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Wavelet modeling of the gravity field

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With the advent of satellite gravity, a tremendous amount of global, high quality measurements becomes available, allowing to study the structure and dynamics of the Earth system in a wide range of scales. For geodetic and geophysical applications at local scales, these data need to be combined to surface measurements within high resolution models. Among the possible approaches, wavelets on the sphere appear particularly promising. Because they are well localized both in space and frequency, they can be used to model and combine heterogeneous datasets in a flexible way, to locally increase the resolution of the gravity model in areas of interest, and to provide a spatio-spectral analysis of the gravity field.
We use Poisson multipole wavelets, first introduced by Holschneider et al. (2003), because their analytical formulation in terms of multipoles allows fast and precise computations and makes them well-suited for potential fields modeling and analysis. We explain how to calculate a regional wavelet model of the gravity field by least-squares adjustment of heterogeneous datasets, and introduce a domain decomposition approach to handle large systems. We present examples of application of this approach, where regional ‘zooms’ are derived from global geopotential models, leading to high resolution hybrid spherical harmonic/wavelet models. We finally show how to analyze the obtained models for studies of the Earth system at various scales.