

Rapportserie: Geodesi och Geografiska informationsystem

SWEREF 99 – New ETRS 89 Coordinates in Sweden



Lotti Jivall

Gävle 2001

LANTMÄTERIVERKET



2005-01-28

SWEREF 99 - New ETRS 89 Coordinates in Sweden

(Observation data from June-July 1999)

Analysis Report

Lotti Jivall

GEODETTIC RESEARCH DIVISION, NATIONAL LAND SURVEY

801 82 GÄVLE, SWEDEN

PHONE: +46 26 63 37 40 FAX: +46 26 61 06 76

E-MAIL: lotti.jivall@lm.se

Contents

1. Abstract.....	1
2. Introduction.....	1
3. Description of the Campaign	1
3.1. Stations.....	1
3.2. Receiver and antennas.....	3
4. Other data used by the processing.....	5
4.1. ITRF and other apriori coordinates.....	5
4.2. Satellite orbits	7
4.3. Antenna phase centres.....	7
4.4. Other data.....	7
5. Processing Strategy	7
5.1. Processing for each session.....	7
5.2. Combination of sessions	8
5.2.1. Weekly combinations.....	8
5.2.2. Minimum constrained solution for the campaign	8
5.2.3. Constrained solution – alternative 1.....	8
5.2.4. Constrained solution – alternative 2.....	9
6. Results from the Processing.....	9
6.1. Quality of the Daily and Combined Solutions.....	9
6.2. Comparison of Daily Solutions.....	10
6.3. Comparison with Reference Coordinates	14
6.4. Three different solutions	17
6.5. Comparison of the minimum constrained and the constrained solutions	18
6.6. Transformation into ETRS 89.....	19
7. Comparison with other EUREF solutions.....	20
7.1. SWEREF 93.....	20
7.2. Denmark.....	21
7.3. Finland	22
7.4. Norway.....	22
7.5. EUVN 97.....	22
8. Choice of the Final Solution	23
9. Acknowledgements.....	24
10. References.....	24
Appendix 1: Apriori coordinates.....	26
Appendix 2: Fixed stations – Alternative 2, Step 1	28
Appendix 3: Fixed stations – Alternative 2, Step 2	29
Appendix 4: Daily repeatability- coordinates	30
Appendix 5: Minimum Constrained Solution ITRF 97 ep 99.5	45
Appendix 6: Minimum Constrained Solution ITRF 97 ep 99.5 fitted by a 3-parameter transformation to Permanent EUREF and IGS stations in table 5 (Onsala corrected and Metsähovi excluded).....	46
Appendix 7: Constrained Solution alt 1 ITRF 97 ep 99.5	47
Appendix 8: Constrained Solution alt 2 ITRF 97 ep 99.5	48

Appendix 9: Minimum Constrained Solution ETRF 97 ep 99.5 fitted by a 3-parameter transformation to Permanent EUREF and IGS stations in table 5 (Onsala corrected and Metsähovi excluded) and converted to ETRF 97 ep 99.5.....	49
Appendix 10: Constrained Solution alt 1 ETRF 97 ep 99.5	50
Appendix 11: Constrained Solution alt 2 ETRF 97 ep 99.5	51
Appendix 12: Estimation of the shift at Onsala	52

1. Abstract

This paper contains the documentation of SWEREF 99 – the new ETRS 89 realisation in Sweden. SWEREF 99 is based on observations from the GPS-weeks 1014-1019 (June-July 1999) on permanent reference stations in Sweden (SWEPOS), Denmark, Finland (FinnRef) and Norway (SATREF). In all, data from 49 stations were processed and 21 Swedish stations are proposed to become official EUREF sites. SWEREF 99 will replace SWEREF 93, the present EUREF/ETRS 89 realisation in Sweden.

The processing of SWEREF 99 was performed according to the EUREF guidelines by Lotti Jivall at the National Land Survey of Sweden, using the Bernese Software version 4.2 and version 4.0.

2. Introduction

Since 1994, SWEREF 93 has been used as the Swedish realisation of ETRS 89 (EUREF 89). SWEREF 93 was established 1993-94 before there were any official guidelines how to realise ETRS 89. SWEREF 93 was aligned to EUREF by a 6-parameter transformation to the coordinates of 11 stations from the original EUREF 89 campaign. The RMS of the residuals are 14, 14 and 23 mm for the north, east and height components, respectively. SWEREF 93 has a high internal accuracy but differs on the 5 cm level to the neighbouring ETRS 89-realizations in the Nordic countries. SWEREF 93 has mainly been used for intermediate steps in GPS processing and the use of it for final presentation is so far limited.

There is an on-going discussion at the National Land Survey about replacing our national reference frame RT 90, which is based on the Bessel ellipsoid, with a globally aligned reference frame. It is important that the new reference system will be appropriate for a long time. SWEREF 93 does not fulfil this criterion perfectly. It is not officially approved by the European community and it differs to the ETRS 89 realizations in the neighbouring countries. Furthermore it represents the relations between the points, with respect to the land uplift, at epoch 1993. Since then we have had movements in the vertical component of c. 5-6 cm within the country.

Choosing an ETRS 89 solution approved by EUREF and originating from recent observation data, would give us good possibilities to get a reference system, that could last for a long time. Of course the land uplift will continue, and also the new set of coordinates will get obsolete if we do not take the land uplift into account after some years. Starting from the land uplift epoch 1999.5 will give us some more years to develop models for the movements within our country and methods to handle those models.

Before this campaign, the following official EUREF sites existed in Sweden: 5 stations belonging to permanent EUREF (ONSA, KIR0, MAR6, VIL0 and VIS0), 6 EUVN stations (SE02, SE04, SE06, SE07, SE03 and SE05), and additional 2 stations from the original EUREF 89 campaign (Klinta and Bureberget).

3. Description of the campaign

3.1. Stations

The campaign includes 49 stations. All stations are included in one of the national permanent networks in the Nordic countries. The distribution of the stations is shown in figure 1. Table 1 shows the observation period for each station (in GPS weeks), which stations are proposed to become official Swedish ETRS 89 stations and finally which stations have ITRF 97 coordinates in

the IERS ITRF 97 solution. Some Norwegian stations have ITRF 97 coordinates in the IERS solution though they are not IGS nor permanent EUREF sites. These are marked by “(YES)” in the column for known ITRF.

Table 1: Stations included in the campaign.

Station	Country	ITRF 97	Proposed	1014	1015	1016	1017	1018	1019
ARJE 0	Sweden		YES	X	X	X	X	X	X
KIR0 10422M001	Sweden	YES	YES	X	X	X	X	X	X
OVER 0	Sweden		YES	X	X	X	X	X	X
UMEA 0	Sweden		YES	X	X	X	X	X	X
VIL0 10424M001	Sweden	YES	YES	X	X	X	X	X	X
BORA 0	Sweden		YES	X	X	X	X	X	X
VIS0 10423M001	Sweden	YES	YES	X	X	X	X	X	X
GAVL 1	Sweden			X	X	X	X	X	X
SUND 0	Sweden		YES	X	X	X	X	X	X
GOTE 0	Sweden			X	X	X	X	X	X
JONK 0	Sweden		YES	X	X	X	X	X	X
HASS 0	Sweden		YES	X	X	X	X	X	X
VANE 0	Sweden		YES	X	X	X	X	X	X
KARL 0	Sweden		YES	X	X	X	X	X	X
MAR6 10405M002	Sweden	YES	YES	X	X	X	X	X	X
MALM 0	Sweden			X	X	X	X	X	X
NORR 0	Sweden		YES	X	X	X	X	X	X
ONSA 10402M004	Sweden	YES	YES	X	X	X	X	X	X
LEKS 0	Sweden		YES	X	X	X	X	X	X
LOVO 0	Sweden		YES	X	X	X	X	X	X
OSKA 0	Sweden		YES	X	X	X	X	X	X
OSTE 0	Sweden		YES	X	X	X	X	X	X
SKEL 0	Sweden		YES	X	X	X	X	X	X
VAST 0	Sweden			X	X	X	X	X	X
SVEG 0	Sweden		YES	X	X	X	X	X	X
BUDP 01-13-829	Denmark				X	X			X
SULD 61-10-802	Denmark				X	X			X
SMID 117-05-810	Denmark				X	X			X
OULU	Finland				X	X			
SODA 10513M001	Finland	YES			X	X			
JOEN 10512M001	Finland	YES			X	X			
KUUS	Finland				X	X			
METS 10503S011	Finland	YES			X	X			
ROMU	Finland				X	X			
VIRO	Finland				X	X			
KEVO	Finland				X	X			
KIVE	Finland				X	X			
OLKI	Finland				X	X			
TUOR	Finland				X	X			
VAAS 10511M001	Finland	YES			X	X			
ALES 0	Norway				X				X
BERG 0	Norway				X				X
OSLO 10307M001	Norway	(YES)			X				X
STAV 10330M001	Norway	(YES)			X				X
TRON 10331M001	Norway	(YES)			X				X
BODO 0	Norway				X				X
TROM 10302M006	Norway	YES			X				X
VARD 10322M002	Norway	(YES)			X				
KRIS 0	Norway								X



Figure 1: Stations included in the campaign.

3.2. Receiver and antennas

Receiver and antenna types as well as antenna eccentricities are shown in table 2. All receivers, antennas and antenna heights are constant during the whole campaign. The *names* of antennas and receivers have changed during the campaign, since this was just during the time when RINEX-headers and site logs were updated according to the new IGS-naming convention.

The stations Onsala (ONSA 10402M004) and Metsähovi (METS 10503S011) were equipped with Dorne Margolin B antennas. For all other stations antennas of type Dorne Margolin T were used.

Table 2: Receiver types, antenna types and antenna heights.

Station	Antenna	Ecc N	Ecc E	Receiver	Antenna
ALES 0	5.536	-0.001	0.005	TRIMBLE 4000SSI	TRM29659.00
ARJE 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
BERG 0	5.512	-0.010	-0.003	TRIMBLE 4000SSI	TRM29659.00
BODO 0	5.500	0.008	-0.002	TRIMBLE 4000SSI	TRM29659.00
BORA 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
BUDP 01-13-829	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
GAVL 1	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
GOTE 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
HASS 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
JOEN 10512M001	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
JONK 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
KARL 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
KEVO	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
KIR0 10422M001	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
KIVE	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
KRIS 0	5.505	-0.001	-0.013	TRIMBLE 4000SSI	TRM29659.00
KUUS	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
LEKS 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
LOVO 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
MALM 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
MAR6 10405M002	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
METS 10503S011	0.000			ROGUE SNR-8100	DORNE MARGOLIN B
NORR 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
OLKI	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
ONSA 10402M004	0.995			ASHTECH Z-XII3	DORNE MARGOLIN B
OSKA 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
OSLO 10307M001	5.496	0.017	0.013	TRIMBLE 4000SSI	TRM29659.00
OSTE 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
OULU	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
OVER 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
ROMU	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
SKEL 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
SMID 117-05-810	0.000			ASHTECH Z-XII3	700936 RADOM
SODA 10513M001	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
STAV 10330M001	5.559	-0.002	-0.005	TRIMBLE 4000SSI	TRM29659.00
SULD 61-10-802	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
SUND 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
SVEG 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
TROM 10302M006	0.000			TRIMBLE 4000SSI	ASH701073.1
TRON 10331M001	5.546	0.018	0.007	TRIMBLE 4000SSI	TRM29659.00
TUOR	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
UMEA 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
VAAS 10511M001	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
VANE 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
VARD 10322M002	5.512	0.006	0.017	TRIMBLE 4000SSI	TRM29659.00
VAST 0	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
VIL0 10424M001	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T
VIRO	0.000			ASHTECH Z-XII3	DORNE MARGOLIN T
VIS0 10423M001	0.071			ASHTECH Z-XII3	DORNE MARGOLIN T

4. Other data used by the processing

4.1. ITRF and other apriori coordinates

The permanent EUREF stations and IGS stations included in the campaign have the following coordinates and velocities in ITRF 97 epoch 1997.0 (from the IERS solution) – see table 3 and 4. In table 5, the coordinates in table 3 have been converted to ITRF 97 epoch 1999.5 using the velocities in table 4. The Bernese program COOVEL was used for the conversion. Four Norwegian stations (OSLO, VARD, STAV and TRON) were also included in the ITRF file though they are neither permanent EUREF nor IGS stations.

Table 3: IERS ITRF 97 epoch 1997.0 coordinates of permanent EUREF and IGS sites and some Norwegian sites.

```
ITRF97 EPOCH 1997.0 GENERATED FROM ITRF97_GPS.SNX                                27-JUL-1999
-----
```

LOCAL GEODETIC DATUM: ITRF97		EPOCH: 1997-01-01 0:00:00			
NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
105	TROM 10302M006	2102928.6248	721619.3908	5958196.1860	I97
106	OSLO 10307M001	3169981.9958	579956.6949	5485936.5846	I97
108	VARD 10322M002	1844607.4646	1109719.1265	5983936.0940	I97
109	STAV 10330M001	3275753.7325	321110.9456	5445041.9715	I97
110	TRON 10331M001	2820170.9828	513485.9507	5678935.8954	I97
111	ONSA 10402M004	3370658.6756	711877.0294	5349786.8684	I97
113	MAR6 10405M002	2998189.5353	931451.6662	5533398.5655	I97
114	KIRO 10422M001	2248123.3260	865686.5984	5886425.6726	I97
115	VIS0 10423M001	3246470.3911	1077900.3986	5365278.0101	I97
116	VIL0 10424M001	2620258.7163	779138.0526	5743799.3621	I97
117	METS 10503S011	2892570.9331	1311843.3371	5512634.0473	I97
118	VAAS 10511M001	2699864.4528	1078263.8957	5658064.7544	I97
119	JOEN 10512M001	2564139.2363	1486149.6624	5628951.3517	I97
120	SODA 10513M001	2200146.8158	1091638.2552	5866870.6777	I97

Table 4: IERS ITRF 97 epoch 1997.0 velocities of permanent EUREF and IGS sites and some Norwegian sites.

```
ITRF97 EPOCH 1997.0 GENERATED FROM ITRF97_GPS.SNX                                27-JUL-1999
-----
```

LOCAL GEODETIC DATUM: ITRF97	
------------------------------	--

NUM	STATION NAME	VX (M/Y)	VY (M/Y)	VZ (M/Y)	FLAG	PLATE
105	TROM 10302M006	-0.0175	0.0076	0.0050	I97	EURA
106	OSLO 10307M001	-0.0131	-0.0035	0.0016	I97	EURA
108	VARD 10322M002	-0.0139	0.0202	0.0228	I97	EURA
109	STAV 10330M001	-0.0064	0.0065	0.0159	I97	EURA
110	TRON 10331M001	-0.0212	0.0255	0.0019	I97	EURA
111	ONSA 10402M004	-0.0136	0.0147	0.0084	I97	EURA
113	MAR6 10405M002	-0.0118	0.0169	0.0148	I97	EURA
114	KIRO 10422M001	-0.0139	0.0115	0.0106	I97	EURA
115	VISO 10423M001	-0.0175	0.0155	0.0050	I97	EURA
116	VIL0 10424M001	-0.0136	0.0145	0.0108	I97	EURA
117	METS 10503S011	-0.0176	0.0139	0.0049	I97	EURA
118	VAAS 10511M001	-0.0120	0.0182	0.0169	I97	EURA
119	JOEN 10512M001	-0.0187	0.0178	0.0079	I97	EURA
120	SODA 10513M001	-0.0152	0.0174	0.0186	I97	EURA

Table 5: IERS ITRF 97 epoch 1999.5 coordinates of permanent EUREF and IGS sites and some Norwegian sites.

ITRF97 EPOCH 1997.0 GENERATED FROM ITRF97_GPS.SNX 27-JUL-1999

LOCAL GEODETIC DATUM: ITRF97 EPOCH: 1999-07-01 0:00:00

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
105	TROM 10302M006	2102928.5812	721619.4098	5958196.1985	I97
106	OSLO 10307M001	3169981.9631	579956.6862	5485936.5886	I97
108	VARD 10322M002	1844607.4299	1109719.1769	5983936.1509	I97
109	STAV 10330M001	3275753.7165	321110.9618	5445042.0112	I97
110	TRON 10331M001	2820170.9299	513486.0143	5678935.9001	I97
111	ONSA 10402M004	3370658.6417	711877.0661	5349786.8894	I97
113	MAR6 10405M002	2998189.5059	931451.7084	5533398.6024	I97
114	KIRO 10422M001	2248123.2913	865686.6271	5886425.6990	I97
115	VISO 10423M001	3246470.3475	1077900.4373	5365278.0226	I97
116	VIL0 10424M001	2620258.6824	779138.0888	5743799.3890	I97
117	METS 10503S011	2892570.8892	1311843.3718	5512634.0595	I97
118	VAAS 10511M001	2699864.4229	1078263.9411	5658064.7966	I97
119	JOEN 10512M001	2564139.1897	1486149.7068	5628951.3714	I97
120	SODA 10513M001	2200146.7779	1091638.2986	5866870.7241	I97

The apriori coordinates used for the processing could be found in appendix 1. They were obtained by a preliminary solution similar to the constrained solution – alternative 2 – described in this paper. (The processing of weeks 1014, 1017 and 1018 were performed within the routinely weekly solutions of SWEPOS (25 stations) and have slightly different apriori coordinates, but they agree within 1 cm with the other apriori coordinates in appendix 1.)

4.2. Satellite orbits

All data were processed using precise orbits from Center for Orbit Determination in Europe (CODE). The earth rotation parameters belonging to these orbits were used.

4.3. Antenna phase centres

Antenna phase centre corrections from International GPS Service (IGS) were used – see table 6.

Table 6: Used antenna models. Unit: meter.

Antenna	Freq	N	E	U
DORNE MARGOLIN T	L1	0	0	0.110
	L2	0	0	0.128
DORNE MARGOLIN B	L1	0	0	0.078
	L2	0	0	0.096

4.4. Other data

Eccentricities and antenna heights are dealt with in section 3.2. No meteorological observations have been used.

5. Processing strategy

The processing of weeks 1015, 1016 and 1019 was performed with the Bernese GPS Software version 4.2. To strengthen the solution three weeks (1014, 1017 and 1018) were added from the weekly processing of SWEPOS (25 stations), which for those weeks were performed with the Bernese GPS Software version 4.0. The same processing strategy has been used in both cases.

5.1. Processing for each session

1. Conversion of RINEX data to Bernese format.
2. Generation of standard orbits from precise ephemeris. Precise orbits from Center for Orbit Determination in Europe (CODE) were used together with the earth rotation parameters belonging to these orbits.
3. Estimation of receiver clock offsets for each epoch. Satellite clocks from precise ephemeris (CODE) were used.
4. Creation of single differences of carrier phase data using the OBSMAX strategy.
5. Pre-processing of the single difference phase measurements using triple differences. In this step cycle slips were detected and removed (if possible), outliers were detected and removed and multiple ambiguities were introduced if needed. Sampling rate 30 seconds.

6. Ambiguity resolution baseline by baseline, using the Quasi Ionospheric Free method (QIF) in combination with an ionospheric model from CODE. Sampling rate 30 seconds.
7. Final ambiguity-fixed session solution. The solution was performed as a multi-station adjustment with the correlations correctly modelled. The following options were used for each session:
 - ONSA 10402M004 was constrained to the apriori coordinates (ITRF 97 epoch 1999.5)
 - Ionospheric free linear combination (L3).
 - Eight tropospheric parameters were estimated for each station and 24-hour session. This means that every parameter covers approximately 3 hours. The tropospheric model of Saastamoinen was used as standard model.
 - Elevation cut off angle: 15 degrees.
 - No elevation dependent weighting.
 - Sampling rate: 60 s.
 - The normal equations were saved.
8. The coordinates from the final session solution were fitted to the IERS ITRF 97 epoch 1999.5 coordinates with a 3-parameter transformation (translation).

5.2. Combination of sessions

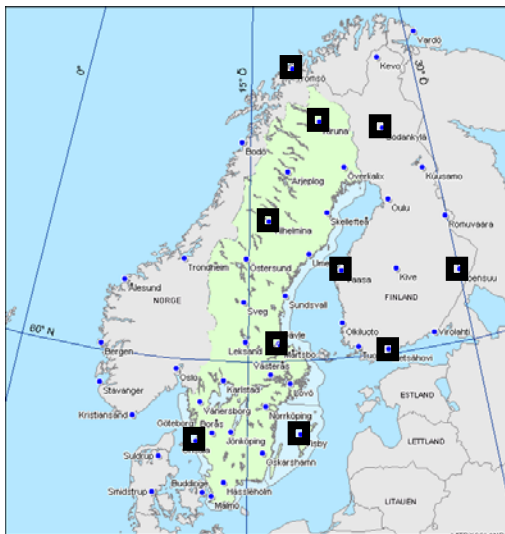
5.2.1. Weekly combinations

The normal equations from the session solutions were combined into weekly solutions. Onsala (ONSA 10402M004) was constrained to the apriori coordinates (ITRF 97 epoch 1999.5). The weekly normal equations were saved for later combination of the whole campaign. The Bernese program ADDNEQ was used.

5.2.2. Minimum constrained solution for the campaign

The six weekly normal equations were combined into a solution where Onsala (ONSA 10402M004) was constrained to its apriori coordinates (ITRF 97 epoch 1999.5). The normal equations were saved. The Bernese program ADDNEQ was used for the task. The resulting coordinates from the minimum constrained solution were fitted to the IERS ITRF 97 epoch 1999.5 coordinates.

5.2.3. Constrained solution – alternative 1



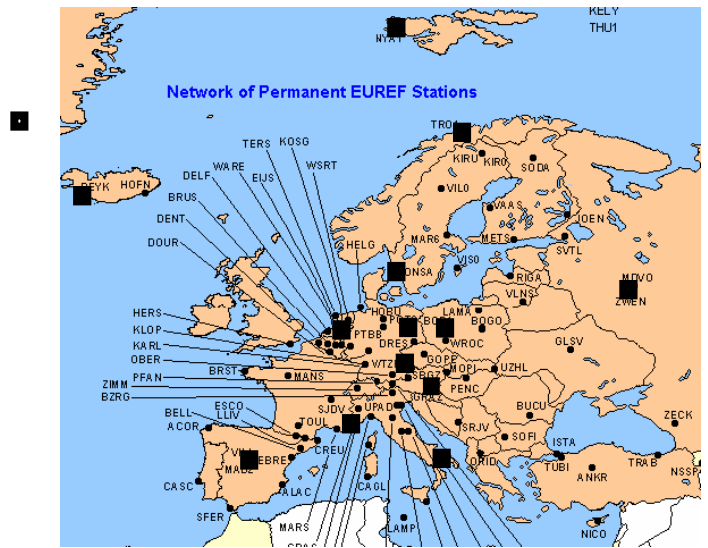
The six weekly normal equations were combined into a solution where 10 stations (permanent EUREF and IGS – see figure 2) were heavily constrained (0.01 mm, i.e. fixed in ADDNEQ sense) to their IERS ITRF 97 epoch 1999.5 coordinates.

Figure 2: Constrained stations (IGS or Permanent EUREF) in constrained alternative 1.

5.2.4. Constrained solution – alternative 2

In this alternative the constraining was done in two steps. In the first step (step 1) 6 weekly solutions from permanent EUREF (weeks 1014-1019) were combined and heavily constrained to IERS ITRF 97 epoch 1999.5 on the 14 IGS Core stations (see figure 3) in Europe. In the second step (step 2) the six weekly solutions from the “Nordic network” were combined and heavily constrained to the coordinates from step 1 of the 10 IGS/Permanent EUREF stations (the same 10 stations as in alternative 1).

Figure 3: Constrained stations (IGS Core stations) in constrained alternative 2, step 1.



6. Results from the processing

6.1. Quality of the daily and combined Solutions

The estimated unit weight errors for the daily solutions and the average percentage of resolved ambiguities are shown in figure 4 and 5.

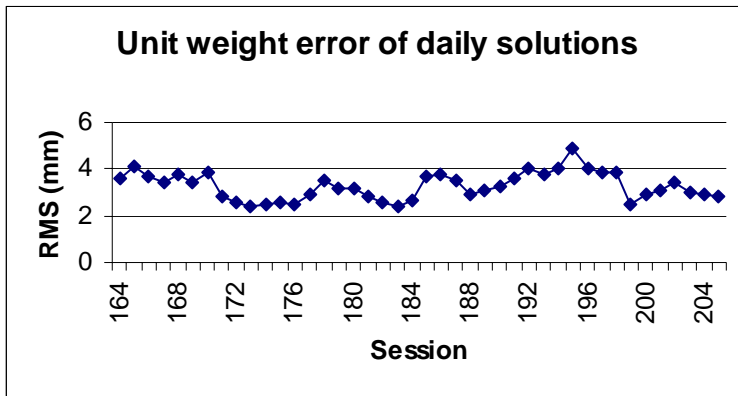


Figure 4: Unit weight error of daily solutions.

The unit weight error of the combined weekly solutions are 2.7 - 4.1 mm. The unit weight errors of the minimum constrained solution and the two constrained solutions are all 2.8 mm.

No solution was considered as outlier in this step.

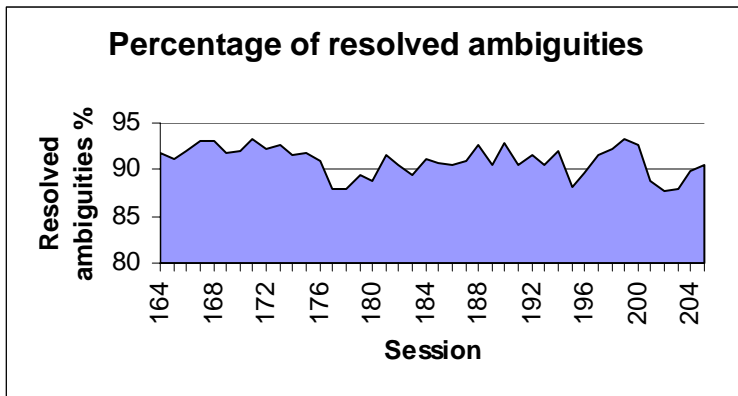
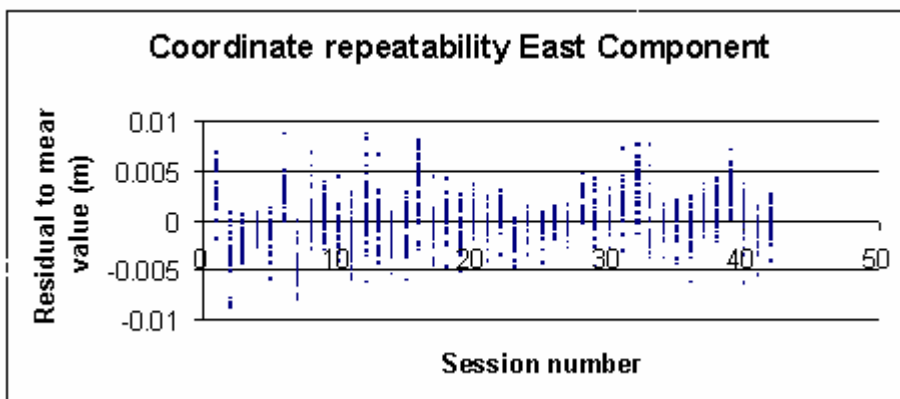
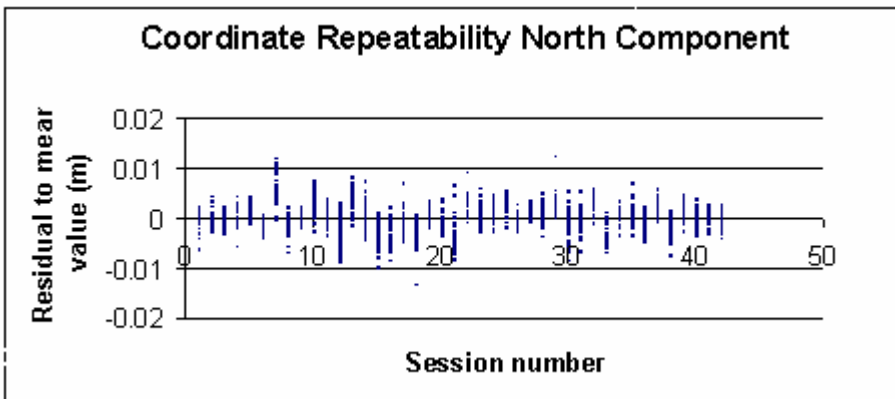


Figure 5: Percentage of resolved ambiguities.

6.2. Comparison of daily solutions

The coordinates from the daily solutions were compared with the Bernese program COMPAR. The coordinate difference from the average value is plotted for each component (north, east and up) for the 42 sessions and the 49 stations, respectively– see figure 6 and 7. The stations are sorted after the distance to the constrained station ONSA. The full matrix with differences is available in appendix 4.



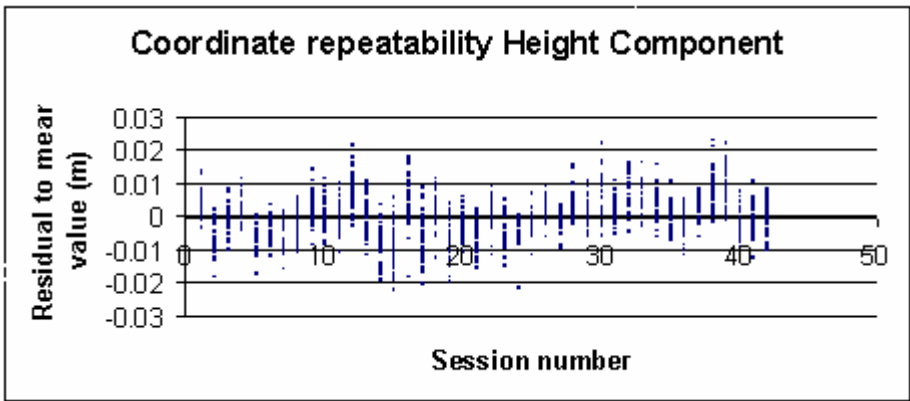
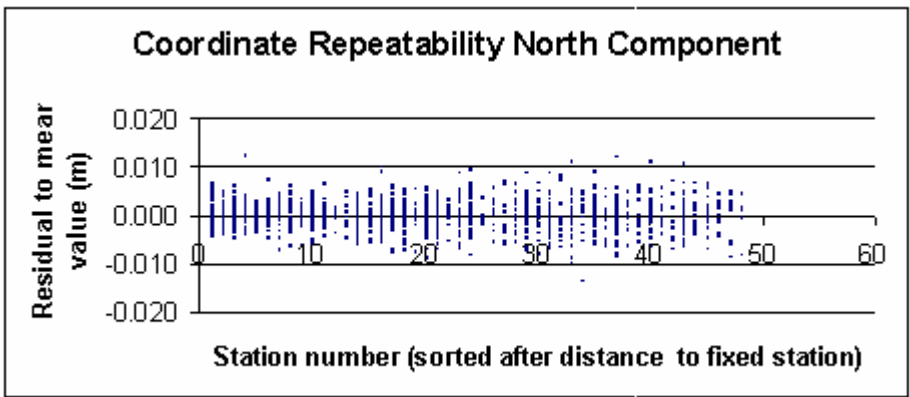
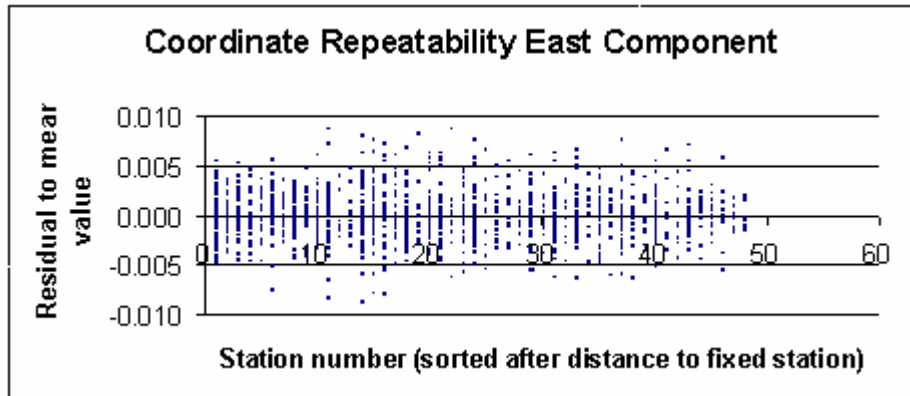


Figure 6: Coordinate repeatability v. session number. (session No. 1 = day 164).



or



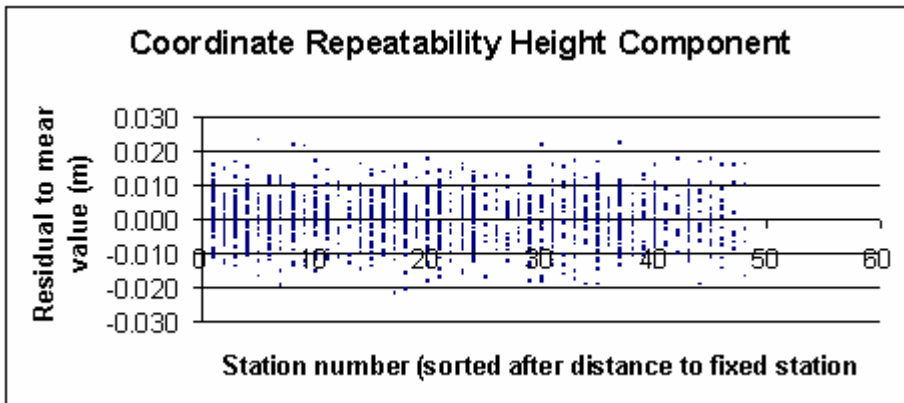
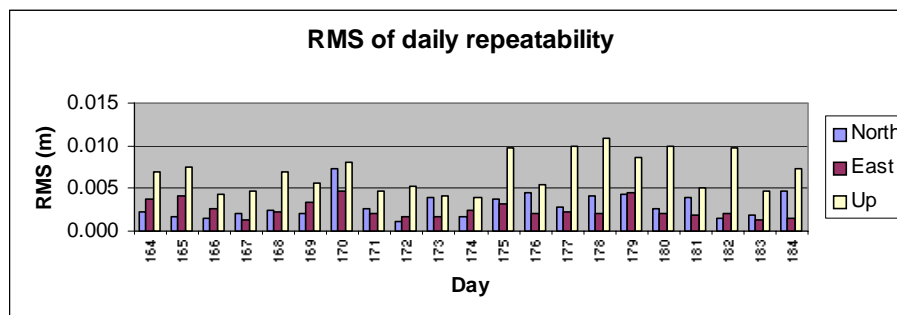
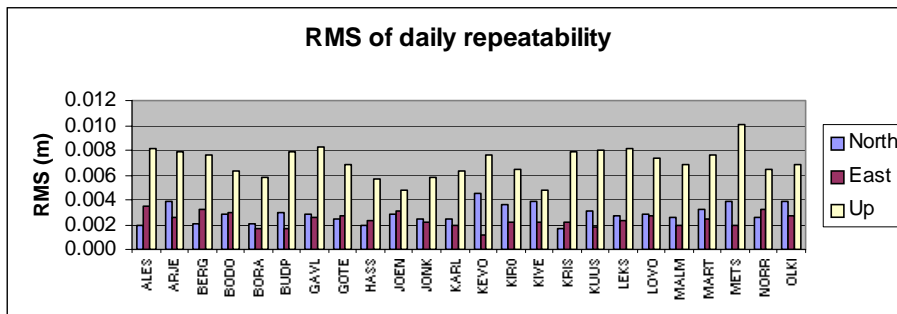
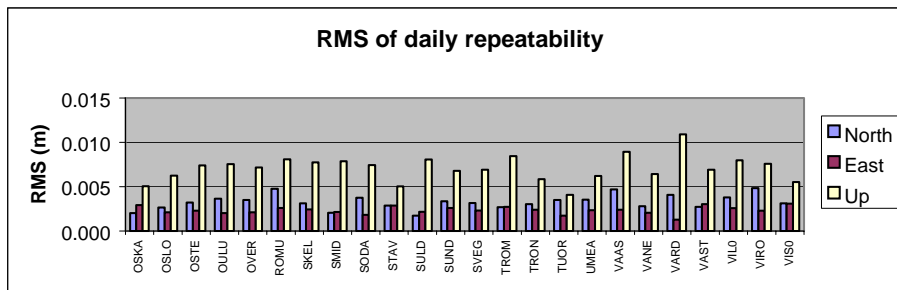


Figure 7: Coordinate repeatability v. stations.

The RMS of the daily repeatabilities are to be found in Figure 8.



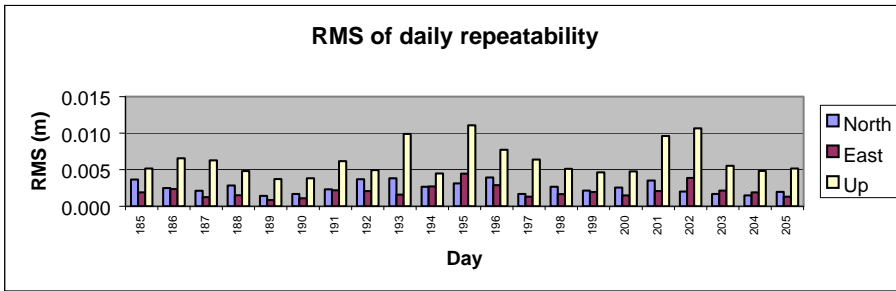
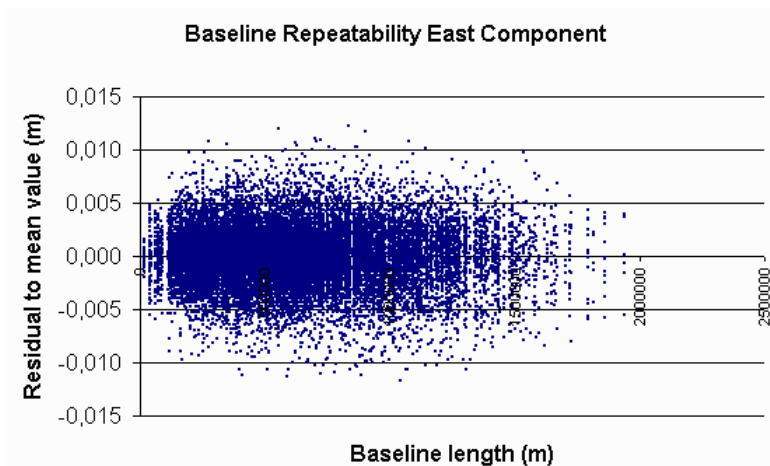
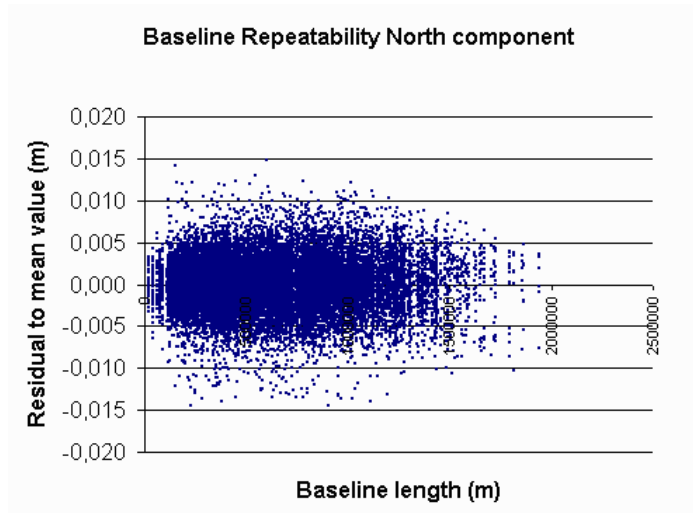


Figure 8: RMS of daily repeatability v. station and day, respectively.

The repeatability in north, east, up and baseline length of all possible baselines (22 867) are plotted versus baseline length in figure 9.



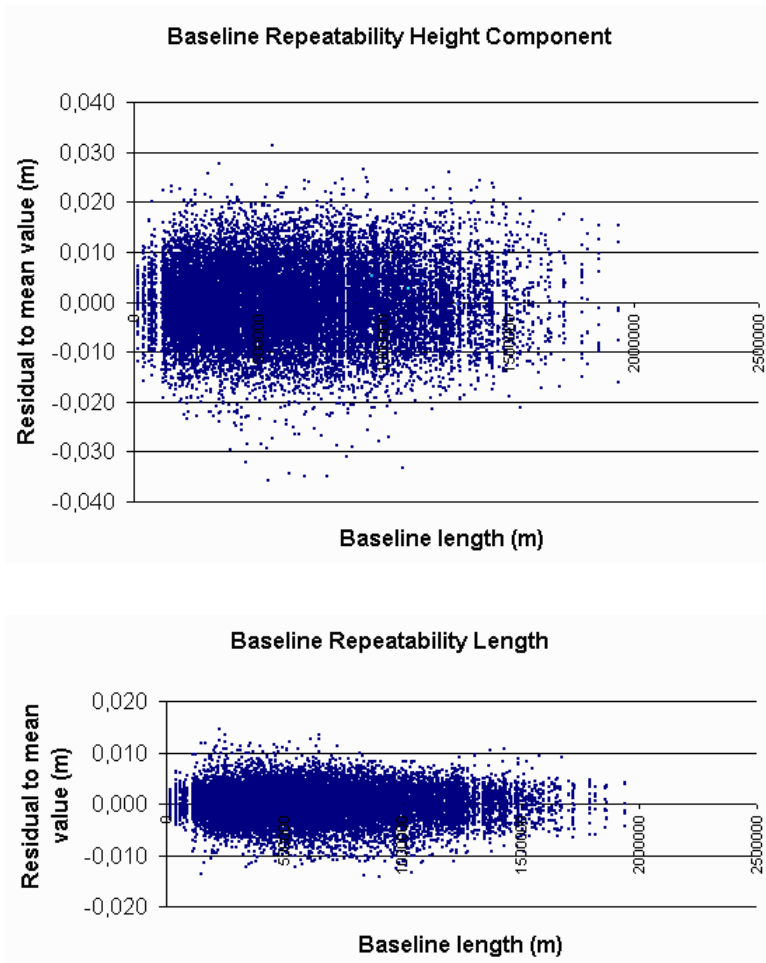


Figure 9: Daily baseline repeatability.

No outlier and no distance dependence could be identified.

6.3. Comparison with reference coordinates

The final solution each day was compared with the reference coordinates in table 5 (IERS ITRF 97 epoch 1999.5). The daily comparisons show the same pattern as the combined minimum constrained solution, therefore only the latter is included in this report.

The coordinates of the minimum constrained solution are found in appendix 5.

The minimum constrained solution was compared with the reference coordinates in table 5 by a 3-parameter transformation. The 3-parameter (translation) transformation in table 7 shows that the 4 non IGS/permanent EUREF stations (OSLO, VARD, STAV and TRON) are not consistent with the new solution. In table 8 those stations are excluded.

Table 7: Residuals of the translation to the reference coordinates in table 5.

Unit: mm	North	East	Up
TROM 10302M006	6.6	4.5	0.3
OSLO 10307M001	-3.4	-19.6	-20.7
VARD 10322M002	-13.7	-3.1	39.5
STAV 10330M001	3.5	-9.5	-9.4
TRON 10331M001	-1.6	17.3	27.1
ONSA 10402M004	-1.2	-2.6	8.5
MAR6 10405M002	1.3	0.8	1.3
KIRO 10422M001	-0.4	-3	-0.9
VISO 10423M001	-0.7	0.9	-10.9
VILO 10424M001	-0.5	1	-6.3
METS 10503S011	0	-2.3	-15.4
VAAS 10511M001	-0.9	3	-2.3
JOEN 10512M001	0.1	3.6	-5.5
SODA 10513M001	0.3	4.4	-4.3

Table 8: Residuals of the translation to the reference coordinates (table 5), non IGS and permanent EUREF sites excluded.

Unit: mm	North	East	Up
TROM 10302M006	5.6	3.7	3.9
ONSA 10402M004	-1.5	-3.2	12.3
MAR6 10405M002	0.8	0.1	5.1
KIRO 10422M001	-1.3	-3.8	2.7
VISO 10423M001	-0.9	0.1	-7.2
VILO 10424M001	-1.3	0.3	-2.6
METS 10503S011	-0.4	-3.3	-11.7
VAAS 10511M001	-1.5	2	1.4
JOEN 10512M001	-0.3	2.4	-1.9
SODA 10513M001	-0.5	3.3	-0.8

Table 8 shows that Onsala (ONSA) and Metsähovi (METS) have quite large residuals in the height component. Also Tromsø have quite large residuals in the north and east components. All stations are IGS stations, coordinates of which are determined also by other techniques than GPS (SLR, VLBI).

The discrepancy at Onsala has also another explanation. February 1, 1999, the Turbo Rogue SNR-8000 receiver at Onsala was replaced by an Ashtech Z-XII3. At the same time the conical shaped radome was replaced by a hemispherical radome of the same type as on all other SWEPOS stations – see figure 10. In IGS mail 2133 it was anticipated that this change might introduce a jump in the coordinate time series, which later on showed to be the fact – see figure 11.

The time series in figure 11 was taken from the BIFROST project. The coordinates of Onsala have been computed by precise point positioning (PPP) with GIPSY using products from JPL.



Figure 10: GPS antenna with radome at Onsala before and after February 1, 1999.

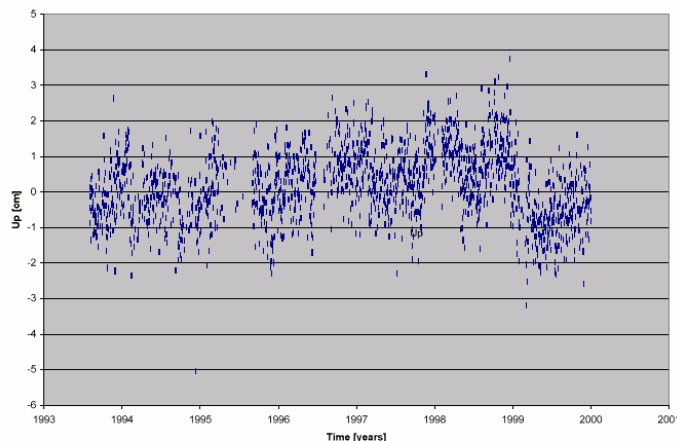


Figure 11: Coordinate time series (from the BIFROST-project) of the up component at Onsala.

A shift is clearly visible in the up component. Onsala has sunk. Some disturbances could be noticed in the north and east components, but no significant shift.

The shift in the height component of Onsala means that the ITRF 97 coordinates will not be valid for epoch 1999.5 (or any other epoch after 1999-02-01). The shift has to be estimated and corrected for, if Onsala should be used for the constraint.

The shift at Onsala was estimated from the daily processing at SWEPOS, which uses exactly the same processing strategy as for the SWEREF 99 solution. The estimation is based on baselines to the two closest SWEPOS stations for 57 days around February 1 1999. The average of the estimation from the two baselines is -20 mm. The estimation of the shift as well as corrected coordinates for Onsala is documented in appendix 12.

The corrected coordinates of Onsala fit much better and Onsala is not an outlier anymore. Metsähovi is still an outlier, and was excluded from the 3-pramater fit –see table .9. An examination of the Metsähovi time series from permanent EUREF shows that the up component is somewhat higher during the weeks 1014-1019 than during the time period up to week 963, which is included

in the IERS ITRF 97-solution – see figure 12. This explains the high residual, even though the reason still is unknown.

Table 9: Residuals of the translation to the reference coordinates of the IGS/Permanent EUREF stations (table 5), Onsala corrected and Metsähovi excluded.

Unit:mm	North	East	Up
TROM 10302M006	5.3	3.1	4.8
ONSA 10402M004	-1.7	-3.7	-6.8
MAR6 10405M002	0.6	-0.5	6.0
KIRO 10422M001	-1.6	-4.4	3.6
VISO 10423M001	-1.1	-0.5	-6.3
VIL0 10424M001	-1.5	-0.2	-1.7
METS 10503S011	-0.5	-3.9	-10.8
VAAS 10511M001	-1.7	1.4	2.3
JOEN 10512M001	-0.3	1.7	-1.0
SODA 10513M001	-0.7	2.6	0.1

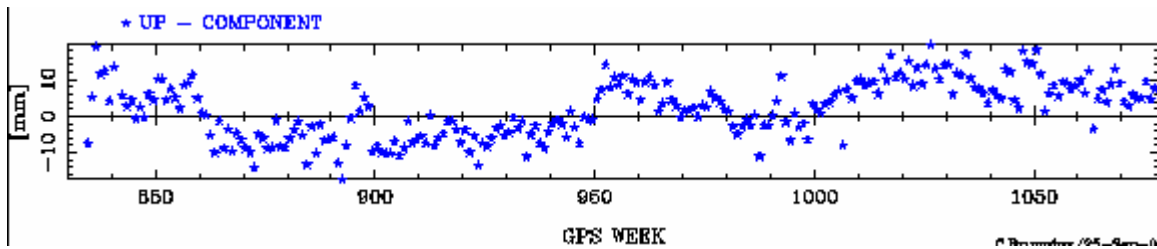


Figure 12: Time series of Metsähovi.

6.4. Three different solutions

Three main solutions were produced, one minimum constrained solution and two constrained solutions.

The minimum constrained solution was fitted by a 3-parameter transformation (translation) to IERS ITRF 97 epoch 1999.5 with correction at Onsala (table 9). The non IGS/permanent EUREF stations as well as the outlier Metsähovi were not used as fitting points. Resulting coordinates are found in appendix 6.

The constrained solution according to alternative 1 was performed with corrected coordinates at Onsala and without using Metsähovi for the constraint. Resulting coordinates for this alternative is found in appendix 7.

The constrained solution according to alternative 2 was performed with corrected coordinates at Onsala. First all 14 IGS core stations were heavily constrained when combining the 6 weekly solutions from permanent EUREF (step 1). The resulting coordinates from step 1 was checked with a translation (3-parameter-fit) to the minimum constrained solution. Tromsö turned then out to be an outlier – see table 10. Step 1 was rerun without constraining Tromsö. After this all stations fitted well. In step 2 all 10 stations were used for the constraint. Resulting coordinates from constrained alternative 2 are found in appendix 8.

Table 10: Constrained alternative 2, step 1, translated to the minimum constrained solution. Tromsø excluded.

Unit:mm	North	East	Up
VIL0 10424M001	0.5	0.3	0.7
METS 10503S011	0.7	0.3	0.2
ONSA 10402M004	-1.3	0.5	2.1
MAR6 10405M002	-0.1	0.1	0.5
KIR0 10422M001	0.7	1.0	3.2
TROM 10302M006	3.4	6.6	13.8
JOEN 10512M001	0.2	-1.8	-3.1
SODA 10513M001	0.1	-0.2	-3.5
VAAS 10511M001	0.2	0.5	-3.0
VIS0 10423M001	-0.3	0.3	3.0

6.5. Comparison of the minimum constrained and the constrained solutions

The two constrained solutions, alternative 1 and 2, were compared to the minimum constrained solution (translated to ITRF) by a 3-parameter transformation (translation) – see table 11.

Table 11: Constrained alt 1 and 2 compared to the translated minimum constrained solution.

Unit:mm Station	Constrained alt 1			Constrained alt 2		
	North	East	Up	North	East	Up
ALES 0	-0.1	-0.8	-0.8	0.0	-0.3	0.7
ARJE 0	0.2	-0.1	-0.1	0.4	0.2	0.4
BERG 0	-0.3	-0.9	-0.7	0.0	-0.3	0.6
BODO 0	0.9	-0.3	0.7	0.5	0.1	0.2
BORA 0	-0.5	-0.5	-0.4	-0.2	0.0	0.6
BUDP 01-13-829	-0.9	-0.4	-0.7	-0.4	-0.1	0.6
GAVL 1	-0.3	-0.3	-0.1	0.0	0.1	0.5
GOTE 0	-0.5	-0.5	-0.4	-0.3	0.0	0.5
HASS 0	-0.7	-0.4	-0.4	-0.4	0.0	0.6
JOEN 10512M001	0.1	2.3	0.7	0.3	-1.8	-4.0
JONK 0	-0.6	-0.4	-0.3	-0.3	0.0	0.5
KARL 0	-0.3	-0.4	-0.3	-0.1	0.0	0.5
KEVO	0.9	0.6	0.4	0.4	0.3	-0.1
KIR0 10422M001	-0.8	-2.7	5.3	0.7	0.5	2.4
KIVE	-0.1	0.5	-0.3	0.2	0.3	0.0
KRIS 0	-0.5	-0.8	-0.7	-0.3	-0.3	0.5
KUUS	0.3	0.6	-0.1	0.3	0.2	-0.1
LEKS 0	-0.3	-0.3	-0.4	-0.1	0.1	0.5
LOVO 0	-0.4	-0.3	-0.2	-0.2	0.1	0.4
MALM 0	-0.7	-0.4	-0.3	-0.5	0.0	0.7
MAR6 10405M002	1.0	0.2	7.6	-0.1	-0.1	-0.5
METS 10503S011	-0.4	0.3	-0.1	0.8	0.1	-0.7
NORR 0	-0.5	-0.3	-0.3	-0.2	0.1	0.5

OLKI	-0.2	0.2	-0.3	-0.1	0.1	0.3
ONSA 10402M004	-0.9	-2.2	-5.2	-0.9	0.4	1.1
OSKA 0	-0.5	-0.3	-0.5	-0.3	0.1	0.6
OSLO 10307M001	-0.4	-0.6	-0.7	-0.1	-0.2	0.5
OSTE 0	0.0	-0.3	-0.3	0.2	0.1	0.3
OULU	0.3	0.4	-0.3	0.3	0.3	0.2
OVER 0	0.2	0.0	0.0	0.3	0.4	0.4
ROMU	0.1	0.8	-0.2	0.2	0.2	-0.1
SKEL 0	0.1	-0.1	-0.3	0.3	0.2	0.3
SMID 117-05-810	-0.8	-0.5	-0.7	-0.3	-0.1	0.7
SODA 10513M001	-0.3	3.1	1.9	0.1	-0.3	-4.5
STAV 10330M001	-0.5	-0.8	-0.9	-0.2	-0.3	0.7
SULD 61-10-802	-0.7	-0.5	-0.7	-0.3	-0.1	0.7
SUND 0	-0.1	-0.2	-0.2	0.1	0.1	0.4
SVEG 0	-0.2	-0.3	-0.2	0.1	0.0	0.4
TROM 10302M006	5.4	3.6	6.5	1.0	0.9	-5.4
TRON 10331M001	0.1	-0.4	-0.6	0.2	0.0	0.4
TUOR	-0.4	0.3	-0.3	0.0	0.2	0.1
UMEA 0	0.0	-0.2	-0.2	0.2	0.2	0.4
VAAS 10511M001	-1.0	2.0	3.9	0.2	0.2	-4.0
VANE 0	-0.5	-0.4	-0.4	-0.2	0.0	0.5
VARD 10322M002	1.0	0.8	0.0	0.4	0.3	0.1
VAST 0	-0.4	-0.3	-0.2	-0.1	0.1	0.4
VIL0 10424M001	-0.7	0.3	0.0	0.5	0.1	-0.5
VIRO	-0.4	0.6	-0.2	0.1	0.1	-0.1
VIS0 10423M001	-0.3	0.2	-4.6	-0.2	0.2	2.1
RMS	0.9	1.1	2.1	0.4	0.4	1.5
Translation	0.0	-0.8	-1.8	-2.7	-4.9	-7.1

The constrained solution alternative 2 fits slightly better to the minimum constrained solution. The shift is of course smaller between the constrained alternative 1 and the translated minimum constrained solution, since the same coordinates were used for the connection to ITRF in both cases. (In constrained alternative 2, on the other hand, coordinates for connection to ITRF were obtained by adjustment of corresponding weeks of permanent EUREF.)

6.6. Transformation into ETRS 89

The conversion to ETRS 89 was performed according to the guidelines in “Specifications for reference frame fixing in the analysis of a EUREF GPS campaign” version 4.0 (1998-01-08) by C.Boucher and Z. Altamimi. The last step, which is to take the velocities within the European plate into account, has not been performed since we lack a good model for the movements within the European plate.

The following model and parameters were used for the conversion:

$$X_E(1999.5) = X_{97}(1999.5) + \begin{bmatrix} T1_{97} \\ T2_{97} \\ T3_{97} \end{bmatrix} + \begin{bmatrix} 0 & -\dot{R}3_{97} & \dot{R}2_{97} \\ \dot{R}3_{97} & 0 & -\dot{R}1_{97} \\ -\dot{R}2_{97} & \dot{R}1_{97} & 0 \end{bmatrix} \cdot X_{97}(1999.5) \cdot (1999.5 - 1989.0)$$

$X_E(1999.5)$ = Coordinates in ETRS 89 at epoch 1999.5 (ETRF 97)

$X_{97}(1999.5)$ = Coordinates in ITRF 97 at epoch 1999.5

$T1_{97} = 4.1$ cm

$T2_{97} = 4.1$ cm

$T3_{97} = -4.9$ cm

$\dot{R}1_{97} = 0.00020''/Y$

$\dot{R}2_{97} = 0.00050''/Y$

$\dot{R}3_{97} = -0.00065''/Y$

Coordinates in ETRF 97 epoch 1999.5 for the (translated) minimum constrained solution and the two alternatives of the constrained solution could be found in appendix 9, 10 and 11, respectively.

7. Comparison with other EUREF solutions

7.1. SWEREF 93

SWEREF 93 is based on the DOSE 93 campaign, which was observed August 24-27, 1993. A special solution, DOSE 93A, was aligned to EUREF 89 by a 6-parameter-transformation (Helmert-transformation with fixed scale) to 11 stations with coordinates from the original EUREF 89-campaign. The DOSE 93A coordinates thus transformed were used to define SWEREF 93.

SWEREF 93 is compared to SWEREF 99 in table 12.

Note that this comparison approximately could be interpreted as the comparison to the original EUREF 89 campaign. (The difference between SWEREF 93 and ETRF 89 epoch 89.0 at Onsala is below 1 cm in the horizontal components). This indicates that the realisations of ETRS 89 has drifted away c. 5 cm since 1989!

Table 12: SWEREF 93 minus SWEREF 99.

Unit: mm	Translated			Constrained alt 1			Constrained alt 2		
	North	East	Up	North	East	Up	North	East	Up
ARJE 0	-0.004	0.062	-0.015	-0.004	0.063	-0.013	-0.006	0.066	-0.007
BORA 0	0.016	0.043	0.010	0.017	0.045	0.012	0.017	0.048	0.017
GAVL 1	0.005	0.052	-0.020	0.006	0.053	-0.019	0.005	0.055	-0.013
GOTE 0	0.017	0.042	0.012	0.019	0.043	0.014	0.018	0.046	0.020
HASS 0	0.011	0.037	0.022	0.012	0.039	0.024	0.012	0.041	0.029
JONK 0	0.013	0.041	0.003	0.015	0.042	0.005	0.014	0.045	0.010
KARL 0	0.014	0.049	-0.005	0.015	0.050	-0.003	0.014	0.053	0.002
KIRO	-0.009	0.059	0.000	-0.007	0.063	-0.003	-0.011	0.062	0.006
LEKS 0	0.012	0.056	-0.019	0.013	0.057	-0.017	0.013	0.059	-0.012
LOVO 0	0.008	0.048	-0.015	0.009	0.049	-0.013	0.008	0.052	-0.007
MALM 0	0.016	0.041	0.029	0.018	0.042	0.031	0.018	0.045	0.036
MAR.6	0.006	0.048	-0.025	0.006	0.048	-0.031	0.006	0.052	-0.017
NORR 0	0.012	0.042	-0.018	0.013	0.043	-0.016	0.012	0.046	-0.010
ONSA	0.018	0.048	0.029	0.020	0.051	0.036	0.020	0.052	0.036
OSKA 0	0.013	0.040	0.009	0.014	0.041	0.011	0.014	0.044	0.016
OSTE 0	0.007	0.056	-0.006	0.008	0.057	-0.004	0.006	0.060	0.001
OVER 0	-0.013	0.061	-0.031	-0.013	0.061	-0.029	-0.014	0.064	-0.023
SKEL 0	-0.003	0.056	-0.044	-0.003	0.057	-0.042	-0.004	0.059	-0.036
SUND 0	0.002	0.055	-0.030	0.002	0.056	-0.029	0.001	0.059	-0.023
SVEG 0	0.007	0.055	-0.022	0.008	0.056	-0.020	0.007	0.059	-0.014
UMEA 0	-0.001	0.054	-0.043	0.000	0.055	-0.041	-0.002	0.058	-0.036
VANE 0	0.014	0.046	0.003	0.015	0.047	0.005	0.014	0.050	0.010
VAST 0	0.010	0.048	-0.018	0.011	0.049	-0.017	0.010	0.052	-0.011
VIL0	0.001	0.062	-0.019	0.003	0.062	-0.017	0.000	0.065	-0.010
VIS0	0.006	0.044	-0.018	0.007	0.045	-0.012	0.007	0.048	-0.012
RMS	0.011	0.050	0.022	0.012	0.051	0.022	0.012	0.054	0.020
MAX	0.018	0.062	0.044	0.020	0.063	0.042	0.020	0.066	0.036

7.2. Denmark

The Danish EUREF 89 originates from the EUREF-DK94 campaign and is based on ITRF 92 epoch 1994-09-15. The Danish permanent reference stations had not started their operation in 1994 and are therefore not included in the EUREF-DK94-campaign. Buddinge has got EUREF 89 coordinates by excentric measurements and the other two permanent reference stations by connection to EUREF-DK94 and its densification.

Table 13: Danish EUREF 89 minus SWEREF 99

Unit: mm	Translated			Constrained alt 1			Constrained alt 2		
	North	East	Up	North	East	Up	North	East	Up
BUDP	-0.002	-0.015	0.006	0.000	-0.014	0.009	-0.001	-0.011	0.014
SMID	-0.008	-0.009	-0.015	-0.006	-0.008	-0.013	-0.006	-0.004	-0.008
SULD	-0.015	-0.011	-0.010	-0.013	-0.010	-0.008	-0.013	-0.007	-0.003
RMS	0.010	0.012	0.011	0.008	0.011	0.010	0.008	0.008	0.009
MAX	0.015	0.015	0.015	0.013	0.014	0.013	0.013	0.011	0.014

7.3. Finland

The Finnish EUREF 89 originates from the EUREF-FIN-campaign and is based on ITRF 96 epoch 1997.0.

Table 14: EUREF-FIN minus SWEREF 99

Unit: mm	Translated			Constrained alt 1			Constrained alt 2		
	North	East	Up	North	East	Up	North	East	Up
JOEN	-0.001	-0.004	-0.011	-0.001	-0.006	-0.010	-0.003	0.000	0.002
KEVO	0.002	-0.002	-0.012	0.002	-0.002	-0.011	0.000	0.000	-0.004
KIVE	-0.003	-0.003	-0.015	-0.002	-0.003	-0.013	-0.004	0.000	-0.007
KUUS	-0.006	-0.003	-0.023	-0.006	-0.003	-0.021	-0.008	-0.001	-0.014
METS	-0.005	-0.006	-0.006	-0.004	-0.005	-0.004	-0.006	-0.002	0.003
OLKI	-0.002	-0.006	-0.012	-0.002	-0.005	-0.010	-0.003	-0.002	-0.004
OULU	-0.003	-0.005	-0.024	-0.002	-0.004	-0.022	-0.004	-0.002	-0.016
ROMU	-0.001	-0.003	-0.016	0.000	-0.003	-0.014	-0.002	-0.001	-0.008
SODA	-0.005	-0.005	-0.028	-0.004	-0.008	-0.028	-0.006	-0.002	-0.015
TUOR	-0.003	-0.004	-0.008	-0.002	-0.004	-0.006	-0.003	-0.001	0.000
VAAS	-0.002	-0.005	-0.019	0.000	-0.007	-0.021	-0.003	-0.002	-0.007
VIRO	-0.004	-0.004	-0.008	-0.003	-0.004	-0.006	-0.004	-0.001	0.001
RMS	0.003	0.004	0.017	0.003	0.005	0.016	0.004	0.001	0.009
MAX	0.006	0.006	0.028	0.006	0.008	0.028	0.008	0.002	0.016

7.4. Norway

The Norwegian EUREF 89 originates from the EUREF-NOR94 campaign and is based on ITRF 93. The SATREF stations are not primary carriers of the Norwegian EUREF 89 system and there are different sets of EUREF 89 coordinates on the SATREF stations. The reason for the multiple sets of coordinates is uncertainties in the eccentricity measures. We have chosen a solution made by Oddgeir Kristiansen October 1998 for the comparison.

Table 15: Norwegian EUREF 89 minus SWEREF 99

Unit: mm	Translated			Constrained alt 1			Constrained alt 2		
	North	East	Up	North	East	Up	North	East	Up
ALES 0	0.004	0.014	-0.010	0.005	0.015	-0.007	0.005	0.018	-0.003
BERG 0	-0.006	0.011	-0.003	-0.005	0.013	0.000	-0.006	0.016	0.005
BODO 0	0.002	0.028	-0.009	0.002	0.029	-0.008	0.001	0.032	-0.001
KRIS 0	0.001	-0.001	-0.007	0.002	0.000	-0.005	0.002	0.003	0.000
OSLO	-0.001	0.015	-0.013	0.000	0.017	-0.011	0.000	0.020	-0.006
STAV	0.002	0.013	-0.006	0.003	0.015	-0.004	0.003	0.018	0.001
TROM	-0.002	0.024	-0.012	-0.007	0.021	-0.017	-0.005	0.027	0.002
TRON	0.000	0.021	-0.004	0.000	0.022	-0.002	0.000	0.025	0.003
VARD	-0.010	0.024	-0.021	-0.011	0.023	-0.019	-0.012	0.026	-0.012
RMS	0.004	0.019	0.011	0.005	0.019	0.010	0.005	0.022	0.005
MAX	0.010	0.028	0.021	0.011	0.029	0.019	0.012	0.032	0.012

7.5. EUVN 97

The result from the EUVN97 campaign is in ETRF 96 epoch 1997.4. Nine permanent EUREF stations and two other SWEPOS stations are included both in the EUVN 97 campaign and in SWEREF 99. The Swedish tide gauge pillars SE02, SE04, SE06 and SE07 are not included in

SWEREF 99. Coordinates in SWEREF 99 for those pillars have been obtained in the following way. Observation data on the pillars from the EUVN 97 campaign has been processed together with the SWEPOS-network. For each tide gauge pillar this solution has been fitted by a 6-parameter transformation to SWEREF 99 (Translated minimum constrained, constrained alternative 1 and constrained alternative 2, respectively) using the 6-8 nearest SWEPOS stations.

Table 16: EUVN 97 minus SWEREF 99.

Unit: mm	Translated			Constrained alt 1			Constrained alt 2		
	North	East	Up	North	East	Up	North	East	Up
JOEN	-0.002	-0.011	-0.011	-0.002	-0.013	-0.010	-0.003	-0.007	0.002
KIRO	-0.004	-0.006	-0.003	-0.002	-0.003	-0.006	-0.006	-0.003	0.003
MAR.6	0.000	-0.005	-0.013	-0.001	-0.004	-0.018	0.000	-0.001	-0.004
METS	-0.001	-0.002	-0.006	0.000	-0.002	-0.004	-0.003	0.001	0.003
ONSA	-0.001	0.002	0.006	0.001	0.005	0.013	0.000	0.006	0.013
OSTE 0	-0.002	0.000	-0.010	-0.002	0.002	-0.008	-0.003	0.004	-0.002
SE02	-0.002	0.000	0.007	-0.001	0.001	0.010	-0.001	0.003	0.014
SE04	-0.003	-0.002	-0.018	-0.002	-0.001	-0.016	-0.004	0.001	-0.010
SE06	-0.002	-0.001	0.002	0.000	0.000	0.004	-0.001	0.003	0.009
SE07	0.000	-0.002	-0.007	0.000	-0.001	-0.007	0.000	0.002	0.001
SKEL 0	-0.003	-0.003	-0.016	-0.002	-0.003	-0.014	-0.004	0.000	-0.008
SODA	-0.008	-0.007	-0.028	-0.008	-0.009	-0.028	-0.010	-0.003	-0.016
VAAS	-0.003	-0.007	-0.018	-0.001	-0.009	-0.021	-0.004	-0.004	-0.006
VIL0	-0.002	-0.005	-0.010	-0.001	-0.005	-0.009	-0.004	-0.001	-0.002
VIS0	0.000	-0.004	0.002	0.001	-0.003	0.009	0.001	0.000	0.008
RMS	0.003	0.005	0.013	0.002	0.005	0.013	0.004	0.003	0.008
MAX	0.008	0.011	0.028	0.008	0.013	0.028	0.010	0.007	0.016

8. Choice of the final solution

The primary demand on the new Swedish ETRS 89, besides that it should be officially approved, is that it should be accurate, homogeneous and consistent with normal GPS processing, so that a usual GPS user will not run into problems due to the reference frame. The new Swedish ETRS 89 should also agree as well as possible with the ETRS 89 realisations used in our neighbouring countries – Denmark, Norway and Finland. It might also be an advantage if the new Swedish ETRS 89 has a specific epoch with respect to the land uplift, as we later on intend to model this kind of movements within Sweden.

The constrained alternative 2 solution is the solution that best fulfils the above mentioned demands and is therefor chosen as the final solution.

The constrained alternative 2 solution is the constrained solution that has the best agreement with the minimum constrained solution (and also with weekly solutions from SWEPOS spring 2000). It is not dependent on the velocity vectors of non-IGS sites. Furthermore, this solution agrees best with other existing EUREF realisations.

The National Land Survey of Sweden proposes the stations in table 17 to be approved as official EUREF GPS Stations. All stations belong to SWEPOS – the Swedish network of permanent reference stations. All proposed stations are monumented as (isolated and heated) concrete pillars on solid bedrock.

Table 17: SWEREF 99 (ETRS 89) coordinates of the new Swedish EUREF stations.

Station	X	Y	Z	Latitude	Longitude	Height
ARJE_0	2441775.4373	799268.0366	5818729.1711	66 19 4.85691	18 7 29.49556	489.145
BORA_0	3328984.8136	761910.0660	5369033.4748	57 42 53.84111	12 53 28.84159	219.904
HASS_0	3464655.8414	845749.9472	5270271.4971	56 5 31.97370	13 43 5.06237	114.016
JONK_0	3309991.8454	828932.0763	5370882.2638	57 44 43.69608	14 3 34.57899	260.352
KARL_0	3160763.3610	759160.1384	5469345.4948	59 26 38.46674	13 30 20.23720	114.265
KIRO_10422M001	2248123.5038	865686.5326	5886425.5943	67 52 39.26375	21 3 36.84353	497.965
LEKS_0	3022573.1884	802945.6368	5540683.9551	60 43 19.71351	14 52 37.21262	478.092
LOVO_0	3104219.4534	998383.9817	5463290.5080	59 20 16.08058	17 49 44.08197	79.605
MAR6_10405M002	2998189.7132	931451.5886	5533398.4735	60 35 42.50805	17 15 30.67778	75.375
NORR_0	3199093.3220	932231.2871	5420322.4852	58 35 24.82429	16 14 46.96242	40.917
ONSA_10402M004	3370658.8318	711876.9387	5349786.7450	57 23 43.06580	11 55 31.84722	45.534
OSKA_0	3341340.1876	957912.3012	5330003.2150	57 3 56.29169	15 59 48.50148	149.753
OSTE_0	2763885.5164	733247.3303	5682653.3430	63 26 34.04843	14 51 29.03061	490.01
OVER_0	2368885.0271	994492.1727	5818478.1810	66 19 4.28199	22 46 24.12554	222.887
SKEL_0	2534031.1978	975174.4040	5752078.3436	64 52 45.10136	21 2 53.82526	81.197
SUND_0	2838909.9330	903822.0452	5620660.2035	62 13 56.90159	17 39 35.57936	31.776
SVEG_0	2902495.1066	761455.7889	5609859.6815	62 1 2.67953	14 42 0.03006	491.183
UMEA_0	2682407.9229	950395.8843	5688993.1146	63 34 41.29143	19 30 34.53185	54.498
VANE_0	3249408.2921	692757.9173	5426396.9317	58 41 35.24916	12 2 5.99772	169.664
VIL0_10424M001	2620258.8912	779137.9797	5743799.2762	64 41 52.24160	16 33 35.73391	449.936
VIS0_10423M001	3246470.5614	1077900.3132	5365277.9025	57 39 13.92217	18 22 2.32437	79.778

9. Acknowledgements

We would like to thank our Nordic colleagues at the National Survey and Cadastre in Denmark, the Finnish Geodetic Institute and the Norwegian Mapping Authority for supplying us with data from their permanent reference stations as well as national EUREF 89 coordinates.

10. References

- BOUCHER C.; ALTAMIMI Z.; SILLARD P.: IERS technical Note 27. The International terrestrial Reference Frame (ITRF97). May 1999. Observatoire de Paris.
- BRUYNINX C.: <http://homepage.oma.be/euref/series/mets.html>
- FANKHAUSER S.; GURTNER W.: *Denmark Euref Densification Campaign EUREF-DK94*. Report on the Symposium of the IAG Subcommission for Europe (EUREF) held in Helsinki 3-6 May 1995.
- INEICHEN D.; GURTNER W.; SPRINGER T.; ENGELHARDT G.; LUTHARDT J.; IHDE J.: *EUVN 97 Combined GPS Solution*. Distributed by EUVN Working group.
- JOHANSSON J.: Time series of Onsala from the BIFROST-project. 2000.
- KRISTIANSEN O.; HARSSON B-G: *The Norwegian National Geodetic Network – EUREF 89*. The 13th General Meeting of the Nordic Geodetic Commission. 25-29 May 1998.
- OLLIKAINEN M., KOIVULA A.; POUTANEN M.: *The Densification of the EUREF Network in Finland*. Report on the Symposium of the IAG Subcommission for Europe (EUREF) held in Prague, 2-5 June 1999.
- REIT B-G.: *SWEREF 93 - a Swedish Reference System for GPS*. Coordinate systems, GPS, and the geoid. Reports of the Finnish Geodetic Institute. 95:4.

ROTHACHER M.;MERVART L.: *Bernese GPS Software Version 4.0*. Astronomical Institute University of Berne.
September 1996.

Appendix 1: Apriori coordinates

NORDIC 1015, 1016, 1019 FIXED ON ITRF97 EP 99.5

23-NOV-99 14:49

LOCAL GEODETIC DATUM: WGS - 84

EPOCH: 1999-07-01 0:00:00

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
701	ALES 0	2938027.4200	319096.3035	5633413.9052	M
702	BERG 0	3155871.2284	290902.8169	5516573.5026	M
708	TRON 10331M001	2820170.9153	513485.9905	5678935.8704	M
501	ARJE 0	2441775.2232	799268.1366	5818729.2789	M
114	KIRO 10422M001	2248123.2839	865686.6263	5886425.6924	F
505	OVER 0	2368884.8061	994492.2702	5818478.2840	M
506	SKEL 0	2534030.9785	975174.5063	5752078.4506	M
116	VILO 10424M001	2620258.6783	779138.0840	5743799.3845	F
601	BUDP 01-13-829	3513638.3531	778956.3222	5248216.3718	M
512	JONK 0	3309991.6434	828932.2005	5370882.3928	M
509	BORA 0	3328984.6130	761910.1908	5369033.6040	M
115	VISO 10423M001	3246470.3488	1077900.4346	5365278.0247	F
522	GAVL 1	2993587.5881	922762.5716	5537295.2055	M
507	SUND 0	2838909.7199	903822.1559	5620660.3181	M
524	GOTE 0	3341445.3573	708148.3931	5368462.6730	M
511	HASS 0	3464655.6411	845750.0762	5270271.6297	M
602	SULD 61-10-802	3446394.2969	591713.0661	5316383.3856	M
525	MALM 0	3518626.9236	814264.6983	5239551.8158	M
504	NORR 0	3199093.1142	932231.4087	5420322.6086	M
111	ONSA 10402M004	3370658.6416	711877.0660	5349786.8894	F
521	VANE 0	3249408.0927	692758.0399	5426397.0596	M
603	SMID 117-05-810	3557911.3225	599176.6053	5242066.3829	M
523	VAST 0	3097214.7777	921046.0723	5480693.5062	M
513	KARL 0	3160763.1576	759160.2582	5469345.6197	M
514	LEKS 0	3022572.9817	802945.7530	5540684.0767	M
515	LOVO 0	3104219.2412	998384.1002	5463290.6275	M
113	MAR6 10405M002	2998189.5008	931451.7034	5533398.5898	F
517	OSKA 0	3341339.9814	957912.4263	5330003.3429	M
705	OSLO 10307M001	3169981.9639	579956.7027	5485936.6026	M
518	OSTE 0	2763885.3079	733247.4390	5682653.4587	M
706	STAV 10330M001	3275753.7202	321110.9670	5445042.0109	M
519	SVEG 0	2902494.8993	761455.9019	5609859.8008	M

520	UMEA 0	2682407.7065	950395.9905	5688993.2253	M
703	BODO 0	2393811.7011	612747.6951	5860377.6054	M
707	TROM 10302M006	2102928.5829	721619.4071	5958196.2003	F
709	VARD 10322M002	1844607.3970	1109719.1616	5983936.1053	M
801	JOEN 10512M001	2564139.1867	1486149.6986	5628951.3618	F
808	ROMU	2410839.2606	1388069.5507	5720515.2356	M
812	VIRO	2788248.2709	1454873.4092	5530280.1191	M
802	KEVO	1972158.2715	1005174.4311	5961798.7337	M
809	SODA 10513M001	2200146.7736	1091638.2903	5866870.7135	F
804	KUUS	2282711.5575	1267071.8123	5800215.7795	M
803	KIVE	2632277.2657	1266957.3690	5651027.6352	M
805	METS 10503S011	2892570.8887	1311843.3724	5512634.0629	F
806	OLKI	2863210.0645	1126271.4757	5568267.3201	M
807	OULU	2423778.5382	1176553.7788	5761860.9429	M
811	VAAS 10511M001	2699864.4166	1078263.9340	5658064.7859	F
810	TUOR	2917810.8492	1205222.6446	5523550.0397	M
704	KRIS 0	3348185.9305	465040.9732	5390738.2275	M

Appendix 2: Fixed stations – alternative 2, Step 1

FIXED STATIONS IN STEP 1, ALTERNATIVE 2

 LOCAL GEODETIC DATUM: WGS - 84 EPOCH: 1999-07-01 0:00:00

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
144	MATE 12734M008	4641949.6755	1393045.3266	4133287.3633	F
153	VILL 13406M001	4849833.7785	-335049.1341	4116014.8521	F
161	WTZR 14201M010	4075580.6574	931853.7090	4801568.0600	F
157	KOSG 13504M003	3899225.2259	396731.8545	5015078.3643	F
121	GRAZ 11001M002	4194423.9309	1162702.6018	4647245.3372	F
160	POTS 14106M003	3800689.7426	882077.3069	5028791.2555	F
111	ONSA 10402M004	3370658.6312	711877.0639	5349786.8725	F
103	REYK 10202M001	2587384.4500	-1043033.5089	5716563.9896	F
135	ZWEN 12330M001	2886325.4993	2155998.4390	5245816.1469	F
128	BOR1 12205M002	3738358.5670	1148173.6275	5021815.7084	F
431	THU1 43001M001	538981.3727	-1388714.7994	6181005.1295	F
107	NYAL 10317M003	1202433.9308	252632.2562	6237772.5133	F
105	TROM 10302M006	2102928.5812	721619.4098	5958196.1985	F
101	GRAS 10002M006	4581690.9964	556114.7324	4389360.7073	F
107	NYA1 10317M003	1202433.9326	252632.2574	6237772.5240	F
105	TRO1 10302M006	2102928.5830	721619.4069	5958196.2005	F

Appendix 3: Fixed stations – alternative 2, Step 2

PERMANENT EUREF, 13 STN FIX(-TROM)ONS CORR I97 99.5

18-SEP-00 14:22

LOCAL GEODETIC DATUM: WGS - 84

EPOCH: 1999-07-01 0:00:00

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
116	VIL0 10424M001	2620258.6783	779138.0838	5743799.3839	M
117	METS 10503S011	2892570.8884	1311843.3722	5512634.0619	M
111	ONSA 10402M004	3370658.6312	711877.0639	5349786.8725	F
113	MAR6 10405M002	2998189.5006	931451.7031	5533398.5893	M
114	KIRO 10422M001	2248123.2843	865686.6260	5886425.6917	M
105	TROM 10302M006	2102928.5796	721619.4031	5958196.1804	M
119	JOEN 10512M001	2564139.1872	1486149.6977	5628951.3620	M
120	SODA 10513M001	2200146.7743	1091638.2898	5866870.7131	M
118	VAAS 10511M001	2699864.4164	1078263.9334	5658064.7848	M
115	VIS0 10423M001	3246470.3482	1077900.4342	5365278.0231	M

Appendix 4: Daily repeatability- coordinates

North component

Station	164	165	166	167	168	169	170	171	172
ALES								0,000	-0,001
ARJE	-0,004	0,000	0,001	0,000	0,003	-0,002	0,012	-0,001	-0,001
BERG								-0,002	-0,002
BODO									-0,001
BORA	0,001	-0,001	0,001	0,002	0,001	-0,003	0,003	-0,004	0,001
BUDP								-0,002	0,001
GAVL	0,000	0,003	0,002	0,001	0,002	-0,001	-0,001	-0,002	0,000
GOTE	-0,001	0,001	0,000	0,002	-0,001	-0,004	0,004	-0,001	0,000
HASS	0,000	0,000	-0,001	0,002	0,001	-0,002	0,007	-0,003	0,000
JOEN								-0,002	0,001
JONK	0,000	0,000	0,001	-0,002	-0,001	-0,001	0,006	-0,002	0,000
KARL	0,001	-0,002	0,002	0,000	0,001	0,000	0,005	0,001	-0,002
KEVO								0,001	0,002
KIRO	-0,003	0,002	-0,002	-0,001	0,004	-0,001	0,011	-0,001	0,001
KIVE								-0,001	0,001
KRIS									
KUUS								-0,003	0,000
LEKS	-0,001	-0,001	-0,003	0,002	0,002	-0,002	0,005	0,000	-0,002
LOVO	0,001	0,000	0,000	0,002	0,003	0,000	0,005	-0,007	0,000
MALM	0,002	-0,003	-0,001	0,003	0,003	-0,003	0,005	-0,004	0,001
MART	0,002	0,002	0,001	0,000	0,003	-0,002	0,003	-0,002	0,000
METS								0,000	0,002
NORR	0,002	-0,001	0,002	0,002	0,004	0,000	0,004	-0,006	0,001
OLKI								-0,003	0,001
OSKA	0,002	-0,001	-0,001	-0,002	0,001	-0,004	0,006	-0,001	0,000
OSLO								0,001	-0,002
OSTE	0,000	0,000	0,001	0,003	0,002	-0,001	0,009	0,002	-0,002
OULU								-0,004	-0,001
OVER	-0,007	0,000	-0,002	0,000	0,002	-0,002	0,011	-0,001	0,001
ROMU								-0,007	0,002
SKEL	-0,003	0,000	0,001	0,002	0,003	-0,001	0,009	-0,001	0,000
SMID								-0,001	-0,001
SODA								0,001	0,000
STAV								0,000	-0,001
SULD								0,001	0,000
SUND	0,001	0,000	-0,001	-0,001	0,003	0,000	0,009	-0,002	-0,001
SVEG	0,001	-0,002	-0,003	-0,002	0,004	0,000	0,009	0,001	0,000
TROM									0,001
TRON								-0,002	-0,002
TUOR								0,002	0,000
UMEA	-0,003	0,004	-0,001	0,004	0,002	-0,001	0,009	-0,003	0,000
VAAS								-0,003	-0,001
VANE	-0,001	-0,001	0,001	0,000	0,000	-0,001	0,003	0,000	0,000
VARD									0,001
VAST	0,000	0,001	0,001	-0,006	0,002	-0,001	0,006	-0,002	-0,001
VIL0	-0,002	0,001	0,000	0,000	0,003	0,001	0,011	0,001	-0,001
VIRO								0,002	0,001
VISO	0,002	-0,002	-0,001	0,000	-0,001	-0,004	0,010	0,000	-0,001
RMS	0,002	0,002	0,002	0,002	0,003	0,002	0,007	0,003	0,001
MAX	0,007	0,004	0,003	0,006	0,004	0,004	0,012	0,007	0,002

North component

Station	173	174	175	176	177	178	179	180	181
ALES	0,004	0,000	-0,001	-0,001	-0,001				
ARJE	0,003	0,001	-0,008	0,004	0,001	-0,006	-0,009	-0,004	-0,007
BERG	0,002	0,001	-0,001	0,002					
BODO	0,002	-0,002	-0,006	0,002	0,000				
BORA	0,001	0,000	-0,001	0,005	-0,001	0,000	-0,002	-0,003	-0,001
BUDP	0,004	0,003	0,002	0,004	0,002	0,000	-0,001	-0,001	-0,001
GAVL	0,004	-0,002	-0,003	0,005	-0,004	-0,001	-0,005	-0,002	-0,003
GOTE	-0,003	-0,002	-0,003	0,003	-0,001	-0,004	-0,001	-0,002	-0,001
HASS	0,002	0,000	0,001	0,003	0,000	0,001	-0,001	-0,001	-0,001
JOEN	0,004	0,002	-0,001	0,006	-0,004	-0,002	-0,002	-0,001	
JONK	-0,001	0,000	-0,002	0,001	-0,001	-0,002	-0,004	-0,005	-0,003
KARL	0,004	-0,001	-0,003	0,005	-0,002	-0,001	0,000	-0,003	-0,001
KEVO	0,005	0,003	-0,005	0,004	0,003	-0,006	-0,009	0,002	
KIRO	0,002	-0,001	-0,006	0,003	0,002	-0,006	-0,007	-0,003	-0,007
KIVE	0,005	0,001	0,000	0,005	0,005	-0,006	-0,005	-0,001	-0,006
KRIS									
KUUS	0,005	0,002	-0,003	0,002	-0,001	-0,001	-0,004	0,007	-0,002
LEKS	0,003	-0,001	-0,001	0,006	-0,002	-0,003	-0,001	-0,002	-0,002
LOVO	0,004	-0,001	-0,001	0,003	-0,002	-0,001	-0,004	-0,001	-0,005
MALM	0,004	0,003	-0,001	0,006	-0,001	0,001	-0,002	-0,001	0,000
MART	0,005	-0,001	-0,004	0,005	-0,003	0,000	-0,004	-0,001	-0,003
METS	0,007	0,003	-0,001	0,005	0,003	-0,008	-0,004	0,001	-0,002
NORR	0,000	0,000	0,001	0,002	-0,005	-0,001	-0,002	-0,003	-0,004
OLKI	0,007	0,002	-0,002	0,006	0,002	-0,006	-0,004	0,002	-0,003
OSKA	0,002	0,001	-0,001	-0,002	0,001	-0,001	0,002	-0,003	0,000
OSLO	0,002	-0,002	0,000	0,005	-0,002				
OSTE	0,003	-0,001	-0,007	0,004	0,001	-0,007	-0,005	-0,002	-0,002
OULU	0,006	0,000	-0,004	0,005	0,005	-0,006	-0,002	0,003	-0,002
OVER	0,002	0,000	-0,007	0,005	0,000	-0,003	-0,006	0,001	-0,005
ROMU	0,004	0,001	-0,001	0,007	0,007	-0,005	-0,005	-0,003	
SKEL	0,004	0,001	-0,004	0,005	0,003	-0,005	-0,006	-0,001	-0,005
SMID	0,002	0,002	0,000	0,003	0,001	0,000	-0,001	-0,001	-0,001
SODA	0,006	0,001	-0,005	0,006	0,004	-0,001	-0,007	-0,003	-0,005
STAV	0,002	0,001	0,000	0,005					
SULD	0,002	0,000	0,003	0,001	-0,001	0,001	-0,003	0,002	0,001
SUND	0,006	-0,001	-0,004	0,006	0,001	-0,005	-0,004	-0,001	-0,004
SVEG	0,004	0,000	-0,002	0,006	0,000	-0,004	-0,006	-0,002	-0,001
TROM		-0,001	-0,004	0,004	0,003				
TRON	0,003	-0,003	-0,006	0,006	-0,002				
TUOR	0,005	0,001	-0,001	0,006	0,000	-0,006	-0,004	-0,002	-0,003
UMEA	0,004	0,001	-0,007	0,005	0,003	-0,006	-0,004	-0,004	-0,005
VAAS	0,007	0,002	-0,003	0,008	0,008	-0,007	-0,002	-0,001	-0,004
VANE	0,000	-0,004	-0,003	0,003	-0,003	-0,002	-0,004	-0,001	0,000
VARD	0,005	-0,001	-0,008	0,002	0,002				
VAST	0,002	-0,001	0,001	0,005	-0,001	0,000	-0,003	-0,005	-0,001
VIL0	0,003	0,001	-0,009	0,005	0,003	-0,010	-0,006	-0,005	-0,003
VIRO	0,005	0,003	0,001	0,005	0,004	-0,002	-0,005	0,003	-0,014
VISO	0,004	0,000	0,001	0,001	-0,003	-0,001	-0,002	-0,002	-0,002
RMS	0,004	0,002	0,004	0,005	0,003	0,004	0,004	0,003	0,004
MAX	0,007	0,004	0,009	0,008	0,008	0,010	0,009	0,007	0,014

North component

Station	182	183	184	185	186	187	188	189	190
ALES									
ARJE	0,001	0,000	-0,006	0,003	0,006	0,002	0,004	-0,001	0,003
BERG									
BODO									
BORA	-0,001	-0,003	0,004	0,001	-0,001	0,000	0,001	0,001	0,002
BUDP	0,001	-0,003	-0,007						
GAVL	0,000	-0,001	-0,006	0,004	0,005	-0,001	0,003	-0,002	0,002
GOTE	0,001	-0,003	0,006	-0,001	-0,003	-0,001	0,000	0,000	0,001
HASS	-0,002	-0,002	-0,005	0,001	-0,001	0,001	0,002	-0,001	-0,001
JOEN									
JONK	0,000	-0,001	0,005	0,003	-0,002	-0,001	-0,002	0,000	0,003
KARL	0,001	-0,001	-0,005	0,004	0,000	-0,003	0,002	-0,002	0,001
KEVO									
KIRO	0,002	0,002	0,000	0,003	0,004	0,005	0,003	-0,002	0,000
KIVE	0,000	0,004	-0,003						
KRIS									
KUUS	0,001	0,001	-0,003						
LEKS	-0,001	-0,001	-0,008	0,003	0,002	0,003	0,002	-0,001	0,000
LOVO	0,000	-0,001	-0,003	0,005	0,000	-0,002	0,002	-0,002	0,001
MALM	-0,002	-0,002	-0,006	-0,001	0,001	0,001	0,001	-0,001	0,001
MART	-0,002	0,000	-0,007	0,004	0,002	-0,003	0,005	0,000	0,001
METS	0,001	-0,002	-0,005						
NORR	0,002	-0,002	-0,001	0,003	-0,002	0,001	0,002	0,001	0,001
OLKI	0,002	0,002	-0,006						
OSKA	0,001	-0,002	-0,002	0,000	-0,001	0,002	0,003	0,000	-0,001
OSLO									
OSTE	0,000	-0,003	-0,003	0,003	0,001	-0,001		-0,001	0,003
OULU	0,003	0,000	-0,004						
OVER	0,001	-0,003	-0,005	0,001	0,003	0,002	-0,001	-0,002	0,001
ROMU									
SKEL	0,000	-0,001	-0,001	0,004	0,003	0,002	0,002	-0,001	0,003
SMID	0,000	-0,001	-0,006						
SODA	0,002	-0,001	0,001						
STAV									
SULD	0,001	0,000	-0,004						
SUND	-0,001	0,002	-0,008	0,005	0,001	0,001	0,004	0,000	0,002
SVEG	0,001	-0,002	-0,004	0,005	0,000	0,003	0,003	-0,001	0,001
TROM									
TRON									
TUOR	0,003	0,003	-0,004						
UMEA	0,001	0,000	-0,006	0,002	0,004	0,002	0,005	-0,001	0,002
VAAS	0,003	-0,001	-0,005						
VANE	-0,001	-0,001	-0,003	0,004	0,000	0,000	0,003	-0,003	0,001
VARD									
VAST	0,001	-0,001	-0,004	0,005	-0,001	-0,001	0,005	-0,001	0,002
VIL0	0,000	-0,001	-0,004	0,004	0,001	0,001	0,001	-0,001	0,002
VIRO	0,001	0,000	-0,004						
VISO	0,003	-0,003	-0,001	0,009	0,000	0,003	0,003	0,002	0,000
RMS	0,002	0,002	0,005	0,004	0,002	0,002	0,003	0,001	0,002
MAX	0,003	0,004	0,008	0,009	0,006	0,005	0,005	0,003	0,003

North component

Station	191	192	193	194	195	196	197	198	199
ALES									
ARJE	0,002	0,003	0,003	0,002	-0,001	0,000	-0,001	-0,001	-0,003
BERG									0,001
BODO									-0,003
BORA	0,002	0,004	-0,003	0,002	0,000	-0,001	-0,002	0,002	-0,002
BUDP									-0,005
GAVL	0,003	0,000	-0,007	0,000	0,002	-0,004	0,000	0,001	0,001
GOTE	0,001	0,002	0,000	0,001	0,006	0,001	0,002	0,005	-0,003
HASS	-0,001	0,003	0,002	-0,001	0,002	-0,001	-0,001	-0,002	-0,002
JOEN									
JONK	0,005	0,002	-0,001	0,003	0,003	-0,001	-0,002	0,004	-0,002
KARL	0,001	0,003	-0,001	0,001	0,002	-0,006	0,001	0,001	-0,002
KEVO									
KIRO	-0,004	0,002	-0,001	0,001	0,000	-0,003	0,003	0,007	-0,003
KIVE									
KRIS									0,001
KUUS									
LEKS	0,002	0,002	-0,007	0,001	0,004		-0,002	0,003	-0,001
LOVO	0,003	0,003	0,005	-0,002	0,002	-0,006	0,000	0,001	0,002
MALM	0,003	0,001	0,002	-0,002	0,002	-0,002	0,001	-0,003	-0,004
MART	0,002	0,003	-0,009	-0,001	0,004	-0,005	-0,002	0,002	0,001
METS									
NORR	0,003	0,003	-0,003	0,000	0,004	-0,005	0,002	0,002	0,000
OLKI									
OSKA	0,001	0,001	-0,002	0,001	0,002	-0,004	-0,001	0,000	-0,001
OSLO									0,002
OSTE	0,002	0,003	-0,005	-0,003	0,005	-0,004	-0,002	0,004	0,001
OULU									
OVER	0,003	0,002	0,001	0,005	0,002	-0,004	0,002	0,005	-0,004
ROMU									
SKEL	-0,002	0,003	-0,001	-0,004	0,001	-0,001	-0,001	-0,001	-0,004
SMID									
SODA									
STAV									-0,002
SULD									0,000
SUND	0,000	0,004	-0,005	-0,002	0,002	-0,005	-0,002	0,001	0,001
SVEG	0,001	0,001	-0,006	0,000	0,004	-0,007	0,001	0,001	-0,001
TROM									-0,001
TRON									0,000
TUOR									
UMEA	-0,001	0,001	-0,003	-0,007	0,002	-0,002	-0,004	0,000	-0,001
VAAS									
VANE	0,003	0,012	0,001	0,002	0,003	-0,004	0,001	0,003	-0,001
VARD									
VAST	0,000	0,004	0,000	-0,002	0,004	-0,006	-0,001	-0,001	-0,002
VIL0		0,005	-0,001	-0,005	0,005	-0,001		0,001	-0,001
VIRO									
VISO		0,000	0,000	-0,002	0,003	-0,006	0,001	0,001	-0,003
RMS	0,002	0,004	0,004	0,003	0,003	0,004	0,002	0,003	0,002
MAX	0,005	0,012	0,009	0,007	0,006	0,007	0,004	0,007	0,005

North component

Station	200	201	202	203	204	205	RMS	MAX
ALES		-0,002	0,003			-0,002	0,002	0,004
ARJE	0,004	-0,005	0,001	-0,002	0,002	-0,002	0,004	0,012
BERG	0,001	-0,005	0,003	0,000	0,001	-0,001	0,002	0,005
BODO	0,005	-0,003	0,003	0,002	0,002	0,000	0,003	0,006
BORA	0,000	-0,003	-0,003	0,000	0,001	-0,003	0,002	0,005
BUDP	0,001	0,000	0,004	0,002	-0,003	0,000	0,003	0,007
GAVL	0,003	-0,002	0,000	0,004	0,000	0,003	0,003	0,007
GOTE	-0,001	-0,001	0,003	-0,003	0,001	-0,001	0,002	0,006
HASS	-0,001	0,000	0,001	0,002	0,000	-0,001	0,002	0,007
JOEN							0,003	0,006
JONK	0,001	-0,003	0,001	0,002	0,000	-0,002	0,002	0,006
KARL	0,002	-0,005	0,000	0,001	0,002	-0,003	0,003	0,006
KEVO							0,005	0,009
KIRO	0,000	-0,005	0,001	0,001	0,001	-0,003	0,004	0,011
KIVE							0,004	0,006
KRIS	0,002	-0,004	0,000	0,001	-0,001	0,002	0,002	0,004
KUUS							0,003	0,007
LEKS		-0,001	0,001	-0,001	0,001	0,000	0,003	0,008
LOVO	0,001	-0,006		0,002	0,000	-0,002	0,003	0,007
MALM	0,001	-0,001	0,003	0,002	-0,003	-0,002	0,003	0,006
MART	0,006	-0,003	0,000	0,000	0,001	0,002	0,003	0,009
METS							0,004	0,008
NORR	0,001	-0,004	0,001	0,000	0,000	-0,002	0,003	0,006
OLKI							0,004	0,007
OSKA	0,001	-0,002	0,003	0,001	-0,002	0,000	0,002	0,006
OSLO	0,004	-0,005	0,002	-0,002	-0,001		0,003	0,005
OSTE	0,003	-0,003	0,001	0,000	0,001	0,000	0,003	0,009
OULU							0,004	0,006
OVER	0,003	-0,005	0,002	0,000	0,001	-0,001	0,003	0,011
ROMU							0,005	0,007
SKEL	0,006	-0,001	-0,001	-0,002	0,000	-0,002	0,003	0,009
SMID	0,000	0,001	0,001	0,001		-0,002	0,002	0,006
SODA							0,004	0,007
STAV	0,001	-0,008	0,000	0,002	-0,001	-0,001	0,003	0,008
SULD	0,001	-0,003		-0,001	-0,002	0,001	0,002	0,004
SUND	0,004	-0,003	0,000	-0,004	0,001	-0,001	0,003	0,009
SVEG	0,003	-0,002	0,000	-0,002	0,000	-0,002	0,003	0,009
TROM	0,002	-0,004	0,002	0,000	0,002	-0,004	0,003	0,004
TRON	0,002	-0,003	0,003	0,002	0,001	0,001	0,003	0,006
TUOR							0,004	0,006
UMEA	0,003	-0,002	0,001	-0,001	0,002	0,001	0,004	0,009
VAAS							0,005	0,008
VANE	0,000	-0,004	0,001	0,000	0,000	-0,003	0,003	0,012
VARD							0,004	0,008
VAST	0,002	-0,001	0,001	0,001	0,000	-0,002	0,003	0,006
VIL0	0,003	0,000	0,000	-0,001	0,000	-0,001	0,004	0,011
VIRO							0,005	0,014
VISO	0,000	-0,005	0,004	0,001	-0,003	-0,004	0,003	0,010
RMS	0,003	0,004	0,002	0,002	0,001	0,002		
MAX	0,006	0,008	0,004	0,004	0,003	0,004		

East component

Station	164	165	166	167	168	169	170	171	172
ALES								-0,003	0,000
ARJE	0,004	-0,003	-0,001	0,000	-0,003	0,000	-0,006	-0,002	0,000
BERG								-0,001	0,001
BODO									0,001
BORA	0,001	-0,004	-0,003	-0,002	-0,001	0,003	-0,003	0,000	0,001
BUDP								0,001	0,001
GAVL	0,006	-0,003	-0,004	-0,001	-0,001	0,005	-0,001	0,001	-0,002
GOTE	-0,002	-0,001	0,001	0,001	-0,001	0,004	-0,001	0,000	0,001
HASS	0,002	-0,005	-0,003	-0,002	-0,002	0,002	-0,008	0,001	0,000
JOEN								0,000	0,000
JONK	0,003	-0,005	-0,004	-0,003	0,001	0,003	-0,005	0,000	-0,001
KARL	0,003	-0,003	-0,002	0,000	-0,001	0,002	-0,002	-0,001	0,001
KEVO								-0,001	0,002
KIRO	0,003	-0,001	-0,001	-0,001	0,001	0,001	-0,003	-0,001	0,000
KIVE								0,001	0,002
KRIS									
KUUS								0,002	0,000
LEKS	0,003	-0,004	-0,002	0,000	-0,001	0,004	-0,005	0,000	-0,001
LOVO	0,007	-0,005	-0,003	-0,002	-0,003	0,002	-0,004	0,007	-0,002
MALM	0,001	-0,004	-0,003	-0,002	-0,004	0,001	-0,002	0,002	0,001
MART	0,005	-0,004	-0,003	-0,001	0,000	0,004	-0,002	0,001	-0,001
METS								-0,002	0,001
NORR	0,002	-0,009	-0,004	-0,002	-0,006	0,002	-0,004	0,004	-0,003
OLKI								0,005	-0,001
OSKA	0,002	-0,008	-0,002	-0,001	-0,003	0,009	-0,007	0,002	-0,002
OSLO								-0,002	0,000
OSTE	0,006	-0,002	-0,002	-0,001	-0,002	0,004	-0,006	-0,002	-0,002
OULU								0,001	0,004
OVER	0,001	-0,003	-0,001	-0,001	0,001	0,002	-0,005	-0,002	0,000
ROMU								0,002	-0,001
SKEL	0,003	-0,004	-0,002	0,001	0,000	0,002	-0,005	-0,002	0,001
SMID								-0,001	0,002
SODA								-0,003	0,003
STAV								-0,001	0,003
SULD								0,001	0,003
SUND	0,005	-0,003	-0,003	-0,002	-0,001	0,002	-0,005	0,001	-0,002
SVEG	0,004	-0,003	0,000	-0,001	-0,002	0,004	-0,006	0,000	-0,001
TROM									0,002
TRON								-0,001	0,002
TUOR								0,000	0,001
UMEA	0,002	-0,003	-0,002	0,000	0,000	0,002	-0,004	-0,001	0,000
VAAS								0,003	0,001
VANE	0,001	-0,001	-0,001	-0,001	-0,001	0,004	-0,002	-0,001	0,002
VARD									0,002
VAST	0,003	-0,008	-0,004	-0,003	-0,002	0,003	-0,004	0,004	-0,003
VIL0	0,005	-0,002	-0,002	0,000	-0,003	0,003	-0,006	-0,001	-0,002
VIRO								0,001	0,000
VISO	0,006	0,001	-0,003	0,001	-0,004	0,003	-0,008	-0,003	0,001
RMS	0,004	0,004	0,003	0,001	0,002	0,003	0,005	0,002	0,002
MAX	0,007	0,009	0,004	0,003	0,006	0,009	0,008	0,007	0,004

East component

Station	173	174	175	176	177	178	179	180	181
ALES	-0,002	0,002	0,004	0,007	-0,005				
ARJE	0,001	-0,003	0,000	0,000	-0,003	0,000	0,005	-0,001	0,001
BERG	0,000	0,000	0,009	0,002					
BODO	0,004	0,002	0,000	0,003	-0,001				
BORA	-0,003	-0,002	0,001	0,000	0,000	0,000	0,003	0,000	-0,001
BUDP	-0,002	0,000	0,004	0,001	-0,002	-0,003	0,002	-0,001	0,001
GAVL	-0,001	-0,005	0,000	-0,003	-0,003	0,000	0,006	-0,001	0,001
GOTE	-0,003	0,000	0,005	0,000	0,001	0,000	-0,002	-0,003	-0,005
HASS	-0,002	-0,002	0,003	0,003	-0,001	0,001	0,006	-0,001	0,000
JOEN	0,001	0,000	0,007	-0,004	-0,004	-0,002	0,004	-0,002	
JONK	-0,001	-0,001	-0,001	-0,001	0,000	-0,002	0,005	-0,001	0,001
KARL	-0,001	-0,002	0,002	-0,001	-0,001	0,000	0,006	-0,002	-0,002
KEVO	0,000	-0,002	-0,001	0,000	0,000	0,002	0,001	0,000	
KIRO	-0,001	-0,003	0,001	0,000	-0,002	-0,002	0,004	-0,001	0,002
KIVE	-0,001	0,003	-0,001	0,002	0,001	-0,006	-0,002	0,001	0,000
KRIS									
KUUS	0,000	-0,003	0,001	0,001	0,000	0,001	0,000	-0,004	-0,001
LEKS	-0,002	-0,002	0,004	0,000	-0,004	0,000	0,006	-0,001	-0,001
LOVO	-0,001	-0,004	0,001	-0,003	-0,003	-0,002	0,004	0,004	0,000
MALM	-0,001	0,001	0,003	0,000	0,001	0,001	0,001	-0,002	-0,001
MART	-0,001	-0,004	-0,001	-0,003	-0,003	-0,002	0,006	0,000	0,001
METS	0,000	-0,001	0,001	0,000	-0,001	-0,004	0,004	-0,001	-0,001
NORR	-0,001	-0,003	0,003	-0,003	-0,002	0,000	0,008	0,000	0,004
OLKI	-0,003	-0,001	-0,003	0,000	-0,003	-0,003	0,004	-0,001	0,003
OSKA	-0,004	-0,002	0,001	-0,002	0,001	0,001	0,007	0,000	0,001
OSLO	-0,001	0,000	0,003	-0,003	-0,001				
OSTE	0,001	-0,004	0,000	-0,001	-0,003	0,001	0,004	0,000	-0,001
OULU	-0,002	-0,001	0,002	0,002	-0,001	-0,004	-0,003	0,000	-0,001
OVER	-0,003	-0,002	0,002	-0,002	-0,003	-0,003	0,003	-0,002	0,001
ROMU	-0,001	0,003	-0,002	-0,004	-0,003	0,002	0,004	0,001	
SKEL	-0,002	-0,004	-0,001	-0,002	-0,002	-0,003	0,004	0,001	0,000
SMID	0,000	0,002	0,005	0,001	0,001	0,000	0,002	-0,004	-0,001
SODA	-0,001	-0,002	0,000	-0,002	-0,002	0,002	0,001	-0,001	0,000
STAV	0,000	-0,001	0,008	0,001					
SULD	0,001	0,002	0,003	0,001	-0,001	0,001	0,004	-0,005	-0,003
SUND	-0,001	-0,004	-0,004	-0,002	-0,004	0,001	0,003	-0,003	0,001
SVEG	0,000	-0,005	0,000	0,001	-0,003	0,000	0,004	0,001	-0,003
TROM		-0,001	0,000	0,001	-0,001				
TRON	0,001	0,000	0,004	-0,002	-0,003				
TUOR	0,000	-0,001	-0,001	0,001	-0,003	0,000	0,004	-0,001	0,001
UMEA	0,000	-0,001	-0,006	-0,003	-0,002	-0,002	0,003	-0,001	0,002
VAAS	-0,003	0,001	-0,002	-0,001	0,000	-0,002	0,004	-0,005	0,000
VANE	0,001	-0,001	0,003	0,000	-0,002	0,003	0,005	-0,004	-0,001
VARD	0,002	0,000	-0,002	-0,001	-0,001				
VAST	-0,001	-0,006	0,002	0,000	-0,003	-0,001	0,008	0,000	0,001
VIL0	0,000	-0,003	0,000	-0,001	-0,003	0,000	0,007	0,000	-0,001
VIRO	-0,002	0,002	0,003	0,001	-0,001	-0,002	0,004	-0,001	-0,005
VISO	-0,003	-0,006	0,001	-0,003	-0,001	0,001	0,005	0,000	0,002
RMS	0,002	0,003	0,003	0,002	0,002	0,002	0,005	0,002	0,002
MAX	0,004	0,006	0,009	0,007	0,005	0,006	0,008	0,005	0,005

East component

Station	182	183	184	185	186	187	188	189	190
ALES									
ARJE	-0,001	0,000	-0,001	0,000	-0,003	0,000	0,001	-0,001	0,000
BERG									
BODO									
BORA	0,000	-0,001	0,000	0,000	-0,001	0,000	-0,001	0,001	0,001
BUDP	-0,002	0,000	-0,002						
GAVL	-0,002	-0,001	0,000	0,002	0,000	0,001	0,000	0,001	-0,003
GOTE	-0,002	-0,003	-0,004	-0,003	-0,005	-0,004	-0,004	0,000	0,001
HASS	-0,001	0,000	-0,001	-0,001	-0,003	0,000	-0,003	0,000	0,000
JOEN									
JONK	-0,002	0,000	-0,001	-0,001	-0,003	0,000	-0,002	-0,001	0,001
KARL	-0,002	-0,001	0,000	0,001	-0,002	0,001	-0,002	-0,001	0,001
KEVO									
KIRO	0,000	-0,001	0,000	0,001	-0,003	0,001	0,000	-0,001	-0,002
KIVE	0,003	-0,001	0,001						
KRIS									
KUUS	0,001	0,001	0,002						
LEKS	-0,002	-0,001	0,000	0,003	-0,002	-0,001	-0,001	0,001	-0,001
LOVO	-0,003	0,000	-0,001	0,003	-0,001	-0,001	0,001	-0,001	0,000
MALM	0,000	0,000	-0,001	-0,001	-0,004	-0,001	-0,002	0,000	0,000
MART	-0,002	-0,001	0,000	0,002	-0,002	0,000	0,000	0,000	-0,001
METS	0,002	0,002	0,000						
NORR	-0,003	0,000	-0,001	0,001	-0,001	-0,002	0,000	0,000	-0,002
OLKI	0,001	0,001	0,002						
OSKA	-0,003	0,000	-0,001	0,002	0,000	-0,002	-0,001	0,001	0,000
OSLO									
OSTE	-0,001	0,002	0,000	0,002	-0,001	-0,001		0,000	0,000
OULU	0,000	0,001	0,002						
OVER	0,000	0,002	0,000	0,002	-0,002	0,001	0,000	-0,002	-0,001
ROMU									
SKEL	0,001	0,001	0,000	0,002	-0,001	0,001	-0,001	-0,002	0,000
SMID	-0,003	0,000	-0,004						
SODA	0,001	0,003	0,002						
STAV									
SULD	-0,003	0,000	-0,003						
SUND	0,000	-0,001	0,001	0,003	-0,003	0,000	0,000	0,000	-0,002
SVEG	-0,002	0,000	0,000	0,002	-0,003	0,000	-0,001	0,001	0,000
TROM									
TRON									
TUOR	-0,001	-0,002	0,001						
UMEA	0,000	0,001	0,000	0,001	-0,002	0,001	-0,001	-0,001	0,000
VAAS	0,000	0,003	0,001						
VANE	-0,001	-0,001	0,000	0,000	-0,003	-0,001	-0,001	0,001	0,000
VARD									
VAST	-0,002	-0,001	-0,001	0,003	-0,001	0,000	-0,001	0,000	-0,002
VIL0	-0,002	0,001	-0,002	0,002	-0,002	0,000	-0,001	0,000	-0,001
VIRO	0,002	0,002	-0,002						
VISO	-0,005	0,000	0,001	0,002	0,000	-0,002	-0,002	-0,001	0,000
RMS	0,002	0,001	0,002	0,002	0,002	0,001	0,002	0,001	0,001
MAX	0,005	0,003	0,004	0,003	0,005	0,004	0,004	0,002	0,003

East component

Station	191	192	193	194	195	196	197	198	199
ALES									
ARJE	0,000	0,002	0,002	0,002	0,005	0,007	-0,001	-0,004	-0,003
BERG									-0,006
BODO									-0,003
BORA	0,002	0,001	0,002	0,001	-0,001	0,000	0,000	-0,001	0,000
BUDP									-0,001
GAVL	0,001	-0,001	-0,001	0,000	0,005	-0,003	-0,002	0,001	-0,001
GOTE	0,000	0,004	0,003	0,004	0,003	0,002	-0,001	0,002	0,002
HASS	0,001	0,001	0,002	0,001	0,000	0,003	0,000	-0,002	0,001
JOEN									
JONK	0,003	0,003	0,002	0,004	0,003	-0,002	-0,001	0,001	0,000
KARL	0,004	-0,003	0,002	0,001	0,001	0,000	-0,001	0,001	0,000
KEVO									
KIRO	0,001	0,001	-0,002	0,002	0,006	0,000	0,002	0,000	-0,002
KIVE									
KRIS									-0,002
KUUS									
LEKS	0,002	-0,002	0,000	0,000	0,005		-0,001	0,000	0,000
LOVO	0,000	0,000	0,000	0,003	0,004	-0,003	-0,001	0,001	0,001
MALM	0,000	0,001	0,000	-0,002	0,001	0,002	0,001	-0,001	0,001
MART	0,001	-0,001	0,000	0,001	0,006	-0,001	-0,001	0,002	-0,001
METS									
NORR	0,003	0,003	0,000	0,004	0,006	-0,004	0,000	-0,001	-0,001
OLKI									
OSKA	0,001	0,001	0,003	0,001	0,002	-0,002	-0,001	0,001	0,001
OSLO									-0,001
OSTE	0,003	0,002	0,002	0,001	0,003	-0,002	-0,002	0,000	0,001
OULU									
OVER	0,001	0,000	0,000	0,003	0,004	0,005	0,001	0,001	-0,002
ROMU									
SKEL	0,002	-0,002	0,001	0,002	0,005	0,004	-0,001	-0,005	-0,001
SMID									
SODA									
STAV									0,000
SULD									-0,001
SUND	0,000	0,000	-0,001	0,003	0,008	-0,001	0,001	0,001	0,001
SVEG	0,003	0,002	-0,001	0,002	0,005	-0,004	-0,001	-0,002	0,002
TROM									-0,004
TRON									-0,003
TUOR									
UMEA	0,001	0,000	0,001	0,002	0,006	0,002	-0,004	-0,001	0,002
VAAS									
VANE	0,002	-0,005	-0,001	-0,003	0,002	0,000	-0,001	-0,001	0,000
VARD									
VAST	0,005	-0,002	0,001	0,002	0,006	-0,003	0,001	0,001	-0,001
VIL0		0,003	0,000	0,002	0,006	0,001		-0,002	0,002
VIRO									
VISO		0,000	-0,003	0,007	0,004	-0,002	0,000	0,002	0,000
RMS	0,002	0,002	0,002	0,003	0,004	0,003	0,001	0,002	0,002
MAX	0,005	0,005	0,003	0,007	0,008	0,007	0,004	0,005	0,006

East component

Station	200	201	202	203	204	205	RMS	MAX
ALES		0,001	0,002			-0,004	0,004	0,007
ARJE	0,002	0,002	0,003	0,000	-0,003	0,000	0,003	0,007
BERG	-0,001	0,001	0,000	-0,003	-0,002	-0,001	0,003	0,009
BODO	0,000	0,001	0,004	-0,006	-0,002	-0,002	0,003	0,006
BORA	0,000	0,001	0,003	0,002	-0,002	0,001	0,002	0,004
BUDP	0,002	-0,002	0,002	0,001	-0,001	0,002	0,002	0,004
GAVL	0,002	0,003	0,006	0,000	-0,001	0,000	0,003	0,006
GOTE	0,004	0,003	0,002	0,001	0,001	0,001	0,003	0,005
HASS	0,003	0,004	0,001	0,001	0,000	0,001	0,002	0,008
JOEN							0,003	0,007
JONK	0,000	0,002	0,003	0,002	-0,001	0,000	0,002	0,005
KARL	0,002	-0,002	0,002	0,001	0,000	-0,001	0,002	0,006
KEVO							0,001	0,002
KIRO	0,000	0,000	0,007	-0,001	-0,004	-0,002	0,002	0,007
KIVE							0,002	0,006
KRIS	-0,001	0,003	0,004	-0,001	-0,001	-0,001	0,002	0,004
KUUS							0,002	0,004
LEKS		0,002	0,002	0,002	0,000	0,000	0,002	0,006
LOVO	0,000	0,003		0,001	0,000	0,000	0,003	0,007
MALM	0,002	0,003	0,003	0,003	0,000	0,003	0,002	0,004
MART	0,001	0,002	0,005	0,000	-0,002	0,000	0,002	0,006
METS							0,002	0,004
NORR	0,001	0,003	0,003	0,001	0,000	-0,001	0,003	0,009
OLKI							0,003	0,005
OSKA	0,003	0,002	0,003	0,001	-0,001	0,000	0,003	0,009
OSLO	0,000	0,000	0,005	-0,002	0,001		0,002	0,005
OSTE	0,000	-0,001	0,002	-0,003	-0,001	0,000	0,002	0,006
OULU							0,002	0,004
OVER	0,001	0,002	0,003	-0,001	-0,001	-0,001	0,002	0,005
ROMU							0,003	0,004
SKEL	0,000	0,002	0,005	0,004	-0,003	0,000	0,002	0,005
SMID	0,000	-0,001	0,003	0,001		0,000	0,002	0,005
SODA							0,002	0,003
STAV	-0,002	-0,001	0,001	-0,003	-0,003	-0,002	0,003	0,008
SULD	0,000	-0,001		0,002	0,000	0,002	0,002	0,005
SUND	0,002	0,002	0,006	0,003	-0,002	0,001	0,003	0,008
SVEG	0,001	0,000	0,003	0,003	-0,001	0,000	0,002	0,006
TROM	0,000	0,001	0,006	0,001	-0,006	0,000	0,003	0,006
TRON	0,000	0,001	0,005	-0,003	-0,001	-0,001	0,002	0,005
TUOR							0,002	0,004
UMEA	0,002	0,002	0,005	-0,001	0,000	0,000	0,002	0,006
VAAS							0,002	0,005
VANE	0,001	0,002	0,004	0,001	0,000	0,000	0,002	0,005
VARD							0,001	0,002
VAST	0,002	0,002	0,004	0,002	0,000	0,000	0,003	0,008
VIL0	0,000	0,001	0,005	0,000	-0,003	-0,001	0,003	0,007
VIRO							0,002	0,005
VISO	0,000	0,004	0,003	0,000	0,000	0,002	0,003	0,008
RMS	0,001	0,002	0,004	0,002	0,002	0,001		
MAX	0,004	0,004	0,007	0,006	0,006	0,004		

Up component

Station	164	165	166	167	168	169	170	171	172
ALES								-0,007	-0,002
ARJE	0,004	-0,011	-0,010	-0,003	-0,005	-0,009	-0,009	-0,003	0,006
BERG								-0,009	-0,002
BODO									0,004
BORA	0,002	-0,007	0,000	0,007	-0,005	-0,007	-0,007	-0,003	0,003
BUDP								0,002	0,005
GAVL	0,005	-0,006	-0,001	0,006	-0,007	-0,012	-0,008	-0,008	0,015
GOTE	-0,001	-0,002	-0,002	-0,002	-0,005	-0,001	0,002	0,003	-0,009
HASS	0,005	0,002	-0,001	0,002	0,000	0,001	-0,009	-0,004	0,006
JOEN								0,000	0,004
JONK	-0,003	0,000	0,000	-0,003	-0,006	-0,002	-0,002	-0,001	-0,001
KARL	0,004	-0,010	0,000	0,001	0,000	-0,002	-0,002	-0,001	0,002
KEVO								-0,004	0,002
KIRO	0,008	-0,005	-0,001	-0,003	-0,005	-0,003	-0,011	-0,002	0,002
KIVE								0,001	0,005
KRIS									
KUUS								-0,002	-0,002
LEKS	0,008	-0,001	-0,003	0,009	-0,012	0,000	-0,003	0,001	0,011
LOVO	0,007	-0,001	-0,003	0,004	-0,002	0,001	-0,016	-0,008	0,006
MALM	0,008	-0,006	-0,007	0,004	-0,002	-0,002	-0,003	-0,002	0,003
MART	0,005	-0,006	0,000	0,007	-0,002	-0,008	-0,010	-0,001	0,009
METS								-0,009	0,005
NORR	0,008	0,000	0,009	0,001	-0,007	-0,007	-0,010	0,006	0,007
OLKI								-0,004	0,005
OSKA	0,007	-0,009	0,002	0,000	-0,004	0,000	-0,011	0,002	0,004
OSLO								0,000	0,002
OSTE	0,013	-0,018	0,004	0,006	-0,007	-0,004	-0,006	0,000	0,005
OULU								-0,011	0,001
OVER	-0,001	-0,013	0,003	0,000	-0,011	-0,007	-0,004	0,005	0,006
ROMU								-0,010	-0,004
SKEL	0,006	-0,012	0,002	0,003	-0,009	-0,006	-0,001	-0,003	0,003
SMID								0,003	0,000
SODA								-0,001	0,001
STAV								-0,006	0,004
SULD								0,003	0,005
SUND	0,014	-0,007	0,003	-0,004	-0,005	0,003	-0,011	-0,001	0,004
SVEG	0,007	-0,004	-0,008	0,001	-0,002	-0,005	-0,003	-0,002	0,004
TROM									0,005
TRON								-0,009	0,005
TUOR								0,004	0,005
UMEA	0,003	-0,002	0,002	0,011	-0,005	-0,003	-0,010	0,001	0,007
VAAS								0,006	-0,001
VANE	0,002	-0,004	0,003	-0,002	-0,004	-0,009	-0,011	-0,005	-0,003
VARD									-0,003
VAST	0,008	-0,008	-0,005	0,004	-0,012	-0,003	-0,010	0,001	0,008
VIL0	0,013	-0,001	0,008	0,001	-0,017	-0,007	-0,007	-0,005	0,002
VIRO								-0,001	0,007
VISO	-0,001	-0,001	-0,001	0,000	-0,002	-0,006	0,000	0,005	0,004
RMS	0,007	0,007	0,004	0,005	0,007	0,006	0,008	0,005	0,005
MAX	0,014	0,018	0,010	0,011	0,017	0,012	0,016	0,011	0,015

Up component

Station	173	174	175	176	177	178	179	180	181
ALES	-0,002	0,002	0,013	0,007	-0,017				
ARJE	0,001	-0,001	0,008	0,001	-0,014	-0,010	0,006	-0,011	0,001
BERG	-0,004	0,003	0,014	0,007					
BODO	-0,001	-0,006	0,010	0,010	-0,010				
BORA	-0,005	0,004	0,003	-0,004	-0,005	-0,002	0,000	-0,012	-0,001
BUDP	-0,003	0,006	0,011	0,004	-0,004	-0,004	-0,002	-0,016	0,003
GAVL	-0,003	-0,006	0,006	-0,006	-0,008	-0,015	0,002	-0,017	0,009
GOTE	0,011	0,001	0,007	0,003	-0,010	0,000	0,016	-0,010	0,003
HASS	-0,008	-0,002	0,003	-0,009	-0,004	-0,004	0,002	-0,011	0,002
JOEN	0,009	-0,003	0,003	0,004	-0,008	-0,001	0,000	-0,007	
JONK	-0,005	0,002	0,003	-0,004	-0,004	0,001	0,006	-0,014	0,002
KARL	-0,004	0,000	0,000	0,002	-0,004	-0,015	0,012	-0,012	-0,005
KEVO	0,002	-0,005	0,011	0,002	-0,009	-0,007	0,016	-0,007	
KIRO	0,005	0,001	0,011	0,000	-0,010	-0,001	0,010	-0,007	-0,001
KIVE	0,001	-0,003	0,006	-0,004	-0,008	-0,008	0,004	-0,001	0,004
KRIS									
KUUS	-0,004	0,000	-0,003	-0,003	-0,019	0,006	0,017	0,008	0,008
LEKS	0,002	0,000	0,010	0,004	-0,007	-0,022	0,009	-0,006	0,000
LOVO	-0,004	0,001	0,005	-0,007	-0,016	-0,008	0,007	-0,020	0,004
MALM	-0,001	0,000	-0,001	-0,004	-0,009	-0,014	0,009	-0,013	-0,002
MART	0,001	-0,004	0,009	-0,001	-0,008	-0,013	0,003	-0,014	0,010
METS	0,006	0,006	0,022	-0,006	0,003	-0,017	-0,018	0,002	0,004
NORR	-0,008	0,002	0,006	-0,007	-0,004	-0,010	0,002	-0,006	0,001
OLKI	0,004	0,004	0,013	0,001	-0,008	-0,013	0,002	0,009	0,000
OSKA	-0,003	0,004	0,005	-0,003	-0,009	-0,012	0,001	-0,004	-0,002
OSLO	-0,003	-0,002	0,003	-0,002	-0,011				
OSTE	-0,001	-0,001	0,004	0,001	-0,009	-0,010	-0,001	-0,005	0,000
OULU	0,004	0,001	0,007	-0,007	-0,008	-0,009	0,013	0,006	0,012
OVER	0,002	0,004	0,016	0,009	-0,015	-0,004	-0,001	-0,001	0,005
ROMU	-0,004	-0,010	0,003	0,002	0,004	-0,005	0,018	0,007	
SKEL	-0,005	0,001	0,012	0,009	-0,006	-0,019	0,008	-0,006	0,004
SMID	0,002	0,002	0,006	-0,004	0,000	-0,014	0,007	-0,014	-0,001
SODA	-0,008	-0,006	0,018	0,006	-0,007	0,003	0,010	-0,011	0,001
STAV	-0,001	-0,004	0,012	0,002					
SULD	0,001	0,000	0,007	-0,002	-0,003	-0,005	0,006	-0,017	-0,013
SUND	0,001	0,001	0,013	0,002	-0,008	-0,013	0,005	-0,012	0,003
SVEG	0,001	0,000	0,009	0,005	-0,016	-0,015	0,002	-0,008	-0,005
TROM		-0,006	0,016	-0,011	-0,015				
TRON	-0,002	-0,003	0,008	0,003	-0,006				
TUOR	0,007	0,002	0,002	-0,004	-0,004	-0,006	0,004	-0,004	0,000
UMEA	-0,001	0,008	0,004	0,004	-0,008	-0,012	0,003	-0,013	0,000
VAAS	0,004	0,002	0,016	0,010	-0,016	-0,014	0,009	-0,001	0,005
VANE	-0,005	0,000	0,007	-0,005	-0,007	-0,008	0,003	-0,006	-0,006
VARD	0,000	-0,007	0,017	0,010	-0,017				
VAST	0,000	-0,001	0,013	-0,004	-0,002	-0,014	0,013	-0,007	0,003
VIL0	-0,002	0,003	0,004	0,008	-0,005	-0,018	0,007	-0,003	0,008
VIRO	0,001	0,010	0,012	0,000	-0,019	0,003	-0,006	-0,002	0,005
VISO	0,002	0,002	0,008	-0,006	-0,011	-0,010	0,010	-0,009	0,002
RMS	0,004	0,004	0,010	0,006	0,010	0,011	0,009	0,010	0,005
MAX	0,011	0,010	0,022	0,011	0,019	0,022	0,018	0,020	0,013

Up component

Station	182	183	184	185	186	187	188	189	190
ALES									
ARJE	-0,004	0,001	-0,014	-0,003	-0,006	-0,005	-0,003	0,001	-0,001
BERG									
BODO									
BORA	-0,013	-0,008	-0,002	0,006	-0,006	-0,003	-0,002	0,007	0,002
BUDP	-0,020	0,000	0,000						
GAVL	-0,014	-0,002	-0,009	-0,001	0,002	-0,008	-0,006	0,003	0,004
GOTE	-0,011	-0,010	-0,002	0,007	0,005	-0,001	-0,005	0,009	-0,001
HASS	-0,012	0,006	-0,002	0,001	0,003	-0,002	-0,004	0,003	-0,009
JOEN									
JONK	-0,011	0,001	-0,004	0,007	-0,008	0,000	-0,003	0,002	-0,003
KARL	-0,011	-0,004	-0,010	-0,001	0,002	-0,004	-0,005	0,001	0,000
KEVO									
KIRO	-0,009	0,000	-0,006	-0,009	-0,012	0,000	-0,003	-0,001	-0,010
KIVE	0,004	0,005	-0,006						
KRIS									
KUUS	0,002	-0,002	-0,007						
LEKS	-0,009	-0,005	-0,006	0,004	-0,009	-0,022	-0,003	0,005	0,000
LOVO	-0,011	-0,007	0,000	0,006	0,002	-0,001	0,001	0,001	-0,001
MALM	-0,014	-0,003	0,001	0,003	0,005	-0,001	-0,005	0,001	-0,001
MART	-0,018	-0,009	-0,010	0,006	-0,003	-0,008	0,000	-0,001	0,000
METS	-0,003	0,006	-0,001						
NORR	-0,015	-0,007	-0,008	0,002	-0,003	-0,003	-0,001	0,001	0,001
OLKI	-0,009	0,002	-0,006						
OSKA	0,000	-0,001	-0,006	0,002	-0,003	-0,002	0,001	0,004	0,000
OSLO									
OSTE	-0,013	-0,005	-0,014	-0,004	-0,007	-0,007		0,002	0,000
OULU	0,000	0,001	-0,009						
OVER	-0,006	-0,008	-0,003	-0,003	-0,010	-0,006	-0,011	-0,006	-0,005
ROMU									
SKEL	-0,008	-0,004	-0,007	-0,011	-0,015	-0,005	-0,002	0,000	-0,004
SMID	-0,013	-0,001	0,002						
SODA	-0,001	-0,002	-0,004						
STAV									
SULD	-0,010	0,005	0,000						
SUND	-0,009	-0,001	-0,013	0,004	-0,005	-0,003	-0,006	0,001	0,000
SVEG	-0,009	-0,006	-0,005	-0,002	-0,003	0,000	-0,004	0,000	-0,002
TROM									
TRON									
TUOR	-0,003	0,001	-0,004						
UMEA	0,002	-0,004	-0,006	-0,002	-0,006	0,000	0,001	-0,002	0,000
VAAS	-0,005	-0,004	-0,010						
VANE	-0,006	-0,001	-0,010	0,009	0,002	-0,008	-0,001	0,007	-0,001
VARD									
VAST	-0,012	0,000	-0,008	0,005	-0,008	-0,007	0,007	0,000	0,002
VIL0	0,000	-0,006	-0,015	0,001	-0,005	-0,006	-0,011	0,005	-0,003
VIRO	-0,008	-0,003	0,002						
VISO	-0,005	0,001	0,001	0,006	-0,007	-0,004	0,003	0,003	-0,010
RMS	0,010	0,005	0,007	0,005	0,007	0,006	0,005	0,004	0,004
MAX	0,020	0,010	0,015	0,011	0,015	0,022	0,011	0,009	0,010

Up component

Station	191	192	193	194	195	196	197	198	199
ALES									
ARJE	0,010	-0,002	0,022	0,005	0,001	0,011	0,008	-0,007	-0,005
BERG									-0,004
BODO									-0,009
BORA	0,006	0,007	0,007	0,001	0,005	0,004	0,005	0,004	0,000
BUDP									-0,009
GAVL	0,006	0,009	-0,003	0,011	0,014	0,010	0,008	0,010	0,005
GOTE	0,001	0,000	0,002	0,000	0,013	-0,003	0,010	-0,004	-0,010
HASS	-0,002	0,005	0,012	0,001	0,003	0,007	0,000	0,011	-0,003
JOEN									
JONK	0,005	-0,002	-0,005	0,008	0,008	0,005	-0,002	-0,001	0,004
KARL	0,004	0,000	0,009	0,002	0,010	-0,002	0,006	0,002	-0,001
KEVO									
KIRO	0,003	0,010	0,006	0,004	0,006	0,011	0,008	0,005	-0,006
KIVE									
KRIS									-0,011
KUUS									
LEKS	0,004	0,006	0,009	0,000	0,009		0,003	0,001	-0,009
LOVO	0,000	0,003	0,006	-0,004	0,015	0,016	0,001	0,004	-0,002
MALM	-0,001	-0,003	0,005	0,006	0,004	0,009	0,007	0,003	-0,005
MART	0,005	0,000	0,002	0,004	0,013	0,005	-0,004	0,001	0,005
METS									
NORR	0,007	0,003	0,002	0,004	0,017	0,010	0,003	-0,003	0,003
OLKI									
OSKA	0,002	0,004	0,010	-0,002	0,014	0,001	-0,001	0,001	-0,001
OSLO									0,001
OSTE	0,016	0,002	0,012	0,002	0,013	0,002	0,006	0,005	0,002
OULU									
OVER	0,004	-0,005	-0,001	0,006	0,010	0,004	0,016	0,011	-0,002
ROMU									
SKEL	0,003	0,001	0,017	0,003	0,011	0,005	0,007	0,003	0,001
SMID									
SODA									
STAV									-0,003
SULD									0,000
SUND	-0,001	0,011	0,006	0,001	-0,001	0,012	0,007	0,001	0,002
SVEG	0,015	0,003	-0,006	0,005	0,016	-0,002	0,002	-0,005	0,003
TROM									-0,003
TRON									-0,004
TUOR									
UMEA	0,000	-0,001	0,016	-0,005	-0,005	0,007	-0,006	-0,006	0,001
VAAS									
VANE	0,003	-0,005	0,010	0,007	0,011	0,007	0,008	0,003	-0,003
VARD									
VAST	0,002	0,000	0,003	0,000	0,014	0,003	0,001	-0,004	0,000
VIL0		-0,006	0,017	0,002	0,010	0,010		-0,006	-0,001
VIRO									
VISO		-0,002	0,009	-0,001	0,014	0,009	0,004	0,000	-0,001
RMS	0,006	0,005	0,010	0,004	0,011	0,008	0,006	0,005	0,005
MAX	0,016	0,011	0,022	0,011	0,017	0,016	0,016	0,011	0,011

Up component

Station	200	201	202	203	204	205	RMS	MAX
ALES		0,004	0,007			-0,005	0,008	0,017
ARJE	0,008	0,007	0,009	0,008	0,010	0,007	0,008	0,022
BERG	0,002	0,012	0,005	-0,008	-0,012	-0,004	0,008	0,014
BODO	0,002	0,001	0,007	-0,004	-0,002	-0,001	0,006	0,010
BORA	0,004	0,001	0,015	-0,003	0,006	-0,006	0,006	0,015
BUDP	0,004	0,011	0,013	0,003	-0,007	0,002	0,008	0,020
GAVL	0,002	0,003	0,014	-0,003	-0,005	0,004	0,008	0,017
GOTE	0,005	0,008	0,006	-0,010	-0,004	-0,010	0,007	0,016
HASS	0,001	0,013	0,002	-0,003	-0,006	0,005	0,006	0,013
JOEN							0,005	0,009
JONK	0,007	0,012	0,017	-0,005	-0,006	0,004	0,006	0,017
KARL	0,008	0,005	0,017	-0,002	0,005	0,003	0,006	0,017
KEVO							0,008	0,016
KIRO	-0,002	0,003	0,010	-0,003	0,005	0,000	0,006	0,012
KIVE							0,005	0,008
KRIS	0,007	0,010	0,009	-0,007	-0,003	-0,004	0,008	0,011
KUUS							0,008	0,019
LEKS		0,005	0,015	-0,006	-0,002	0,009	0,008	0,022
LOVO	-0,001	0,010		0,002	0,004	0,004	0,007	0,020
MALM	0,005	0,010	0,022	0,005	-0,006	-0,006	0,007	0,022
MART	0,006	0,008	0,018	0,002	-0,003	0,008	0,008	0,018
METS							0,010	0,022
NORR	-0,006	0,010	0,007	-0,003	-0,004	0,001	0,006	0,017
OLKI							0,007	0,013
OSKA	0,006	0,002	-0,001	0,003	-0,003	0,003	0,005	0,014
OSLO	0,005	0,009	0,009	-0,013	0,001		0,006	0,013
OSTE	0,000	0,006	0,010	-0,006	0,002	0,004	0,007	0,018
OULU							0,008	0,013
OVER	0,004	-0,002	0,007	0,007	0,003	0,002	0,007	0,016
ROMU							0,008	0,018
SKEL	0,004	0,010	0,013	-0,010	0,006	0,000	0,008	0,019
SMID	-0,001	0,021	0,007	-0,001		0,000	0,008	0,021
SODA							0,007	0,018
STAV	0,002	0,002	0,003	-0,003	0,001	-0,009	0,005	0,012
SULD	0,003	0,023		-0,005	-0,001	0,003	0,008	0,023
SUND	0,007	0,003	0,002	-0,009	-0,005	0,009	0,007	0,014
SVEG	0,001	0,010	0,014	0,006	0,001	0,006	0,007	0,016
TROM	0,003	0,001	0,009	0,003	0,006	-0,008	0,008	0,016
TRON	0,003	0,003	0,013	-0,005	-0,004	-0,002	0,006	0,013
TUOR							0,004	0,007
UMEA	0,008	0,010	0,007	-0,006	0,003	0,002	0,006	0,016
VAAS							0,009	0,016
VANE	0,006	0,015	0,007	-0,001	-0,003	0,006	0,006	0,015
VARD							0,011	0,017
VAST	0,006	0,014	0,002	0,001	-0,004	0,000	0,007	0,014
VIL0	0,005	0,011	0,009	-0,003	-0,002	0,005	0,008	0,018
VIRO							0,008	0,019
VISO	-0,002	-0,001	0,002	-0,001	0,003	-0,006	0,006	0,014
RMS	0,005	0,010	0,011	0,006	0,005	0,005		
MAX	0,008	0,023	0,022	0,013	0,012	0,010		

Appendix 5: Minimum constrained solution ITRF 97 ep 99.5

S+DK+FIN+N GWEEK 1014-1019 MIN CONSTRAINED ONSALA FIX

30-MAY-00 11:34

 LOCAL GEODETIC DATUM: WGS - 84

EPOCH: 1999-06-16 11:59:45

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
701	ALES 0	2938027.4304	319096.3074	5633413.9174	M
702	BERG 0	3155871.2377	290902.8206	5516573.5141	M
708	TRON 10331M001	2820170.9258	513485.9937	5678935.8822	M
501	ARJE 0	2441775.2340	799268.1389	5818729.2900	M
114	KIRO 10422M001	2248123.2963	865686.6287	5886425.7056	M
807	OULU	2423778.5505	1176553.7813	5761860.9585	M
505	OVER 0	2368884.8173	994492.2724	5818478.2961	M
506	SKEL 0	2534030.9903	975174.5086	5752078.4632	M
809	SODA 10513M001	2200146.7877	1091638.2944	5866870.7336	M
116	VIL0 10424M001	2620258.6909	779138.0873	5743799.4005	M
509	BORA 0	3328984.6222	761910.1931	5369033.6168	M
115	VIS0 10423M001	3246470.3589	1077900.4370	5365278.0378	M
601	BUDP 01-13-829	3513638.3612	778956.3245	5248216.3838	M
512	JONK 0	3309991.6517	828932.2027	5370882.4047	M
522	GAVL 1	2993587.5987	922762.5738	5537295.2184	M
507	SUND 0	2838909.7310	903822.1586	5620660.3315	M
524	GOTE 0	3341445.3667	708148.3961	5368462.6865	M
511	HASS 0	3464655.6496	845750.0777	5270271.6418	M
602	SULD 61-10-802	3446394.3052	591713.0690	5316383.3976	M
525	MALM 0	3518626.9323	814264.6999	5239551.8286	M
504	NORR 0	3199093.1237	932231.4103	5420322.6222	M
111	ONSA 10402M004	3370658.6418	711877.0664	5349786.8885	W
603	SMID 117-05-810	3557911.3306	599176.6082	5242066.3951	M
521	VANE 0	3249408.1016	692758.0423	5426397.0724	M
523	VAST 0	3097214.7870	921046.0740	5480693.5177	M
801	JOEN 10512M001	2564139.1999	1486149.7039	5628951.3818	M
804	KUUS	2282711.5699	1267071.8152	5800215.7956	M
805	METS 10503S011	2892570.9013	1311843.3759	5512634.0785	M
808	ROMU	2410839.2726	1388069.5529	5720515.2504	M
812	VIRO	2788248.2823	1454873.4115	5530280.1328	M
513	KARL 0	3160763.1673	759160.2609	5469345.6325	M
802	KEVO	1972158.2846	1005174.4343	5961798.7514	M
803	KIVE	2632277.2781	1266957.3716	5651027.6513	M
514	LEKS 0	3022572.9915	802945.7554	5540684.0888	M
515	LOVO 0	3104219.2520	998384.1022	5463290.6419	M
113	MAR6 10405M002	2998189.5127	931451.7066	5533398.6062	M
806	OLKI	2863210.0762	1126271.4782	5568267.3342	M
705	OSLO 10307M001	3169981.9730	579956.7057	5485936.6138	M
517	OSKA 0	3341339.9907	957912.4281	5330003.3554	M
518	OSTE 0	2763885.3185	733247.4419	5682653.4709	M
706	STAV 10330M001	3275753.7295	321110.9709	5445042.0231	M
519	SVEG 0	2902494.9095	761455.9043	5609859.8126	M
810	TUOR	2917810.8613	1205222.6471	5523550.0547	M
520	UMEA 0	2682407.7177	950395.9931	5688993.2381	M
811	VAAS 10511M001	2699864.4303	1078263.9373	5658064.8047	M
703	BODO 0	2393811.7131	612747.6980	5860377.6169	M
707	TROM 10302M006	2102928.5945	721619.4064	5958196.2015	M
709	VARD 10322M002	1844607.4120	1109719.1649	5983936.1239	M
704	KRIS 0	3348185.9390	465040.9764	5390738.2387	M

Appendix 6: Minimum constrained solution ITRF 97 ep 99.5 fitted by a 3-parameter transformation to Permanent EUREF and IGS stations in table 5 (Onsala corrected and Metsähovi excluded).

S+DK+FIN+N GWEEK 1014-1019 MIN CONSTRAINED ONSALA FIX

30-MAY-00 11:34

LOCAL GEODETIC DATUM: ITRF97

EPOCH: 1999-06-16 11:59:45

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
701	ALES 0	2938027.4212	319096.3089	5633413.9081	M
702	BERG 0	3155871.2285	290902.8221	5516573.5048	M
708	TRON 10331M001	2820170.9166	513485.9952	5678935.8729	M
501	ARJE 0	2441775.2248	799268.1404	5818729.2807	M
114	KIRO 10422M001	2248123.2871	865686.6302	5886425.6963	M
807	OULU	2423778.5413	1176553.7828	5761860.9492	M
505	OVER 0	2368884.8081	994492.2739	5818478.2868	M
506	SKEL 0	2534030.9811	975174.5101	5752078.4539	M
809	SODA 10513M001	2200146.7785	1091638.2959	5866870.7243	M
116	VILO 10424M001	2620258.6817	779138.0888	5743799.3912	M
509	BORA 0	3328984.6130	761910.1946	5369033.6075	M
115	VISO 10423M001	3246470.3497	1077900.4385	5365278.0285	M
601	BUDP 01-13-829	3513638.3520	778956.3260	5248216.3745	M
512	JONK 0	3309991.6425	828932.2042	5370882.3954	M
522	GAVL 1	2993587.5895	922762.5753	5537295.2091	M
507	SUND 0	2838909.7218	903822.1601	5620660.3222	M
524	GOTE 0	3341445.3575	708148.3976	5368462.6772	M
511	HASS 0	3464655.6404	845750.0792	5270271.6325	M
602	SULD 61-10-802	3446394.2960	591713.0705	5316383.3883	M
525	MALM 0	3518626.9231	814264.7014	5239551.8193	M
504	NORR 0	3199093.1145	932231.4118	5420322.6129	M
111	ONSA 10402M004	3370658.6326	711877.0679	5349786.8792	W
603	SMID 117-05-810	3557911.3214	599176.6097	5242066.3858	M
521	VANE 0	3249408.0924	692758.0438	5426397.0631	M
523	VAST 0	3097214.7778	921046.0755	5480693.5084	M
801	JOEN 10512M001	2564139.1907	1486149.7054	5628951.3725	M
804	KUUS	2282711.5607	1267071.8167	5800215.7863	M
805	METS 10503S011	2892570.8921	1311843.3774	5512634.0692	M
808	ROMU	2410839.2634	1388069.5544	5720515.2411	M
812	VIRO	2788248.2731	1454873.4130	5530280.1235	M
513	KARL 0	3160763.1581	759160.2624	5469345.6232	M
802	KEVO	1972158.2754	1005174.4358	5961798.7421	M
803	KIVE	2632277.2689	1266957.3731	5651027.6420	M
514	LEKS 0	3022572.9823	802945.7569	5540684.0795	M
515	LOVO 0	3104219.2428	998384.1037	5463290.6326	M
113	MAR6 10405M002	2998189.5035	931451.7081	5533398.5969	M
806	OLKI	2863210.0670	1126271.4797	5568267.3249	M
705	OSLO 10307M001	3169981.9638	579956.7072	5485936.6045	M
517	OSKA 0	3341339.9815	957912.4296	5330003.3461	M
518	OSTE 0	2763885.3093	733247.4434	5682653.4616	M
706	STAV 10330M001	3275753.7203	321110.9724	5445042.0138	M
519	SVEG 0	2902494.9003	761455.9058	5609859.8033	M
810	TUOR	2917810.8521	1205222.6486	5523550.0454	M
520	UMEA 0	2682407.7085	950395.9946	5688993.2288	M
811	VAAS 10511M001	2699864.4211	1078263.9388	5658064.7954	M
703	BODO 0	2393811.7039	612747.6995	5860377.6076	M
707	TROM 10302M006	2102928.5853	721619.4079	5958196.1922	M
709	VARD 10322M002	1844607.4028	1109719.1664	5983936.1146	M
704	KRIS 0	3348185.9298	465040.9779	5390738.2294	M

Appendix 7: Constrained solution alt 1 ITRF 97 ep 99.5

CONSTRAINED ALT 1, ONSA JMP CORR, METS EXCL I97 99.5

17-OCT-00 10:38

 LOCAL GEODETIC DATUM: WGS - 84

EPOCH: 1999-07-01 0:00:00

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
701	ALES 0	2938027.4210	319096.3073	5633413.9055	M
702	BERG 0	3155871.2285	290902.8204	5516573.5022	M
708	TRON 10331M001	2820170.9164	513485.9939	5678935.8706	M
501	ARJE 0	2441775.2247	799268.1394	5818729.2789	M
114	KIRO 10422M001	2248123.2907	865686.6279	5886425.6991	F
807	OULU	2423778.5408	1176553.7822	5761860.9472	M
505	OVER 0	2368884.8080	994492.2730	5818478.2851	M
506	SKEL 0	2534030.9810	975174.5091	5752078.4519	M
809	SODA 10513M001	2200146.7780	1091638.2983	5866870.7241	F
116	VIL0 10424M001	2620258.6823	779138.0885	5743799.3891	F
509	BORA 0	3328984.6134	761910.1934	5369033.6051	M
115	VIS0 10423M001	3246470.3476	1077900.4372	5365278.0226	F
601	BUDP 01-13-829	3513638.3524	778956.3249	5248216.3716	M
512	JONK 0	3309991.6429	828932.2031	5370882.3930	M
522	GAVL 1	2993587.5898	922762.5743	5537295.2071	M
507	SUND 0	2838909.7219	903822.1591	5620660.3202	M
524	GOTE 0	3341445.3579	708148.3964	5368462.6748	M
511	HASS 0	3464655.6409	845750.0781	5270271.6300	M
602	SULD 61-10-802	3446394.2963	591713.0692	5316383.3855	M
525	MALM 0	3518626.9236	814264.7003	5239551.8168	M
504	NORR 0	3199093.1149	932231.4108	5420322.6106	M
111	ONSA 10402M004	3370658.6311	711877.0645	5349786.8725	F
603	SMID 117-05-810	3557911.3218	599176.6084	5242066.3829	M
521	VANE 0	3249408.0927	692758.0426	5426397.0607	M
523	VAST 0	3097214.7781	921046.0745	5480693.5062	M
801	JOEN 10512M001	2564139.1898	1486149.7067	5628951.3714	F
804	KUUS	2282711.5602	1267071.8163	5800215.7845	M
805	METS 10503S011	2892570.8923	1311843.3770	5512634.0671	M
808	ROMU	2410839.2629	1388069.5542	5720515.2391	M
812	VIRO	2788248.2731	1454873.4128	5530280.1213	M
513	KARL 0	3160763.1584	759160.2612	5469345.6210	M
802	KEVO	1972158.2746	1005174.4352	5961798.7410	M
803	KIVE	2632277.2687	1266957.3727	5651027.6399	M
514	LEKS 0	3022572.9825	802945.7558	5540684.0772	M
515	LOVO 0	3104219.2431	998384.1027	5463290.6304	M
113	MAR6 10405M002	2998189.5062	931451.7083	5533398.6022	F
806	OLKI	2863210.0670	1126271.4791	5568267.3227	M
705	OSLO 10307M001	3169981.9639	579956.7058	5485936.6019	M
517	OSKA 0	3341339.9818	957912.4286	5330003.3436	M
518	OSTE 0	2763885.3093	733247.4423	5682653.4595	M
706	STAV 10330M001	3275753.7204	321110.9708	5445042.0110	M
519	SVEG 0	2902494.9005	761455.9047	5609859.8012	M
810	TUOR	2917810.8522	1205222.6481	5523550.0431	M
520	UMEA 0	2682407.7085	950395.9936	5688993.2268	M
811	VAAS 10511M001	2699864.4229	1078263.9409	5658064.7966	F
703	BODO 0	2393811.7035	612747.6983	5860377.6068	M
707	TROM 10302M006	2102928.5815	721619.4096	5958196.1984	F
709	VARD 10322M002	1844607.4016	1109719.1658	5983936.1131	M
704	KRIS 0	3348185.9300	465040.9763	5390738.2267	M

Appendix 8: Constrained solution alt 2 ITRF 97 ep 99.5

NORDIC CON_AL2K STEP 2 FIXED ON 10 STN I_PEUK-T.CRD

18-SEP-00 14:38

 LOCAL GEODETIC DATUM: WGS - 84

EPOCH: 1999-07-01 0:00:00

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
701	ALES 0	2938027.4188	319096.3038	5633413.9016	M
702	BERG 0	3155871.2261	290902.8169	5516573.4982	M
708	TRON 10331M001	2820170.9139	513485.9903	5678935.8663	M
501	ARJE 0	2441775.2218	799268.1356	5818729.2741	M
114	KIRO 10422M001	2248123.2844	865686.6259	5886425.6917	F
807	OULU	2423778.5383	1176553.7781	5761860.9424	M
505	OVER 0	2368884.8051	994492.2693	5818478.2802	M
506	SKEL 0	2534030.9782	975174.5054	5752078.4472	M
809	SODA 10513M001	2200146.7743	1091638.2899	5866870.7131	F
116	VIL0 10424M001	2620258.6783	779138.0838	5743799.3839	F
509	BORA 0	3328984.6108	761910.1898	5369033.6008	M
115	VIS0 10423M001	3246470.3482	1077900.4342	5365278.0231	F
601	BUDP 01-13-829	3513638.3499	778956.3212	5248216.3677	M
512	JONK 0	3309991.6403	828932.1995	5370882.3886	M
522	GAVL 1	2993587.5870	922762.5706	5537295.2024	M
507	SUND 0	2838909.7191	903822.1553	5620660.3155	M
524	GOTE 0	3341445.3553	708148.3928	5368462.6704	M
511	HASS 0	3464655.6383	845750.0745	5270271.6257	M
602	SULD 61-10-802	3446394.2939	591713.0656	5316383.3816	M
525	MALM 0	3518626.9211	814264.6967	5239551.8125	M
504	NORR 0	3199093.1122	932231.4071	5420322.6061	M
111	ONSA 10402M004	3370658.6311	711877.0637	5349786.8725	F
603	SMID 117-05-810	3557911.3193	599176.6048	5242066.3791	M
521	VANE 0	3249408.0901	692758.0390	5426397.0563	M
523	VAST 0	3097214.7753	921046.0708	5480693.5016	M
801	JOEN 10512M001	2564139.1871	1486149.6979	5628951.3620	F
804	KUUS	2282711.5576	1267071.8119	5800215.7792	M
805	METS 10503S011	2892570.8884	1311843.3722	5512634.0619	F
808	ROMU	2410839.2604	1388069.5496	5720515.2340	M
812	VIRO	2788248.2702	1454873.4082	5530280.1164	M
513	KARL 0	3160763.1557	759160.2576	5469345.6165	M
802	KEVO	1972158.2722	1005174.4310	5961798.7350	M
803	KIVE	2632277.2659	1266957.3684	5651027.6350	M
514	LEKS 0	3022572.9799	802945.7522	5540684.0728	M
515	LOVO 0	3104219.2404	998384.0990	5463290.6258	M
113	MAR6 10405M002	2998189.5006	931451.7031	5533398.5893	F
806	OLKI	2863210.0644	1126271.4750	5568267.3180	M
705	OSLO 10307M001	3169981.9615	579956.7022	5485936.5978	M
517	OSKA 0	3341339.9793	957912.4250	5330003.3393	M
518	OSTE 0	2763885.3065	733247.4386	5682653.4549	M
706	STAV 10330M001	3275753.7181	321110.9673	5445042.0072	M
519	SVEG 0	2902494.8977	761455.9010	5609859.7966	M
810	TUOR	2917810.8494	1205222.6439	5523550.0384	M
520	UMEA 0	2682407.7057	950395.9899	5688993.2222	M
811	VAAS 10511M001	2699864.4164	1078263.9334	5658064.7848	F
703	BODO 0	2393811.7008	612747.6946	5860377.6009	M
707	TROM 10302M006	2102928.5796	721619.4030	5958196.1804	F
709	VARD 10322M002	1844607.3996	1109719.1616	5983936.1077	M
704	KRIS 0	3348185.9276	465040.9728	5390738.2226	M

Appendix 9: Minimum constrained solution ETRF 97 ep 99.5 fitted by a 3-parameter transformation to Permanent EUREF and IGS stations in table 5 (Onsala corrected and Metsähovi excluded) and converted to ETRF 97 ep 99.5

MINIMUM CONSTRAINED TRANSLATED TO ITRF 9 ST (NOT METS) ETRF 97 EPOCH 1999.5

LOCAL GEODETIC DATUM: WGS - 84

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
701	ALES 0	2938027.6161	319096.1954	5633413.7876	M
702	BERG 0	3155871.4195	290902.7026	5516573.3785	M
708	TRON 10331M001	2820171.1191	513485.8851	5678935.7574	M
501	ARJE 0	2441775.4403	799268.0414	5818729.1777	M
114	KIRO 10422M001	2248123.5065	865686.5369	5886425.5989	M
807	OULU	2423778.7678	1176553.6850	5761860.8505	M
505	OVER 0	2368885.0301	994492.1773	5818478.1876	M
506	SKEL 0	2534031.2007	975174.4087	5752078.3503	M
809	SODA 10513M001	2200147.0049	1091638.2044	5866870.6304	M
116	VIL0 10424M001	2620258.8946	779137.9847	5743799.2835	M
509	BORA 0	3328984.8158	761910.0708	5369033.4815	M
115	VIS0 10423M001	3246470.5629	1077900.3175	5365277.9079	M
601	BUDP 01-13-829	3513638.5523	778956.1974	5248216.2440	M
512	JONK 0	3309991.8476	828932.0810	5370882.2706	M
522	GAVL 1	2993587.8019	922762.4609	5537295.0933	M
507	SUND 0	2838909.9357	903822.0500	5620660.2102	M
524	GOTE 0	3341445.5585	708148.2734	5368462.5504	M
511	HASS 0	3464655.8435	845749.9519	5270271.5039	M
602	SULD 61-10-802	3446394.4919	591712.9434	5316383.2576	M
525	MALM 0	3518627.1244	814264.5727	5239551.6891	M
504	NORR 0	3199093.3243	932231.2918	5420322.4920	M
111	ONSA 10402M004	3370658.8333	711876.9429	5349786.7517	W
603	SMID 117-05-810	3557911.5156	599176.4797	5242066.2524	M
521	VANE 0	3249408.2944	692757.9221	5426396.9385	M
523	VAST 0	3097214.9887	921045.9583	5480693.3900	M
801	JOEN 10512M001	2564139.4241	1486149.6043	5628951.2734	M
804	KUUS	2282711.7912	1267071.7232	5800215.6921	M
805	METS 10503S011	2892571.1168	1311843.2666	5512633.9599	M
808	ROMU	2410839.4959	1388069.4574	5720515.1449	M
812	VIRO	2788248.5029	1454873.3055	5530280.0184	M
513	KARL 0	3160763.3634	759160.1432	5469345.5015	M
802	KEVO	1972158.5014	1005174.3509	5961798.6531	M
803	KIVE	2632277.4956	1266957.2695	5651027.5389	M
514	LEKS 0	3022573.1908	802945.6415	5540683.9618	M
515	LOVO 0	3104219.4558	998383.9864	5463290.5148	M
113	MAR6 10405M002	2998189.7161	931451.5936	5533398.4811	M
806	OLKI	2863210.2869	1126271.3693	5568267.2145	M
705	OSLO 10307M001	3169982.1636	579956.5875	5485936.4807	M
517	OSKA 0	3341340.1898	957912.3058	5330003.2218	M
518	OSTE 0	2763885.5192	733247.3351	5682653.3497	M
706	STAV 10330M001	3275753.9105	321110.8496	5445041.8847	M
519	SVEG 0	2902495.1092	761455.7937	5609859.6882	M
810	TUOR	2917811.0735	1205222.5369	5523549.9344	M
520	UMEA 0	2682407.9257	950395.8890	5688993.1212	M
811	VAAS 10511M001	2699864.6417	1078263.8329	5658064.6887	M
703	BODO 0	2393811.9143	612747.6017	5860377.5039	M
707	TROM 10302M006	2102928.8018	721619.3187	5958196.0970	M
709	VARD 10322M002	1844607.6328	1109719.0855	5983936.0300	M
704	KRIS 0	3348186.1234	465040.8533	5390738.0999	M

Appendix 10: Constrained solution alt 1 ETRF 97 ep 99.5

MINIMUM CONSTRAINED TRANSLATED TO ITRF 9 ST (NOT METS) ETRF 97 EPOCH 1999.5

 LOCAL GEODETIC DATUM: WGS - 84

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
701	ALES 0	2938027.6159	319096.1938	5633413.7850	M
702	BERG 0	3155871.4195	290902.7009	5516573.3759	M
708	TRON 10331M001	2820171.1189	513485.8838	5678935.7551	M
501	ARJE 0	2441775.4402	799268.0404	5818729.1759	M
114	KIRO 10422M001	2248123.5101	865686.5346	5886425.6017	F
807	OULU	2423778.7673	1176553.6844	5761860.8485	M
505	OVER 0	2368885.0300	994492.1764	5818478.1859	M
506	SKEL 0	2534031.2006	975174.4077	5752078.3483	M
809	SODA 10513M001	2200147.0044	1091638.2068	5866870.6302	F
116	VIL0 10424M001	2620258.8952	779137.9844	5743799.2814	F
509	BORA 0	3328984.8162	761910.0696	5369033.4791	M
115	VISO 10423M001	3246470.5608	1077900.3162	5365277.9020	F
601	BUDP 01-13-829	3513638.5527	778956.1963	5248216.2411	M
512	JONK 0	3309991.8480	828932.0799	5370882.2682	M
522	GAVL 1	2993587.8022	922762.4599	5537295.0913	M
507	SUND 0	2838909.9358	903822.0490	5620660.2082	M
524	GOTE 0	3341445.5589	708148.2722	5368462.5480	M
511	HASS 0	3464655.8440	845749.9508	5270271.5014	M
602	SULD 61-10-802	3446394.4922	591712.9421	5316383.2548	M
525	MALM 0	3518627.1249	814264.5716	5239551.6866	M
504	NORR 0	3199093.3247	932231.2908	5420322.4897	M
111	ONSA 10402M004	3370658.8318	711876.9395	5349786.7450	F
603	SMID 117-05-810	3557911.5160	599176.4784	5242066.2495	M
521	VANE 0	3249408.2947	692757.9209	5426396.9361	M
523	VAST 0	3097214.9890	921045.9573	5480693.3878	M
801	JOEN 10512M001	2564139.4232	1486149.6056	5628951.2723	F
804	KUUS	2282711.7907	1267071.7228	5800215.6903	M
805	METS 10503S011	2892571.1170	1311843.2662	5512633.9578	M
808	ROMU	2410839.4954	1388069.4572	5720515.1429	M
812	VIRO	2788248.5029	1454873.3053	5530280.0162	M
513	KARL 0	3160763.3637	759160.1420	5469345.4993	M
802	KEVO	1972158.5006	1005174.3503	5961798.6520	M
803	KIVE	2632277.4954	1266957.2691	5651027.5368	M
514	LEKS 0	3022573.1910	802945.6404	5540683.9595	M
515	LOVO 0	3104219.4561	998383.9854	5463290.5126	M
113	MAR6 10405M002	2998189.7188	931451.5938	5533398.4864	F
806	OLKI	2863210.2869	1126271.3687	5568267.2123	M
705	OSLO 10307M001	3169982.1637	579956.5861	5485936.4781	M
517	OSKA 0	3341340.1901	957912.3048	5330003.2193	M
518	OSTE 0	2763885.5192	733247.3340	5682653.3476	M
706	STAV 10330M001	3275753.9106	321110.8480	5445041.8819	M
519	SVEG 0	2902495.1094	761455.7926	5609859.6861	M
810	TUOR	2917811.0736	1205222.5364	5523549.9321	M
520	UMEA 0	2682407.9257	950395.8880	5688993.1192	M
811	VAAS 10511M001	2699864.6435	1078263.8350	5658064.6899	F
703	BODO 0	2393811.9139	612747.6005	5860377.5031	M
707	TROM 10302M006	2102928.7980	721619.3204	5958196.1032	F
709	VARD 10322M002	1844607.6316	1109719.0849	5983936.0285	M
704	KRIS 0	3348186.1236	465040.8517	5390738.0972	M

Appendix 11: Constrained solution alt 2 ETRF 97 ep 99.5

CONSTR ALT 2 (FIXED ON I_PEUK-T.CRD - TROM, ONSA CORR) ETRF 97 EPOCH 1999.5

 LOCAL GEODETIC DATUM: WGS - 84

NUM	STATION NAME	X (M)	Y (M)	Z (M)	FLAG
701	ALES 0	2938027.6137	319096.1903	5633413.7811	M
702	BERG 0	3155871.4171	290902.6974	5516573.3719	M
708	TRON 10331M001	2820171.1164	513485.8802	5678935.7508	M
501	ARJE 0	2441775.4373	799268.0366	5818729.1711	M
114	KIRO 10422M001	2248123.5038	865686.5326	5886425.5943	F
807	OULU	2423778.7648	1176553.6803	5761860.8437	M
505	OVER 0	2368885.0271	994492.1727	5818478.1810	M
506	SKEL 0	2534031.1978	975174.4040	5752078.3436	M
809	SODA 10513M001	2200147.0007	1091638.1984	5866870.6192	F
116	VIL0 10424M001	2620258.8912	779137.9797	5743799.2762	F
509	BORA 0	3328984.8136	761910.0660	5369033.4748	M
115	VIS0 10423M001	3246470.5614	1077900.3132	5365277.9025	F
601	BUDP 01-13-829	3513638.5502	778956.1926	5248216.2372	M
512	JONK 0	3309991.8454	828932.0763	5370882.2638	M
522	GAVL 1	2993587.7994	922762.4562	5537295.0866	M
507	SUND 0	2838909.9330	903822.0452	5620660.2035	M
524	GOTE 0	3341445.5563	708148.2686	5368462.5436	M
511	HASS 0	3464655.8414	845749.9472	5270271.4971	M
602	SULD 61-10-802	3446394.4898	591712.9385	5316383.2509	M
525	MALM 0	3518627.1224	814264.5680	5239551.6823	M
504	NORR 0	3199093.3220	932231.2871	5420322.4852	M
111	ONSA 10402M004	3370658.8318	711876.9387	5349786.7450	F
603	SMID 117-05-810	3557911.5135	599176.4748	5242066.2457	M
521	VANE 0	3249408.2921	692757.9173	5426396.9317	M
523	VAST 0	3097214.9862	921045.9536	5480693.3832	M
801	JOEN 10512M001	2564139.4205	1486149.5968	5628951.2629	F
804	KUUS	2282711.7881	1267071.7184	5800215.6850	M
805	METS 10503S011	2892571.1131	1311843.2614	5512633.9526	F
808	ROMU	2410839.4929	1388069.4526	5720515.1378	M
812	VIRO	2788248.5000	1454873.3007	5530280.0113	M
513	KARL 0	3160763.3610	759160.1384	5469345.4948	M
802	KEVO	1972158.4982	1005174.3461	5961798.6460	M
803	KIVE	2632277.4926	1266957.2648	5651027.5319	M
514	LEKS 0	3022573.1884	802945.6368	5540683.9551	M
515	LOVO 0	3104219.4534	998383.9817	5463290.5080	M
113	MAR6 10405M002	2998189.7132	931451.5886	5533398.4735	F
806	OLKI	2863210.2843	1126271.3646	5568267.2076	M
705	OSLO 10307M001	3169982.1613	579956.5825	5485936.4740	M
517	OSKA 0	3341340.1876	957912.3012	5330003.2150	M
518	OSTE 0	2763885.5164	733247.3303	5682653.3430	M
706	STAV 10330M001	3275753.9083	321110.8445	5445041.8781	M
519	SVEG 0	2902495.1066	761455.7889	5609859.6815	M
810	TUOR	2917811.0708	1205222.5322	5523549.9274	M
520	UMEA 0	2682407.9229	950395.8843	5688993.1146	M
811	VAAS 10511M001	2699864.6370	1078263.8275	5658064.6781	F
703	BODO 0	2393811.9112	612747.5968	5860377.4972	M
707	TROM 10302M006	2102928.7961	721619.3138	5958196.0852	F
709	VARD 10322M002	1844607.6296	1109719.0807	5983936.0231	M
704	KRIS 0	3348186.1212	465040.8482	5390738.0931	M

Appendix 12: Estimation of the shift at Onsala

The shift in the height component of Onsala, due to the change of antenna radome February 1, 1999, was estimated using solutions from the daily processing of SWEPOS. 56 days were used, 29 before the shift and 26 after. The baselines from the two closest SWEPOS-stations (Borås and Vänersborg) were plotted as a function of time – see figure A12-1. The shift was estimated as the difference between the average before the jump and the average after – and as an average of the estimation from Borås and Vänersborg – see table A12-1. The absolute values in figure A12-1 and table A12-1 are arbitrary, it is just the relative values that are interesting.

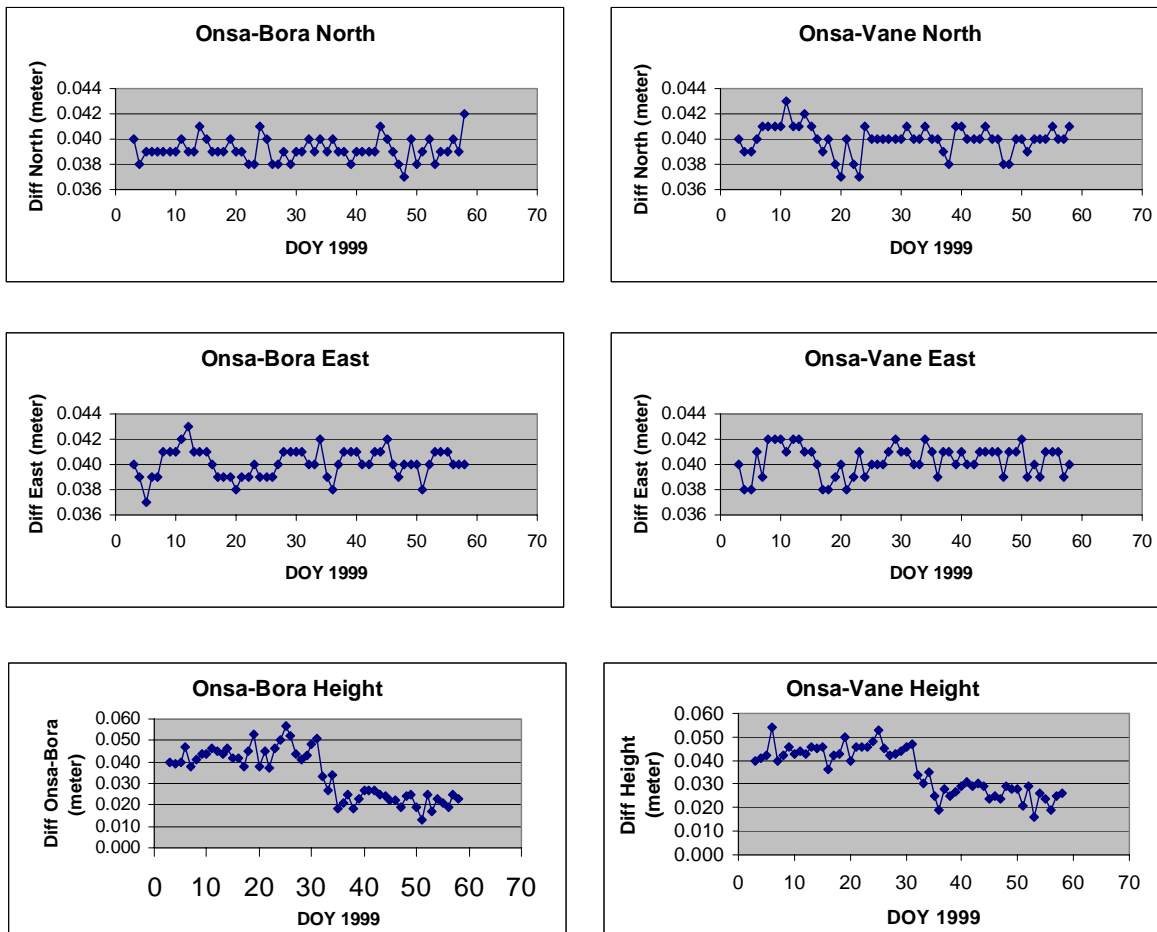


Figure A12-1: Time series of the baselines Borås-Onsala and Vänersborg-Onsala respectively. Day 32 = February 1 1999.

Table A12-1: Estimation of the shift.

Unit:meter	Onsala minus Borås			Onsala minus Vänersborg		
	North	East	Height	North	East	Height
Average before	0.039	0.040	0.044	0.040	0.040	0.044
Average after	0.039	0.040	0.023	0.040	0.040	0.026
Shift	0.000	0.000	-0.022	0.000	0.000	-0.018

There is no shift in the north and east components and the average of the shifts in the height components are –20 mm. Thus the IERS ITRF 97 epoch 1999.5 coordinates for Onsala were updated with this shift. The geocentric cartesian coordinates were first converted to geodetic coordinates and then the shift was applied before the coordinates were converted back to geocentric cartesian coordinates. See table A12-2.

Table A12-2: ITRF 97 epoch 1999.5 coordinates of Onsala before and after correction.

ONSA_before	3370658.6417	711877.0661	5349786.8894
ONSA_before	57 23 43.072664	11 55 31.857032	45.5696
ONSA_after	57 23 43.072664	11 55 31.857032	45.5496
ONSA_after	3370658.6312	711877.0639	5349786.8725