

## Evaluating the Potential of the Snow Model Crocus driven by *in situ* and Recent Reanalysis Data for Arctic Applications

DANIELA KRAMPE<sup>1</sup>, FRANK KAUKER<sup>1,2</sup>, MARIE DUMONT<sup>3</sup>, AND ANDREAS HERBER<sup>1</sup>

### ABSTRACT

In the Arctic, snow covers the ground for most of the year and affects flora, fauna, and local conditions but also has global impacts e.g. due to the snow-albedo effect and the impact from snow on near-surface atmospheric conditions. Previous studies show that snow can alter circulation patterns and precipitation regimes. Despite its importance, reliable and detailed *in situ* data of snow depth and physical snow properties in the Arctic are limited in time and space. The same is true for meteorological *in situ* data. These are needed to drive snow models to compensate for missing snow measurements.

To overcome these limitations, we first evaluate how well the recent ECMWF atmospheric reanalysis ERA5 represents atmospheric *in situ* measurements at Villum Research Station in northeast Greenland. Second, we use ERA5 and the atmospheric *in situ* measurements to force the alpine snow model Crocus and investigate the model performance for an Arctic site.

As atmospheric conditions in the Arctic and the European Alps are different (e.g. colder air temperatures, stronger winds), leading to differences in the snow stratigraphy, we introduce a new parametrization for the density of freshly fallen snow.

Comparison of atmospheric variables from ERA5 with *in situ* measurements results in good agreement except for biases in precipitation, wind speed, and direction. We attribute these biases to the resolution of ERA5, which is too coarse to resolve local topography adequately. However, simulations forced with ERA5 represent measured snow depth better than simulations forced with atmospheric *in situ* measurements. The performance of Crocus to simulate snow depths is satisfying, but there are discrepancies between measured and simulated snow stratigraphy. Using the newly introduced fresh-fallen snow density parametrization leads to improvements in the simulations, but deviations remain. Nevertheless, both the ERA5 reanalysis and Crocus show high potential for future snow modeling in the Arctic and are great tools to get a more comprehensive picture of atmospheric and snow conditions in the strongly under-observed Arctic.

---

<sup>1</sup> Alfred-Wegener-Institut Helmholtz-Zentrum für Polar-und Meeresforschung, Bremerhaven, Germany

<sup>2</sup> Ocean Atmosphere Systems GmbH, Hamburg, Germany

<sup>3</sup> Université Grenoble Alpes, Université de Toulouse, Météo-France, CNRS, CNRM, Centre d'Études de la Neige, Grenoble, France