Geodetic Data assimilation and ESTimation of references for climate change
InvEstigation. An overall presentation of the French GEODESIE project.

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Overview

Many major indicators of climate change are monitored with space observations (sea level rise from satellite altimetry, ice melting from dedicated satellites, etc.) that only geodesy can provide. The current accuracy of these observations does not fully support the challenges that the constantly evolving Earth system gives rise to, and can consequently limit the accuracy of these indicators. For this reason, the core framework of the Global Geodetic Observing System (GGOS), among its requirements are fixed to the International Terrestrial Reference Frame (ITRF) for the next decade: an accuracy of the level of 1 mm and a stability at the level of 0.1 mm/yr. This means an improvement of the current quality of ITRF by a factor of 5-10.

Improving the quality of the geodetic references is an issue which requires a thorough reassessment of the methodologies involved. The most relevant and promising method to improve this quality is the direct combination (Combination at Observation Level — COL) of the space-geodetic measurements used to compute the official references of the International Earth Rotation and Reference Systems Service (IERS). The GEODESIE project aims at (i) determining highly-accurate global and consistent references (time series of Terrestrial Reference Frames and Celestial Reference Frames, of Earth’s Orientation Parameters, and orbits of Earth’s observation satellites) and (ii) providing the geophysical and climate research communities with these references, for a better estimation of geoscientic sea level rise, ice mass balance and on-going climate changes. Time series of sea levels computed from altimetric data and tide gauge records with these references (orbits of satellite altimetry, Terrestrial Reference Frames and related vertical velocities of stations) will also be provided.

The geodetic references will be essential for Earth’s observation and monitoring to support the challenges of the century. The geocentric time series of sea levels will permit to estimate of references for climate change and understanding, but also for Astronomics, Geophysics, etc.

Geodetic References and Geosciences

Geodetic References are essential, not only for the sea level rise monitoring and understanding, but also for Earth’s Orientation Parameters, and Terrestrial Reference Frames and Celestial Reference Frames, of Earth’s Orientation Parameters, and orbits of Earth’s observation satellites and (ii) providing the geophysical and climate research communities with these references, for a better estimation of geoscientic sea level rise, ice mass balance and on-going climate changes. Time series of sea levels computed from altimetric data and tide gauge records with these references (orbits of satellite altimetry, Terrestrial Reference Frames and related vertical velocities of stations) will also be provided.

The current scientific and societal user requirements are demanding in terms of accuracy, resolution, latency and reliability, and the requirements are expected to increase in the future. The GGOS products must have sufficient accuracy, temporal and spatial resolution, and latency to meet these requirements, which can be achieved by meeting the most demanding requirements. In order to have a frame of at least an order of magnitude more accurate than the signal to be monitored, the terrestial reference frame should be accurate at a level of 1 mm and be stable at a level of 0.1 mm/yr.

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Project Team

The team of the GEODESIE project is made of 24 people from six different institutes/laboratories.

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Objectives and Issues

The GEODESIE project aims at:

- demonstrating all the potentialities of direct combinations of space-geodetic observations to derive the geodetic references needed to support the challenges in Earth’s observation and monitoring, by taking into account all the data available since the advent of space geodesy and all the possible links between the four space-geodetic techniques (GNSS, DORIS, LLR-SLR and VLBI), in a specific data assimilation framework;
- providing references to the geophysics, oceanography and climate research communities;
- preparing the future arrival of space missions such as GRASP and E-GRASP.

Issues that the project will address:

- Space data: All the space-geodetic data available since the beginning of the eighties. Standards and models required over the whole period.
- Time series of sea level rise from satellite altimetry data over 1992-2008. 4 uniform levels of 1/2 mm/yr (low down north, locations of some tide gauges are interpolated [Bouguet & Wöppelmann, 2011]).
- Time series of positions (cm) of some tide gauges are indicated [Collilieux & Wöppelmann, 2012].

Global Approach

The GEODESIE project is also on Twitter: @GEODESIE_ANR.