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Two Major Modes of the Wintertime Precipitation over Northwest China and the Associated Atmospheric Circulation

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The leading modes of wintertime rainfall over Northwest China and its association with atmospheric circulation anomalies were investigated by using the observed precipitation data and the NCEP/NCAR reanalysis data for the period 1961-2013 through empirical orthogonal function (EOF) method, composite analysis and the linear regression method. The analysis results indicate that the first two leading modes of wintertime precipitation account for 25.0% and 15.8% of the total variance, respectively. The first one shows uniform sign in the entire domain and its associated time series (PC1) has significant interannual and interdecadal variations. The interdecadal variations indicate that the wintertime precipitation over Northwest China was below normal before the late-1980s and reversed afterward with a clear increasing trend in recent years. The second leading mode exhibits a zonal dipole pattern distribution with an obvious interdecadal variability occurred in the late-1990s. Further analysis suggests that EOF1 is closely related to the EU teleconnection-like wave-train. The correlation coefficient between PC1 and EU index is -0.54. When EU is in its negative phase, the blocking high over the Ural Mountains is very weak and it would cause a reduced East Asia winter monsoon. In that case, the anomalous southwest water vapor transports from Arabian Sea and Red Sea and anomalous southerlies moisture transfer from South China Sea enhanced and convergence in Northwest China, along with the profound ascending motion, there is positive wintertime precipitation anomaly in the whole area. For the second mode, it is closely connected to the AO-like pattern. When AO is in its weak phase, there is a cyclonic circulation over Mongolia and an enhanced westerly jet over Eurasia which leading to intensive water vapor transportation from the Arctic Ocean and the Atlantic Ocean respectively. Then the moisture converges in the west part, with the addition of ascending motion, it results in an increasing rainfall there, which was opposite to the east.