4.050 UKESM1: A first assessment of the pre-industrial to present-day anthropogenic forcing.

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Abstract:

A quantitative understanding of the role of different forcing agents in both historical and future
climate change remains a key motivation and scientific question for the forthcoming 6th Coupled
Model Intercomparison Project (CMIP6). Fundamental to this question is the impact of physical and
chemical perturbations due to anthropogenic activities on the Earth's radiative balance. In this
work, effective radiative forcings (ERFs) are quantified for different anthropogenic forcing agents
with the UK's Earth System Model, UKESM1. By using a single modelling framework and adopting the
protocol from the Radiative Forcing Model Intercomparison Project (RFMIP), pre-industrial to
present-day ERFs are calculated consistently for all anthropogenic climate forcers. The forcing
agents considered here are the long-lived well-mixed greenhouse gases (GHGs), stratospheric and
tropospheric ozone (O3), aerosols, and land use change. In particular, additional UKESM1 simulations
are used to attribute the methane ERF, as an example, to forcing by methane, tropospheric O3,
aerosols, and stratospheric water vapour, and to attribute the tropospheric O3 ERF to its individual
precursors. The impact of pre-industrial to present-day oxidant changes on aerosol forcing is also

explored.