Evaluation of the cloud fields in the UK Met Office HadGEM3-UKCA model using the CCCM satellite data product to advance our understanding of the influence of clouds on tropospheric composition and chemistry

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INTRODUCTION
As well as absorbing and scattering radiation, clouds are involved in a variety of processes that influence constituent composition in the UTLS. These include:
- the modification of photolysis rates of gaseous molecules through the backscattering of radiation (Δf)[1,2]
- convective transport, upwelling (VT) and wet removal processes (WR); and
- NOx emissions from lightning (LNOx).7

HOW ACCURATE ARE MODEL CLOUD FIELDS? AN EVALUATION OF HadGEM3
Simulation of clouds varies significantly from model to model which makes the analysis of clouds effects difficult1,8,9. We are using the CCCM cloud data product to evaluate the cloud fields and vertical distribution in the HadGEM3 Met Office Model and to quantify the influence of the model’s bias on its simulation of key tropospheric and lower stratospheric key trace gases.

AIM
To determine the role of clouds in driving inter-annual and inter-seasonal variability of trace gases in the troposphere and lower stratosphere with a particular focus on the importance of cloud modification of photolysis.

To evaluate the cloud fields and their vertical distribution in the HadGEM3 model utilizing CCCM, a unique 3-D cloud data product merged from multiple A-Train satellites (CERES, CloudSat, CALIPSO, and MODIS) developed at the NASA Langley Research Center.

EVIDENCE OF CLOUD MODIFICATION OF PHOTOLYSIS GLOBALLY

Figure i) shows zonal mean percentage differences in annual mean J(NO2) and J(O3) between model runs 1) incorporating ECMWF cloud data and 2) removing clouds.1 There are net increases in J(O3) and J(NO2) rates across the upper troposphere and net decreases in the lower troposphere.1

Figure ii) shows regionally that clouds are strongly correlated with J(NO2) and J(O3) over several regions following a similar pattern to correlations globally although these correlations are stronger in the MESSy model and overall with J(NO2).

REFERENCES