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Evaluation of linear ozone photochemistry parametrizations in a stratosphere-troposphere data assimilation system

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Abstract. This paper evaluates the performance of various linear ozone photochemistry parametrizations using the stratosphere-troposphere data assimilation system of the Met Office. A set of experiments were run for the period 23 September 2003 to 5 November 2003 using the Cariolle (v1.0 and v2.1), LINOZ and Chem2D-OPP (v0.1 and v2.1) parametrizations. All operational meteorological observations were assimilated, together with ozone retrievals from the Michelson Interferometer for Passive Atmospheric Sounding (MIPAS). Experiments were validated against independent data from the Halogen Occultation Experiment (HALOE) and ozonesondes. Additionally, a simple offline method for comparing the parametrizations is introduced.

It is shown that in the upper stratosphere and mesosphere, outside the polar night, ozone analyses are controlled by the photochemistry parametrizations and not by the assimilated observations. The most important factor in getting good results at these levels is to pay attention to the ozone and temperature climatologies in the parametrizations. There should be no discrepancies between the climatologies and the assimilated observations or the model, but there is also a competing demand that the climatologies be objectively accurate in themselves. Conversely, in the lower stratosphere outside regions of heterogeneous ozone depletion, the ozone analyses are dominated by observational increments and the photochemistry parametrizations have little influence.

We investigate a number of known problems in LINOZ and Cariolle v1.0 in more detail than previously, and we find discrepancies in Cariolle v2.1 and Chem2D-OPP v2.1, which are demonstrated to have been removed in the latest available versions (v2.8 and v2.6 respectively). In general, however, all the parametrizations work well through much of the stratosphere, helped by the presence of good quality assimilated MIPAS observations.

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