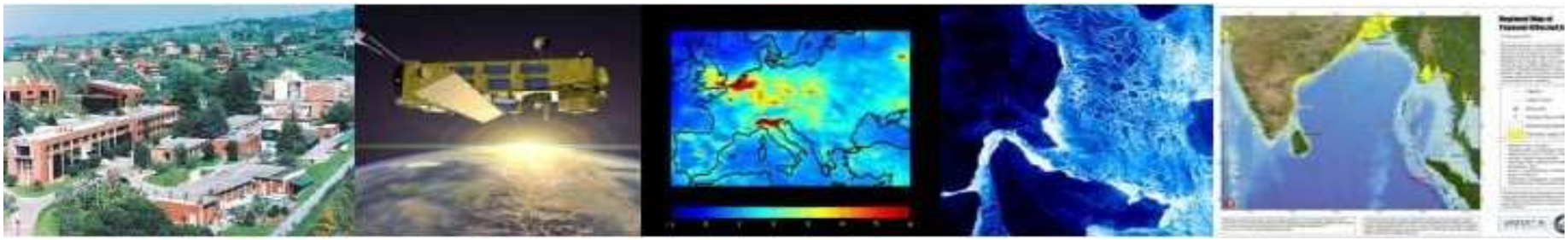
ESOC IDS (re-) processing



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Introduction

Early in 2008 ESOC replaced its old GNSS analysis software with its new software, called NAPEOS. Besides efficient GNSS analysis the NAPES software is also fully capable of processing DORIS and SLR observations. ESOC joined in the beginning of 2008 the reprocessing efforts of the International Doris Service (IDS), and is currently working on joining the ILRS reprocessing efforts.

- This presentation will give an overview of the different activities ESOC performs for the new ITRF-2008 release focusing on our IDS activities.

IGS and ILSR Processing at ESOC

- ESOC is a full IGS analysis centre:
  - New GNSS software, NAPEOS, since January 2008.
  - Key features:
    - Very fast: 30 minutes for a full final solution from scratch using 100 stations, 60 minutes when using 150 stations
    - Excellent product quality
    - Ideally suited for IGS reprocessing, but also for IGS real time!

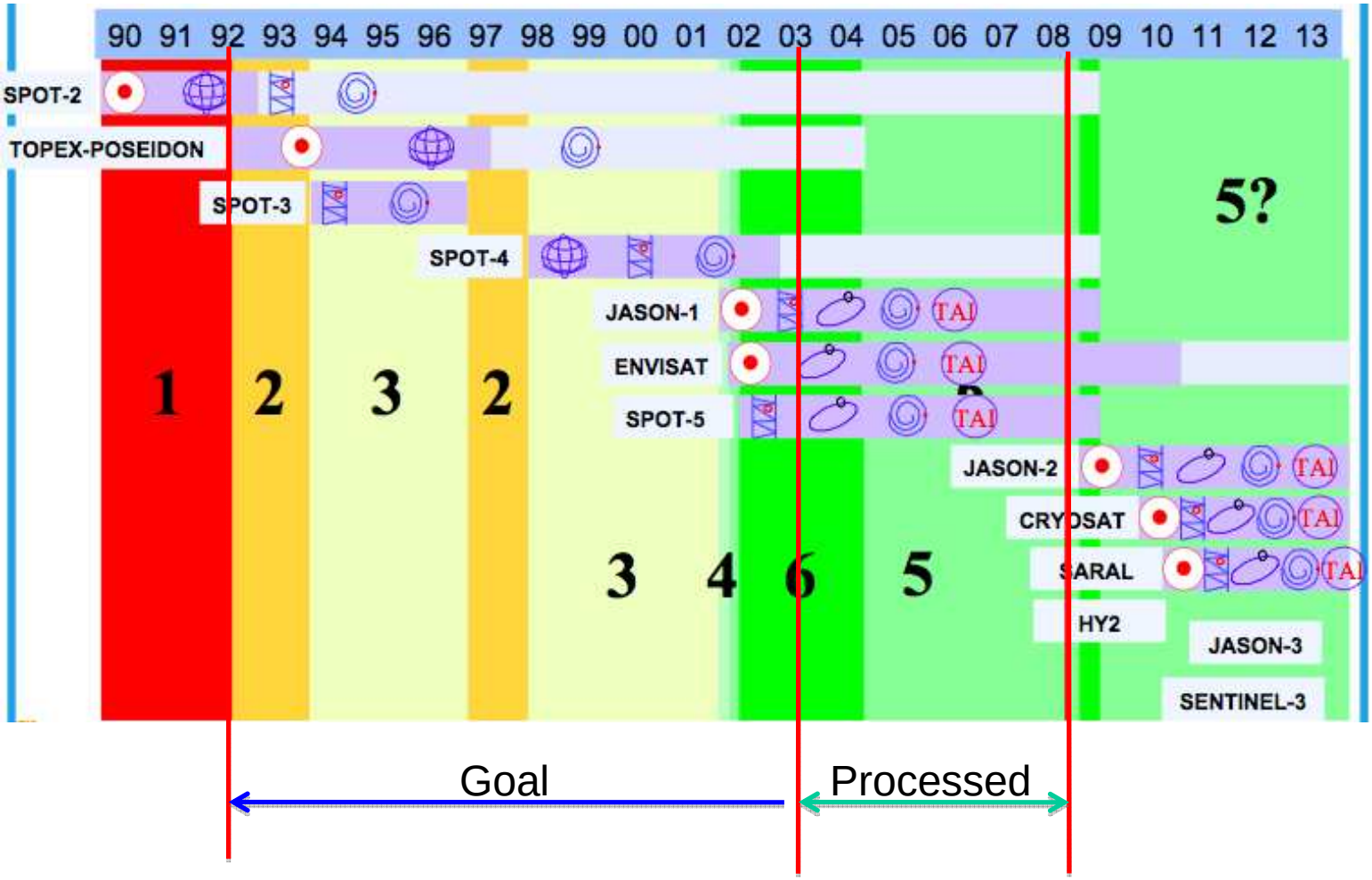
- ILRS associate analysis centre with as key activities:
    - Prediction centre for several satellites, e.g., Giove-A
    - Analysis of ENVISAT, ERS-1 and ERS-2
    - Analysis of the SLR data from the GNSS targets
    - Planning ILRS reprocessing

Current Status of Reprocessing

- IGS reprocessing
  - 2002 to 2008 finished and submitted.
  - 2000 and 2001 “quick run” done. Full run is running.
  - 1994 to 2000 will follow before the end of this year.
- IDR reprocessing
  - 2003 to 2008 finished 2005 to 2007 submitted.
  - 199x to 2003 will follow before the end of this year.
- ILRS reprocessing
  - Just starting….
  - “old” Benchmark run but with IERS2003 standards.
    - Results seem to be OK with <10 mm RMS of fit.

IGS and IDS reprocessing well underway.
ILRS reprocessing starting

DORIS Satellite Constellation



Period 2003 – mid 2008 has been processed, currently processing 1998 until 2003. From then will be working back on an yearly basis.

Processing Standards

REFERENCE SYSTEM:

-polar motion and UT1: IERS bulletin A with IERS 2003 daily and sub-daily corrections

-stations coordinates: DPOD-2005 reference for Doris Stations, LPOD-2005 reference for SLR stations

-satellite reference: Post-Launch value of Mass, attitude model: Nominal Yaw Steering Law

FORCE MODELS:

- EIGEN-GL04S gravity field including seasonal variations up to degree/order 50
- Atmospheric contribution to the gravity field up to degree/order 20 (AGRA service at GSFC)
- IERS 2003 Solid Earth tides
- FES 2004 ocean tides (all principal constituents, with admittance) up to degree/order 50
- Sun, Moon, and all Planets (DE-405)
- ANGARA or box-wing model for drag, solar, infrared and albedo radiation
- MSIS-90 model for atmospheric density

Processing Standards

SATELLITE PARAMETERS:

- 1-Day arcs, estimated Satellite State Vector
- Ten drag coefficients and one 1/rev along-track and cross-track constant per 24 hours for SPOT-X and Envisat.
- Four drag coefficients and one 1/rev along-track and cross-track constant per 24 hours for T/P and Jason-1/2

TRACKING DATA:

- All station displaced corrections according to IERS 2003
- DORIS:
- Troposphere: Saastamoinen with GPT, GMF with estimated zenith delay (wet)
- Frequency: Bias per pass adjusted
- Weight: 0.5 mm/s
- LASER (for T/P, Jason-1/2 and Envisat):
- Troposphere correction: Mendes-Pavlis following IERS 2003 update
- Retroreflector correction: Constant radial correction for all stations
- Weight: Globally 4 cm

Processing Standards

ESTIMATED ITRF PARAMETERS:

One day normal equation solutions are generated free of any constrains that include all the estimated parameters including the following ITRF parameters:

- Station coordinates
- One set of EOP values (offsets and rates)
- UT1
- LOD

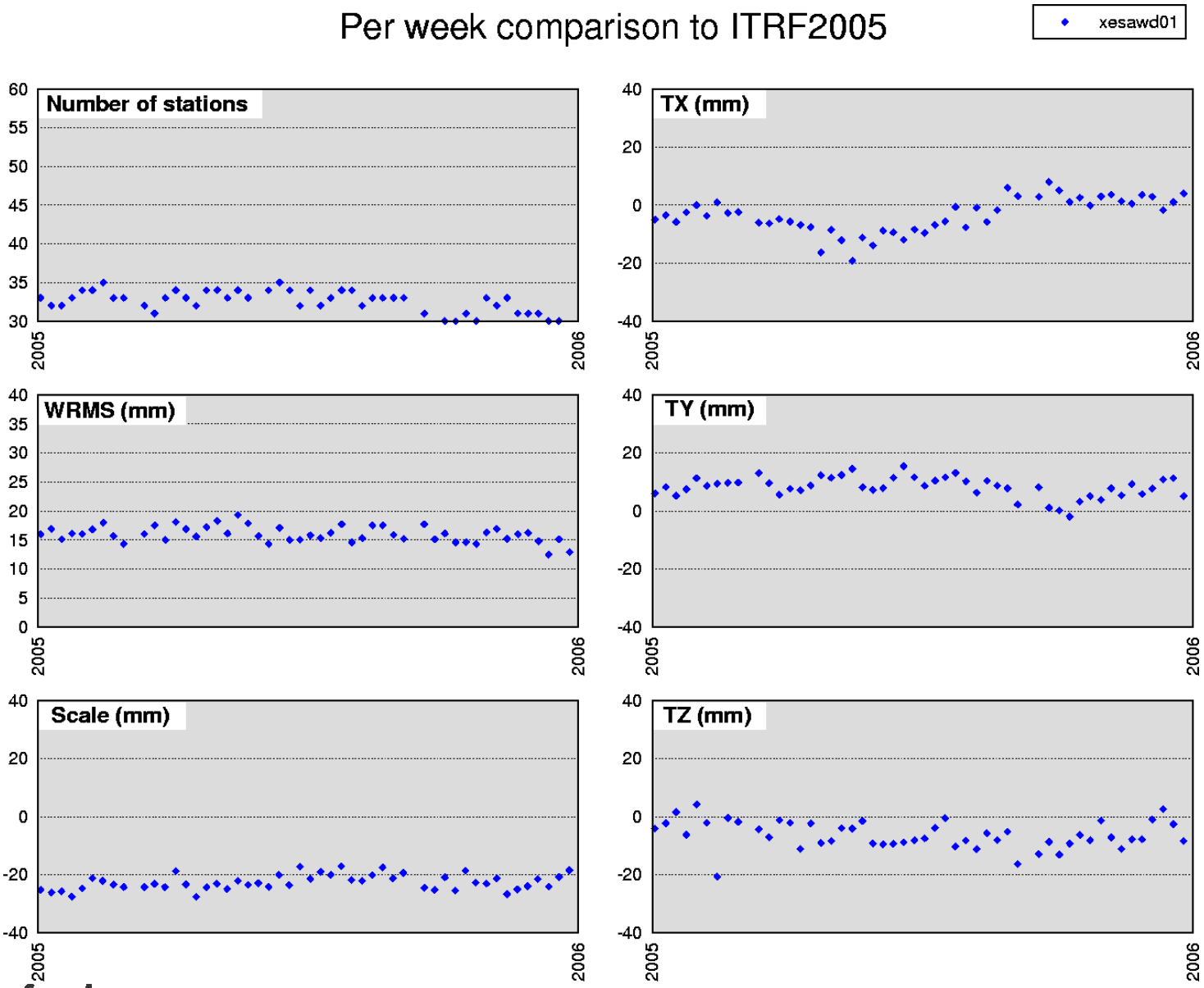
WEEKLY SINEX GENERATION:

• 7-Daily Solutions are stacked together on the normal equation level. From each daily solution the none ITRF parameters are rigorously eliminated (for the satellite drag and CPR parameters constrains are applied when eliminating them).

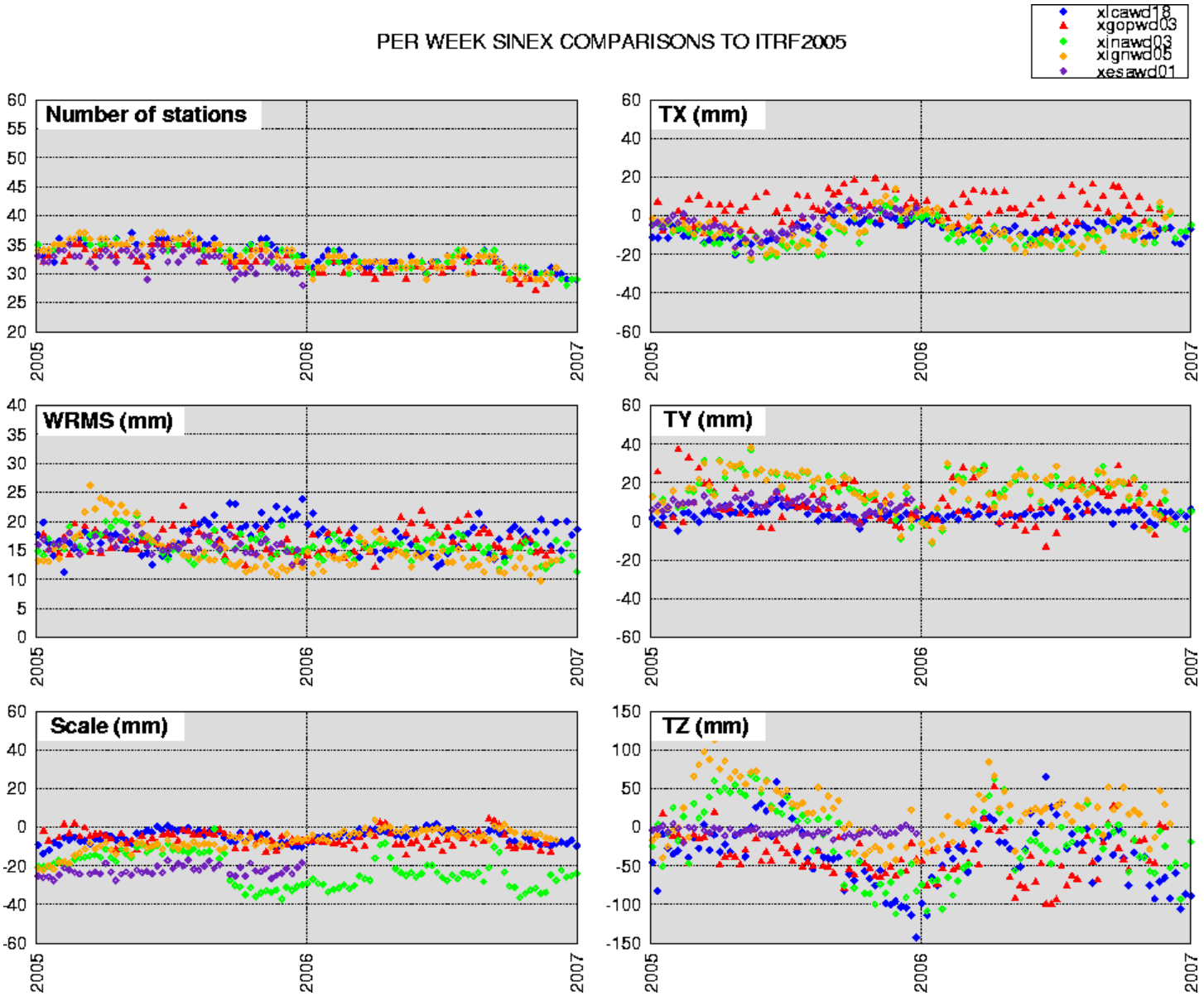
• The resulting SINEX file contains thus the ITRF parameters free of any constrain.

• The daily normal equation files are saved and different elimination strategies can be used without having to regenerate the daily solutions.

Initial Results



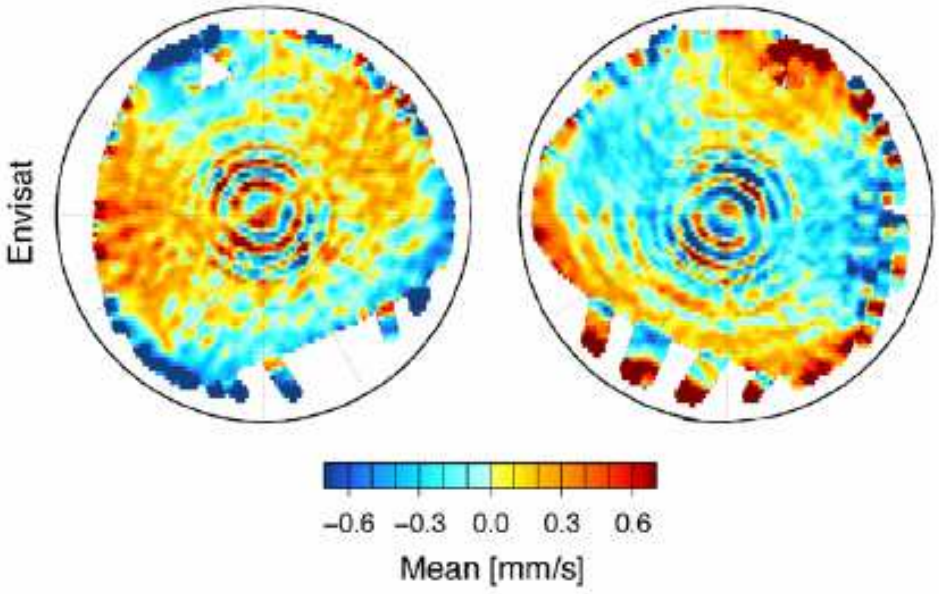
Initial Results



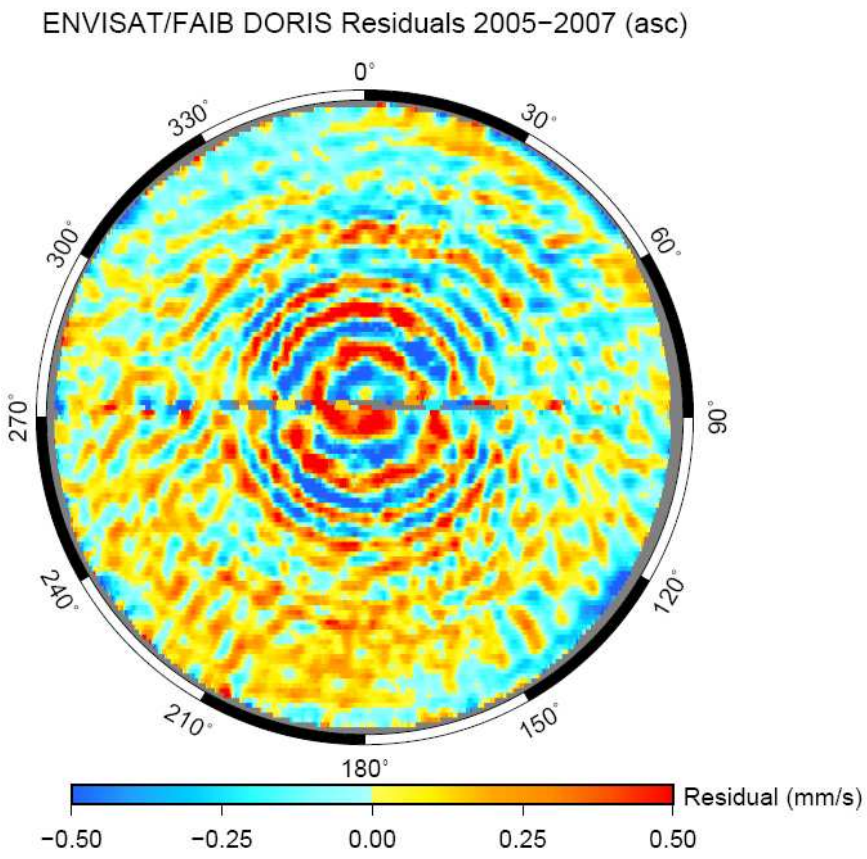
DORIS Residual Analysis

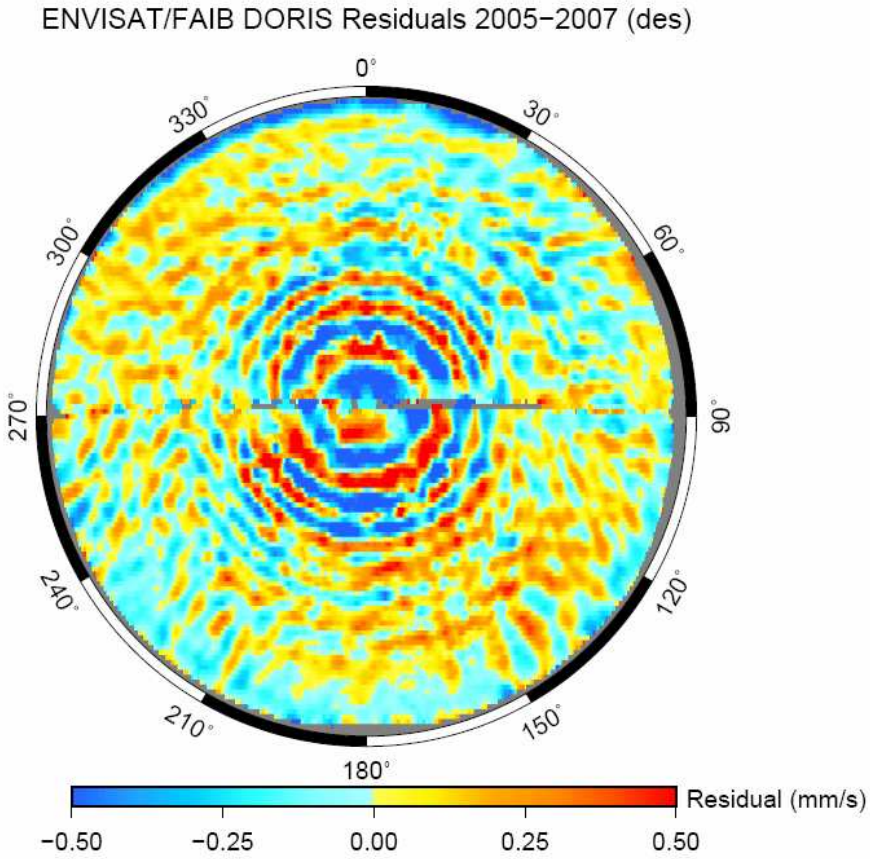
The IDS processing gives us an wealth of information on the DORIS system. One of the things we are currently analysing is the behaviour of the DORIS residuals for the different beacons and Satellites. The following slides show some initial results from this analysis. This work is based on an earlier study from Eelco Doornbos and Pascal Willis

The plot on the left is taken from Eelco's and Pascal's paper showing the ascending (left) and descending (right) mean residuals for FAIB (Fairbanks, Alaska). As you can see from the plot the ascending and descending residuals have an opposite sign. Further the residuals seem to be symmetric around the 'flight direction' of Envisat over the beacon.



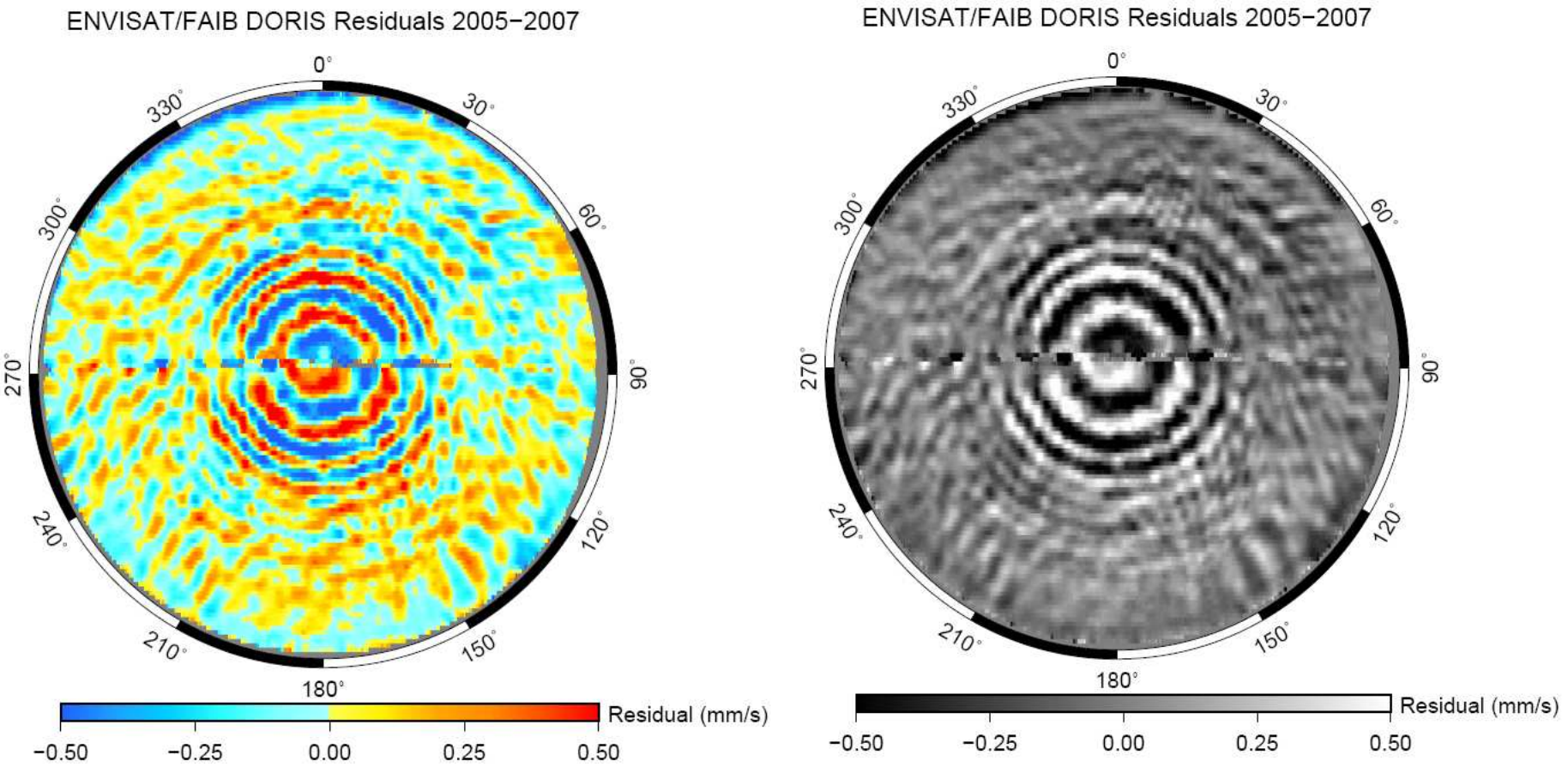
DORIS Residual Analysis





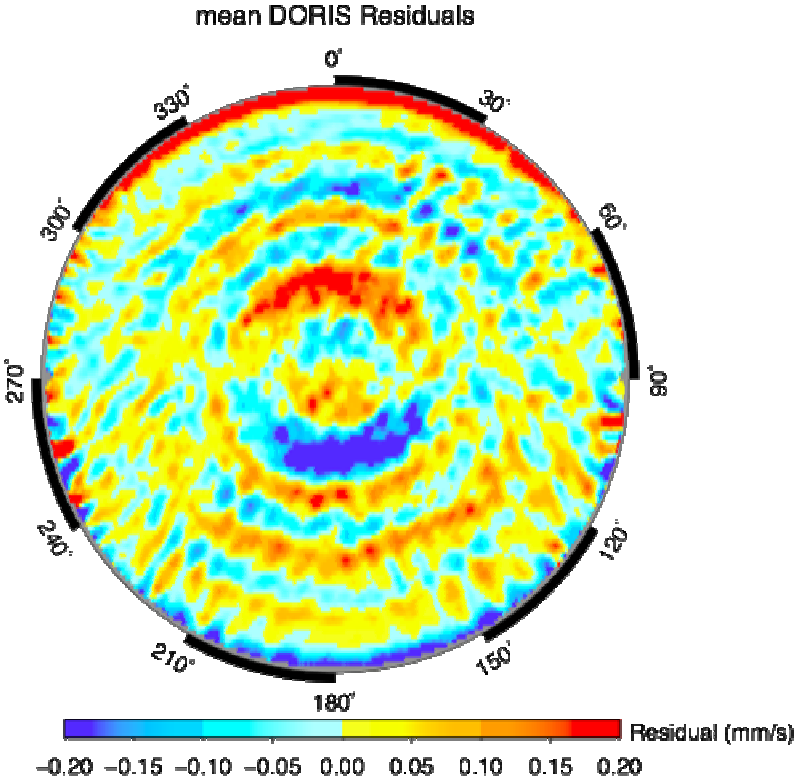
Same plot as previous slide but residuals are now plotted as seen from the Satellite (yaw and nadir angle) and can thus be combined.

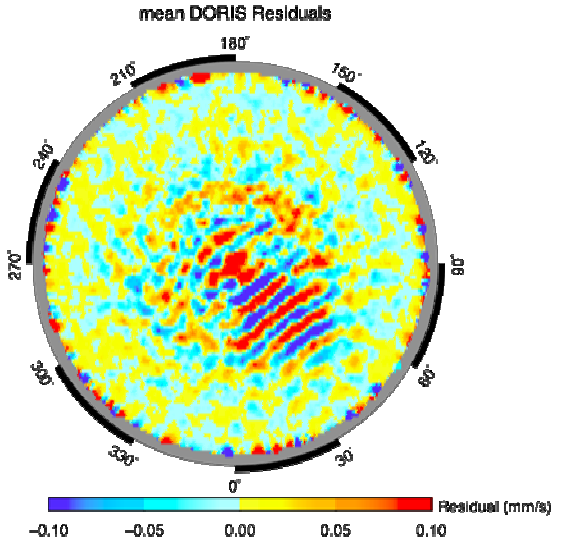
DORIS Residual Analysis

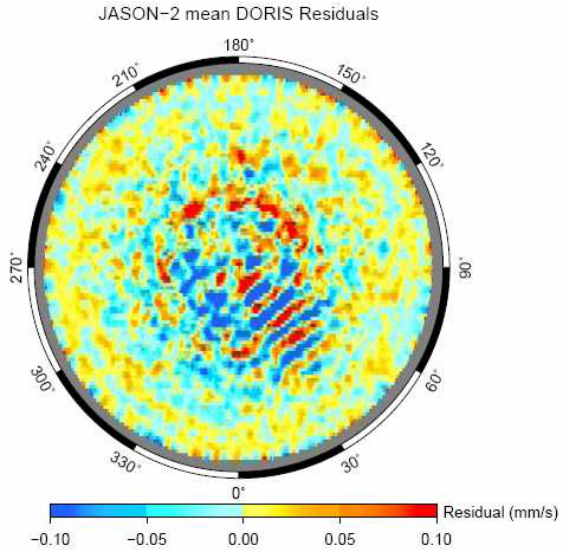


Envisat mean DORIS residuals for period from 2005-2007 as seen from Satellite shown in colour and b/w for Fairbanks beacon (FAIB).

DORIS Residual Analysis







On the left shown all the Envisat Doris residuals as seen from the Satellite (the DORIS transmitting antenna). The top right plot shows Jason-1 the bottom left plot shows Jason-2.

Outlook

- Before the end of February 2009 the goal will be to process the ESOC contribution to the IDS from the launch of T/P in August 1992 until the end of 2008.
- Current Reprocessing Focus:
  - Reprocessing the individual techniques and get a proper ITRF2008
- Future Enhancements:
  - 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 centre maps “directly”
  - Add VLBI capabilities and enhance GPS LEO activities

Combination of the techniques will be key for future progress and is important in framework of GGOS and GMES!