SECULAR GRACE GRAVITY AND ICE ALTIMETRY MEASUREMENTS FOR PRESENT-DAY AND PAST ICE MASS VARIATIONS–A GLOBAL INVERSE APPROACH

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We investigate the contributions of secular gravity change measurements up to spherical harmonic degree and order 90 caused by present-day and historical ice mass variations in a framework of global grid inverse analysis. In the simulated solutions for ice mass variations over the present-day ice sheets we assume a gravitational field resolution and accuracy that is anticipated for the GRACE mission and the ready availability of concurrent ice altimetry data from missions such as IceSat. In order to assess separation of global sources of mass variation and to statistically evaluate spatio-temporal resolution and accuracy from full posterior covariance matrices, we have developed a global simultaneous grid inverse algorithm using JPL's multi-thread super computing platforms and well-optimized codes. Linear solutions using 200 km scale grids have been achieved. One problem to overcome is that gravitational and altimetric rebound signatures of the solid earth from past ice mass changes are mixed with those associated with present-day ice changes. Additionally, variable firn compaction must be dealt with if robust constraints are to be derived for present-day ice mass balance. However, our geographically iterative inverse algorithm indicates that the gravity plus altimetry data sets reduce the level of corruption significantly in the desired solutions for ice sheet mass balance and their contribution to sea level rise caused by these two error sources. Also, the data sets offer us an opportunity to learn more about global past ice load evolution if mantle viscosity profile is known. However, it appears that the gravity and altimeter data lack the resolving power to constrain both the historical ice load and lower mantle viscosity and we infer that additional data are required to distinguish them.