Project acronym: UpForSnow

Project title: Upscaling forest snow process models in boreal forests

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Discipline: Earth Sciences & Environment: Water sciences/Hydrology

Station(s): Pallas-Sodankylä Research Station (Finland)

In forested regions, trees affect energy and mass exchange between the snow and the atmosphere. These processes vary over small spatial scales due to the complex three-dimensional structures of canopies, and create a spatially heterogeneous snow cover. Representing these complex interactions in coarse-resolution land surface models remains an unsolved problem, which limits the accuracy of these models in snow-covered forested environments. The proposed project will tackle this challenge, building on methods we have developed following an INTERACT TA campaign in 2019. Having shown that detailed representation of canopy radiative transfer is key for successful simulations of forest snow cover dynamics at the meter scale, we now aim to extend our modelling concepts to enable simulations at coarser resolutions and over large extents. This requires 1) continued refinement of our meter-scale modelling approaches and 2) adapting our existing radiative transfer modelling capabilities to work with simpler canopy structure datasets that are typically available at regional scales. The proposed campaign at the Sodankylä Arctic Research Station targets the acquisition of data that will allow us to advance our current models accordingly. We plan to capture a wide range of relevant forest structures at diverse sites in and around the station with high-resolution hemispherical images and canopy height information from UAV-LiDAR. These data will allow us to calibrate and test a new radiative transfer model based on the Finnish low-resolution lidar dataset. Moreover, meteorological observations from ground-based and UAV-borne multi-sensor platforms and coincident snow depth distribution surveys in heterogeneous forest will provide a complementary dataset for further enhancement and validation of our forest snow model. The Sodankylä station is ideally suited for our purposes, given the interesting forest structure in its surroundings in

combination with minimal topographic influences, and high-quality meteorological data as well as extraordinary long-term snow monitoring efforts from FMI. This work will provide modelling solutions for improved estimates of forest snow cover dynamics over regional extents, ideally suited to study the impacts of ongoing environmental change in boreal forest environments.