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Effects of stratospheric ozone on tropical tropospheric and stratospheric circulation after a stratospheric sudden warming event

M. Deushi and Y. Kuroda

Meteorological Research Institute, Atmospheric Environment and Applied Meteorology, Tsukuba-city, Ibaraki, Japan
(mdeushi@mri-jma.go.jp)

In this study we examine effects of stratospheric ozone on the tropospheric and stratospheric circulation in the tropics after a stratospheric sudden warming (SSW) event. To investigate dynamical feedbacks from anomalous stratospheric ozone after the SSW in the winter of 2003–4, the following ensemble forecasts were performed using a chemistry-climate model (CCM) and an atmospheric general circulation model (AGCM).

(Exp.1) CCM (interactive ozone) ensemble forecast

(Exp.2) AGCM (with prescribed climatological ozone) ensemble forecast

The above ensemble forecasts were performed based on the Lagged Averaged Forecasting method. The ensemble member was 32 in each ensemble forecast. The CCM used in this study resolves well a full stratospheric and tropospheric chemistry with dynamical feedbacks from ozone.

In the Exp.1 persistent negative ozone anomalies are simulated in the tropical lower stratosphere due to the strengthening of the Brewer–Dobson circulation after the SSW. The negative ozone anomalies decrease solar short-wave heating rates, leading to negative temperature anomalies of several kelvins in the tropical lower stratosphere. Impacts of the anomalous temperature on tropical tropospheric circulation and convective activity are investigated in detail.