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TITLE: Climatic Responses to Future Trans?Arctic Shipping

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ABSTRACT:

Abstract As global temperatures increase, sea ice loss will increasingly enable commercial shipping traffic to cross the Arctic Ocean, where the ships' gas and particulate emissions may have strong regional effects. Here we investigate impacts of shipping emissions on Arctic climate using a fully coupled Earth system model (CESM 1.2.2) and a suite of newly developed projections of 21st?century trans?Arctic shipping emissions. We find that trans?Arctic shipping will reduce Arctic warming by nearly 1 °C by 2099, due to sulfate?driven liquid water cloud formation. Cloud fraction and liquid water path exhibit significant positive trends, cooling the lower atmosphere and surface. Positive feedbacks from sea ice growth?induced albedo increases and decreased downwelling longwave radiation due to reduced water vapor content amplify the cooling relative to the shipping?free Arctic. Our findings thus point to the complexity in Arctic climate responses to increased shipping traffic, justifying further study and policy considerations as trade routes open.

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