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Where the north wind meets the sea: rainfall variability and change and its implications for food security in the Sahel

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Many factors have been suggested to explain variability and change in Sahel rainfall. Of those, sea surface temperature (SST) in the Eastern Mediterranean Sea (EMS) and zonal moisture flux south of the Sahel show strong correlations. Based on observational and reanalysis data on temperature, pressure, wind and moisture flux, this paper identifies a mechanism that explains both correlations. The mechanism hinges on the Jebel Marra massif and the Ethiopian highlands, where the mesoscale convective systems (MCSs) develop that bring most of the rain to the Sahel. We find that cold SST anomalies in the EMS between June and September cause a greater trans-Sahara temperature contrast and coincide with high pressure over Libya, resulting in stronger northerlies towards Sudan. This prevents Tropical Atlantic moisture from reaching the MCS genesis region, which reduces the seasonal northward spread of Sahel rainfall and of the Atlantic intertropical convergence zone, which in turn suppresses the development of the west-African westerly jet and the African westerly jet and inhibits Atlantic moisture from reaching the MCS genesis region, thus further reducing Sahel rainfall. Anomalous moisture transport from the Mediterranean does not play a role. Mediterranean SST variability raises questions about the future development of Sahel rainfall. If a new dry period materialises, this will have substantial implications on food production in the region. There are however opportunities for mitigating against the effects of such a dry period.