MIPs and ILAMB
[aka: IPCC/Climate applications and evaluation]

Chris Jones
Introduction

1. MIPs
   - Model Intercomparison Projects
   - Main modelling activity for IPCC
   - Land surface (and hence JULES) central to many

2. Evaluation
   - Tools (ILAMB)
   - Priorities (PEGs)
# MIPs specific to JULES

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C4MIP: What we did for AR5

Contributed strongly to AR5 WG1: carbon cycle (Ch.6), projections (Ch.12), evaluation (Ch.9) and TCRE (SPM)

AR5 WG1 said:

- The climate’s changing – we already knew that
- It’s down to humans – we already knew that
- It’s affecting people – some advance
- Now we can quantify what to do about it – new bit! Thanks to C4MIP
C4MIP: plans for CMIP6

TCRE was a defining aspect of AR5, but has substantial uncertainty which hinders usefulness.

The primary aim of C⁴MIP is to understand and quantify future (century-scale) changes in the global carbon cycle and its feedbacks on the climate system, making the link between CO₂ emissions and climate change.

- process development/feedback analysis
- evaluation (E-driven CMIP6 HIST, +PICTL)
- projection (E-driven high scenario, SSP 5-8.5; C-driven BGC-coupled SSP5-8.5 plus extension and overshoot SSP5-3.4-over scenario)

*Jones et al., GMD* (http://www.geosci-model-dev-discuss.net/gmd-2016-36/)
New science post-Paris?

- COP21 in Paris reached the “Paris Agreement”
  - (very) ambitious climate targets
  - Will require “negative emissions”
  - How will carbon cycle respond?
  - Feedback experiments on increasing (business as usual) and also overshoot scenarios

**COP21 final deal: Key points...**

- COP21 President Laurent Fabius says text is “differentiated, balanced, durable and “legally-binding”
- Text “emphasises” need to keep warming “well below 2C”
- ... And “Pursuing” efforts to keep warming “below 1.5C”
- 5-year ‘stocktake’ of how countries are doing on their climate plans
- Issues of ‘Differentiation’ and ‘Loss & Damage’ included
- No clear timescale of when fossil fuels must be phased out
MIP Science questions: LUMIP

- Role of land-use and land cover change
- Biogeochemical (carbon) vs Biophysical (surface properties)
- Likely HadGEM2-ES responded too strongly
- Historical and future scenario runs with/without land-use change or alternative scenarios
- Offline runs with factorial approach to specific activities (harvest, irrigation, fertilisation etc)
MIP Science questions: Scenarios

- ScenarioMIP
- Explore climate response to scenarios of possible future socio-economic pathways
- Build on RCPs
MIP Science questions

**LS3MIP**
- Role of land-surface and its coupling to the atmosphere
- Energy and water cycles
- Feedbacks on climate variability and change

**AerChemMIP**
- Focus on atmospheric composition and processes
- Land-surface relevant still - E.g. BVOC emissions

CMIP6 special issue of GMD:

http://www.geosci-model-dev.net/special_issue590.html
Experiment designs are settled

Model (JULES / UKESM) in final stages

• Thanks to JULES community over last 5+ years for all the developments (snow, PFTs, N-cycle, wetlands, …)

• Both are community models – built and exploited by all...

Get stuck into analysis

• JULES/UKESM – now – can help evaluate and final tunings. [Anna’s talk on ESM config]

• MIPs – begin running over next 12 months or so. From late 2017 onwards start writing papers for next IPCC report
Pt 2. Evaluation

• Model development has moved towards greater complexity
  • Carbon-cycle, chemistry, more interactive aerosols now common place in CMIP5-class models

• Evaluation not necessarily kept apace
CMIP6 vision

- Need to show **demonstrable** progress in ES components
  - CMIP1-2-3-5 progress for climate models

What will CMIP6 look like?
- Emergent behaviour/response/sensitivity might not converge
  - E.g. climate sensitivity
- But basic properties must get better

Reichler and Kim, 2008
Evaluation: community tools

- There are a wide range of tools
  - JULES benchmarking
  - ILAMB
  - Met Office auto-assess
  - ESMValTool
Evaluation: community tools

- There are a wide range of tools
  - JULES benchmarking
    - Not widely engaged with
  - ILAMB
    - Rapidly gaining traction and international use
  - Met Office auto-assess
    - Great, within Met Office. Not much land-surface in there (yet)
  - ESMValTool
    - ESM-wide (across all science areas and modelling groups)
    - Eventually a super-set of all the above?
Evaluation: community tools

**ILAMB**

- US-developed (Jim Randerson, Forrest Hoffman):
- now used by NCAR/CLM as community tool
  - Currently: 25 variables, 4 categories, 60 datasets
- [http://www.ilamb.org](http://www.ilamb.org)

*This could/should be the activity JULES community engages with, makes use of, and contributes to*
Mobilising JULES community to target common priorities: PEGs

• Process Evaluation Groups
  • Focussed groups address single issues identified as priorities
  • Complements specific “bottom-up” developments
  • JULES needs some coordinated and targeted activity to address and improve key processes

• Overview of PEGs idea
• Kick-off with an example JULES PEG
The warm tropical tropopause temperature bias in HadGEM increased from $\sim2K$ to $\sim5K$ with ENDGAME. This bias will increase stratospheric water vapour influencing stratospheric chemistry in UKESM1. Aim to reduce bias to acceptable level.
What PEGs do we need? What is the purpose of PEGs?

How to decide what subjects to focus on?

- June UM Users workshop involves all users (incl international partners) of the UM
- List what they want to use the model for, and therefore known model biases they care about
- Order this list, based on biases that affect most processes / people care most about
- Top 10 priorities → subjects of PEGs   [currently we have 4 “critical” PEGs]

The purpose of PEGs

- More weight to ask for people's time/effort/resources in dealing with a model bias
- More weight to negotiate on what should go into the next GA configuration (although should probably accept a process that is more physical but still degrades your bias)
- To bring experts together from across science, to work on a specific task
What should be the focus of PEGs?

Model development or scientific understanding? Ideally both!

Decide on the quantities that you care about, and on the physical processes that might influence these quantities...
PEGs way of working

- Annual “assessment session” at JULES meeting
- As a community decide 2-3 (??) top priority processes
  - Requires assessment areas to present some evaluation results of latest JULES configurations
- Form PEG group/membership/leadership
  - Helps prioritise and gain effort from multiple groups
- Following year, PEGs report back and we re-assess where the priorities now lie
  - [Penny Boorman’s poster – come and interact]
To get us started...

- Suggest a single PEG:
  - *Soil water stress and vegetation*
  - Anna Harper and Karina Williams leading
  - Impacts across space/time scales – hydrology for weather and climate, surface physics and exchange, carbon cycle, crop modelling for impacts

- In process of developing the PEG process
  - Defining the specific problem and metrics to measure it
  - Developing a plan to tackle it
  - Open discussion this week – get in touch/get involved!
    - *Talk to Anna/Karina at lunch or coffee*
    - *Leave contact details – skype meeting soon…*
Conclusions

- MIPs
  - There are many!
  - Land surface central to lots of them
  - UK community key in forming the MIPs and answering the science
  - Great opportunity for JULES to impact on AR6

- Evaluation
  - Need to coordinate on common tools
  - Engage with international efforts
  - PEGs - Prioritise “big ticket” common requirements and biases to tackle together