# Replicating the Regional Hadley Cell Response to Increased $CO_2$ in CMIP6

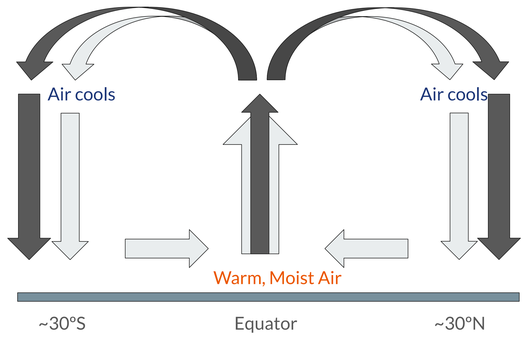
Patricia Hutton[1] and Molly Menzel[2]

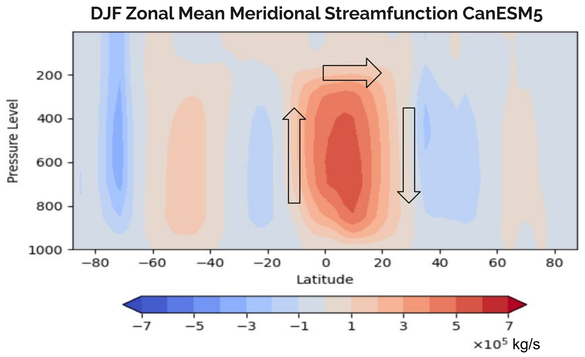
[1]University of Fairbanks Alaska
[2]NASA Goddard Institute for Space Studies

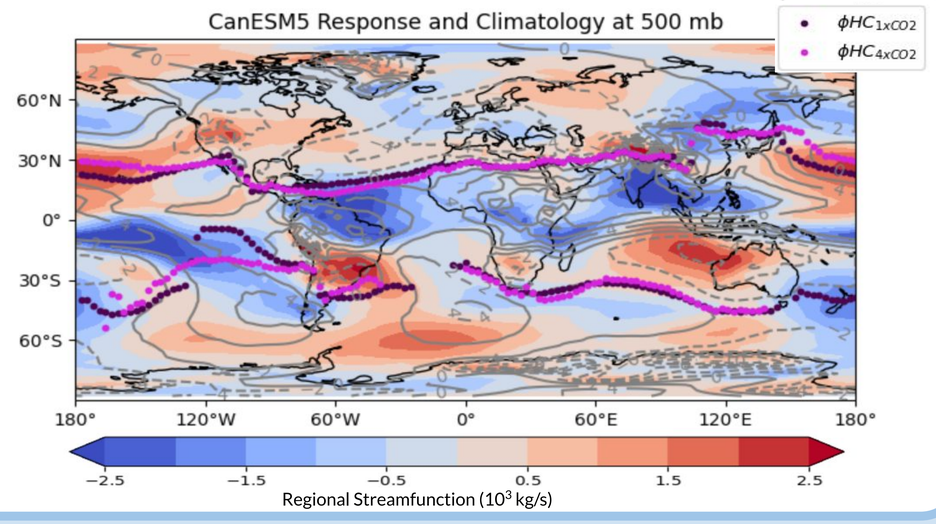
NASA NEW YORK
Space Grant Consortium

## Background and Motivation:

The Hadley Cells transport heat from the equator toward the subtropics, playing a key role in global climate by regulating heat distribution and precipitation distribution. Under pre-industrial conditions, Hadley Cells exhibit a distinct edge that separates tropical and subtropical regions. Increased $CO_2$ concentrations are predicted to cause a weakening and expansion of the Hadley Cells on a global scale. However, these changes are typically analyzed in a zonal-mean perspective, which does not account for regional differences. Understanding regional variations in Hadley Cell responses is crucial for assessing local climate impacts and societal consequences.




## Methods:

Regional Streamfunction Calculation $\psi(\lambda, \phi, p, t) = \frac{1}{g}\int_0^p v_{div} dp$

**Coupled Model Intercomparison Project Phase 6 (CMIP6)**

| Models | Simulations |
|---|---|
| CanESM5 | piControl |
| ISPL-CM6A-LR | abrupt-4xCO2 |
| MIROC6 | |
| MRI-ESM2-0 | |

## Results:

- ➔ Hadley Cells **strengthen (weaken)** in areas where they **expand (contract)**
- ➔ Findings are consistent across multiple climate models

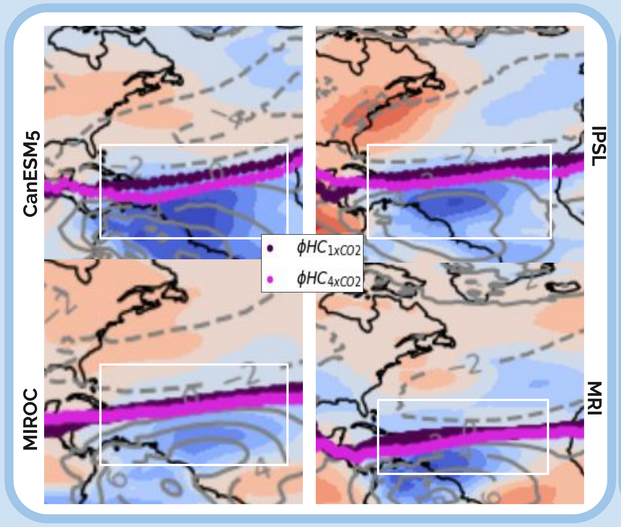
## Discussion:

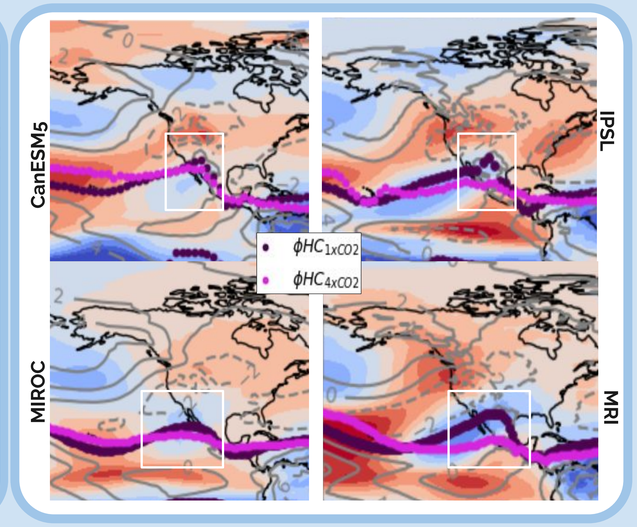
Changes in the Hadley Cell can have significant impacts on **localized weather patterns** and **societal consequences.**

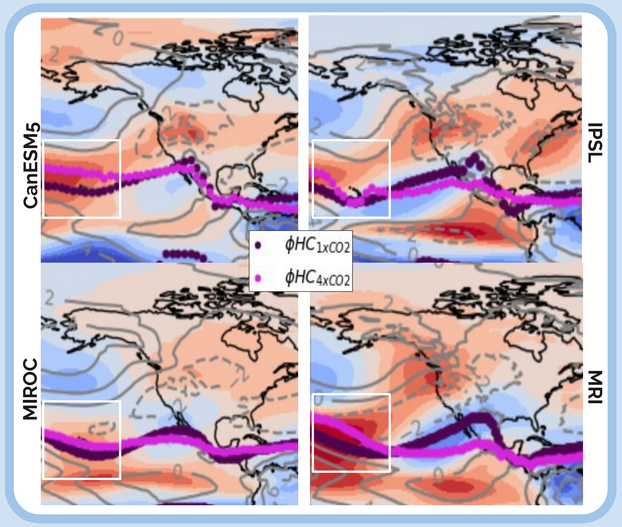
➔ In regions where the Hadley Cells expand:

- Shifts in precipitation patterns
- Increased droughts
- Changes to ecosystems
- Effects on agriculture, water resources, and human settlements

**Regional climate models are crucial to** predict and mitigate climate impacts




Contact the Author:
If you have any questions about this work, please contact the author at phutton5@alaska.edu