Special Seminar

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Visiting from the University of Melbourne

Understanding Self-Organization of Tropical Convection by Gravity Waves

Hosted by Leah Grant

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ATS 101

Observations and simulations of tropical clouds have shown that convection has the tendency to "self-organize." Self-organization, sometimes called "aggregation," refers to the ability of convection to modify its environment and generate its own circulations, which leads to upscale growth of convective systems in the absence of the external forcing normally associated with organization. The processes controlling self-organized convection are not completely understood, and fundamental questions remain about the relative roles of gravity waves, cold pools, and radiative feedbacks. In this talk, I will start by summarizing previous foundational work on convection – gravity wave interactions. Then I will use a set of three-dimensional idealized cloud system-resolving model simulations to explore some aspects of how tropospheric gravity waves contribute to the self-organization of convection. These simulations follow the transition of convection from disorganized plumes to mesoscale convective systems and clusters. Spectral analysis is used to identify a clear association between the clouds and deep tropospheric gravity waves, attempting to separate the roles of "slow" and "fast" waves in modulating convective clustering. Further, a modelling framework is developed where stratospheric shear is used to change the ability of the gravity waves to propagate vertically, ultimately leading to a change in the tropospheric wave field, and the behaviour of the simulated organized convection. The results clearly demonstrate the importance of gravity wave-convection coupling. Moreover, this approach identifies an interesting influence of lower-stratospheric shear on the organizational process and highlights a potential mechanism for stratosphere-troposphere interactions.