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Meteorological data and mass balance measurements on Davies Dome and Whisky Glacier in 2006–2010, James Ross Island, Antarctica

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Rapid disintegration of ice shelves along the Antarctic Peninsula and the retreat of land-based glaciers on islands document the recent climate warming in the Maritime Antarctic. Two glaciers located on the northern part of James Ross Island (Ulu Peninsula) are studied to determine the impact of local climate changes on glacier mass balance. Whisky Glacier is a well-delimited valley glacier located mostly below the local Equilibrium line altitude (ELA). The glacier has an area of ∼2.3 km2 and lies in the altitude range of 215–460 m a.s.l. Davies Dome is a flat-bottom dome glacier with significant part of its surface located above the ELA and a single outlet that flows towards the SW. The Davies Dome has an area of ∼6.7 km2 and lies in the altitude range of 0–514 m a.s.l.
The meteorological and glaciological observations started on Davies Dome in January 2006. In 2009, two automatic weather stations were installed on both glaciers. Each station was equipped with albedometer CM7B (Kipp-Zonen, Netherlands), air temperature and humidity sensor EMS33 (EMS, Czech Republic), propeller anemometer 05103 (Young, USA), and snow depth sensors (Judd, USA). The annual mean temperature on the top of Davies Dome was -8.8 °C in the period of 2006–2009. The sum of positive degree-day temperature (number of days with daily mean temperature >0 °C) differed significantly: 181.3 °C d in 2006, 79.2 °C d in 2007, 108.3 °C d in 2008, and 40.7 °C d in 2009. The wind blew from the S to SW directions transporting increased amount of snow on the upper part of Whisky Glacier. The advection of relatively warm and humid air masses from WSW and W caused high ablation rates that occurred during advection events.
Field mapping and mass balance measurements were used to reveal the spatial change of glacier surfaces and to assess the annual mass balance. The traditional mass balance method based on annual measurements of snow density and snow depth along 53 and 18 stakes was applied on Davies Dome and Whisky Glacier respectively. The mapping revealed the retreat of the NW part of Davies Dome glacier in order of meters from 2006 to 2009. An average ablation of 20 cm was observed on this glacier in the same period. However, positive mass balance was measured on both studied glaciers between summers 2009 and 2010. The average accumulation was 0.36 m and 0.65 m for Davies Dome and Whisky Glacier respectively. Ground Penetrating Radar (GPR) sounding was realized in 2010 to determine thickness and volume of glaciers. GPR data were collected along six profiles evenly located on the glaciers using an unshielded 50 MHz RTA antenna and RAMAC CU-II control unit. The maximum thickness of Davies Dome and Whisky Glacier is 85 m and 145 m respectively. GPR data were used to construct digital elevation models of glaciers and to reveal the subglacial bedrock topography.

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