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Role of synoptic eddy feedback on climate change in the Northern Hemisphere under global warming

Da-Hee Choi (1), Jong-Seong Kug (2), Fei [U+2010] Fei Jin (3), Won [U+2010] Tae Kwon (1), Hee-Jeong Baek (1), and ChunHo Cho (1)

(1) National Institute of Meteorological Research, KMA, Seoul,Republic Of Korea (dhchoi99@korea.kr), (2) Korea Ocean Research Development and Institute, Ansan, Republic Of Korea , (3) Department of Meteorology, SOEST, University of Hawaii at Manoa, Honolulu, USA

The purpose of this study is to investigate the role of synoptic eddy feedback on changes in the northern hemisphere climate in response to global warming. Using a time-slice technique, we have produced 30-year enhanced resolution (∼100 km) data based on the 20C3M (1971-2000) and A1B (2071-2100) scenario for present and future climate conditions, respectively. Firstly, this study investigates possible changes in the leading mode over the Northern Hemisphere, representing the Arctic Oscillation (AO), in response to the projected increases in greenhouse gas concentrations. It is demonstrated that the dipole pattern associated with the AO distinctively shifts poleward in the future climate. The poleward shift is more pronounced over the Pacific region than over the Atlantic region. This change in the AO pattern is consistent with the change in the synoptic eddy feedback, estimated from the convergence of the eddy [U+2010] vorticity flux, indicating a close linkage between the AO change and the change in the synoptic eddy feedback. Further analysis of changes in eddy feedback strength suggests a possible hypothesis that the poleward shift of the jet stream and storm tracks can make synoptic eddy feedback more effective over the higher latitudes, which in turn enhances the poleward shift of the AO mode. Secondly, we find that a poleward shift of the westerly jet stream and associated synoptic eddy feedback play a critical role in enhancing polar warming and moistening. Namely, the mean circulation changes due to global warming lead to the changes in synoptic eddy feedbacks, which reinforce again climate responses, particularly the polar responses such as the enhanced polar warming and moistening. It is demonstrated here that the synoptic eddy feedback can be explained by a simple rule based on the mean circulation change. This rule can be used for understanding other regional climate responses to global warming.