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The simulation of the Antarctic ozone hole by chemistry-climate models

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Abstract. While chemistry-climate models are able to reproduce many characteristics of the global total column ozone field and its long-term evolution, they have fared less well in simulating the commonly used diagnostic of the area of the Antarctic ozone hole i.e. the area within the 220 Dobson Unit (DU) contour. Two possible reasons for this are: (1) the underlying Global Climate Model (GCM) does not correctly simulate the size of the polar vortex, and (2) the stratospheric chemistry scheme incorporated into the GCM, and/or the model dynamics, results in systematic biases in the total column ozone fields such that the 220 DU contour is no longer appropriate for delineating the edge of the ozone hole. Both causes are examined here with a view to developing ozone hole area diagnostics that better suit measurement-model inter-comparisons. The interplay between the shape of the meridional mixing barrier at the edge of the vortex and the meridional gradients in total column ozone across the vortex edge is investigated in measurements and in 5 chemistry-climate models (CCMs). Analysis of the simulation of the polar vortex in the CCMs shows that the first of the two possible causes does play a role in some models. This in turn affects the ability of the models to simulate the large observed meridional gradients in total column ozone. The second of the two causes also strongly affects the ability of the CCMs to track the observed size of the ozone hole. It is shown that by applying a common algorithm to the CCMs for selecting a delineating threshold unique to each model, a more appropriate diagnostic of ozone hole area can be generated that shows better agreement with that derived from observations.

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