Eyewall structure of tropical cyclones using high-resolution numerical simulation

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The life cycle of tropical cyclones is intimately linked to their multiple interactions with the ocean, especially through ocean-atmosphere fluxes which are highly impacted by boundary layer dynamics. Numerical simulations with low horizontal resolution (≤1 km), do not resolve fine scales structures in this part of the atmosphere, and in this case, only ocean-atmosphere parameterization fluxes work for modeling these interactions. Nowadays, numerical models can perform simulation at a resolution where mesostructures in the boundary layer are partially resolved. In this context, it is interesting to evaluate the role of these mesostructures on ocean-atmosphere fluxes and how it impacts the evolution of tropical cyclones.

In this study, we performed idealized simulations of tropical cyclones using the French non-hydrostatic mesoscale model, Meso-NH (http://mesonh.aero.obs-mip.fr), developed by Lab. d'Aérologie and the Centre National de Recherches Météorologiques. Using non-coupled (i.e. atmosphere only) simulation, we show that horizontal resolution first impacts the intensity and surface maximum wind of the simulated tropical cyclone. For horizontal resolution below or equal to 500 m mesostructures, characterized by vorticity anomalies, formed in the eyewall boundary layer. These mesostructures have a mean horizontal wavelength around 3 km and a mean vertical extension of 2 km. We also test the performance of Meso-NH model in a real configuration for typhoon Trami (2018). The simulation was initialized at 00:00 UTC on from the 23 of September, and the initial and lateral boundary conditions are provided by the operational European Centre for Medium-Range Weather Forecasts analyses every 6 h. It appears that the intensification phase is rather well represented while the decreasing phase shall be improved through ocean-atmosphere coupling.