



Attribution of Ozone Changes in the Near Future: Nonlinear Feedbacks between Ozone Depleting Substances and Greenhouse Gases

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In the first half of the 21st century the stratospheric burden of ozone depleting substances (ODSs) is predicted to decrease due to the regulations in the Montreal Protocol and its amendments. Concomitantly, the concentrations of well-mixed greenhouse gases (GHGs) will continue to rise. As the removal of the ODSs from the stratosphere is also affected by changes in the Brewer-Dobson Circulation, the decrease of halogens will also depend on the rate of the GHG increase. Furthermore, the increasing concentrations of the GHGs methane (CH₄) and nitrous oxide (N₂O) can modify the halogen-ozone chemistry.

Therefore, a non-linear contribution has to be included in the attribution analysis of the ozone changes to ODS and GHG changes. In this study we detect and analyze this non-linear term in a set of appropriately defined timeslice simulations for the year 2045 with the Chemistry-Climate-Model EMAC. The causal processes of the non-linear interactions are studied in more detail by separating the relative ozone changes in the contribution from chemistry (production and loss) and transport. This allows us to identify not only feedbacks between chemistry and temperature but also between chemistry and dynamics, i.e. ozone transport.