Biophysical Implications of Plant Physiological Responses to Increasing CO_2

Claire Zarakas[1], Abigail Swann[1], Marysa Laguë[1,2], Kyle Armour[1], and James Randerson[3]

[1]University of Washington, [2]University of California, Berkeley, [3]University of California, Irvine

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Plant physiological responses to CO_2 increase the magnitude and spread of the TCR in CMIP6 ESMs

Motivation:

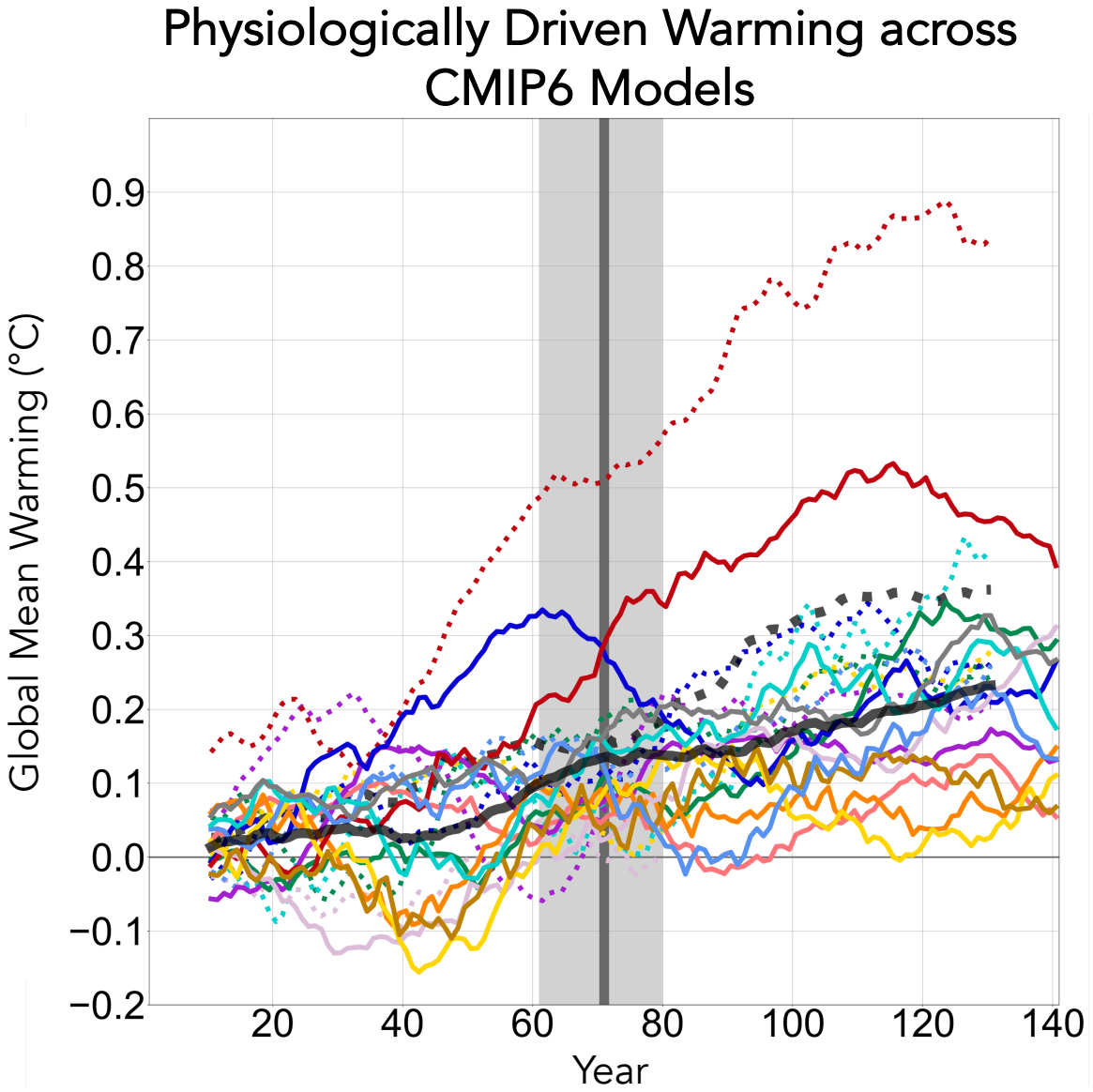
- Plant responses to CO_2 alter surface energy and water fluxes
- Physiological contribution to the transient climate response (TCR) not previously systematically assessed across Earth system models (ESMs)

Methods:

- Used simulations from CMIP6 to isolate the radiative and physiological contributions to the TCR

Key findings:

- CMIP6 TCR_{PHYS} = 0.12°C (6.1% of full TCR)
- Variation in TCR_{PHYS} across models contributes to inter-model spread in the TCR

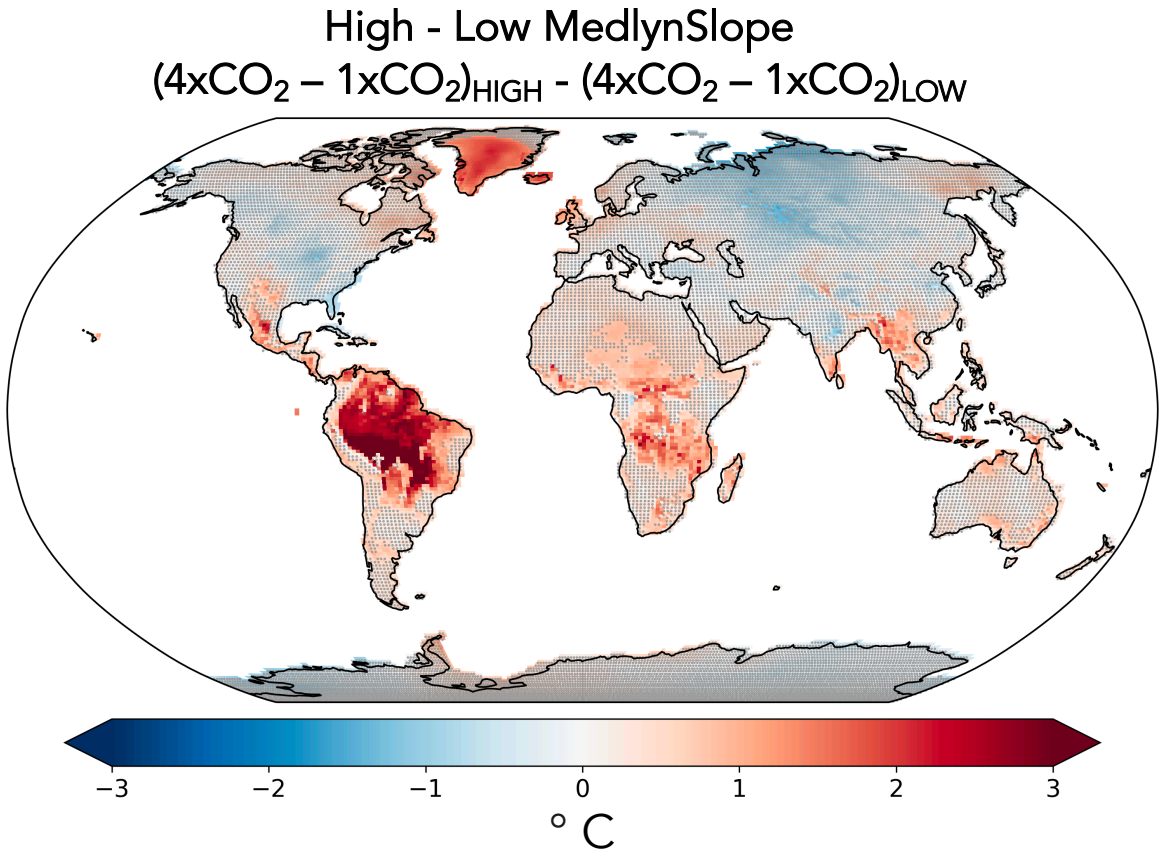


We will quantify how stomatal conductance contributes to uncertainty and biases in hydrologic cycling

- Many ESMs represent stomatal conductance using the same parameters (e.g. stomatal slope parameter g1)
- Wide variation in g1 across plant types
- Preliminary research suggests the stomatal slope parameter has a large influence on surface energy budgets
- We will run experiments quantifying the extent to which the stomatal slope parameter influences hydrologic cycling in E3SM

$$g_s \sim g_o + g_1 \frac{A}{h} \frac{1}{C_s}$$

With a high Medlyn slope, the land surface ***warms more*** than it does with a low Medlyn slope in CESM2



Relationship to White Paper

- *Gaps in Current Research*
  - Vegetation physiological responses to increasing CO_2, surface energy budgets, nutrients, and atmospheric forcing
  - Land-atmosphere interactions
- *Goals*
  - Evaluate plant physiological and land surface responses to changing atmospheric CO_2 levels and surface energy budgets
  - Design and conduct new model–data intercomparison experiments to elucidate mechanisms influencing future biogeochemical cycling and climate