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DEPENDENCE OF PROJECTED FUTURE CHANGES IN THE ARCTIC OSCILLATION ON THE STRATOSPHERIC WAVE ACTIVITY AMONG HIGH-TOP CMIP5 MODELS

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Abstract

The Arctic Oscillation (AO) is a zonally symmetric mode of mass exchange (also, zonal-mean zonal winds) between the mid- and high-latitude in the Northern Hemisphere with a vertically equivalent barotropic structure. The AO owes its existence to the wave-mean flow interaction in the mid-latitude westerly zone. One way of the wave-mean flow interaction is that the breaking or absorption of planetary waves (i.e., the convergence of EP fluxes) locally changes the speed of zonal-mean zonal winds, which should influence the AO phase. In the present study, projected future AO changes are evaluated among historical and RCP runs of the 5th phase Coupled Model Intercomparison Project (CMIP5) models, in the context of the wave-mean flow interaction in the troposphere and stratosphere. The CMIP5 models can be broadly grouped into two: one with lid height above 1 hPa ("high-top model") and the other with lid height below 1 hPa ("low-top model"). In the high-top model group, the projected future change of seasonal intensity of stratospheric wave absorption/breaking (measured by the EP flux divergence) is a systematic indicator for the AO change, because the two parameters are linearly related with each other among the models. In contrast, the linear relationship is not found in the low-top model group. The results may imply that the more realistically resolved stratospheric processes in the high-top model group enhance the structural dependence of the AO changes on the stratospheric changes, which may, in turn, imply the increased role of stratosphere-troposphere coupling on the AO changes in the high-top models.