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A combined global gravity field model based on full normal equations complete to degree/order 720

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Global satellite-only gravity field models are on the one hand known for their excellent quality in the long wavelength part, but on the other hand their spectral resolution is restricted due to Newton's law. Although satellite-only gravity field models which are mainly based on GRACE and GOCE data, such as those of the GOCO-S series, show unprecedented performance in the low to medium wavelengths down to 80-100 km, for many applications also the high-degree spectral information is required to reduce significantly the omission error of satellite-only models, which are in the order of 30 cm in terms of geoid height.

Therefore, the satellite information has been complemented by additional terrestrial data sets and altimetry data over the oceans to achieve a high resolution global gravity field solution. This is the challenging task, due to the fact, that terrestrial and altimetric gravity information is not very homogenous, and that there is a total lack of terrestrial gravity field data in some areas. Specific strategies have to be applied to fill these observation gaps. Furthermore, high spectral gravity field determination puts high demands on computer resources, because full normal equations systems become very large, and parallel methods have to be applied.

On the way to a first official GOCO-C model, a gravity field model based on full normal equation of all observation groups up to d/o 720 has been retrieved at IAPG. Special emphasis is given to the stochastic modelling of all involved satellite and gravity data types, the related optimum relative weighting in the course of the combination, as well as rigorous error propagation, resulting in a full variance-covariance matrix of the gravity field coefficients. The resulting gravity field model is validated by independent external gravity field information, such as GPS/levelling observations.