Predictability of the specific monthly-mean large-scale atmospheric anomalies over the North Pacific

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The North Pacific shows the specific monthly-mean large-scale atmospheric anomalies, even after removing the components of the northern annular mode (NAM) and the El Niño/Southern Oscillation (ENSO). This work examines the spatial structures, precursors, and development of the residual anomalies using global objective reanalysis data. The rotated empirical orthogonal function (REOF) analysis extracts the prevailing anomalies in upper tropospheric geopotential height in the northern hemisphere (NH). The first REOF mode (REOF1) is featured by a monopole in the North Pacific, while a dipole characterizes the second REOF mode (REOF2), both of which have large month to month variability. The equivalent barotropic structure characterizes the two modes, and the stationary Rossby waves form the anomalous circulations downstream. The blocking and the transient eddy (TE) are effective to maintain the two modes over the North Pacific. The precursors for REOF1 and REOF2 are detected in one month earlier; that is, there appear systematic zonal bands over Eurasia and North America in the anomaly fields of surface temperature and baroclinic instability in the lower troposphere. The later extends into the central North Pacific at different latitudes with the convergence of thermal fluxes. The anomalous zonal bands are also identified in the anomaly field of upper tropospheric geopotential height. Such systematic organization of anomalous zonal bands over the two continents reflects the ovalization of polar vortex in the upper troposphere and of polar high in the lower troposphere with the continent-ward shift of longer axis. The latitudinal difference determines which of REOF1 and REOF2 develops in the following month with the zonally guided activation of TEs over the North Pacific. The anomalies of the two REOF modes disappear by the further following month with the change of surface temperature over the two continents, while the anomalies of sea surface temperature retain in the North Pacific.

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