



Environment and
Climate Change Canada

Environnement et
Changement climatique Canada

Theme 3 (Modelling) update

PermafrostNet AGM
Nov 2023



Environment and Climate Change Canada's 50th anniversary
50^e anniversaire d'Environnement et Changement climatique Canada

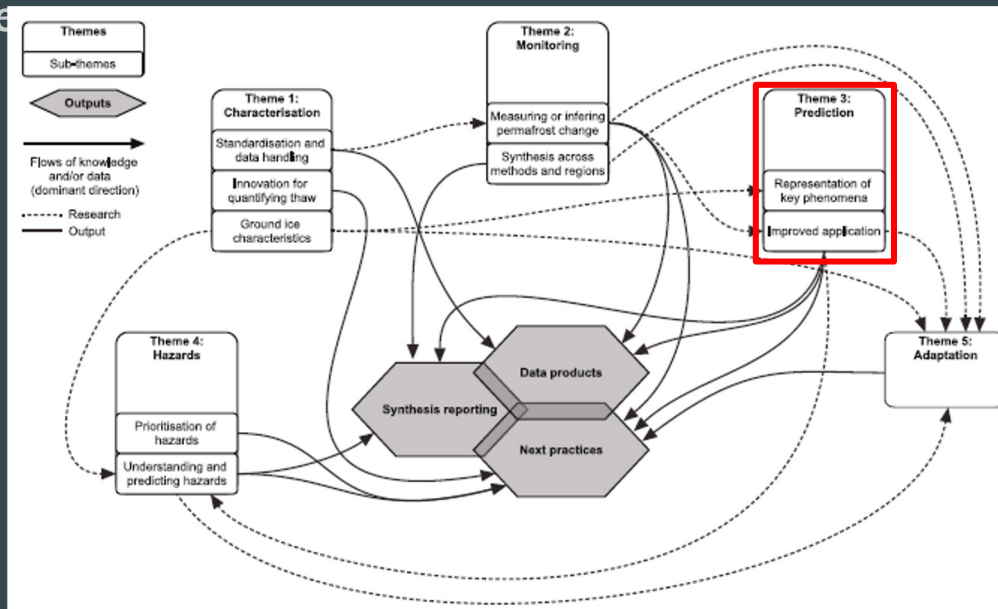
Meteorological Service of Canada's 150th anniversary
150^e anniversaire du Service météorologique du Canada



Canada

Theme 3's role in the network

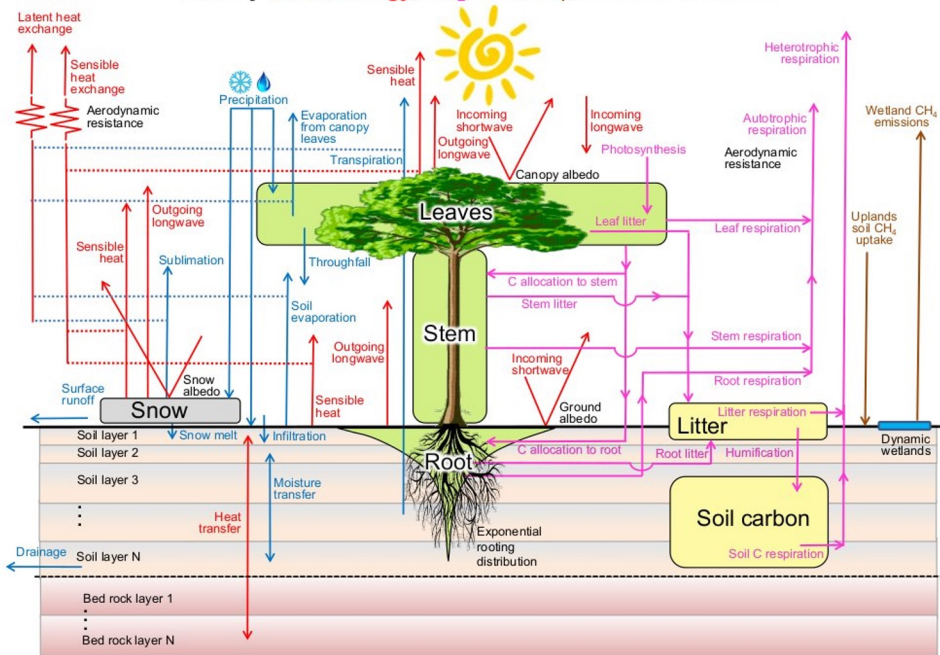
- Objective: Improve the accuracy and delivery of transient permafrost simulation so that its results can support stakeholder needs at local and national scale



Theme 3's tools

FreezeThaw1DExIce

Primary water, energy, CO₂, and CH₄, fluxes in CLASSIC



CLASSIC

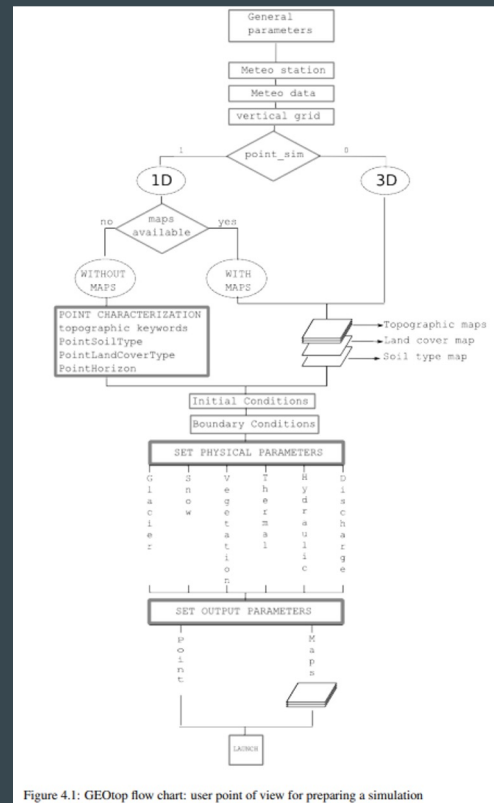


Figure 4.1: GEOtop flow chart: user point of view for preparing a simulation

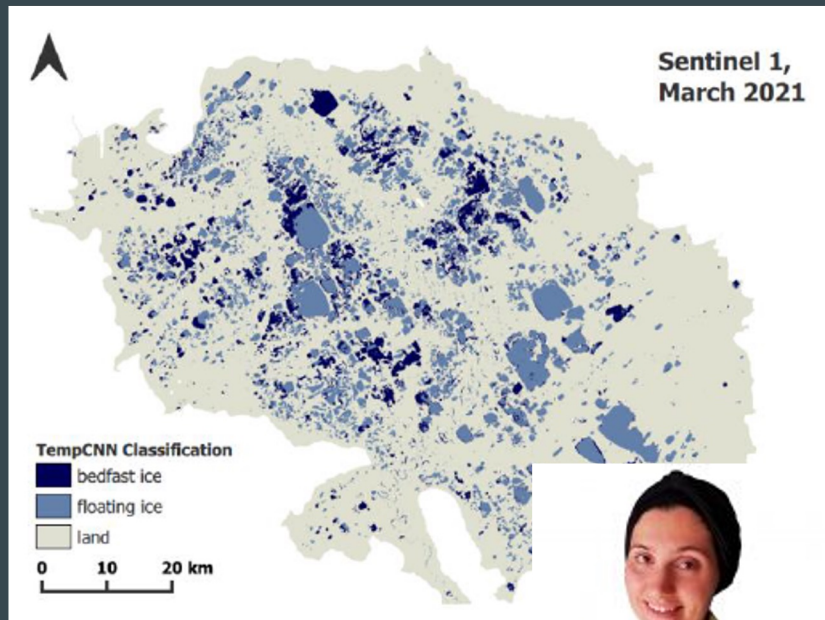
GEOtop

Present status: Completed projects

Thesis:
*Temporal Deep Learning Approach to
Bedfast and Floating Thermokarst Lake Ice
Mapping using SAR imagery: Old Crow Flats,
Yukon, Canada*

Maria Shaposhnikova, MSc (with C. Duguay)

- Old Crow Flats, Yukon
- Methods:
 - Introduced and implemented a temporal deep learning approach for analysis of time series of synthetic aperture radar imagery (SAR; Sentinel 1, ERS1/2, RADARSAT 1)
 - Produced labeled dataset of bedfast ice, floating ice or land
 - Trained temporal convolutional neural network (TempCNN) from dataset
 - Period: 1993 - 2021
- Found an extensive transition to bedfast ice caused by growing number of catastrophic drainages resulting from climatic warming and thermokarst processes



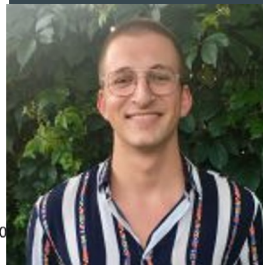
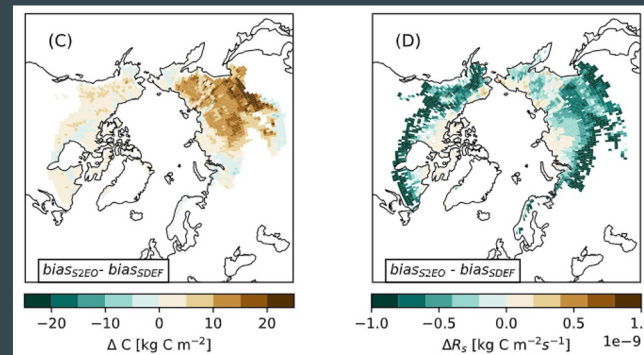
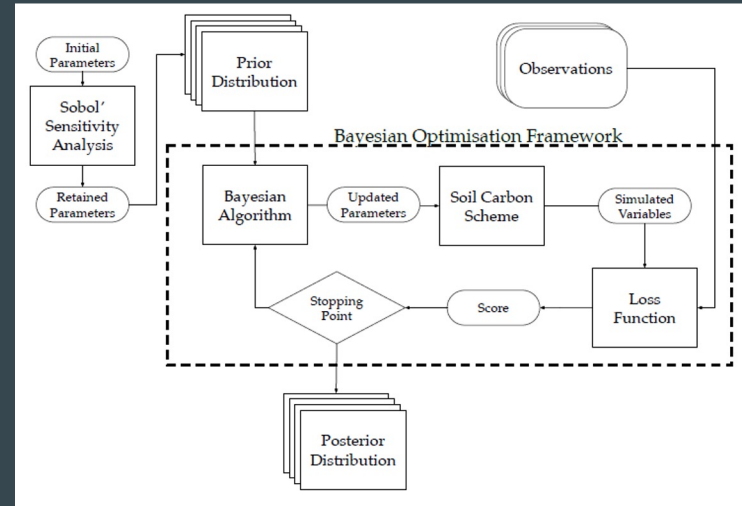
Thesis:

Optimisation des paramètres de carbone de sol dans le modèle CLASSIC à l'aide d'optimisation bayésienne et d'observations

Present status: Completed projects

Charles Gauthier, MSc (with J. Melton and O. Sonnentag)

- Where: Global
- Methods:
 - Performed parameter sensitivity analysis for soil carbon scheme of CLASSIC terrestrial biosphere model
 - Most sensitive parameters were optimized in Bayesian framework against observations
 - soil C and respiratory fluxes
 - Optimal parameters used in global simulations of present day and future conditions and compared to CLASSIC default values
- More accurate soil C simulation and response to future climate change
 - Important differences: SSP-370 now sees a net loss in soil C, default model gave increase



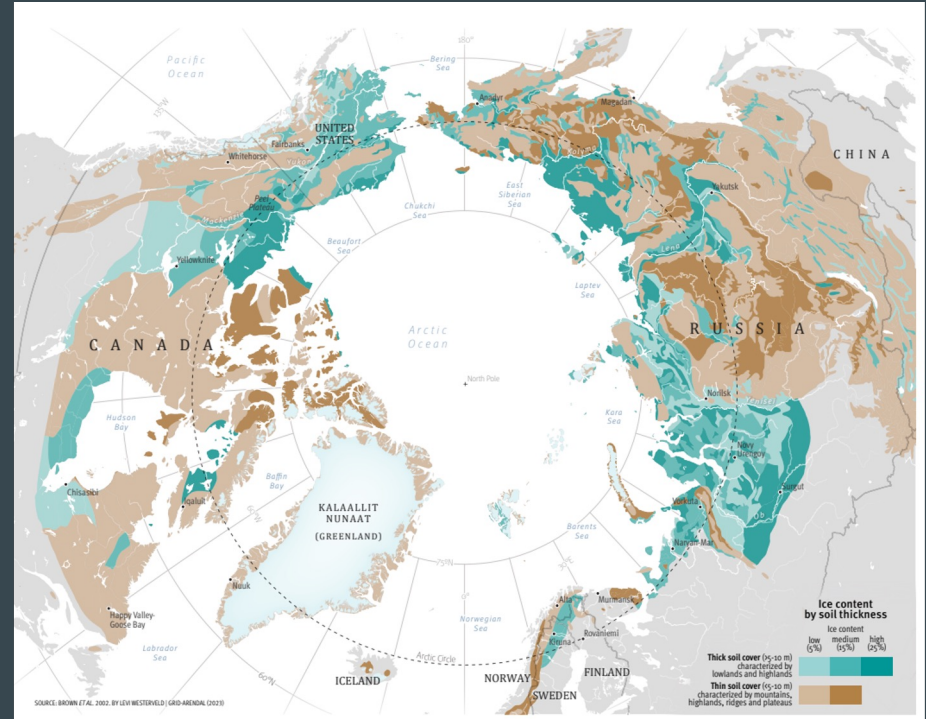
Present status: Projects underway

- Hannah Macdonell (MSc with S. Gruber)
 - Quantifying confidence in simulations
 - See talk and poster
- Galina Jonat (PhD with S. Gruber)
 - Simulation-based climate services for permafrost environments
 - See talk
- Rose Lefebvre (MSc with O. Sonnentag and J. Melton)
 - Simulating land cover change and its influence on permafrost with CLASSIC
 - See poster



Present status: It's complicated...

- Incorporation of excess ground ice and its impacts into CLASSIC
 - PhD project abandoned
 - Project converted to PDF, but no candidate at present
- Mapping and parameterising permafrost terrain types
 - PhD project abandoned
- Loss of these projects makes it challenging for contributions to synthesis products



Plans for the theme

- Continue to support student projects underway
- Planning is underway to try and backfill for the missing PhD projects
 - Potential to generate smaller domain mapping of ground ice along with some model simulations

