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Scale-dependant sensitivity analysis of time-variable gravity field data

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It is a common practise to use spherical harmonic coefficients and the associated global spectrum to analyse the sensitivity of time-variable potential field data, e.g. those provided by the GRACE satellite mission. It has been recognised that such global methods are not necessarily optimal, in particular when studying strongly localised features. For signals of local nature, such as e.g. quasi-periodic signals caused by hydrological variations at basin scale, episodic signals caused by earthquakes or secular signals caused by ice melting, sensitivity studies should rather be based on localised spectral analysis methods. In these cases a global spectral analysis will compare a signal whose energy is concentrated in a small area to an error spectrum whose energy is more evenly spread around the globe, and thus underestimate the signal-to-noise ratio (S/N).

In this contribution we will compare a suite of methods designed for the localised spectral characterisation of a geophysical signal of limited geographical extent. This will include simple and optimised (Simons et al. 2006) windowing, as well as spherical wavelet spectra.

These methods will be applied to the combination of i) a time series of spherical harmonic models derived from the GRACE mission and ii) a geophysical model of the gravity effect caused by the 2004 Sumatra-Andaman earthquake. We will then assess the benefits of the discussed methods for the study of the sensitivity of a gravity mission with respect to localised signals.

In the long term we hope to develop a reliable method to determine the detectability of a given feature based only on the estimated variances and covariances of the potential

field data, with the aim of applying it to possible future missions.