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Radiative impacts of future Arctic sea ice melt

The dramatic retreat in Arctic sea ice in recent decades has reduced the top-of-atmosphere albedo over this region and added more solar energy to the climate system. Here we use two satellite datasets--17 years of CERES top-of-atmosphere albedo and 38 years of microwave sea ice concentration measurements-- to estimate the radiative impact of the loss of Arctic sea ice. We then use these observations to estimate the potential impact of a future complete loss of the Arctic sea ice. This presentation will also discuss the seasonal variation in the estimated warming, the dependence of the results on the potential cloud response to ice loss, and a comparison with CMIP5 model results.

Using the close relationship between observed sea ice and albedo, we estimate that the observed decline in sea ice (1979-2016) has resulted in 0.21 W/m2 of globally-averaged warming over this period. Approximately half (0.11 W/m2) of this already-realized heating occurred during the CERES observational record (2000–2016), with the other half occurring beforehand (1979-1999). Assuming cloud conditions remain constant, we estimate that an additional global radiative heating of 0.5 W/m2 would occur if the Arctic sea ice were to completely disappear. This total 0.71 W/m2 is equivalent to the effect of one trillion tons of CO2 emissions, thus having substantial implications for global climate change adaptation timelines.