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GRACE Observations of Land Ice Evolution: Signal and Error Analysis

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The joint NASA/DLR Gravity Recovery and Climate Experiment (GRACE) mission is making significant contributions to our understanding of the temporal variability of the Earth's surface mass distribution. Significant contributions have been made in Geodesy, Oceanography, Hydrology and Cryospheric science. GRACE data processing and analysis techniques are now rapidly maturing, facilitating the combination of GRACE data with other data types (e.g. altimetry), and the assimilation of GRACE data into models. In order to best support the data combination and assimilation analysis, the signals and error characterization of the GRACE observations must be optimized and tuned for each application. Here we explore GRACE observations of land ice mass evolution as an example of GRACE multi-technique and comprehensive signal and error analysis. In particular, we present the signal and error analysis for the Greenland and Antarctic ice sheets and the Gulf of Alaska glaciers. At the foundation of our investigation is the reduction of nearly eight years of GRACE Level-1B data and the estimation of both time dependent spherical harmonic and high-resolution mascon solutions. We compare the land ice solutions derived from various solution techniques including regional and global mascons as well as regional averaging and localization of time-dependent spherical harmonic solutions. In addition we explore the impact of level-1B processing and arc parameterization, as well as forward modeling on the final solutions. Solution results as well as errors and limitations will be discussed.