



## **Mass Variation in the Mediterranean Sea from Satellite Altimetry and Grace**

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Time-variable gravity changes measured by GRACE are mainly caused by water mass variations in ocean, land and atmosphere. Monthly estimates of the mass variation estimated from GRACE and expressed in terms of equivalent water thickness are compared between April 2002 and July 2004 to monthly sea level change corrected for the steric variations in the Mediterranean Sea and to estimates of mass fluctuation in the continental storage. The monthly sea level change is evaluated from the Topex/Poseidon and Jason satellites and the steric variation from the temperature and salinity fields of the 10-day solutions of the ECCO model, the mass in continental storage from gridded hydrologic fields.

GRACE monthly fields represent rather a spatial averaging of mass variations, with a resolution of few hundred kilometers, than a point measurement. Due to measurement noise on the K band observable and the downward continuation from satellite altitude, spherical harmonics of higher degree and order appear significantly corrupted when derived from (sub-) monthly time spans. Expected errors in mass change are thus significantly larger than the time-variable signal except at the longest wavelengths, if no precautions are taken. To minimise the errors in the mass recovery in the selected region, a spatial averaging kernel is constructed which varies smoothly from a value of 1 inside to a value of 0 outside the basin of interest and its effects are investigated. The exact average kernel is finally smoothed with a Gaussian function with an average radius of 400 km to reduce both the satellite measurement error and the leakage error. For a consistent processing, it is important to apply the same smoothing filter in averaging the altimeter and the steric data over the Mediterranean Sea.

The seasonal variability is the dominant component in both the equivalent water heights from GRACE, the sea level from altimetry and the steric contribution averaged over the selected region. The steric component is subtracted from the altimeter component and a seasonal variation is identified with a maximum amplitude of four centimetres in Autumn. The equivalent water thickness from GRACE has a comparable amplitude and the phase maximum occurs one month later in the first year and a few months later, in early spring, in the second year. We investigate possible causes for the phase lag between GRACE and altimetry-steric as well as their residual differences. Land hydrology leakage (the average of nearby land hydrology from gridded fields for the smoothed Mediterranean region) may explain these in part. According to preliminary computations, the corresponding mass thickness leaking into the smoothed Mediterranean Sea average has an average of about one centimetre and a maximum in early spring.