

Predictability of the mid-latitude extreme weather changes in response to Arctic sea ice loss

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Abstract

Arctic sea-ice loss has been linked to subsequent changes in the Northern Hemisphere atmospheric circulation and severe cold winters over the mid-latitude continents, which could have major socioeconomic impacts; however, in spite of recent progress in understanding these links, it remains a challenge to draw firm conclusions about the remote impact of reduced Arctic sea-ice because of diverse results from different studies. Identifying causes of discrepancies between studies is complicated by differences in methodology employed, hindering direct comparison of conflicting results. Here we investigate the significance and robustness of the link between Arctic sea-ice loss and changes in mid-latitude weather patterns by simulating the atmospheric response to ten different sea ice scenarios with systematically decreasing sea-ice coverage in the Arctic. Using a large ensemble of 550 simulations, we show that prescribed Arctic sea-ice anomalies produce statistically significant mid-latitude circulation anomalies more often than would be expected by chance, but the circulation anomalies do not scale linearly with the sea-ice anomalies, and are not present in all scenarios. Reduced Arctic sea ice may favor a negative Arctic Oscillation-like circulation pattern and increase the risk of cold outbreaks in eastern Asia by almost 50 %, but this response is found in only half of the scenarios with negative sea-ice anomalies. Our finding of frequent significant anomalies without a robust linear response suggests interactions between variability and persistence in the coupled system, which may contribute to the lack of convergence among studies of Arctic influences on mid-latitude circulation.