Improvements to Stratospheric Ozone in UKESM1

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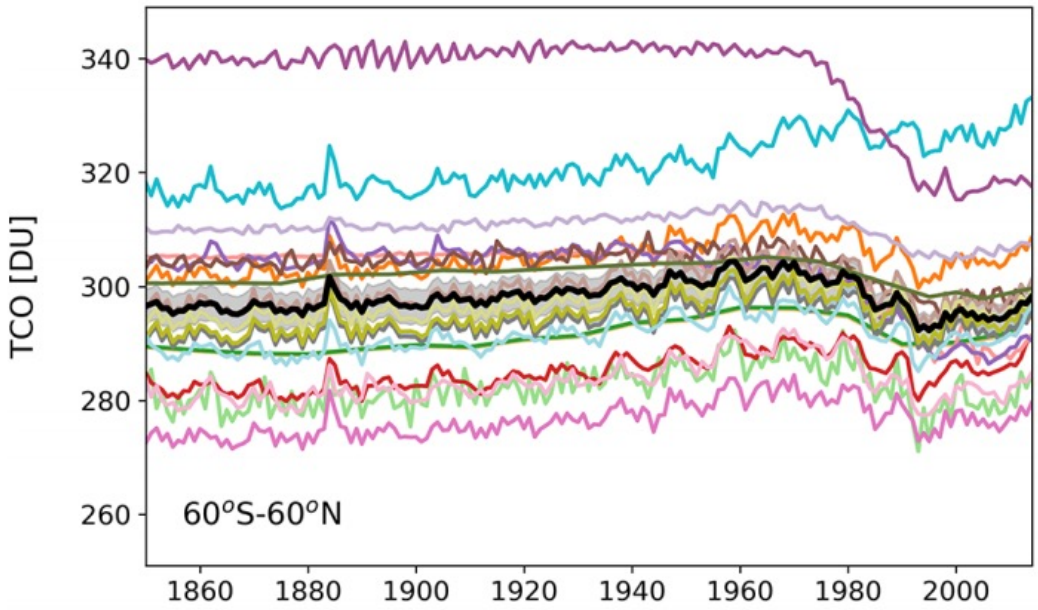
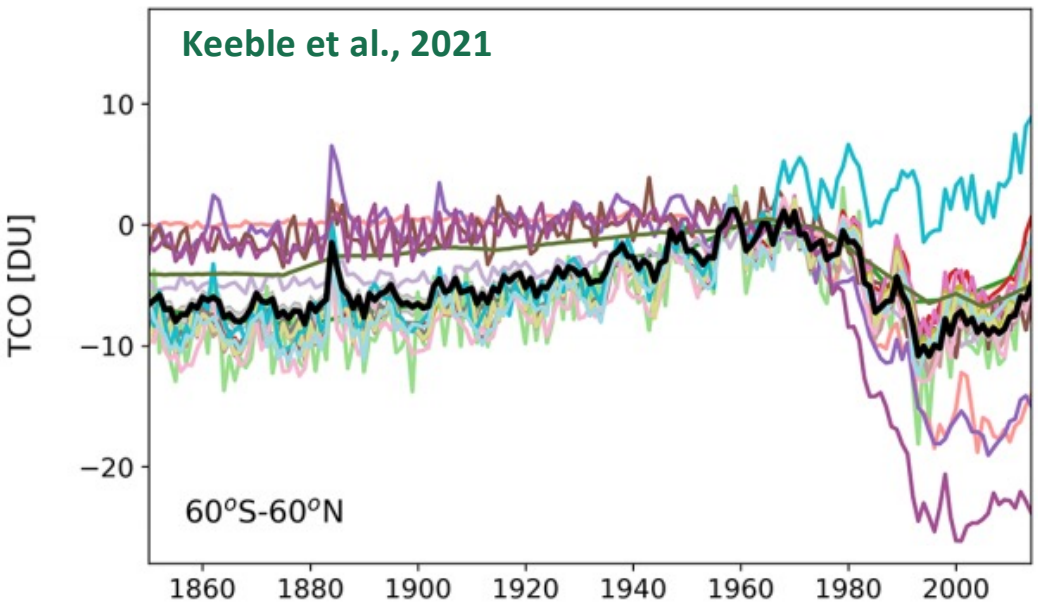
UKESM1 in relation to other CMIP6 models





AWI-ESM-1-1-LR
BCC-CSM2-MR
BCC-ESM1
CESM2-FV2
CESM2
CESM2-WACCM-FV2
CESM2-WACCM
CNRM-CM6-1
CNRM-ESM2-1
E3SM-1-0
E3SM-1-1
FGOALS-g3
GFDL-CM4
GFDL-ESM4
IPSL-CM6A-LR
MPI-ESM-1-2-HAM
MPI-ESM1-2-HR
MPI-ESM1-2-LR
MRI-ESM2-0
NorESM2-MM
SAM0-UNICON
UKESM1-0-LL
MMM

60S-60N annual mean TCO in UKESM1 ~40 DU higher than the MMM, and a similar bias is seen for all latitudinal ranges

When TCO is normalized to the 1960 annual mean value, UKESM1 models much stronger ozone depletion – important consideration for regional climate change

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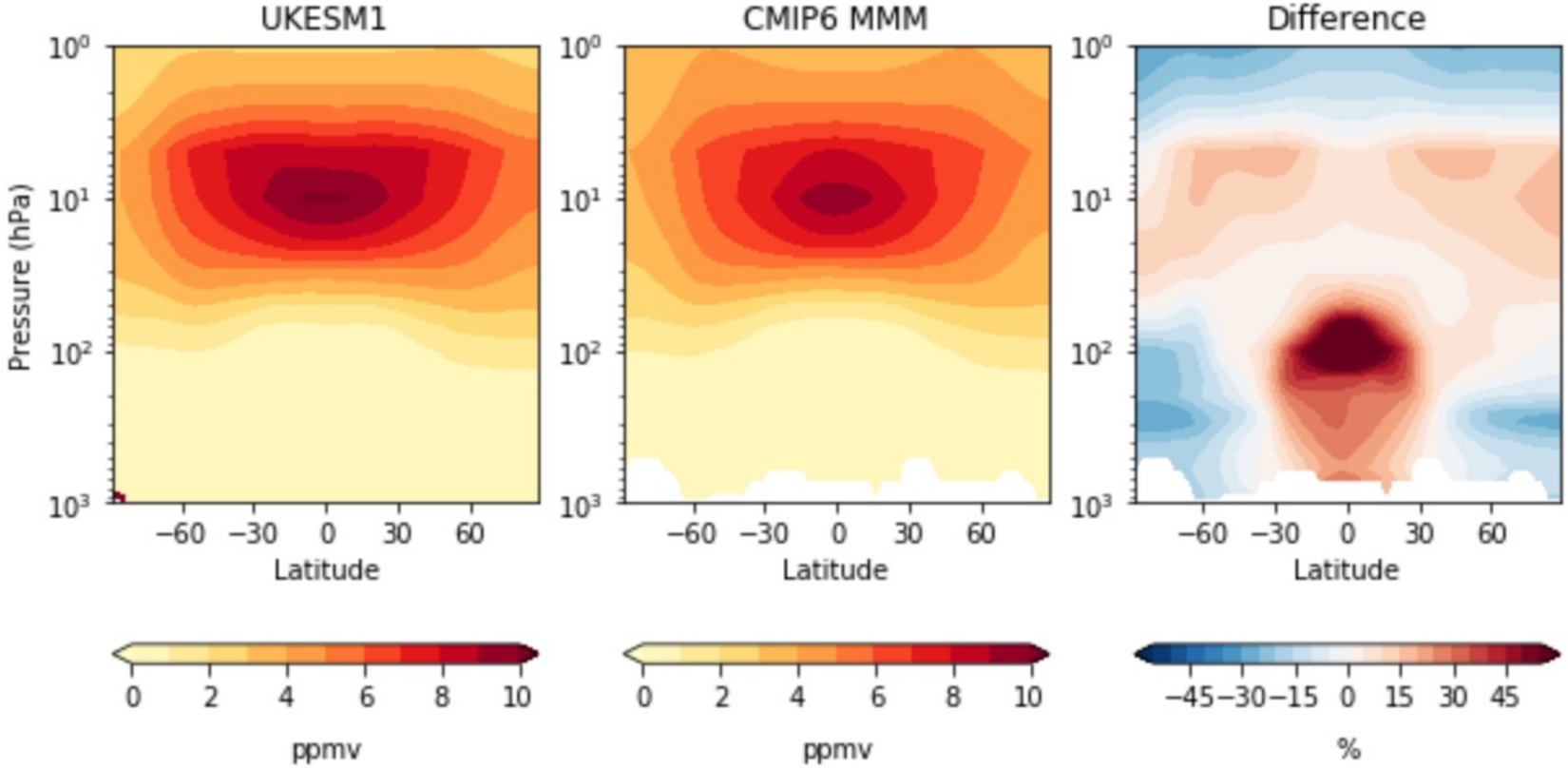

Zonal mean O3 mixing ratios, averaged from 2000-2014, in UKESM1 (left), the CMIP6 multi-model mean (middle) and the difference between the two (UKESM1-MMM)

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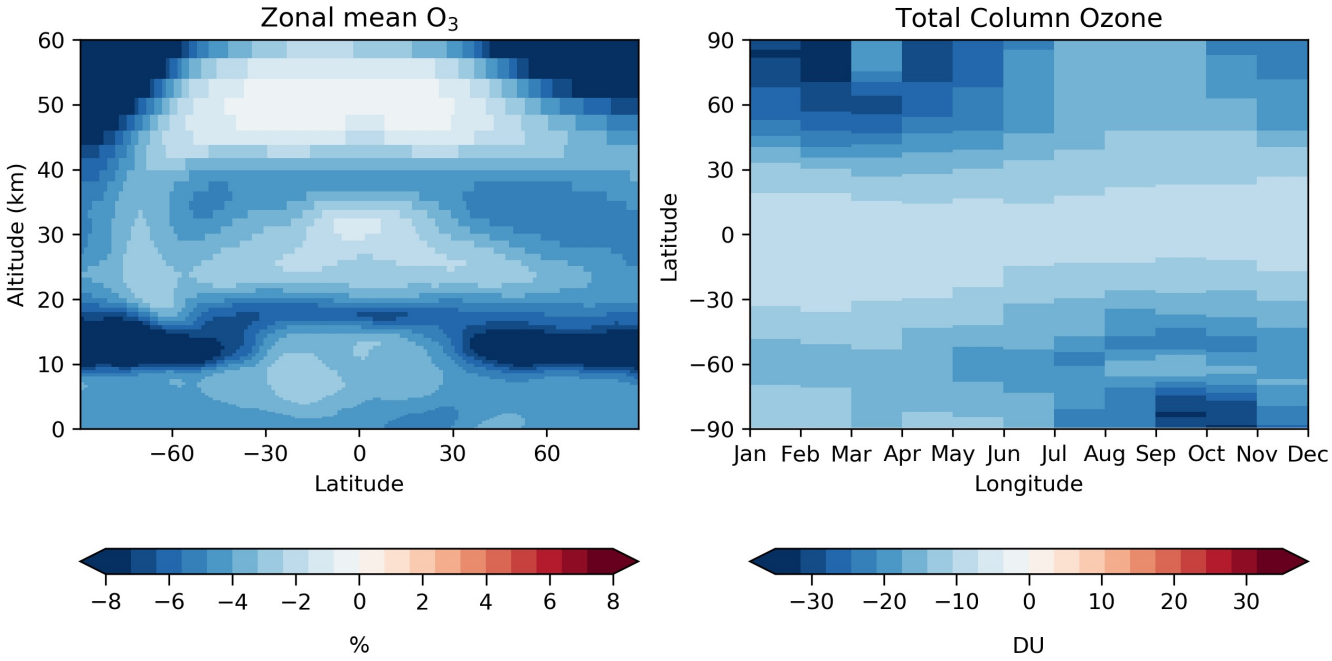
What changes have been made to UKESM1?

1. **Updates to FAST-JX input files**

2. **Changes to treatment of the top boundary**

3. **Additional heterogeneous chemistry (Dennison et al., Improvements to stratospheric chemistry scheme in the UM-UKCA (v10.7) model: solar cycle and heterogeneous reactions, Geosci. Model Dev., 12, 1227–1239, https://doi.org/10.5194/gmd-12-1227-2019, 2019)**

4. **Update to reaction rate data**



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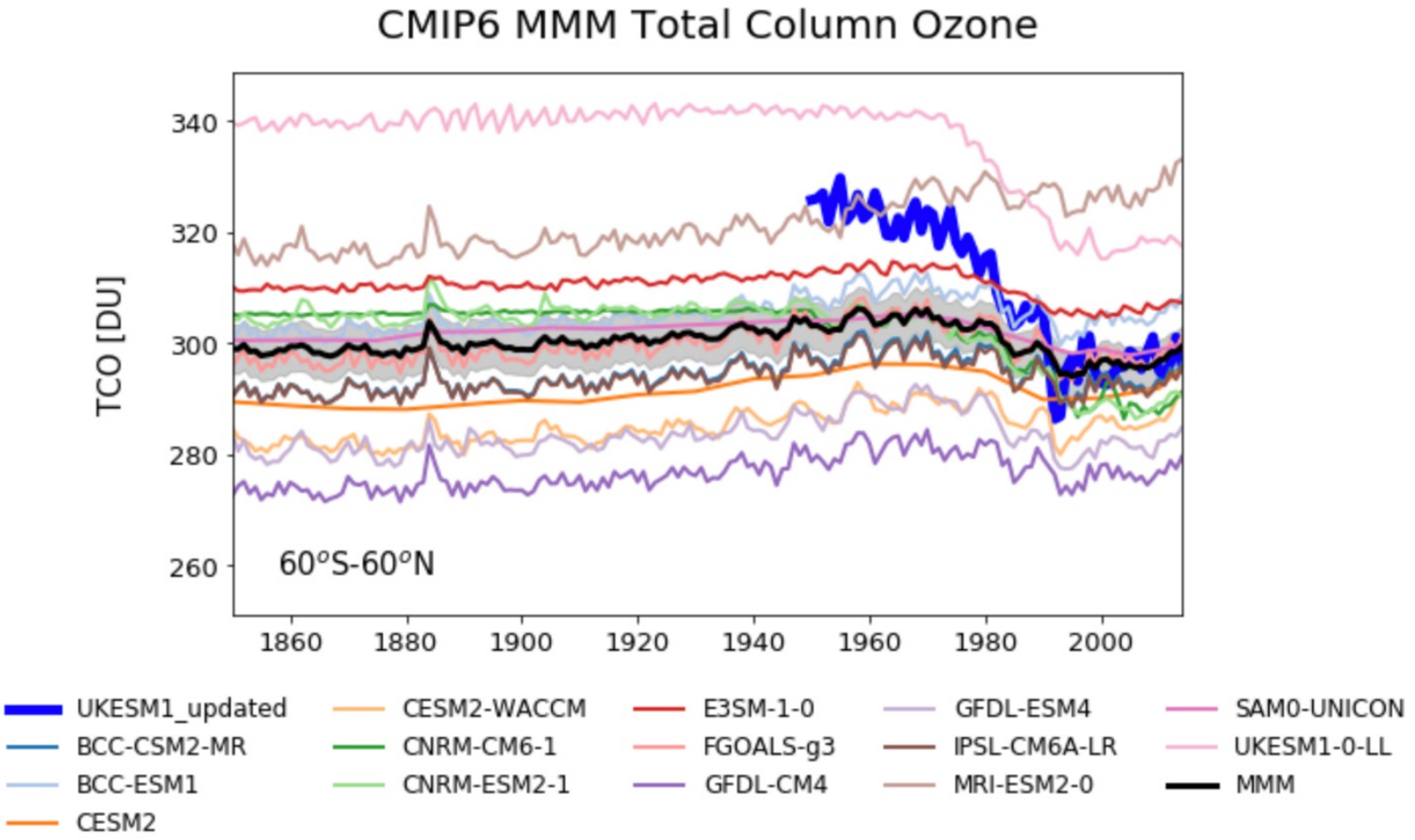

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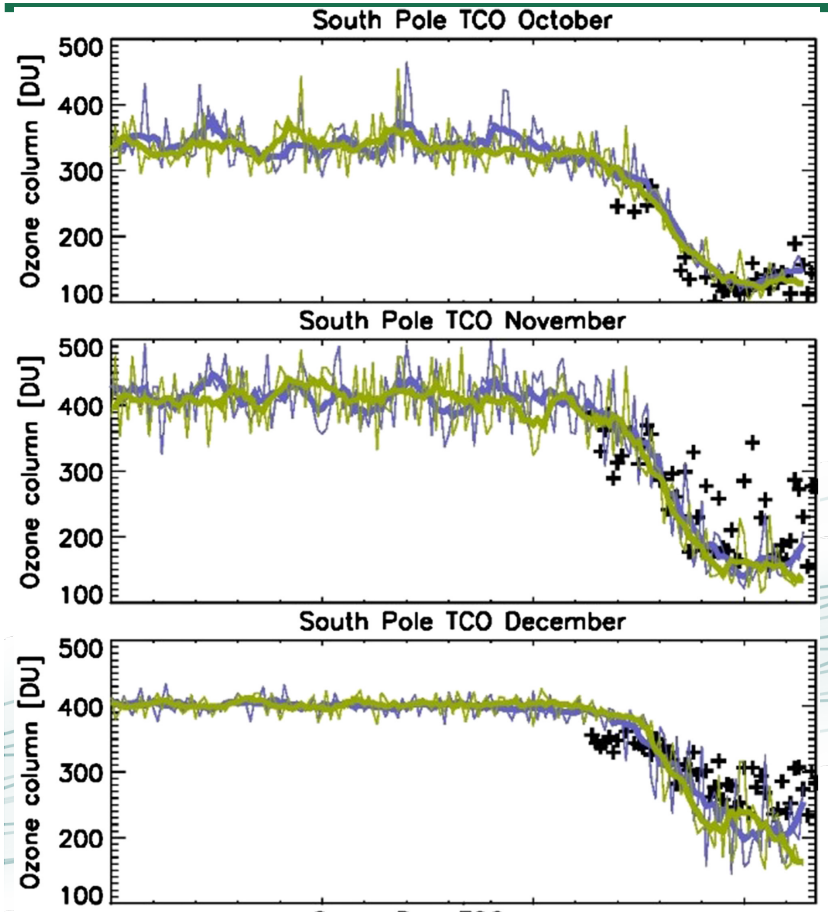
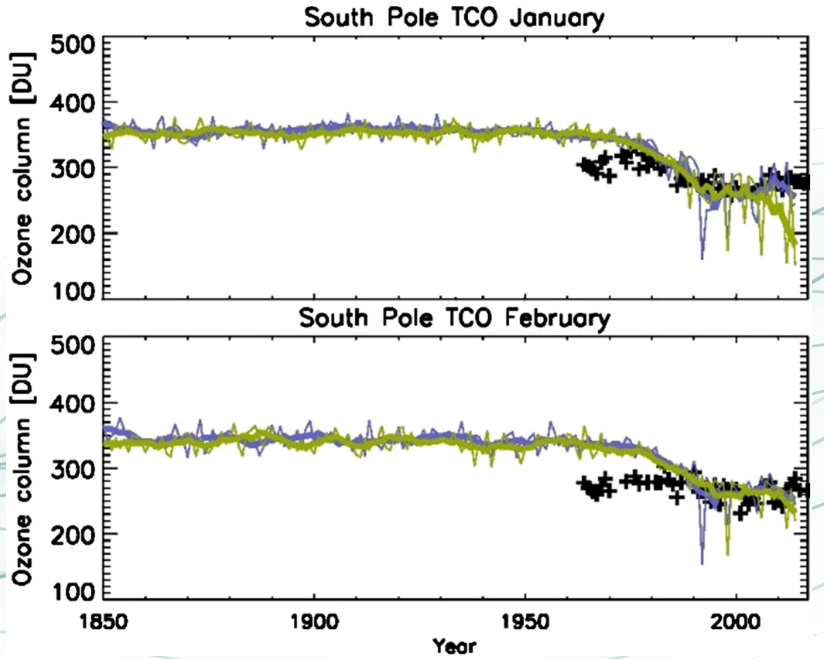
Do we need to rethink the way we do model evaluation?



Presently, the UKCA evaluation suite evaluates model output against observations, usually producing 1-2 figures for each variable.

- Limited to range of observations
- Often compares to a climatology, so no information about time evolution

< Column ozone evaluation in Sellar et al., 2019 shows good agreement between modelled TCO and observations over Antarctica for the spring



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