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Natural and human contribution to recent Arctic sea-ice melting patterns

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Arctic sea-ice has declined sharply during recent three decades with seasonally and regionally different melting patterns. Identifying causes of the spatial patterns of Arctic sea-ice loss is critical to better understanding of global and regional impacts of Arctic cryosphere, but it remains uncertain. This study conducts a quantitative analysis of recent sea-ice melting by comparing observed and model-simulated trend patterns using an optimal fingerprinting technique. Satellite observations show overall decreasing trends across all seasons with stronger melting occurring over Kara-Laptev Seas, E. Siberia-Chukchi Seas, and Barents Seas during warm seasons. The CMIP5 multi-model simulations including greenhouse-gas forcings can largely capture the observed trend patterns, enabling detection of human influence, but with weaker amplitude. As natural factors of observed sea-ice melting, the Arctic Oscillation (AO) and Atlantic Multidecadal Oscillation (AMO) are further considered. AMO exhibits a significant impact on regional variation of sea-ice melting patterns while AO impact is found very weak. Good agreement can be obtained between observed and model-simulated trend patterns when taking account of the AMO influence on observations. This result suggests contribution of both human and natural factors to the recent abrupt reduction in Arctic sea ice.