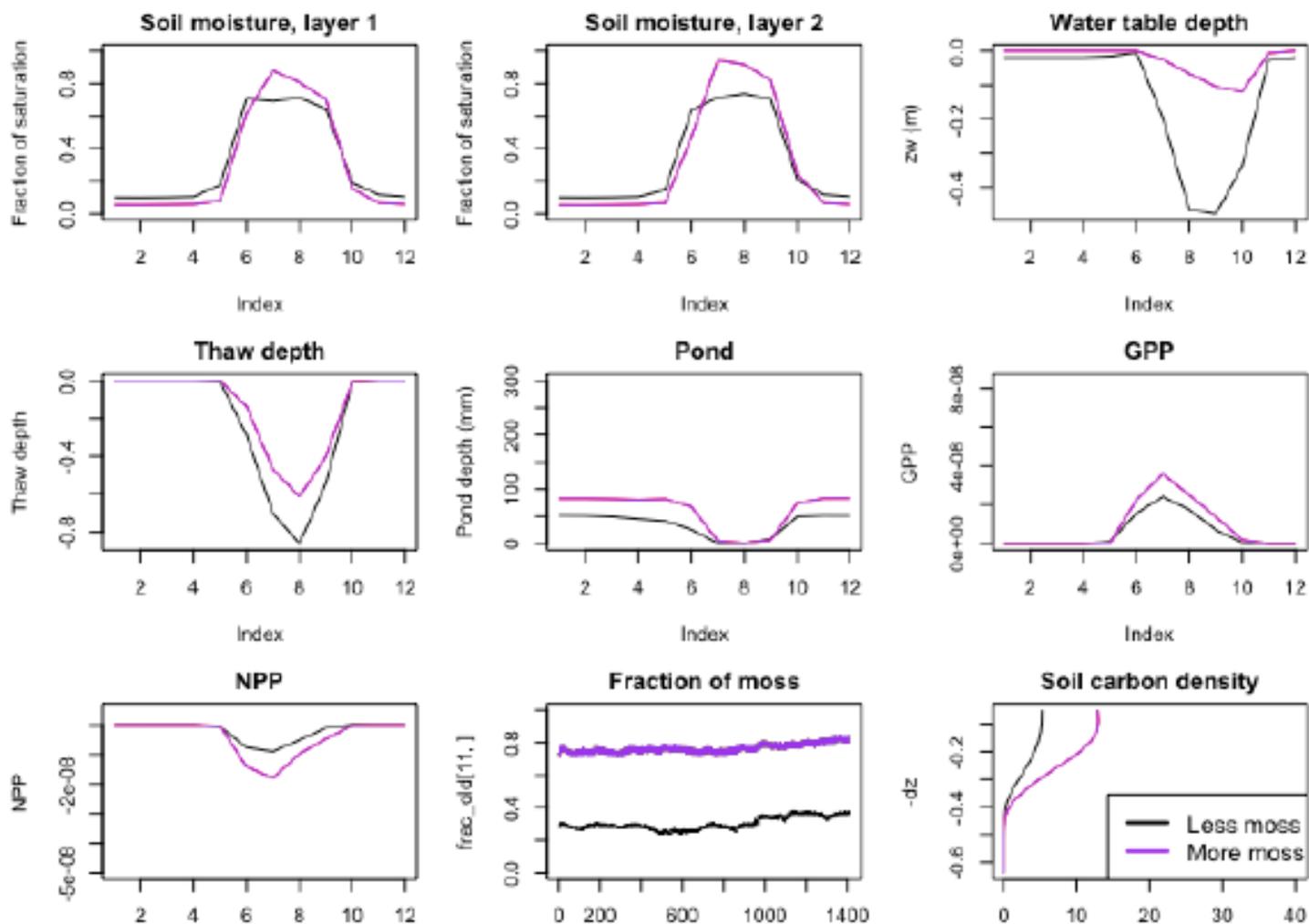


JULES Vegetation module updates

Lina Mercado, Anna Harper and Karina Williams

Moss PFT, protects soil from drying → important for northern peatlands

- Code from Rachael Turton, Eddy Comyn-Platt and Richard Coppell
- Modified how the moss affects evaporation and its respiration rate
- NPP and GPP have sensible values, and it grows (at sites)

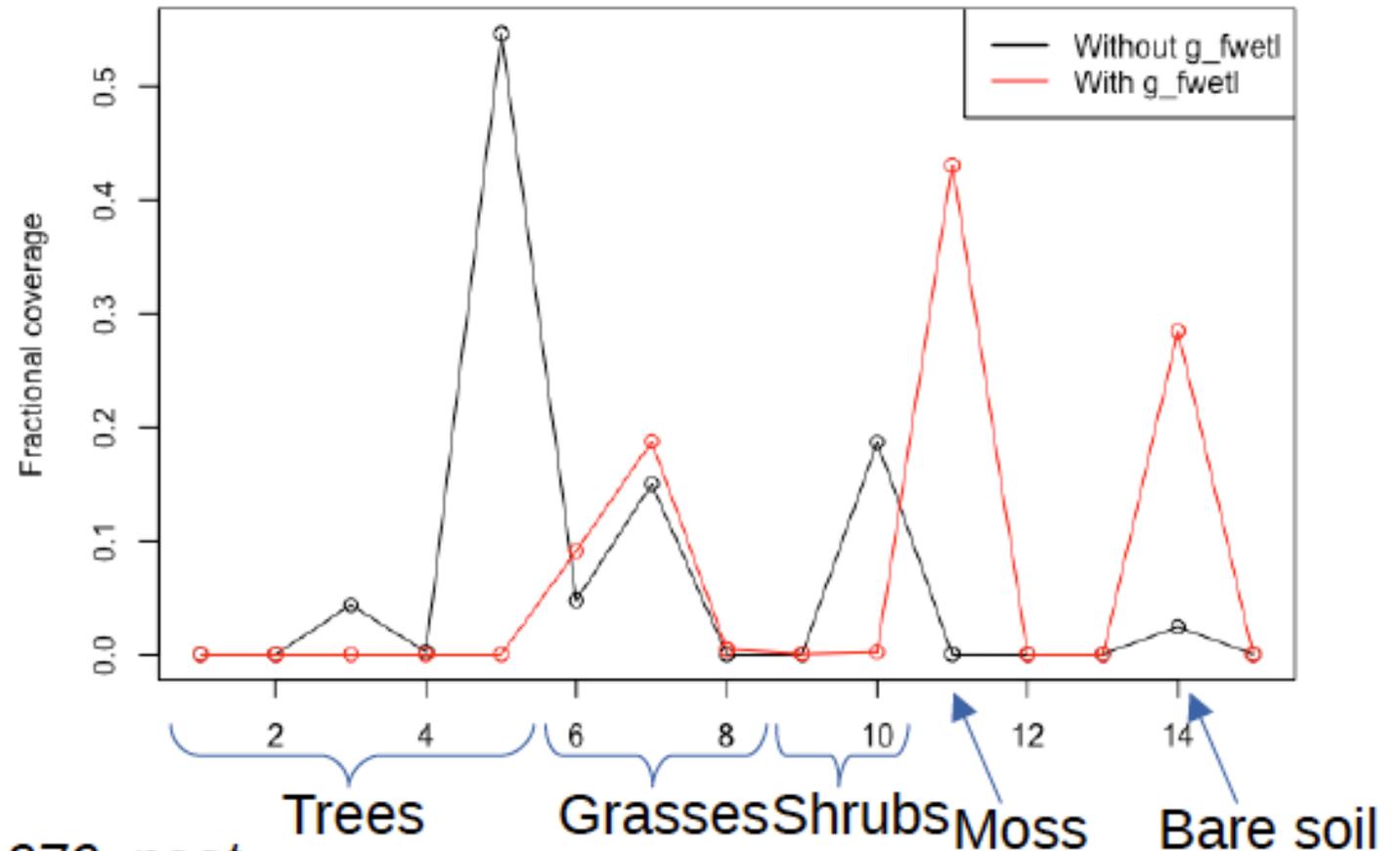


New functionality: g_fwetl

- Disturbance term for 'non-wetland' PFTs in wet environments based on fraction of roots below water table. Modified from code by Eddy Comyn-Platt

Trees (deeper roots) die more than grass. Grass (shallower roots) dies at wetter sites. Seems to be working fine!

Slides by Sarah Chadburn, UoE



In veg-veg2
[/main/branches/dev/sarahchadburn/r21970_peat](https://github.com/sarahchadburn/r21970_peat)

Updated from Becky Oliver, Lina Mercado, Phil Harris -UK CEH and UoE

- PAPER Farquhar photosynthesis, Medlyn stomatal conductance and thermal acclimation of photosynthesis implemented and evaluated in JULES-vn5.6 of JULES in the following paper (<https://gmd.copernicus.org/articles/15/5567/2022/>) (PORCELAIN project and UKESM). These options are available in the trunk for the community to use. The work in the paper was done with fixed vegetation,
- Testing thermal acclimation scheme from Kumarathunge et al (Oliver, Mercado)
- Phil Harris is looking at thermal acclimation (kattge & Knorr, Kumarathunge et al) with dynamic vegetation on.
- The impact of thermal acclimation of photosynthesis on carbon, water and energy fluxes in the GCM is being explored with colleagues at Reading university (PORCELAIN project). Additionally, Phil H is working on implementing thermal acclimation into UKESM.
- Plan to start working on optimisation based approaches in JULES to determine photosynthetic capacity and its acclimation to environmental conditions.
- As part of the QUINTUS project we are developing a dynamic carbon allocation scheme based on optimisation – the allocation of carbon will respond to N availability and atmospheric CO2 concentration to maintain maximum growth. This is currently being developed offline, but with a plan to implement it into JULES. This project links to the BiFOR FACE facility, as we will be using data from there to evaluate the model. (Huntingford C, Oliver B)
- Re-calibrating the ozone damage part of JULES to run with 9 PFTs and using the Farquhar photosynthesis scheme

Further UoE updates

Jules CNP paper Nahkavali et al incl L Mercado, S Sitch, I Hartley (2022) Representation of the phosphorus cycle in the Joint UK Land Environment Simulator (vn5.5_JULES-CNP) GMD, <https://doi.org/10.5194/gmd-15-5241-2022>

Applications

Amazon basin including P constrains on productivity :Jules simulations with JULES-CNP for the Amazon basin using soil maps of P pools, foliar traits (N, P, LMA) by soil type –Andre Nahkavali, L Mercado, S Sitch, I Hartley, UoE

Application at Birmingham University elevated CO2 facility -Bifor

Jules- CNP evaluation under ambient and elevated CO2 , Andre Nahkavali, L Mercado, S Sitch, I Hartley, UoE

Development

Inclusion of soil texture dependence on decomposition processes Andre Nahkavali, L Mercado, S Sitch, I Hartley, UoE

Development on nocturnal plant respiration –(Mercado, Clark, Ellis, Thu presentation)

Branch that accounts for temperature and non temperature dependent processes on plant respiration during night

Application : Evaluation of Jules phenology at a coneiferous and deciduous forest sites

Wong C, Mercado LM, Altaf AR, Ensminger I (2022) Remotely sensed carotenoid dynamics improve modelling photosynthetic phenology in conifer and deciduous forests. Agrig Forest Met , <https://doi.org/10.1016/j.agrformet.2022.108977>

Here is a list of the main vegetation-related JULES stuff going on in 901 (**P Cox and team, UoE**)

1.JULES-RED coupling (Arthur Argles)

2.SUGAR sub-model of non-structural carbohydrate (Simon Jones);

3.SOX sub-model of stomatal conductance with improved root uptake (Cleiton Eller, Peter Cox);

4.Reframing of SOX in terms of control theory (Simon Jones, Peter Cox);

5.Theory of optimum allocation of assimilate to seeds in RED (Jon Moore);

6.New 'big-leaf' version of JULES which produces more realistic responses to light (Simon Jones, Peter Cox).

7.Data assimilation techniques and history matching to calibrate JULES. Nina Raoult Marie-Curie with Research Fellowship "CLARION: Constraining Land Response by Integrating Observations"

8. Aiming to get SUGAR and SOX implemented in the next full JULES release. Speak to Peter Cox for more details

Updates from Anna Harper UoE

Emma Littleton -bioenergy crops, Thursday afternoon talk .

2 papers : One looking at some nature-based solutions for climate mitigation using JULES (<https://iopscience.iop.org/article/10.1088/1748-9326/ac3c6c/meta>) and another comparing various approaches to estimating mitigation potential from Miscanthus (including JULES), <https://onlinelibrary.wiley.com/doi/abs/10.1111/gcbb.12982>

Two projects on land-based climate mitigation using JULES

-Tree planting in the UK (NetZeroPlus, with Arthur Argles and Peter Cox)

-The impacts of bioenergy crops on biogeochemical cycles and biophysical feedbacks (UKESM with Emma Littleton, Andy Wiltshire, Eddy Robertson, Chris Jones).

-EU ESM2025 project : process improvements in JULES related to permafrost (Eleanor Burke) and CN cycles (Ayesha Hussain and Pierre Friedlingstein): Vegetation response to increased CO₂ and nutrient limitations.

Evan Baker & Anna Harper -emulating JULES with Gaussian processes. Proof-of-concept approach at narrowing parameter uncertainties by comparing the model to satellite data <https://gmd.copernicus.org/articles/15/1913/2022/> , hope to extend this through the NetZeroPlus project

Hiring for an 18 month PDRA starting Nov 1st to take Arthur's place on NetZeroPlus project. – Contact Anna Harper

- Cat de Burgh-Day (BOM): impact of the leaf phenology on the atmosphere
- Christoph Rudiger (BOM): effect of leaf phenology on performance of the land surface model
- Lirong You, Karina Williams, Stephen Sitch(Exeter): The effect of climate change and climate extremes on crop production in China
- DroughtHeatMIP (led by Elisabeth Tschumi, Bern, JULES runs Karina Williams): Global vegetation models simulate large variability in the response of vegetation composition and carbon dynamics to variations in drought-heat occurrence
- Calibration and evaluation of JULES-crop for maize in Brazil, Amauri Cassio Prudente, Murilo S Vianna, Karina Williams, Marcelo V Galdos, Fábio R Marin, Agronomy, 2022 <https://access.onlinelibrary.wiley.com/doi/abs/10.1002/agj2.21066>
- Improving the representation of sugarcane crop in the JULES model with site observations across Brazil, Vianna, M. S.; Williams, K.E.; Littleton, E. W.; Cabral, O.; Cerri, C.E.P.; De Jong van Lier, Q.; Marthews, T. R.; Hayman, G.; Zeri, M.; Cuadra, S. V.; Challinor, A. J; Marin, F.R.; Galdos, M. V., accepted in GCB Bioenergy
- [CO2 fertilization of crops offsets yield losses due to future surface ozone damage and climate change](#), Felix Leung, Stephen Sitch, Amos P K Tai, Andrew J Wiltshire, Jemma L Gornall, Gerd A Folberth and Nadine Unger, Environmental Research Letters, 2022

New EU project: OptForEU: Optimising Forest management decisions for a low-carbon, climate resilient future in Europe - includes JULES (University of Exeter (Karina Williams, Anna Harper, Emma Littleton, Carolina Duran Rojas), Met Office (Debbie Hemming))

Agricultural maize model intercomparison - paper just submitted to Agricultural and Forest Meteorology, "Prediction of Evapotranspiration and Yield of Maize: An Inter-comparison among 41 Maize Models", Kimball et al (JULES runs Karina Williams)

Towards Equitable and Sustainable Nature-based Solutions in Southern Africa (TES NbS project), includes modelling the impacts of Nature-based Solution scenarios on water supply and carbon sequestration considering climate change for the southern African region as well as the persistence of these Nature-based Solutions under climate change - Petra Holden, Assumpta Onyeagoziri

Garry Hayman (CEH): Wheat modelling with JULES-crop (see talk).

JULES-FACE Working Group

Eleanor Burke, Doug Clark, Martin De Kauwe, Hilary Ford, Anna Harper, Debbie Hemming, Ayesha Hussein, Felix Leung, Andre Nakhavali, Rebecca Oliver, Colin Prentice, Tristan Quaife, Andy Smith, Rachael Turton, Rebecca Varney, Karina Williams, Andy Wiltshire, Huiyi Yang, Lirong You

To get added to the mailing list, email Karina (k.e.williams@exeter.ac.uk)

For summary of JULES simulations at FACE sites, see <https://code.metoffice.gov.uk/trac/jules/wiki/JulesFace>

Updates from this year:

- Lots of work at the BIFOR FACE site, mature deciduous woodland - Andre Nakhavali (see talk), Debbie Hemming, Karina Williams, Ayesha Hussein, Martin De Kauwe, QUINTUS, + ...
- ClimGrass (**Lirong You**, Karina Williams, Stephen Sitch, Huiyi Yang), alpine grassland. Lirong has done JULES runs for model intercomparison.