SUMMARY

Climate warming is leading to glacier recession in different parts of the world, including Svalbard. Since 1979, Svalbard has warmed seven times faster than the global average. Low-elevated glaciers in southern Spitsbergen are particularly sensitive to ongoing warming as they have one of the most negative mass balances in Svalbard. Knowledge of the past glacial fluctuations, in particular in the warmer phases with glacier retreat, is crucial for understanding the possible consequences of contemporary warming in the Arctic. Despite recent advances in the paleogeography of Svalbard, most studies address the central and northern part of Spitsbergen. Knowledge of glacier evolution in the southern part of the archipelago before the regular monitoring based on field measurements and remote sensing data remains limited. This work aimed to reconstruct the fluctuations of selected glaciers in southern Spitsbergen in the Holocene, including (1) identification of the phases of glacier advances and recession based on ^{14}C and ^{10}Be dating, (2) identification of the role of glacier surges based on geomorphological and historical data, and (3) identification of the main factors of the fluctuations of selected glaciers in the Holocene. Detailed studies included four glaciers and their forefields: Hornbreen, Hansbreen, Vestre Torellbreen and Werenskioldbreen. In addition, I used comparative observations, literature data, and historical cartographic and photographic data for other glaciers of the investigated region.

Geomorphological mapping of the glacier forefields based on high-resolution remote sensing data and field investigation revealed characteristic landforms of surging glaciers, including crevasse-squeeze ridges (CSRs), concertina eskers and thrust-block moraines. During field work, I collected samples of marine mollusc shells, subfossil vegetation and driftwood. I also used four samples of mollusc shells and a sample of a whalebone from glacial sediments in the resources of the Institute of Earth Sciences. Sixty-three new radiocarbon dates were compiled with twenty-five previously published ^{14}C dates from the glacier forefields. The ages indicate the periods of glacier recession, which allowed the colonization of new fjords and ice-free terrestrial areas by marine molluscs and tundra. I also collected 11 samples of boulders from the moraine and trimline of Hansbreen for ^{10}Be dating. The ^{10}Be ages were anomalously old due to nuclide inheritance from the previous exposure in the Early and Middle Holocene. Therefore, they have not revealed the age of moraine abandonment. Historical maps from the 1600s to 1900s provided qualitative data on the fluctuations of tidewater glaciers indicated by changes in the extent of particular branches of Hornsund. Archival photographs from 1872, 1899–1901, 1917–1918 and 1936 had documented characteristic features in glaciers' surface morphology, which provided evidence for glacier surges: folded and looped moraines and deformed ice structures, a steepened and bulging terminus, heavy and extensive surface crevassing reaching high up the glacier, shear margins on the glacier surface between surging flow units and tributary glaciers in the quiescent phase.

Compilation of new and published ^{14}C and ^{10}Be ages together with geomorphological, historical and published paleoclimatic data allowed me to identify the following phases of glacier changes in southern Spitsbergen: (1) deglaciation, (2) glacier recession in the Early and Middle Holocene, (3) glacier re-growth in the first half of the Late Holocene, (4) glacier advances in c. 2.2–1.5 cal ka BP, (5) glacier recession c. 1.5–1.0 cal ka BP, (6) glacier advances after c. 0.7 cal

ka BP and (7) Little Ice Age (LIA). The ^{14}C ages of marine mollusc shells from the terminal moraine of Werenskioldbreen indicated glacier recession by 12.5 cal ka BP until the emergence of a raised marine terrace sometime after 10.0 cal ka BP. The oldest shell samples from the forefields of other glaciers also demonstrated glacier retreat in this period (Hansbreen: 11.3 ka cal BP; Hornbreen: 10.9 cal ka BP; Vestre Torellbreen: 10.5 cal ka BP). New and published radiocarbon dates indicated glacier retreat in the Early and Middle Holocene, when the climate of Svalbard was warmer than present. The ^{14}C ages also evidenced reduced glacier extent (compared to the LIA maximum) in the first half of the Late Holocene, as well as glacier recession in c. 1.6–0.7 cal ka BP, which may have been related to the increase in air temperature and sea surface temperature in Hornsund. The maximum Late Holocene glacier extent identified in this work corresponded to glacier surges, preceded by long-lasting mass accumulation in the reservoir area due to the climate cooling and increase in snow precipitation at the beginning of the warmer phase. Glacier surges may have occurred in response to increased water content at the glacier beds in the warmer phases. Synchronous glacier surges blocked the Hornsund strait and developed an ice bridge linking Torell Land and Sørkapp Land.

I paid particular attention to the Hornbreen-Hambergbreen glacier system as its dynamics decide whether Hornsund has been a fjord or a strait between the Greenland Sea and the Barents Sea. I reconstructed the fluctuations of this glacier system using new and published ^{14}C ages and published ^{10}Be ages of moraine boulders from the Hornbreen forefield. Glacier recession in the Early Holocene led to the opening of the strait c. 10.9 cal ka BP or earlier. Glacier advances blocked the strait c. 3.9 cal ka BP or later, 2.1 cal ka BP or even 1.9 ± 0,3 ka (Philipps et al., 2017). Subsequent re-opening of the strait may have occurred c. 1.3 cal ka BP until the next glacier advance c. 0.7 ± 0.2 ka (Birkenmajer, Olsson, 1997; Philipps et al., 2017).

Fluctuations of glaciers in the study area were synchronous with the rest of Svalbard. Similar to other parts of the archipelago, they reflected changes in the air and seawater temperatures. Low-elevated accumulation areas facilitated rapid glacier recession in the warmer periods and hindered their regrowth in the colder phases of the Holocene. Glacier surges played a key role in the glacial evolution of this region as they allowed for the build-up of the ice bridge between Torell Land and Sørkapp Land.