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Improving Antarctic Total Ozone Projections by a Process-Oriented Multiple Diagnostic Ensemble Regression

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Accurate projections of stratospheric ozone are required, because ozone changes impact onexposures to ultraviolet radiation and on tropospheric climate. Unweighted multi-model ensemble mean (uMMM) projections from chemistry-climate models (CCMs) are commonly used to project ozone in the 21 th century, when ozone-depleting substances are expected to decline and greenhouse gases expected to rise. Here, we address the question whether Antarctic total column ozone projections in October given by the uMMM of CCM simulations can be improved by using a process-oriented multiple diagnostic ensemble regression (MDER) method. This method is based on the correlation between simulated future ozone and selected key processes relevant for stratospheric ozone under present-day conditions. The regression model is built using an algorithm that selects those process-oriented diagnostics which explain a significant fraction of the spread in the projected ozone among the CCMs. The regression model with observed diagnostics is then used to predict future ozone and associated uncertainty. The precision of our method is tested in a pseudo-reality, i.e. the prediction is validated against an independent CCM projection used to replace unavailable future observations. The test shows that MDER has a higher precision than uMMM, suggesting an improvement in the estimate of future Antarctic ozone. Our method projects that Antarctic total ozone will return to 1980 values around 2060 with the 95% confidence interval ranging from 2040 to 2080. This reduces the range of return dates across the ensemble of CCMs by more than a decade and suggests that the earliest simulated return dates are unlikely.

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