ROSAME

Réseau d'Observation Subantarctique et Antarctique du Niveau de la Mer

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(http://www.obs-mip.fr/omp/umr5566/francais/obs/rosame/Default.htm)

Scientific context

The mean sea level is a major index of the dynamical variability of the ocean. From seasonal to interannual, climatic fluctuations are mainly gouverned by exchanges between Tropical Ocean and Atmosphere. The mean sea level, which contain the vertival density field, is an indicator of the ocean heat contents, especially in tropical regions, of the thermocline depth. Its monitoring permits to determine climatological state of the ocean and to identify the caracteristics of low frequency baroclines events, which El Niño is the most spectacular illustration. At seasonal interannual and decennal time scale, the thermodynamic state of the ocean is linked to the global oceanic circulation. Horizontal sea level gradients gives the geostrophic component of this circulation. At secular time scale, mean sea level variation are due to natural climatic oscillation and now to anthropogenic influence. The aim of the study of the long term mean sea level is to evaluate the importance of the anthropogenic perturbation. At the end of the eighties the Intergouvernemental Oceanographic Commission of the UNESCO set an in situ observation network dedicated to the study of the variation of the mean sea level : This is the GLOSS network (Global Sea Level Observing System). It was followed by the development of the satellite altimetry for physical oceanography studies. It's in this context that the **ROSAME** network was created (Fig. 1) as a sub-network of the global network, and as a contribution for calibration of altimetric measurements of the Topex/Poséidon and ERS1/2 missions.

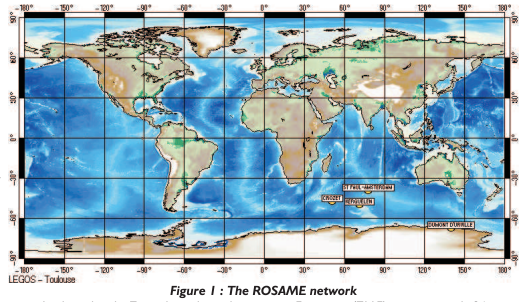

Figure 1 : The ROSAME network

Implanted in the Terres Australes et Antarctiques Françaises (TAAF) it is composed of 4 sites: Crozet archipelago, Kerguelen archipelago, Nouvelle-Amsterdam island and the Saint Paul crater , and Dumont d'Urville french base in Terre Adélie

Technology and data

Figure 2 : Pressure and Temperature Aanderaa sensor in Kerguelen

Figure 3 : The Argos antenna and the tide gauge station below (Crozet)

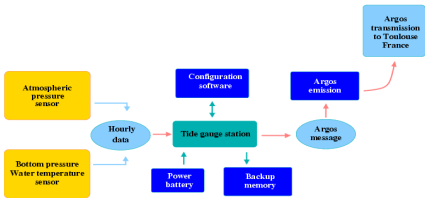

Figure 4 : Acquisition and transmission of data

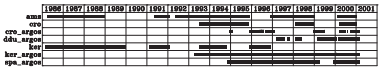

Figure 5 : Acquisition period of the ROSAME data

Name with the extension ARGOS correspond to the 4 coastal stations of ROSAME. Others correspond to off-shore tide gauges

Measured parameters

On each of the sites (Fig. 2 and 3) was set up a coastal tide gauge station measuring:

- the bottom pressure of the sea water;
- the temperature of the sea water;
- the atmospheric pressure.

From water temperature, the water density is computed using UNESCO formula for the sea water equation of state where the water salinity is supposed as a constant and equal to 35 psu. As far as we have simultaneous atmospheric pressure and bottom pressure and as the water density and gravity are known, the sea level upon the tide gauge sensor is deduced. Two subantarctic stations (Crozet and Saint Paul) were doubled by off shore tide gauges stations to allow to connect the measurement made in the coastal station, to the oceanographic signal of the open ocean.

Instrumentation

Stations consist of a tide recorder installed in a stilling well. The recorder is triggered by a central unit where the atmopheric pressure is measured. The real time data are transmitted via the ARGOS satellite at one hour sampling rate (Fig 4). The real time data are gathered by CLS/ARGOS processing center in Toulouse which send to LEGOS the raw satellite messages on a monthly basis. The messages are decrypted and the sea level is computed at LEGOS.

Data bank

At the end of the process line, sea level data are transmitted to the Sea Level Fast Delivery Center of Hawaii. The PSMSL (Permanent Service for Mean Sea Level) collect, publish, analyzes and interprets the tide gauge data of world networks. The ROSAME data are also available in LEGOS via the anonymous ftp site:

- `ftp spike.cst.cnes.fr`
- `Name: anonymous`
- `Password: e-mail address`
- `cd pub/techine/rosame`

Scientific applications

Waves	Saint-Paul Argos components		FES94 Hydrodynamic model	
	Amplitude (cm)	Phase (degrees)	Amplitude (cm)	Phase (degrees)
M2	39.5916	230.69	38.6346	227.52
S2	21.2761	274.4	21.8074	271.98
N2	7.2074	214.01	6.8213	207.22
K1	6.8582	153.29	6.5589	148.65
K2	5.9515	272.62	6.1361	263.13
O1	3.2621	175.78	4.2895	171.23
Q1	0.7952	190.56	0.7304	167.69
2N2	0.7888	192.87	0.7747	190.77

Figure 6 : Comparison between model and harmonic analyses

Comparison between Saint-Paul Argos amplitudes and phases components and FES94 model (Le Provost et al. 1994)

Study of oceanic tides and high frequency phenomena

Up to now several global oceanic tides models were developed. Tide gauge data acquired allow, after treatment of the signal to validate these models (Fig 6). Besides, by mathematical methods of assimilation of data, these measurements allow to improve their precision by bringing a supplementary information. ROSAME network is helpfull for such improvement in region where data are sparse. The hourly measurement of tide gauge also permit to study the high frequency components of the sea level.

Comparaison and validation of the satellite observations

The measure of the ocean topography by satellite altimetry (ERS / 1, T/P, JASON and ENVISAT) is a major constituent of international programs. In accompanying of these altimetrics measurements, the in situ data sea level of the oceans is indispensable:

- to supply temporal series, punctual in the space but continue in time,
- to compare them with altimetric data which are synoptic in space but discontinue in the time; which contribute to the validation of the altimetric measurements;
- to connect sets of altimetric data coming from different satellites of successive periods.

ROSAME is an original contribution because of the situation of tide gauge stations in the South of Indian Ocean. Kerguelen's site was chosen as major reference site of calibration for the long term of the altimetric missions (Fig. 7).

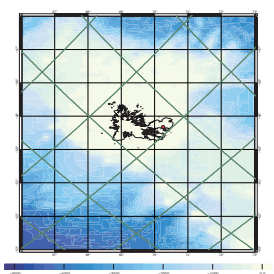

Figure 7 : Topex/Poseidon ground tracks on the Kerguelen plateau

The kerguelen tide gauge (red point) allows to compare and validate T/P data.

Monitoring of the Antarctic Circumpolar Current

A world network of tide gauge stations in the Southern Ocean studies the variability of the Antarctic Circumpolar Current (Fig. 8). The French contribution is supplied by the network ROSAME. A continuous observation of the sea level between Kerguelen and Amsterdam is led since 1986. The series of simultaneous recordings are interpreted in narrow relation with the data analysis T/P and ERS1 / 2. The signatures of the variability of transport in the Circumpolar Current Antarctica are of the order of 10 cm.

Observation of the sea level secular variations

The actual average rise of the sea level at the global is of the order of 1 or 2 mm / year. A reasonable estimation predicts an average rise of the level of the oceans of the order of 50 cm during the next century. By settling for objective to discover this tendency over 10 years with a 10 % uncertainty, it is necessary to discover a global rise of the order of some cm with an error of some mm. To verify this variability, it is necessary to have recordings of high quality in several independent stations in the global scale (Fig. 9). The aim of the GLOSS / WOCE program is to establish and to maintain a network of stations of measurements of the sea level, and to realize continuous measurements exactly controlled . The WOCE network includes 80 stations. The four stations of the ROSAME network are a part of the WOCE network.

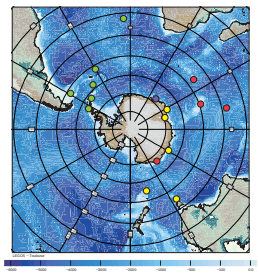

Figure 8 : Tide gauge stations for the monitoring of the Antarctic Circumpolar Current

French ROSAME network (red), English network (green), Australian (yellow) and Japanese(blue). (Background is the bathymetry)

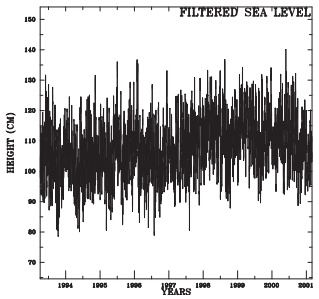

Figure 9 : Hourly mean sea level after filtering (Demerliac) in Kerguelen from 1993 to 2001.

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