JULES-Peat: A new approach to simulate peat accumulation, degradation and stability

Sarah Chadburn
Eleanor Burke, Angela Gallego-Sala, Noah Smith
Syndonia Bret-Harte, Dan Charman, Julia Drewer, Colin Edgar, Eugenie Euskirchen, Krzysztof Fortuniak, Yao Gao, Andre Nakhavali, Włodzimierz Pawlak, Ted Schuur, Sebastian Westermann
Peatlands: an important and potentially unstable carbon store

Methane

$\text{CO}_2$

$> 500 \text{ Gt C}$
Peatlands: an important and potentially unstable carbon store

> 500 Gt C

Earth System Models

IPCC AR5

CO$_2$

Change in average surface temperature (1986–2005 to 2081–2100)
Problem number 1

- Soil column needs to be able to grow to accumulate peat
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Observations: Gallego-Sala et al., 2018 *Nat Clim Change* **8** 907-913
Problem number 1: Solution

- Effective layer thickness during update of soil carbon
- Interpolate back onto original soil layers: scheme that preserves vertical structure
Problem number 1: Solution

Observations: Gallego-Sala et al., 2018 *Nat Clim Change* 8 907-913
Problem number 2: Stability and resilience

- Peatland ‘function’ can restore water table to surface when it drops
- Carbon loss/gain can be self-reinforcing → instability
Solution: Hydraulic properties of peat vary with decomposition status and control its dynamics

- Prescribe bulk density of carbon pools in JULES:
  Higher bulk density for more decomposed organic matter

- Use relationships $\leftarrow$ to update soil properties
Dynamics of drained peatland

Water table drops. Peat decomposes and becomes compacted…
(water table can sometimes re-form on top of compacted layer)
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Remaining challenges for modelling

- **Hydrology**: Can be simulated for individual peatland if not groundwater fed (Bechtold et al., 2019). Challenge to integrate seamlessly in large-scale model and to simulate lateral flow.

- **Vegetation**: New plant functional types needed. Interactions with water table $\rightarrow$ instability.

For JULES users

- vn6.1_accumulate_soil (thanks Eleanor)

- **Switches** (in jules_soil_biageochem namelist, note you must also have l_layereddc=.true.)
  - l_accumulate_soil
  - l_dynamic_soilprops

- Calculates age of soil carbon in each layer/pool:
  - l_soilage = .true.
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Thanks for listening :)

[Image of a person squatting next to water]