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Regional wavelet modeling of the gravity field using domain decomposition methods

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Knowing the Earth's gravity field is of primary importance for many geophysical and geodetic applications, such as the study of the Earth's internal structure, the determination of oceanic currents, and the improvement of height references. To that aim, regional models of the gravity field at high resolution, refining the satellite-derived information with surface or airborne measurements, are very useful. The challenging problem of high resolution regional modeling has been the topic of many studies over the past years, and several approaches have been proposed. Among them, the spherical wavelets provide a representation of the gravity field that is both localized in space and frequency, allowing to model heterogeneous datasets, to increase locally the resolution, and to analyze the obtained model in space and frequency.

Here we show how wavelets can be used to refine a global spherical harmonics model using regional surface measurements in an area of interest, in a numerically fast and economic way. We use Poisson multipole wavelets (Holschneider et al., 2003), well-suited for potential fields modeling because of their multipolar nature. The geopotential is represented as a linear combination of wavelets, and the coefficients are derived by least-squares adjustment of the data. We show how domain decomposition methods can be applied in order to compute a high resolution wavelet model over a large area by splitting the area into smaller subdomains. We apply a pyramidal algorithm, allowing to compute iteratively the wavelet coefficients at the different scales and in-

troduce, for each scale, a spatial splitting of the area into blocks, which size depends on the computed scale. We show and discuss some examples of application of this approach.