	-0.71
15	b210	1	-237993618.10	0.70	-431704248.34	1.43	403549602.94	1.04	0.33	0.65	1.75	-0.59	0.35	-0.41	0.51	-0.88	-0.75
16	b220	1	-236649492.18	0.76	-433210323.78	1.17	402727269.75	1.01	0.22	0.51	1.62	0.03	0.03	-0.22	0.66	-0.94	-0.77
17	b230	1	-235661144.46	0.64	-434539601.24	1.03	401878832.02	0.89	0.20	0.44	1.42	-0.03	0.07	-0.15	0.66	-0.94	-0.77
18	b250	2	-234524025.88	0.60	-435363851.99	0.96	401670439.69	0.83	0.19	0.43	1.32	-0.04	0.07	-0.14	0.63	-0.94	-0.75
19	b270	1	-233437718.73	0.65	-435856549.17	1.05	401781926.80	0.92	0.20	0.44	1.46	0.00	0.06	-0.10	0.67	-0.94	-0.77
20	b280	1	-232287639.54	0.85	-436564684.35	1.85	401687061.45	1.36	0.63	0.85	2.21	-0.74	0.32	-0.24	0.45	-0.76	-0.81
21	b290	1	-231065058.10	0.71	-437158345.76	1.26	401776965.88	1.03	0.24	0.52	1.68	-0.25	0.17	-0.25	0.64	-0.93	-0.78
22	c100	4	-227082593.03	0.55	-436056837.21	0.86	405232396.32	0.76	0.18	0.40	1.19	-0.01	0.05	-0.12	0.60	-0.93	-0.73
23	c200	4	-230024391.79	0.60	-437914808.48	0.97	401639209.54	0.83	0.20	0.43	1.33	-0.10	0.08	-0.13	0.62	-0.93	-0.75
24	c300	4	-232979059.01	0.55	-440319603.83	0.88	397278639.67	0.76	0.18	0.41	1.21	-0.01	0.07	-0.05	0.60	-0.93	-0.73
25	c220	2	-227413540.31	0.70	-438509585.65	1.11	402430001.33	0.96	0.22	0.48	1.54	-0.04	0.03	-0.16	0.65	-0.94	-0.76
26	c240	2	-224930388.98	0.68	-438753116.08	1.12	403526551.29	0.96	0.23	0.49	1.54	-0.16	0.05	-0.18	0.63	-0.93	-0.76
27	c260	2	-223665232.64	0.71	-440074104.58	1.31	402807271.10	1.04	0.29	0.57	1.70	-0.42	0.17	-0.29	0.57	-0.90	-0.76
28	c280	2	-220968044.59	0.63	-440852957.71	1.03	403452158.67	0.89	0.21	0.45	1.42	-0.10	0.03	-0.15	0.63	-0.93	-0.75
29	d100	4	-215514738.33	0.62	-438740098.92	1.01	408628061.93	0.88	0.21	0.45	1.40	-0.10	0.01	-0.20	0.63	-0.93	-0.75
30	d200	4	-218360427.57	0.64	-441695899.17	1.10	403935586.51	0.91	0.22	0.47	1.47	-0.21	0.08	-0.23	0.61	-0.93	-0.75
31	d300	4	-223270317.74	0.65	-443043853.17	1.06	399863964.03	0.90	0.21	0.46	1.45	-0.10	0.03	-0.13	0.63	-0.93	-0.75
32	d220	2	-215784320.31	0.79	-442893032.69	1.34	404021859.90	1.14	0.26	0.54	1.83	-0.17	0.02	-0.23	0.66	-0.94	-0.78
33	d240	2	-214910485.31	0.78	-444582302.19	1.35	402619850.50	1.13	0.26	0.54	1.83	-0.20	0.04	-0.22	0.66	-0.94	-0.79
34	d260	2	-212960456.28	0.76	-445365107.17	1.33	402815629.46	1.12	0.25	0.53	1.81	-0.19	0.04	-0.22	0.66	-0.94	-0.78
35	d280	1	-209238779.81	0.98	-447051575.06	2.19	402948103.64	1.60	0.51	0.82	2.72	-0.59	0.29	-0.41	0.59	-0.90	-0.79
36	e100	4	-204447704.48	0.74	-445484771.45	1.30	407117837.87	1.08	0.27	0.54	1.74	-0.26	0.03	-0.27	0.62	-0.93	-0.76
37	e200	4	-208607630.45	0.76	-448310635.07	1.37	401862114.71	1.11	0.28	0.56	1.81	-0.30	0.07	-0.25	0.62	-0.92	-0.77
38	e300	4	-211170690.00	0.74	-450183505.67	1.29	398401553.64	1.07	0.26	0.53	1.73	-0.24	0.03	-0.18	0.63	-0.93	-0.77
39	e220	2	-207047552.25	0.83	-451026432.67	1.54	399659945.64	1.24	0.31	0.61	2.03	-0.35	0.08	-0.25	0.63	-0.92	-0.78
40	e240	2	-205315602.82	0.81	-451495461.97	1.48	399932809.54	1.20	0.30	0.59	1.96	-0.32	0.04	-0.24	0.63	-0.92	-0.78
41	e260	2	-203271384.95	0.82	-452209803.05	1.50	400180257.17	1.21	0.31	0.60	1.98	-0.34	0.05	-0.25	0.62	-0.92	-0.78
42	e280	2	-200902987.22	0.76	-453642840.28	1.33	399711137.08	1.08	0.30	0.59	1.76	-0.32	0.02	-0.22	0.57	-0.91	-0.74
43	f100	4	-197089361.13	0.79	-451445786.32	1.44	404040275.40	1.17	0.31	0.59	1.90	-0.34	0.02	-0.26	0.61	-0.92	-0.77
44	f200	4	-198773167.21	0.81	-454332150.05	1.49	400052087.37	1.20	0.32	0.61	1.96	-0.38	0.04	-0.24	0.60	-0.91	-0.77
45	f300	4	-199865896.94	0.79	-456026064.67	1.44	397569425.12	1.17	0.31	0.60	1.91	-0.35	0.03	-0.20	0.60	-0.92	-0.77
46	f210	1	-197958669.86	0.90	-454614403.64	1.84	400070954.70	1.41	0.40	0.69	2.36	-0.45	0.14	-0.33	0.61	-0.91	-0.78
47	f220	1	-196974816.56	0.94	-455513851.25	1.71	399527377.40	1.38	0.35	0.67	2.27	-0.31	0.00	-0.25	0.64	-0.93	-0.78
48	f230	2	-195061643.53	0.85	-454595768.78	1.59	401518789.65	1.28	0.34	0.64	2.09	-0.38	0.03	-0.27	0.61	-0.92	-0.77
49	f250	2	-193565719.40	0.85	-454999923.39	1.57	401759639.53	1.27	0.34	0.64	2.07	-0.37	0.01	-0.26	0.61	-0.92	-0.77
50	f270	1	-191813317.86	0.92	-455478040.47	1.74	402043798.87	1.41	0.35	0.67	2.30	-0.36	0.02	-0.25	0.63	-0.93	-0.78
51	f280	2	-189357995.71	0.83	-456123370.97	1.51	402479136.86	1.19	0.37	0.67	1.96	-0.39	0.03	-0.27	0.54	-0.89	-0.73
52	f290	2	-188837799.91	0.84	-457937478.94	1.57	400671910.66	1.27	0.34	0.63	2.06	-0.36	-0.01	-0.24	0.61	-0.92	-0.77
53	g100	4	-185566214.71	0.83	-455909442.61	1.52	404491428.63	1.23	0.34	0.62	2.01	-0.36	-0.02	-0.28	0.60	-0.91	-0.76
54	g200	3	-187548362.19	0.85	-458610009.36	1.64	400538043.81	1.29	0.36	0.64	2.13	-0.40	0.03	-0.28	0.60	-0.92	-0.77
55	g300	4	-191804586.62	0.83	-460924224.63	1.51	395903586.61	1.21	0.34	0.64	1.98	-0.38	0.01	-0.19	0.58	-0.91	-0.75
56	g210	2	-186130801.39	0.94	-458423370.83	1.81	401409921.48	1.45	0.38	0.70	2.37	-0.38	0.00	-0.27	0.62	-0.92	-0.78
57	g220	1	-186109850.23	1.00	-459678051.19	1.89	400021648.22	1.53	0.40	0.71	2.50	-0.34	-0.04	-0.24	0.65	-0.92	-0.79
58	g230	2	-185389798.05	0.93	-460833472.33	1.79	398997600.46	1.43	0.39	0.70	2.34	-0.38	0.00	-0.25	0.62	-0.92	-0.77
59	g250	2	-184124217.66	1.03	-461784298.79	1.93	398517479.41	1.56	0.41	0.76	2.54	-0.35	-0.03	-0.23	0.62	-0.92	-0.77
60	g270	2	-182676248.09	0.95	-462879364.36	1.81	397977499.45	1.44	0.39	0.71	2.36	-0.38	-0.02	-0.24	0.61	-0.92	-0.77
61	g280	2	-181628404.46	0.99	-463913188.36	1.88	397242634.41	1.49	0.41	0.75	2.45	-0.40	-0.01	-0.24	0.59	-0.91	-0.76
62	g290	1	-180064456.99	1.72	-464100385.09	2.85	397677115.21	2.05	0.66	1.40	3.59	0.02	-0.02	-0.49	0.50	-0.93	-0.61
63	h100	2	-177347502.86	0.96	-461515367.49	1.84	401871295.86	1.46	0.42	0.74	2.39	-0.38	-0.02	-0.29	0.58	-0.91	-0.75
64	h200	2	-179241145.50	1.06	-464238326.95	1.96	397897914.99	1.56	0.42	0.79	2.57	-0.34	-0.06	-0.25	0.61	-0.92	-0.76
65	h300	2	-182133870.30	0.96	-465731557.11	1.85	394875038.23	1.46	0.40	0.72	2.41	-0.39	-0.01	-0.24	0.61	-0.92	-0.77

Coordinates and point repeatabilities (p1t)

#	station	n	plt network solutions and wrms around them (cm)								
			x	rx	y	ry	z	rz	rn	re	ru
1	quin	2	-251723090.25	0.00	-419859518.99	0.00	407653127.17	0.00	0.00	0.00	0.00
2	a100	2	-245726825.28	0.02	-424945899.33	0.11	406115532.01	0.37	0.21	0.04	0.29
3	a200	2	-249559098.55	0.53	-426642794.54	1.38	402105721.30	0.56	0.46	0.47	0.75
4	a300	2	-248453866.84	0.47	-431655035.92	1.27	397440618.30	0.76	0.04	1.01	1.24
5	a210	1	-248040424.27	0.00	-427166953.46	0.00	402421302.37	0.00	0.00	0.00	0.00
6	a220	1	-247647663.50	0.00	-428375910.20	0.00	401404147.01	0.00	0.00	0.00	0.00
7	a230	1	-247280297.69	0.00	-429639690.77	0.00	400318755.90	0.00	0.00	0.00	0.00
8	a250	2	-246174941.38	0.49	-430294597.54	2.18	400199218.47	1.55	0.17	0.63	2.63
9	a270	1	-243859231.80	0.00	-430138610.26	0.00	401744129.51	0.00	0.00	0.00	0.00
10	a280	1	-242536864.51	0.00	-430337580.72	0.00	402323832.03	0.00	0.00	0.00	0.00
11	a290	1	-240669734.81	0.00	-430742716.11	0.00	403002201.54	0.00	0.00	0.00	0.00
12	b100	4	-235051147.94	1.91	-429274114.27	3.40	407851121.30	3.11	0.23	0.33	0.60
13	b200	3	-238463716.47	1.49	-431286091.96	1.02	403718882.75	1.33	0.13	0.61	1.16
14	b300	4	-242586605.99	2.69	-433274011.20	4.00	399248212.95	3.51	0.03	1.04	1.22
15	b210	1	-237993618.10	0.00	-431704248.34	0.00	403549602.94	0.00	0.00	0.00	0.00
16	b220	1	-236649492.18	0.00	-433210323.78	0.00	402727269.75	0.00	0.00	0.00	0.00
17	b230	1	-235661144.46	0.00	-434539601.24	0.00	401878832.02	0.00	0.00	0.00	0.00
18	b250	2	-234524025.88	0.01	-435363851.99	0.00	401670439.69	0.15	0.13	0.01	0.09
19	b270	1	-233437718.73	0.00	-435856549.17	0.00	401781926.80	0.00	0.00	0.00	0.00
20	b280	1	-232287639.54	0.00	-436564684.35	0.00	401687061.45	0.00	0.00	0.00	0.00
21	b290	1	-231065058.10	0.00	-437158345.76	0.00	401776965.88	0.00	0.00	0.00	0.00
22	c100	4	-227082593.03	0.29	-436056837.21	1.01	405232396.32	0.82	0.15	0.13	0.32
23	c200	4	-230024391.79	0.30	-437914808.48	1.57	401639209.54	1.23	0.33	0.44	1.03
24	c300	4	-232979059.01	0.37	-440319603.83	0.79	397278639.67	0.73	0.06	0.06	0.70
25	c220	2	-227413540.31	0.22	-438509585.65	0.02	402430001.33	0.33	0.18	0.19	0.26
26	c240	2	-224930388.98	0.02	-438753116.08	0.32	403526551.29	0.21	0.34	0.16	0.07
27	c260	2	-223665232.64	0.06	-440074104.58	0.35	402807271.10	0.04	0.21	0.20	0.17
28	c280	2	-220968044.59	0.20	-440852957.71	0.19	403452158.67	0.43	0.16	0.09	0.46
29	d100	4	-215514738.33	0.85	-438740098.92	1.62	408628061.93	1.49	0.08	0.47	0.75
30	d200	4	-218360427.57	1.29	-441695899.17	2.18	403935586.51	1.75	0.23	0.28	1.21
31	d300	4	-223270317.74	1.18	-443043853.17	1.67	399863964.03	1.63	0.01	0.10	0.57
32	d220	2	-215784320.31	0.27	-442893032.69	1.19	404021859.90	0.18	0.48	0.76	0.86
33	d240	2	-214910485.31	0.18	-444582302.19	0.71	402619850.50	0.28	0.14	0.48	0.62
34	d260	2	-212960456.28	0.29	-445365107.17	0.60	402815629.46	0.02	0.29	0.54	0.33
35	d280	2	-209238779.81	0.70	-447051575.06	1.16	402948103.64	0.09	0.55	1.13	0.53
36	e100	4	-204447704.48	0.19	-445484771.45	0.86	407117837.87	0.35	0.46	0.37	0.67
37	e200	4	-208607630.45	0.51	-448310635.07	1.35	401862114.71	0.90	0.43	1.00	1.42
38	e300	4	-211170690.00	0.49	-450183505.67	0.32	398401553.64	0.94	0.33	0.34	0.87
39	e220	2	-207047552.25	0.05	-451026432.67	0.25	399659945.64	0.13	0.24	0.15	0.08
40	e240	2	-205315602.82	0.04	-451495461.97	0.34	399932809.54	0.17	0.31	0.17	0.12
41	e260	2	-203271384.95	0.23	-452209803.05	0.67	400180257.17	0.04	0.42	0.07	0.58
42	e280	2	-200902987.22	0.03	-453642840.28	0.47	399711137.08	0.08	0.33	0.22	0.28
43	f100	4	-197089361.13	0.59	-451445786.32	1.09	404040275.40	0.81	0.13	0.08	0.17
44	f200	4	-198773167.21	0.69	-454332150.05	1.09	400052087.37	0.63	0.20	0.10	0.40
45	f300	4	-199865896.94	0.49	-456026064.67	0.85	397569425.12	0.38	0.06	0.21	0.45
46	f210	1	-197958669.86	0.00	-454614403.64	0.00	400070954.70	0.00	0.00	0.00	0.00
47	f220	1	-196974816.56	0.00	-455513851.25	0.00	399527377.40	0.00	0.00	0.00	0.00
48	f230	2	-195061643.53	0.36	-454595768.78	0.21	401518789.65	0.02	0.05	0.16	0.02
49	f250	2	-193565719.40	0.77	-454999923.39	0.04	401759639.53	0.03	0.14	0.14	0.24
50	f270	1	-191813317.86	0.00	-455478040.47	0.00	402043798.87	0.00	0.00	0.00	0.00
51	f280	2	-189357995.71	0.37	-456123370.97	0.77	402479136.86	0.26	0.11	0.42	0.82
52	f290	2	-188837799.91	0.37	-457937478.94	0.16	400671910.66	0.03	0.16	0.31	0.26
53	g100	4	-185566214.71	0.72	-455909442.61	0.61	404491428.63	0.58	0.10	0.07	1.04
54	g200	3	-187548362.19	0.83	-458610009.36	0.22	400538043.81	0.60	0.21	0.32	0.79
55	g300	4	-191804586.62	0.48	-460924224.63	1.38	395903586.61	1.09	0.27	0.41	1.59
56	g210	2	-186130801.39	0.94	-458423370.83	1.22	401409921.48	1.21	0.03	0.38	1.94
57	g220	1	-186109850.23	0.00	-459678051.19	0.00	400021648.22	0.00	0.00	0.00	0.00
58	g230	2	-185389798.05	1.20	-460833472.33	1.66	398997600.46	1.41	0.14	0.50	2.45
59	g250	2	-184124217.66	0.18	-461784298.79	0.81	398517479.41	0.66	0.00	0.04	0.76
60	g270	2	-182676248.09	0.64	-462879364.36	0.06	397977499.45	0.63	0.30	0.59	0.62
61	g280	2	-181628404.46	1.40	-463913188.36	2.05	397242634.41	2.07	0.10	0.36	2.77
62	g290	1	-180064456.99	0.00	-464100385.09	0.00	397677115.21	0.00	0.00	0.00	0.00
63	h100	2	-177347502.86	1.35	-461515367.49	0.46	401871295.86	1.00	0.15	1.23	1.21
64	h200	2	-179241145.50	0.99	-464238326.95	0.97	397897914.99	1.07	0.06	0.56	1.27
65	h300	2	-182133870.30	1.28	-465731557.11	1.21	394875038.23	1.10	0.18	0.84	1.59

Appendix 2 Data : The ambiguity fixed, troposphere modeled solution (p4t)

List of coordinates (p4t)

Basin & Range 92 network adjustment solution p4t Fri Apr 15 09:15:30 1994

local geodetic datum: ITRF91

num	station name	latitude	longitude	height	flag
1	quin	39 58 28.39736	-120 56 39.92915	1105.7719	s
2	a100	39 47 27.30515	-120 2 19.80930	1532.1978	s
3	a200	39 19 4.62344	-120 19 29.78104	2162.0462	s
4	a300	38 46 38.09901	-119 55 26.60092	2134.5054	s
5	a210	39 21 27.81928	-120 8 31.87712	1750.7666	s
6	a220	39 14 18.30685	-120 1 57.22577	1879.9000	s
7	a230	39 6 38.96495	-119 55 21.70737	2087.1445	s
8	a250	39 6 5.23713	-119 46 27.17317	1471.9230	s
9	a270	39 16 55.96789	-119 33 0.99823	1301.9614	s
10	a280	39 20 59.45257	-119 24 19.68113	1280.6503	s
11	a290	39 25 44.71388	-119 11 36.56148	1254.3033	s
12	b100	39 59 43.36794	-118 42 11.25164	1429.2730	s
13	b200	39 30 47.05616	-118 56 19.60604	1203.3192	s
14	b300	38 59 17.21962	-119 14 38.79919	1892.1193	s
15	b210	39 29 36.07652	-118 52 2.80590	1197.9064	s
16	b220	39 23 51.44323	-118 38 47.12825	1175.6036	s
17	b230	39 17 55.86723	-118 28 19.30224	1171.0280	s
18	b250	39 16 25.71743	-118 18 38.46808	1278.8867	s
19	b270	39 17 10.11219	-118 10 22.01524	1365.5801	s
20	b280	39 16 29.25201	-118 0 59.69100	1408.1373	s
21	b290	39 17 1.73098	-117 51 33.13738	1603.2500	s
22	c100	39 41 8.69492	-117 30 31.91948	1767.1641	s
23	c200	39 15 49.37795	-117 42 42.08105	2156.5748	s
24	c300	38 45 35.71963	-117 53 2.12155	1943.5996	s
25	c220	39 21 27.52000	-117 24 41.43261	1899.1715	s
26	c240	39 29 11.81474	-117 8 32.34712	1743.6400	s
27	c260	39 24 7.90203	-116 56 30.12987	1817.9081	s
28	c280	39 28 36.43404	-116 37 16.79411	1898.5453	s
29	d100	40 5 1.05162	-116 9 39.09723	1842.4997	s
30	d200	39 32 1.35908	-116 18 22.78706	1830.3064	s
31	d300	39 3 22.17495	-116 44 44.34537	2347.8421	s
32	d220	39 32 35.37239	-115 58 33.81098	1914.3704	s
33	d240	39 22 49.99307	-115 47 56.61721	1791.4228	s
34	d260	39 24 7.72802	-115 33 20.70479	1956.1245	s
35	d280	39 24 54.71711	-115 4 53.59583	2278.5510	s
36	e100	39 54 6.01132	-114 39 7.04405	2435.7676	s
37	e200	39 17 22.86910	-114 57 12.50007	2150.9350	s
38	e300	38 53 23.57591	-115 7 48.68292	1921.3224	s
39	e220	39 1 58.70449	-114 39 28.42262	2283.8577	s
40	e240	39 4 7.26869	-114 27 12.45984	1726.3686	s
41	e260	39 5 48.62675	-114 12 15.27091	180[illegible].7584	s
42	e280	39 2 40.33569	-113 53 12.92657	1512.9572	s
43	f100	39 32 54.55478	-113 35 5.33965	1486.9242	s
44	f200	39 4 52.56823	-113 37 46.84702	1897.6837	s
45	f300	38 47 41.08062	-113 40 0.30294	1773.2931	s
46	f210	39 5 11.03801	-113 31 49.37284	1495.4932	s
47	f220	39 1 25.64490	-113 23 5.21465	1436.6769	s
48	f230	39 15 13.81131	-113 13 24.94723	1596.1237	s
49	f250	39 16 58.60015	-113 2 45.00456	1447.6718	s
50	f270	39 18 59.73750	-112 50 13.88386	1368.7977	s
51	f280	39 22 1.18819	-112 32 44.18787	1407.8221	s
52	f290	39 9 24.43580	-112 24 34.49230	1409.4854	s
53	g100	39 36 2.62584	-112 8 51.06146	1549.1792	s
54	g200	39 8 23.70230	-112 14 31.50948	1590.2947	s
55	g300	38 36 8.40666	-112 35 37.24833	1799.0337	s
56	g210	39 14 27.76044	-112 5 53.96495	1614.1298	s
57	g220	39 4 42.37122	-112 2 29.57360	1802.1572	s
58	g230	38 57 40.75169	-111 54 52.37219	1585.6086	s
59	g250	38 54 15.70889	-111 44 17.98172	1774.3570	s
60	g270	38 50 20.95171	-111 32 12.36540	2153.6475	s
61	g280	38 45 17.71027	-111 22 51.69980	2060.4436	s
62	g290	38 48 27.42160	-111 12 20.00395	1714.1550	s
63	h100	39 17 35.75902	-111 1 13.35975	1809.9475	s
64	h200	38 49 57.44455	-111 6 41.17748	1785.2440	s
65	h300	38 28 58.08731	-111 21 32.40678	1952.8746	s

Coordinates and point scaled formal errors (p4t)

#	station	n	x	dx	y	dy	z	dz	dn	de	du	n-e	e-u	u-n	x-y	y-z	z-x
			p4t avarage position and scaled formal error (cm)									correlation					
1	quin	2	-251723090.25	0.01	-419859518.99	0.01	407653127.17	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2	a100	2	-245726825.73	0.55	-424945899.14	0.95	406115531.84	0.89	0.15	0.12	1.40	-0.10	0.05	-0.10	0.97	-0.97	-0.96
3	a200	2	-249559099.75	1.17	-426642793.10	1.98	402105721.12	1.78	0.30	0.24	2.88	-0.13	0.01	-0.27	0.97	-0.98	-0.97
4	a300	2	-248453868.53	0.64	-431655034.26	1.10	397440618.55	0.99	0.17	0.14	1.59	-0.08	0.03	-0.15	0.97	-0.97	-0.96
5	a210	1	-248040426.11	1.18	-427166955.01	1.96	402421304.53	1.77	0.31	0.24	2.86	0.00	-0.08	-0.26	0.97	-0.98	-0.96
6	a220	1	-247647663.40	0.97	-428375909.97	1.74	401404147.40	1.50	0.30	0.22	2.47	-0.36	0.17	-0.33	0.97	-0.97	-0.97
7	a230	1	-247280299.11	1.28	-429639691.58	2.14	400318756.88	1.88	0.33	0.25	3.09	0.07	-0.10	-0.33	0.97	-0.98	-0.96
8	a250	2	-246174941.83	0.82	-430294596.94	1.37	400199218.71	1.23	0.21	0.17	1.99	-0.05	-0.11	-0.24	0.97	-0.97	-0.96
9	a270	1	-243859232.72	0.92	-430138609.09	1.59	401744129.91	1.45	0.25	0.19	2.31	-0.03	-0.02	-0.15	0.97	-0.97	-0.96
10	a280	1	-242536865.78	1.24	-430337579.97	2.14	402323833.31	1.92	0.33	0.25	3.11	0.05	-0.07	-0.26	0.97	-0.98	-0.96
11	a290	1	-240669735.88	0.83	-430742715.60	1.46	403002202.01	1.34	0.21	0.17	2.13	-0.08	-0.03	-0.17	0.97	-0.98	-0.97
12	b100	4	-235051149.24	0.48	-429274114.41	0.87	407851122.28	0.80	0.14	0.11	1.27	-0.08	0.07	-0.16	0.96	-0.97	-0.96
13	b200	3	-238463717.70	0.60	-431286091.44	1.08	403718883.39	0.98	0.17	0.13	1.57	-0.06	0.02	-0.17	0.97	-0.97	-0.96
14	b300	4	-242586607.06	0.48	-433274010.59	0.87	399248213.55	0.79	0.14	0.11	1.26	-0.09	0.11	-0.08	0.96	-0.97	-0.96
15	b210	1	-237993619.31	0.75	-431704248.14	1.33	403549603.77	1.20	0.20	0.16	1.92	-0.02	-0.05	-0.22	0.97	-0.98	-0.96
16	b220	1	-236649493.59	0.75	-433210323.57	1.36	402727270.47	1.24	0.21	0.17	1.97	-0.06	0.01	-0.12	0.97	-0.97	-0.96
17	b230	1	-235661145.91	0.64	-434539601.08	1.16	401878832.99	1.05	0.18	0.14	1.68	-0.09	0.02	-0.13	0.97	-0.97	-0.96
18	b250	2	-234524027.01	0.60	-435363851.59	1.08	401670440.43	0.98	0.17	0.13	1.56	-0.08	-0.02	-0.13	0.97	-0.97	-0.96
19	b270	1	-233437719.89	0.67	-435856549.02	1.22	401781927.52	1.11	0.19	0.15	1.76	-0.09	-0.02	-0.14	0.97	-0.97	-0.96
20	b280	1	-232287640.59	0.84	-436564685.19	1.53	401687062.42	1.35	0.24	0.17	2.18	-0.08	-0.07	-0.24	0.97	-0.97	-0.96
21	b290	1	-231065058.58	0.77	-437158344.96	1.40	401776965.89	1.25	0.21	0.17	2.01	-0.08	-0.09	-0.19	0.97	-0.98	-0.96
22	c100	4	-227082594.35	0.53	-436056836.57	0.97	405232396.89	0.88	0.15	0.12	1.39	-0.05	-0.10	-0.15	0.96	-0.97	-0.96
23	c200	4	-230024392.98	0.58	-437914807.66	1.07	401639210.01	0.96	0.16	0.13	1.54	-0.05	-0.09	-0.14	0.97	-0.97	-0.96
24	c300	4	-232979060.25	0.54	-440319603.36	0.98	397278640.32	0.89	0.15	0.12	1.41	-0.07	-0.05	-0.05	0.96	-0.97	-0.96
25	c220	2	-227413541.68	0.64	-438509584.96	1.18	402430001.93	1.06	0.18	0.15	1.69	-0.08	-0.10	-0.14	0.97	-0.97	-0.96
26	c240	2	-224930390.19	0.65	-438753115.27	1.20	403526551.69	1.08	0.19	0.15	1.73	-0.07	-0.14	-0.16	0.97	-0.97	-0.96
27	c260	2	-223665233.93	0.71	-440074103.57	1.31	402807271.53	1.17	0.21	0.16	1.88	0.00	-0.17	-0.21	0.97	-0.97	-0.96
28	c280	2	-220968046.03	0.63	-440852956.74	1.17	403452159.16	1.06	0.18	0.15	1.68	-0.05	-0.19	-0.15	0.97	-0.97	-0.96
29	d100	4	-215514740.19	0.62	-438740098.32	1.15	408628062.89	1.04	0.18	0.15	1.65	0.00	-0.24	-0.21	0.96	-0.97	-0.96
30	d200	4	-218360428.89	0.65	-441695898.89	1.20	403935587.34	1.08	0.19	0.15	1.72	-0.02	-0.23	-0.18	0.97	-0.97	-0.96
31	d300	4	-223270319.20	0.63	-443043852.54	1.18	399863964.70	1.06	0.18	0.15	1.69	-0.05	-0.18	-0.11	0.97	-0.97	-0.96
32	d220	2	-215784321.71	0.81	-442893031.29	1.53	404021860.28	1.38	0.24	0.19	2.19	-0.05	-0.20	-0.17	0.97	-0.97	-0.96
33	d240	2	-214910486.67	0.81	-444582301.33	1.55	402619851.18	1.39	0.23	0.19	2.21	-0.05	-0.23	-0.17	0.97	-0.98	-0.96
34	d260	2	-212960457.83	0.80	-445365106.33	1.53	402815630.15	1.36	0.23	0.19	2.18	-0.03	-0.24	-0.17	0.97	-0.98	-0.96
35	d280	1	-209238780.84	1.15	-447051569.43	2.30	402948102.14	2.02	0.35	0.26	3.24	0.01	-0.17	-0.21	0.97	-0.98	-0.96
36	e100	4	-204447705.90	0.75	-445484770.84	1.44	407117838.57	1.29	0.22	0.19	2.05	0.02	-0.34	-0.22	0.96	-0.97	-0.96
37	a200	4	-208607631.69	0.78	-448310633.73	1.50	401862115.08	1.33	0.23	0.19	2.13	0.00	-0.30	-0.18	0.97	-0.97	-0.96
38	e300	4	-211170691.19	0.75	-450183505.19	1.44	398401554.19	1.28	0.22	0.18	2.04	-0.04	-0.29	-0.10	0.96	-0.97	-0.96
39	e220	2	-207047553.30	0.87	-451026431.83	1.70	399659946.10	1.50	0.25	0.21	2.41	0.01	-0.30	-0.15	0.97	-0.98	-0.96
40	e240	2	-205315604.32	0.85	-451495461.67	1.66	399932810.54	1.46	0.25	0.21	2.35	0.01	-0.34	-0.16	0.96	-0.97	-0.96
41	e260	2	-203271386.38	0.85	-452209802.41	1.67	400180257.84	1.47	0.25	0.22	2.36	0.01	-0.36	-0.16	0.96	-0.97	-0.96
42	e280	2	-200902988.41	0.76	-453642839.46	1.46	399711137.59	1.29	0.25	0.22	2.07	0.00	-0.41	-0.12	0.96	-0.97	-0.95
43	f100	4	-197089362.50	0.82	-451445785.93	1.59	404040276.02	1.41	0.24	0.22	2.26	0.04	-0.43	-0.20	0.96	-0.97	-0.96
44	f200	4	-198773168.58	0.84	-454332149.70	1.64	400052088.21	1.44	0.25	0.22	2.31	0.01	-0.42	-0.15	0.96	-0.97	-0.96
45	f300	4	-199865897.94	0.81	-456026064.30	1.59	397569425.73	1.40	0.24	0.22	2.25	-0.01	-0.42	-0.10	0.96	-0.97	-0.96
46	f210	1	-197958671.06	0.99	-454614402.69	2.02	400070955.24	1.76	0.31	0.25	2.83	0.02	-0.32	-0.16	0.96	-0.97	-0.95
47	f220	1	-196974818.02	1.04	-455513851.42	2.12	399527378.48	1.84	0.33	0.27	2.97	-0.02	-0.32	-0.16	0.96	-0.97	-0.95
48	f230	2	-195061644.96	0.92	-454595768.40	1.84	401518790.43	1.61	0.28	0.25	2.59	0.03	-0.41	-0.18	0.96	-0.97	-0.96
49	f250	2	-193565720.72	0.91	-454999922.91	1.82	401759640.19	1.60	0.28	0.25	2.56	0.03	-0.43	-0.18	0.96	-0.97	-0.96
50	f270	1	-191813319.18	1.03	-455478039.50	2.13	402043799.27	1.86	0.32	0.28	2.98	0.03	-0.37	-0.18	0.96	-0.98	-0.95
51	f280	2	-189357997.24	0.84	-456123370.48	1.63	402479137.50	1.43	0.29	0.26	2.30	0.05	-0.48	-0.18	0.95	-0.97	-0.94
52	f290	2	-188837801.30	0.89	-457937477.67	1.79	400671910.97	1.57	0.28	0.25	2.51	0.03	-0.48	-0.15	0.96	-0.97	-0.95
53	g100	4	-185566216.55	0.86	-455909441.30	1.70	404491428.87	1.50	0.27	0.25	2.40	0.08	-0.53	-0.21	0.96	-0.97	-0.95
54	g200	3	-187548363.68	0.90	-458610007.61	1.82	400538043.83	1.59	0.28	0.26	2.56	0.05	-0.48	-0.17	0.96	-0.97	-0.95
55	g300	4	-191804588.49	0.84	-460924224.32	1.64	395903587.41	1.45	0.27	0.25	2.31	-0.01	-0.49	-0.06	0.96	-0.97	-0.95
56	g210	2	-186130802.94	1.04	-458423369.35	2.17	401409921.68	1.89	0.34	0.30	3.02	0.04	-0.42	-0.17	0.96	-0.97	-0.95
57	g220	1	-186109851.67	1.13	-459678050.71	2.38	400021648.89	2.06	0.39	0.32	3.31	-0.03	-0.39	-0.15	0.96	-0.97	-0.95
58	g230	2	-185389799.67	1.00	-460833471.63	2.08	398997601.23	1.81	0.33	0.29	2.90	0.01	-0.44	-0.13	0.96	-0.97	-0.95
59	g250	2	-184124219.32	1.05	-461784297.70	2.22	398517479.97	1.92	0.35	0.31	3.08	-0.01	-0.42	-0.13	0.96	-0.97	-0.95
60	g270	2	-182676249.08	1.02	-462879363.32	2.13	397977499.94	1.84	0.33	0.30	2.96	0.00	-0.45	-0.13	0.96	-0.97	-0.95
61	g280	2	-181628405.94	1.06	-463913188.28	2.26	397242635.56	1.94	0.35	0.31	3.12	0.02	-0.43	-0.12	0.96	-0.97	-0.95
62	g290	1	-180064458.18	1.14	-464100383.88	2.49	397677115.89	2.14	0.38	0.34	3.44	0.00	-0.38	-0.13	0.95	-0.97	-0.95
63	h100	2	-177347504.48	1.01	-461515365.78	2.12	401871296.11	1.84	0.33	0.31	2.94	0.04	-0.49	-0.16	0.95	-0.97	-0.95
64	h200	2	-179241146.53	1.06	-464238325.92	2.28	397897915.62	1.96	0.35	0.32	3.15	0.03	-0.45	-0.13	0.96	-0.97	-0.95
65	h300	2	-182133871.72	1.01	-465731556.82	2.13	394875039.32	1.83	0.33	0.30	2.96	-0.02	-0.46	-0.09	0.96	-0.97	-0.95

Coordinates and point repeatabilities (p4t)

#	station	n	p4t network solutions and wrms around them (cm)								
			x	rx	y	ry	z	rz	rn	re	ru
1	quin	2	-251723090.25	0.31	-419859518.99	0.04	407653127.17	0.03	0.05	0.07	0.15
2	a100	2	-245726825.73	0.28	-424945899.1[illegible]	0.30	406115531.84	0.30	0.00	0.03	0.21
3	a200	2	-249559099.75	0.92	-426642793.1[illegible]	0.99	402105721.12	0.56	0.30	0.03	1.54
4	a300	2	-248453868.53	1.73	-431655034.26	1.41	397440618.55	1.03	0.37	0.47	2.35
5	a210	1	-248040426.11	0.00	-427166955.01	0.00	402421304.53	0.00	0.00	0.00	0.00
6	a220	1	-247647663.40	0.00	-428375909.97	0.00	401404147.40	0.00	0.00	0.00	0.00
7	a230	1	-247280299.11	0.00	-429639691.58	0.00	400318756.88	0.00	0.00	0.00	0.00
8	a250	2	-246174941.83	0.72	-430294596.94	0.35	400199218.71	0.18	0.03	0.44	0.00
9	a270	1	-243859232.72	0.00	-430138609.09	0.00	401744129.91	0.00	0.00	0.00	0.00
10	a280	1	-242536865.78	0.00	-430337579.97	0.00	402323833.31	0.00	0.00	0.00	0.00
11	a290	1	-240669735.88	0.00	-430742715.60	0.00	403002202.01	0.00	0.00	0.00	0.00
12	b100	4	-235051149.24	2.01	-429274114.41	4.45	407851122.28	3.43	0.21	0.19	1.19
13	b200	3	-238463717.70	1.77	-431286091.44	3.01	403718883.39	2.17	0.16	0.29	0.61
14	b300	4	-242586607.06	2.69	-433274010.59	5.04	399248213.55	3.55	0.42	0.35	1.25
15	b210	1	-237993619.31	0.00	-431704248.14	0.00	403549603.77	0.00	0.00	0.00	0.00
16	b220	1	-236649493.59	0.00	-433210323.57	0.00	402727270.47	0.00	0.00	0.00	0.00
17	b230	1	-235661145.91	0.00	-434539601.08	0.00	401878832.99	0.00	0.00	0.00	0.00
18	b250	2	-234524027.01	0.14	-435363851.59	0.12	401670440.43	0.06	0.16	0.08	0.09
19	b270	1	-233437719.89	0.00	-435856549.02	0.00	401781927.52	0.00	0.00	0.00	0.00
20	b280	1	-232287640.59	0.00	-436564685.19	0.00	401687062.42	0.00	0.00	0.00	0.00
21	b290	1	-231065058.58	0.00	-437158344.96	0.00	401776965.89	0.00	0.00	0.00	0.00
22	c100	4	-227082594.35	0.38	-436056836.57	1.01	405232396.89	0.79	0.15	0.07	0.13
23	c200	4	-230024392.98	0.70	-437914807.66	1.42	401639210.01	1.42	0.28	0.16	1.04
24	c300	4	-232979060.25	0.43	-440319603.36	0.99	397278640.32	0.84	0.04	0.09	0.73
25	c220	2	-227413541.68	0.30	-438509584.96	0.13	402430001.93	0.42	0.17	0.20	0.48
26	c240	2	-224930390.19	0.26	-438753115.27	0.26	403526551.69	0.47	0.14	0.12	0.57
27	c260	2	-223665233.93	0.23	-440074103.57	0.50	402807271.53	0.44	0.01	0.02	0.69
28	c280	2	-220968046.03	0.31	-440852956.74	0.19	403452159.16	0.45	0.15	0.21	0.54
29	d100	4	-215514740.19	0.80	-438740098.32	1.33	408628062.89	1.35	0.15	0.14	0.94
30	d200	4	-218360428.89	1.28	-441695898.89	2.02	403935587.34	1.79	0.09	0.11	1.18
31	d300	4	-223270319.20	1.09	-443043852.54	1.66	399863964.70	1.50	0.07	0.17	0.30
32	d220	2	-215784321.71	0.12	-442893031.29	0.08	404021860.28	0.57	0.36	0.07	0.45
33	d240	2	-214910486.67	0.11	-444582301.33	0.18	402619851.18	0.15	0.01	0.02	0.25
34	d260	2	-212960457.83	0.02	-445365106.33	0.08	402815630.15	0.10	0.12	0.01	0.00
35	d280	2	-209238780.84	0.70	-447051569.43	1.47	402948102.14	1.12	0.17	0.01	1.97
36	e100	4	-204447705.90	0.48	-445484770.84	1.12	407117838.57	1.17	0.21	0.24	1.60
37	e200	4	-208607631.69	0.54	-448310633.73	0.71	401862115.08	0.40	0.38	0.16	0.86
38	e300	4	-211170691.19	1.20	-450183505.19	2.32	398401554.19	2.05	0.15	0.14	3.28
39	e220	2	-207047553.30	0.11	-451026431.83	0.12	399659946.10	0.14	0.20	0.05	0.03
40	e240	2	-205315604.32	0.13	-451495461.67	0.42	399932810.54	0.02	0.29	0.06	0.32
41	e260	2	-203271386.38	0.23	-452209802.41	0.55	400180257.84	0.06	0.43	0.02	0.42
42	e280	2	-200902988.41	0.06	-453642839.46	0.44	399711137.59	0.13	0.37	0.12	0.25
43	f100	4	-197089362.50	0.67	-451445785.93	1.42	404040276.02	1.12	0.19	0.13	0.72
44	f200	4	-198773168.58	0.78	-454332149.70	1.79	400052088.21	1.16	0.30	0.06	0.82
45	f300	4	-199865897.94	0.27	-456026064.30	0.88	397569425.73	0.53	0.21	0.17	0.48
46	f210	1	-197958671.06	0.00	-454614402.69	0.00	400070955.24	0.00	0.00	0.00	0.00
47	f220	1	-196974818.02	0.00	-455513851.42	0.00	399527378.48	0.00	0.00	0.00	0.00
48	f230	2	-195061644.96	0.01	-454595768.40	0.52	401518790.43	0.47	0.08	0.21	0.39
49	f250	2	-193565720.72	0.32	-454999922.91	0.38	401759640.19	0.32	0.03	0.12	0.28
50	f270	1	-191813319.18	0.00	-455478039.50	0.00	402043799.27	0.00	0.00	0.00	0.00
51	f280	2	-189357997.24	0.06	-456123370.48	0.02	402479137.50	0.03	0.01	0.05	0.26
52	f290	2	-188837801.30	0.42	-457937477.67	0.64	400671910.97	0.68	0.03	0.15	1.29
53	g100	4	-185566216.55	0.19	-455909441.30	0.44	404491428.87	0.38	0.00	0.01	0.34
54	g200	3	-187548363.68	0.41	-458610007.61	0.78	400538043.83	0.86	0.10	0.09	1.33
55	g300	4	-191804588.49	0.46	-460924224.32	0.95	395903587.41	0.81	0.07	0.11	2.13
56	g210	2	-186130802.94	0.42	-458423369.35	0.76	401409921.68	0.77	0.05	0.11	1.16
57	g220	1	-186109851.67	0.00	-459678050.71	0.00	400021648.89	0.00	0.00	0.00	0.00
58	g230	2	-185389799.67	0.53	-460833471.63	1.45	398997601.23	0.99	0.20	0.05	1.03
59	g250	2	-184124219.32	0.36	-461784297.70	1.10	398517479.97	0.68	0.20	0.07	1.33
60	g270	2	-182676249.08	0.18	-462879363.32	1.00	397977499.94	0.65	0.12	0.20	1.19
61	g280	2	-181628405.94	0.98	-463913188.28	2.44	397242635.56	1.82	0.23	0.02	3.16
62	g290	1	-180064458.18	0.00	-464100383.88	0.00	397677115.89	0.00	0.00	0.00	0.00
63	h100	2	-177347504.48	0.34	-461515365.78	0.56	401871296.11	0.66	0.10	0.11	0.90
64	h200	2	-179241146.53	0.47	-464238325.92	1.53	397897915.62	1.05	0.19	0.11	1.90
65	h300	2	-182133871.72	0.71	-465731556.82	1.87	394875039.32	1.24	0.28	0.01	2.37