Altimetry CAL/VAL: a closer look at Cryosat-2

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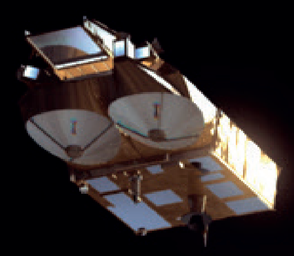


CryoSat-2 was launched in April 2010 to map the cryosphere with an altimeter that includes SAR and SARin capabilities. The mission goal is to observe sea ice freeboard and ice sheet elevation changes. The altimeter however also perfectly samples the ocean surface. To be able to exploit these data it is necessary to assess and validate them. Another reason is that we want to to complement the Radar Altimeter Database System RADS with this dataset to improve the combined altimeter sampling resolution both in time and space. This has become important now Envisat and Jason-1 stopped providing data and meanwhile successors like Sentinel-3 and Jason-3 are not yet in place.

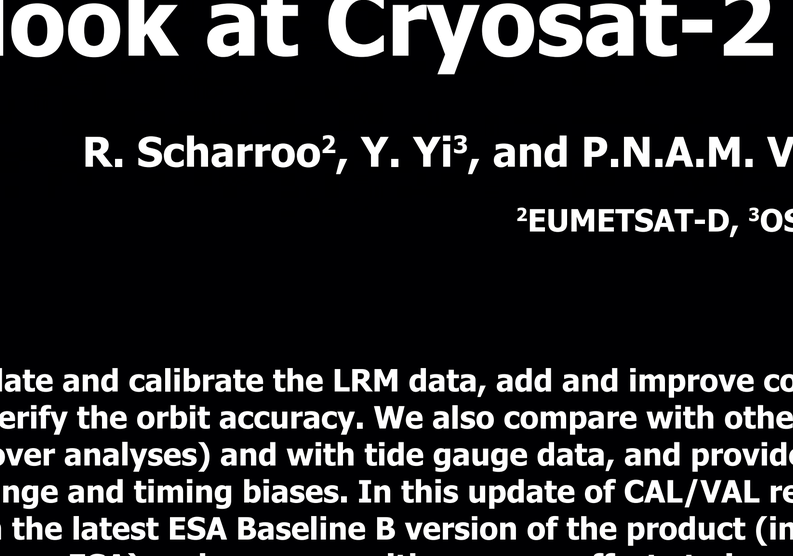
So, we validate and calibrate the LRM data, add and improve corrections, and verify the orbit accuracy. We also compare with other satellites (crossover analyses) and with tide gauge data, and provide estimates on range and timing biases. In this update of CAL/VAL results we focus on the latest ESA Baseline B version of the product (indicated by l, c2l, lrm, or ESA) and compare with our own efforts to improve the level 2 ocean product (i, c2i, lrm+, or cor. ESA), and the standard RADS products (r, c2r, rads, or RADS) which includes retracking of the ocean echoes (L1B) and estimating a taylored hybrid sea state model. (Crossovers have been computed with $\Delta t < 0.5 \times$ (sub)cycle period)

Original CS2 LRM L2

- Get delay-time LRM L2 data (Baseline B) from ESA
- Merge data files (few to tens of minutes normally) into passes and subcycles of 29 days (like GDRs) in RADS
- Contains only SSH at 20-Hz (not range or orbit)
- All corrections and orbit given at the beginning of each 1-Hz period (should be middle)
- Get orbit and range at the middle of 1-Hz
- Add –4.699112 ms (S. Dinardo/ESA) plus an additional –4.2 ms to time tags; correct orbit accordingly
- All the rest untouched

Timing Bias

- All close to 0ms, a priori applied bias is about right, so bias in original ESA product is –8.9ms

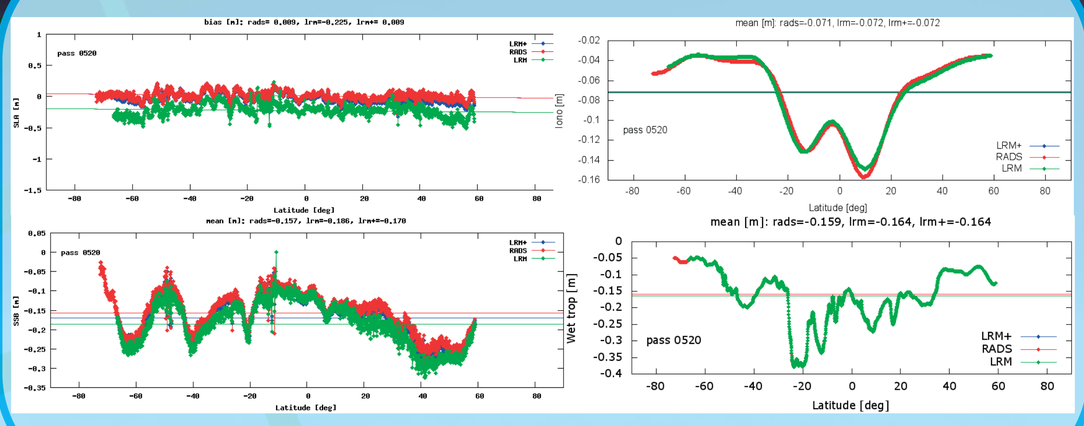


Improved CS2 LRM L2

- Overwrite/add common RADS geophysical corrections, like own determined SSB, latest MSS, Tides, ECMWF/NCEP meteo, MOG2D, alternative orbits, and Abdalla windspeed

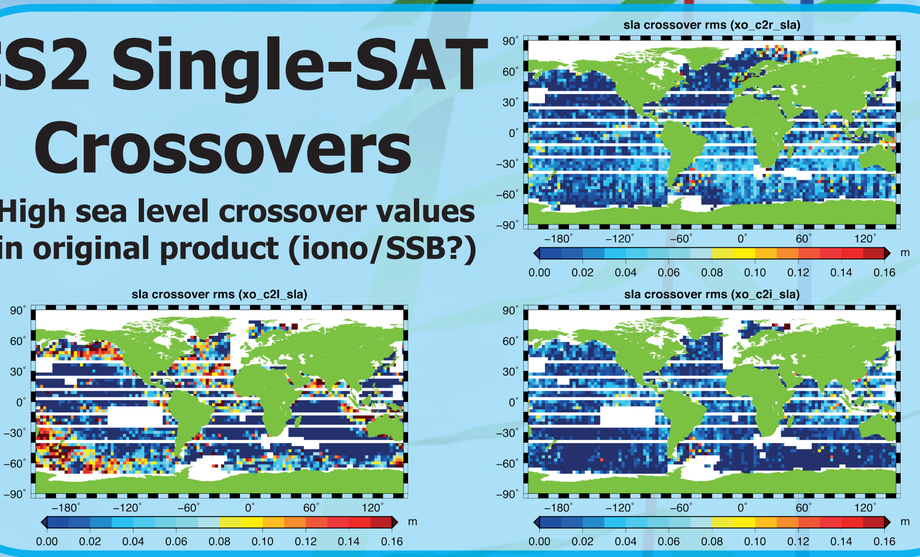
RADS product: retracked LRM

- Daily download FDM and LRM L1B data from ESA
- Retrack waveforms to compute our own wave height, backscatter, and range (MLE3-type retracker)
- Merge data files into passes and subcycles (29 days) in RADS
- Overwrite/add common RADS geophysical corrections



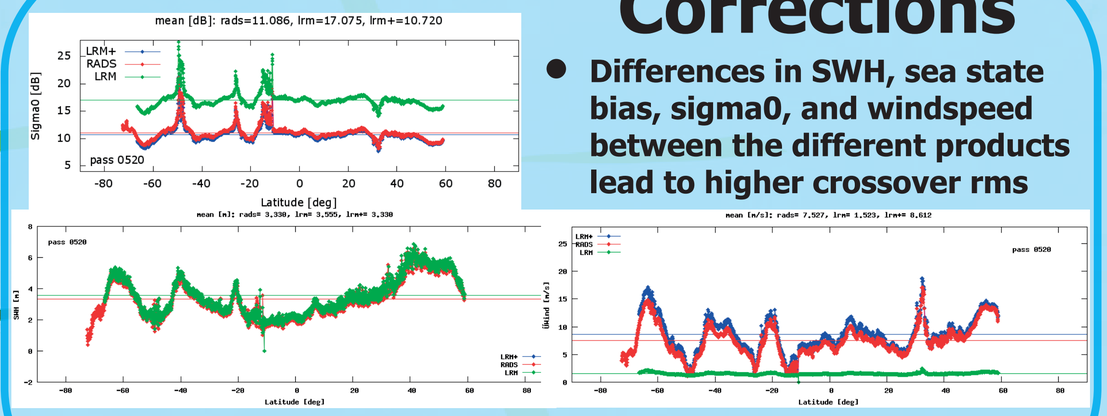
CS2 Single-SAT Crossovers

- High sea level crossover values in original product (iono/SSB?)

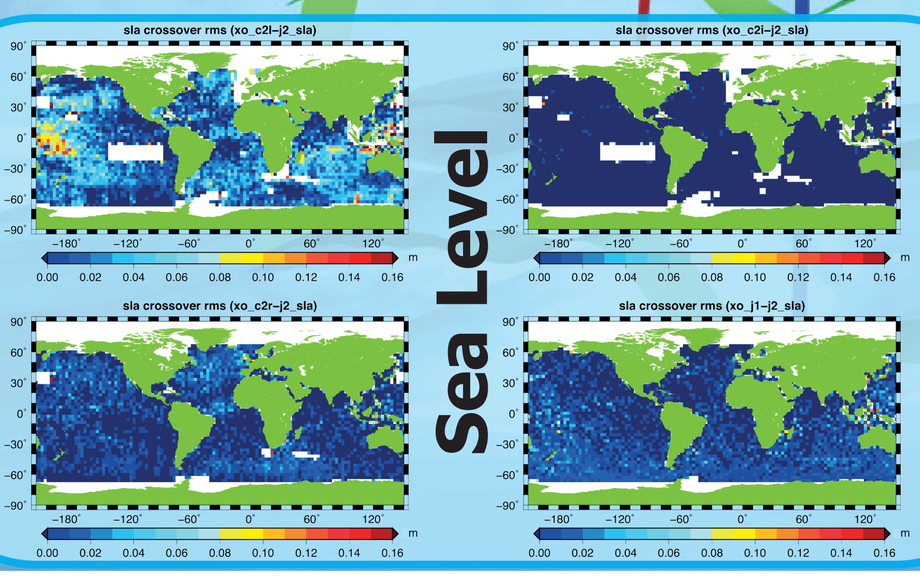


Corrections

- Differences in SWH, sea state bias, sigma0, and windspeed between the different products lead to higher crossover rms



Dual-SAT Sea Level Crossovers



Overall conclusions

- Timing bias in ESA product is –4.7ms (ESA correction) plus –4.2 from own analyses, totalling –8.9ms; not an issue anymore!
- ESA product SLA crossover rms 12.7cm high! when compared to corrected product 6.1cm and RADS product 6.5cm
- High xover rms is greatly reduced by improved corrections:
  - Sea state bias: ESA product suffers from erroneous σ0 (7 dB bias) and by that erroneous wind speed. Corrected product takes SSB from retracked level1b, similar as RADS product)
  - Ionosphere: similar GIM implementation for the products but maybe differences in used maps or cut-off height
- Range bias ESA product is –23.4cm wrt TOPEX frame

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CRYOSAT

Ocean Surface Topography Science Team (OSTST) Meeting and 7th Coastal Altimetry Workshop (CAW-7)

7 Oct 2013 to 11 Oct 2013
Boulder, CO

Challenge the future

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