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Greenhouse-gas contribution to Arctic sea-ice loss

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Arctic sea-ice area (ASIA) has been declining rapidly throughout the year during recent decades, but a formal quantification of greenhouse gas (GHG) contribution remains limited. This study conducts an attribution analysis of the observed ASIA changes from 1979 to 2017 by comparing three satellite observations with the Coupled Model Intercomparison Project Phase 6 (CMIP6) multi-model simulations using an optimal fingerprint method. The observed ASIA exhibits overall decreasing trends across all months with stronger trends in warm seasons. CMIP6 anthropogenic plus natural forcing (ALL) simulations and GHG-only forcing simulations successfully capture the observed temporal trend patterns. Results from detection analysis show that ALL signals are detected robustly for all calendar months for three observations. It is found that GHG signals are detectable in the observed ASIA decrease throughout the year, explaining most of the ASIA reduction, with a much weaker contribution by other external forcings. We additionally find that the Arctic Ocean will occur ice-free in September around the 2040s regardless of the emission scenario.