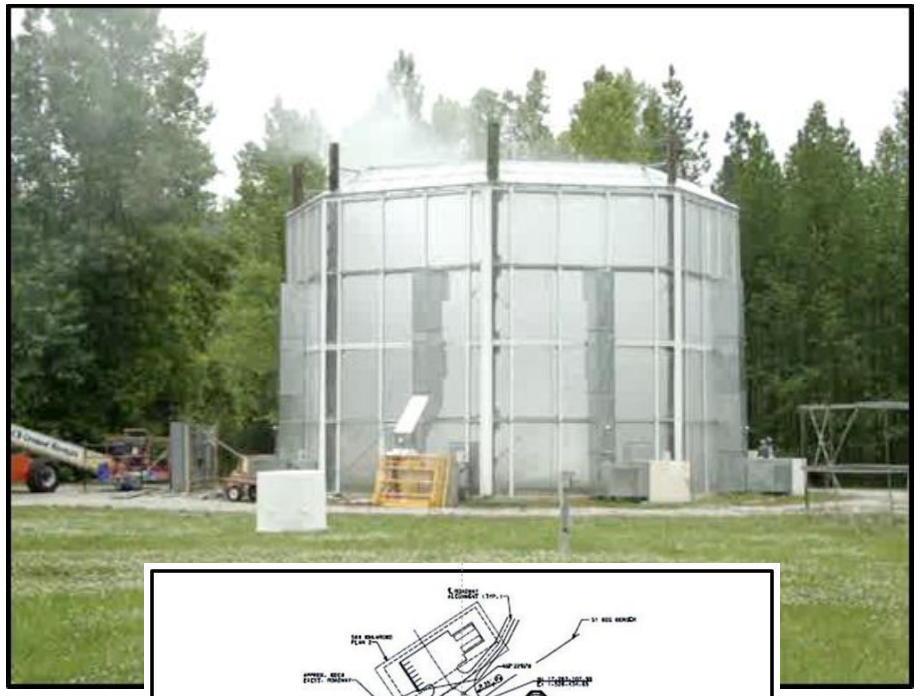
SPRUCE Reflection

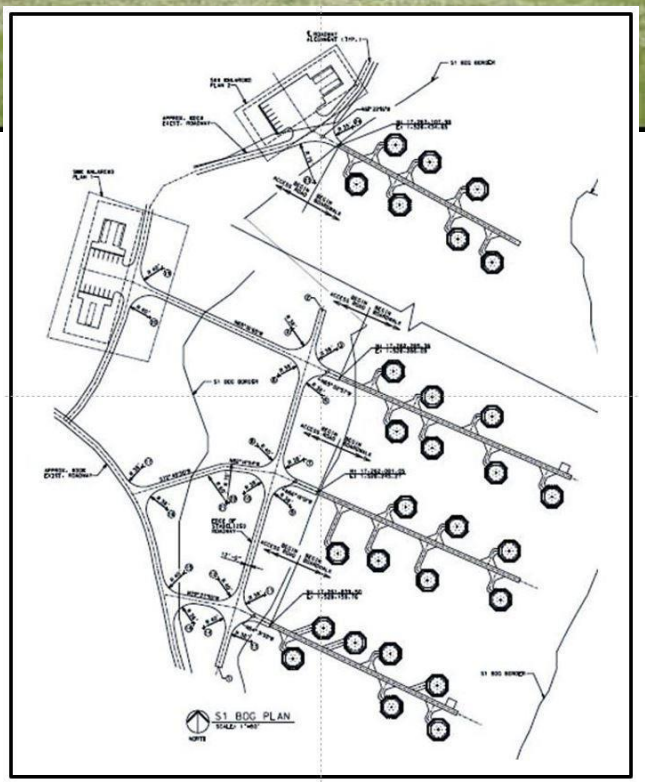
SPRUCE Timeline

- Initial planning for SPRUCE began almost 20 years ago.
- Funding for new Science Focus Areas began in 2008.
- Directive to research an understudied ecosystem important to the terrestrial C cycle; ‘National Lab Worthy’ approaches; with failure as a possibility.
- Internal (ORNL) funding to engineer new approaches for whole-ecosystem warming, including belowground warming.
- Initial trip to Marcell Expt. Forest in April 2009.

SPRUCE Timeline

- Proposed experimental design included 28 plots in an ANOVA design.
- Prototype warming enclosure development at ORNL (2010-2011) with engineering groups.
- NEPA process (2010-2011).
- Pre-treatment peatland characterization (2010 through 2014).
- SPRUCE construction (November 2011 through August 2015).



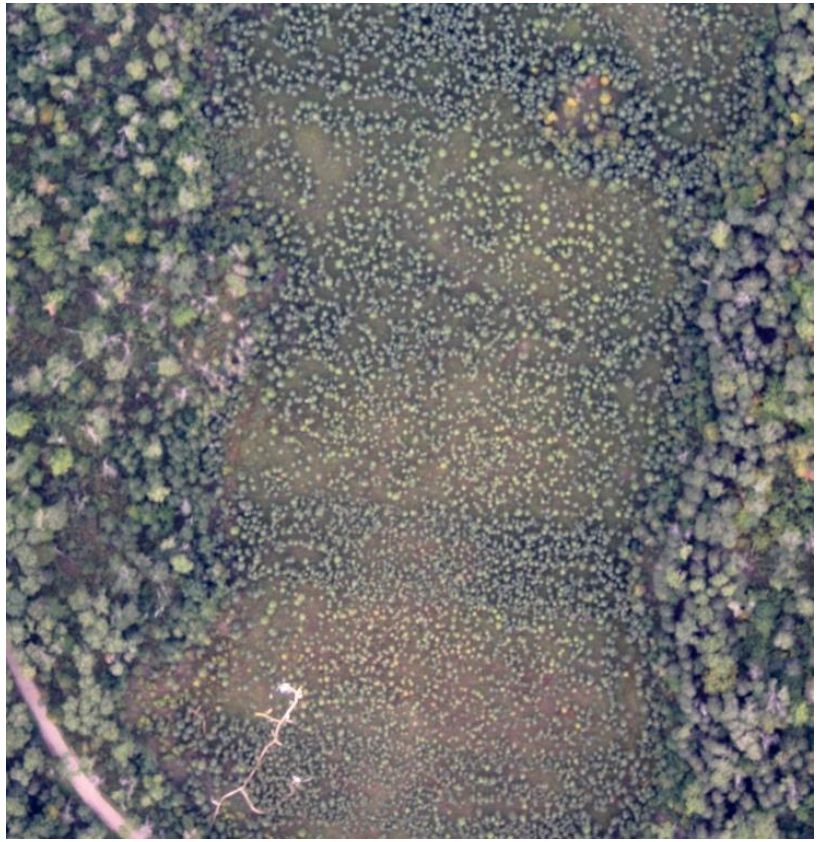


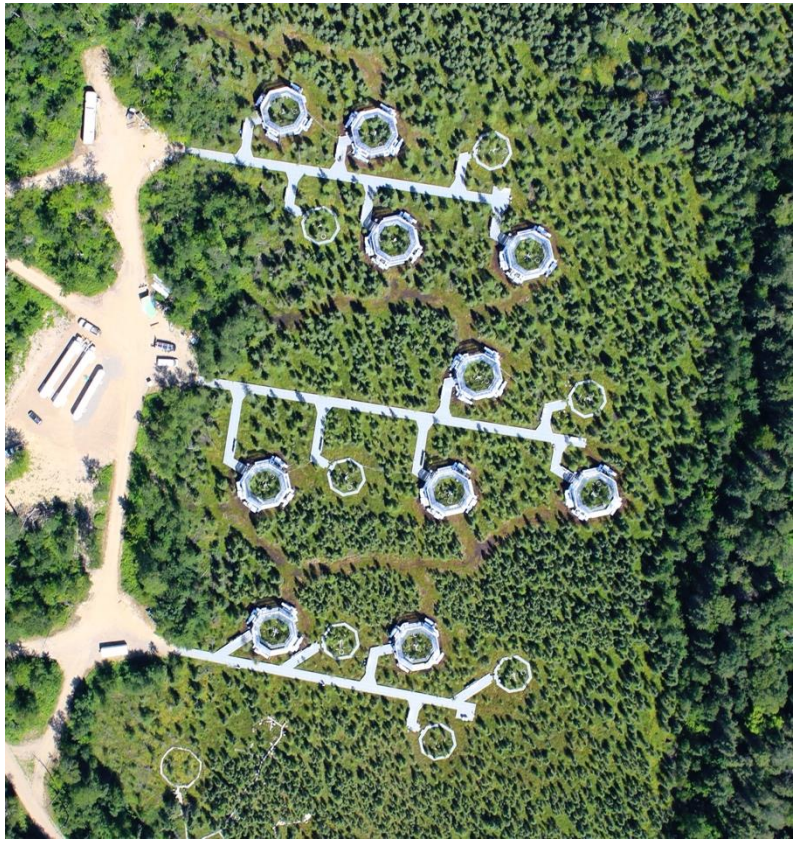
SPRUCE Timeline – Change of Plans

- Transect #4 very different, so no longer included in experimental design.
- Modeling team suggested that a regression design would better serve research needs.
  - Transitioned to 14-plot regression design (7 temp. treatments, with and without eCO_2).
  - Building 14 enclosures ended up being cost-prohibitive, so ended up with 10.
- Construction completed in summer 2015, and treatments initiated in August 2015.

SPRUCE Timeline – A Five-Year Transition from the S1 Bog to SPRUCE

- “It took substantial risk, time, funding, and expert input from many to become a reality.”





SPRUCE Timeline




2009 2012 2015 2018 2021 2024 2027

Pre-treatment characterization

SPRUCE construction

Whole-ecosystem warming and elevated [CO_2]

Decommissioning

The Early Years of SPRUCE


PROPANE

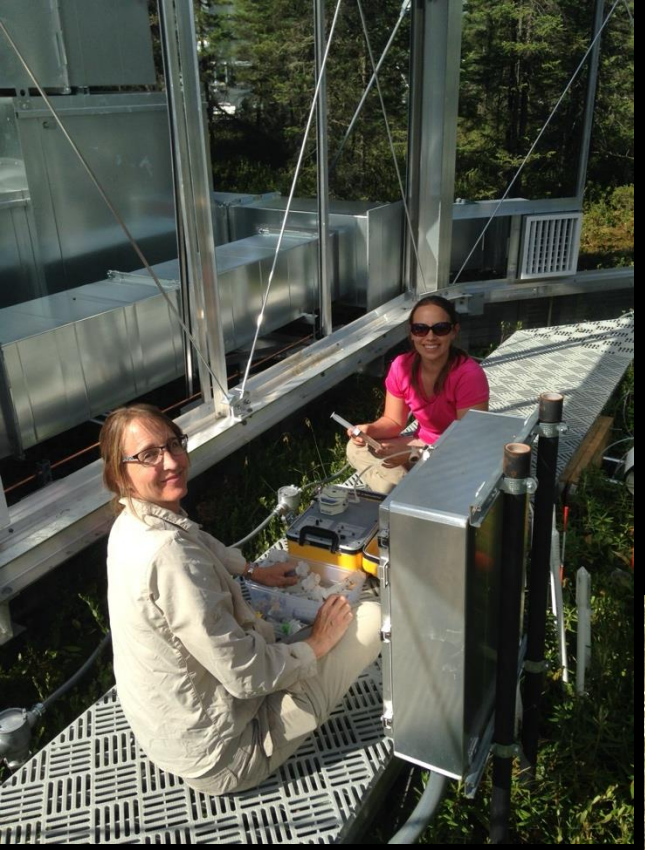

SKYTRAK


Welcome to a warmer future
+9.0 ˚C, Elevated CO_2
PLOT
10

SPRUCE in the field and in the lab

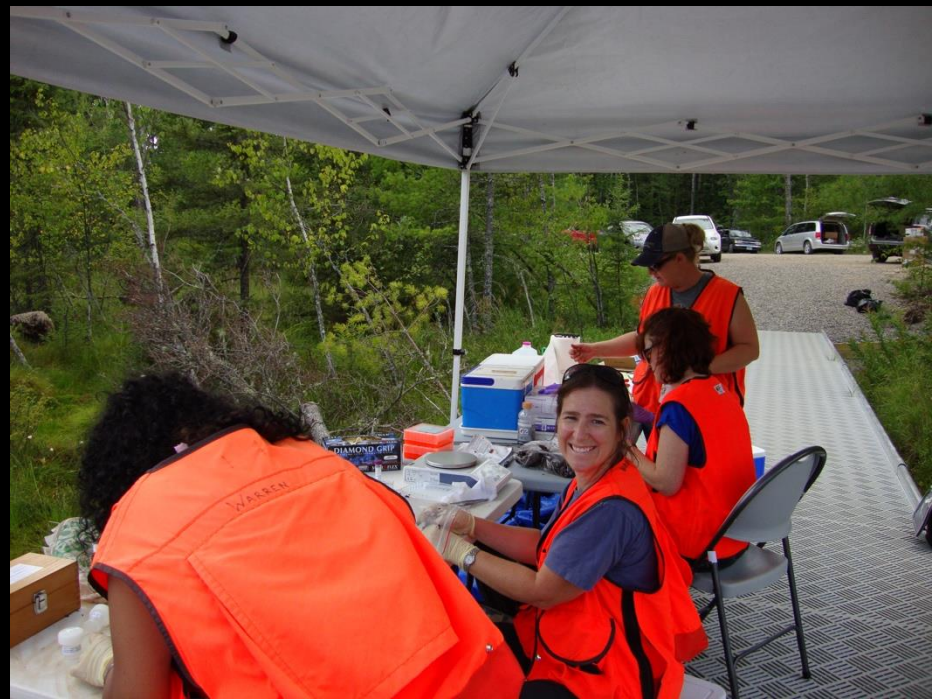

WELCOME TO MARCELL
RESEARCH CENTER
Northern Research
Station


Fluke




es EX-L

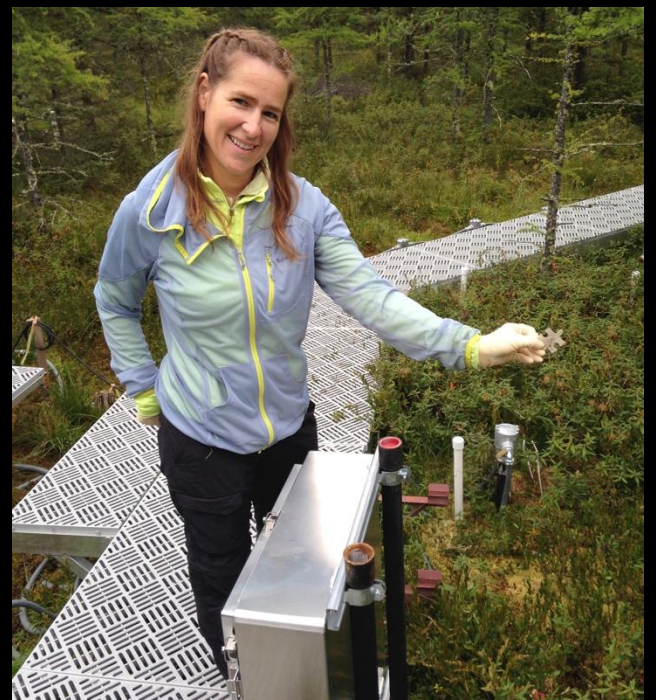

Peatland Vegetation Responses to 3-Years of Warming and Elevated CO2




OAK RIDGE

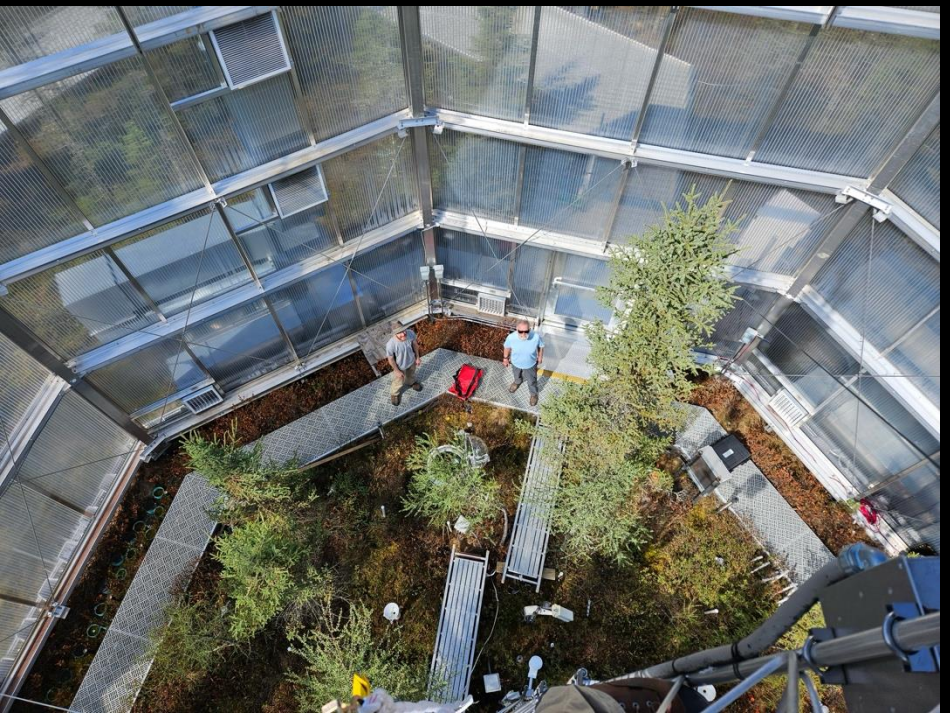

12/09/2010


NASA




WERNER


PETZL




OAK RIDGE


NO ZMOKING
ON BOARD
39
66


NO
HOCKEY
STICKS
ALLOWED
IN BUILDING
Thank you


RAPIDS AERIE 2469
GUY CLAIRMONT
FINANCIAL
248-926-3000

SPRUCE All Hands Meetings

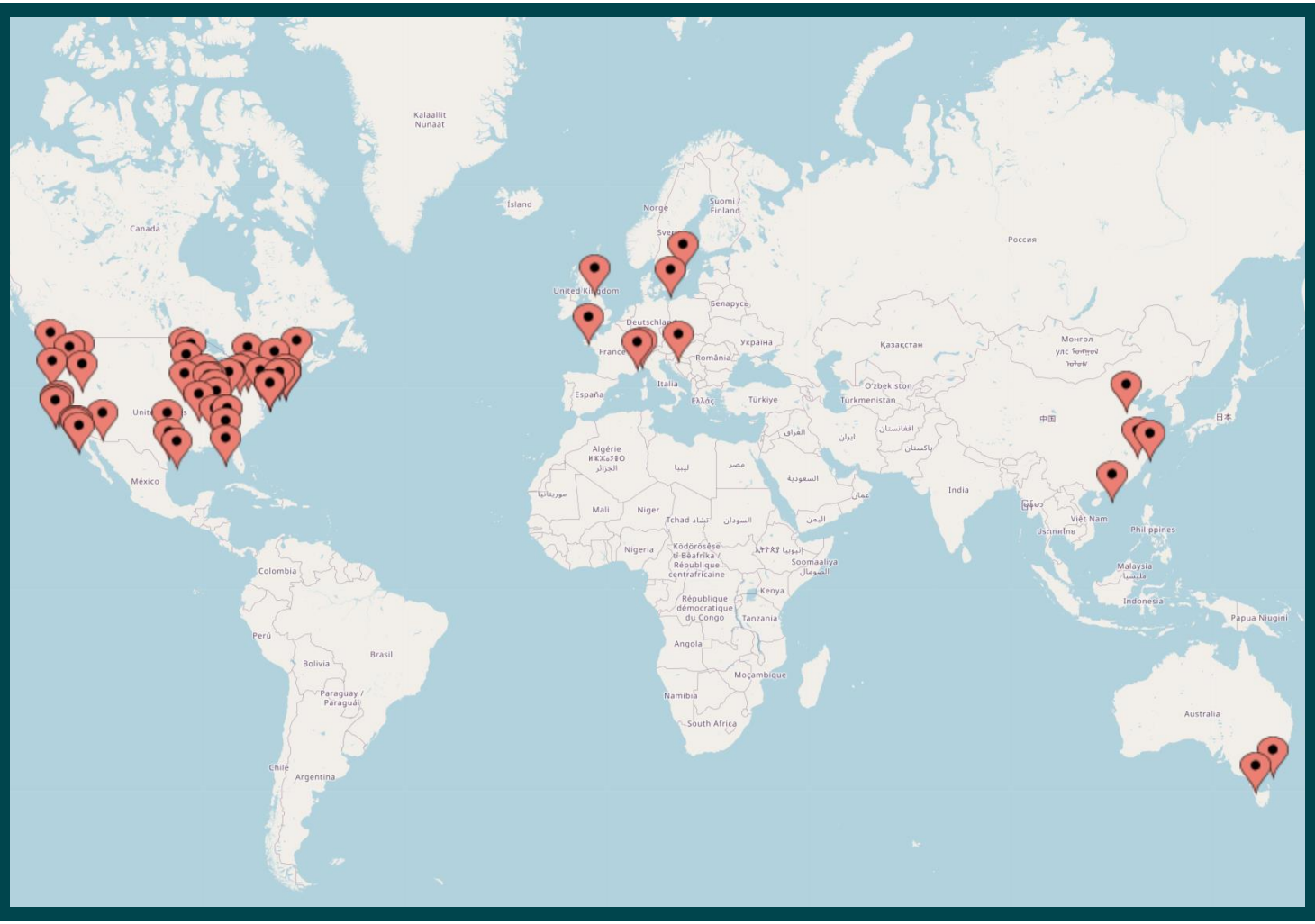
- First All Hands Meeting was in 2016 in St. Paul, MN.
- In-person meetings in 2017 and 2018.
- Skipped 2019 due to TES SFA review.
- COVID resulted in virtual meetings in 2020, 2021, and 2022.
- We last met in person in 2023 in Minneapolis.
- Anticipate that this meeting (2025) will be our last!


Graduate
MINNEAPOLIS

SPRUCE by the Numbers

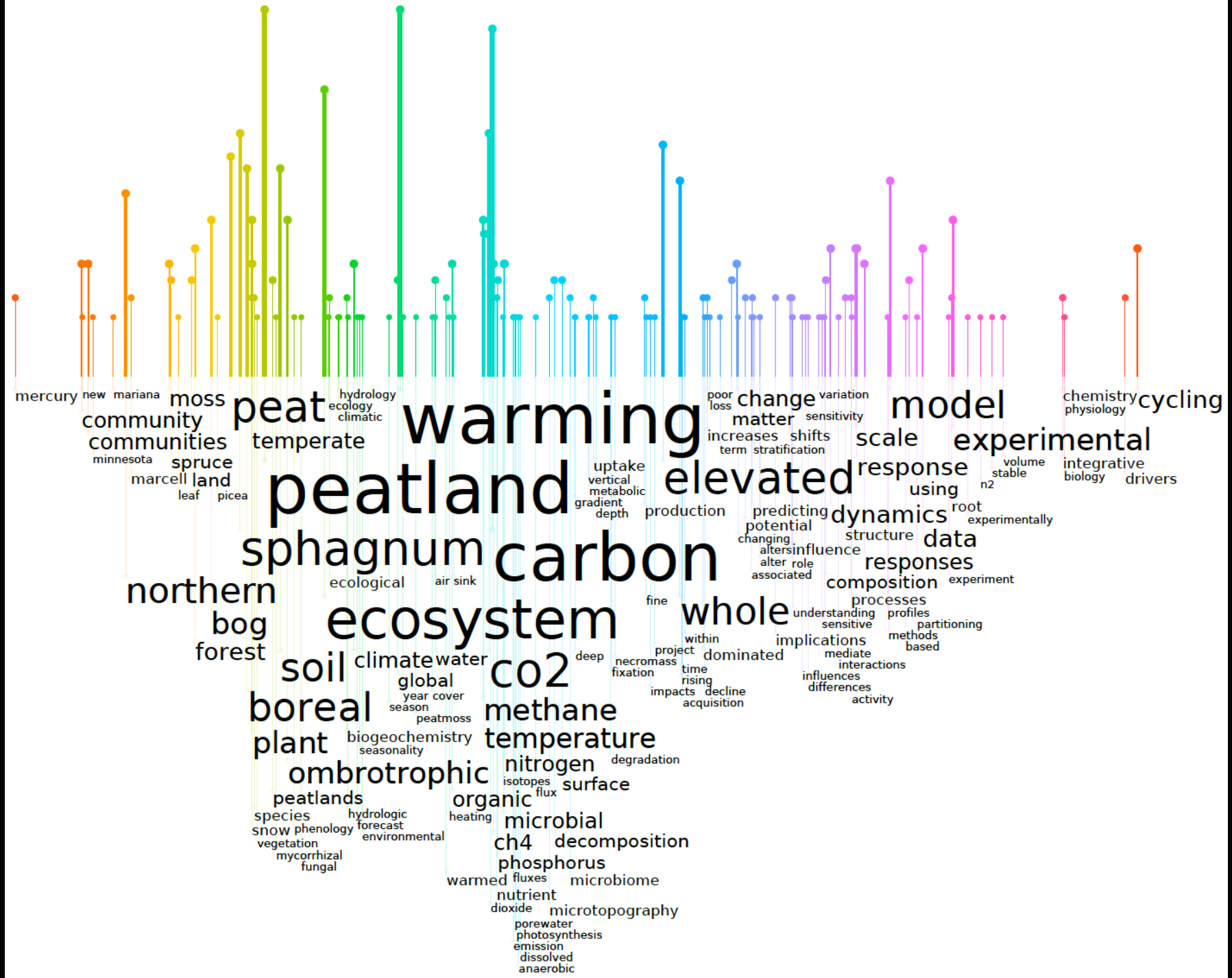
250+ individuals

65+ institutions



100+ publications

107 datasets


mercury
new
mariana
moss
peat
hydrology
ecology
climatic
warming
poor
loss
change
variation
sensitivity
model
chemistry
physiology
cycling
community
matter
communities
temperate
increases
shifts
scale
experimental
minnesota
spruce
term
stratification
marcell
land
peatland
uptake
vertical
metabolic
gradient
depth
elevated
response
volume
stable
integrative
biology
drivers
leaf
picea
using
n2
production
predicting
dynamics
root
experimentally
potential
changing
structure
data
sphagnum
carbon
alters
influence
responses
alter
role
associated
northern
ecological
air sink
composition
experiment
fine
processes
bog
ecosystem
whole
understanding
profiles
sensitive
partitioning
forest
within
implications
methods
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deep
dominated
mediate
based
soil
climate
water
co2
necromass
fixation
interactions
time
rising
influences
global
impacts
decline
differences
year cover
acquisition
activity
boreal
season
peatmoss
methane
plant
biogeochemistry
seasonality
temperature
degradation
ombrotrophic
nitrogen
isotopes
flux
surface
peatlands
organic
species
hydrologic
heating
microbial
snow
phenology
forecast
environmental
ch4
decomposition
vegetation
mycorrhizal
fungal
phosphorus
warmed
fluxes
microbiome
nutrient
dioxide
microtopography
porewater
photosynthesis
emission
dissolved
anaerobic

In the Heart of the Bog: A SPRUCE Song | *By ChatGPT* |

Beneath the sky of northern hue, where tamarack and spruce trees grew, the mosses sleep on ancient peat, a carbon tale beneath our feet.

With tender hands and measured flame, the scientists of ORNL came. They built a ring of warming light, to mimic Earth's advancing plight.

The bog, so still, began to stir — A whisper from the conifer. The roots grew wary, methane sighed, as microbes woke and carbon cried.

What happens when the world grows warm, to forests steeped in ice-born form? When permafrost begins to weep, and secrets rise from ages deep?

They watch, they measure, day and night, to cast this darkness into light. For SPRUCE is more than steel and wire — Its knowledge forged from peat and fire.

So future eyes may clearly see, the cost of warming's legacy. And know that deep in forest gloom, a silent bog foretold our doom—

Or hope, if we but choose to heed, the whispered warnings of the reed.

Thanks to Everyone for your Contributions, Enthusiasm, and Collegiality!

SPRUCE is a TEAM effort.
We are grateful for you all!

- Many, many students and interns
- Post-Masters and Post-Docs
- ORNL research and technical staff
- USFS research and technical staff
- University and federal collaborators
- Administrative and support staff
- Subcontractors (research, operations, construction)
- Engineers, safety staff
- Volunteers
- DOE Program Managers
- SPRUCE Science Advisory Board

SPRUCE Awards








SPRUCE Award for Outstanding Leadership

Thank you, Paul, for your steadfast and successful leadership of SPRUCE;

for your outstanding management of an incredibly large and complex project;

for directing years of your scientific energy into getting SPRUCE established and keeping it going;

for your ability to equitably manage the real estate of ten 114.8 m^2 enclosures without compromising scientific activities;

for supporting ORNL staff in our collaborative research endeavors;

and for your commitment to facilitating external collaborators' research and expanding the breadth of scientific inquiry at SPRUCE.