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Intensification mechanisms of tropical cyclones

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Wind Induced Surface Heat Exchange (WISHE) mechanism is considered very important for tropical cyclone intensification in a large part of the scientific literature([1], [2], [3]): heat flux from the ocean increase with increasing wind speed, building up a positive feedback on the intensification.
Simple WISHE-based models of tropical intensification predict that tropical cyclones intensify up to a steady state at the Potential Intensity (PI), obtained from the balance of heat supply rate from the ocean and dissipation rate in the boundary layer and dependent on boundary conditions only ([1]). The main problem of such models is the fact that they typically drastically simplify the convective motion within the cyclone, assuming a troposphere neutral to moist convection. ([4]).
In our work we tested these predictions in idealized numerical experiments performed using the non-hydrostatic, high-resolution model System for Atmospheric Modelling (SAM). The results showed a significantly different intensity evolution, with the cyclone undergoing a oscillation in surface wind speed with peak intensity significantly lower than the PI.
This intensity evolution was related to that of the environmental conditions along the whole air column: convective heating exports latent and sensible heat in the middle-upper troposphere, increasing environmental air buoyancy and so reducing CAPE. Radiative heating from the clouds further stabilizes the upper troposphere, weakening convection and thus cyclone intensity. After the intensity decay phase the upper level air surrounding the cyclone cools down through radiation emission: entrainment of cold air by the cyclone itself rebuilts CAPE and triggers a new intensification. Despite this work showed some limits in the predictivity of WISHE theory, WISHE feedback itself was proved to be fundamental for tropical cyclone intensification with a sensitivity numerical experiment.

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