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The combined gravity field model GOCO05c

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Knowledge of the static gravity field is of importance for various scientific disciplines, such as geodesy, geophysics and oceanography. While for geophysics the gravity field provides insight into the Earth's interior, the geoid serves as an important reference surface for oceanographic applications. Moreover this reference surface is a key parameter on the way to a globally unified height system.
In order to exploit the full potential of gravity measurements and to achieve the best gravity field solution, all kinds of complementary gravity field information have to be combined. By combining GRACE and GOCE information, a state of the art satellite-only gravity field is available, which is highly accurate at the very long to medium wavelengths (80-100 km). By adding information from terrestrial/airborne gravimetry and satellite altimetry, which both are measurement techniques providing short wavelength gravity information beyond the resolution of GOCE, the full gravity field spectrum can be obtained.
This paper focuses on the presentation of the combined gravity field model GOCO05c, a global gravity field model up to degree and order 720 based on full normal equation systems (more than 500,000 parameters). During the calculation of GOCO05c we put emphasis on the question how the complementary data types can be combined in a global gravity field model in the way that all data types keep their specific strengths and are not degraded by the combination with other information in certain wavelengths. Realistic stochastic modelling and a tailored weighting scheme among all available data results in different regional relative weighting of satellite and terrestrial data in the combined solution, mainly depending on the quality of the available terrestrial gravity information. From this procedure, as complementary product realistic error estimates are available in terms of a full-covariance matrix, which can be mapped in a spatial error grid reflecting regionally specific uncertainty estimates. The analysis of the model demonstrates the good performance of GOCO05c. The application of the model in oceanographic analyses exhibits the improved performance due to the GOCE data and the combination technique.