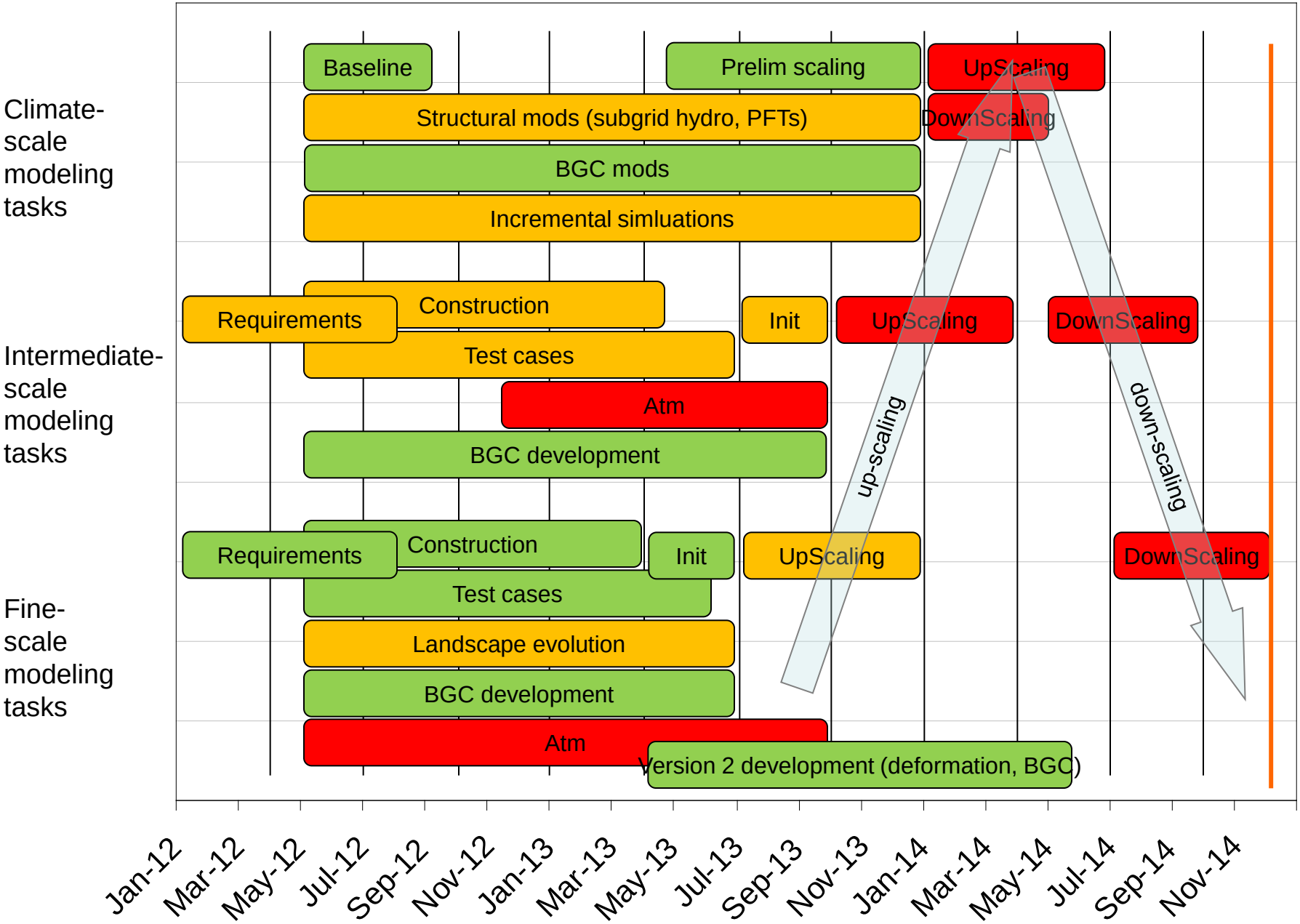
NGEE-Arctic Phase 1 Scaling Objectives

- Deliver fine scale models of coupled surface-subsurface thermal-hydrological-biogeochemical dynamics, informed by observations from BEO and broader Arctic tundra landscape.
- Deliver climate-scale models which receive initialization and parameterization information (modeled and observed) from finer scales.
- Develop intermediate-scale models as needed to bridge gaps between fine-scale and climate-scale.
- Demonstrate improved climate-scale process representation through upscaling and downscaling iteration: evaluate against independent observations.

Timeline for initiation and completion of major modeling tasks



Fine-scale modeling lessons learned (the non-expert's interpretation)

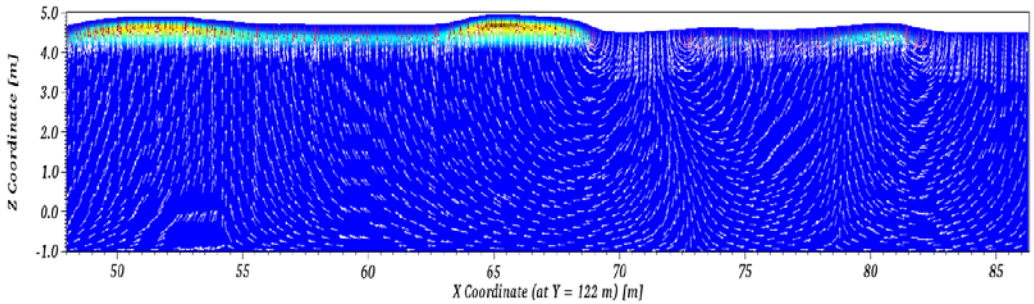
- Compressibility of soil matrix is an essential feature of the simulations

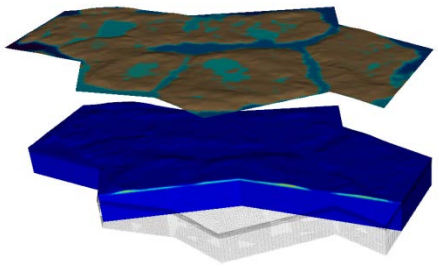
- Surface flows in flat terrain require velocity damping to avoid "sloshing"

- Not all surface grids are created equal
- Snow pack accumulation/melt and snow redistribution important and challenging

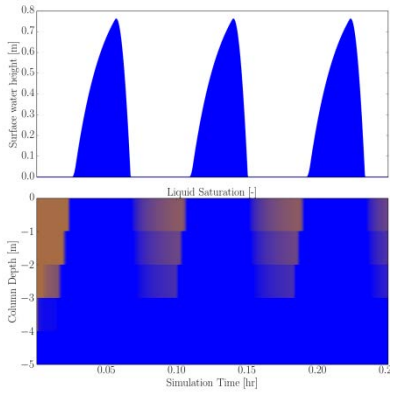
Fine-scale modeling highlights

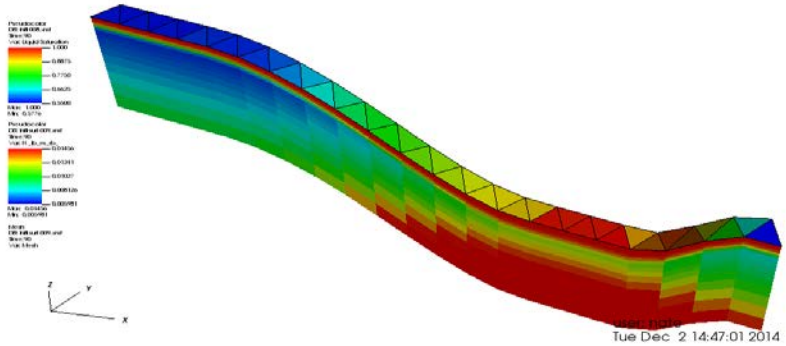
- 1D, 2D, and 3D surface-subsurface thermal-hydrology coupling achieved in ATS.



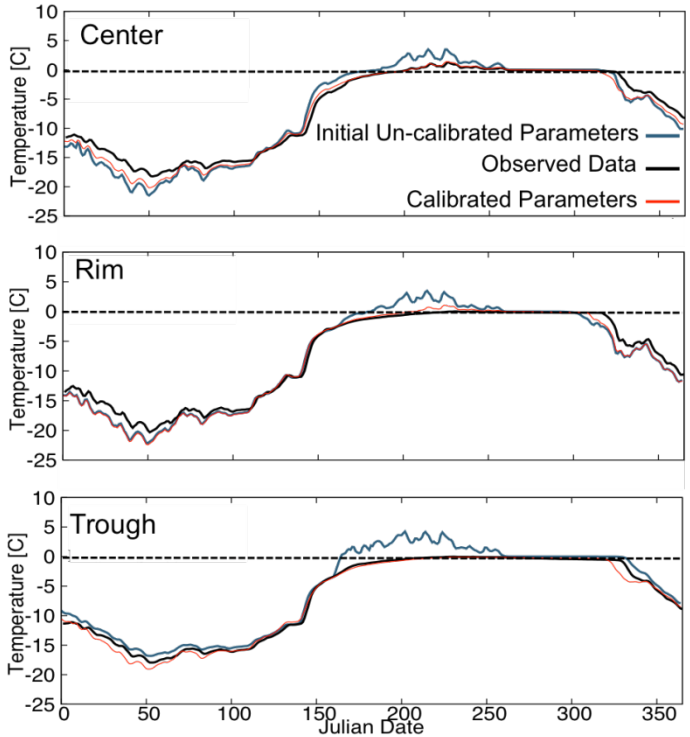


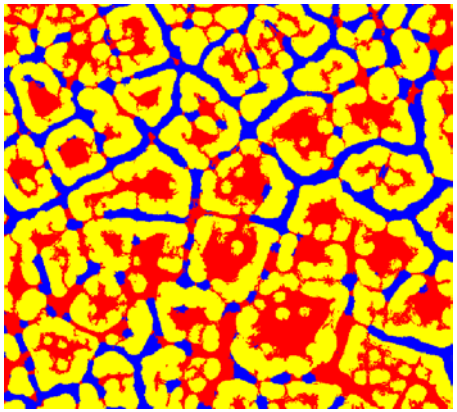
- 1D, 2D surface-subsurface thermal-hydrology coupling achieved in CLM-PFLOTRAN.

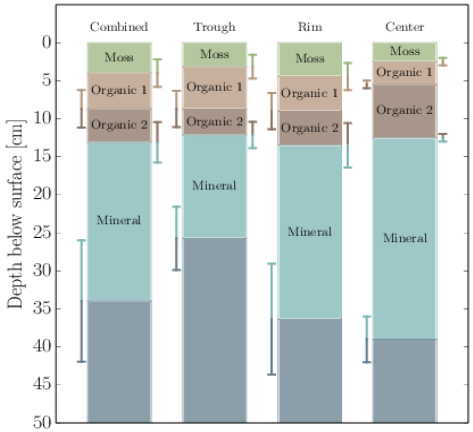




Integration of observations







Temperature data used to parameterize ATS

Vegetation and material property data used to parameterize fine and intermediate-scale meshes

Coupling to biogeochemistry

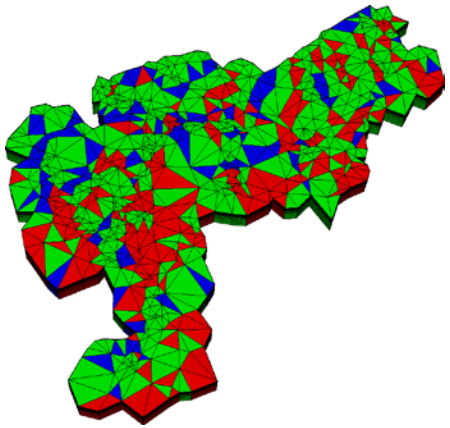
- PFLOTRAN reaction networks can now reproduce behavior of CLM biogeochemistry.
- BGC can be driven by thermal-hydrology from either CLM or PFLOTRAN.
- Generality still being explored for other species (e.g. CH_4, P cycle) and for redox reactions.
- Allows evaluation of multiple nutrient limitation hypotheses.

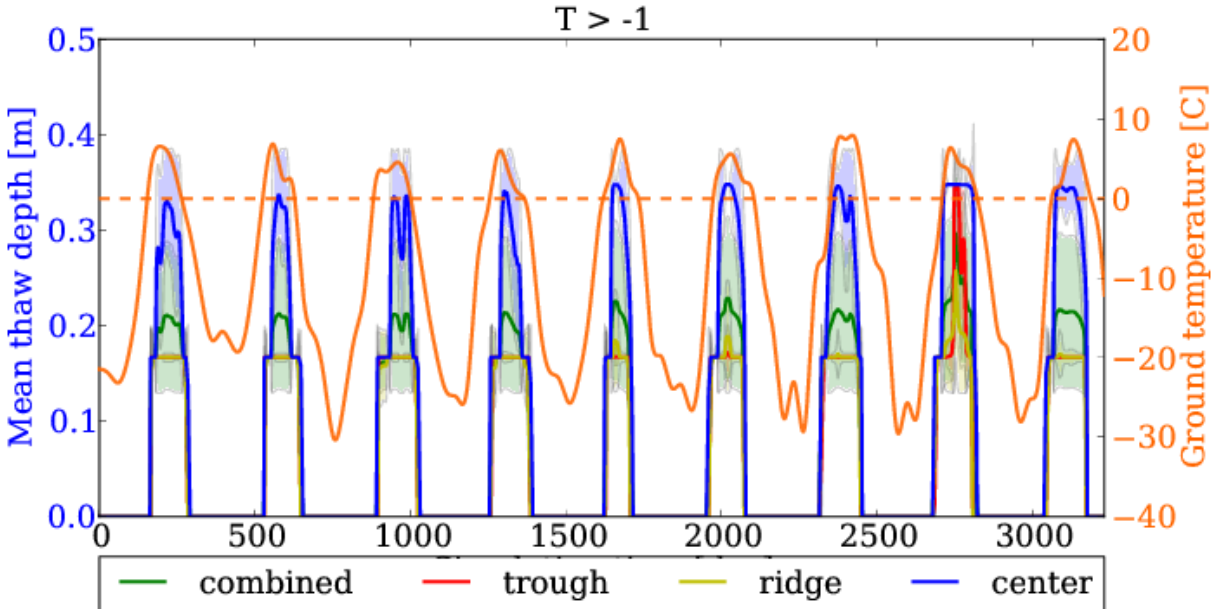
Climate-scale modeling

- Multiple interacting column hydrology evaluated (collaboration with ORNL TES-SFA, CLM-SPRUCE)
- Broad-scale Arctic PFTs parameterized, using field observations and parameter optimization, demonstrated in CLM-PF (Fengming Yuan, poster).
- Inundated area fraction parameterization remains to be done (primary scaling variable)

Intermediate-scale modeling

- Explorations of intermediate-scale meshing and PFLOTRAN simulations underway





Coming up:

- Mark Lara
  - Geomorphology and landscape characterization, with upscaling and modeling applications
- Scott Painter and Ethan Coon
  - Arctic Terrestrial Simulator (ATS) results and connection to observations
- Gautam Bisht
  - Reduced form modeling results and application to scaling