

# CWPIES, a shallow water current, waves and pressure inverted echo sounder for higher resolution satellite altimetry calibration and validation.

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Integrated Marine  
Observing System



UNIVERSITY of  
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## Introduction:

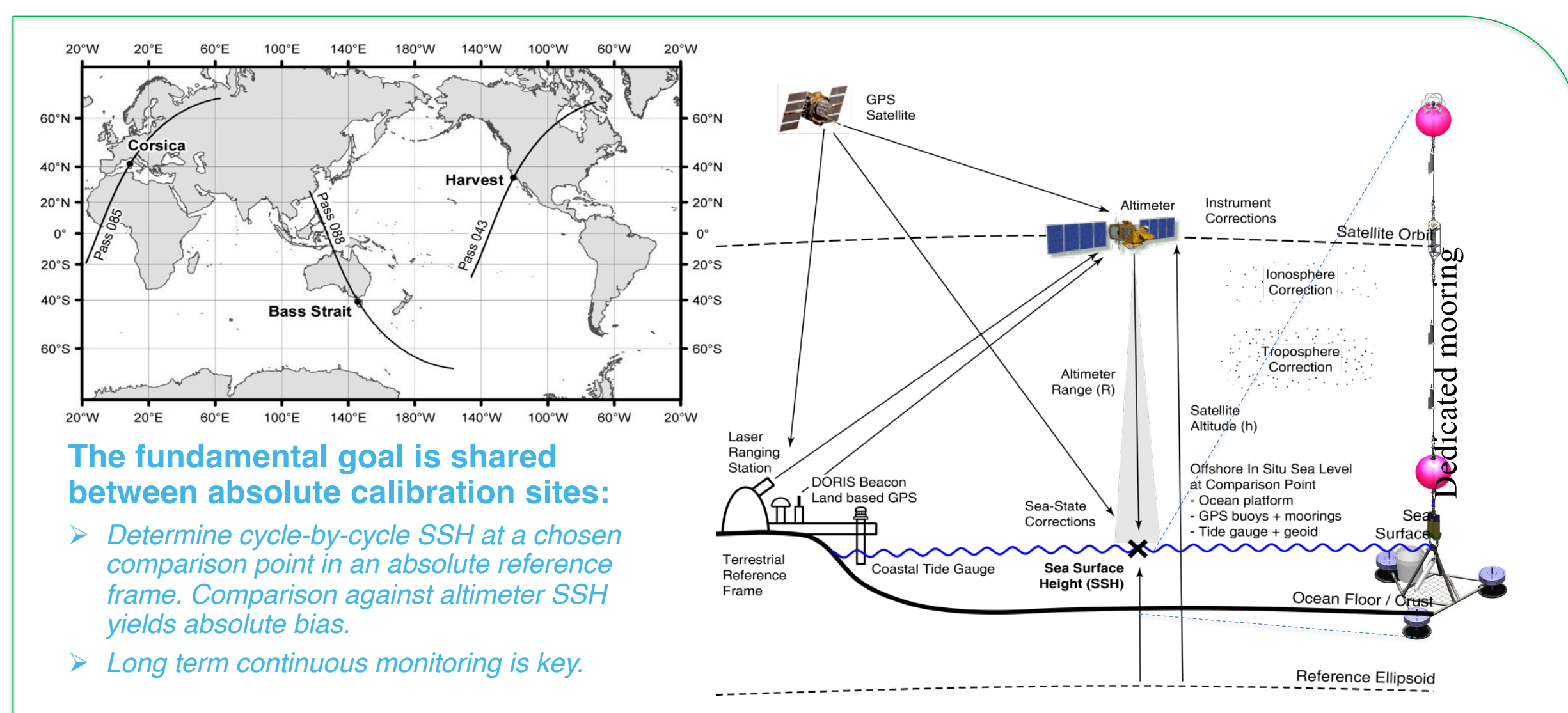
The Bass Strait site is one of the main cal/val sites around the globe and the only site in the southern hemisphere that has contributed to absolute calibration of all sea level reference missions TOPEX/Poseidon, Jason-1 and Jason-2 and Jason-3, commencing in late 1992. Sentinel-3A (S3A) was launched in Feb. 2016 and Sentinel-3B (S3B) in 2018, Jason-CS planned for 2020 and SWOT for 2021.

With the growing number of missions to calibrate and sites to instrument, we are developing novel and independent ways to estimate the SSH which can assist the absolute calibration.

One aspect innovation is a longer term capable GPS buoy (see Watson et al. presentation).

Here we show the recent development we have made using a wave-ADCP as a Pressure Inverted Echo Sounder at the Sentinel-3B comparison point in Bass Strait. This site boasts a 28m water depth. This is quite shallow and allowed us to confidently install a 5 Beam 500 KHz ADCP which allows to range the surface accurately in addition to measure currents and waves.

Over the period from April to August 2019 we had both the ADCP system, and a more classic Pressure, Temperature and Salinity moorings. On top of this we had a 70h GPS buoy session at the end of July. This allows us to do a 3 way comparison of 3 different ways to estimate SSH.



Bass Strait historical and long term absolute calibration Jason site is 8-9 km away from the Sentinel-3A crossover monitored since they are both in 50m deep waters.

The Sentinel-3B reference crossover is ~40km West of the Jason and Sentinel-3A calibration sites and is in 28m deep waters.

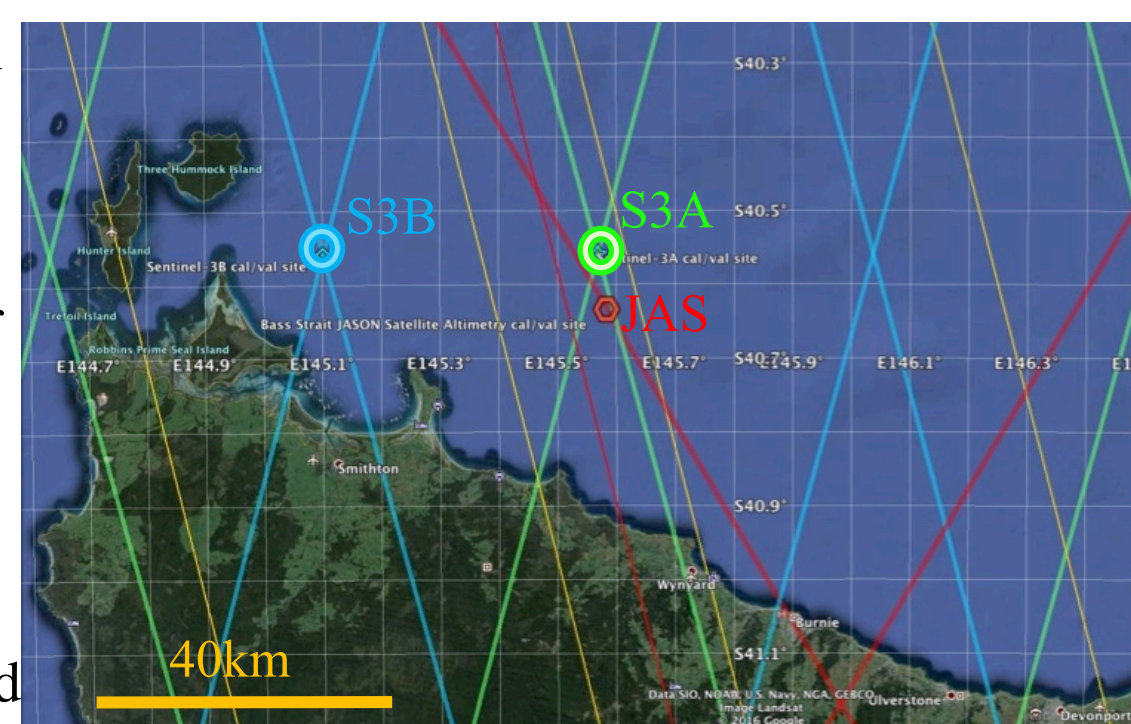
A full set of instrumentation is installed in preparation for Sentinel-3B:

- One mooring with bottom Pressure, Temperature and Salinity measurements.
- One mooring with bottom P,T,S and a 5 beam ADCP.

The ADCP operates over 2 parallel programs:

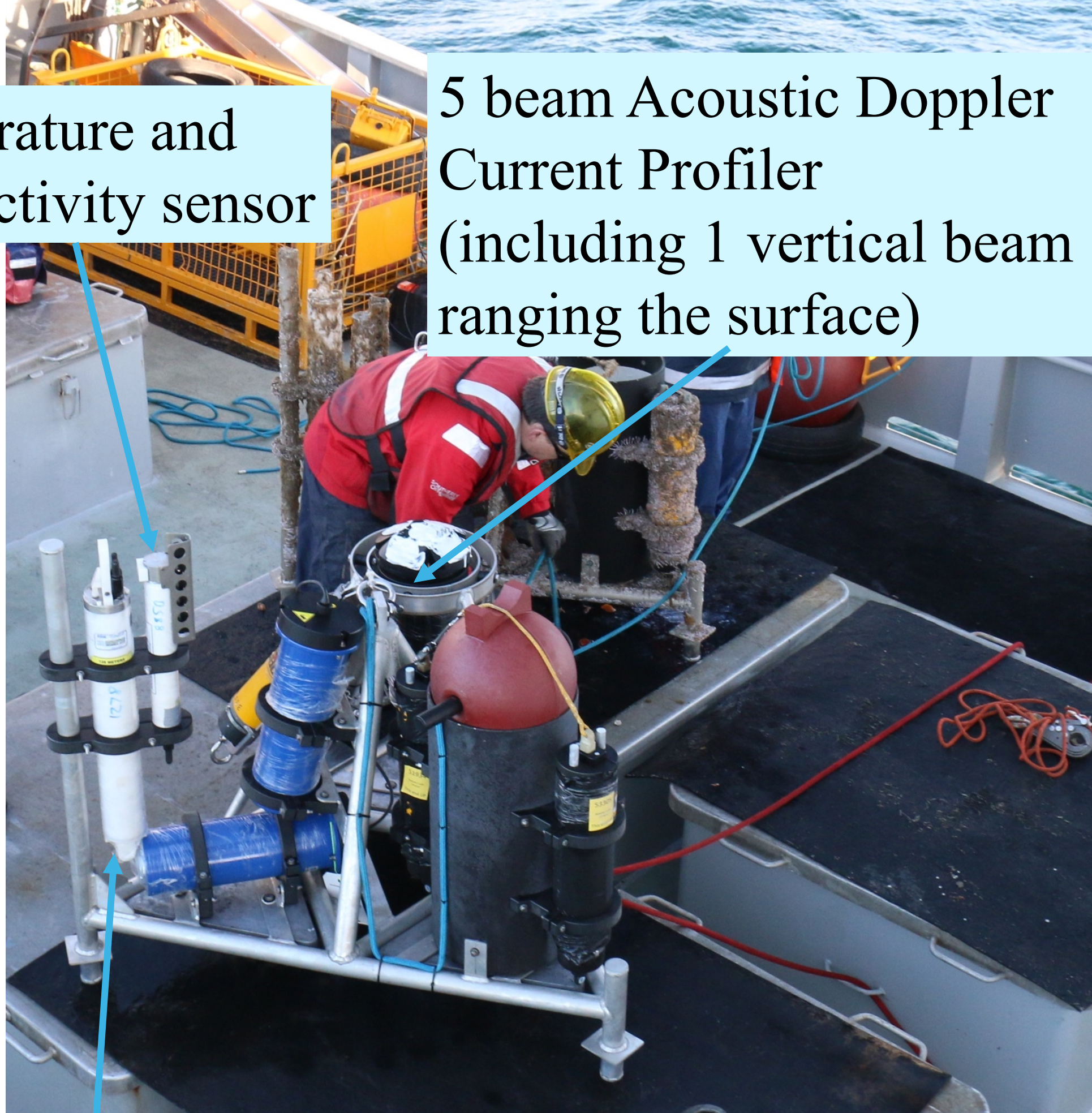
- one operates the 5 beams to measure currents, wave spectra and Sea Surface Height during 20min every hour
- one operates the vertical beam only for the 40 other minutes of every hour.

This configuration allows us to record the SSH continuously while fitting energy and data storage for over 6 month long deployments. 2 SSH detection modes are available with the ADCP: leading edge detection (LE) and acoustic surface tracking (AST). We obtain a continuous SSH record at ~2Hz.



Temperature and Conductivity sensor

5 beam Acoustic Doppler Current Profiler (including 1 vertical beam ranging the surface)



Bottom Pressure sensor

FOR FURTHER INFORMATION  
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## REFERENCES

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## ACKNOWLEDGEMENTS

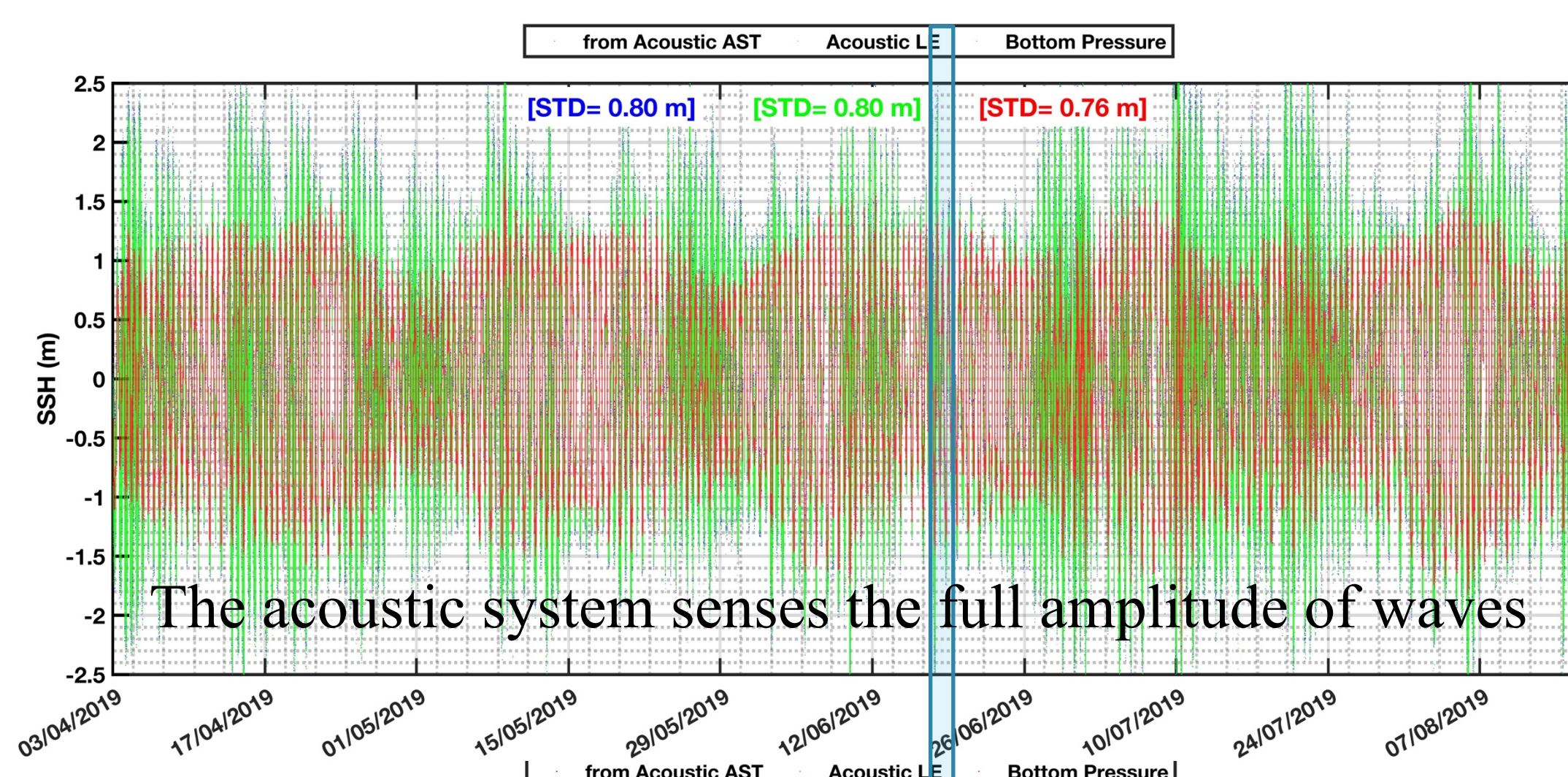
Our ongoing Cal/Val effort heavily relies on (American, French and European) space agencies and data provision through AVISO+, RADS, CMEMS and other corrections contributors. This Australian contribution is supported by IMOS, CSIRO and the University of Tasmania.

The Integrated Marine Observing System (IMOS) is a national collaborative research infrastructure, supported by Australian Government.

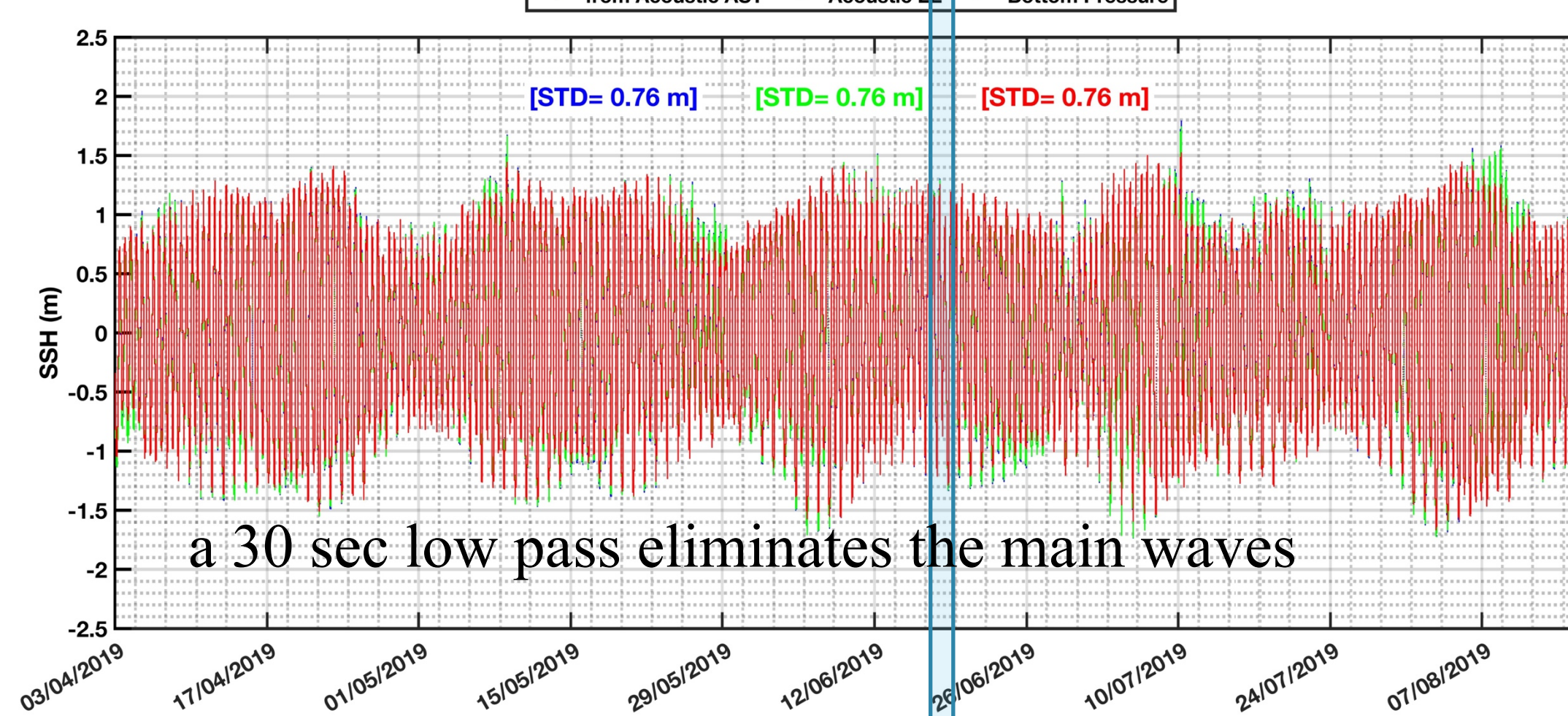
[http://www.cmar.csiro.au/sealevel/sl\\_hist\\_last\\_decades.html](http://www.cmar.csiro.au/sealevel/sl_hist_last_decades.html)

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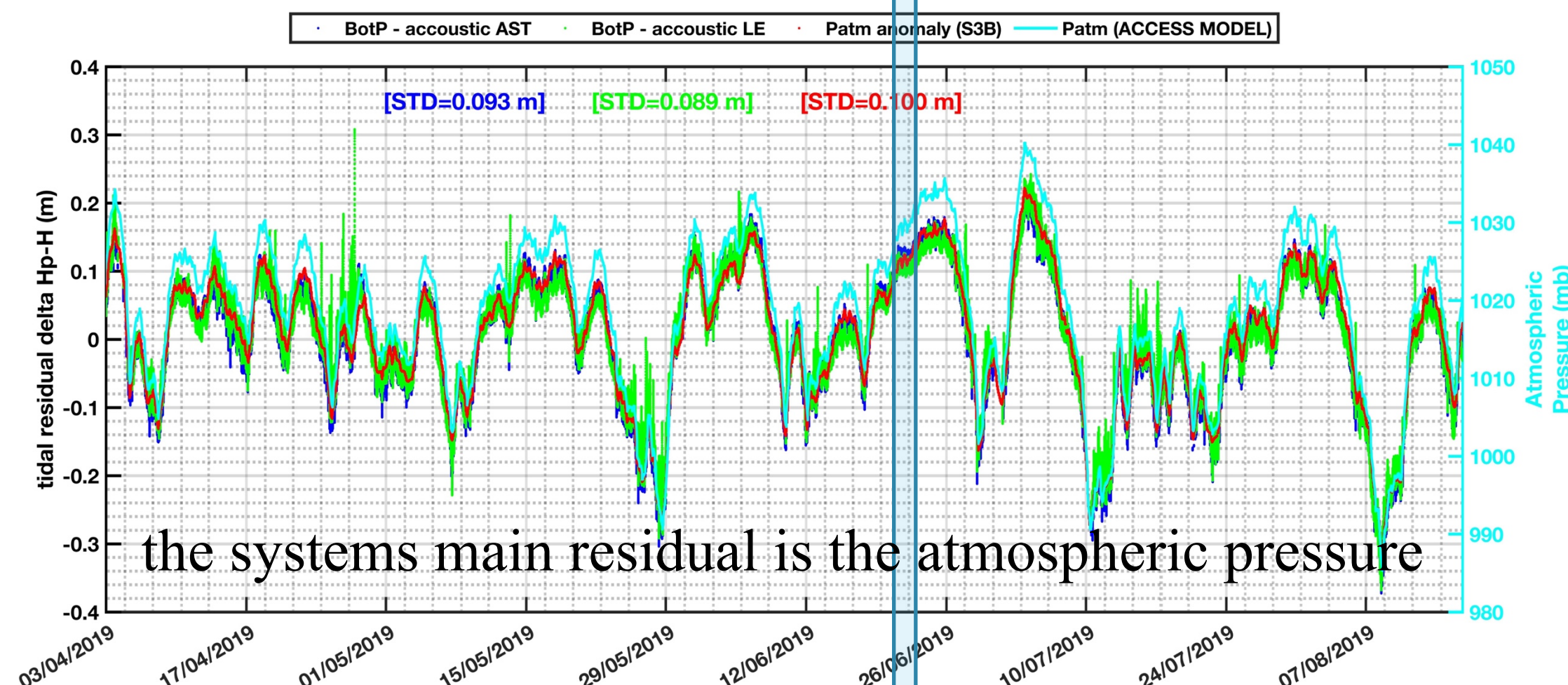
## Acoustic and bottom P



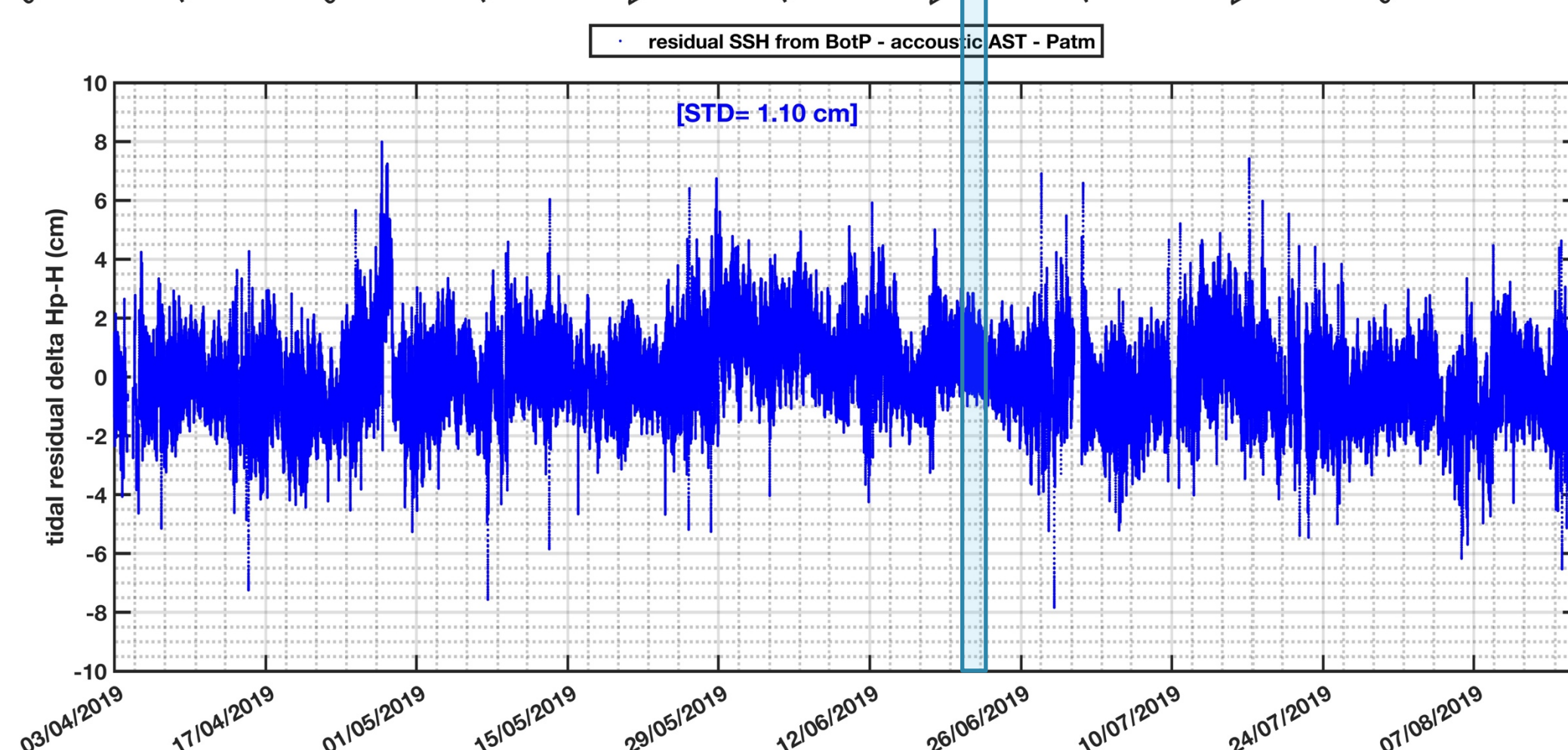
The acoustic system senses the full amplitude of waves



a 30 sec low pass eliminates the main waves



the systems main residual is the atmospheric pressure



This system is valid to do altimetry cal/val.

The collocation of Pressure, Temperature and Salinity as well as 2 acoustic ranging helps to detect outliers (<1%) inherent to acoustic ranging. The acoustic system measures accurately the waves and we can observe the damping when comparing to the pressure sensor at depth. The system SSH compares very well to the bottom pressure estimates. The comparison to the GPS buoy data is at the cm level when the waves are filtered (low pass 30 seconds).

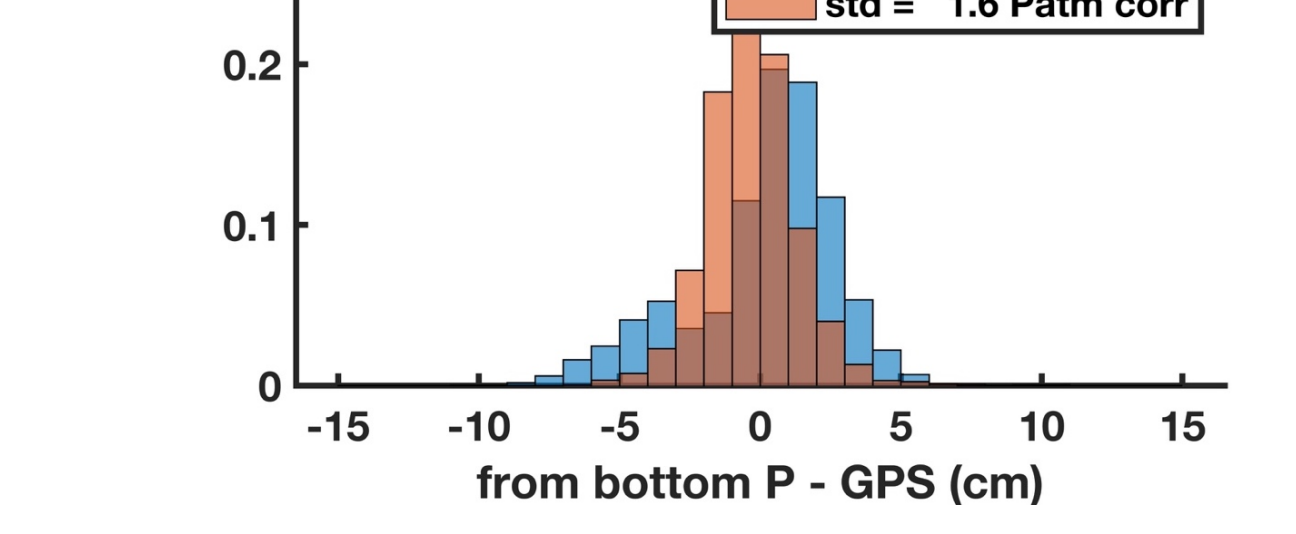
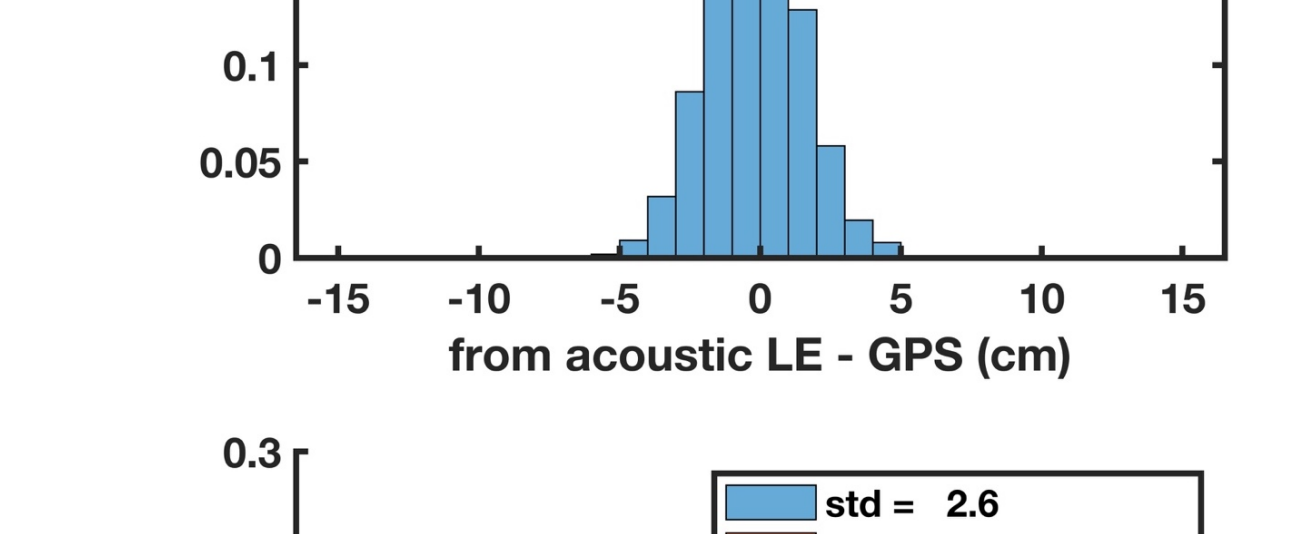
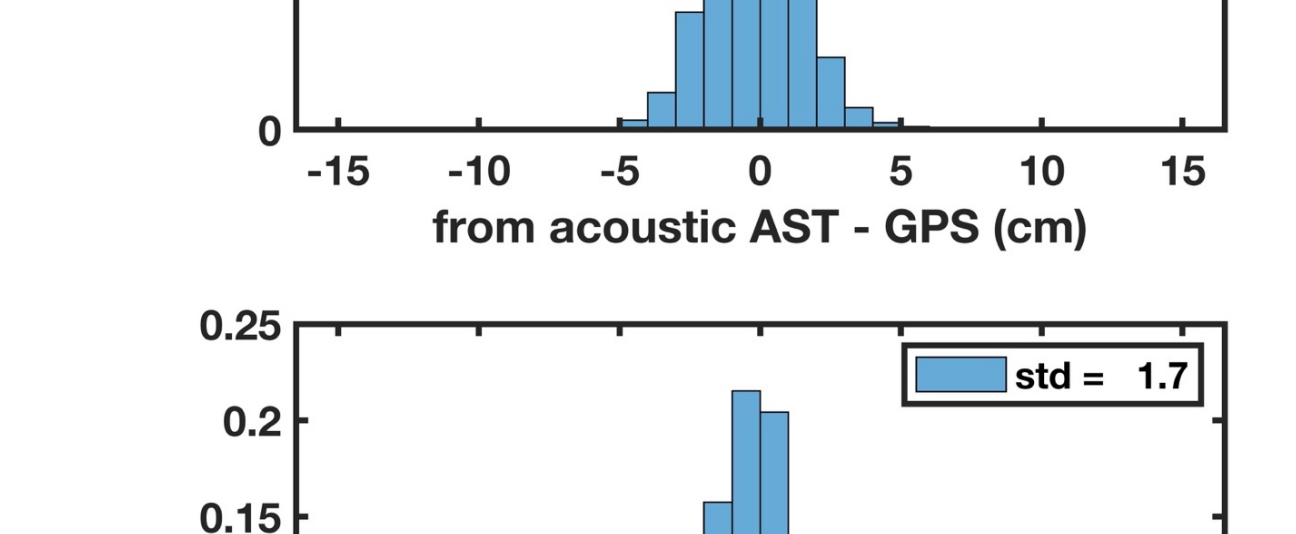
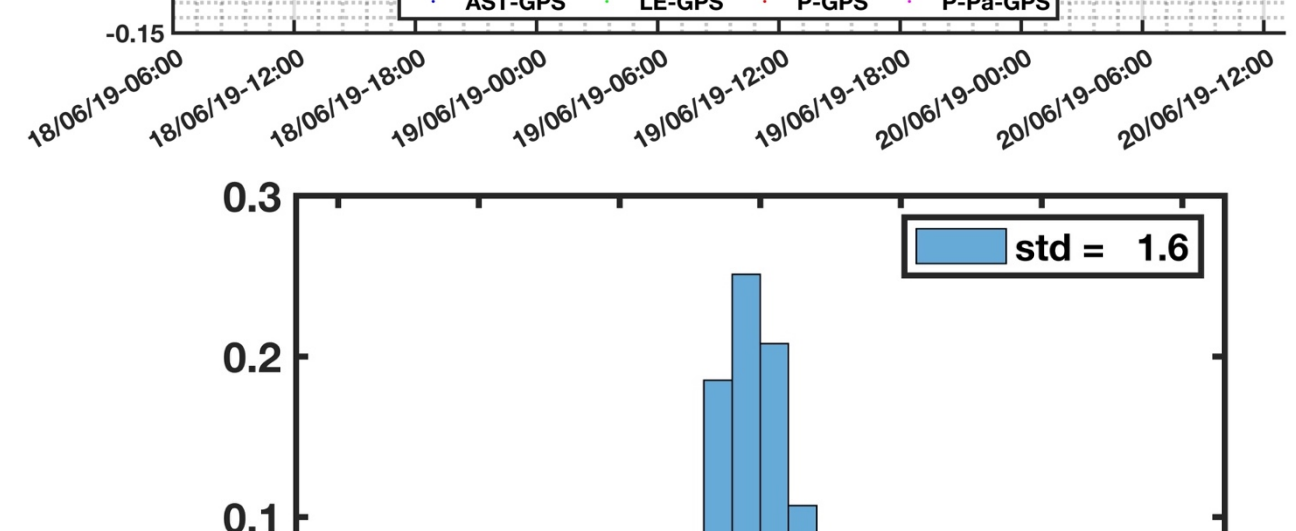
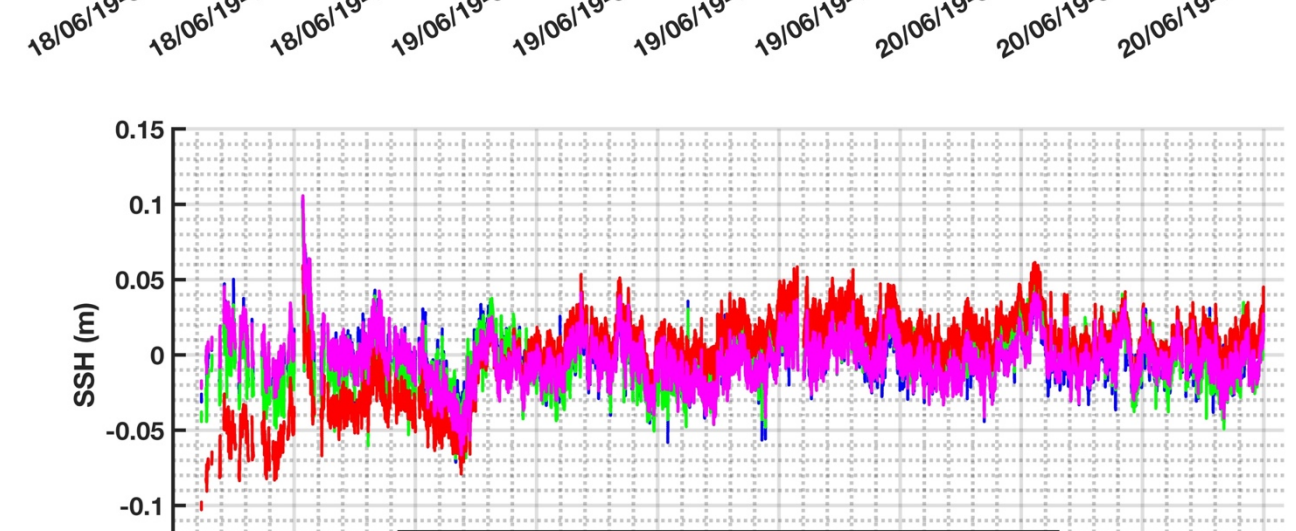
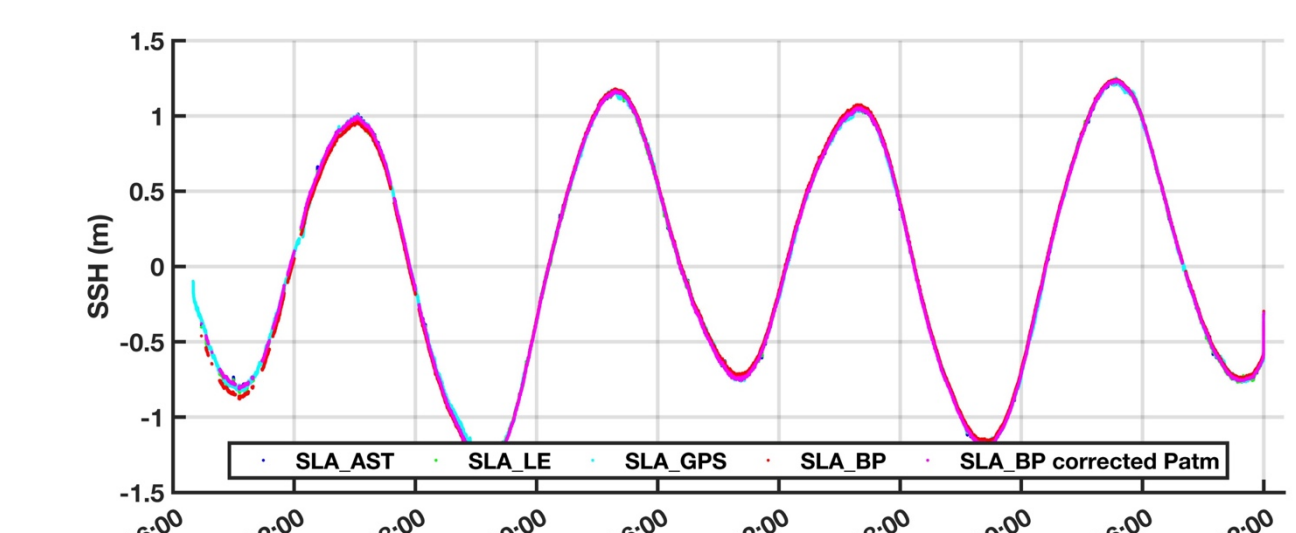
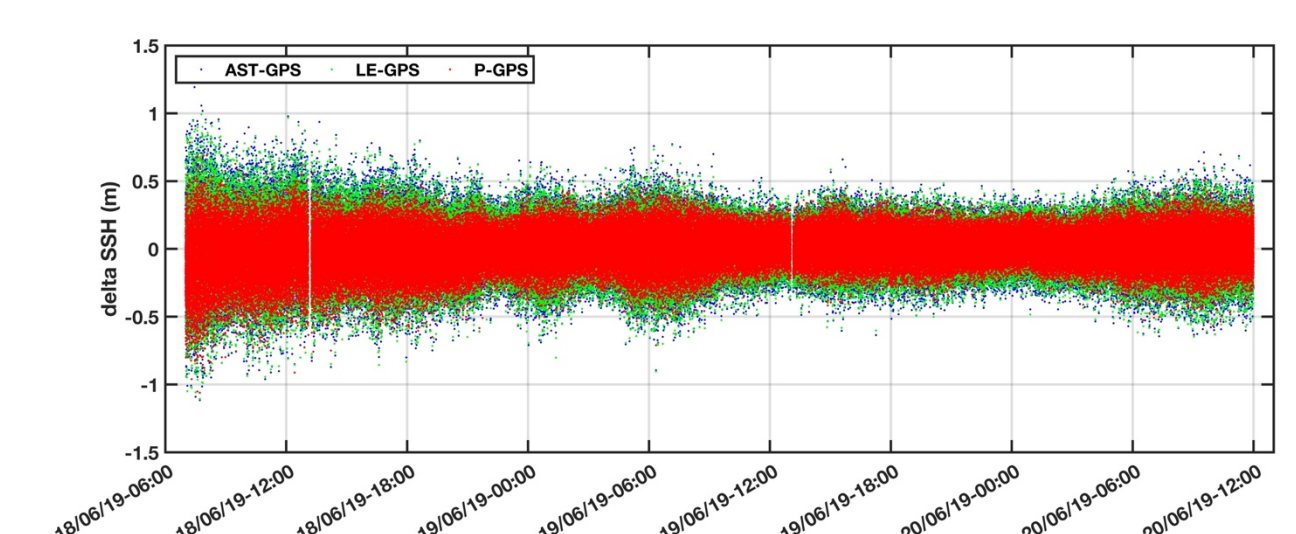
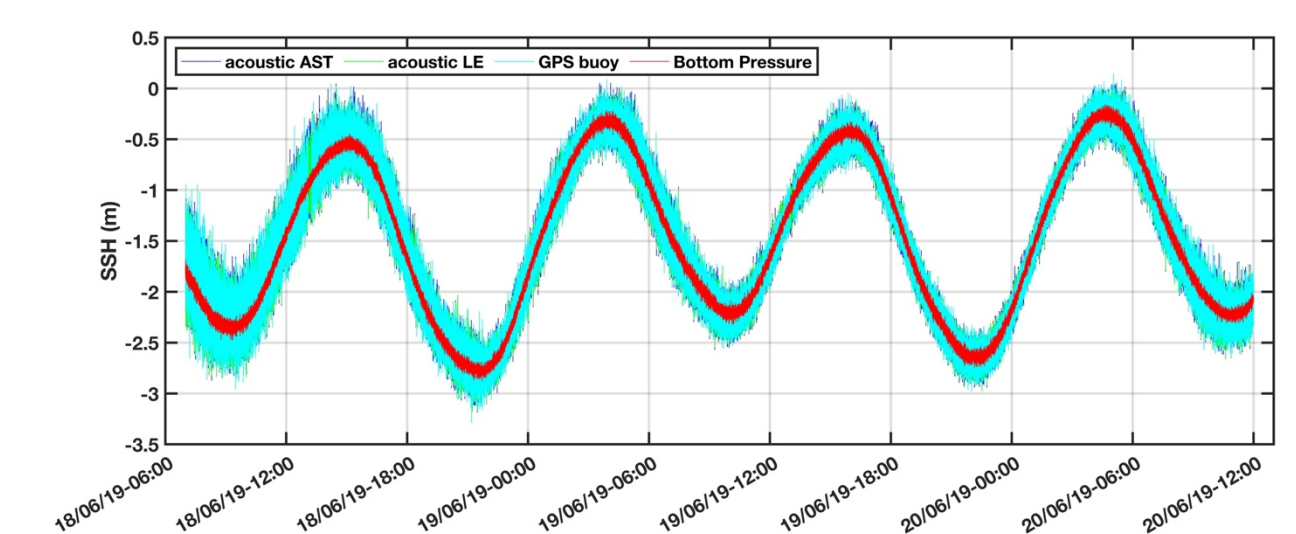
Besides tides, the system main SSH signal in acoustic system (and in altimetry) is the atmospheric pressure and here it correspond very nicely to the Australian ACCESS model. This is an indirect validation which gives us confidence to use this model in our cal/val and on the IBE validity.

Improvements are ongoing on the data QC. One important aspect of the mooring design relate to the necessity for a vertical and stable pointing of the ADCP as a previous experiment showed a quick degradation of the measurements when the pointing was affected by large swell.

Unlike the bottom pressure systems the Acoustic and GPS systems do not show significant time drifts. This new kind of mooring as well as other ongoing longer term deployable GPS buoys help with the increase in the number sea level capable altimetry missions.

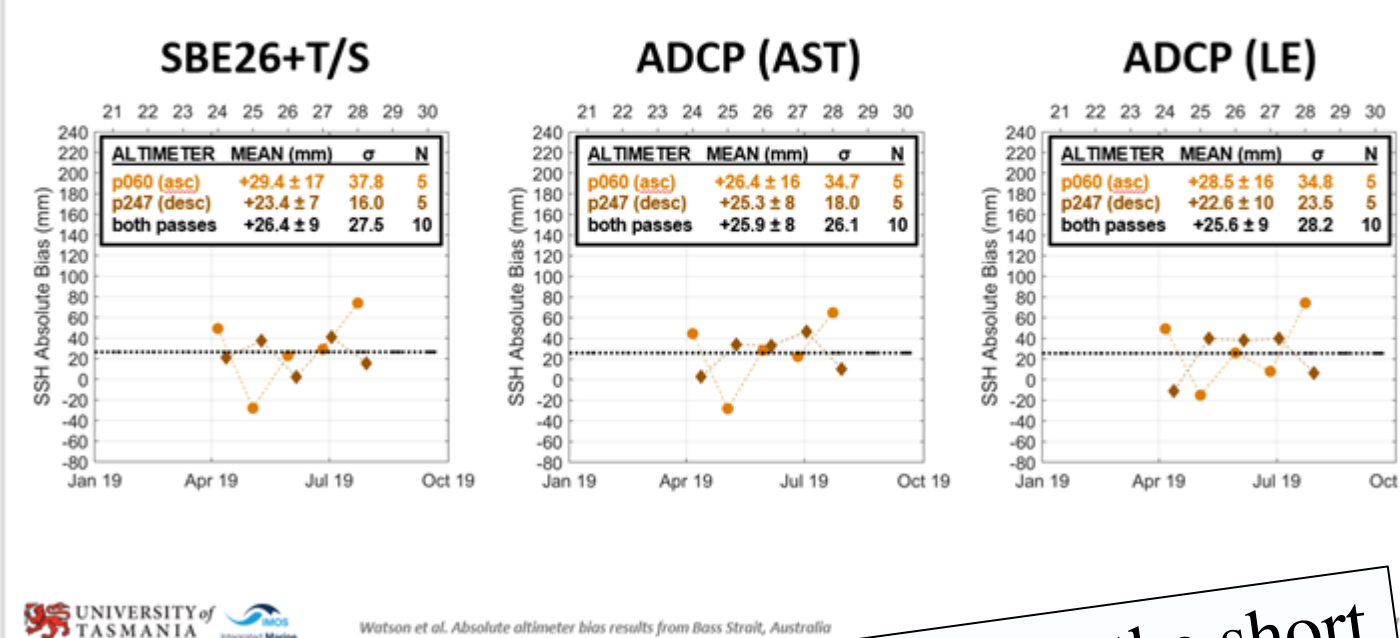
2 additional moorings are being built and will be deployed in December 2019 along an S3B line and after Sentinel-6 launch along a Jason line before being used for the SWOT cal/val.

## Acoustic, GPS and bottom P



See Talk Watson et al. for inferred satellites bias estimates

## S3B – Evaluation of CWPIES



While hardly significant yet given the short time period and few repeats, these first results are highly encouraging.