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Rigorous covariance propagation of geoid errors to geodetic MDT estimates

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The mean dynamic topography (MDT) is defined as the difference between the mean sea surface (MSS) derived from satellite altimetry, averaged over several years, and the static geoid. Assuming geostrophic conditions, from the MDT the ocean surface velocities as important component of global ocean circulation can be derived from it. Due to the availability of GOCE gravity field models, for the very first time MDT can now be derived solely from satellite observations (altimetry and gravity) down to spatial length-scales of 100 km and even below.

Global gravity field models, parameterized in terms of spherical harmonic coefficients, are complemented by the full variance-covariance matrix (VCM). Therefore, for the geoid component a realistic statistical error estimate is available, while the error description of the altimetric component is still an open issue and is, if at all, attacked empirically. In this study we make the attempt to perform, based on the full gravity VCM, rigorous error propagation to derived geostrophic surface velocities, thus also considering all correlations. For the definition of the static geoid we use the third release of the time-wise GOCE model, as well as the satellite-only combination model GOCO03S.

In detail, we will investigate the velocity errors resulting from the geoid component in dependence of the harmonic degree, and the impact of using/no using covariances on the MDT errors and its correlations. When deriving an MDT, it is spectrally filtered to a certain maximum degree, which is usually driven by the signal content of the geoid model, by applying isotropic or non-isotropic filters. Since this filtering is acting also on the geoid component, the consistent integration of this filter process into the covariance propagation shall be performed, and its impact shall be quantified. The study will be performed for MDT estimates in specific test areas of particular oceanographic interest.