Geophysical Research Abstracts
Vol. 14, EGU2012-6813, 2012
EGU General Assembly 2012

The effect of different forms of interpolation on estimates of Antarctic ice height change

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Ice-sheets in the past have been largely inaccessible to land-borne sensing due to a combination of factors which include extreme climate, moving surfaces both on land and water, large coverage distances and, not least of all, the financial resources to overcome the earlier factors. Remote sensing, in the form of airborne altimetry and gravimetry, has largely overcome the above concerns, costs withstanding, giving the scientific community an extremely useful tool to measure the height and mass of ice-sheets.
Remote sensing, however, is not without its shortcomings. In the case of satellite altimetry, there are a number of concerns, one of the most important is that each new ground-track does not pass directly over and diverges slightly from the older corresponding ground-tracks. As we are interested in observing changes in ice height over time, it is imperative that when a measurement is taken at one location, it can be compared to other measurements. This is not always possible with satellite altimetry as mentioned above. A number of different methods have been used to find points on ground-tracks that are close to each other over time, crossover analysis being the most prevalent. This method, as well as others, relies heavily on interpolation and slope correction to reconcile the variation in measurement location.
Using the GLAS product from the ICESat mission, we will look specifically at the uncertainty contribution of estimating ice height changes from different forms of interpolating all ground-tracks to a "mean" ground-track. A number of different ice-sheet surfaces have been simulated through time. The surfaces are created using the original ICESat data with different levels of Gaussian noise to create different levels of surface variation. More homogeneous surfaces were made using digital elevation models (DEM) derived from ICESat data, again Gaussian noise was added. The surfaces are then sampled using the coordinates from the original ICESat ground-track observations, producing simulated observations that have similar characteristics to that of real ice-sheet observations. Using these simulated observations we assessed when different forms of interpolation become unreliable and the effect of slope on the uncertainty of the height/mass estimate.