

Which cyclones transport North Atlantic heat and moisture to Europe?: insights from the analysis of cyclone composites

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There is a widely-held view that Atlantic cyclones, particularly those originating from the Gulf Stream area, are largely responsible for the heat and moisture transport to Europe. Our analysis of highly accurate cyclone composites allowed for estimation of cyclone energy and moisture balance at different stages of cyclone development. Composite analysis allows for the extension of cyclone tracking to the consideration of internal structure of cyclones. Surprisingly, Gulf Stream oceanic cyclones contribute little to the advection of heat and moisture from the North Atlantic to Europe. These cyclones gradually dry with the water content and precipitation rate decreasing drastically during the lifetime. Furthermore, typically, they never reach Europe rather propagating solely over the Atlantic Ocean. More likely, they provide preconditioning for forming East Atlantic systems responsible for the further transport of heat and moisture to Europe. Another specific feature of the North Atlantic cyclones is that the total air-sea turbulent fluxes provided by Gulf Stream cyclones are not significantly different from the averaged background fluxes. Being armed with these insights we performed the analysis of synoptic systems propagating to Europe and influencing European heat and precipitation anomalies. We used an advanced procedure of cyclone compositing applied to the NCEP-NCAR reanalysis (winter seasons) in the North Atlantic in for the period from 1948 till 2011. For the first time we considered interannual variability of the thermodynamic structure of cyclones at different stages of the development and in different regions providing insights for understanding the sources of climate anomalies over Europe during the past 60 years. This approach allows for establishing a novel avenue linking European climate anomalies and oceanic input in the atmospheric synoptic dynamics.