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Analysis of atmospheric data products for the reduction of satellite gravity measurements

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This study aims at improving the so-called atmospheric de-aliasing products, which are essential in the process of deriving gravity solutions from GRACE. We develop a numerically and physically improved three-dimensional integration approach.
In order to reveal seasonal and long-term hydrological and oceanographic signals, a careful reduction of high-frequency atmospheric mass contributions from satellite gravimetry observations is essential. To this end, it is common to extract meteorological parameters from atmospheric models and convert them to gravity spherical harmonics, known as atmospheric de-aliasing products. This conversion uses a three-dimensional integration approach that involves various approximations. Yet, in the light of the next generation of gravity missions, any of these approximations may pose a limitation for exploiting the full accuracy of the measuring systems.
Therefore, in this study the effects of geometrical, numerical and physical approximations for computing the atmospheric de-aliasing products are revisited. Moreover, the influence of different mean atmospheric fields is investigated. Numerical investigations for the period of 2001 to 2009 were performed using atmospheric models from the Integrated Forecast System (IFS) of the European Center for Medium Range Weather Forecast (ECMWF) and the ERA-Interim reanalysis. To study the impact of uncertainties of each atmospheric parameter on the de-aliasing products, IFS conventional errors and the difference of the IFS and ERA-Interim data sets were propagated.
We suggest a method for computing atmospheric de-aliasing products, which involves a more realistic parameterization of the Earth within a numerically and physically improved three-dimensional approach. Our results show that a non-negligible difference between the suggested new method and the current approach of the GeoForschungsZentrum, Potsdam, exists up to degree 13 with respect to the sensitivity of GRACE, and up to degree 50 with respect to the sensitivity of a future Bender-type satellite configuration equipped with a laser interferometer.
Keywords: Atmospheric de-aliasing products, GRACE, Improved 3D-integration, ECMWF, ERA-Interim