Sentinel-3 calibration and validation in Bass Strait as an extension of the Jason site.

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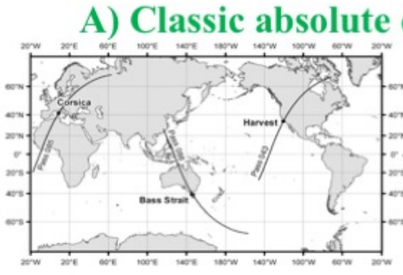
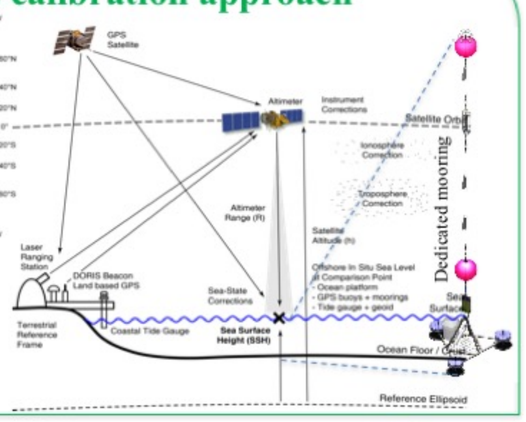
Introduction: The Bass Strait site is one of the main cal/val sites around the globe and the only site in the southern hemisphere that has contributed to absolute calibration of all sea level reference missions TOPEX/Poseidon, Jason-1 and Jason-2 and Jason-3, commencing in late 1992. Sentinel-3A (S3A) was launched in Feb. 2016 and Sentinel-3B (S3B) is planned for 2018 and SWOT is planned for launch in 2021. Here we show the S3A first year results of the integrated approach that we are developing to contribute to the new missions while keeping the effort developed for the Jason series. We took 3 main approaches to address the S3A Cal/Val in the Australian side :

- **A)** we doubled up the Jason off shore mooring + GPS buoy + Burnie tide gauge and vertical land motion.
- **B)** we used the regional Gridding Sea Level Anomalies CSIRO product to track the missions evolution against the merged grids.
- **C)** we use a regional hydrodynamic model (SHOC) to guide our calibration network development and also as a validation of the altimetry signals. As a tool to extend in situ measurements spatially.

A) Classic absolute calibration approach

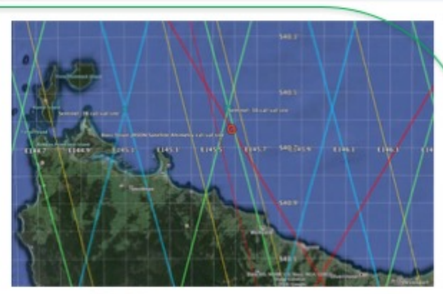


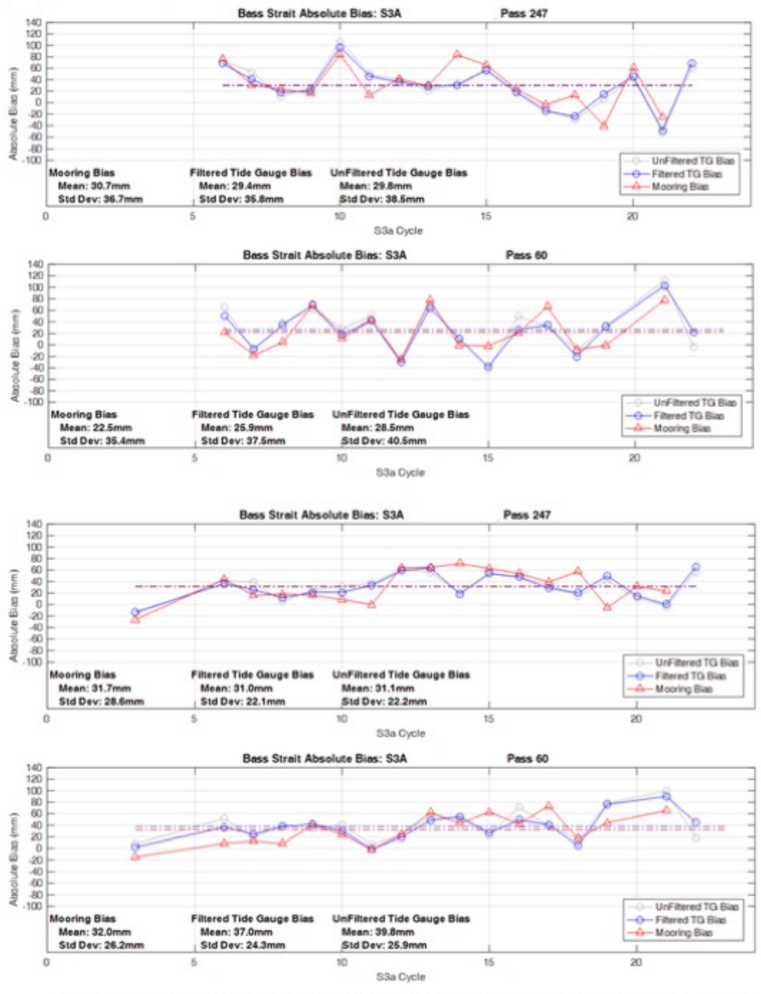


The fundamental goal is shared between absolute calibration sites:

- *Determine cycle-by-cycle SSH at a chosen comparison point in an absolute reference frame. Comparison against altimeter SSH yields absolute bias.*
- *Long term continuous monitoring is key.*
- *Short term (60d) is challenging.*

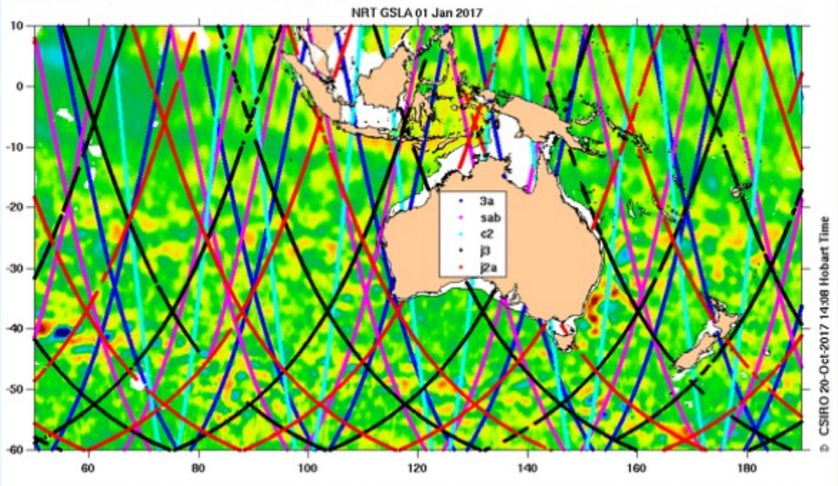
Bass Strait historical and long term absolute calibration zone is 8-9 km away from the S3A crossover of passes 60 and 247.
With now 2 GPS buoys deployed 6 times for a couple of days systematically and simultaneously at JAS and S3A for the mooring datum reference. We can estimate the geoid difference between the 2 sites at ~33mm which confirms a relatively flat geoid in the area with a raw 16mm gps-mooring std difference and a 6mm datum uncertainty. This is here performed using the products homogenized through RADS.



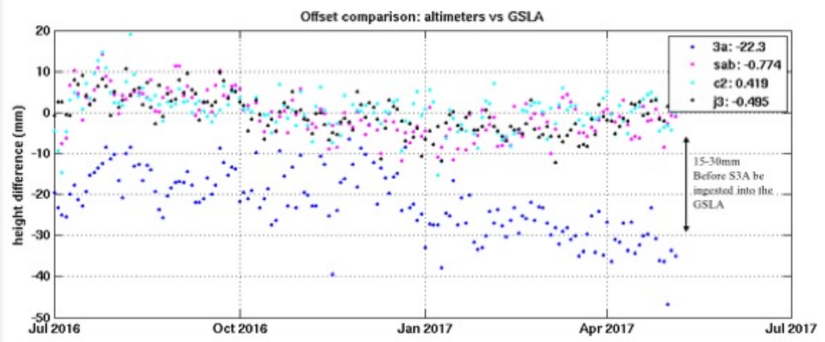


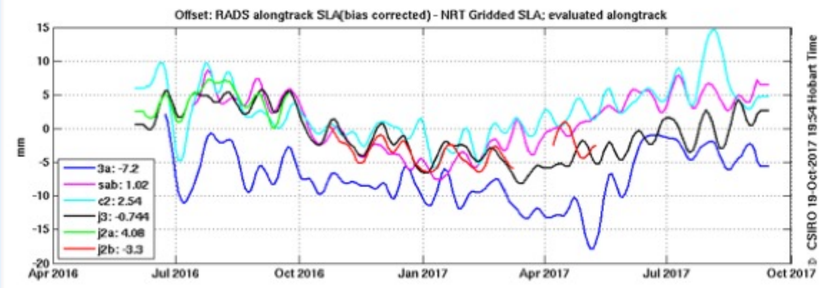
While the number of repeat cycles available remains small the placement of the absolute calibration mooring at a crossover doubles our capability to contribute to the S3A SSH evaluation.
Here one can notice a quite consistent behavior between ascending and descending passes.
One can also notice the significant improvement in the statistics with the SAR mode.
There is an expectable mean difference between SAR and PLRM which probably points to need for SSB handling.

B) Validation of individual missions against the regional Gridded SLA



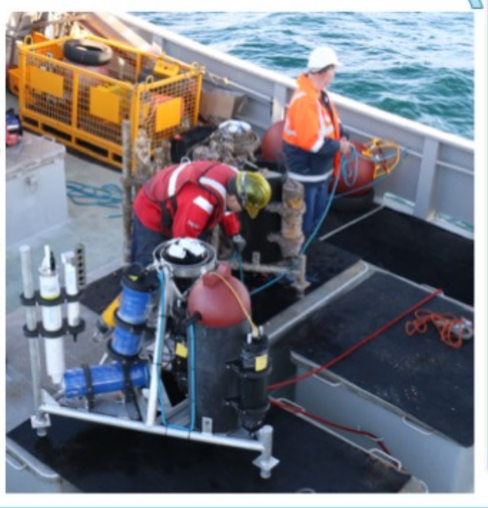
Passes of each satellites for a given day with GSLA in background (oceancurrent.imos.org.au)



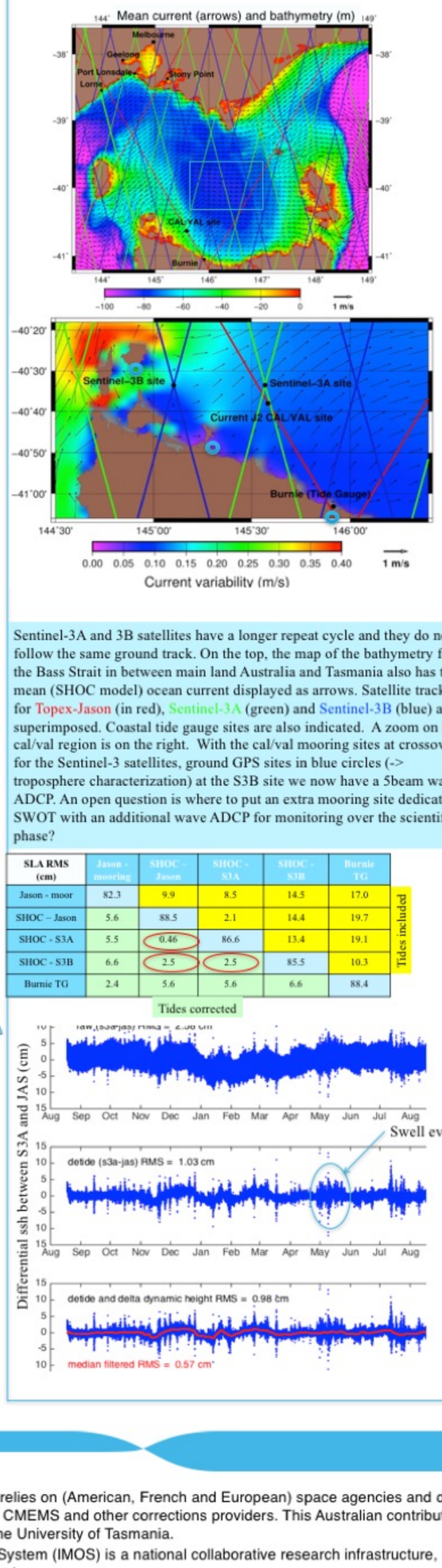


S3A ingested in GSLA since june 2017, with now a reference offset of ~19mm in the RADS. Note the S3A coming closer to the Jason-3 as the other non-reference orbit missions seem to drift away, … is this a sign of some remaining offset mapping through the GSLA process ?

Using the mooring at a Sentinel-3A crossover, recording bottom pressure year round and the T-S density extrapolated from the not too distant JASON site works well and provides an optimized solid extension to the JASON calibration system. The model validates well against the moorings (still some improvement to be implemented on the tidal forcing), the numbers produced by the model in the mooring network design are impressively confirmed by the mooring observations and gives us confidence for future strategy development (e.g. SWOT) but also lead to our next development of using the model to extend spatially the altimetry validation across the wider area.
The moorings at the Sentinel-3B are now operational and provides not only pressure, temperature and salinity, but also boast a new generation ADCP system which does perform good SSH estimates at high frequency.



C) We use a regional model[4] to assist with the absolute calibration and have a validation capability for Sentinels and SWOT.



Sentinel-3A and 3B satellites have a longer repeat cycle and they do not follow the same ground track. On the top, the map of the bathymetry for the Bass Strait in between main land Australia and Tasmania also has the mean (SHOC model) ocean current displayed as arrows. Satellite tracks for Topex-Jason (in red), Sentinel-3A (green) and Sentinel-3B (blue) are superimposed. Coastal tide gauge sites are also indicated. A zoom on our cal/val region is on the right. With the cal/val mooring sites at crossovers for the Sentinel-3 satellites, ground GPS sites in blue circles (-> troposphere characterization) at the S3B site we now have a 5beam wave ADCP. An open question is where to put an extra mooring site dedicated to SWOT with an additional wave ADCP for monitoring over the scientific phase?

SLA RMS (cm)	Jason - mooring	SHOC – Jason	SHOC - S3A	SHOC - S3B	Burnie TG
Jason - moor	82.3	9.9	8.5	14.5	17.0
SHOC – Jason	5.6	88.5	2.1	14.4	19.7
SHOC - S3A	5.5	0.46	86.6	13.4	19.1
SHOC - S3B	6.6	2.5	2.5	85.5	10.3
Burnie TG	2.4	5.6	5.6	6.6	88.4

Tides included

Tides corrected

FOR FURTHER INFORMATION
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http://www.cmar.csiro.au/sealevel/sl_hist_last_decades.html
http://oceancurrent.imos.org.au & http://imos.org.au/facilities/srs/srscalval/