MS Defense Announcement
Michael Needham
Friday, January 22 at 1:00 p.m.

Michael Needham
MS Defense

January 22, 2021
1:00 p.m.

Defense
Virtual through Teams (full link at bottom)

Post Defense Meeting
Virtual

Committee:
David Randall (Adviser)
James Hurrell
Xinfeng Gao (Mechanical Engineering)

LINKS BETWEEN ATMOSPHERIC CLOUD RADIATIVE EFFECTS AND TROPICAL CIRCULATIONS

Atmospheric cloud radiative effects (ACRE) quantify the radiative heating or cooling due to clouds within the atmosphere. In this study, a framework is developed with which to analyze the ways that ACRE impact large-scale circulations in humid and dry regions of the tropics. The framework is applied to a set of simulations from a global atmospheric model configured with uniform tropical sea surface temperatures, following the protocol of the Radiative Convective Equilibrium Model Intercomparison Project. It is found that humid regions export energy and import moisture, and that ACRE in extremely humid regions are strong enough to change the sign of the net radiation tendency. This net heating drives a feedback in which large-scale ascent moistens the troposphere by lifting latent energy from near the surface. Moisture at these higher levels then forms clouds which in turn reinforce the ACRE, continuing the process. The relevance of this feedback to the germinal study of Riehl and Malkus (1958) is discussed.

Additionally, the analysis method reveals a simple relationship between cloud radiative effects and column relative humidity in the idealized model. The same relationship is also observed in cloud radiative effects calculated from satellite observations. This suggests a simple way to estimate the cloud radiative effect at the top of the atmosphere. The estimated cloud radiative effect may be useful in estimating the ACRE, which is harder to infer from measurements using previous methods. The estimation shows some skill at estimating the cloud radiative effect in humid regions across the tropics on time scales of one month or longer. The method is found to be extremely effective at estimating observed cloud radiative effects in the equatorial west Pacific. Weaknesses of the estimation method in relation to marine stratus clouds are discussed.

M.S. Defense: Michael Needham
Join on your computer or mobile app
Click here to join the meeting
Or call in (audio only)
+1 970-628-0547,,80124033# United States, Grand Junction
Phone Conference ID: 801 240 33#
Find a local number| Reset PIN