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Coupling Atmospheric Chemistry Transport Model MOZART with General Circulation Model ECHAM5 and its feedback of ozone

Y. Xu (1,2), G. P. Brasseur (1,3)

(1) Max-Planck-Institute For Meteorology, Hamburg, Germany, (2) Now at York University, Toronto, Canada, (2) Now at NCAR, Boulder, USA (yiwenxu@yorku.ca)

It is known that greenhouse gases like CO_2, O_3, CH_4, N_2O, water vapor, aerosol are closely related to climate change. Ozone shows its GHG effects through direct and indirect impact on atmospheric radiation. In this work, the tropospheric version MOZART2.1 (Model of Ozone and Related Chemical Tracers) is coupled with ECHAM5, with the feedback of tropospheric and lower stratospheric ozone simulated by MOZART to replace the ozone climatology data in GCM. Simulations were performed for one-way coupling (no ozone feedback) for year 2000, and two-way coupling (ozone feedback) for April, May, and June 2000, at a spatial resolution of T42L19 (2.8˚ x 2.8˚ with 19 vertical layers). It is found that the atmospheric conditions can be affected significantly as a result of the change of radiation and heating rates due to the feedback of space and time dependent ozone from MOZART. Sample results from the analysis of ECHAM5 output with and without ozone feedback indicate the typical change of daily averaged zonal mean temperature from ECHAM5 can be as large as ± 4 ˚C, specific humidity $\pm 30\%$, surface solar radiation ± 500 Wm^{-2}, surface temperature ± 12 ˚C in June. These changes in the atmosphere consequently altered the photochemical cycle, causing variations in the spatial distribution of photochemical species, including ozone itself. The comparison of one-way and two-way simulation results in May shows that the change of monthly averaged zonal mean ozone concentration from MOZART generally can be as large as $\pm 10\%$, with maximum around tropopause and tropical region. The coupled modeling results suggest the strong effects on atmospheric variables, forcing fields, and photochemical cycle due to the feedback of MOZART ozone. This is an implication of potential impact of lower stratospheric and tropospheric ozone on regional and global climate.