The Synthetic Method

The synthetic method consists in removing for each observation of the total ocean signal, the ocean variability measured by altimetry.

The temperature and salinity profiles are used to compute the synthetic heights. All measurements of Argo floats from 2002 to 2008 and all temperature and salinity profiles from CTD relative to the 1993-2007 period are taken into account.

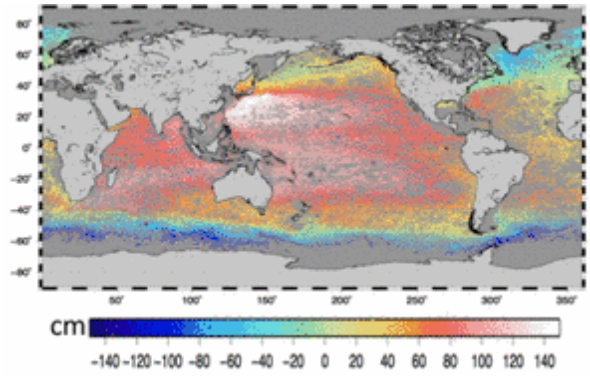
Geostrophic velocities from drifting buoys are extracted to compute the synthetic velocities. Between 1993 and 2008, 2 800 000 measurements of *in-situ* geostrophic velocities across the globe, are taken into account.

Computation of the synthetic observations of heights

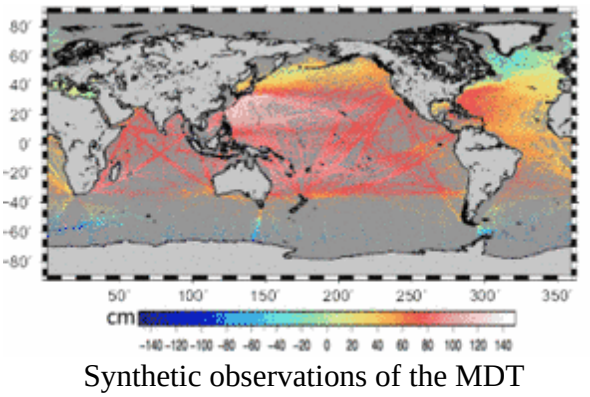
All the profiles are used to compute by integration along the water column a set of synthetic estimates of the mean dynamic topography according to the equation:

$$\langle h \rangle_{1993\text{-}1999} = h_{insitu} - h'_{alti}$$

However, by integrating these temperature and salinity measurements along the water column, the sea surface height obtained is representative of the steric content until the baseline profile. To return to a synthetic estimate of the ocean dynamic topography (barotropic and baroclinic components from the surface to the bottom), we had to add an estimate of the mean dynamic topography to this baseline profile. The missing component is approximated by subtracting to a large-scale estimate of the mean dynamic topography, a large-scale estimate of the mean steric component referenced to the depth of the baseline profile.



Synthetic observations of the MDT_CNES-CLS09 (in cm) averaged on a grid box size of 0.25°x0.25°.



Synthetic observations of the MDT Rio05 (in cm) averaged on a grid box size of 0.5°x0.5°.

By comparing this new set of synthetic estimates of heights with the combined mean dynamic topography Rio05, which was computed on a grid box size of 0.5°x0.5°, we observe that the sampling is significantly improved, particularly in the Southern Hemisphere, made possible to the Argo program.

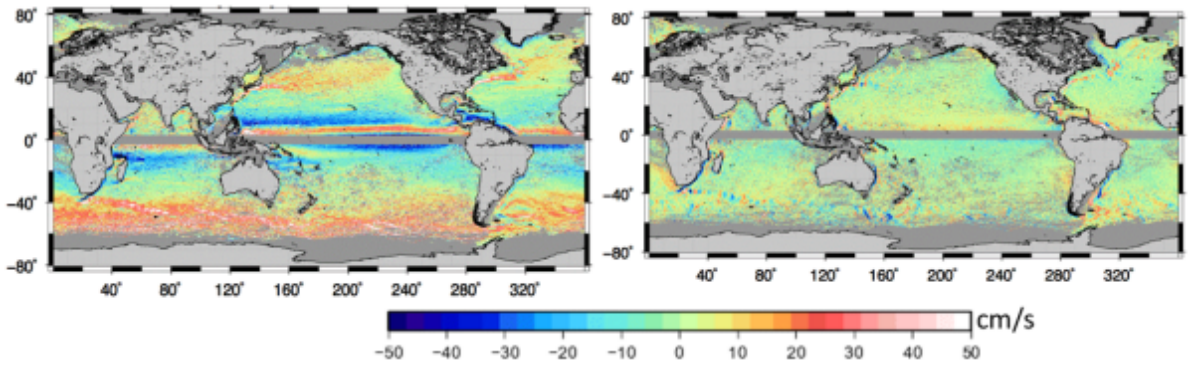
Computation of the synthetic observations of velocities

In a similar way, geostrophic velocities deduced from surface drifters can be used together with geostrophic velocities (anomalies) computed with altimeter slopes. The synthetic observations of velocities are computed by subtracting, along the drifting buoys paths, the altimetric velocity anomaly to the geostrophic velocity extracted from the buoy velocity according to the equation:

$$\langle U \rangle_{1993\text{-}1999} = U_{insitu} - U'_{alti} \quad \text{and} \quad \langle V \rangle_{1993\text{-}1999} = V_{insitu} - V'_{alti}$$

In addition to the geostrophic component, the velocity extracted from the drifting buoy path includes the tide currents, the Ekman currents, the inertial currents and others high-frequency ageostrophic currents. To extracte the only geostrophic component from the drifting buoys velocities, we had to precisely model each of these ageostrophic components and subtract them to the buoy velocity.

Le retrait des courants de marées et barotropes haute fréquence ne sont, à l'heure actuelle, pas encore suffisamment précis pour corriger les vitesses de bouées dérivantes. The removal of tidal and high-frequency barotropic currents are, currently, not yet precise enough to correct the drifting buoys velocities. Only the component of the Ekman currents, computed along the path, is removing from the drifting buoys velocities. Then a low pass filtering is applied to remove the signals with a period less than 3 days. Finally, the synthetic observations of mean geostrophic velocities are obtained after averaging in a grid box size of 0.25 ° by 0.25.



Synthetic estimates of the mean geostrophic velocities (in cm/s) computed on a grid box size of 0.25°x0.25° for the zonal (left) and meridian (right) components.

Those estimates of height and velocity are finally combined in a multivariate objective analysis in order to improve locally the first guess computed with the direct method.