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 (CO₂) concentrations using the abrupt 4xCO₂ 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 CO₂ levels spanning 1/8-8xCO₂. We show that the effective climate sensitivity (ECS) increases non-monotonically with CO₂, with radiative forcing changes explaining the overall increase in ECS between 1/8xCO₂ and 8xCO₂, 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 CO₂, 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