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Synoptic Analysis of the Pacific-North American Teleconnection Pattern

Christian Franzke (1), Steven Feldstein (2), and Sukyoung Lee (2)

(1) British Antarctic Survey, Cambridge, United Kingdom (chan1@bas.ac.uk), (2) Department of Meteorology, The Pennsylvania State University, University Park, Pennsylvania

In this study, we investigate the synoptic characteristics of the Pacific-North American (PNA) teleconnection pattern by examining the daily evolution of the potential temperature field on the 2 potential-vorticity-unit (PVU) surface. National Center for Environment Prediction/National Center for Atmospheric Research reanalysis data is used. These data cover the years 1948 through 2008 for the months of November through March.

The observational analysis finds that development of the positive PNA phase is associated with an intense synoptic-scale disturbance along the east coast of Asia that propagates eastward and undergoes strong cyclonic wave breaking over the northeast Pacific. In contrast, negative PNA growth is observed to coincide with the suppression of upstream synoptic-scale eddy activity and with the absence of cyclonic wave breaking. These synoptic characteristics are interpreted as a response to changes in the background flow excited by tropical convection. For the positive PNA, the background flow is found to coincide with enhanced baroclinicity upstream of the PNA region and an increase in the cyclonic shear and a decrease in the meridional potential vorticity gradient in the northeast Pacific. These background flow features are consistent with both the intensified synoptic eddy activity and the strong wave breaking. The background flow associated with the negative PNA exhibits opposite characteristics, which is consistent with the weakened eddy activity and suppressed wave breaking associated with that phase.

The results of the analysis suggest that a sequence of cyclonically-breaking upstream disturbances contributes toward the maintenance of the positive PNA phase via a positive feedback. This contrasts with the negative PNA, which is found to exhibit weakened upstream eddy activity throughout its life cycle. The roles of topographic forcing along with optimal growth are also discussed.