

Sodankylä Radiometer Experiment SoRaX

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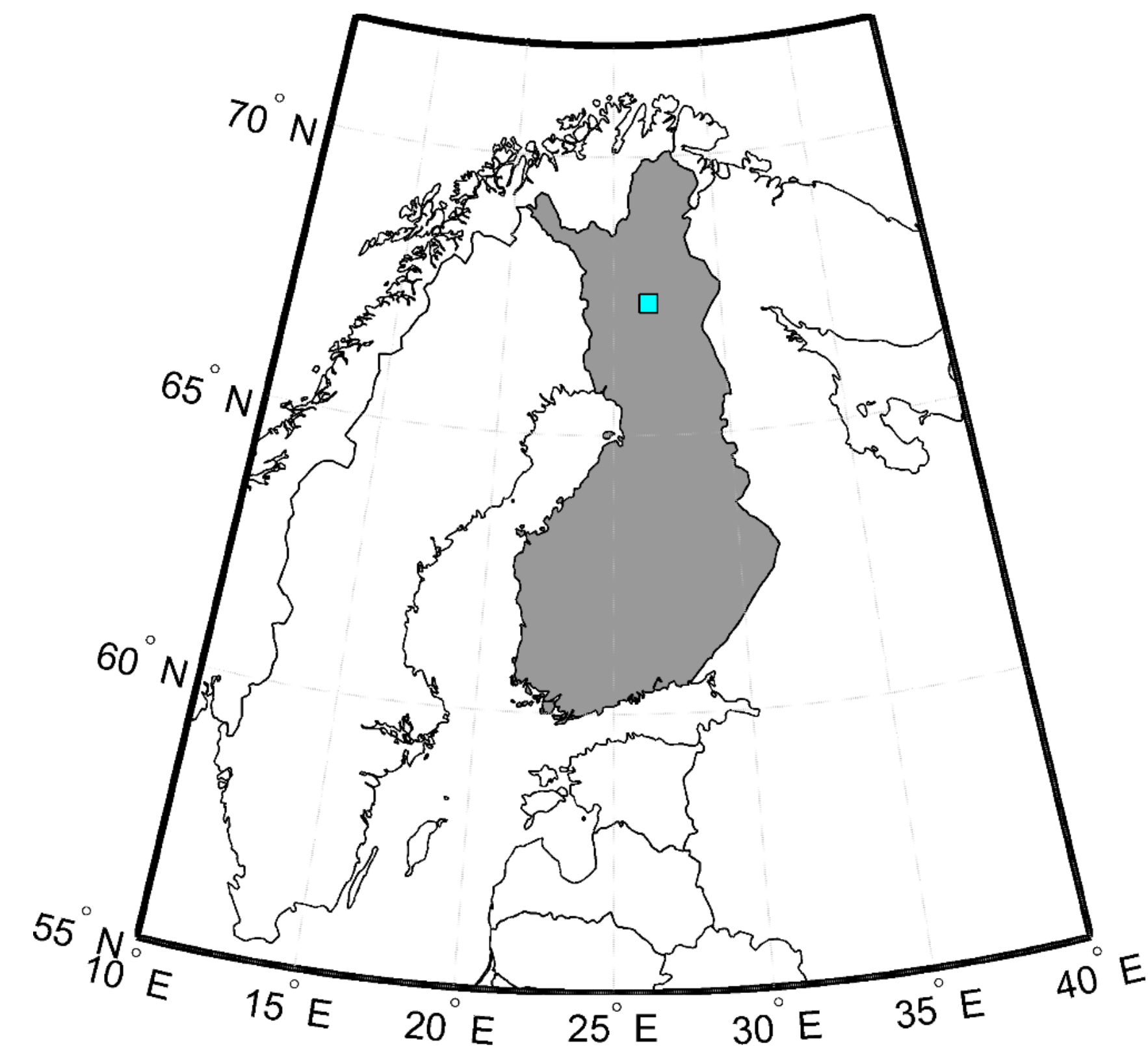
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Microwave instruments for snow and soil observations

Ground-based observations are essential in the development of geophysical retrieval algorithms for needs of Earth Observation. These need to be supported by sufficient reference data of surface and atmospheric conditions. The **FMI Arctic Research Centre in Sodankylä, Finland**, provides regular ground based observations of **passive microwave signatures** with several instruments in a boreal forest (taiga) environment, as well as a wide array of **supporting measurement on soil, snow cover and atmospheric properties**. These are also supported by a manual observation program which cover quantities not monitored by automated instruments (e.g. snow stratigraphy).

The SoRaX (Sodankylä Radiometer Experiment) was a dedicated campaign from August 2015 to March 2016, designed to **determine the influence of small-scale spatial variability of snow cover on microwave signatures**. Three radiometer systems (photo on left) were employed covering frequencies from L to W bands. The measurement area (IOA) locates in an opening of a coniferous forest with low surface vegetation (lichen and heather) on mineral soil.



Arctic Research Centre of Finnish Meteorological Institute (FMI-ARC) locates in Sodankylä, Finland

SodRad 1 & 2

- Radiometers (RPG-8CH-DP and RPG-4CH-DP by Radiometer Physics GmbH, Germany)
- SWE observations
- Frequencies 10.6, 18.7, 21, 36.5, 89 and 150 GHz, vertical and horizontal polarizations
- 2D scan every hour

ELBARA-II

- Radiometer (GAMMA Remote Sensing and Consulting, Switzerland)
- ESA SMOS satellite reference instrument
- Observations on soil moisture and soil freezing
- Frequency 1.4 GHz, vertical and horizontal polarizations
- Elevation scan every hour

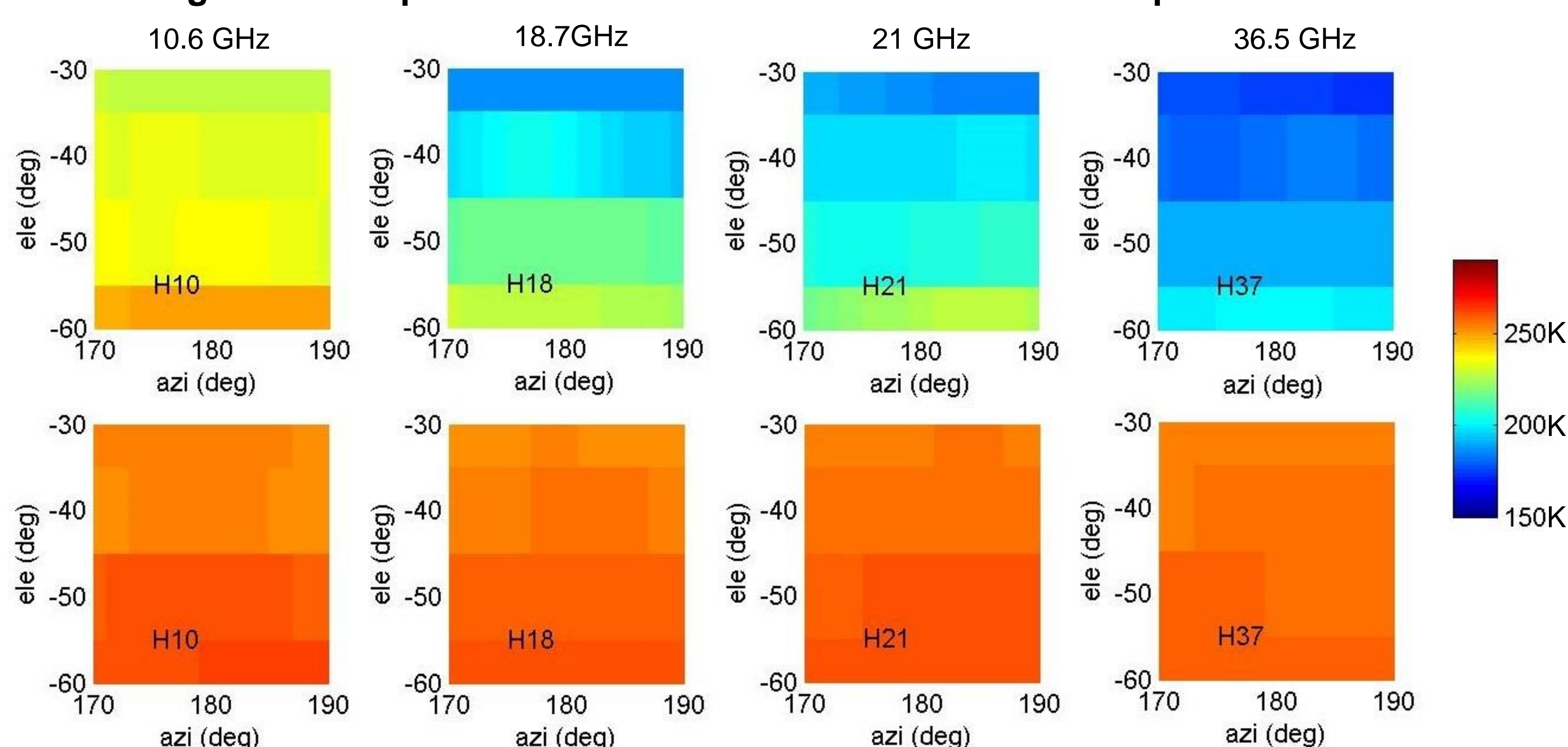
Reference measurements

- **Automatic measurements:** soil temperature and moisture profiles, snow depth, snow temperature profile, SWE, meteorological parameters, broadband albedo, reflectance with ASD Field Spec Pro JR and webcam.
- **Manual weekly measurements:** snow pit¹ (stratigraphy, grain size from macro-photographs, specific surface area (SSA) with IceCube, liquid water content (LWC) and density with SnowFork, density with cutter, temperature, SWE) and soil frost

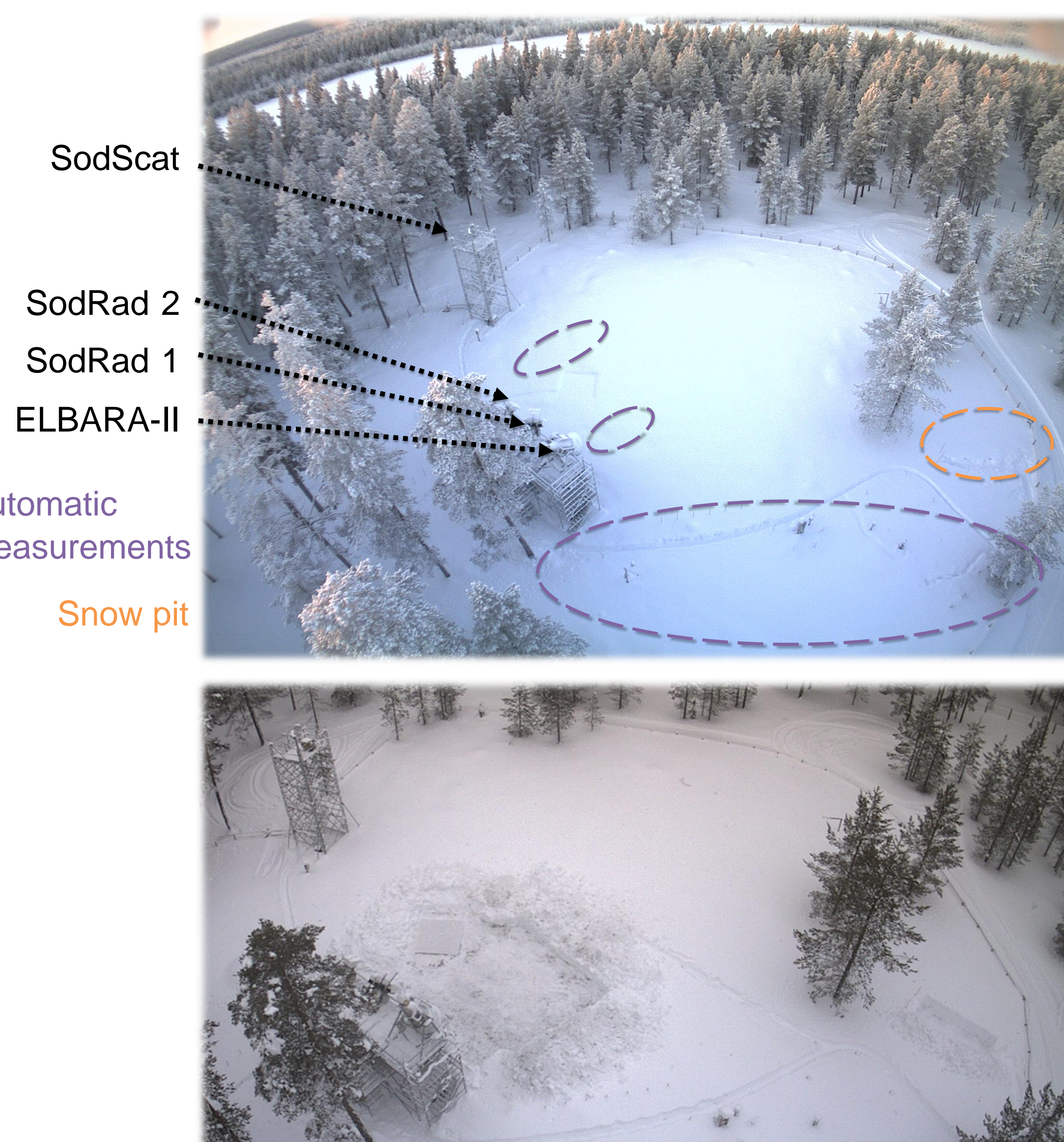
SoRaX data set

The radiometer data collected during SoRaX consists elevation and azimuth scans over the test field. The scans were performed every hour, providing a **near-continuous data set of brightness temperature variations both temporally and spatially**. Snow properties were defined manually in weekly snow pit measurements. The SoRaX experiment ended with a **snow removal experiment**, where snow in the test field was carefully quantified and manually removed. The measurements confirmed that snowpack is homogenous at IOA. Some of the brightness temperatures before and after the experiment are shown below.

Brightness temperatures before and after snow removal experiment



Brightness temperatures from horizontal polarization of 2D scan before (upper, 28 Feb 2016) and after (lower, 4 Mar 2016) removing snow from measurement area.



IOA is the measurement site of SoRaX experiment. Lower photo is taken after snow removal experiment.

More information about measurements at IOA and data availability in <http://litdb.fmi.fi/iaa.php>

¹Leppänen, L., Kontu, A., Hannula, H.-R., Sjöblom, H., and Pulliainen, J.: Sodankylä manual snow survey program, Geosci. Instrum. Method. Data Syst. Discuss., 5, 405-426, doi:10.5194/gid-5-405-2015, 2015.