KEEP satellites in check

Flower pots

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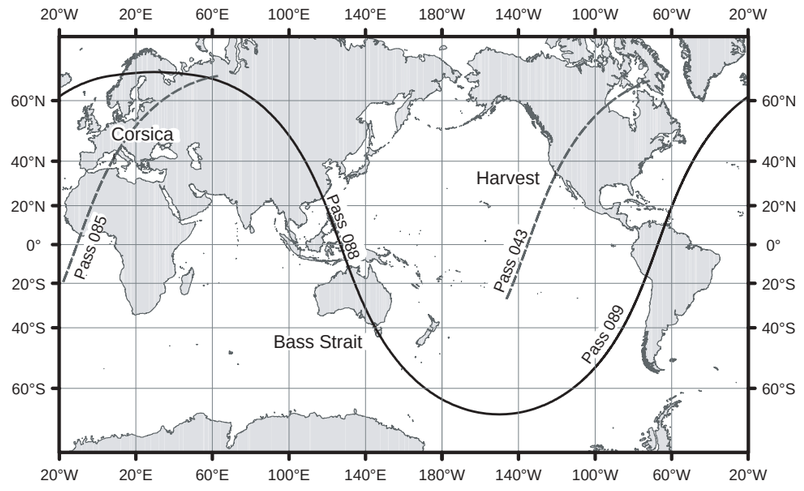
Overview

One of three primary studies to calibrate the French/USA (CNES/NASA) satellite altimeter missions was completed in Bass Strait.

Instruments onboard the TOPEX/Poseidon and Jason-1 satellites make precise measurements of sea level over the world's oceans. Detecting even the smallest change in the average sea level year by year is critical – particularly if you are one of 100 million or so people presently living within one metre of sea level. Measuring global sea-level change is a key application for the two satellites.

Following the launch of Jason-1, the two satellites flew in 'formation flight' covering the same ground track only 70 seconds apart. This 'calibration' phase of the mission lasted from January through August 2002 – enough time to put the satellites under the microscope.



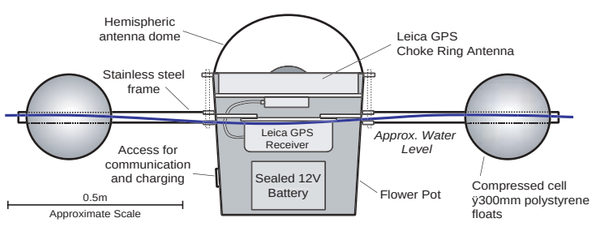
The Bass Strait site is the sole "absolute" calibration facility in the Southern Hemisphere. The NASA site is offshore from California at Harvest Platform, whilst the French Centre National d'Études Spatiales (CNES) operates a site in the Mediterranean Sea offshore from Corsica.

Flower pots?

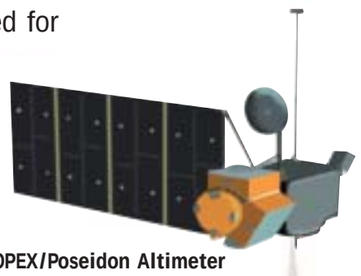
A pair of buoys and a series of ocean moorings were deployed, directly beneath the track of the satellite to measure precisely the height of the sea surface.

The two buoys – affectionately known as B1 and B2 – are deployed for a period of several hours centred on the time the satellites fly overhead, 20 km offshore from Tasmania in Bass Strait.

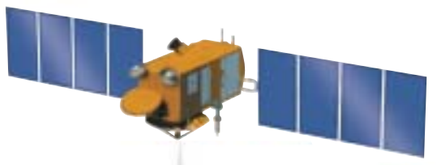
The buoys are constructed from simple $20 plastic flowerpots but each house a sophisticated $40,000 Global Positioning System (GPS) receiver. The receiver measures the buoy positions relative to the centre of the earth every second – each of these accurate to better than two centimetres. The buoys were designed and built by Dr Tony Sprent, UTAS.



An oceanographic mooring deployed for the duration of the "formation flight" period was used with the GPS buoy data to calculate a precise sea-surface height time series.



TOPEX/Poseidon Altimeter
Launched in August 1992



Jason-1 Altimeter
Launched in December 2001

What do the altimeters measure in space?

Whilst passing approximately 1340 km overhead, altimeters use radar pulses to measure the Sea Surface Height (SSH) relative to the centre of the earth.

Regional changes in sea level are indicative of ocean currents – currents which drive heat around the Earth regulating our everyday climate. A long term rise in mean sea level (currently at the 2 mm per year level) reflects the changing climate.

What do we measure on the ground?

To verify and monitor the satellite data, SSH is measured at a comparison point on the ground track of the satellite (40 km north west from Burnie in Bass Strait).

Three instruments are used to measure the SSH as the altimeters fly overhead:
- A coastal tide gauge
- An oceanographic mooring array deployed at the comparison point
- Two GPS buoys deployed episodically at the comparison point

In Situ Comparison Point

How accurate are they?

By comparing the sea level measured from the buoys, the ocean moorings and the tide gauge at Burnie with the sea level measured from the satellite altimeters we can keep a check on the accuracy and stability of the new satellite system.

Each sea surface height measurement from the altimeter is accurate to 30-35 mm. Using many measurements from the altimeter and the ground-based instruments, we are able to determine the height offset, or "bias", for each altimeter. The bias, for TOPEX/Poseidon over Bass Strait is 0 ± 14 mm and for Jason-1 the bias is +152 ± 13 mm.

The difference in the Jason-1 bias from Bass Strait compared with results from the Northern hemisphere sites confirm small but consistent large scale errors in the satellite orbit heights. The cause of the large Jason-1 bias remains unexplained.

The results highlight the importance of ongoing monitoring of Jason-1 and future satellite altimeter missions.

Poster design by Louise Bell