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Multi-scale modeling and analysis of the Earth's gravity field using Poisson wavelets

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The Earth gravity field reflects the mass distribution and mass displacements inside the Earth system, from the surface and fluid envelops to the core. With the advent of satellite gravity and the launch of the CHAMP, GRACE and GOCE missions, measurements of unprecedented quality are available and provide a new view of the static and time-varying gravity field at low and medium resolutions. Combined with the surface gravity data within high resolution models, they allow to study geodynamic processes and their interactions in a wide range of spatial and temporal scales.

To derive such models and analyze them, Poisson multipole wavelets (Holschneider et al., 2003) appear particularly promising. Because of their localization properties both in space and frequency, they are well-suited to derive regional gravity models from heterogeneous datasets. The analysis of the obtained models allows to unfold the different components of the gravity field in different scales and locations and thus, to highlight specific geodynamic signals of interest.

We present a few examples of applications of this approach to model and analyze the static and time-varying gravity field, for studying the Earth's structure and the mass redistributions after large earthquakes.