FSU Meteorology Seminar Series, Spring 2020

Dr. Levi Silvers
Stony Brook University

A mock-Walker Circulation and Radiative Convective Equilibrium: Clouds and Precipitation

Abstract

The overturning tropical Pacific circulation known as the Walker circulation embodies complex interactions between large-scale circulations, deep and shallow convection, stratocumulus clouds, and microphysical cloud processes. The large-scale nature of the Walker circulation has made high-resolution modeling costly, while understanding the feedbacks between parameterized clouds and the large-scale circulation have remained challenging in the context of global models. This study uses an idealized Walker circulation to explore how multiple tropical cloud types interact with a large-scale circulation. A high-resolution model with explicit convection (1km and 2km grid-spacing) is used to examine the system free of the complications inherent in convective parameterizations. The same model is also used at GCM-like resolutions with parameterized convection (25km and 100km grid-spacing) to gain insight into how the clouds and circulations interact in a configuration similar to a GCM.

The interaction between clouds and the longwave radiation increases, or decreases, precipitation depending on whether high or low clouds are dominant. Interactions between the longwave radiation and parameterized convection result in the precipitation maximum being shifted off of the SST maximum. Cloud resolving simulations result in stronger overturning, more condensate aloft, and a relative humidity that is 40% higher in the deep convective regions than it is for GCM-like simulations. This configuration can also be used as a bridge between experiments of radiative convective equilibrium and those with more complex boundary conditions. We argue that a mock-Walker Circulation is an ideal framework with which to build on the insight we have gained from RCE experiments and we are optimistic that it can help us to solve some of the more persistent questions about how clouds and the large-scale circulation interact.

Time: Thursday, Jan. 23 @ 3:30 PM
Location: LOV 353