

Towed and static GPS buoys for CAL/VAL and SSH

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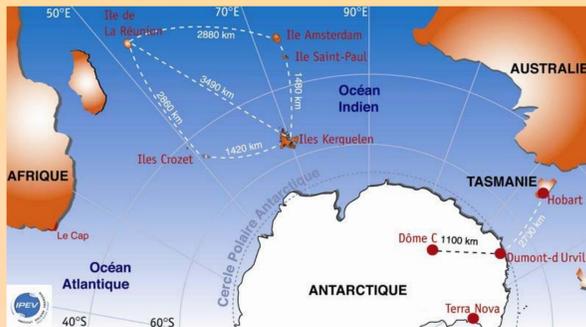
NIVMER program and the ROSAME network

The tide gauge network "ROSAME" ("Réseau d'Observation Subantarctique et Antarctique du niveau de la MER" - Network of Subantarctic Observation and Antarctic sea level) was established in the early 1990s. The ROSAME Service is a French contribution to the international GLOSS (Global sea level observing system) observation network of the long-term sea level evolution.

The "NIVMER" program (sea level) helps to exploit the sea observation at a global scale, in the study of the climate dynamics. Tide stations measuring sea level have been installed in the field of French Southern and Antarctic Lands ("photo right: TAAF - Terres Australes et Antarctiques Françaises"). The program focuses on observing the secular variations of the sea level and provides minute real time data for Tsunamis prevention network. The observations of the sea level are performed with different types of material: coastal tide station and autonomous mooring of the tide recorders. The absolute level of the sea is given by a GPS static buoy over the tide recorder. It is coupled to a GPS base station over a geodetic point.

The NIVMER main objectives are:

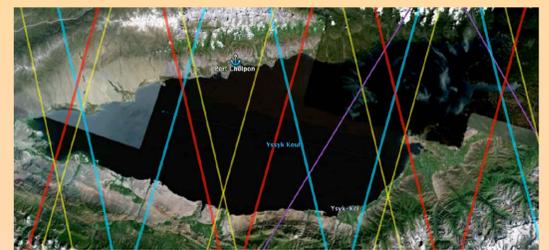
- Recording data in hostile environment
- Contributing to the validation and the exploitation of the satellites altimetric height measurements, including tide studies,
- Controlling the Antarctic Circumpolar Current variability



FOAM program

FOAM (From Ocean to inland waters Altimetry Monitoring) is an altimetric measurement program which carries out calibration and validation of the ocean surface topography. Continuous monitoring is performed in operational sites like Corsica for CNES and Harvest for NASA. They are equipped with tide recorders and permanent GPS stations for in situ measurements.

FOAM uses several geodetic sites for single point verification like inland waters (photo down: satellites tracks above lake Issykkul in Kyrgyztan) and non or dedicated sites like Vanuatu and Kerguelen. The material used for in situ calibration of altimetric height is a towed GPS buoy,



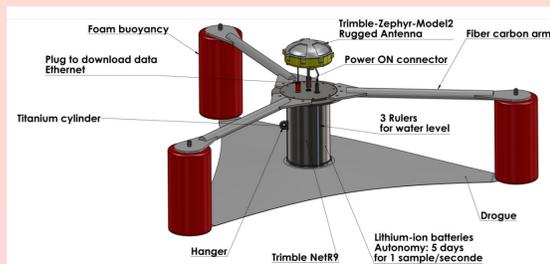
Technical Description

The GPS buoy

A reference level for the absolute measurement of the water height is determined by a leveling process with respect to a known geodesic point, or with respect to the position relative to the sea surface given by a GPS buoy.

The buoy consists of a geodetic GPS (TOPCON GB1000) with an antenna (PGA1-GP) on a surface float coupled to a GPS base station located on land above a geodetic point. It allows to define an absolute level of the sea :

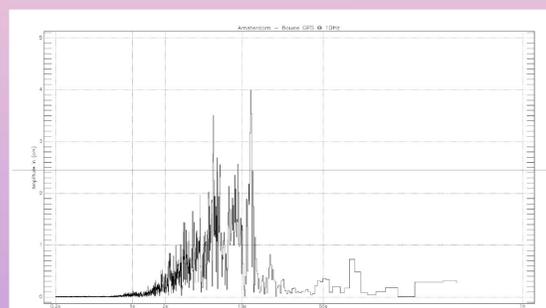
- Acquisition of high-frequency data (1-50 Hz)
- Sub-centimeter accuracy in post-processing (associated with a base station)
- Ability to deploy in the open ocean in PPP mode
- Measurement of the position of the free sea surface to calibrate altimetric satellites (JASON, ENVISAT, SENTINEL3A,3B, SARAL/ALTIKA, TOPEX/POSEIDON)
- weight 20Kg, 2m diameter
- a floating drogue is tied up at the 3 ends and the center of the buoy to improve stability.



Drawing of the buoy

Static GPS Buoy moored at sea

Water line is constant whatever the swell

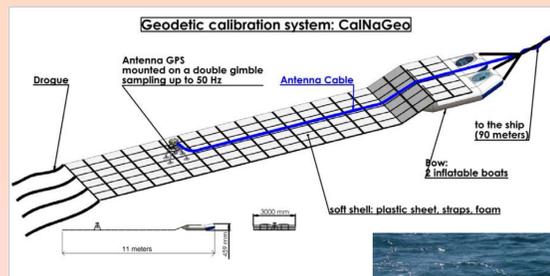


GPS buoy spectrum at 10Hz on Amsterdam island, wave signal between 2 and 12s

The towed GPS buoy: CalNaGeo

The system consists of a geodetic GPS on a soft shell (to avoid artefacts due to rigid structures) to follow the sea surface. The antenna is gimballed and towed (up to 15 knots) by a ship. This is used for in-situ CAL/VAL calibration of altimetric height (SSH for ocean surfaces) and waves monitoring (up to 50 Hz).

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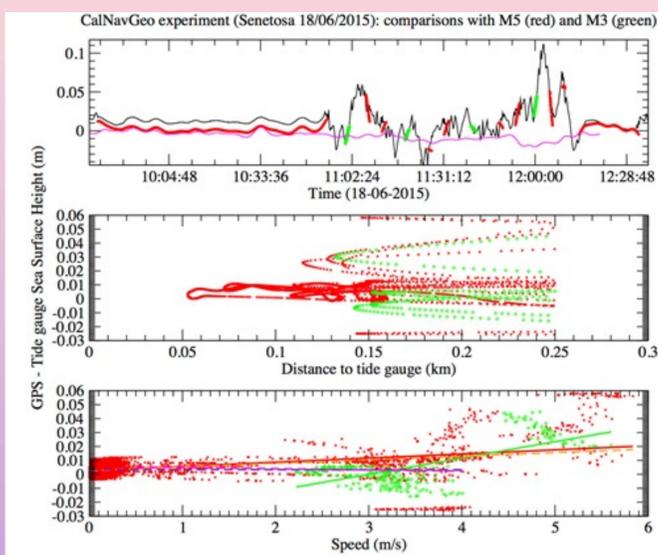
Drawing of the Towed GPS buoy

Towed GPS buoy at sea

Water line is constant whatever the speed and the swell



- towed up to 12 knots whatever the sea state
- don't lose satellite tracking stability: <1 cm extra movement
- autonomy: at least 5 days
- sampling: 1 to 50 Hz (to monitor waves)
- 2 versions available: open sea (these pictures) and coastal (smaller)



Top: Differences between CalNaGeo and tide gauges M5 and M3 at Senetosa site as a function of time

Middle: as a function of distance to tide gauges

Bottom: as a function of velocity

These buoys are available for rent and for sale

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