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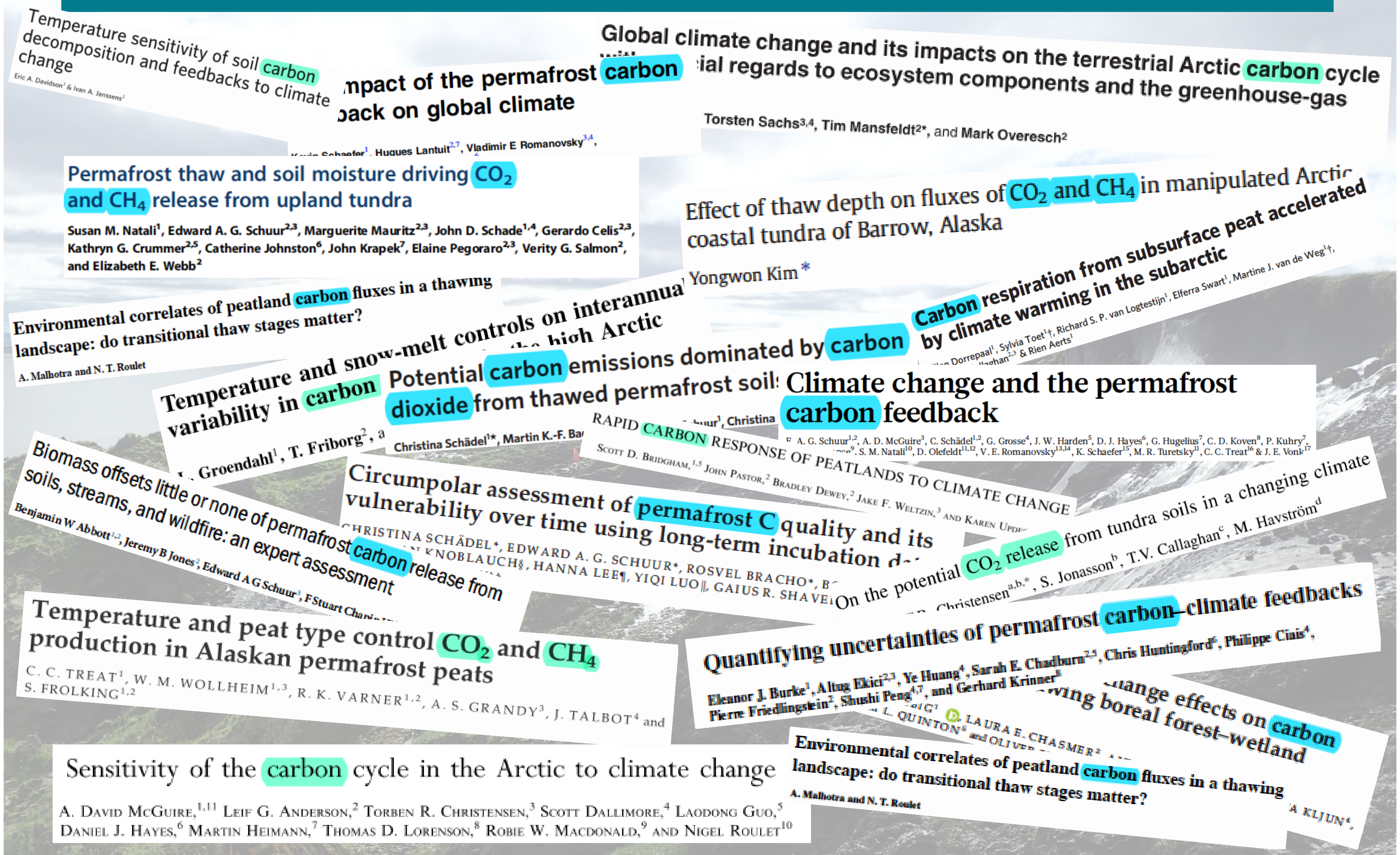
Christina Biasi, Maija E. Marushchak, Carolina Voigt,
Alexey Faguet, Dmitry Kaverin

ARKTIKO meeting, 20 November 2018, Helsinki

Steps towards constraining the circumarctic N2O budget in the frame of the NOCA project

AKA/RFBR project, 2018-2020

Background: Permafrost C studies



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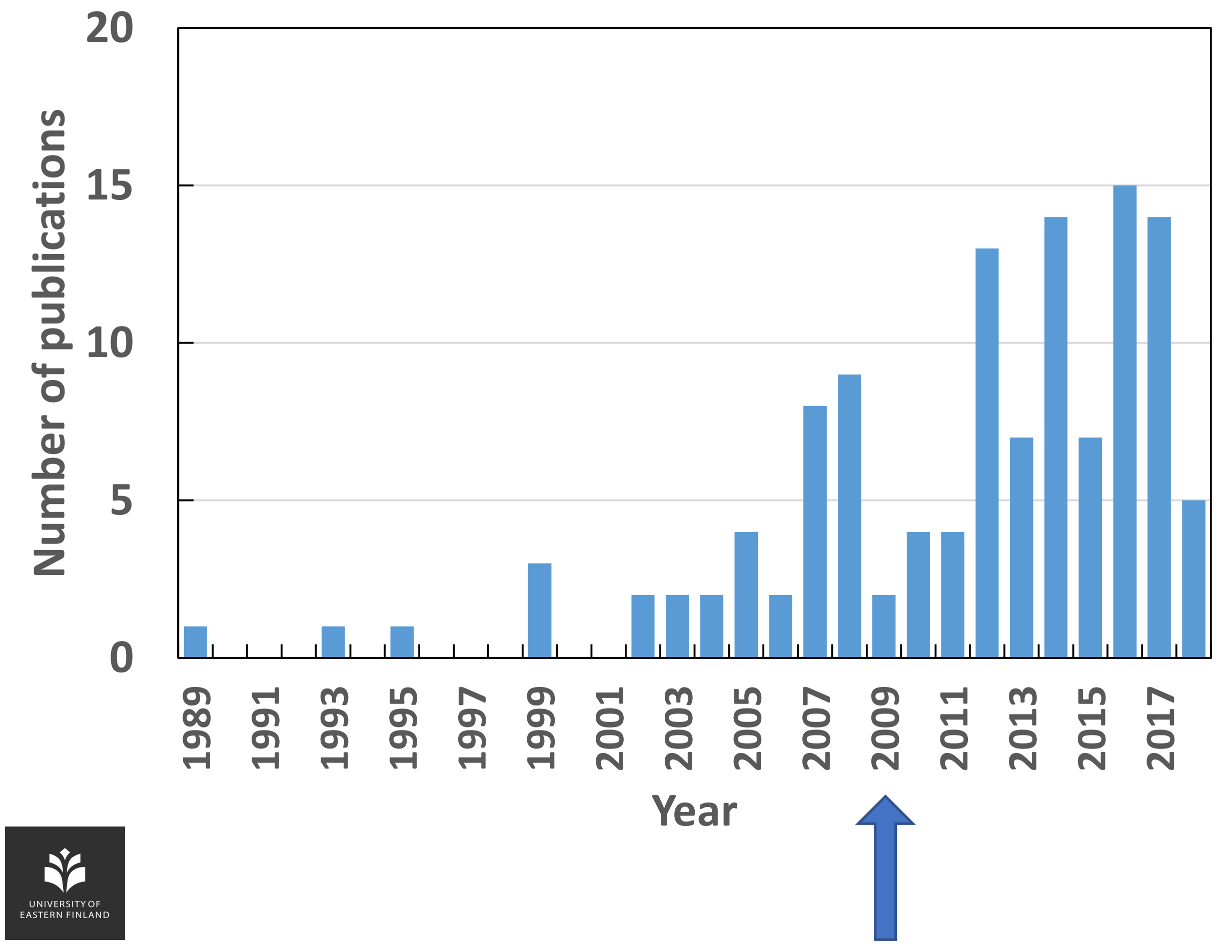
Arctic N_2O emissions

<u>Literature search in Web of Science:</u>

(N2O OR nitrous oxide) AND (arctic OR permafrost) AND soil



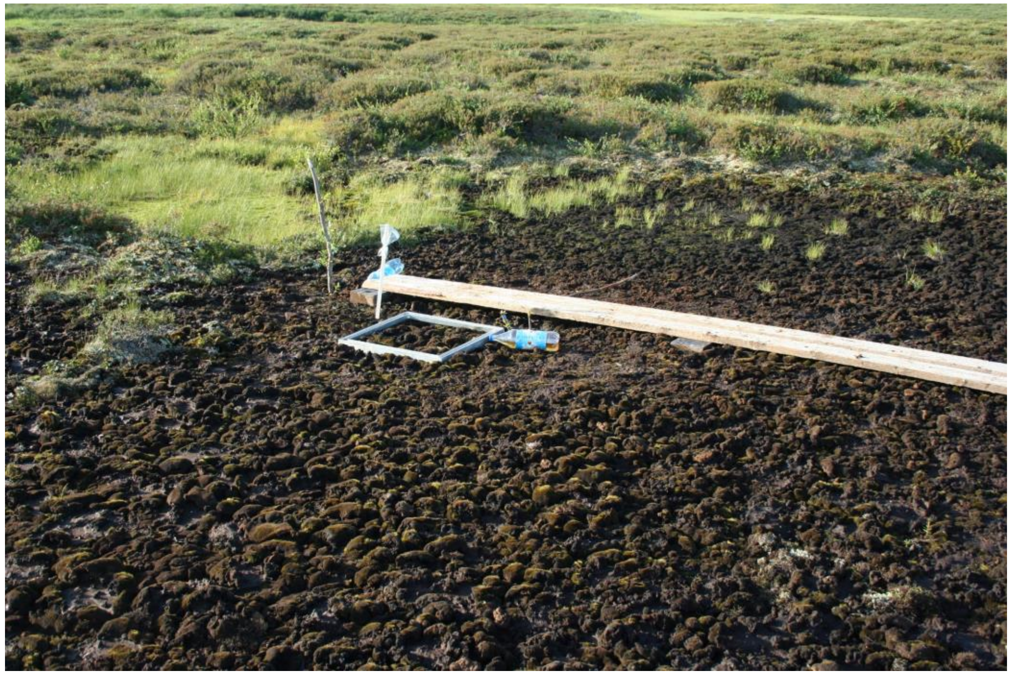
nature geoscience

LETTERS

PUBLISHED ONLINE: 15 FEBRUARY 2009 | DOI: 10.1038/NGEO434

Large N_2O emissions from cryoturbated peat soil in tundra

Maija E. Repo[1], Sanna Susiluoto[2], Saara E. Lind[1], Simo Jokinen[1], Vladimir Elsakov[3], Christina Biasi[1], Tarmo Virtanen[2] and Pertti J. Martikainen[1]*



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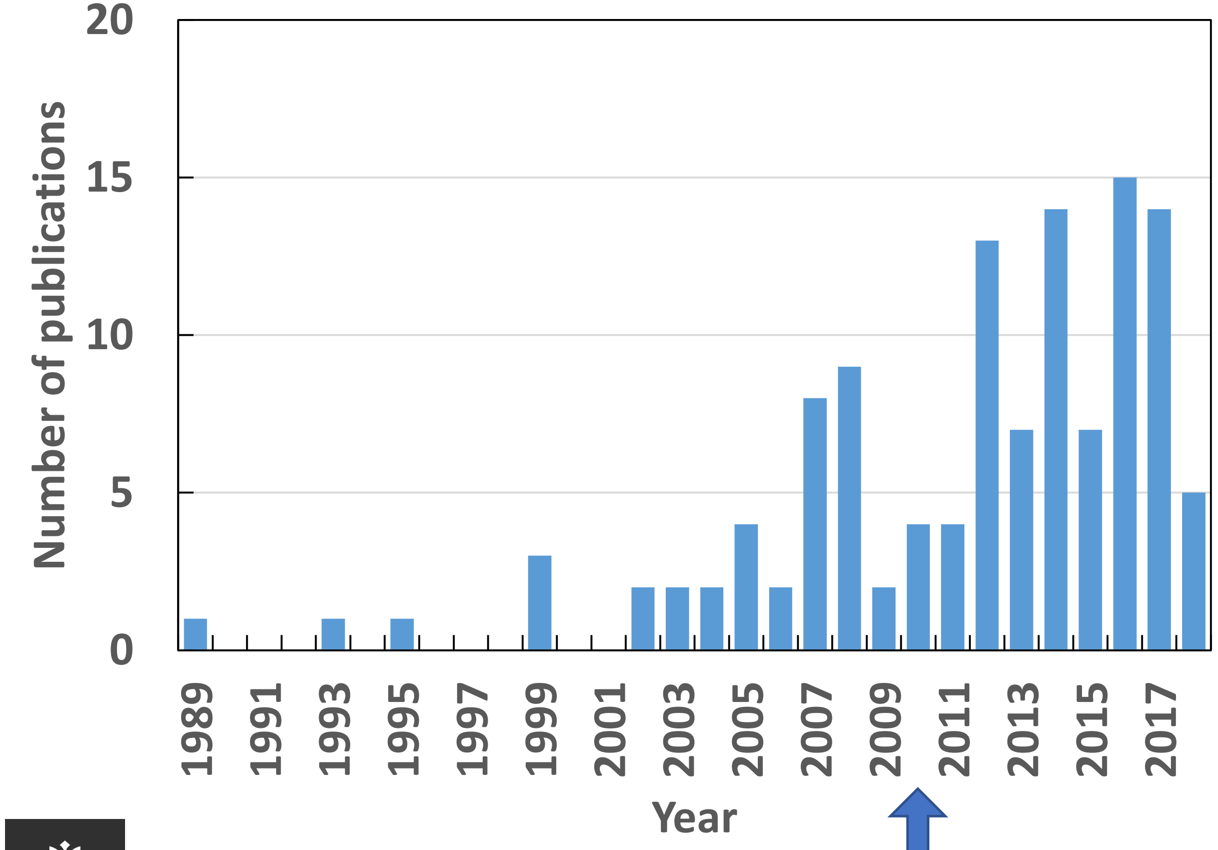
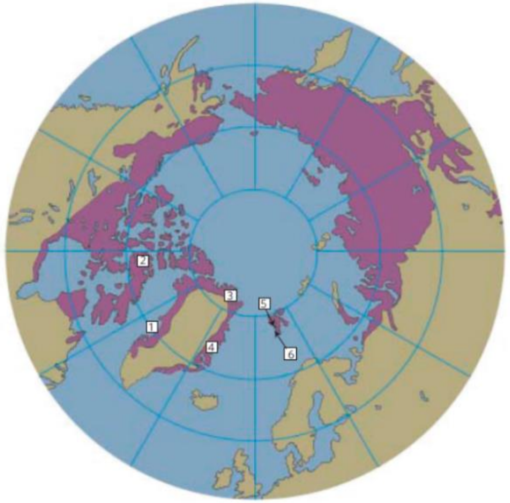
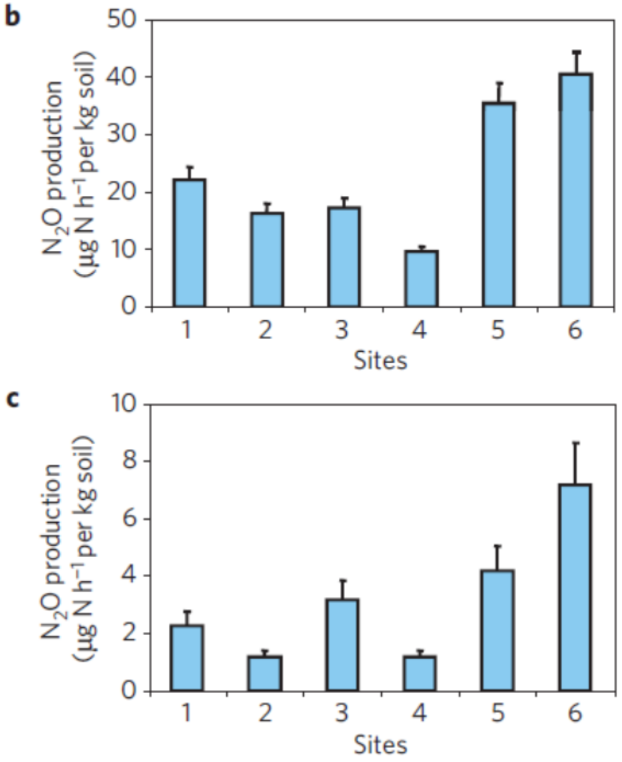


nature geoscience LETTERS
PUBLISHED ONLINE: 4 APRIL 2010 | DOI:10.1038/NGEO803

High nitrous oxide production from thawing permafrost

Bo Elberling[1,2,3]★, Hanne H. Christiansen[3] and Birger U. Hansen[1]





Arctic N_2O emissions

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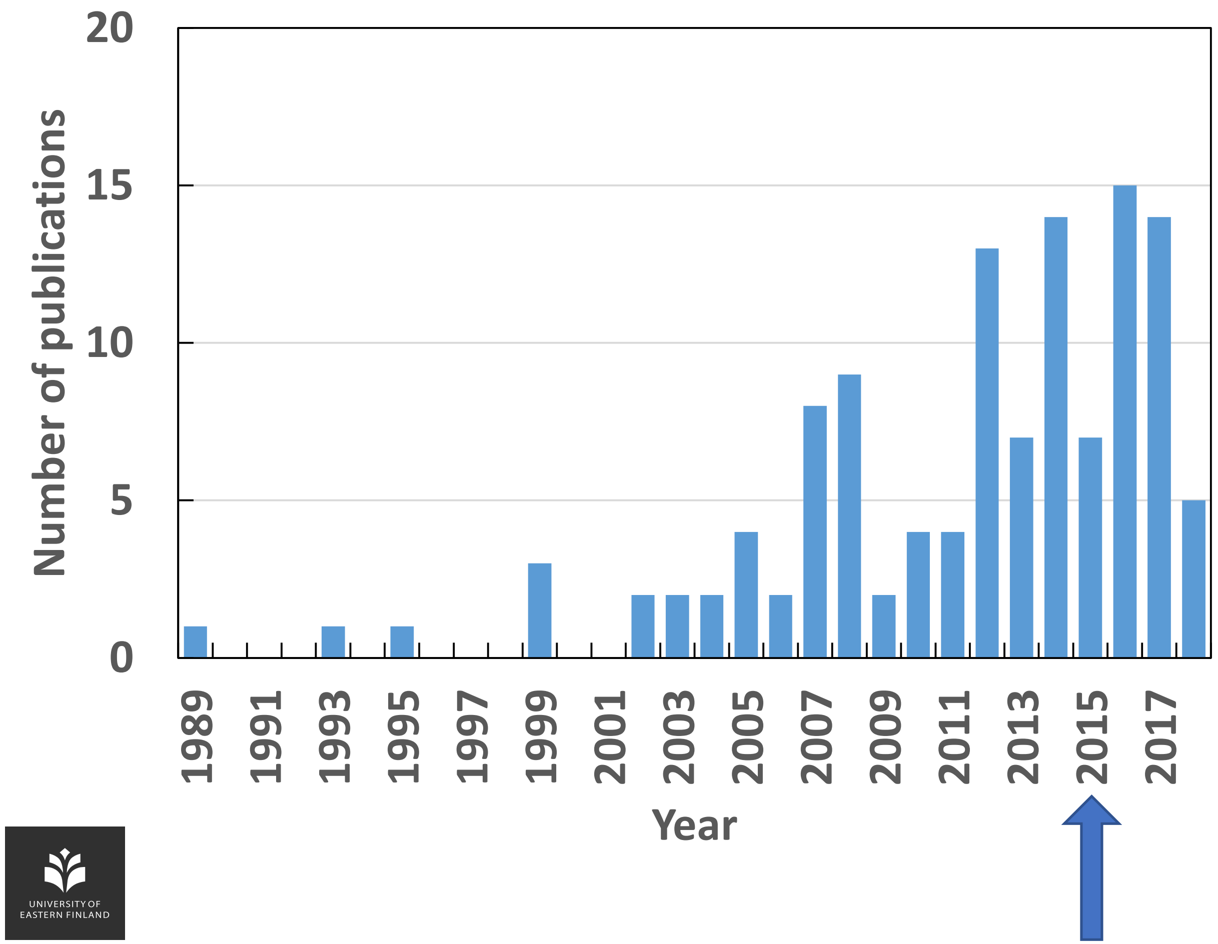


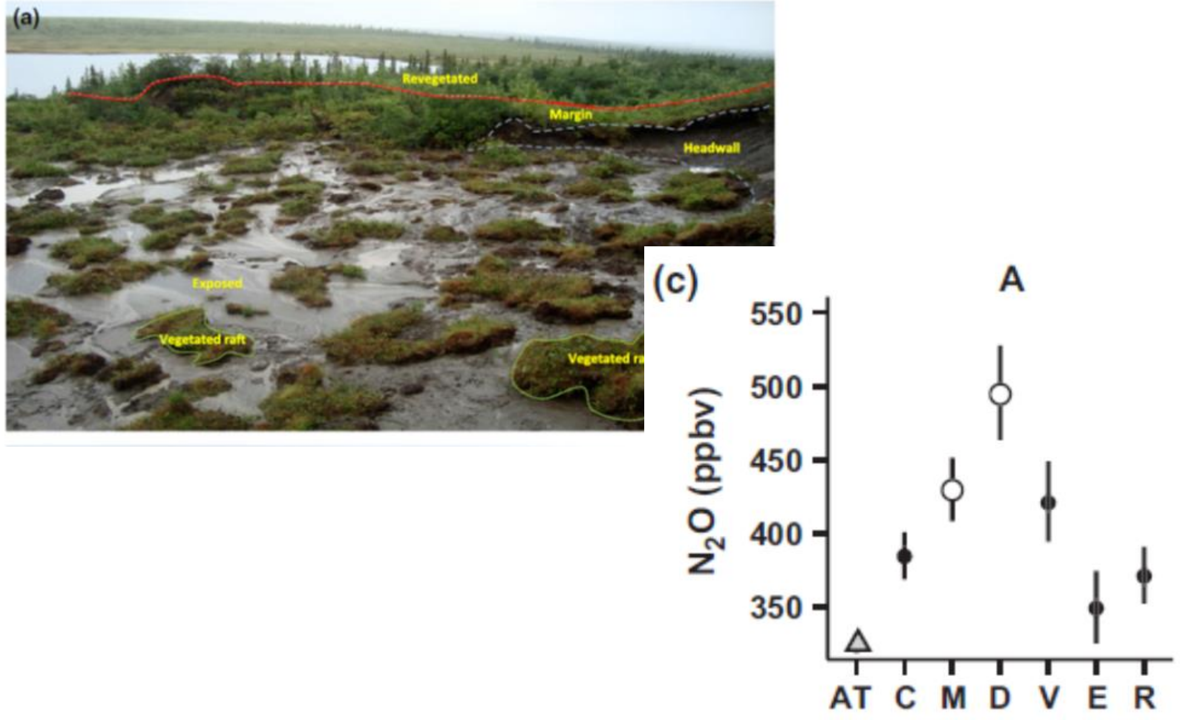
Global Change Biology

Global Change Biology (2015) 21, 4570–4587, doi: 10.1111/gcb.13069

Permafrost collapse alters soil carbon stocks, respiration, CH_4, and N_2O in upland tundra

BENJAMIN W. ABBOTT[1,2] and JEREMY B. JONES[2]

[1]*OSUR, CNRS, UMR 6553 ECOBIO, Université de Rennes 1, Rennes, France,* [2]*Department of Biology and Wildlife and Institute of Arctic Biology, University of Alaska Fairbanks, Fairbanks, AK, USA*



Arctic N_2O emissions

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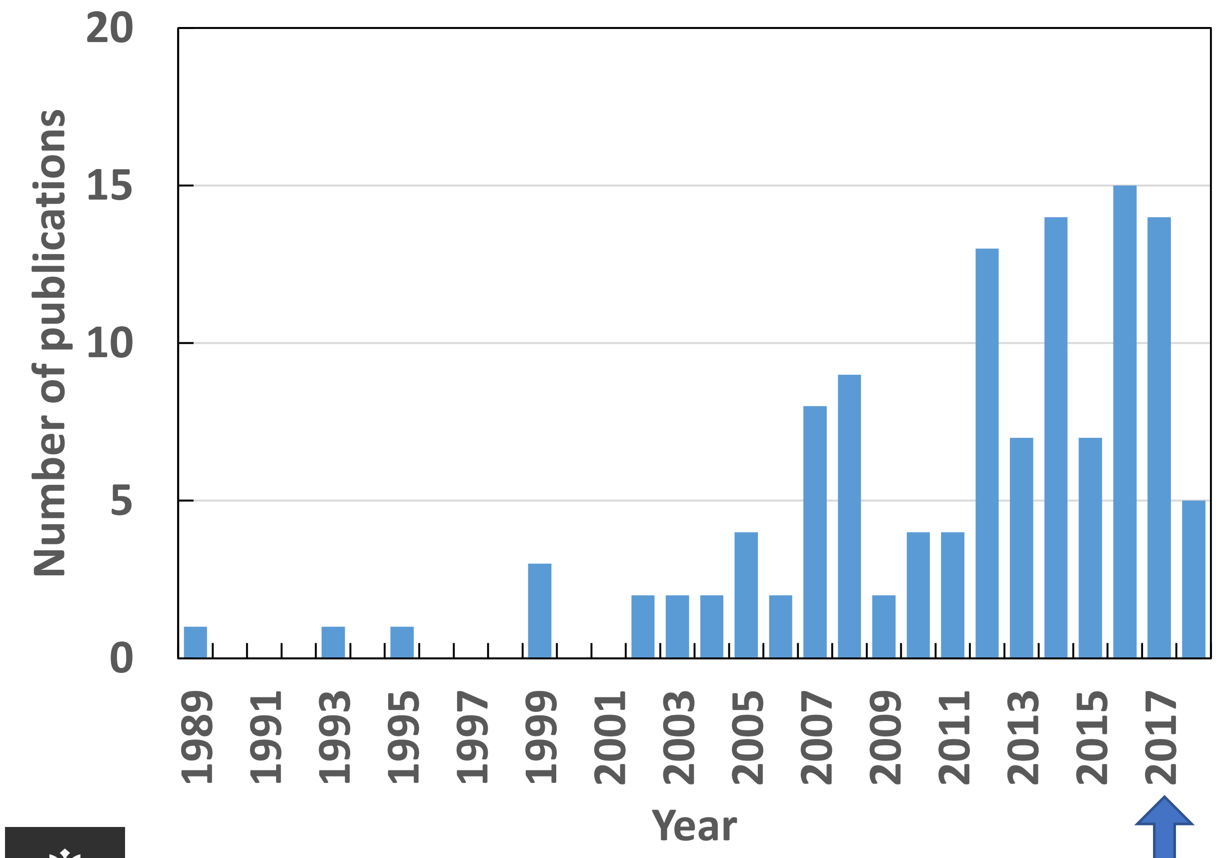

Permafrost Nitrous Oxide Emissions Observed on a Landscape Scale Using Airborne Eddy Covariance Method

Jordan Wilkerson[1], Ronald Dobosy[2,3], David S. Sayres[4], Claire Healy[5], Edward Dumas[2,3], Bruce Baker[2], and James G. Anderson[1,4,5]

[1]Department of Chemistry and Chemical Biology, Harvard University, Cambridge, MA 02138, USA; [2]Atmospheric Turbulence and Diffusion Division, NOAA/ARL, Oak Ridge, TN 37830, USA; [3]Oak Ridge Associated Universities (ORAU), Oak Ridge, TN 37830, USA; [4]Paulson School of Engineering and Applied Sciences, Harvard University, Cambridge, MA 02138, USA; [5]Department of Earth and Planetary Sciences, Harvard University, 12 Oxford Street, Cambridge, MA 02138, USA.

Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-1108
Manuscript under review for journal Atmos. Chem. Phys.
Discussion started: 19 October 2018

Atmospheric Chemistry and Physics Discussions

Open Access

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Figures and Tables

Figure 1. FOCAL during flight. a, Top-down schematic of the atmospheric gas f sample inlet is located on the BAT probe, located at the nose of the plane. The ga detection cell of the ICOS spectrometer, located within the luggage bay in front of flying around 15 m above the surface.

Table 2: Observed flux averages. Area covered is the footprint scope of the measurements made for each flight. Spatially averaged fluxes are presented with bootstrap-derived 90% confidence intervals in parentheses. Asterisks indicate mean flux is significantly greater than 0 μg N_2O m^{-2} s^{-1} ($p < 0.01$).

Flight date DD.HH	Area covered (km^2)	Mean N_2O flux (μg N_2O m^{-2} s^{-1})
25.18	90	0.05* (0.031, 0.082)
27.11	86	-0.01 (-0.035, 0.028)
27.19	22	0.015 (0.004, 0.032)
28.10	69	0.10* (0.068, 0.140)
28.15	44	0.04 (0.005, 0.080)
All flights	311	0.043* (0.025, 0.055)

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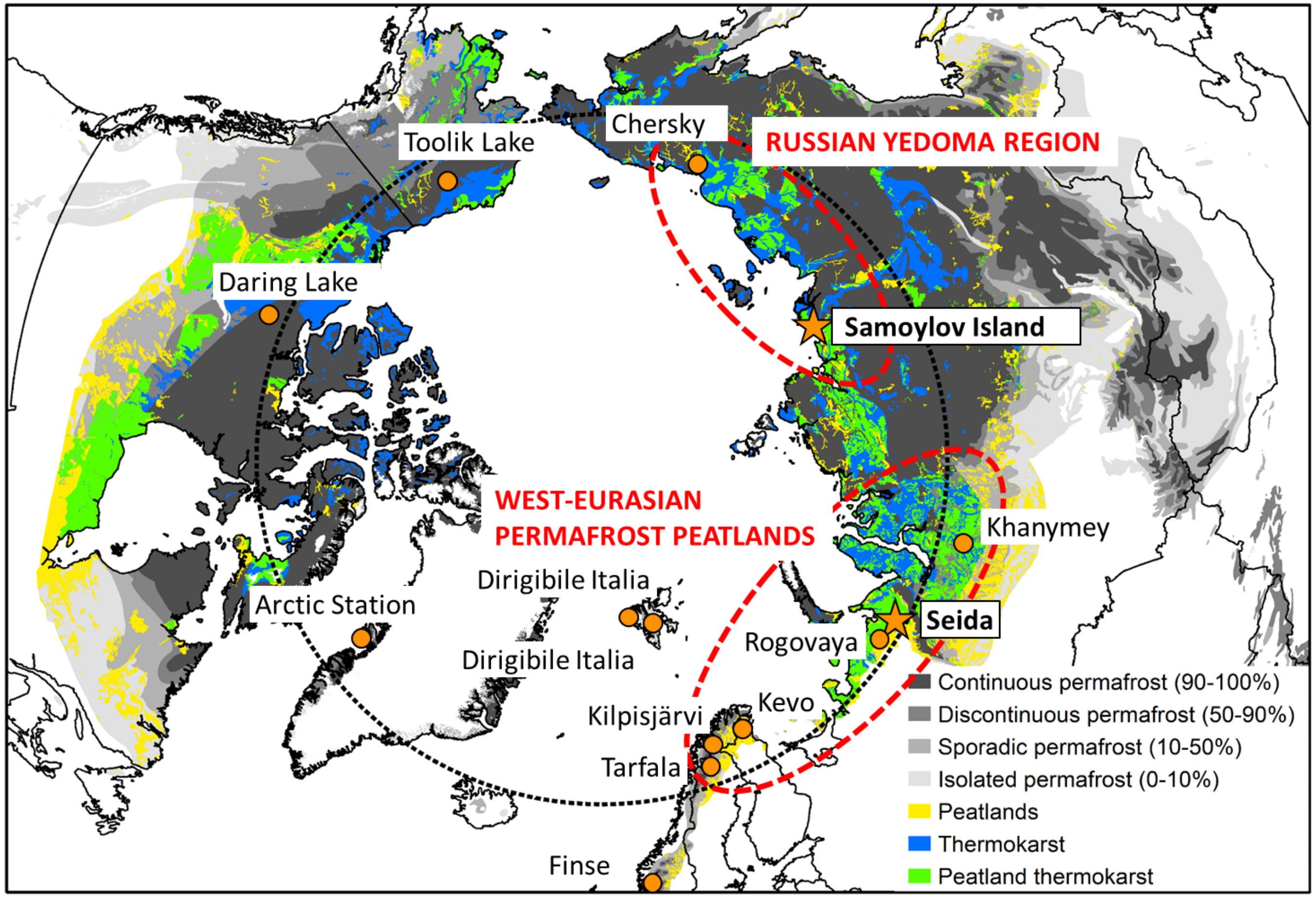
Main aim of NOCA

….is to produce the first circumpolar N_2O budget



Modified from Voigt *et al*. (2017), *PNAS*.

Potential N_2O hot-spot areas

Primary NOCA sites

Secondary NOCA sites

SITE ACCESS:

- **Field work in the frame of NOCA**
- **INTERACT Remote Access scheme**
- **Existing data from UEF**
- **Existing & novel data from collaborators**

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INTER ⇄ ACT

ACCESSING THE ARCTIC | MANAGING STATIONS | HANDLING DATA | ARCTIC AWARENESS | COPING WITH CHANGE | MANAGING RISKS | USING DRONES | TRACKING BIODIVERSITY

ACCESSING THE ARCTIC

Facebook | Twitter | RG ResearchGate | G+ Google+

Tarfala: Radar measurements on a glacier in the winter. Photo: Peter Jansson

What is "Transnational Access" within INTERACT?

The INTERACT project under EU H2020 provides altogether 7800 person-days of Transnational Access (both physical and remote) in 2016-2020. Access is offered to 43 research stations located in the Arctic and northern alpine and forest areas in Europe, Russia and North-America.

The sites represent a variety of glacier, mountain, tundra, boreal forest, peatland and freshwater ecosystems, providing opportunities for researchers from natural sciences to human dimension.

Remote Access is a form of Transnational Access in which the user(s) do not visit the infrastructure/installation physically themselves; instead the staff of the infrastructure/installation is conducting the study/collecting the samples/doing the monitoring for the user(s) according to their research plan.

TA calls are open annually for scientists and research groups (=users/user groups) to apply Transnational Access.

Transnational Access includes:

- Free access for eligible user groups to research facilities and field sites
- Support for travel and logistics costs
- Free access to information and data in the public domain held at the infrastructures

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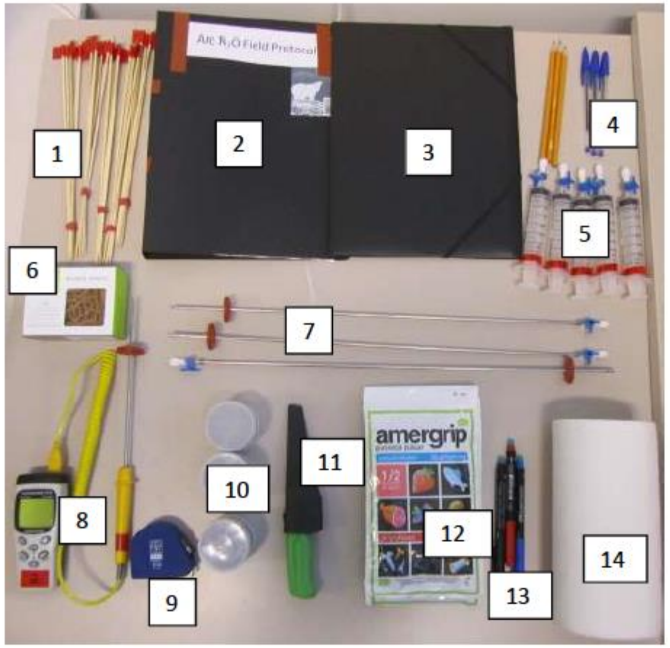
Methods

"Simple, harmonized methods, easily applicable at all kinds of sites by anyone will be used."

- static chamber measurement (if possible)
- **soil gas sampling for determination of N2O fluxes**
- surface soil sampling
- temperature and moisture measurements
- vegetation description with photographs of the sites.



[Protocol]
[Field template]
[Demonstration videos]

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Field protocol:

Determination of soil N_2O fluxes by a diffusion gradient method

Version 1

INTERACT

ACADEMY OF FINLAND

Contents

Field template for INTERACT Remote Access project Arc-N_2O

Station:	Sampler:

Date (dd.mm.yy)	Surface type:	Surface type photo no.

AMBIENT AIR SAMPLING (FIELD PROTOCOL PAGE 4)

Ambient air sample no.	Syringe no.	Vial no.	Sample comment
1			
2			
3			

SOIL GAS SAMPLING (N_2O flux determination) (FIELD PROTOCOL PAGE 4)

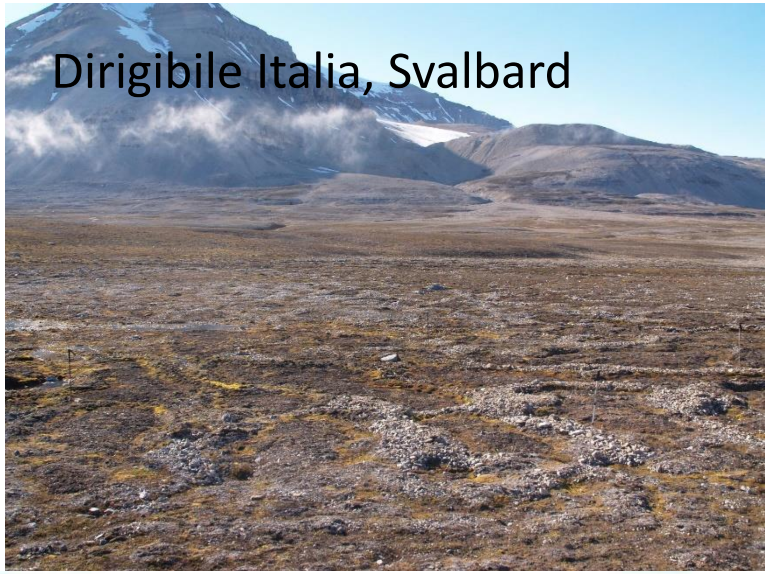
Plot no.	Local time (hh:mm)	Sampling depth	Syringe no.	Vial no.	Sample comment
1		5 cm			
Plot coordinates	Plot photo no.	10 cm			
		20 cm			

Plot no.	Local time (hh:mm)	Sampling depth	Syringe no.	Vial no.	Sample comment
2		5 cm			
Plot coordinates	Plot photo no.	10 cm			
		20 cm			

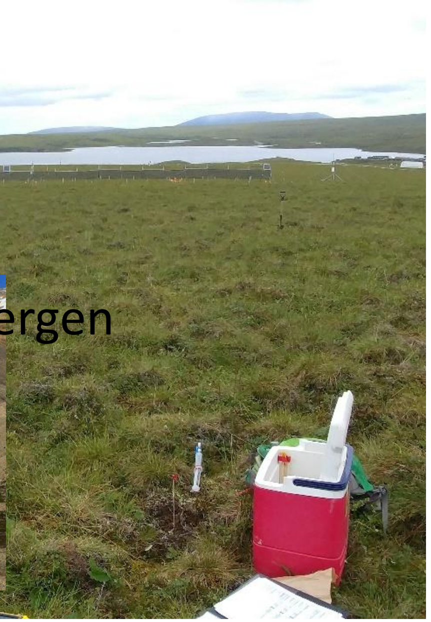
Plot no.	Local time (hh:mm)	Sampling depth	Syringe no.	Vial no.	Sample comment
3		5 cm			
Plot coordinates	Plot photo no.	10 cm			
		20 cm			

Plot no.	Local time (hh:mm)	Sampling depth	Syringe no.	Vial no.	Sample comment

Remote Access Sampling 2018



Dirigibile Italia, Svalbard



Toolik Lake

Petuniabukta, Sptzbergen

<u>Remote access to 8 INTERACT stations, 5 stations sent samples</u>

- Focus in spatial screening of N_2O sinks and sources
- Measurements took place during peak growing season
- Quick and simple methods, successfully applied
  - ➢ Soil gas samples
  - ➢ Soil samples
  - ➢ Auxiliary data

Tarfala, Sweden

Finse station, Norway

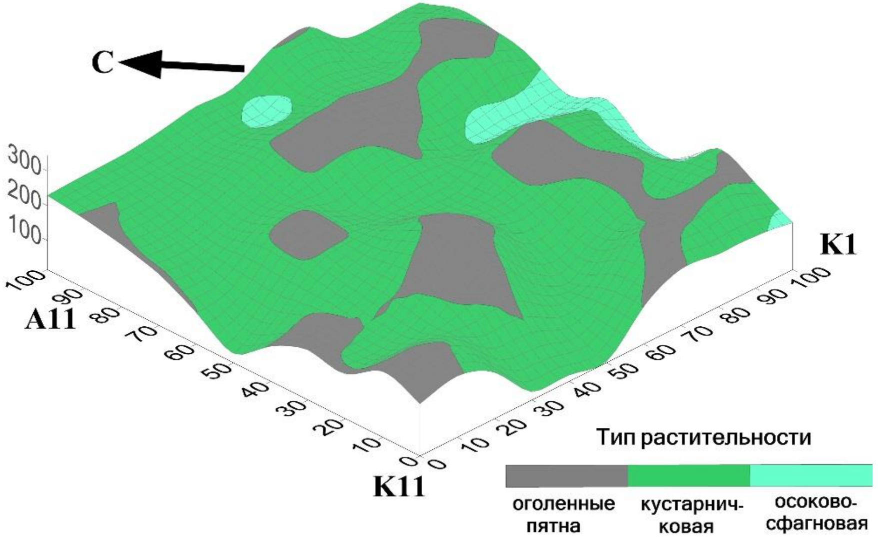
Own field work in 2018

Two Russian peat plateaus sites:
Seida and Rogovaya

Several palsa mires in Finnish Lapland

Field work in key NOCA sites

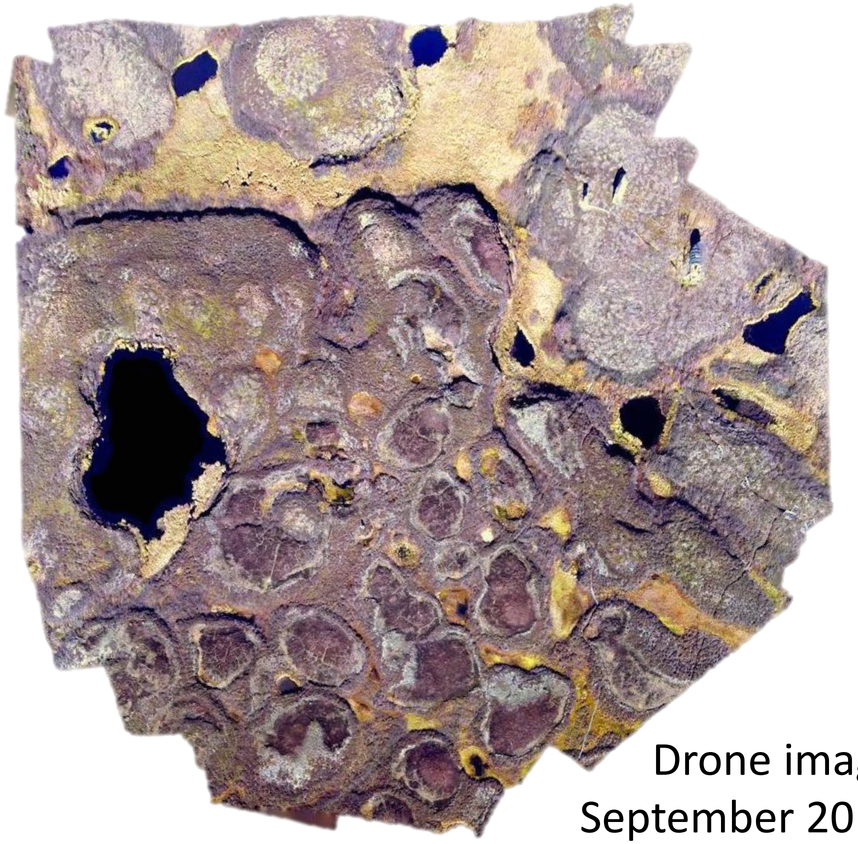
- Focus in spatial screening of N_2O sinks and sources
- Measurements during peak growing season
- Quick and simple methods, successfully applied in previous projects
  - ➢ Manual flux chambers
  - ➢ Soil gas sampling & diffusion calculation



Upscaling of N_2O sources and sinks

Seida, West Russian permafrost peatlands

- **Drone imaging**
- **Complementary vegetation and soil surveys**



Drone image:
September 2016,
Vladimir Elsakov, Komi Science Center

Lena Delta, NE Siberian Yedoma Region

- **Detailed vegetation & soil surveys within the area of previous drone images**

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NOCA project team

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Dr. Alexander Pastukhov

Dr. Vladimir Elsakov

Trofimuk Institute of Petroleum Geology and Geophysics (IPGG)
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Dr. Alexey Fague

Massachusetts Institute of Technology

Dr. Ali Ibrahimi

Alfred Wegener Institute

Dr. Guido Grosse

Dr. Anne Morgenstern

Stockholm University

Dr. Gustaf Hugelius

Number of collaborators operating at study sites across the Circumarctic


Thank you!
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