Geophysical Research Abstracts, Vol. 8, 08686, 2006
SRef-ID:

Antarctic Megadunes Characteristics from ICESat Elevation Data

C.A. Shuman (1), M.A. Fahnestock (2), T.A. Scambos (3), M. Albert (4), R. Bauer (3), V.P. Suchdeo (6),

(1) Cryospheric Sciences Branch, Code 614.1, Room A210, Building 33, NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA, (2) Institute for the Study of Earth, Oceans, and Space, Morse Hall, University of New Hampshire, 39 College Road, Durham, NH 03824, USA, (3) National Snow and Ice Data Center, CIRES, Campus Box 449, University of Colorado, Boulder, CO 80309, USA, (4) Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, USACE, 72 Lyme Road, Hanover, NH, 03755, USA, (5) Sigma, Inc., Cryospheric Sciences Branch, Code 614.1, Building 33, Room B209B, NASA Goddard Space Flight, Greenbelt, MD 20771, USA, Christopher.A.Shuman@nasa.gov, Fax 301-614-5644, Tel. 301-614-5706

More than 500,000 square kilometers of Antarctica (Fahnestock, et al., 2000) are covered by long, broad, sinuous ‘megadune’ features (Swithinbank, 1988) that are related primarily to persistent down slope winds and low, differential accumulation. They have a very subtle but distinctive morphology; characterization of these features requires detailed elevation data in a broader remote sensing context. In this paper, we will discuss ICESat laser altimetry data that measures some of these features near an NSF-OPP funded research site occupied during the 2002-2003 and 2003-2004 field seasons. The ICESat data across the area show the megadunes to have 1) heights above the regional slope of up to 10 meters, 2) trough-to-trough distances of between 2 and 6 kilometers, 3) crest lengths of up to 100 kilometers, 4) a steeper and rougher upwind accumulation face, and 5) a smoother and longer downwind ‘glazed’ backslope.

Using continent-wide remote sensing data sets, field observations, and preliminary modeling results, we can fully characterize these features on the Antarctic Plateau, including the extent, variability, and likely formation processes of megadunes. The new 125-meter MODIS-based Mosaic of Antarctica (MOA), coupled with SAR imagery from the Radarsat Antarctic Mapping Mission (RAMP; Jezek, 1999) elevation profiles from ICESat, and compilations of mean accumulation (e.g., Vaughan et al., 1999; Davis et al., 2005) form the basis for the remote sensing analysis. Field measurements from ground penetrating radar, automatic weather stations, surface photos, snowpits, and shallow cores provide in situ and subsurface information on dune structure.

Based on these data, Antarctic megadunes can be characterized as linear strips of the accumulation of fine-grained, wind-packed snow, generally forming 2 - 8 meter high, 1-2 km wide ridges separated by 2-6 km of near-zero-accumulation ‘glaze’ regions. Glaze surfaces overlie extremely metamorphosed firn, with very coarse recrystallized grains and poorly expressed layering. Ground-penetrating radar profiles coupled with simple models of snow accumulation reveal that the accumulation rate and the surface profile shape in the windward direction are intimately related for megadunes; this relationship is extended to all megadune areas by a comparison of ICESat profiles, RAMP backscatter intensity, and the MOA composite image.