



EPN Analysis – Products and Report

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Outline

- Status of Local Analysis Centres
- Status of sub-network combination
- (ITRF 2005 Densification)
- Short latency / high resolution products
- EPN Local Analysis Center Workshop 2008

Status of Local Analysis Centres

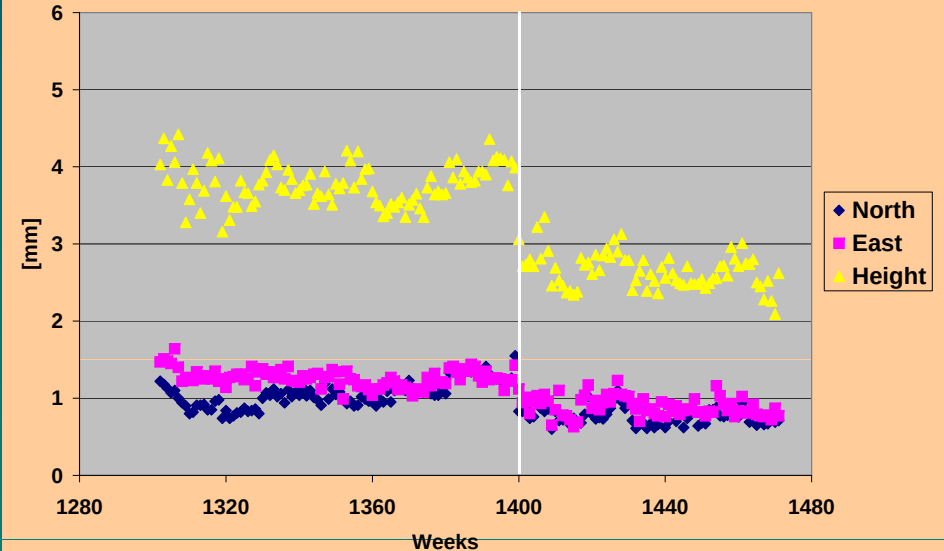
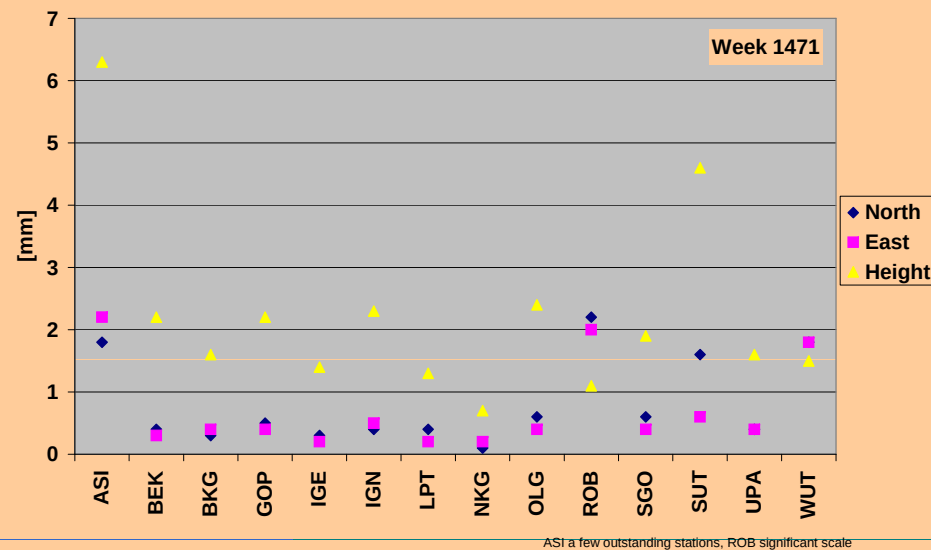
ASI	MicroCosm 2005.0	Final Weekly	Final Daily	Rapid Daily,	Hourly	<u>GLONASS</u>
BEK	Bernese 5.0		Final Daily,	Rapid Daily,	Hourly	
BKG	Bernese 5.0		(.)			
COE	Bernese 5.1		Final Daily,	Rapid Daily		
DEO	GIPSY v2.5/cov2snx		Final Daily	Rapid Daily,	Hourly,	
GOP	Bernese 5.0					
IGE	Bernese 5.0					
IGN	Bernese 5.0					
LPT	Bernese 5.0					
NKG	Bernese 5.0					
OLG	Bernese 5.0					
ROB	Bernese 5.0					
SGO	Bernese 5.0					
SUT	Bernese 5.0					
UPA	Bernese 5.0					
WUT	Bernese 5.0					

Status of Sub-Network Combination

Indication of Precision

Precision between LACs

Day to Day Repeatability



EUREF Regional Densification of ITRF2005 - Scope

- Cumulative solution of EPN weekly results to realise a European densification of ITRF2005
- Providing a “reference coordinate list”
 - Coordinates and velocities unchanged after adoption unlike the operational (weekly) update of a cumulative solution
- Processing now finished and product files *online* available
- Draft report document distributed among TWG members

- ALL_ITRF2005_060920.snrx (*IGS offsets*)
- outliers.snrx (*IGS outliers*)
- EPN_offsets.snrx (*EPN SP offsets*)
- EPN_outliers.snrx (*EPN outliers*)
- ITRF2005_GPS.SSC (*coordinates and velocities*)

Priority Offsets:

1. ITRF2005
2. EPN SP Time Series
3. EPN Multiyear Solution

Priority Outlier Definition:

1. EPN Multiyear Solution
2. EPN SP Time Series

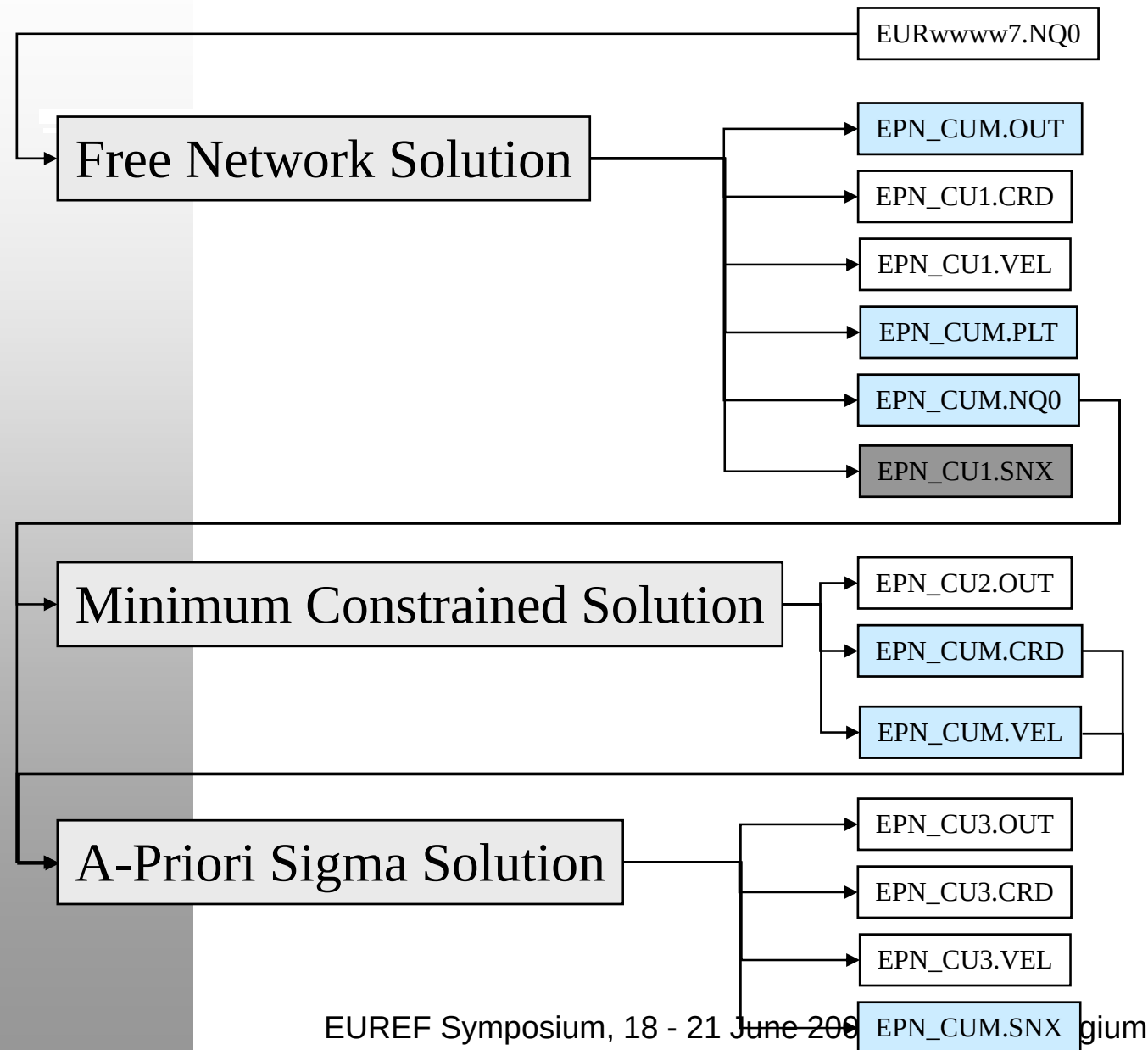
Priority Coordinates/Vel.:

1. ITRF2005 (Flag I)
2. EPN Weekly (Flag E)

Many, many ...
manual editing

EPNC.STA
EURF05.CRD
EURF05.VEL

EPN Multiyear Solution Strategy



Contributing NEQ-Files

- Weekly SINEX files converted to NEQs (mandatory to start with 1 solution per week)
- Weeks 860 to 1355 result to 496 contributing files
- Covered time span in conformance with ITRF2005
→ basic component of concept

Rejection Criteria

ADDNEQ2 4: Comparison of Individual Solutions

NOTIFICATION OF POSSIBLE OUTLIERS

Maximum tolerated residual	North	10	millimeters
	East	10	millimeters
	Up	20	millimeters
Maximum tolerated root-mean-square error	North	10	millimeters
	East	10	millimeters
	Up	20	millimeters
Minimum number of solutions for each station		2	

Reference Station Selection

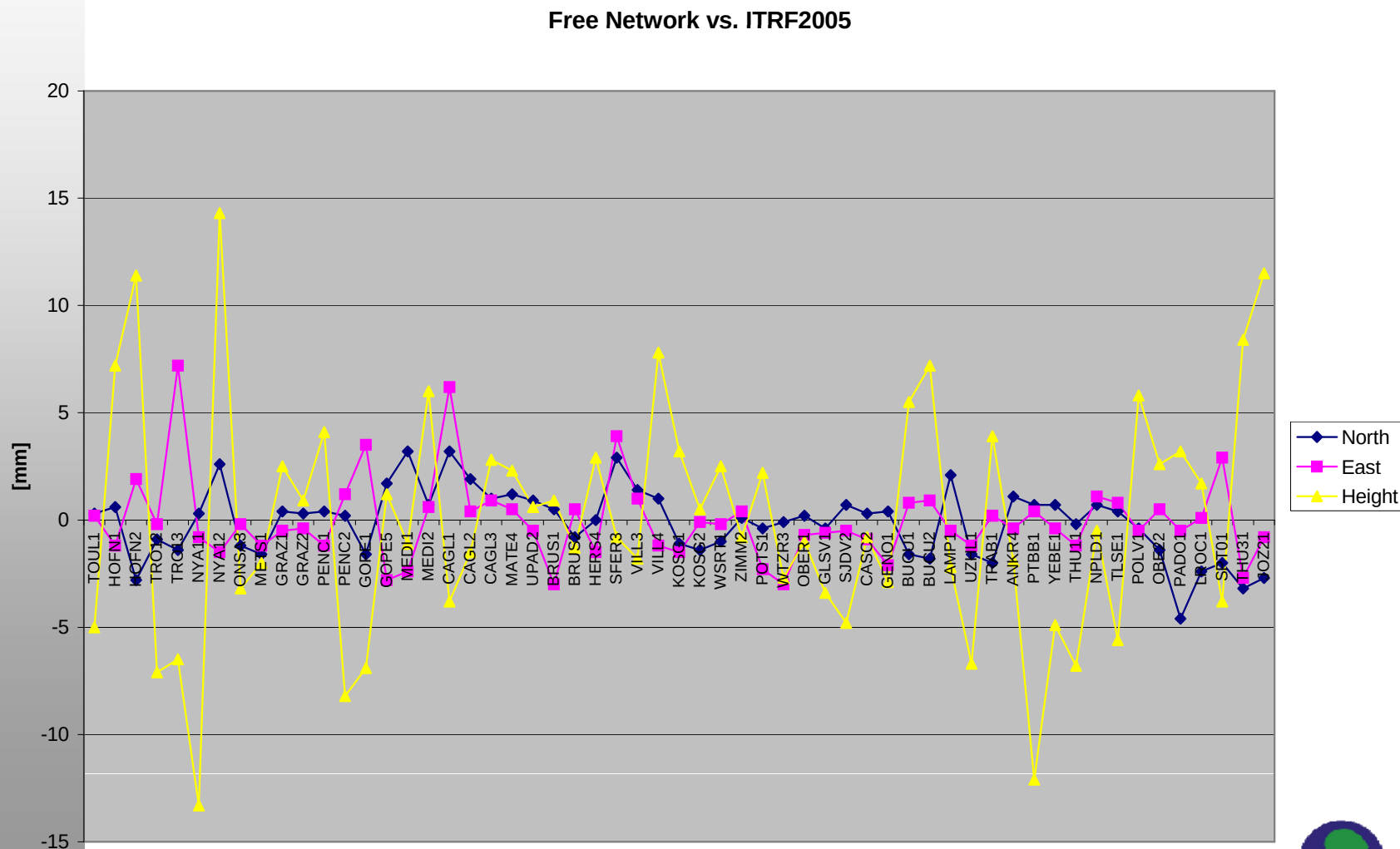
- Initially all ITRF2005 sites of EPN have been considered as references site
- Exclusion of stations from reference list after residual screening
- Finally 44 stations with 57 solution numbers selected for definition of minimum constraint conditions

Reference Sites



EUREF Symposium, 18 - 21 June 2008, Brussels, Belgium

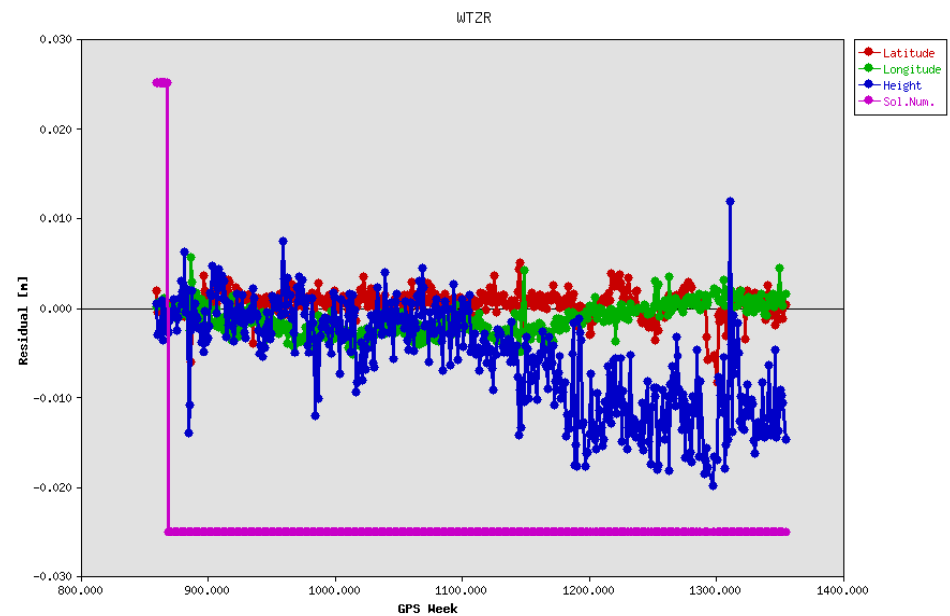
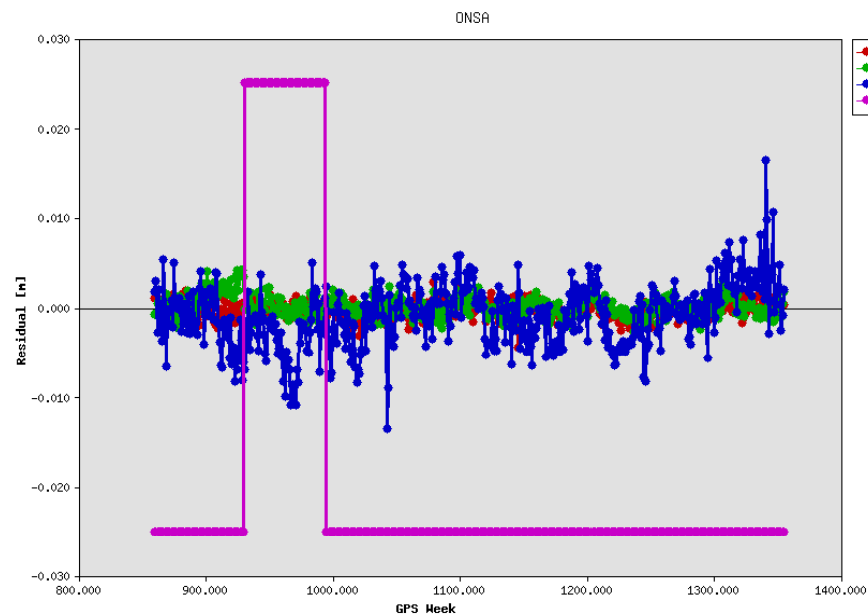
Residuals of Final Reference Stations



Processing Runtime

Total Time:	20:00 mm:ss
Free network solution from weekly NEQs:	07:47 mm:ss
Minimum constrained solution from combined NEQ:	01:53 mm:ss
Full Constrained solution from combined NEQ:	09:36 mm:ss

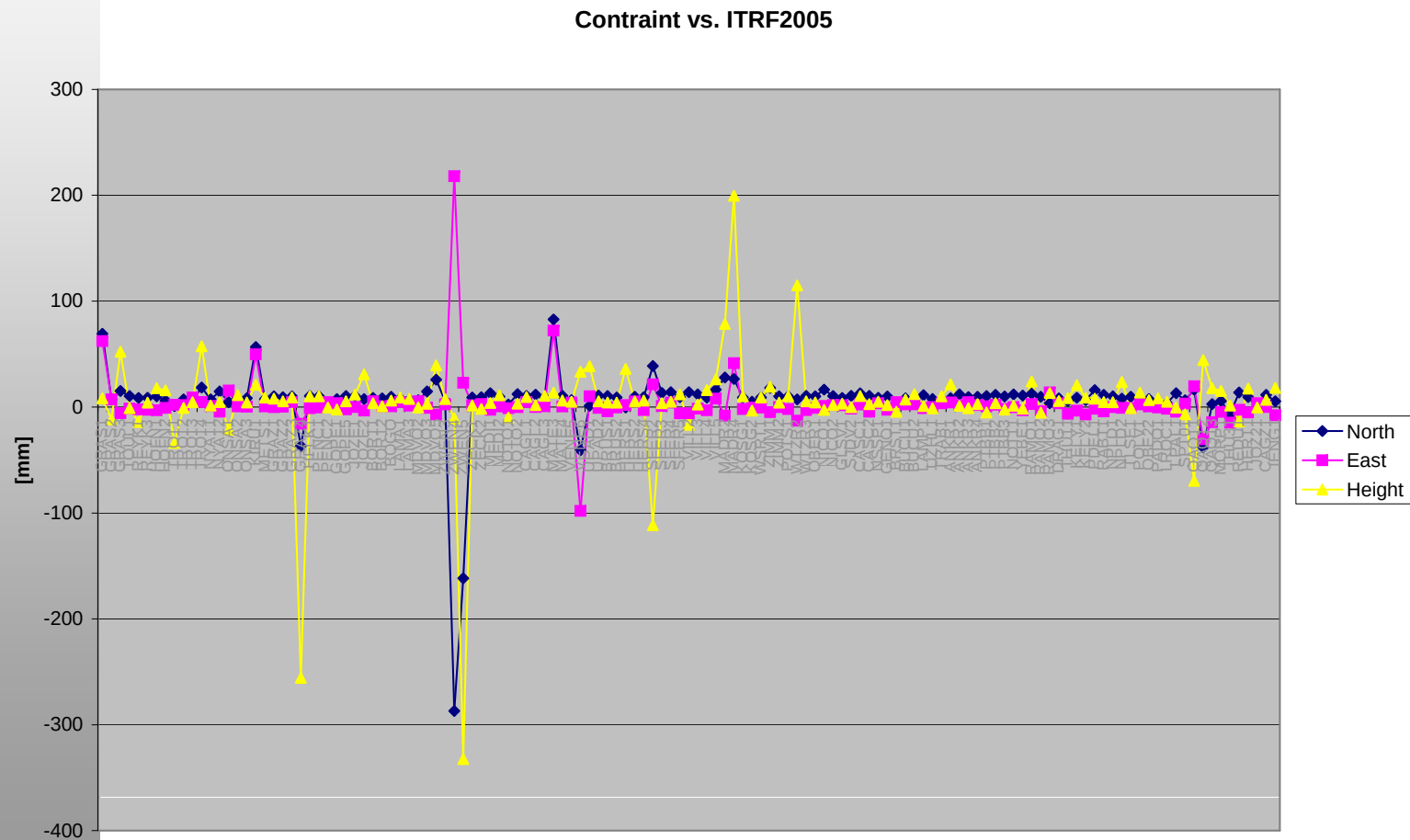
Coordinate Time Series Example



Validation of Coordinates and Velocities

- Estimated station coordinates (epoch 2000.0) and velocities → coordinates for epoch 2007.0
- ITRF2005 station coordinates (epoch 2000.0) and velocities → coordinates for epoch 2007.0
- → Direct coordinates comparison for epoch 2007.0
→ Validation of estimated coordinates and velocities

No Velocity Constraints



ZWEN



EURF05.REF

Converted from ITRF2005_IGS-TRF.SNX (= ITF05.SNX)

ITF05.CRD

73	ZWEN	12330M001A	2886325.4712	2155998.4337	5245816.1559	I
261	ZWEN	12330M001B	2886325.4761	2155998.4393	5245816.1567	I
456	ZWEN	12330M001C	2886325.4729	2155998.4515	5245816.1689	I
468	ZWEN	12330M001	2886325.4791	2155998.4420	5245816.1527	I

ITRF2005 GENERATED FROM ITRF2005_GPS.SSC

08-OCT-06 15:00

EURF05.CRD

135	ZWEN112330M001	2886325.471	2155998.434	5245816.156	I
135	ZWEN212330M001	2886325.4766	2155998.4356	5245816.1561	E
135	ZWEN312330M001	2886325.476	2155998.439	5245816.157	I
135	ZWEN412330M001	2886325.473	2155998.452	5245816.169	I
135	ZWEN512330M001	2886325.479	2155998.442	5245816.153	I

CUMULATIVE SOLUTION OF EPN WEEKLY COMBINED SOLUTIONS - MCC

04-OCT-07 05:59

EPN_CUM.CRD_fin

135	ZWEN112330M001	2886325.4710	2155998.4340	5245816.1560	
135	ZWEN212330M001	2886325.4766	2155998.4356	5245816.1561	
135	ZWEN312330M001	2886325.4778	2155998.4372	5245816.1475	A
135	ZWEN412330M001	2886325.4182	2155998.1389	5245816.3395	A
135	ZWEN512330M001	2886325.5357	2155998.4558	5245816.5186	A

ITF05.VEL

73	ZWEN	12330M001A	-0.0227	0.0109	0.0049	I
261	ZWEN	12330M001B	-0.0227	0.0109	0.0049	I
456	ZWEN	12330M001C	-0.0227	0.0109	0.0049	I
468	ZWEN	12330M001	-0.0227	0.0109	0.0049	I

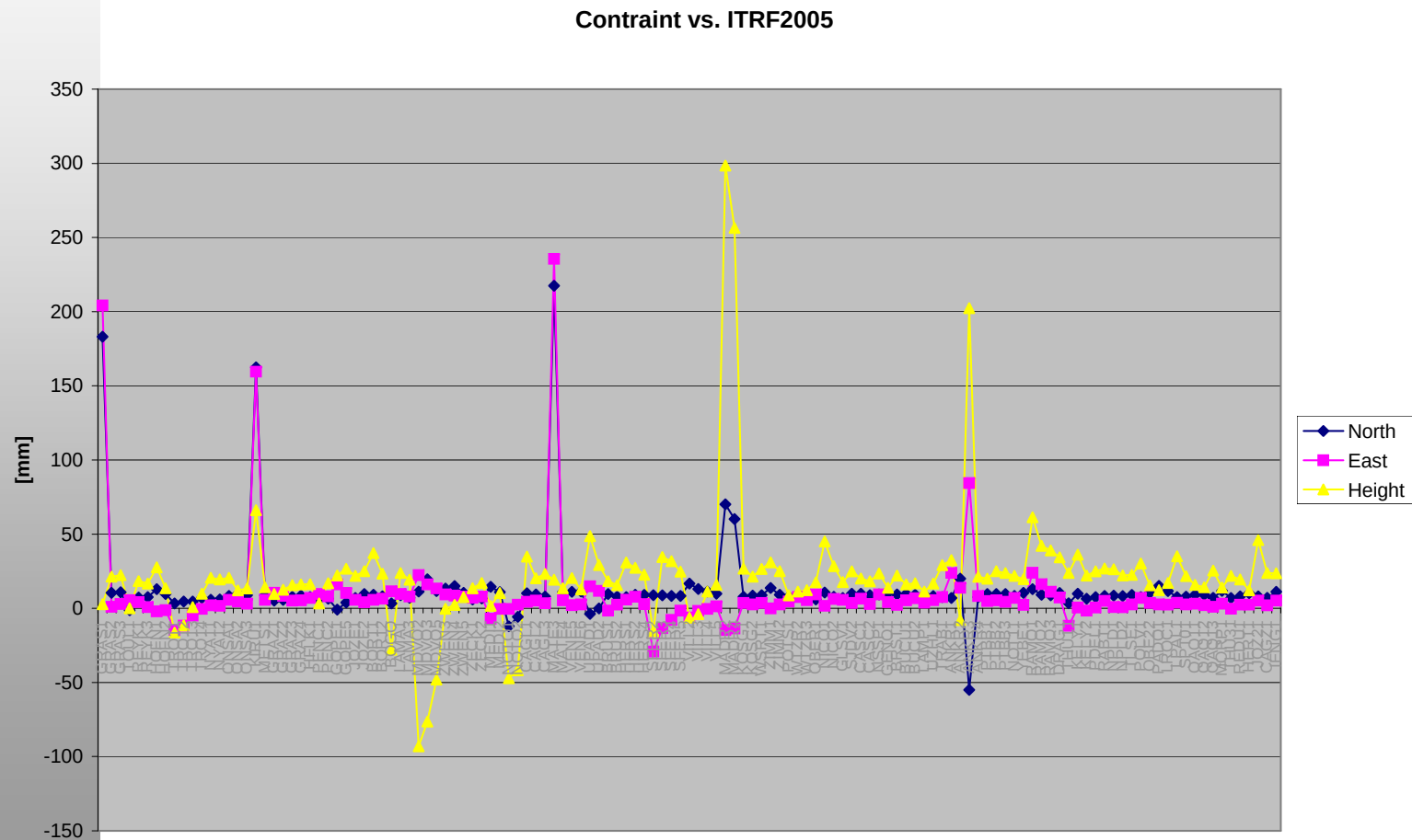
EURF05.VEL

135	ZWEN112330M001	- .0227	0.0109	0.0049		EURA
135	ZWEN212330M001	- .0227	0.0109	0.0049		EURA
135	ZWEN312330M001	- .0227	0.0109	0.0049		EURA
135	ZWEN412330M001	- .0227	0.0109	0.0049		EURA
135	ZWEN512330M001	- .0227	0.0109	0.0049		EURA

EPN_CUM.VEL_fin

135	ZWEN112330M001	-0.0227	0.0109	0.0049		EURA
135	ZWEN212330M001	-0.0227	0.0109	0.0049		EURA
135	ZWEN312330M001	-0.0211	0.0111	0.0049	A	EURA
135	ZWEN412330M001	-0.0089	0.0790	-0.0349	A	EURA
135	ZWEN512330M001	-0.0338	0.0072	-0.0744	A	EURA

Velocity Constraints

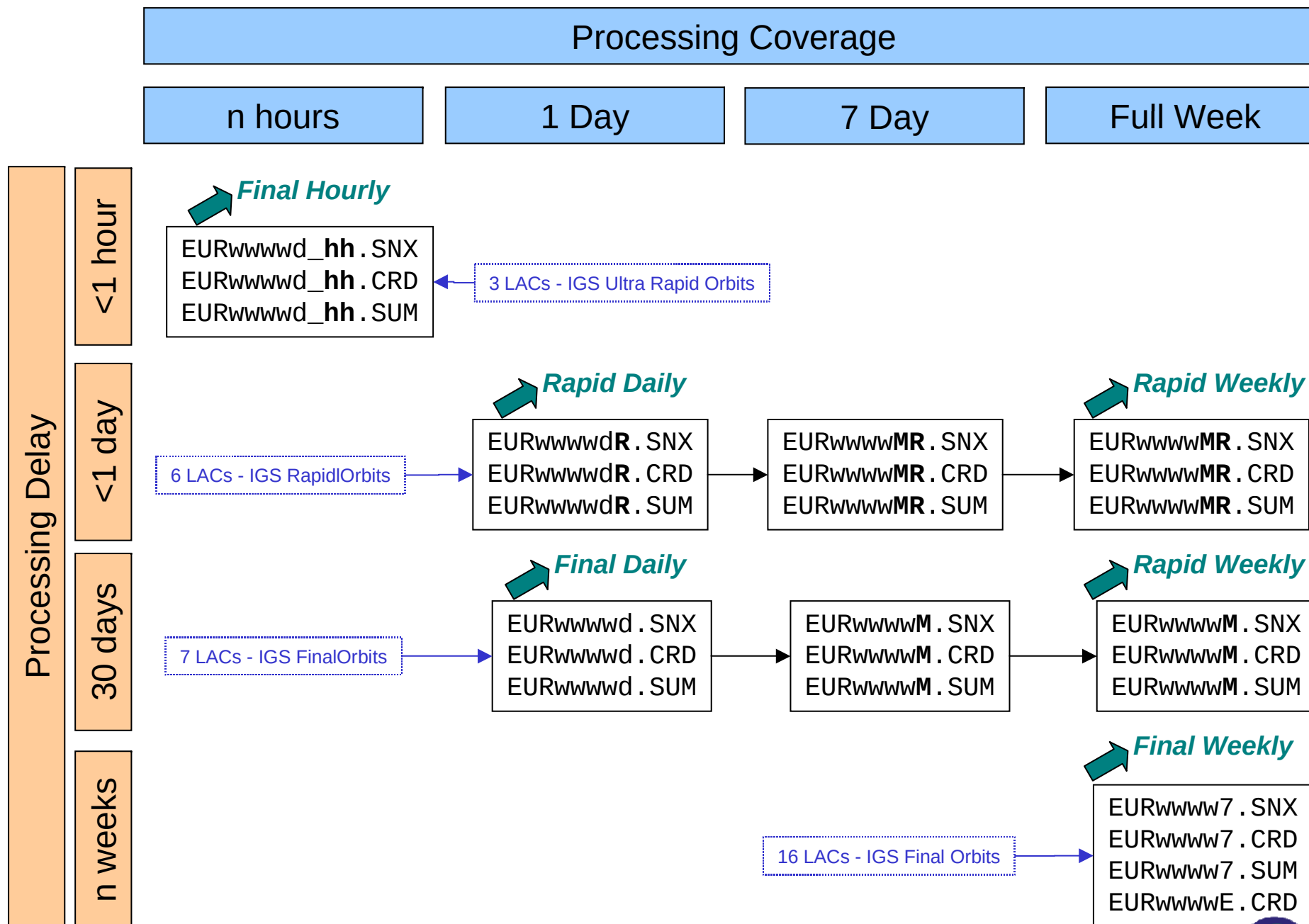


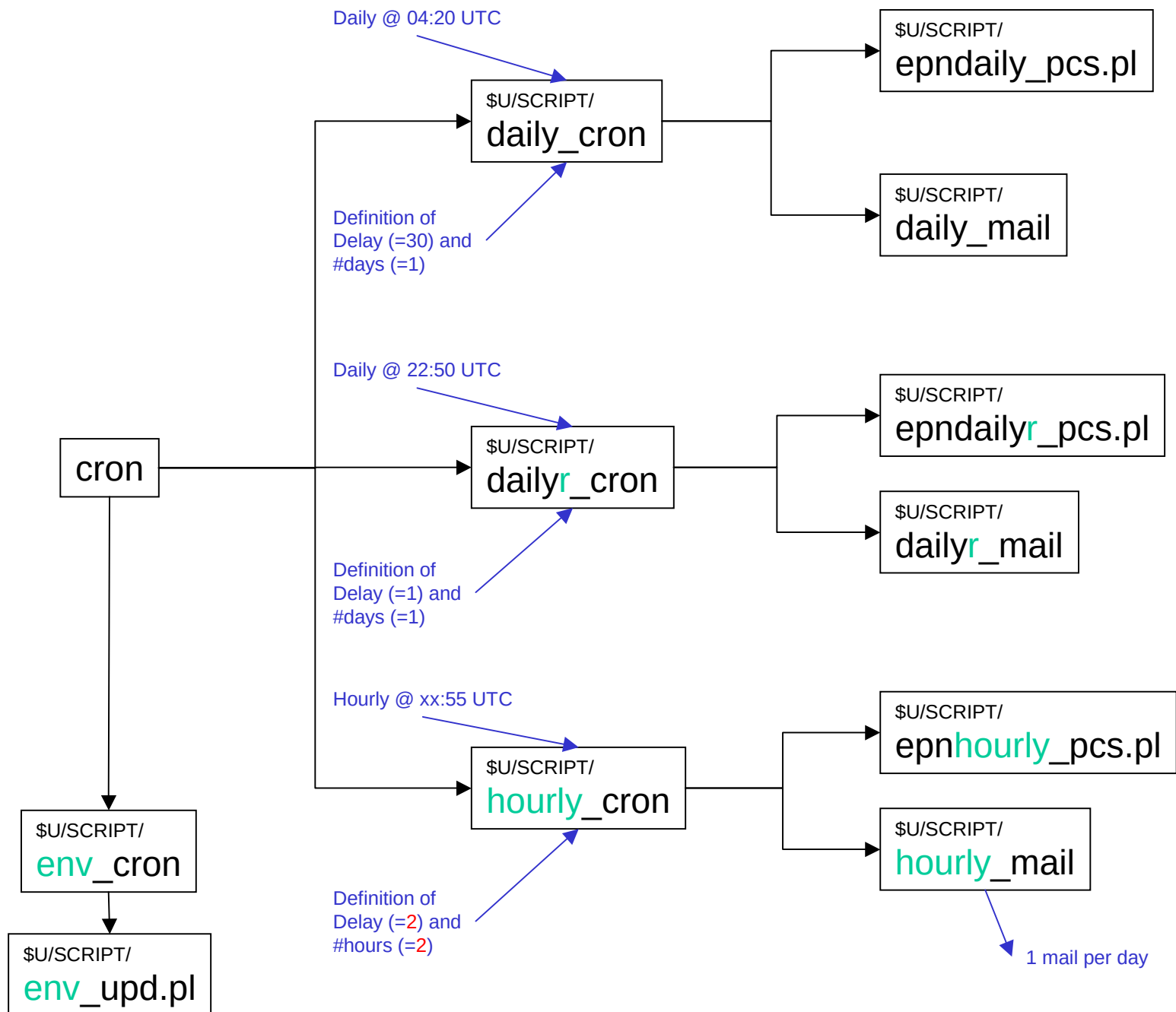
Results ITRF2005 Densification

- Velocity constraints under consideration
 - Neither “no” nor “full” velocity constraints between solution numbers are in agreement with ITRF2005
 - Station specific solution?
 - Proof on concept ongoing
- Product files available at
<ftp://igs.bkg.bund.de/MISC/ITRF/ITRF2005/>
- Comparisons to results from other organisations welcome
- Public announcement pending

EPN Rapid Analysis Products - *Update*

- Scope:
 - Short latency of solutions
 - High resolution coordinates
 - Monitoring





Hourly Combination - Daily report

Hourly Summary for day 14721

Hour	#Sol.	#Sta.	Repeatability (mm)			Local Analysis Centres					
			N	E	U	RMS	Helmert	Transformation	(mm)		
00	3	120	3.92	4.33	15.03	ASI(	0.14)	BKG(	6.66)	LPT(	2.34)
01	3	118	3.63	5.03	9.47	ASI(	0.18)	BKG(	4.48)	LPT(	2.35)
02	3	120	4.30	7.09	9.65	ASI(	0.22)	BKG(	5.04)	LPT(	3.02)
03	3	118	2.93	4.92	7.94	ASI(	0.15)	BKG(	3.86)	LPT(	1.53)
04	3	121	5.86	6.91	14.63	ASI(	0.21)	BKG(	6.90)	LPT(	2.74)
05	3	124	4.46	9.01	10.22	ASI(	0.91)	BKG(	6.01)	LPT(	2.53)
06	3	122	11.23	31.07	14.74	ASI(	0.18)	BKG(	15.04)	LPT(	2.91)
07	3	121	3.64	8.85	7.62	ASI(	0.18)	BKG(	4.85)	LPT(	2.89)
08	3	116	2.48	4.34	6.26	ASI(	0.15)	BKG(	2.87)	LPT(	2.68)
09	3	121	15.54	31.43	12.71	ASI(	1.09)	BKG(	15.89)	LPT(	2.60)
10	3	109	1.89	3.93	5.68	ASI(	1.95)	BKG(	2.56)	LPT(	0.58)
11	3	121	2.72	3.94	7.02	ASI(	1.14)	BKG(	3.41)	LPT(	2.16)
12	3	120	2.67	4.76	6.51	ASI(	1.13)	BKG(	3.46)	LPT(	1.96)
13	3	121	4.89	9.06	8.53	ASI(	1.30)	BKG(	6.18)	LPT(	1.92)
14	3	118	6.22	11.64	9.97	ASI(	0.12)	BKG(	6.76)	LPT(	2.06)
15	3	121	3.67	4.07	7.54	ASI(	0.87)	BKG(	3.67)	LPT(	2.10)
16	3	120	3.27	3.84	7.87	ASI(	0.14)	BKG(	3.74)	LPT(	2.20)
17	3	118	3.68	3.74	9.77	ASI(	1.09)	BKG(	4.48)	LPT(	2.04)
18	3	122	4.59	4.53	9.33	ASI(	1.33)	BKG(	4.68)	LPT(	2.25)
19	3	121	3.75	4.34	7.27	ASI(	0.11)	BKG(	3.77)	LPT(	2.26)
20	3	119	10.55	10.74	6.96	ASI(	0.13)	BKG(	6.95)	LPT(	2.45)
21	3	118	10.10	4.93	13.50	ASI(	0.12)	BKG(	7.11)	LPT(	2.27)
22	3	119	6.29	5.80	14.11	ASI(	0.13)	BKG(	6.89)	LPT(	2.12)
23	3	121	4.00	5.17	7.65	ASI(	0.13)	BKG(	4.06)	LPT(	2.23)

Rapid Combination Requirements

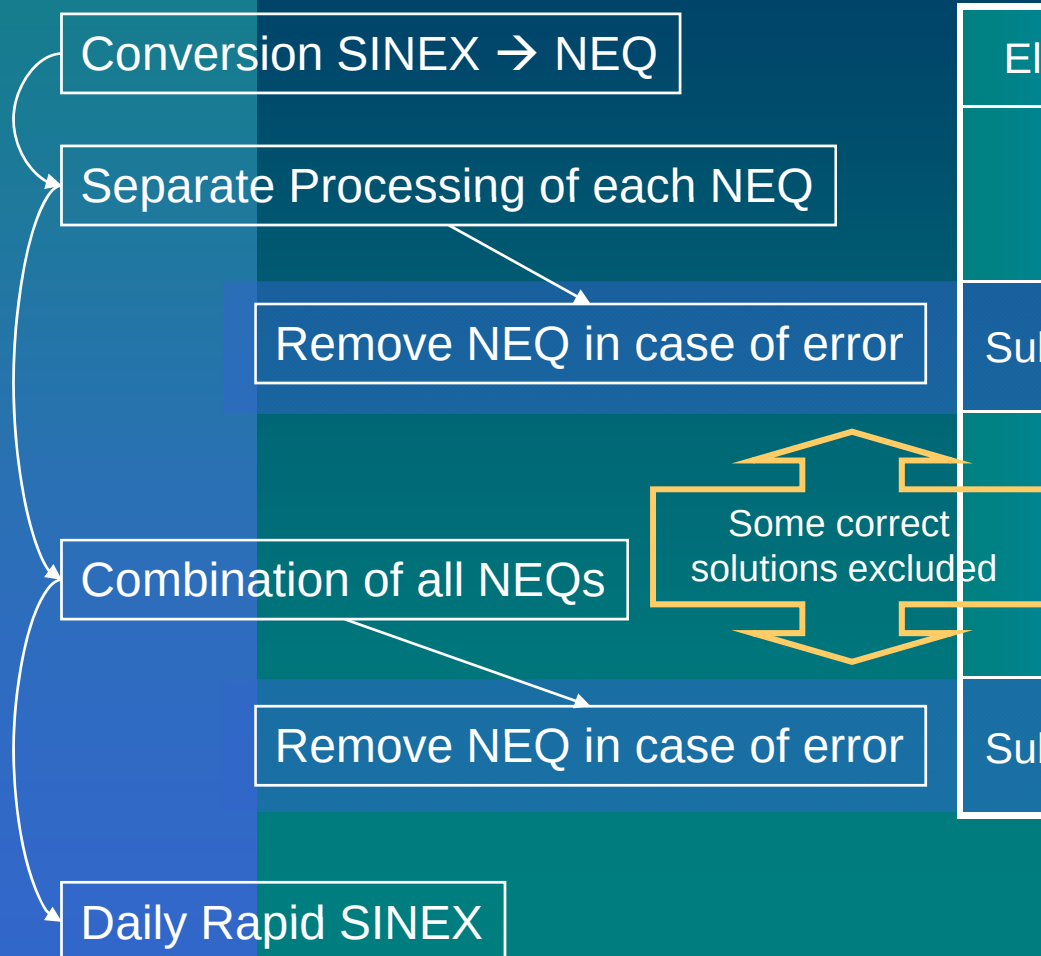
- Automated processing according to fixed schedule
- No manual interaction for day-to-day processing
- Automated event handling
 - Processing abort due to
 - ❖ Format error in SINEX file
 - ❖ Numerical problem in a single contribution
 - ❖ Numerical problem in the combination of all contributions
 - Clear objective needed to respond on processing abort
 - ❖ Generating a reference solution → eliminate outliers
 - ❖ Monitoring task → keep outliers included

Product Objectives

	Referencing	Monitoring
Final Hourly		X
Rapid Daily	X	X
Rapid Weekly (IGR)	X	X
Final Daily	X	
Rapid Weekly (IGS)	X	
Final Weekly	X	

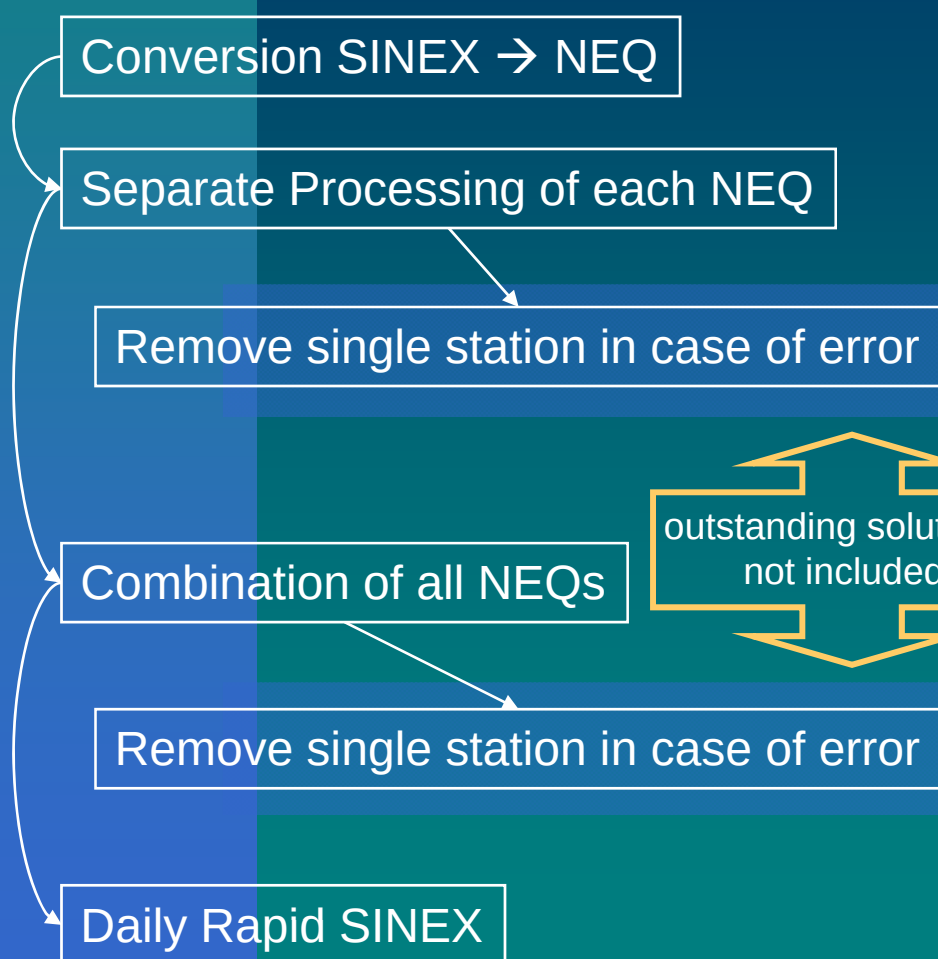
- Outlier Handling in „rapid daily“ and „rapid weekly (IGR)“ is a critical issue
- Majority of missing rapid combinations product are of type „rapid daily“

Current Event Handling – Daily Rapid Combination



Elimination	Referencing	Monitoring
Sub-Network	☹	☹
Sub-Network	☹	☹

Alternative Event Handling – Daily Rapid Combination

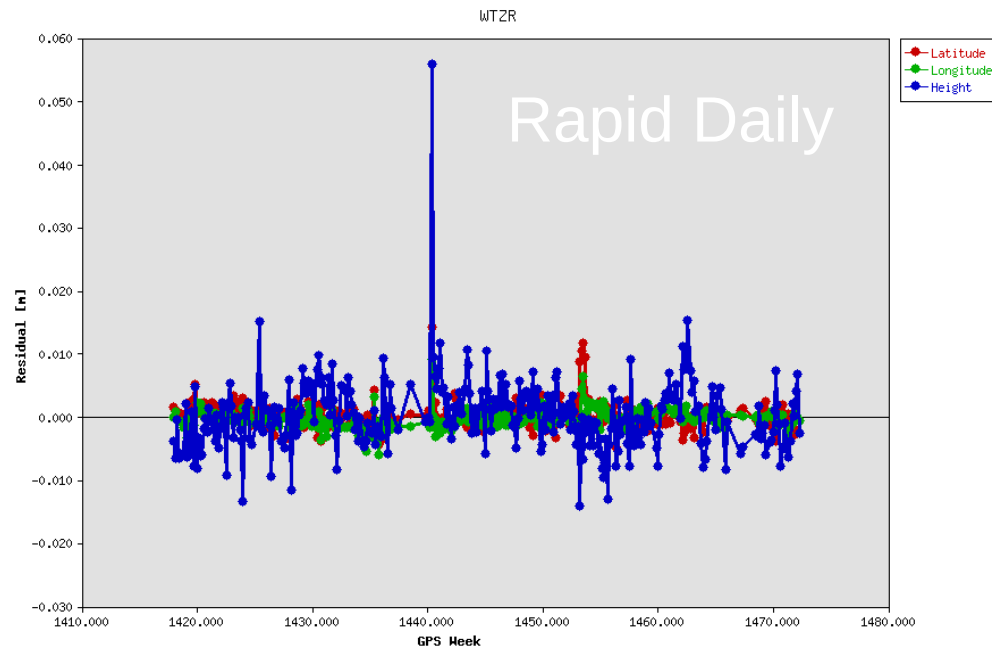


outstanding solutions
not included

Elimination	Referencing	Monitoring
single-station	😊	😞
single-station	😊	😞

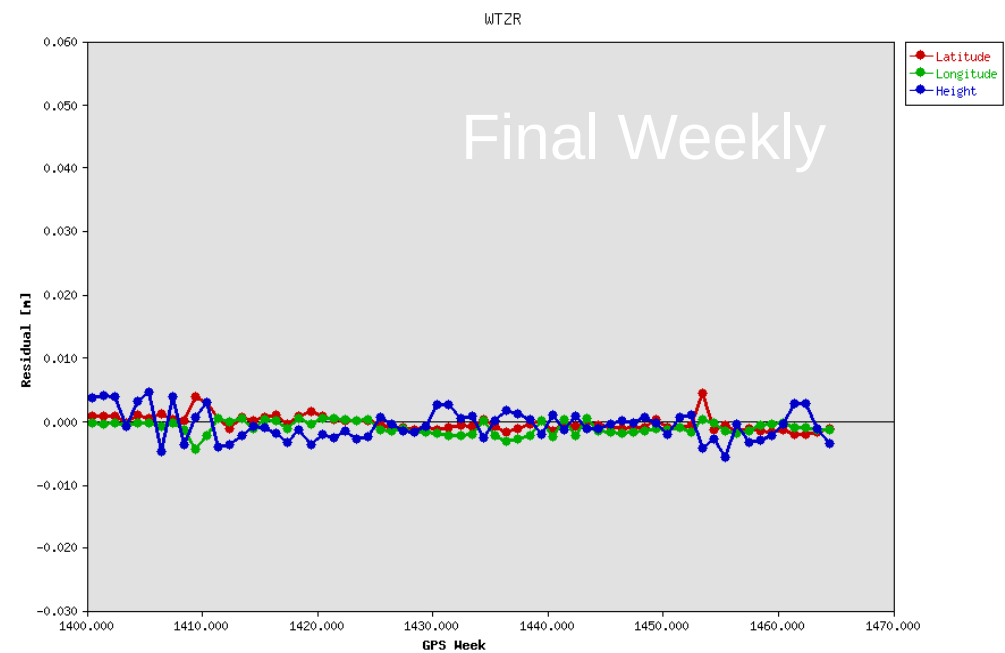
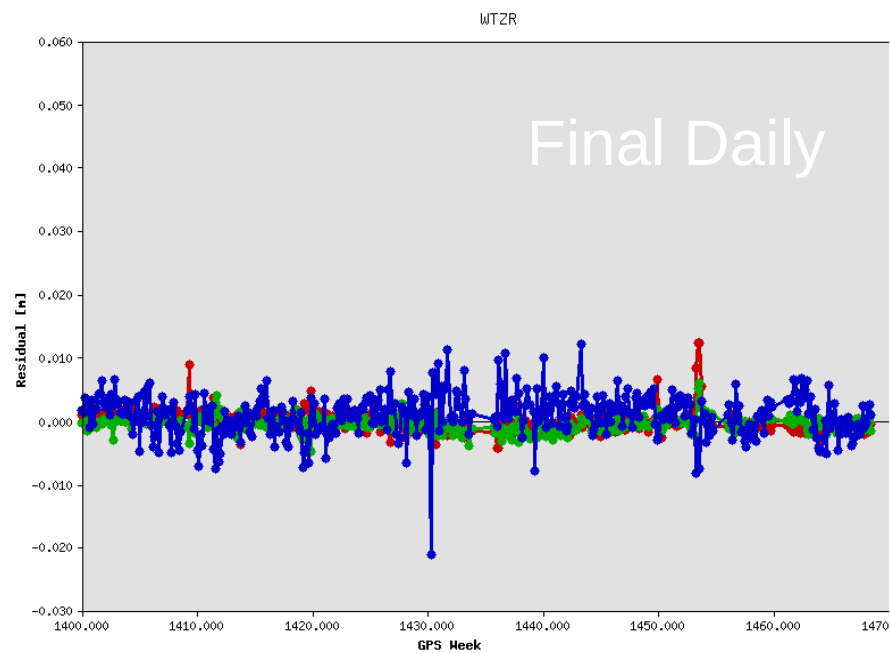
More Product Objectives

- Network solution:
 - Single bad performing stations may degrade a complete sub-network (LAC solution)
 - It is NOT possible to keep (significant) bad solutions in the combination for monitoring purpose
 - The combined solution validates coordinates of good performing sites, BUT no information for absent sites (possibility of no or bad data)
- Single point solution:
 - Provides even outstanding single station solutions for monitoring purpose (→ PPP discussion)



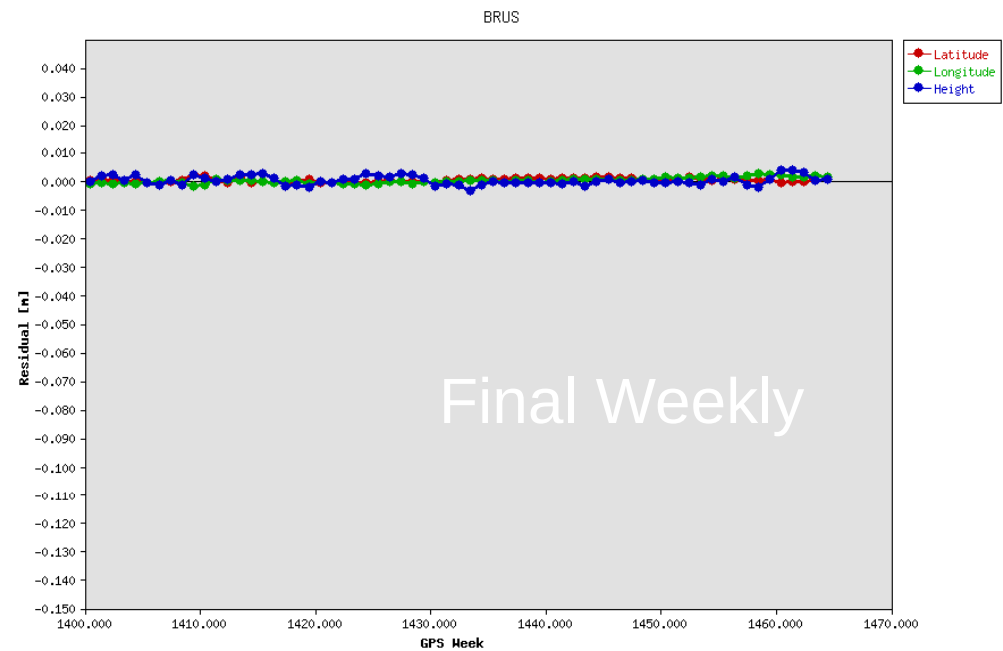
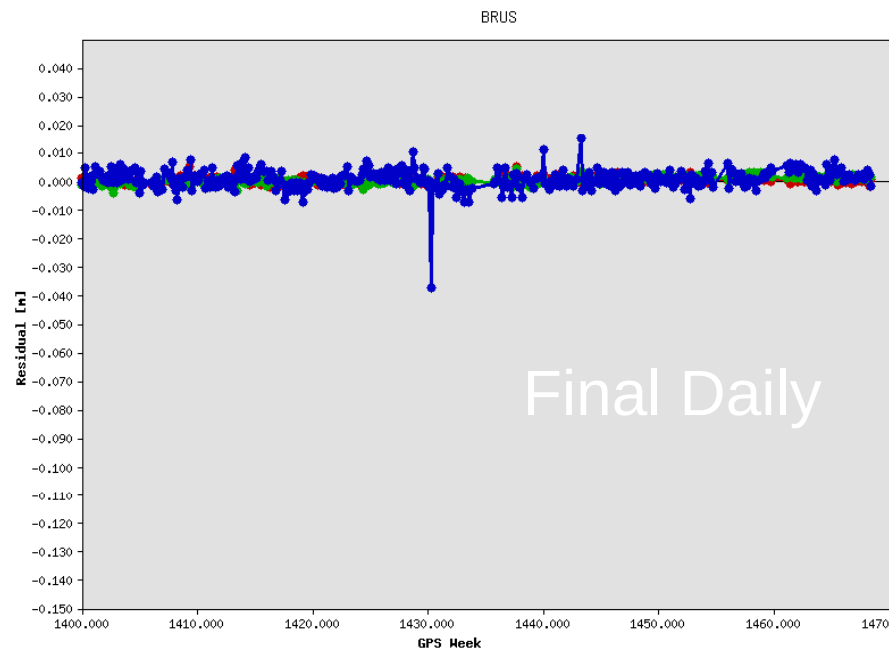
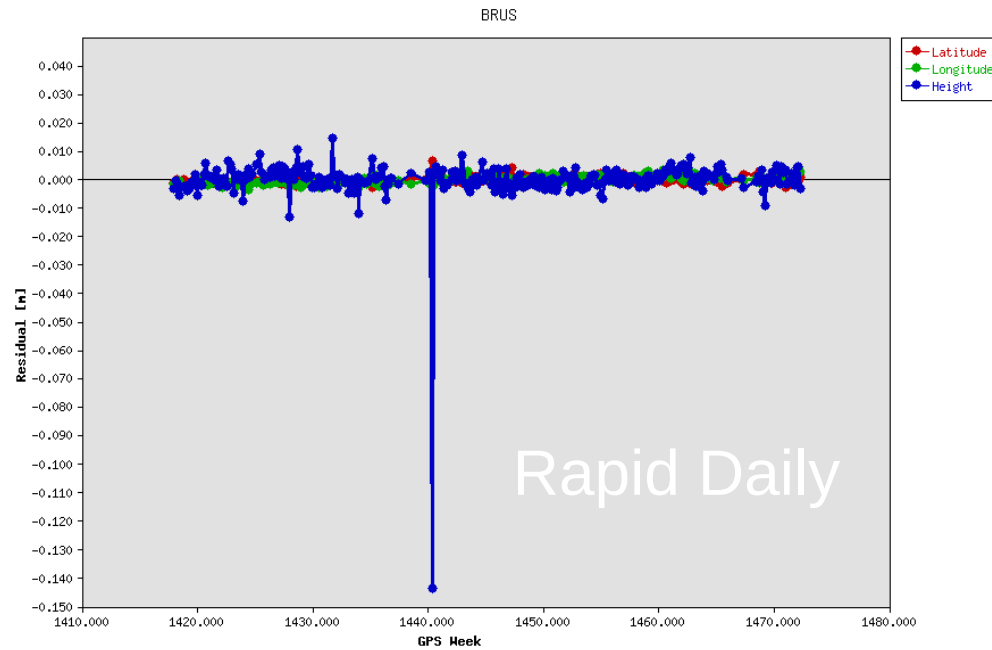
WTZR Time Series

- daily/weekly vs. combined (NEQ stacking)



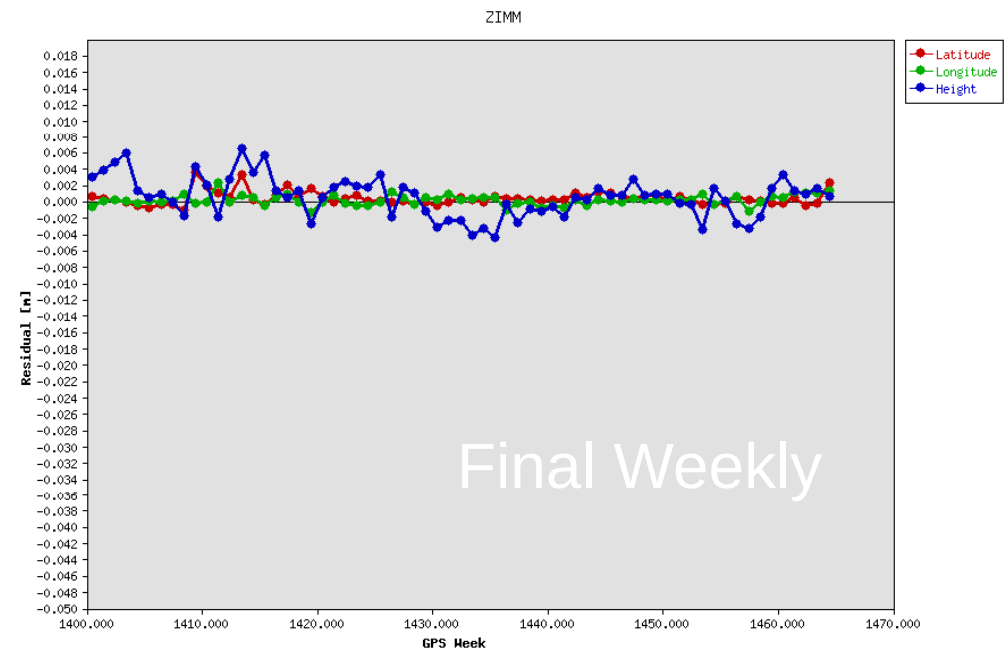
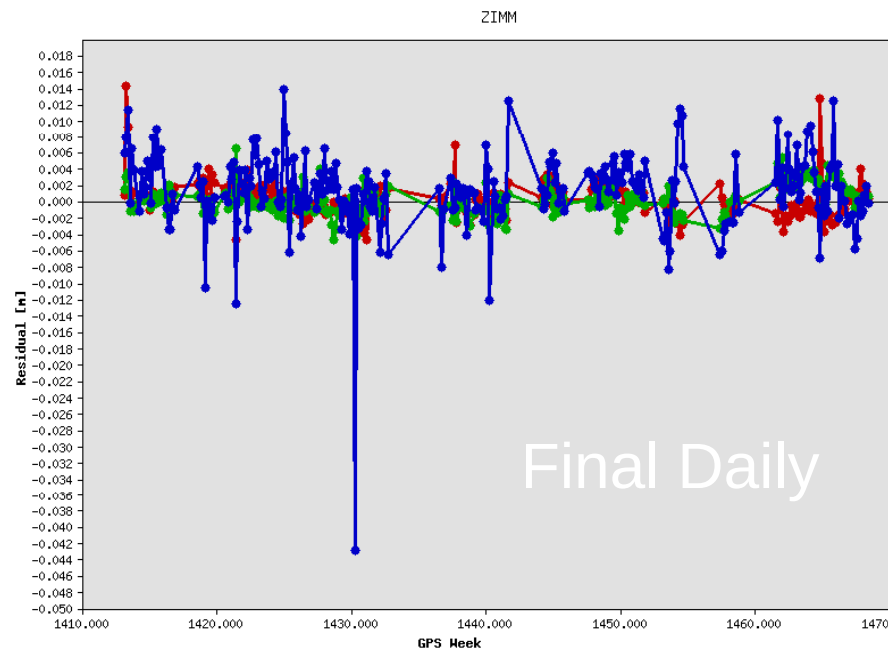
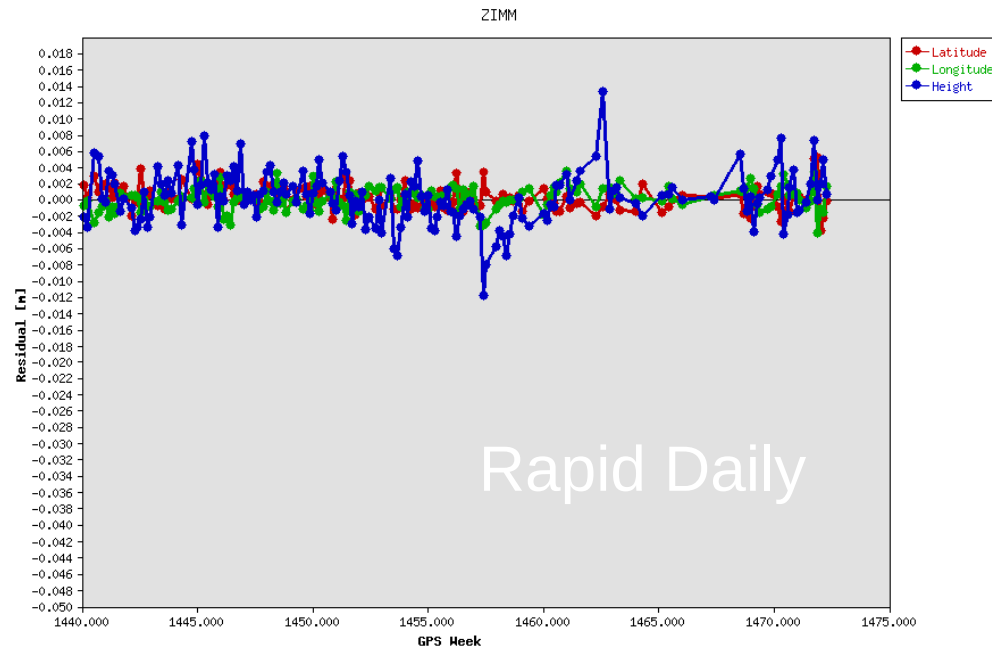
BRUS Time Series

- daily/weekly vs. combined (NEQ stacking)



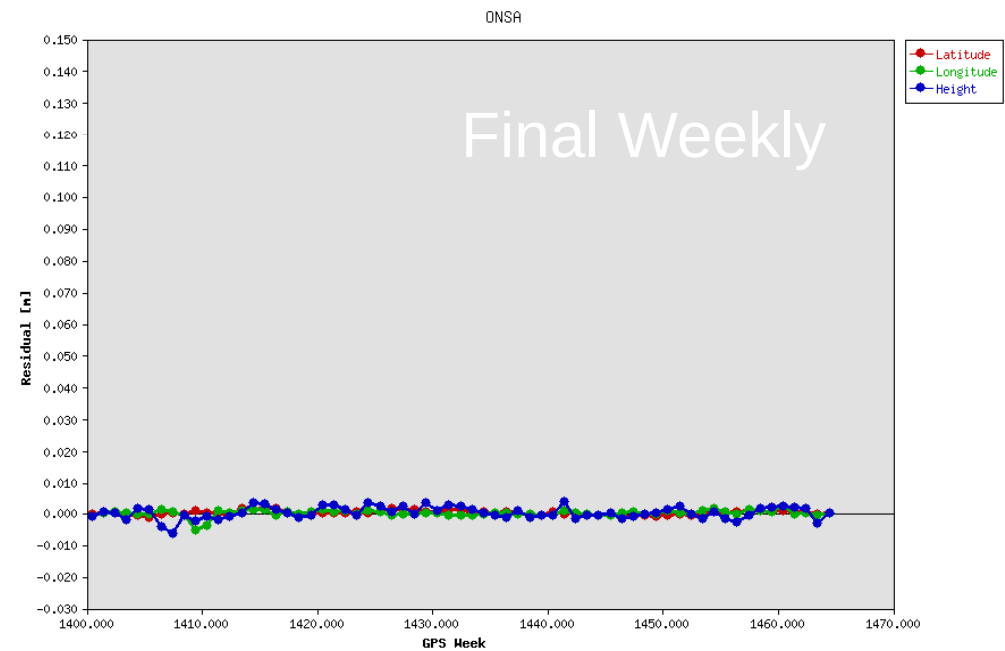
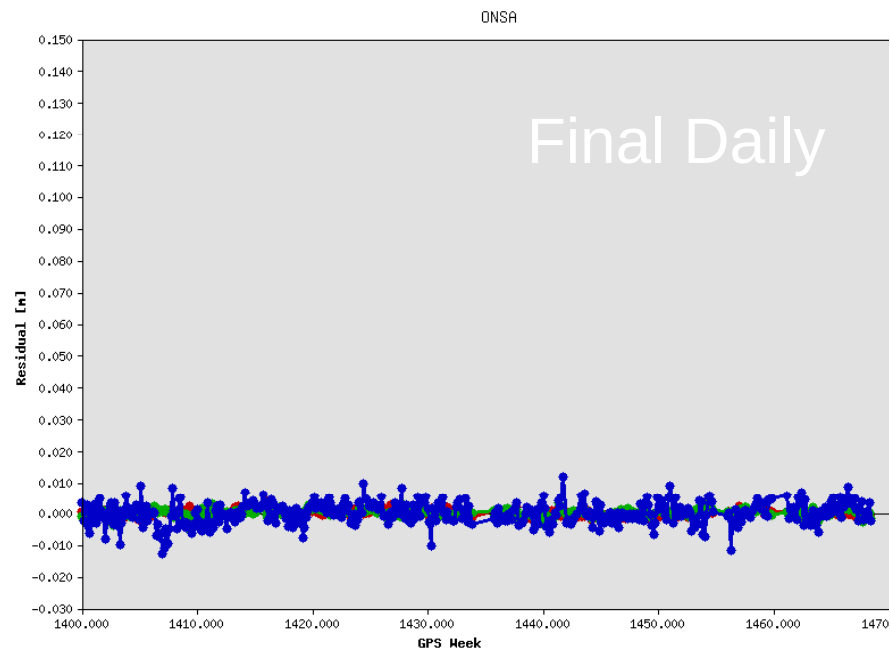
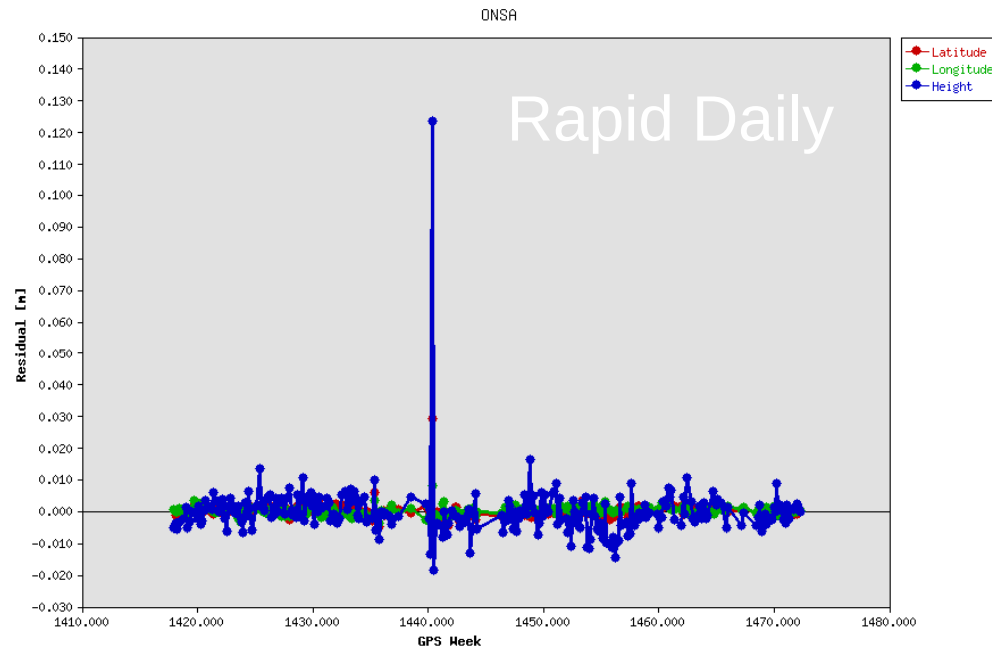
ZIMM Time Series

- daily/weekly vs. combined (NEQ stacking)



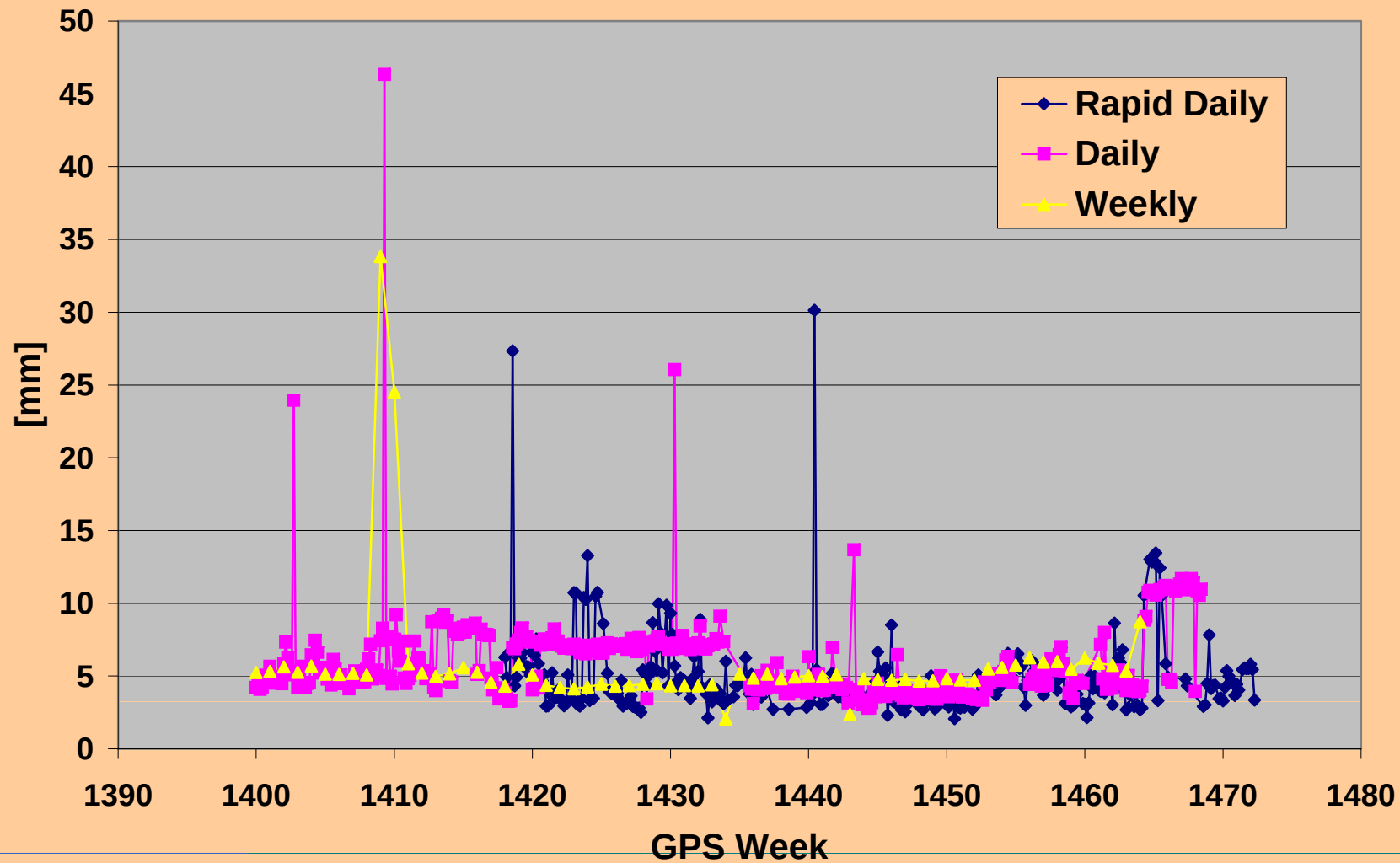
ONSA Time Series

- daily/weekly vs. combined (NEQ stacking)



Network Comparison

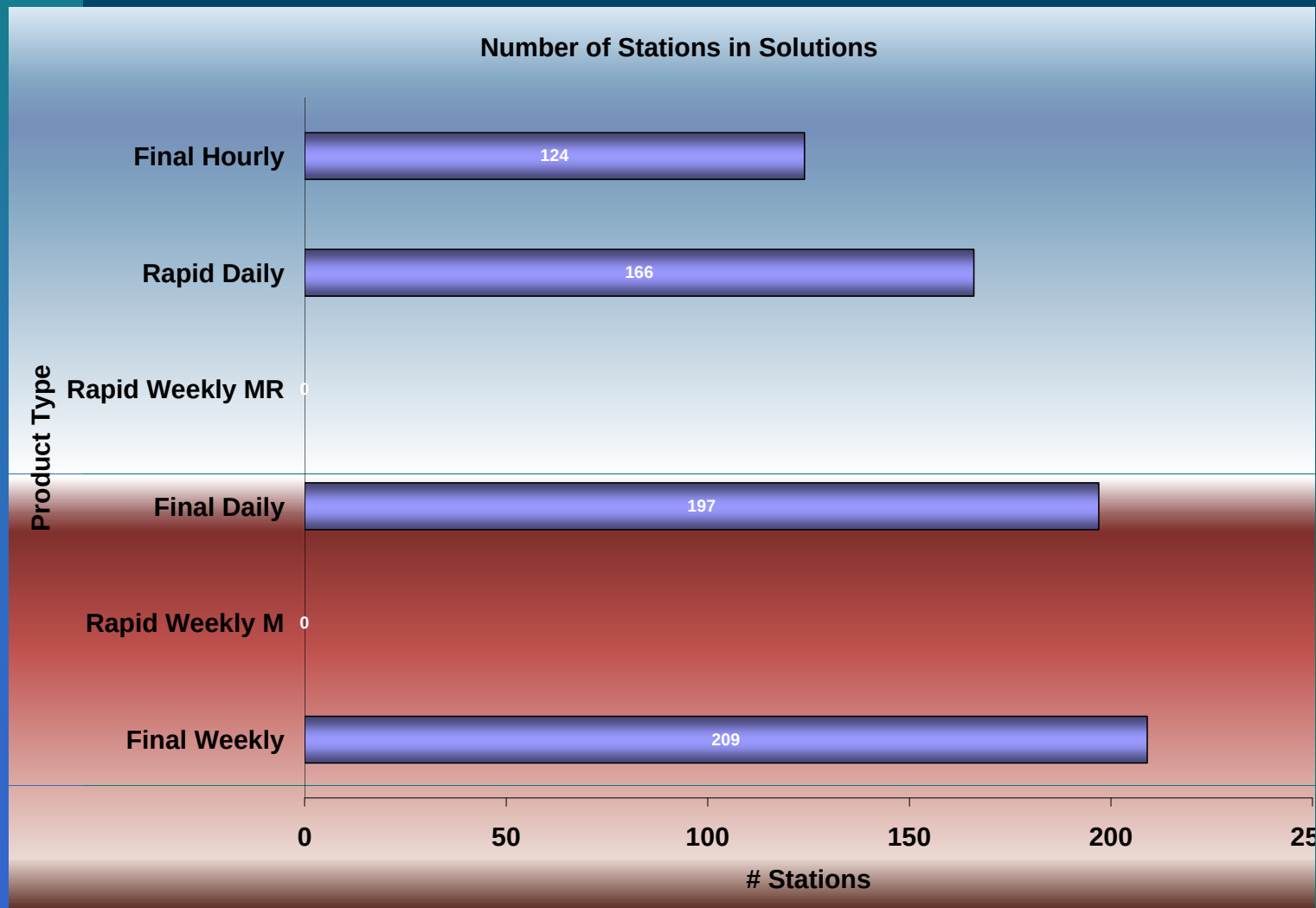
RMS Helmert Transformation daily/weekly vs. combined



Usage of products

Station Coordinates Product Type	Proposed Usage
Final weekly	Final reference
Final weekly M (final daily combination)	Contribution to IGS Associate Analysis Centres ??
Final daily	High resolution final reference
Rapid daily	Short latency, high quality coordinates

Station Counting since week 1400



EPN Rapid Analysis - *Next Steps*

- Extension to all EPN sites
- Product announcement and feedback from users
- Discussion of monitoring objective
 - Improvement of outlier handling
 - Harmonisation of hourly analysis specifications
 - Establishment of „alert system“ ?

EPN LAC-Workshop 2008

- Date/Venue:
 - October 22 – 23, 2008
 - Frankfurt at Main, Germany
- EPN Re-Processing
 - Relation to IGS re-processing
 - Establishment of new reprocessing facility? Call for participation?
 - Data holding / replacement
- ETRS89 Realisation through EPN
- Others topics

- For any suggestions and questions related to EPN analysis please contact

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Thank you