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The microclimate and mass balance of Qaamarujup Sermia, West Greenland 1929-2022

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Understanding the interaction of the atmosphere and cryosphere is critical for predicting the consequences of the rapidly changing climate, particularly in the Arctic. To accurately represent feedback mechanisms between ice and climate in physical models, their thorough quantification at the local scale is required. This study analyses two high-resolution datasets from the Qaamarujup Sermia outlet glacier (West Greenland) that were collected 90 years apart (1929-1931 and 2022 onward). The first is a dataset from Alfred Wegener's last expedition 1929-31, including sub-daily atmospheric observations as well as monthly to (bi-)weekly mass balance measurements. An almost identical monitoring network was installed in 2022 with the goal of observing changes in microclimate and their impact on the glacier. Both periods cover far above-normal air temperatures. The newly installed monitoring network consists of two automatic weather stations (AWS), of which one is placed near the coast and the other one on the ice sheet in approx. 940 m a.s.l.. The station network is supplemented with three temperature and humidity sensors in 50, 270 and 950 m a.s.l. . Further, there are four autonomous ablations sensors and six ablation stakes to quantify the surface mass balance of the glacier. During the field campaign in 2022, 39 vertical drone flights were performed to investigate temperature and humidity profiles of the lowest 400 m of the atmosphere. Preliminary findings show that a surface-based temperature inversion above the glacier surface is present on all days investigated during the study period (2-10.7.2022). An elevated temperature inversion above the ice-free valley part is also present at 50% of the days, with one day reaching further inland than the glacier front. Both types of inversion occur in combination on three out of the eight study days. Comparison of the historic surface mass balance with data from a regional climate model shows reasonable agreement for locations 950 m a.s.l., while the complex topography in the valley is not represented sufficiently. Our results emphasize the value of validation data on a small spatial scale as well as the potential of short-term observations almost a century apart to investigate changing feedback mechanisms of the ice/climate interaction.