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Interdecadal Variation of the MJO Propagation During the Boreal Winter in the Context of Global Climate Change

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Characteristics of interdecadal variation of the Madden-Julian Oscillation (MJO) during the boreal winter in the context of global climate change are investigated by using the real-time multivariate MJO (RMM) index, the National Oceanic and Atmospheric Administration (NOAA) daily outgoing longwave radiation data and the National Centers for Environmental Prediction/ Nation Center for Atmospheric Research (NCEP/NCAR) reanalysis data, etc. It is found that from the rapid warming period (1985–1997) to the warming hiatus period (2000–2012), the frequencies of MJO in 2–4 phases decreased, while those in 5–7 phases increased obviously. This indicates that the MJO convection stays shorter over the tropical Indian Ocean (IO) but stays longer over the tropical western Pacific during the latter episode. Namely, the propagation of MJO slows down over the tropical IO but speeds up over the tropical western Pacific. Further analyses suggest that the interdecadal variation of MJO propagation is closely related to interdecadal fluctuation of global climate change. In negative phases of Pacific Decadal Oscillation (PDO), global warming slows down, and the tropical eastern IO–western Pacific is abnormally warmer than normal, which favors the enhancement of convection and associated ascending motion. Thus, the atmospheric circulation at low-level converges, and moisture and the moist static energy (MSE) increase over the Maritime Continent. When the MJO convective center is located over the tropical IO, there are a positive center of mean MSE transport by anomalous MJO circulation to the east of the MJO convective center and a negative one to the west, favorable for the positive MSE tendency to the east and thus speeding up the propagation of MJO over the tropical IO. However, when the MJO convective center is located over the tropical western Pacific, the mean MSE transport by anomalous MJO circulation leads to a negative MSE tendency to the east of the MJO convective center, and the propagation of MJO slows down. Therefore, the interdecadal variation of MJO propagation is significantly modulated by the PDO in the context of global climate change through the interdecadal changes of atmospheric moisture content and MSE.