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Analysis of Mechanism of Tibetan Plateau Vortex Frequency Differences between Strong and Weak MJO Periods

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There are many unique weather systems over the Tibetan Plateau (TP). Among them, the TP vortex (TPV for short) is representative of the low air pressure weather systems. The generation, development and eastward propagation of the TPV is usually accompanied by precipitation, strong winds, thunderstorms and other weather processes, resulting in a series of extreme weather events over the TP and the Sichuan-Chongqing basin where is the downstream of the plateau. Some TPVs, which move from the plateau to the east and develop strongly, even affect a wide range of China's eastern region. NCEP/DOE reanalysis data, OLR data from NOAA, the Australian Meteorological Bureau Real-time Multivariate MJO index, and Tibetan Plateau vortex (TPV) statistical data from the Institute of Plateau Meteorology, are used to discuss the modulation of the TPV by the MJO. Wavelet analysis and composite analysis are the methods used. The results show that: (1) The MJO plays an important role in modulating the TPV, for the number of TPVs generated in strong MJO periods is three times more than in weak periods. (2) During strong (weak) MJO periods, the Tibetan Plateau is in control of a low-frequency, low-pressure cyclone (high-pressure anticyclone) system, and thus the atmospheric circulation conditions over the plateau are conducive (not conducive) to the generation of TPVs. (3) During strong (weak) MJO periods, southerly (northerly) winds prevail in the east of the plateau, but northerly (southerly) winds in the west. Over the northern part of the plateau, easterly (westerly) flow is predominant, while westerly (easterly) flow prevails over the south, thus conducive (not conducive) to the formation of cyclonic circulation (i.e. TPVs) at low altitude over the plateau. (4) In strong MJO periods, water vapor is relatively less abundant over most of the plateau, which is not conducive to the generation of TPVs; however, moisture transported by the south branch trough and the low-frequency, high-pressure anticyclone system from the Bay of Bengal, are very important for the development of TPVs. As the strength of the MJO changes continuously during its eastward propagation, the intensity of tropical convection and vertical circulation structures of the tropical atmosphere also change accordingly. Alternation between favorable and unfavorable conditions for the generation of TPVs occurs, thus resulting in significant frequency differences of TPVs between strong and weak MJO periods.

Key words: Tibetan Plateau vortex, MJO, modulation, real-time multivariate MJO index, composite analysis.