CROSS-COMPARISON AT CROSS-OVER BETWEEN SWOT LR PRODUCTS AND SENTINEL-3 MARINE ALTIMETRY PRODUCTS

Salvatore Dinardo[(1)]
Email address: salvatore.dinardo@eumetsat.int
[(1)] EUMETSAT, Eumetsat Allee 1, Darmstadt, Germany

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Introduction

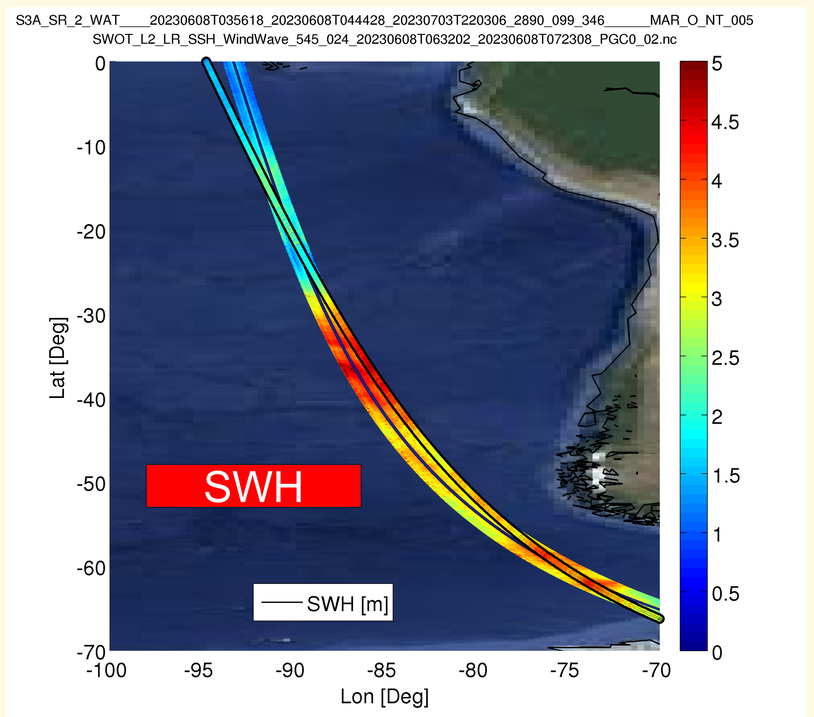
SWOT is an Earth-Observation science mission dedicated to measuring surface water and ocean topography and jointly developed by NASA and CNES, in partnership with the Canadian Space Agency and UK Space Agency. The primary payload on board SWOT is a Ka-Band swath radar altimeter (KaRIn) which is covering the ocean in Low-Rate (LR) operation mode. A Ku-band Poseidon-Class nadir radar altimeter and microwave radiometer is also embarked to support and complement the KaRIn swath measurements. Over the ocean, the SWOT Science Team provides the user community with the LR Level-2 SSH (Sea Surface Height) forward-processed products via the NASA and CNES data distribution centres. These products are delivered on a 2x2 km geographically fixed grid with a short latency (usually few days) and they are now in version D, spanning the time-frame 28-April-2025 onward. CNES delivers as well a SWOT Level-3 product which is a cross-calibrated product from multiple missions that contains only the ocean topography content necessary for thematic research and related applications. This product is designed to be simple and ready-to-use, and can be combined with other altimetry missions.

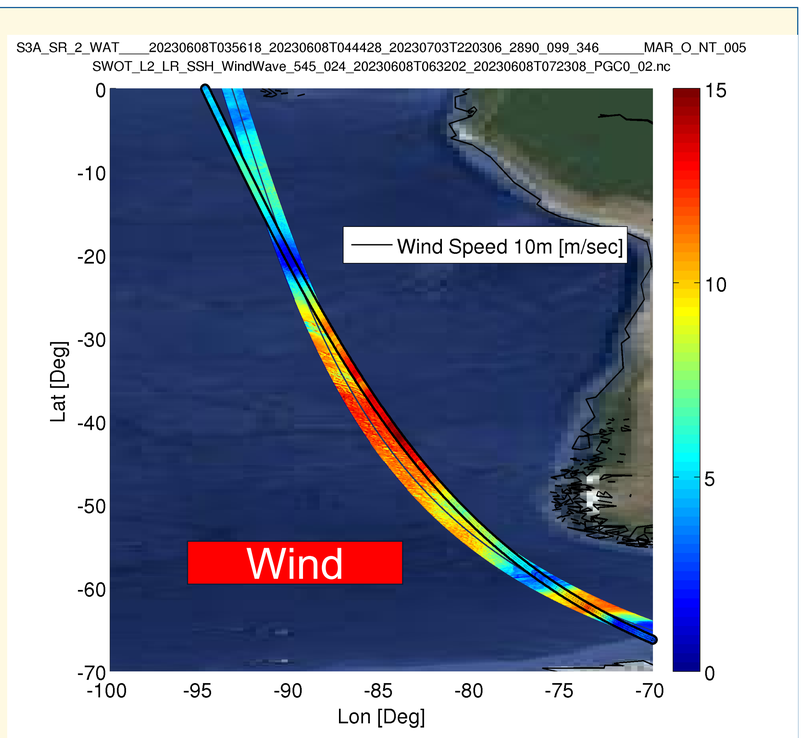
A Long Collinear Transect between SWOT and Sentinel-3A

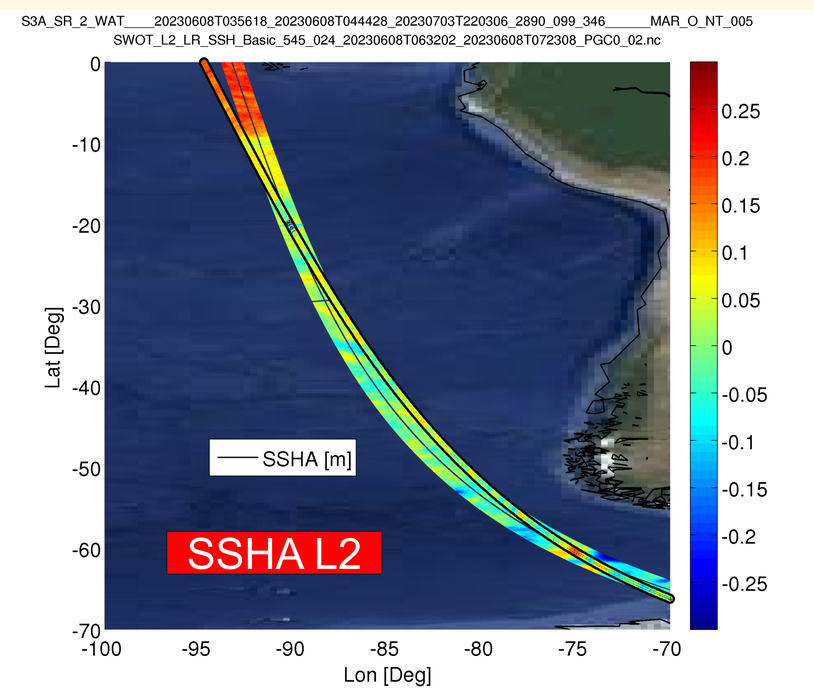
On 6 June 2023, Sentinel-3A (cycle #99, pass #692) and SWOT (cycle #545, pass #24) ground-tracks cross for a long collinear transect over the southern pacific ocean, east of Chile. The time separation was only three hours which allows to minimize the impact from natural ocean variability. Along this transect, we have compared the geophysical measurements from Sentinel-3A Level-2 products versus the measurements from SWOT Karin, as given in Level-2 LR SSH & WindWave products (PGC0) and in Level-3 LR SSH (v2.0.1). Sentinel-3 altimetry data are from EUMETSAT marine baseline collection BC005 in NTC timeliness.

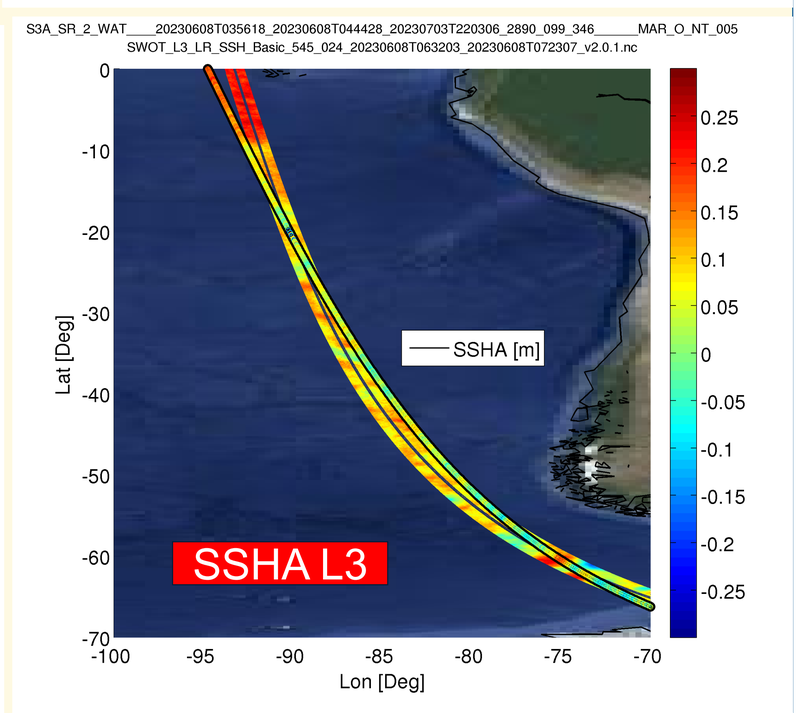
A Cross-Comparison

In the right box, we show on the left-hand side top, the significant wave height (SWH in meter) from S3A SRAL and Karin, while on the right-hand side top, the wind speed at 10 meter (m/sec) always from S3A SRAL and Karin is presented.
Visually, the wave-height and wind speed from SWOT Karin and S3A SRAL match each other fairly well for low and high sea state conditions and for the full transect length.
On the left-hand side bottom, the sea surface height anomaly (ssha in meter) from S3A SRAL and SWOT Karin L2 LR is displayed, while on the right-hand side top, instead we have ssha from S3A SRAL and SWOT Karin L3 LR (unfiltered), which is multi-mission intercalibrated.
Here, the L2 ssha measurements from SRAL and Karin are "out of the box" which means that two ssha are not in the same standards for the geophysical corrections.
The main ocean topography structures observed by Sentinel-3 are well captured as well by SWOT Karin, with SWOT Karin showing more fine scale structure content, as expected.









Way-Forward

A more systematic analysis is necessary between Sentinel-3 and SWOT Karin products at cross-over locations for a long time span. The objective is to compute a global map of bias and standard deviation at crossover locations so as to identify any residual long wavelength error or systematic sea-state bias dependency error which may be still persisting after the KaRIn cross-over calibration application. In this more extensive cross-comparison exercise, for the sea surface height anomaly, we need to take care that the same “standards” are used on both sides.