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Comparison between Developing and Nondeveloping Disturbances for Tropical Cyclogenesis in Different Large-Scale Flow Patterns over the Western North Pacific

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This study classifies 407 developing disturbances (DEV) and 2309 nondeveloping disturbances (NONDEV) over the western North Pacific into five large-scale circulation patterns, namely the pre-existing cyclone (PC), easterly wave (EW), zonal wind convergence (CON), zonal wind shear line (SL), and mixed zonal wind convergence and shear line (CON-SL) patterns. The SL pattern has the highest TC yield percentage, followed by the CON-SL, while the EW is the least favorable pattern. The composite analysis shows that upper-level divergence, midlevel relative humidity, and surface heat flux (SHF) growth are crucial to the disturbance development in all the five patterns. Besides, large lower-level barotropic kinetic energy conversion and a well-developed primary circulation are good indicators for disturbance development in the PC, EW, and CON rather than in the SL and CON-SL patterns. Furthermore, for the PC, EW and CON patterns, the DEV features strong and rapidly growing SHF and mesoscale convective systems (MCS) closer to the disturbance center, which allows deep-layer warming and moistening, and drives a deep secondary circulation. Interestingly, due to an environment with high lower-level vorticity, the SL and CON-SL patterns typically foster a relatively mature primary circulation with strong SHF and MCS concentrated close to the center, especially for the NONDEV at the pre-genesis stage. However, a drier mid-to-upper-level environment for the NONDEV inhibits deep convection and causes insufficient upper-level suction, which may explain its shallow secondary circulation and therefore poor potential to develop further.