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Recent changes detected on two glaciers at the northern part of James Ross Island, Antarctica

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Antarctic Peninsula is one of the regions, which have been exposed to the most rapid warming of the Earth since 1950. Consequences of climate changes are clearly documented by recent disintegration of ice shelves on both sides of the Antarctic Peninsula as well as by the retreat of land-based glaciers. James Ross Island, located close to the northernmost tip of the Antarctic Peninsula, represents an excellent place to study changes in the glacier mass-balance and their sensitivity to a regional warming trend. Two different types of glaciers of the Ulu Peninsula, the Whisky Glacier and the Davies Dome have been studied. Multi-temporal remote sensing data (aerial photographs, Landsat MSS, TM and ETM+ and Aster satellite optical and thermal multispectral data) and field survey allowed detecting changes in extent (2-D) as well as calculating glacier mass-balance changes (3-D) for these two glaciers from 1977 to 2009.

The Whisky Glacier is a well-delimited valley glacier located mostly below the local Equilibrium line altitude (ELA). The glacier with high-flow velocities is fed by an intensive snow accumulation caused by prevailing southwestern winds. The Whisky Glacier covers an area of 2.3 km2 and its altitude varies from 215 to 475 m a.s.l. The Davies Dome is a flat-bottom dome glacier. Significant parts of its surface are located above the ELA and limited flow velocities are characteristic for the most parts of its body. However, the Davies Dome has a single 500–700 m wide southwestern outlet flowing towards the Whisky Bay. The Davies Dome extends an area of 6.7 km2 and its altitude ranges from 0 to 514 m a.s.l. Both glaciers experienced massive extension of their ice tongues towards the Brandy Bay during the mid Holocene. Lateral moraines located in front of the both glaciers heading down to the left coast of the Brandy Bay document this event.

According to the remote sensing data and field investigations both glaciers have retreated since 1977. Between 2006 and 2009 repeated mapping of the Davies Dome was carried out and the results showed that the largest retreat ranging from 10 to 20 m occurred in the NW flat part of the glacier. Digital elevation models calculated on bases of aerial stereo-photographs from 1979 and 2006 allowed us to define mass-balance changes of the studied glaciers. Ground Penetrating Radar measurements taken on both glaciers helped with mass-balance investigations, furthermore, made it possible to increase the accuracy of the 3-D models. Annual mass balance measurements on the Davies Dome indicated a mean ablation about 20 cm between 2006 and 2009. On the Whisky Glacier, a network of 20 ablation stakes was established just recently (February 2009). Therefore, another 3-year investigation is necessary to bring comparable results.

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