

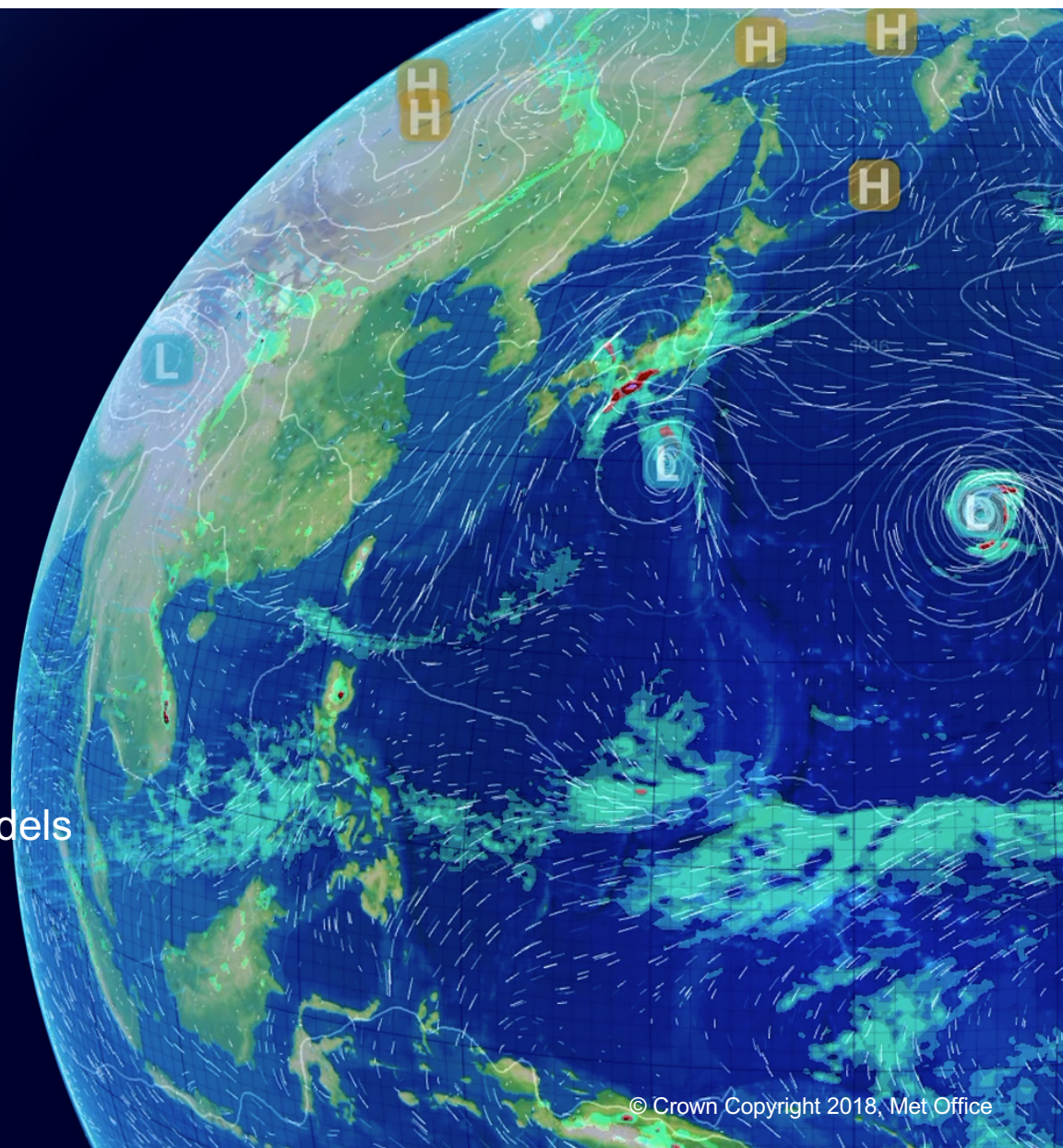
UK CMIP6 Status

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WGCM23 Dec 9,15,16, 2020

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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

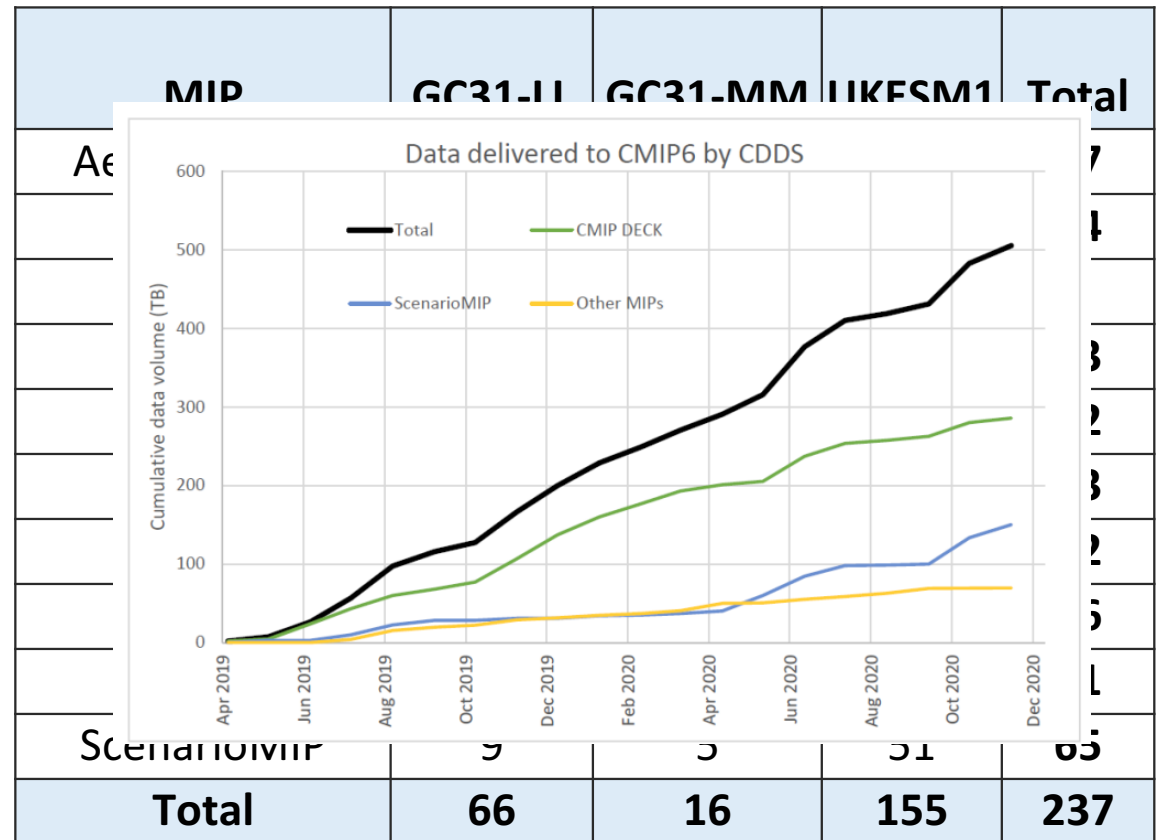
DCPP: All runs complete, some processing (~10k datasets) done

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

C4MIP: Core runs complete, extensions running

CDRMIP: Core runs complete, extensions running

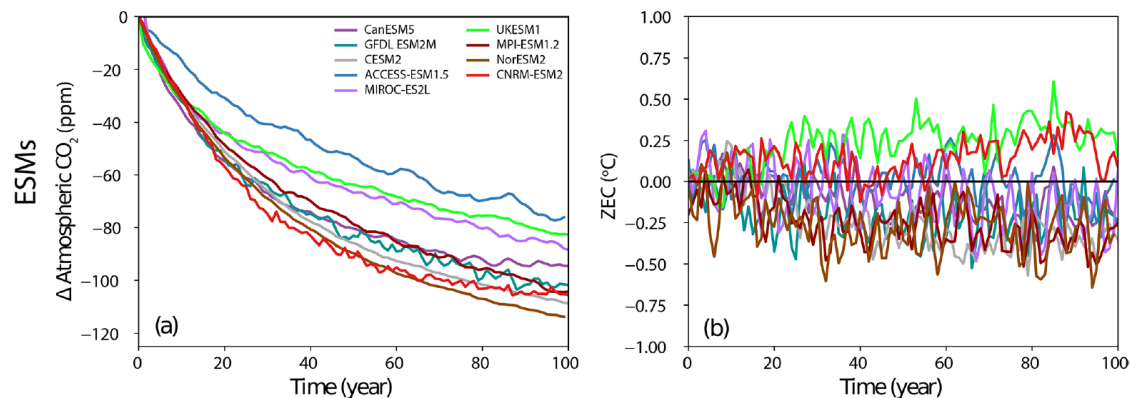
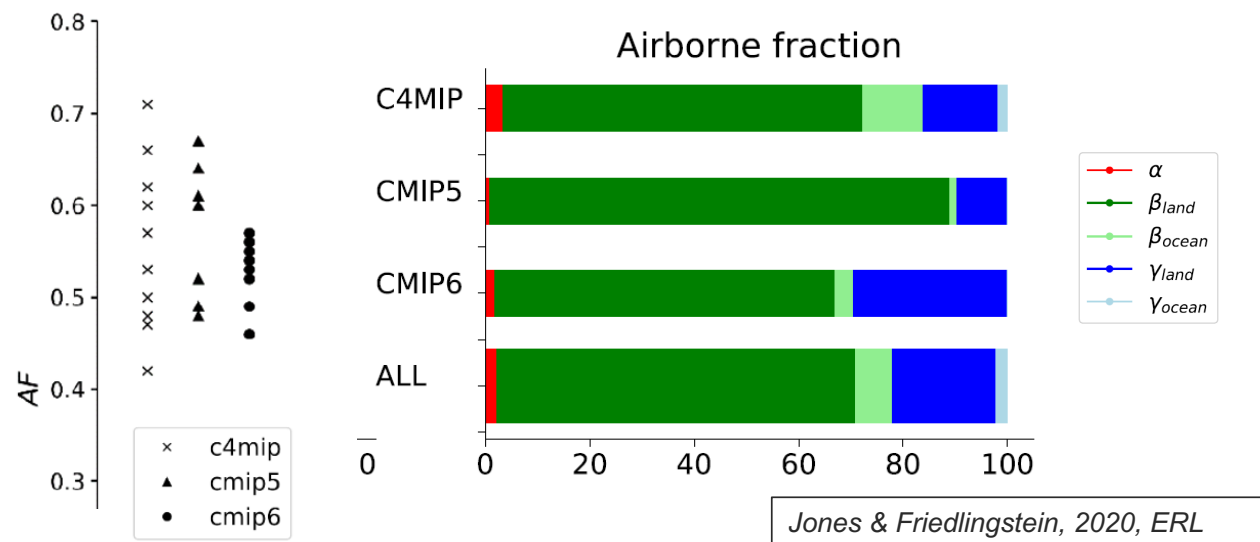
RFMIP: All MOHC runs complete & processed. NERC runs under way



Jeremy Walton, Matthew Mizielski

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, = $-0.07 \pm 0.19^\circ\text{C}$

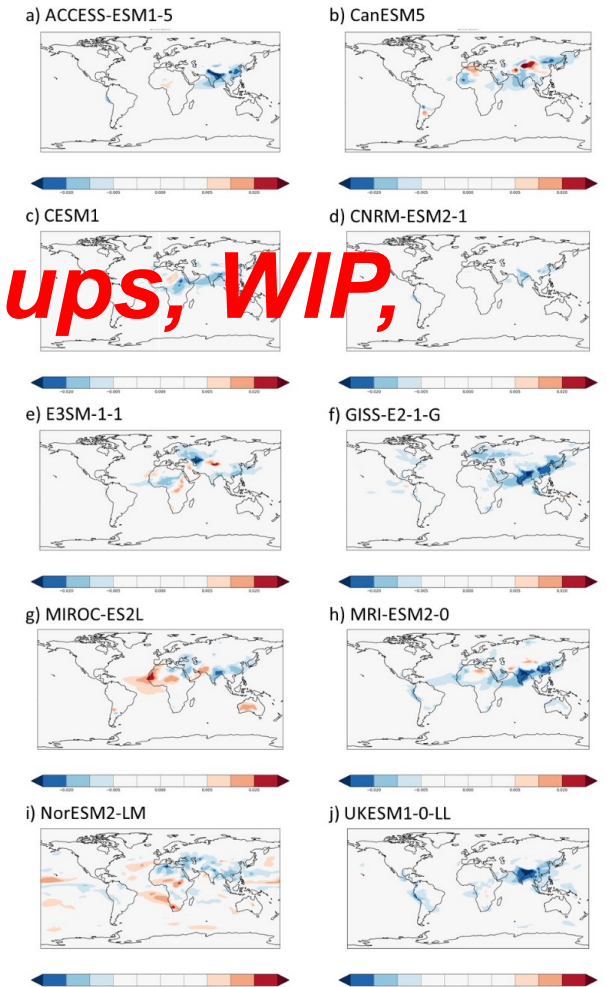
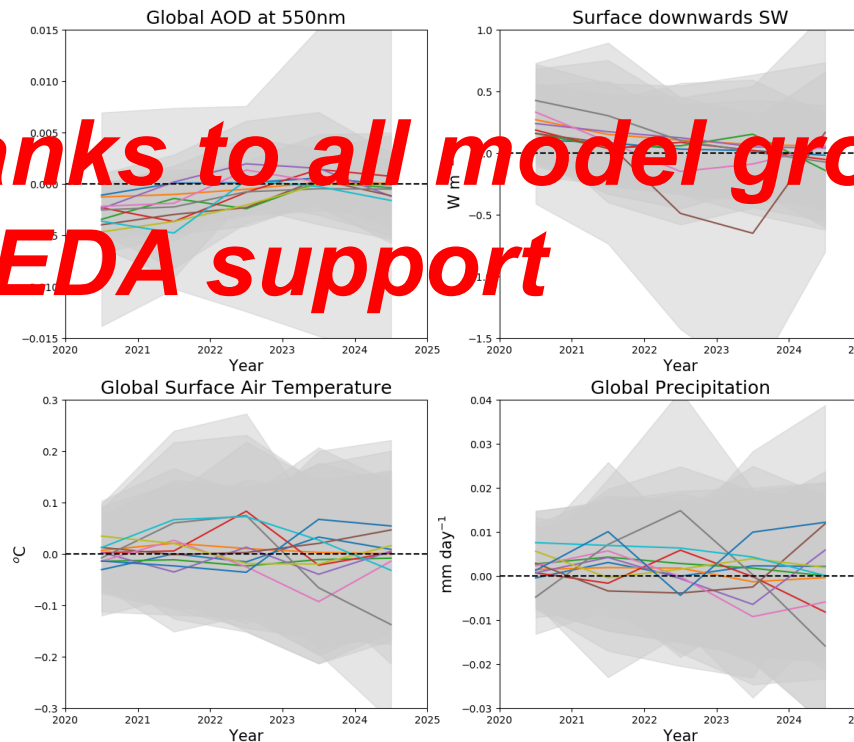


Jones et al., (2019, GMD); MacDougall et al. (2020, Biogeosciences)

Impact of COVID-19-induced emissions reductions

- “what impact have emissions reductions due to COVID-19 lockdown/restrictions had on climate?”
- 11 models now run 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

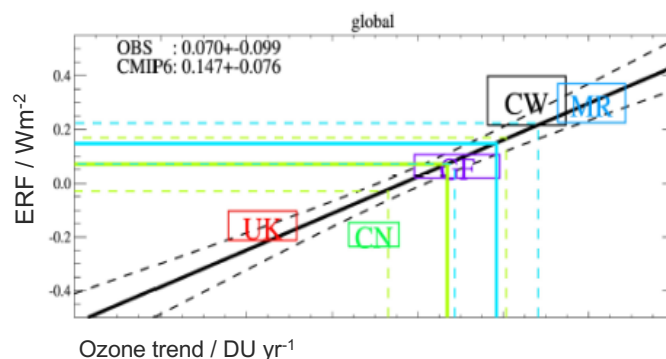
HUGE thanks to all model groups, WIP, Jasmin/CEDA support



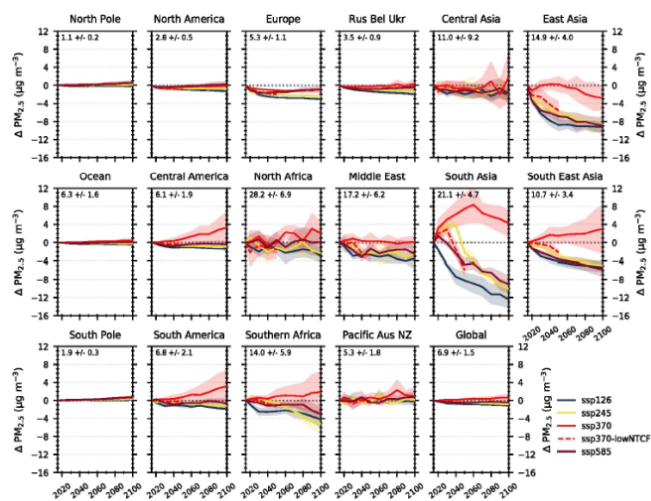
Jones et al., GRL, submitted

UK-based CMIP6 analysis of chemistry and aerosols within AerChemMIP

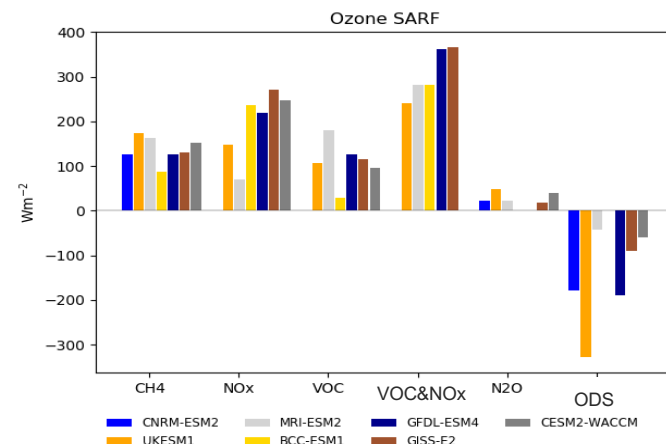
- Effective Radiative Forcing
 - Emergent constraint on ERF from ODS
 - Attribution of PD O_3 forcing to different drivers:
- Impact of future mitigation policies on NTCF
 - Small reductions in $PM_{2.5}$ in SSP3-7.0 in Europe & America but increases in South Asia;
 - Disagreement over sign of the change in East Asia
- Chemistry and aerosol feedbacks, contribute up to $-0.2 \pm 0.1 \text{ W m}^{-2} \text{ K}^{-1}$
 - smaller than the carbon cycle ($\sim 0.5 \text{ W m}^{-2} \text{ K}^{-1}$) or physical climate feedbacks ($1\text{-}2 \text{ W m}^{-2} \text{ K}^{-1}$)



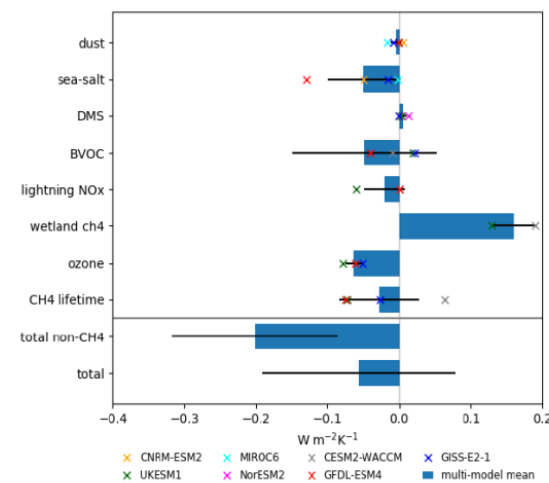
Morgenstern et al., *Geophys. Res. Lett.* 2020



Turnock et al., *Atmos. Chem. Phys.* (2020)



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



Thornhill 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

JAMES | Journal of Advances in Modeling Earth Systems

JAMES is a Gold Open Access journal that publishes original research articles advancing the development and application of models at all scales in understanding the physical Earth system and its coupling to biological, geological and chemical systems.

The UK Earth System Models for CMIP6

Earth System Modeling 2018-2020 | First published: 1 August 2018 | Last updated: 14 April 2020

This special issue is devoted to the scientific characterisation and evaluation of the physical and Earth-system models developed in the UK. The Met Office has a long history in developing high quality climate models submitted to CMIP with ever increasing fidelity and complexity. These papers will describe a second generation Earth System model, UKESM1 which for the first time has been developed jointly by the Met Office Hadley Centre and the UK Academic community; as well as the physical model HadGEM3-GC3, which it is built on.

Williams, Keith D	The Met Office Global Coupled model 3.0 and 3.1 (GC3.0 & GC3.1) configurations
Mulcahy, Jane Patricia	Improved aerosol processes and effective radiative forcing in HadGEM3 and UKESM1
Kuhlbrodt, Till	The low-resolution version of HadGEM3 GC3.1: 1 Development and evaluation for global climate
Menary, Matthew B.	Pre-industrial control simulations with HadGEM3-GC3.1 for CMIP6
Bodas-Salcedo, Alejandro	Strong dependence of atmospheric feedbacks on mixed-phase microphysics and aerosol-cloud interactions in HadGEM3
Hardiman, Steven Charles	The impact of prescribed ozone in climate projections run with HadGEM3-GC3.1
Sellar, Alistair	UKESM1: Description and evaluation of the UK Earth System Model
Andrews, Timothy	Forcings, feedbacks and climate sensitivity in HadGEM3-GC3.1 and UKESM1
Sellar, Alistair	Implementation of UK Earth system models for CMIP6
Williams, Keith D	Use of short range forecasts to evaluate fast-physics processes relevant for climate sensitivity
Yool, Andrew	Spin-up of UK Earth System Model 1 (UKESM1) for CMIP6
Andrews, Martin B	Historical simulations with HadGEM3-GC3.1 for CMIP6
O'Connor, Fiona M.	Apportionment of the Pre-Industrial to Present-Day Climate Forcing by Methane using UKESM1
Robson, Jon I	The evaluation of the North Atlantic climate system in UKESM1 historical simulations for CMIP6
Senior, Catherine	UK Community Earth System Modelling for CMIP6

[https://agupubs.onlinelibrary.wiley.com/doi/toc/10.1002/\(ISSN\)1942-2466.UKESM1](https://agupubs.onlinelibrary.wiley.com/doi/toc/10.1002/(ISSN)1942-2466.UKESM1)