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Thermal sea ice classification during the MOSAiC expedition

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The MOSAiC expedition took place in the Arctic from September 2019 to October 2020 while having measurements under, in, and above sea ice for a complete annual cycle. Airborne thermal infrared imaging was conducted during 41 helicopter survey flights along the MOSAiC drift track. We analyze the infrared brightness temperature of snow, sea ice, and ocean water surfaces from October 2019 until May 2020 from the airborne measurements. While the snow-covered sea ice appears very cold, thin ice and open water are significantly warmer. These surface types will be considered with particular attention because they dominate the heat exchange between the ocean, ice, and atmosphere during wintertime. This influences the Arctic Climate and becomes even more important in the currently changing Arctic, where the sea ice gets thinner, moves faster, and breaks up easier. After georeferencing and merging the recorded images to a mosaic, we can provide maps of infrared brightness temperatures in a high spatial resolution of 1 m for each flight. The spatial range of the maps varies from local (~5 km) up to regional (~30 km). This data set provides a basis to study the spatial and temporal variability of sea ice characteristics in the Arctic winter. We derive the physical surface temperature from the brightness temperature, surface emissivity, and downwelling radiation from the sky or clouds. Using the surface temperature, we calculate the heat flux from a local up to a regional scale based on thermodynamic assumptions and atmospheric measurements on the ice floe. From more complex thermodynamic simulations, we estimate ice thickness and ice age based on the airborne measured surface temperatures. The model calculates for each surface temperature a specific ice thickness and heat flux based on the knowledge about the surface's thermodynamic history. The simulated ice thickness allows a sea ice classification which is compared to our first classification approach which deals with the flight's temperature distribution only. In the future, we will investigate the sub-footprint scale variability of ice surface temperature and thin ice thickness for satellite data, e.g. MODIS and Sentinel-3.