FSU Meteorology Seminar Series, Spring 2021

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A Theory of Spontaneous Tropical Cyclogenesis from Quasi-random Convection

Abstract

What makes the sparse and stochastic cumulus clouds organize into a hurricane? There is no satisfactory answer yet. On one hand, the supply-consumption equilibrium of energy determines the vigor of deep convection at the large scale, which is deterministic. On the other hand, the trigger of individual convection at the small scale is stochastic. In this way, the atmospheric mesoscale regime (50-500 km) where tropical cyclogenesis resides must be deterministic and stochastic at the same time. Based on these understandings, we established a barotropic numerical model for simulating tropical cyclogenesis. Deep convection is represented as a multitude of isolated convergence forcing. The convection is assigned to distribute stochastically at the small scale. At the mesoscale, the distribution relies on a spatially filtered vertical vorticity field. The filter implicitly represents the nonlocal convective trigger by gravity wave and cold pool (thunderstorm outflow in the boundary layer). The result shows that the early-stage evolution is dominated by vortex tube stretching. Subsequently, the regions where repetitive stretching occurs become vortex clusters, and induce more convection around it. The collision and coalescence between vortex clusters lead to a major vortex, which is in turn strengthened by random stretching. We preliminarily established a coupled random stretching-random collision model to depict the full evolution process.

Zoom Link

https://fsu.zoom.us/j/98656802895?pwd=MEJjTVBQTXNkZTdLQlJGMmwrVzNqQT09

Time:	Thursday, Jan. 28, 2021 @ 3:30 PM
Host:	Dr. Zhaohua Wu
Note:	Meeting the speaker at 3:00 PM.