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The seasonal cycle in ocean bottom pressure from 5 years of GRACE observations

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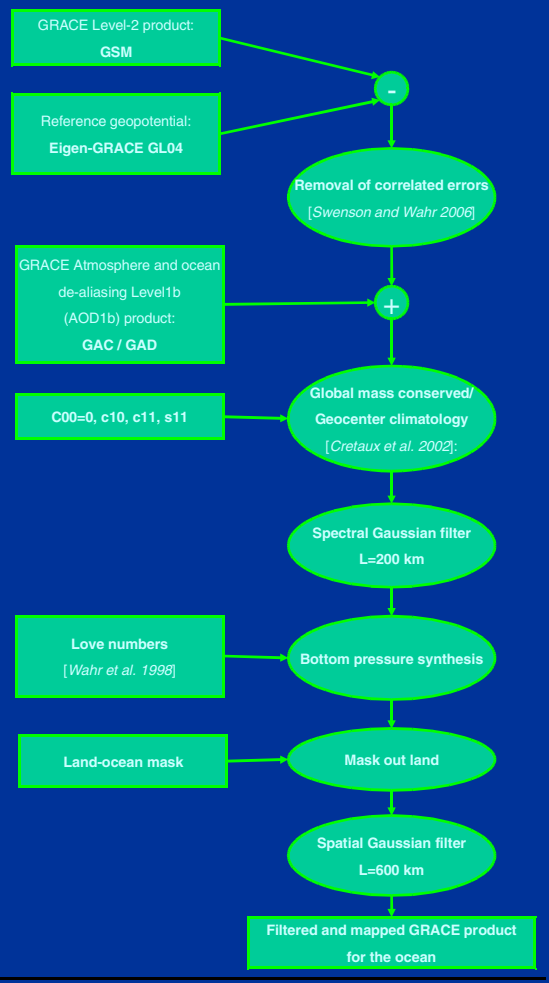
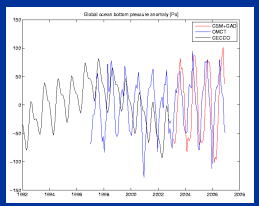
Abstract

Gravity fields as derived from the GRACE satellite mission require smoothing to reduce the effects of errors present in short wavelength components. For the ocean special care is needed since here the signals are generally smaller than on the continent. In addition, the highest variability is found near the coast and is thus subject to leakage of external land signals due to the representation of the GRACE fields as a (finite) set of spherical harmonic coefficients, and the filtering process. Here we present a simple sequence of filters designed to both minimize the leakage of land signals into the ocean and maximize the spatial resolution. The sequence of filters consists of the Svenson and Wahr [2006] decorrelation filter, a spectral filter, a land-sea mask and a spatial Gaussian filter. Using this filter technique, we use GRACE Level-2 data to calculate the mean seasonal cycle of ocean bottom pressure from 5 years of GRACE gravimetric data. Differences to two general ocean circulation models are discussed: (1) the Ocean Model for Circulation and Tides (OMCT), which is also used in the dealiasing process to produce GRACE Level-2 data, and (2) results from the Estimation of the Circulation and Climate of the Ocean (ECCO) project.

Method: Filter for GRACE Level-2 products for ocean applications

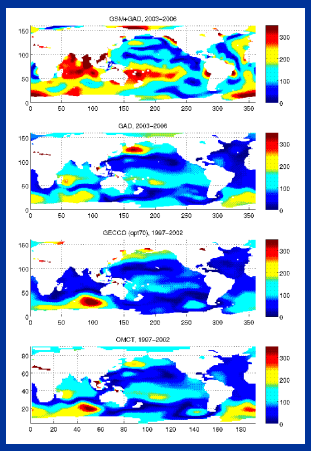


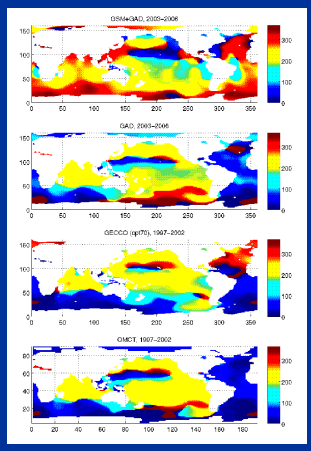
Application: Global variability of ocean bottom pressure



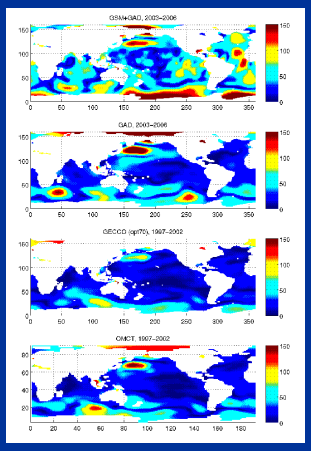
Global mean ocean bottom pressure anomaly (in Pa) from GRACE monthly products and hydrodynamic models (OMCT/ ECCO).

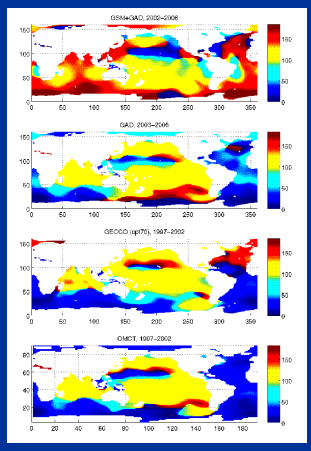
Application: Local (semi)annual variability of ocean bottom pressure





Amplitude (in Pa; left) and phase (day of max. Value; right) of annual cycle in ocean bottom pressure from GRACE monthly products and hydrodynamic models (OMCT/ ECCO). Note the varying reference periods.





Amplitude (in Pa; left) and phase (day of max. Value; right) of semiannual cycle in ocean bottom pressure from GRACE monthly products and hydrodynamic models (OMCT/ ECCO). Note the varying reference periods.

Results:

- The filter reduces essentially leakage of land signals compared to a pure spectral filter and at the same time retains a significant part of the ocean signal along the coast lines
- The two hydrodynamic models exhibit comparable (semi)annual variability of ocean bottom pressure while discrepancy to GRACE (GSM+GAD) is comparably large
- (Semi)annual variability is subject to large variability on interannual to decadal time scales.

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