



TEACHERS AND RESEARCHERS
EXPLORING AND COLLABORATING

Welcome to *PolarConnect*

with Tom Lane and the Carbon Balance
in Warming and Drying Tundra 2013
PolarTREC Expedition

Tuesday 30 April 2013

9:40a.m. AKDT

(10:40am PDT, 11:40am MDT, 12:40pm CDT, 1:40pm EDT)

Slides will be shown here

Exit the presentation

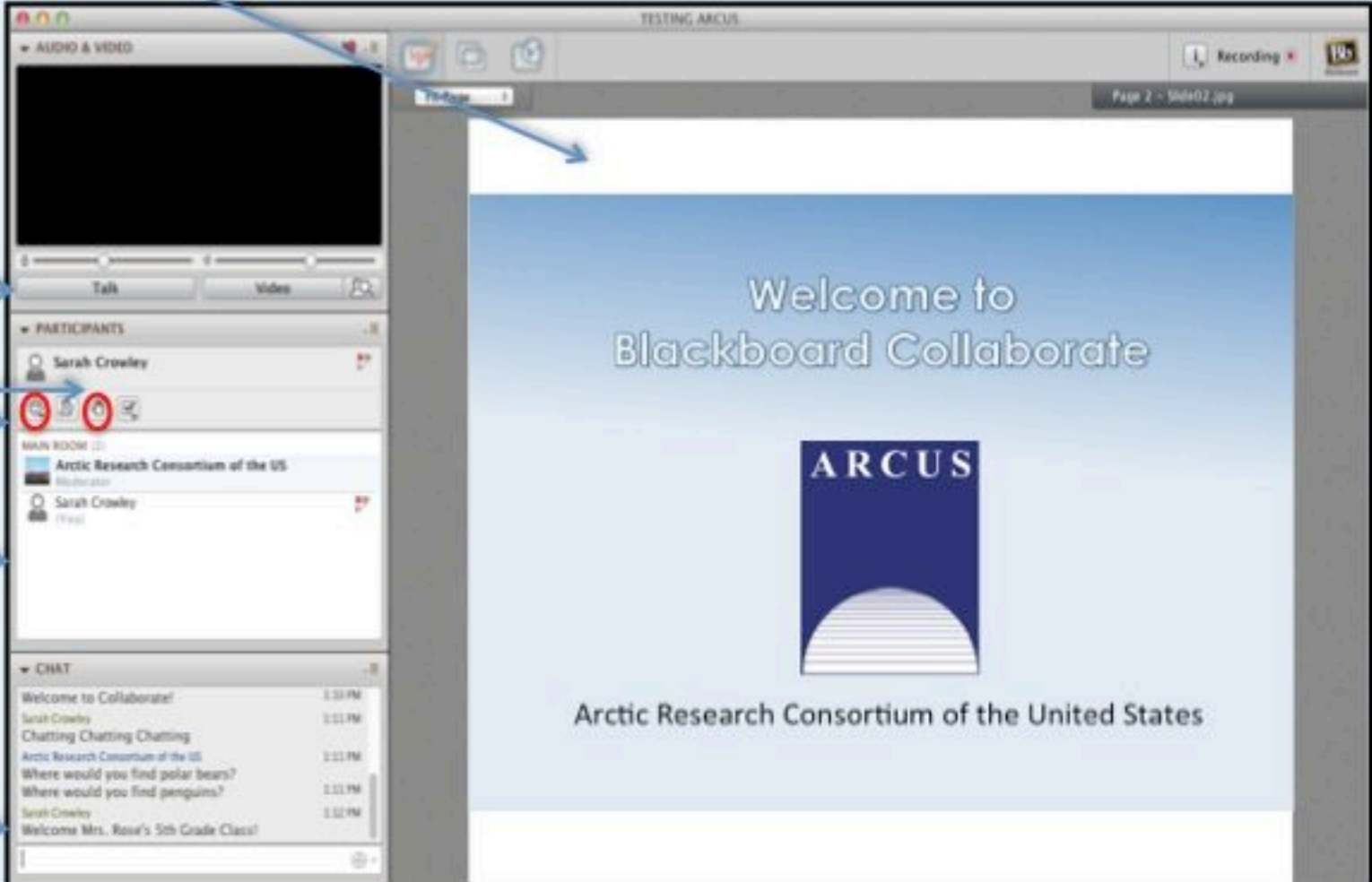
Click to Talk,
Unclick to finish talking

Raise your hand to ask a question

Share with emoticons

List of all participants

Chat with one person or the entire group



The screenshot shows the Blackboard Collaborate interface. The main window displays a presentation slide titled "Welcome to Blackboard Collaborate" with the ARCUS logo and the text "Arctic Research Consortium of the United States". The left sidebar contains several panels: "AUDIO & VIDEO" with a "Talk" button and a "Video" button; "PARTICIPANTS" with a list of participants including Sarah Crowley and Arctic Research Consortium of the US; "MAIN ROOM" with a list of participants; and "CHAT" with a chat history showing messages like "Welcome to Collaborate!" and "Where would you find polar bears?". Blue arrows point from the text labels on the left to the corresponding elements in the interface.

Please Note:

- Participants using the telephone can mute/unmute by **pressing *6** on the phone.
- Today's event will be recorded and archived.

Participant Introductions

Please type in the chat box:

- ✓ Name
- ✓ Affiliation (School, Institution, Etc.)
- ✓ The number of students and adults participating with you in the same location



TEACHERS AND RESEARCHERS
EXPLORING AND COLLABORATING

What is PolarTREC?

PolarTREC is a professional development experience in which K-12 teachers are paired with researchers for 2-6 week research experiences in the polar regions.

From 2010-2013, nearly 50 teachers from around the United States will join scientists in the Arctic and Antarctica to learn about science, the polar regions, and to share what they have learned with their students and communities.



TEACHERS AND RESEARCHERS
EXPLORING AND COLLABORATING

Questions

During the Presentation:

- Type your question in the text chat box

At the End of the Presentation:

- Raise your hand with the “hand button”.
- PolarTREC staff will call on you.
- Speak loud and clear and directly into the phone to ask your question.

Click on the Talk button to speak.

Unclick when you are done.

Carbon Balance in Warming and Drying Tundra



Historically, tundra ecosystems have been a carbon sink. How will this change with warming?

~840 Pg Carbon

Plant and soil
microbe
respiration

Photosynthesis

~1670 Pg Carbon

2x as much C in permafrost
soils as in the atmosphere

(Post et al., 1982; Sabine et al.,
2004; IPCC, 2007).

slide courtesy of Elizabeth Webb

How does this research relate to Climate Change?

- **Northern Latitudes experiencing much higher change in temperatures.**
 - 2-3°C (3.5-5.5°F) rise in temperature the last 50 years**
- **Little hard data on effect of increased temperature on permafrost.**
- **Potential for Positive-feedback loops.**
 - Permafrost thaw**



Carbon in Permafrost Experimental Heating Research (CiPEHR)

Stampede Rd. Healy, AK.



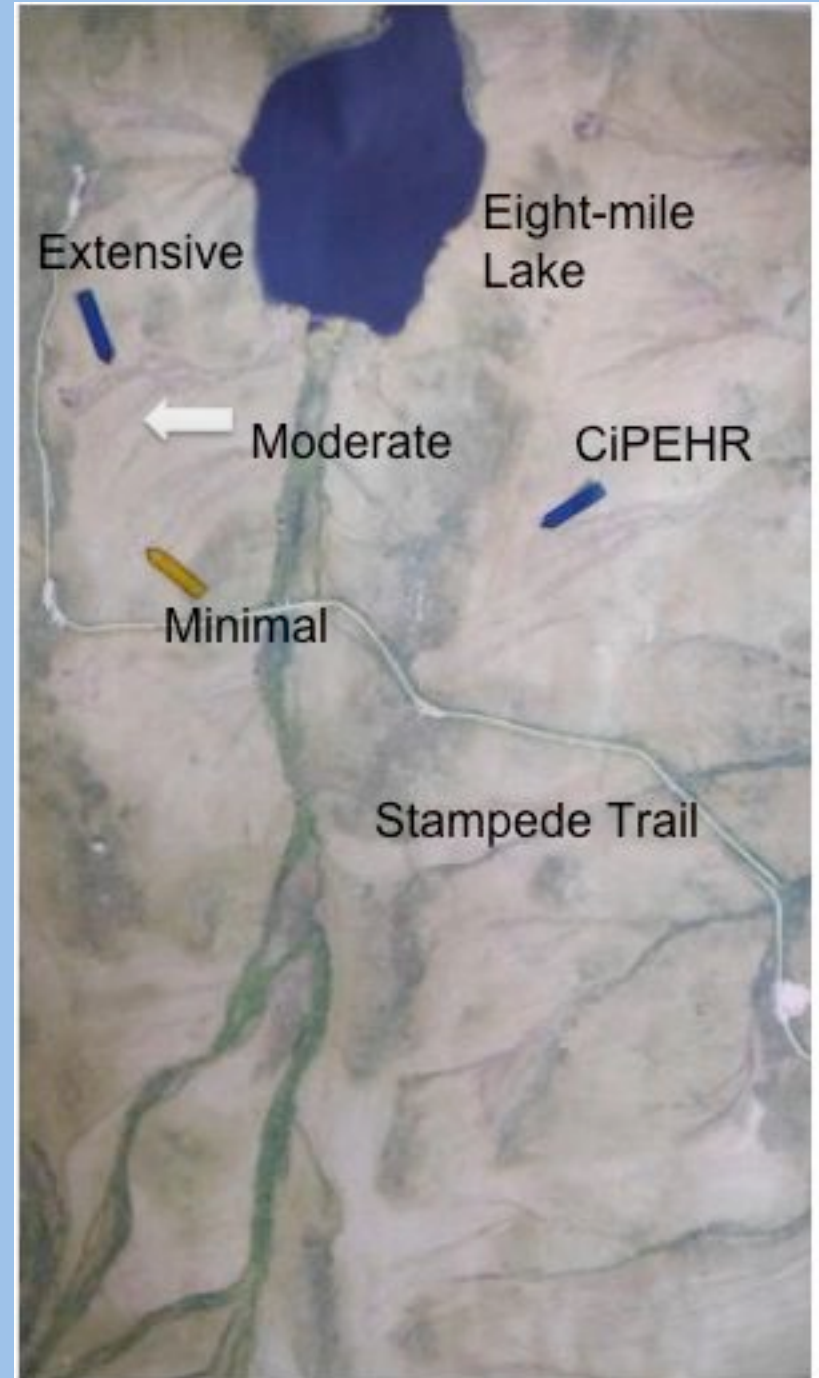
Sue Natali, Principal Investigator



Ted Schuur, Principal Investigator
University of Florida

The goal of CiPEHR is to examine the effects of air, soil and surface permafrost warming on carbon dynamics in tundra ecosystems.

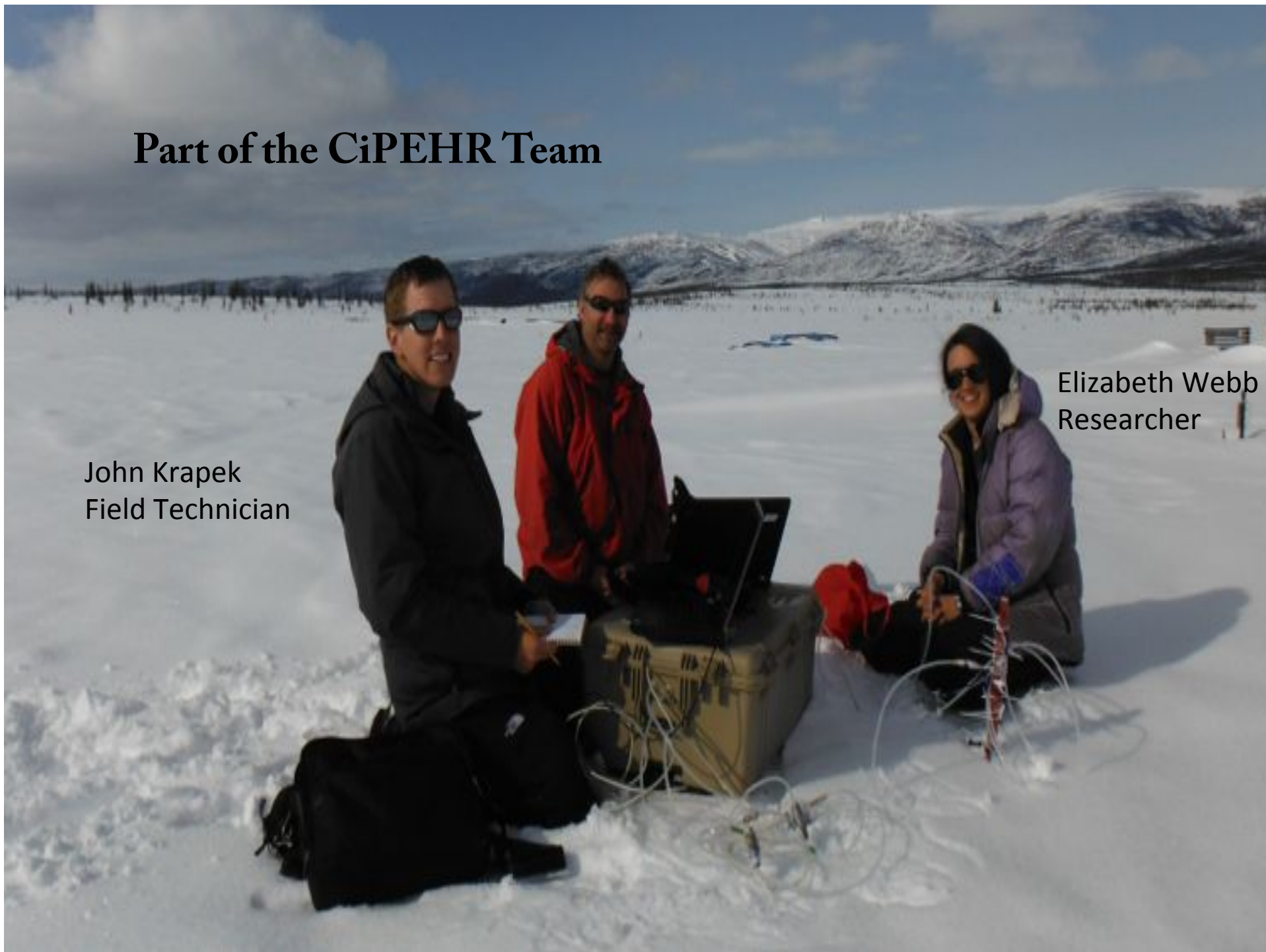
Alaska



Part of the CiPEHR Team

John Krapek
Field Technician

Elizabeth Webb
Researcher



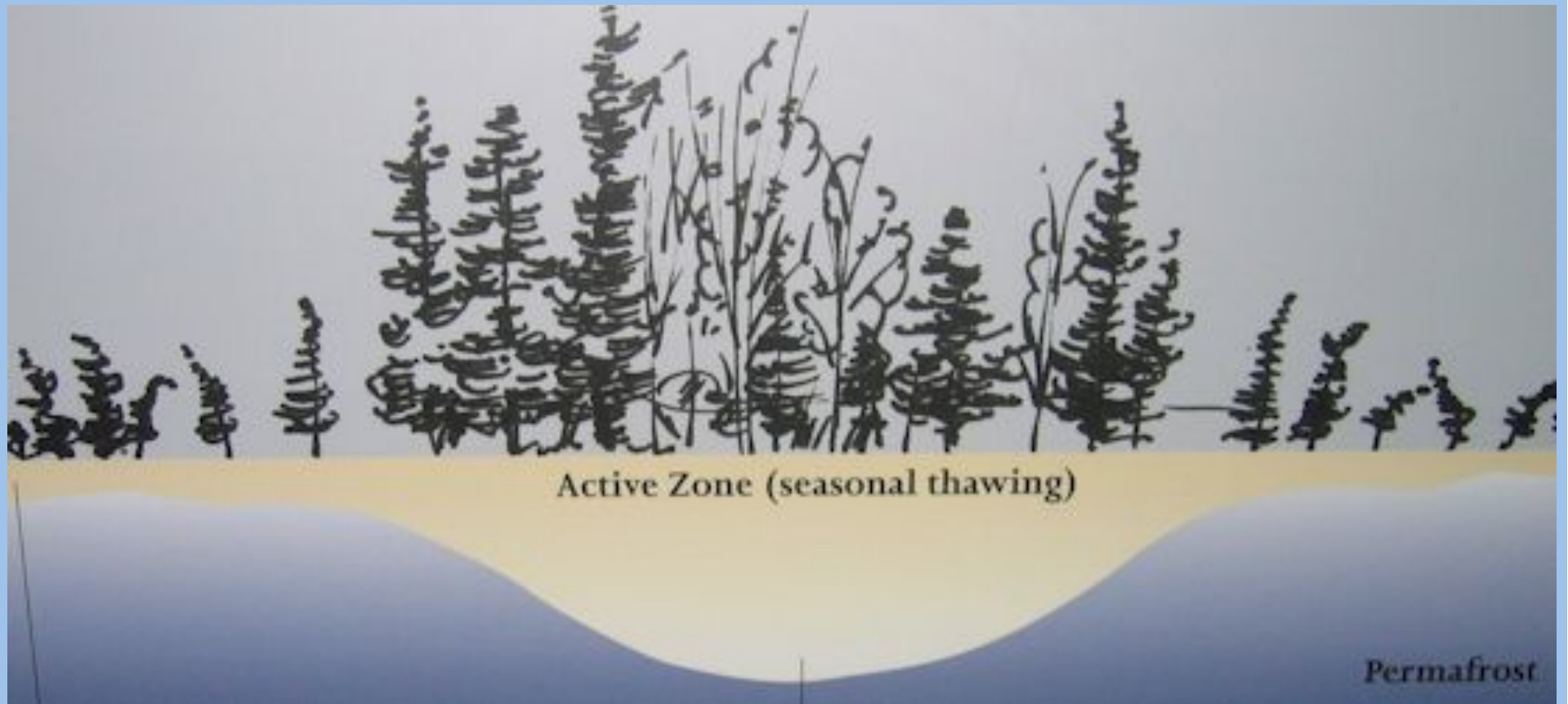
What is Permafrost?

- Ground that remains at or below 0°C for two or more years.
- Though it makes up less than 20% of global soil area it stores approximately 50% of the below ground carbon pool (Schuur et al., 2008; Tarnocai et al., 2009).
- These regions occupy 80% of Alaska (Jorgenson et al., 2008).





Figure 1. Latitudinal zonation of permafrost. Source: Brown and colleagues (1998).



Active Zone (seasonal thawing)

Permafrost



5 ways carbon flux is measured at the research site.

- Soda lime

- Eddy Covariance

- Forced Diffusion Sensors

- On-plot chamber measurements

- Off-plot chamber measurements
(snow removal)

Soda Lime



-Place soda lime (absorbs CO_2) in bucket.

-Buckets are open to soil but sealed to atmosphere.



Eddy Covariance

ECT



2nd Energy Tower



Thaw Gradient Monitoring



Forced Diffusion sensors



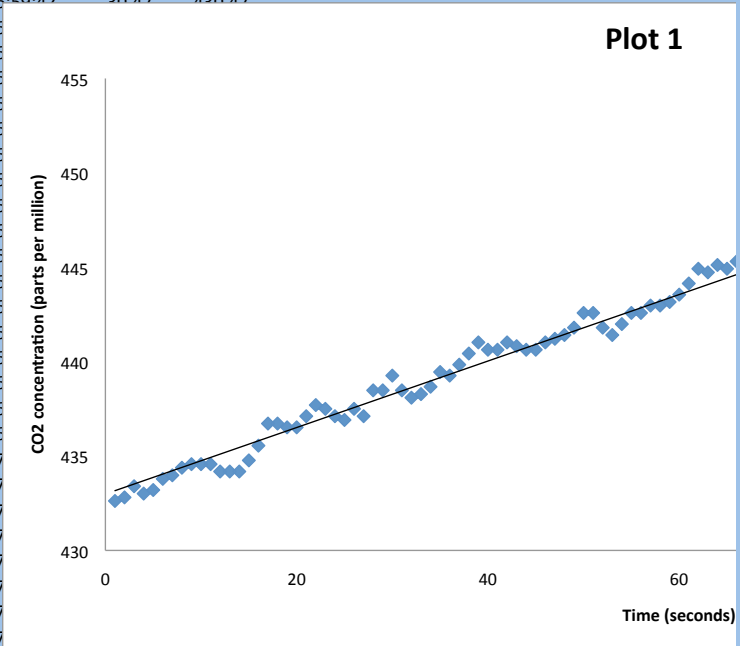
CO₂ movement determined by a diffusion constant and CO₂ concentrations in the two chambers.

**Off-plot chamber measurements
(snow removal)**



3/25/13	16:59:37	25.2	425.2
3/25/13	16:59:38	33.2	433.2
3/25/13	16:59:39	38.09	438.09
3/25/13	16:59:40	35.16	435.16
3/25/13	16:59:41	31.05	431.05
3/25/13	16:59:42	20.47	420.47

3/25/13 16:59:43
3/25/13 16:59:44
3/25/13 16:59:45
3/25/13 16:59:46
3/25/13 16:59:47
3/25/13 16:59:48
3/25/13 16:59:49
3/25/13 16:59:50
3/25/13 16:59:51
3/25/13 16:59:52
3/25/13 16:59:53
3/25/13 16:59:54
3/25/13 16:59:55
3/25/13 16:59:56
3/25/13 16:59:57
3/25/13 16:59:58
3/25/13 16:59:59
3/25/13 17:00:00
3/25/13 17:00:01
3/25/13 17:00:02
3/25/13 17:00:03
3/25/13 17:00:04
3/25/13 17:00:05
3/25/13 17:00:06
3/25/13 17:00:07



3/25/13	17:00:08	37.5	437.5
3/25/13	17:00:09	37.11	437.11
3/25/13	17:00:10	38.48	438.48
3/25/13	17:00:11	38.48	438.48
3/25/13	17:00:12	39.26	439.26
3/25/13	17:00:13	38.48	438.48
3/25/13	17:00:14	38.09	438.09
3/25/13	17:00:16	38.28	438.28
3/25/13	17:00:17	38.67	438.67
3/25/13	17:00:18	39.45	439.45
3/25/13	17:00:19	39.26	439.26
3/25/13	17:00:20	39.84	439.84
3/25/13	17:00:21	40.43	440.43
3/25/13	17:00:22	41.02	441.02
3/25/13	17:00:23	40.63	440.63
3/25/13	17:00:24	40.63	440.63
3/25/13	17:00:25	41.02	441.02

On-plot Chamber Measurements



1. Measure ambient air.
2. Scrub chamber to ambient.
3. Measure flux.



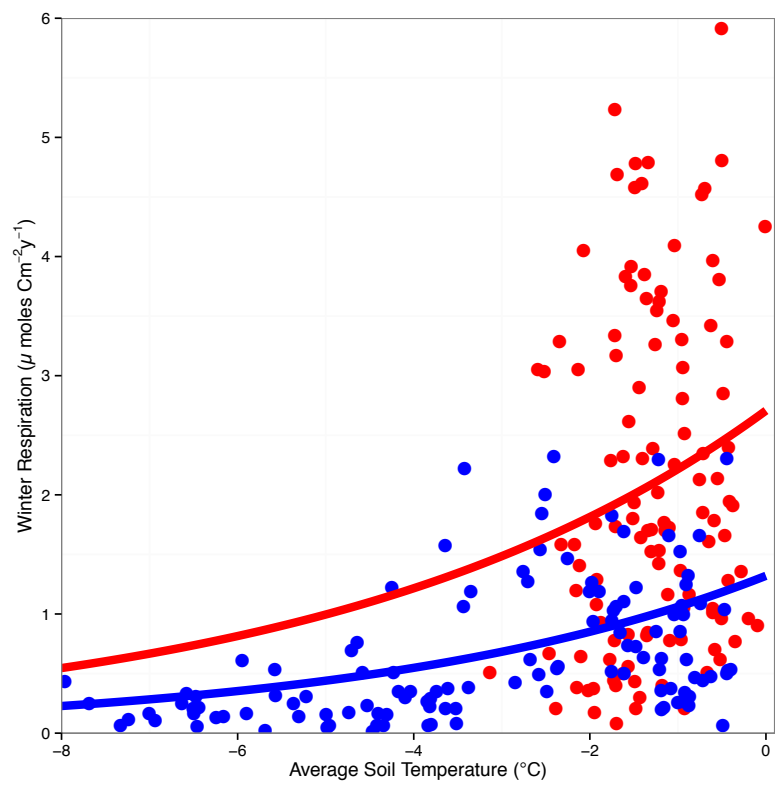
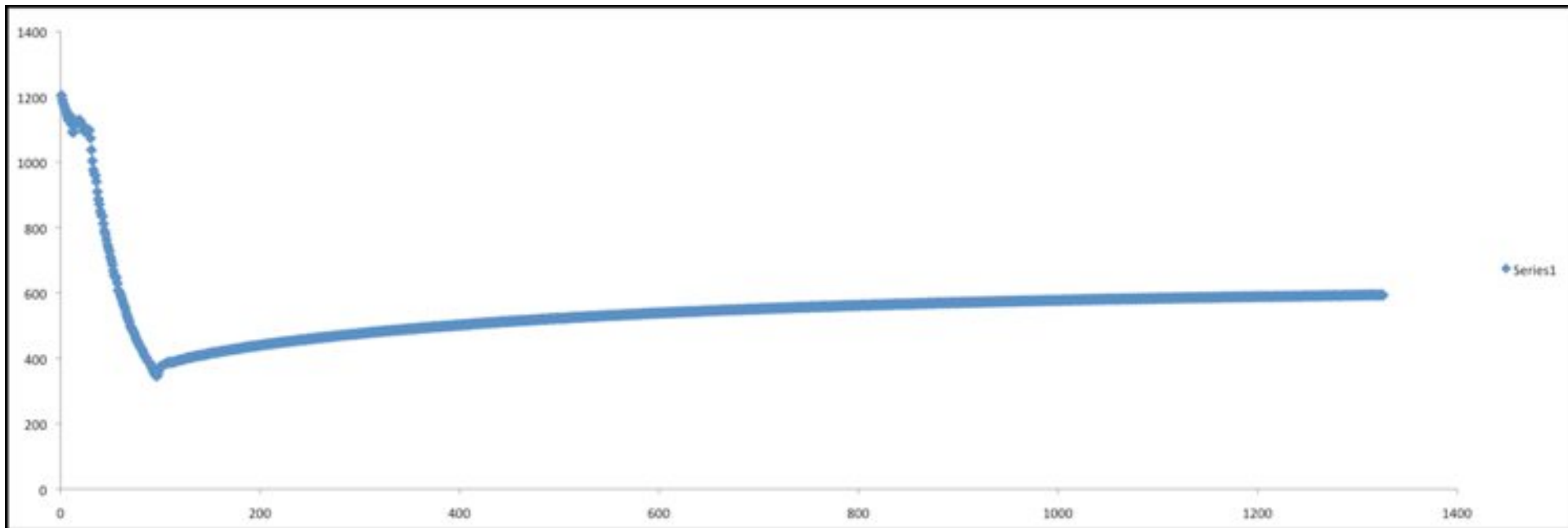
Chamber

Test ends



Sampling with the LI-COR







Measuring how much snow to remove.



Snow removal from experimental side of fences.



Snow removed from experimental plot.



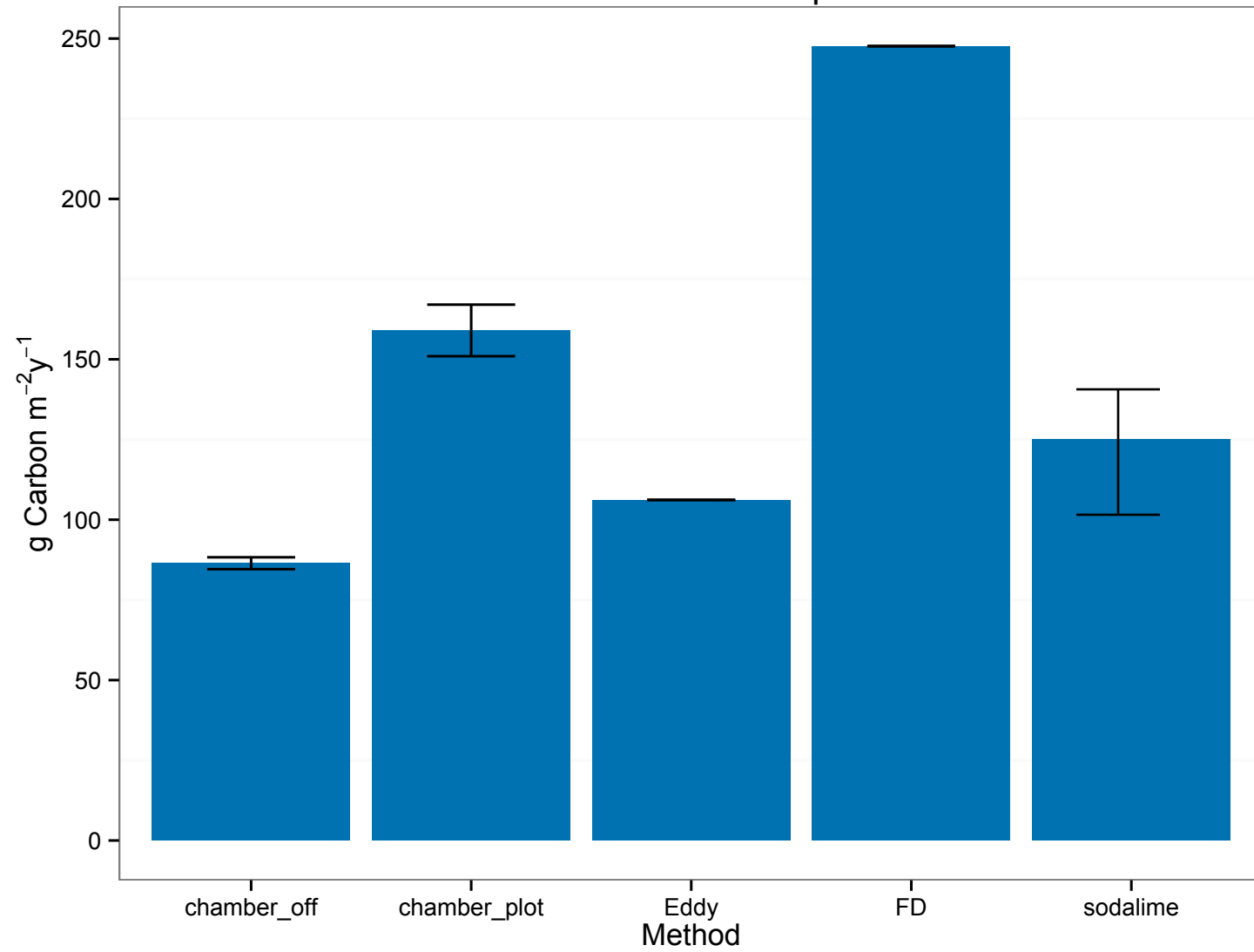
Testing a tracked snow blower.

Snow Removal Crew 2013



Method	Description	Advantages	Disadvantages
Soda lime	Buckets dug into the ground are closed to the atmosphere but open to the ground. Inside enclosure is a mason jar with soda lime, which adsorbs CO ₂ throughout the winter.	-Easy	-Only get winter season total (cannot correlate with moisture, temp, etc.) -Buckets left on for entire winter- does this change CO ₂ balance?
Eddy Covariance	Measures CO ₂ flux from a tower. Flux calculation based on co-variance of wind speed and CO ₂ concentration.	-Can measure over a large area -Provides high resolution (every 30 minutes) fluxes	-Cannot measure treatments or individual plots -Requires wind for good measurements
Forced Diffusion Sensors	Two chambers, each with a gas permeable membrane that passively regulates the mixing of atmosphere (one chamber) or soil (the other chamber) air in the chamber. Flux determined by a diffusion constant and CO ₂ concentrations in the two chambers. Chambers installed before winter.	-Low maintenance -Can place directly on plots -Does not require pump; chamber mixing occurs with free air diffusion and thermal convection	-Cannot re-calibrate mid-season -Sometimes returns negative values -Still being tested; venting/pressure conditions are still being worked out
On-plot chamber measurements	Chambers are installed at the beginning of the winter with tubes extending to an off-plot location. CO ₂ concentration in the chamber exceeds ambient snow-pack concentrations, so the chamber must be scrubbed to ambient before a flux can be recorded (using an infra-red gas analyzer).	-Can measure plots directly - Measurements not related to diffusion through snow	-Cannot sample in cold (<-30F) weather -Requires a pump for circulation; pumping may increase diffusion rates - Chambers are left on for the entire winter; this might affect CO ₂ flux. -First time using this method; scrubbing chamber may affect flux.
Off-plot chamber measurements (snow removal)	A snow pit is dug to unearth a previously installed base. Portable chamber attached to infra-red gas analyzer measures CO ₂ flux from the soil.	-Measure the soil directly	-Disturbs the snow pack -Exposes soil to cold air temperatures; this could decrease flux (although some literature indicates this is not a problem) -Cannot sample in cold (<-30F) weather -Requires a pump for circulation; pumping may increase diffusion rates -"Chimney Effect": CO ₂ rushes into snow pit because CO ₂ concentration in pit is less than CO ₂ concentration in snow pack

2011-2012 Winter Respiration



Remember: In each method the amount of carbon produced (source) is in excess of the amount of carbon absorbed (sink) that means an overall addition of CO² into the atmosphere thus contributing to a positive –feedback loop that increases the effects of Climate Change.





















TEACHERS AND RESEARCHERS
EXPLORING AND COLLABORATING

Teachers: Join PolarTREC!

www.polartrec.com/about/join

Every teacher can participate in different ways:

- **Following Expeditions**
- **Participate in PolarConnect Events**
- **Join the Polar Education Email List**
- **Take Online Professional Development Courses**
- **Become a PolarTREC Teacher!**



TEACHERS AND RESEARCHERS
EXPLORING AND COLLABORATING

Upcoming Events

Watch for and register for upcoming events at [www.polartrec.com!](http://www.polartrec.com)



TEACHERS AND RESEARCHERS
EXPLORING AND COLLABORATING

Thank You!

An archive of the event will be available shortly.
<http://www.polartrac.com/polar-connect/archive>

