CRYOSAT plus for Oceans
state-of-the-art data processing

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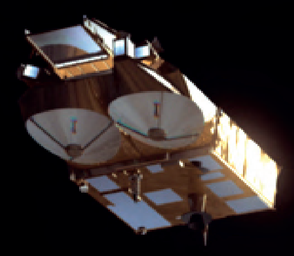


The Cryosat Plus for oceans (CP4O) is an ESA initiative carried out by a European wide consortium of altimetry experts. It aims to build a sound basis for new scientific and operational applications of data coming from Cryosat-2 (CS2) over the open ocean, coastal seas, polar ocean and for seafloor mapping. It also generates and evaluates new methods and products that will enable the full exploitation of the capabilities of the CS2 SIRAL altimeter, and therefore acts as preparation for the upcoming Sentinel and Jason SAR enabled altimetry missions. The state-of-the-art data processing reviews all existing CS2 products and availability, all suitable models for re-tracking, geophysical corrections and data integration, surveys auxiliary data sources to help the development and validation of new CS2 ocean products, upcoming activities that support CS2, and chooses suitable test areas for validation. Deliverables are the Preliminary Analysis Report (PAR) and the Development Validation Plan (DVP) that can be obtained through the website of the CP4O project:

http://www.satoc.eu/projects/CP4O

This poster summarizes the PAR results. More details on the CP4O project and the newly developed products are given in a partner poster.

Open Ocean

- General aim is to contribute to mesoscale and sub-mesoscale oceanography, and the ability to map fine scale features
- We used LRM and SAR mode data, assessed accuracy and sought continuity with previous and concurrent missions
- We also have investigated LRM-like products from SAR mode (RDSAR) to ensure continuity from coastal zone to open ocean, and continuity from LRM to SAR mode
- New SAR retracking schemes have been proposed, developed and investigated with a focus on mapping fine scale features in the sea surface height

SAR innovations (I)

- Dedicated SAR altimetry (Delay-Doppler) processing, not only for CS2 but also to prepare for Sentinel-3 and Jason-CS (SAR waveform is very different from LRM waveform):
  - (semi-) analytical approach (Halimi et al., 2012). 5 parameter model (including mispointing angles) has been developed
  - Analytical SAMOSA-3 model, accounts for mispointing
  - Numerical re-tracking by CNES CPP, accounts for mispointing
- Different methods need further comparison and validation
- Sigma0 retrieval in SAR mode needs further development
- Ability to observe smaller scales than 100km (where LRM sees geographically coherent SLA error)

Coastal Zone

- In the coastal zone even finer scales are wanted
- We explored dedicated SAR retracking with the purpose of minimizing the effect of land contamination in the radar echo
- And investigated SARIN mode data also with a focus on mitigating contamination from off-nadir land targets

Geophysical corrections

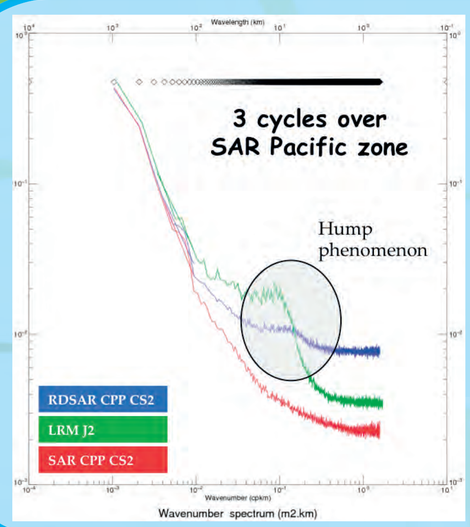
- We assessed the necessary geophysical corrections, and updates are proposed for the ionosphere, wet troposphere, ocean tide corrections, and sea state bias

SAR innovations (II)

- Reduced SAR techniques (RDSAR) or pseudo LRM (PLRM) is the processing of FBR data into LRM waveform data, and applying retracking dealing with the LRM/SAR differences in PRF:
  - SAMOSA approach processes subsets of waveforms, remaining issues: subset optimization and time tag bias
  - CNES RDSAR from the Cryosat Processing Prototype (CPP) based on averaging all pulses from 4 SAR bursts (256 FBR echoes), CPP_LRM and CPP_RDSAR are routinely ingested in CNES/SALP products
  - NOAA/Altimetrics RDSAR as used in RADS based on stacking and averaging all individual SAR echoes

Polar Ocean

- The polar ocean is not much different from the open ocean
- Challenges in the form of sea ice and the fact that no altimeter satellite has gone beyond 81.5° latitude before
- We looked at (to be improved) LRM, SAR and RDSAR products
- We developed and evaluated processing schemes applicable to sea-ice affected regions
- All targeted to improving mean sea surface models, mean dynamic topography models, polar ocean circulation, and polar ocean tide models



Sea level spectrum

- LRM mode is affected by correlated errors for scales between 10 and 80 km
- SAR mode has the potential to directly measure the content of the oceanic signal @ high wave length without complex wave form processing, dedicated retrackers, post-processing

Sea Floor Mapping

- We investigated the ability to resolve short-wavelength sea surface signals from marine gravity and sea-floor topography
- Investigated the ability to map uncharted seamounts and trenches
- Exploited the CryoSat-2 SAR mode data to enable the highest along-track sampling resolution
- To achieve highest cross-track sampling resolution we wait for at least 1 year of continuous data over a suitable region: SAR area (according to latest mode mask) in the North Pacific

Outlook

- In 2014 the 1st Sentinel-3 surface topography satellite will provide LRM over open ocean and SAR globally over all coastal areas and over sea ice, later followed by the 2nd Sentinel-3
- The efforts in the CP4O project not only benefit exploitation of CryoSat-2 data but also pave the way for proper exploitation of Sentinel-3 SAR data and later from Jason-CS (≈2017).
- Core of CP4O is the development and validation of algorithms and processing schemes for new CryoSat-2 ocean products
- From the state-of-the-art analysis we propose the creation of 7 new experimental altimeter data sets, and 4 data sets with new geophysical corrections

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