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GOCE GGM analysis through wavelet decomposition and reconstruction and validation with GPS/Leveling data

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Over the last decade, wavelets (WL) have been exploited widely in all fields of geosciences while they have provided significant outcomes in analyzing gravity field related data in the frequency domain. In this work, we focus on the spectral analysis of GOCE, GOCE/GRACE and combined Global Geopotential Models through wavelet decomposition, filtering and reconstruction in order to improve their performance as to their spectral content in the higher bands of the spectrum. The GGMs evaluated refer to the latest DIR-R4, TIM-R4 and GOCO03s models, which are compared with local GPS/Leveling geoid heights and gravity anomalies, while EGM2008 is used as a reference. Within a wavelet multi-resolution analysis, both gravity anomalies and geoid heights are analyzed to derive their approximation and detail coefficients for various levels of decomposition, which correspond to different spatial scales. The spectral content at each level is analyzed in order to conclude on the gravity field signal power that GOCE/GRACE GGMs represent compared to EGM2008, especially in the targeted waveband up to 110-150 km. Moreover, various types of low-pass and thresholding denoising filters are investigated to remove high-frequency information from the low resolution GOCE models and adjust the WL reconstruction, respectively. The model synthesis that follows, through coefficient reconstruction, aims at the generation of new synthesized GGMs, where both GOCE, GRACE and EGM2008 information is used, in order to investigate possible improvements in the representation of the Earth's gravity field. Validation of the synthesized combined GGMs with available GPS/Leveling geoid heights and terrestrial gravity anomalies is performed, to further assess the improvement brought by the WL analysis.