EGU2020-15597
https://doi.org/10.5194/egusphere-egu2020-15597
EGU General Assembly 2020

Spatial and temporal variations of air temperature inversions over different surface types on Ammassalik Island (East Greenland)

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Air temperature inversion, a situation in which atmospheric temperature increases with height, is a common feature in the Arctic planetary boundary layer. This stable layer has multiple consequences for the Arctic environment. While vertical gradients of flora and fauna are impacted by them, they also have a direct consequence on physical characteristics such as permafrost thaw depths and snow cover. Therefore, a comprehensive knowledge about the spatial and temporal variability of temperature inversion parameters such as thickness, intensity, magnitude and frequency is crucial for the surface impact of Arctic climate change.

Here, we investigate the spatial and temporal variations of temperature inversions over different surface types on Ammassalik Island in East Greenland. During a field campaign in summer 2019, high temporal resolution profiles of atmospheric variables such as air temperature, humidity and pressure were collected using UAVs. We acquired 147 profiles in a period of 13 days (06/07/2019-18/07-2019) over different surface types (rock, gravel, snow, ice) and with varying distance to the ocean (between 0 and 6 km). We found a distinct air temperature inversion present in most of the profiles whereby height and thickness differ considerably. Both ocean and ice surface act as near-surface cooling agents, which favours the development of surface inversions. The ice-free area between ocean and glacier tends to warm up strongly during Arctic summer and those different drivers manifest in an intricate pattern of air temperature stratification along a valley axis.

Our high-frequency and high-resolution profiles are compared with longer time series from the nearby Tassiilaq radiosonde and with ERA-5 reanalysis data in order to bring our campaign data into a larger spatio-temporal context. We conclude that the radiosonde is able to resolve the general pattern well but it fails in adequately representing the stratification relevant for glacio-meteorological processes.