UK CMIP6 Status
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WGCM23 Dec 9, 15, 16, 2020

www.metoffice.gov.uk
Status of UK MIP experiments

**ScenarioMIP:** All runs complete and monthly processing done. Extra ensemble runs under way

**AerChemMIP:** All runs complete and monthly processing done at MOHC & NIWA. Higher frequency processing under way [Some processing done at KMA & NERC]

**GeoMIP:** All runs complete, all processing done

**DAMIP:** Initial condition ensemble runs complete & processed. Lower tier experiments to start shortly. piControl being extended from 500 to 1500 year. Roughly half way through data processing

**DCPP:** All runs complete, some processing (~10k datasets) done

**PAMIP:** Most runs complete, some processing (~19k datasets) done

**C4MIP:** Core runs complete, extensions running

**CDRMIP:** Core runs complete, extensions running

**RFMIP:** All MOHC runs complete & processed. NERC runs under way

<table>
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<tr>
<th>ScenarioMIP</th>
<th>GC31-UL</th>
<th>GC31-MM</th>
<th>UKESM1</th>
<th>Total</th>
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<tr>
<td></td>
<td>66</td>
<td>16</td>
<td>155</td>
<td>237</td>
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Jeremy Walton, Matthew Mizielinski
UK-based CMIP6 analysis for carbon budgets

- Carbon cycle response has been constrained in CMIP6,
  - Inclusion of terrestrial Nitrogen cycle
  - Largest uncertainty comes from vegetation response to CO₂
- ZECMIP initiated at short notice during 2019 to address gap in CMIP6 plans
  - CO₂ declines from 1% simulation after 1000 PgC emitted
  - Some models continue to warm, some models cool
  - Multi-model mean ZEC, centred on 50 years, = -0.07±0.19°C

Jones & Friedlingstein, 2020, ERL

Jones et al., (2019, GMD); MacDougall et al. (2020, Biogeosciences)
Impact of COVID-19-induced emissions reductions

• “what impact have emissions reductions due to COVID-19 lockdown/restrictions had on climate?”

• 11 models run up to 10-100 ensemble members

• small global signal but may be detectable regionally
  • Globally visible reduction in aerosol optical depths (averaged over 2020-2024)
  • Focused over China/India
  • Increased surface SW flux
  • No detectable impact on annual mean T or pr – analysis of extremes ongoing

HUGE thanks to all model groups, WIP, Jasmin/CEDA support

Jones et al., GRL, submitted
UK-based CMIP6 analysis of chemistry and aerosols within AerChemMIP

- Effective Radiative Forcing
  - Emergent constraint on ERF from ODS
  - Attribution of PD O₃ forcing to different drivers:

- Impact of future mitigation policies on NTCF
  - Small reductions in PM$_{2.5}$ in SSP3-7.0 in Europe & America but increases in South Asia;
  - Disagreement over sign of the change in East Asia

- Chemistry and aerosol feedbacks, contribute up to -0.2 ± 0.1 W m⁻² K⁻¹
  - smaller than the carbon cycle (~0.5 W m⁻² K⁻¹) or physical climate feedbacks (1-2 W m⁻² K⁻¹)

Morgenstern et al., Geophys. Res. Lett. 2020

Thornhill et al., Atmos. Chem. Phys. Disc. 2020

Turnock et al., Atmos. Chem. Phys. (2020)
UK appetite for CMIP7?

MIPs

• High level of appetite for MIPs as long as we keep them relevant
  • Many MIPs delivered a large number of papers for AR6
  • Appetite still strong for phase 2 analysis of existing runs (e.g. UK AerChemMIP recently held well attended analysis workshop)
  • Learned a lot about our own model in the context of others.
  • Very useful as long as they serve a purpose (e.g. ZECMIP, CovidMIP…)
  • Simply repeating past ones just because we did them before isn’t enough.
  • MIPS need to evolve as the science questions evolve

DECK

• Potentially new useful ‘idealised’ experiments around composition (AerChemMIP), deforestation (LUMIP)

Data and Experimental Design

• Evolution for processes.
  • Lots of investment in current structures (e.g. data request)
UK CMIP6 papers in JAMES special Issue

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<th>Author(s)</th>
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<td>Williams, Keith D</td>
<td>The Met Office Global Coupled model 3.0 and 3.1 (GC3.0 &amp; GC3.1) configurations</td>
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<td>Mulcahy, Jane Patricia</td>
<td>Improved aerosol processes and effective radiative forcing in HadGEM3 and UKESM1</td>
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<td>Kuhlbrot, Till</td>
<td>The low-resolution version of HadGEM3 GC3.1: 1 Development and evaluation for global climate</td>
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<td>Manery, Matthew B.</td>
<td>Pre-industrial control simulations with HadGEM3-GC3.1 for CMIP6</td>
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<td>Bodas-Salcedo, Alejandro</td>
<td>Strong dependence of atmospheric feedbacks on mixed-phase microphysics and aerosol-cloud interactions in HadGEM3</td>
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<td>Hardiman, Steven Charles</td>
<td>The impact of prescribed ozone in climate projections run with HadGEM3-GC3.1</td>
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<td>UKESM1: Description and evaluation of the UK Earth System Model</td>
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<td>Apportionment of the Pre-Industrial to Present-Day Climate Forcing by Methane using UKESM1</td>
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<td>Robeon, Jon I</td>
<td>The evaluation of the North Atlantic climate system in UKESM1 historical simulations for CMIP6</td>
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<td>Senior, Catherine</td>
<td>UK Community Earth System Modelling for CMIP6</td>
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https://agupubs.onlinelibrary.wiley.com/doi/toc/10.1002/(ISSN)1942-2466.UKESM1