



## **Analysing water mass variation in small basins: assessment of contributions from oceanography, hydrology, climatology and of their observations by GRACE and altimetry**

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The water mass variation in the Mediterranean Sea and Black Sea and mass exchange between the two basins is investigated using altimetry and GRACE measurements, oceanography and hydrology models over six years, between August 2002 and July 2008. The basin averaged signal is estimated from both steric-corrected altimetry and from hydrology-corrected GRACE observations. Various corrections are applied to have fully compatible composite time series.

The water mass in the Mediterranean Sea increases with a rate in equivalent water height of about  $7 \pm 2$  mm/yr. This change is compensated by the decrease of the steric sea level due to the halo-steric component, the total sea level is therefore almost constant. The positive rate of surface freshwater flux (E-P) indicates a change towards a dryer regime in the Mediterranean Sea region.

The water mass in the Black sea has a strong interannual variability, with increase between 2003 and 2005 and decrease in 2006-2008. The mass exchange between the basins results in net inflows in the Mediterranean Sea from the Black Sea and from the Atlantic Ocean with annual amplitudes of 0.008 Sv and 0.06 Sv peaking in Spring and in Autumn.

For each basin both composite time-series are in good agreement. In the Mediterranean Sea they are highly correlated (0.85) with a RMS of 23 mm for the de-seasoned time-series. In the Black Sea the two time series are correlated (0.63) and have a RMS of 70 mm.

Here the differences between the two estimates of ocean water mass change are analysed accounting for both implicit assumptions and uncertainties of input data.

The assumptions made in using the corrections and models products are carefully discussed and alternative approaches considered.

We show that results are slightly dependent on the GRACE products and on the filtering methods applied.

For the first time a dedicated release of the hydrology model WATERGAP tailored to this area is used to correct for the hydrology leakage on land.