Cryosat-2 altimeter performance assessment over ocean

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Cryosat-2 mission is dedicated to Cryosphere sciences. Yet, the relevance and quality of this mission for ocean purpose was already largely demonstrated.

Indeed, and since 2011, ocean Prototype Product (CPP) delivered by CNES is used for ocean monitoring purpose and constitutes a relevant additional mission to SALP/DUACS system.

Its ingestion into databases enables to enrich the Level 3 products distributed to users for mesoscale applications thanks to a careful calval analysis of the data used as input of the system. It consists in:

- Estimating the quality of the geophysical content
- Removing spurious data and select only valid data from a SLA point of view
Overview

Recents studies focused on the second step of the calval activity which consists of selecting the valid data.

This step, essential to the final quality of the products, is difficult and needs to find the best compromise to:
- Remove spurious data AND
- Keep as many data as possible

This talk focuses on 2 examples of recent improvements of data selection to prevent from:

1. Ice pollution
   - Example of Cryosat-2
   - It is the most polluted by ice, as the only one to reach Latitudes > 82°

2. Coastal pollution
   - It has a drifting orbit and thus is more affected by the MSS quality between the mean profiles
Data selection: Ice detection
Dedicated to the very dry polar areas, Cryosat-2 payload does not include any radiometer. The usual ice detection based on Brighness Temperature can therefore not be applied.
A dedicated method (statistics on altimeter parameters based) enables to remove 100% of the ice pollution. Applied over 60° were ice was more likely possible to exist.

After dedicated data selection:
- 100% of the bad data removed BUT some data missed above 60°%.
Yet, the limit of $60^\circ$ can be refined to suit better the complexity of the ice extension signature.


- Product: Global Sea Ice concentration

*Operational Myocean product*

- Daily products
- Value injected in the data base along track
- Mask = Threshold on Sea Ice concentration >0
Data detection near ice: use of an external reference

Every day, OSI-SAF concentration maps is interpolated under Cryost-2 tracks

December 2013:
Strong melting period:
Dynamic signature of the OSI SAF content seen by Cryosat-2 over the 29 day subcycle

OSTST, 28-31th, Octo
Data detection near ice: use of an external reference

Valid Cryosat SLA selected with (Iterative editig ∩ OSI-SAF mask)

100% bad data removed + Improvement of the coverage by 5% above 60°Lat (0.4% in global)

Very high latitudes can be reached with a quality level consistent with open ocean!
Data detection near ice: use of an external reference

Additionnal valid data compared to OSI-SAF mask alone

Added value of altimetry compared to OSI-SAF information:
8% above 60°Lat
(1% in global)

Mutual benefits of merging 2 sources of information!
A new solution for ice data detection: use of an external reference

- New algorithm for ice detection + merging the information of 2 independent products (altimetry+OSI-SAF)
  - Increases the number of valid data in ice areas (more and more of interest)
  - Undergoes the lack of radiometer for Cryosat mission (one of the 3 missions above 66°Latitude)

- Very good results for Cryosat-2 dataset (will be used on Cryosat-2 Duacs DT data in a future version)

- Could be applied for other missions (of higher interest for those without radiometer data)
Data selection: Coastal approach
A new solution for validation near coasts

- Altimetric data are polluted by coastal proximity

- More particularly drifting missions (Cryosat-2, Jason-1 and Envisat drifting phase) because the Mean Sea Surface used as a reference is not built with an associated mean profiles and because of tide higher uncertainty in these zones

- To avoid it, a margin of 20km from the coast can be taken to avoid affected points.

- We tried to refine this distance by using a statistics based method:
  - Application of a *median filter on SLA* for valid data only, to reject residual spurious values
Data selection near coasts along track analysis

Valid SLA data are removed with Duacs solution!

Only spurious data are removed!

North Australian coast

Islands
Before dedicated data selection:
- All bad data are not removed AND
- Some data are missed at less than 20km from the coasts
Data selection near coasts

SLA (cm) - C2 cycle 45

After iterative editing:
- Number of rejected data decreases
- SLA removed data really correspond to extrem values.

SLA (cm) - Data rejected by median filtering (<30km)
Data selection near coasts

Valid SLA Zoom on Egean Sea

SLA (cm) - C2 cycle 45

Without dedicated data selection

With dedicated data selection

DUACS solution

Data rejected by median filtering (<30km)
Conclusion

New frontiers of altimetry???

- Approaching ice or land with altimetry is more and more a challenge to rise.

- Properly selecting the data consists in finding the good compromise between:
  - Not keeping spurious data that could deteriorate the data quality
  - Keeping as much observations as possible

- Such tuning is hard to fix and requires a good knowledge of the geophysics to recover. It is also much depending on the application field

- Through the example of Cryosat-2, we presented 2 methods that refine the current methods and pushes forward the limits of observations with altimetry

- Accounting for the mission specificities, both methods can be applied to other missions and benefit to the future operational products at Level 2p, Level 3 and Level 4 in Delayed Time and Near Real Time products
Thank you for your attention!

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Dedicated to the very dry polar areas, Cryosat-2 payload does not include any radiometer. The usual ice detection based on Brightness Temperature can therefore not be applied.

A first solution had then been developed to remove efficiently 100% of the potential ice pollution in the data.

Based on an iterative statistical process applied on the waveform estimated trailing edge slope.
Cryosat-2 data quality is satisfactory to insure a good mesoscale purpose in SALP/Duacs system.
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