Multi-technique combination at observation level with NAPEOS

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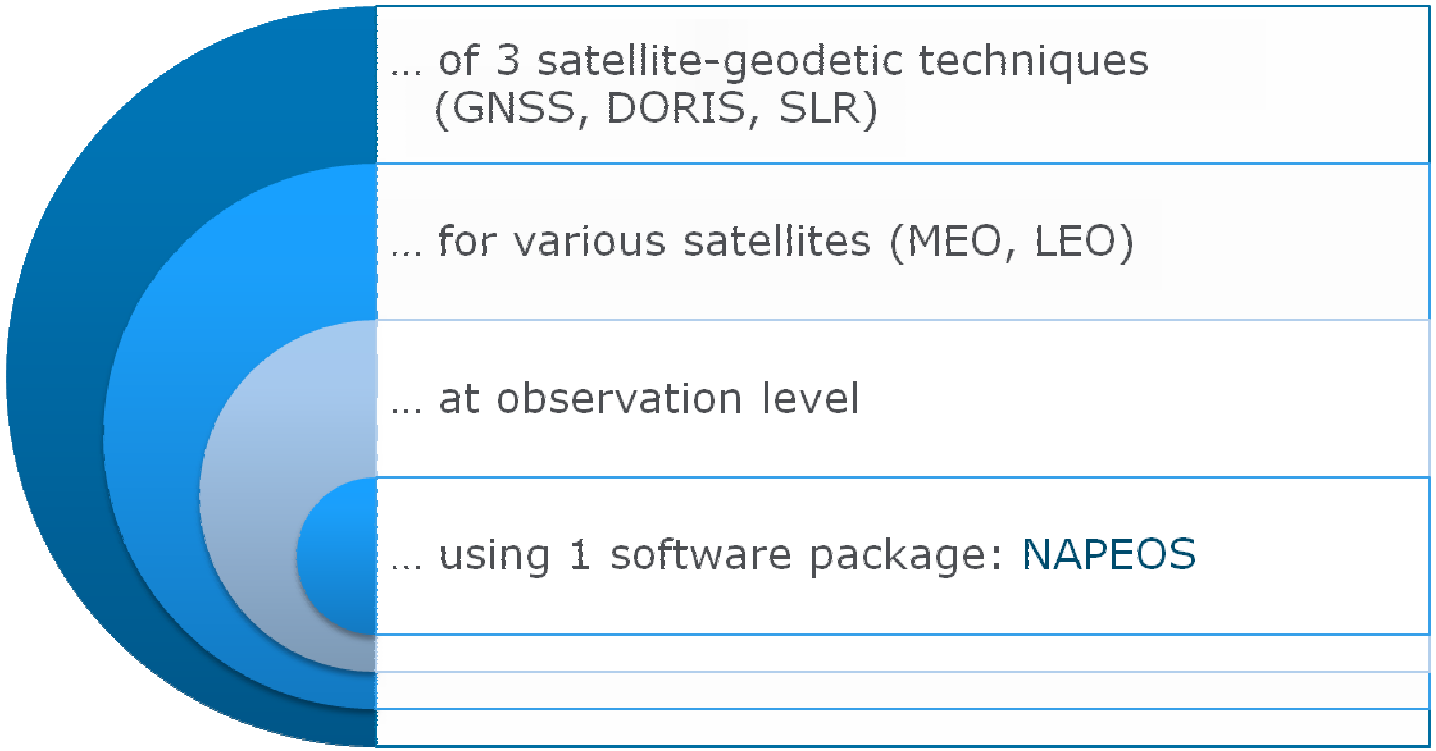
Introduction

Combination …



Motivation

IERS products

- ITRF / ICRF / EOP
- produced by individual analysis centers (process only one space-geodetic technique: GNSS, SLR, DORIS, VLBI)

Technique-dependent combination

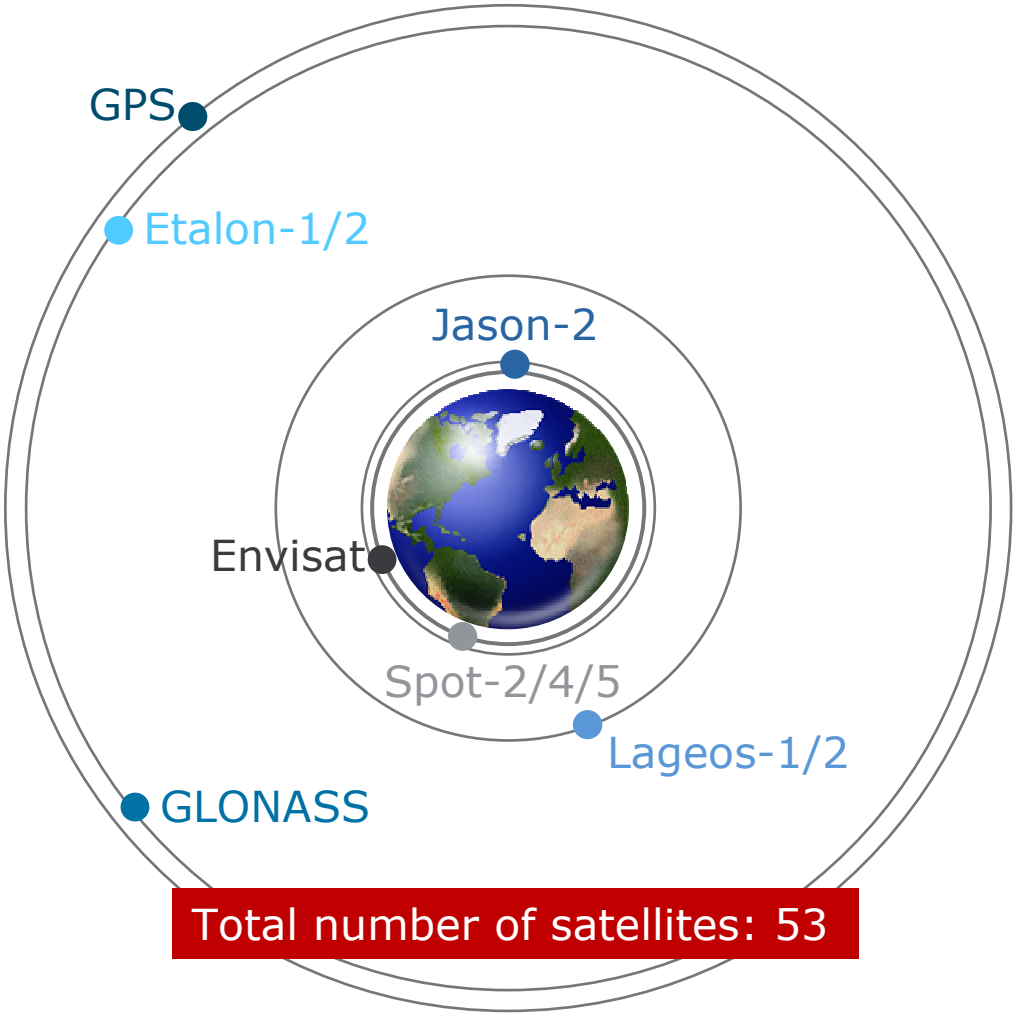
- IGS, ILRS, IDS, IVS
- no guaranty on homogeneity / consistency between techniques

Multi-technique combination

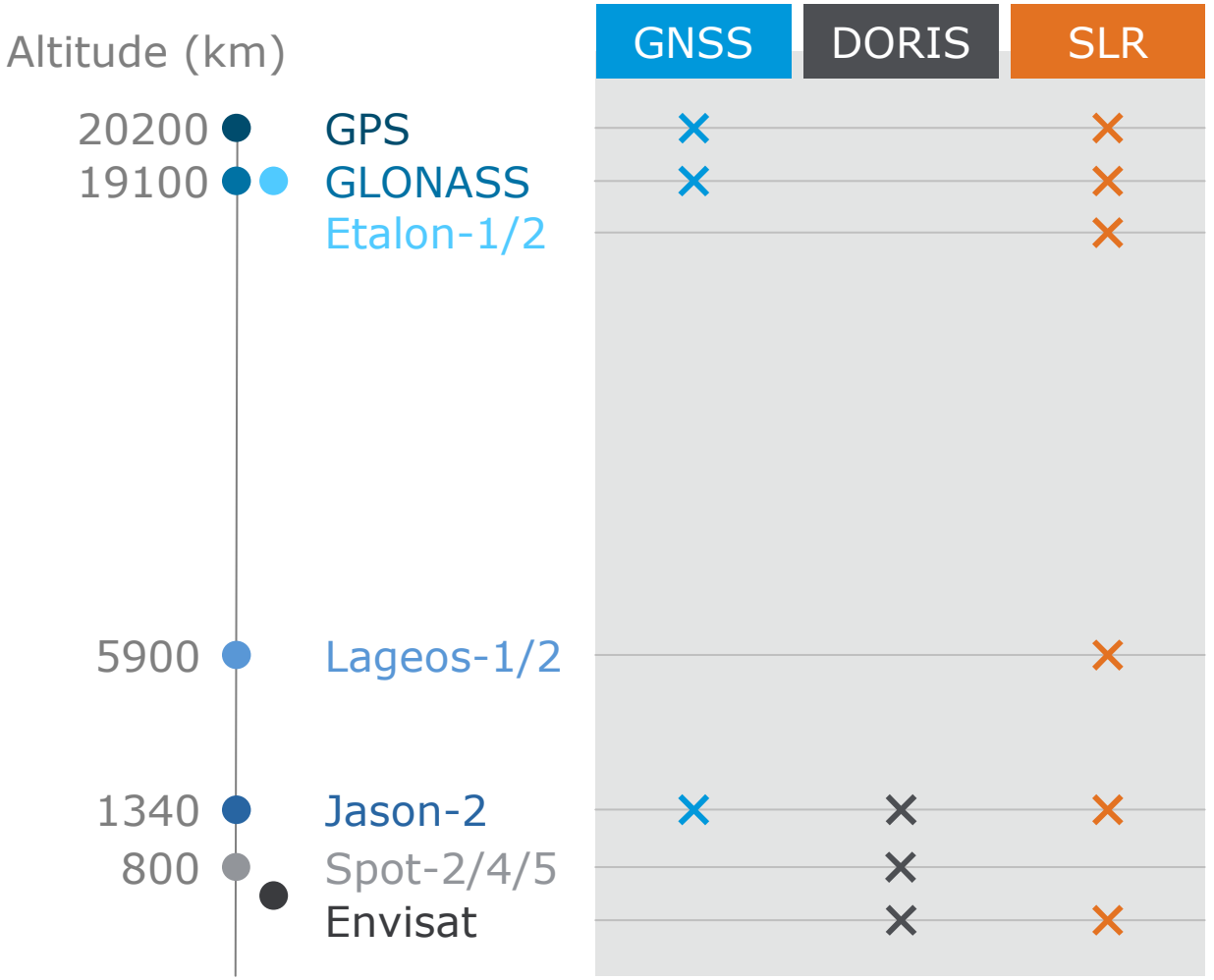
- at observation level
- process techniques together in one run
- make use of different strengths and weaknesses
- detect and reduce technique specific systematic behaviour

Used satellites

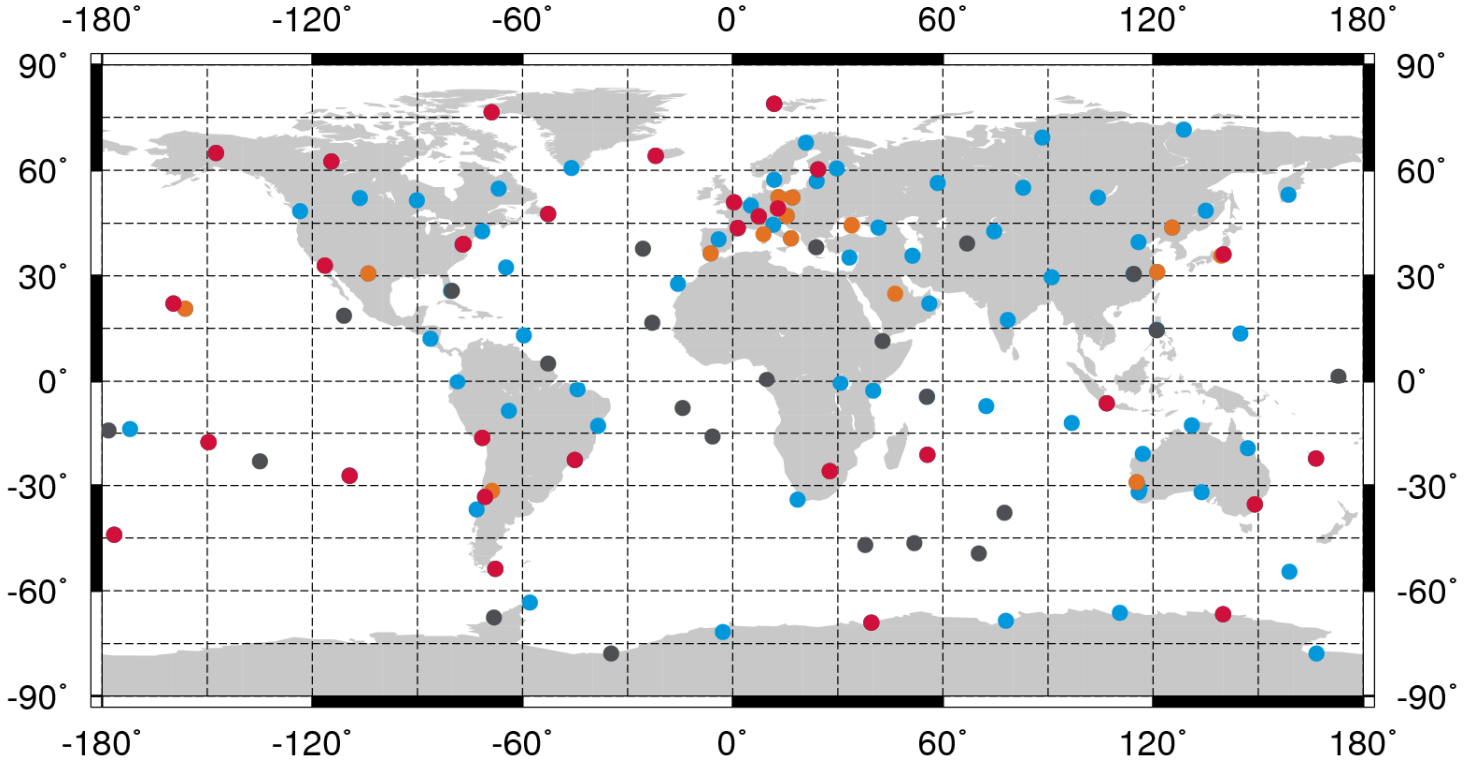
GPS	31
GLONASS	13
Etalon-1/2	2
Lageos-1/2	2
Jason-2	1
SPOT-2/4/5	3
Envisat	1



Combining measurement types



Station distribution (DoY 223)



GNSS (110)

DORIS (49)

SLR (25)

Co-located (32)

Typical number of stations: ~184

Processing with NAPEOS (1/2)

Models and Reference frame

- ITRF2008 reference frame
- IERS2003 standards
- Box-Wing model for all LEO satellite surface forces
- extended Antex IGS08 for GPS antenna phase center model

Observations

- 10/08/2008 – 30/08/2008 (CONT08)
- 1-day arc solutions
- 1 min sampling rate of GNSS observations (GNSS stations, Jason-2)

Processing with NAPEOS (2/2)

Estimated parameters

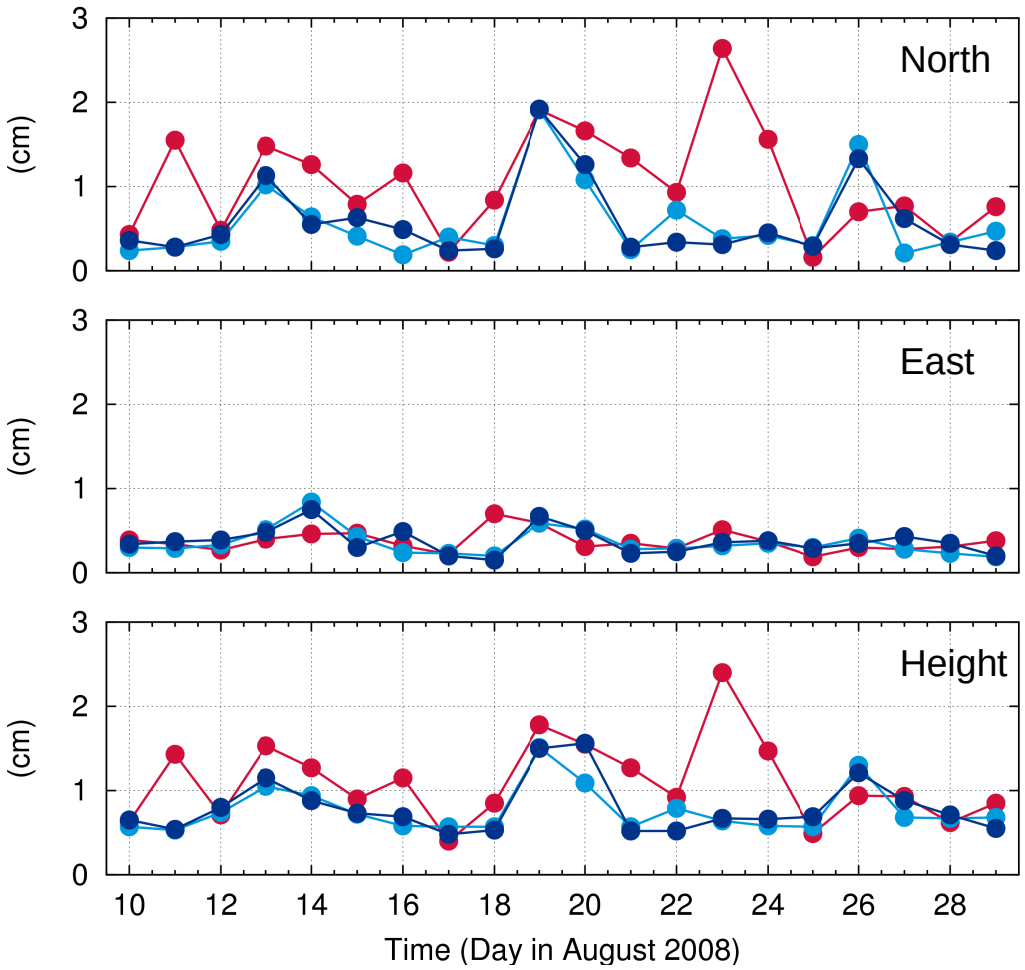
- satellite orbits, clocks, station coordinates, EOPs, troposphere
- GPS: integer ambiguities (~90%) (GPS satellites, Jason-2)
- DORIS: range rate bias per pass

Performance

- Typical number of daily parameters: 16’000 + 220’000 clock parameters
- CPU time: 120 min @2.8GHz Intel Xeon CPU
- Memory: 6 GB

GPS station repeatability

… of daily solutions – without Helmert transformation

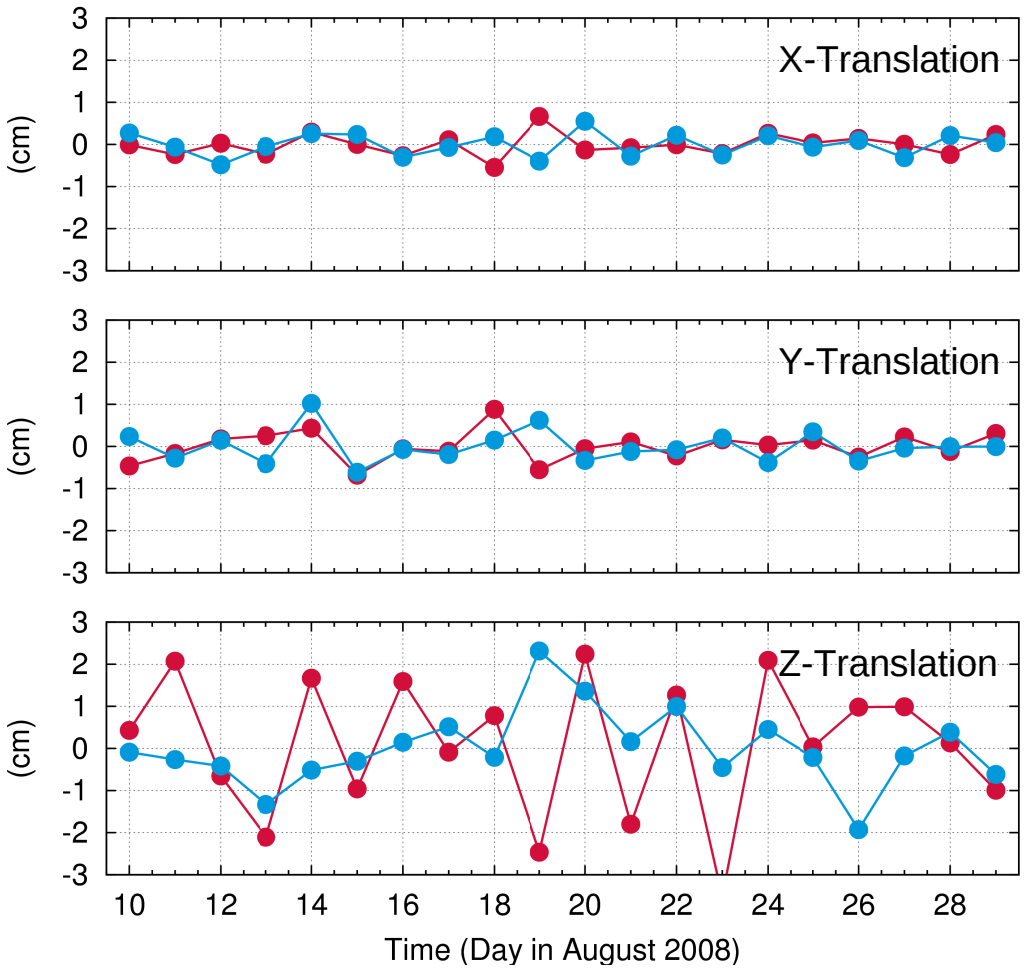


	Mean RMS (STD)
IGS	1.0 (±0.6)
+JA 2	0.6 (±0.5)
ALL	0.6 (±0.5)
IGS	0.4 (±0.1)
+JA 2	0.4 (±0.2)
ALL	0.4 (±0.2)
IGS	1.1 (±0.5)
+JA 2	0.8 (±0.3)
ALL	0.8 (±0.3)

Unit: cm

Adding Jason-2 to the IGS solution

Helmert transformation parameters



IGS

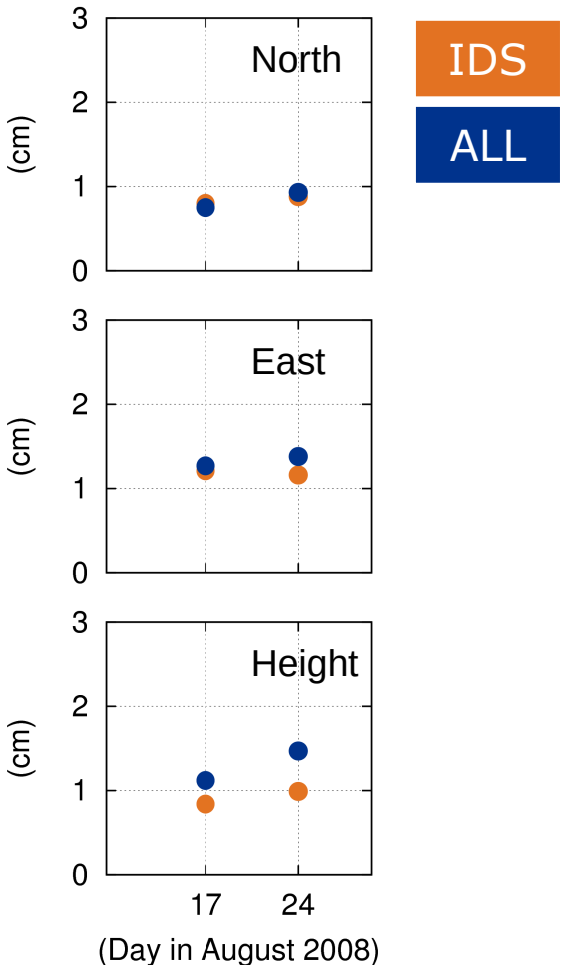
+JA 2

Mean RMS (STD)

0.0	(±0.3)
0.0	(±0.3)
0.0	(±0.4)
0.0	(±0.4)
0.1	(±1.6)
0.0	(±0.9)

Unit: cm

DORIS station repeatability
… of weekly solutions

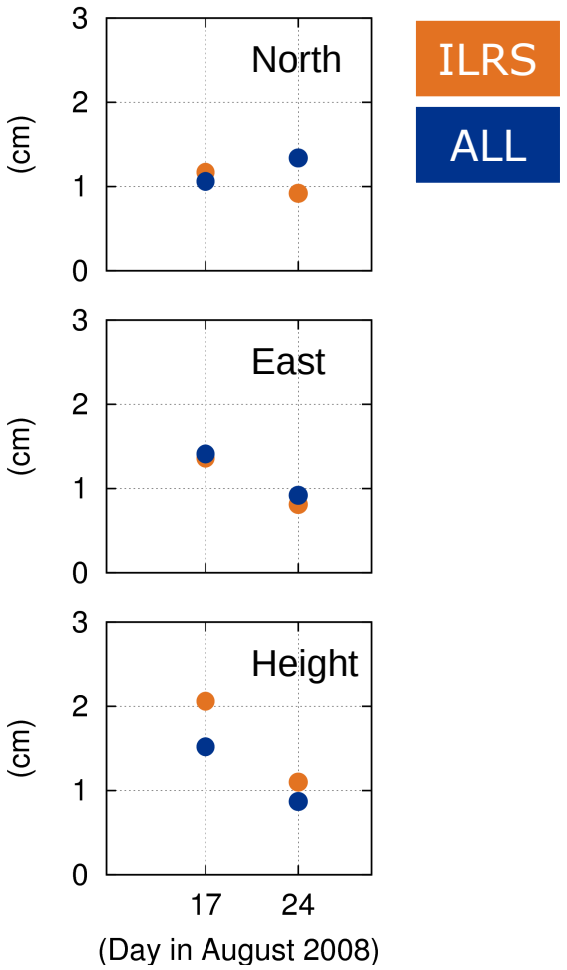


Mean RMS (STD)

0.8	(±0.1)
0.8	(±0.1)
1.2	(±0.0)
1.3	(±0.1)
0.9	(±0.1)
1.3	(±0.2)

Unit: cm

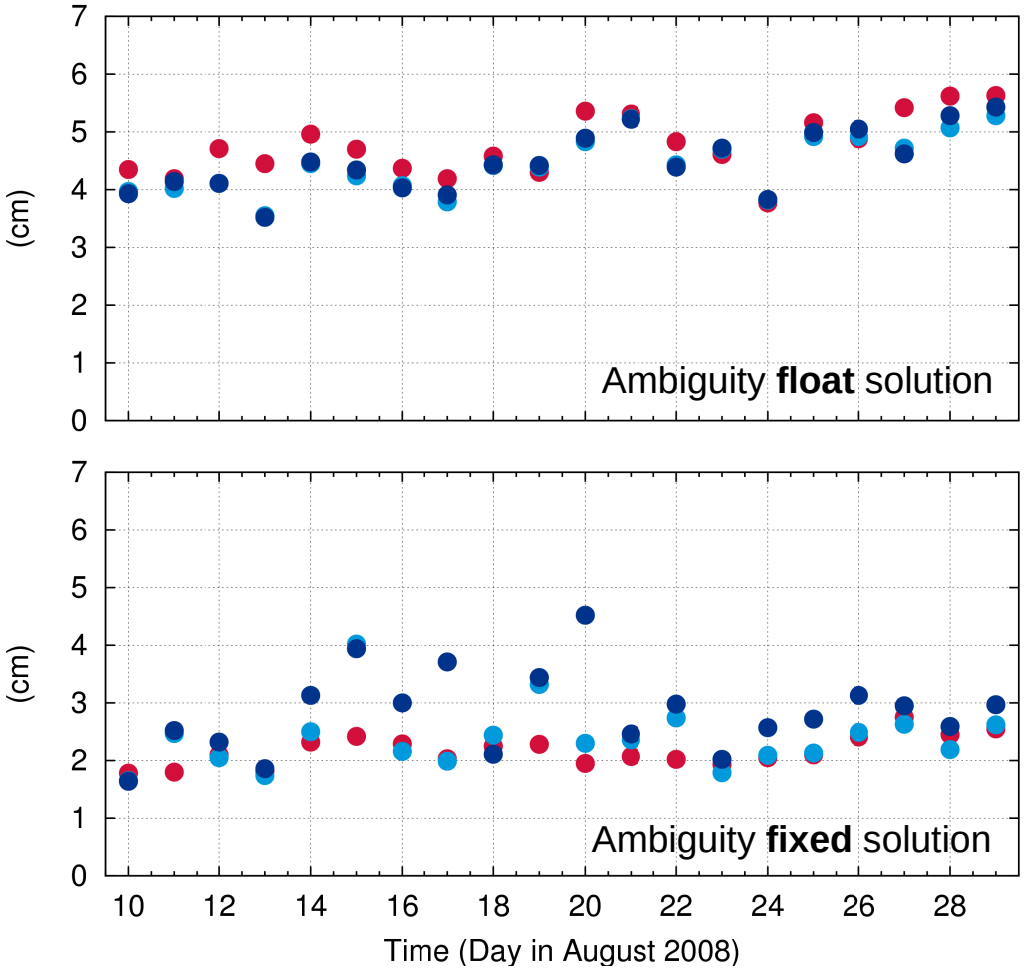
SLR station repeatability
… of weekly solutions



Mean RMS (STD)	
1.0	(±0.2)
1.2	(±0.2)
1.1	(±0.4)
1.2	(±0.3)
1.6	(±0.7)
1.2	(±0.5)

Unit: cm

Orbit overlap errors for GPS satellites



IGS

+JA 2

ALL

Mean RMS (STD)

4.8	(±0.5)
4.4	(±0.5)
4.5	(±0.5)

2.2	(±0.3)
2.4	(±0.5)
2.8	(±0.7)

Unit: cm

Conclusions (1/2)

Multi-technique combination at observation level

In one global run

- Using one software package: NAPEOS

Improve accuracy and consistency of geodetic products

- Combination improves geocenter Z-component
- Combination improves GPS orbits of the ambiguity float solution

Detect inconsistencies between techniques

- Orbit overlap errors increase for the combined solution when fixing ambiguities → orbit model deficiencies?

Conclusion (2/2)

Multi-technique combination at observation level

Next steps

- Tuning of orbit parameter set-up
- Estimation of GPS antenna phase center offsets (Z-component)
- Processing of CONT11 period