Next-Generation Ecosystem Experiments (NGEE Arctic)

Oak Ridge National Laboratory
Brookhaven National Laboratory
Los Alamos National Laboratory
Lawrence Berkeley National Laboratory
University of Alaska Fairbanks

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Project Rationale

- High-latitude ecosystems represent an important feedback to climate and a well-recognized source of uncertainty in climate projections.
- Earth System Models capture many of the key mechanisms responsible for ecosystem-climate feedbacks but must be improved through field and laboratory studies.
- Our goal, therefore, is to integrate field, laboratory, and modeling studies to accelerate predictive understanding of Arctic ecosystems.

North Slope

Seward Peninsula

Science Questions & Objectives

- How do landscape processes control the storage and flux of carbon, water, and nutrients in a changing climate?
- What will control rates of CO_2 and CH_4 fluxes across a range of permafrost conditions?
- How will warming affect plant traits, and what are the consequences for carbon, water, and nutrient fluxes?
- How will shrub distribution and climate feedbacks shift with expected warming in the 21st century?
- Where, when, and why will the Arctic become wetter or drier, and what are the implications for climate forcing?

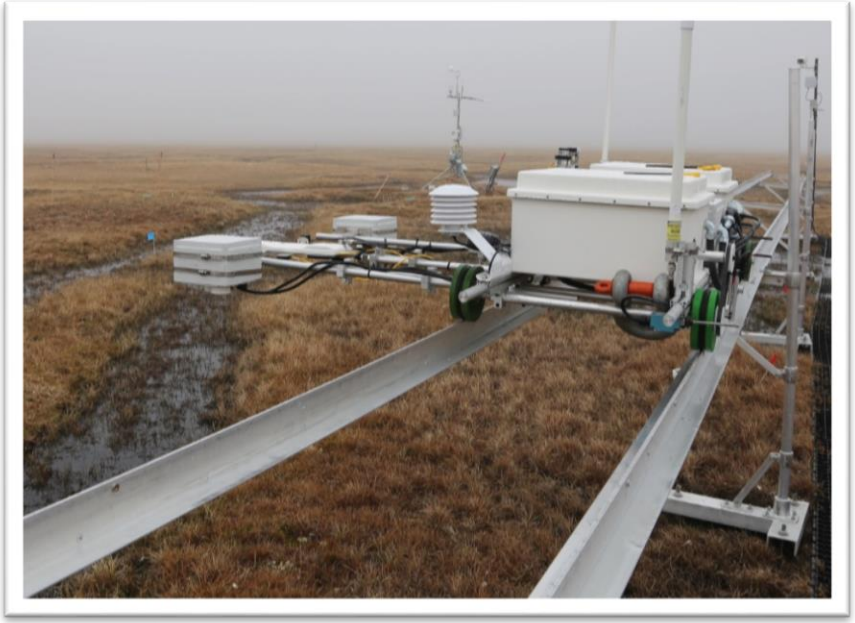
Field and Modeling Studies

- Field sites: North Slope (Barrow) and the Seward Peninsula (Council, Kougarok, and Teller Road)
- Interdisciplinary Research: Geophysics, geomorphology, hydrology, biogeochemistry, genomics, plant physiology, and vegetation dynamics
- Multi-scale Modeling: PFLOTRAN, Advanced Terrestrial Simulator (ATS), TEM, ED, and ACME/ALM
- Data Resources: NGEE Arctic Data Portal with parallel contributions to AmeriFlux, ARM, SpecNet, and GTN-P
- Phase 1 (2012-2014), Phase 2 (2015-2018), and Phase 3 (2019-2022)

Remote Sensing

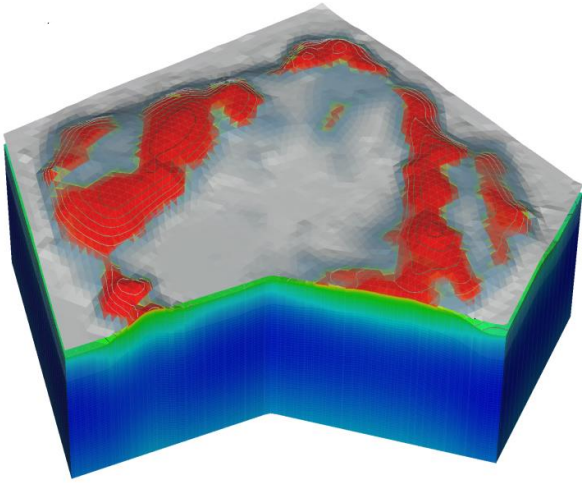
- Satellites
  - MODIS, WorldView, Landsat, Ikonos, QuickBird and Geoeye
- Aircraft (Aerometrics, Jessica Cherry, CARVE)
  - LiDAR, IfSAR, PALSAR
  - Optical imagery, thermal IR, DEM (SfM), NIR, NDVI
  - CO_2 and methane, thermal IR, hyperspectral
- Tethered systems (e.g., kites)
- Ground-based systems (e.g., geophysics, tram)
- UAS pending permits and approvals

Raz-Yaseef, N., M.S. Torn, D.P. Billesbach, Y. Wu, R. Commane, J.O.W. Lindaas, J. Henderson, D.R. Cook, T.J. Kneafsey, V.E. Romanovsky, S.C. Wofsy, C. Miller, and S.D. Wullschleger (2015). Multi-scale evidence of large CO_2 and CH_4 emissions from permafrost during spring thaw in northern Alaska. Nature Geoscience (submitted).



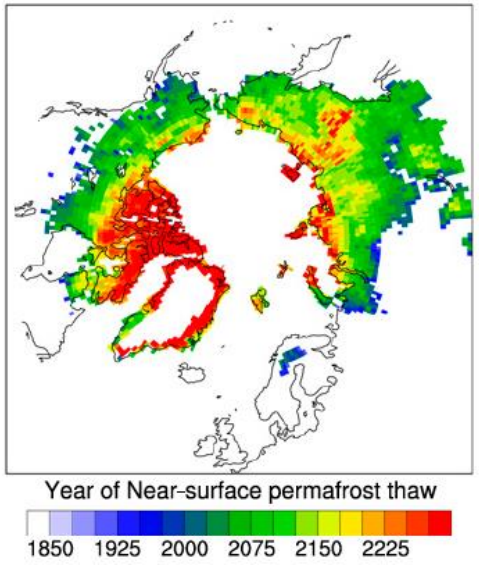
Modeling Approaches

- Fine scale: PFLOTRAN, ATS
- Ecosystem scale: ED and TEM
- Climate scale: ALM



High-Resolution Polygon

Simplified Polygon Grid



Pan-Arctic

Geospatial Data Products

- Maps: Snow cover; snow melt; inundation; ALT; thermal; DEM; vegetation; ground ice; permafrost; landscape characterization
- Geographic coverage: Field plots, watershed, regional, pan-Arctic
- Data formats, grids, and projections: Vector (shapefiles) and raster (NetCDF, GEOtiff); Alaska Albers Equal Area
- Temporal range: 40-year time series; current state; model projections into coming century
- Stakeholder: Science team, broader community, native corporations, and land managers

Web Resources

Web Site: http://ngee-arctic.ornl.gov/

Blog: http://ngee-arctic.blogspot.com/

Flickr: https://www.flickr.com/photos/ngee-arctic/

Data Portal: http://ngee-arctic.ornl.gov/data/

Site Visualization: http://ngee.ornl.gov/viz/sites