

ESA Reprocessing: Advances in GNSS analysis

**Tim Springer, Claudia Flohrer, Michiel Otten,
Werner Enderle**

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- GNSS Reprocessing is a major effort
 - 1994 to 2014 mean reprocessing ~7000 days
 - At 2 hours per daily solution this "costs" ~300 CPU days
 - Is reduced to 75 Quad-core days
 - Is reduced to 50 Hexa-core days
 - Latest Hexa-core at ESOC 2x faster than current quad cores
 - -> 25 days
- Although 25 days is a great performance it is still a significant effort
 - 1 TB of input data (RINEX)
 - 1 TB of output generated (orbit, clocks, sinex, residuals)
- Real manpower costs are in manual checking/validation of results

So why do this to yourself!?

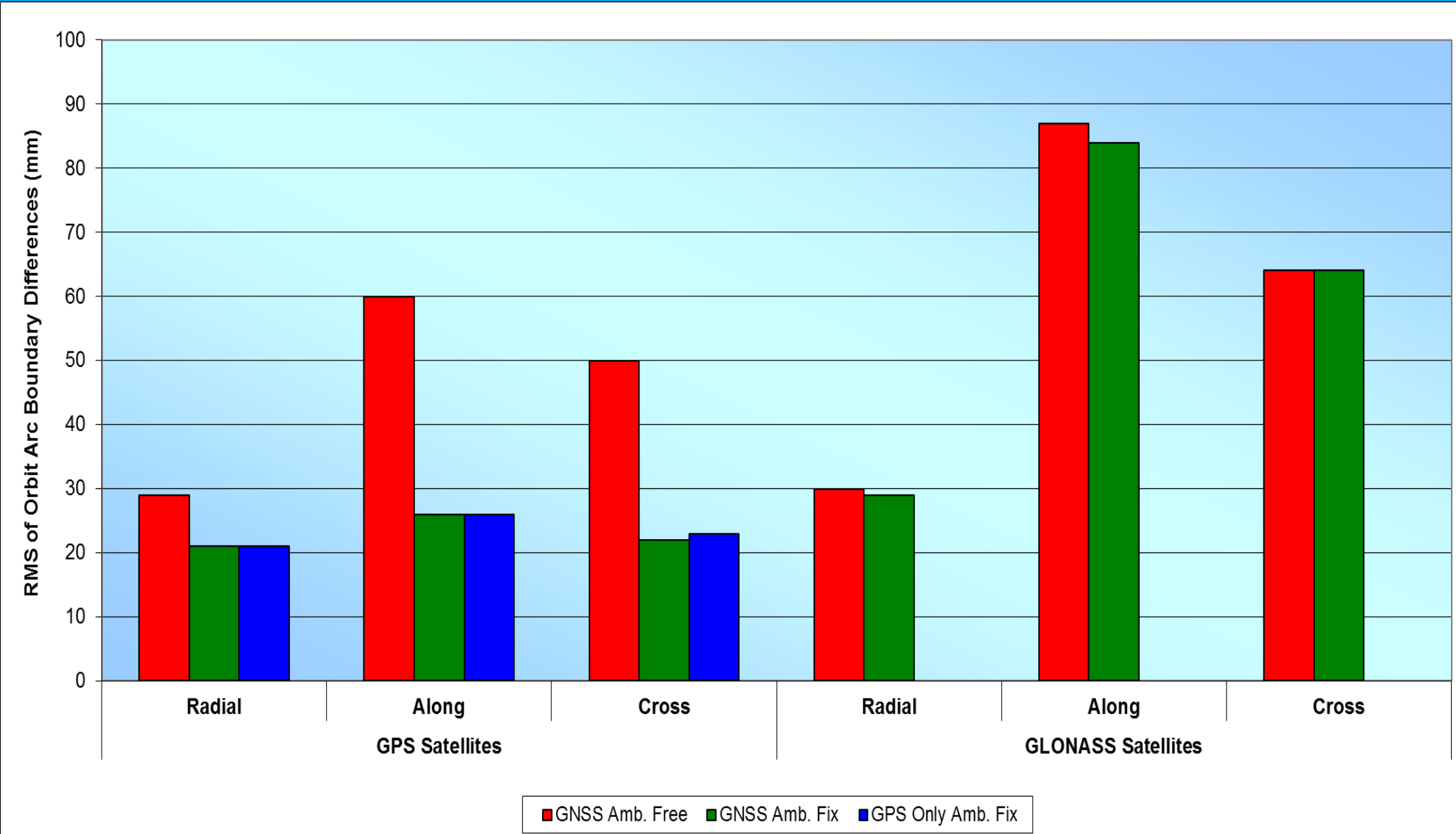
Why Reprocessing?



- Call for ITRF2013
 - But routine solutions can be used if no major changes took place
- Significant changes in the processing strategy
 - Reference Frame realization
 - Inclusion of GLONASS
 - Done in routine analysis since 2008 but not in repro1
 - Good GLONASS tracking network from 2008/2009
- Test/validate changes for the routine processing
 - Box-wing model

So we had a couple of reasons to do repro2

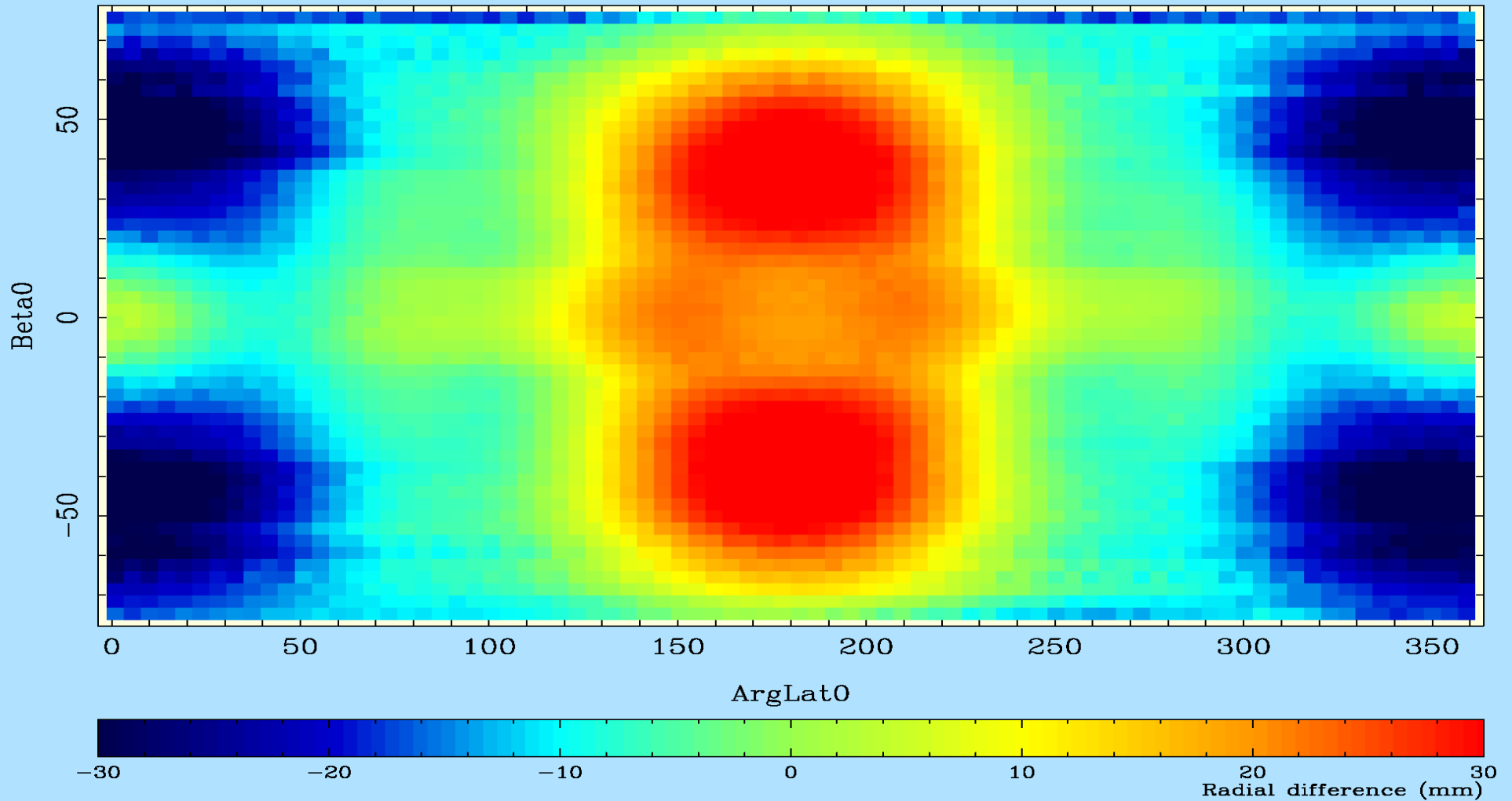
Impact of GLONASS



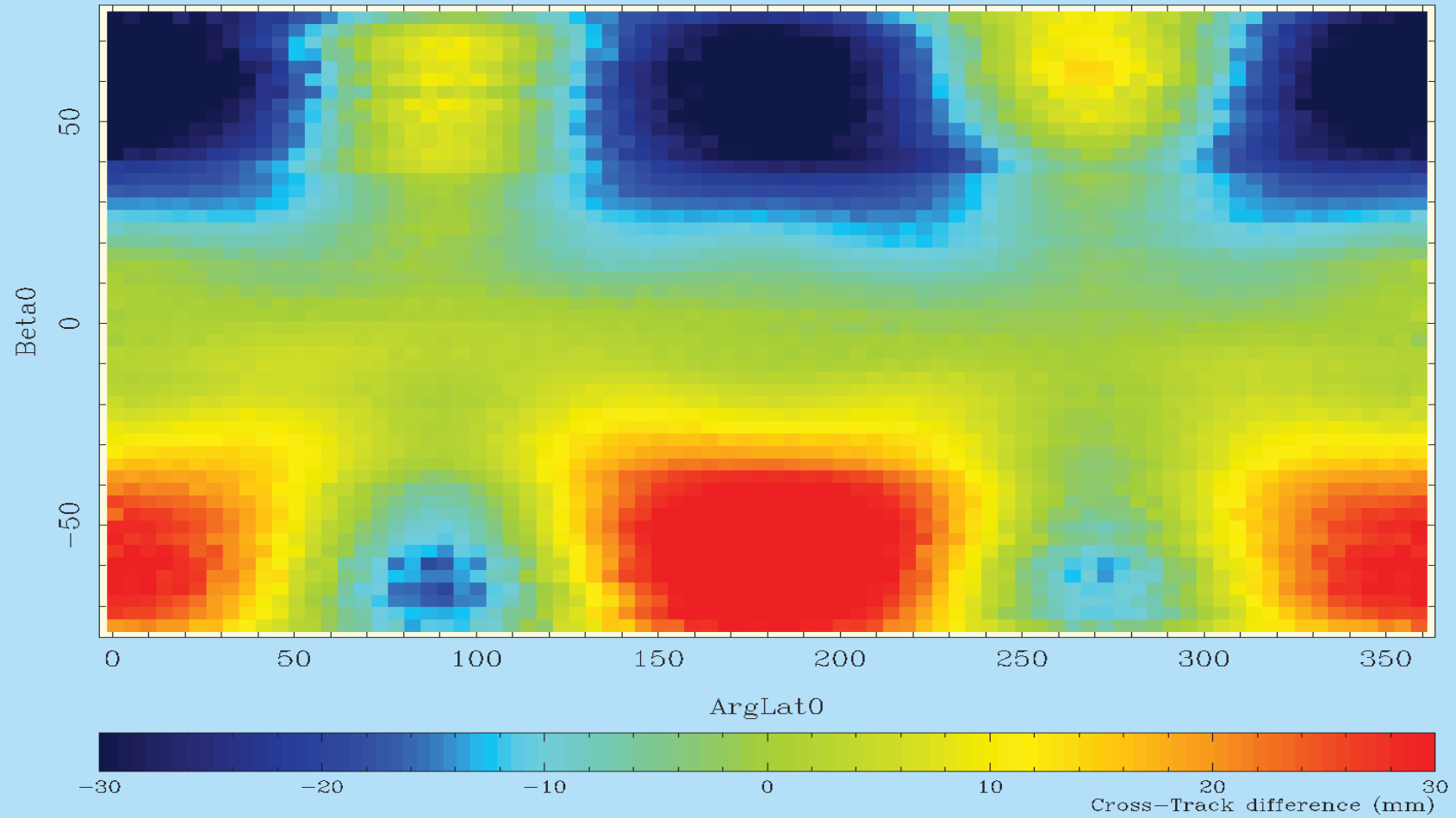
- The work at the TUM by Carlos Rodriguez provided a complete set of information for the GPS and GLONASS satellites
- Although intended for Earth Albedo modeling the values are also applicable for the direct Solar Radiation modeling
- In our NAPEOS software we use box-wing models since several years for all LEO satellites making it very easy to test the box-wing models for the GNSS satellites.
- Testing:
 - Initial test by performing orbit fits
 - Second test by performing full year of reprocessing (2012) with as only difference the a priori box-model
 - More details in our box-wing poster in the orbit poster session tomorrow

- The 2012 reprocessing showed:
 - Box-wing model has a **large effect**
 - ~40mm level for radial and cross-track
 - ~20mm level for along-track
 - But it is a **positive effect**
 - Orbit day boundary overlaps improve with 10 to 20%
 - Pole day boundary consistency improves with ~10%
 - Explains the SLR residual pattern
- Box-wing model was adopted for ESA/ESOC repro2
 - ES2 products should have (much) less power for periods at the orbital frequencies.

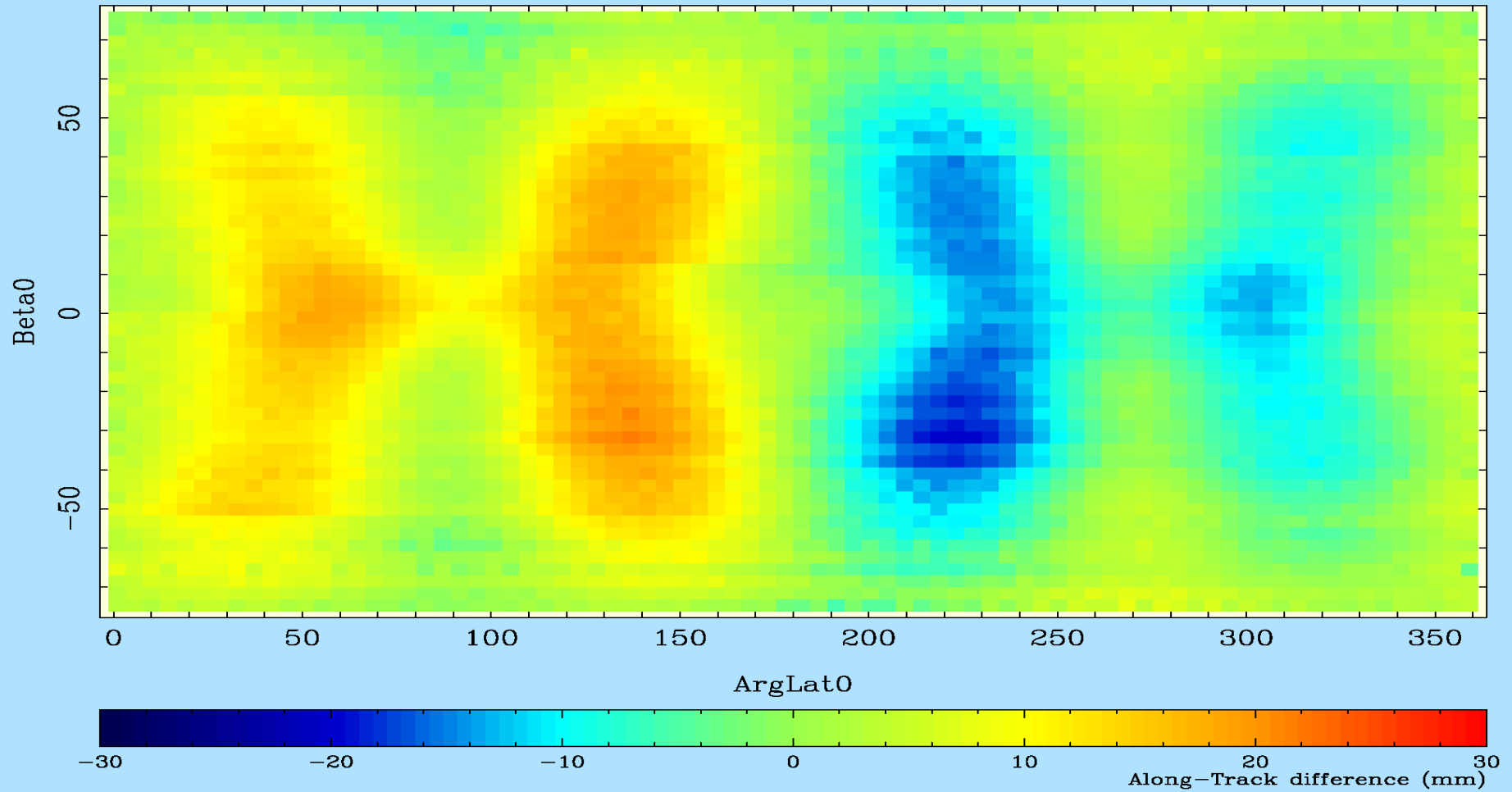
Radial effect of Box-Wing



Cross-track effect of Box-Wing



Along-track effect of Box-Wing

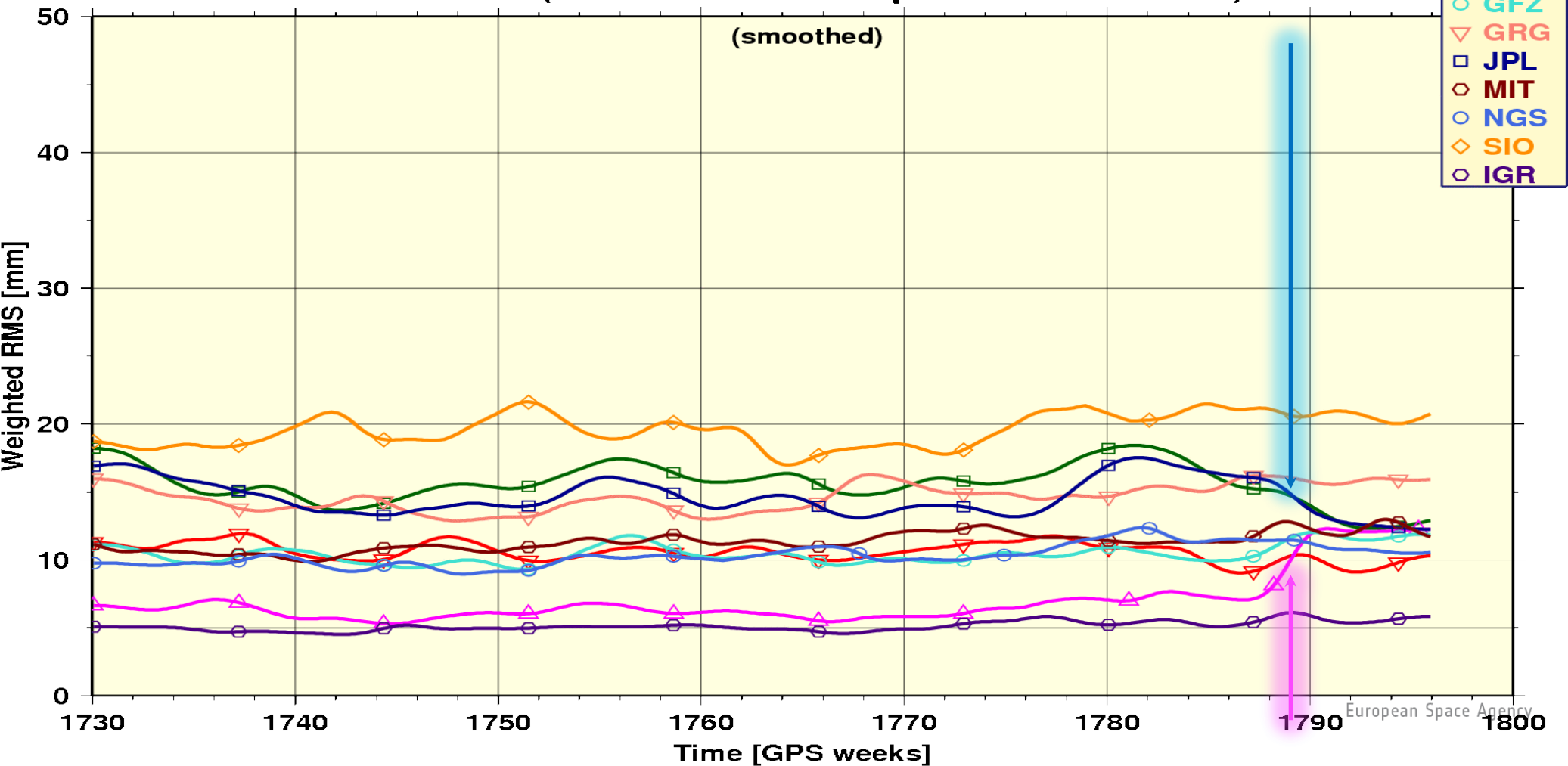


- GLONASS fully included in ESA/ESOC repro2 from 1.1.2009
 - Inclusion of GLONASS does give a small positive effect
- Box-wing model for GPS and GLONASS used for full repro period
 - Solution time series improve with ~ 10 to 20%
 - Very significant effect on orbit
- Box-wing model activated for ESA/ESOC routine products in April 2014 (GPS wk 1789)
 - Although our solutions get better there is a significant negative effect visible in the IGS combination ☹
 - Majority voting! Most ACs do not yet use box wing-model
 - But EMR and JPL results show box-wing like signatures

Effect of Box-Wing on IGS combination



Final Orbits (AC solutions compared to IGS Final)

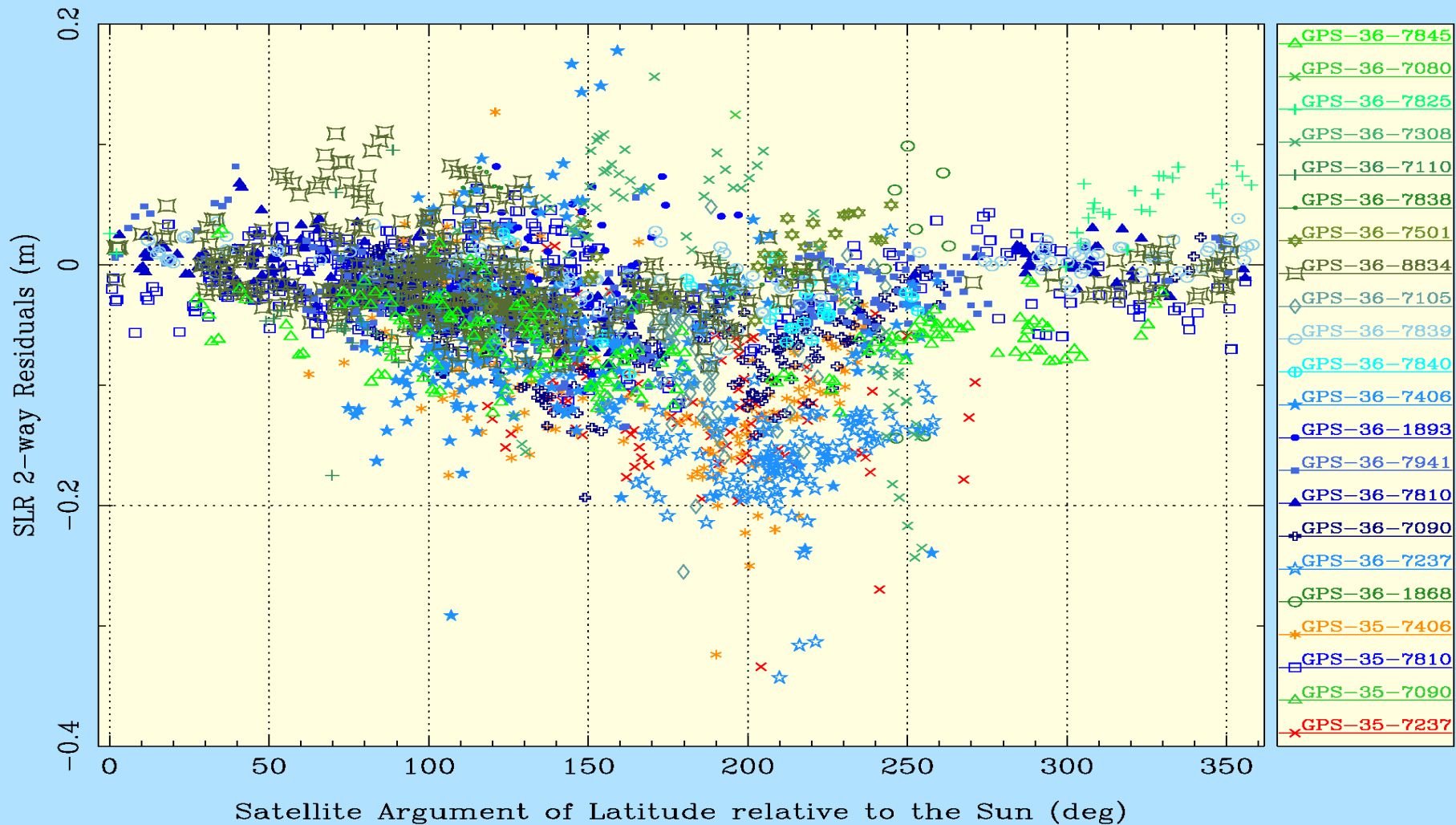


THANK YOU

Tim Springer

Tim.Springer @ esa.int

SLR Residuals without Box-Wing



SLR Residuals with Box-Wing

