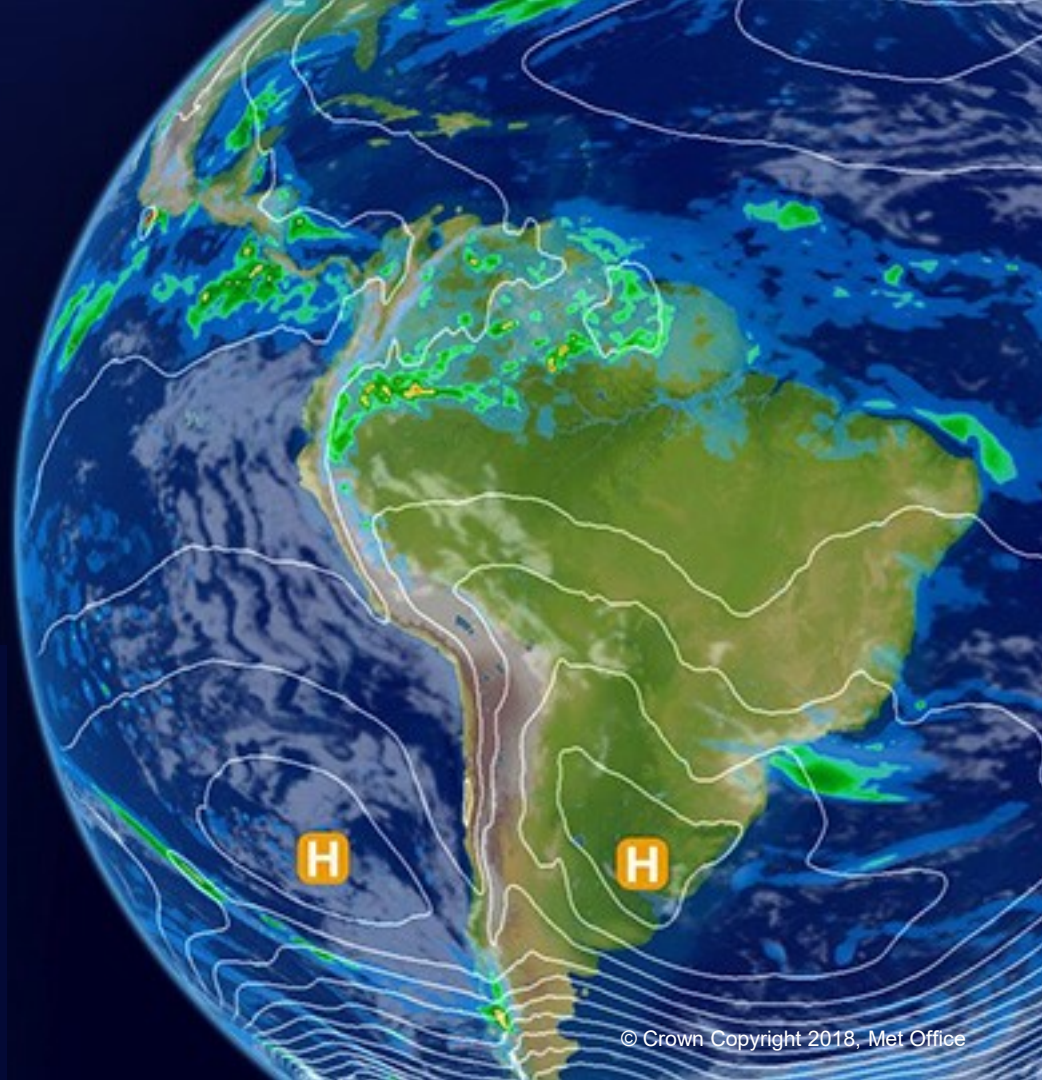# JULES-ES

Andy Wiltshire and Spencer Liddicoat

Anna Harper, Eddy Robertson, Nic Gedney, Gerd Folberth, Alistair Sellar, Chantelle Burton, Chris Jones, Doug Clark, Doug Kelley, Eleanor Burke, Gerd Folberth, Lina Mercado, Peter Cox, Pierre Friedlingstein, Rich Ellis, Sarah Chadburn, Stephen Sitch, T Davies-Barnard,Sonke Zaehle (MPI), Stephanie Woodward

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JULES is just a collection of code

- JULES out-of-the-box ≠ JULES-ES

A configuration has been carefully developed to set those options to work well together
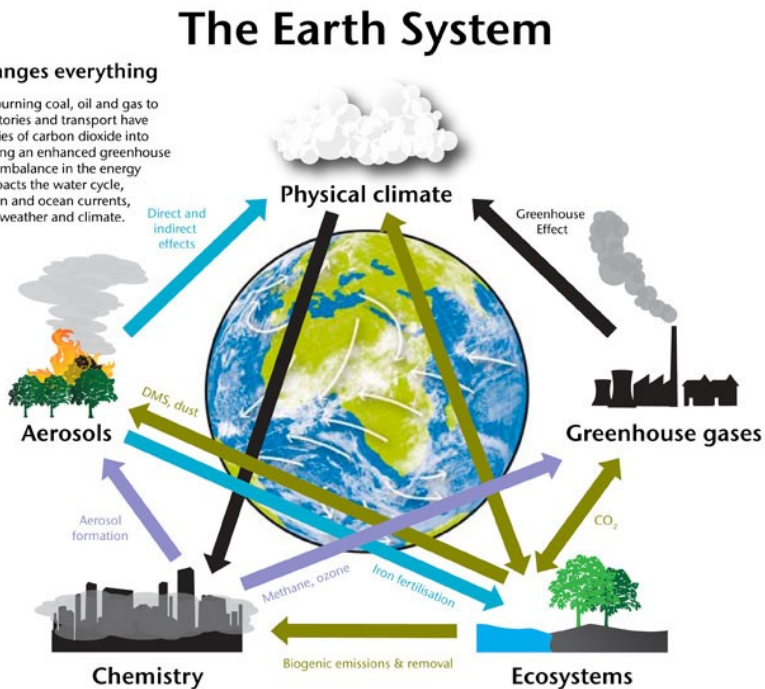
What defines an experiment?

Code version + Configuration + Experimental Setup

- Code version is the JULES release – we aim for these to be scientifically comparable - i.e. it doesn't matter which release you use.
- The configuration by definition is the collection of parameters, switches and ancillary information
- The experimental setup is the driving data, resolution and experimental details – e.g. time varying CO_2, land-use etc.

What is JULES-ES?

- Latest Earth System Configuration used in UKESM and CMIP6
- Simulates: exchange of heat, water momentum, carbon, nitrogen, methane, BVOCs and the distribution of ecosystems
- Based on GL7 with additional processes
- Many uses, but includes advice of carbon budgets for stabilising climate given to policy makers.

The Earth System

One thing changes everything

Human activities like burning coal, oil and gas to power our homes, factories and transport have released huge quantities of carbon dioxide into the atmosphere, causing an enhanced greenhouse effect. This causes an imbalance in the energy cycle that, in turn, impacts the water cycle, atmospheric circulation and ocean currents, leading to changes in weather and climate.

Physical climate

Greenhouse Effect

Direct and indirect effects

Aerosols

DMS, dust

Greenhouse gases

Aerosol formation

CO_2

Methane, ozone

Iron fertilisation

Chemistry

Biogenic emissions & removal

Ecosystems

What's new?

JULES-ES is a substantial upgrade relative to HadGEM2-ES.

- Extended PFTs to 13 (5 trees, 2 shrubs, 2 grasses and 4 managed land classes)

  - Trait based physiology: parameterised based on huge datasets of measurements, classified in a way to capture the variation in functional trait

- Various improvements in Canopy processes, including a new canopy radiation module

- New interactive Nitrogen model downregulating growth during nutrient scarcity

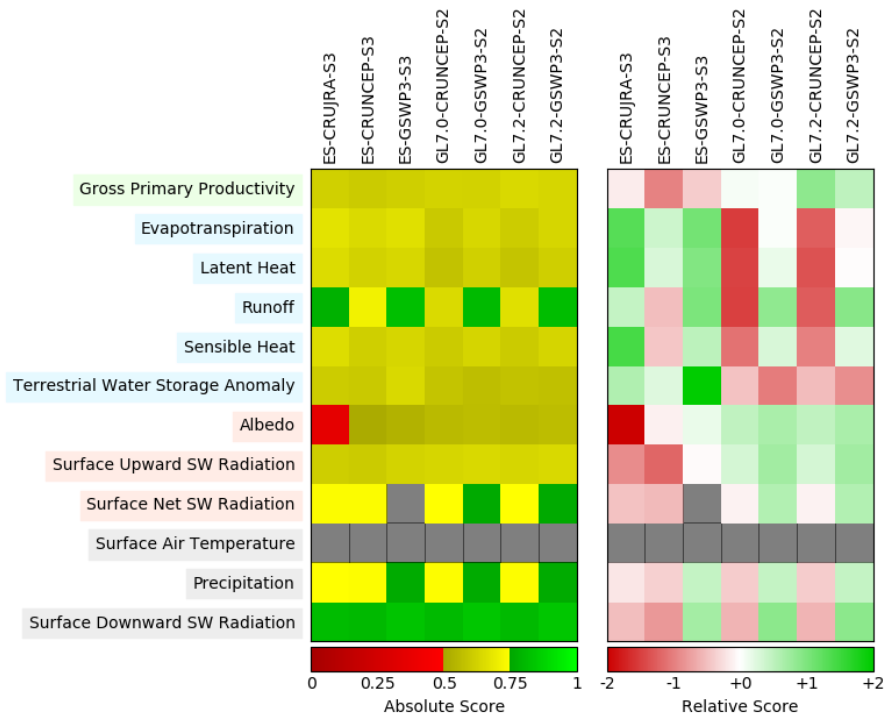- New land-use scheme separating land-use into C3,C4 grasses for crops and pasture

Coupled Terrestrial Carbon-Nitrogen Cycle
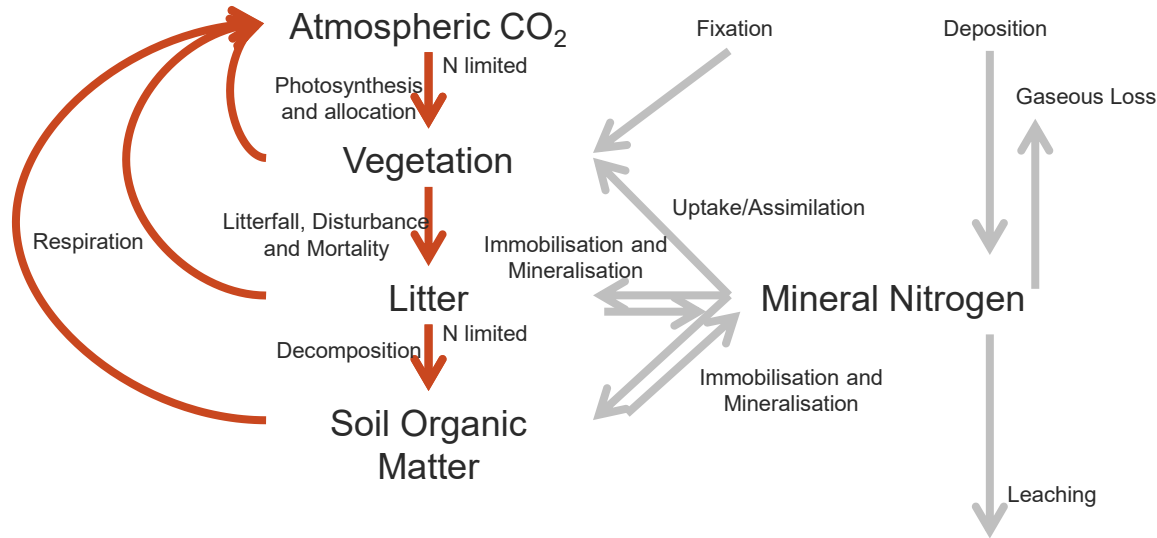
- Extended to include terrestrial Nitrogen Cycle
- Availability of N limits assimilation of Carbon and Turnover of soil Carbon

Benchmarking

http://gws-access.ceda.ac.uk/public/jules/ILAMB/JULES_GL7_GL7.2_CRUNCEP_GSWP_LONG/

Development Process

1. Users download and run standard configuration on JASMIN (prototype u-bk950) (https://code.metoffice.gov.uk/trac/jules/wiki/JulesConfigurations)
2. Get in touch with configuration manager (myself or Spencer)
3. Develop their own science, including lodging code to the JULES trunk
4. Benchmark the new run and share results code (present at annual JULES meeting) with configuration manager.
5. We'll look 'packaging' together all the new developments and release a new version ~6 months before annual JULES meeting.

Summary

- JULES-ES-1.0 does a good job, but could be better… where the community comes in

- We could have better parameters based on more data and/or observational constraints

- We could have more and/or improved processes – interactive fire, permafrost

- But, we need the model to perform well and be reliable. This is where the benchmarking comes in.

Questions and Answers