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Coupled Chemistry-Climate Model Assessment and Predictions of Total Ozone Variations

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A number of coupled chemistry-climate models (CCMs) have been developed during the last few years. In comparison with models used in support of the 2002 WMO/UNEP ozone assessment, current CCMs mostly have improved representations of physical processes. The preferred strategy with CCMs involves ensembles of transient simulations but significant effort is required to specify the boundary conditions. To obtain consistency of anthropogenic and natural forcings in this model-intercomparison, two transient reference simulations and a set of model forcings have been defined as part of the CCM Validation Activity for SPARC (CCMVal). In this study results of the reference simulations of 12 state-of-the-art CCMs with detailed stratospheric chemistry schemes are used to assess the near-term and long-term evolution of stratospheric ozone.

While the focus of this work is on past and possible total ozone variations in the future, main uncertainties in current CCMs are discussed first. Participants in CCMVal have developed a number of diagnostics to evaluate stratospheric dynamics, transport, chemistry, and radiation (see http://www.pa.op.dlr.de/CCMVal/CCMVal_EvaluationTable.html). Here, a subset of the CCMVal diagnostics is applied with a particular focus on evaluating the model's ability to simulate transport and dynamics. The modeled evolution of total ozone in the past is compared to the NIWA assimilated total column ozone data base. A set of Arctic and Antarctic ozone depletion indices is applied to assess the horizontal and vertical extent of the ozone hole with time. This allows a more quantitative assessment of the model scenarios for the detection of the recovery stages of ozone amounts, i.e. the slowing of ozone decline, the onset of ozone increases (turnaround), and full recovery of ozone.