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Coastal Landscape Dynamics of Eastern Svalbard since the End of the 20th Century

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An exceptionally strong climate warming (Arctic amplification) has led indirectly to intensive coastscape transformation in East Spitsbergen and the East Svalbard islands.

There are three main processes through which climate warming affects the coastal landscape: (1) recession of tidewater glaciers which abandoned large areas from ice; (2) shortening of the sea ice season, which allows for more frequent and more intense sea storms; (3) deeper thawing of the permafrost active layer.

The effects of these processes were observed during the research cruise of the yacht "Ocean A", implemented as part of the project "HarSval – Bilateral initiative for harmonisation of the Svalbard cooperation", financed by "Norway grants", led by University of Silesia and Dariusz Ignatiuk personally.

For this purpose, twelve coastal areas were explored from 20th to 30th August.

In four of them – located in the central-eastern and southeastern Spitsbergen – the main reason for the landscape transformation was the recession of tidewater glaciers. This recession has led to: (1) flooding of the depressions in the glacier bedrock by the Barents Sea (i.e., the formation of new or the enlargement of old sea bays); (2) appearance of new landscapes in areas abandoned by glaciers. Such transformation was observed in the following coastal areas: Hambergbukta and Hambergbreen, Diabastangen and Backlundbreen, Straumslandet and Pedašenkobreen (Fig. 1), Kapp Weyprecht and Hochstetterbreen.

In six coastal areas – located in Edgeøya, Berentsøya, Von Otterøya, westernmost Nordaustlandet, northernmost Spitsbergen – which are raised above 4–5 m above sea level, undercutting from below by storm waves is the main factor changing their coastlines slowly. The contour of these shorelines remains almost unchanged but behind the beaches low cliffs were formed (Fig. 2).

In the next two explored coastal areas – in Berentsøya at the front and east of the Freemanbreen glacier, and near Sjutnes – all the mentioned landscape transformations occurred.

Deeper thawing of the permafrost active layer contributes to acceleration of sliding and creeping (including solifluction) on the slopes. This process is causing the shoreline to recede

Fig. 1. Straumslandet north of Heleysundet, Central-East Spitsbergen: the marginal zone of the Pedašenkobreen glaciers with the new sea bay, formed after 2004.

Fig. 2. Diskobukta at the foot of Muen, Edgeøya: the mountain coast with the new low cliff behind the beach.

in the places where the slopes covered with weathering or morainic material descend directly to the sea, e.g., in Hambergbukta and nearby.

The results of the observations could be quantified thanks to comparisons with previously released maps, satellite images and papers (among others: Szupryczyński 1963; Lefauconnier and Hagen 1991; Hagen et al. 1993; Bondevik et al. 1995; Dowdeswell and Bamber 1995; Ziaja et al. 2007, 2009; Cygankiewicz-Truś and Ziaja 2021; Ziaja et al. 2023).

In the near future, the East Svalbard coastscape transformation caused by recession of tidewater glaciers will be continued due to a relatively low elevation of their (highest) accumulation zones which are in risk of being below the rising snow and equilibrium (of their net mass balance) lines.

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