5.056 Parallel simulations of methane oxidation in UM-UKCA reveal hemispheric biases in climatological oxidant fields and methane concentrations.

Early Career Scientist

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Abstract:

Methane is the second most important anthropogenic greenhouse gas after carbon dioxide and a major ozone precursor. Its relatively short lifetime allows any changes in the methane burden to have near immediate effects on global climate. However, large uncertainties exist in the estimates of methane sources and hence in the global methane budget.

The UM-UKCA has been modified to use both prescribed offline oxidant fields and interactively simulated oxidant fields in parallel. Thus, in one simulation methane oxidation can be treated as both a linear first order process, removing the methane feedback onto itself, and a fully interactive process. The linear oxidation scheme allows methane emissions to be tagged by source type and region. The analysis presented here focuses on the source-sink-balance of methane in the early 2000s.

We show that methane observations can be used to assess the performance of the model, using a consistent method for comparison between a standard OH climatology (Spivakovsky) and a chemistry climate model oxidant field and analyse their effects on methane lifetime. The UM-UKCA OH field (North-South gradient 1.31) compares well with the ACCMIP multi-model mean. Methane concentrations are low biased with respect to observations at all latitudes but with an acceptable hemispheric gradient. The methane lifetime with respect to tropospheric OH loss is at the lower end of the ACCMIP multi-model mean. In contrast, the Spivakovsky OH field (North-South gradient 1.01) gives good agreement with methane observations with a small high bias in the Northern Hemisphere resulting in too strong a hemispheric gradient. The lifetime agrees well with observational constraints. We will present an analysis of the footprints of the different source types and regions which allows us to perform detailed comparison to observations. We will show that these data allow a quantitative assessment of the speciated methane source strengths.