Mass Balance of the northern Antarctic Peninsula from image- and ICESat-based dH/dt

T. A. Scambos[1], E. Berthier[2], T. Haran[1], C. A. Shuman[3], A. J. Cook[4], and J. Bohlander[1]
1: National Snow and Ice Data Center, University of Colorado at Boulder, Boulder CO 80303 USA
2: CNRS/LEGOS, Universite de Toulouse, Toulouse 31400 France
3: UMBC/JCET at NASA/GSFC, Greenbelt, MD 20771 USA
4: Department of Geography, Swansea University, Swansea SA2 8PP UK

An assessment of the most rapidly changing areas of the Antarctic Peninsula (north of 66DEGS) shows that ice mass loss for the region is dominated by areas affected by eastern-Peninsula ice shelf losses in the past 20 years. We combined satellite stereo-image DEM differencing and ICESat-derived along-track elevation changes to measure ice mass loss for the Antarctic Peninsula north of 66DEGS between 2001-2010, focusing on the ICESat-1 period of operation (2003-2009). This mapping includes all ice drainages affected by recent ice shelf loss in the northeastern Peninsula (Prince Gustav, Larsen Inlet, Larsen A, and Larsen B) as well as James Ross Island, Vega Island, Anvers Island, Brabant Island and the adjacent west-flowing glaciers. Polaris Glacier (feeding the Larsen Inlet, which collapsed in 1986) is an exception, and may have stabilized. Our method uses ASTER and SPOT-5 stereo-image DEMs to determine dh/dt for elevations below 800 m; at higher elevations ICESat along-track elevation differencing is used. To adjust along-track path offsets between its 2003-2009 campaigns, we use a recent DEM of the Peninsula to establish and correct for cross-track slope (Cook et al., 2012, doi:10.5194/essdd-5-365-2012 [adsabs.harvard.edu]; http://nsidc.org/data/nsidc-0516.html [nsidc.org]) . We reduce the effect of possible seasonal variations in elevation by using only integer-year repeats of the ICESat tracks for comparison. Total mass loss from the Peninsula north of 66DEGS is 22+/- 8 Gt (preliminary estimate), or roughly 20 to 35% of the total Antarctic mass imbalance. Little if any of the dynamically-driven mass loss is compensated by increased snowfall in the northwestern or far northern areas, but there is evidence of increasing accumulation in the southwestern portion of the study area. Mass losses are dominated by the major glaciers that had flowed into the Prince Gustav (Boydell, Sjorgren, Roehss), Larsen A (Edgeworth, Bombardier, Dinsmoor, Drygalski), and Larsen B (Hektoria, Jorum, and Crane) embayments. The pattern of mass loss emphasizes the significant and multi-decadal response to ice shelf loss along the eastern Peninsula coast. Areas with shelf losses occurring 30 to 100s of years ago seem to be relatively stable or losing mass only slowly (western glaciers, northernmost areas). The remnant of the Larsen B, Scar Inlet Ice Shelf, shows signs of imminent break-up, and its feeder glaciers (Flask and Leppard) are already increasing in speed as the ice shelf remnant decreases in area.