

Recent improvements in DORIS processing at ESOC – Preparing for ITRF2013

Michiel Otten, Werner Enderle

The Navigation Support Office, ESA/ESOC, Darmstadt
Germany.

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- This presentation will give an overview of the new ESA WD06 solution.
- This solution has been generated this year and is the first ESA solution that goes back to 1993 since the ITRF2008 submission (ESAWD03)
- It includes all the improvements that have been made since ESAWD03 which have been available to the IDS in the form of ESAWD04 and ESAWD05. Further it is the first ESA solution to include HY-2A.
- The main goal of this version is to form the baseline for the ESA ITRF2013 solution and test the improvements made since 2008 and see if these improvements also hold all the way back to 1993.

Summary of major model improvements



- Inclusion of all manoeuvring satellites in the daily solution for which manoeuvre files are available (still missing are Spot-3 and Topex)
- Centre of Mass (COM) correction computed and no longer taken from product and COM history files used from the IDS ftp server for all missions except Spot-3*
- Switch to satellite box/wing model for all non conservative forces for all satellites except Envisat (ANGARA model)
- Switch to GFZ-GRGS EIGEN-6C and including time varying gravity up to degree and order 50
- Tropospheric gradients estimation, daily values in North and East.
- Inclusion of low elevation data (from 10° to 7°) down weighting of low elevation data (sine)

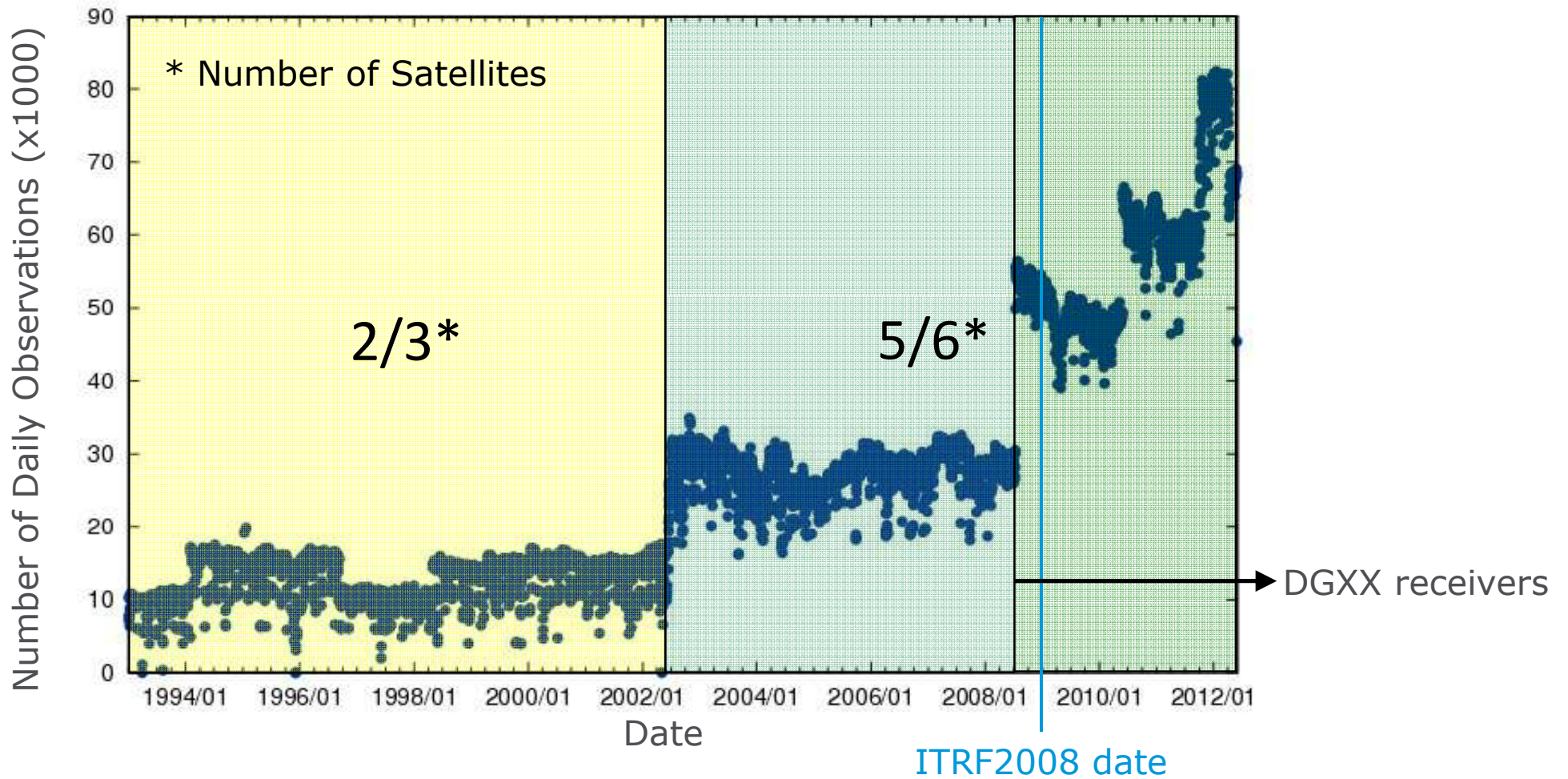
*Not available for Spot-3

New Missions – DGXX receiver



- Jason-2, Cryosat-2 and HY-2A are the three new missions that were not used for the ESAWD03 solution.
- Both Cryosat-2 and HY-2A were not yet launched and only half a year of Jason-2 data was available and it was decided to not include Jason-2 into the ITRF2008 submission.
- All these three missions make use of the new DGXX DORIS receiver which is capable to track up to 7 beacons simultaneous compared to the two beacons for the older DORIS receivers.
- These three missions have let to a major increase in number of available daily measurements.

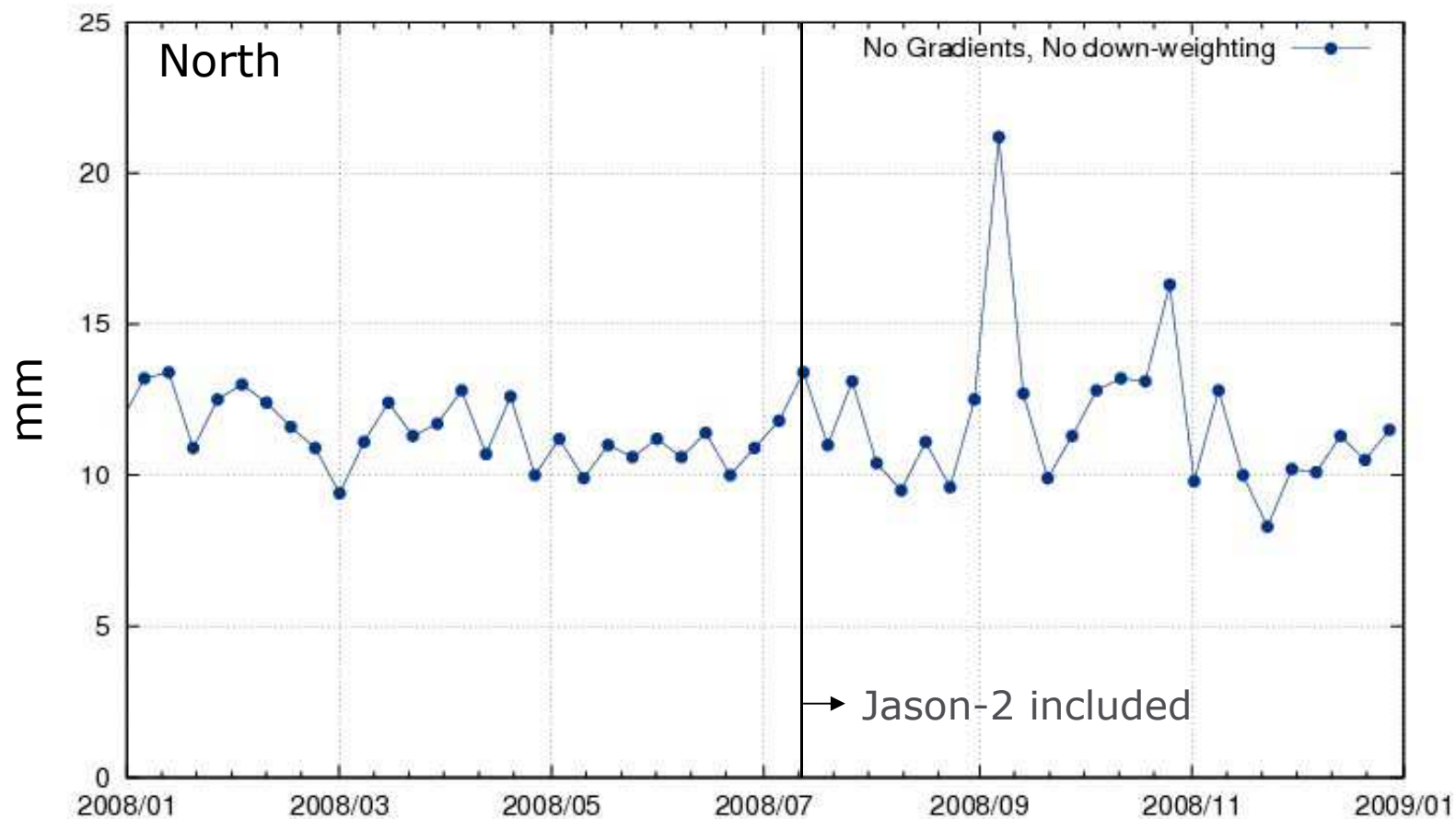
Number of observation – The big difference



Low elevation and Tropospheric gradients



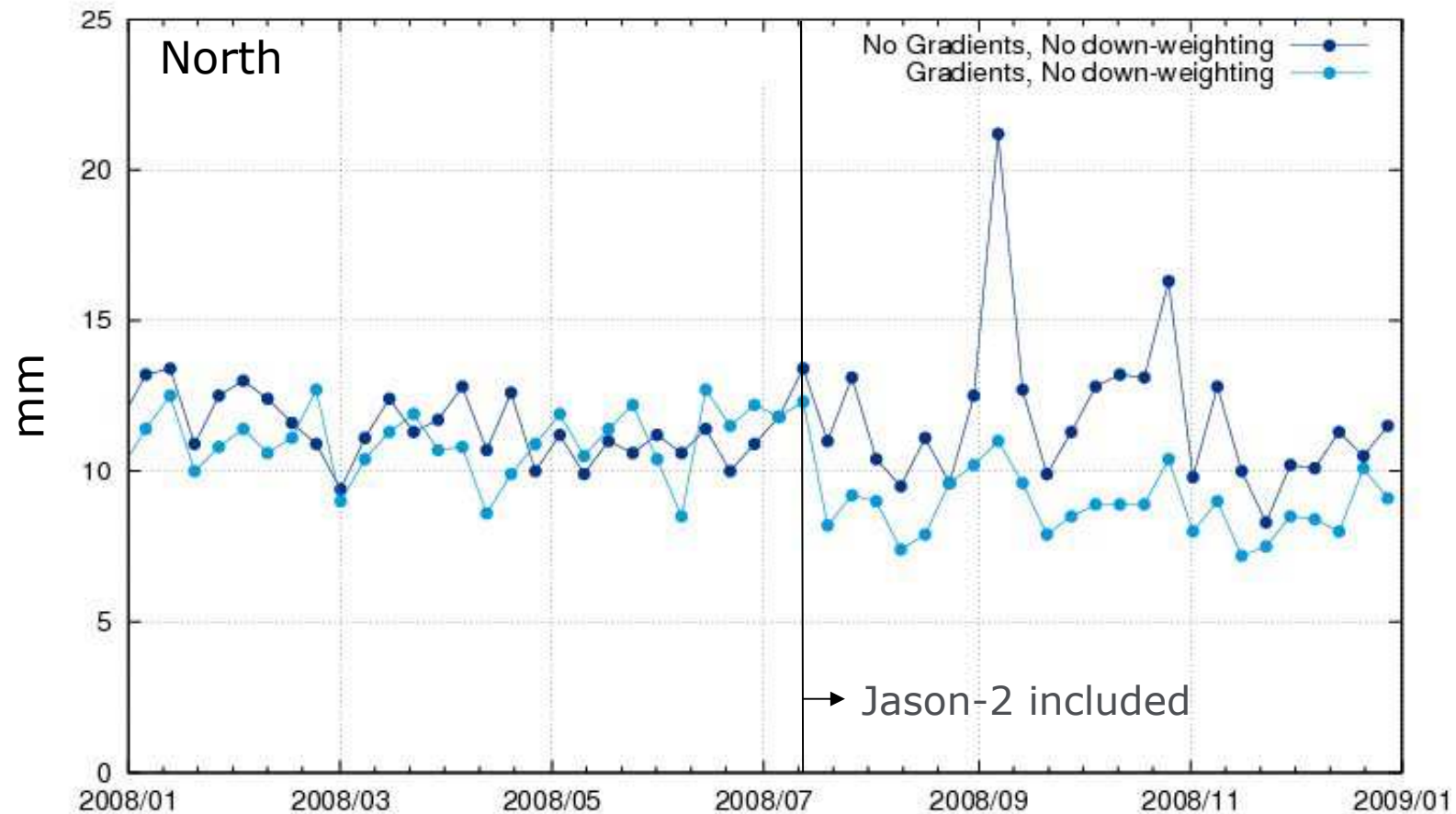
Week to week repeatability of stations coordinates in North



Low elevation and Tropospheric gradients



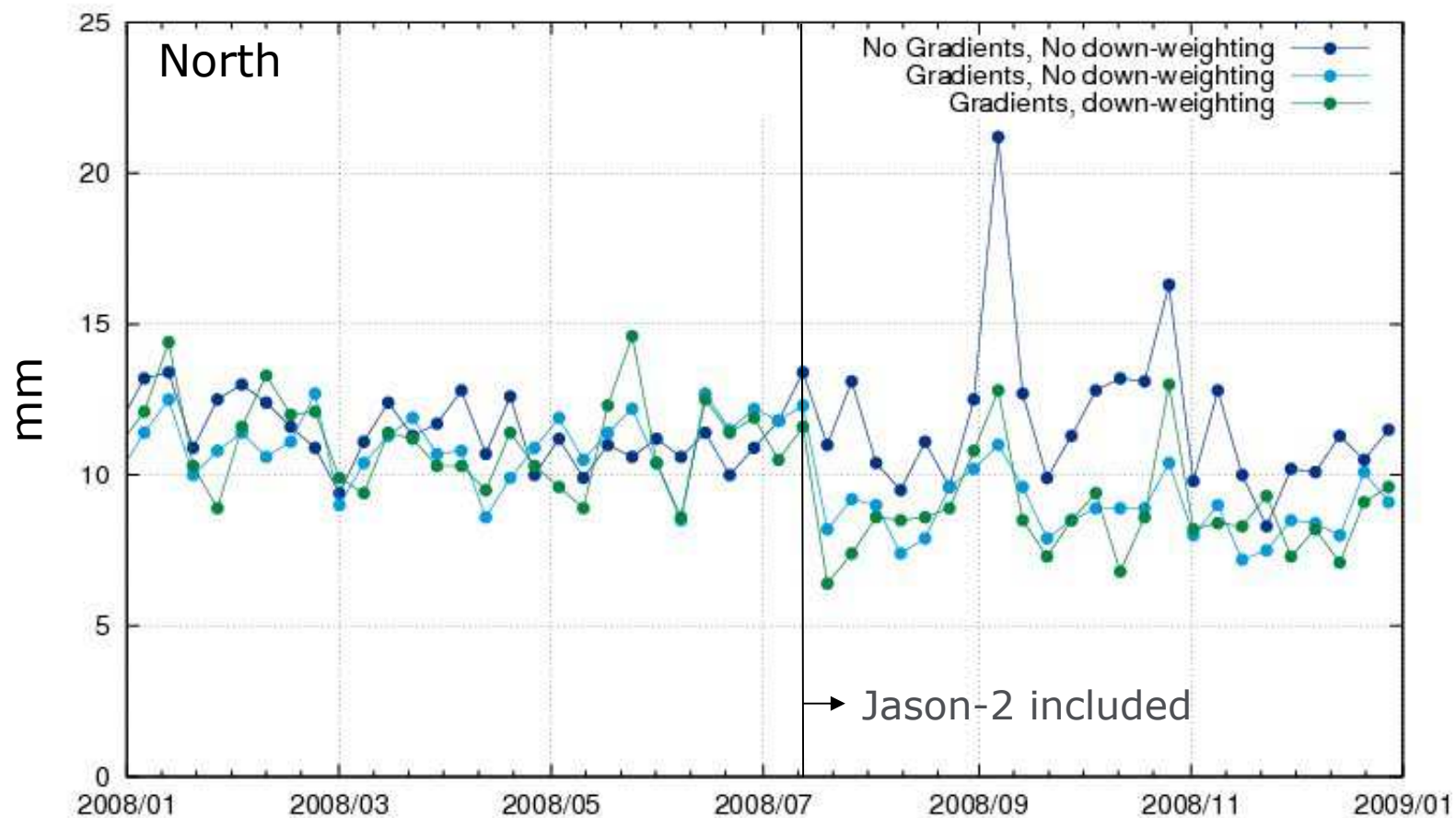
Week to week repeatability of stations coordinates in North



Low elevation and Tropospheric gradients



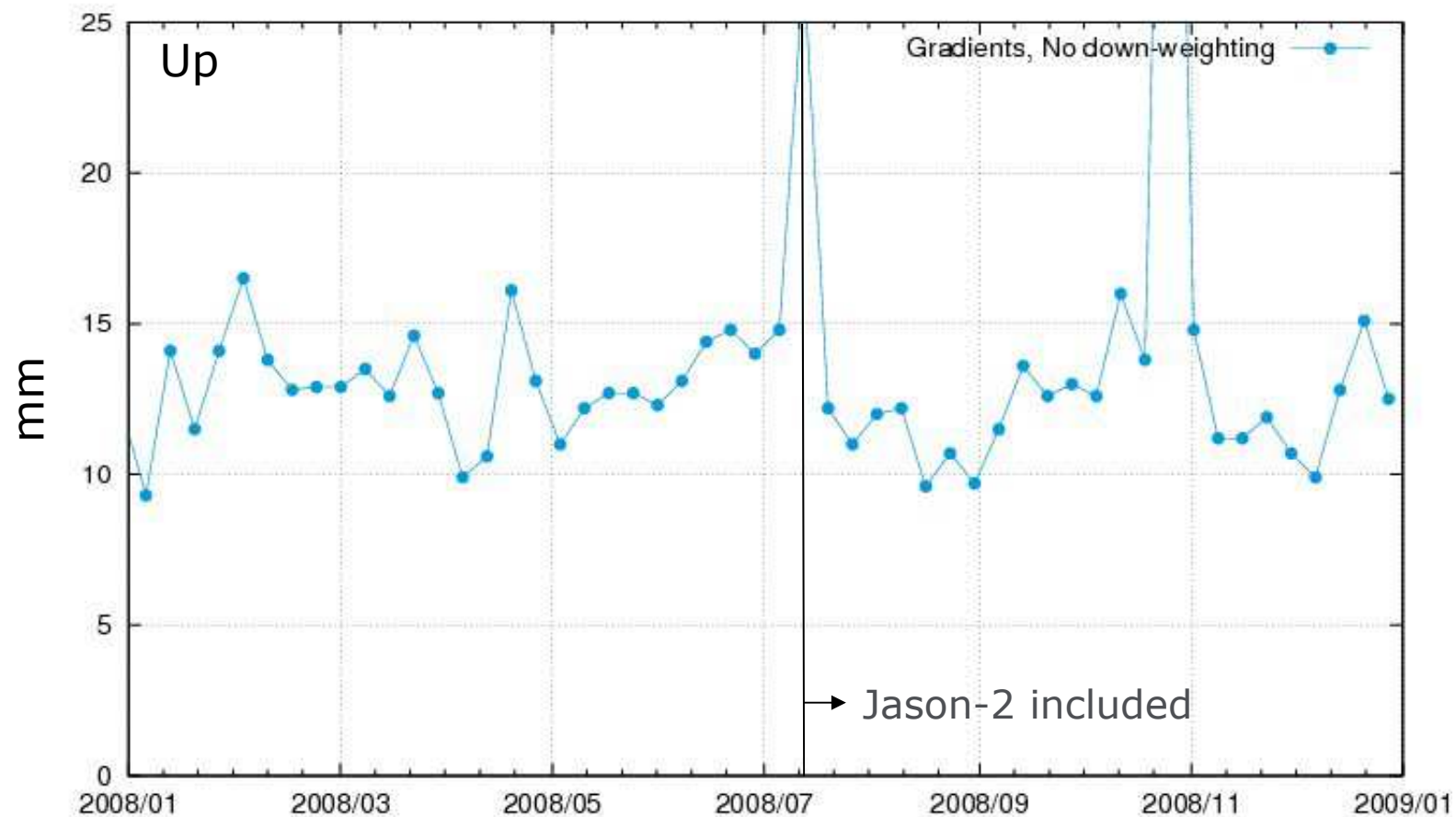
Week to week repeatability of stations coordinates in North



Low elevation and Tropospheric gradients



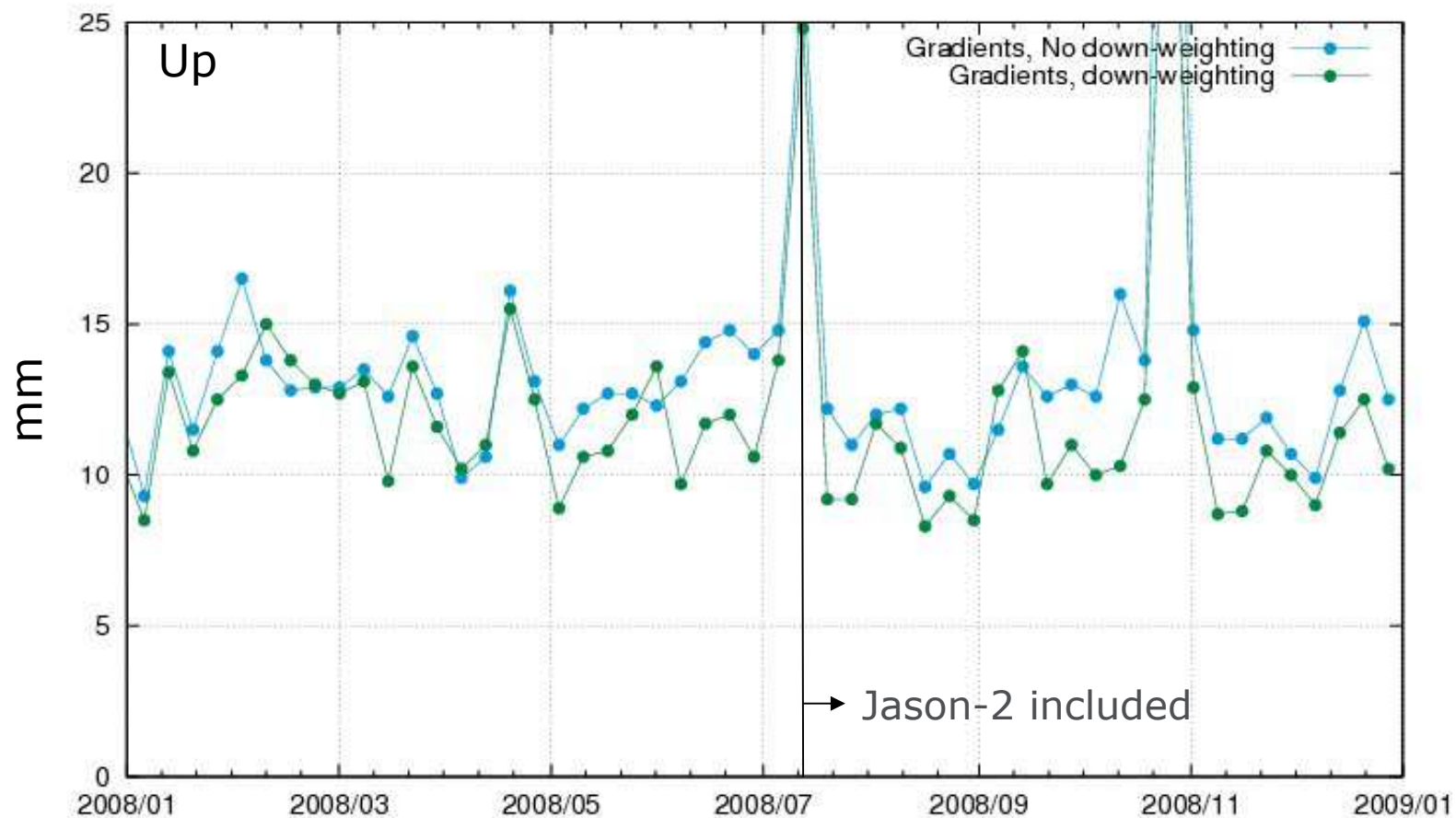
Week to week repeatability of stations coordinates in Up



Low elevation and Tropospheric gradients



Week to week repeatability of stations coordinates in Up



Low elevation and Tropospheric gradients

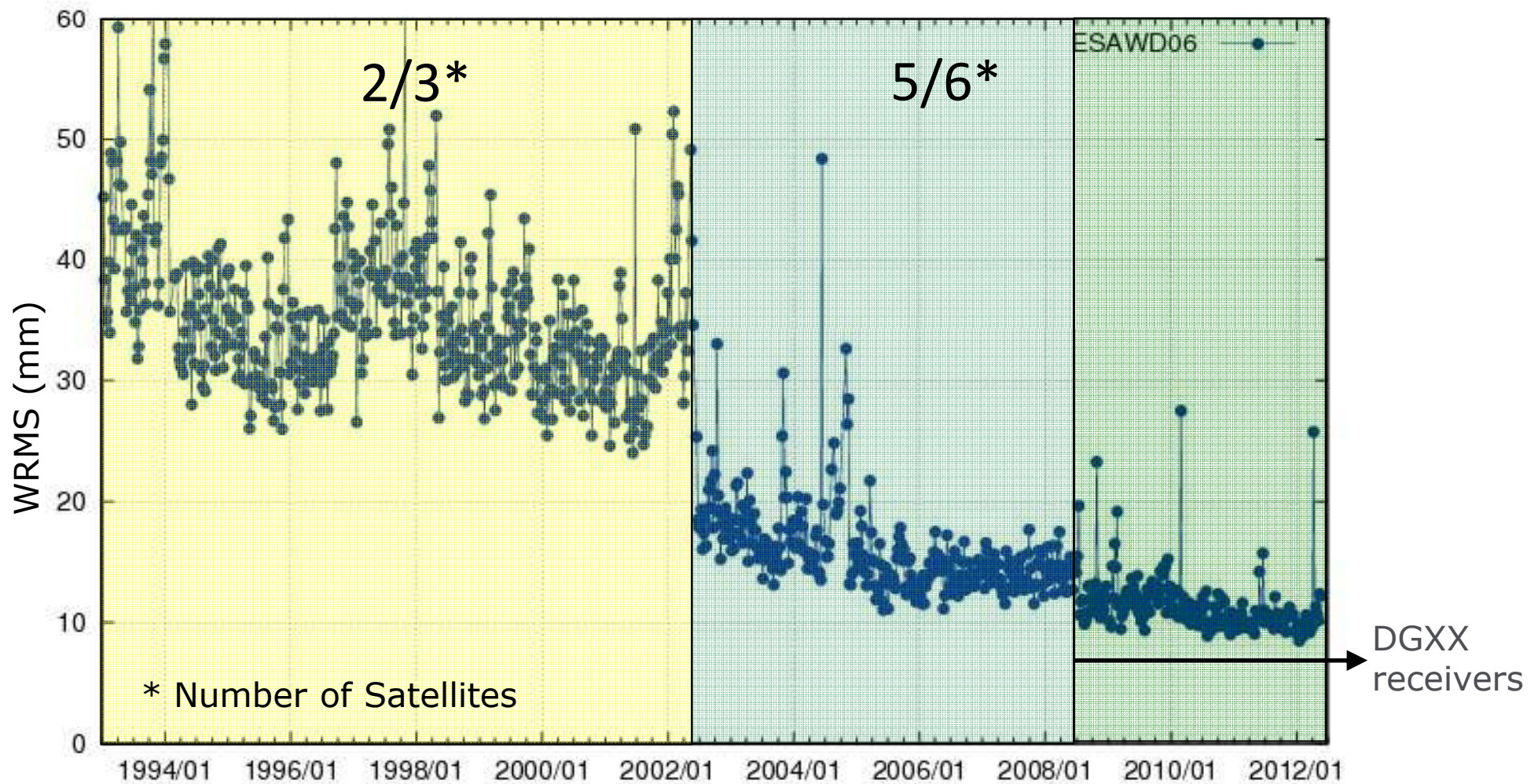


- With the new satellites a large amount of extra data has become available especially at low elevations ($\sim 35\%$ of all data for Jason-2 is below 10 degrees).
- The addition of these extra observations allows for the estimation of additional parameters like atmospheric gradients.
- Low elevation data has to be down weighted. Currently we are using $\sin(\text{elevation})$ as a weighting function.
- The low elevation data up to 5 degrees improves the solution. The ESAWD06 solution uses all data up to 7 degrees. ESAWD03 through ESAWD05 used 10 degrees cut-off.
- The improvement of low elevation data and gradients is of the order of 3-5mm in 3D WRMS depending on the week for the period after the Jason-2 launch (July 2008).

Results – ESAWD06



Week to week repeatability of stations coordinates

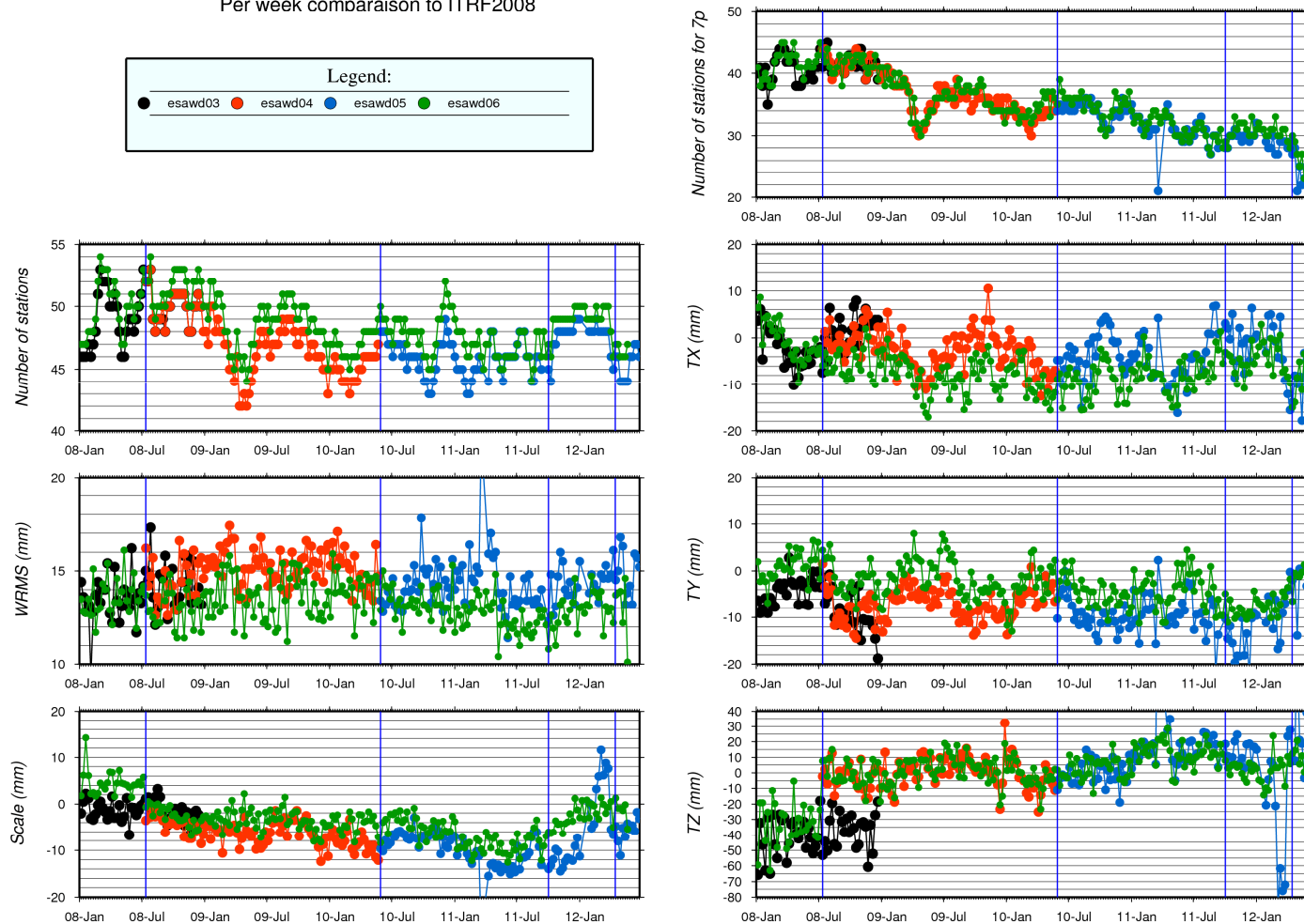
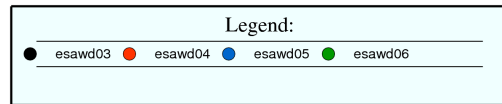


Results – ESAWD03 through 06



Plots provided by Guilhem Moreaux of CLS

Per week comparison to ITRF2008

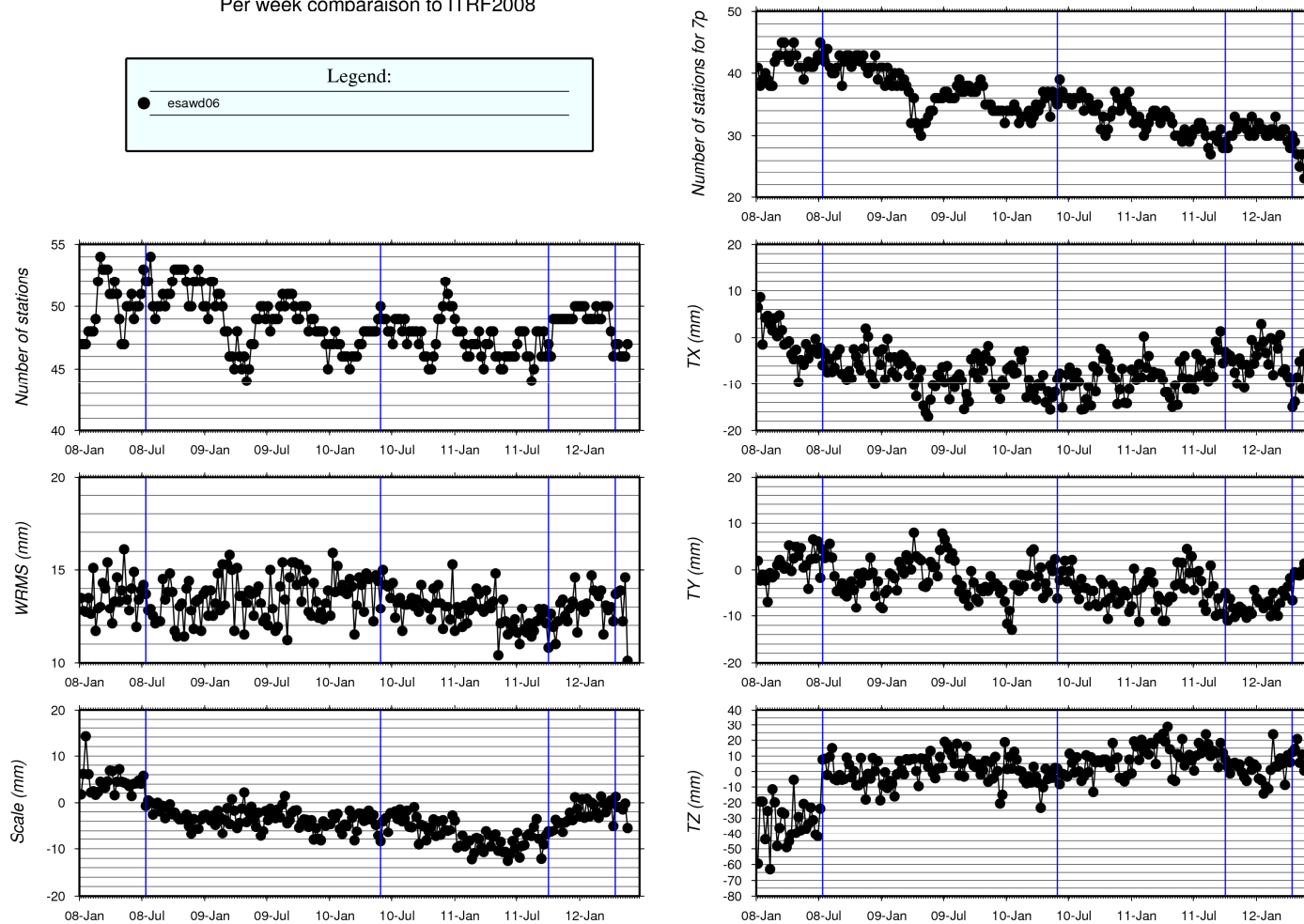
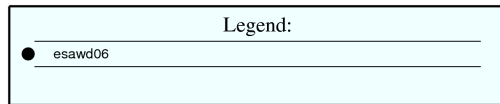


Results – ESAWD06



Plots provided by Guilhem Moreaux of CLS

Per week comparison to ITRF2008



Problems encountered (1/2)



- Going back to 1993 has been a larger effort than expected. Not having processed the older data with all of the improvements made in the last 5 years has resulted in some unexpected problems like:
- Detailed manoeuvre files not available for Spot-3 and Topex resulted in crashes on days that these satellites had manoeuvres [fixed].
- Due to HDD crash at ESOC we had to download tracking data for TOPEX again. TOPEX data on CDDIS from cycle 89-123 is corrupt (EOL garbage in files) [reported and fixed].
- Switched to computing COM correction instead of tracking from DORIS data files -> wrong values for TOPEX DORIS transponder in ESOC database [fixed]

Problems encountered (2/2)



- Using COM correction from IDS ftp server -> COM values for Spot-3 are set to zero resulting in very high residuals for Spot-3 [fixed]
- Switch to box/wing model -> forgot to update the Spot-3 values as available in DORIS satellites models document on IDS website
- Lessons Learned: not processing the older data for a long time (5 years in this case) will result in unexpected problems! Especially for the satellites which are no longer in operations.

- With the availability of the new DORIS DGXX receivers and the resulting leap in daily measurement since mid 2008 allows for additional parameters to be estimated as shown in this presentation with the inclusion of daily atmospheric gradients in North and East.
- The new DORIS DGXX receivers add much more low elevation observations as beacons can now be tracked over the entire pass and the DORIS receiver no longer has to switch beacons due to only have 2 channels (or 1). To make best use of this extra data a weighting function is needed.
- Since September 2010 the IDS processing at ESOC is running successfully in a routine and automatic way. The ESAWD06 is the first complete solution using the same automatic processing strategy.

Still to include in processing before ITRF2013:

- IERS2010 conventions instead of IERS2003
- Upgrade ocean tide model to EOT11a

- ESAWD06 is first version of an updated ESA IDS solution going back to 1993. More test will be performed before the ITRF2013 deadline focusing on how to handle the huge increase in new DORIS observations and if different processing approaches will be needed for the different time periods (1993/2002, 2002/2008 and 2008+)

Thank you



Michiel Otten
Michiel.Otten@esa.int

Processing Time for 1993-2013



- Currently with latest NAPEOS version (3.7) a weekly solution takes 13-35 minutes (highly depends on number of satellites).
- Estimated total CPU time needed for 20 years: ~25' 000 minutes, using 4 CPUs would allow us to process all data within 5 days.
- Thus it is possible for us to generate several test solutions
- Including of Atmospheric Tides (Ray-Ponte 2003)