Regional and Global CAL/VAL for Assembling a Climate Data Record

Session chairs: Pascal Bonnefond, Shailen Desai, Bruce Haines, Eric Leuliette, Nicolas Picot

14 orals, 23 posters

Presentations from the four absolute calibration sites
Harvest, Gavdos/Crete, Corsica, and Bass Strait

Main findings for Jason-3:

All products (OGDR, IGDR and GDR-T) are of very good quality with very small differences compared to Jason-2

Summary of absolute bias results:

Mission	Bass Strait (TG)	Harvest	Corsica	Gavdos/ Crete
TOPEX-A	+7 mm	+8	0	
TOPEX-B	+19	+11	0	
Poseidon-1		–11	–12	
Jason-1 GDR-E	+47	+25	+19	+39
Jason-2 GDR-D	+20	+20	–8	–8
Jason-3 GDR-T	+2	–9	–38	– 31
HY-2				+287
SARAL/AltiKa		–37	–63	– 47
Sentinel-3A			+5	+ 20

The Harvest Experiment: Connecting Jason-3 to the Long-term Sea Level Record

(Haines, Desai, Leben, Masters, Meinig, Nerem, Rashmi, Stalin)

Preliminary results from Daisy Bank GPS buoy at Jason crossover off Oregon coast very promising

- Returned high-quality, uninterrupted data for entire open-ocean test (~120 d).
- Supported accurate retrievals of SSH, SWH, wet path delay and ionosphere.
- Competitive with Harvest for all altimeter calibration metrics.

Absolute altimeter bias estimates from the Bass Strait site in Australia

(Chris Watson, Legresy, Church, King)

Jason-3 GDR-T performing well at Bass Strait

- Absolute bias ~2 cm lower than Jason-2 GDR-D and insignificantly different from zero.

GPS wet delay appears dryer than the radiometer for all missions at Bass Strait

- Effect would be to lower absolute bias estimates by 1-2 cm, but further investigation required.

Corsica: a multi-mission absolute calibration site

Pascal Bonnefond, Exertier, Laurain, Guinle, Féménias

Main findings for Jason-1 reprocessing (GDR-E):

A small but significant remaining SSH bias of +18 mm (SSH too high)

A degraded standard dry troposphere correction for cycle 1-150 in some coastal areas (step of 8 mm before/after cycle 150 evidenced at Senetosa.

Gavdos/West Crete Cal-Val site: Over a decade calibrations for Jason series, SARAL/AltiKa, Cryosat-2, Sentinel-3 and HY-2 altimeter satellites

(Stelios Mertikas, Donlon, Mavrocordatos. Desjonqueres, Galanakis, Vergos, Andersen, Tripolitsiotis, Picot, Fratzis, Peng)

Transponder calibrations

Satellite	Ascending	Descending	Average	Year
JA-2 (Gavdos)	-13.6 mm	+ 15.6 mm	**+1.1 mm**	2011-2012
JA-2 (CDN1, Crete)		+ 15.0 mm		2015-2016
JA-3(CDN1, Crete)		+ 38.0 mm	**J3-J2=23mm**	2016

Changes made at PACF to attain Fiducial Reference Measurements 4ALT

Jason-2/Jason-3 tandem calibration using transponders (Jean-Damien Desjonqueres)

Transponder technique has proved to be an efficient and low noise calibration tool

- "easy" for relative calibrations (especially for missions tandem phase)
- Real absolute calibration needs an accurate measurement of the TRP system (including antenna): not so easy

Regional in situ CalVal of satellite altimeter range at non-dedicated sites

Mathilde Cancet, Bonnefond, Haines, Watson, Lyard, Cotton, Benveniste

Regional CAL/VAL method (Combination of absolute CALVAL and offshore CALVAL)

- Calibration of altimeters with tracks near absolute sites
- Implemented in Harvest, Corisca, and Bass Strait

Jason-2 absolute bias at Senetosa

Sentinel-3A absolute bias in Senetosa and in Ajaccio (only 3 cycles)

Cross calibration and validation of Jason-2 and Jason-3 (Nicolas Picot, Desai, Leuliette, Scharroo)

Jason-3 GDRs products are fully inline mission requirements and on par with Jason-2 mission.

Summarized important anomalies in the products addressed during the CalVal period

Few remaining points needs to be further addressed:

- Remaining geographical patterns observed on SSH, SWH and sigma0/wind deserve additional analysis

Initial comparisons of Jason-3 and Sentinel-3A and tide gauges (Eric Leuliette, Plagge)

Differences between TOPEX-ERS-2 are reduced when TOPEX's Beta-prime dependence is removed

- Reduces error in TOPEX A/B bias

Tide gauge comparison

- TX/J1/J2 minus TG drift: 0.03 ± 0.4 mm/year
- Jason-3 bias cycles 1-19: –26.7 ± 1 mm (std error)

Assessment of the Jason-3 extension to the TOPEX/Poseidon/Jason Sea Surface Height Climate Data Record referenced to ITRF2014

(Brian Beckley, Lemoine, Zelensky, Ray, Mitchum, Yang, Ricko, Vandemark, Feng)

Seamless transition from Jason-2 to Jason-3 in the GMSL record

- 23.5 ± 1.3 mm Jason-3 range bias wrt Jason-2 based on GDR_T (c001 –c019) SSH collinear residuals. *No significant regional biases.*

Impact of GSFC ITRF2014 orbits (std1504)

- Reduces geographically corrected orbit errors

Tide gauge comparison

- TX/J1/J2 minus TG drift: 0.12 ± 0.4 mm/year
- Jason-3 bias cycles 1-17: –27.4 ± 4.0 (stdev)

Sentinel-3A calibration and validation (Remko Scharroo, Labroue, Raynal)

Overall: SRAL of very good quality

- S3A L2 production started 23 June; release of data expected in mid-December
- SLA performing close to Jason-2

Other issues still under investigation

- Future evolution possible wet troposphere retrieval algorithm
- Ionospheric correction not as accurate and bias for Jason-2 values
- Performance and small drift in SLA with respect to J2 and J3

Global multi-mission crossover analysis: performance of Jason-3 and other new data sets

(Denise Dettmering, Schwatke)

Jason-1 GDR-E

- Interleaved mission phase 2009-2012: drift w.r.t. Jason-2 has been reduced probably due to improved wet troposphere correction

Jason-3

- Scatter of radial errors: 1.1 cm for GDR and 1.3 cm for IGDR

Sentinel-3A

- Analysis done on S3A is based on preliminary products provided by EUM Marine Center
- Scatter of radial errors: 2.2 cm

Global assessment of Jason-1 GDR-E Reprocessing (Roinard, Marielle Guibbaud, Philipps, Ablain, Bronner, Desjonqueres, Picot)

- Mesoscale error reduction
- Consistency between asc/dsc tracks is improve and improved consistency with J2
- Significant impact on trend and great reduction of variability.

Global Assessment of Sentinel-3A NRT Wind and Wave Products (Saleh Abdalla)

Results from initial version of release

Data suitable for practical applications (some tuning needed)

- Wind and waves stable since late June 2016

Surface Wind Speed (both SAR & PLRM):

- Too high by ~ 1.0 m/s and slightly noisier than the other altimeters.

Significant Wave Height (SWH):

- Slightly noisier than the other altimeters.
- Underestimates low SWH (< ~2 m) & overestimate high SWH (> ~5 m).
- Possible adverse swell impact on SAR SWH.

Key points

1 - Assess the Jason-3 data quality: GDR notably - this *is* the Final Verification Workshop.

Confirm that the Jason-3 GDRs meet or exceed the requirements and endorse the release of the GDRs.

2 - Jason-2 EoL orbit: discussion between -27 and +35 km orbit.

The 17-day sub-cycle of the –27 km option is arguably better for cal/val.

4 - Cold sky calibration for Jason-2 as well as Jason-3 (frequency).

In the case of a Jason-3 failure, it will be valuable for the GMSL record for the Jason-2 wet troposphere drift to have been monitored with cold sky calibrations.

Jason-3 should be at least every 60 days. We recommend studying the feasibility of increasing the frequency of Jason-3 cold sky calibration.

Key points

5 - Extend the 60-day requirement to 90 days for GDR latency (Jason-3 but also Jason-2) to improve the AMR stability thanks to the cold sky calibration.

The longer GDR latency will clearly improve the errors and could allow for other improvements (e.g. orbit processing with time-varying gravity, ERA-interim)

6 - AMR on Jason-CS: there is a small probability that the external calibrator can fail in a position that renders the AMR unusable for the remainder of the mission.

Should we accept this risk and keep the strong requirement on wet tropospheric correction drift that is very important for the climate data record?

If the additional risk is inline with other risks, we would accept it.

7 - Full-time open-loop (DIODE/DEM) tracking mode for Jason-2 (already done for J-3).

It is not proposed to operate J2 in open loop full time. J2 can not switch between modes automatically like J3/S3. Open-loop be used for transponders or specific targets. Needs to be weighed against the needs of the inland water community and operational constraints.

Issues raised at the round table

1. Interest in a special issue/special collection for Jason-3/Sentinel-3 cal/val.
2. Recommend that the project informs the OSTST of progress of TOPEX reprocessing efforts because of impact on MSL, etc. studies.
3. The transponder is an interesting and valuable tool. Need to continue discussions about challenges and value of long-time stability monitoring and increased frequency of absolute calibrations and expanding to C-band and sigma0.