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On the coupled response of the equatorial Atlantic to West African dust outbreaks

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The Atlantic Meridional Mode (AMM) is the dominant source of coupled atmosphere–ocean variability in the tropical Atlantic, characterized by a hemispheric sea surface temperature (SST) gradient and cross equatorial surface winds that reinforce SST anomalies in both hemispheres. The AMM provides a theoretical framework for understanding the nature of regional patterns of precipitation and Atlantic hurricane variability. Although the wind-evaporation-SST (WES) feedback reinforces the existing meridional SST gradient when either phase of the AMM is excited the AMM is thermodynamically damped and thus requires external forcing to persist as is observed. However, there is little consensus as to what physical mechanisms may excite the AMM and thus govern regional coupled climate variability. Here I use observations and a physical model to show that the AMM is excited by variability in African dust outbreaks via dust radiatively-forced SST anomalies on interannual to decadal time scales. My analysis suggests that SST anomalies resulting from the aerosol direct effect persist in time via the WES feedback that defines the AMM. I conclude that the AMM and the state of the tropical Atlantic are directly tied to land surface processes over West Africa via dust emission. These results suggest that human activity may already be altering regional climate due to land use change and underscore the importance of resolving uncertainty in modeling land surface processes and dust emissions in order to estimate the regional response to future climate change.