S6 Validation Activities by isardSAT

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Introduction

isardSAT validation activities included in the following main areas:

- Instrumental calibration and validation activities (all for altimeter):
  - **Instrumental CAlibration Research for Understanding Sentinel-6 performance (ICARUS)**
  - Calibration and Validation of the S6 altimeter Sigma-0 and the radiometer brightness temperature over natural surfaces
  - **Sentinel-6 Altimeter Calibration using Point Targets (CaPoTa)** – includes IEEC
- Altimeter Level 1 and Level 2 product validation and calibration:
  - for altimeter: **Sentinel-6 Altimeter Calibration using Point Targets (CaPoTa)**
  - for radiometer: Calibration and Validation of the S6 altimeter Sigma-0 and the radiometer brightness temperature over natural surfaces

Introduction

isardSAT validation activities included in the following main areas:

- Detailed investigation and evolution of altimetric Level 1 and Level 2 processing algorithms:
  - DDP and FF:
    - **Sentinel-6 Altimeter Calibration using Point Targets (CaPoTa)**
    - Validating Algorithms Levels 1A and 2 in Ebre RIver Area (VALERIA)
  - Geophysical retrievals algorithms:
    - for Ocean: Amplitude Compensation and Dilation Compensation Algorithm (ACDC) Validation for S6 (ACDC6)
    - for Coast: COastal Range ALtimetry for Sentinel-6 (CORALS)
    - for Hydrology: Validating Algorithms Levels 1A and 2 in Ebre RIver Area (VALERIA)
    - For Radiometer: Calibration and Validation of the S6 altimeter Sigma-0 and the radiometer brightness temperature over natural surfaces

Instrumental CAlibration Research for Understanding Sentinel-6 performance (ICARUS)

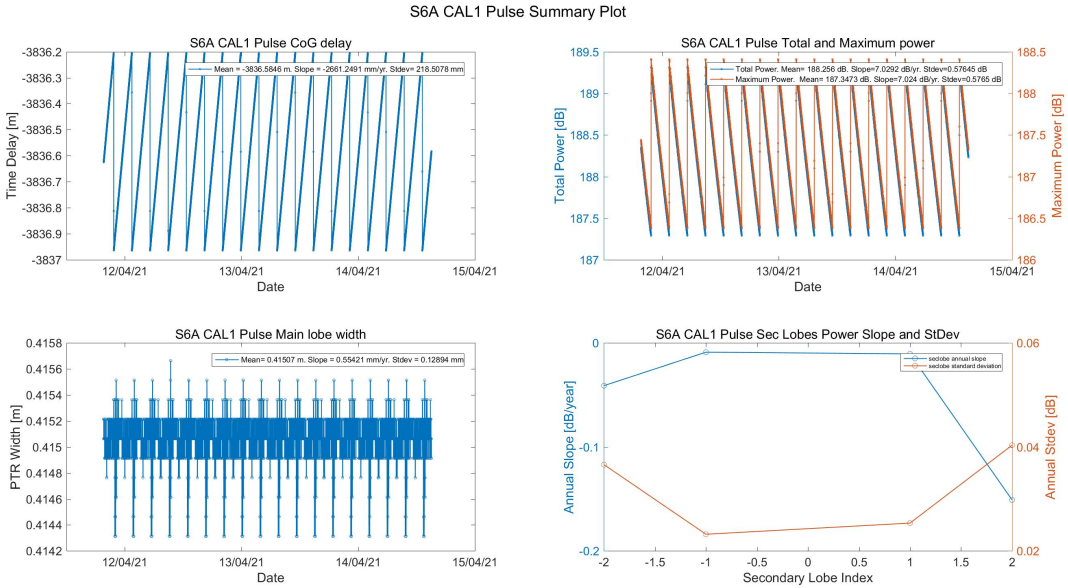
The aims of this activity are:

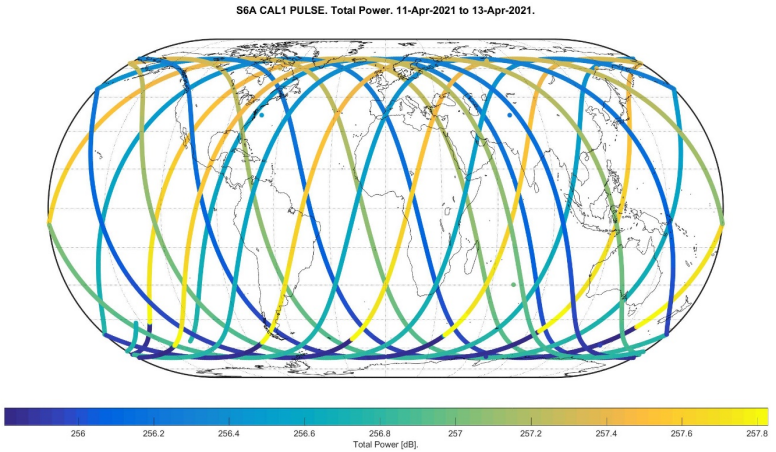
1. Monitoring & Assessment of S6 Calibration data
2. L1B Calibration Processing with alternative options
3. Investigate on expected behaviour and potentially propose evolutions on calibration processing schemes

We will investigate at a global scale the effect of the instrumental calibration corrections on the altimeter science data.

- CAL1 Internal Time Delay → SSH
- CAL1 PTR Width → SWH
- CAL1 Power → winds
- CAL1 Secondary Lobes features → ?

Instrumental CAlibration Research for Understanding Sentinel-6 performance (ICARUS)

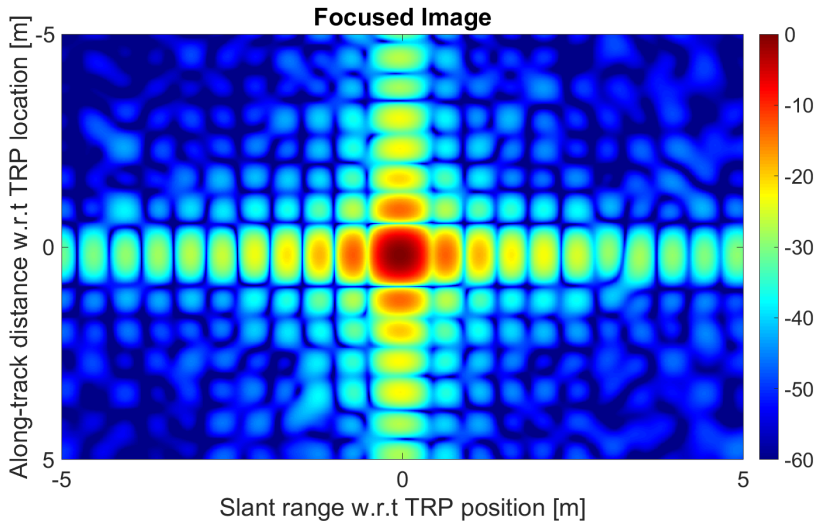




Learned from S3MPC project:
Impact of PTR shape in SSH (0.4 mm/year) & in SWH (3 mm/year) (S. Dinardo 2020).
We will also monitor the S6 CAL1 waveform shape (secondary lobes features).

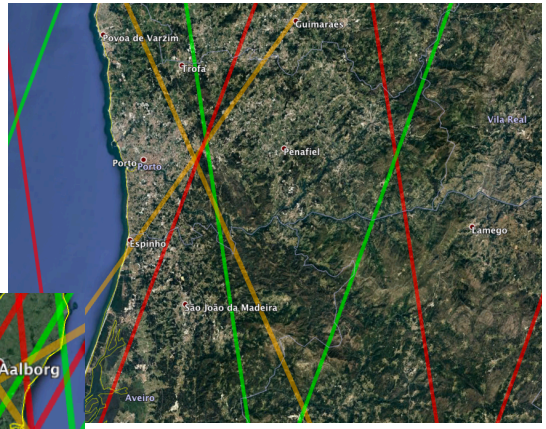
Sentinel-6 Altimeter Calibration using Point Targets (CaPoTa)

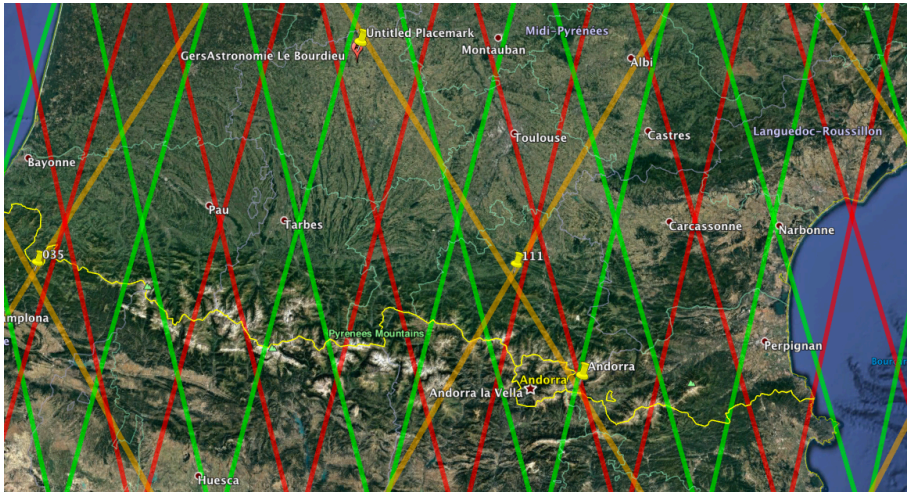
- The aim of this project is to **calibrate** the following **altimetric scientific parameters of Sentinel-6 altimeter using point targets**:
  - Range bias, allowing to derive surface elevations;
  - Datation bias, which has a direct implication for the geo-location of the scatters and in turn the elevation itself;
  - Sigma-0 bias, which has a direct impact on the wind measurements.
- Delay-Doppler Processing (DDP), heritage from Sentinel-3 and Cryosat-2, and Fully-Focused (FF)
- Cross validation with S3A and S3B

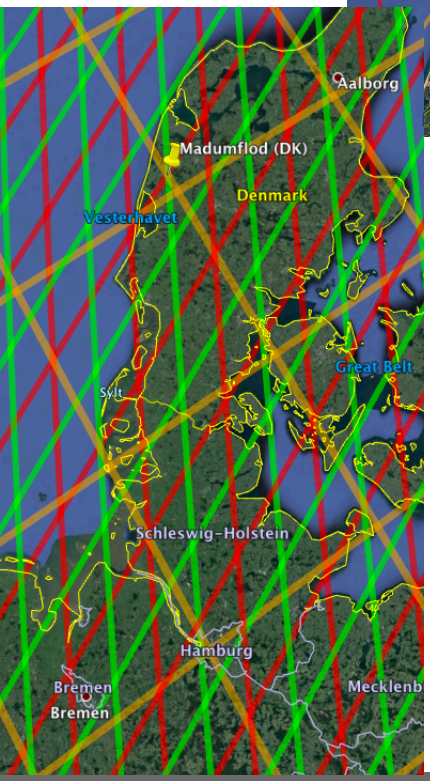


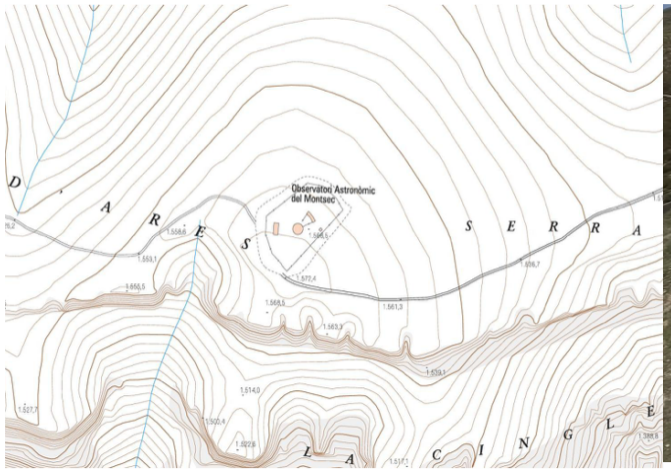
Focused image obtained from a CS2 pass over Crete transponder

Sentinel-6 Altimeter Calibration using Point Targets (CaPoTa)









Montsec Astronomical Observatory topography map and image (*credit IEEC*)

Calibration and Validation of the S6 altimeter Sigma-0 and the radiometer brightness temperature over natural surfaces

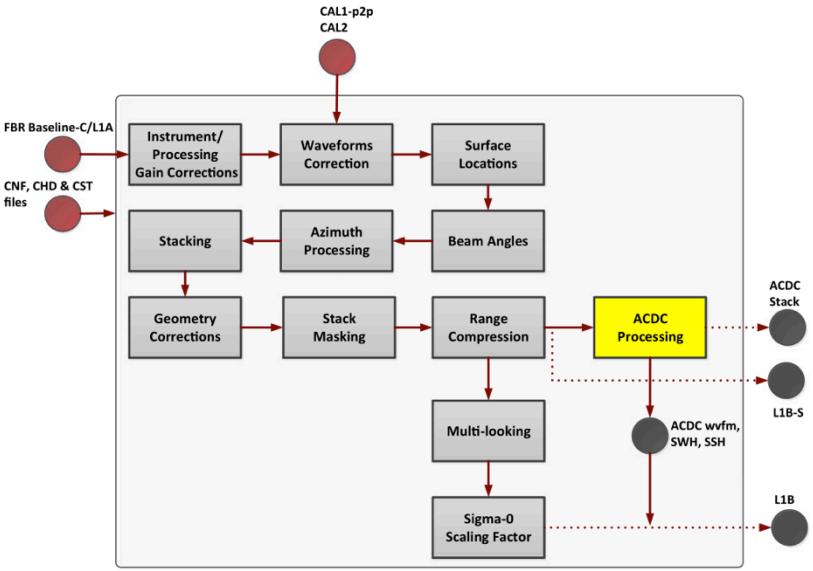
- We propose to monitor brightness temperature and sigma-0 over the Etosha Salt pan (18°47′07″S 16°15′50″E) in Namibia.
- Large (around 4,800 km^2 (100 x 48 km)), flat and radiometrically homogeneous area.
- Its **emissivity is high** and rather homogeneous except when flooded (exceptionally after a heavy rain).
- Provides a perfect calibration site for the altimeter sigma-0 and the radiometers brightness temperature.

Calibration and Validation of the S6 altimeter Sigma-0 and the radiometer brightness temperature over natural surfaces

- Monitor TB at different frequencies over the Salar and cross-comparison with other instruments
- Investigate the relationship of sigma-0 and reflectivity over the Salar

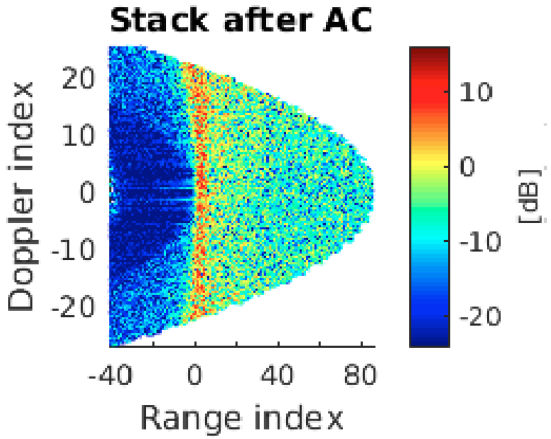
Amplitude Compensation and Dilation Compensation Algorithm (ACDC) Validation for S6 (ACDC6)

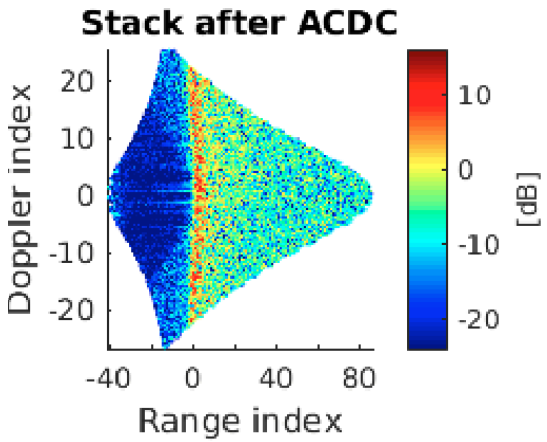
- Provide improvements in geophysical parameters retrieval's precision by ACDC algorithm implementation:
  - Integrated and evaluated within the L1B + L2 chains (L1B-S product)
  - Allows to implement a simpler and faster retracker
- Evaluation against our SAR altimetry conventional retracker and ESA L2 products
- Specific processing block are currently under review to improve precision:
  - Multi-looking
  - Fitting steps



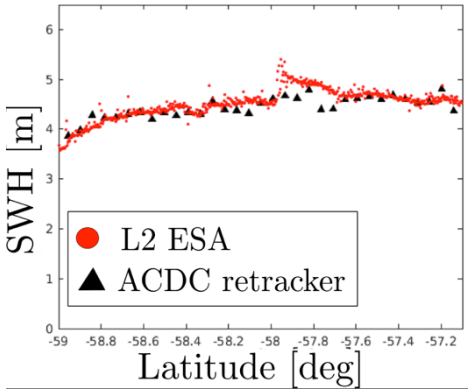
Amplitude Compensation and Dilation Compensation Algorithm (ACDC) Validation for S6 (ACDC6)

- SAR altimetry waveform model: $P_{k,l} = P_u \cdot B_{k,l} \cdot \sqrt{g_l} \cdot f_0\left(g_l \cdot (k - epoch)\right)$
  - Amplitude Compensation
  - Dilation Compensation
  - Multilooking





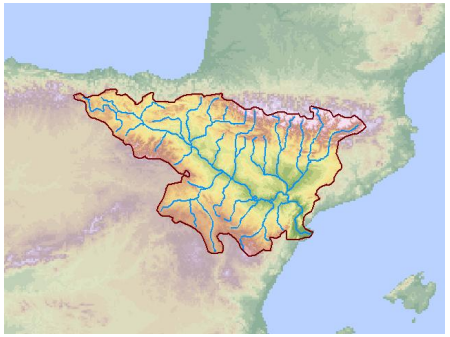
(epoch, SWH, sigma0)

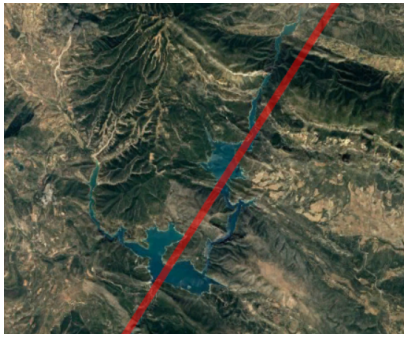


- Input data: co-located SAR altimetry data across different satellite missions (central Pacific Ocean and North Atlantic)

Validating Algorithms Levels 1A and 2 in Ebre RIver Area (VALERIA)

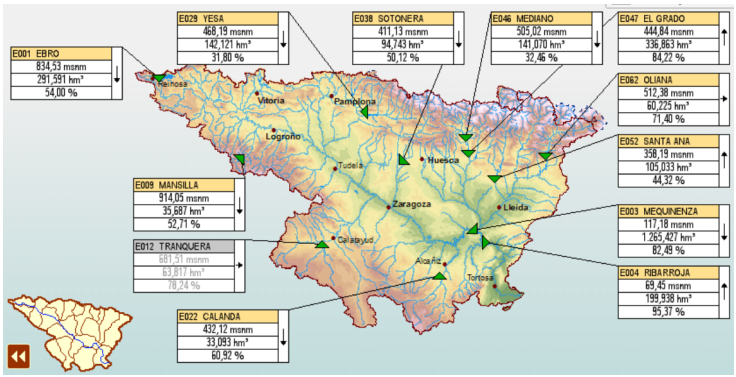
- S6: first radar altimeter to operate at open burst
  - Fully-Focused SAR techniques will benefit from that
    - Along-track resolution down to sub-meter level, free from along-track replicas
  - Opportunity to observe small targets
- Ebre river basin in the Iberian Peninsula is an interesting test area with a high variety of water systems
  - Reservoirs, rivers, irrigation channels, mountain lakes
  - Highly monitored area





Validating Algorithms Levels 1A and 2 in Ebre RIver Area (VALERIA)

- This study proposes to **validate range measurements** over a subset of different aquatic spots using Fully-Focused (FF) SAR processing techniques and Delay-Doppler processing (DDP)
- Both FF&DPP waveforms retracked with a DDP-based physical retracker
- In-site validation water levels provided by local entities
- Input data: HR over land
  - Can the mask be adapted for this kind of studies?

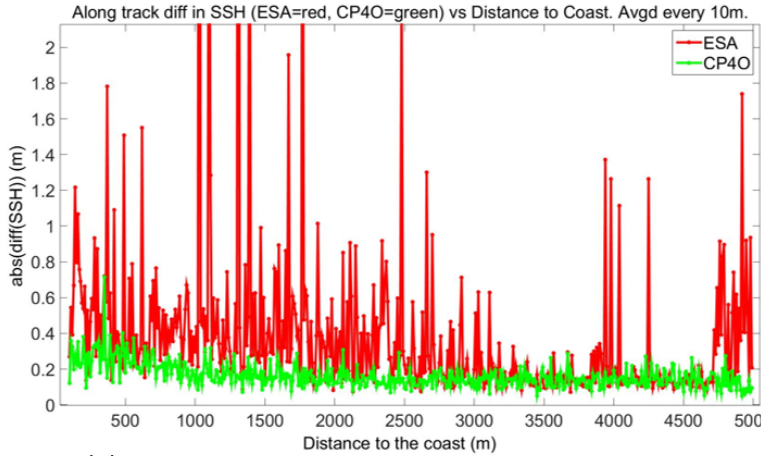


CORALS (COastal Range ALtimetry for Sentinel-6)

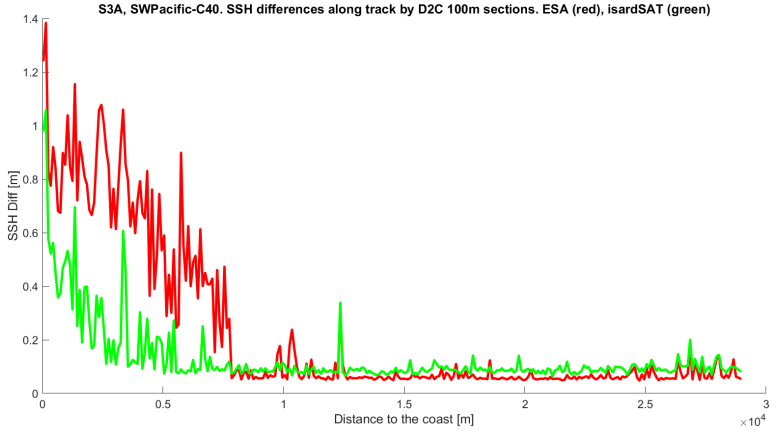
- The aim of this study is to adapt the design, implement, test, and validate with Sentinel-6 data, an advanced method developed for retrieving **Coastal Ocean SSH**.

- It has been tested for CS2 and S3A/B missions. Overall and consistent **improvement of more than 50% in SSH stability**.

CS2

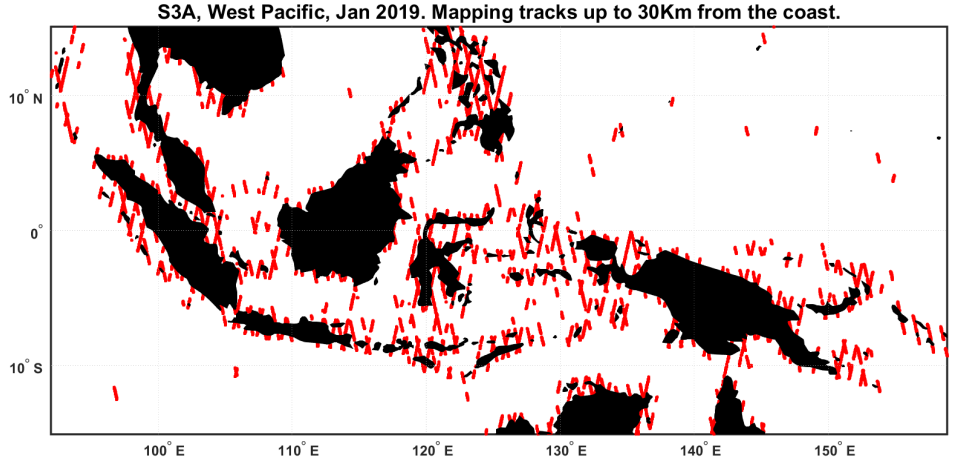


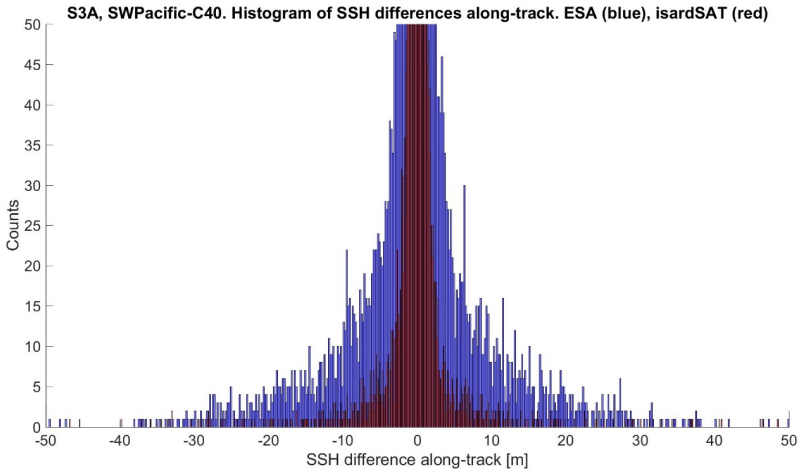
S3A



CORALS (COastal Range ALtimetry for Sentinel-6)

- Results for S3A mission in the SW Pacific Area:





- Same areas will be studied with S6 data

The Coastal Processor is designed so that it can be run operationally, without additional external data, and with similar run-time performance. It could be added as an L2 processor option in Coastal Areas.

Thank you

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