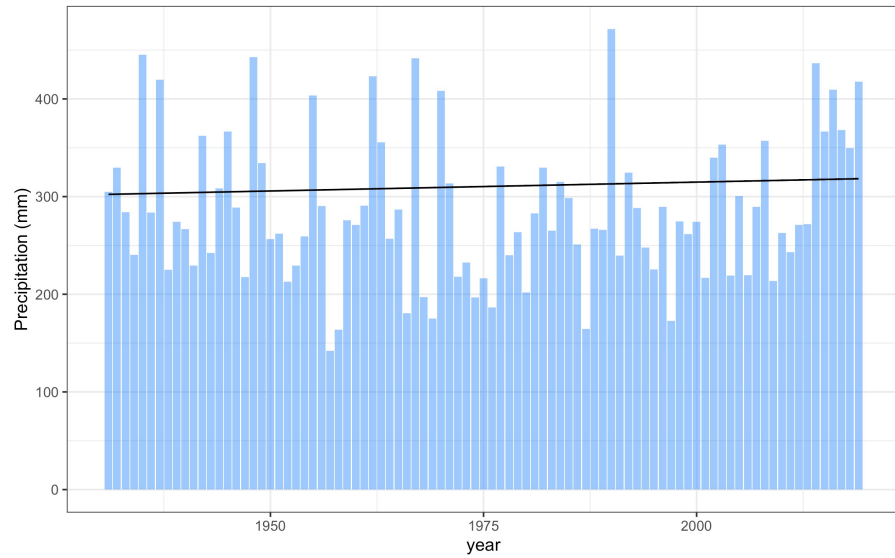


Permafrost and Ecohydrology Working Group

Motivations

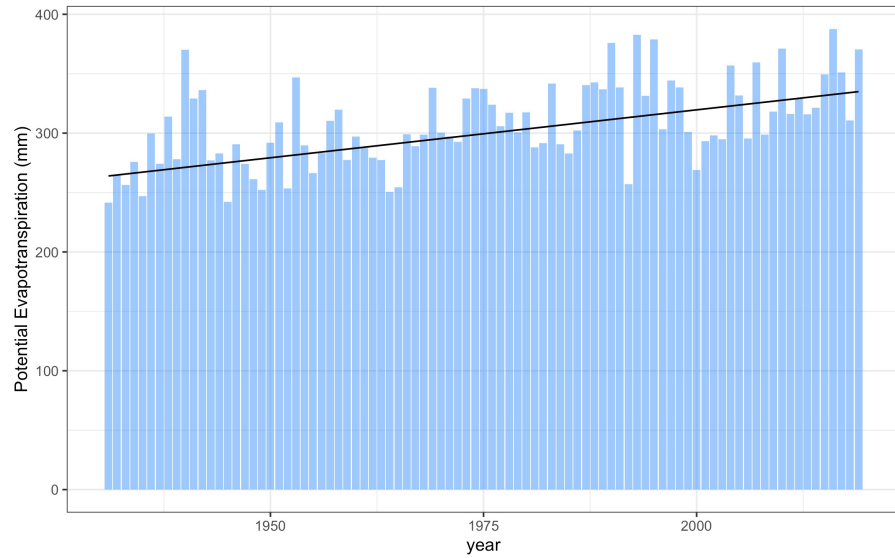
Fairbanks International Airport

Trend = 0.18



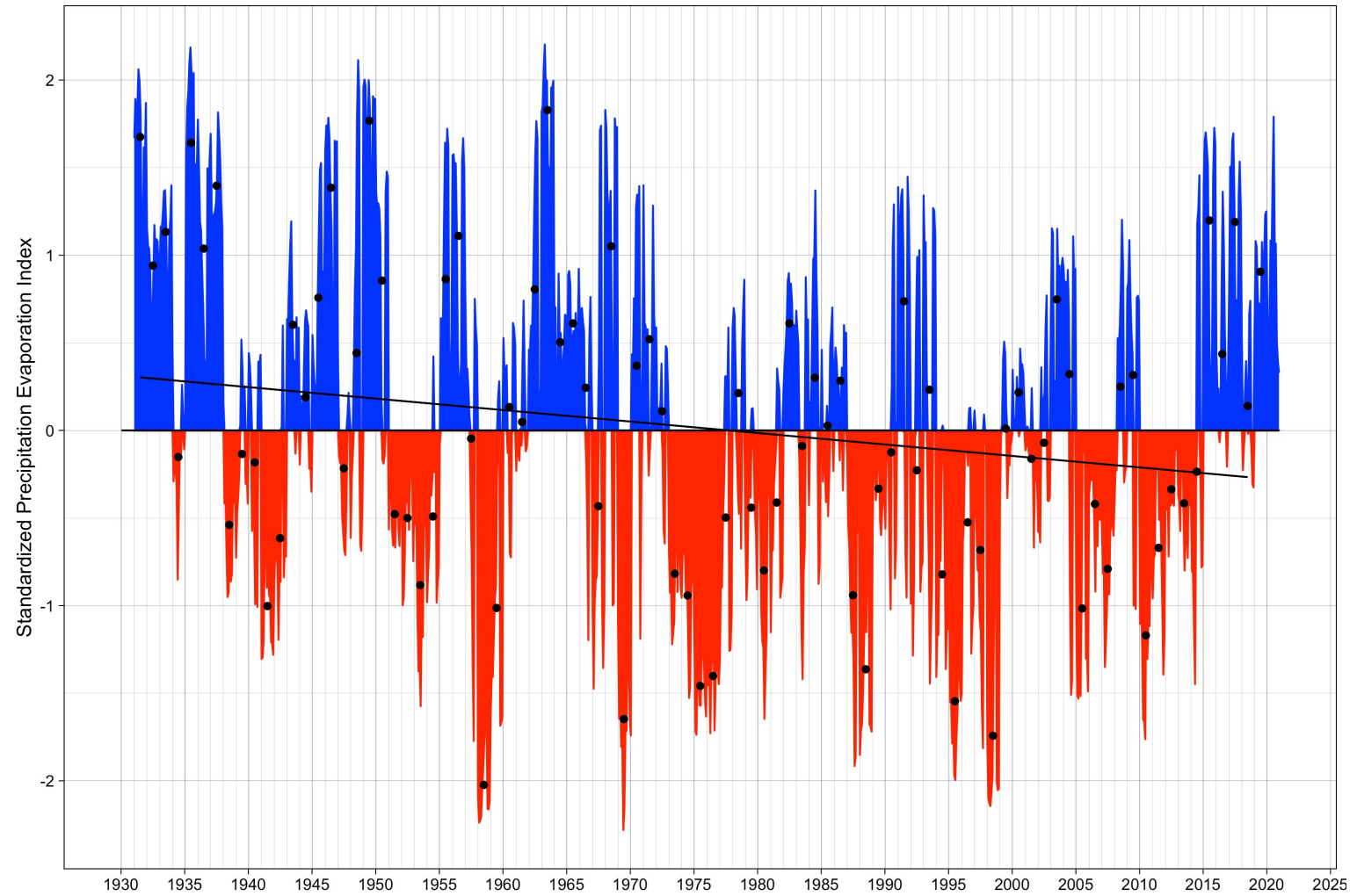
Fairbanks International Airport

Trend = 0.81



Fairbanks International Airport

Trend = -0.0065



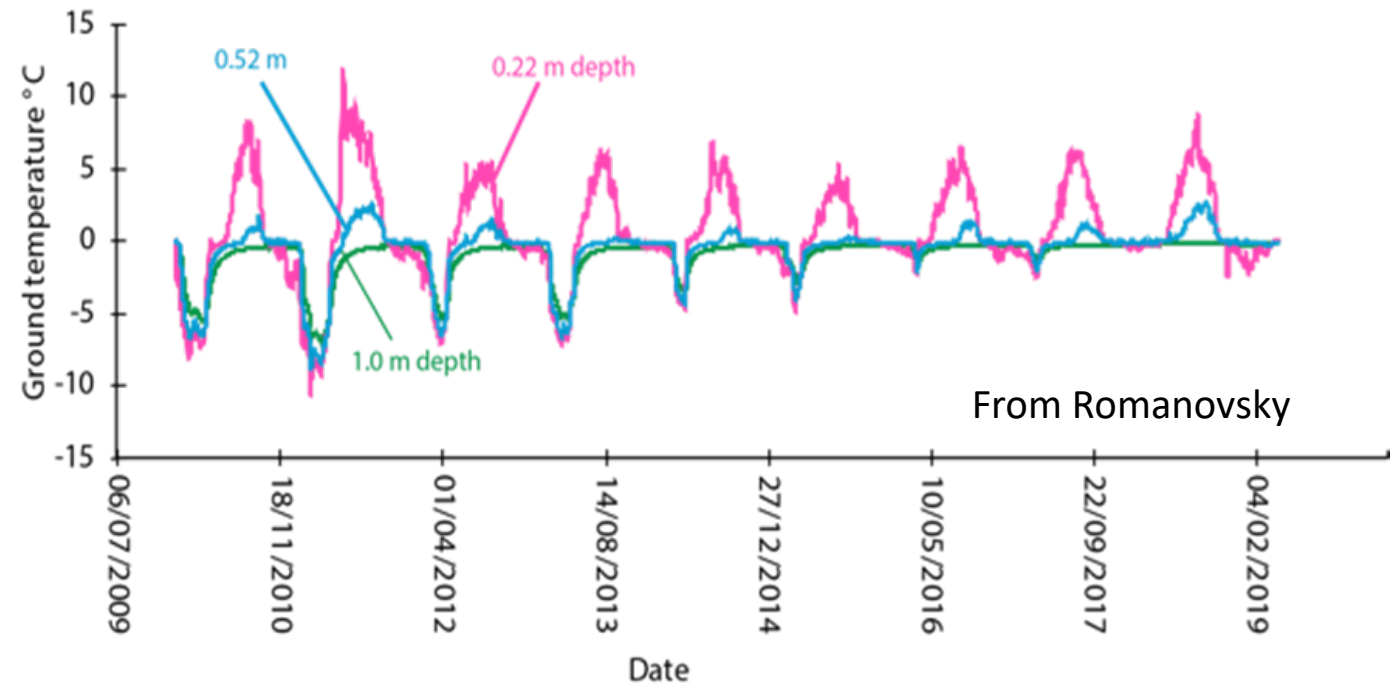
Motivations

Environmental Research Letters

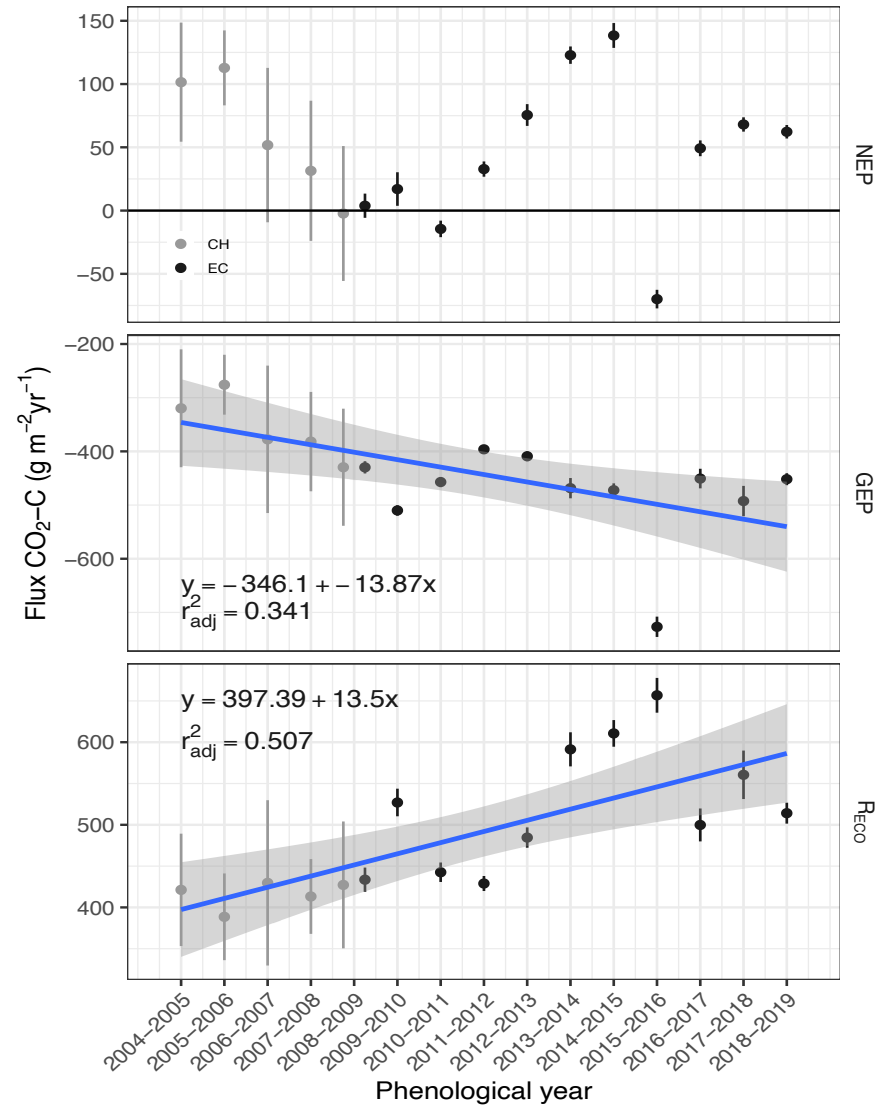
Development of perennial thaw zones in boreal hillslopes enhances potential mobilization of permafrost carbon

Michelle A Walvoord¹, Clifford I Voss², Brian A Ebel¹ and Burke J Minsley³

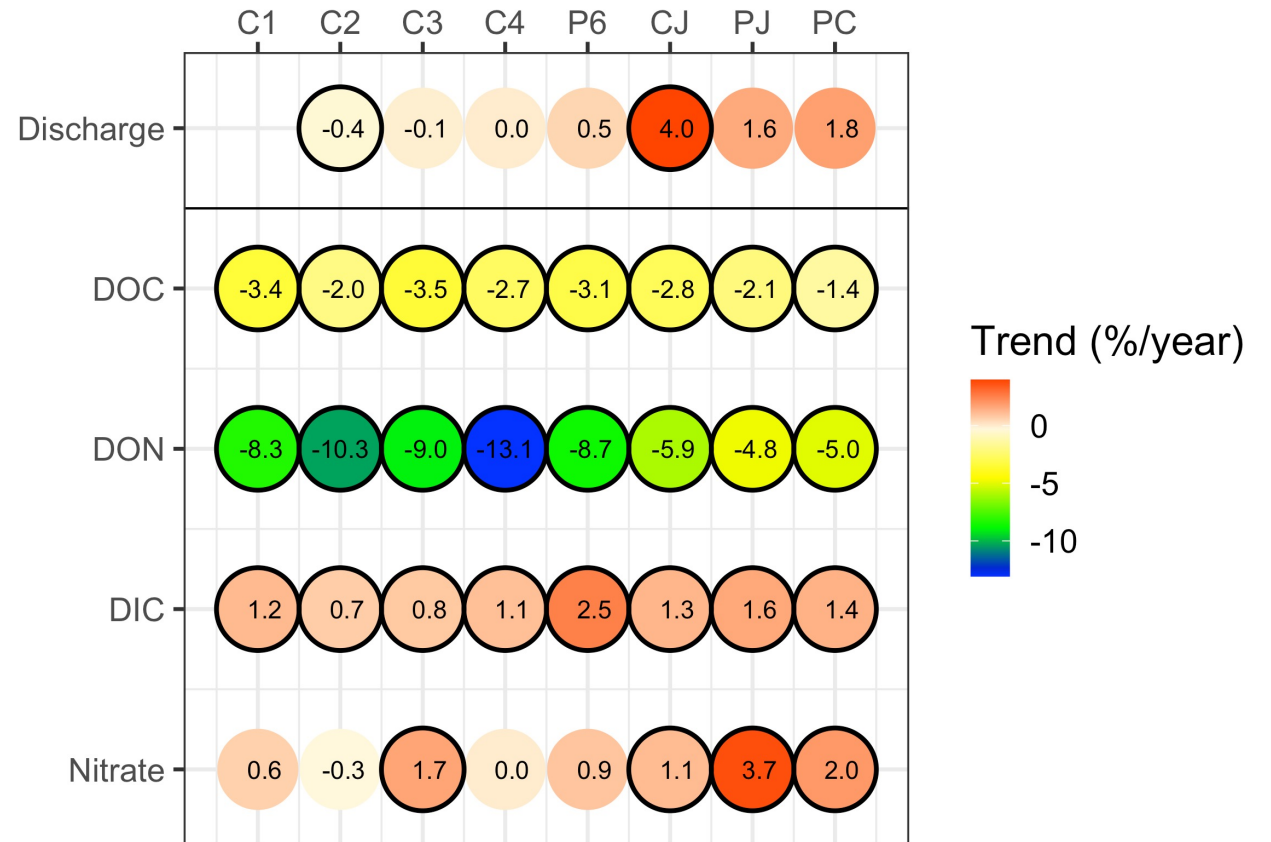
Bonanza Creek 2010-2019 ground temperature



Motivations



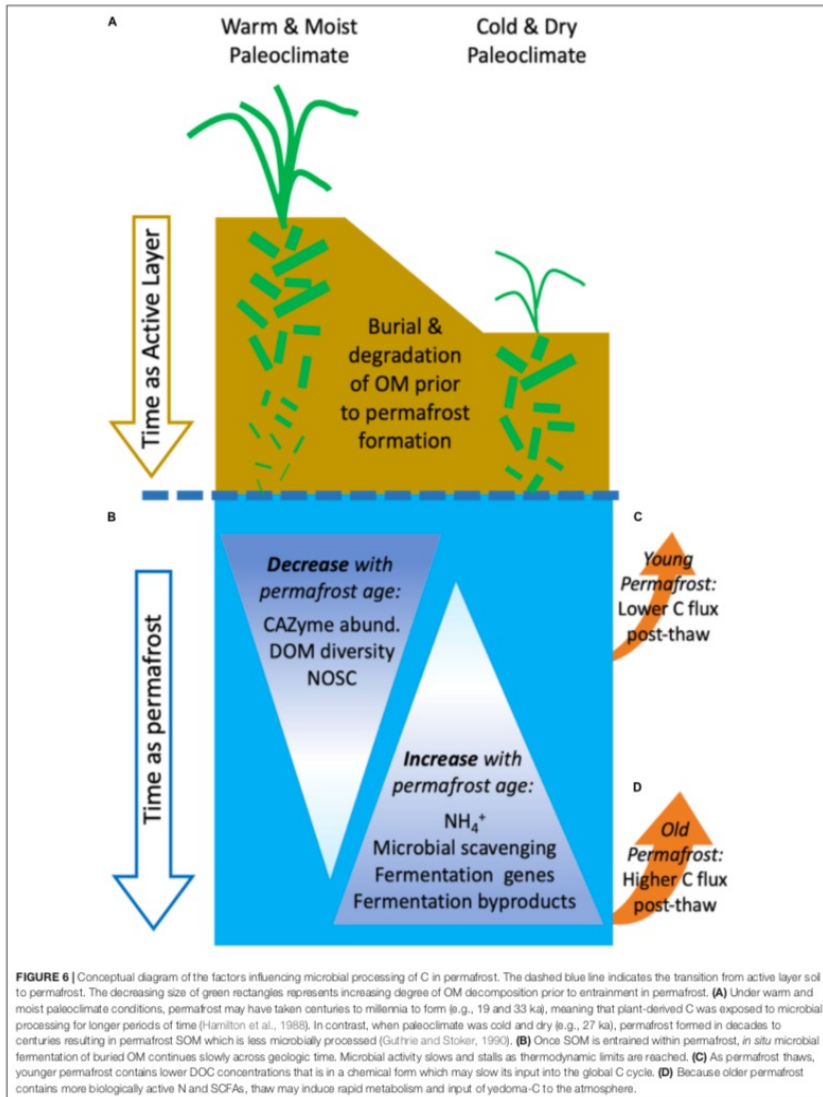
From Schuur et al.



From Jones et al.

Motivations

- Increased drying across the landscape
- Deepening of active layer and formation of lateral taliks
- Changes in hydrologic connectivity between terrestrial and aquatic ecosystems
- Permafrost stored carbon, which has been transformed by microbial processing
 - Potentially highly labile
 - Lower C:N
- Changing carbon exchange between terrestrial and the atmosphere
- Altered solute and gaseous inputs into aquatic ecosystems

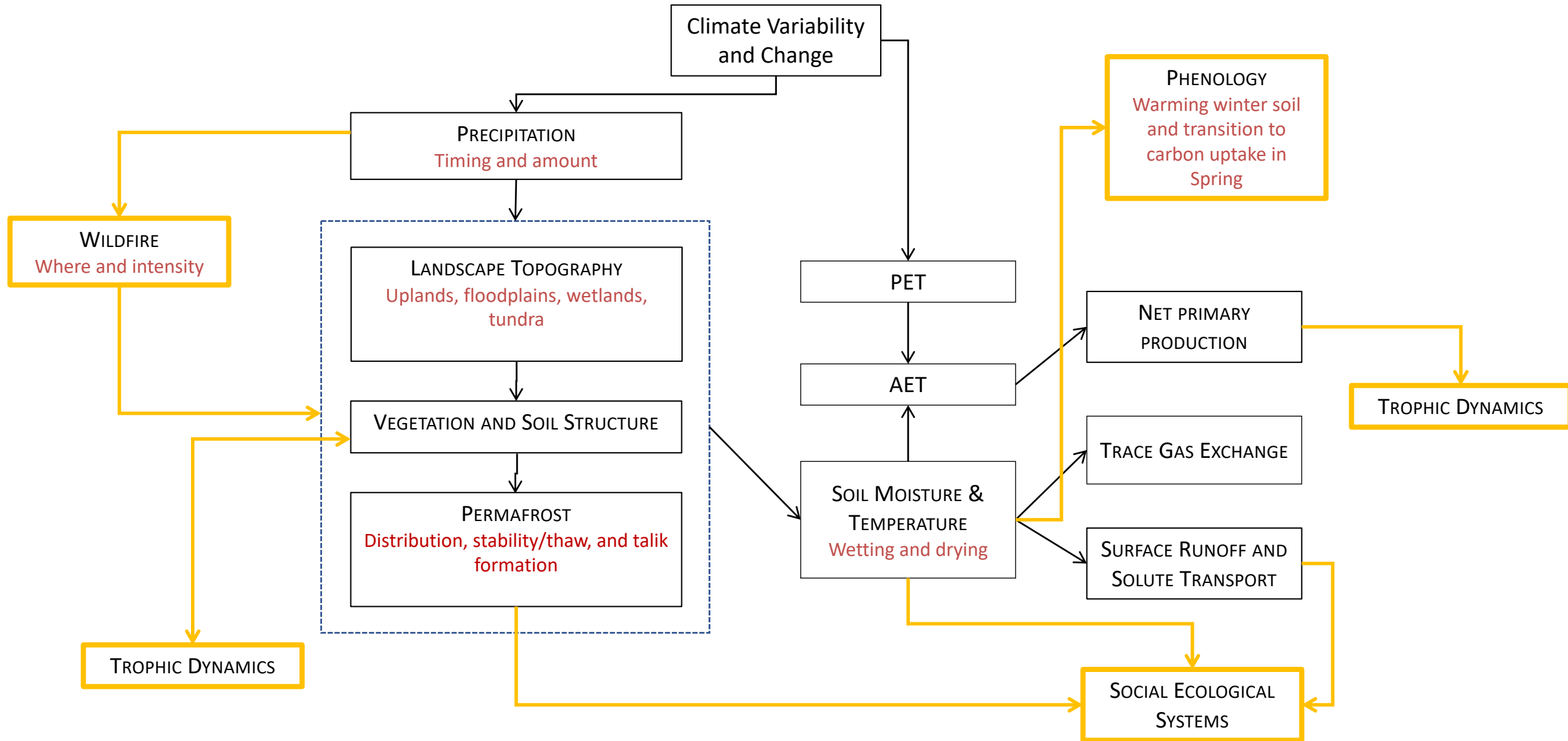


From Leewis et al. 2020

Research Questions

- What is the effect of changing permafrost on ecosystems, global carbon cycling, and the feedback to climate?
 - How will the development of taliks influence the seasonal release of permafrost carbon?
 - Does permafrost degradation release old carbon as greenhouse gases or export into lateral or aquatic ecosystems?
 - Where and when will permafrost recovery occur following disturbance by wildfire?
 - What is the role of forest and fire management practices on permafrost resilience?
 - What is the influence of changing temperature, precipitation, and climate extremes on ecosystem processes?
- How will permafrost thaw alter biogeochemical coupling to affect plant productivity, fitness, and competition
 - Role of biomass and altered rhizosphere on ecosystem carbon balance?
- What are the impacts of thawing permafrost on human & wildlife livelihood (wildlife habitat, water quality, access and infrastructure)?

Connections to other themes



Connections to broader research questions

- A. How do the thermal, material and information legacies of the past constrain the response of the Alaskan boreal forest to climate change?
 - Permafrost condition is the thermal legacy that is now changing
 - Carbon stored in permafrost is a material legacy, which will impact ecosystems as it is released

- B. How will these legacies affect future ecosystem trajectories and emergent states, and what are the local, regional, and global impacts of those responses now and in the future?
 - The input of C and N into terrestrial and aquatic ecosystems will have a large impact on the ultimate fate of ecosystem response, from ecosystem to global scales

- C. What are the consequences of these transitional dynamics and state changes for net regional feedbacks to climate and social ecological systems?
 - CO₂ and CH₄ input into atmosphere and transport to oceans
 - Alteration of river flows and ground stability affecting movement of humans and animals across landscape
 - Feedback on distribution of vegetation, which in turn will alter wildfire intensity and distribution

Use of core data stream

- Active layer depths
- Soil moisture data
- Stream flow and chemistry data
- Soil moisture
- Meteorological data
- Snow survey and snow pillow
- NADP precipitation and chemistry
- Permafrost Laboratory ground temperature data
- Active layer depth
- Also need to consider other datasets that will be updated and understood annually
 - EML and APEX

Modeling

- Comparison across models of model parameter uncertainty
- Retrospective modeling of watershed hydrology and solute fluxes
- Modeling of coupling between terrestrial CO₂ production and stream export

Connections to integrative themes

- Education
 - Development of teaching modules to use online data in undergraduate education
 - Use of LTER data in course exercises

Aspirational goals

- Collaborative science: more than one scientist working together to tackle bigger and more complex questions, share resources more effectively, compliment or reinforce skill sets, mentor early career scientists, and generate novelty
 - Permafrost Carbon Network
 - Cross-site synthesis efforts