Assimilation of geodetic dynamic ocean topography with an ensemble based Kalman filter

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We improve model generated fields in Southern Ocean by assimilating absolute dynamical topography data globally into the finite element ocean model (FEOM) using the ensemble Kalman filter.

Mean dynamical ocean topography (MDT)

- The geoid is obtained from the gravity model GOCO2s that combines the GRACE and GOCE satellite data.
- The Mean Sea Surface (MSS) DGFI2010 uses altimetric measurements from the ERS-1/2, ENVISAT, TOPEX/ Poseidon, Jason-1 and Jason-2, acquired within the period from October 1992 to April 2010.
- The MSS is extended over land as well as within gaps in the data with values obtained by solving Laplace equation.
- Filtering of the MSS and the geoid in order to obtain the same spectral content is done in spectral domain with Jekeli-Wahr filter to degree 150.

Verification of MDT data

- In order to calculate the MDT, one of the central objectives is to obtain the MSS and the geoid spectrally consistent without loss of accuracy and resolution.
- The artifacts of the extension of the MDT over land seen in the gradients of the MDT are absent.

Verification of data assimilation results

- The RMSE compared to the drifter SST reduces from 1.9°C for free model to 1.1°C after assimilation [60°S,42°S][58°W,30°W].
- The SST from surface drifter data (left) and as result of data assimilation experiment (right). The black line is the southern boundary of ACC computed from in-situ measurements (Orsi et al., 1995).
- The RMSE compared to ARGO temperature data at 800 m depth reduces from 0.4°C for free model to 0.2°C after assimilation north of 60°S.

Verification of data assimilation

- The assimilation approach follows Janjic et al. (2012) except that here the MDT is constructed first and a new MDT filtering technique is used.
- The results are closer to observations which were not used for assimilation and lie outside the area covered by the altimetry in the Southern Ocean (e.g. temperature of surface drifters or deep temperatures in the Weddell Sea area at 800 m depth derived from Argo composite.)

Validation of MDT data

- The geostrophic velocities calculated from the MDT agree with RMSE errors of 7.6 cm/s and 6.2 cm/s for u (left) and v (right) with the drifter data in Southern Ocean.
- The geoid is obtained from the gravity model GOCO2s that combines the GRACE and GOCE satellite data.

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