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Analysis of GRACE time-variable gravity signals over North America by means of principal component analysis

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Models of the Earth's static gravity field are provided every month in terms of spherical harmonic coefficients (L2 products) by the NASA/CSR/GFZ Gravity Recovery and Climate Experiment (GRACE) satellite mission. With a mission life-time of at least 5 years, it is expected that GRACE will provide constraints on the dynamical processes in the Earth's interior. In North America in particular, a good knowledge of short term mass variations and aliasing effects in GRACE data is required in order to have reliable estimates of the secular changes in the gravitational potential due to postglacial rebound. In addition, GRACE can provide constraints on hydrology and snow mass variability models. In this study, time series of monthly averaged coefficients are constructed and analyzed subsequently in order to study short term (annual and inter-annual) mass redistributions over North America.

We focus on non-secular mass variations over the continent. The data sets contain time series of monthly mean geopotential coefficients of a two-year time interval (2003 - 2005). To study the spatial patterns of the time varying mass effects, principal component analysis (PCA) is applied on the series of the residual (with respect to the mean) geopotential field. Then, singular spectrum analysis (SSA) is applied on the first few significant spatial principle components in order to reveal their temporal structure. The first component of the PCA shows a strong annual signal in Northwestern Canada, Alaska, and Québec, which correlates well with snow water equivalent data for North America. The significant components from the PCA that exhibit annual periodicity

will also be compared with continental water storage output from the LaD model to draw conclusions about their agreement with each model.