EGU25-45, updated on 12 Apr 2026
https://doi.org/10.5194/egusphere-egu25-45
EGU General Assembly 2025

Improvement of the CLASSIC Snow Model to Better Simulate Arctic Snowpacks

Mickaël Lalande[1], Christophe Kinnard[1], and Alexandre Roy[2]
[1]GLACIOLAB, UQTR, Trois-Rivières, Canada
[2]ReMoTE-Nord, UQTR, Trois-Rivières, Canada

Current snow models – including the most sophisticated ones, such as CROCUS and SNOWPACK – struggle to properly simulate Arctic snowpack characteristics such as density profiles. Indeed, those models have been developed and designed for Alpine snowpacks, which evolve differently from Arctic ones due to higher wind speeds, increasing the compaction of the upper snowpack layers, and stronger temperature gradients, inducing upward water vapor fluxes within the snowpack and influencing the compaction and metamorphism. Both phenomena – combined with complex interactions with the vegetation – are at the origin of the wind-slab and depth hoar formation in Arctic snowpacks. The Canadian Land Surface Scheme including Biogeochemical Cycles (CLASSIC) – being the Canadian Earth System Model (CanESM) land surface component – uses a medium-complexity single-layer snow scheme. Whether correctly representing Arctic snowpack bulk characteristics requires a multilayer approach over a single-layer snow scheme is still an open question. To assess the model skills, 1D simulations were performed at ten sites – including three Arctic sites. Improvements in the snow model scheme were carried out, including three new parameterizations to better represent Arctic snow: (1) blowing snow sublimation losses, (2) wind inclusion in the computation of fresh snow density, and (3) increased wind compaction. Those improvements allow most of the current model skills to be improved at the Arctic sites. Uncertainties related to the meteorological forcing, variable measurements, snow drift, and model bias compensations are a perpetual challenge in those model assessments. Future studies will involve spatial evaluation of those model developments in addition to implementing new snow cover fraction parameterization in CLASSIC. The influence of these new developments will be assessed against the ESA Snow CCI variables for different land types and for the simulated surface energy and carbon fluxes.