Siberian cooling trends and the linkage to Arctic sea ice loss

T. Koenigk[1,2], Y. Gao[3,4,5], G. Gastineau[6], R. Fuentes Franco[1], N. Keenlyside[7,4], T. Nakamura[8], F. Ogawa[7,4], L. Suo[3], T. Tian[9], T. Wang[5], S. Yang[9]

[1] *Swedish Meteorological and Hydrological Institute, Norrköping, Sweden*
[2] *Bolin Centre for Climate Research, Stockholm University, Stockholm, Sweden*
[3] *Nansen Environmental and Remote Sensing Center, Bergen, Norway*
[4] *Bjerknes Centre for Climate Research, Bergen, Norway*
[5] *Nansen-Zhu International Research Center, Inst of Atmosph Physics, Chinese Academy of Science, China*
[6] *Sorbonne Universités, UPMC/CNRS/IRD/MNHN, LOCEAN/IPSL, Paris, France*
[7] *Geophysical Institute, University of Bergen, Bergen, Norway*
[8] *Faculty of Environmental Earth Science, Hokkaido University, Sapporo, Japan*
[9] *Danish Meteorological Institute, Copenhagen, Denmark*

The winter Siberian cooling trend and its potential linkage to Arctic sea ice loss is controversially discussed. Here, we analyze ERA-Interim data until 2017 and ERA20C reanalysis to investigate the robustness of the winter surface air temperature trends to updated and extended time periods. Our results show that winter temperatures in Siberia were above normal after 2013 leading to strongly reduced cooling trends. The trend before 2014 was dominated by four cold winters between 2010 and 2013. Shifts from negative to positive phases of both North Atlantic Oscillation and Pacific Decadal Oscillation in 2014 caused the return to warmer Siberian temperatures. The North Atlantic Oscillation shows no trend between 1980 and 2017 but continuously low Arctic sea ice in recent years and a slightly negative trend in the Pacific Decadal Oscillation since 1980 contribute to the remaining observed cold trends over parts of Eurasia between 1980 and 2017.

We further investigated the impact of Arctic sea ice on lower latitudes through coordinated experiments with six atmospheric general circulation models forced by observed and climatological daily sea ice concentration and sea surface temperature. The results show that the impact of the recent sea ice decline is rather limited to the high-latitude lower troposphere. The Arctic amplification is strongly coupled with sea ice loss over the Arctic lower troposphere throughout winter, while the warming aloft is mostly associated with remote SST changes. Sea ice changes do not significantly lead to colder winters over Eurasia. The observed temperature trends and corresponding circulation trends are reproduced in a small number of ensemble members but not by the multi-model ensemble mean, suggesting that atmospheric internal dynamics could have played a major role in the observed trends..

Key words: Siberian cooling, Arctic sea ice loss, North Atlantic Oscillation, Pacific Decadal Oscillation, global climate modelling