Long-term variations of circulation in East Asian summer during the past half century

Hirokazu ENDO
Meteorological Research Institute, JAPAN
Mio MATSUEDA
University of Oxford, UK.

Long-term variations of East Asian summer during the past half century (1958-2002) are investigated using the ECMWF (European Centre for Medium Range Weather Forecast) 40-year Reanalysis (ERA-40) and surface observational data. Differences between the latter period (1980-2002) and the former period (1958-1979) in 500hPa geopotential height show positive anomalies over eastern Siberia as well as over the tropics including the western Pacific, while they show relatively negative anomalies over mid-latitudes of East Asia to the Pacific. Associated with the changes, the Asia subtropical jet shifts southward in the latter period, and the Okhotsk high at the surface, which intermittently appears over the Sea of Okhotsk and brings northeasterly cold flow (called the Yamase in Japan) over northeastern Japan, becomes stronger in the latter period. It is also found that atmospheric blocking activity over eastern Siberia is enhanced in the latter period, based on a blocking index using 500hPa height. These large-scale circulation changes prevent some regions of East Asia from surface warming, though warming is commonly observed over the world.

In order to examine potential causes behind the observed trends, an AGCM (atmospheric general circulation model) simulation forced by observed historical sea surface temperature (SST), sea ice concentrations, and greenhouse gases is conducted for the same period, consisting of 3-member ensemble integration with different initial conditions. The model used in the simulation is the Meteorological Research Institute Atmospheric Circulation Model version 3.2 with horizontal resolution of 60km (MRI-AGCM3.2H), which is the lower resolution version of the 20-km mesh AGCM (Mizuta et al. 2012, JMSJ). The simulation reproduces the observed tripolar meridional wavy anomalies over East Asia, consisting of a subtropical ridge, a mid-latitude trough, and a high-latitude ridge in 500hPa height. The simulation also reproduces an observed positive trend in blocking occurrence over eastern Siberia. However, intensification of the Okhotsk high is not reproduced well. The results suggest that the observed trend of the East Asian summer in the past half century is strongly influenced by boundary conditions such as SST.

Corresponding Author:

Name: Hirokazu ENDO

Organization: Meteorological Research Institute of Japan Meteorological Agency

Address: 1-1 Nagamine, Tsukuba, Ibaraki, 305-0052, Japan

Email Address: hendo@mri-jma.go.jp