Projected winter Arctic sea-ice decline coupled to Eurasian circulation

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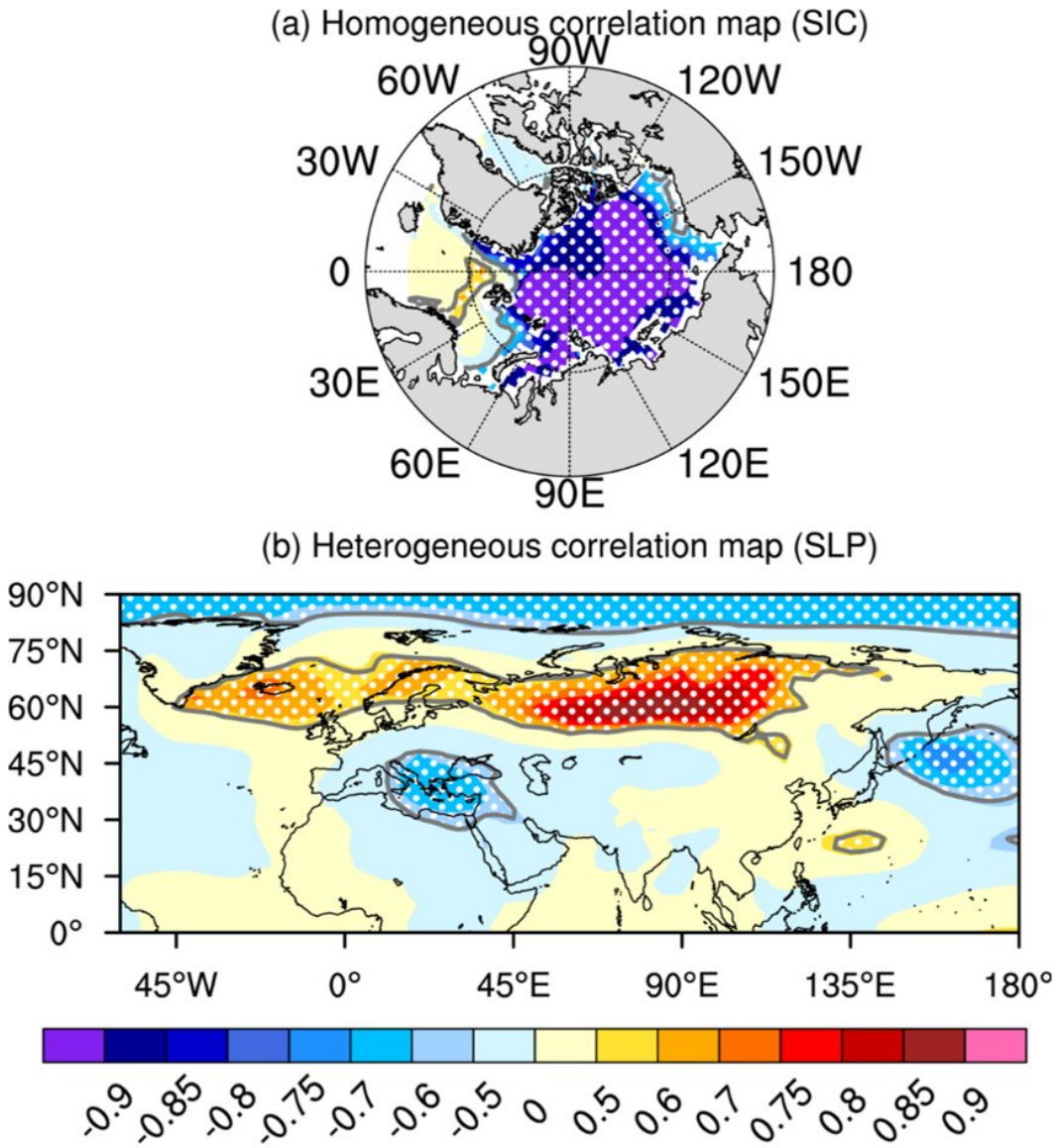

Coupling between uncertainties in the global warming response: Arctic sea-ice

concentrations (top) and mean sea level pressure over Eurasia (bottom), explaining 70.5 percent of intermodel covariability. Credit: Hoffman Cheung

Arctic sea-ice cover will diminish rapidly under global warming, but its rate of retreat in boreal winter shows large intermodel differences across the models involved in Phase 5 of the Coupled Model Intercomparison Project (CMIP5). When a model simulates a larger sea-ice decline, how does the circulation outside the Arctic change?

A new study conducted by Prof. Noel Keenlyside of the University of Bergen and colleagues sought to address this question by first applying singular value decomposition (SVD) to the projection of winter Arctic sea ice and mean sea level pressure (SLP) over Eurasia [2069-98 in the RCP8.5 run (the most severe future global warming scenario) minus 1971-2000 in the historical run] across 11 CMIP5 models. Importantly, the power of using SVD analysis here is in quantifying the largest covariability between the model uncertainties of these projections, and to depict their spatial patterns. This is better than using the relatively simpler methods of composite or correlation analysis, which first require an index (say, sea-ice change in the Arctic) to be defined.

The dominant SVD mode has an explained variance of 70.5 percent, and it corresponds to a larger pan-Arctic sea-ice decline. Normally, intense cold air masses sink in the Arctic and move toward the equator near the surface. This drives the polar cell that exchanges air masses with the mid-latitudes. When a model simulates a larger pan-Arctic sea-ice decline, the Arctic becomes warmer and less cold air sinks in the polar region. The associated polar cell is weaker, and its equatorward side has anomalous sinking motion. In Eurasia, the mean SLP response shows an increase in the Urals-Siberia region and near Iceland, while it decreases in the Mediterranean. The anomalous SLP responses over the Euro-

Atlantic region project onto the negative North Atlantic Oscillation-like pattern, which is the dominant mode of large-scale circulation in the Euro-Atlantic region. Therefore, a more accurate winter Arctic sea-ice projection could be useful for constraining projections of winter Eurasian climate.

More information: Hoffman H. N. Cheung et al, Remarkable link between projected uncertainties of Arctic sea-ice decline and winter Eurasian climate, *Advances in Atmospheric Sciences* (2017). DOI: 10.1007/s00376-017-7156-5

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