****Please note the special date and time****

ATS/CIRA Colloquium

Allison A. Wing, Ph.D.

NSF AGS Postdoctoral Research Fellow, Lamont-Doherty Earth Observatory, Columbia University

Organization of tropical convection: Self-aggregation and spontaneous tropical cyclogenesis

Hosted by Eric Maloney

Monday, March 21, 2016

ATS room 101; Discussion will begin at 3:30 pm
Refreshments will be served at 3:00 pm in the weather lab

Tropical clouds and relative humidity play a key role in both the planetary energy balance and the sensitivity of global climate to radiative forcing. Both clouds and relative humidity are also strongly modulated by the organization of tropical convection, which results in a large fraction of tropical cloudiness and rainfall. Here, we investigate the organization of tropical convection in the context of self-aggregation, a spontaneous transition in idealized numerical simulations from randomly distributed to organized convection despite homogeneous boundary conditions. Specifically, the System for Atmospheric Modeling is used to perform 3-d simulations of radiative-convective equilibrium in a non-rotating framework, with interactive radiation and surface fluxes and fixed sea surface temperatures. The results of simulations employing a highly elongated 3-d channel domain, in which self-aggregation takes the form of multiple moist and dry bands, are compared to that of a square domain, in which self-aggregation takes the form of a single moist cluster. We characterize the fundamental physical mechanisms that lead to self-aggregation. Cloud-radiative feedbacks and surface flux feedbacks are found to be important in the initial instability, but advection only contributes to aggregation in the square geometry.

Self-aggregation has primarily been studied in a non-rotating framework, but it has been hypothesized to be important to tropical cyclogenesis. In numerical simulations of tropical cyclones, a broad vortex or moist bubble is often used to initialize the circulation. Here, we instead allow a circulation to develop spontaneously from a homogeneous environment in 3-d cloud-resolving simulations of radiative-convective equilibrium (RCE) in a rotating framework, and compare the resulting tropical cyclogenesis to non-rotating self-aggregation. We find that in the initial development of a broad circulation, the feedback processes leading to cyclogenesis are similar to the initial phase of non-rotating aggregation. Sensitivity tests in which the degree of interactive radiation is modified are also performed to determine the extent to which the radiative feedbacks that are essential to non-rotating self-aggregation are important for tropical cyclogenesis.

Link to colloquium videos and announcement page: http://www.atmos.colostate.edu/dept/colloquia.php