Possible impacts of stratospheric ozone on circulation changes in the tropical troppposphere following a stratospheric sudden warming event

*Makoto Deushi[1]

1. Department of Atmospheric Environment and Applied Meteorology, Meteorological Research Institute

Many studies have shown that there are significant impacts of the stratospheric ozone on dynamical coupling between the stratosphere and troposphere (S-T) at middle and high latitudes, especially in the Southern hemisphere (e.g. Marshall *et al.*, JC, 2006; Thompson *et al.*, Nature Geo, 2011). In contrast, little attention has been given to role of the stratospheric ozone in modulating S-T dynamical coupling in the tropics (and sub-tropics) so far. Recently, there has been an increasing interest in the S-T dynamical coupling in the tropics because it has been recognized that this coupling has significant influences on moist convection and organized convective systems in the tropics (e.g. Son *et al.*, JC, 2017; Nishimoto and Yoden, JAS, 2017).
In this study, possible impacts of the stratospheric ozone on tropospheric circulation and precipitation in the tropical and sub-tropical regions were examined, focusing on a period of several months following a major stratospheric sudden warming (SSW) event. As a case study, the major SSW occurred in the winter of 2003/2004 was investigated. A set of ensemble re-forecasts was performed by using a chemistry-climate model (CCM) and an atmospheric general circulation model (AGCM) to elucidate radiative effects of the stratospheric ozone anomalies induced by the major SSW on the troposphere at low latitudes. The ensemble re-forecasts were conducted using the Lagged Averaged Forecasting (LAF) method with 60 ensemble members, where the initial-times were set just before the occurrence of the major SSW. The CCM resolves well full stratospheric and tropospheric chemistry processes, and considers online radiative feedbacks from the simulated atmospheric ozone. The CCM ensemble re-forecast was compared to the AGCM ensemble re-forecast in which climatological monthly mean ozone was forced. The CCM ensemble re-forecast reproduced well significant ozone decrease in the lower tropical stratosphere due to rapidly enhanced upward Brewer-Dobson circulation there after the major SSW. About two weeks after the occurrence of the major SSW, systematic differences with statistical significance between the two ensemble re-forecasts were simulated in the tropospheric circulation and precipitation especially in the northern tropics and sub-tropics. The northern cell of the Hadley circulation became stronger in the CCM ensemble re-forecast than in the AGCM one, with the larger amount of precipitation over the Intertropical Convergence Zone (ITCZ). To confirm these impacts of the stratospheric ozone on the (sub-) tropical troposphere, other major SSW events are also investigated.

Keywords: stratosphere-troposphere coupling, stratospheric ozone, tropical tropospheric circulation, stratospheric sudden warming

