Master Thesis

Satellite microwave radiometry of Summit, Greenland: Extending a multi-parameter retrieval to land ice

The Institute of Environmental Physics (IUP) has a longstanding history in retrieving sea ice and atmospheric properties from satellite observations. Within the research group for Remote Sensing of Polar Regions (www.seaice.uni-bremen.de) new methods for satellite remote sensing are developed and interpreted in a climate system context.

For example, we are using satellite data from microwave radiometers like JAXA's and NASA's AMSR-E/2 sensors to simultaneously retrieve several geophysical parameters such as sea ice concentration and water vapor. This method is based on a forward model relating these parameters to simulated brightness temperatures, i.e., the quantities measured by the satellite sensors. Currently this method is only implemented for sea ice and ocean regions. In this study we will explore the potential of including snow-covered land in the forward model (using radiative transfer modelling or statistical methods) to then evaluate the accuracy of the retrieved parameters. The latter will be based on comparisons to observations above Summit, Greenland, from the ICECAPS project.

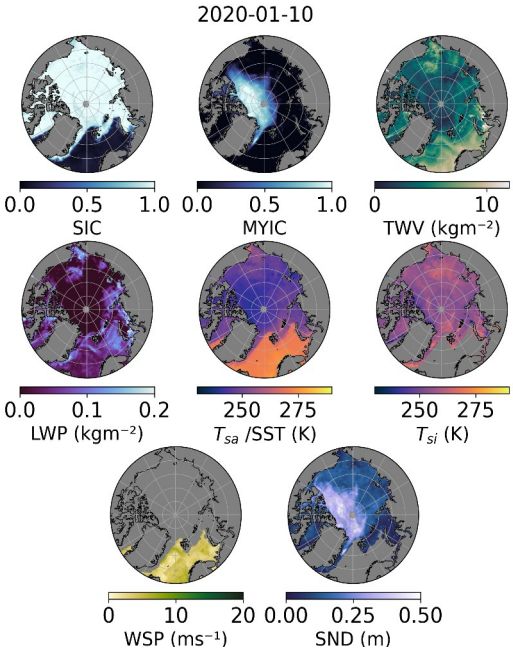

Figure 1: Daily (January 1st, 2020) map of the Arctic showing the different parameters that are retrieved by the optimal estimation method: sea ice concentration (SIC), multiyear ice concentration (MYIC), total columnar water vapor (TWV), liquid water path (LWP), (sea) surface temperature (SST/Tsa), snow-ice-interface temperature (Tsi), wind speed (WSP) and snow depth (SND). Currently, there is no data over Greenland.

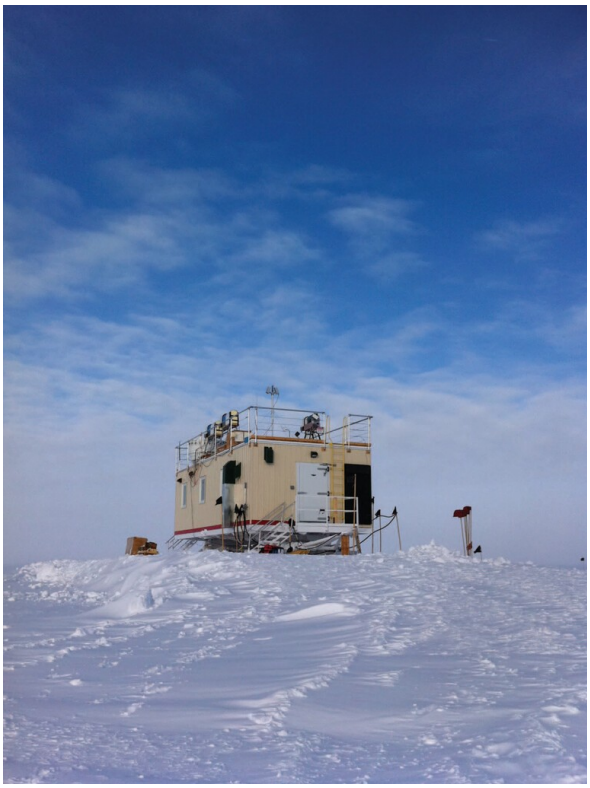

Figure 2: The Mobile Science Facility housing ICECAPS instruments at Summit, Greenland. Shupe et al. 2013.

What you need and what you will learn

Knowledge in physics is needed and computer programming experience will be helpful, best Python (or Julia) under Linux.

You will gain insights about satellite microwave radiometry, snow physics, a snow microwave radiative transfer model and how to evaluate the performance of remote sensing retrievals, which is especially challenging and fascinating in a remote region such as the Arctic. You will also learn how to work with meteorological reanalysis data. Additionally you will use meteorological data from an Arctic Observation site. Our working group offers an open discussion atmosphere and worldwide contacts to the leading institutions in the field.

Contact

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Earliest start date is November 2025.