STERIC AND MASS-INDUCED VARIATIONS IN THE MEDIERRANEAN SEA, REVISITED

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ABSTRACT

Sea Level Variations (SLV) are produced by a combination of steric and mass-induced SLV, and can be observed by radar altimetry satellites. Steric SLV can be computed from in situ measurements of temperature and salinity profiles, or from Ocean General Circulation Models (OGCM) that assimilate those measurements. Mass-induced SLV can be estimated, since 2002, from Time Variable Gravity (TVG) measurements by GRACE mission. This methodology has been successfully applied in estimations of the global ocean mass-induced SLV. However, some difficulties arise when studying semienclosed basins due to land aliasing of the signal. The problem is specially complicated in the Mediterranean Sea as reported in several studies. We revisit this problem analyzing different approaches.

COMPONENTS OF SEA LEVEL: Correlated Error Filter + Chen et al. Filter (CEF+CF) versus Gaussian Filter (750km)

Using the Correlated Error Filter [1] in combination with the filter from Chen et al. [2] improves notably, with respect to the Gaussian Filter [3], the spatial resolution reducing the noise in Spherical Harmonics of high degree and order.
Figures 1 and 2 illustrate this fact by showing the effect of the filters on synthetic GRACE estimated from Ocean Bottom Pressure (OBP) ECCO + GLDAS for April 2003 and October 2004, respectively.
In these figures are represented (a) simulated data; (b) reconstruction of the data using Spherical Harmonics (SH) up to degree 50; (c) the data in (b) recovered through a combination of the Correlated Error Filter and the Chen *et al.* (CEF+CF) filter; (d) the data in (b) recovered from a Gaussian Filter (GF) of 750 km.
Figure 3 shows the differences on the mass component averaged over the Mediterranean Sea filtered by the CEF+CF (in red) vs the GF (in black).

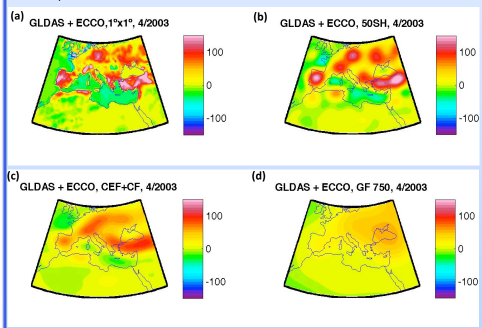

Figure1: Synthetic GRACE data from OBP ECCO + GLDAS from April 2003 Illustrating the effect of reconstruct the data truncating the SH at degree 50, filtering the SH with CEF+CF and with GF.

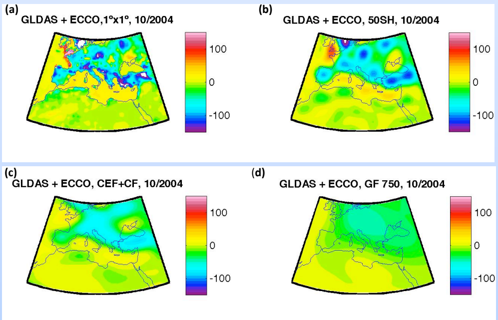

Figure 2: Synthetic GRACE data from OBP ECCO + GLDAS from October 2004 Illustrating the effect of reconstruct the data truncating the SH at degree 50, filtering the SH with CEF+CF and with GF.

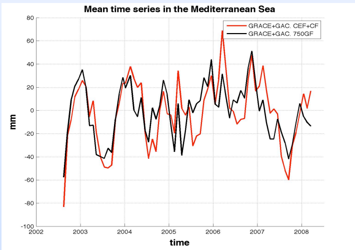

Figure 3: Mass Component from GRACE

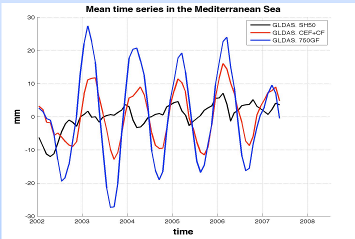

Figure 4: Aliasing from the continents in the Mediterranean signal depending on the filter

COMPARISON WITH SIMULATED OCEAN BOTTON PRESSURE

Ocean bottom pressure from two ocean circulation models, Mercator and ECCO, are compared with the inferred bottom pressure from GRACE data. Comparison of simulated and GRACE data for both models is made using the CEF+CF and GF filters.

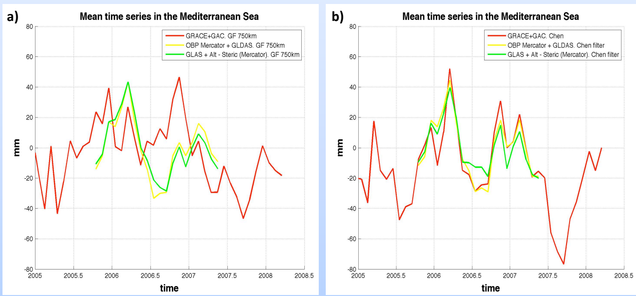

Figure 5: GRACE vs GLDAS + OBP Mercator

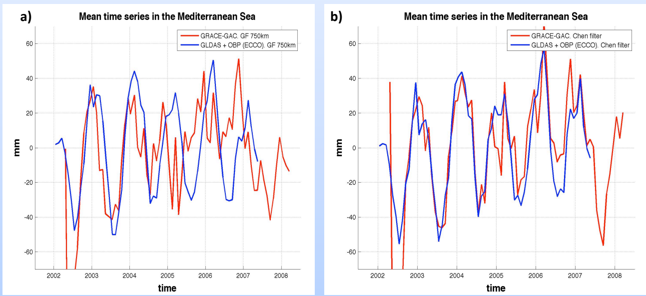

Figure 6: GRACE vs GLDAS + OBP ECCO

MEDITERRANEAN WATER MASS VARIATION

Though the time period is still short, we can begin to evaluate interannual and secular water mass variation for the Mediterranean sea. We account for leakage of land hydrologic variations into observed changes of mass from GRACE using the estimates of the Global Land Data Assimilation Systems (GLDAS)

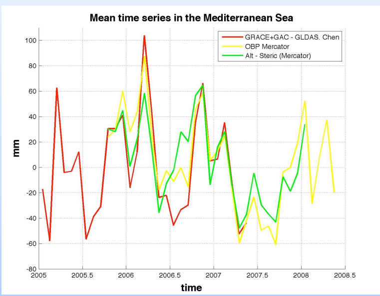

Figure 7: Mediterranean water mass variation as estimated from GRACE in red, Mediterranean water mass variation computed from SLV (altimetry) – Steric (Mercator) in green and, ocean bottom presure in the Mediterranean Sea from the Mercator Model (yellow),

CONCLUSIONS

✓ In this study we show that a combination of the CEF+CF filter outperforms the Gausian filter when applied to GRACE data in the Mediterranean Sea.

✓ Under the CEF+CF filter the agreement between the direct and indirect estimation of water mass variation of the Mediterranean Sea is remarkable.

✓ Comparison of simulated data from the ECCO and Mercator models with GRACE data suggests that Mercator should be preferred when modelling ocean circulation for the Mediterranean Sea.

References:
[1] Swenson, S., and J. Wahr, Post-processing removal of correlated errors in GRACE data, *Geophys. Res. Lett., 33*, L08402, 2006.
[2] Chen, J.L., C.R. Wilson, K.-W. Seo, Optimized Smoothing of GRACE Time-Variable Gravity Observations, J. Geophys. Res., 111, B6, B06408, 10.1029/2005JB004064, 2006.
[3] Jekeli, C. (1981), Alternative methods to smooth the Earth's gravity field, Dep. of Geod. Sci. and Surv., Ohio State Univ., Columbus.

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