

A multivariate approach of the factors impacting a small arctic glacier

(Oral presentation)

Sophie Schiavone¹, Florian Tolle¹, Éric Bernard¹, Jean-Michel Friedt², Madeleine Griselin¹, Daniel Joly¹

¹ ThéMA - UMR 6049–CNRS

Université de Franche-Comté, Besançon, FR

² FEMTO-ST - UMR 6174–CNRS

Université de Franche-Comté, Besançon, FR

Key words: multivariate statistics, mass balance, arctic glacier

Arctic glaciers are good indicators of the ongoing climate change as their dynamics are strongly linked to it. This study is focused on the Austre Lovén glacier, on the Brøgger peninsula in Spitsbergen (Svalbard, 79°N). The aim is to understand how contrasted climate and snow conditions over the course of a year can lead to multiple consequences, sometimes unexpected, on mass balance. In 2014, a negative budget was expected, but data analysis has shown the first positive mass balance in 7 years. The objective here is to (i) identify and qualify the combination of factors affecting an arctic glacier mass balance. Three primary indicators seem to display the greatest influence: summer temperatures, liquid precipitations and winter snow accumulation. A specific focus would also be to (ii) understand the seasonal chronology and to rank parameters that have the greatest influence on glacial dynamics.

The Austre Lovén glacier (4,5km²) has been systematically instrumented and monitored since 2007. Mass balance is measured yearly at the end of September with an evenly-spaced 36 stakes network. At the end of April, before the start of the melting season, snow accumulation is also measured through drillings. Air temperatures have been recorded continuously since 2007 with 20 sensors on the glacier. The last parameter we are mainly interested in for this study is liquid precipitation data. It could not be continuously recorded in situ because of technical reasons. Hence it was reconstructed with data from the closest meteorological station, in Ny Ålesund, about 6km from the site.

These parameters were then used as explanatory variables to identify their influence on the Austre Lovén glacier. Data being recorded punctually was subjected to spatial generalization at the scale of the glacier. Factors conditioning accumulation area are not necessarily analogous to the ones having a great influence in the ablation area. Observed data need to be prepared in order to provide more explicit indicators as input for the statistical analysis. For example, a degree-days indicator allows to considerate only positive temperatures which have the greatest influence on the glacier. All of the original and derived factors are then constituting the basis of all subsequent multivariate analysis.