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Spray effects at high winds via LES modelling

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The development and maintenance of hurricanes depends strongly upon the exchange of momentum and energy (enthalpy) between the sea and atmosphere. This ocean-air exchange can be significantly influenced by sea spray, so accurate hurricane models need to account for spray's influence. As only sparse limited measurements have been taken in hurricane conditions, incorporating sea spray into large-eddy simulations∼(LES) is an attractive method for examining spray's role(s) in the hurricane atmospheric boundary layer∼(HABL).

An atmospheric LES model has been augmented to treat momentum transfer (horizontal and vertical) between air and spray, spray generation and phase change accounting for different droplet size ranges, dissipative heating in the two-phase hurricane regime, over a moving three-dimensional boundary that models the air-sea interface. Simulations incorporating these modeled physics together offer a view of the limitations of current bulk spray-flux models, motivating a recommendation against bulk treatments for latent heat fluxes as well as a simpler alternative for the effect of spray on ocean-air enthalpy fluxes in the HABL, in agreement with recent analytical developments and simpler modelling arguments.
The results of the LES model underscore the significance of HABL-scale thermodynamic balance, spray-induced fluxes, and wind-dependent thermodynamic feedback in the HABL.