GRAVITY DATA IMPACT STUDY IN THE BAY OF BISCAY

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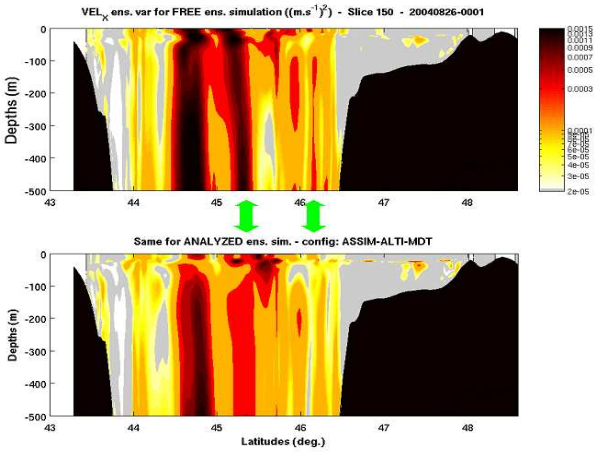
In the framework of the preparation of the GOCE satellite gravity mission, a gravity impact study by data assimilation was conducted in the ESA "GOCEAN" project with partners at NOVELTIS, POL, and Puertos del Estado. Our area of interest was the Bay of Biscay, and in particular the slope current system South of the Armorican shelf.

The signal associated with the slope current is small and at the limit of the ability of GOCE to detect. Coupled with the particularly large geoid omission errors over the slope, and the strong correlation between the expected sea level signal and the expected geoid error, this makes detection of the slope current a practical impossibility unless some other information can be brought to bear.

In our work, that additional information was the forecast of the SYMPHONIE eddy-resolving, 3D numerical ocean model. We conducted direct assimilation experiments of simulated altimetry and GOCE data using the SEQUOIA-based Local Ensemble Kalman Filter (LEnKF). We designed our diagnostics to look in particular at the impact of simulated GOCE data onto the topographically-steered flow at the shelf break and its associated mesoscale and submesoscale field. Typically, we wanted to know whether, if we assimilate GOCE data in addition to altimetry, those dynamical features and associated cross-slope transports are made closer to the "truth". To that end, we developed a state-of-the-art, LEnKF-based impact assessment approach for both altimetry and GOCE, which seems general and powerful. That methodology could be used to test the impact of improved geoid products including the smaller scales when they become available. Both GOCE MDT and altimetry SLA simulated measurements were considered with their own realistic error covariances. In the case of GOCE, these included a commission error correlation model.

As far as results are concerned, it was shown that assimilating GOCE mean dynamic topography in addition to altimetry improves the results further, despite the fact that the signals are very small in those regions, and the fact that the omission error is very correlated with the signal to extract. One encouraging outcome was the correction of the slope current and recirculation loop in the Bay of Biscay domain (see Figure), within prescribed GOCE and altimetry errors, although the correction was very small in amplitude and although the predictive skill was not found to be consistently improved. It appears that advanced assimilation with its realistic, built-in error dynamics and realistic error budgets (including correlations) was able to extract a useful signal, albeit at a relatively large scale.

The methodology can also be considered as a base for a scheme which would ultimately assimilate real gravity data and/or multisensor high-resolution MDT estimates.



Cross-section of normal velocity ensemble variance across 5°W in the Bay of Biscay (South is left). The green arrows show the locations of the slope current recirculation loop, which is a relatively stable feature; The top figure is free (no assimilation), while the bottom panel assimilates both altimetry and simulated GOCE Mean Dynamic Topography (MDT). Interpreting the ensemble variance as a proxy to the actual prior state error, the improvement to both the eddy field and to the semi-permanent features is clearly