Low-cost, high precision GPS to measure sea level height

Submission theme: Coastal and marine technologies supporting management

Anne-Elise Nieblas[1,*], Julien Ancelin[2], Wilfried Heintz[3], Julien Barde[4], Jérémie Chanut[1], Pierre Gogendeau[5], Sylvain Bonhommeau[5]

[1] Company for Open Ocean Observations and Logging, 61 rue Haute, Saint Leu, La Reunion 97436
[2] UE INRA de Saint Laurent de la Prée
[3] Wilfried Heintz, UMR INRA 1201 Dynafor, GIP Ecofor, CS 52627 - 31326 Castanet Tolosan Cedex
[4] IRD, UMR MARBEC (IRD/Ifremer/Univ.Montpellier/CNRS), IOC, Rue de l'Institut, Ebène, Maurice
[5] IFREMER- DOI, rue Jean Bertho, 97822 LE PORT CEDEX, La Réunion, France
* Presenting author

Sea level height is primarily measured using tide gauges and satellite altimetry, with a heavy reliance on the former. Tide gauge measurements are precise at the mm scale, but their accuracy is dependent upon their distance from and the strength of their communication with the linked Global Navigation Satellite Systems (of which Global Positioning Systems (GPS) are the best known). The advent of satellite altimetry allowed the expansion of sea level measurements from a limited coastal network of tidal gauges to coverage of the global oceans. However, the accuracy of satellite altimetry is dependent on the accuracy of the orbit determination, which varies by satellite, and is generally within 4-5 cm. Recently, tests have been made to explore the use of GNSS in measuring sea level height directly to sub-centimeter precision via GPS units attached to buoys (Andre et al. 2014). These units were able to measure sea level height within 1-2.2 cm of tide gauge data, making them useful tools in sea level measurements.

Until recently, very precise (sub-centimeter) GPS technology has been available primarily for professional use, and is very expensive (~20,000€). However, a new, low-cost GPS module has recently been produced by EMLID : the Reach RS+ differential GPS. These modules have been produced to make centimeter-level real-time kinematics (RTK) positioning accuracy available to the wider public at a much reduced price (600€). RTK technology enables GPS precision to the centimeter and sub-centimeter level. RTK technology requires a monthly subscription to a local receiver network (~200€/month). However, if the data are not required in real time, a free alternative to achieve precise position data is the Post-Processing Kinematics technology (PPK).

At this precision and price, Reach RS+ units are interesting tools to investigate their role in building a network precise and wide-spread coastal sea level measurements. Here, we investigated the horizontal and vertical accuracy and precision using PPK of the Reach RS+ modules for both land and sea trials. A series of tests were performed to check the function of the Reach RS+ units. These included tests on the horizontal and vertical accuracy and precision of the GPS, using the base setup average single, post-processed kinematic, and

precise point-positioning methods. We show that these modules have a vertical precision of ± 2 cm without PPK. The GPS positioning provided by Reach, even without PPK precision, can provide higher precision data than satellite altimetry at a fraction of the cost of tidal gauges, thereby making it an ideal tool to measure coastal sea level height.