In-situ Calibration: The Potential Benefits of Single-Pass, Multi-Site, Data Collection

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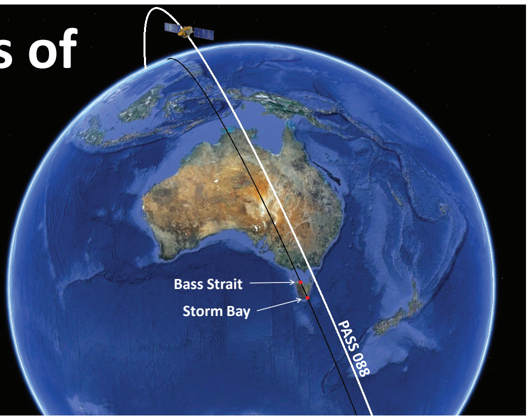
IMOS Integrated Marine Observing System



1 Overview

The comparison of altimeter absolute bias estimates between different calibration sites (e.g. Fig 1) is complicated by potential geographic differences in the orbit, differences in atmospheric and sea state effects and differences in the local realisation of the terrestrial reference frame.

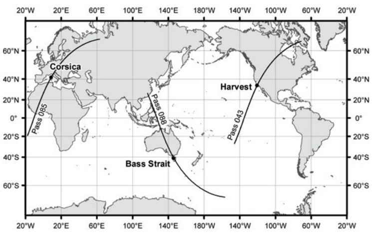


Fig 1: Absolute calibration sites at Corsica, Harvest and Bass Strait

We have begun to explore the benefits of single-pass, multi-site data collection. We have supplemented the Bass Strait site with infrastructure located in Storm Bay, some ~350 km further south on Pass 088 (Fig 2) to better characterise the altimeter absolute bias, with a particular focus on providing independent estimates of sea state bias.

2 Sites

Fig 2: Bass Strait and Storm Bay comparison points.
(Comparison points in red are located at 40°39' S, 145°36' E and 43°18' S, 147°39' E respectively. GPS sites in yellow, tide gauges in white)

The Bass Strait calibration site has its current comparison point situated in the south-western margin of Bass Strait, comparatively sheltered with respect to the wave climate. The mean SWH over the duration of the Jason-1 mission was ~1 m, with a mean wind speed of ~6 m/s (Figs 3 and 4).

The new site is located on the opposite side of the island of Tasmania in Storm Bay. The selected comparison point is exposed to significant fetch from the south west, and despite comparable wind speeds, has a mean SWH of ~2 m, double that recorded at Bass Strait over the same period (Figs 3 and 4).

Given identical instrumentation and methods of determining absolute bias at both sites, and highly correlated orbit errors, we seek to better understand the influence of sea state bias within the measurement loop using these two sites.

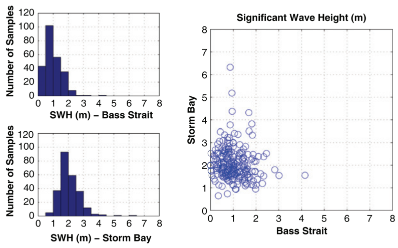


Fig 3: Significant Wave Height (Ku-band) at Bass Strait and Storm Bay, over the duration of the Jason-1 mission.

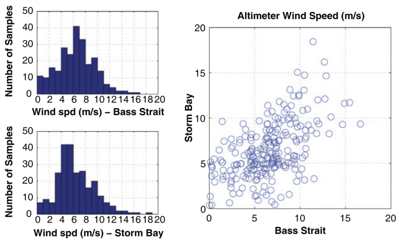


Fig 4: Altimeter derived wind speed at Bass Strait and Storm Bay, over the duration of the Jason-1 mission.

3 Approach

We use moored oceanographic sensors (Fig 6) to sample pressure, temperature and salinity (the later used to convert pressure to in-situ SSH). The absolute datum of the mooring SSH is defined through the use of episodic deployments of 2 GPS buoys (Fig 5). Deployments of ~50 hr duration compare well with the mooring SSH record (RMS of the difference ~14 mm, Fig 7). The reference frame is imposed via the 1 Hz kinematic processing of the GPS buoys against a series of land based GPS reference sites. Local wave and wind models will be used to independently characterise the local sea state.

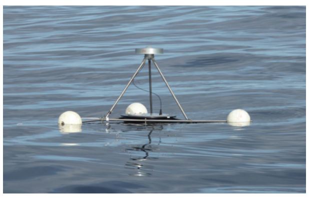


Fig 5: The UTAS Mk-III GPS buoy (Storm Bay)

4 Infrastructure

A vitally important component of this work will be the simultaneous operation of moorings at both sites. This allows the most precise and direct observation of SSH at each point, without the need to augment coastal tide gauge data or estimate a marine geoid.

At Bass Strait, we can derive an absolute bias time series with an RMS of 30-35 mm using this technique, compared with 40-45 mm using a coastal tide gauge, tidally corrected to fit the mooring SSH data.

From October 2010, moorings will be deployed at both sites. Using a six month visit cycle, these moorings will produce a continuous three year data stream. Repeated buoy deployments will assist in assessing the stability of the mooring SSH record.

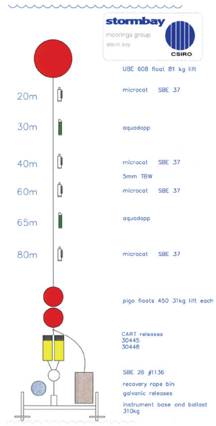


Fig 6: Moored instrument array at the Storm Bay site. A comparable array is to be deployed at the Bass Strait site.

5 Trial Deployment

An initial mooring deployment, solely at the Storm Bay site was undertaken in 2009/10, to investigate the ability to observe SSH at the precision required in the deeper water depth.

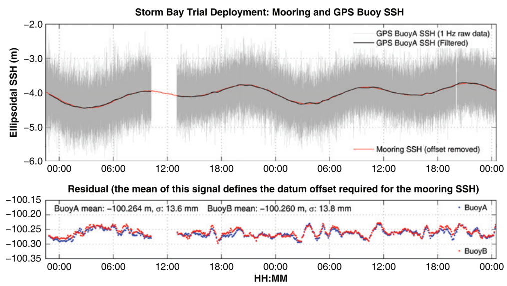


Fig 7: Example mooring SSH spanning a ~50 hr GPS buoy deployment. The difference between the buoy SSH and mooring SSH (lower panel) defines the datum for the mooring record.

The altimeter bias record computed from the trial deployment shows precision comparable to that derived at Bass Strait (RMS ~32 mm, Fig 8)

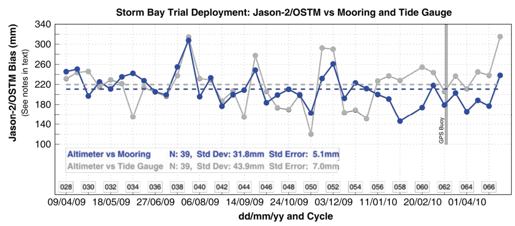


Fig 8: Bias time series from trial deployment (see notes below)

Further detailed interpretation of the absolute bias record (Fig 8) from the trial mooring deployment is limited due to a) an incomplete temperature and salinity record due to equipment failure and b) suspected settlement of the mooring. Both issues have been addressed for the formal IMOS deployments in October 2010.

The trial deployment shows we are able to generate bias time series with equivalent RMS (~30-35 mm) at two sites on the same pass, each with significantly different wave characteristics.

IMOS Integrated Marine Observing System

IMOS was established under the Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS), with initial funding of $50M in 2007. It has successfully deployed a range of observing equipment in the oceans around Australia, and is making all of the data freely and openly available through the IMOS Ocean Portal - http://imos.aodn.org.au/webportal/. With an additional $52M from the Education Investment Fund (EIF) in the 2009 Federal Budget as part of the Super Science initiative, IMOS will be extended out to mid-2013 and enhance its monitoring in the Southern Ocean and northern Australian waters. IMOS is led by the University of Tasmania on behalf of the Australian marine and climate science community.

As part of its commitment to ocean remote sensing infrastructure, IMOS supports an Australian contribution to the calibration and validation of satellite altimetry. From July 2010, the IMOS altimetry calibration and validation sub-facility aims to provide estimates of absolute bias from the Bass Strait and Storm Bay calibration sites, as well as bias drift computed from the global tide gauge and GPS network. For further information, visit: www.imos.org.au

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