# Two distinct influences of Arctic warming on cold winters over North America and East Asia

Jong-Seong Kug[1], Jee-Hoon Jeong[2*], Yeon-Soo Jang[1], Baek-Min Kim[3], Chris K. Folland[4,5], Seung-Ki Min[1], Seok-Woo Son[6]

[1]School of Environmental Science and Engineering, Pohang University of Science and Technology (POSTECH), Pohang, Korea
[2]Department of Oceanography, Chonnam National University, Gwangju, Korea
[3]Korea Polar Research Institute, Incheon, Korea
[4]Met Office Hadley Centre, UK
[5]Department of Earth Sciences, Gothenburg University, Gothenburg, Sweden
[6]School of Earth and Environmental Sciences, Seoul National University, Seoul, Korea

Arctic warming has sparked a growing interest because of its possible impacts on mid-latitude climate. A number of unusually harsh cold winters have occurred in many parts of East Asia and North America in the past few years, and observational and modelling studies have suggested that atmospheric variability linked to Arctic warming might have played a central role. Here we identify two distinct influences of Arctic warming which may lead to cold winters over East Asia or North America, based on observational analyses and extensive climate model results. We find that severe winters across East Asia are associated with anomalous warmth in the Barents-Kara Sea region, whereas severe winters over North America are related to anomalous warmth in the East Siberian-Chukchi Sea region. Each regional warming over the Arctic Ocean is accompanied by the local development of an anomalous anticyclone and the downstream development of a mid-latitude trough. The resulting northerly flow of cold air provides favorable conditions for severe winters in East Asia or North America. These links between Arctic and mid-latitude weather are also robustly found in idealized climate model experiments and CMIP5 multi-model simulations. We suggest that our results may help improve seasonal prediction of winter weather and extreme events in these regions.

Key words: Arctic warming, Cold winters