JULES and the northern high latitudes

Eleanor Burke and Sarah Chadburn
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
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

GPP / LAI (μmol/m²/s)

Mean annual air temp (°C)

Observations

JULES

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)
Warming experiments for process evaluation

Global Change Biology

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

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

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

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Supporting Information:
Permafrost degradation stimulates carbon loss from experimentally warmed tundra

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Nutrient fertilization with JULES

- No fertilization
- Shallow fertilization
- Deep fertilization
- Fertilization at both depths
- Sum of deep and shallow fertilization

Vitali et al. (2019)
• 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.