

Instrumental Calibration of Copernicus Altimeters

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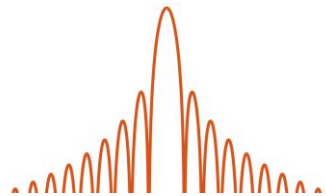
isardSAT[®]

S3VT 2026, ESRIN



SRAL Altimeters Instrumental Parameters

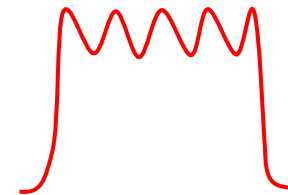
CAL1 Products



(Internal Calibration Path Waveform)

- **Internal Delay**
- **Integrated Power**
- PTR Width
- **Burst Power & Phase**
- **Attenuation Steps**
- Secondary Lobes (monitoring)
- ***E2E spectral distortions***

CAL2 Products



(Rx Transfer Function Waveform)

- **CAL2 normalised shape**
- Slope (monitoring)
- Standard Deviation (monitoring)

... + **USO**

+ **aux data**
measured
on-ground

The **calibration** parameters correct for the instrument impact in the **science** data:

The **CAL1 delay & the USO clock period** correct the final range (**SSH**).

The **CAL1 power** corrects the sigma0 (**winds**).

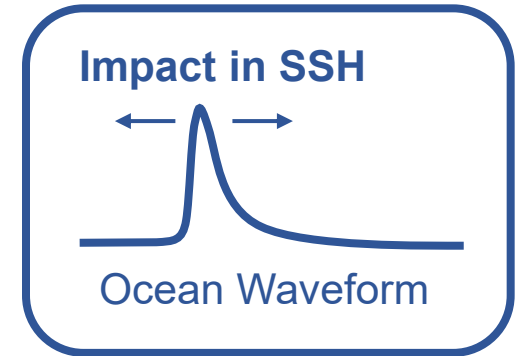
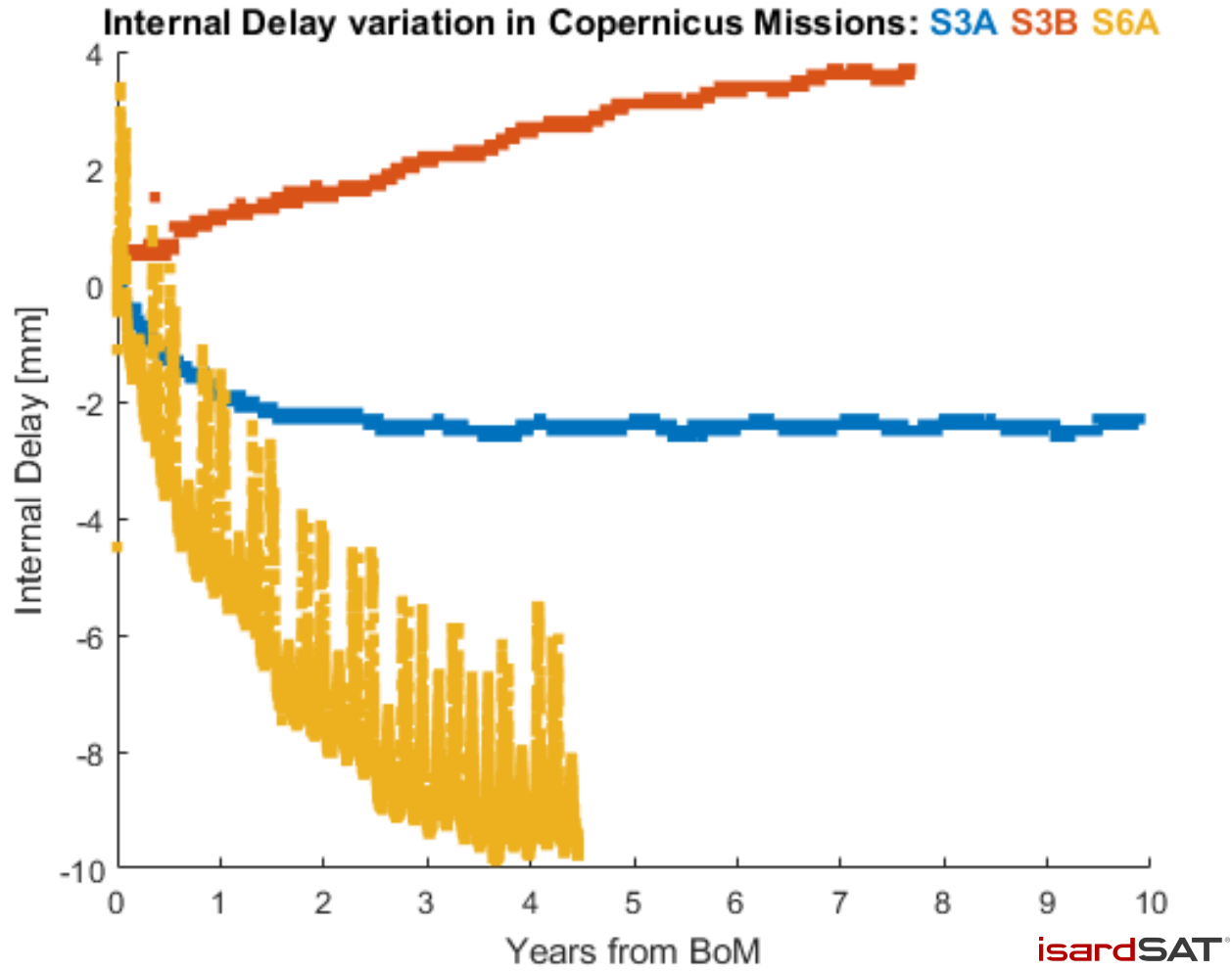
The **CAL1 PTR width** corrects (at L2 processing) the **SWH**.

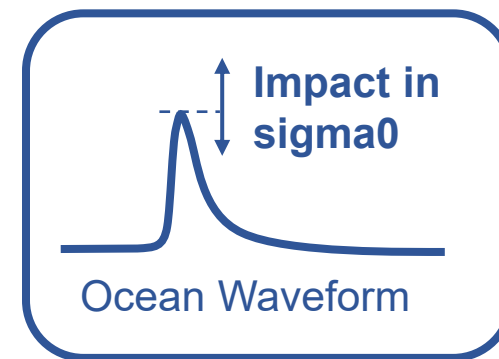
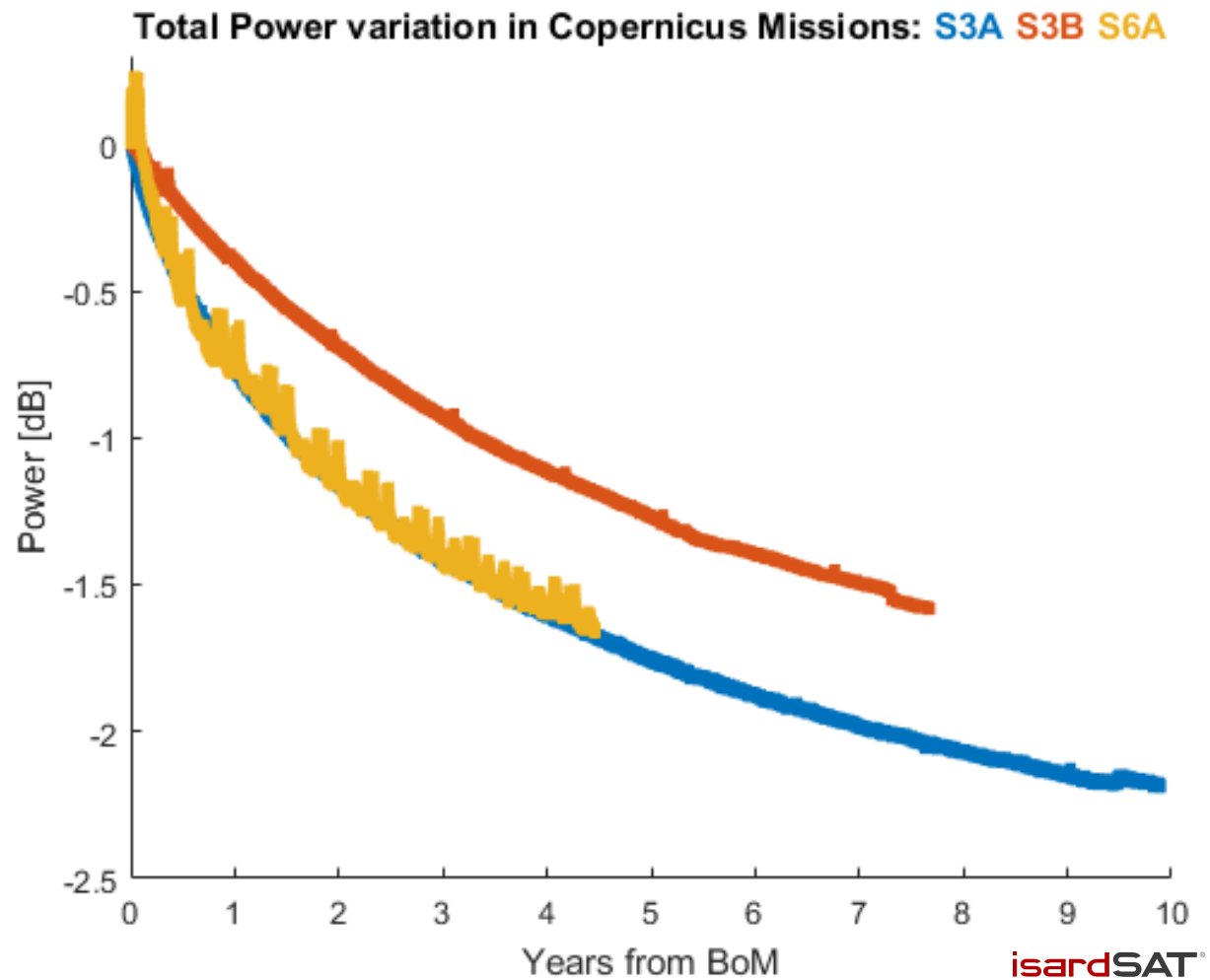
The **CAL2** correction reshapes the science **waveform shape**.

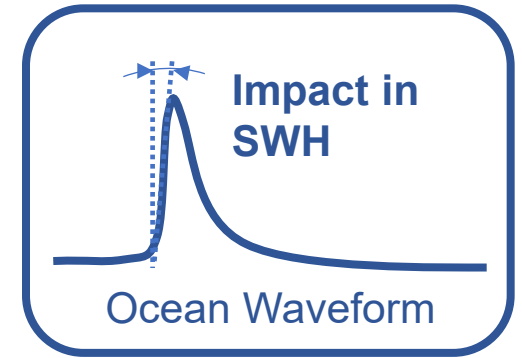
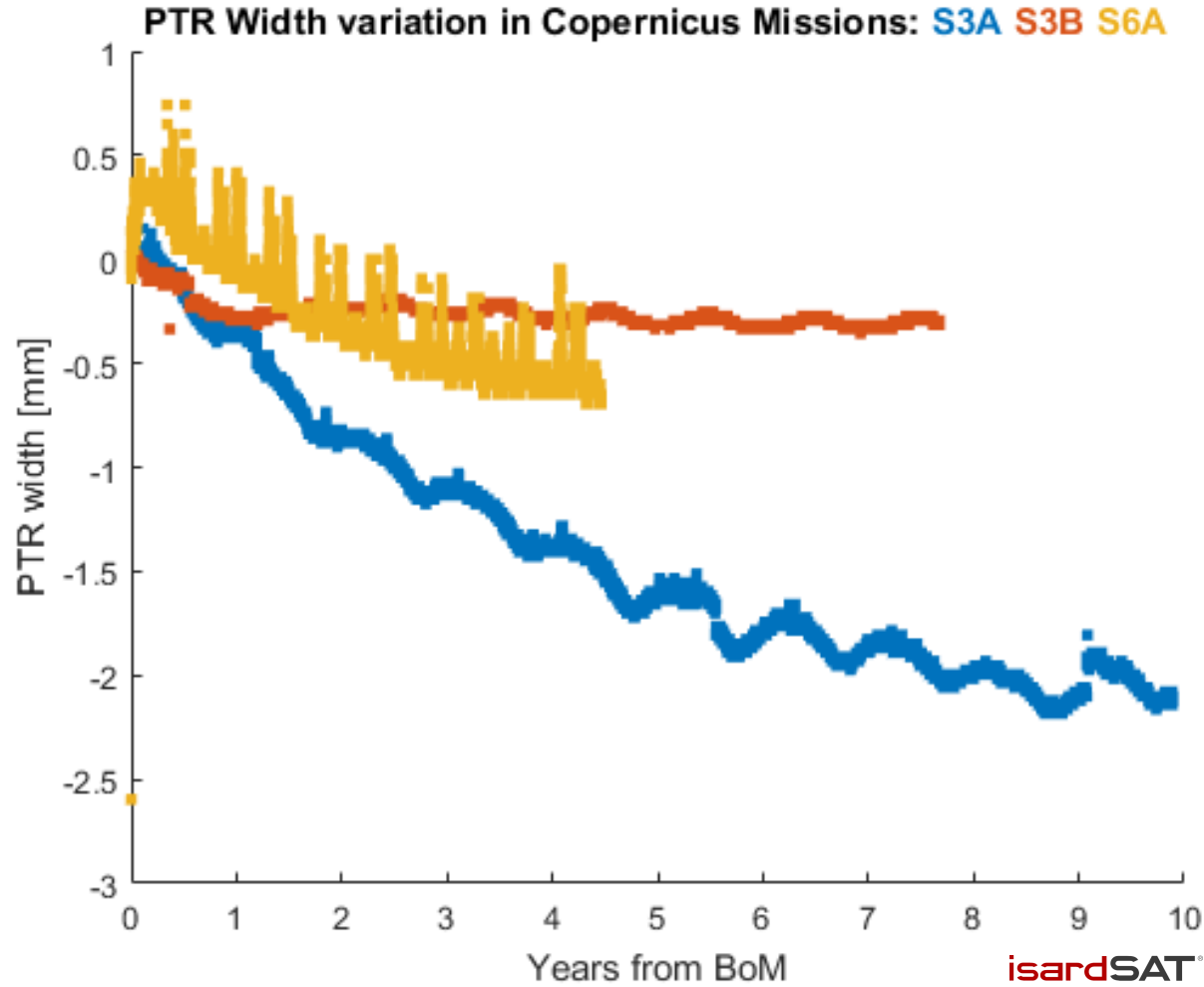
The **Burst Power and Phase** corrections improve the **stack alignment**.

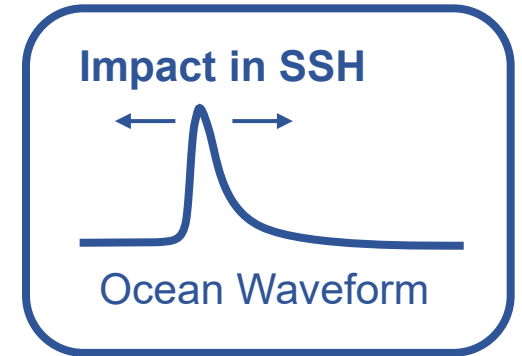
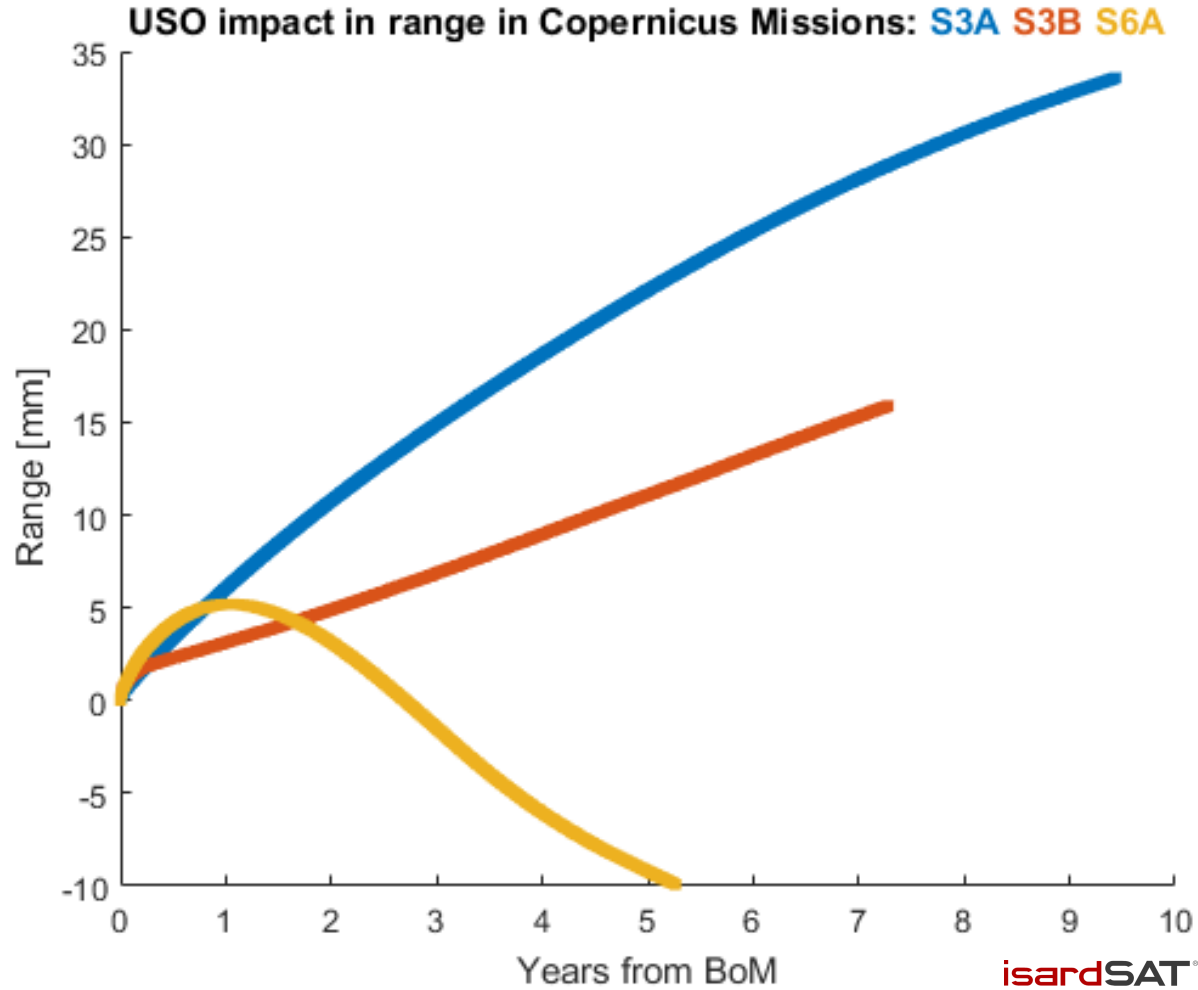
The **ATT attenuation steps** tables corrects for the actual onboard science waveforms attenuation (**sigma-0**).

The **E2E distortions** correction reshapes the science **spectral shape**.

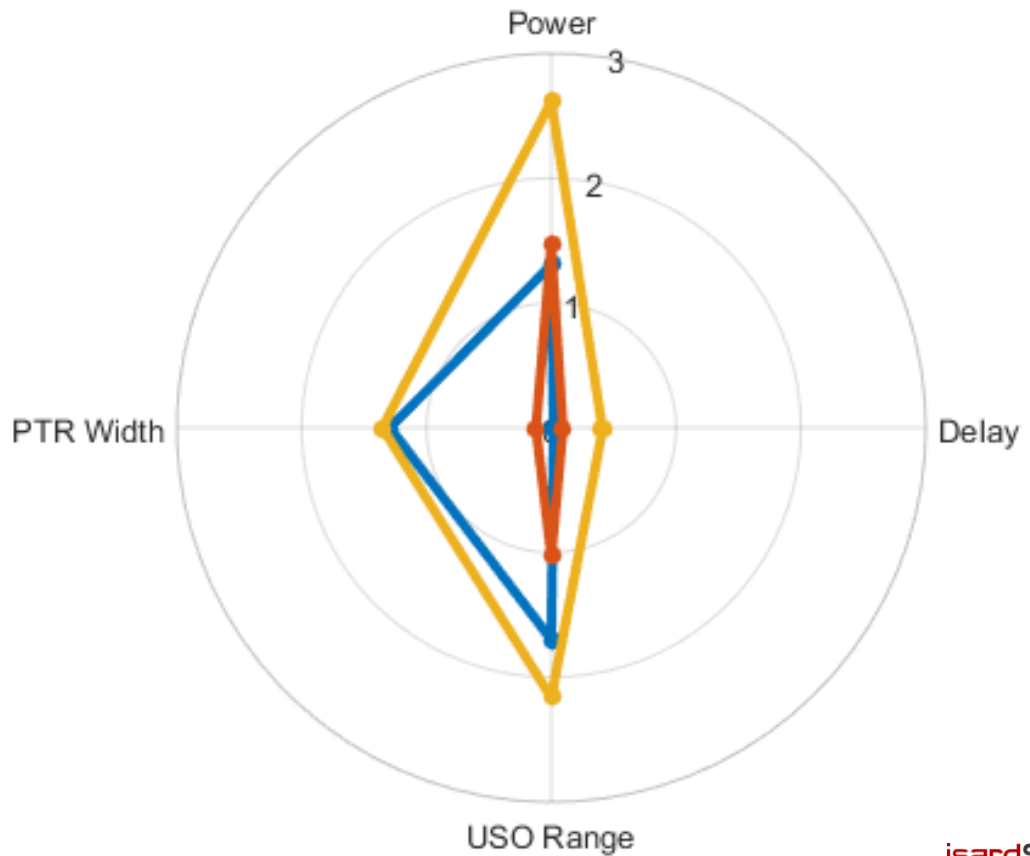








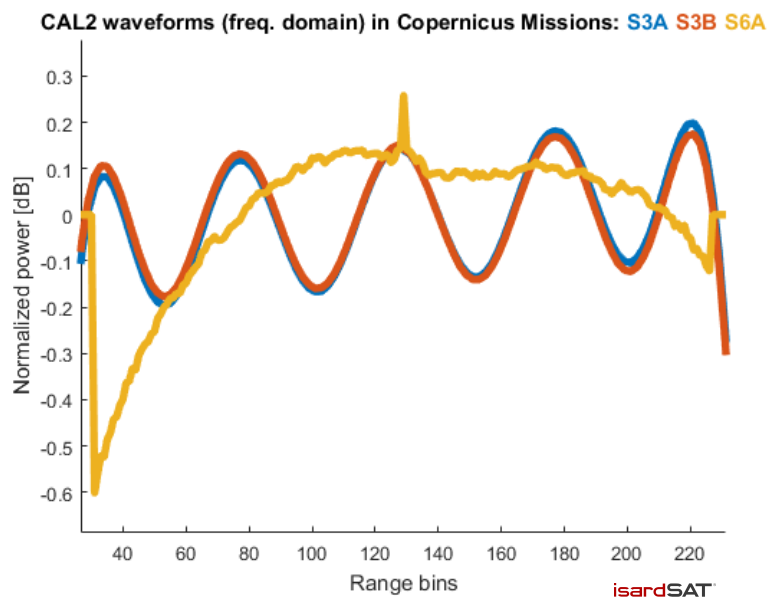
Copernicus Altimeters Instruments Behaviour
Absolute drift comparison **S3A** **S3B** **S6A**



Summary table with all values presented in the previous figure:

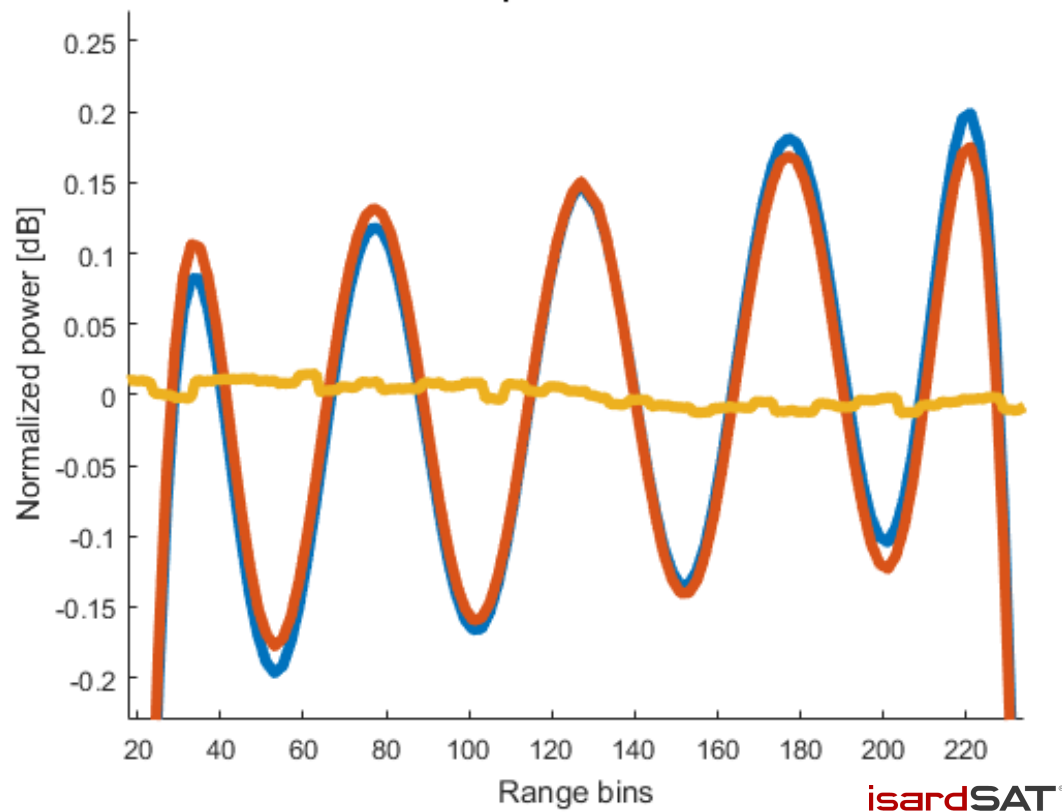
Calibration Parameters Drifts	Delay mm/year	Power dB/year	Width mm/year	USO mm/year
Sentinel-3A	+ 0.1	- 0.17	- 0.21	+ 3.3
Sentinel-3B	+ 0.4	- 0.19	- 0.02	+ 2.0
Sentinel-6A	- 1.9	- 0.34	- 0.22	- 4.2

Comparable CAL2 waveforms

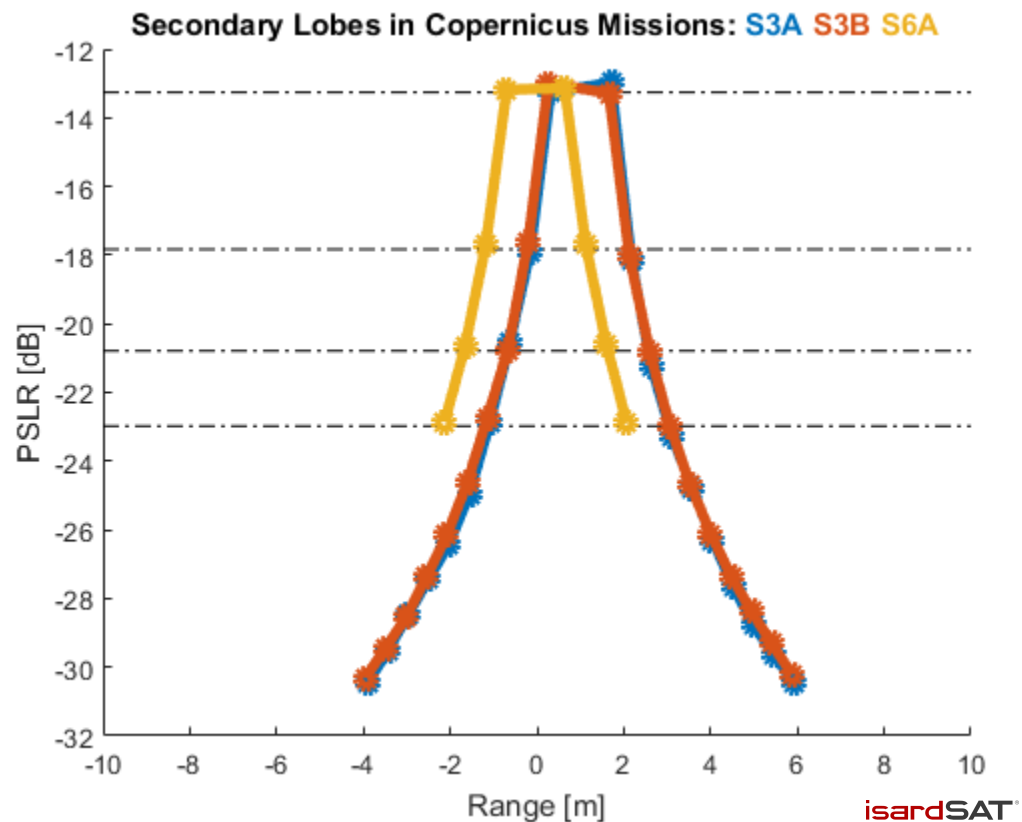


Instrument corrections from CAL2 measurements

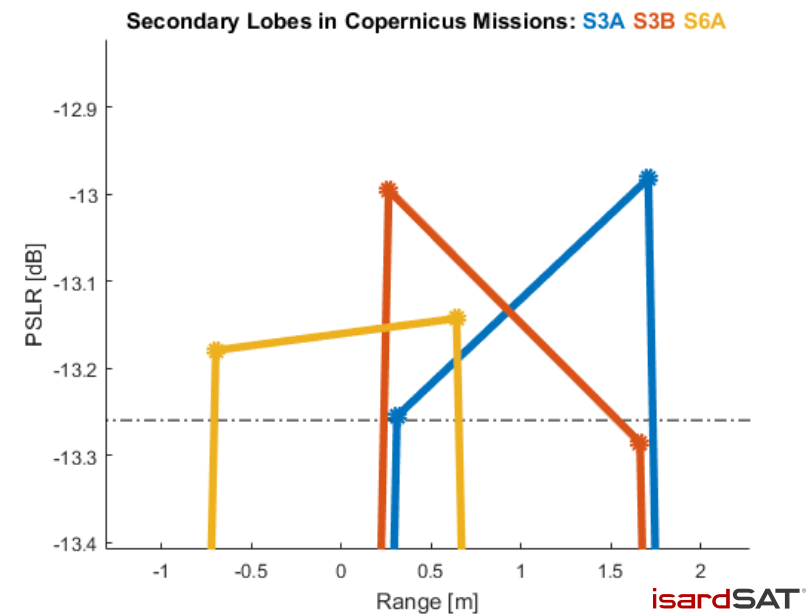
CAL2 corrections in Copernicus Missions: S3A S3B S6A



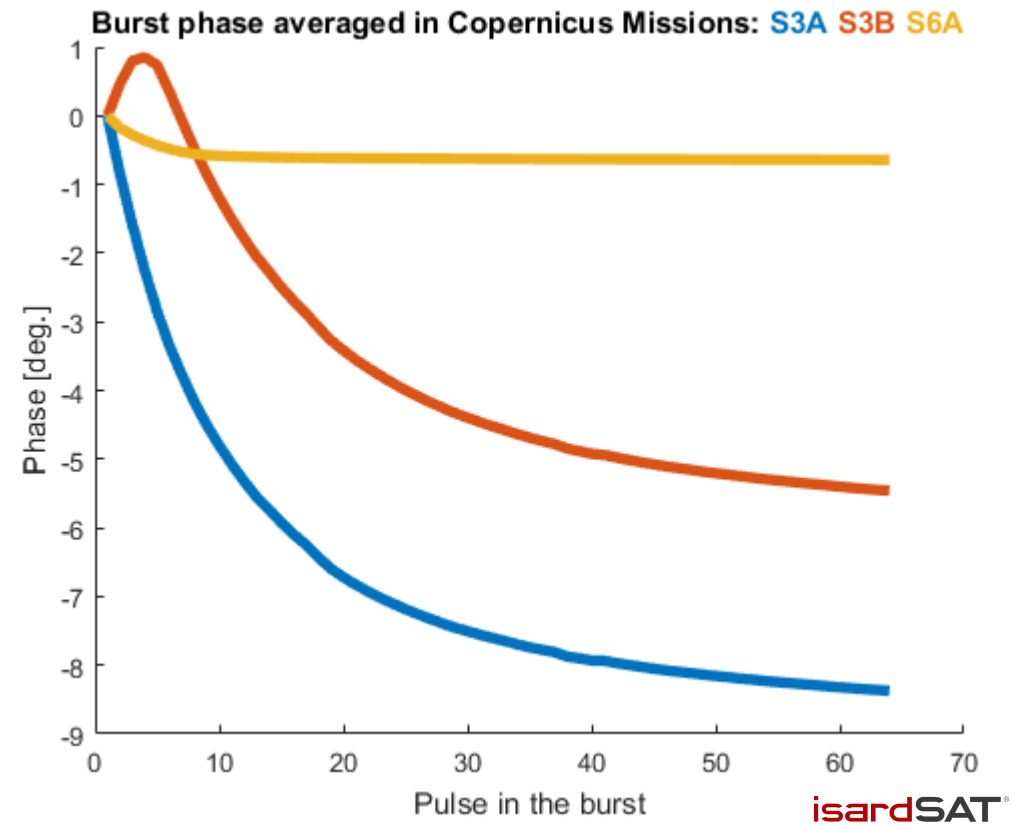
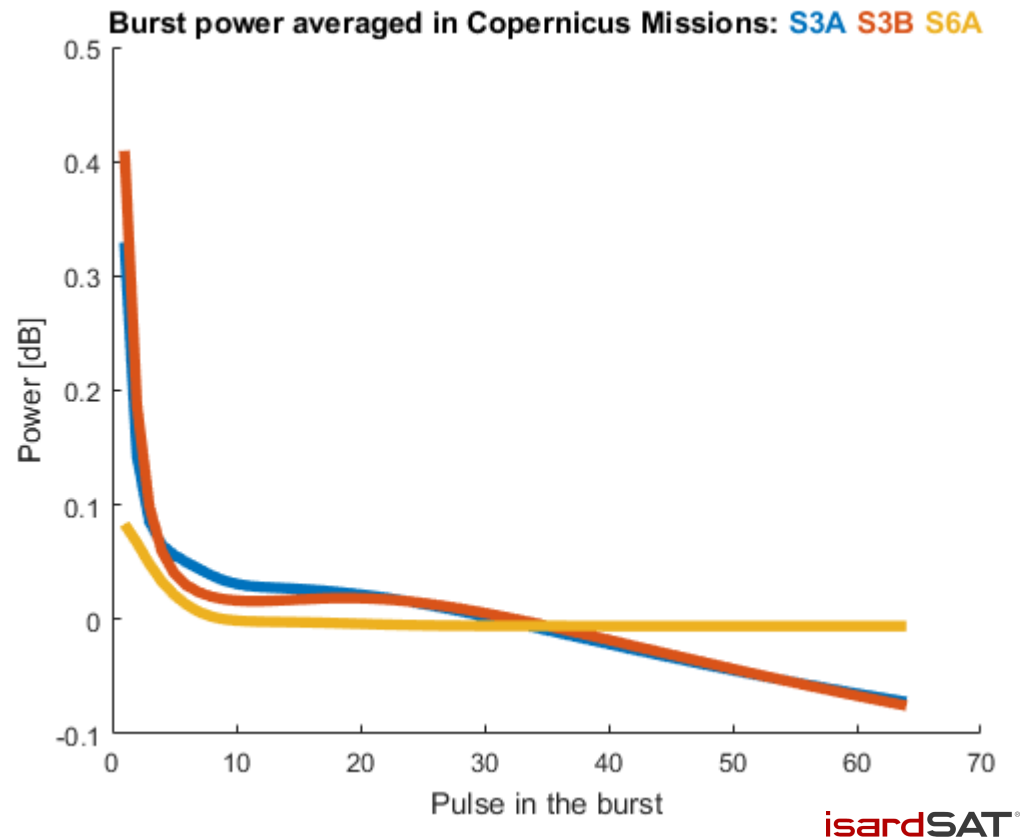
Range positioned Power PSLR of Secondary Lobes



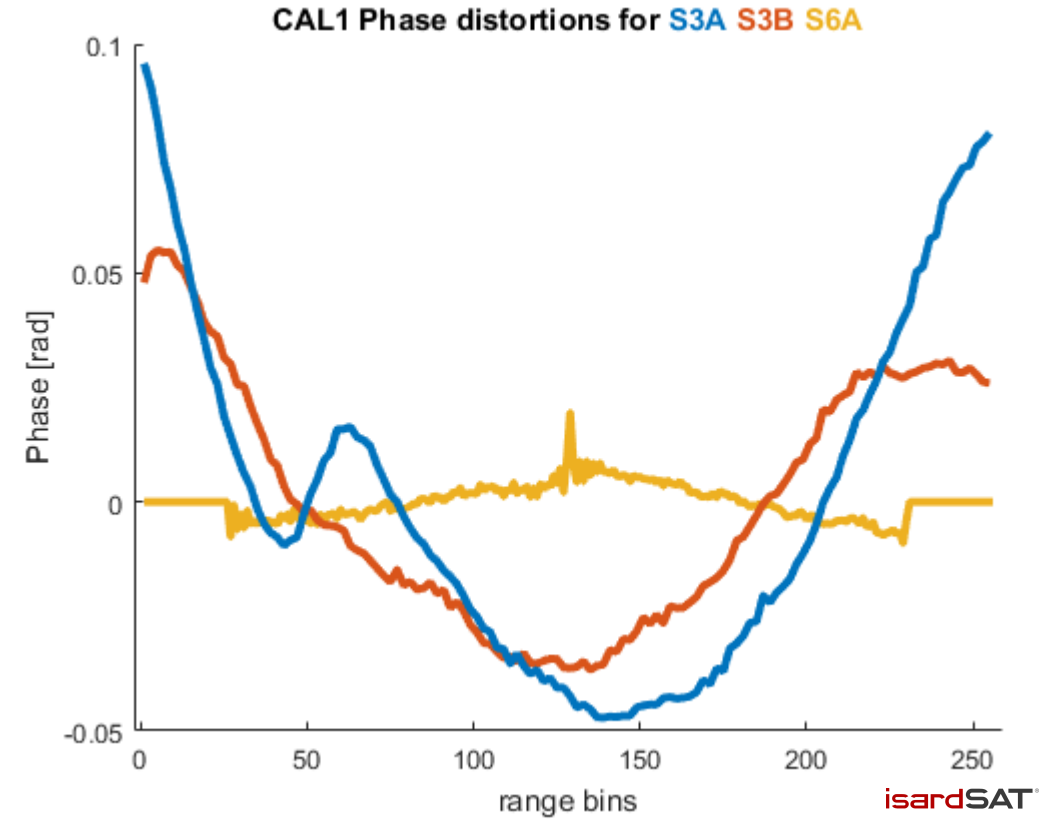
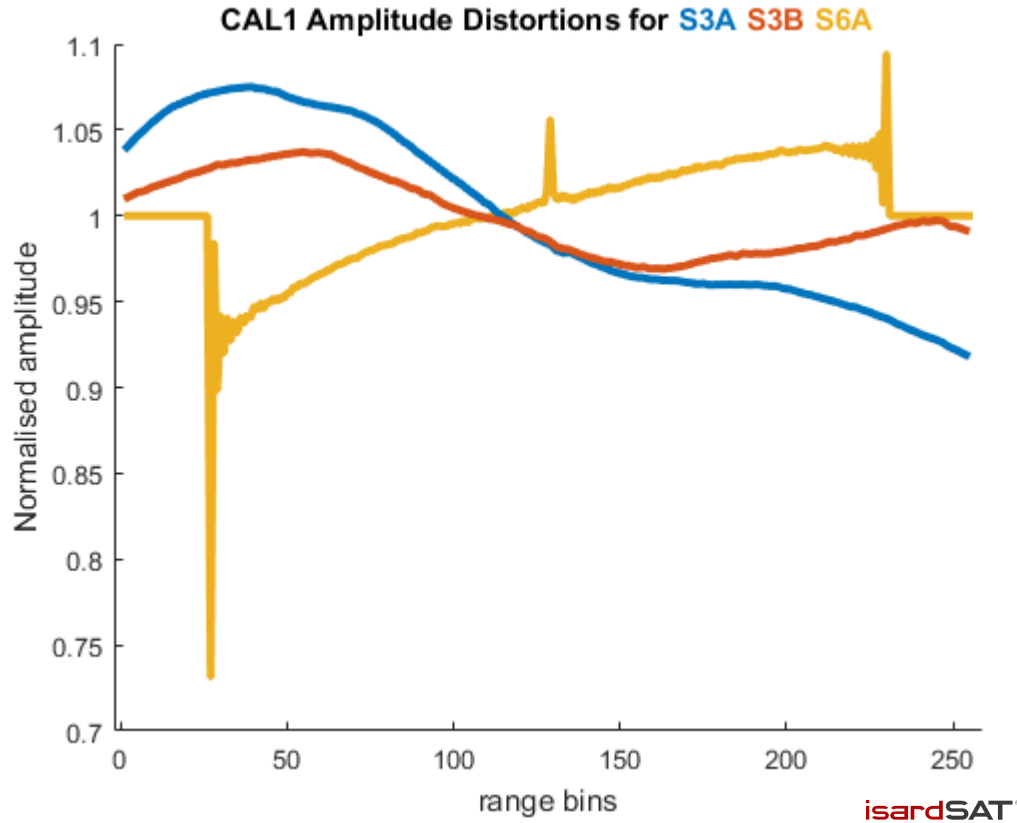
Zoom 1st sec lobe →



Burst Power and Phase corrections, full mission averaged



CAL1 Distortions in Phase and Amplitude



Conclusions

- The different instrumental calibration corrections compensates the science data for the possible instrument drifts and excursions.
- The 3 Copernicus altimeter's instrument behaviour are nominal, with all calibration parameters compliant with mission requirements.
- The initial Sentinels (3A, 3B, 6A) power drops are now much more stable.
- A new added calibration correction accounts for the whole system (internal + external) spectral distortions in power and phase using a complex RIR correction.
- **S3C launch** is coming soon. The next S3C-S3B and S3C-S3A tandem phases during the S3C commissioning phase will be unique and very valuable for different intercomparisons of the 3 S3 instrument performances.

Acknowledgements

- The different **isardSAT**® assessments and studies on calibration measurements here presented have been performed under the following projects:

- S3MPC (Sentinel-3 Mission Performance Cluster), by ESA



- COPAS (Copernicus Altimeter Service), by EUMETSAT / EU



- Sentinel-6 Poseidon-4 Level 1 GPP, by ESA



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