



# Integrating Boots-on-the-Ground Observations with the Virtual World of Models to Answer Big Science Questions Across the Arctic



Colleen Iversen  
On Behalf of the NGEE Arctic Team  
IDEAS-Watersheds  
28 May 2024



# Acknowledgements

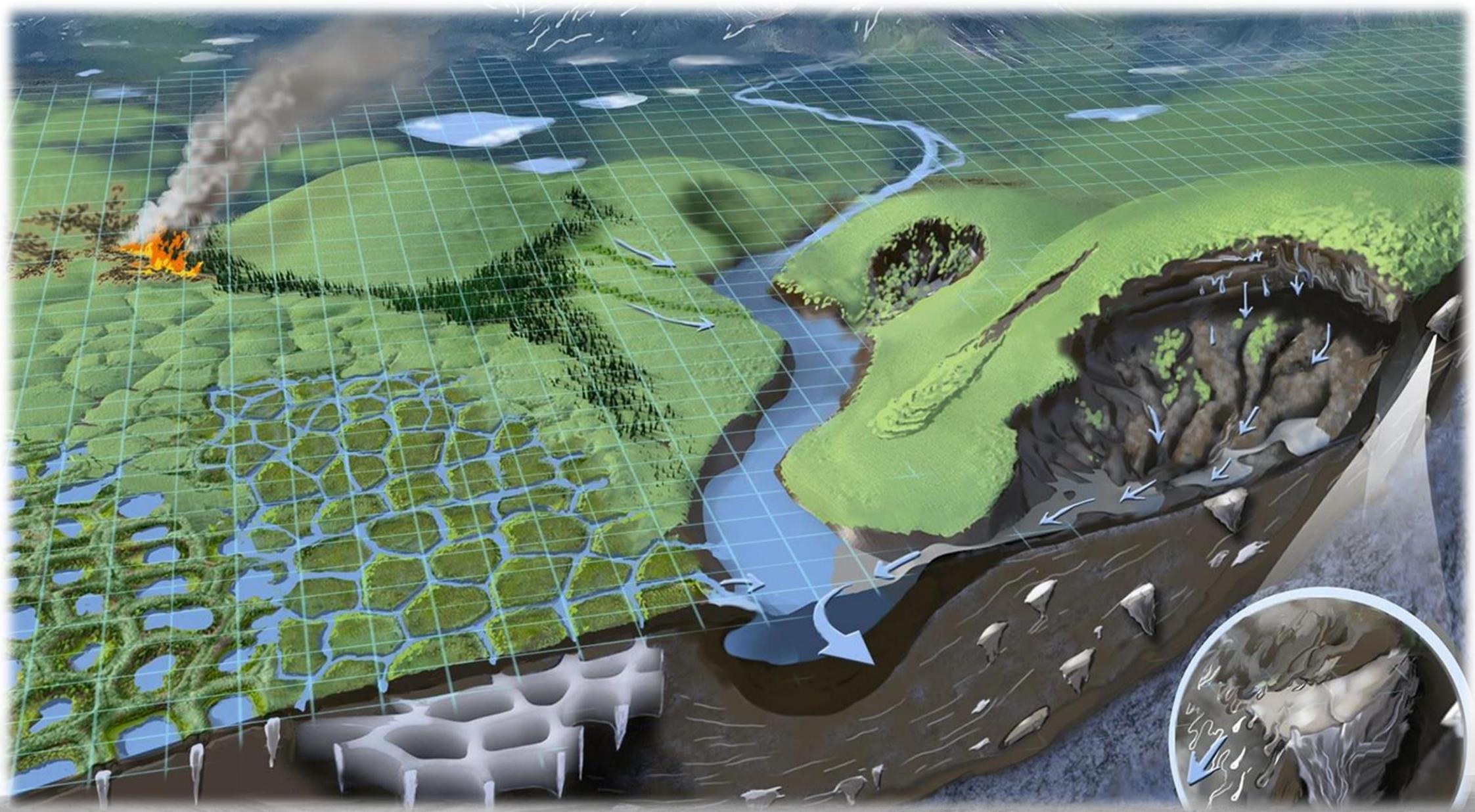
NGEE Arctic is supported by the Biological and Environmental Research Program in the Department of Energy's Office of Science.

We thank our partners from the Native Communities in Alaska for allowing us to conduct our research on the traditional homelands of the Iñupiat, including the UIC Science, Mary's Igloo, Council, Sitnasuak, and Bering Straits Native Corporations.

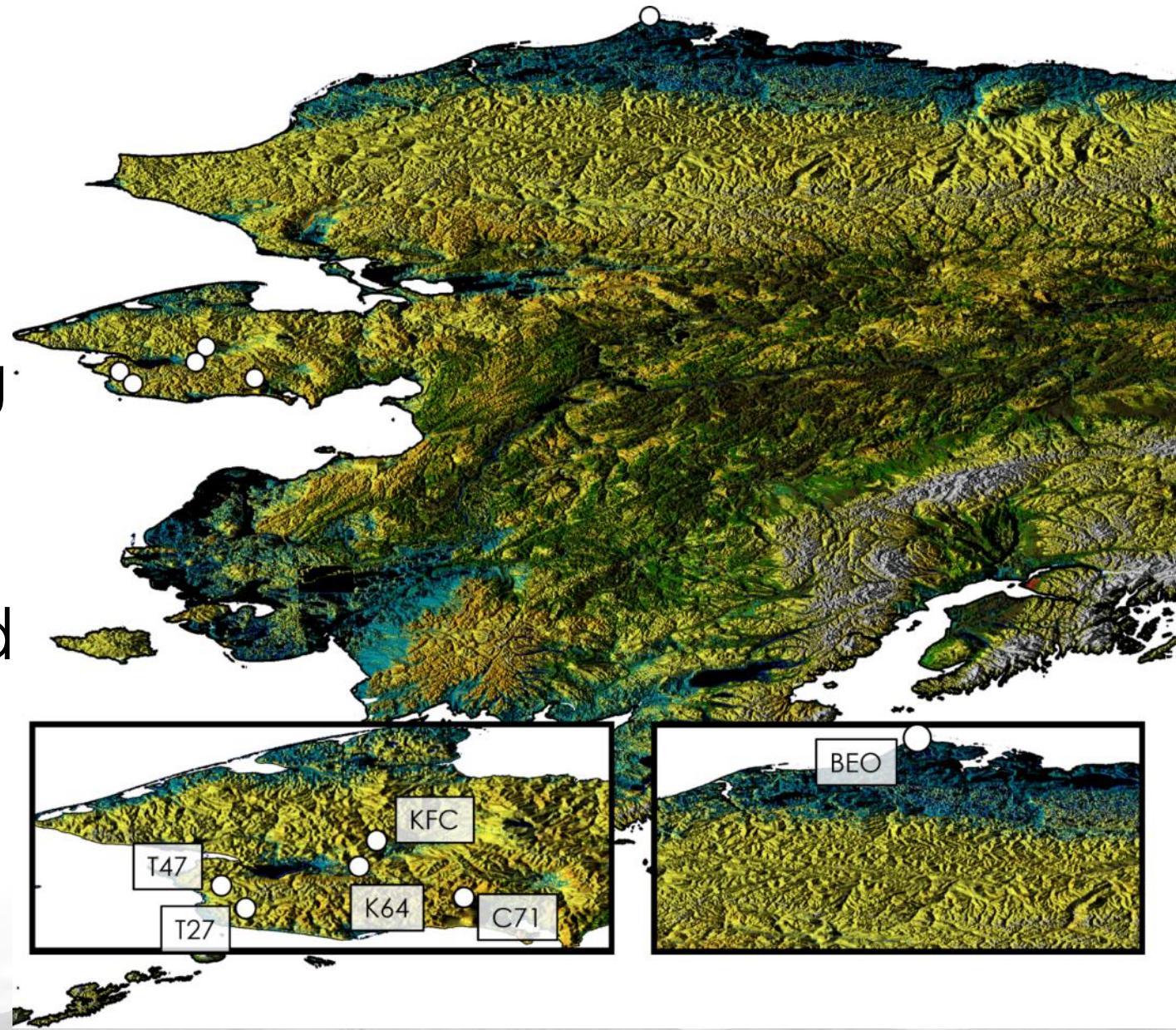
We also thank our Science Advisory Board as well as colleagues in Utqiagvik and Nome, Alaska, for their insights and support.

NGEE Arctic is underscored by a foundation of open science and data sharing and a safe, inclusive project culture.

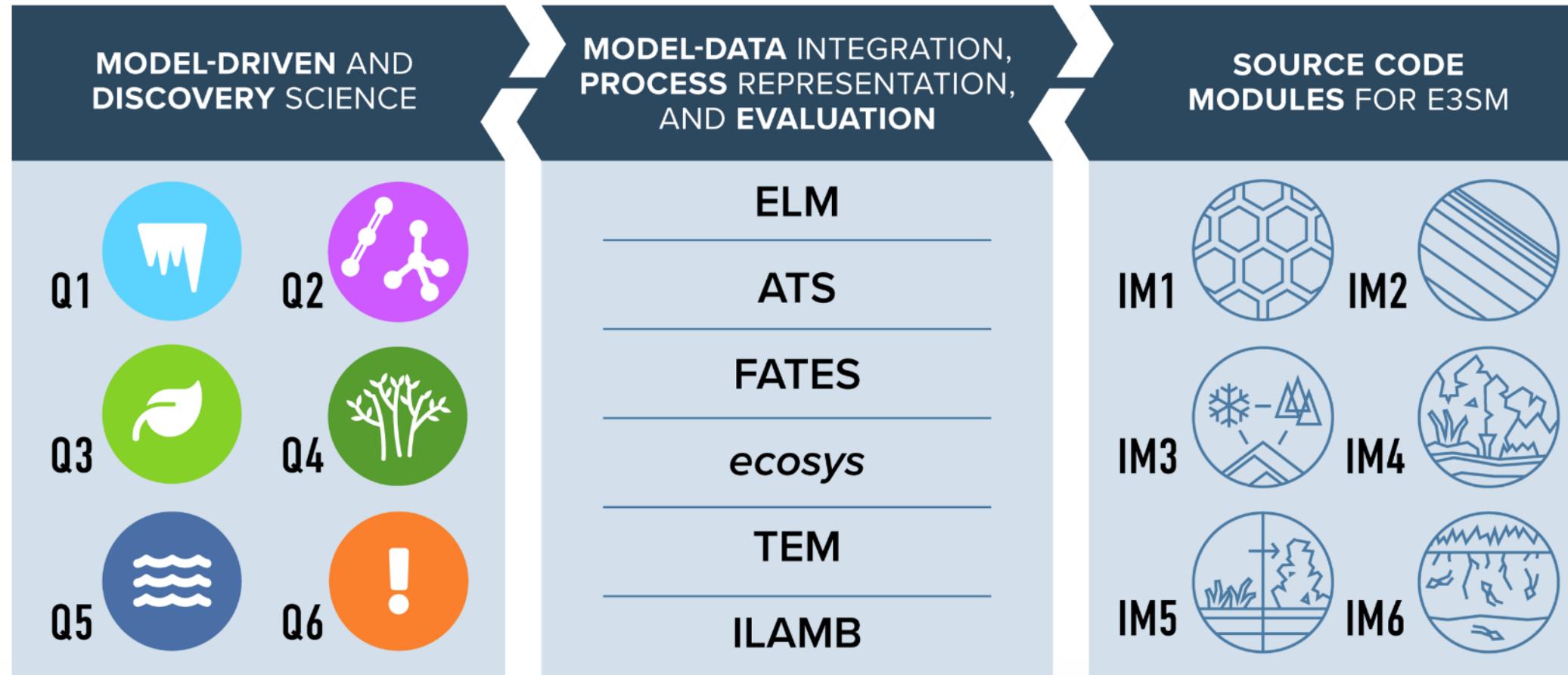




NGEE Arctic is a model-driven, multi-scale research project that leverages a decade-long foundation of model-data integration in arctic Alaska to understand and predict climate-ecosystem feedbacks across the Arctic.



# We Emphasize Collaboration Across Disciplines



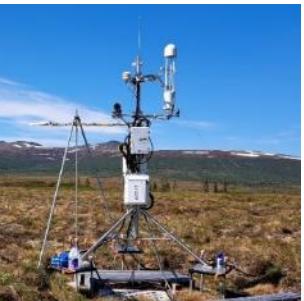
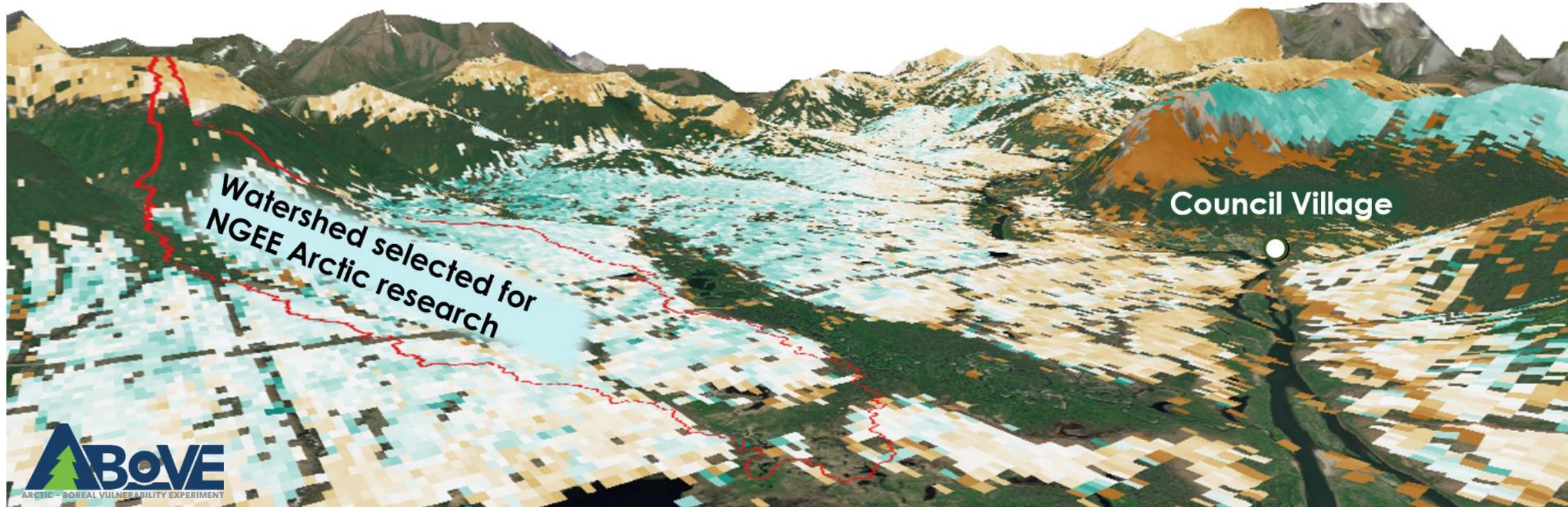
DATA ARCHIVED AT ENVIRONMENTAL SYSTEM SCIENCE DATA INFRASTRUCTURE FOR A VIRTUAL ECOSYSTEM (ESS-DIVE\*)

\*E3SM is the Department of Energy's Energy Exascale Earth System Model; ELM is the land model.

\*ESS-DIVE is a freely accessible online platform for data sharing funded by DOE.



# We Gratefully Conduct Science on Native Lands



# Data are Openly Shared and Publicly Available



## NGEE Arctic - Data Search

Next-Generation Ecosystem Experiments

*Improving climate model predictions through advanced understanding of coupled processes in Arctic terrestrial ecosystems*

SEARCH

HOME NGEET ARCTIC WEBSITE CREATE METADATA HELP

Use suggestions from type-ahead feature or use quotes around search

Data Search

246

Results

CURRENT SELECTION(S):

datasource:"NGEE Arctic"

Data Source

NGEE Arctic (246)

Access Restriction

Hosted by ESS-DIVE



### Next-Generation Ecosystem Experiments Arctic (NGEE Arctic)

The Next-Generation Ecosystem Experiments (NGEE Arctic) is a project to improve the predictive understanding of carbon (C)-rich Arctic system processes and feedbacks to climate. This is achieved through experiments, observations, and synthesis of existing datasets that strategically inform model process representation and parameterization, and that enhance the knowledge base required for model initialization, calibration, and evaluation.

Data

Metrics

About

Search

Search these datasets

DATASETS 1 TO 25 OF 64

1 2 3 Next

Sort by Most recent

Fiolleau S; Daffron B; Uhlemann S; Wielandt S; Wang C; Shirley I; Lamb J (2023): **Continuous soil temperature and soil deformation measurements, Teller road Mile 47, Nome, Alaska**. Next-Generation Ecosystem Experiments (NGEE) Arctic, ESS-DIVE repository. Dataset. doi:10.15485/2251663

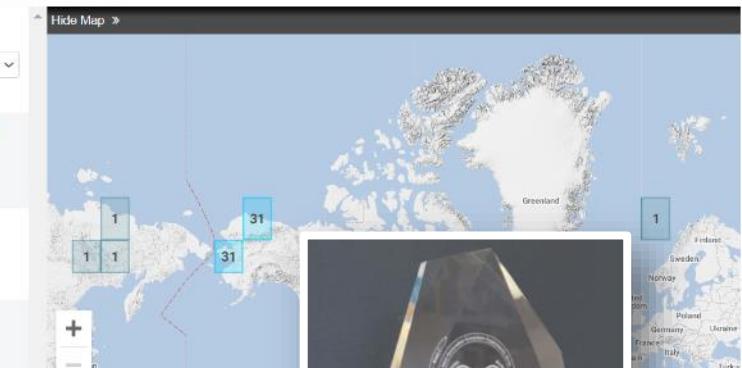
2 76

Serbin S; Lieberman-Cribbin W; Ely K; Rogers A (2019): **NGEE Arctic Leaf Spectral Reflectance and Transmittance, Barrow, Alaska, 2014-2016**. Next-Generation Ecosystem Experiments (NGEE) Arctic, ESS-DIVE repository. Dataset. doi:10.5440/1437044

21 134

Serbin S; Rogers A (2019): **NGEE Arctic Leaf Spectral Reflectance, Kougarok Road, Seward Peninsula, Alaska, 2016**. Next-Generation Ecosystem Experiments (NGEE) Arctic, ESS-DIVE repository. Dataset. doi:10.5440/1430079

21 134



< 1 2 3 ... 24 25 > displaying 1 to 10 of 246

Results: 10 Sort By: End Date

**Plant Root Characteristics and Dynamics in Arctic Tundra Ecosystems, 1960-2012**

NGEE Public Dataset

Data Source: NGEE Arctic  
Federal Agency: Department of Energy

Begin Date: 01/01/1960 End Date: 01/01/2012

# We Build a Culture of Safety, Trust in Team Science

An Arctic research team of 150 members that implemented a culture of safety, inclusion, and trust as the foundation for cross-disciplinary science shares lessons from its experiences.



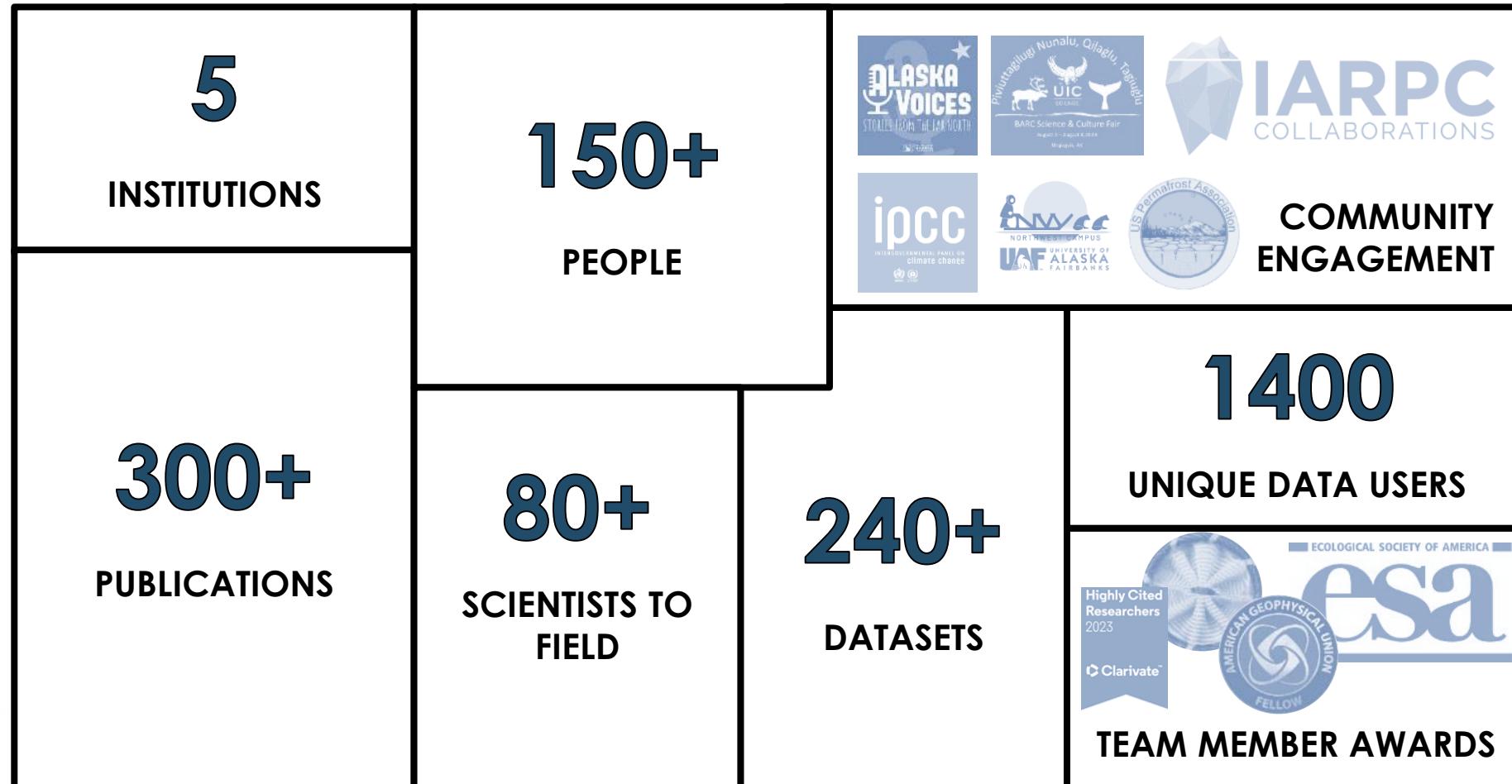
Members of the Next-Generation Ecosystem Experiments–Arctic (NGEE Arctic) unmanned aerial laser altimeter team (Christian Andresen, Lauren Charsley-Groffman, Adam Collins, and Erika Swanson) take a break on a portable drone landing pad at a field site outside Nome, Alaska. Credit: Christian Andresen, University of Wisconsin, Madison

By Colleen M. Iversen, W. Robert Bolton, Alistair Rogers, Cathy J. Wilson, and Stan D. Wullschleger ©  
21 April 2020

“As scientists become part of larger teams and join broader and more diverse scientific endeavors, they must all become leaders in creating cultures of safety, inclusion, and trust.”

Iversen et al. 2020 (Eos)

# NGEE Arctic: By the Numbers



# NGEE Arctic Phases 1–4

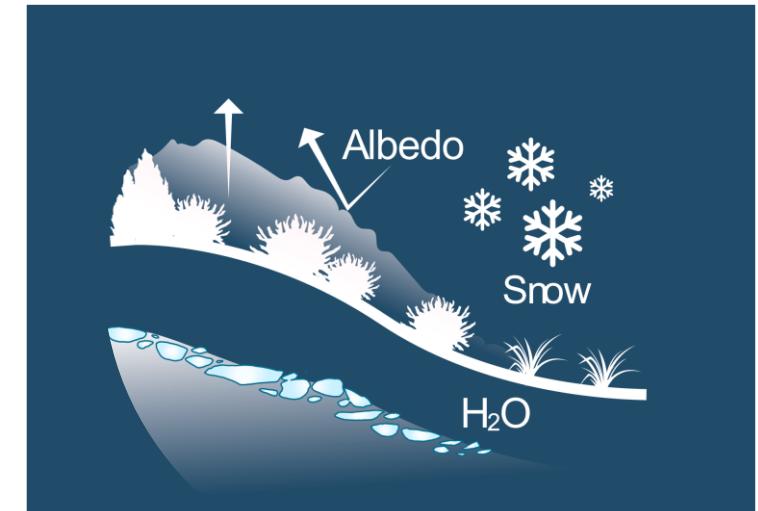
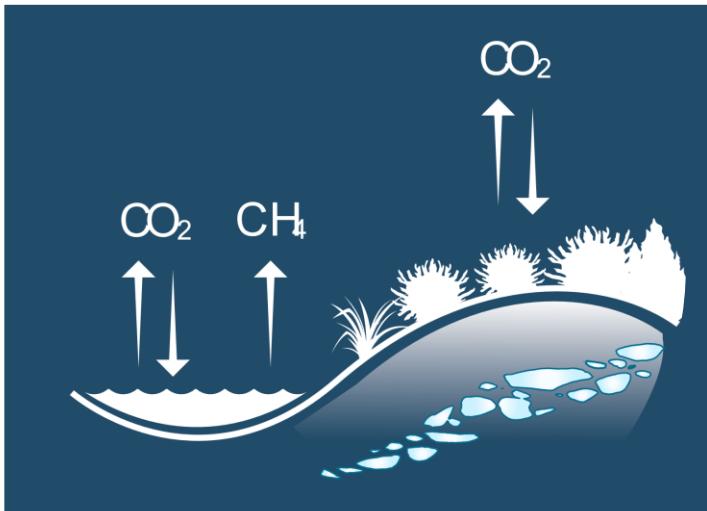
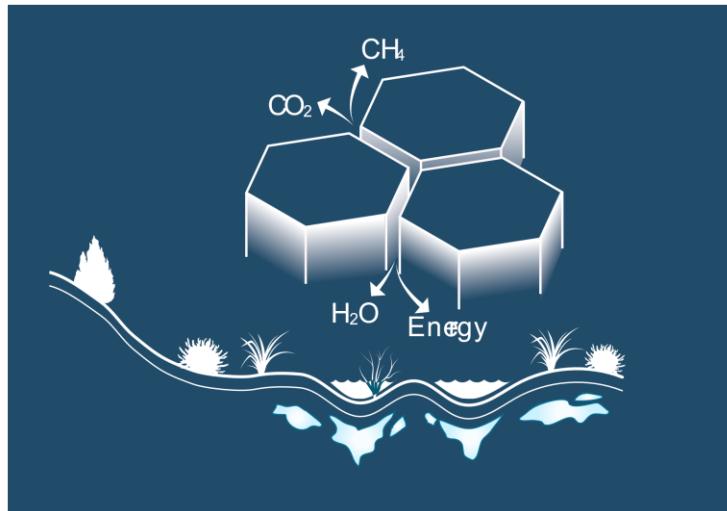
**Phase 1 (2012–2014):** Modeling approach driven by the failure of current models to capture tundra processes.

**Phase 2 (2015–2018):** Multiscale modeling approach informed hypotheses about model priorities.

**Phase 3 (2019–2024):** Observations and model scaling inform integrated model modules in DOE's E3SM land model.

**Phase 4 (2025–2027):** Models trained on observations from arctic Alaska will be evaluated against current observations and projected climate changes from across the Arctic.

# Discovery Science Improves Model Predictions



**PNAS**

Drying of tundra landscapes will limit subsidence-induced acceleration of permafrost thaw

Scott L. Painter Ethan T. Coon Ahmad Jan Khattak and Julie D. Jastrow [Authors Info & Metrics](#)

**JGR Biogeosciences**

Research Article | [Free Access](#)

**Topographical Controls on Hillslope-Scale Hydrology Dr Shrub Distributions on the Seward Peninsula, Alaska**

Zelalem A. Mekonnen , William J. Riley, Robert F. Grant, Verity G. Salmon, Colleen M. Iversen., Sébastien C. Biraud, Amy L. Breen, Mark J. Lara

**EGU**  
European  
Geosciences  
Union

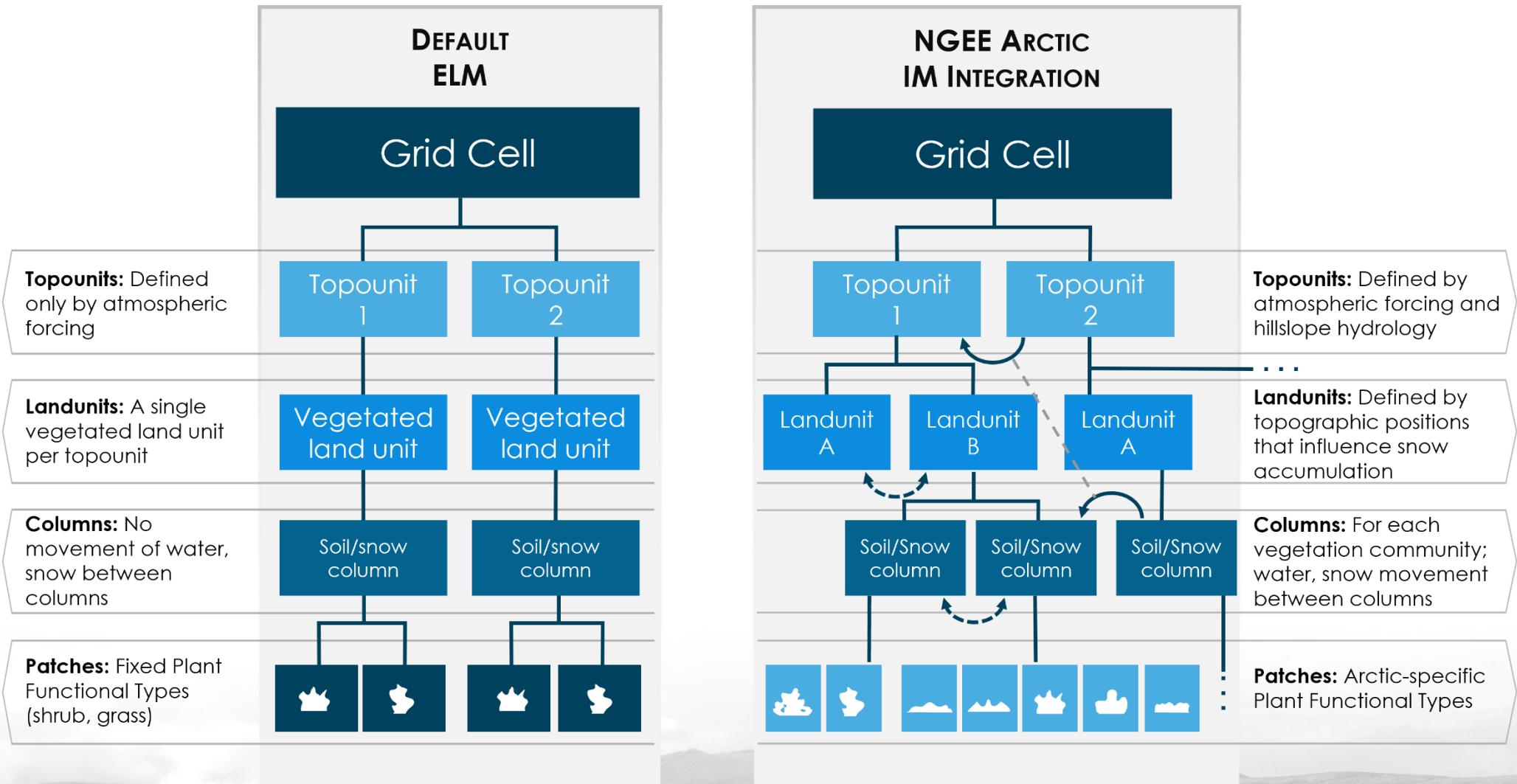
Research article

**The Cryosphere**

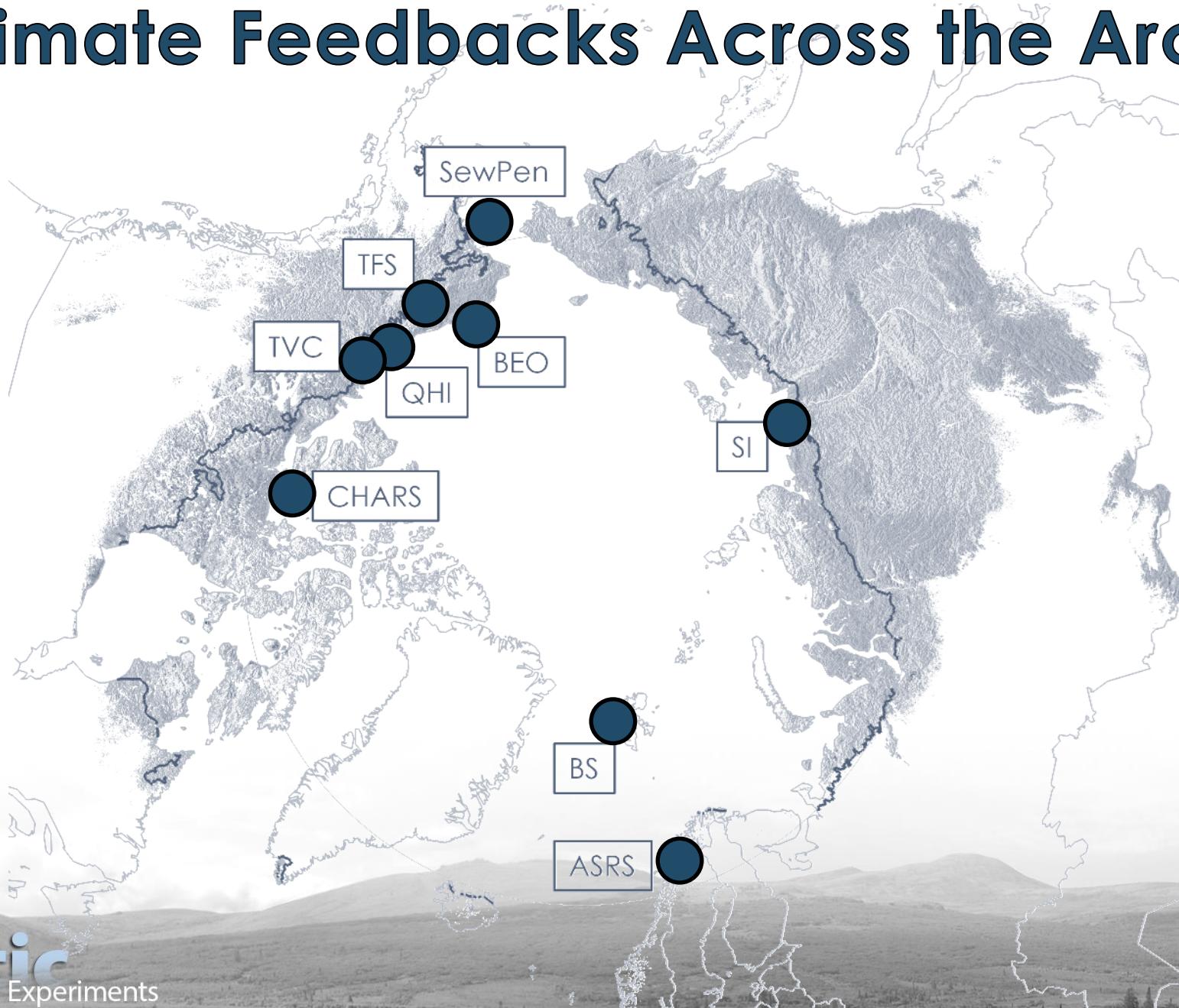
Spatial patterns of snow distribution in the sub-Arctic

Katrina E. Bennett , Greta Miller<sup>1</sup>, Robert Busey<sup>2</sup>, Min Chen<sup>1</sup>, Emma R. Lathrop<sup>1</sup>, Julian B. Dann<sup>1</sup>, Mara Nutt<sup>1</sup>, Ryan Crumley , Shannon L. Dillard<sup>1,5</sup>, Baptiste Dafflon , Jitendra Kumar , W. Robert Bolton<sup>2</sup>, Cathy J. Wilson , Colleen M. Iversen<sup>4</sup>, and Stan D. Wullschleger<sup>4</sup>

# Phase 3: We Will Deliver an Arctic-Informed ELM



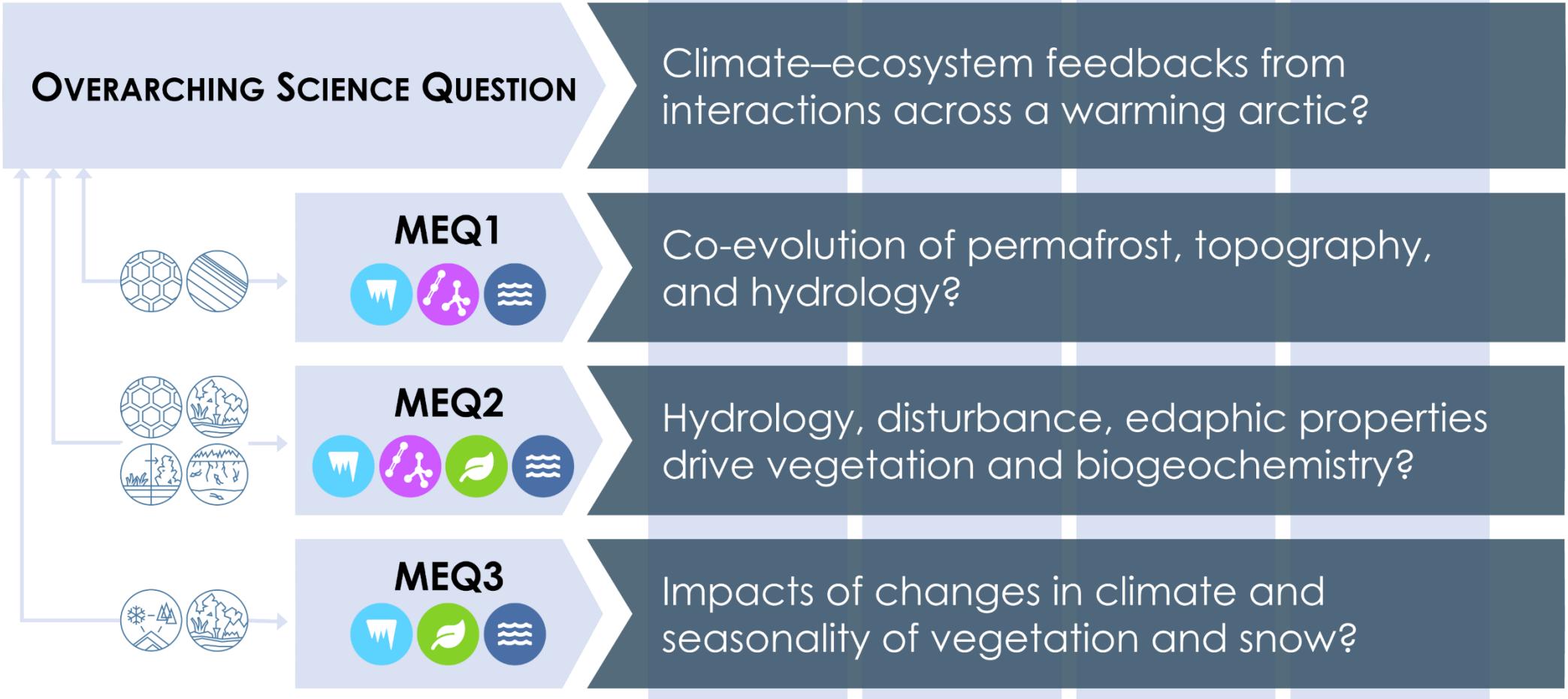
# Does Our Arctic-Informed Model Accurately Predict Climate Feedbacks Across the Arctic?



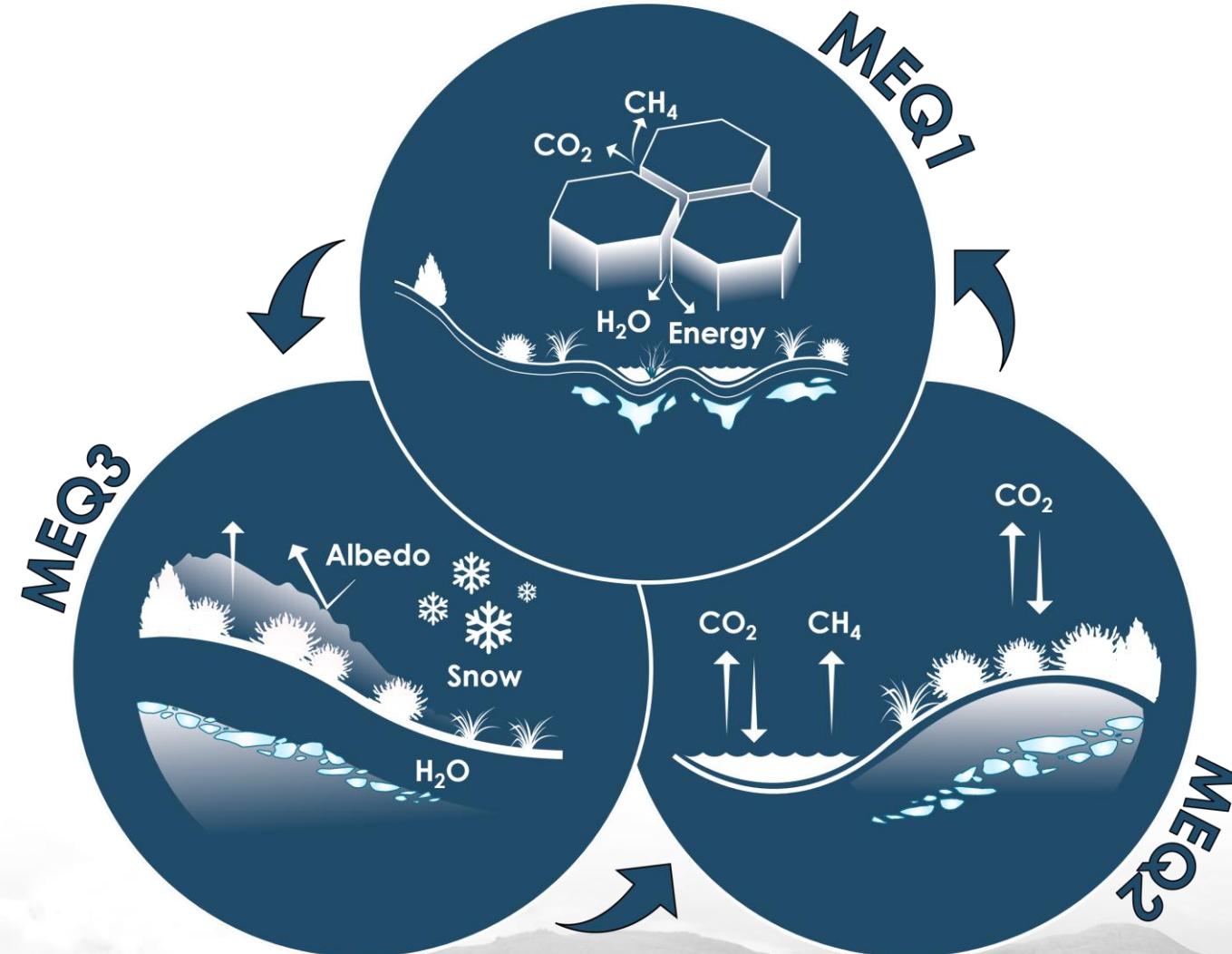
# Phase 4: Overarching Science Question:

What are the climate–ecosystem  
feedbacks from interacting processes  
across a rapidly warming Arctic?

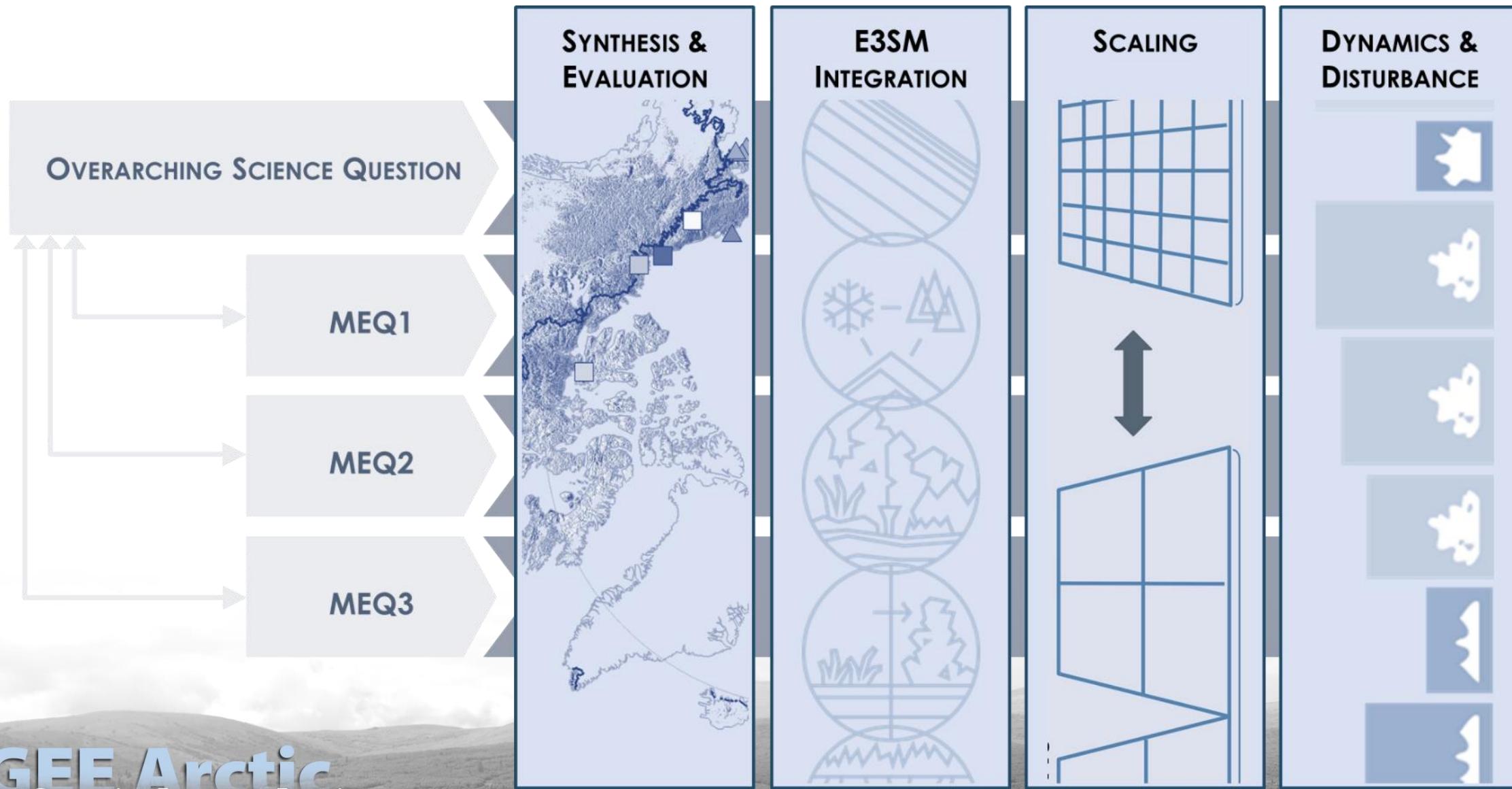
# Model-Inspired Questions Drive Phase 4



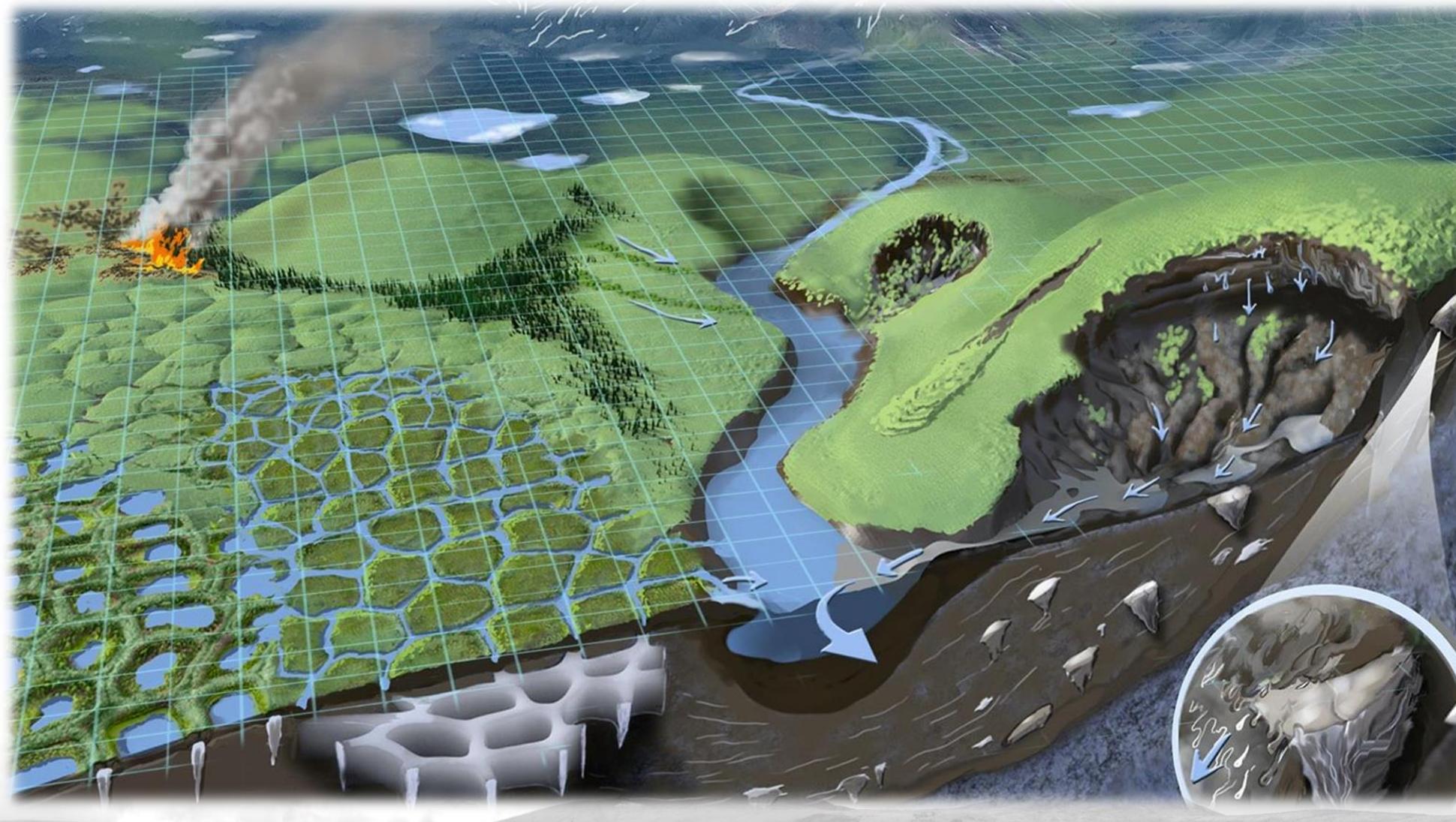
# MEQs Evaluate and Inform Model Understanding



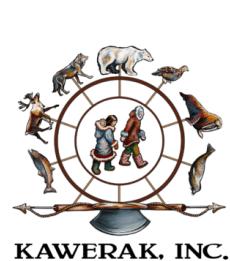
# Crosscutting Science Activities Extend & Evaluate



# Understand Global Implications of Dynamic Arctic



# Collaborative Partnerships Across Institutions, Across the Arctic, Across Sibling Programs at DOE



MARY's IGLOO NATIVE CORPORATION  
COUNCIL NATIVE CORPORATION



ESS-DIVE  
Deep Insight for Earth Science Data

**E<sup>3</sup>SM**  
Energy Exascale  
Earth System Model

**ILAMB**  
RUBISCO

Hil AT RASM



**ARM**

CLIMATE RESEARCH FACILITY

19 NGEE Arctic  
Next-Generation Ecosystem Experiments

**COMPASS**  
Coastal Observations, Mechanisms, and Predictions  
Across Systems and Scales

FIELD, MEASUREMENTS,  
AND EXPERIMENTS

**ABOVE**  
ARCTIC-BOREAL BIOMASS BUDGET EXPERIMENT



We are **grateful** for the time  
that we've had on the tundra  
and in arctic communities.

# Find Out More About NGEET Arctic

**Websites:** [ngee-arctic.ornl.gov](http://ngee-arctic.ornl.gov) + [ess.science.energy.gov/ngee-arctic](http://ess.science.energy.gov/ngee-arctic)

**Podcast:** [The Unseen World of Climate Change \(Sound of Science\)](#)

