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GOCE SGG filtering with FIR, IIR and wavelet MRA

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GOCE Satellite Gravity Gradiometry (SGG) data have been widely used in gravity field research in order to provide improved representations of the gravity field spectrum either in the form of Global Geopotential Models (GGMs) or grids at satellite altitude. One of the key points in utilizing SGG observations is their proper filtering, in order to remove noise and long-wavelength correlated error, while the signals in the GOCE measurement bandwidth (MBW) should be preserved. Due to the gradiometer's design, the GOCE satellite can achieve high accuracy and stable measurements in the MBW of 0.005 Hz to 0.1 Hz. The gravity gradient in MBW are at an equivalent accuracy level, while are of lower accuracy. Outside of the MBW, systematic errors, colored noise, and noise with sharp peaks are observed, especially in the frequencies lower than 0.005 Hz. With that in mind, the present work focuses on the investigation of various filtering options ranging from Finite Impulse Response (FIR) filters, Infinite Impulse Response (IIR) filters, and filtering based on Wavelets. The latter are employed given their inherent characteristic of being localized both in frequency and space, meaning that the signal can be decomposed at different levels, thus allowing multi-resolution approximation (MRA). The analysis is performed with one month of GOCE SGG data in order to conclude on the method that provides the overall best results. SGG observations are reduced to a GGM in order to account for the long- and medium-wavelengths of the gravity field spectrum. Then, various filter orders are investigated for the FIR and IIR filters, while selective reconstruction is employed for the WL-MRA. Evaluation of the results is performed in terms of the smoothness of the filtered fields and the Power Spectral Density (PSD) functions of the entire GOCE tensor.