



Characterization of the Altimeter Mission Performances over Ocean

Comparison and Interpretation

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OSTST Meeting, **October 2015**, **Reston – USA**



Objective

The objective of this presentation is twofold:

to provide the users with performance intercomparison references based on different metrics.

The knowledge of these results should allow them to improve/optimize their use of the altimeter data set.

- to give to agencies key numbers to anticipate the future altimeter mission peformances depending on their main characteristics.
- Performance analysis based on many altimeter mission data set

	Saral
Envisat/RA-2	□ HY-2
Jason (1/2/3)	Cryosat-2 (LRM/RDSAR/SAR)



Where does the performance come from ?

The mission performances depend on 4 kinds of parameters

Parameters relative to the mission :

- Orbite height
- Pointing quality

Parameters relative to the instrument

- Mode (LRM, delay/doppler)
- Tracker mode ("closed loop", "open loop")
- Frequency (Ku/Ka)
- Bandwidth (B)
- Pulse Length
- Nbre of integrated Ind.Echoes (N)
- Pulse Rep. Frequency (PRF)
- Ant_Gain_Pattern
- > SNR
- Weighting on WF (Hamming AT/XT)
- WF quantization

Parameters relative to the processing :

 Retracking (model + estimation method – NewtonRaphson, Lev-Marquardt or NelderMead)

- Width of the analysis window
- All the corrections (WTC, SSB, Iono, MSS, Tides, etc ...)
- Editing criteria

Parameters relative to the geophysics :

> SWH

Sea State / perturbations (Rain, Bloom, Swell, etc ...)





Where does the performance come from ?





Where does the performance come from ?

Page 5





How to characterise the performances ?

Page 6

- Which metrics ?
 - ✓ 20Hz/40Hz standard deviations
 - Power Spectral Density
 - Mean/Median of HF abs. differences bined by boxes (in coastal regions)

Which data ?

- Simulations in theoretical/ideal conditions
- Performances obtained during ground acceptance test before launch
- On real data

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→ Comparing missions is a complex task because of the big amount of data on which similar processing, corrections and editings have to be applied. Comparison must be done on coherent periods and regions.

	Jason 2	AltiKa	Envisat	Cryosat-2	HY2
Cycles	200-203	9	85	50-51	58-61
Period	26/12/2013 - 14/01/2014	19/12/2013 - 23/01/2014	07/12/2009 - 11/01/2010	04/12/2013 - 31/01/2014	12/12/2013 - 20/01/2014



Tracker performances

Page 7







1.0



Standard deviation of 20Hz heights

SLA variability wrt a 1Hz linear regression





Standard deviation of 20Hz heights

SLA variability wrt a 1Hz linear regression



- ENVISAT/RA-2 performances degraded due to the Hamming function
- Cryosat-2 LRM slightly better than Jason-2 because of its orbit height
- Saral and CS-2 SAR very close but <u>Saral at 40Hz</u>























Page 15





Page 16





Page 17





SARAL SLA Power Spectral Density







Page 19







Influence of the data editing on spectra



→ Editing bloom and rain events allows a huge reduction of the hump energy



SLA metric comparison





Standard deviation of 20Hz SWH

Page 23

IASON-2 Cycle 20 **Envisat-RA-2 Jason-2** y=0.0522x+0.412 y=0.0328x+0.4466 4 SWH (m) SWH (m) AltiKa Cycle 9 Passes 1-300 CRYOSAT2 Cycle 50 LRM 0.6 ₩ 0.4 0 Saral/AltiKa **Cryosat-2 LRM** y=0.046x+0.232 y=0.0508x+0.323 SWH (m) SWH (m) CRYOSAT2 Cycle 50 SAF CRYOSAT2 Cycle 50 pLRM **Cryosat-2 SAR** (iii) H 0.4 20 Cryosat-2 **Pseudo-LRM** y=0.0336x+0.571 y=0.0565x+0.253 SWH (m) SWH (m)



Standard deviation of 20Hz SWH





Standard deviation of 20Hz SWH



- ENVISAT/RA-2 performances degraded by the Hamming function for the highest SWH
- Cryosat-2 LRM slightly better than Jason-2
- Saral better than CS-2 SAR but Saral at 40Hz







SWH Power Spectral Density sorted by SWH





SWH metric comparison





Conclusions

Page 29

□ Most of past/present altimeter missions have been looked at and compared with the same processing applied

- Each mission configuration determines the final performances
- Performances have been derived using different metrics
- 20Hz std and PSD noise level are strictly equivalent at low SWH and coherent with simulations (ideal Brownian's conditions)
- PSD noise level for high SWH doesn't represent the instrumental noise. Does SWH/Swell introduce correlated errors in the estimates ?
- Very good SLA performances of CS-2 SAR but also of SARAL (Ka band / 40 Hz)
- Even better SWH performances with Saral
- Why not a SAR mission in Ka band ?





THANK YOU !

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Extra-Ball









SLA denoised Power Spectral Density





SLA Power Spectral Density sorted by SWH

