Comprehensive surface elevations for Thwaites Glacier: Results from AGASEA airborne laser altimetry

D. Young, S. Kempf, D. Blankenship and J. Holt
University of Texas at Austin

Accurate surface elevation data is vital for modeling ice sheet dynamics and estimating ice sheet change. Currently, satellite observations using incoherent radar and laser ranging dominate evaluations of Antarctic ice sheet topography; however, both of these methods have limitations. Space borne radar altimetry is sensitive to slopes, while existing orbital laser altimetry is strongly impacted by clouds and has limited coverage at the coasts. It is precisely these coastal areas of the West Antarctic ice sheet that appear to be changing most rapidly and are most poorly understood dynamically. A more effective approach to gathering surface elevations both in the coastal environment and regions of high surface slope is airborne laser altimetry

Between mid December 2004 and February 2005, the University of Texas Institute for Geophysics (in collaboration with the British Antarctic Survey and supported by the National Science Foundation), conducted the first comprehensive areogeophysical survey of the Thwaites Glacier catchment. Survey lines extending up to 500 km from the base camps in a 15 X 15 kilometer grid over the entire catchment; ultimately 35,000 line-kilometers of laser range data was acquired, in addition to ice penetrating radar, gravity and magnetic measurements. We collected laser altimetry data using a Riegl nadir-pointing distance meter, which output modal range data at 3.5 Hz (~20 meters along track) representing spots of 1 meter X 20 meters on the surface. Range data were filtered for clouds and merged with aircraft pitch and roll data at 8 Hz to find the height above the surface. Distance meter orientations were measured in the field and validated through inversion of line crossings.

For positioning kinematic GPS data collected at 2 Hz to find the surface elevations was merged with our 3.5 Hz distance ranges. We used both a K&RS kinematic differential GPS system with a basecamp positioned using static GYPSY, and kinematic GPYSY software. Kinematic GPYSY positions were more reliable far from the camp; however, we discovered a 17 cm bias between kinematic K&RS using a static GYPSY for the base and kinematic GYPSY. To remove this offset use a cross-over deviation minimization scheme to determine the best of eighteen computed solutions for each line. An initial set of best K&RS solutions (comprising two thirds of the transects) gave a crossover RMS error of ±5.5 cm after leveling. The remaining transects which including biased GYPSY solutions were linearly fitted to the best lines, providing surface elevations with an RMS error of ±19 cm.

We present these surface elevations, that are being prepared for release, as well as comparisons with GLAS data crossovers and reflights.