SOME ASPECTS OF THE LARGE-SCALE CIRCULATION VARIABILITY OVER THE TROPICAL WESTERN NORTH PACIFIC

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ABSTRACT

The basic structure of the variability of the large-scale circulations over the tropical western Pacific is investigated with respect to its influence on tropical cyclone characteristics. A vector empirical orthogonal analysis and fuzzy cluster algorithm are applied to a nine-year data set to define six recurrent 700 mb circulation patterns that represent large-scale variabilities associated with the monsoon trough and subtropical ridge. Five of the cluster patterns, which contain 48% of the sample, define combinations of active/inactive monsoon trough and strong/weak subtropical ridge circulations. The sixth cluster, which contains 26% of the data sample, depicts small deviations from the long-term climatology. After the cluster centers are defined, the fuzzy cluster coefficients are used to identify a seventh cluster, which contains the remaining 26% of the circulation patterns, that could not be classified within any of the original six clusters. The 700 mb circulation patterns are shown to be physically consistent with outgoing longwave radiation anomalies and the 200 mb streamfunction and velocity potential anomalies. Active and inactive monsoon trough patterns are related to large-scale velocity potential anomalies over the tropical western Pacific and Indian Ocean basins. Anomalous cyclonic circulations are found to be regions of anomalous convergence at 700 mb, divergence at 200 mb, and enhanced large-scale convection. Anticyclonic anomalies are regions of anomalous 700 mb divergence, 200 mb convergence, and reduced large-scale convection. Variability of the subtropical ridge is associated with large-scale 200 mb streamfunction anomalies that are related to variations in the midlatitude longwave pattern.

Tropical cyclone activity is found to be significantly related to the variability of the monsoon trough described within the cluster framework. Active (inactive) periods are found to occur when the large-scale circulation anomalies are contained within clusters that represent an active (inactive) monsoon trough. However, grouping of clusters based exclusively on the variability of the monsoon trough does not adequately account for the variability in tropical cyclone track types. Comparisons between observed tropical cyclone track characteristics and the cluster definition at the time the tropical cyclone reaches tropical storm strength identify a statistically significant relationship between track type (straight- moving versus recurving) and the individual five cluster patterns that describe the variability of the monsoon trough and subtropical ridge. No relationships are found between tropical cyclone characteristics and the cluster that represents small deviations from the climatological mean or the cluster that is defined to contain circulation patterns not classified in any of the original six clusters. It is concluded that the cluster patterns define the basic structure of large-scale circulation variability over the tropical western Pacific and that these structures are related to tropical cyclone characteristics.