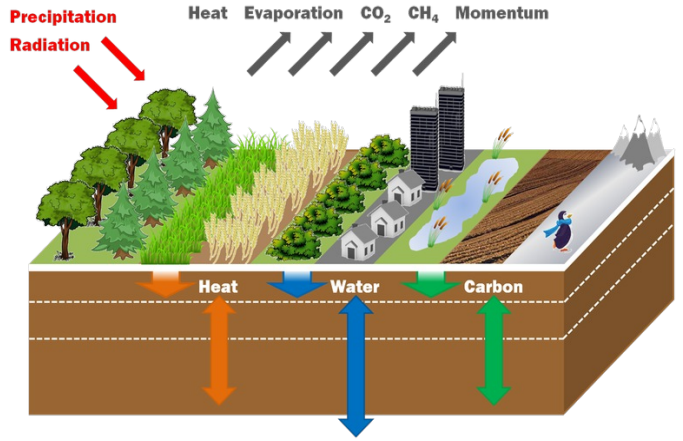
Representing peatlands in JULES

Sarah Chadburn

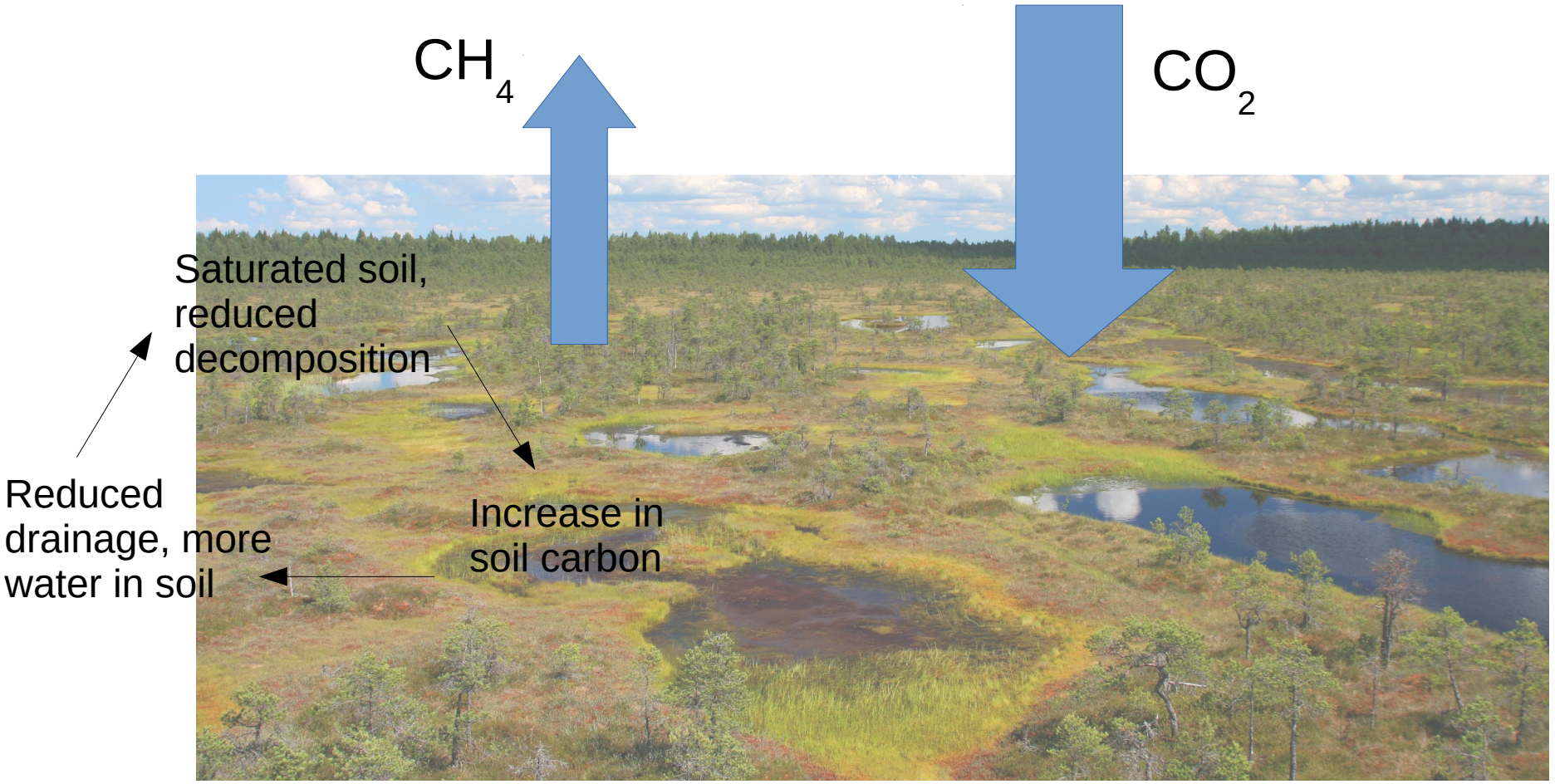
JULES meeting 2019
Edinburgh



Peatlands

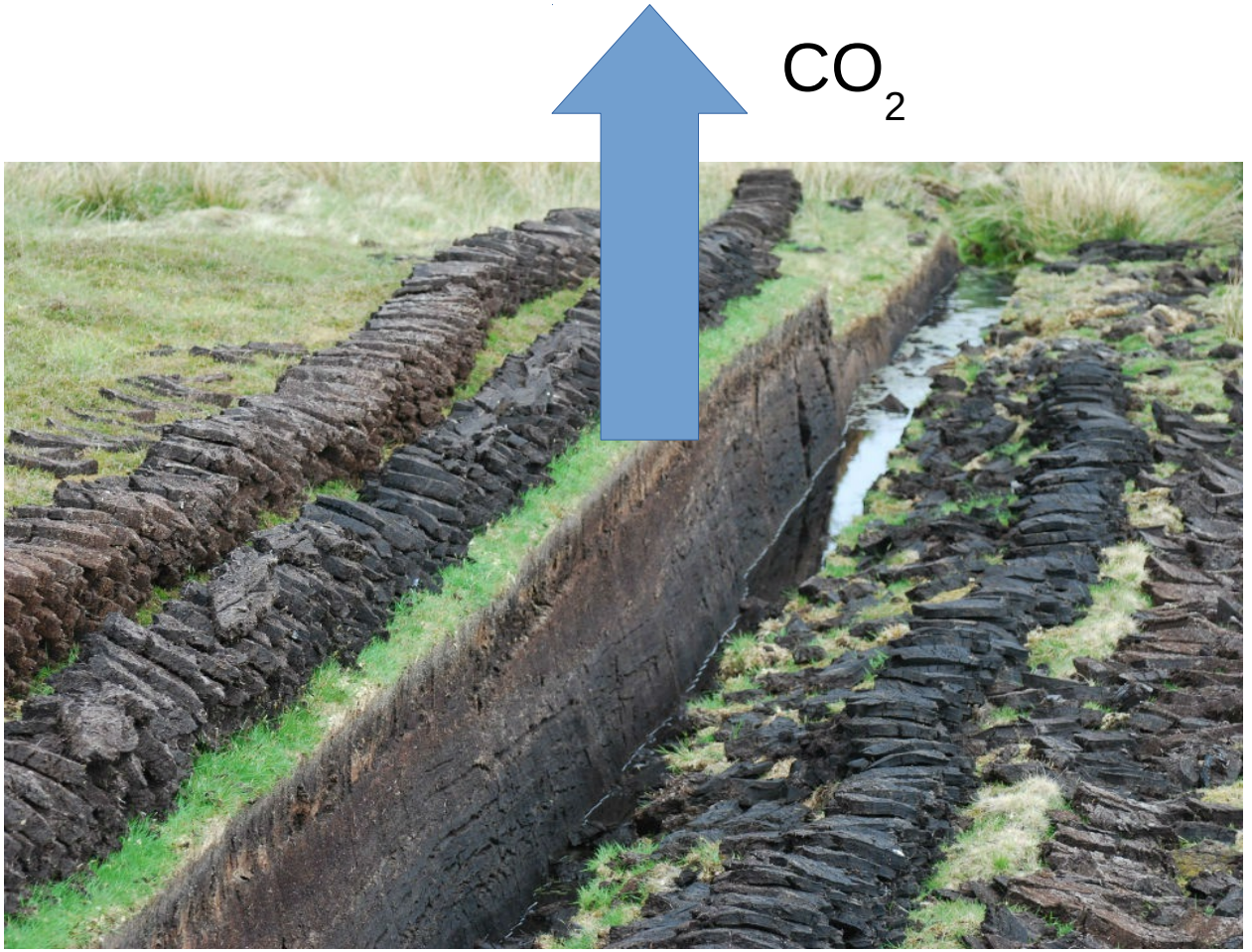
Peatlands cover ~ 3% of the land surface, but store ~ 30% of the world's soil organic carbon (500+ GtC)

Undisturbed peatlands are usually a net carbon sink



Peatlands

Draining peatlands can lead to a very strong net carbon source as they degrade and return towards low carbon non-peatland soils



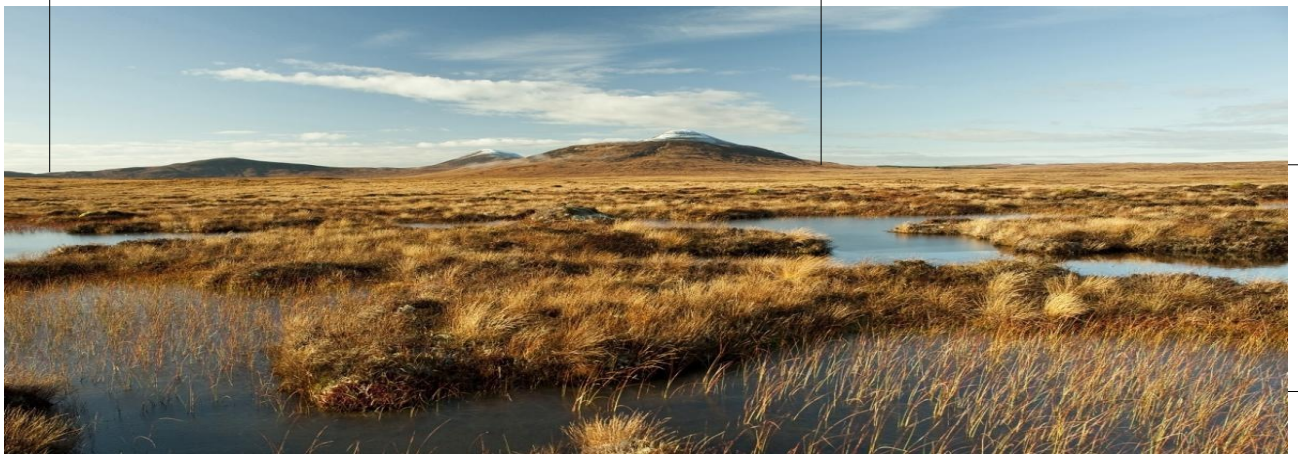
Reasons to include them in JULES

Mitigation efforts are increasingly focusing on peatland protection and restoration

To simulate **climate and land-use impacts on the carbon cycle**, **land-based mitigation** options and **feedbacks to climate change**, including peatlands in JULES is a high priority

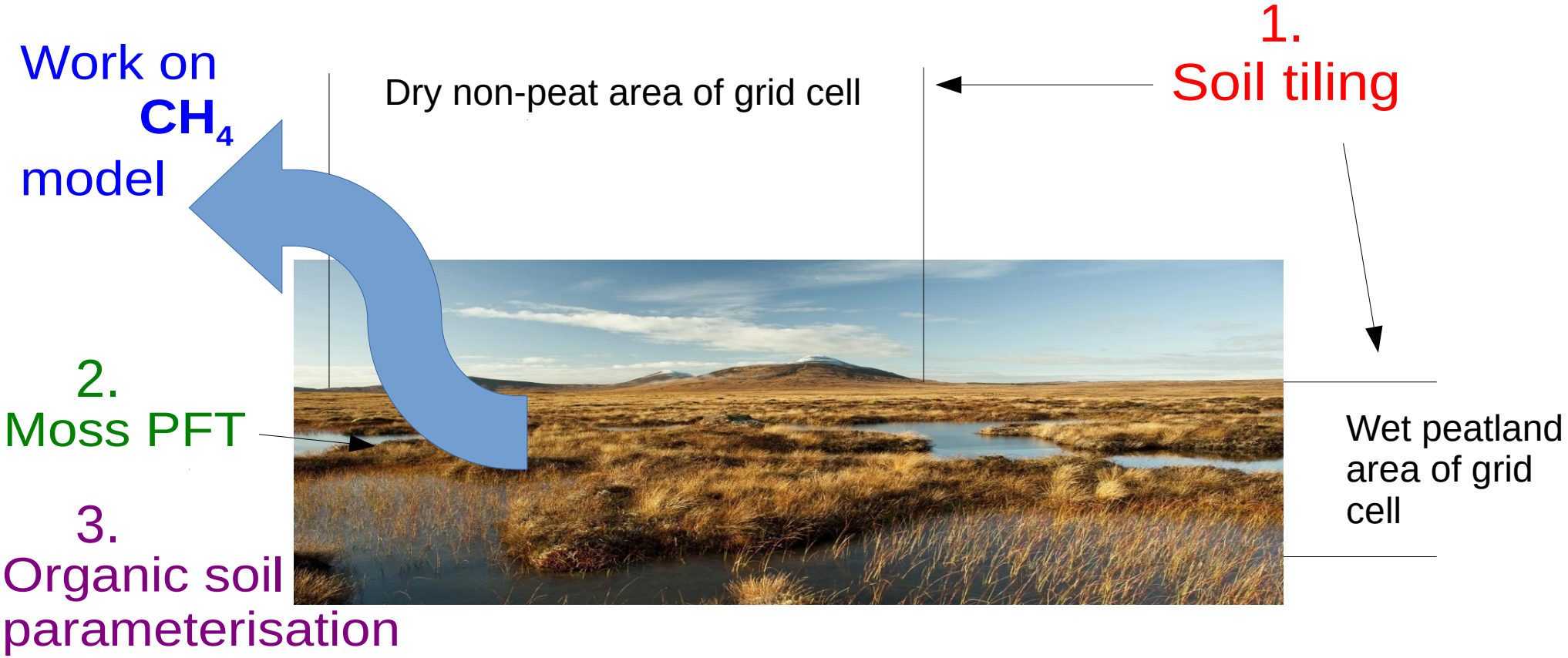
Challenges

1. *Non-linear* so need soil tiling (for veg and soil), including lateral water flux
2. New PFT's
3. Coupling between soil carbon and properties



Challenges

Latest developments in JULES that make steps towards including peatlands...

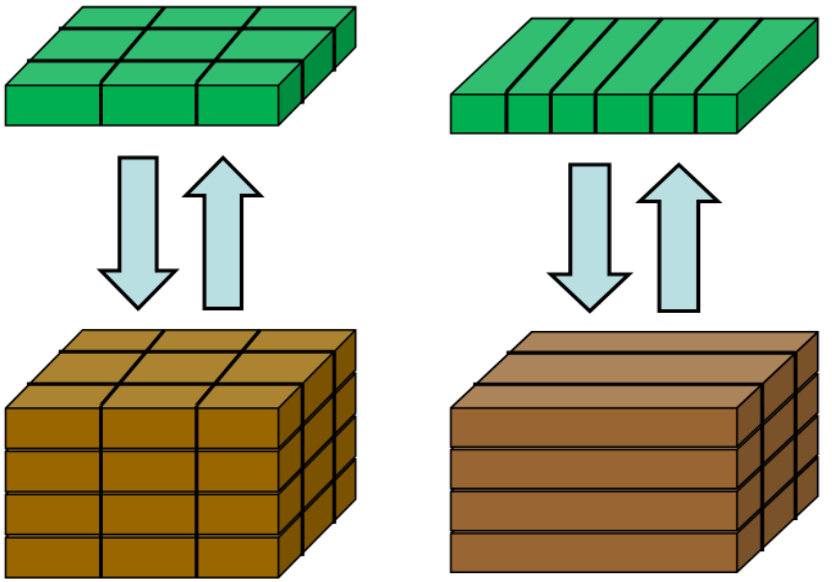


Soil tiling

Rich Gilham (now gone)

- Code went in over versions 4.7 – 5.1
- No hydrological connection between soil tiles. Use topographic index dataset? (Toby)

	Tree	Grass	Soil	
Clay	0.2	0.0	0.0	**0.2**
Clay	0.0	0.4	0.0	**0.4**
Loam	0.0	0.0	0.4	**0.4**
	0.2	**0.4**	**0.4**	**1.0**



Moss PFT

Eddy Comyn-Platt (now gone)

- Photosynthesis + thermal properties

What and where is the moss in JULES? I model the growth and phenology of moss as a PFT but I also include moss as part of the soil column for the heat capacity and conductivity calculations. To unify these two components, the moss in effect grows from the surface then down into the top soil layer

Stomatal conductance is no longer a function of photosynthesis and humidity. It is a function of the water content of the moss using the relationship described in Williams and Flanagan (1998).

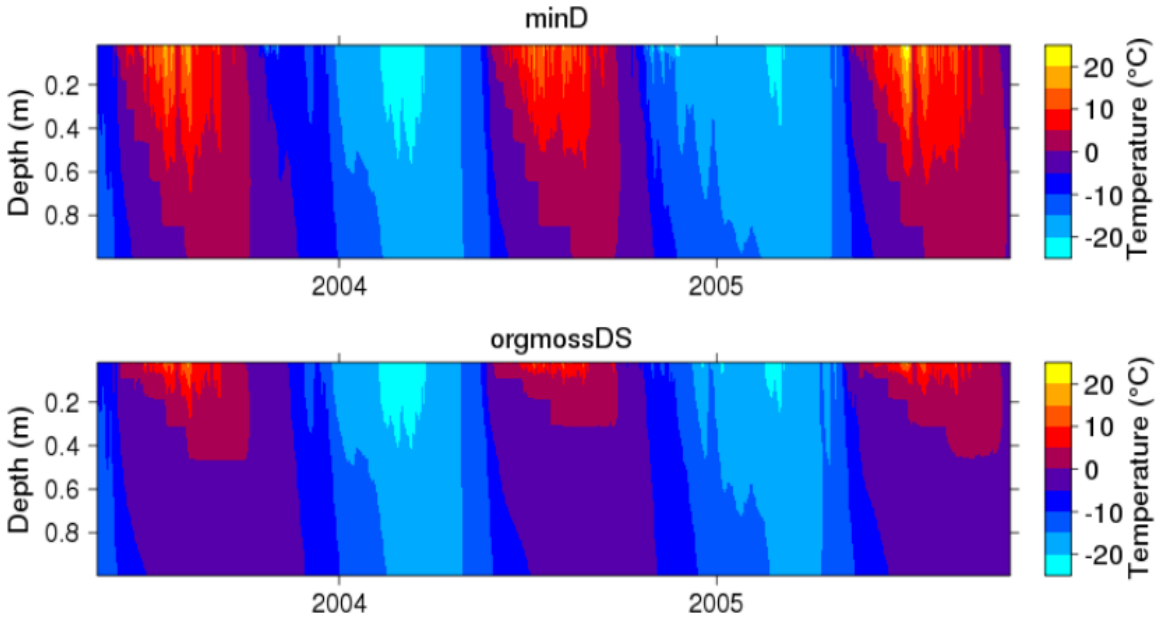
JULES code branch:

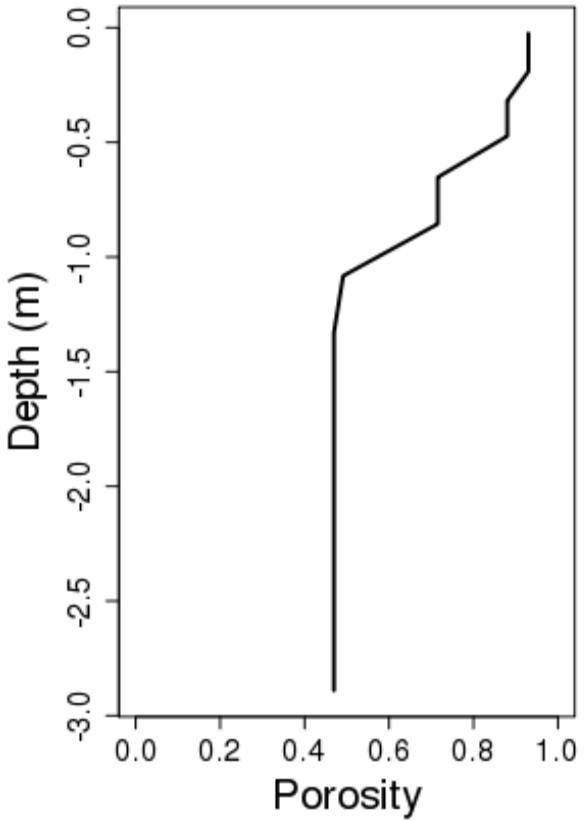
https://code.metoffice.gov.uk/trac/jules/browser/main/branches/dev/edwardcomynplatt/vn5.1_moss_pft

Organic soil parameterisation

Eleanor Burke/me/student

- Organic properties as function of density?
- Combine with mineral properties
- Use database to generate ancillary





Chadburn et al. *Geosci. Model Dev*. **8** 1493-1508, 2015

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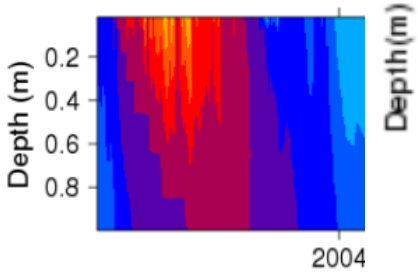
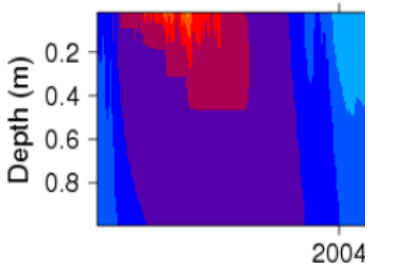
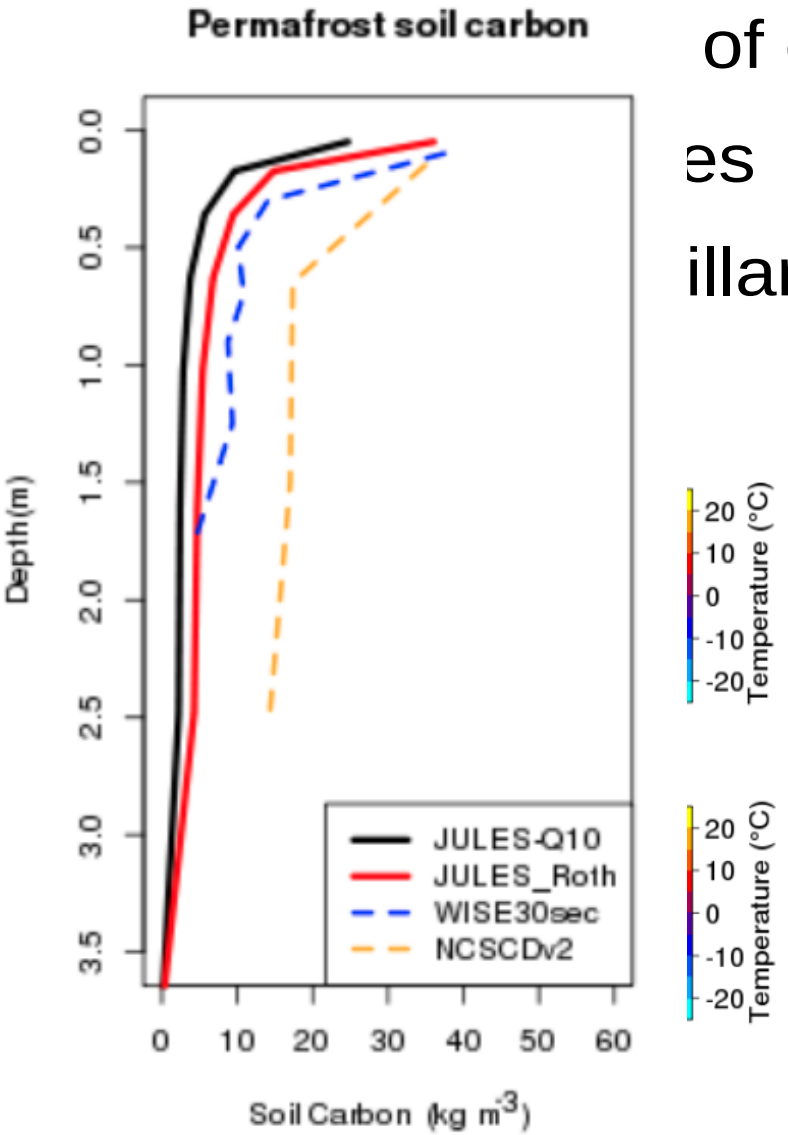
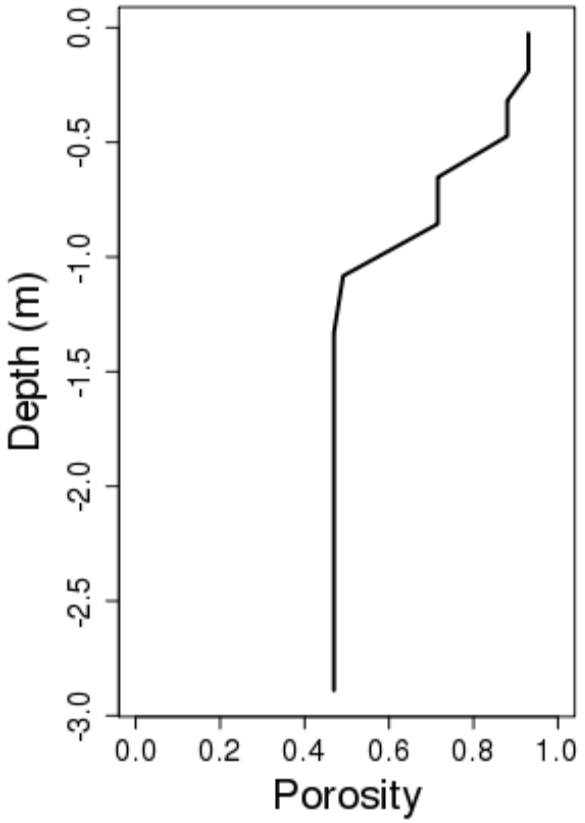




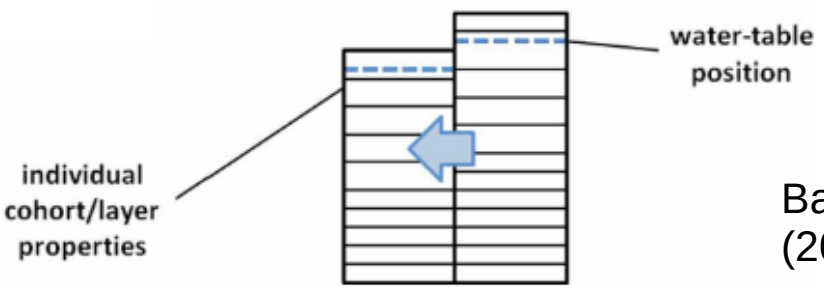




Burke et al. *Geosci. Model Dev*. **10** 959-975, 2017

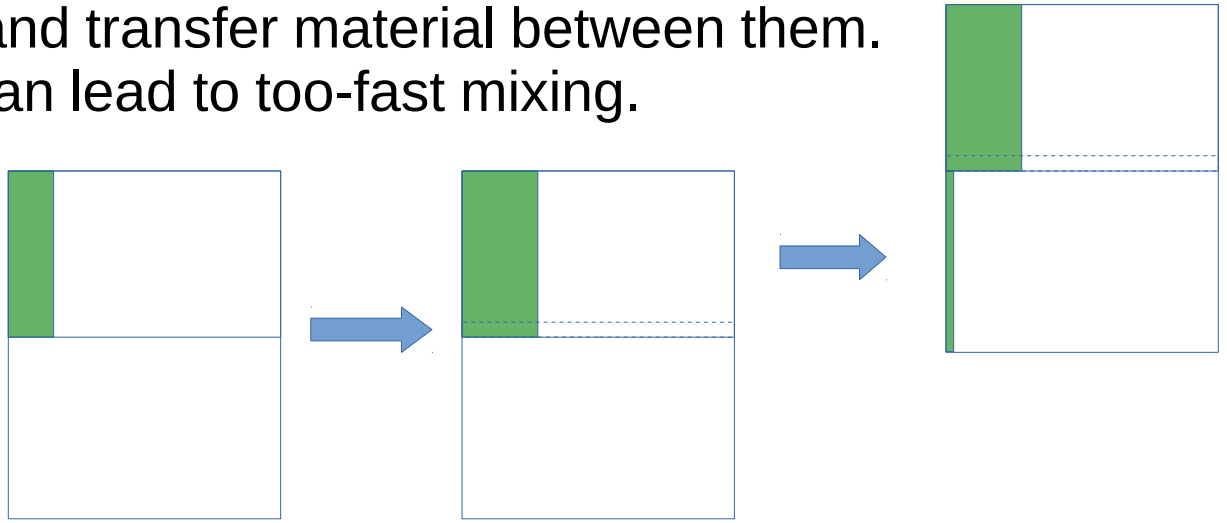
Coupling soil carbon to soil physics

- DigiBog: Adds layers to surface and keeps track of their age and therefore density/properties.
  - Requires variable and **large** number of layers.
  - Only works for peat (could add a mixing term?)



Baird, et al. *Ecohydrology* **5** (2012) 242-255

- Alternative: Keep layer boundaries fixed and transfer material between them. This can lead to too-fast mixing.



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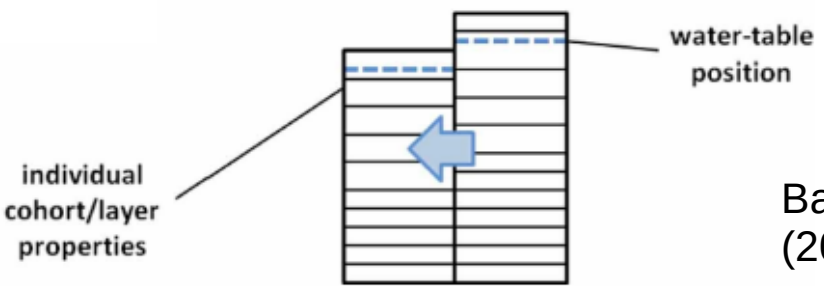

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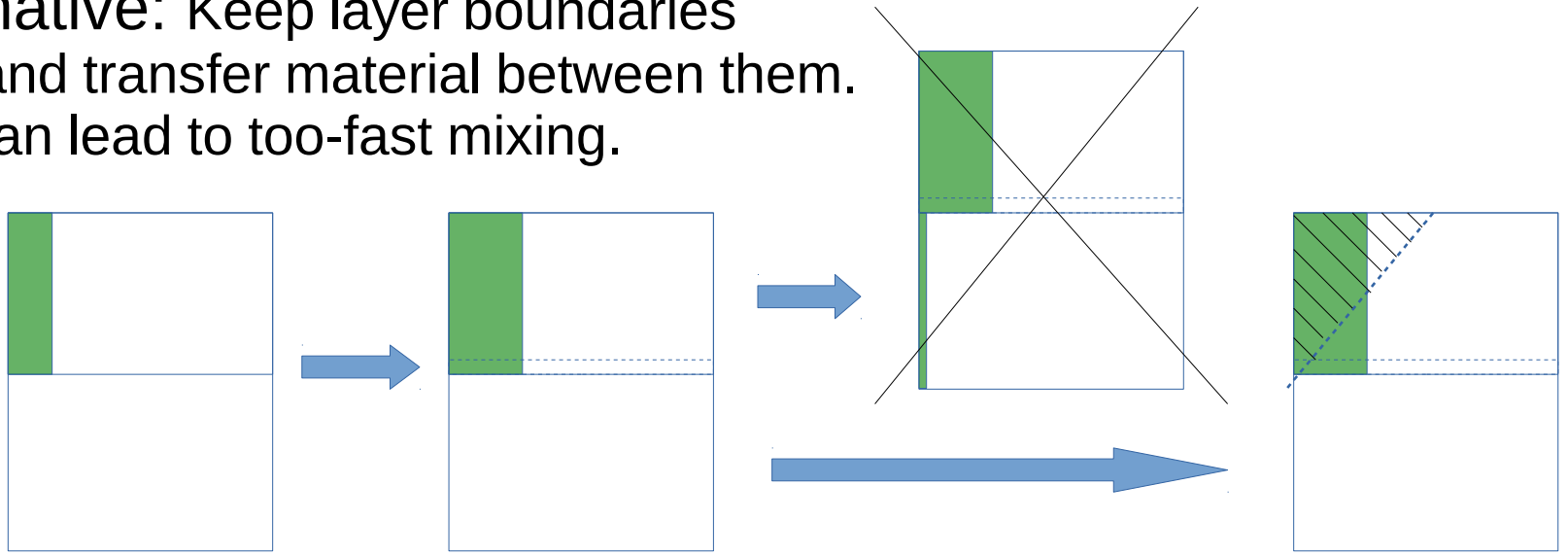


Upcoming projects

- **CongoPeat postdoc**: tropical peatlands
- **Thermokarst PhD**: permafrost peatlands
- Proposals…? (eg. UK peatlands)

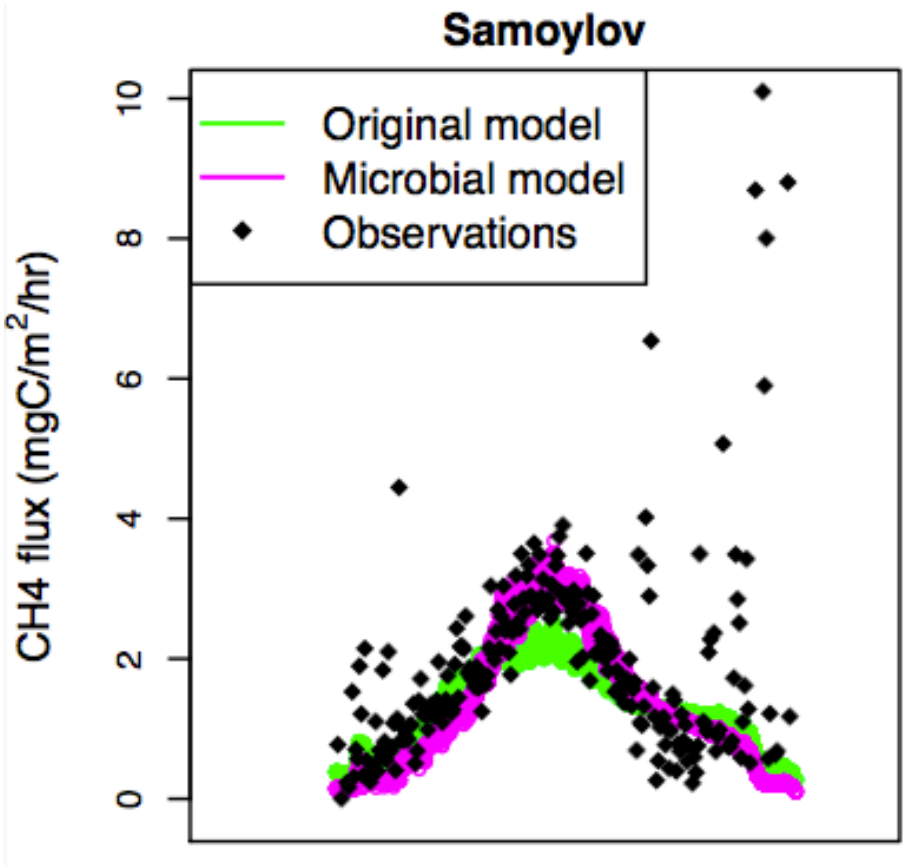
Collaboration & meeting

- Workshop next year…?
- Feedback/input is very welcome

s.e.chadburn@exeter.ac.uk

Methane modelling

- Developing microbial model of methane emissions, recreating site-level eddy covariance data



Impact on soil temperature of running with saturated soil