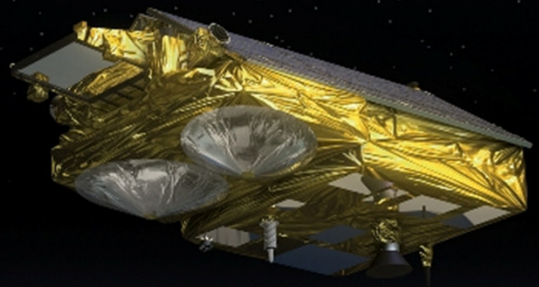


CryoSat SIRAL: calibration and achievable performance after ten years of operations

Michele Scagliola, Marco Fornari, Marco Meloni, Jerome Bouffard, and Tommaso Parrinello

Outline

- Status of SIRAL Internal Calibration
- End-to-End calibration of the CryoSat Interferometer

SIRAL internal calibrations

The following calibration parameters can be used by the science processors and are continuously monitored:

a. CAL1 pulse-to-pulse phase/amplitude corrections
b. CAL1 internal path delay and gain variation corrections
c. CAL2 LPF correction mask (SAR/SARIn)
d. Autocal AGC phase difference corrections
e. Autocal AGC gain corrections
f. Autocal ADC phase difference corrections

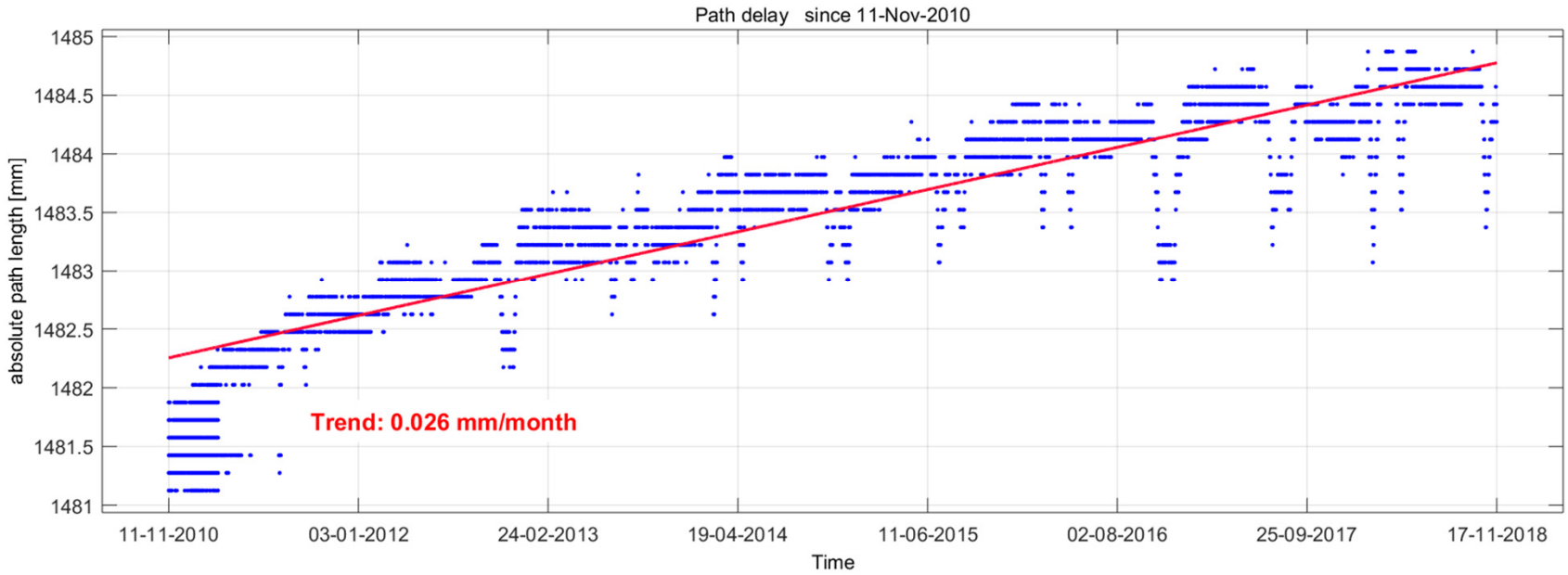
Moreover the following monitoring parameters are observed:

a. CAL1 PSLR and -3dB width
b. CAL4 phase difference

Corrections for
- gain and instrument path delay
- pulse-to-pulse amplitude and phase
- transfer function amplitude and phase with respect to frequency
- phase difference between the two receiving antennas

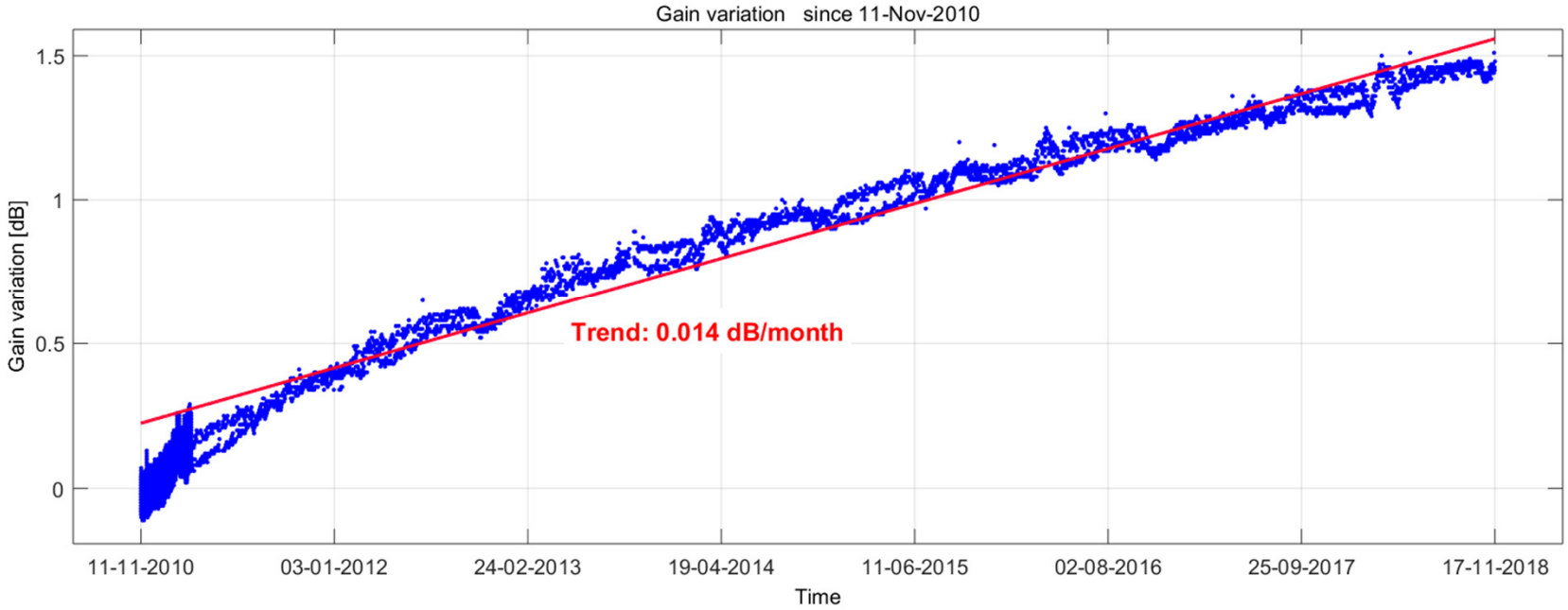
CAL1 SAR: internal path delay correction

The correction for internal path delay contained in the CAL1 products has a constant trend and it is affected by the temperature of the instrument



CAL1 SAR: gain variation correction

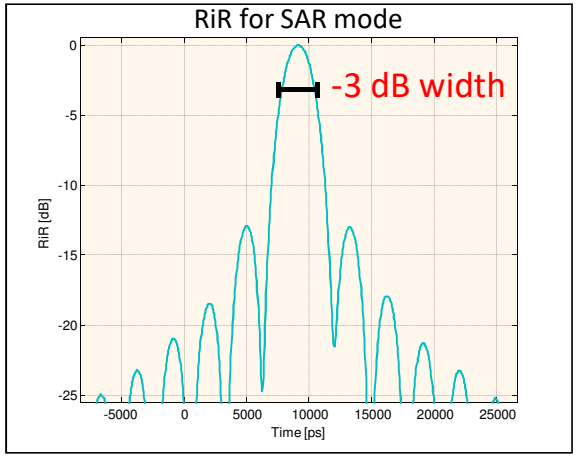
The correction for gain variation contained in the CAL1 products has a constant trend and it is affected by the temperature of the instrument

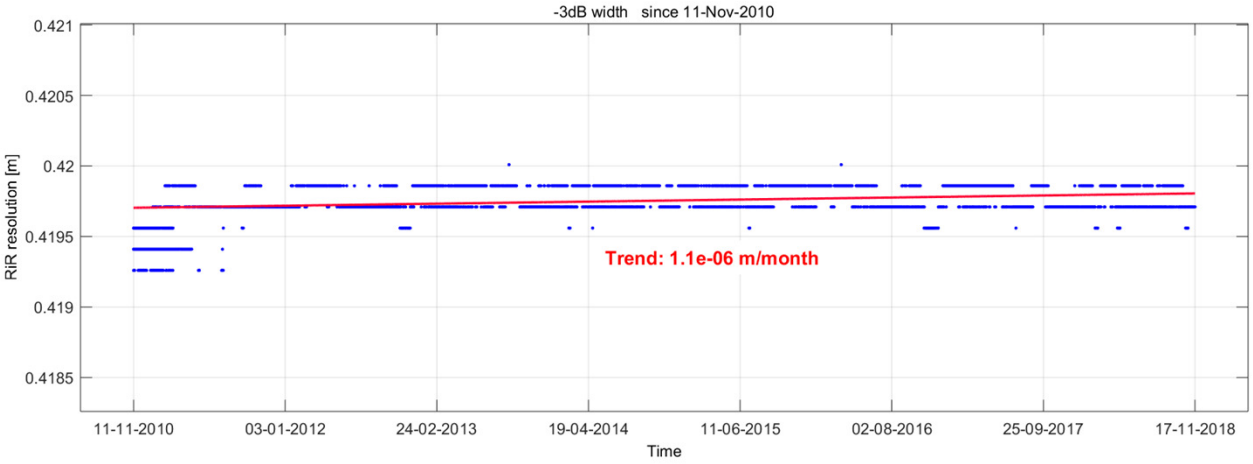


CAL1 SAR: Range Impulse Response parameters

Range Impulse Response:

-3dB width is a measure of instrument range resolution





Requirement on -3 dB width:
0.394 m < -3 dB width < 0.436 m.

Stable for all modes and within requirements

Calibration of CryoSat interferometer

End-to-end calibration of CryoSat interferometer:

- in orbit calibration campaigns rolling left and right the spacecraft of about ±0.4 deg
- the purpose is to determine the across-track slope of the ocean surface

$$\beta = \eta \left(\vartheta - \chi \right)$$

Ocean surface slope

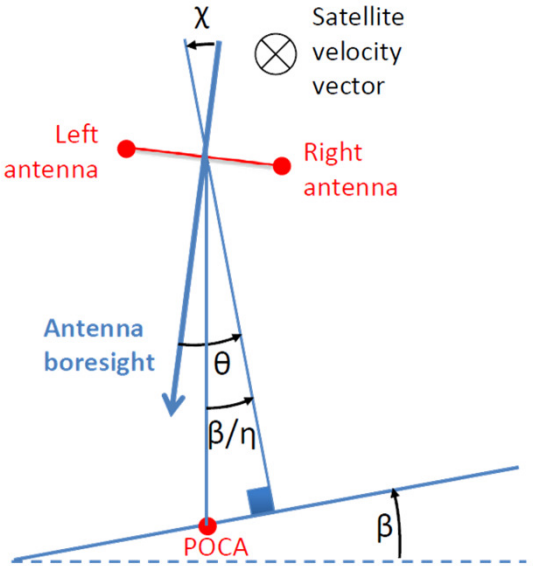
$\eta = 1 + h / R$

a geometric factor

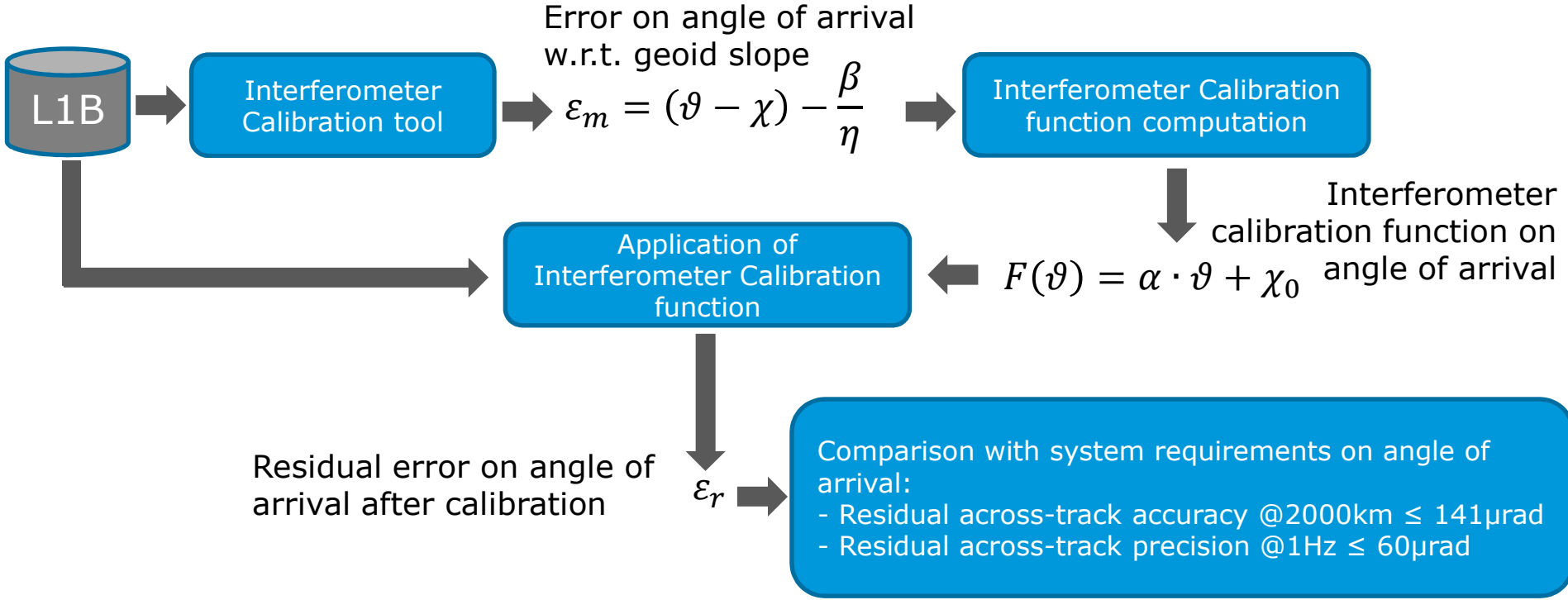
$\vartheta = Arg(\Psi(0)) / (k_0 \cdot B)$

the angle of the first arrival from SARin L1b

roll mispointing angle from Star Trackers

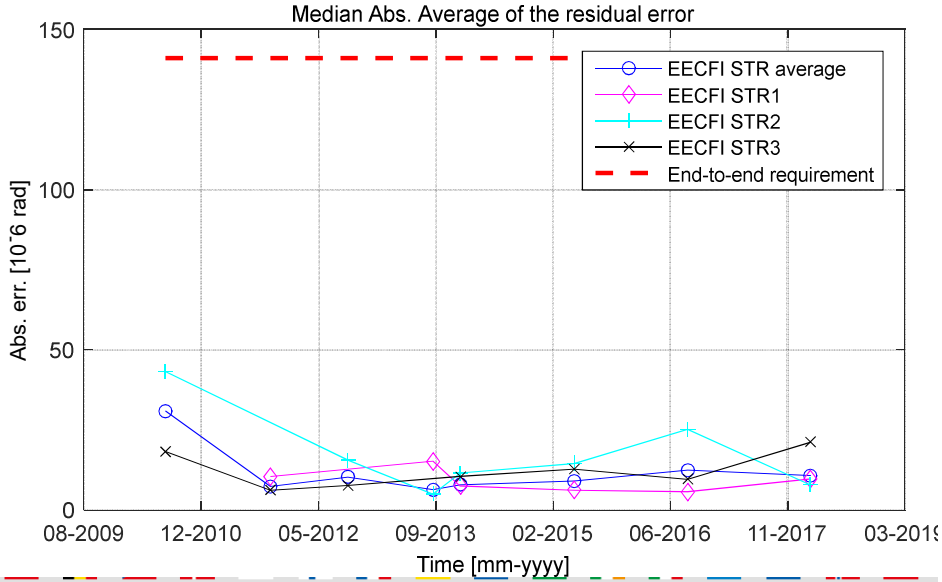


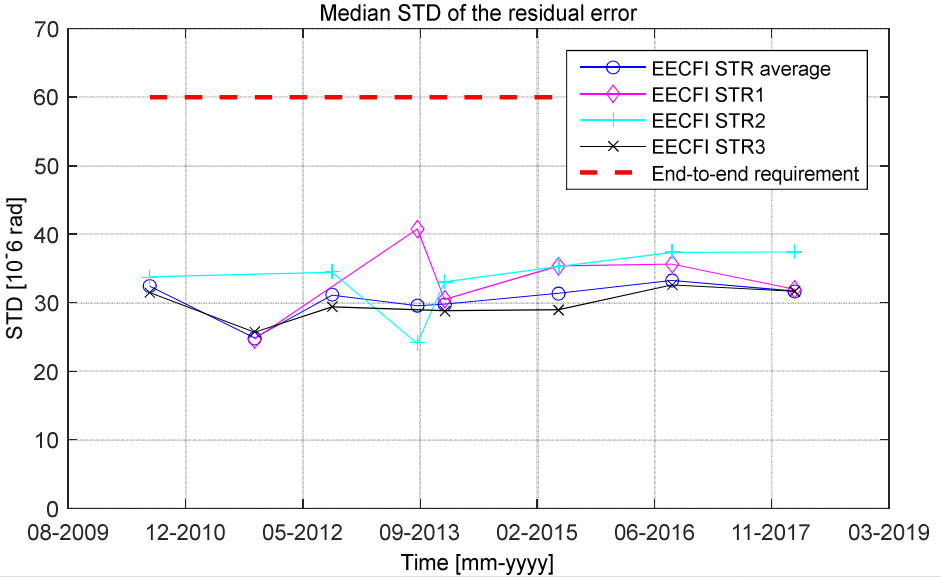
Calibration function and end-to-end performance



CryoSat interferometer end-to-end performance

The End-to-end performance of CryoSat interferometer in the sense of accuracy and precision are stable and below the requirements





Conclusions

By analysis of SIRAL internal calibrations

- Instrument is stable from the beginning of operations
- Instrument is affected by temperature evolution, this is expected due to the non sun synchronous orbit
- Instrument performance parameters are within system requirements

The End-to-end performance of CryoSat interferometer in the sense of accuracy and precision are stable and below the requirements