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Modelling trends in tropical column ozone with the UKCA chemistry-climate model

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Trends in tropical column ozone under a number of different emissions scenarios are explored with the UM-UKCA coupled chemistry climate model. A transient 1960-2100 simulation was run following the RCP6 scenario. Tropical averaged (10S-10N) total column ozone values decrease from the 1970s, reaching a minimum around 2000, and return to their 1980 values around 2040, consistent with the use and emission of ozone depleting substances, and their later controls under the Montreal Protocol. However, when the total column is subdivided into three partial columns, extending from the surface to the tropopause, the tropopause to 30km, and 30km to 50km, significant differences to the total column trend are seen. Modelled tropospheric column values increase from 1960-2000 before remaining steady throughout the 21st Century. Lower stratospheric column values decrease rapidly from 1960-2000, remain steady until 2050 before slowly decreasing to 2100, never recovering to their 1980s values. Upper stratospheric values decrease from 1960-2000, before rapidly increasing throughout the 21st Century, recovering to 1980s values by ~2020 and are significantly increased above the 1980s values by 2100. Using a series of idealised model simulations with varying concentrations of greenhouse gases and ozone depleting substances, we assess the physical processes driving the partial column response in the troposphere, lower stratosphere and upper stratosphere, and assess how these processes change under different emissions scenarios. Finally, we present a simple, linearised model for predicting tropical column ozone values based on greenhouse gas and ozone depleting substance scenarios.