# Structure of extreme NAM events in the simulation of a chemistry-climate model driven by observed forcings

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Extreme northern annular mode (NAM) and its spacial and temporal structure in the stratosphere and troposphere are investigated in the simulation of a middle-atmosphere chemistry-climate model (CCM) of Meteorological Research Institute (MRI). The data is comprised of ensemble simulation (five members) of the past 25 years (from 1980 to 2004) under observed forcings of sea-surface temperature, sea-ice, greenhouse gases, ozone-depleting substances, 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. In the simulation the NAM values (principal component) exhibit approximately even distribution with very small skewness, different from the negatively skewed one in observations. Thereby, the criterion for positive NAMs (vortex intensification) is set to +3.0 at 10 hPa and the one for negative NAMs (stratospheric sudden warming) is -3.0. In total, 36 positive NAMs and 30 negative NAMs are analyzed. The composites of both NAMs possess similarly 40-50 days persistent period in the lower stratosphere and troposphere, being close to the observed NAMs.