ACCURACY ASSESSMENT OF SWOT KaRIn SEA LEVEL DATA

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Abstract

The main objective of our work was to validate the sea level derived from SWOT (KaRIn) with the water levels from three tide gauges located around the Spanish coasts at stations in: Huelva, Barcelona, and Bilbao. To do this, we estimated the standard deviation of the differences (SDD) between the altimeter and the ground-truth data. The accuracy of the Sentinel-3A (S3A) satellite was also computed for comparison. We analyzed two / one track at each location for SWOT / S3A, respectively. From the options available to compute the sea level anomaly from SWOT, we tested the wet tropospheric correction (WTC), the mean sea surface (MSS), and the tidal model. The comparisons with the tide gauges revealed that the ECMWF model for the WTC gave a higher number of valid data and the same level of accuracy as the correction derived from the AMR instrument. The same accuracy was observed regardless of the MSS used (CNES and DTU). Finally, the FES tidal model improved the accuracy with respect to the DTU model. The average SDD of SWOT oscillates between 7.4±0.8 cm (Bilbao) and 12.2±2.3 cm (Barcelona). A more in depth analysis of the SWOT data at the Barcelona station revealed a cycle with anomalous sea level anomalies not detected in the data screening. Removing that cycle, the average SDD dropped to 8.7±1.7 cm. Sentinel-3A showed 4% to 24% better accuracy than SWOT.

Datasets and Methods

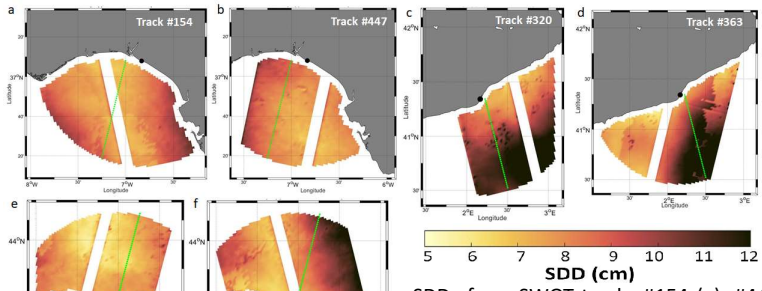
- **SWOT**: Twenty-eight 21-day cycles were obtained from High-level Tool for Interactive Data Extraction (HiTIDE) available at: https://hitide.podaac.earthdatacloud.nasa.gov/. 'Expert' data from Version C (science data product) of Level 2 KaRIn Low Rate (LR) Sea Surface Height Data Product. Regular grid of 2 km × 2 km were used.
- **Sentinel-3A**: Twenty-one 27-day cycles were obtained from the marine product (SM__WAT.006.01.00) available in the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) data store: https://data.eumetsat.int/product/EO:EUM:DAT:0415#. Level 2 along-track Non Time Critical sea level data were obtained at 20 Hz of posting rate.
- **In-situ**: Three radar tide gauges with data freely available through the Spanish Puertos del Estado (https://www.puertos.es/servicios/oceanografia).

$$SLA\_SWOT = ssha\_karin + height\_cor\_xover$$

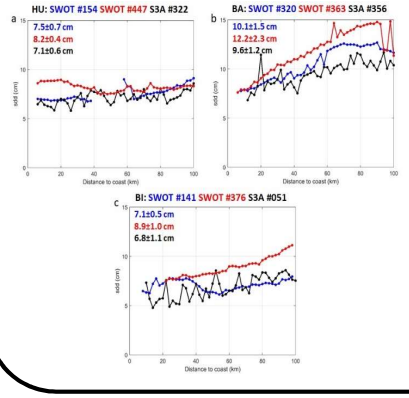
$$SLA\_TG = water\_level - tide\_prediction - DAC$$

$$SDD = \sqrt{\sum_{i=1}^{N} \frac{((SLA\_Alt(i) - SLA\_TG(i)) - mean(SLA\_Alt(i) - SLA\_TG(i)))^2}{(N-1)}}$$

Results

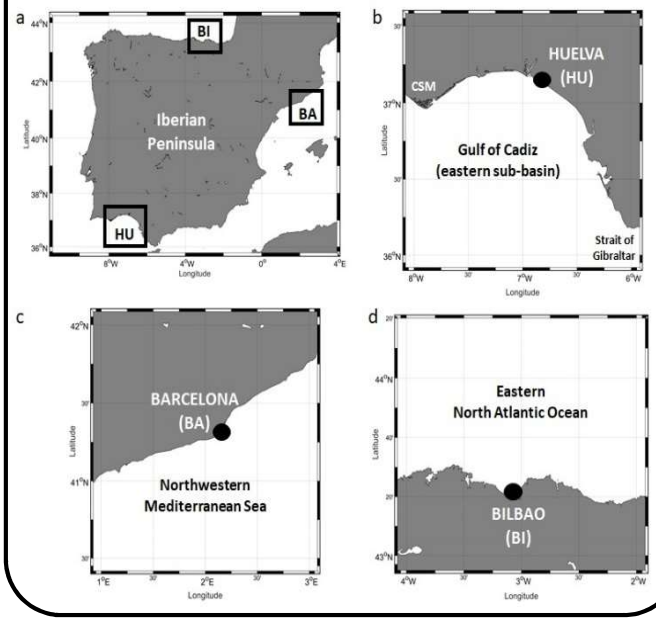


SDDs from SWOT tracks #154 (a), #447 (b), #320 (c), #363 (d), #141 (e) and #376 (f) considering a 100-km radius to the TG stations. Green dots represent the position of the closest S3A tracks to the tide gauges. The black dot shows the position of the TGs.

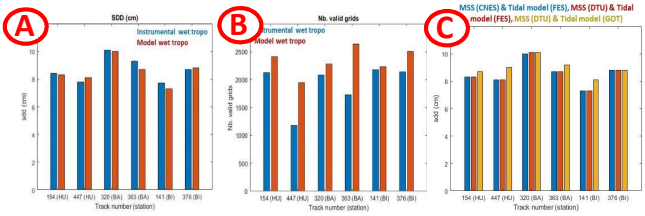


SDDs for S3A (black line) and SWOT (blue and red lines) at Huelva (a), Barcelona (b) and Bilbao (c). The missing data for SWOT #154 (HU) and #376 (BI) is due to S3A crossing the blank zone around the SWOT nadir altimeter measurements. The numbers are the average and standard deviation of SDD along the track segment

Study Area



What is the best *SLA_SWOT*?



Average of the SDD **(A)** and number of valid grids **(B)** from the SWOT tracks analyzed at the three stations (HU, BA and BI). The SLA_SWOT are estimated with the AMR (blue bars) and the ECMWF (red bars) wet tropospheric corrections.

(C) shows the comparison between MSS models: CNES / FES (blue bars) and DTU /FES (red bars). The tidal model comparison was made between DTU / FES (red bars) and DTU / GOT (yellow bars). The model wet tropospheric correction was used in all the comparisons.

CONCLUSIONS

- Validating the sea level data from SWOT KaRIn is still challenging.
- Its accuracy is below 10 cm at 100-km distances to the tide gauges.
- Sentinel-3A showed 4% to 24% better accuracy than SWOT.