SAR Altimetry Workshop Summary

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Organisation and Sessions

Invited paper presented by R. Keith Raney (2kR-LLC)

SAR altimetry: precedent, present, and prospects (fifty years following Apollo 17)

Large number of contributions:

44 abstracts

18 oral presentations

26 posters

4 sessions:

- Innovative SAR processing methods
- SAR mode performances: SAR CALVAL from Cryosat-2 and Sentinel-3
- Applications: SAR for science
- Future missions, recommendations and round table
- Poster Session

Objective: Provide a forum for experts and users to exchange views

Need to adjust the organisation to add room for discussions

SAR CALVAL from Cryosat-2 and Sentinel-3

Very good S-3 PDGS products quality:

- Excellent S-3 SARM performances observed at global scales
- Good consistency with Jason-2 at global scales after only 7 months of full SARM (No mean bias on Sea level/ Reduced noise/No spectral bump)
- Remaining 20cm bias on SAR SWH wrt LRM (both CY2 and S3)
- S-3 with no specific coastal processing already shows coastal precision comparable to C-2 with specific coastal processing
- S-3 SSH is «unbiased » in PDGS product (SARM and PLRM mode) without clear dependency with SWH (Corsica calibration site).
- We need to understand the impact of roughness, swell, waves in the SAR mode – we don't all agree!

S-3 data release plan:

Data set accessible to expert data users (S3VT)

Official S-3 STM data release to the user community (L1A, L1B, L2WAT & L2LAN products) is planned for early December 2016

The L1B-S have still to be QC'ed before official data release. This will nominally happen Q1 2017.

Innovative SAR Processing

Review of topical issues in SAR altimetry from previous work

Fully Focused SAR (FF-SAR)

- Synthetic aperture processing technique during its entire illumination time by the radar (around 2 sec)
- Can reach half meters along track resolution → Direct application for hydrology&sea-ice
- for ocean applications, SAR focused to half meters then incoherently averaged over 300m along track resolution provide SSH, SWH and Sigma0 noise reduction by a factor of sqrt(2) wrt unfocused SAR (CY2&S3 current approach)

SCOOP program:

- Develop, test and implement modifications to the processing of the L1B-S product (e.g. zero-padding, multi-looking, antenna pattern compensation, stack beam weighting), and improvements to the implementation of the model in the re-tracking of the SAR echo to generate the L2 product.
- SCOOP includes an activity to develop an improved WTC for Sentinel-3

DeDOP: open source libraries to process yourself SAR measurements, fully configurable and possibility to modify it to your own needs (see DeDop website).

Applications, SAR for Science

Cryosat-2 stack data for nadir-lead detection in **sea-ice** regions

Isolate leads in order to improve sea level records
Stack data are important. We need them easily available (thanks GPOD)

SAR-Mode altimetry over the Antarctic **ice sheet**

Potential ability to retrieve fine scale topographic variations
Waveform leading edge weakly impacted by volume scattering, negligible sensitivity to along-track slopes

SAR Mode Altimetry Data over **Inland Water** – SHAPE Project

Range of water classes investigated; found to be heterogeneous without clear distinctions between them.
Skewness, Kurtosis and Standard Dev of the Range Independent Power seems to be inter-dependent parameters, nevertheless they could help estimate the water Water Fraction classes.

On the assimilation of Sentinel-3A **wave** data in the wave model MFWAM

Assimilation of S-3A shows a positive impact in the analysis and forecast, but geographically variable.

Bias of S-3A significant wave height seen. More pronounced in Southern winter ocean regions

Ocean SAR Altimetry in Bay of Bengal

Open Ocean: SSH STDD 4-5 cm, SWH STDD 18 cm

Monthly sea level: agreement of SAR with model, geographical patterns reproduced

Scientific Applications of **Fully-Focused SAR** Altimetry

Measured along-track resolution in agreement with theoretical expectations, i.e. ~0.5 meters

Focused SAR multi-looked waveforms @ 1 Hz show increase in the Effective Number of Looks by a factor of 2 -> SLA noise @ 1Hz around 0.75cm (conservative). Recommendation for further investigations, and necessary information in Product

Future missions

Future mission presentation given by the agencies:

SWOT

Sentinel-3B, C&D

Sentinel-6

CFOSAT (for accessing swell information)

Recommendations

From **CALVAL** session:

- ✓ S-3 STM: Provide distance from coast from precise higher resolution map
- ✓ Provide across-track distance from coast for SAR altimetry (with possibly angle of attack)

From **SAR processing methods** session:

Recognizing that "fully focused SAR processing" has new capabilities and applications that improve precision and resolution of Earth surface properties, the OSTST recommends that SAR altimeter missions provide, insofar as possible, characterization information needed to support coherent processing throughout the time when a point on the ground is visible. More R&D is required to consolidate our understanding of fully-focused SAR processing performance.

(see IPM summary, W. Smith)