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Comparison of coincident ICESat and GRACE data over Greenland and Antarctica

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GRACE gravity data and ICESat (crossover) elevation measurements obtained since 2003 are compared over the Greenland and Antarctic ice sheets. GRACE measurements are global and continuous and yield time-varying gravity solutions with a temporal resolution of monthly or better at a spatial resolution of 500 km or better. ICESat laser elevation measurements are captured at 40 Hz from a 600 km altitude, 94 degrees inclination, 91-day repeat orbit, yielding 170 m along-track resolution and about 40 km cross-track separation at 60 degrees latitude every 33 days. The modified ICESat mission scenario includes three 33-day measurement campaigns per year (March, June, November). Most of the ICESat measurement campaigns are now fully calibrated, i.e., have attitude errors at or below the mission requirement of 1.5 arcseconds, which is necessary for precise geolocation of the laser footprints, leading to cm/year elevation change detection. Over the ice sheets, we have obtained synchronization of GRACE gravity and ICESat (crossover) elevation data products and observe correlation between topographic changes observed by ICESat and mass changes observed by GRACE, most notably in regions of coastal melting. The errors and significance of these changes are analyzed, with special attention paid to the temporal sampling errors of ICESat (three times per year) compared to the coincident versus full-time-series GRACE solutions. Additional interpretation of these results considers the implications of ocean and atmosphere aliasing for GRACE and the effects of GIA models on both missions.