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Arctic summer sea-ice loss will accelerate in coming decades

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Every year, the area of the Arctic sea-ice decreases in the boreal spring and summer and reaches its yearly minimum in the early autumn. The continuous satellite-based time series shows that the September area has decreased from 4.5 x 10^6 km^2 in 1979, to 2.8 x 10^6 km^2 in 2020. The decline has been approximately linear in global mean surface temperature, with a rate of loss of 2.7 x 10^6 km^2 per degree C of global warming.

In the CMIP6 ensemble, however, we find that the majority of the models that reach an Arctic sea-ice free state in the SSP585 runs show an accelerated loss of sea-ice for the last degree of warming compared to the second last degree of warming, which implies an increased sensitivity of the sea-ice to temperature changes.

Both in the observational and CMIP6 data, we find that the decline in September sea-ice area is approximately proportional to the area north of which the zonal average temperature in spring and summer is lower than a critical threshold T_c. The Arctic amplification implies that the zonally averaged temperatures increase relative to the global temperatures, and with rates increasing with latitude. Linear extrapolation of the zonally averaged temperatures predicts that, with further warming, the September sea-ice area will depend non-linearly on global temperature, the sensitivity will increase and the September sea-ice area may become less that 1 x 10^6 km^2 for global warming between 0.5 and 1.4^{o}C above the current temperature.

As a result of accelerated sea-ice loss, the average evolution of the sea-ice area among the CMIP6 models before the complete loss of the summer sea-ice shows an increase in the year-to-year fluctuations in minimum ice cover in the next decade. This implies exceptional accumulation of extreme events with very low or no sea-ice at all even before the final loss of the sea-ice. Likewise, an apparent short-term recovery of the sea-ice loss might be observable due to the increasing fluctuations.