The Time of Steady Climate Change

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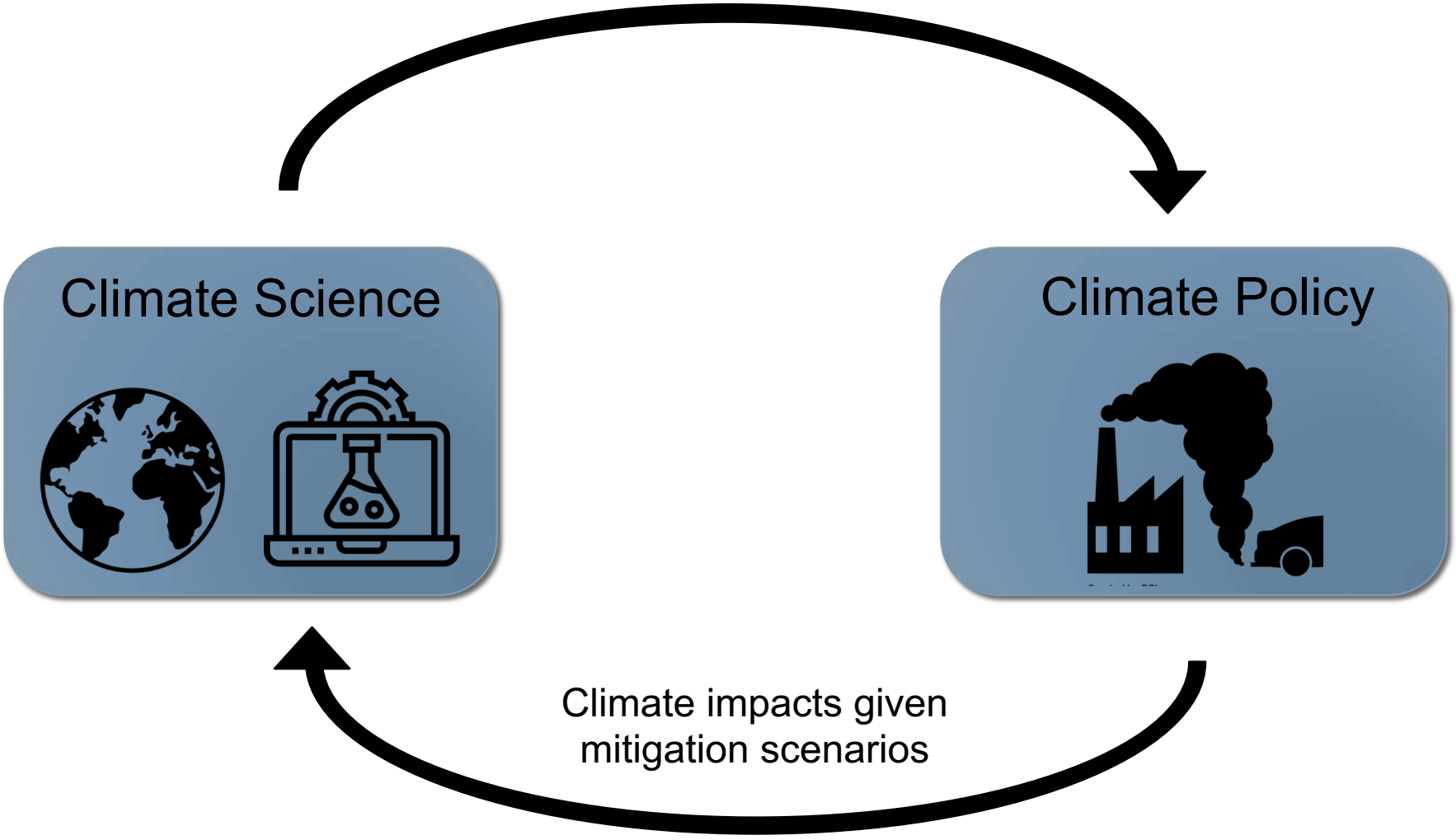
Research and Developing Conference
MIT
November 13, 2019

EAPS
Earth, Atmospheric and Planetary Sciences

Research Overview

Earth models to inform adaptation
and mitigation decisions



Time of Steady Climate Change

AGU100 ADVANCING EARTH AND SPACE SCIENCE

Geophysical Research Letters

RESEARCH LETTER
10.1029/2018GL081704

Time of Steady Climate Change

Megan Lickley[1], b. b. cael[2], and Susan Solomon[1]

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Key Points:

- The stabilization of greenhouse gas concentrations would lead to regional differences in the time of achieving steady temperature increases
- The use of General Circulation Model ensembles allows evaluation of the relative timing of arriving at a state of steady climate change
- The Time of Steady Change occurs latest in low latitudes and the Arctic despite these areas steadying at very different warming rates

Supporting Information:

- Supporting Information S1

Abstract Under an emission scenario where atmospheric greenhouse gas concentrations are stabilized, previous work suggests that on centennial time scales the rate of global temperature increases would steady at significantly lower rates than those of the 21st century. As climate change is not globally uniform, regional differences in achieving this steady rate of warming can be expected. Here, we define a "Time of Steady Change" (TSC) as the time of reaching this steady rate of warming, and we present a method for estimating TSC with the use of General Circulation Model experiments run under greenhouse gas stabilization scenarios. We find that TSC occurs latest in low latitudes and in the Arctic, despite these areas steadying at very different absolute warming rates. These broad patterns are robust across multiple General Circulation Model ensembles and alternative definitions of TSC. These results indicate large regional differences in the trajectory of climate change in coming centuries.

Time of Steady Change: Motivation

Paris Agreement Goal (Article 4): “achieve a balance between anthropogenic emissions by sources and removal by sinks of greenhouse gases”

Lickley, M. J., b.b. cael, Solomon S. (2019) *Geophysical Research Letters*

Time of Steady Change: Motivation

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If there were a balance between sources and sinks, concentrations would become constant, what would happen to the global climate system?

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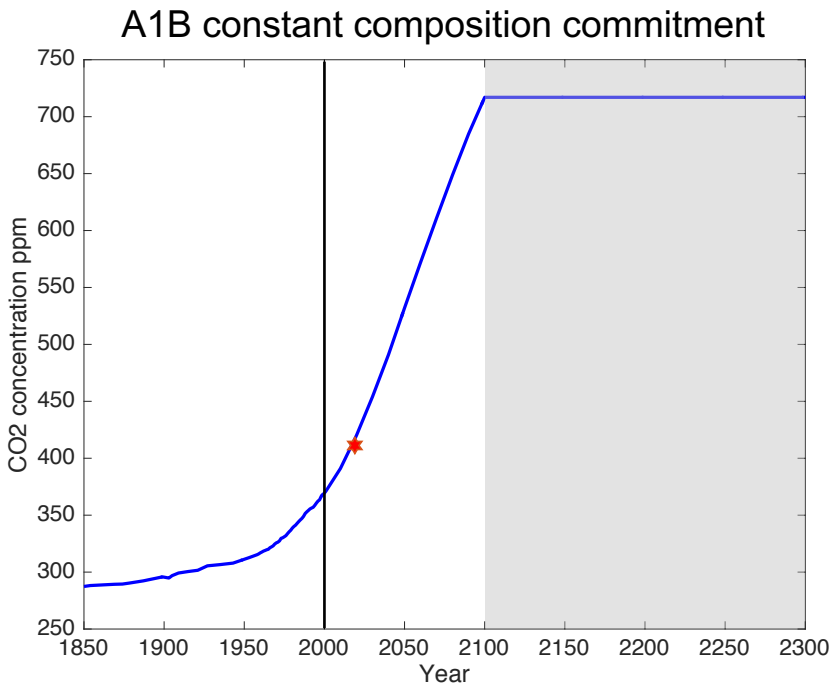
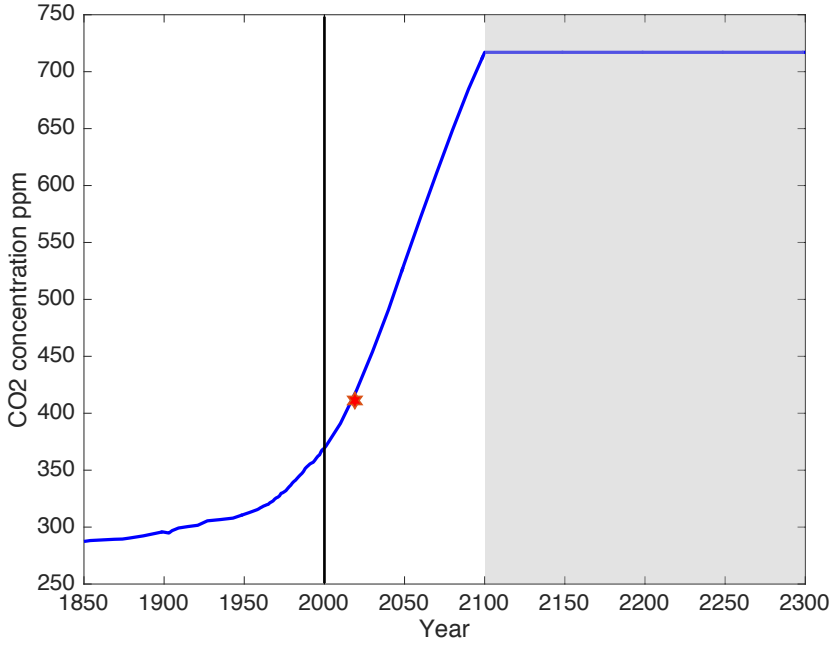


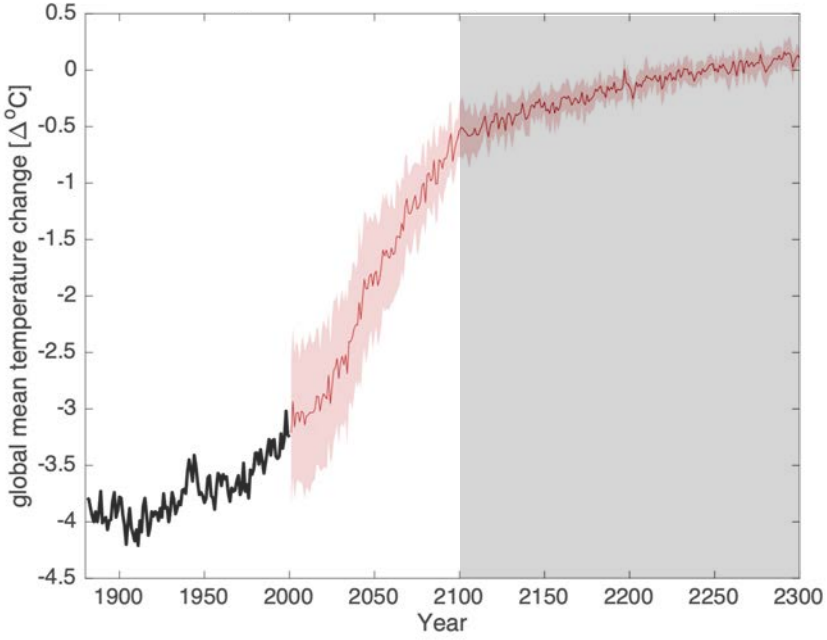
★ **Today's concentrations**

Time of Steady Change: Motivation

A1B constant composition commitment



A1B temperature anomalies
(relative to 23rd century)



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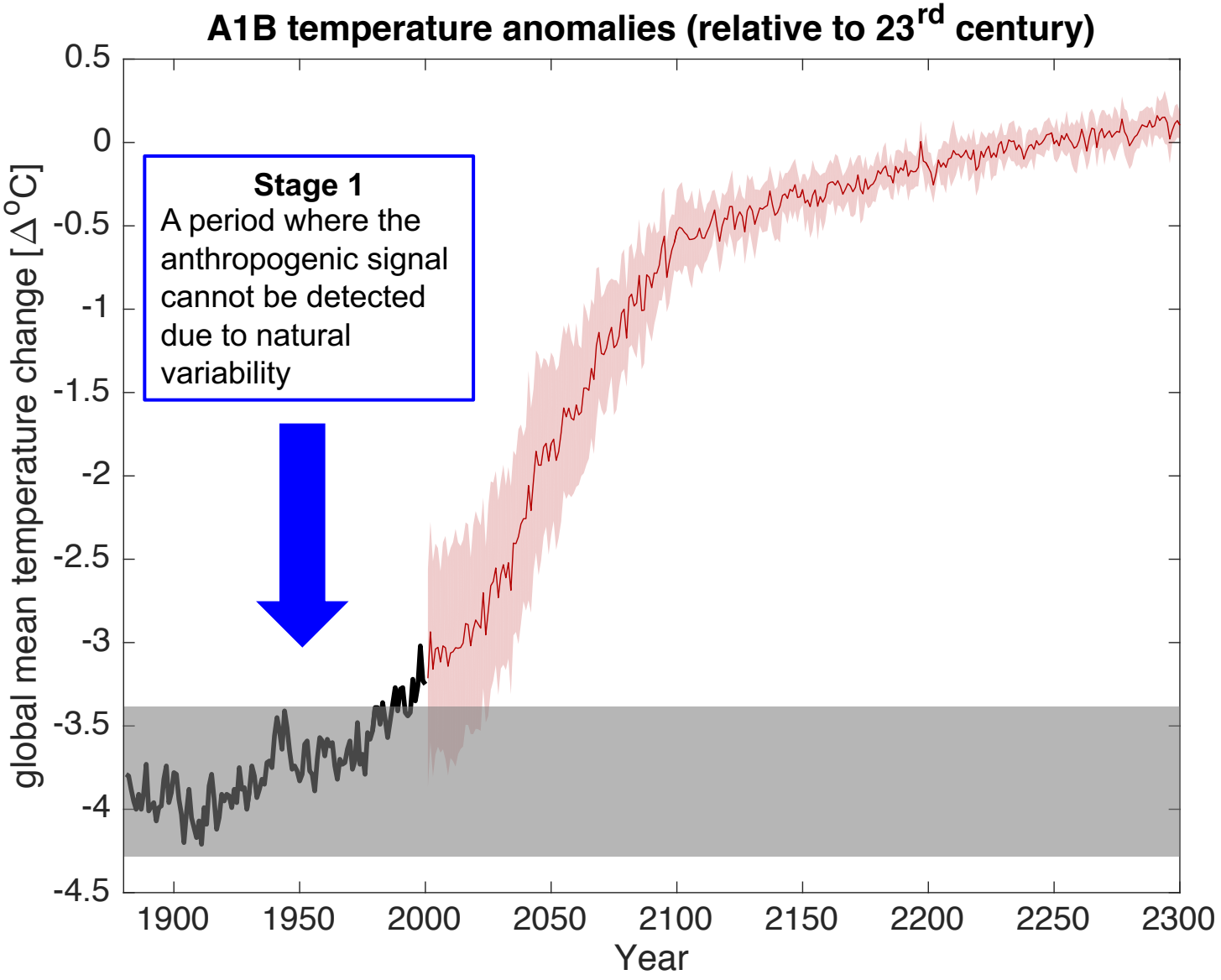

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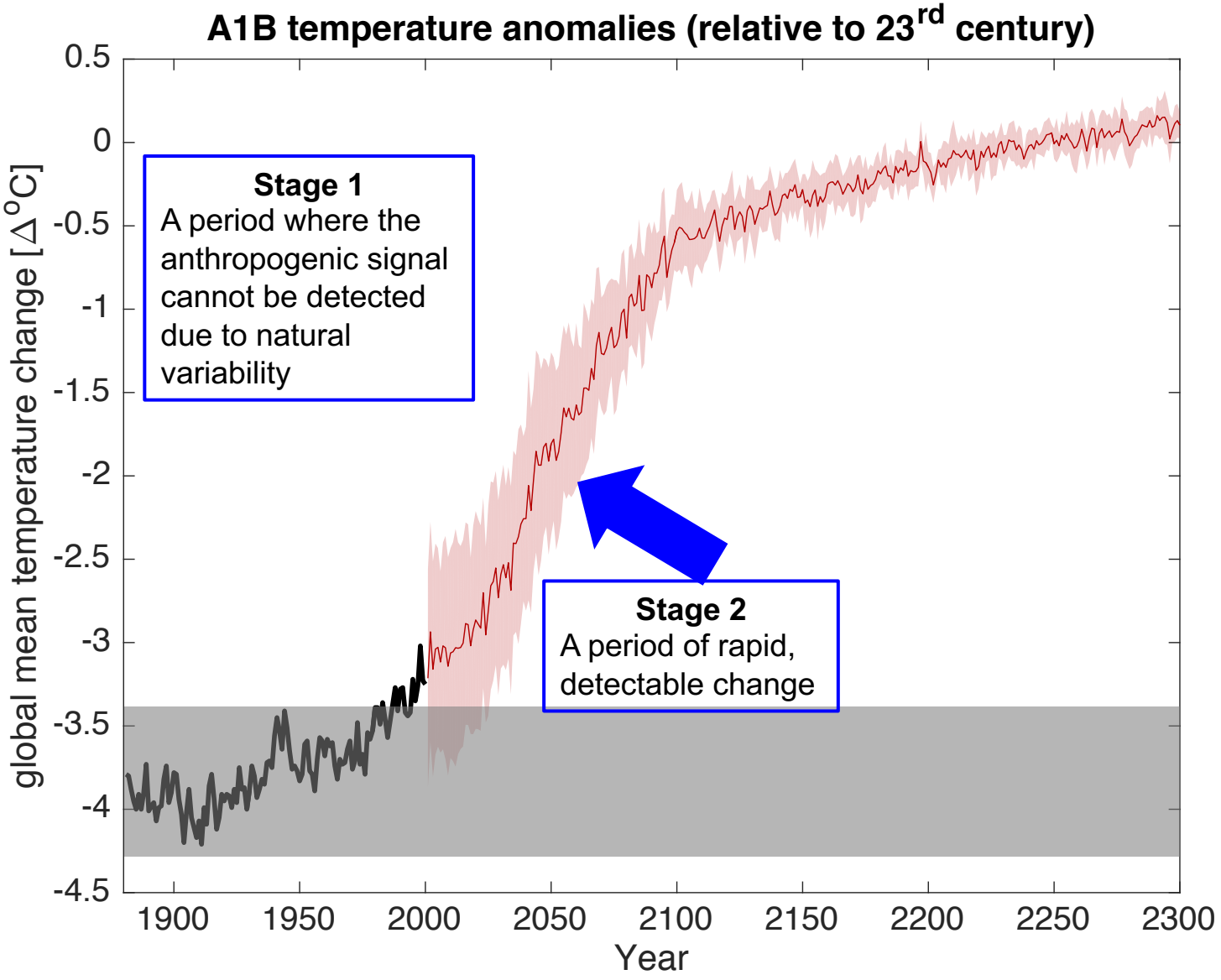

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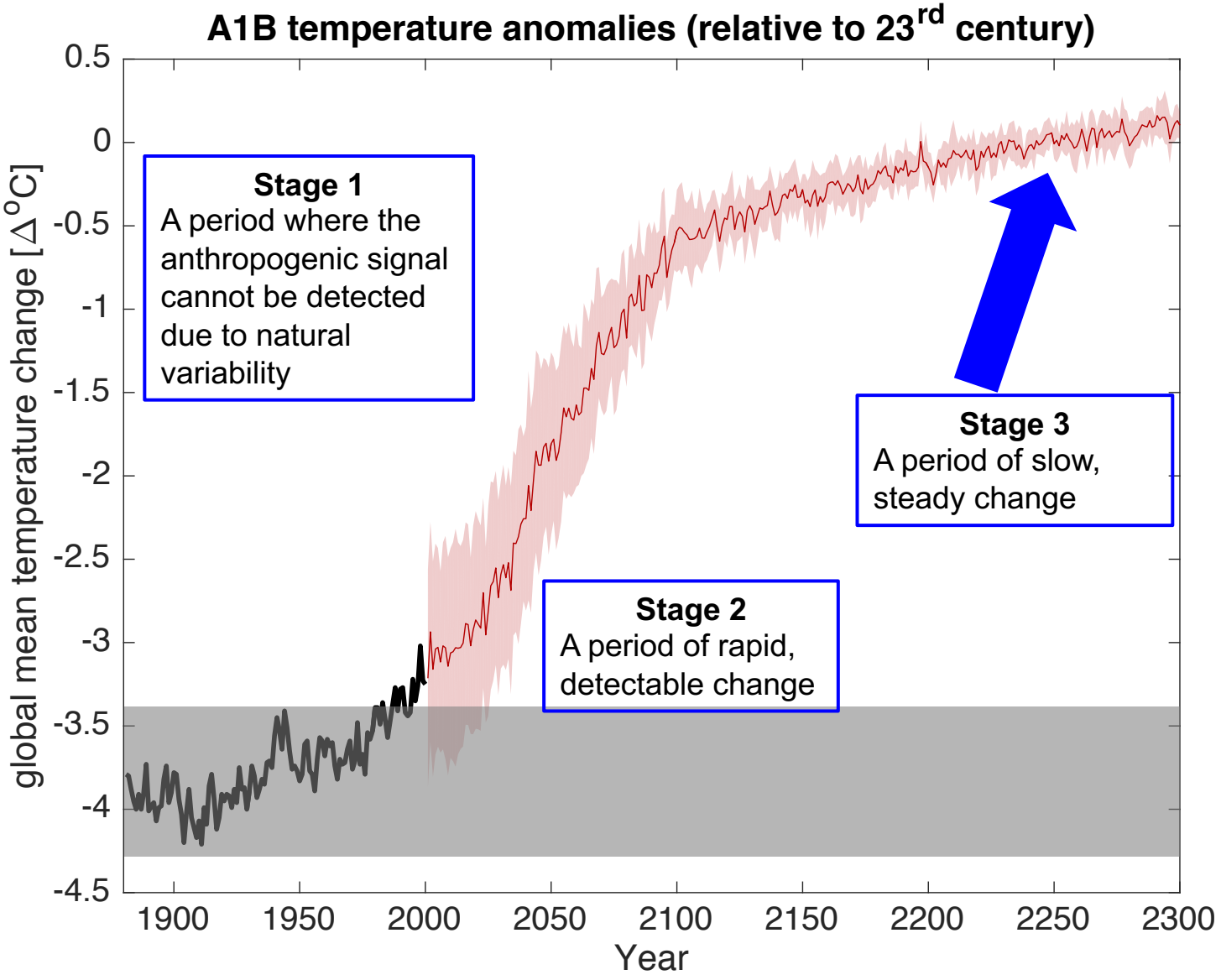

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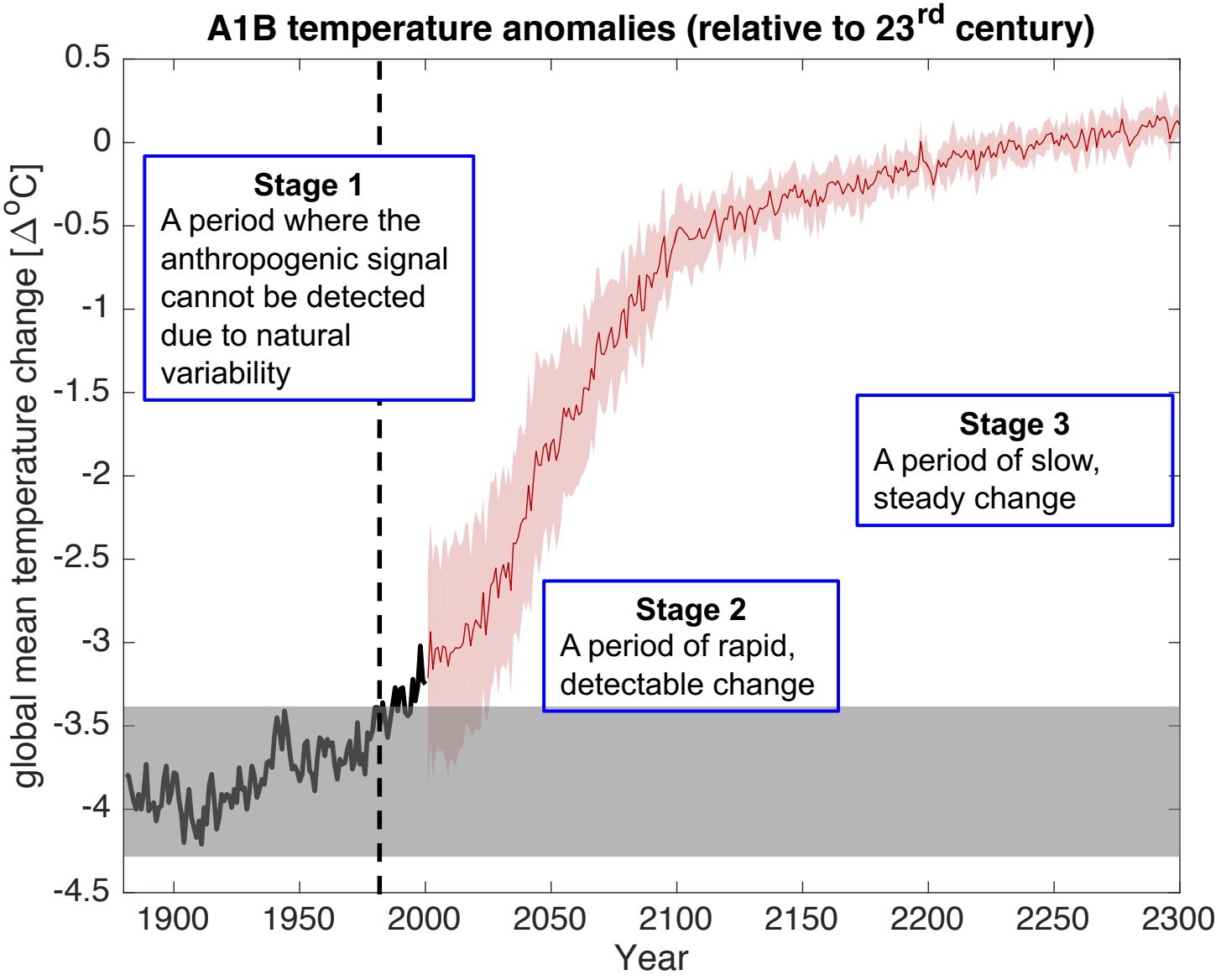
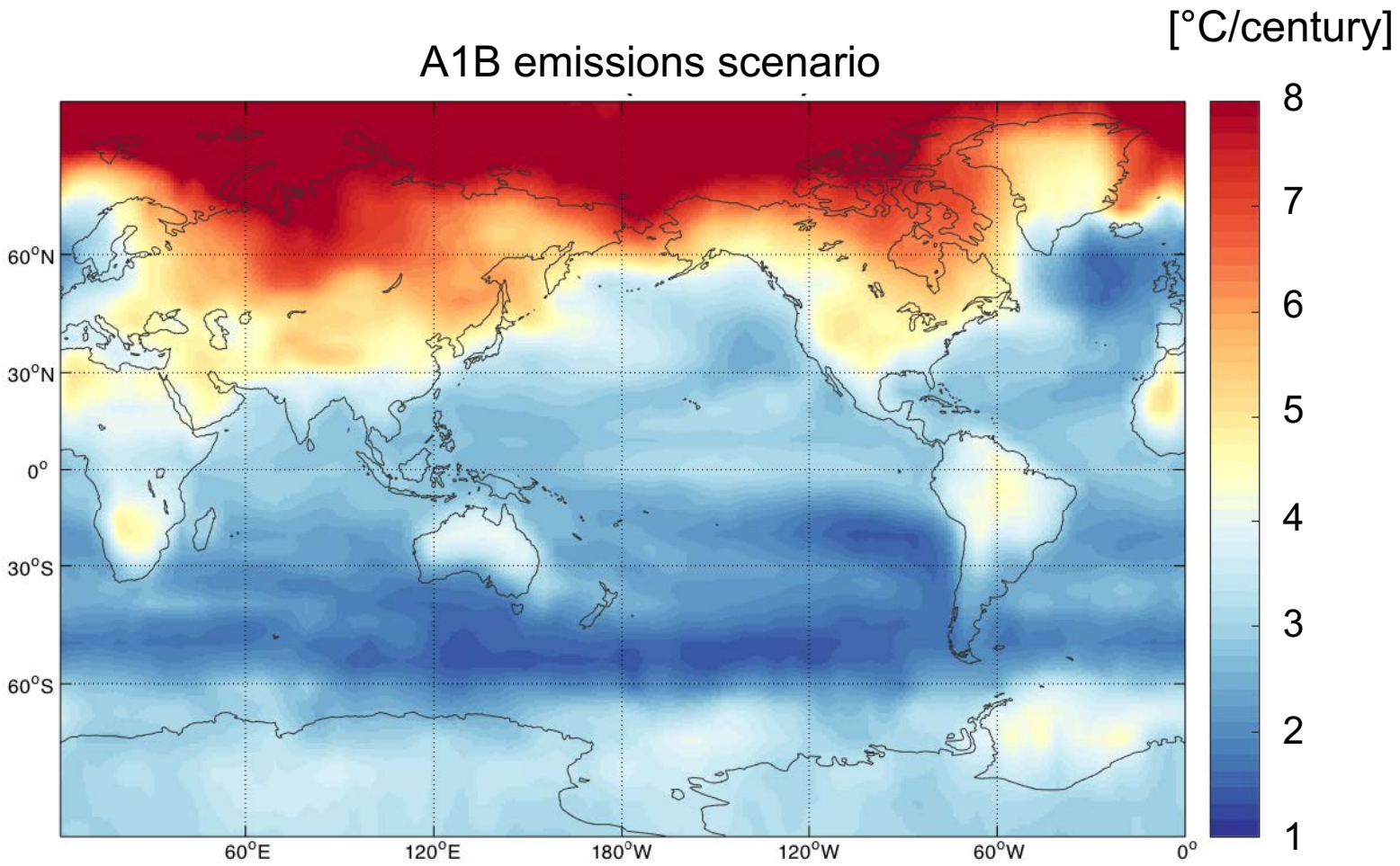


21st century warming rates

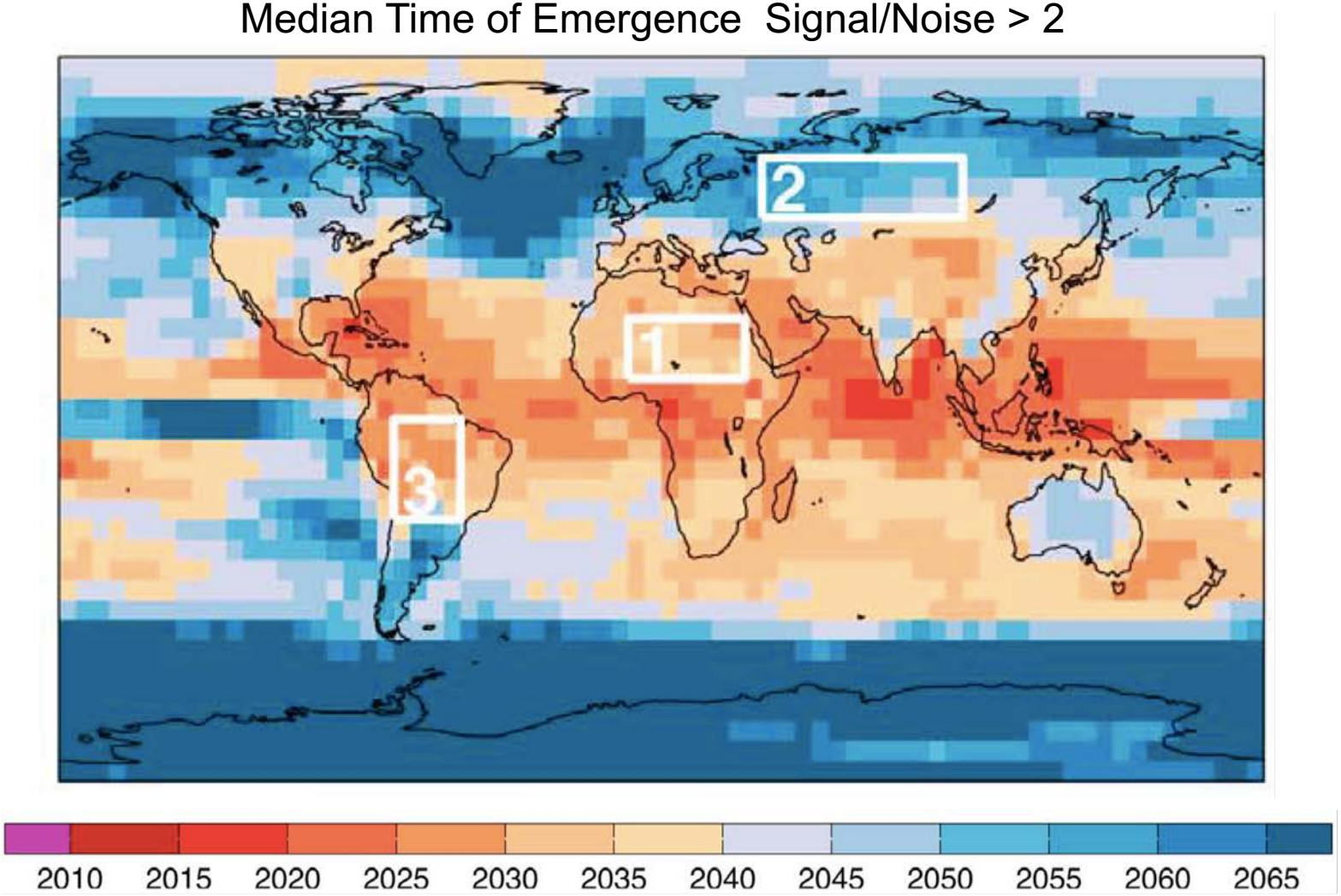


Time of Emergence Literature

Signal = anthropogenic trend
Noise = interannual variability

Median Time of Emergence Signal/Noise > 2

April-Sept



Hawkins and Sutton (2012), *GRL*

Time of Steady Change: Research Questions

- How do we define this transition time?

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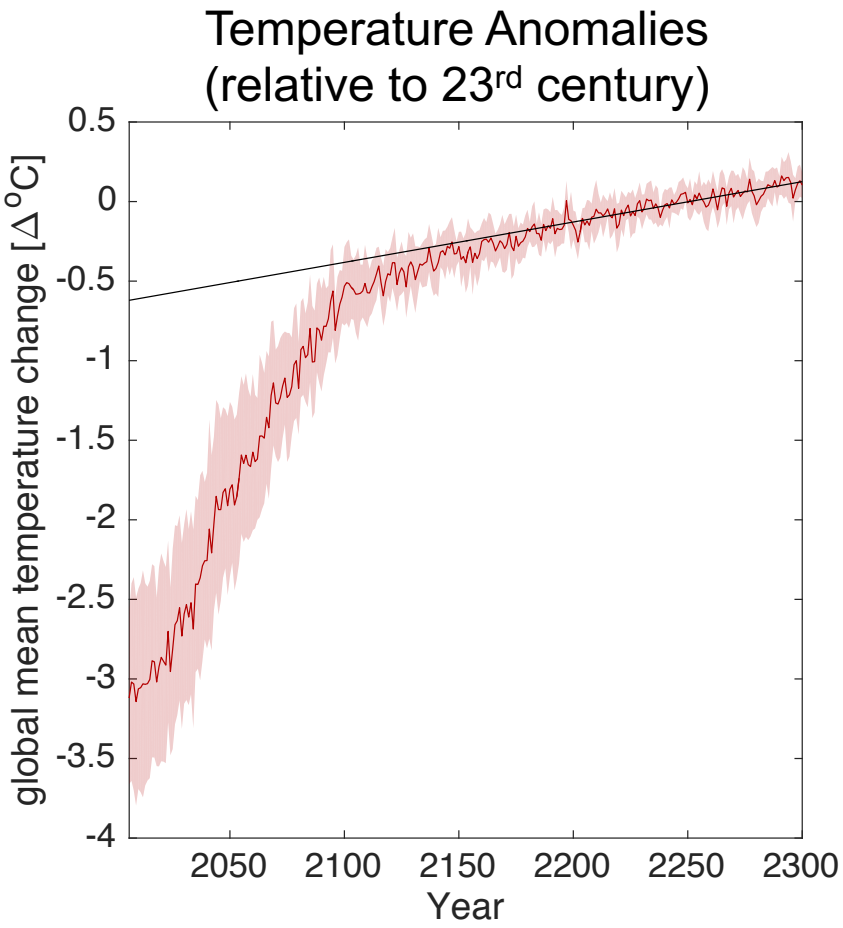
- How do we define the transition time between stages 2 and 3?
- What is the geographic variability of the Time of Steady Change (TSC)?

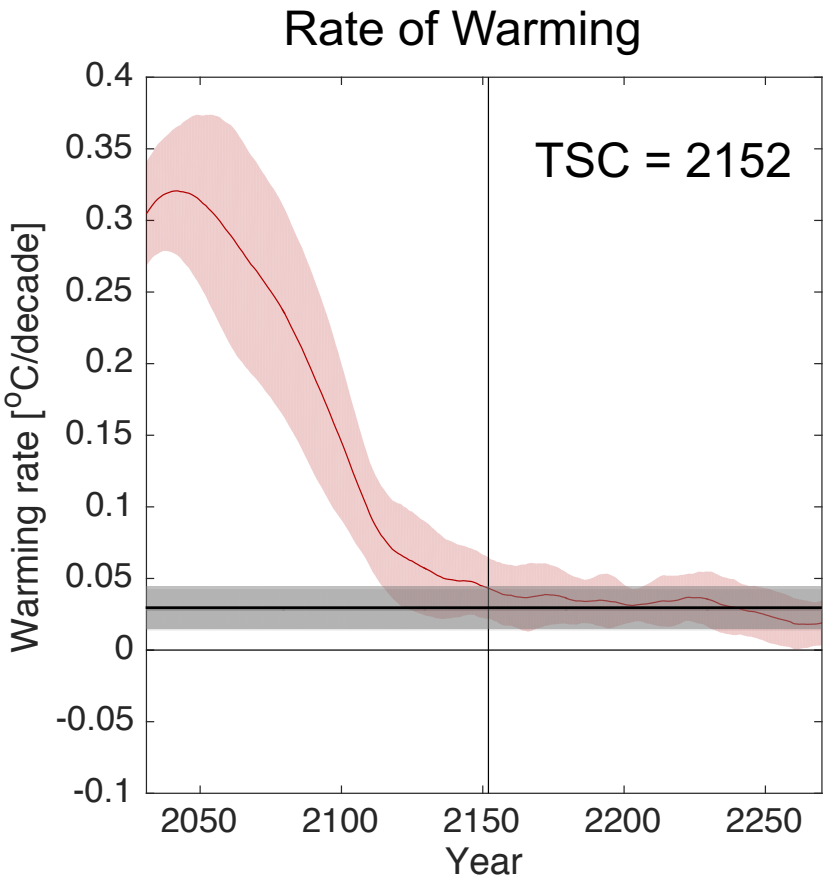
Time of Steady Change: Methods

Climate Data

- Use climate model simulations all forced by ‘constant composition’ commitment emissions scenarios:
  RCP 4.5 (17 models), A1B (10 models), B1 (11 models)

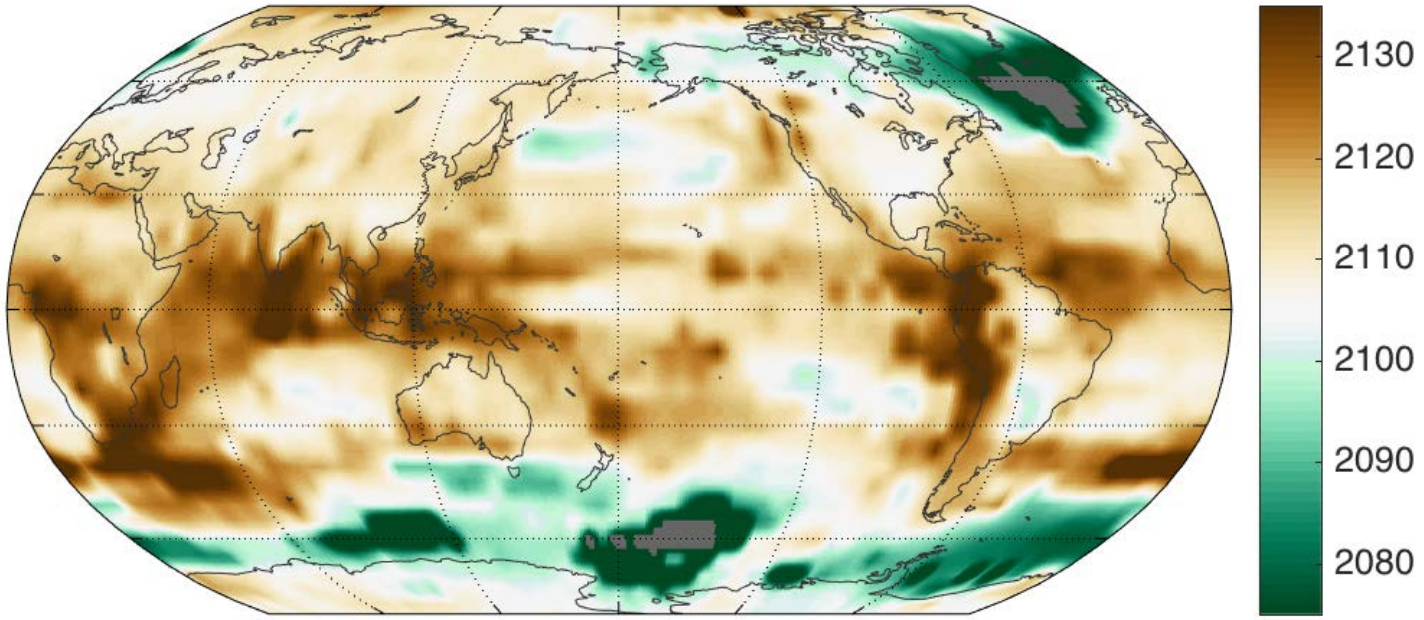
Defining the Time of Steady Change





Lickley et al. (2019)

TSC occurs latest in the tropics and the Arctic



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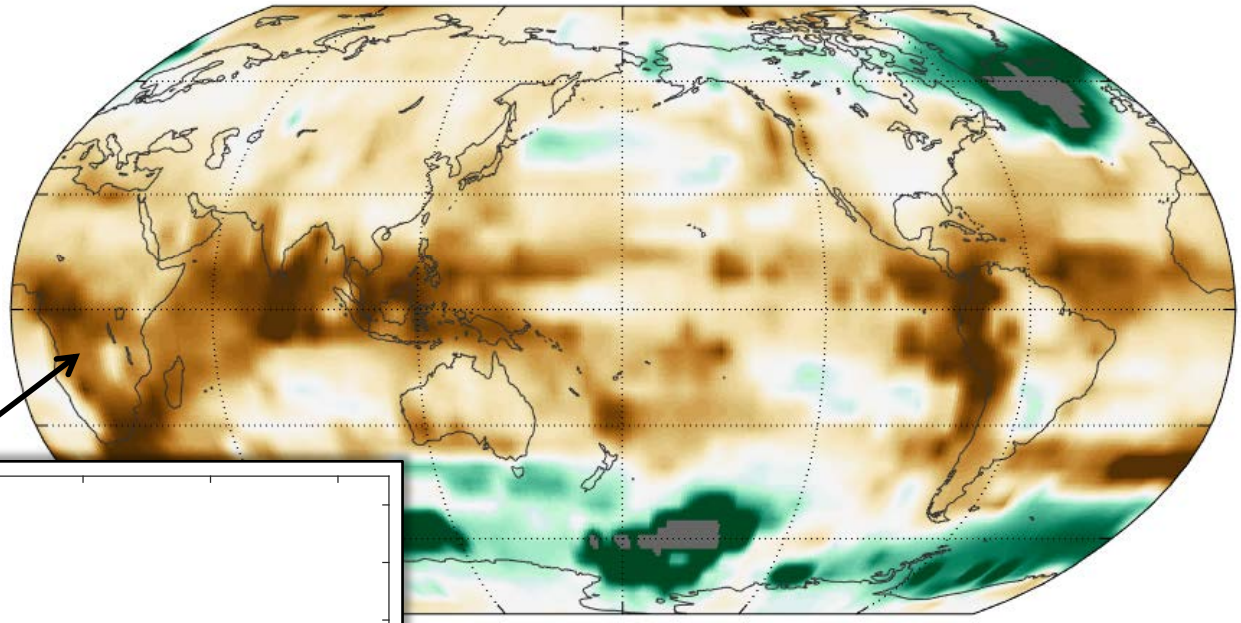

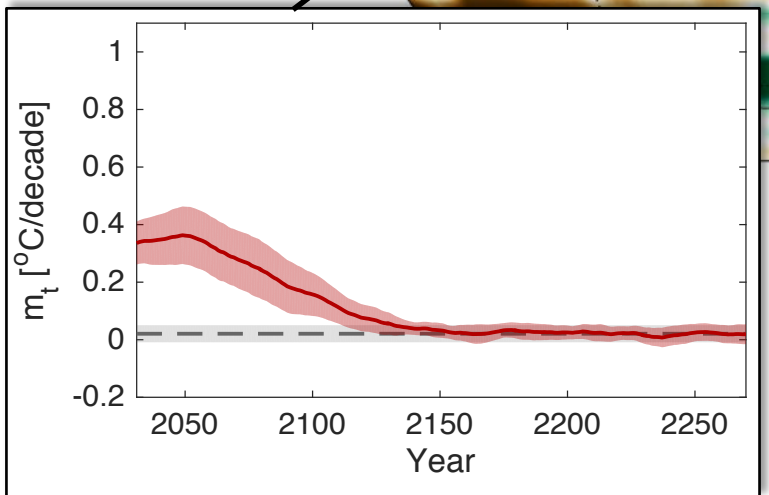

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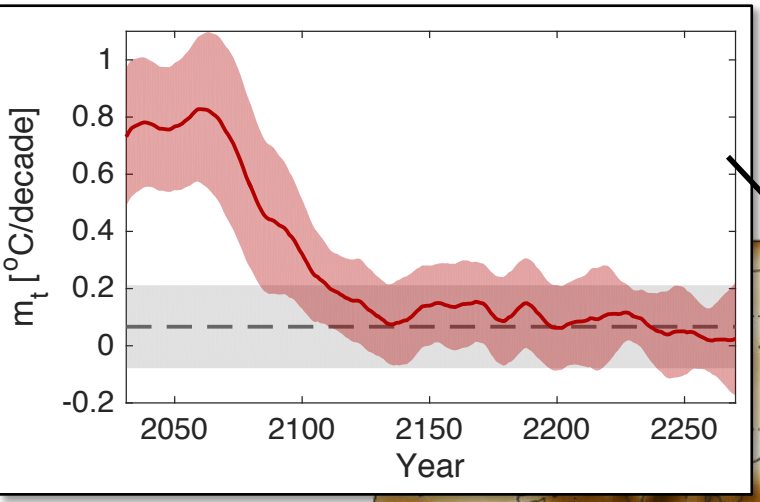

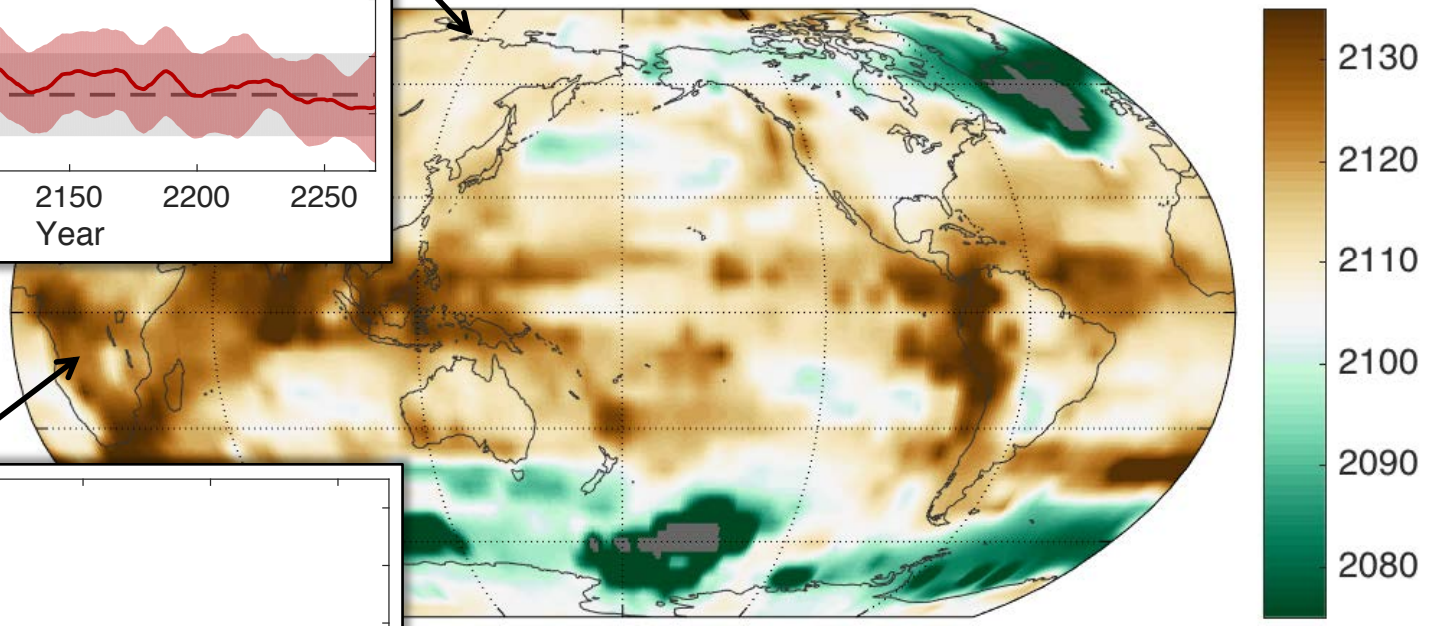

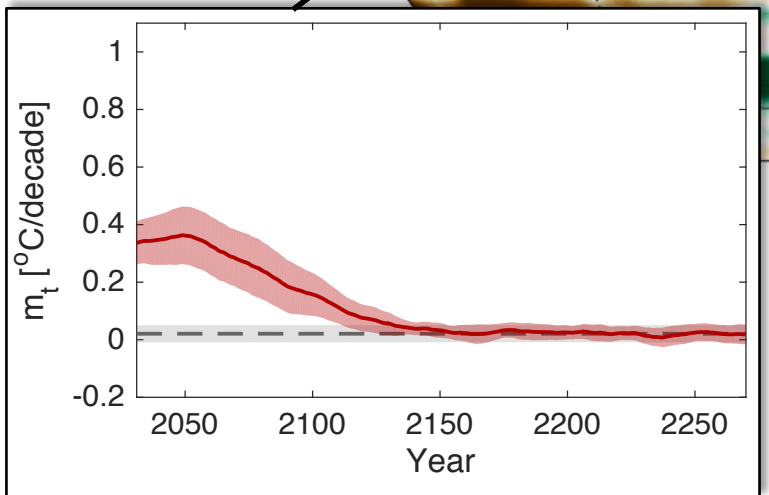

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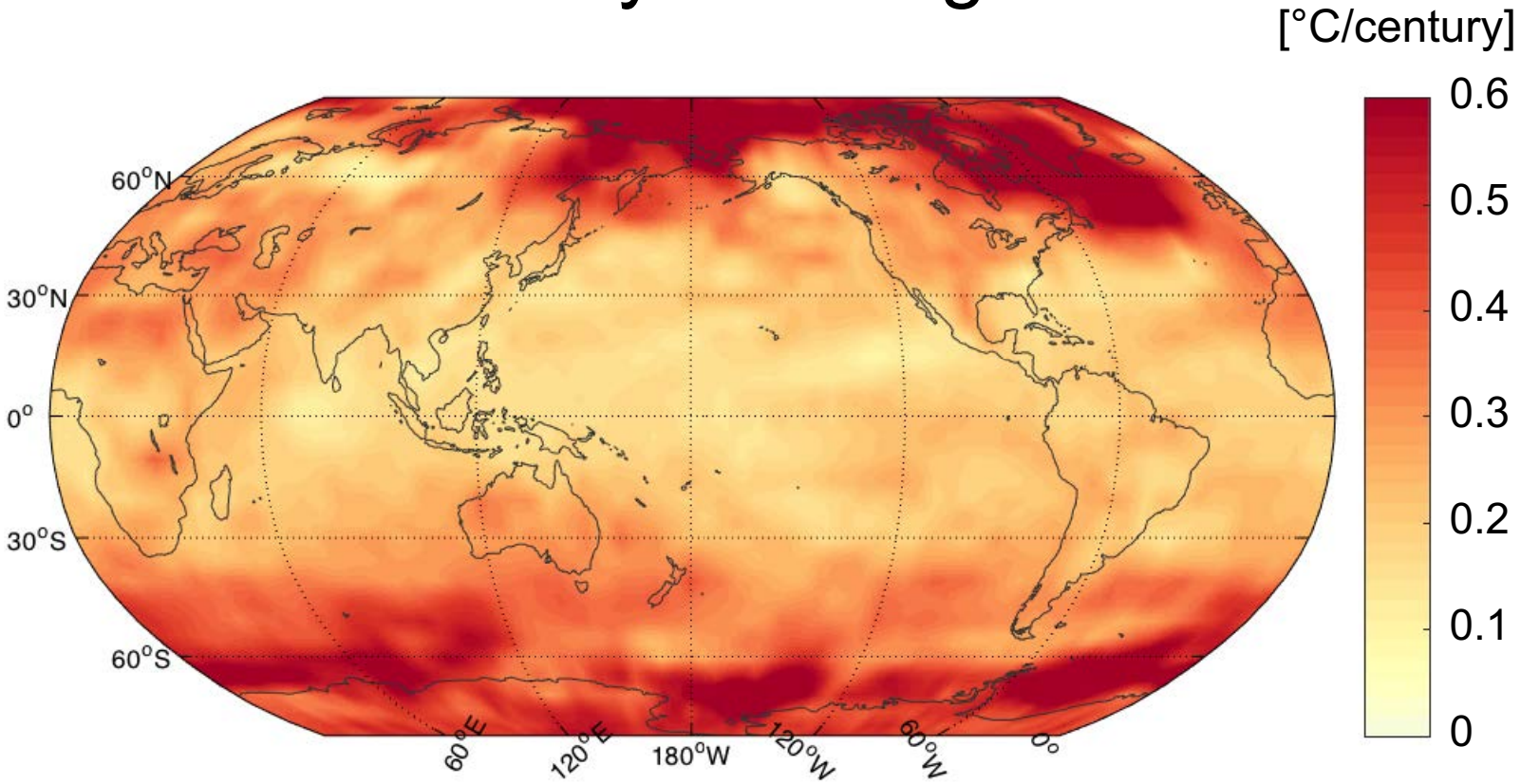

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Is a global goal to stabilize greenhouse gas concentrations sufficient?

Thank you!