The MOTEVAS project

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We installed two sea bottom tide gauges at the nadir of T/P – Jason-1 and ERS tracks in the southwest Pacific (off Santo Island, Vanuatu) in November 1999. Salinity and surface temperature are also recorded. Combination of tide-gauge and altimetry data, cross-correlation of both tide-gauge data, and geodetic measurements on the nearby islands (GPS network and a DORIS beacon planned at Wusi) should allow us to circumvent the widespread problem of sea level versus crustal motion mix in tide-gauge data and provide an alternate calibration site for the Jason altimeter.

Recent works [Mitchum, 1998] have highlighted the importance of tide gauges to validate altimetry-derived results of long-term sea level variations [Nerem, 1999]. However, tectonic rates of vertical motion are difficult to separate from long-term sea level variations in studies based on tide gauge (TG) data unless the potential vertical motion to which the TG is subjected is surveyed accurately. Places where GLOSS tide gauges are maintained in the Pacific area and where crustal deformations have been evidenced are reported in figure 1. In fact, TG data have even been used as a geodetic marker to evidence crustal motion in some of the reported studies.

The Pacific ocean is mostly surrounded by tectonically active margins that are likely to undergo vertical deformations. These deformations are due to the seismic stress accumulation/relaxation cycle. One example among many is provided by the Ambrym earthquake, in November 1999 (magnitude 7.5), Southwest Pacific [Pelletier et al., 2000]. Co-seismic (instantaneous) vertical displacements in East Ambrym varied from metric uplift to decimetric subsidence within five kilometres. Moreover, long-term uplift of four millimetres per year is recorded by risen coral terraces at the easternmost point, while the lagoon in the south exhibits slow subsidence in that area. The long-term trends are likely to be the cumulative effect of opposite millennial and centennial trends. Within the Pacific Ocean, volcanic islands offer the best opportunity to set TGs. However, they load the underlying seafloor that regionally deflects by several kilometres. That Hawaii was thus subsiding until very recent times at even faster rates (4 to 5 mm/yr) is strongly suggested by deep drowned reefs [Jones, 1995].

In both places, a TG operating without monitoring of its own vertical motion is likely to provide erroneous long-term trends of sea level variation. The MOTEVAS project (Mouvements Océaniques et TEctoniques Verticaux par Altimétrie Spatiale) aims to collect TG time series whose ground and sea level components can be separated and which are comparable to altimetric data without spatial interpolation. The site of Wusi has been instrumented for this purpose.

The Wusi bank lies off the West coast of Santo Island, Vanuatu, in the southwest Pacific (figure 2). T/P track #238 runs uninterrupted along the coast of Santo. A sea-bottom TG was immersed in November 1999 (figure 3) right under the T/P track at Wusi, about five kilometres offshore. Because it is likely to undergo vertical motions, a back-up TG has been immersed at Sabine bank, about 70 km southwest of Santo, under an ERS crossover point. It is unlikely to undergo significant vertical motions.

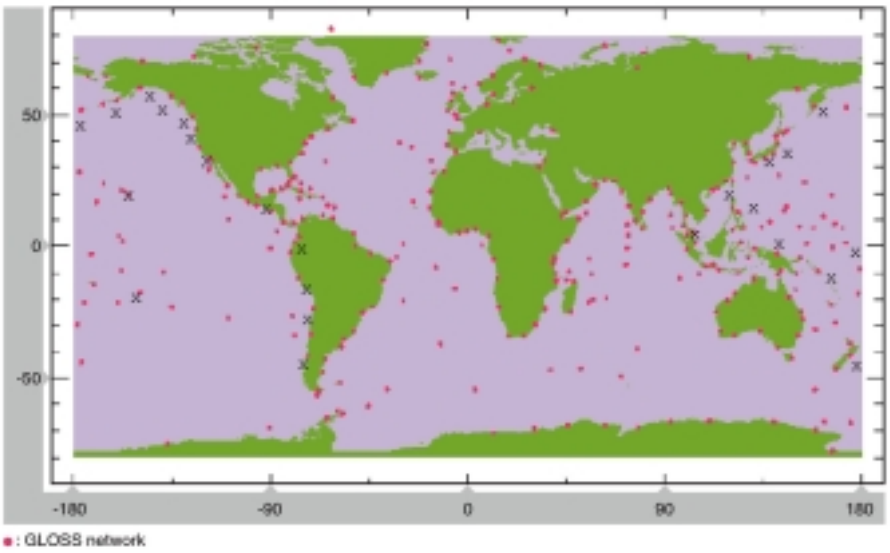

Figure 1: Status of geophysical studies reporting ground deformation near a GLOSS tide gauge.

The potential vertical motion of the TGs will be monitored by directly adding the TG and altimetry data, since the result is independent of the sea level. TG-observed sea level is then derived and compared to altimetry-derived sea level. Results will be validated by a cross-analysis of TG data series (that must output the same sea level variations) and geodetic controls (GPS surveys in neighbouring islands, a DORIS beacon at Wusi is under review by IDS). Rms scatter between altimetry and TG data will provide an estimate of the altimetry data noise and a level of the sea surface with GPS buoys is planned to enable altimeter calibration.

The MOTEVAS TGs also collect data in a remote area of the Tropical Pacific ocean. As such, pressure data will feed global tide models in that poorly constrained area. Height, temperature and salinity records will be included in ENSO studies.

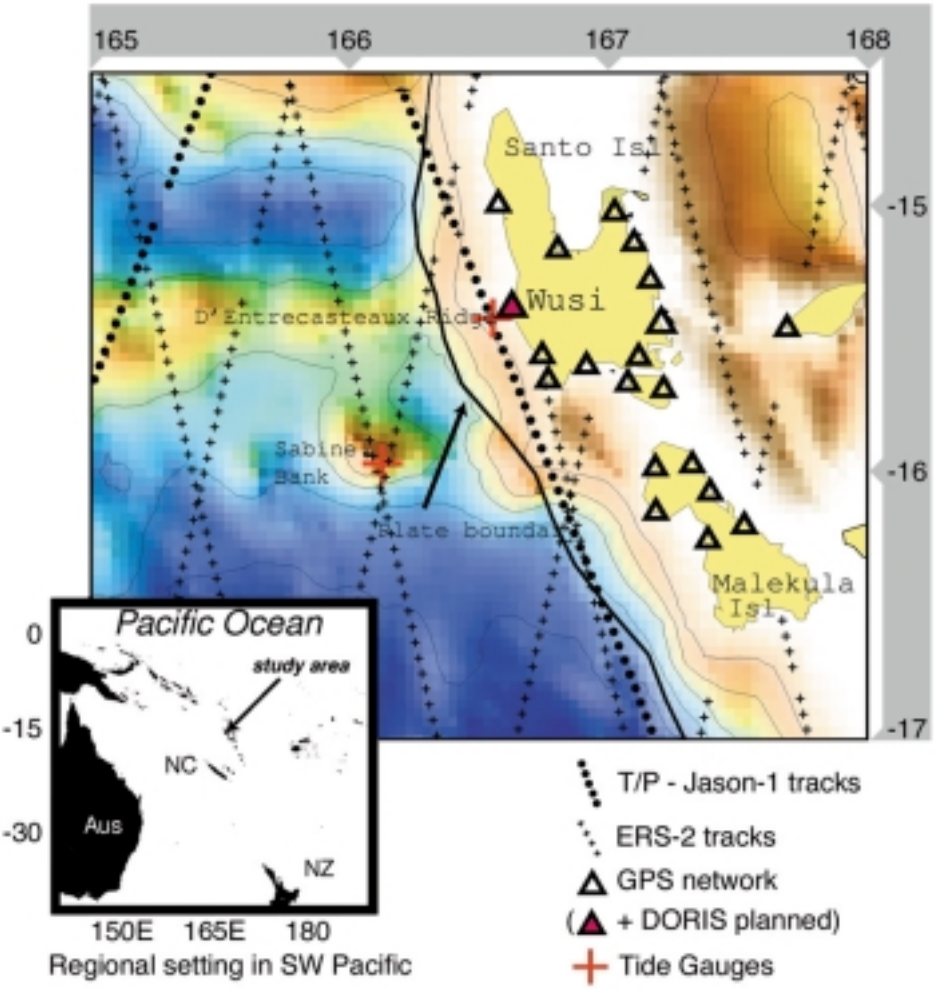

Figure 2: The Wusi experiment (Santo, Vanuatu).

Figure 3: Tide gauge installation at Wusi by divers from IRD/Noumea. The device hosting the TG is designed in order that no mis-positioning can occur when the TG is removed and then fixed back for downloading/ maintenance operations.

References

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