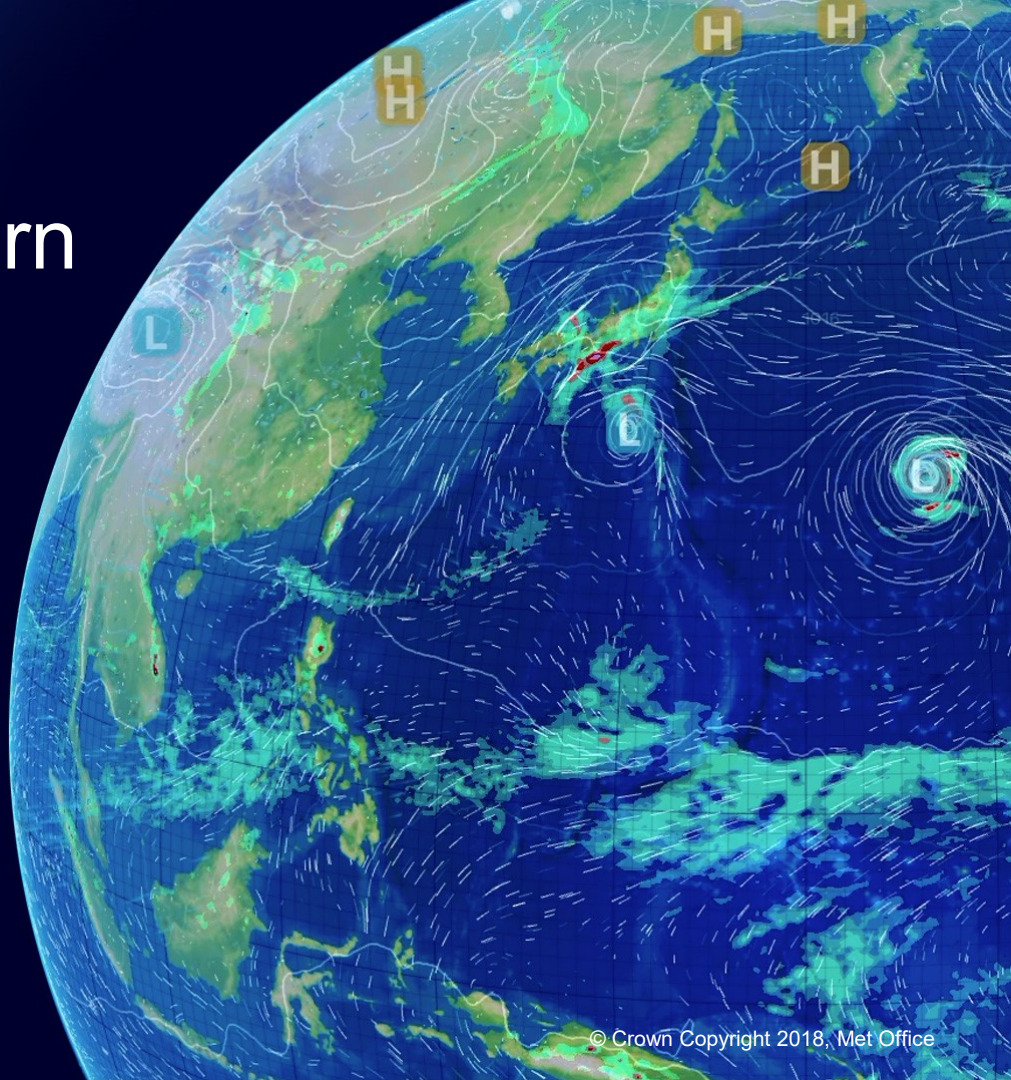
JULES and the northern high latitudes

Eleanor Burke and Sarah Chadburn



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Developing an optimal JULES configuration for the northern high latitudes

- Model development and configuration
- Model evaluation
- Leading to a GMD documentation paper and a recommended configuration for the community and UKESM

A COMMUNITY BUILDING PROCESS

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Available model developments in vn5.5

- Soil thermal conductivity of organic soils
- Ability of permafrost to hold water
- Vertical profile of soil properties *(improved but still buggy)*
- Vertically resolved soil carbon *(and nitrogen – buggy ask me, will sort asap!…..)*
- Wetland methane emissions as a function of depth
- Bedrock

ANYTHING FROM THE COMMUNITY?

Relevant model developments not yet in the trunk

- Fix vertically resolved soil carbon and nitrogen model
- Fix vertical soil properties
- Microbial methane model (see Sarah's talk)
- Moss PFT
- ECOSSE soil carbon and nitrogen
- DOC

ANYTHING FROM THE COMMUNITY?

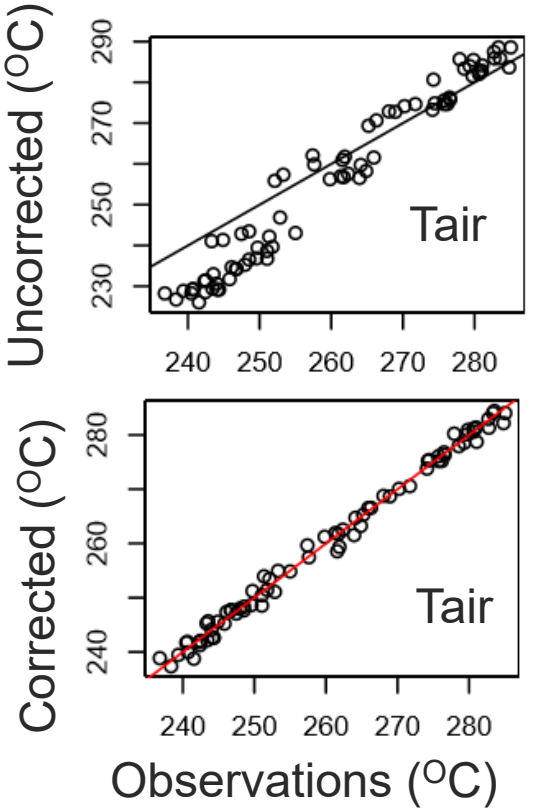
New configuration components and ancillaries

Preliminary Arctic grasses pft
Organic soils
More and deeper soil layers

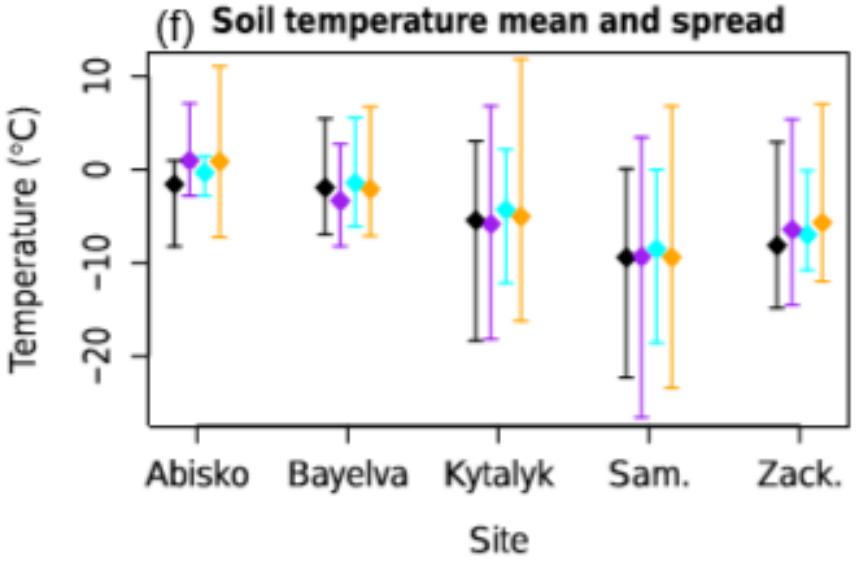
ANYTHING FROM THE COMMUNITY?

Site simulations - driving data

- Code developed to bias correct WATCH/WFDEI based on available site data.
- Snowfall is back-calculated from the observed snow depth
- Happy to help with driving data for additional sites of interest



Site simulations - evaluation

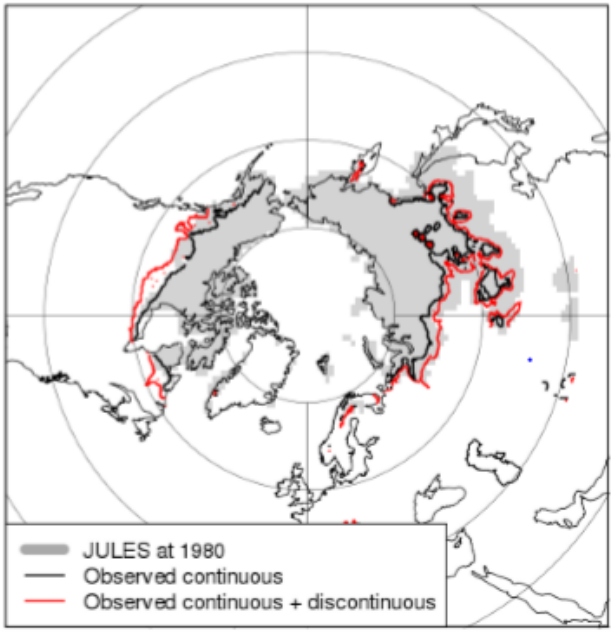


Black is observations and blue is JULES

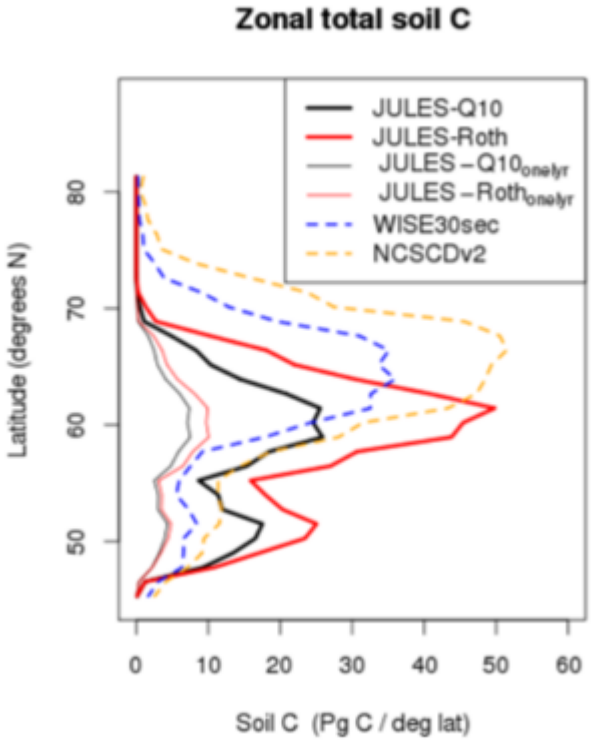
5 tundra sites represented here – more available.

Chadburn et al. (2017)

Pan-arctic simulations



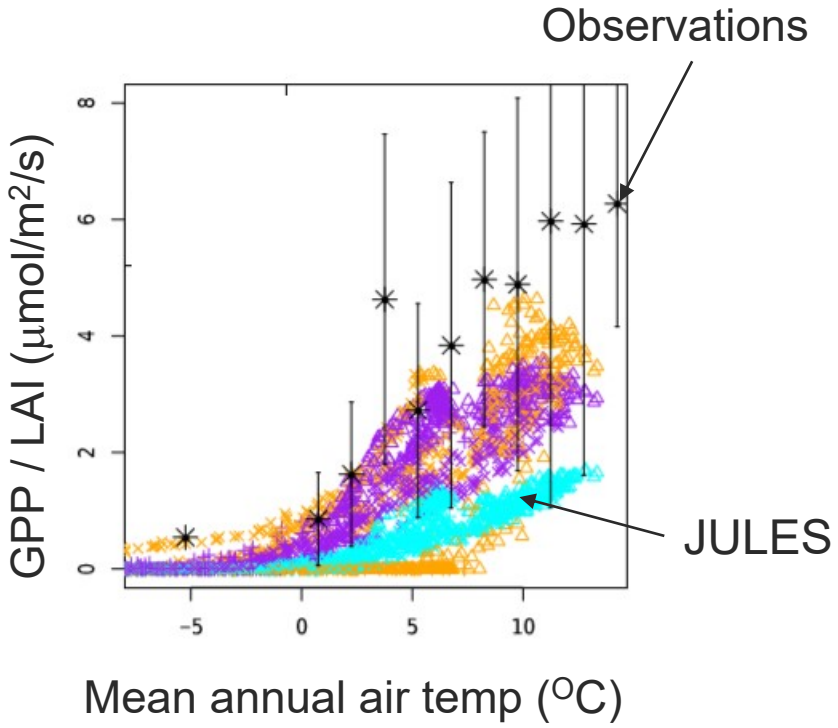
Permafrost area = 20.3 million km^2



Burke et al. (2017)

Examples of process evaluation

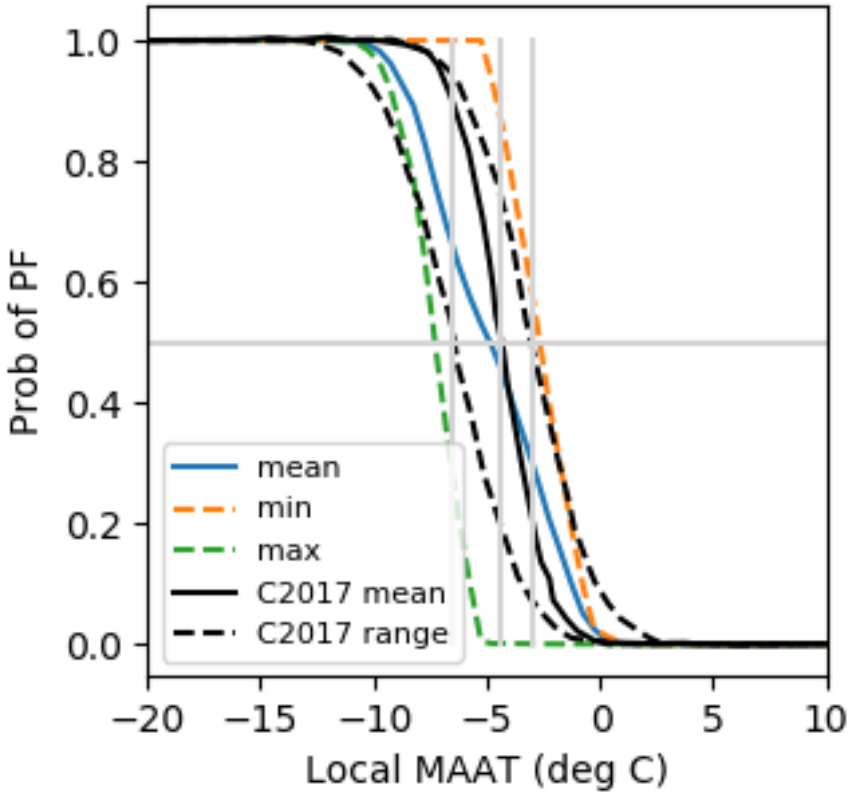
GPP per square meter of leaf



Chadburn et al. (2017)

Examples of process evaluation

Probability of presence of permafrost as a function of mean annual air temperature



Colours are JULES, black are observations

Chadburn et al. (2017)

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Warming experiments for process evaluation

Global Change Biology

Global Change Biology (2016) **22**, 1927–1941, doi: 10.1111/gcb.13204

Nitrogen availability increases in a tundra ecosystem during five years of experimental permafrost thaw

VERITY G. SALMON[1], PATRICK SOUCY[1], MARGUERITE MAURITZ[2], GERARDO CELIS[2], SUSAN M. NATALI[3], MICHELLE C. MACK[1,2] and EDWARD A. G. SCHUUR[1,2]

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Global Change Biology

Global Change Biology (2015) **21**, 4508–4519, doi: 10.1111/gcb.13032

Decadal warming causes a consistent and persistent shift from heterotrophic to autotrophic respiration in contrasting permafrost ecosystems

CAITLIN E. HICKS PRIES[1,2], RICHARD S. P. VAN LOGTESTIJN[3], EDWARD A. G. SCHUUR[2†], SUSAN M. NATALI[2‡], JOHANNES H. C. CORNELISSEN[3], RIEN AERTS[3] and ELLEN DORREPAAL[4]

[1]*Earth Sciences Division, Climate Sciences Department, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, CA 94720, USA,* [2]*Department of Biology, University of Florida, 220 Bartram Hall, Gainesville, FL 32611, USA,* [3]*Department of Systems Ecology, Institute of Ecological Science, VU University Amsterdam, De Boelelaan 1085, NL-1081 HV Amsterdam, the Netherlands,* [4]*Climate Impacts Research Centre, Department of Ecology and Environmental Science, Umeå University, S-981 07 Abisko, Sweden*

AGU PUBLICATIONS

JGR

Journal of Geophysical Research: Biogeosciences

RESEARCH ARTICLE

10.1002/2015JG003251

Key Points:

- Experimentally deepened snow is used to enhance winter soil temperatures
- Long-term deepened snow leads to significantly reduced summer carbon emissions
- The reduced carbon emissions are not driven by changes in microclimate

Supporting Information:

Long-term experimentally deepened snow decreases growing-season respiration in a low- and high-arctic tundra ecosystem

Philipp R. Semenchuk[1,2,3,4], Casper T. Christiansen[2,5,6], Paul Grogan[2,5], Bo Elberling[2], and Elisabeth J. Cooper[1]

[1]Institute for Arctic and Marine Biology, UiT The Arctic University of Norway, Tromsø, Norway, [2]Center for Permafrost, Department of Geosciences and Natural Resource Management, University of Copenhagen, Copenhagen, Denmark, [3]University Center in Svalbard, Longyearbyen, Norway, [4]Climate Impact Research Center, Department of Ecology and Environmental Science, Umeå University, Abisko, Sweden, [5]Department of Biology, Queen's University, Kingston, Ontario, Canada, [6]Arctic Station, Faculty of Science, University of Copenhagen, Qeqertarsuaq, Greenland

Ecology, 95(3), 2014, pp. 602–608
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Permafrost degradation stimulates carbon loss from experimentally warmed tundra

SUSAN M. NATALI,[1,2,3] EDWARD A. G. SCHUUR,[2] ELIZABETH E. WEBB,[2] CAITLIN E. HICKS PRIES,[2] AND KATHRYN G. CRUMMER[2]

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Nutrient fertilization with JULES

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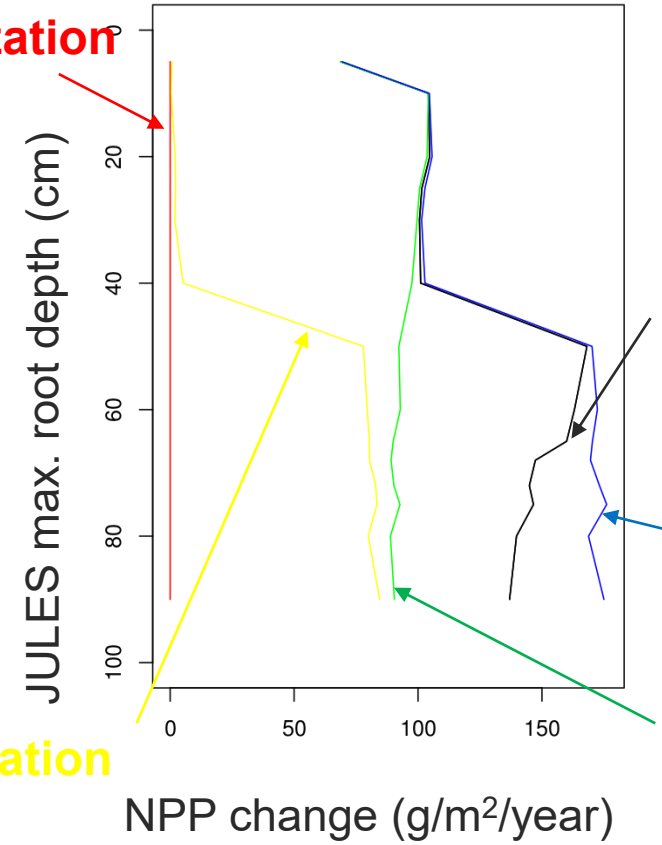
No fertilization



Deep fertilization

Fertilization at both depths

Sum of deep and shallow

Shallow fertilization

Received: 19 December 2016 | Accepted: 31 May 2017
DOI: 10.1111/gcb.13804

PRIMARY RESEARCH ARTICLE

WILEY Global Change Biology

Experimentally increased nutrient availability at the permafrost thaw front selectively enhances biomass production of deep-rooting subarctic peatland species

Frida Keuper[1,2,3] | Ellen Dorrepaal[1,2] | Peter M. van Bodegom[1,4] | Richard van Logtestijn[1] | Gemma Venhuizen[1] | Jurgen van Hal[1] | Rien Aerts[1]

Additional NPP caused by fertilization

Vitali et al. (2019)

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The way forward

- Gather list of people interested in the northern high latitudes from both JULES, EO and experimental community
- Improve and evaluate the current model and configuration and document it in a GMD paper
- Make configuration and evaluation more easily available to the community
- Use up-to-date configuration in upcoming versions of UKESM
- Maintain a network of interested people.