ENSO signal in ozone and wind simulated with the MRI-CCM using observed forcings for 1980-2004.

Kiyotaka Shibata[1]; Makoto Deushi[2]

[1] Atmospheric Environment,MRI; [2] MRI

Middle-atmosphere simulation of the past 25 years (from 1980 to 2004) has been made with a chemistry-climate model (CCM) of the Meteorological Research Institute (MRI) under observed forcings of sea-surface temperature, greenhouse gases, halogens, volcanic aerosols, and solar irradiance variations. The dynamics module of MRI-CCM is a spectral global model truncated triangularly at a maximum wavenumber of 42 with 68 layers extending from the surface to 0.01 hPa (about 80 km), wherein the vertical spacing is 500m from 100 to 10 hPa. The chemistry-transport module treats 51 species with 124 reactions including heterogeneous reactions. Transport of chemical species is based on a hybrid semi-Lagrangian scheme, which is a flux form in the vertical direction and an ordinary semi-Lagrangian form in the horizontal direction. Multiple linear regression analysis is used to isolate specific signals from the zonal-mean anomalies in temperature, zonal wind, and ozone data for the simulation and observations. Reference (explanatory) variables are the mean value, the linear trend, the QBOs at 20 and 50 hPa, volcanic aerosols of El Chichón and Mount Pinatubo, ENSO, and the 11-year solar cycles.Coefficients are expanded by annual, semiannual, and triannual cycles to explain seasonality.The annual average ENSO signal for the zonal mean temperature in the tropics is well reproduced in terms of the spatial pattern of the tropospheric warming and the stratospheric cooling, although the amplitudes are underestimated by about half. The simulated mid-latitude stratospheric warmings in both hemispheres are slightly higher than the observed values. The ENSO signal of zonal-mean zonal wind, represented as the subtropical jet intensification in the equatorward flank in both hemispheres, is also well captured. The stratospheric ENSO ozone signal, revealed as an ozone decrease in the tropics and an ozone increase in the mid-latitudes centered at about 35S and 35N, though slightly overestimated, is well reproduced.