

EGU2020-20778

<https://doi.org/10.5194/egusphere-egu2020-20778>

EGU General Assembly 2020

© Author(s) 2021. This work is distributed under the Creative Commons Attribution 4.0 License.



Temporal and spatial variations of sub-surface ocean temperatures in fjord systems, Western Svalbard

Martin Schulthess¹, Jacqueline Otto¹, Ellen Berntell², and Qiong Zhang²

¹Department of Physical Geography, Stockholm University, Stockholm, Sweden (martin.ch.schulthess@bluewin.ch)

²Department of Physical Geography and Bolin Centre for Climate Research, Stockholm University, Stockholm, Sweden

Frontal ablation processes and resulting mass loss at tidewater glaciers are a key uncertainty in future predictions of sea level rise. As recent studies have shown, frontal ablation is most importantly influenced by the sub-surface and surface water temperatures, at the same time interlinked with complex ice-ocean interactions. Since in the last years warm water masses from the West Spitsbergen Current are increasingly affecting the fjords of Western Svalbard, referred to as the process of Atlantification, the relevance to improve our knowledge about water temperature dynamics as well as the interactions with frontal ablation is rising. In this study, the temporal and spatial variations of sub-surface ocean temperatures in three fjord systems in Western Svalbard were investigated by reanalysing data from previous studies. A high variability of water temperatures on a temporal as well as spatial scale were found, reflecting the complex dynamics between different factors, such as fjord bathymetry, ongoing Atlantification, influence from different ocean currents, salinity, mixing of water masses, and tides.

Measurements at different depths are revealing temperature value ranges of up to $\pm 25\%$ of the annual temperature range for a divergence of 10m in the measurement depth. Profile measurements are therefore strongly recommended for future observations. Tidal variations occur in only one of three fjord system, with temperature variations of up to 2.5°C per day. The analysis of the influence of these warm water peaks, enduring only a few hours, on frontal ablation should be part of future research projects, since the difference to the daily mean water temperature can be up to 1°C. Differences in domination of certain water masses, such as cold or warm waters, can vary strongly in different locations within the fjord system, depending on the interplay of the different impacting factors. Concluding from the results, the depth and location of water temperature measurements, play a key role for making reliable assumptions concerning ice-ocean interactions, since water temperatures can vary strongly with depth and distance from the glacier front.