Geophysical Research Abstracts
Vol. 13, EGU2011-1830-1, 2011
EGU General Assembly 2011
© Author(s) 2011

Interaction between Monthly Mean Circulation and Synoptic-Eddy Intensity in the North-Atlantic Sector

Cheng Sun (1,3) and Jianping Li (2)

(1) State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China (scheng@lasg.iap.ac.cn), (3) Graduate University of Chinese Academy of Sciences, Beijing, China, (2) State Key Laboratory of Numerical Modeling for Atmospheric Sciences and Geophysical Fluid Dynamics, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China (ljp@lasg.iap.ac.cn)

In this study, using NCEP reanalysis data for winters (December–February) 1949–2008, the interaction between monthly mean circulation anomalies and synoptic-eddy intensity (EI) in the North-Atlantic sector is investigated. The singular value decomposition technique (SVD) is applied to correlate monthly mean 500 hPa geopotential height anomalies and monthly fields of root-mean-squares of daily high-pass filtered (2–8-day periods) 500 hPa geopotential height during the winter season over the region. The leading mode of the monthly mean circulation anomalies is the North Atlantic Oscillation (NAO) which is closely related to the principal mode of EI variability (EIM). Generally, positive NAO index months are associated with a northeastward extension of the EI with enhanced EI from the northeast of North-America into the northern Europe and a slight decrease to the south.

The dominating environmental variable controlling eddy intensification, the lower-tropospheric baroclinicity (LTB), is analyzed to investigate the mechanism of the interaction between the NAO and the EIM. The LTB in the North-Atlantic sector can be influenced by the atmospheric circulation anomalies. During strong positive (negative) NAO phases, caused by both zonal and meridional temperature advection, the anomalous pattern of lower-tropospheric temperature consists of a dipolar structure marked by a cold (warm) anomaly centered over Greenland and a warm (cold) anomaly to the south. Moreover, this pattern intensifies (weakens) the meridional temperature gradient and leads to stronger (weaker) LTB aligned with eddy tracks. The enhancement of the EI in positive NAO phases can be interpreted by the larger area with suitable growth conditions for synoptic-eddies.

The impact of the EIM on the NAO is also analyzed through the quasi-geostrophic vorticity equation. The geopotential height tendency induced by the eddy-vorticity fluxes is linked to the EIM in the North-Atlantic sector. During positive (negative) EIM phases, the eddy-forcing-induced tendency is characterized by the seesaw oscillatory pattern between low and high latitudes, which exhibits a negative (positive) tendency north of 55°N and a positive (negative) tendency to the south as well as an equivalent barotropic structure in different vertical levels. The strong positive eddy feedback may play an important role in maintaining the low-frequency atmospheric flow in the North-Atlantic sector.