

Observation-based assessment of the surface climate in West Greenland in the last century

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This study compares high-resolution historical datasets with present-day monitoring data to investigate the surface climate at the Westcoast of Greenland, focusing on Qaamarujup Sermia. The location served as the site of Alfred Wegener's final expedition in 1930/31, during which sub-daily atmospheric observations were recorded at the settlement of Uummanaq (UMQ), at the bottom of the Qaamarujup fjord (FS) and at their West Station (WS) at 940 m a.s.l. on the Greenland ice sheet. The unique dataset is obtained when the first warming period of the 20th century (known as the Early Twentieth-Century Warming) peaked. As we are in another warming period since the 1990s, this similar positive anomaly compared to the average mean temperature from 1991-2020, gave motivation to our project WEG_Re. In June 2022, automated weather stations (AWS) were installed at the exact same locations of the historical expedition at FS and WS, supplemented by additional temperature and humidity sensors at 50, 270 and 950 m a.s.l. and vertical meteorological profiles using UAV flights. The collected data is analyzed to examine the local microclimate and its connection to the glacier's surface mass balance, which is measured using ablation sensors and stakes. On the local scale, the wind direction at FS changes from mostly westerly wind in summertime towards prevailing easterly wind at the end of the year 2022. This switch is not observed at an AWS closer to the open ocean in the UMQ fjord.

Preliminary findings from a comparison of observations from Wegener's expedition and the most recent one (June 2022-January 2023 at FS and January-December 2022 at UMQ) show that the monthly average air temperature in 2022 was warmer than in 1930 in all similar observed months at FS, and in 5 out of 8 similar observed months at UMQ. In comparison to 1931, it was colder in all similar observed months at FS, and 7 of the 9 similar observed months at UMQ in 2022. Although average temperatures at FS and UMQ are below zero degrees Celsius from October to January, both stations experience positive air temperatures in the winters of 1930/31 and 2022/23.

Other historic data compilations such as from the Danish Meteorological Institute and other expeditions from the same year (The fourth Greenland expedition from the university Michigan and the British Arctic Air Route Expedition) can be used to expand the available observations in 1930/31. They include meteorological observations from the settlement Upernavik and its vicinity, a transect comparable to UMQ - FS as well as observations from the Eastcoast of Greenland. This will help attributing changing atmospheric conditions over the past century across altitudes and longitudes.