

## **Tropical origins of a link between Arctic sea ice and the winter NAO on seasonal to interannual timescales.**

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Accurate seasonal climate prediction is important for adaptation and societal resilience to climate variability. To a large degree, European winter weather is controlled by variability in the North Atlantic Oscillation (NAO). Recent skillful dynamical and empirical forecasts of the NAO months in advance suggest there is predictability within the climate system. Tropical teleconnections to NAO are fairly well documented and recently, there has been increased attention on a possible link between Arctic sea ice and the NAO. We propose, through a statistical framework, that significant covariability between September rainfall and October Barents-Kara sea ice could account for the observed correlation between autumn sea ice and the winter NAO. We support this hypothesis using physical arguments to show that planetary waves emanating from the tropics which propagate polewards not only affect sea ice in autumn, but also the NAO through winter. Our results suggest that the observed correlation between autumn Arctic sea ice and the winter NAO is not indicative of a causal relationship and is largely symptomatic of tropical rainfall variability influencing both sea ice and the NAO. Finally, we further interrogate this mechanism through ensemble sub-sampling of both atmosphere only and coupled models, to investigate whether this understanding can be exploited to enable better predictability of the NAO.