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Seasonal variation of meteorological variables and recent surface ablation / accumulation rates on Davies Dome and Whisky Glacier, James Ross Island, Antarctica

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In this study, surface mass balance data of two glaciers on James Ross Island, Antarctica, and its spatial and temporal variations are evaluated using snow ablation stakes, ground-penetrating radar, and dGPS measurements. The investigated glaciers are located on the Ulu Peninsula, northern part of James Ross Island. Davies Dome is an ice dome, which originates on the surface of a flat volcanic mesa at elevations >400 m a.s.l. and terminates with a single 700 m wide outlet in the Whisky Bay. Davies Dome has an area of ∼6.5 km2 and lies in the altitude range of 0–514 m a.s.l. Whisky Glacier is a cold-based land-terminating valley glacier surrounded by an extensive moraine ridges made of debris-covered ice. The glacier has an area of ∼2.4 km2 and lies in the altitude range of 215–520 m a.s.l. Within several summer austral summers, extensive field programme were carried out on both glaciers including the operation of two automatic weather stations, field mapping and mass balance measurements. 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). In the period 2009–2011, high seasonal and interdiurnal variability of incoming solar radiation and near-surface air temperature was found as a result of changes in the circulation patterns and synoptic-scale weather systems moving in the Circumpolar Trough. High ablation and accumulation rates were recorded mainly in the spring and summer seasons (October–February), while negligible changes were found in winter (May–September). The effects of positive degree-day temperatures on the surface ablation rates were examined using a linear regression model. In this approach, near-surface air temperature maps on the glacier surfaces were derived from digital elevation model according to actual temperature lapse rates.
Mass balance investigations started in 2006 on Davies Dome and in 2009 on Whisky Glacier. Since 2009 the surveys cover the whole surface area of both glaciers. The height and position of measurement stakes were measured each year. Preliminary results of mass balance changes suggest the net positive volume balance of the glaciers. Between 2009 and 2010 mass gain was observed on the whole surface of Davies Dome, whereas in 2010–2011 the loss up to 0.25 m took place along southeastern limit of the dome. The net mass gain was identified on the whole Whisky Glacier except for the terminus below 280 m a.s.l., where the surface mass decreased by up to 0.14 m. The repeated measurements reveal the asymmetric pattern of the mass changes with higher accumulation rate on the eastern part of the valley glacier.

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