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Recent transformations in the high-Arctic glacier landsystems based on examples from Svalbard

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Glacier recession and landform development in the foreland of several Svalbard's glaciers were quantified for different spatio-temporal scales. Time-series orthophotos and digital elevation models from 1961, 1990 and 2009 (with ground resolution varying from 0.4 m to 0.7 m) were used for quantification of decadal changes for the whole glacial catchments. Time-series geomorphological maps were constructed using a combination of DEM visualization and stereoscopic viewing of aerial photographs. Planar transformations of landforms were quantified based on orthophotomaps, whereas changes of the volume of ice and landforms were assessed by creation of digital elevation models of differences (i.e. elevation changes between sequential DEMs). Repetitive geomorphological and geodetic field surveys were applied to estimates seasonal and inter-seasonal transformations of various landforms assemblages and individual landforms.

Research were carried out for several glaciers in the central part of the Spitsbergen Island, including: Nordenskiöldbreen, Ebbabreen, Raganrbreen, Hørbyebreen, Cambridgebreen, Balliolbreen, Svenbreen and Ferdinandbreen. In the period LIA-2013, glaciers' margins retreated seriously, moreover ice volume and glaciers' surface profiles changed enormously emphasizing the relative importance of glaciers' thinning over area loss. In terms of landscape alteration, the landforms response was much more varied between glaciers. Most important transformation included: (1) developing of a terminoglacial and/or supraglacial lakes, which acted as a sedimentary trap and at the same time probably accelerated glacier erosion, (2) developing the lateral moraines whose transformations were divided into creation, initial, mature, and senile phases, with various magnitudes of debris flow and backwasting activity that changed with time (3) developing of end moraine complexes, which are now the most stable components, alternated mainly by dead-ice downwasting and to a lesser extent by sporadic debris flows. Short-time dynamics of different components showed very high variability in transformation and illustrate relative importance of ice backwasting over downwasting for studied forelands.

In terms of paleoglaciological reconstructions, our studies suggest that chronological interpretations of landform evolutions ought to take into account the occurrence of permafrost and its impact on lagging in landform alteration.