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On the Observed Relationships between Variability in Gulf Stream Sea Surface Temperatures and the Atmospheric Circulation in the North Atlantic

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The advent of increasingly high-resolution satellite observations and numerical models has led to a series of advances in our understanding of the role of midlatitude sea surface temperature (SST) in climate variability, especially near western boundary currents (WBC). Observational analyses have suggested that ocean dynamics play a central role in driving interannual SST variability over the Kuroshio-Oyashio and Gulf Stream extensions. Numerical experiments have suggested that variations in the SST field within these WBC regions may have a much more pronounced influence on the atmospheric circulation than previously thought.

In this study, the authors examine the observational support for (or against) a robust atmospheric response to midlatitude SST variability in the Gulf Stream extension. To do so, lead/lag analysis based on daily-mean data is applied to assess the evidence for two-way coupling between SST anomalies and the atmospheric circulation on transient timescales, building off of previous studies that have utilized weekly data. A novel decomposition approach is employed to demonstrate that atmospheric circulation anomalies over the Gulf Stream extension can be separated into two distinct patterns of midlatitude atmosphere/ocean interaction: 1) a pattern that peaks 2-3 weeks before the largest SST anomalies in the Gulf Stream extension, which can be viewed as the "atmospheric forcing" and 2) a pattern that peaks several weeks after the largest SST anomalies, which the authors argue can be viewed as the "atmospheric response". The latter pattern is linearly independent of the former, and is interpreted as the potential response of the atmospheric circulation to SST variability in the Gulf Stream extension.