**Abstract**

The geostrophic currents are the result of the geostrophy balance between the pressure gradient force and the Coriolis force. In lack of direct observations, the surface geostrophic currents (SGC) can be derived from ocean dynamic height as a function of space and time. The dynamic height is the current-induced deviation of the actual sea level (e. g. observed by satellite altimetry) from the Earth's geoid (e. g. estimated from satellite gravimetry). In this paper, we evaluate the capabilities of a “full-potential” geoid estimated from the first 61-days cycle of the GOCE mission in estimating the global mean SGC that are derived and analyzed against a combined solution of several altimetric satellites (T/P, Jason 1/2, ERS-1/2, GEOSAT). Results are compared with those obtained from a GRACE-induced mean geoid for the period 2002/08-2009/08, as well as with mean circulation patterns from drifter buoys and from simulations of the ECCO Ocean General Circulation Model. We found GOCE clearly leads to significant improvements in determination and resolution of SGC globally except at the Equator (where special filtering of data might be applied), with velocities and spatial patterns much closer to in-situ measurements of currents than those from GRACE data or ECCO model simulations.

**Data sets and processing**

**GOCE**
- Data type: grids of 1 degree.
- Geographical coverage: [-73, 85]x[0, 360]
- Server: The GDP/Driller DAC (www.earth.nasa.gov)
- Time-span: 1993/01 to 2010/12

**GRACE**
- Data type: release 01, direct solution, Nmax=240
- Server: ESA (nccr-satellite-archaeo.esa.net)
- Time-span: 61-days cycle

**ECCO model**
- Data type: grids of 1 degree.
- Geographical coverage: [-80, 82]x[0, 360]
- Server: MIgM (ecoc.gfd.nasa.gov)
- Time-span: 2002/08 to 2009/08

**Sea Surface Height**
- Data type: grids 1/4 degree
- Geographical coverage: [-80, 82]x[0, 360]
- Server: AVISO (www.pirsa.oceanobs.com)
- Time-span: 1992/10 to 2010/12

**Drifter Buoys**
- Geographical coverage: [0, 360]
- Time-span: 2002/08 to 2009/08

**GOCE resolution increases in higher latitudes since GOCE tracks become closer to each other. This implies filter degree exigencies are weaker**

**Discussion**

Figure 1 shows the SGC components derived from GOCE geoid and the figure 2 the corresponding from the GRACE geoid model. Surfaces involved in the process were filtered with a Gaussian filter of 2000/8/Nmax km of half-wave length.

**Either the GOCE and the GRACE induced results represent quite well the general circulation pattern. However, when comparing both patterns, it is clear the increasing in resolution given by GOCE which has a potential resolving power of 83 km.**

Because of the noise affecting the meridional component is much higher for GOCE (since the spherical expansion is twice the GRACE one), it shows less detailed equator band than the GRACE-induced one. This last implies further filtering is needed to resolve signals in such area, leading into a signal attenuation at higher latitude currents.

It is known the currents are completely zonal at the equator band for seasonal and long-term averaged estimations [Huang et al. (2007)]. In this sense a faster assessment of the real improvement by GOCE relative to GRACE would be the comparison of the zonal components. In figure 1.a and figure 2.a it can be observed the similarities in the longer term SGC with an increased detail in amplitude and delimitation when focused on shorter space scales.

**Conclusions**

- GOCE provides a significant improvement. All major currents are much better defined with intensities significantly increased.
- Although for the equator band a higher degree of filtering would be preferred, the GOCE-induced SGC can be studied from the most optimistic point of view for higher latitudes.
- Validation with in-situ measurements for the major currents areas of the Gulf Stream, Kuroshio Currents and ACC show how magnitude of the velocities estimated from GOCE are nicely close to in-situ observations.
- Geostetic estimation of the SGC starts to be comparable with in-situ measurements.