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Future change in the quasi-biennial oscillation influence on the northern polar vortex simulated with an MRI chemistry

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The impact of climate change on the dynamics of the Holton-Tan (HT) relationship between the quasi-biennial oscillation (QBO) and the polar vortex is examined using a set of transient simulations from the Meteorological Research Institute chemistry climate model (MRI-CCM), focusing on the Northern Hemisphere extended winter (November-March). The set is an ensemble of three simulations extending from 1960 to 2100 under the REF2 scenario (i.e., reference simulations making future predictions) using model prescribed SSTs. The MRI-CCM, which includes the interaction between QBO dynamics and the ozone (i.e., heating) distribution, reproduces the QBO and the extratropical circulation. The climate change has resulted in the colder stratosphere with the decreases temperature of 6 K and a strengthening of the westerlies at high latitudes which peaks at ˜ 4 m s?1. In the ensemble averages, there is considerable multidecadal variability in the composite difference of zonal wind, a striking feature is found that the centers of positive anomalies tend to be higher as the time proceeds. This result indicates that the sensitive regions of the extratropical circulation influenced by the equatorial QBO in the future climate would be different from and higher than that of the past climate. The nature of these trends suggests that climate change is responsible. Further research is required to answer the questions as to and how a multi-decadal oscillation might modulate the QBO influence on the extratropical circulation.

Keywords: QBO, Polar vortex, Stratosphere, Holton-Tan, Future climate