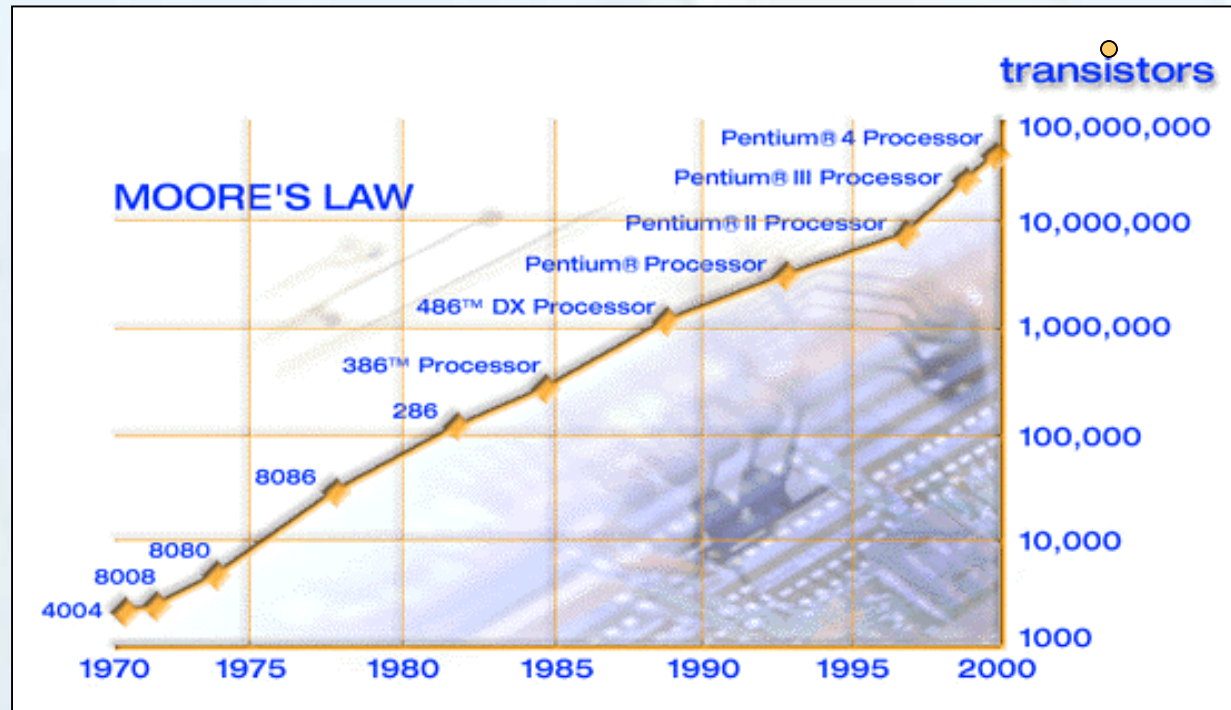


# Routine Processing of Combined Solutions for GPS and GLONASS at CODE

U. Hugentobler, S. Schaer,  
R. Dach, M. Meindl, C. Urschl  
Astronomical Institute, University of Berne

2004 IGS Workshop, Berne Switzerland, March 1–5

# Developments in Computer Power



- How to cope with Moore's law?
- How to break it?

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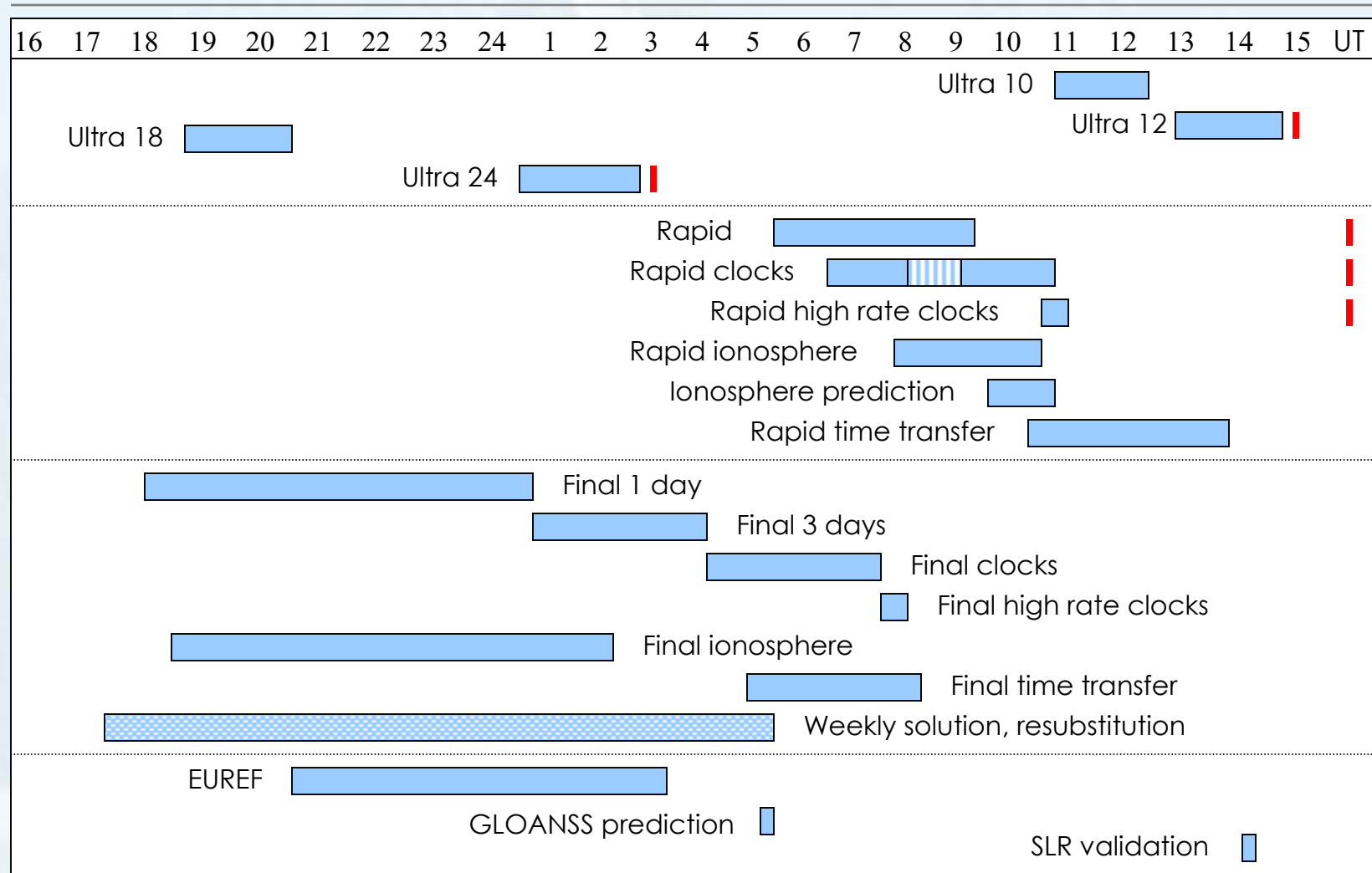


# Requirements

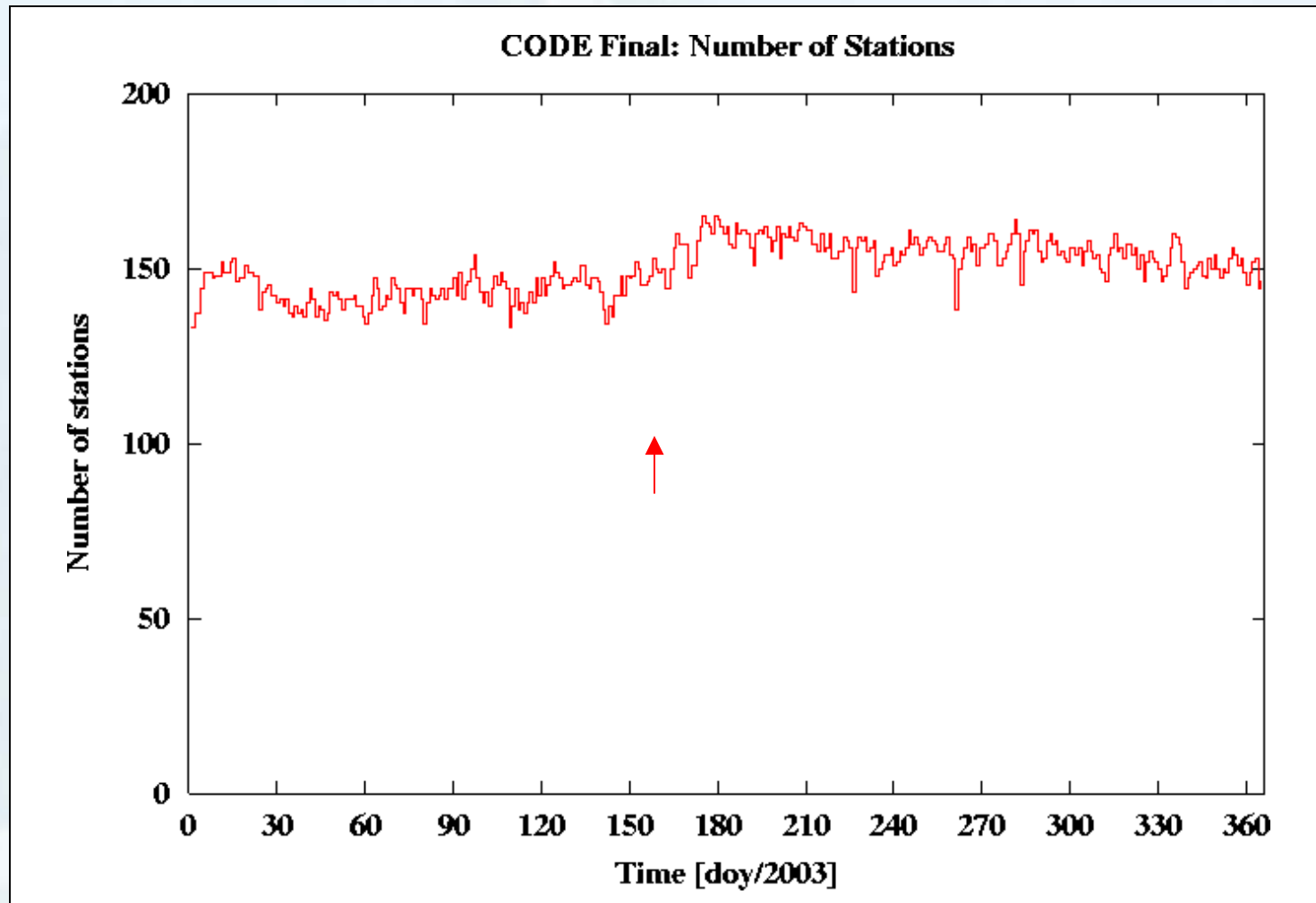
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- Computer and disk resources
- Availability of system
- Reliability, redundancy
- Archiving capabilities
- Quality control of input
- Quality control of products
- Automatisations
- Alarming

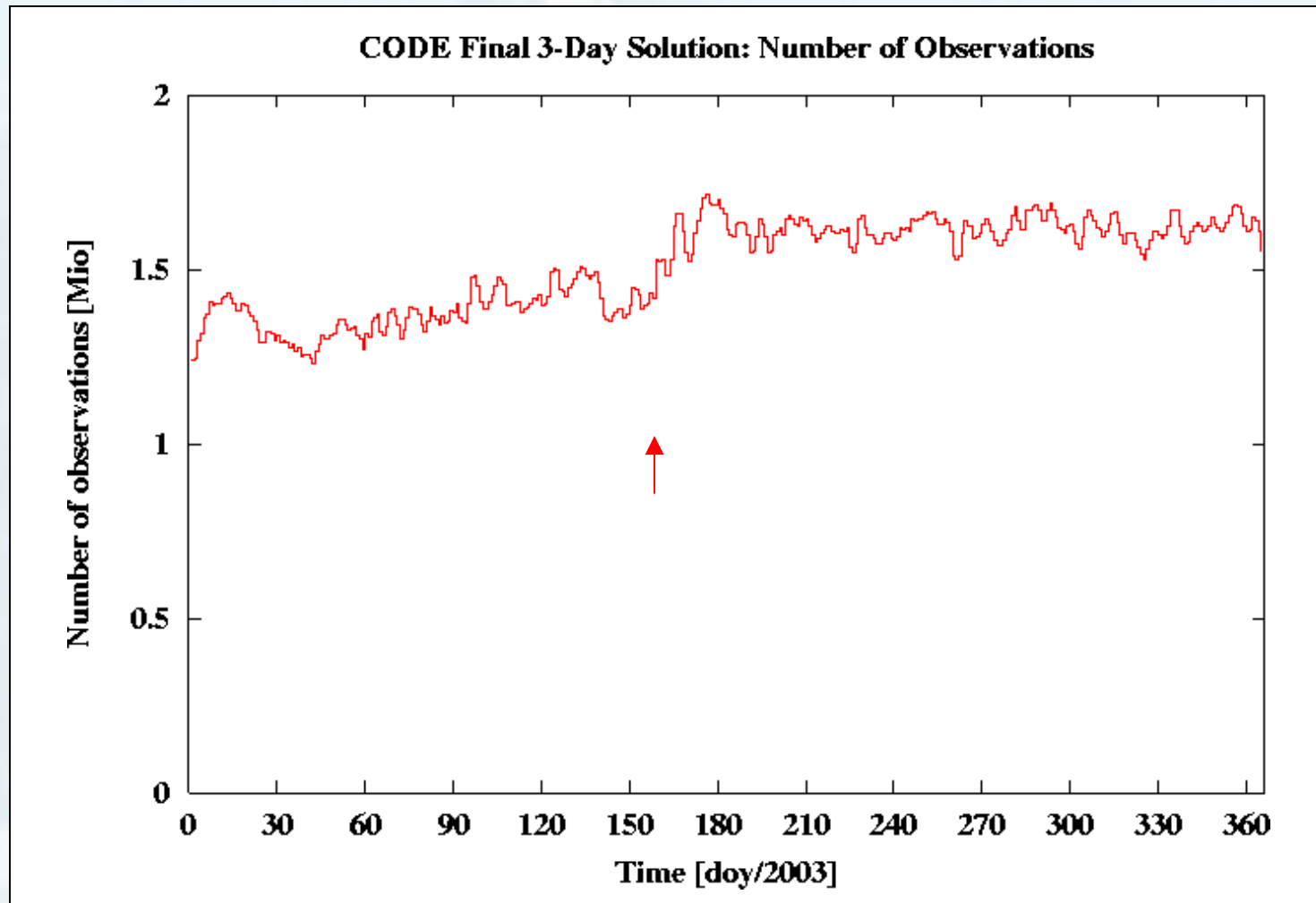
# Processing Chains at CODE



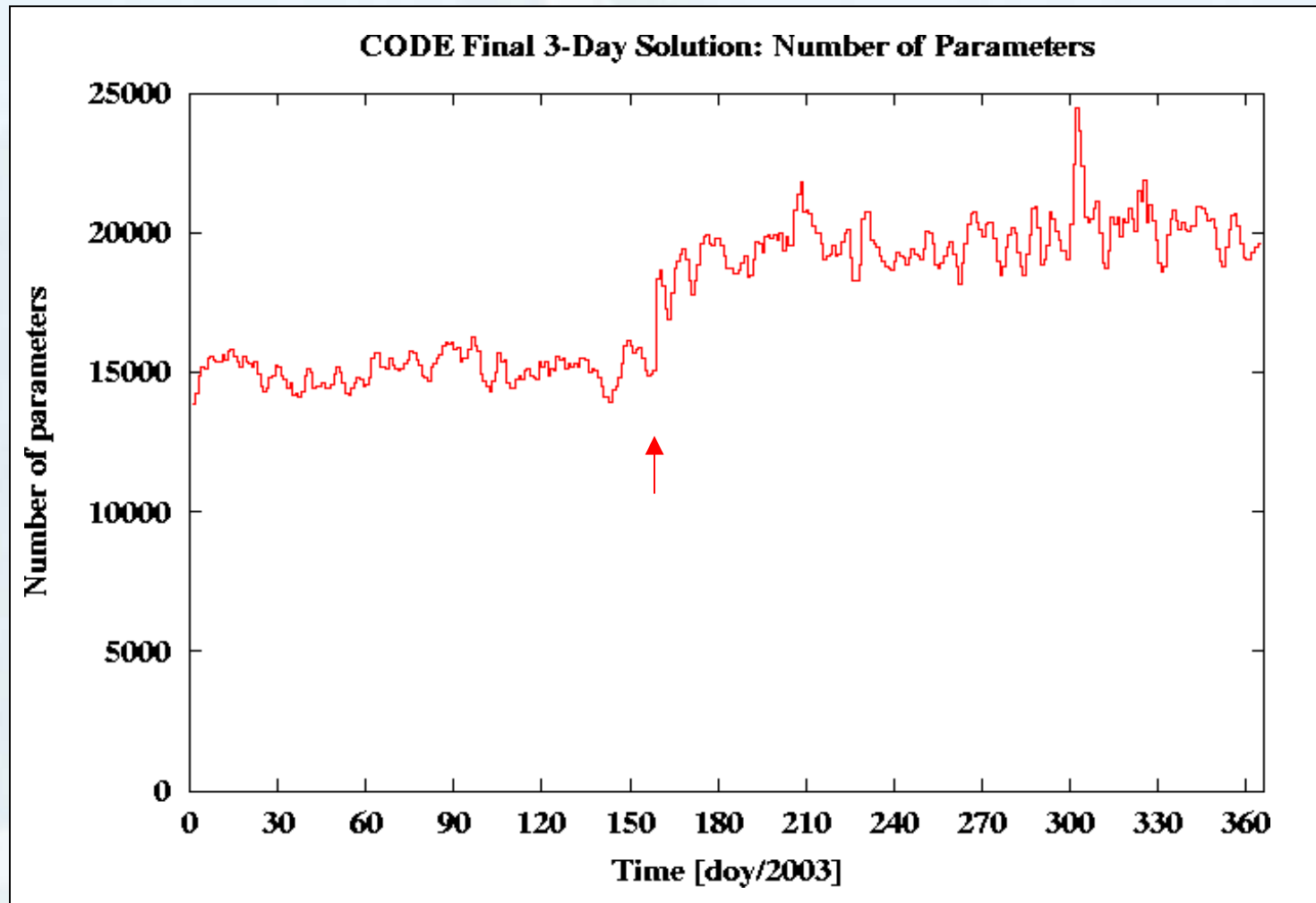
# Number of Stations



# Number of Observations



# Number of Parameters



# Parameters at 1-Day Level

CODE Final, Number of parameters at 1-day level:

Parameter type	Adjusted	explicitly / implicitly	
Station coordinates / velocities	468	468	0
Orbital elements	570	570	0
Site-specific troposphere parameters	2633	2633	0
Earth rotation parameters	65	65	0
Stochastic orbit parameters	114	114	0
Satellite antenna offset parameters	15	15	0
Geocenter coordinates	3	3	0
Satellite antenna phase patterns	79	79	0
Previously pre-eliminated parameters	3354		3354
Total number	7301	3947	3354

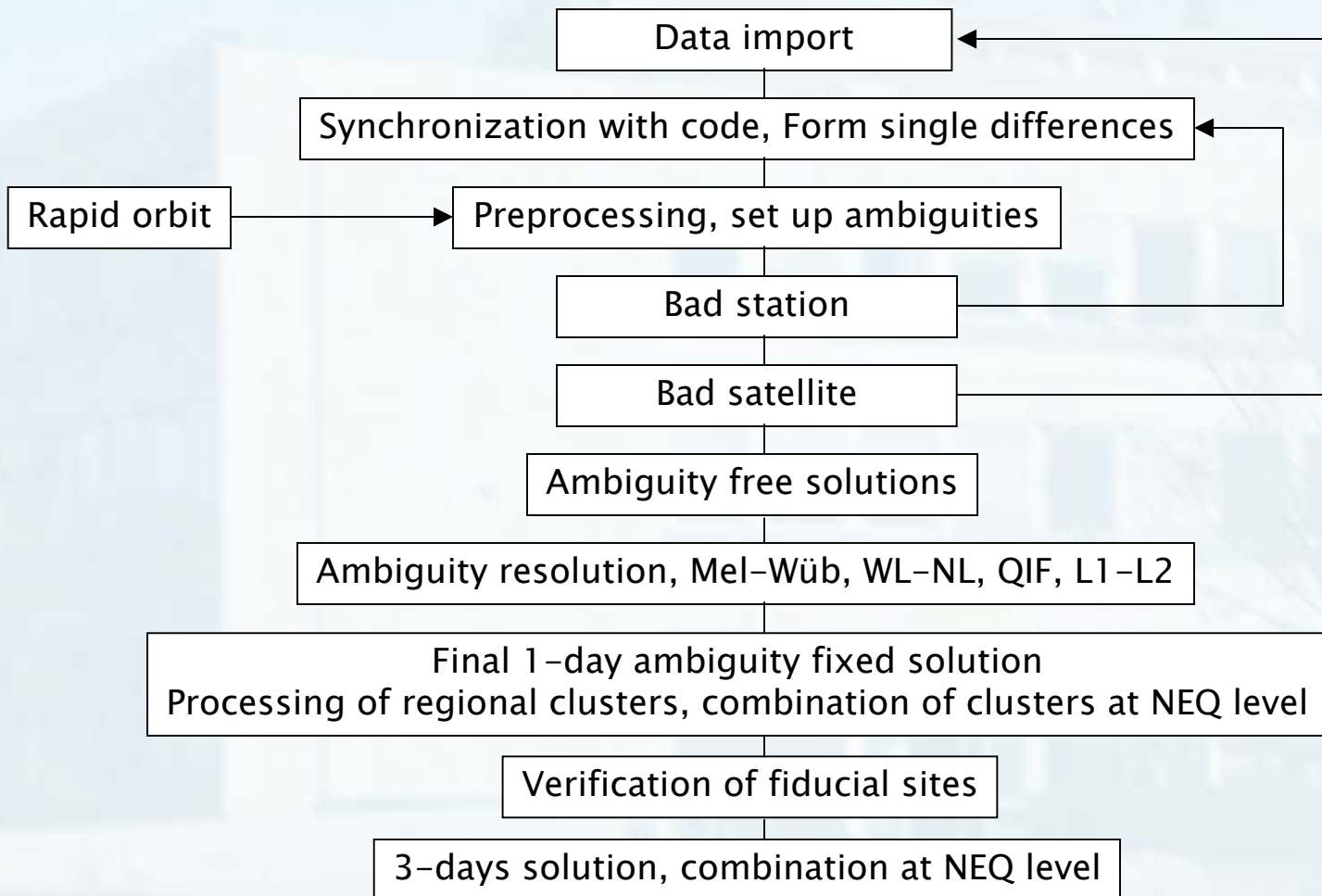


# Parameters at 3-Day Level

CODE Final, Number of parameters at 3-day level:

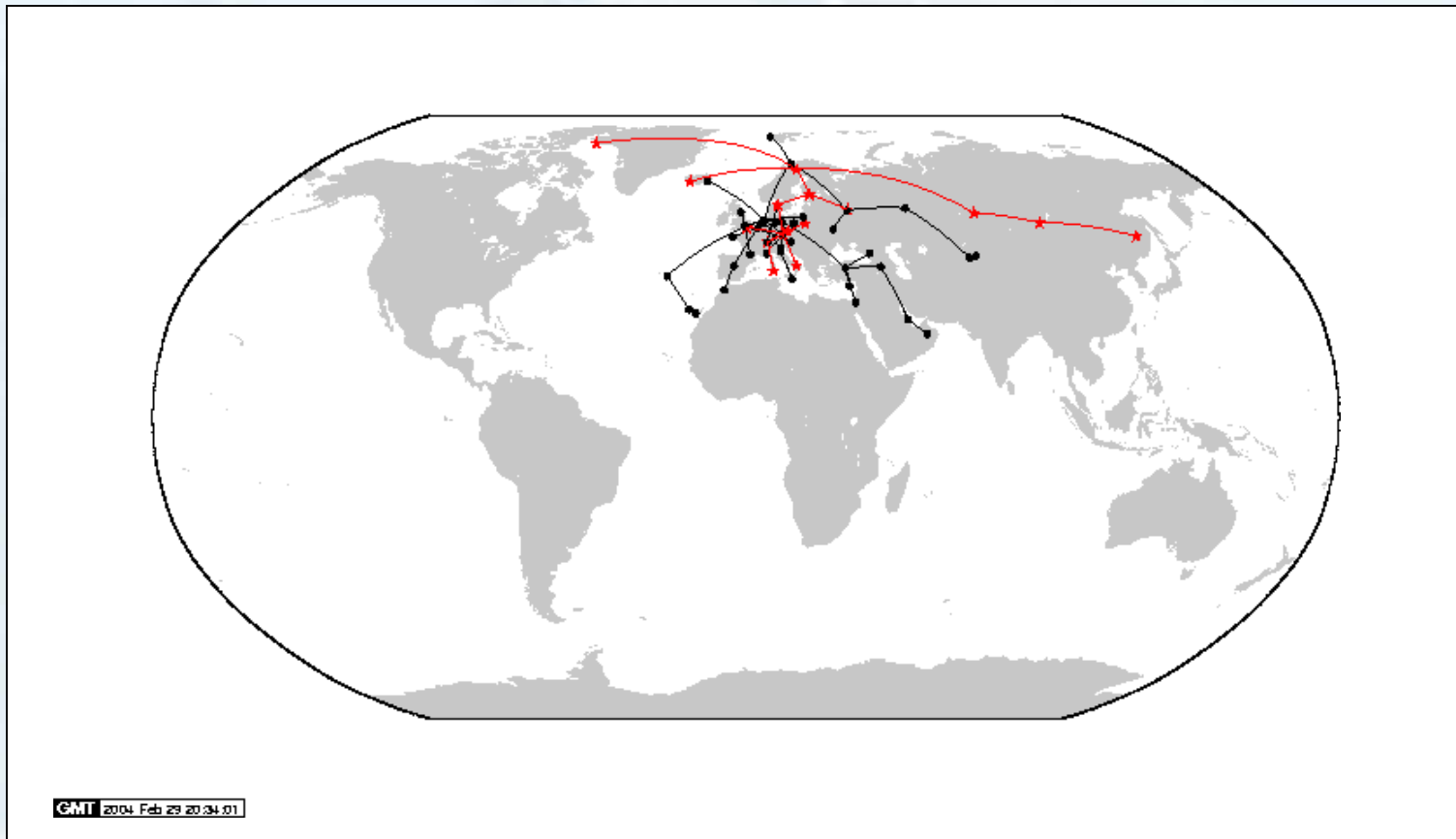
Parameter type	Adjusted	explicitly / implicitly	
Station coordinates / velocities	477	477	0
Orbital elements	570	570	0
Site-specific troposphere parameters	6908	3560	3348
Earth rotation parameters	16	16	0
Stochastic orbit parameters	570	570	0
Satellite antenna offset parameters	15	15	0
Geocenter coordinates	3	3	0
Satellite antenna phase patterns	79	79	0
Previously pre-eliminated parameters	10644		10644
Total number	19282	5290	13992

# Flow Diagram of Final Processing



# Regional Clusters

---

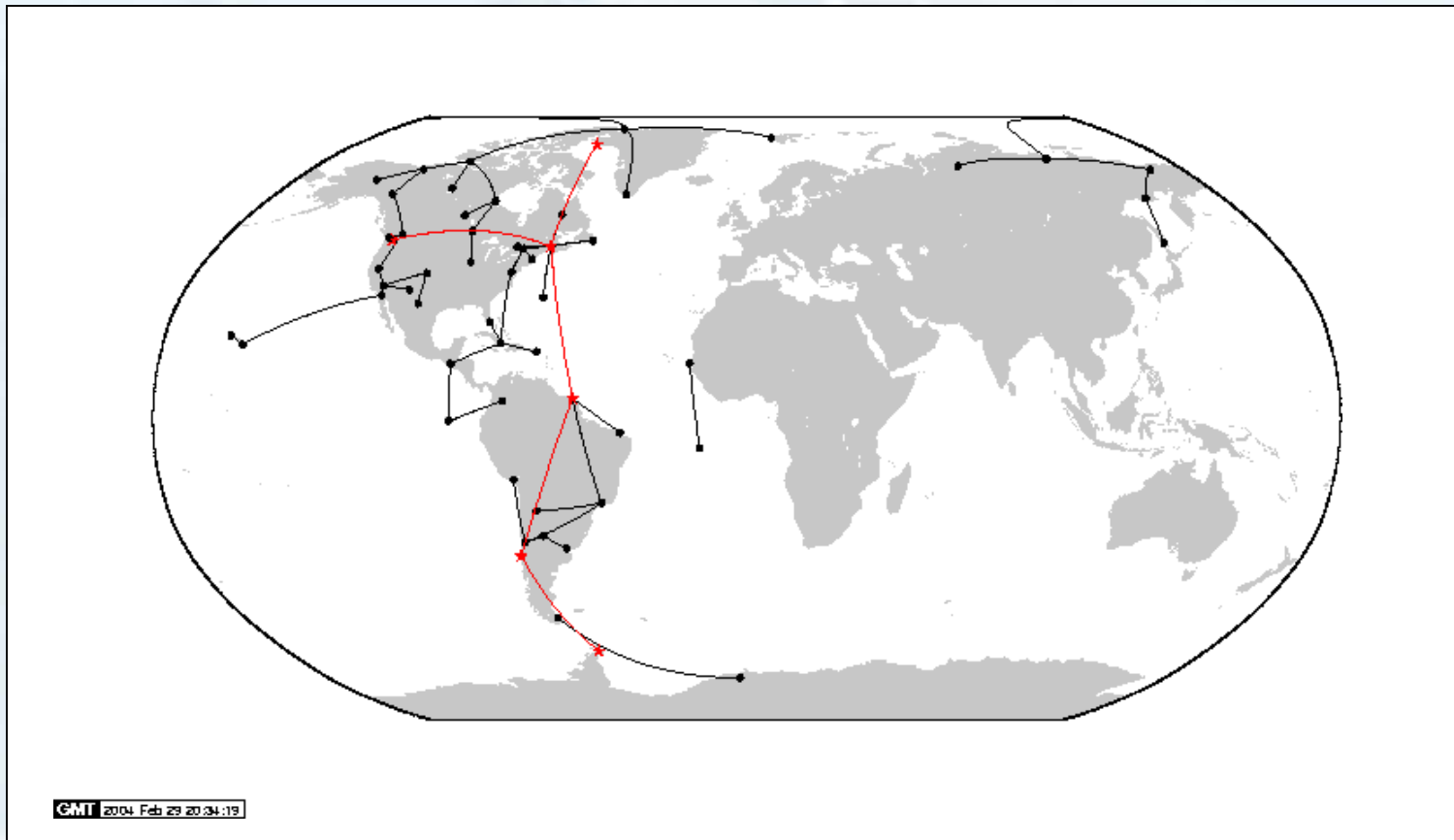


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# Regional Clusters

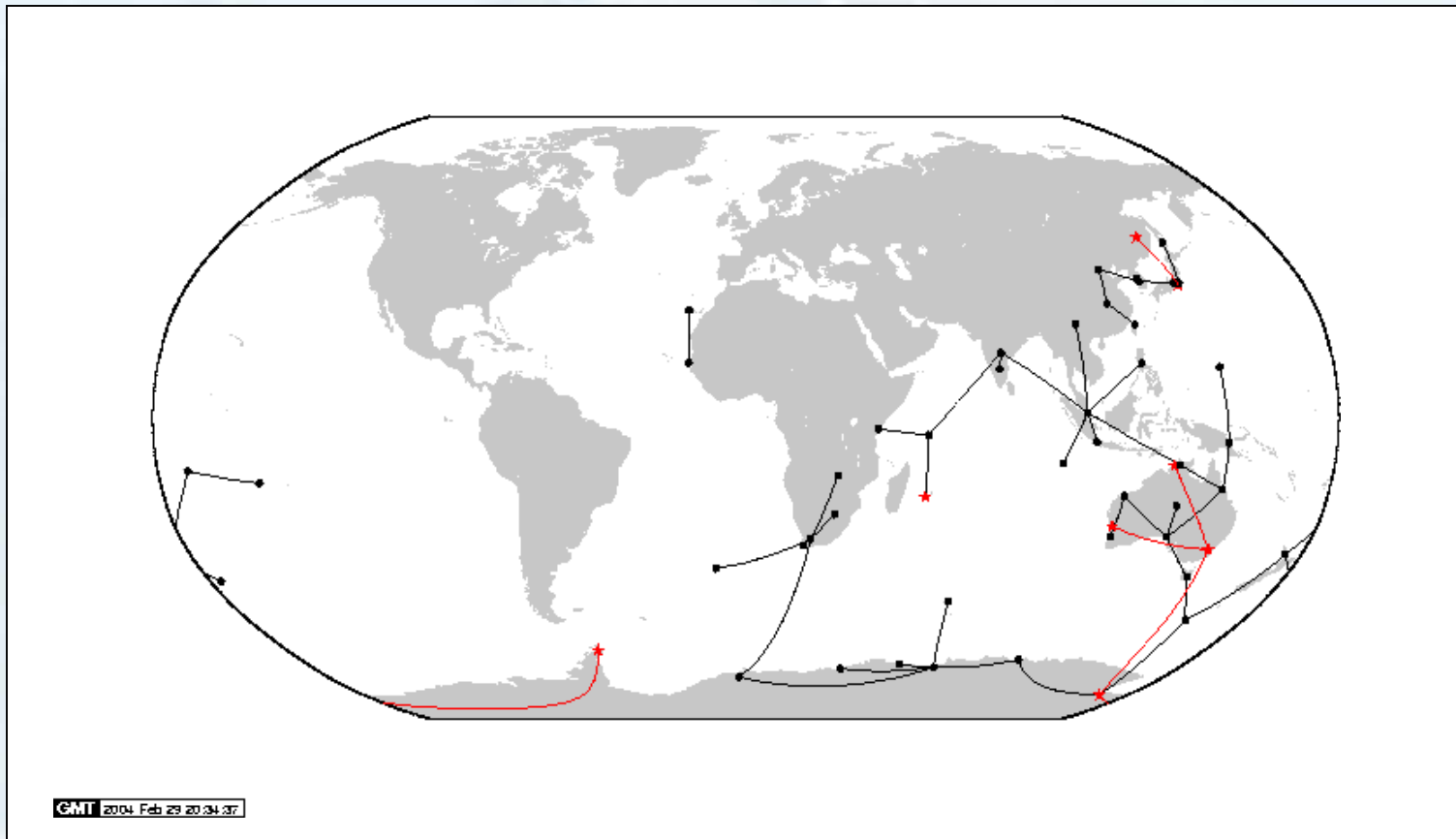


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# Regional Clusters

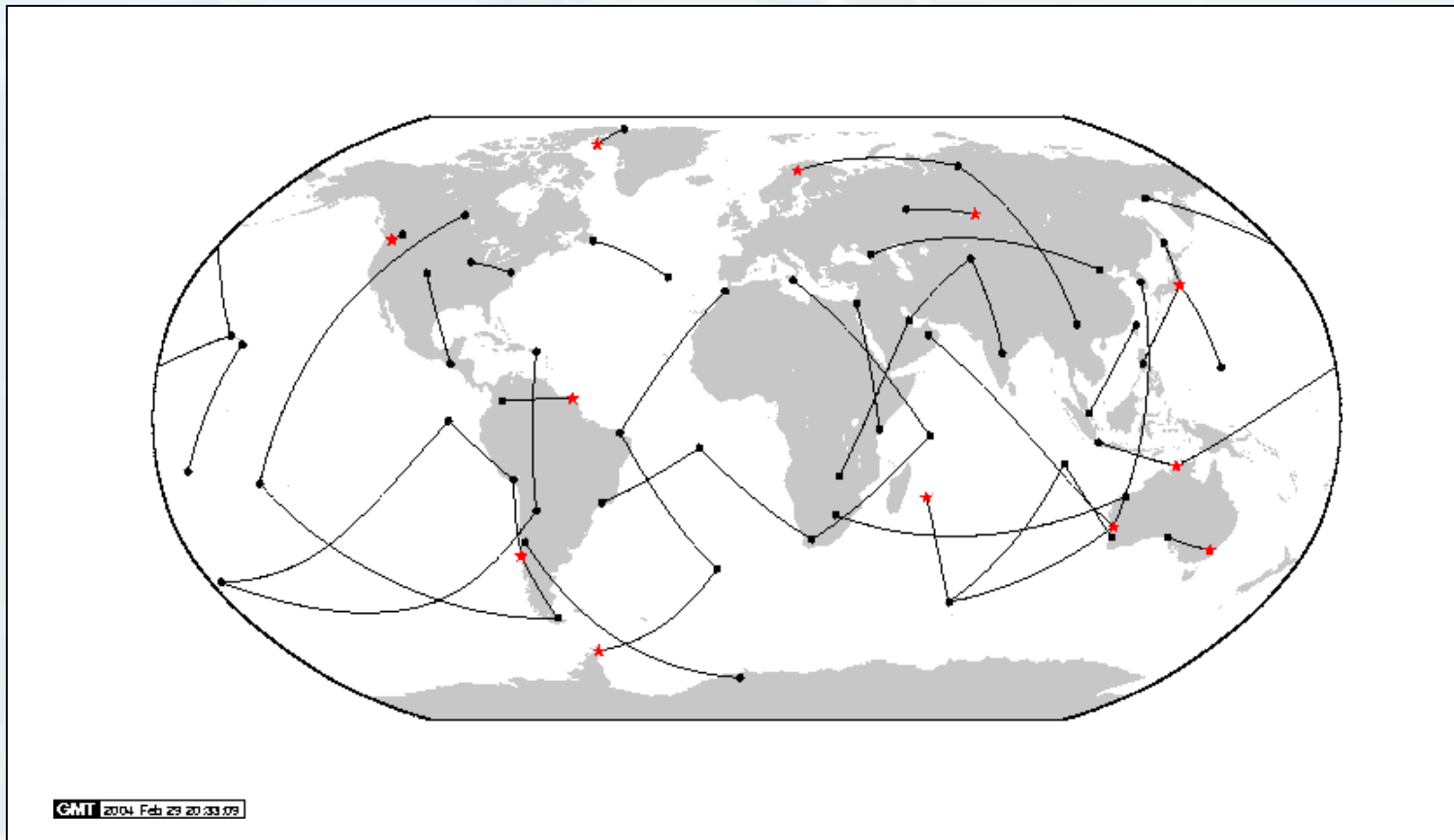


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# Redundant Cluster



# Number of Parameters in Clusters

Parameter type	Cluster				Comb
	1	2	3	4	
-----	-----	-----	-----	-----	-----
Station coordinates	204	162	174	156	468
Orbital elements	420	570	570	570	570
Site-specific troposphere parameters	1156	918	986	884	2633
Earth rotation parameters	120	120	120	120	65
Stochastic orbit parameters	84	114	114	114	114
Satellite antenna offset parameters	15	15	15	15	15
Geocenter coordinates	3	3	3	3	3
Satellite antenna patterns	80	80	80	80	79
-----	-----	-----	-----	-----	-----
Total number of explicit parameters	2082	1982	2062	1942	3947
Total number of implicit parameters	784	1089	638	623	3354
-----	-----	-----	-----	-----	-----
Total number of adjusted parameters	2866	3071	2700	2565	7301

# Motivation

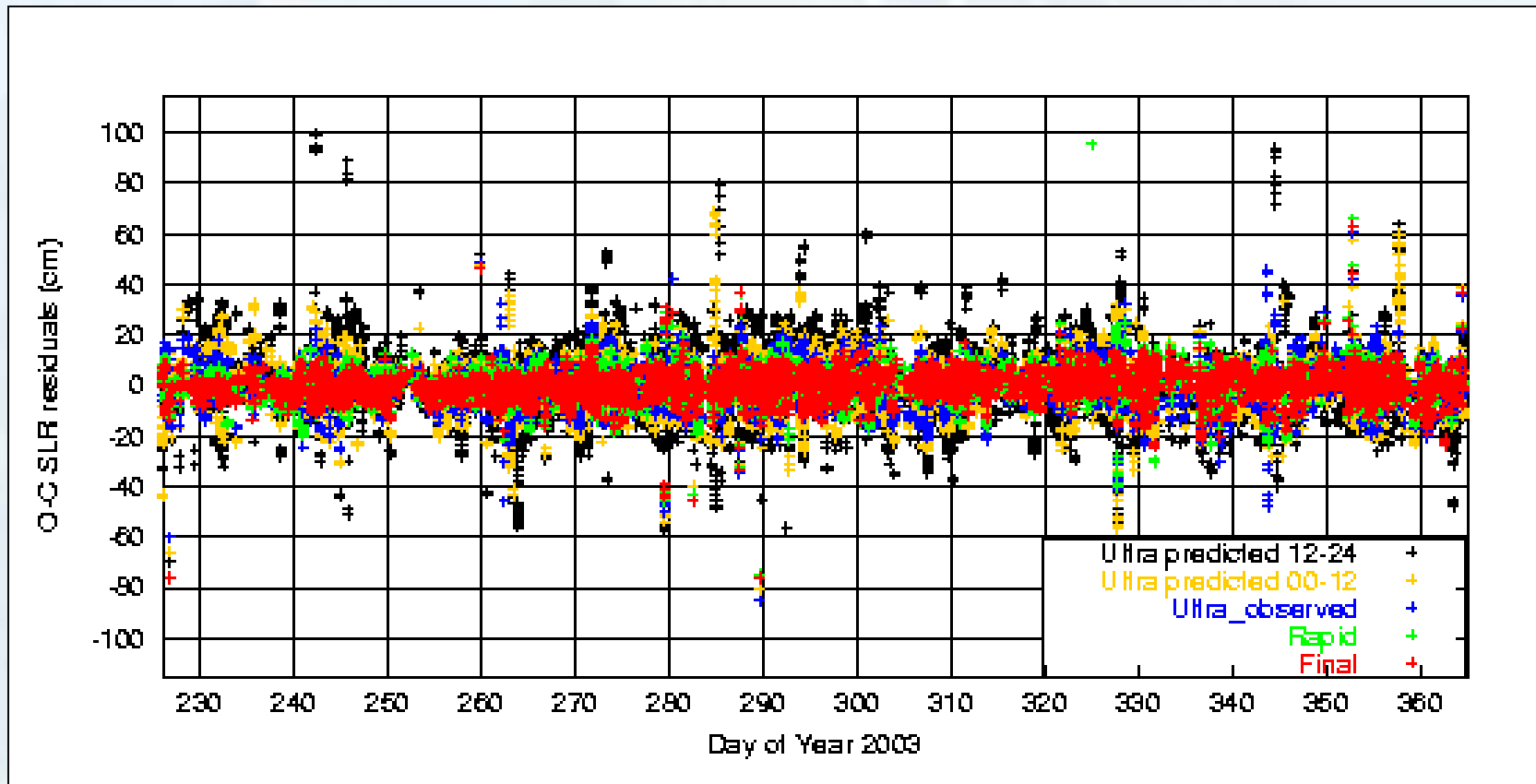
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Motivation for large number of stations:

- Highest *consistency and precision*
- Stability of reference frame
- Redundancy
- Detection of problems (stations, satellites)
- Detection of problems with fiducial sites
- Cope with data problems
- Tracking data for unhealthy satellites



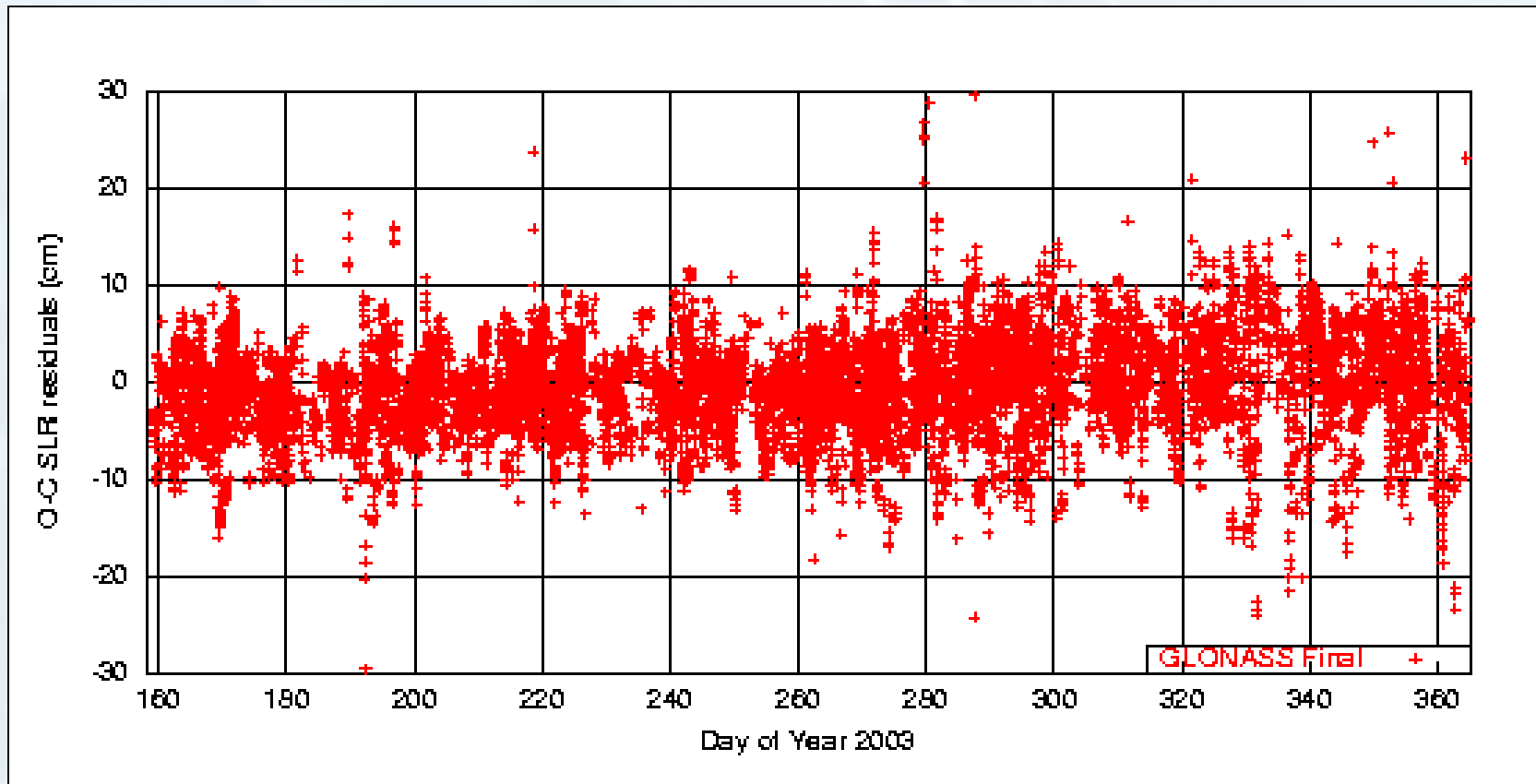
# SLR Validation of GLONASS Orbits



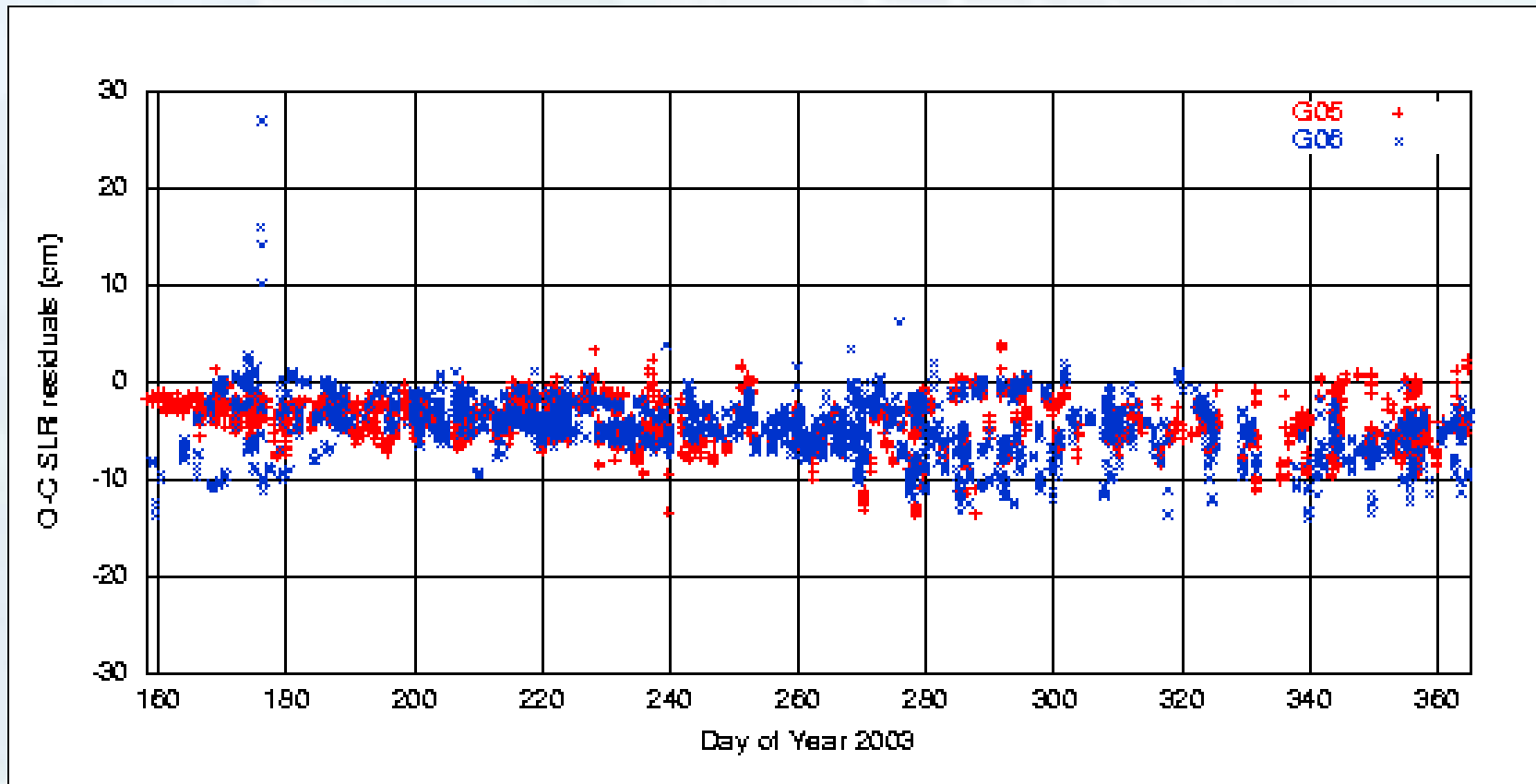
# SLR Validation of Orbits

System	Orbit solution	RMS (cm)	STD (cm)	Mean (cm)	#NP	Days
GLONASS	CODE Final	4.9	4.9	-0.2	4722	140
GLONASS	CODE Rapid	5.6	5.6	0.3	4723	140
GLONASS	CODE Ultra,obs	6.9	6.9	0.2	4563	140
GLONASS	CODE Ultra,00-12	9.3	9.3	0.6	4528	140
GLONASS	CODE Ultra,12-24	13.5	13.4	1.4	4506	140
GLONASS	CODE Final	4.6	4.6	-0.5	7033	207
GPS	CODE Final	4.9	3.2	-3.8	2768	207
GPS	IGS Final	3.9	2.8	-2.6	2768	207

# SLR Validation of GLONASS Orbits

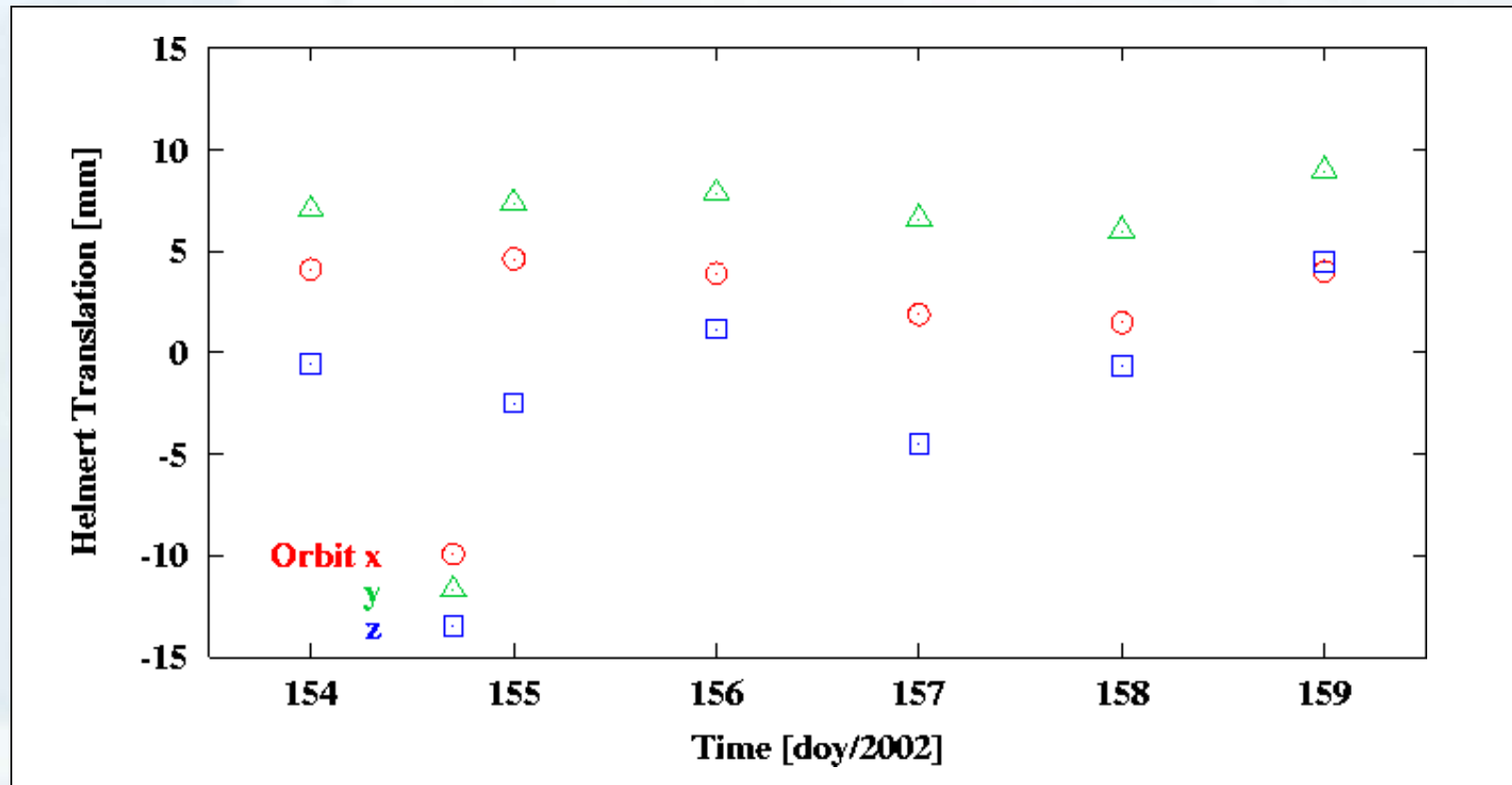


# SLR Validation of GPS Orbits

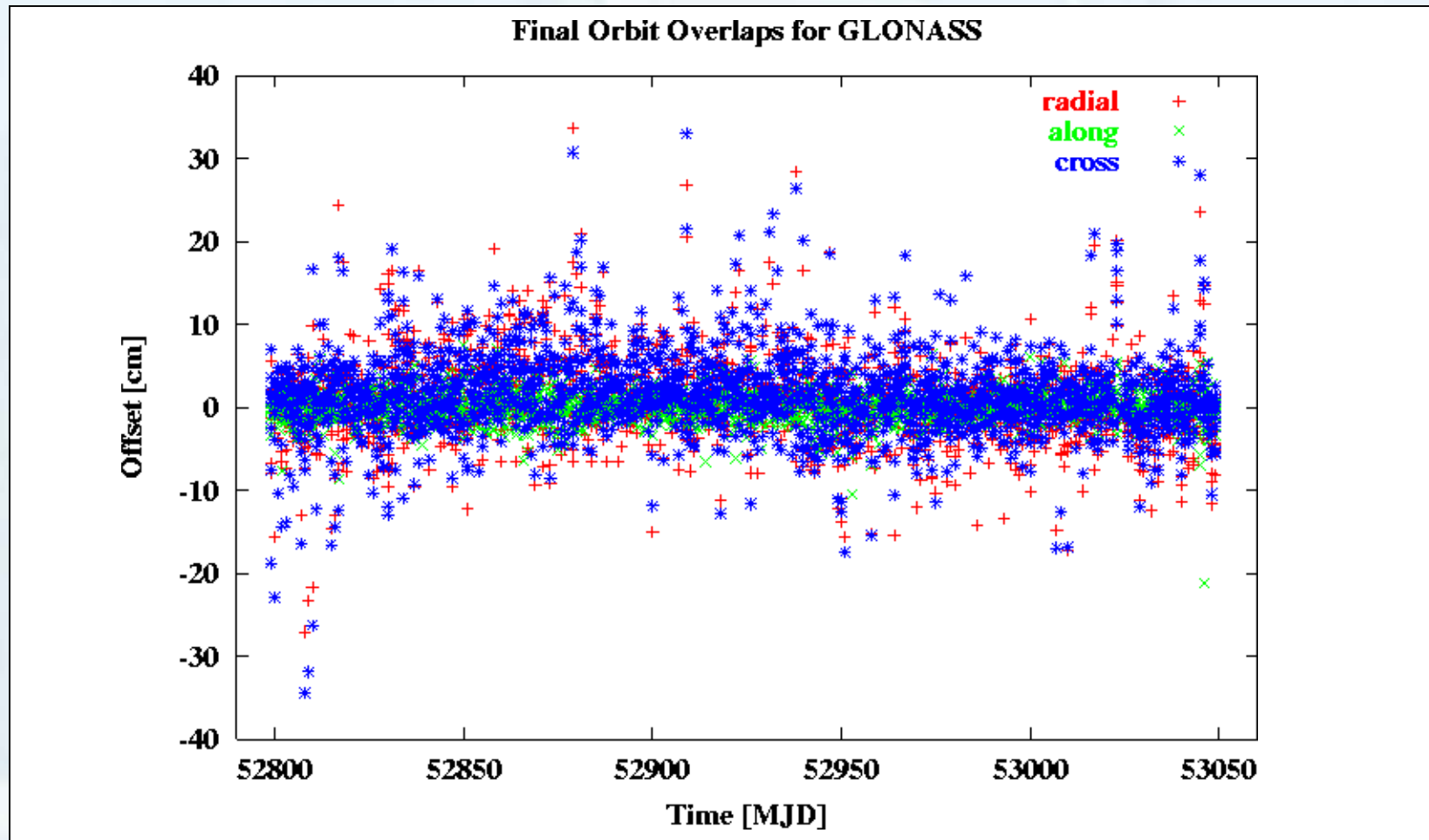


# GPS Orbit Translation

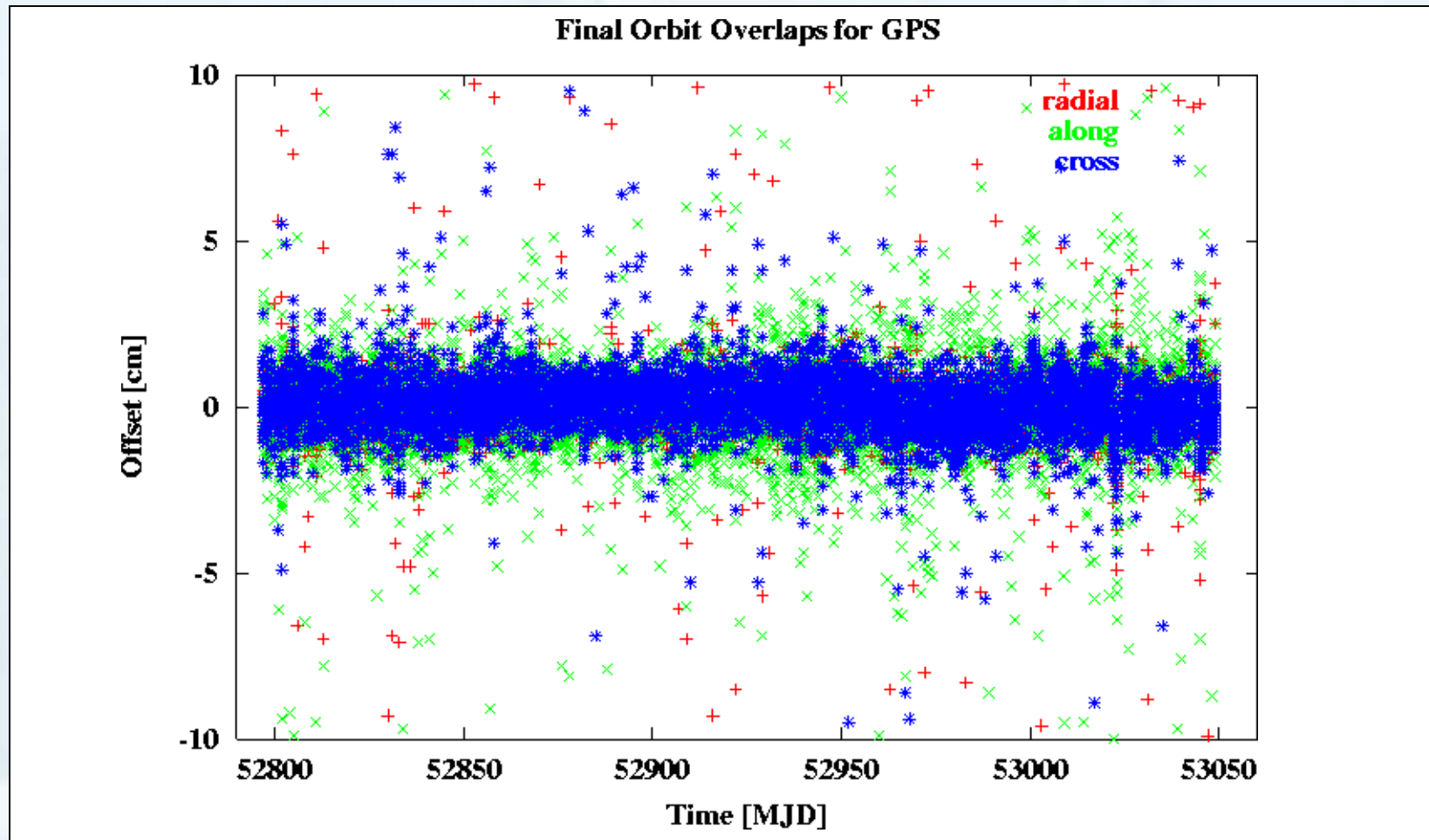
Translation of GPS orbits between GPS-only and GPS-JASON



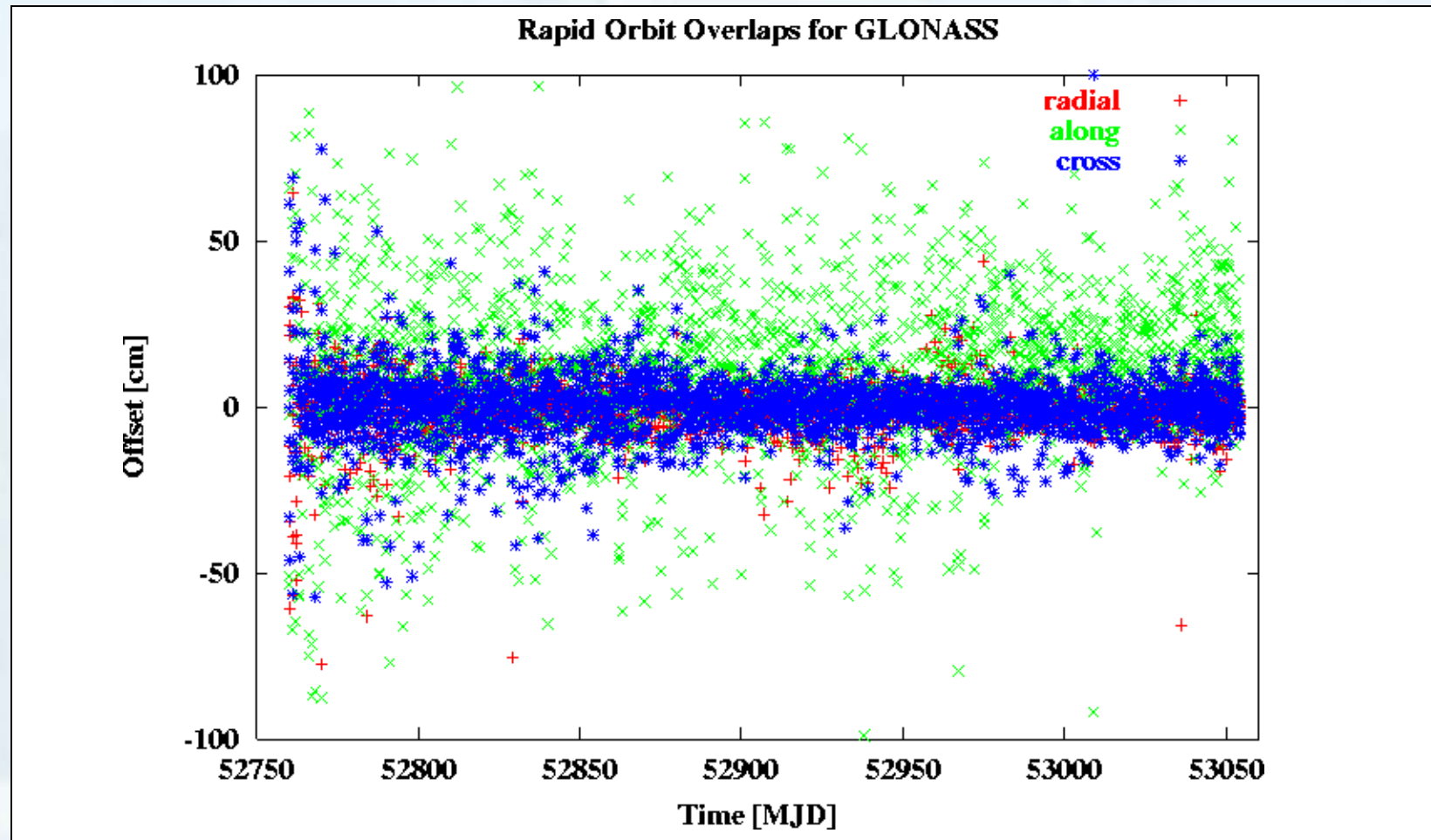
# Orbit Overlaps, CODE Final, GLONASS



# Orbit Overlaps, CODE Final, GPS

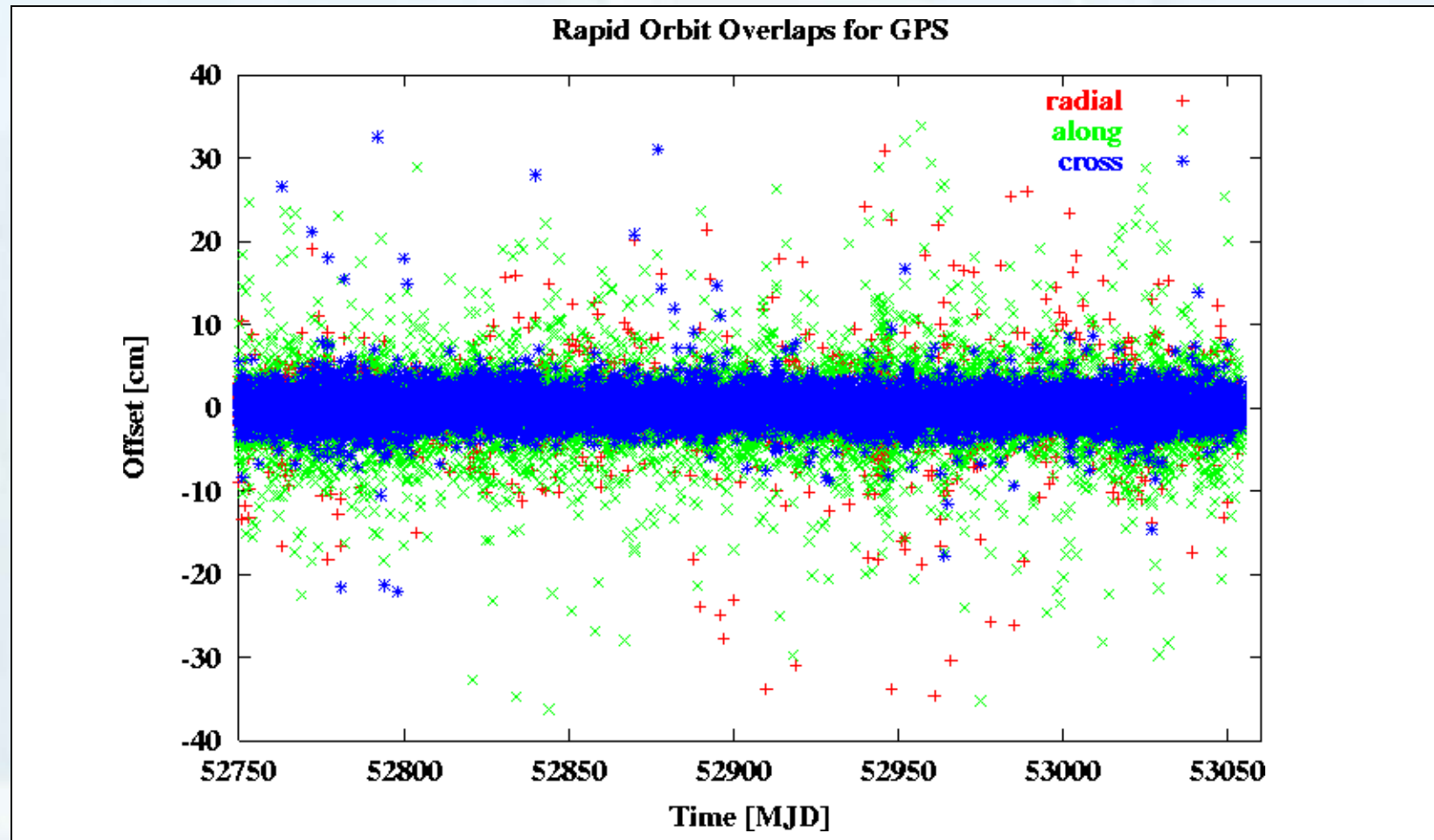


# Orbit Overlaps, CODE Rapid, GLONASS

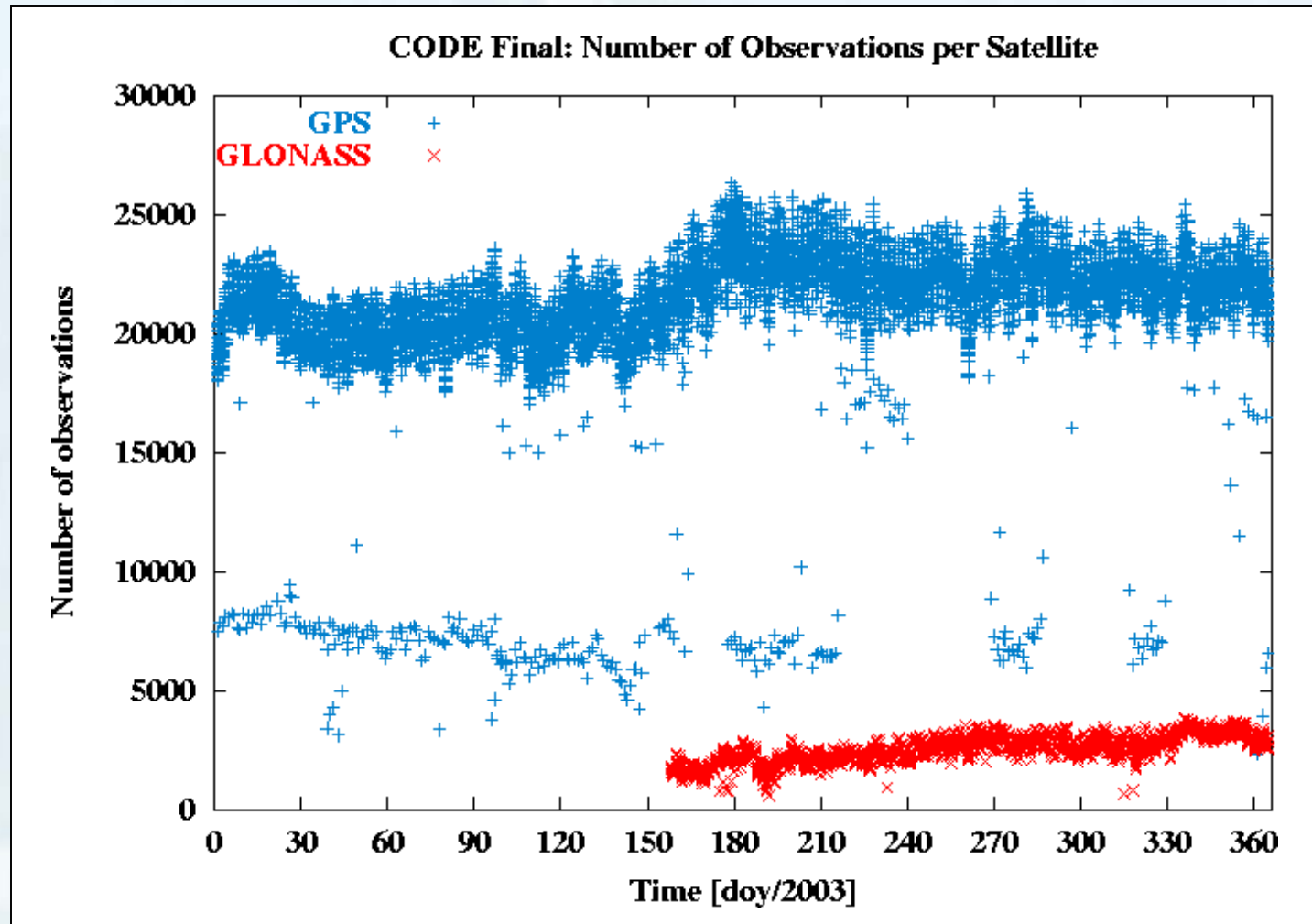




# Orbit Overlaps, CODE Rapid, GPS

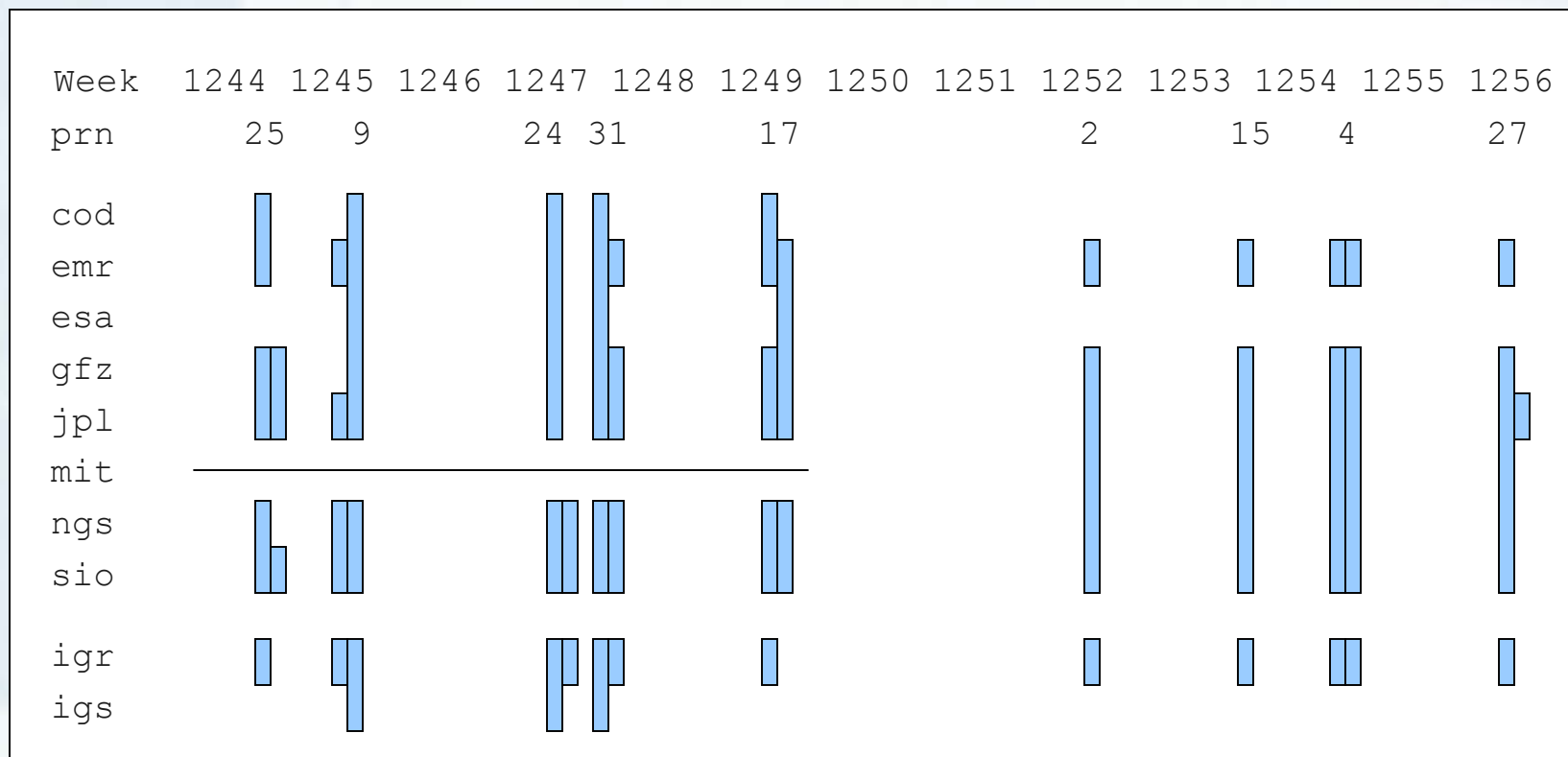


# Observations per Satellite



# IGS Final: Satellite Repositioning

## Days with missing satellites due to repositioning



# Conclusions

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- There are ways to break Moore's law
- Processing of 150 stations in CODE Final is performed in regional clusters
- Reasons to include a large number of stations into the POD solution exist
- Is apparent geocenter affecting SLR residuals?
- No reason to not track unhealthy satellites in permanent network
- Not necessary to exclude repositioned satellites for two days