A future prediction of the ozone layer using the CCSR/NIES Chemistry-Climate Model

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A future prediction of the ozone layer has been made with the CCSR/NIES Chemistry-Climate Model (CCM) and future scenarios of halogen gases and global warming gases. The CCM was developed at National Institute for Environmental Studies (NIES) and Center for Climate System Research of University of Tokyo (CCSR). The WMO Ab scenario and the IPCC A1B scenario are used as the future scenario. These scenarios are specified by the REF2 experiment of Chemistry-Climate Model Validation (CCMVal) project under SPARC. Sea surface temperature data is provided from the outputs of an atmosphere-ocean Coupled General Circulation Model (CGCM) calculation for climate change. The CGCM is called MIROC and developed by CCSR, NIES, and Frontier Research Center for Global Change of the Japan Agency for Marine-Earth Science and Technology (FRCGC).

The results of the REF2 run suggest that ozone hole disappear around 2050-2065. A sensitivity run is performed, where the concentration of the global warming gases is fixed to the values at 1975 and the sea surface temperature is fixed to the 1970s mean. The result shows that the global warming effect accelerates the disappearance of ozone hole by 10-20 years owing to ozone production in a colder stratosphere of the future atmosphere. However, we have to carefully consider a deficiency of the current version of CCM for these conclusions, that is, the water vapor amount of the CCM stratosphere is much lower than the observation, which results from a cold bias in the tropical lower stratosphere of the CCM and may result in a low sensitivity of Polar Stratospheric Clouds (PSCs) amount to the colder stratospheric temperature.