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OCEAN HEAT FLUXES AND RAPID DECLINES IN ARCTIC SEA ICE EXTENT

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Abstract :

Many climate models, including the Community Earth System Model Large Ensemble (CESM-LE), predict future rapid sea ice declines in the Arctic linked with anomalies in northward Ocean Heat Transport (OHT). Using CESM-LE, we find that the partitioning of the poleward OHT between the different Arctic gates (Barents Sea Opening, BSO; Bering Strait; and Fram Strait) is key to this link with the rapid declines. Sixty-four of the 79 rapid declines in CESM-LE are correlated with the OHT anomalies through one of the gates. Rapid declines that happen earlier in the simulations when the sea ice covers the continental shelves are correlated with OHT anomalies. The interaction between OHT and sea ice happens mainly over continental shelves since most rapid declines are correlated with the BSO or Bering Strait OHTs and only a few with the Fram Strait OHT (often also correlated with BSO or Bering Strait OHTs). In most rapid declines not correlated with OHT, the September Sea Ice Extent (SIE) prior to the decline is smaller than the area covered by the deep basins. Those are associated with surface heat flux since the ice-atmosphere heat fluxes are more strongly correlated with the sea ice concentrations over the deep basins than the ice-ocean heat fluxes. Our results suggest that OHTs are causing rapid sea ice declines when the SIE is large enough to cover the continental shelves and that the atmosphere is the main driver when the initial SIE is located only over the deep basins.

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