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Simulations of future Southern Hemisphere climate under a range of ozone recovery scenarios

A Yu Karpechko (1) and N P Gillett (2)

(1) Climatic Research Unit, School of Environmental Sciences, University of East Anglia, Norwich, UK (a.karpechko@uea.ac.uk), (2) Canadian Centre for Climate Modelling and Analysis, Victoria, Canada (nathan.gillett@ec.gc.ca)

Changes in stratospheric ozone have significantly influenced the tropospheric circulation and climate of the Southern Hemisphere (SH) over recent decades and will continue to influence climate during the 21st century when ozone recovery is expected. Therefore, in order to obtain reliable projections of SH climate, it is important to have reliable estimates of future ozone changes. Chemistry-climate models (CCMs) which include interactions between stratospheric ozone chemistry and greenhouse-gas-induced climate change are the most appropriate tool to obtain future ozone estimates. However projections of ozone recovery differ between models even when the same GHG emissions scenario is assumed. In order to choose those models with the most reliable simulations of future ozone, we compare simulations of 20th century ozone by the same models to available observations and quantify agreement between models and observations, making the assumption that correct simulation of past ozone gives more confidence in future projections. The focus of this study is on SH climate and hence we consider the ability of CCMs participating in the CCMVal project to simulate the global distribution of total ozone and the vertical distribution of ozone over the Antarctic as well as changes in these diagnostics over the last two decades of the 20th century. Our results show that no one model performs better than the others in all four diagnostics; however combining RMS differences in the diagnostics into one metric of model performance allows us to objectively rank the models. Our results also show that differences in climatology and trends of the Antarctic ozone profile between different observational data sets are considerable, and comparable to the differences between the observations and the models, highlighting the need for reliable observational ozone records in high-latitudes. The CCMVal simulations all employ prescribed sea surface temperatures, constraining their surface climate response to changes in ozone and other forcings. We therefore use future ozone projections from a subset of CCMVal models with the most realistic 20th century ozone to force 21st century simulations of the HadGEM1 coupled ocean-atmosphere model, along with A1B GHG concentrations. To isolate the effects of ozone recovery, the model is additionally run under a constant ozone scenario with ozone values corresponding to those observed during the period of 1998-2003. Here we present a comparison of future SH climate changes under different ozone scenarios.