The Evolution of Precipitation Efficiency and Gross Moist Stability in the Axisymmetric Spin-up of Tropical Cyclones

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It has been hypothesized that a tropical disturbance must first saturate a deep column around its center in order for tropical cyclogenesis to occur. A natural corollary for this hypothesis is that the drier the initial state, the longer the time it takes for genesis to occur. The genesis time scale is studied through precipitation efficiency and the normalized gross moist stability diagnostics in an axisymmetric hurricane model with varying initial moisture.

Emanuel (1989) found the spin-up time scale of an axisymmetric tropical cyclone scales as vertical depth of the cyclone divided by the drag coefficient and a measure of the air-sea disequilibrium. The latter two variables constitute a vertical velocity scale. The spin-up time scale in an axisymmetric hurricane model also scales inversely by the precipitation efficiency averaged over the pre-genesis period, effectively modifying the vertical velocity scale to include the net effect of downdrafts.

The evolution of the normalized gross moist stability is also examined in order to extend the work of Raymond et al. (2007). The gestation periods of the simulations are all marked by negative normalized gross moist stability, which then transitions to a positive value before the time of genesis. During this transition, the vortex structure undergoes a critical shift to a deep secondary circulation that has a net export of entropy.

References

Emanuel, K., 1989: The Finite-Amplitude Nature of Tropical Cyclogenesis. *J. Atmos. Sci.*, **46**, 3431-3456.

Raymond, D., S. Sessions, and Z. Fuchs, 2007: A theory for the spinup of tropical depressions. *Quart. J. Roy. Meteor. Soc.*, **133,** 1743-1754.