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Linking extreme surface turbulent heat fluxes to cyclone characteristics over the North Atlantic

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Surface turbulent heat fluxes are a key component of the air-sea interaction over the midlatitude oceans. They are highly variable in time ranging from hundreds to thousands W/m2 on synoptic time scales. This variability is linked to atmospheric circulation and extreme high fluxes are very likely associated with atmospheric cyclones. Accurate estimation of extreme turbulent fluxes and understanding of the mechanisms through which they are formed is critically important for both atmospheric and oceanic dynamics.
The main questions addressed in this study are (i) what are the large scale atmospheric conditions leading to the formation of extreme ocean fluxes, are they necessarily related to cyclones?, (ii) are extreme fluxes playing important role in the total oceanic heat losses?, (iii) which characteristics of cyclones are most sensitive to the surface flux signals?
We derive statistics of the extreme surface fluxes from the empirical probability distribution functions of surface fluxes computed from the reanalysis state variables for the period 1979-onwards. Cyclone tracks are derived for the same period from the same reanalysis using state of the art numerical tracking algorithm. To answer these questions, we analyse surface flux statistics and cyclone characteristics over the midlatitudinal oceans (North Atlantic, North Pacific) and investigate their links with each other focusing on cyclone deepening rates, propagation velocities, life time and clustering.
The existence of the high pressure system in the rare part of a cyclone is shown to be the necessary condition for the formation of extreme flux. We also show that the fraction of the oceanic heat loss due to extreme fluxes is highly inhomogeneous over the ocean and linked to the atmospheric circulation and can be as large as 50%. Cyclones tend to produce positive heat flux anomaly at the genesis stage. Over the Gulfstream more than 60% of cyclogenesis is connected to extreme fluxes.