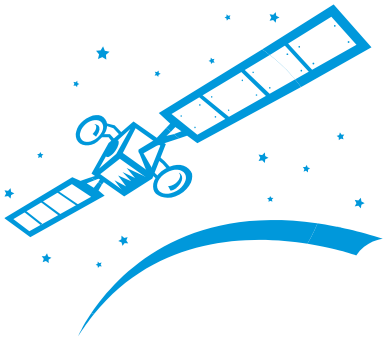


ESOC Integer Ambiguity Resolved Precise and Homogeneous Orbits for ~~Jason-1~~ and Jason-2

Michiel Otten, Claudia Flohrer, Tim Springer, Werner Enderle
The Navigation Support Office, ESA/ESOS, Darmstadt
Germany.

OST-ST Meeting, Venice, Italy, 27-28 September 2012

Motivation

- There is a need for high-quality homogenous altimetry products
  → i.e. precise and homogeneous orbits for altimetry satellites.

- The Navigation Support Office at ESOC is involved in the processing and validation of the ESA altimeter missions:
  ERS-1/2, Envisat and Cryosat-2 since the launch of each mission.

- We have the capability and the software (NAPEOS) to process efficiently all geodetic tracking techniques (SLR, DORIS, and GPS) in a combined processing.

Introduction

- For Jason-2 last years OSTST solution is daily extended and all data from July 2008 until August 2012 has been processed.
- For Jason-1 the same solution from last year is still available and covers the period from launch until January 2009.
- The first slides will give a quick overview of this solution (solution 3) while the major part of this presentation will focus on the first integer ambiguity resolved orbits for Jason-2.

Processing strategy Jason-1 / 2

ESOC solution 3

- Loosely based on the GDR-D standards
- Modeling according to (IERS2003) conventions
- GPS + DORIS + SLR used, technique-specific weighting
- ESA IGS08 GPS orbits and clocks (30s) introduced (kept fixed)
- Estimated parameters
  - Orbit parameter (3-day arcs)
    - SV
    - 4 CPRs (sin/cos in along-track/cross-track) every 12h
    - 5 Drag parameters every 24h
  - GPS phase ambiguites
  - Jason-1/2 clock bias (30s)
  - DORIS station frequency bias, time-tag bias, atmospheric zenith delay correction

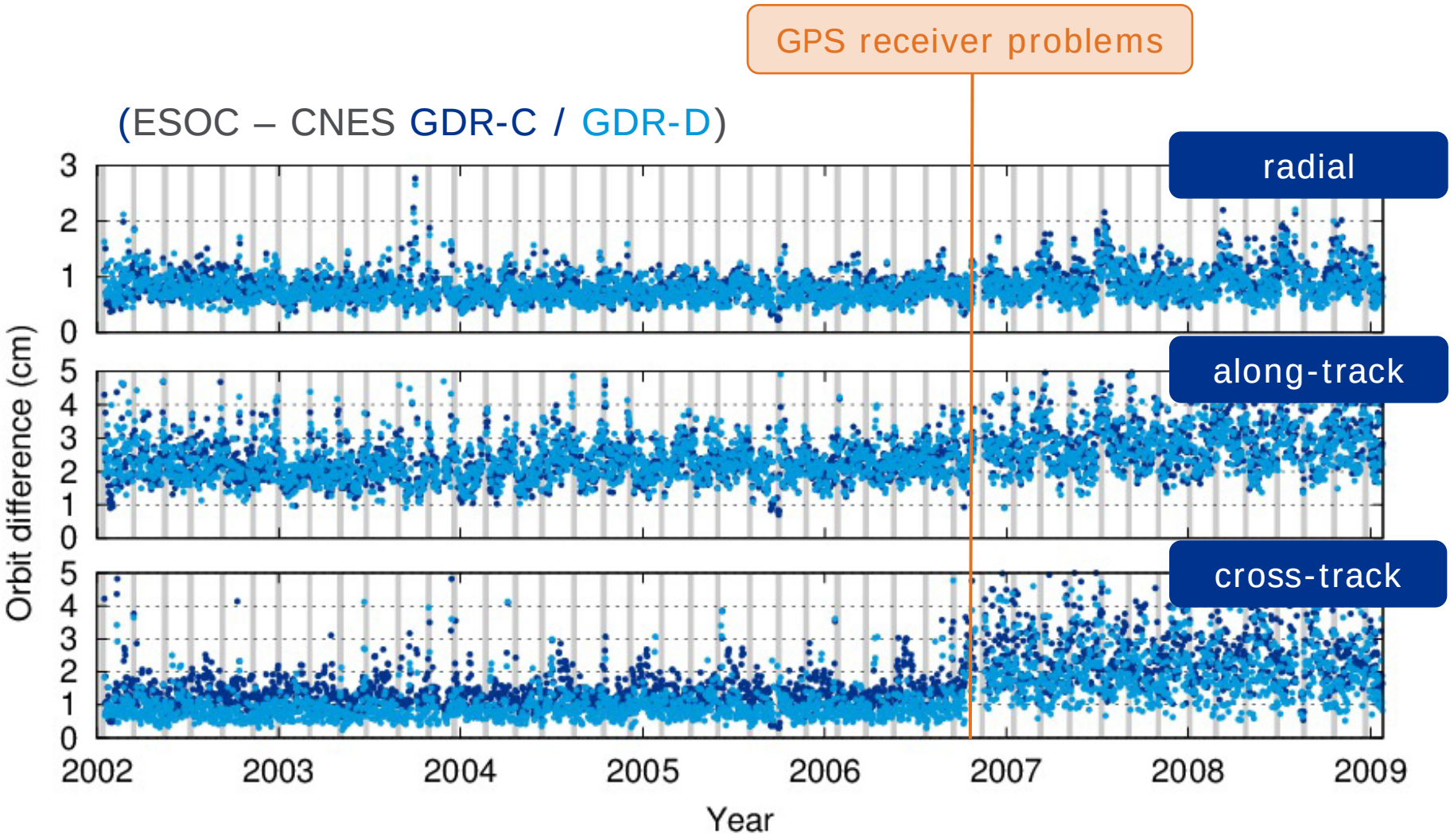
Processing strategy Jason-1 / 2

ESOC solution 3

- Gravityfield
  - GFZ-GRGS EIGEN-6C (120x120) + annual and semi annual varation up to degree and order 50
- Station Coordinates
  - DORIS DPOD2008 and for SLR ITRF2008
- Macro model for non conservative forces
  - ESA model (average of CNES GDR-A and GDR-C model)
- GPS antenna phase centre modeling
  - Estimated based on stacking 2 years of NEQ for Jason-1 and Jason-2. Estimated both GPS & Jason-1/2 antennas in full IGS like scenario (GPS up to 17 degrees).
- Attitude modelling
  - Quaternions with fallback on nominal attitude model (with attitude event file) if not available

Daily RMS of orbit differences

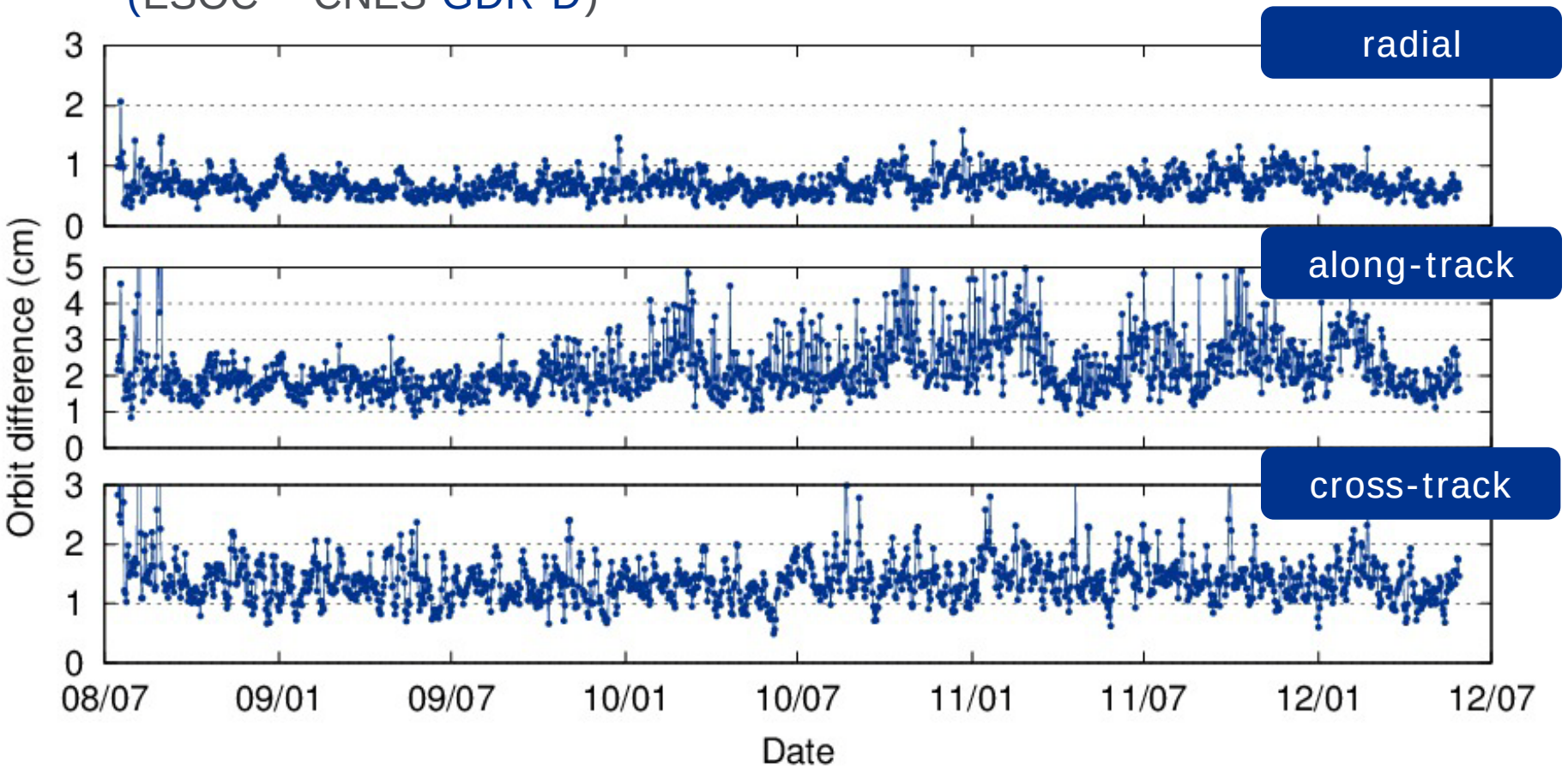
Jason-1



Daily RMS of orbit differences

Jason-2

(ESOC – CNES GDR-D)



Ambiguity Fixing – Two techniques

- Currently we have in our software (NAPEOS) two possible ways of fixing the ambiguities for the LEO satellites:

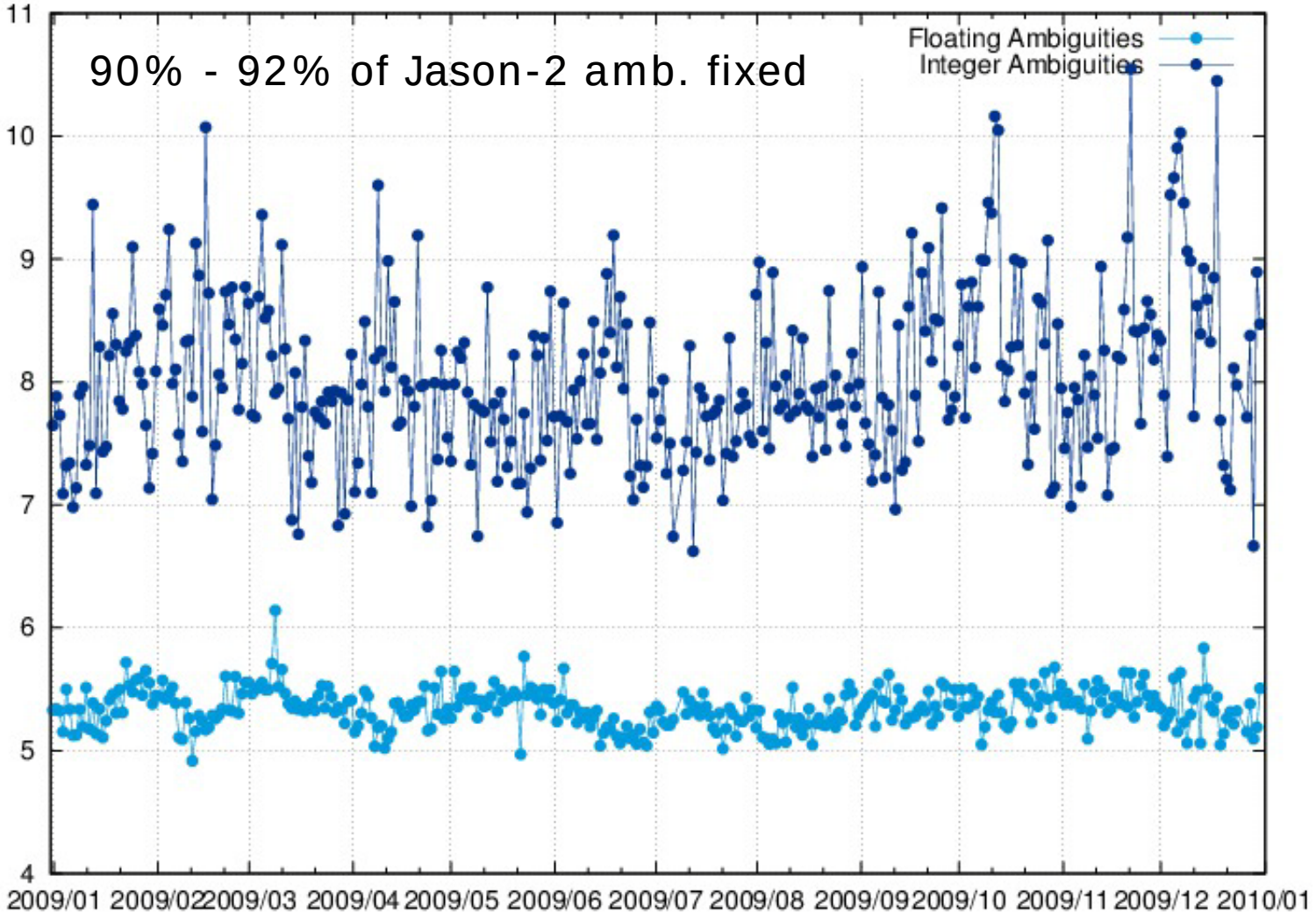
1. The integral approach in which the LEO is included into an IGS like scenario (including GPS station data) and the LEO is treated as another (although orbiting) station and the integer ambiguities are resolved at the double difference level together with the station ambiguities.
2. In the second approach the un-calibrated phase delays (UPD) are saved from our IGS runs and later reintroduced into the LEO ambiguity resolution processing. In this processing the UPDs are used together with two single differences to resolve the integer ambiguities of the LEO.

Processing strategy Ambiguity fixed

- This first method that we tested was the combined processing (method 1) and all results that will be shown are based on this method.
- For the test period we have used the year 2009.
- We included 60 globally well distrusted stations.
- We used 30 second sampling for the ground stations and Jason-2.
- Also included the DORIS data but we excluded the SLR data so we could use it for validation purposes.
- We computed 24hr arcs without overlap.
- Estimate the same number of orbit parameters for Jason-2 as in our ESOC solution 3 (SLR/DORIS/GPS).

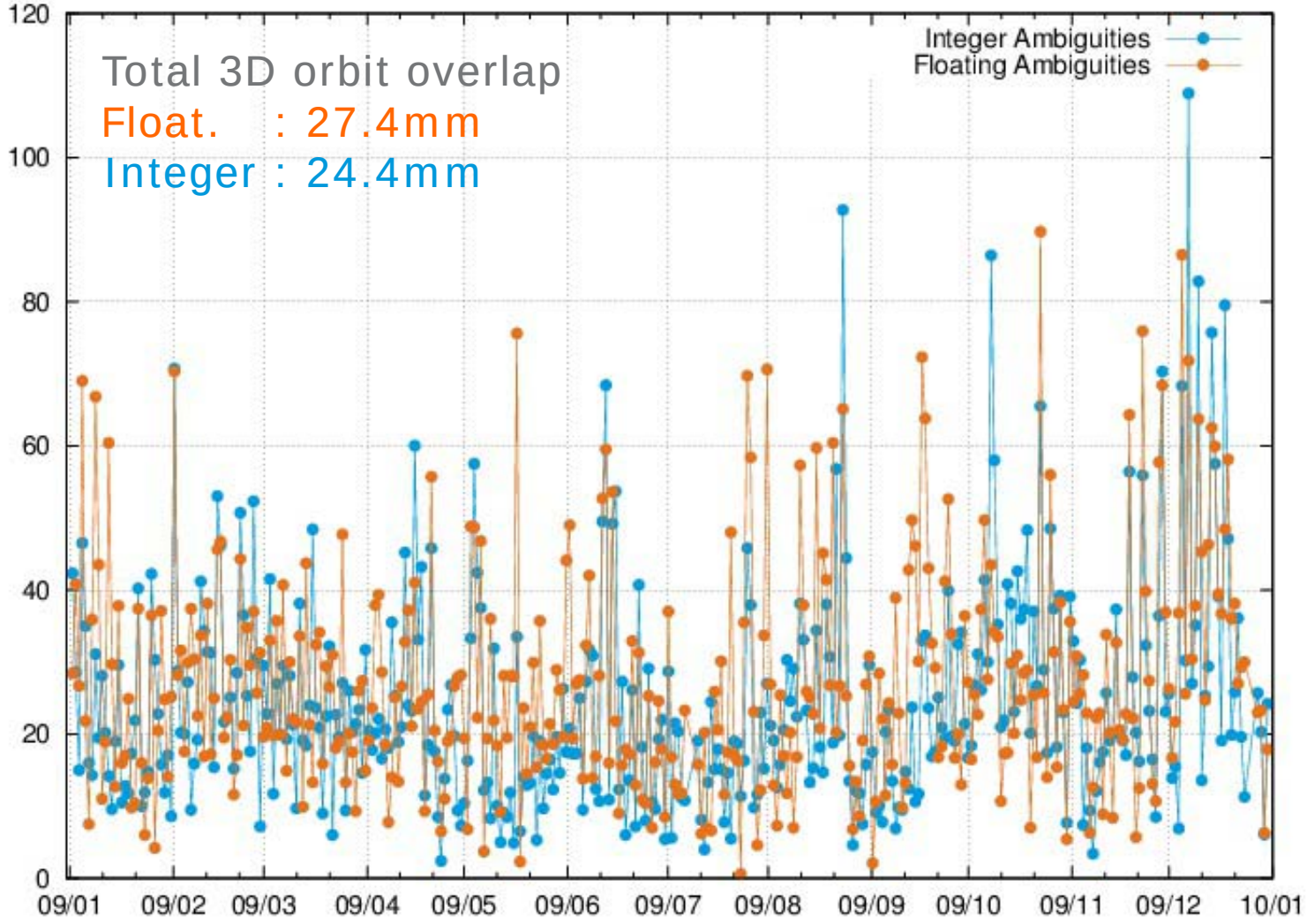
GPS Residuals for 2009 – 60 Day signal?

Jason-2



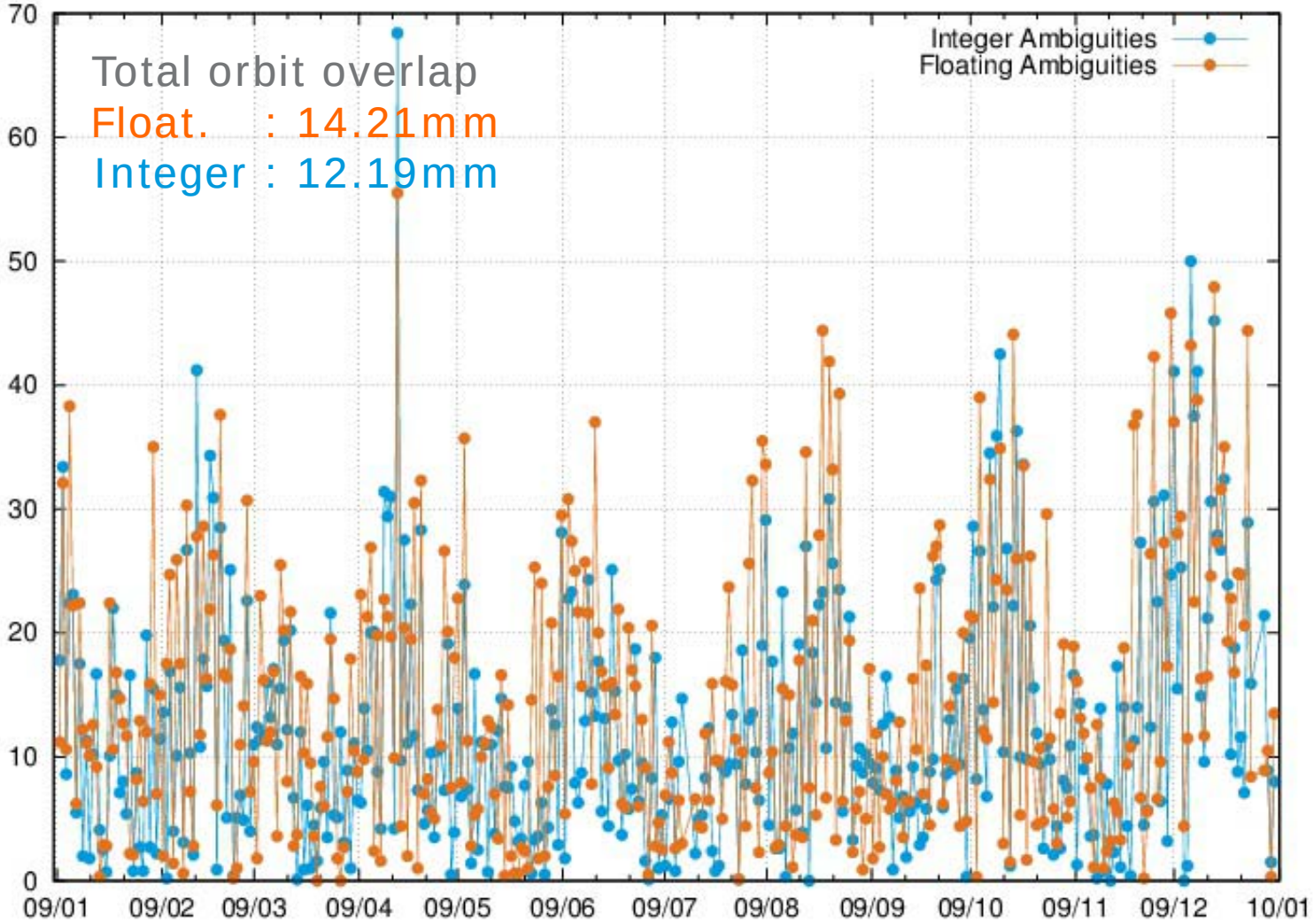
Orbit Overlaps at the day boundary

Jason-2



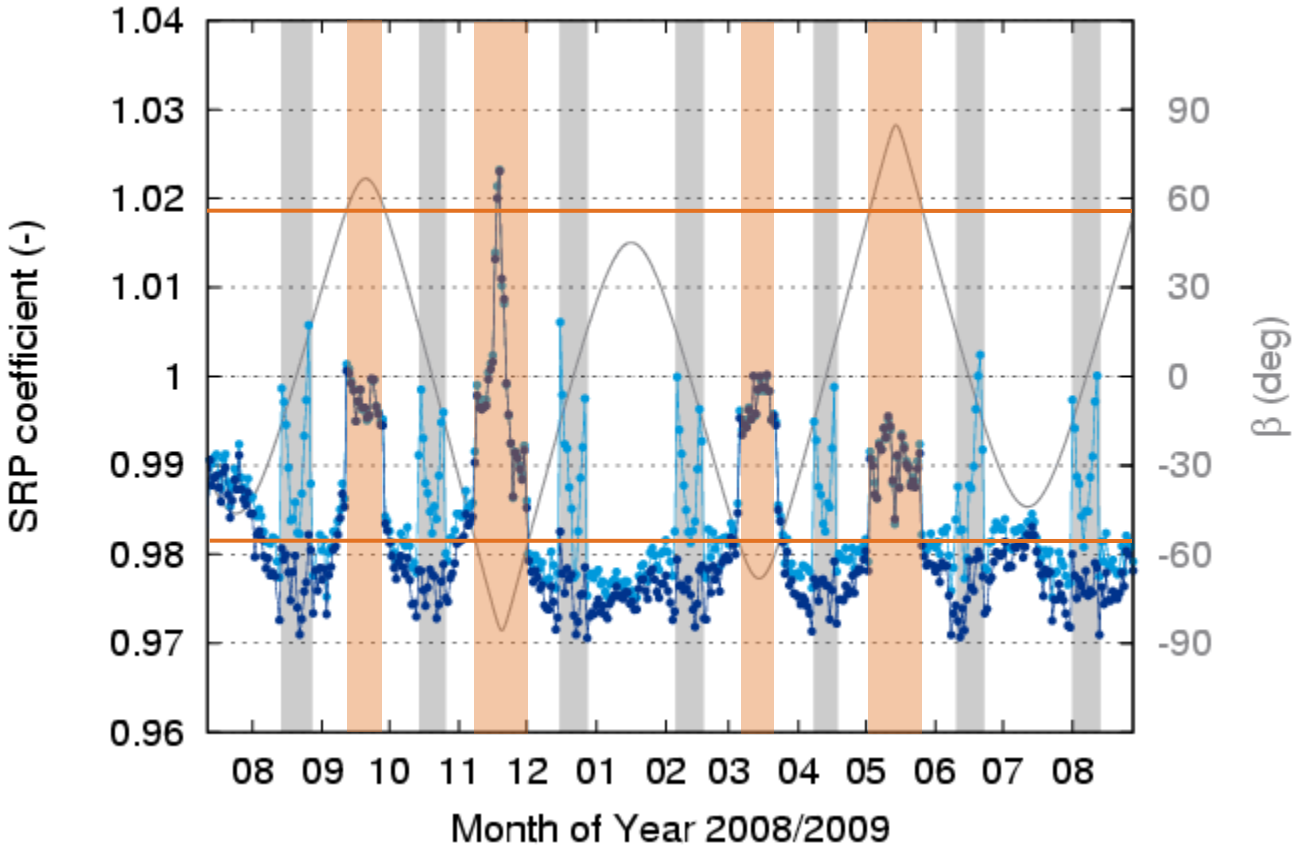
Orbit Overlaps at the day boundary

Jason-2



Scaling of solar radiation pressure model

Jason-2



Jason-2 GDR-C

Jason-2 ESOC

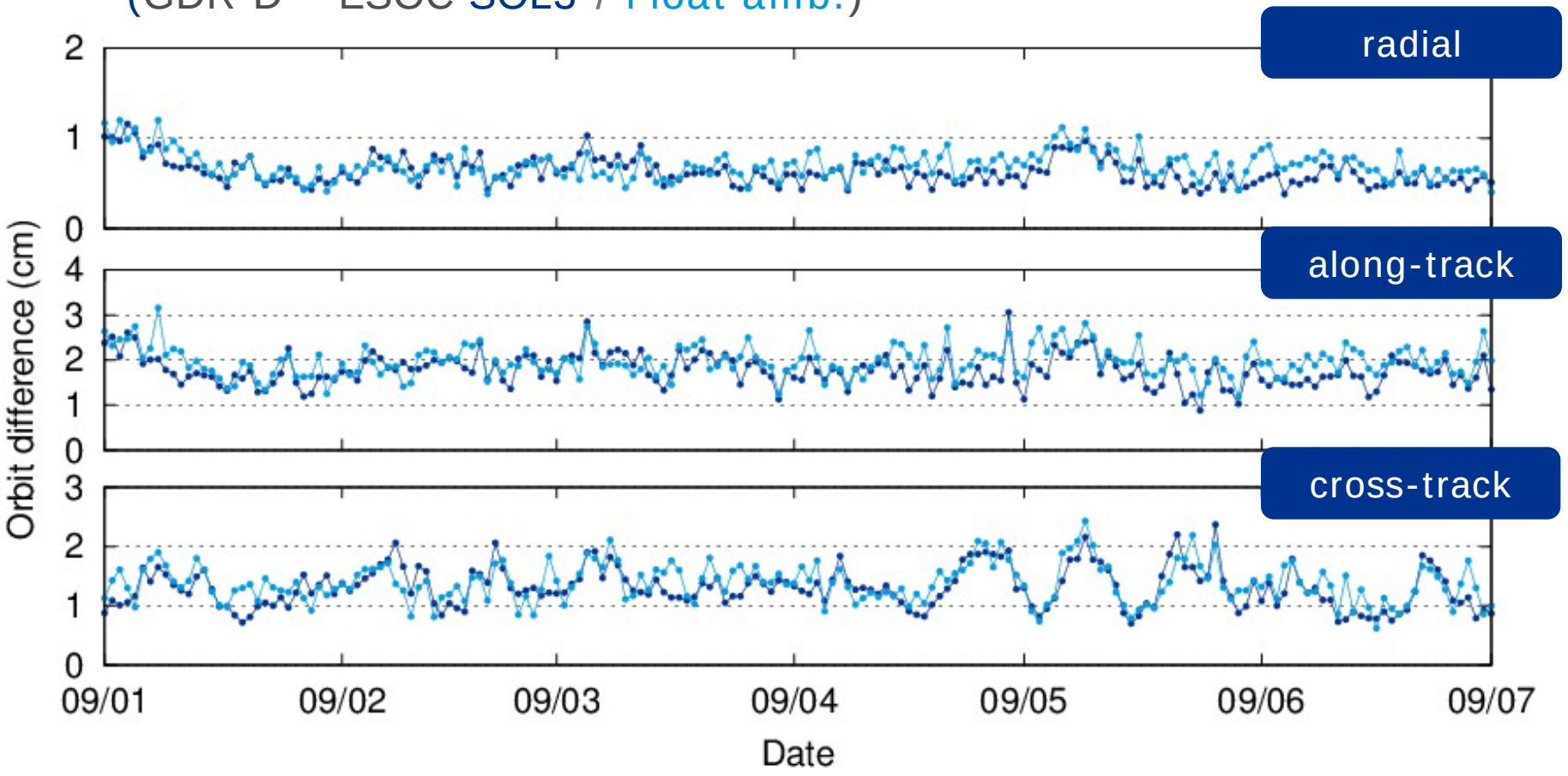
fixed yaw mode

55.7° full Sun

Daily RMS of orbit differences

Jason-2

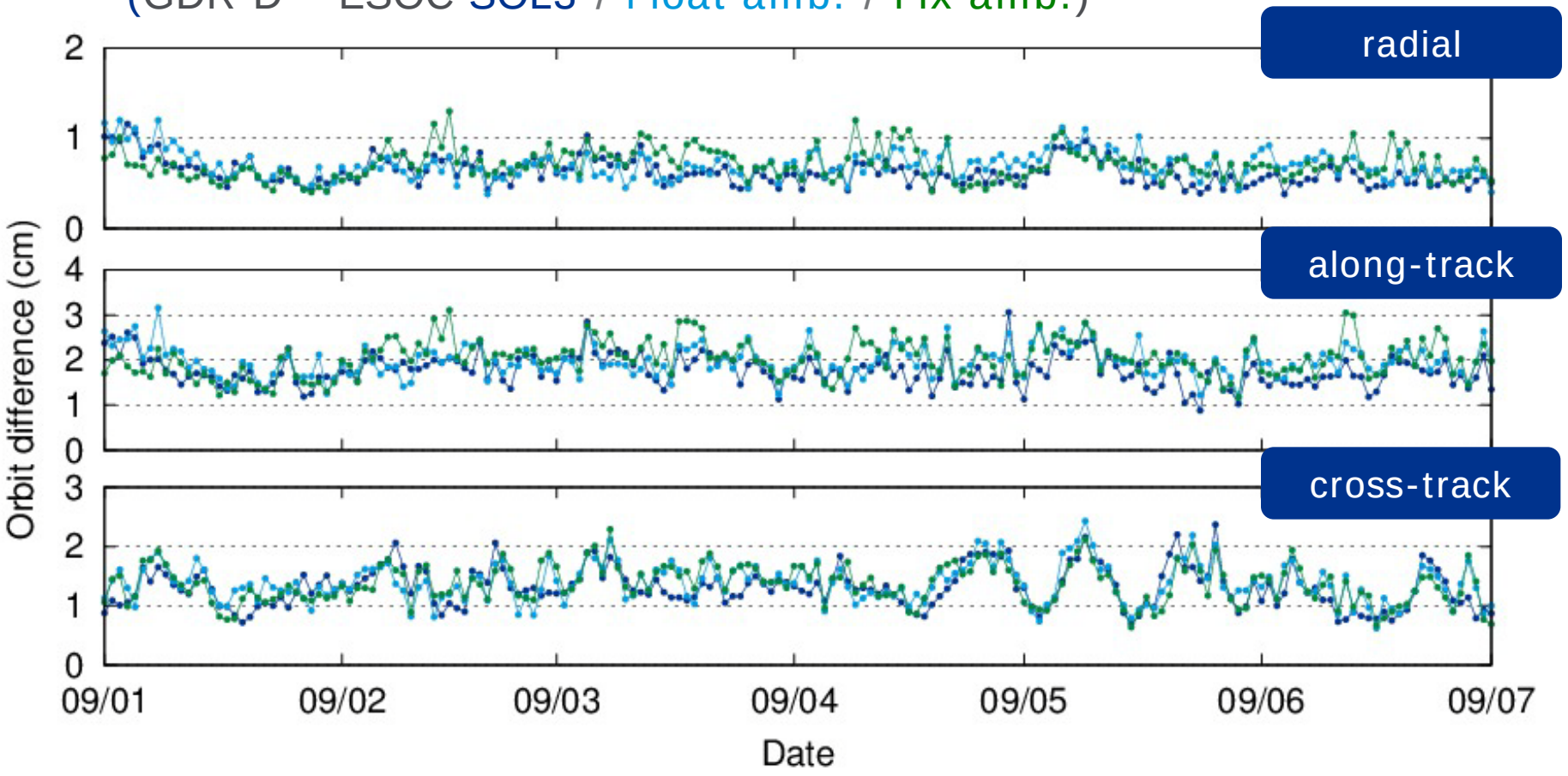
(GDR-D – ESOC SOL3 / Float amb.)



Daily RMS of orbit differences

Jason-2

(GDR-D – ESOC SOL3 / Float amb. / Fix amb.)



SLR residual performance

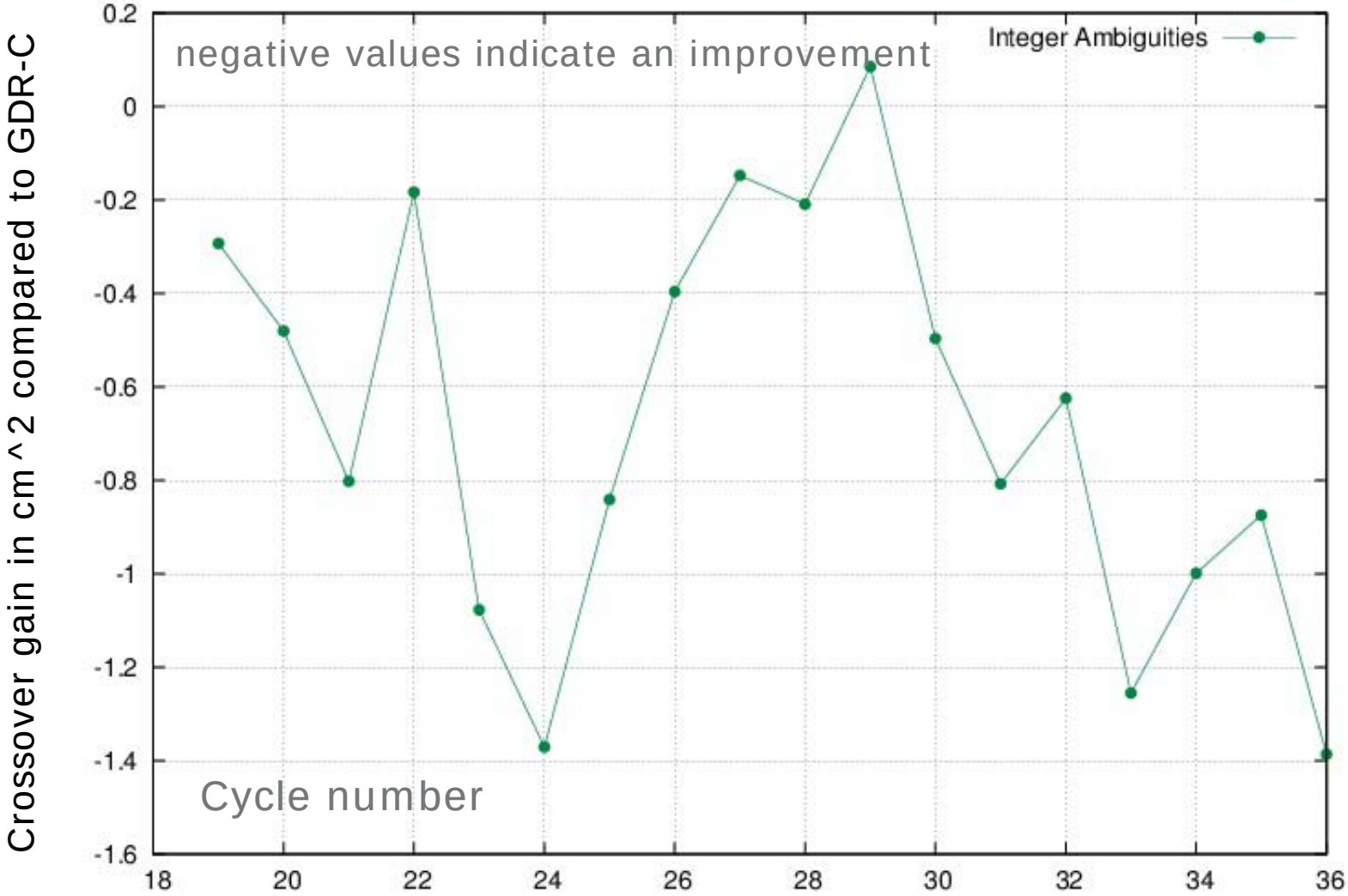
Jason-2

Solution	>60°	>10°
ESOC Sol 3.	17.9mm	25.8mm
ESOC float.	19.3mm	27.1mm
ESOC fix.	19.9mm	25.7mm
CNES GDRD	13.3mm	20.7mm
JPL 11a	13.6mm	17.0mm

2009 SLR residuals for core network

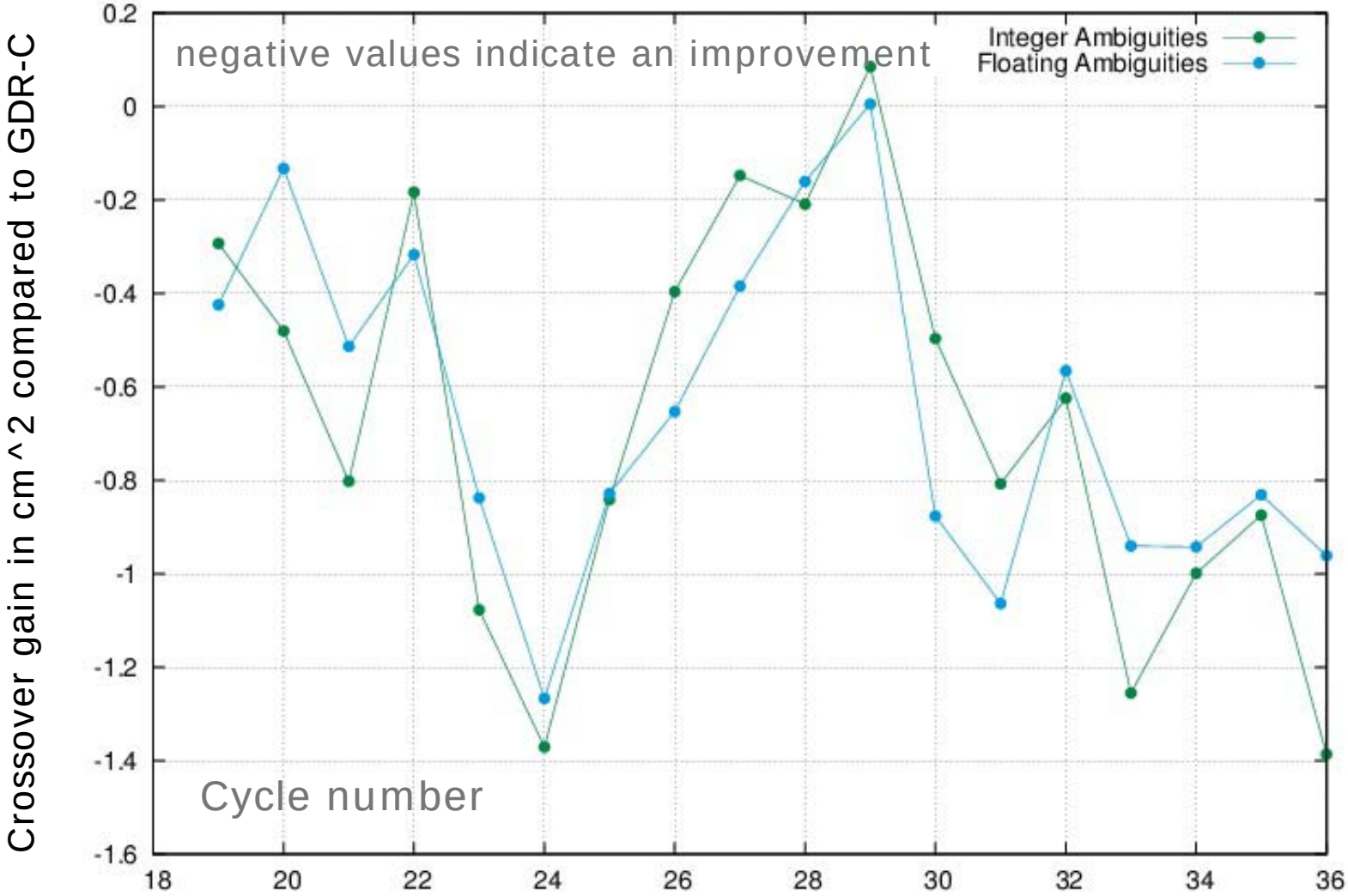
Altimeter Crossover performance

Jason-2



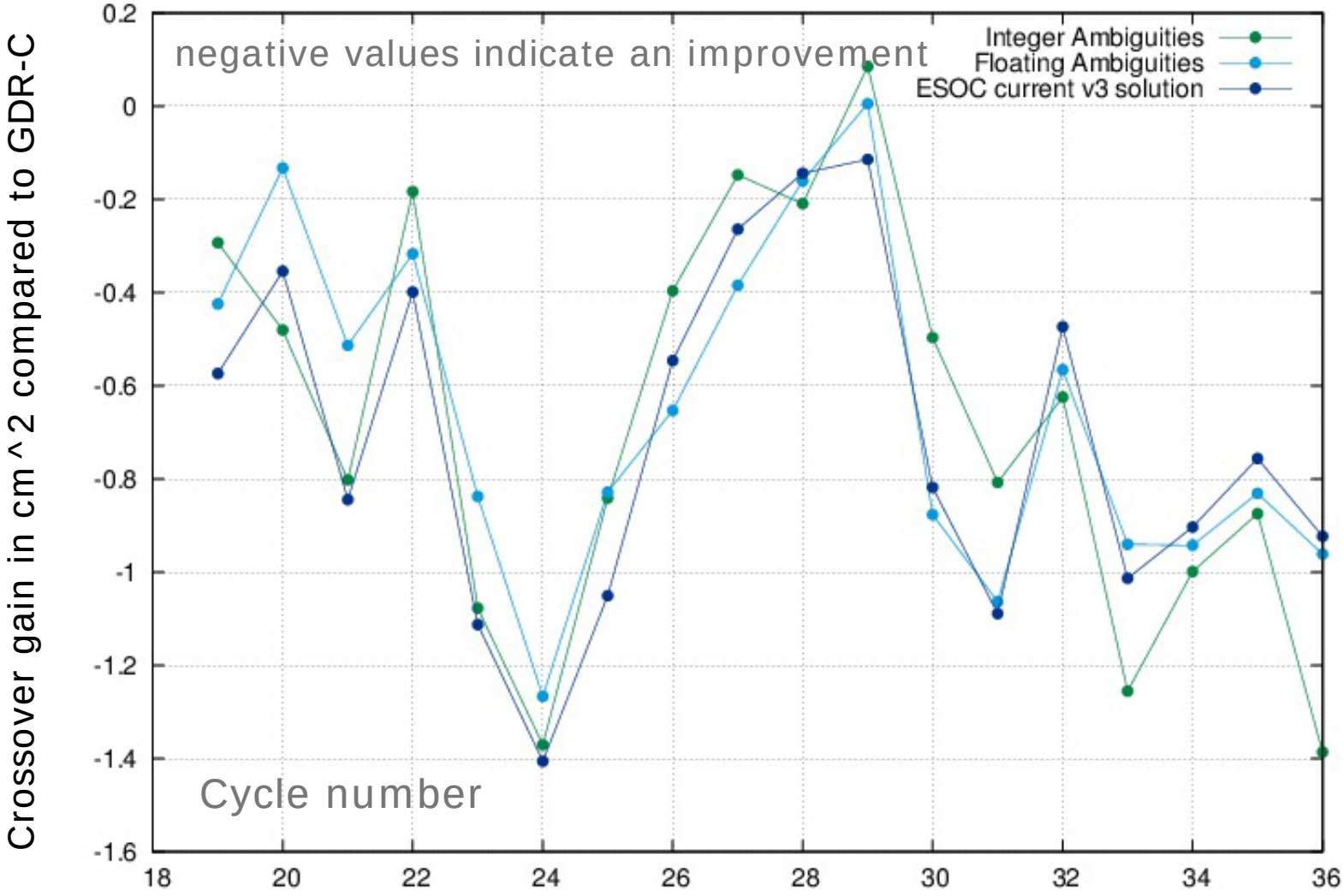
Altimeter Crossover performance

Jason-2



Altimeter Crossover performance

Jason-2



Summary (1)

- The first results of our ambiguity fixed orbits look promising but orbits do not yet perform better then our 3-day float solution (ESOC solution3) when computing altimeter crossover values.
- Possible cause could be the 60 day signal that is present in the GPS residuals and as well as our orbit overlaps.
- This signal could be a result of solar radiation modeling errors
- We currently use the recommended technique by JPL to pre-process the GPS observations at 10 seconds to detect cycle slips
- Our next step will be to process in a similar manor a year of Jason-1 orbits to test if we our ambiguity fixing is affected by the quarter cycle slips that are present in the Jason-2 data.

Summary (2)

- We will also start testing the second method to see if we get similar results when using the UPDs from our IGS processing (currently only a limit period is available but the complete Jason-1 and Jason-2 period will become available with the upcoming IGS reprocessing
- We will further try to see if increasing the number of satellite parameters for the ambiguity fixed solutions will improve the solution.
- Further we will stack our single day Jason NEQ to generate multiday solutions to see if the day boundary jumps are causing our 24hr solutions to perform worse then our 3-day solutions.

ESOC POD orbit availability

- Orbit solutions for Envisat, Cryosat-2, Jason-1/2 and ERS-1/2 (as part of REAPER project) are available on our ftp server
  - ftp://dgn6.esoc.esa.int
  - as a service to the altimetry community
  - continues extension/update of time series

- We will keep updating our processing with newer models when they become available.

Thank you

Michiel Otten
Michiel.Otten@esa.int