



ESOC SLR Activities

T. Springer, C. Flohrer,
M. Otten, J. Dow

ESOC Analysis Centre Activities

- IGS analysis centre:
 - Contributing to all products since the beginning in 1992
 - Performed IGS reprocessing from 1994 to 2008
- IDS associate analysis centre with as key activities:
 - ENVISAT processing
 - IDS reprocessing
- ILRS associate analysis centre with as key activities:
 - Prediction centre for several satellites, e.g., Giove-A
 - Analysis of ENVISAT, ERS-1 and ERS-2
 - Analysis of the SLR data from the GNSS targets
 - ILRS reprocessing

ESOC wants to become an Analysis Centre in all three techniques

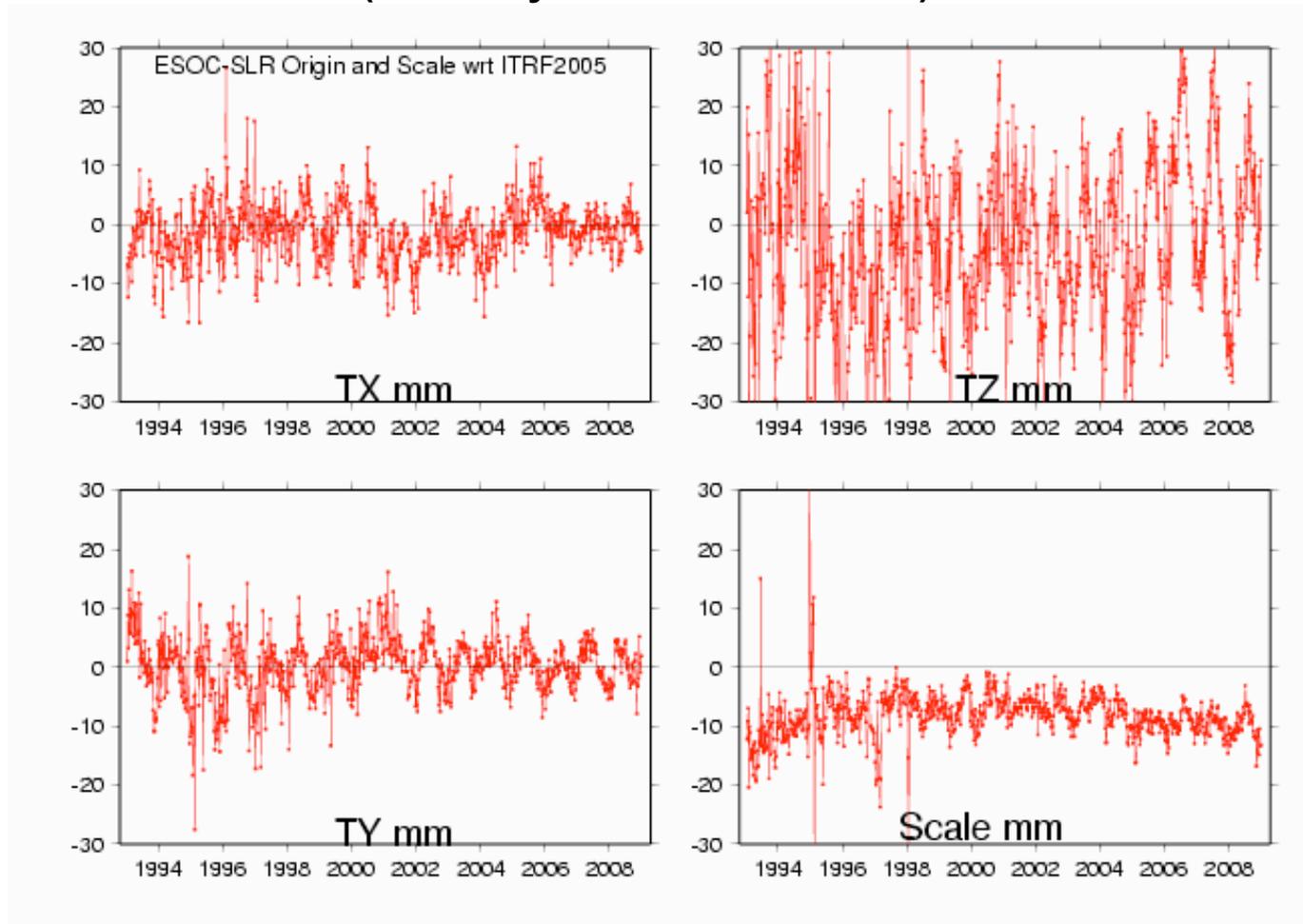
ESOC Reprocessing Efforts

- IGS reprocessing
 - 1995 to 2008 finished and submitted.
 - 1994 done but results are not good enough (early AS years)
- IDR reprocessing
 - 1992 to 2008 finished and submitted.
- ILRS reprocessing
 - 1993 to 2008 finished but not submitted
 - » Using Lageos-1/2 and Etalon-1/2
 - Pending passing the “benchmark” test
 - Not all biases properly corrected

IGS and IDS reprocessing finished and submitted
ILRS reprocessing done but not submitted

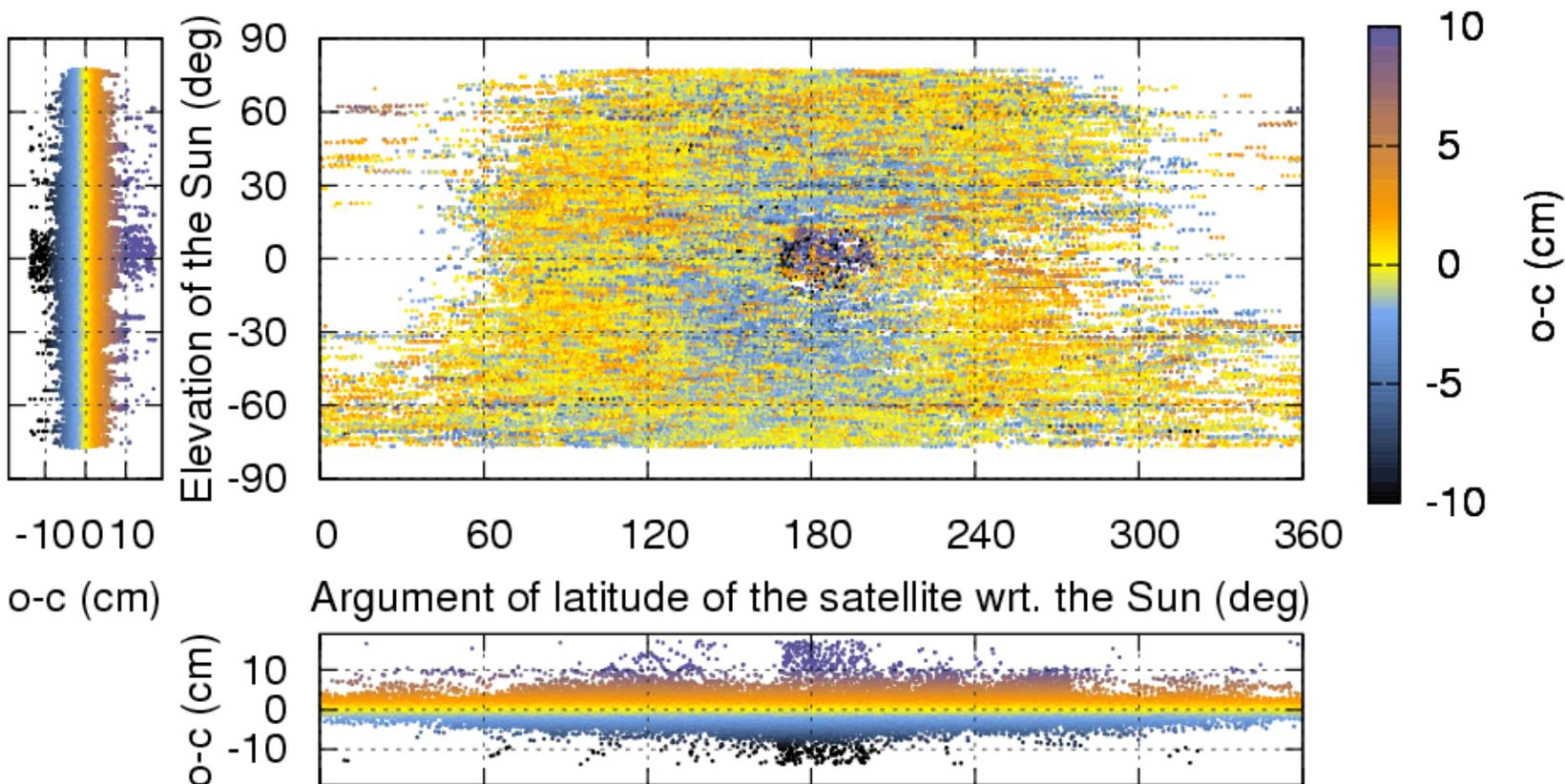
ESOC SLR Reprocessing Results

(Courtesy of Zuheir Altamimi)

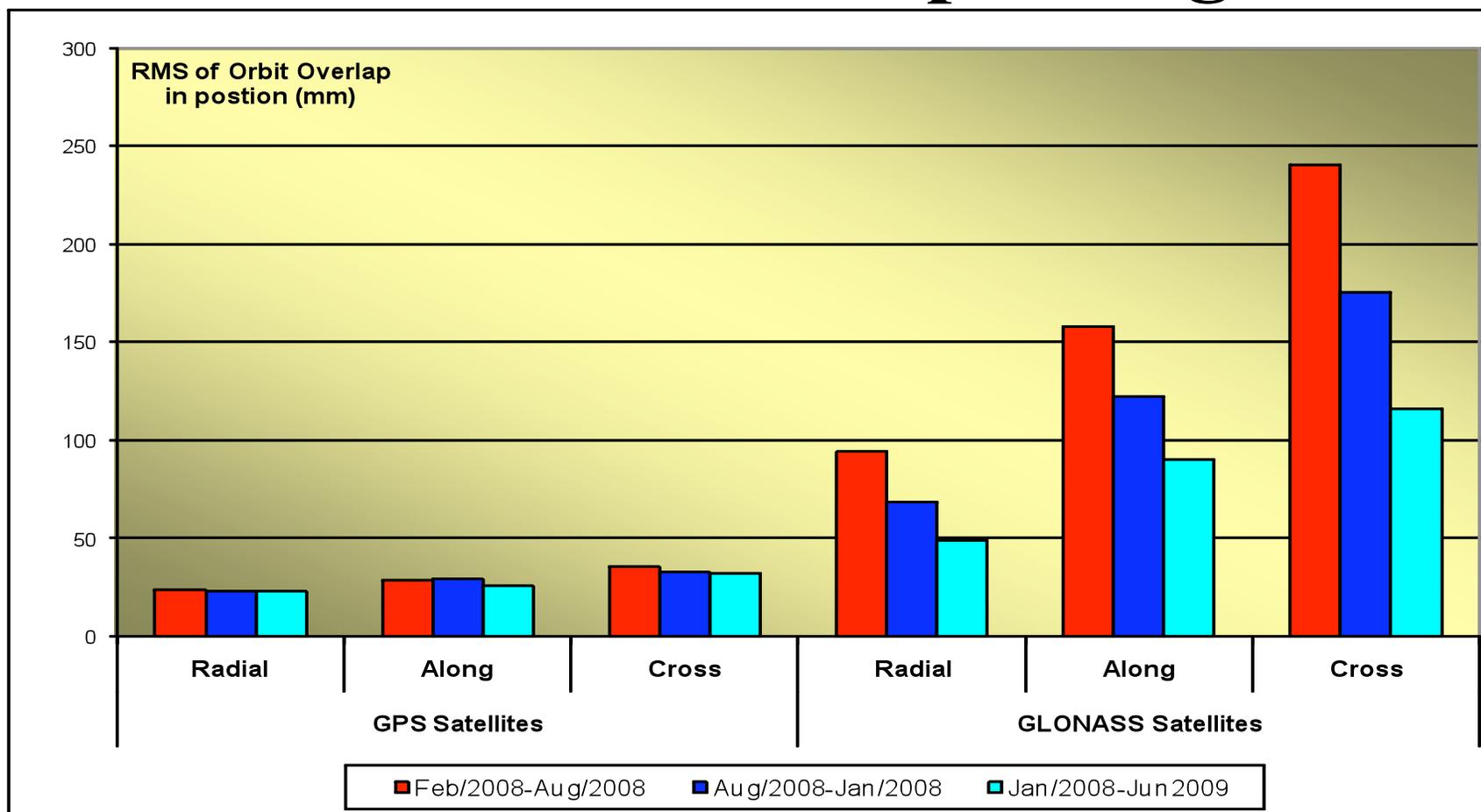


SLR Validation of GPS Reprocessed Orbits

(As function of Satellite Latitude and Elevation of the Sun above the orbital plane)

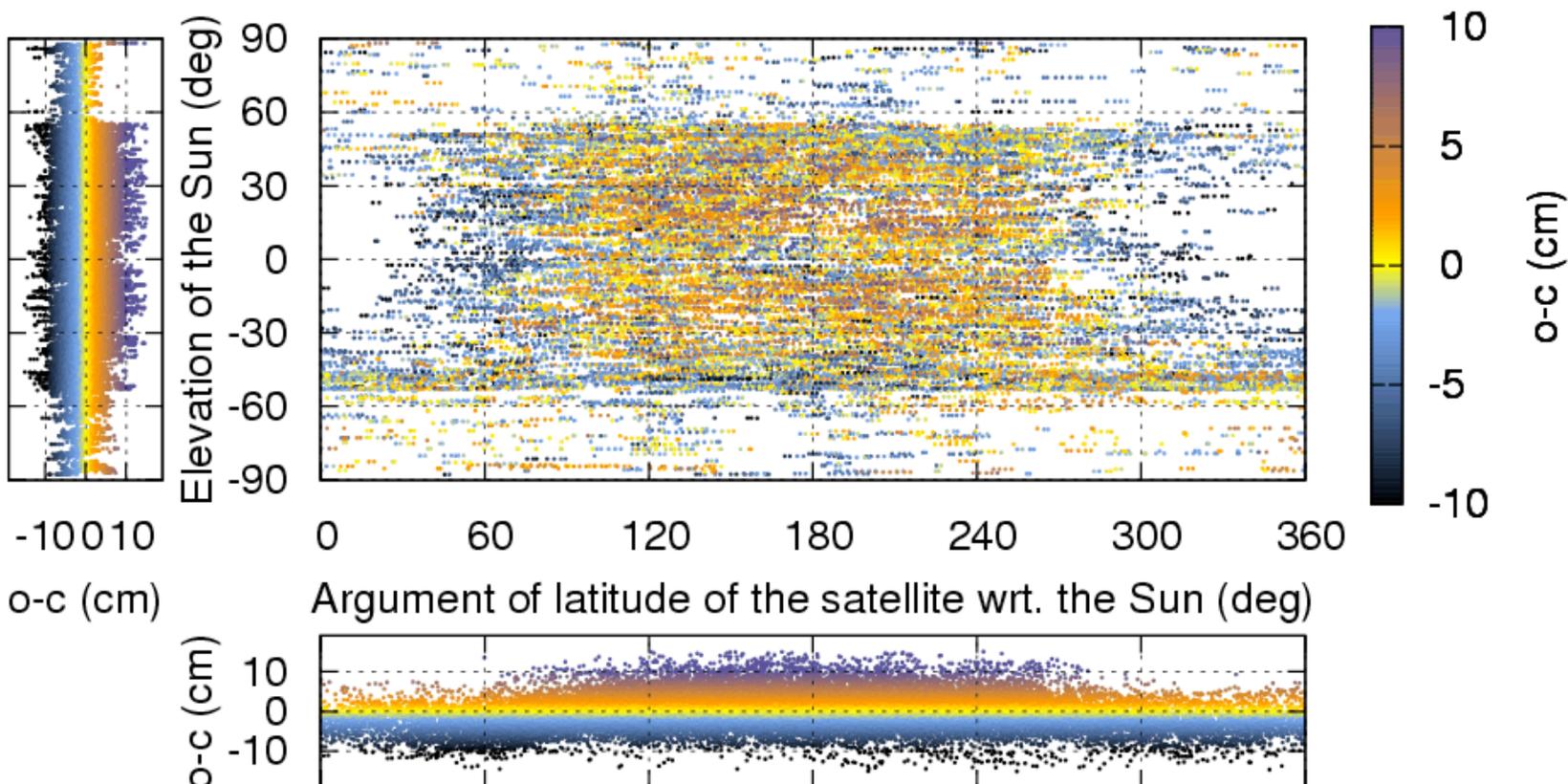


GLONASS is Improving



SLR Validation of GLONASS Orbits

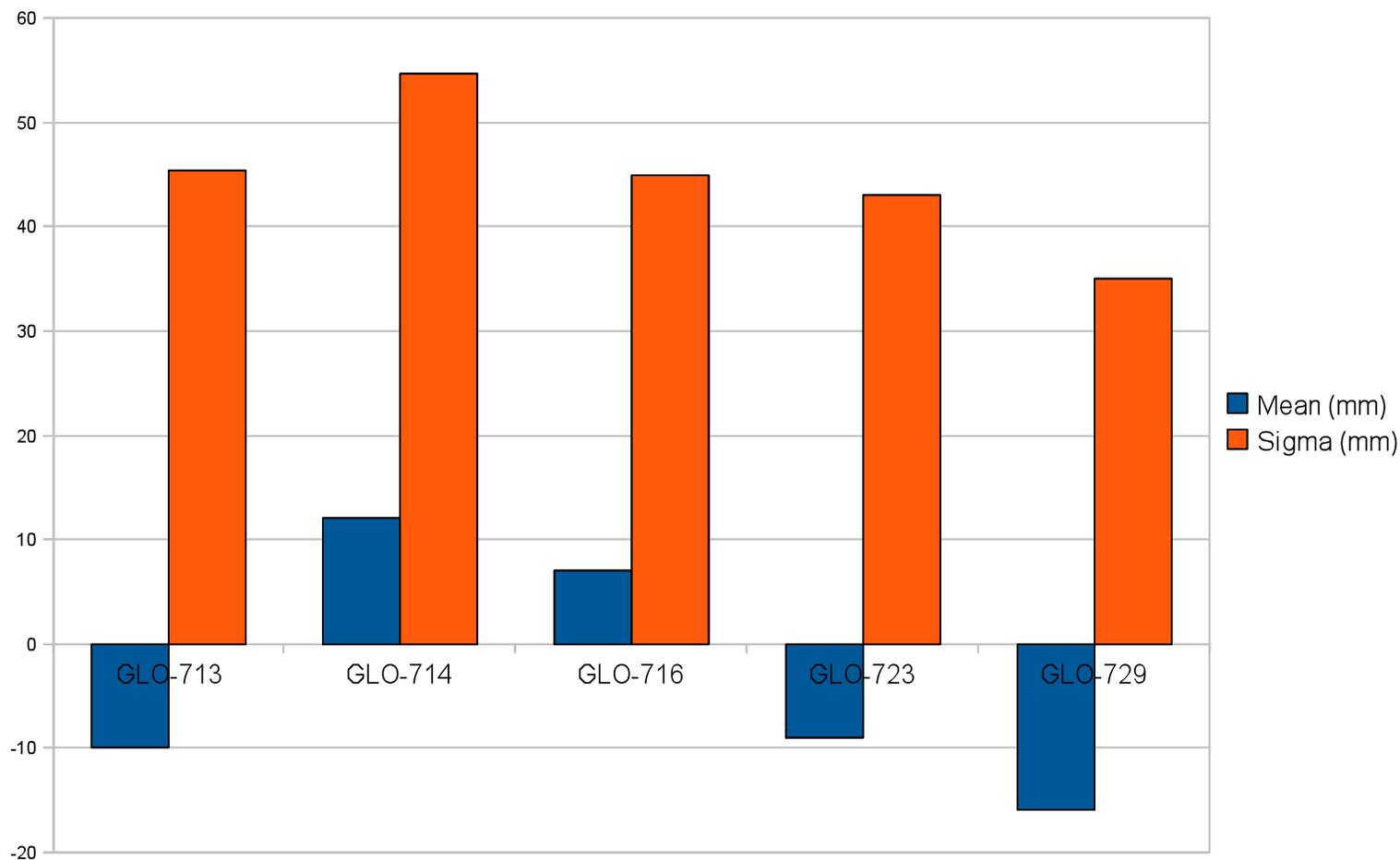
(As function of Satellite Latitude and Elevation of the Sun above the orbital plane)



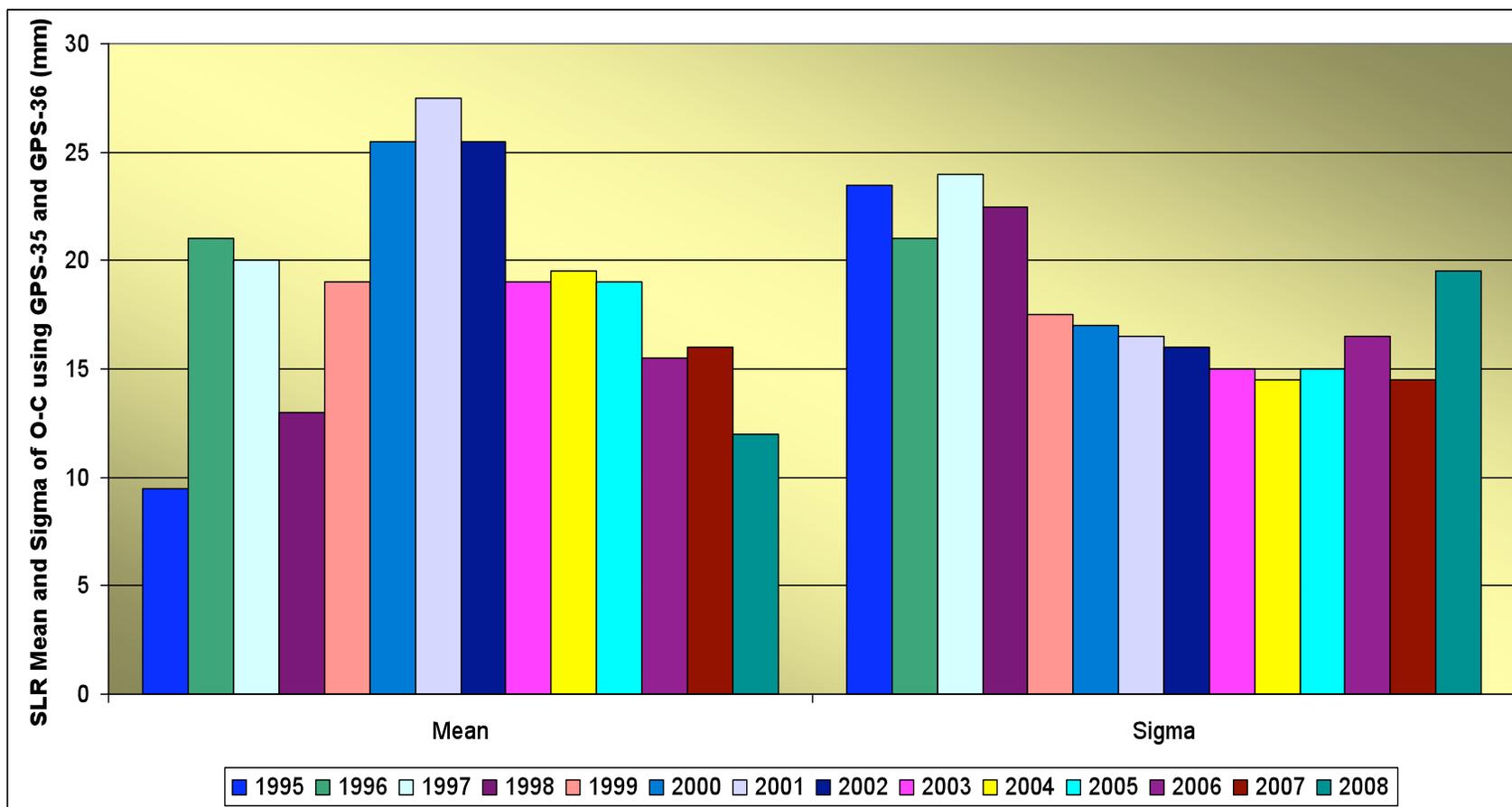
SLR – GNSS Summary

- GPS Reprocessed Orbits from 1995 to 2008
 - Bias: ~18 mm, Sigma: ~20 mm
 - Small bias remains!
- GLONASS Orbits from 2008 to mid 2009
 - Bias: ~0 mm, Sigma: ~44 mm
 - No clear bias but a significant signal as function of Argument of latitude of the satellite w.r.t. the Sun.
- Next steps
 - Look at the residuals in more detail
 - » Eclipse parts, per stations, per satellite, per U0-B0 “bin”
 - Combine GNSS and SLR

SLR – GLONASS Statistics (2008-now)



Yearly GPS-SLR Statistics



Combining GNSS and SLR

(Initial results based on 1 week of IGS data)

	Overlap	Rad	Alo	Cross
All sats				
GNSS		29,10	59,70	71,70
GNSS+SLR_GLO		29,50	59,90	66,20
GNSS+SLR		29,30	59,80	66,30
Glo-SLR sats only				
GNSS		34,20	103,40	149,50
GNSS+SLR_GLO		40,90	104,80	105,90
GNSS+SLR		40,90	105,20	105,20
GPS-SLR sats only				
GNSS		24,30	16,50	41,70
GNSS+SLR_GLO		24,70	16,40	42,80
GNSS+SLR		15,80	18,50	47,80

Conclusions

- ESOC deeply involved as AC in IGS, IDS and ILRS
 - IGS solutions have very high quality!
 - IDS solutions have very high quality!
 - ILRS solutions expected to be good, some bias handling issues to be resolved
- Multi-technique LEO processing starting
 - SLR+DORIS: Envisat
 - SLR+DORIS+GPS: Jason-1, Jason-2
- Next step -> “Space Ties”
 - Combine GNSS and SLR measurements on the observation level
 - Use local site-ties (with full covariance information) where possible
 - Add SLR measurements from GPS and GLONASS -> “Tie in Space”
 - » Derive the GNSS phase centre maps “directly”
- VLBI processing to follow...

Thank You!



Jason-2 Activities: SLR + GPS + DORIS

DORIS

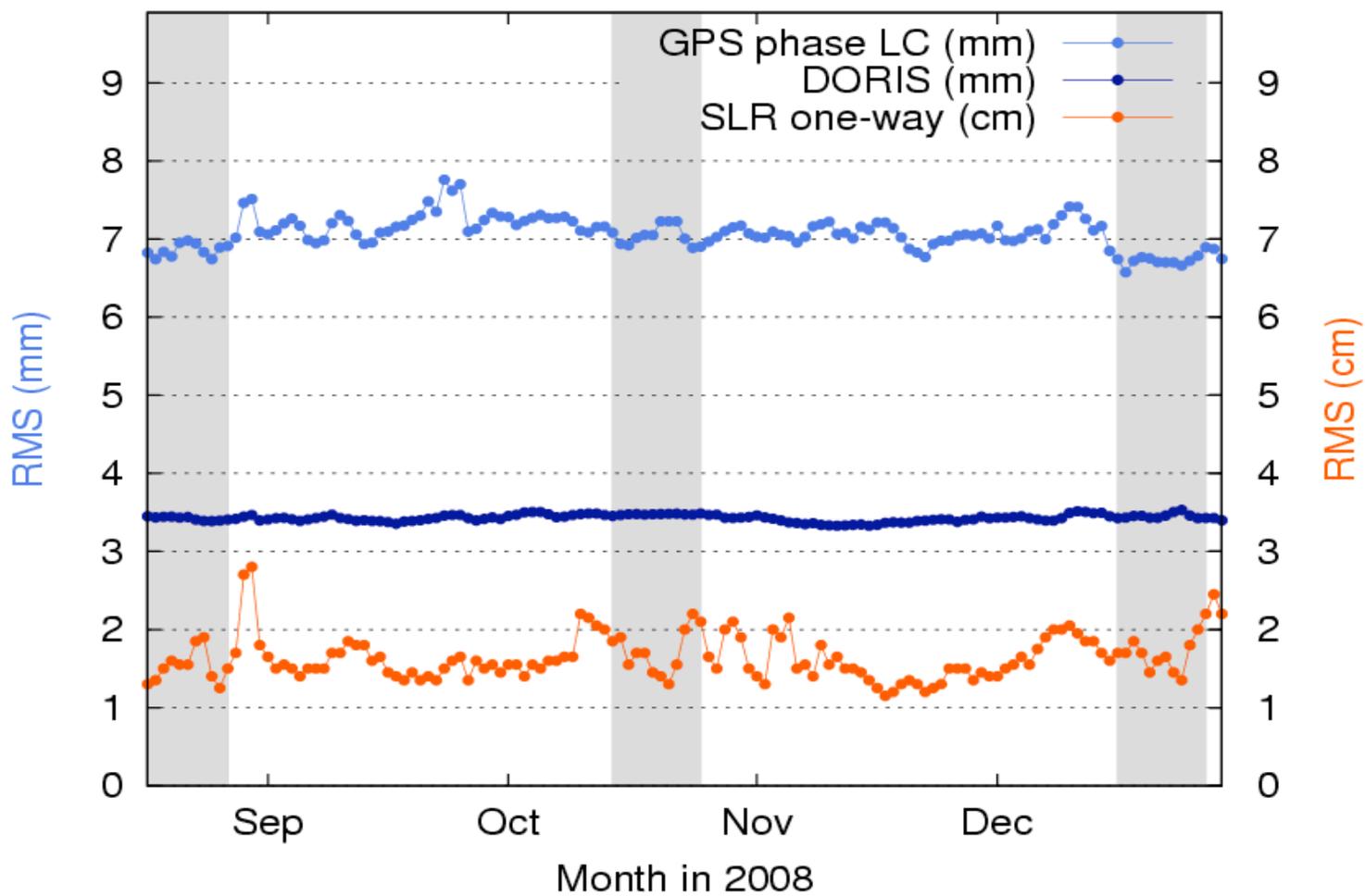
- 10° elevation cut-off
- Weight: 0.35 mm/s
- Pass-specific tropospheric zenith delay estimated
- Frequency bias per pass estimated

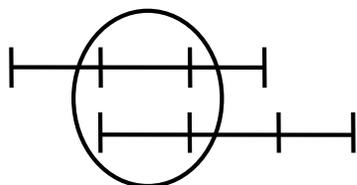
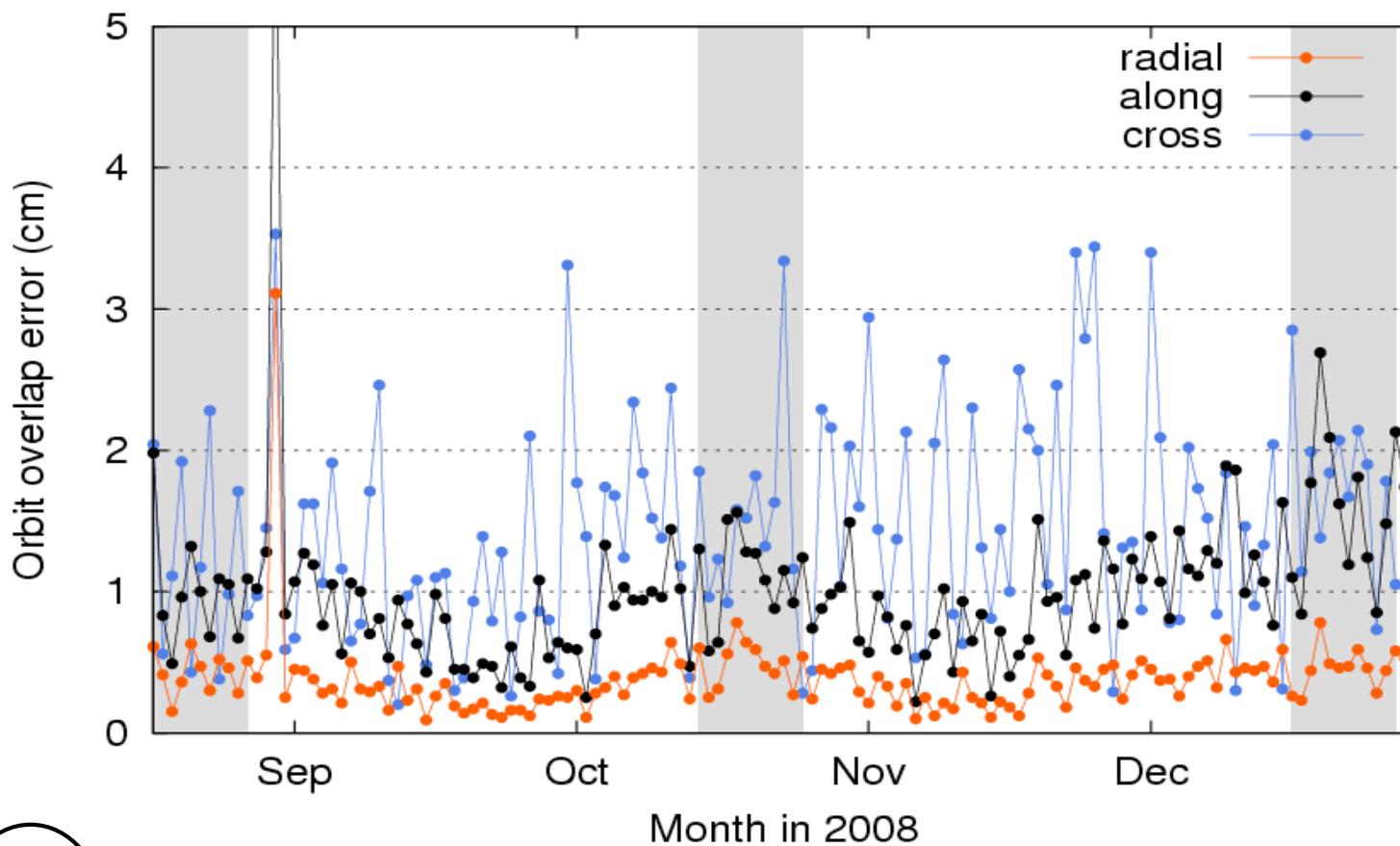
SLR

- 7° elevation cut-off
- Weight: 10 cm
- Retro-reflector: constant correction of 4.9 cm for all stations applied

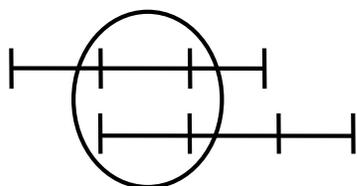
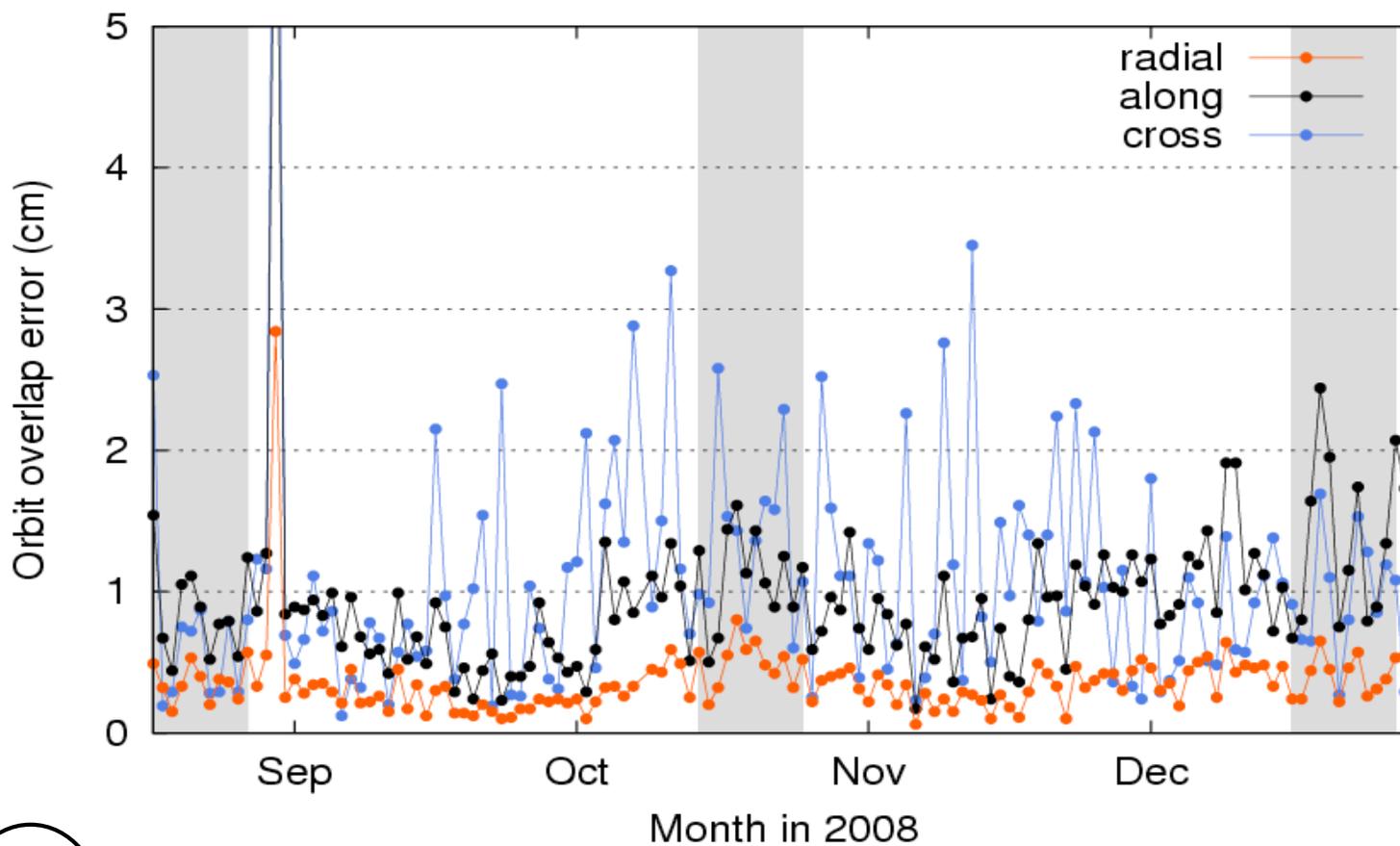
GPS

- 7° elevation cut-off
- Weight: 1 cm for phase, 1 m for code
- ESA orbits and clocks (30 sec)
- No elevation-dependent weighting applied
- Extended ANTEX correction used for GPS satellites (< 17°)

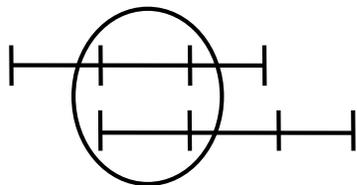
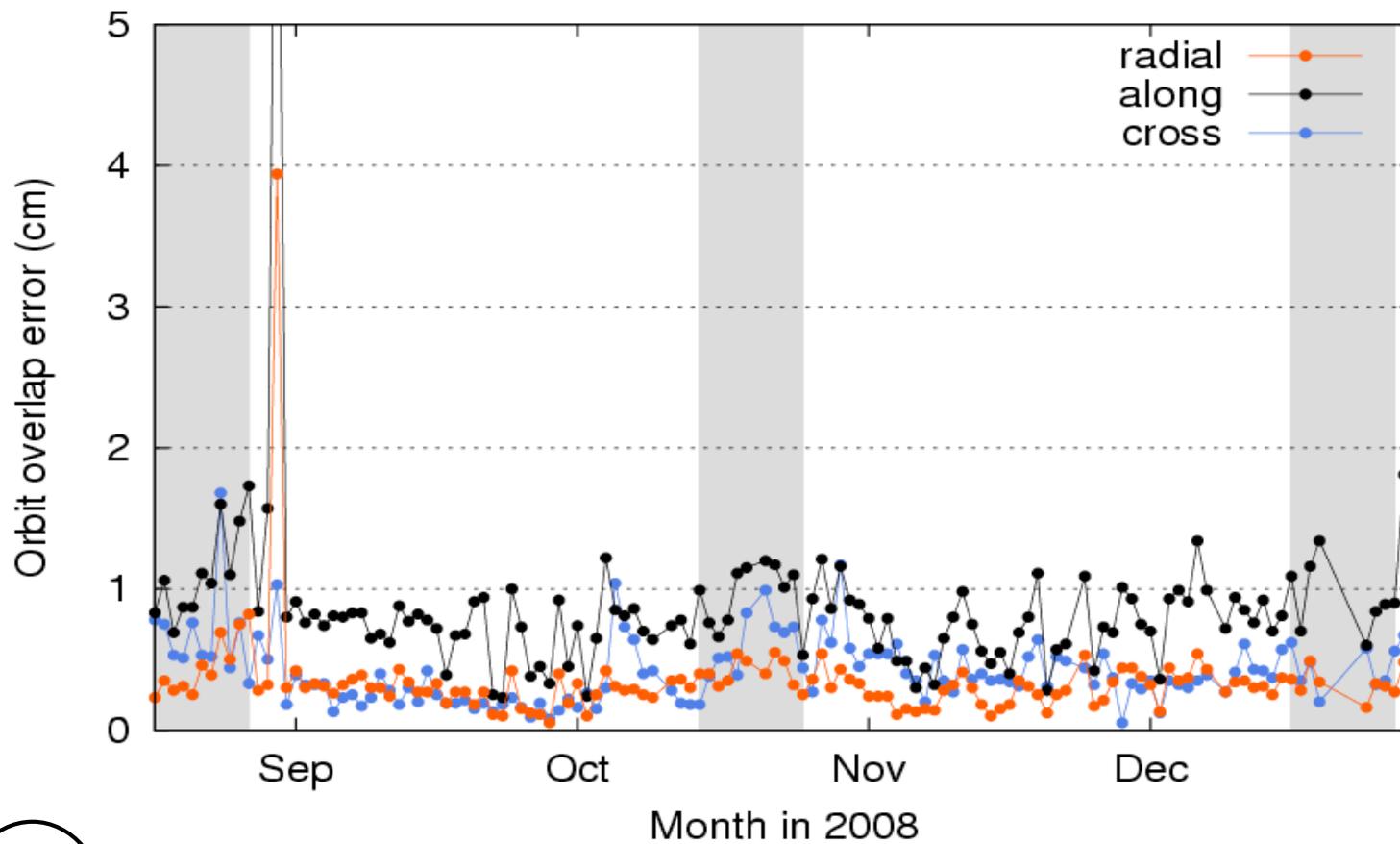




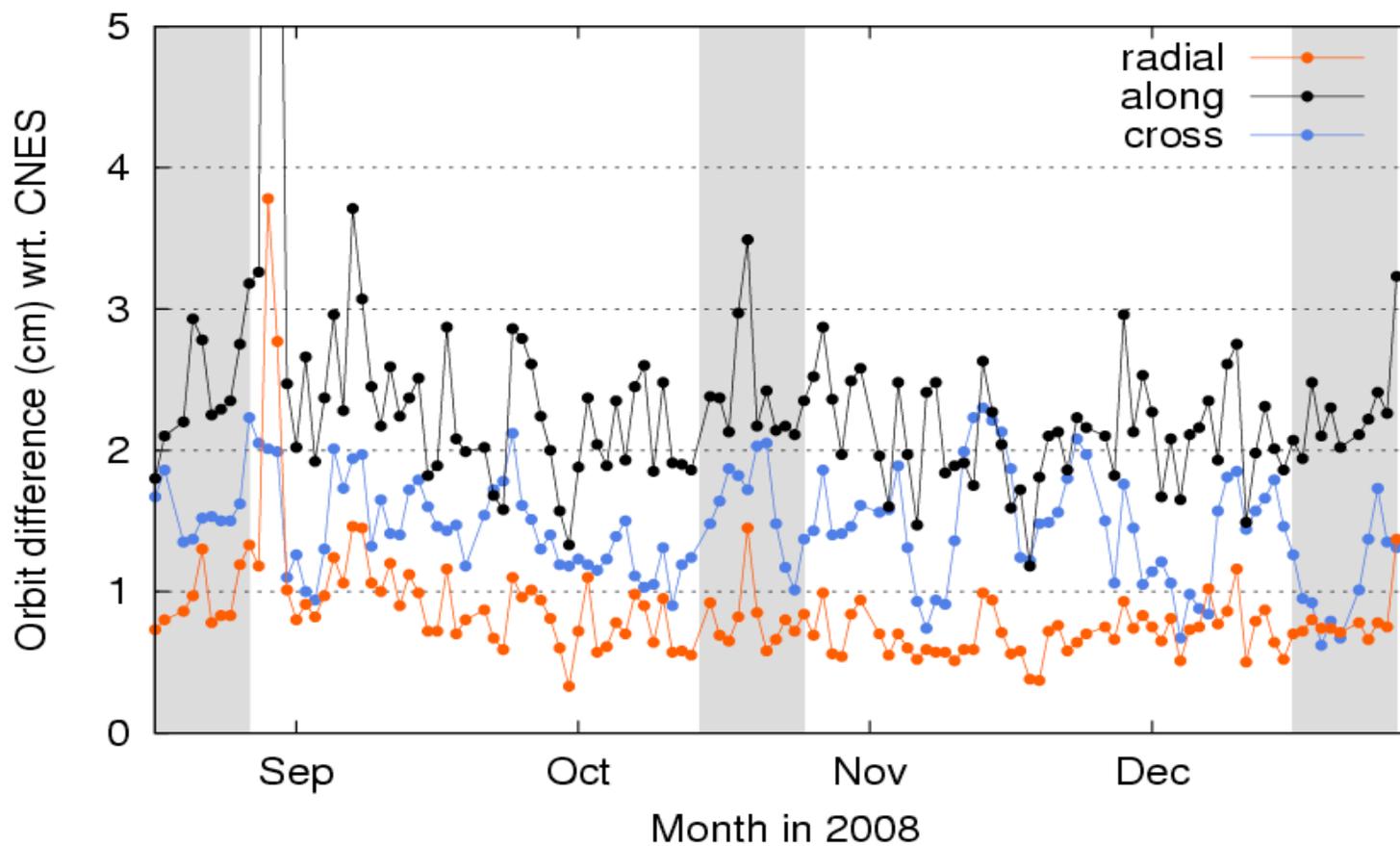
DORIS -- Only



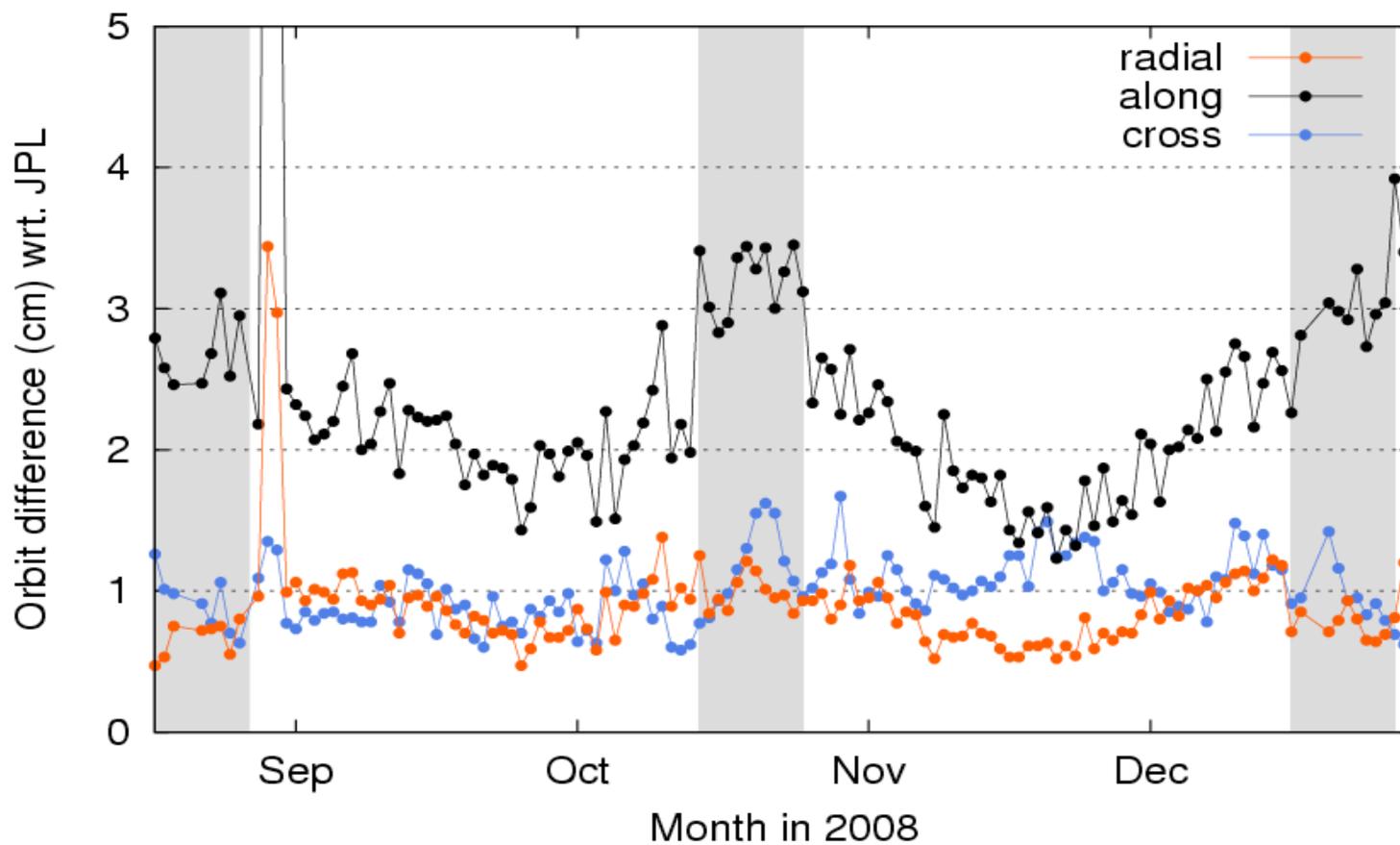
DORIS + SLR



DORIS + SLR + GPS



ESOC (D+S+G) compared to CNES (D+S)



ESOC (D+S+G) compared to JPL (G)

ESOC Analysis Centre Activities

- Current Reprocessing Focus:
 - Reprocessing the individual techniques and get a proper ITRF2008
- Future Enhancements
 - 2009
 - » Combine GNSS, SLR, and DORIS on the observation level
 - Add SLR measurements from GPS and GLONASS
 - » Use local site-ties (with full covariance information) where possible
 - » Derive the GNSS phase center maps “directly”
 - 2010
 - » Add GPS LEO’s to the reprocessing
 - Will make the link between the techniques much stronger!
 - » Add VLBI to the reprocessing

**Combination of the techniques will be key for future progress!
There is only one Earth system**