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Temperature inversion climatology for Zackenberg region (Northeast Greenland)

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The arctic planetary boundary layer provides a favorable condition for the formation of tropospheric temperature inversions, a situation in which temperature increases with elevation. Especially the surface-based inversions (SBIs) are more frequent during polar night, which strongly decouples the surface from the overlaying upper tropospheric atmosphere. Thus, comprehending spatial and temporal variability of inversion parameters like frequency, depth and strength are crucial for studies on the variation of the Arctic biotic and abiotic environment such as vegetation, glaciers or snow cover.

Particularly, for the planned glacier energy and mass balance modeling in the orographically complex Zackenberg region in Northeast Greenland where the SBI is frequently observed, requires in-depth understanding of the spatiotemporal air temperature variations. In this respect, we designed the following research questions: (i) How well are the sub-grid scale near-surface temperature inversions based on Automatic Weather Stations (AWSs) represented by the large-scale vertical temperature profiles of the European Centre for Medium-Range Weather Forecast (ECMWF) reanalysis data set ERA-interim in the highly structured Zackenberg region? (ii) Did the inversion parameters change over time and what are the potential drivers of these changes (e.g. snow-cover, weather patterns and local wind structure)?

With regard to these questions we analyze (i) the vertical temperature profile (< 2 km height above the ground covering the lower troposphere) on the large scale covering entire Greenland to get better understanding of the relevance of spatiotemporal inversion characteristics for our region using the ERA-interim dataset, (ii) how the near surface temperature (measured by AWS) at certain elevation (meters above sea level) compares to the ERA-interim vertical temperature profile, (iii) the difference between the large-scale (ERA-interim) and point-scale (AWS) temporal changes in terms of inversion magnitude and frequency. We finally aim to derive a robust relationship between the vertical reanalysis temperature profiles and the near surface AWS temperatures at different elevations to spatially interpolate near surface temperature over the entire period of the reanalysis data.