ESA/ESOC Status

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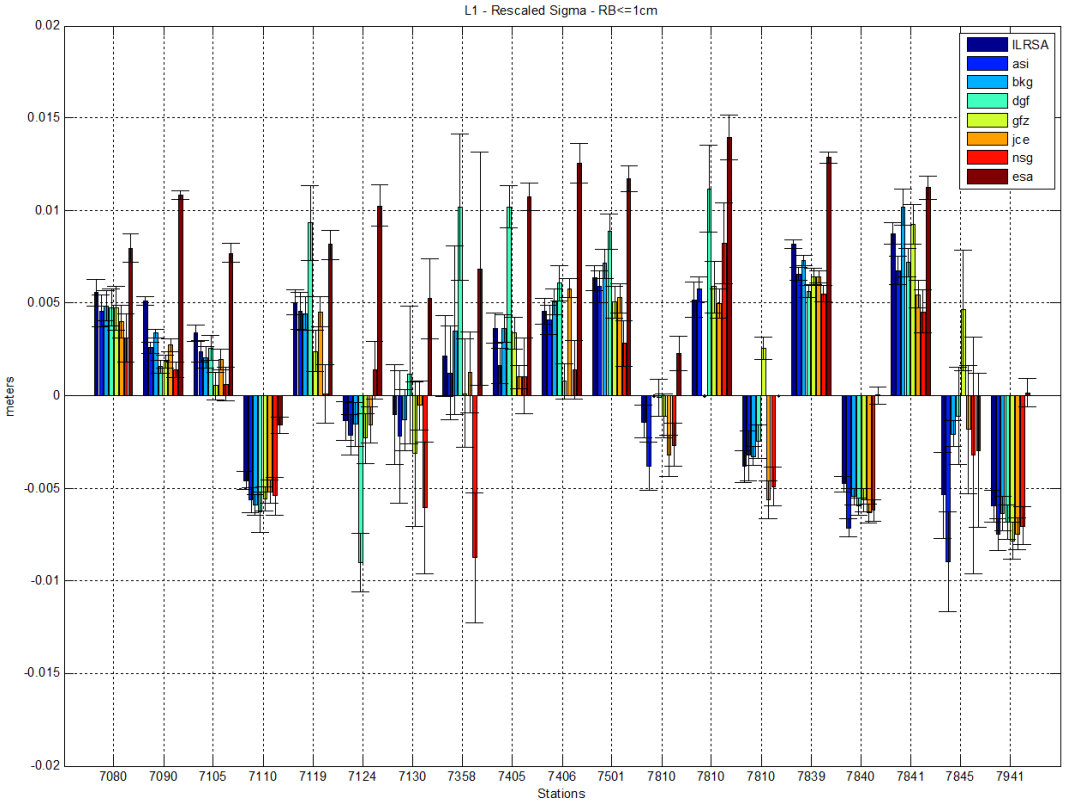
ESA/ESOC Navigation Support Office

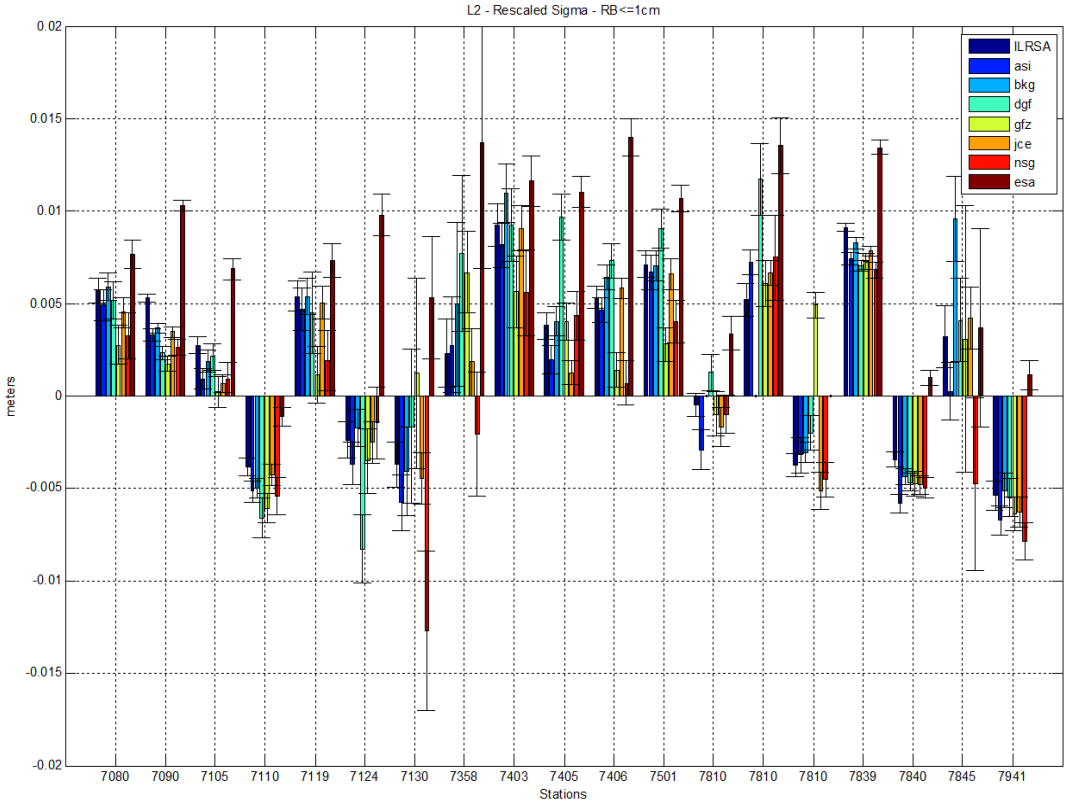
Content

- Issues in BIAS PP
- Status regarding future ILRS plans
- Other ILRS/SLR related activities and plans
    - LARGE working group!?

BIAS PP ISSUE (plots courtesy of Cinzia and Paolo)



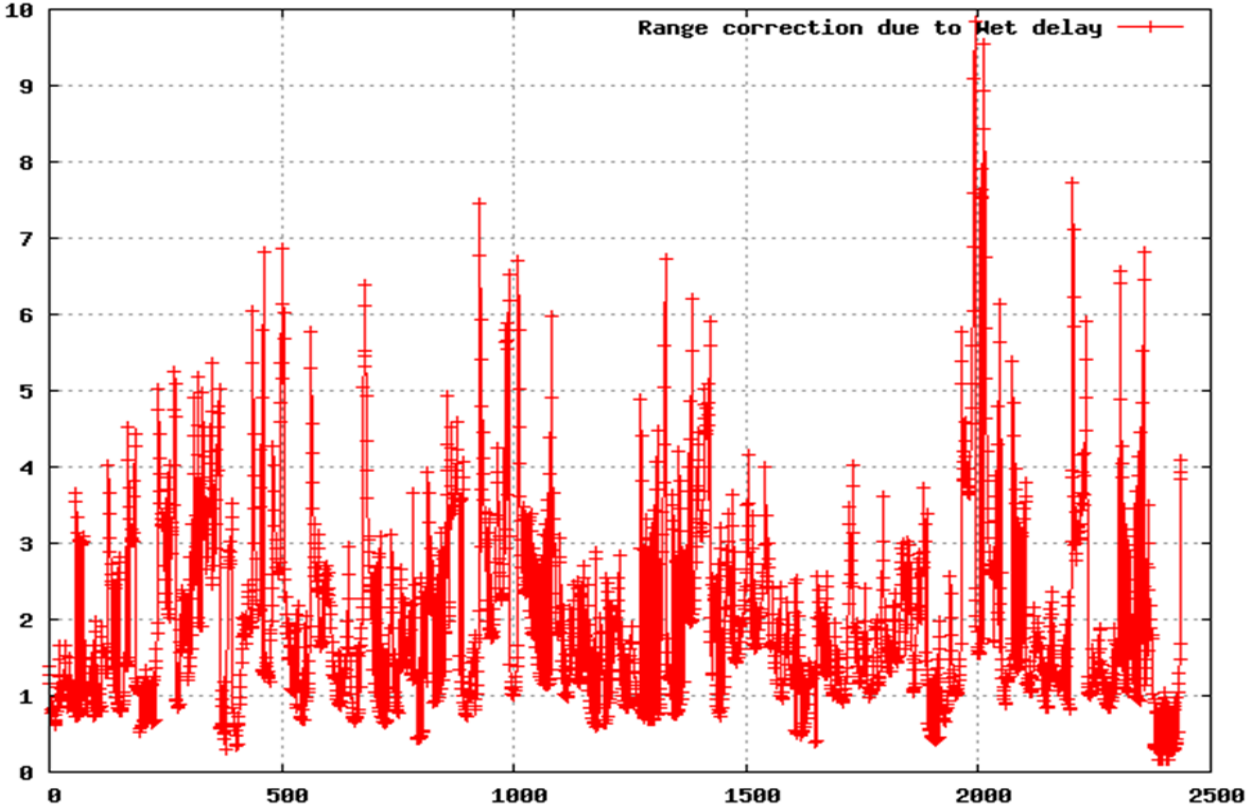
BIAS PP ISSUE (plots courtesy of Cinzia and Paolo)



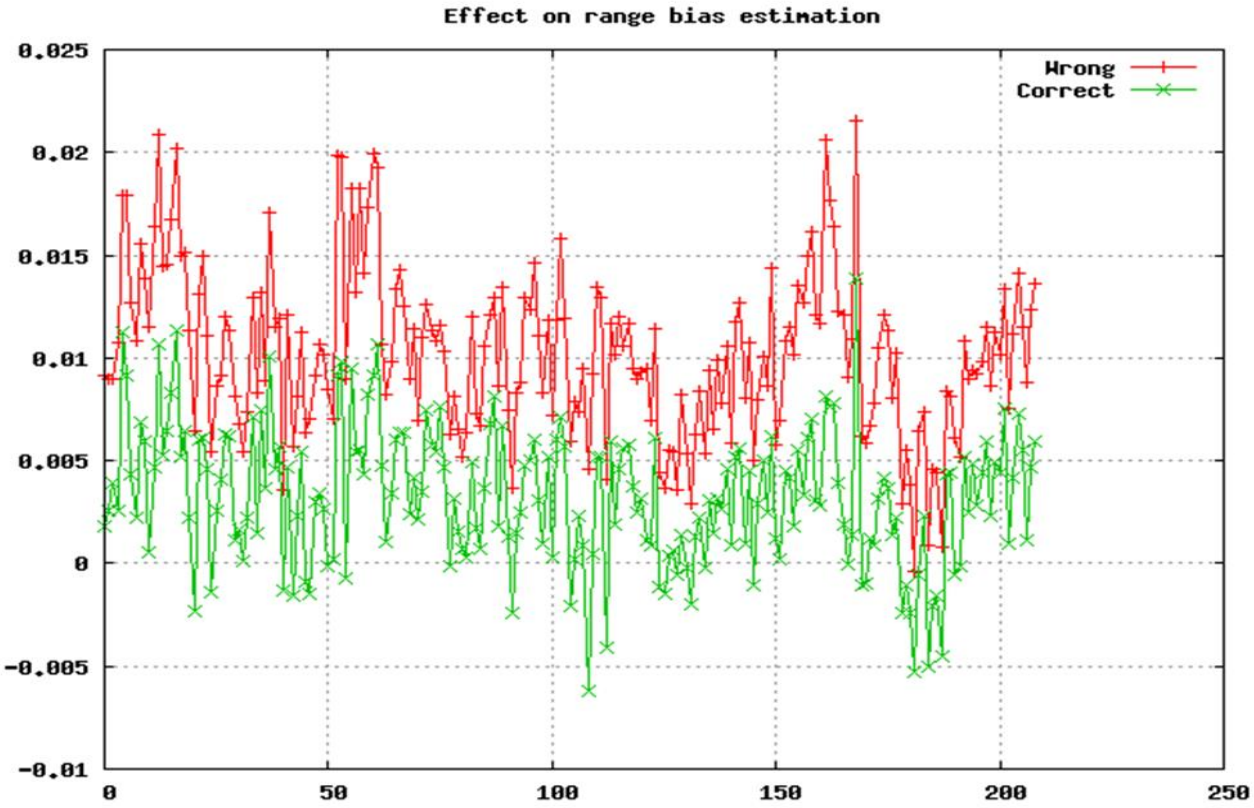
BIAS PP Issue

- A clear bias was observed in the ESA solutions for all stations
  - In particular also for good stations which should have hardly have a bias
- At ESA many tests were done to investigate the issue
  - Only test which showed a similar performance was switching the troposphere from the new Mendez-Pavlis model to the old Marini-Murray model, indicating that something in the troposphere model was most likely causing the issue.
  - In the end the effect was found “deep down” in the software being caused by an option which should only be used for Altimetry processing but was incorrectly also active for GNSS and ILRS under certain circumstances.
  - Was causing the “wet” troposphere effect to be set to zero.

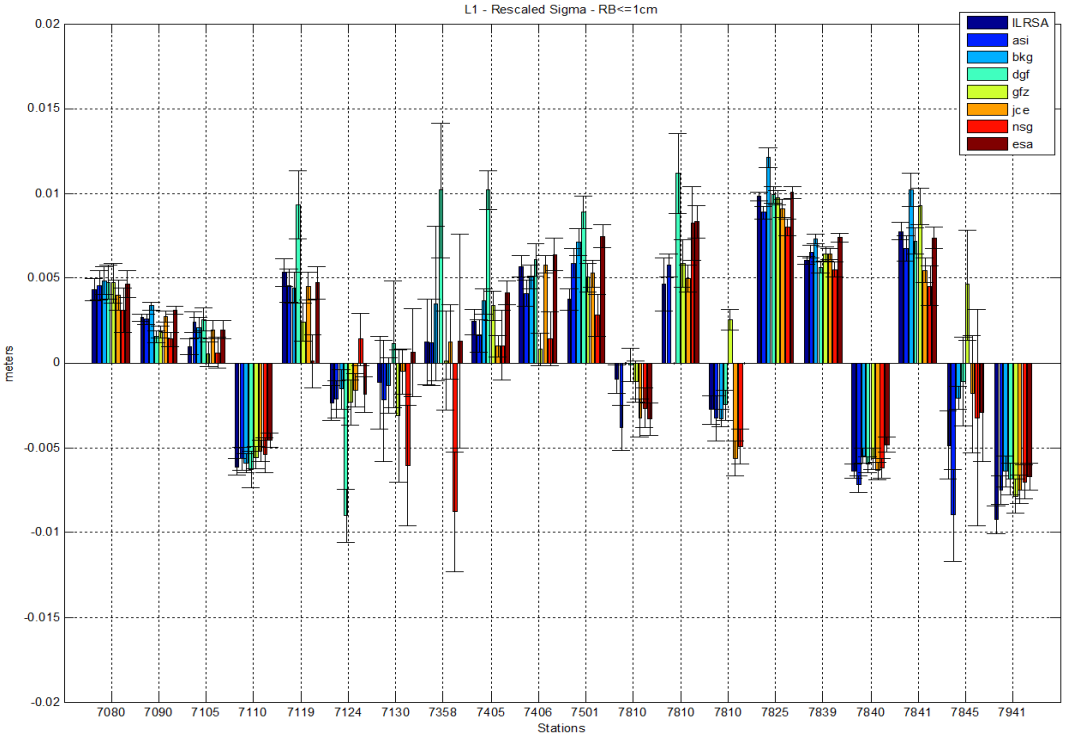
Range correction due to Wet delay



Effect on Range Bias estimation (station 7090)



ISSUE Resolved (plots courtesy of Cinzia and Paolo)



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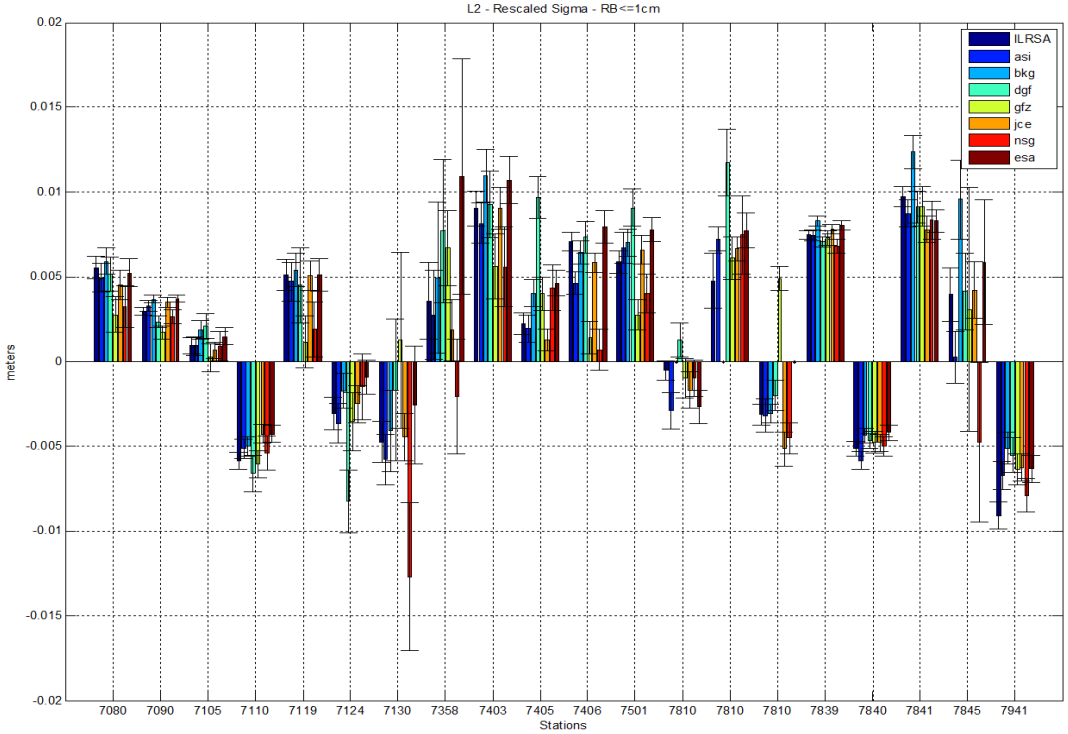


Status of ESA/ESOC ILRS AC

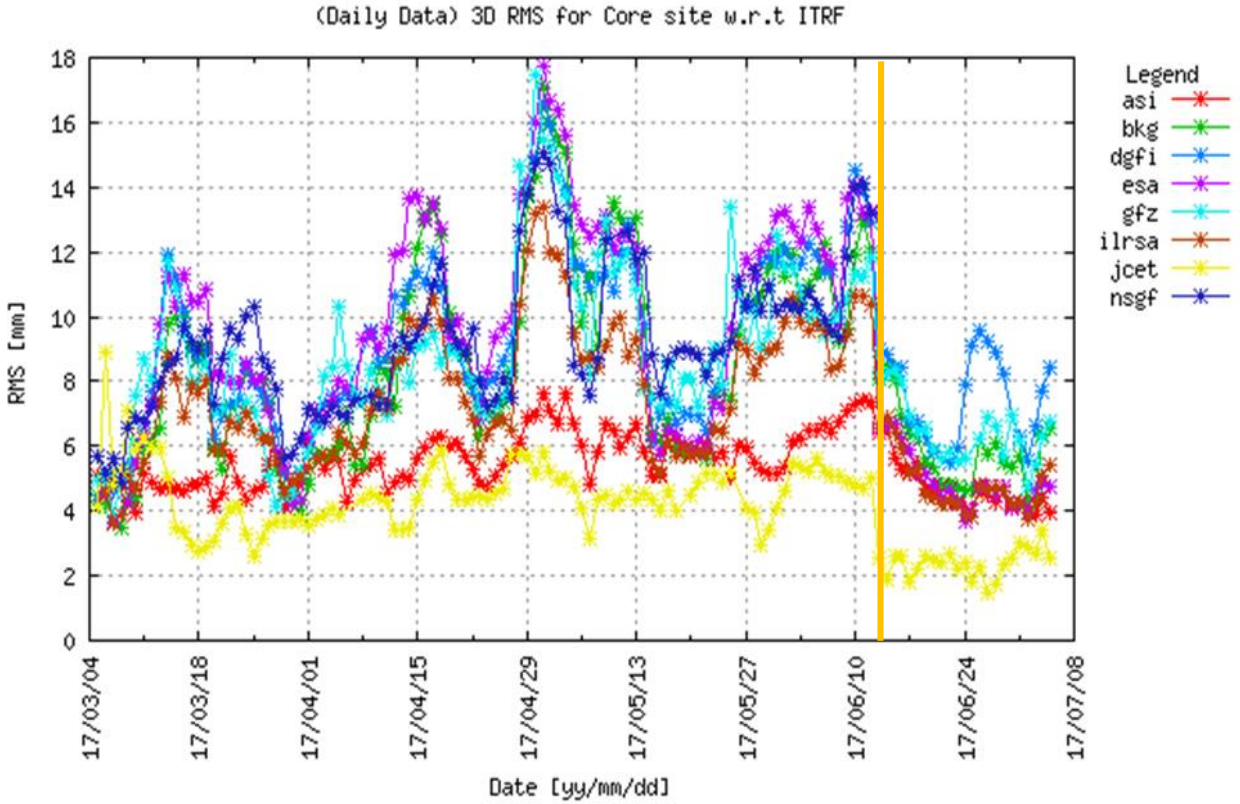
ESA/ESOC AC Status

- Reprocessing for ITRF2104 was used to improve our processing scheme
  - Discovered that estimation constant cross track force was sub-optimal
  - Most significant change was station data weighting
  - We now use 4 groups: CORE, Good, OK, and rest

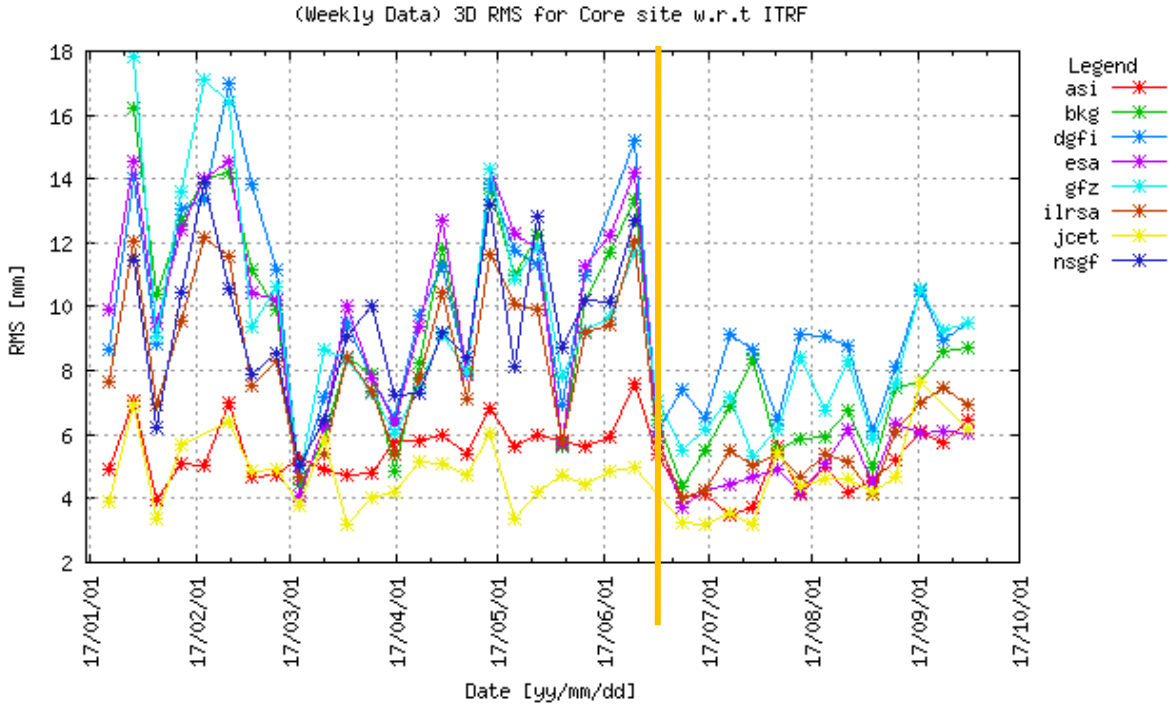
- Switch to using our processing strategy developed for the ILRS reprocessing
  - At same time as the switch to ITRF2014

- All our solution were affected in scale by the tropo bias
  - Must be a visible “jump” in our scale since our recent bug fix

Improvement in 3D RMS for ESA after switch

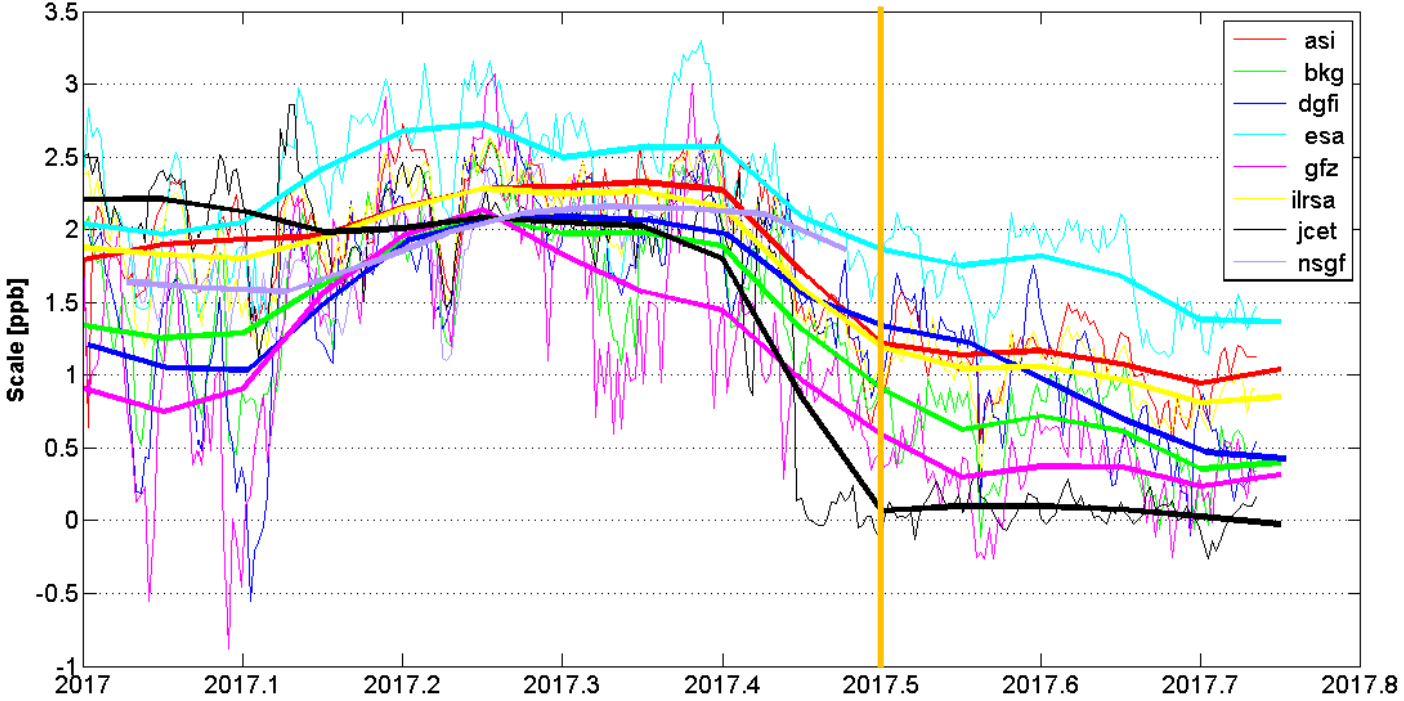


Improvement in 3D RMS for ESA after switch



ESA Scale issue. Should have improved now!

But still on the high side.



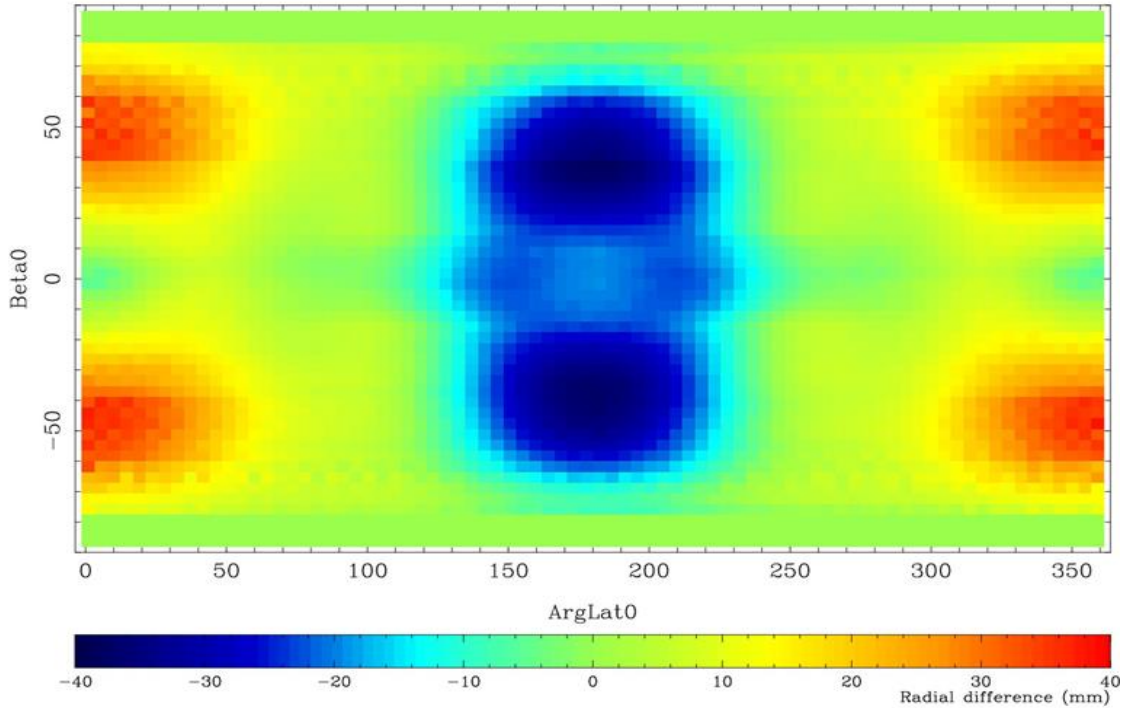
Open Issues

- Bias per station per wavelength
  - Only works for one wavelength
  - Some work needed to handle stations with multiple wavelengths
- SINEX with gravity field coefficients
  - Not 100% sure that the partials are correct
  - Otherwise fully ready for LARES (SRP coefficient?)
- Time biases to be tested/reviewed
  - 1-way versus 2-way issue in our software
  - Simple enough so no issue expected
- Detailed tests of sub-daily ERP planned
  - So far did not notice much in the ILRS solutions
  - Gipson model tested, Sibois model to be tested
- Several different mean pole motions available in the software, no issue there.

Other ILRS/SLR Activities at ESA/ESOC

GPS Radial Orbit Differences

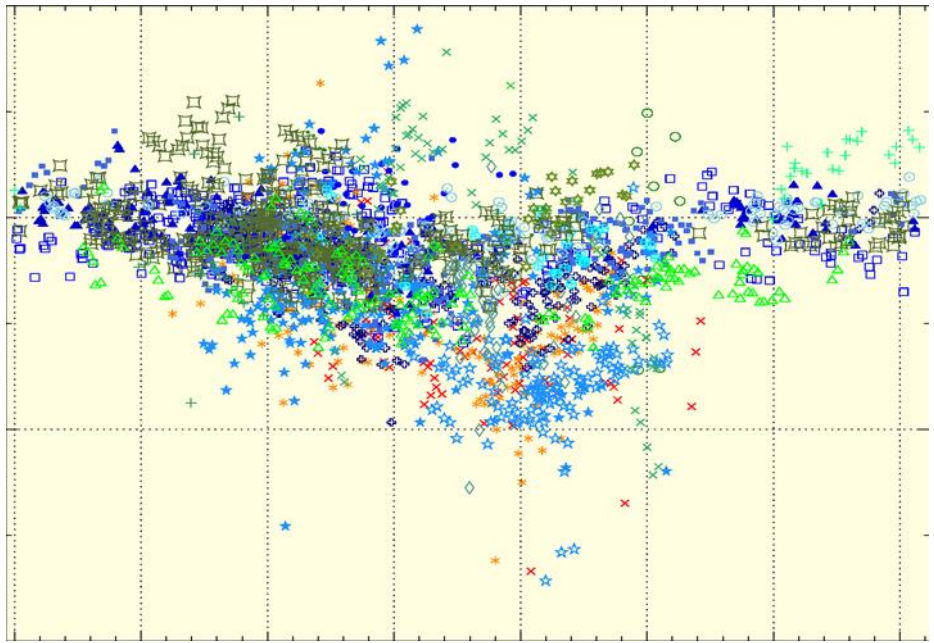
GPS-IIA no-model vs box-wing model



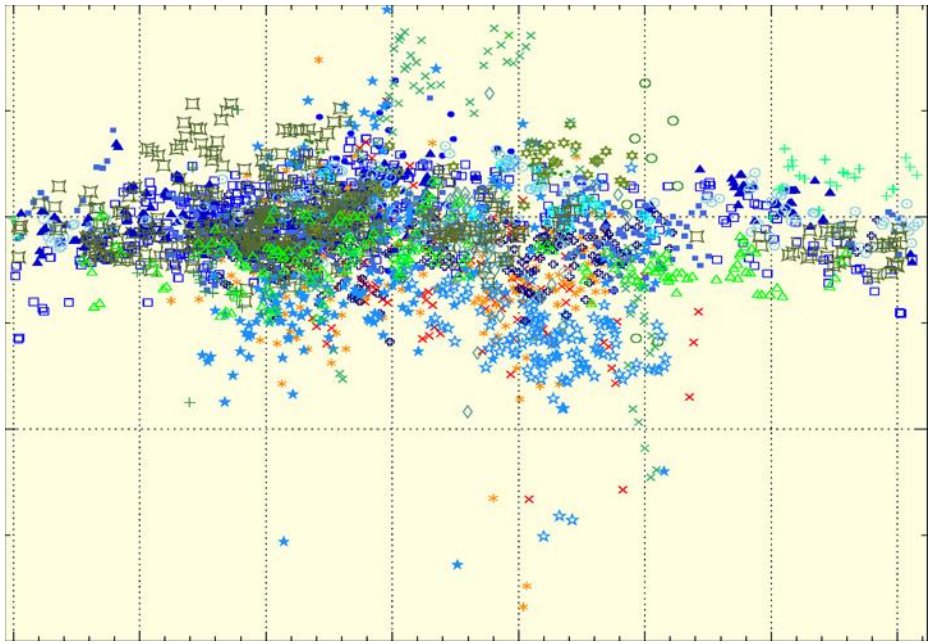
GPS SLR Orbit Validation

SLR residuals (2-way) GPS-IIA

without box-wing

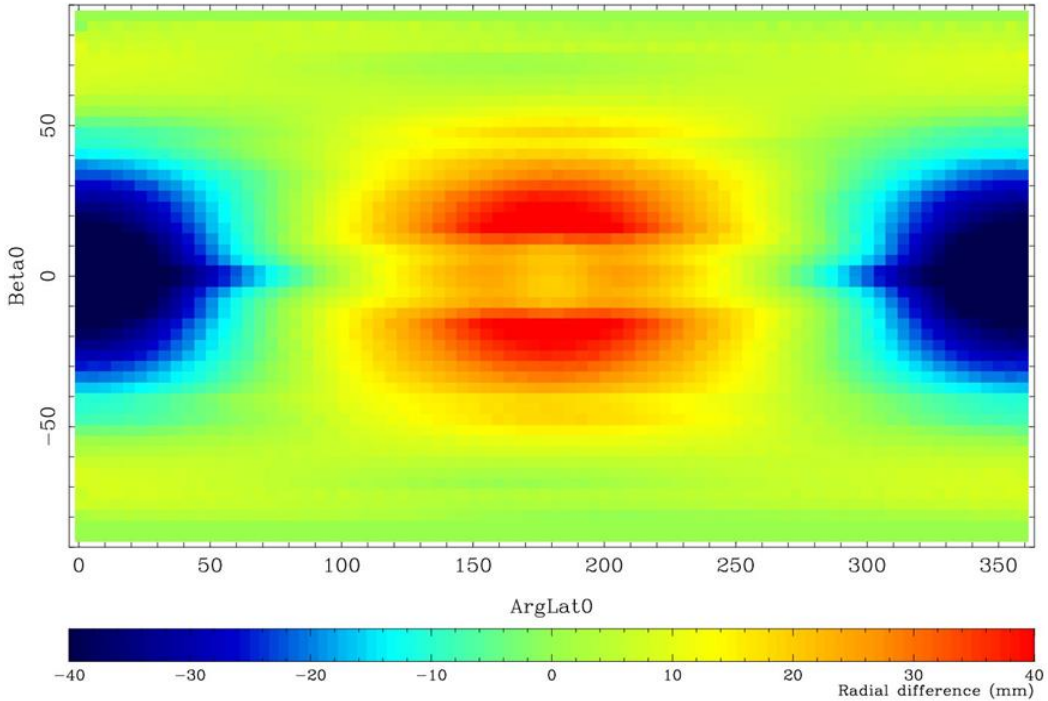


with box-wing



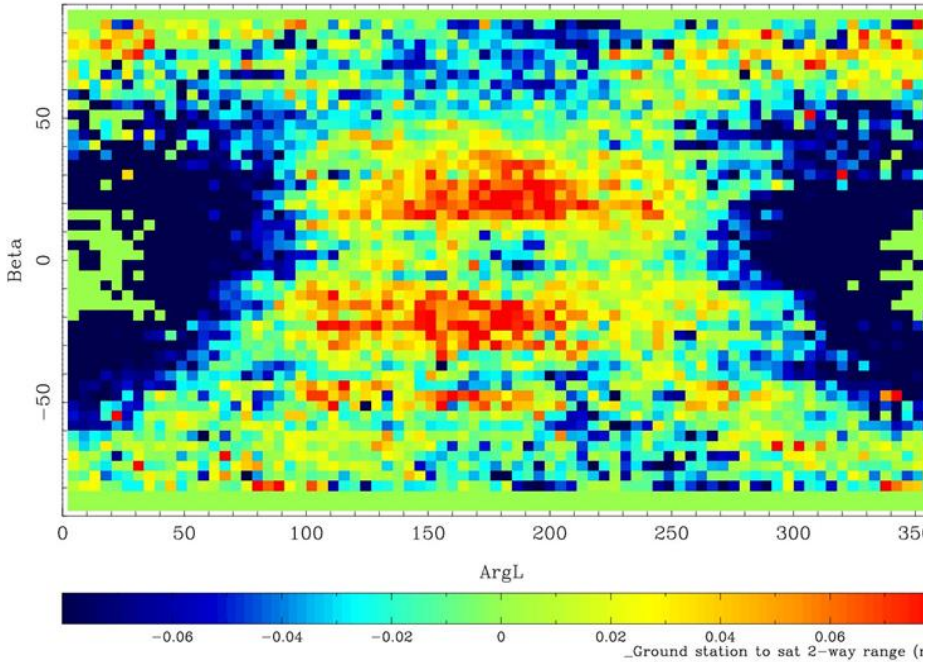
GLONASS Radial Orbit Differences

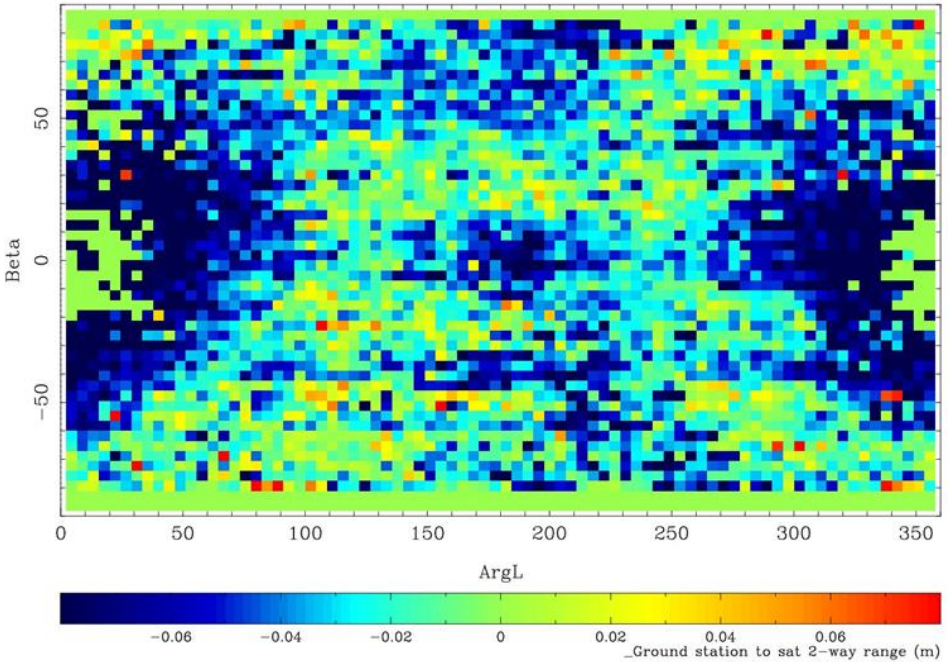
GLONASS no-model vs box-wing model



GLONASS SLR Orbit Validation

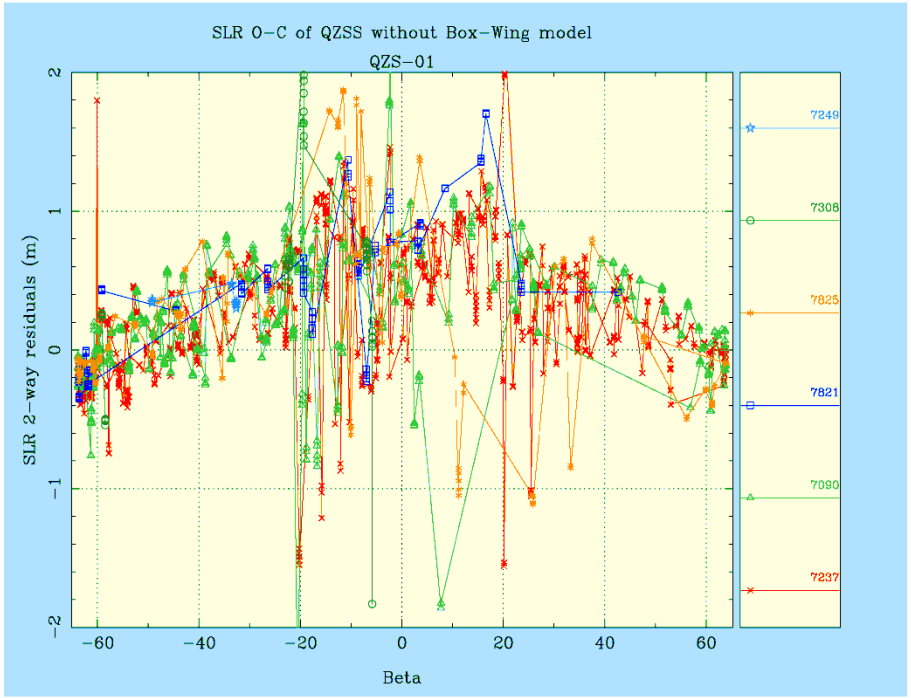
no-model vs box-wing model

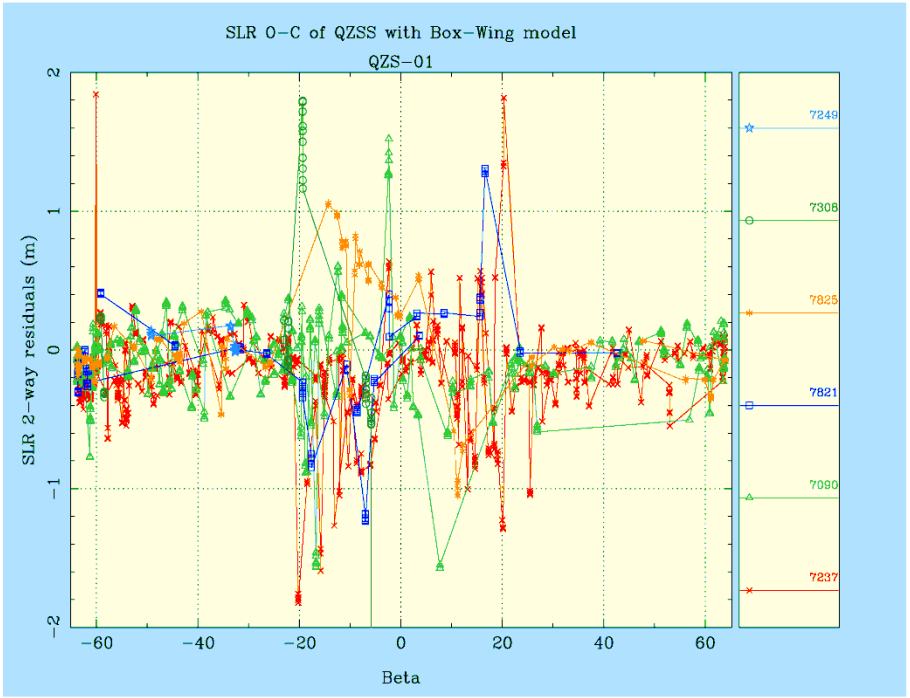




QZSS SLR Orbit Validation

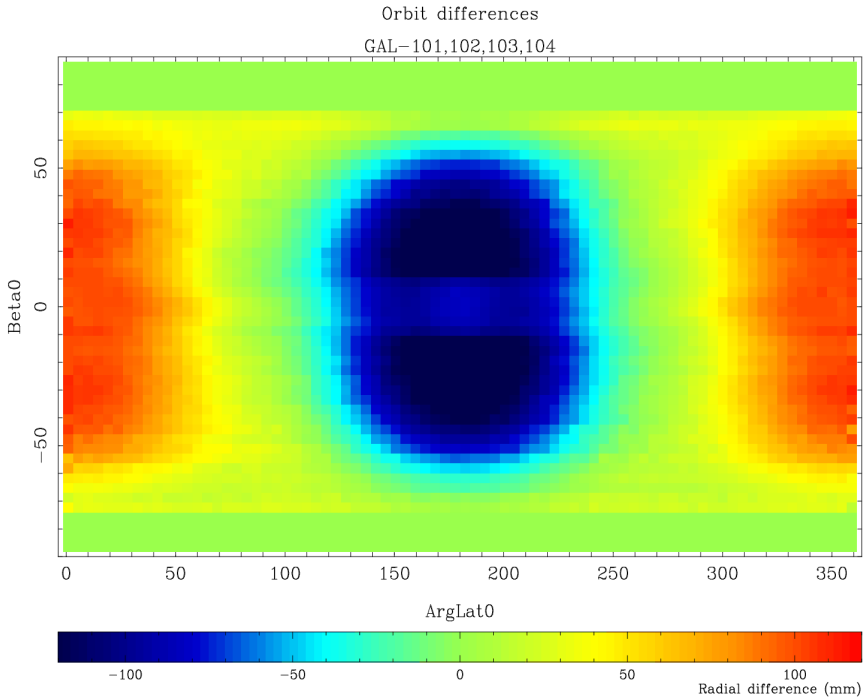
no-model vs box-wing model

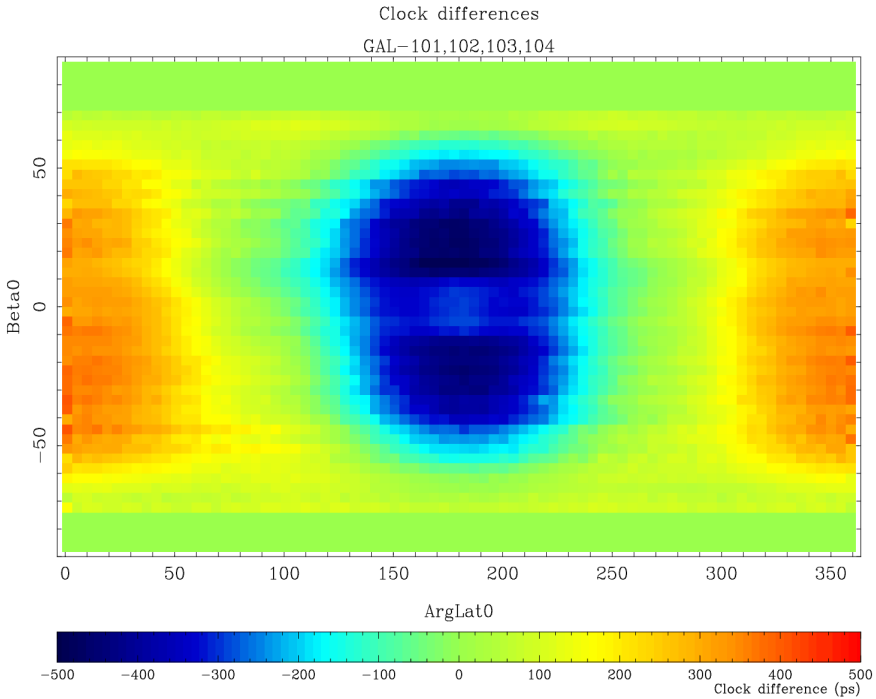




GALILEO Radial Orbit Differences

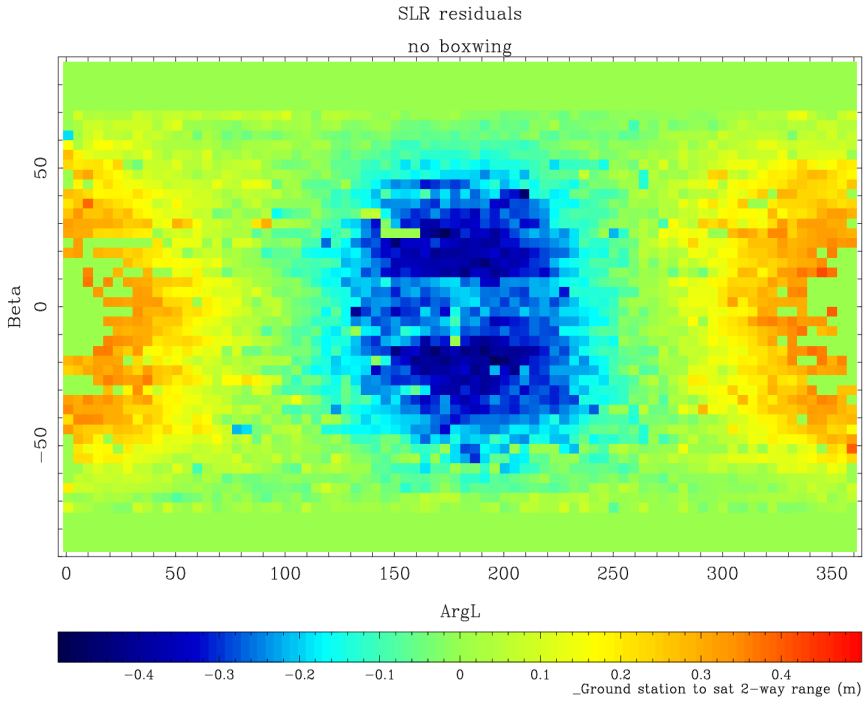
GALILEO no-model vs box-wing model

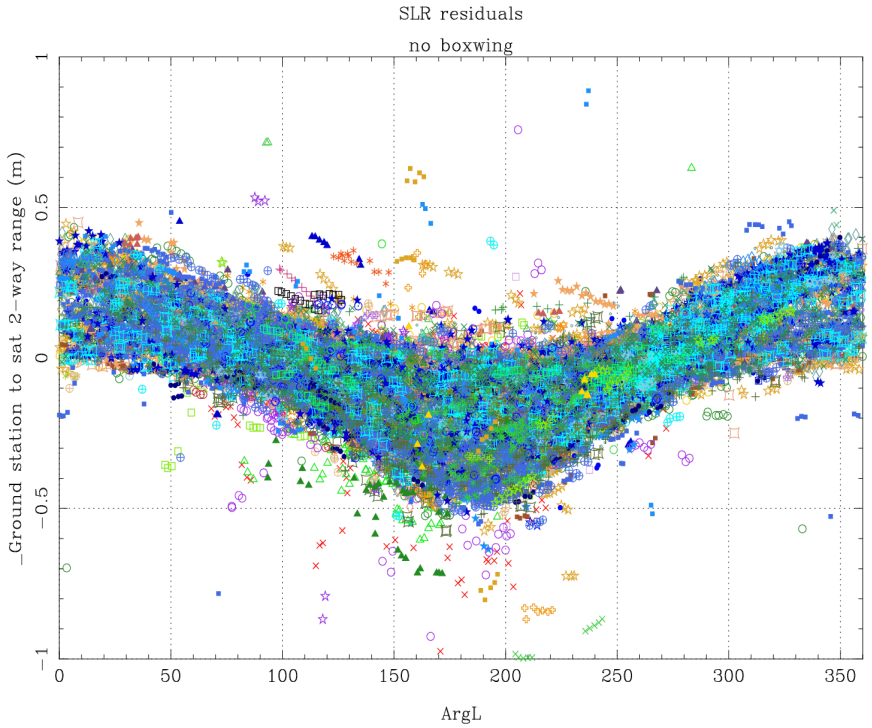




GALILEO SLR Residuals without Box-Wing model

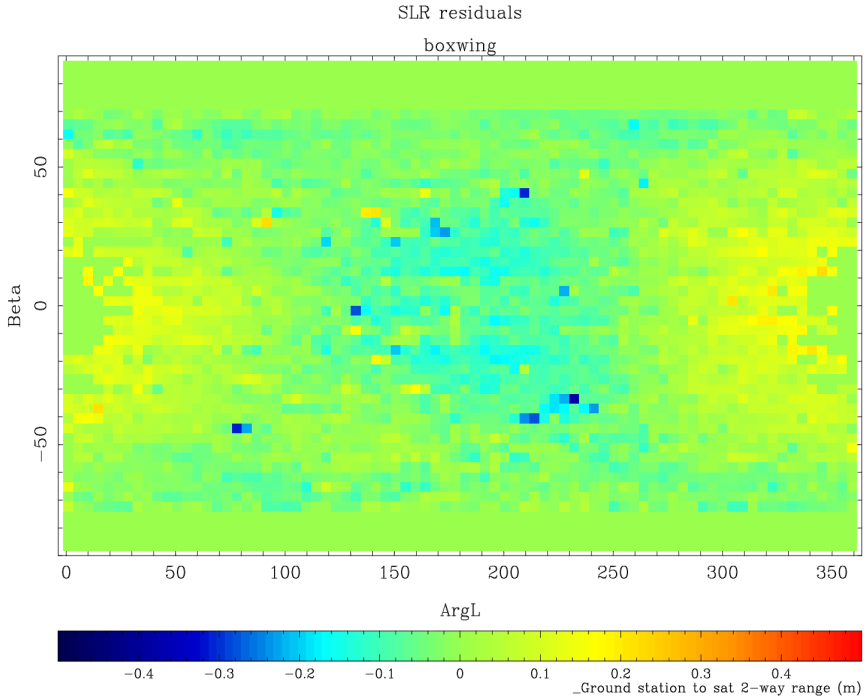
GALILEO no-model vs box-wing model

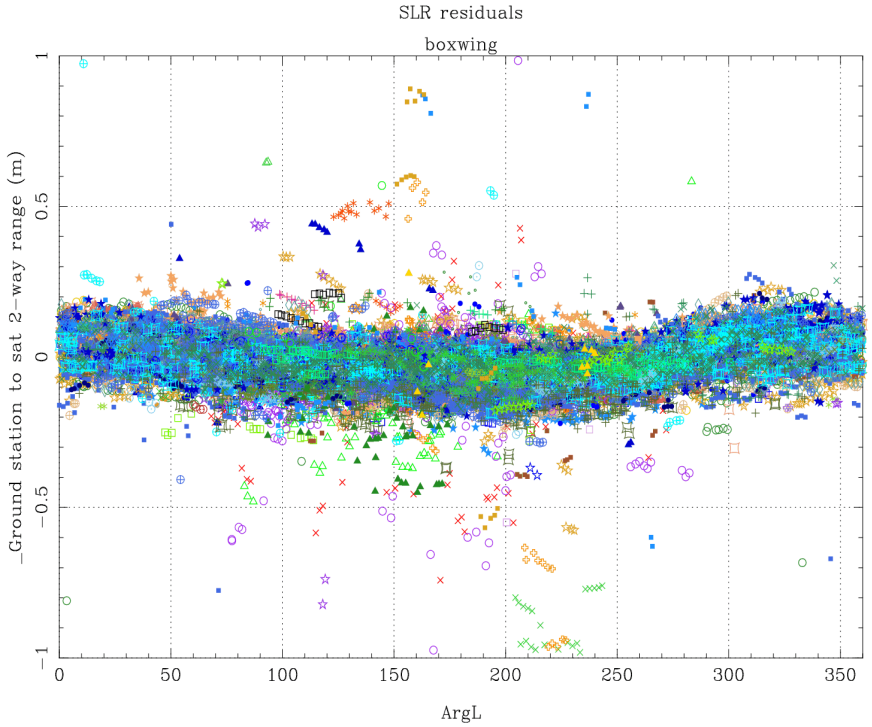




GALILEO SLR Residuals with Box-Wing model

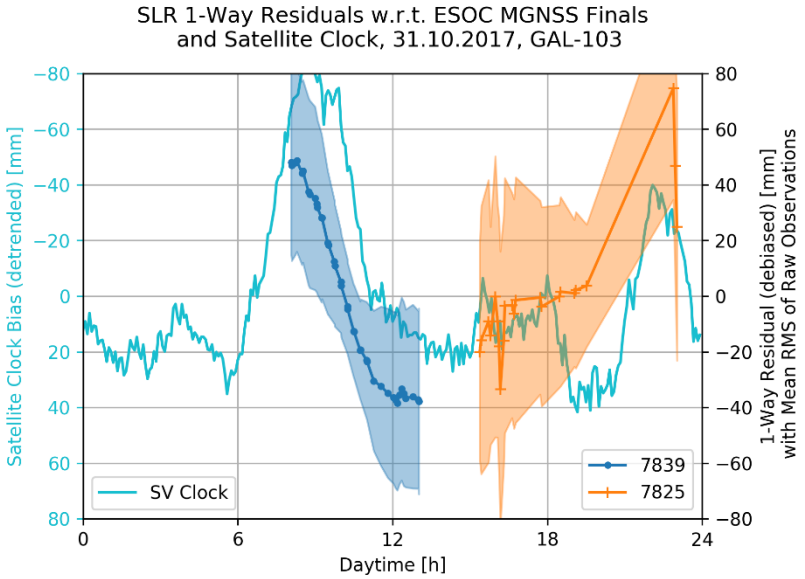
GALILEO no-model vs box-wing model

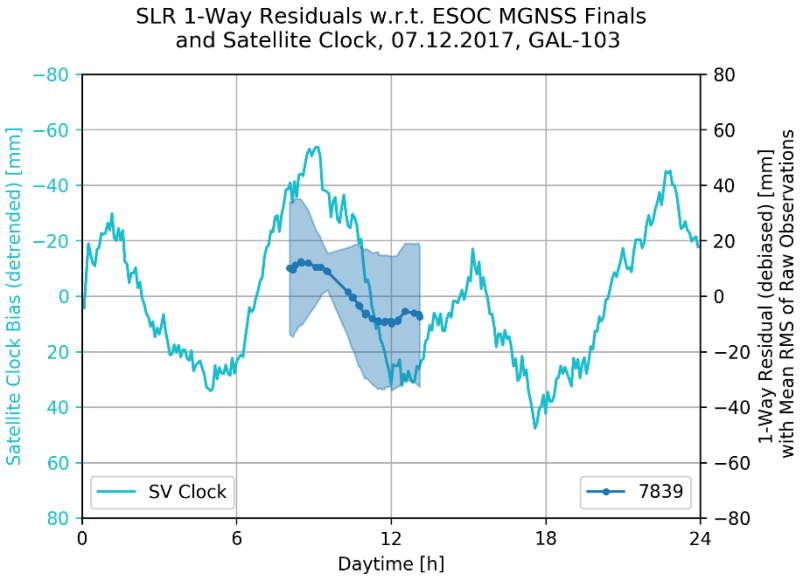




Example analysis

Comparison of Orbit Residuals and Clock Bias



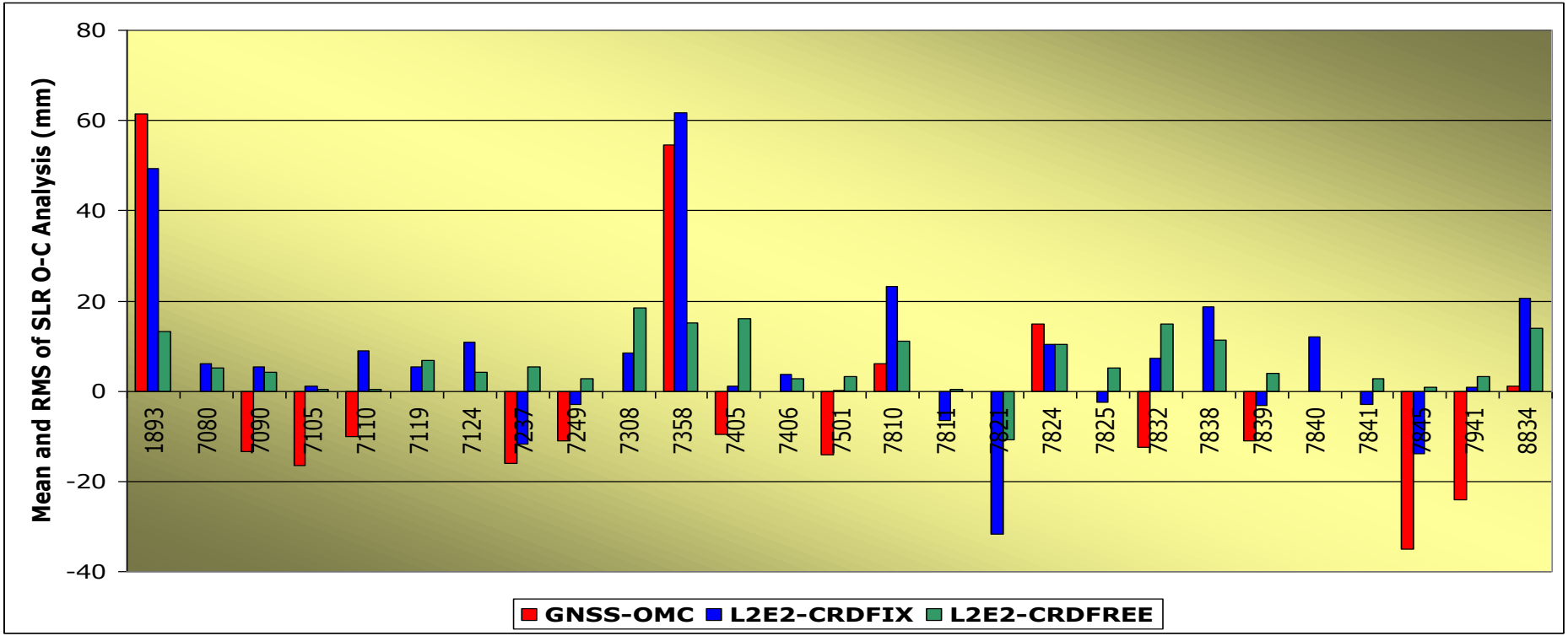


SLR residuals confirm orbit effects on clock estimate.

Significant differences in NP accuracy/systematics between stations.

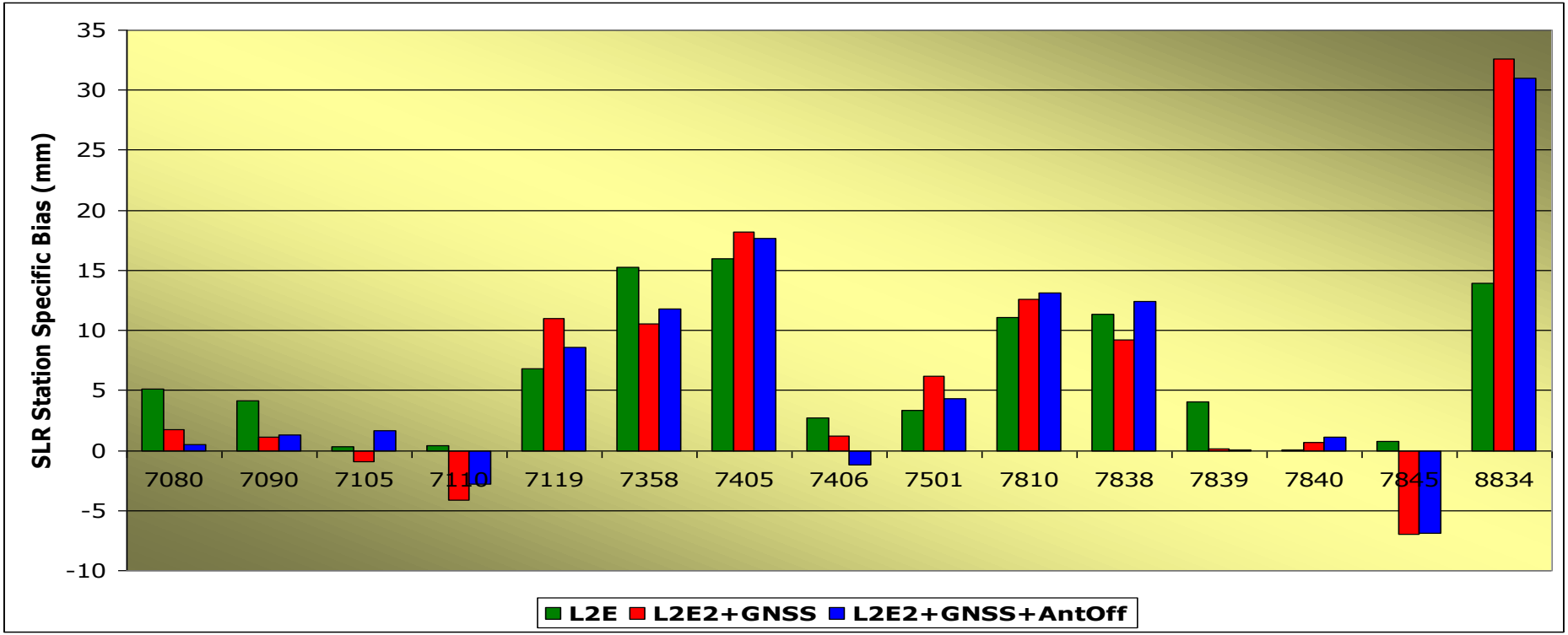
Combined ILRS + IGS Analysis + SLR observations of the GNSS targets

SLR Station Specific Mean of Residuals
GNSS OMC and SLR(L2E2) (from 2009) (2-way)



Good agreement for large biases (coordinate issues?)!
SLR(L2E2) biases mostly positive, GNSS OMC biases negative

SLR Station Specific Range Biases (2-way)
GNSS + SLR(GNSS) + SLR(L2E2) (from 2009)



Combination of GNSS and SLR works.
Biases in good agreement. Some significant GNSS influence visible

Discussion / Outlook

- Combination on the obervation Level (CooL) of SLR and GNSS is very strong!
  - Issue with 8834 (Wetzel) showed up very clear in the 2009 combined analysis
  - When it was later (2010 or even 2013?) detected this made us realize how strong this combo is!
- But in 2010 we gave up on this CooL combo because
  - No more GPS with SLR reflectors
  - SLR tracking of GLONASS more noisy
  - GLONASS orbits worse then GPS
- Now (2018) SLR+GNSS CooL becomes interesting again
  - Much more and better tracking of GNSS targets
  - Galileo orbits quality equal to that of GPS, and in some aspects even better
  - All Galileo satellites have SLR reflectors
  - GLONASS orbits meanwhile also significantly better then in 2010
- What kind of tracking of the GNSS makes most sense for CooL
  - Make LARGE GREAT again!?