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An Internal Atmospheric Process Determining Summertime Arctic Sea Ice Melting in the Next Three Decades: Lessons Learnt from 5 Large Ensembles and CMIP5 Simulations

Daniel Topal[1,2,3], Qinghua Ding[3], Jonathan Mitchell[4,5], Ian Baxter[3], Mátyás Herein[6,7], Tímea Haszpra[6,7], Rui Luo[3], and Qingquan Li[8]

[1]Eötvös Loránd University, Institute of Geography and Earth Sciences, Department of Meteorology, Hungary (topaldani@gmail.com)
[2]Institute for Geological and Geochemical Research, Research Centre for Astronomy and Earth Sciences, Budapest, Hungary
[3]Department of Geography, Earth Research Institute, University of California, Santa Barbara, Santa Barbara, California, USA
[4]Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles, California, USA
[5]Department of Earth, Planetary and Space Sciences, University of California, Los Angeles, California, USA
[6]Institute of Theoretical Physics, Eötvös Loránd University, Budapest, Hungary
[7]MTA–ELTE Theoretical Physics Research Group, Eötvös Loránd University, Budapest, Hungary
[8]Laboratory for Climate Studies, National Climate Center, China Meteorological Administration, Beijing, China

Arctic sea ice melting processes in summer due to internal atmospheric variability have recently received considerable attention. A regional barotropic atmospheric process over Greenland and the Arctic Ocean in summer (June-July-August), featuring either a year-to-year change or a low-frequency trend toward geopotential height rise, has been identified as an essential contributor to September sea ice loss, in both observations and the CESM1 Large Ensemble (CESM-LE) of simulations [1-2]. This local melting is further found to be sensitive to remote sea surface temperature (SST) variability in the East Central Pacific [3]. Here, we utilize five available single-model large ensembles and 31 CMIP5 models' pre-industrial control simulations to show that the same atmospheric process, resembling the observed one and the one found in the CESM-LE, also dominates internal sea ice variability on interannual to interdecadal time scales in pre-industrial, historical and future scenarios, regardless of the modeling environment. However, all models exhibit limitations in replicating the correct magnitude of the observed local atmosphere-sea ice coupling and its sensitivity to remote tropical SST variability. These biases cast a shadow over models' credibility in simulating interactions of sea ice variability with the Arctic and global climate systems. Further efforts toward identifying possible causes of these model limitations may provide profound implications for alleviating the biases and improving interannual and decadal time scale sea ice prediction and future sea ice projection.

[1] Ding, Q., and Coauthors, (2017): Influence of high-latitude atmospheric circulation changes on summertime Arctic sea ice. Nat. Climate Change, **7**, 289-295.

[2] Ding, Q., and Coauthors, (2019): Fingerprints of internal drivers of Arctic sea ice loss in observations and model simulations. Nat. Geosci., **12**, 28–33.

[3] Baxter, I., and Coauthors, (2019): How tropical Pacific surface cooling contributed to accelerated sea ice melt from 2007 to 2012 as ice is thinned by anthropogenic forcing. J. Climate, **32**, 8583–8602 https://doi.org/10.1175/JCLI-D-18-0783.1