FSU Meteorology Seminar Series, Spring 2020

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Climate sensitivity across the RCEMIP simulations

Abstract

Simulations of radiative-convective equilibrium (RCE) have greatly influenced the understanding of climate, and climate change. Early simulations were performed with very simple one-dimensional models of the atmosphere, followed by cloud-resolving simulations. In the last five years it has also become common practice to simulate RCE with comprehensive general circulation models. These recent studies have revealed that different RCE states can be found, depending on how convection aggregates, even in the absence of external asymmetries in the forcing, and have motivated the RCEMIP project, which defines a standardized experimental protocol, to study RCE across a range of models. For each RCEMIP model, simulations at fixed sea-surface temperatures of 295 K, 300 K and 305 K have been performed, both on a small and on a large domain.

Here our focus is on investigating how climate sensitivity differs across those simulations, with the aim to understand what processes control climate sensitivity. The results show that as long as simulations are run on a small domain, differences in climate sensitivity among the different models are still relatively small, while climate sensitivities vary tremendously for the large domain simulations. The climate sensitivity parameter ranges from very low to high or even negative values, the latter indicating an unstable climate state. The variability of climate sensitivity is larger on the large domain than on the small domain because convective self-aggregation is suppressed on the small domain, while self-aggregation is free to change with temperature on the large domain, thereby affecting climate sensitivity: if self-aggregation increases with temperature, then climate sensitivity is small, and if self-aggregation decreases with temperature, then climate sensitivity is high or even negative. We can attribute this effect to a drying and expansion of the subsiding regions in response to convective self-aggregation, causing an increase in outgoing longwave radiation. In addition, changes in low clouds play a critical role.

Time:	Tuesday, Jan. 28 @ 3:30 PM
Location:	LOV 353