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A climate feedback between hurricanes and the wind-driven circulation of the tropical ocean: implications for the early Pliocene and contemporary climate change

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Hurricanes and tropical storms are now recognized as an important component of the global climate system. By modifying the upper ocean thermal structure and the ocean poleward heat transport they can affect sea surface temperatures and provide a number of crucial feedbacks for the climate system on long timescales. Here, we discuss a positive feedback between hurricanes and the wind-driven circulation of the tropical and subtropical Pacific ocean that we hypothesize was critical for the maintenance of the warm, El Niño-like conditions in the tropics during the early Pliocene, roughly 3 to 5 million year ago. This feedback is based on the ability of hurricanes to warm up water parcels traveling at depths of 100-250 m towards the equator and then surfacing in the eastern equatorial Pacific as part of the shallow subtropical cells (STC). In the present climate, very few hurricane paths cross the water parcel trajectories; therefore, there is little exchange of heat between waters at such depths and the ocean surface - the parcels travel towards the equator virtually adiabatically. More frequent and/or stronger hurricanes imply greater heating of the parcels, warmer temperatures in the eastern equatorial Pacific, generally warmer tropics and, in turn, even more hurricanes. Calculations with coupled GCMs support the importance of this mechanism. Even though we discuss this feedback mainly for the Pliocene climate, it must be also relevant to other equable climates of the past and, potentially, to contemporary climate change.