JOHNS HOPKINS
Center for Environmental & Applied Fluid Mechanics

SPRING 2022 CEAFM VIRTUAL SEMINAR

"Dynamical Sensitivity in Response to a Wide Range of Abrupt CO_2 Forcings"

Presented by Dr. Clara Orbe

NASA Goddard Institute for Space Studies

Hosted by Prof. Darryn Waugh (EPS)

Future emissions of greenhouse gases are projected to result in significant circulation changes. The forcing and feedback response characteristics of these changes can be unambiguously attributed to an increase in carbon dioxide (CO_2) concentrations using the abrupt $4xCO_2$ forcing simulations from the Coupled Model Intercomparison Project Phase 6 DECK experiments. Thus, while typically used to evaluate the climate sensitivity in models, with a primary focus on global surface temperature change, here we focus on several measures of "dynamical sensitivity", including projected changes in the storm tracks, the Hadley Cell and tropical precipitation. In particular, we use the NASA Goddard Institute for Space Studies climate model (ModelE) to explore the linearity of the response of dynamical sensitivity to a broad range of CO_2 levels spanning $1/8\text{-}8xCO_2$. We show that the effective climate sensitivity (ECS) increases non-monotonically with CO_2, with radiative forcing changes explaining the overall increase in ECS between $1/8xCO_2$ and $8xCO_2$, while feedback changes determine the non-monotonic behavior. We further show that the expansions of the Hadley Cell and the jet streams also vary non-monotonically with increased CO_2, especially in the Northern Hemisphere, and that this can be interpreted in terms of changes in ocean heat transport. Similar results are also found in simulations conducted using the Community Earth System Model. This non-monotonic behavior, apparent in various climate metrics, suggests that future changes in Earth's circulation beyond the 21st century might be significantly different from the changes projected by 2100.

Friday, April 8, 2022 at 3:00 PM

In-Person Gilman Hall 132

https://wse.zoom.us/j/93762992307