

Year of significant emergence of changes in temperature over land regions (S/N>2)

Observational Uncertainty Delays the Detection of Regional Surface Warming Trends

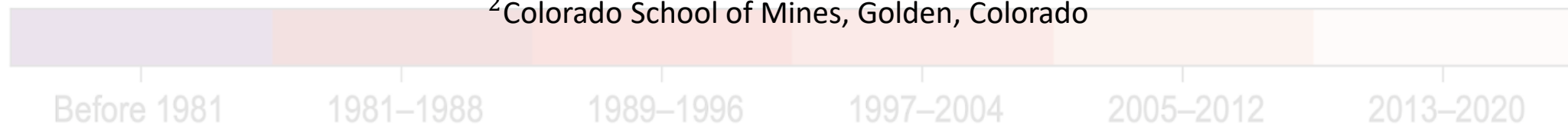
Jonah Shaw¹ and Nathan Lenssen²

Climate Variability & Change Working Group Meeting

03.06.2024

¹Dept. Atmospheric and Oceanic Sciences and Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder

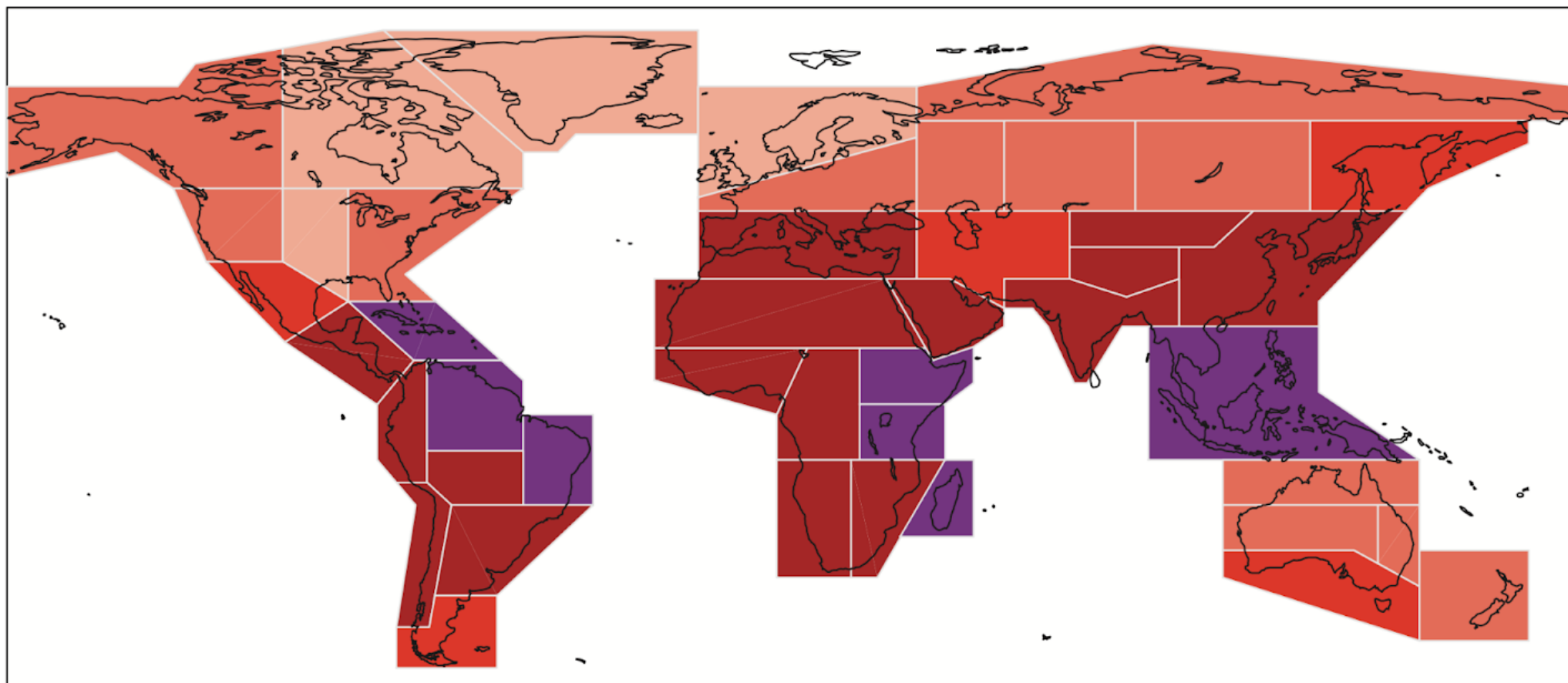
²Colorado School of Mines, Golden, Colorado



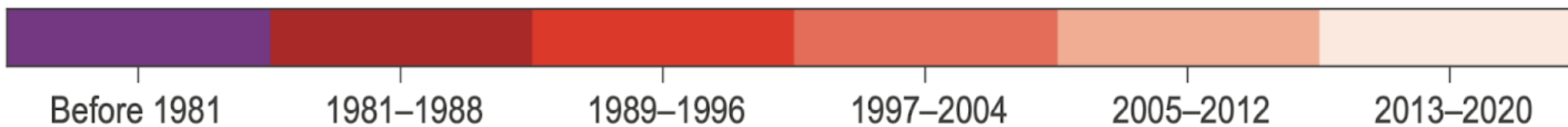
Dataset: Berkeley Earth. Temperature changes relative to 1850-1900.



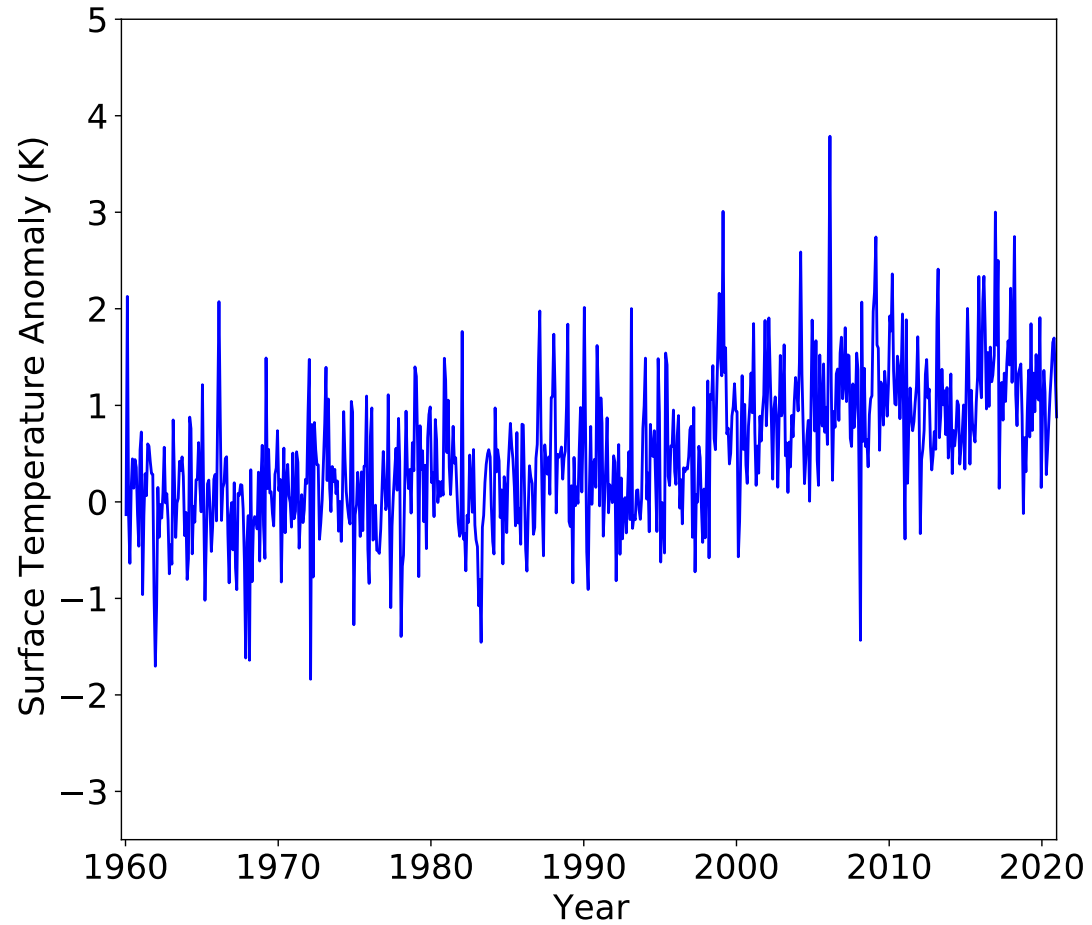
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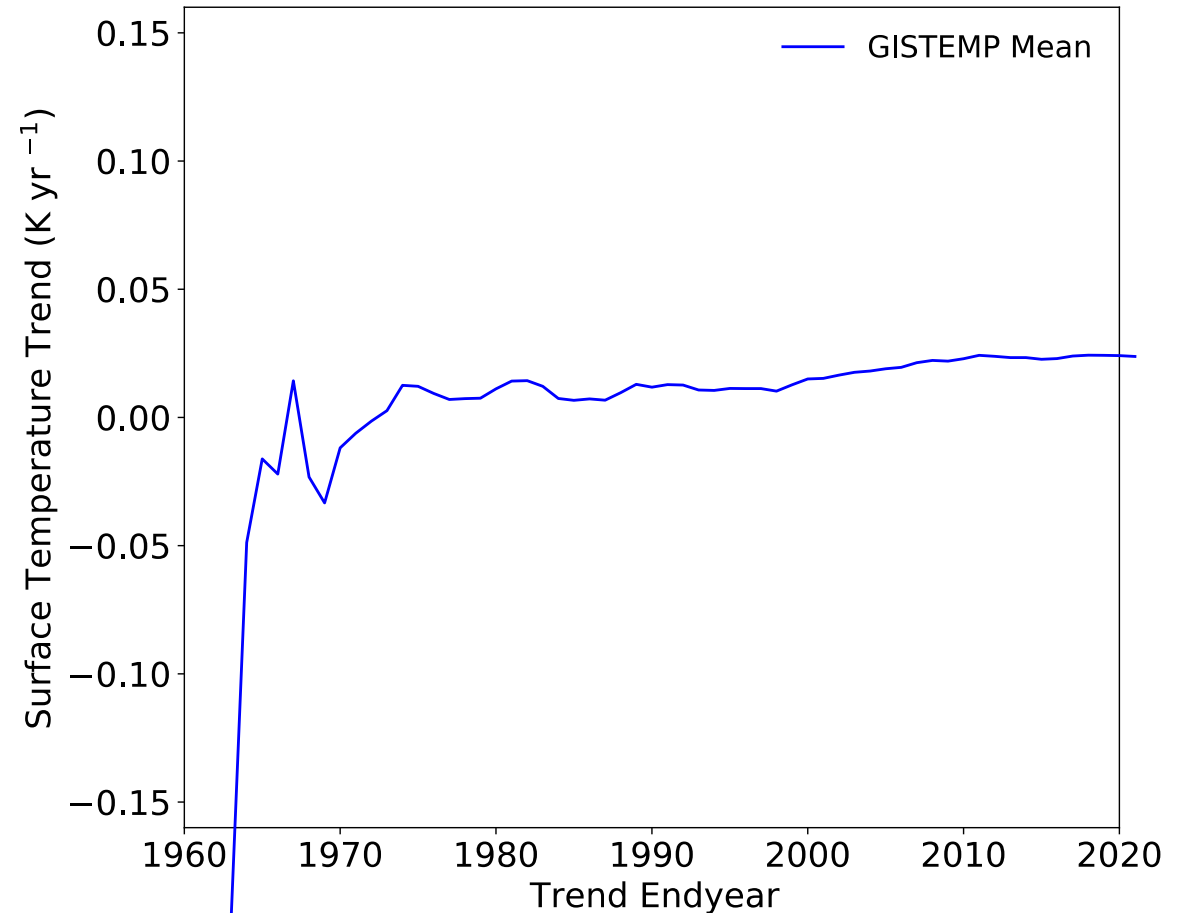
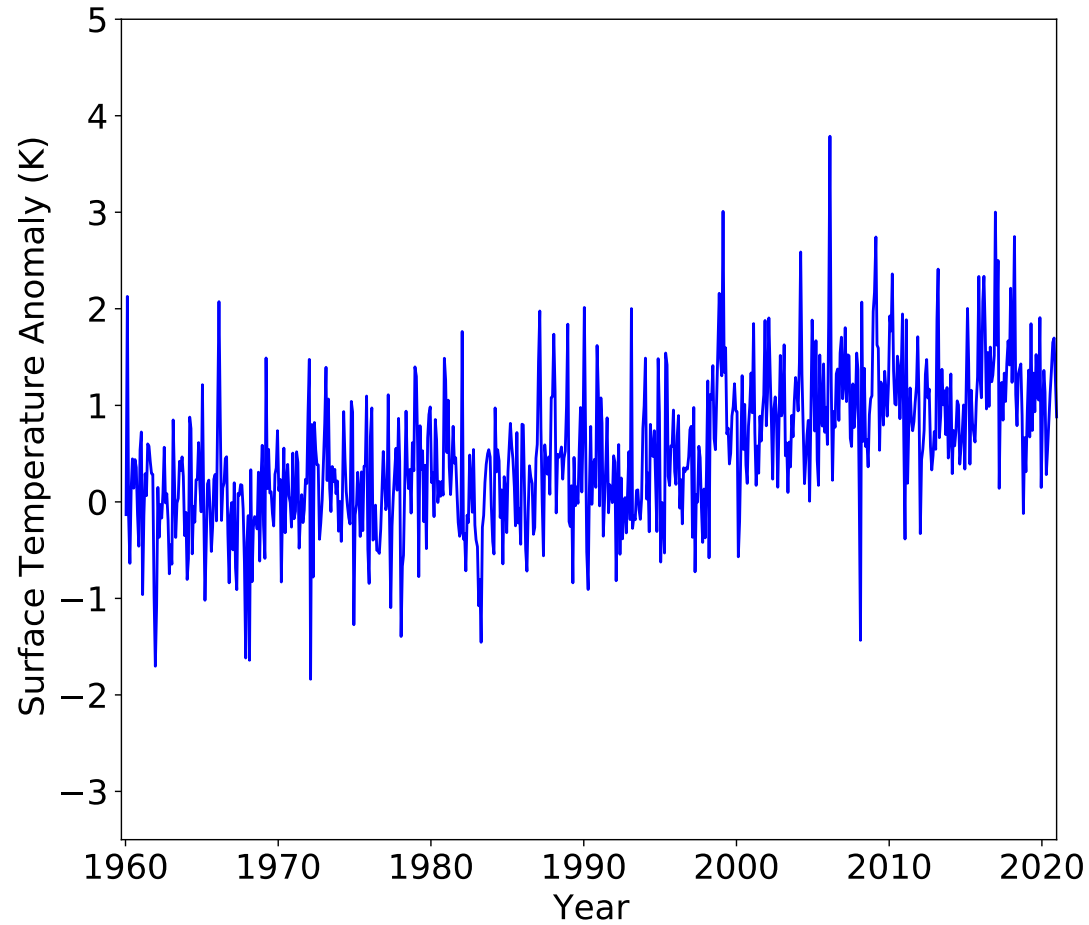
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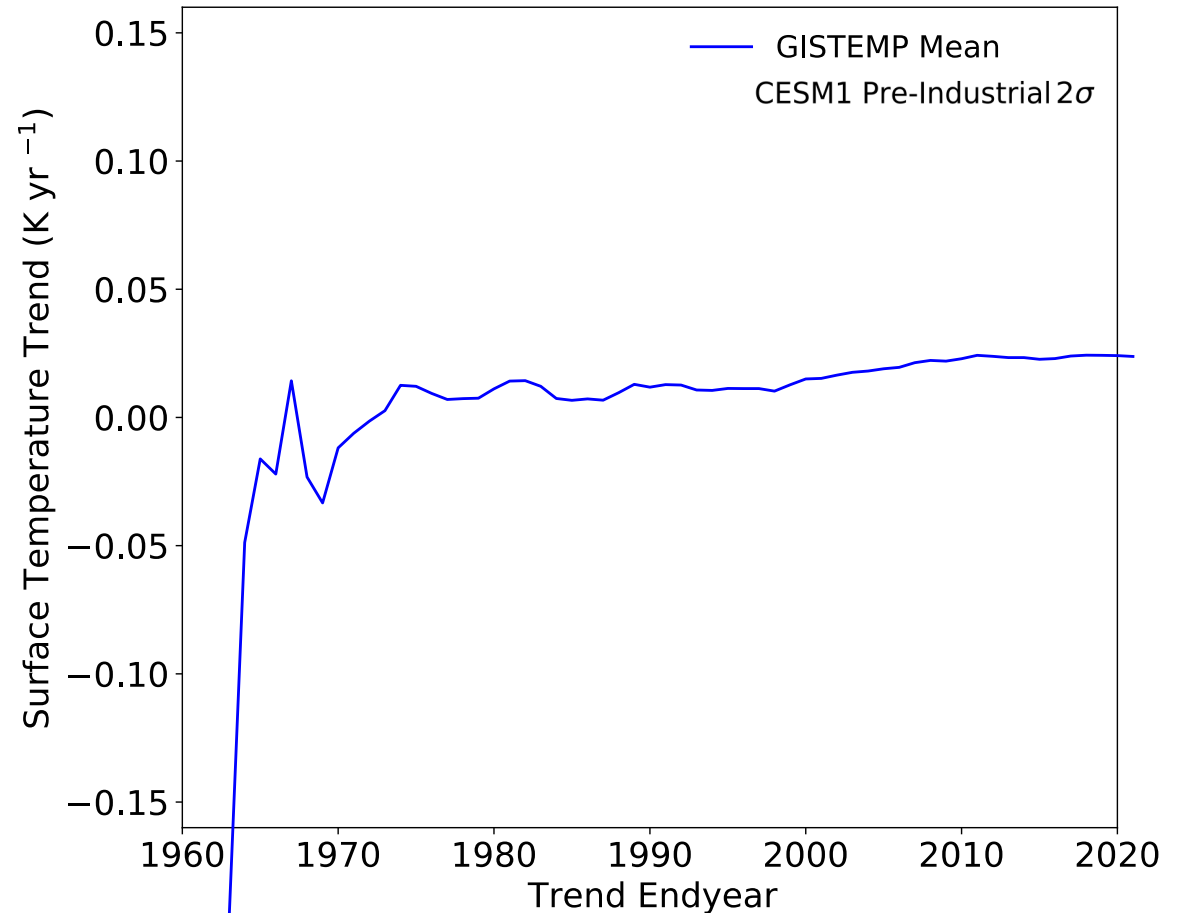
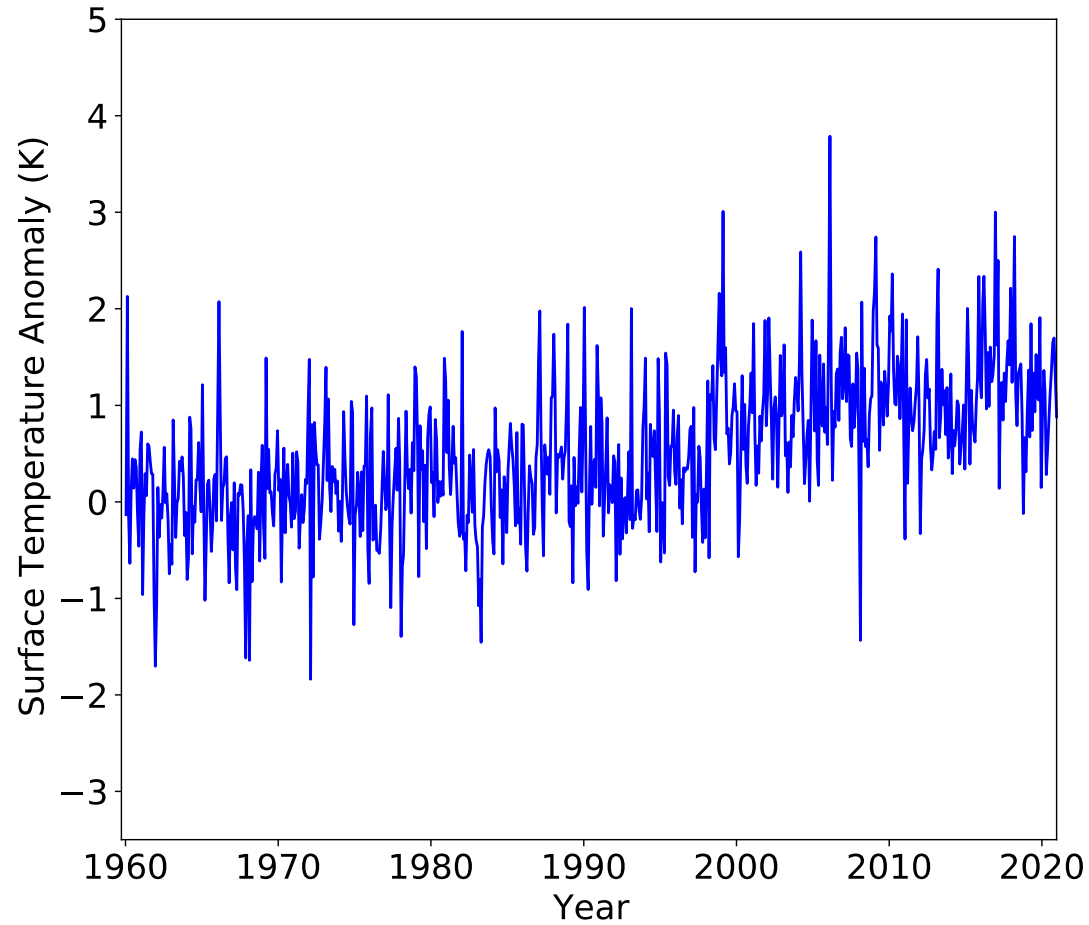
Emergence: Observed trends exceed natural variability



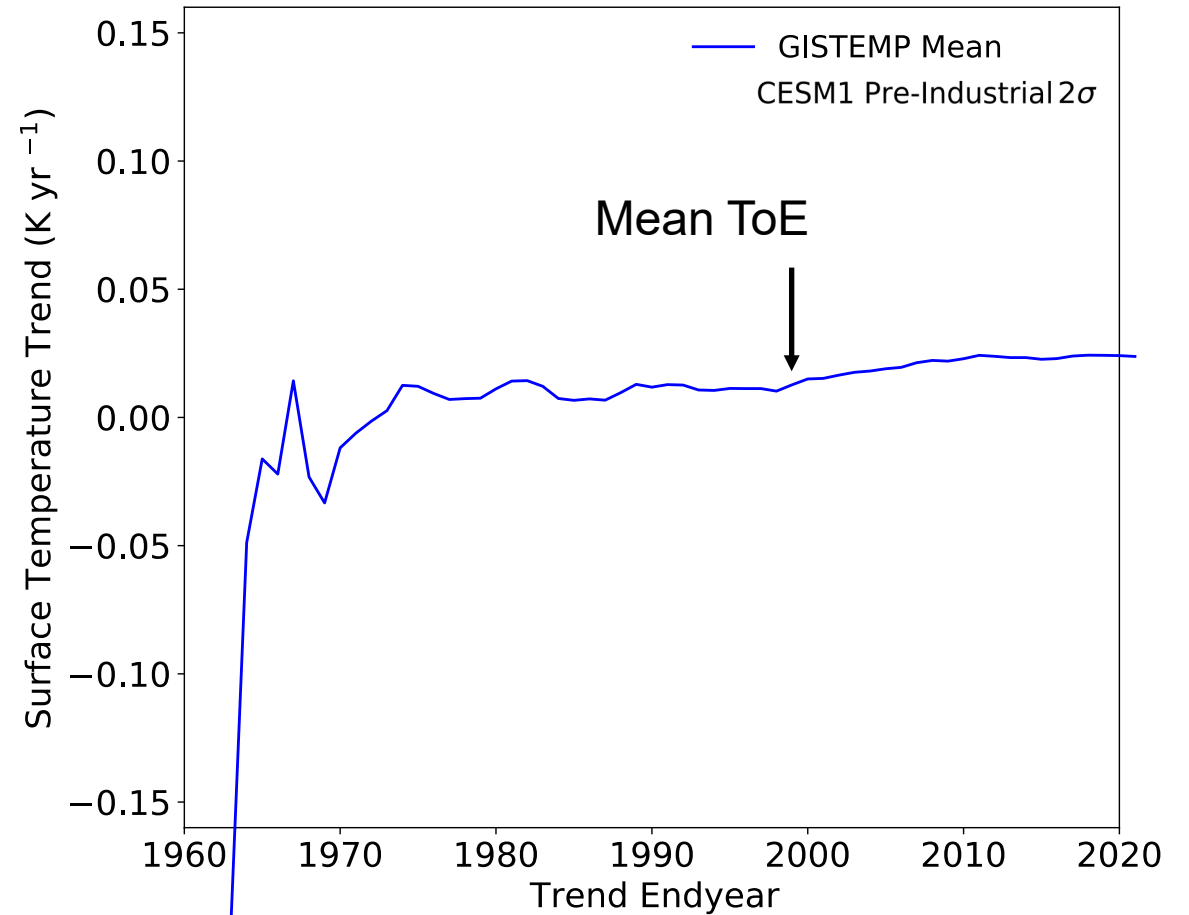
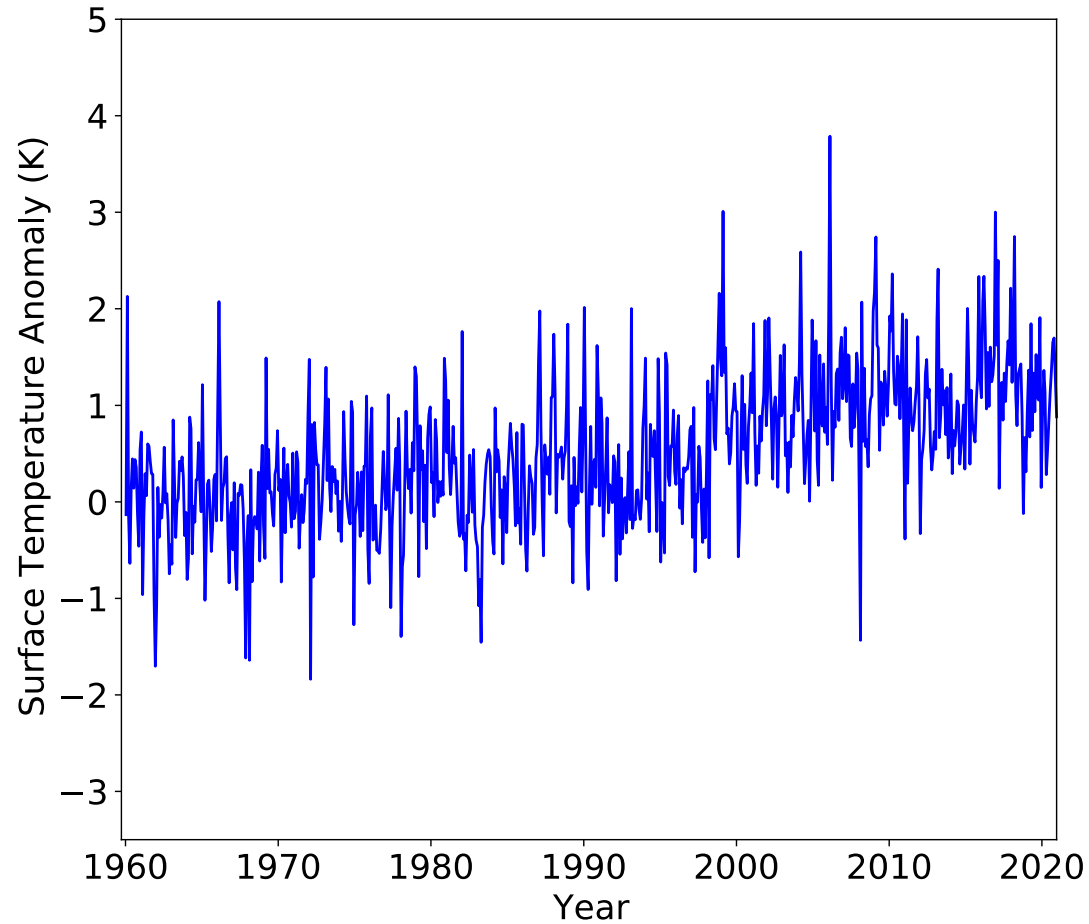
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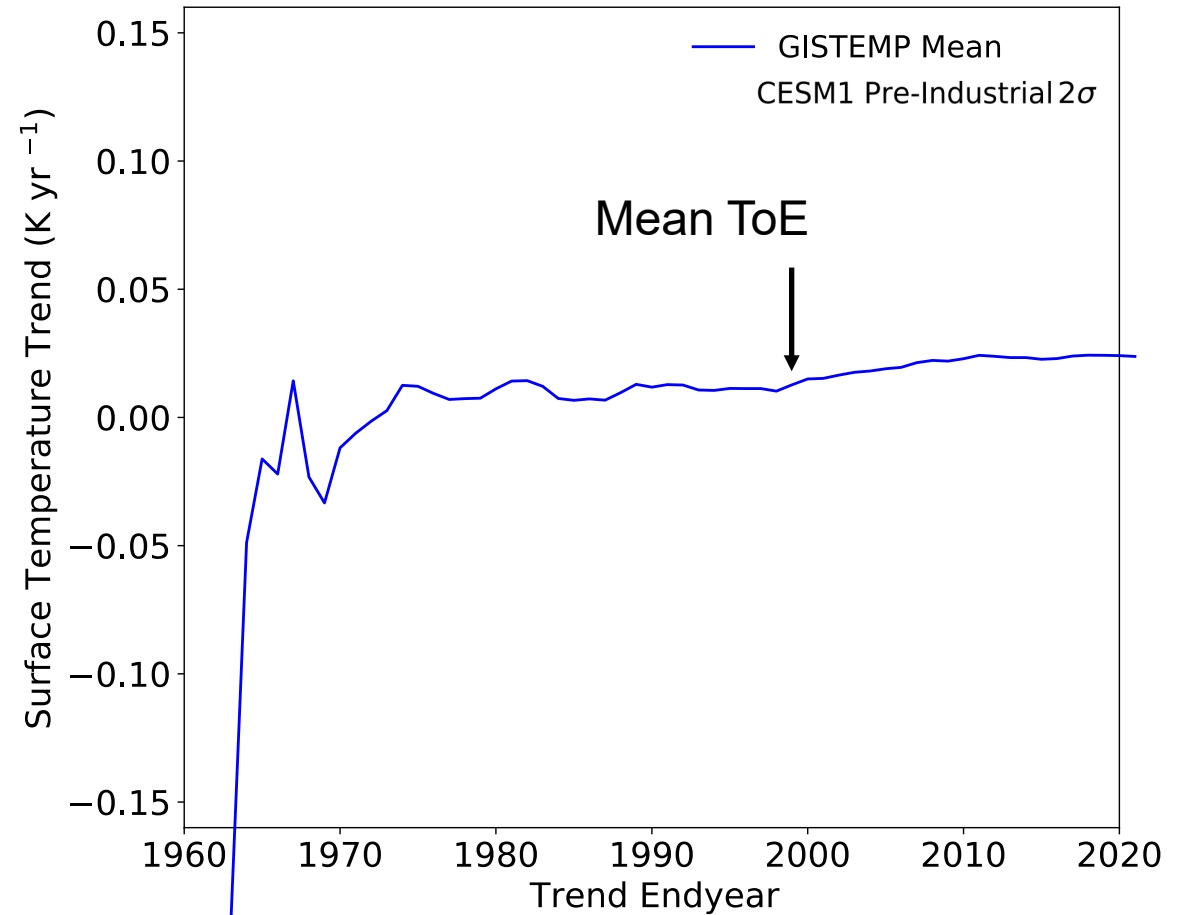
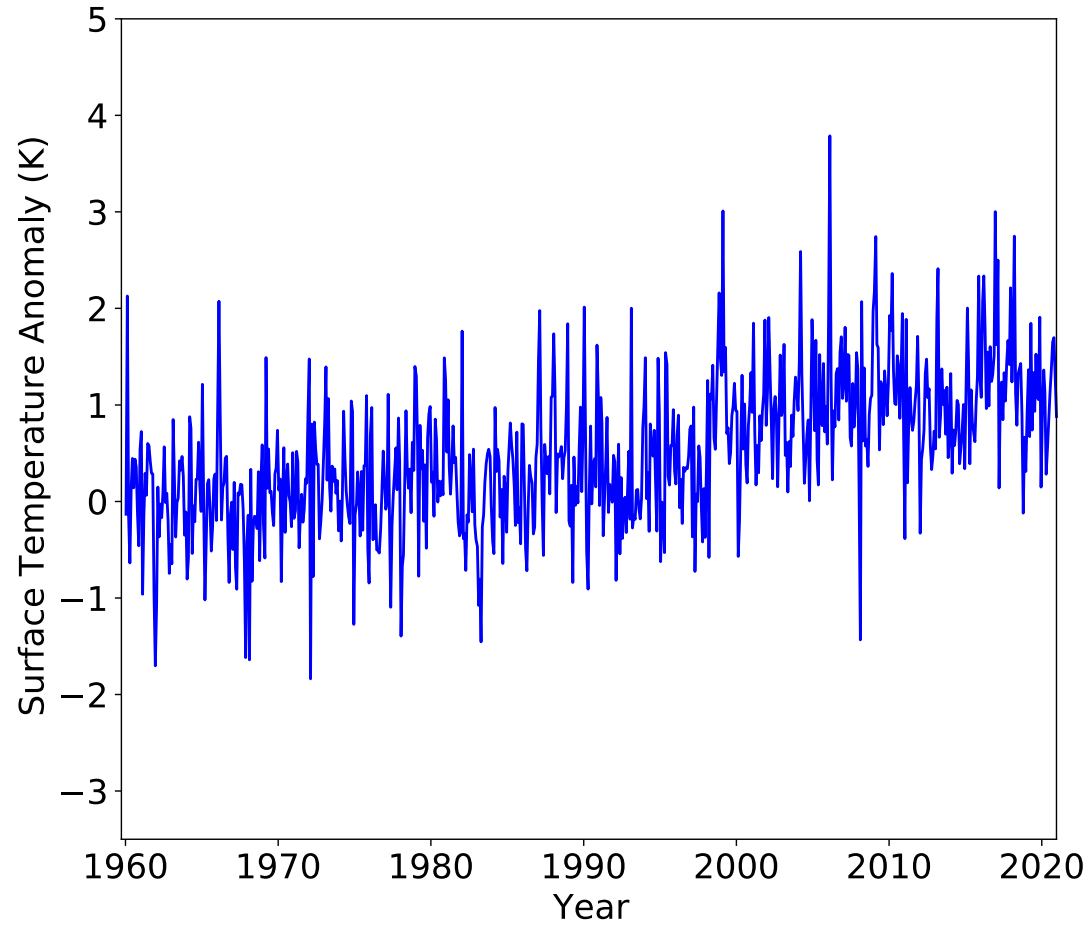
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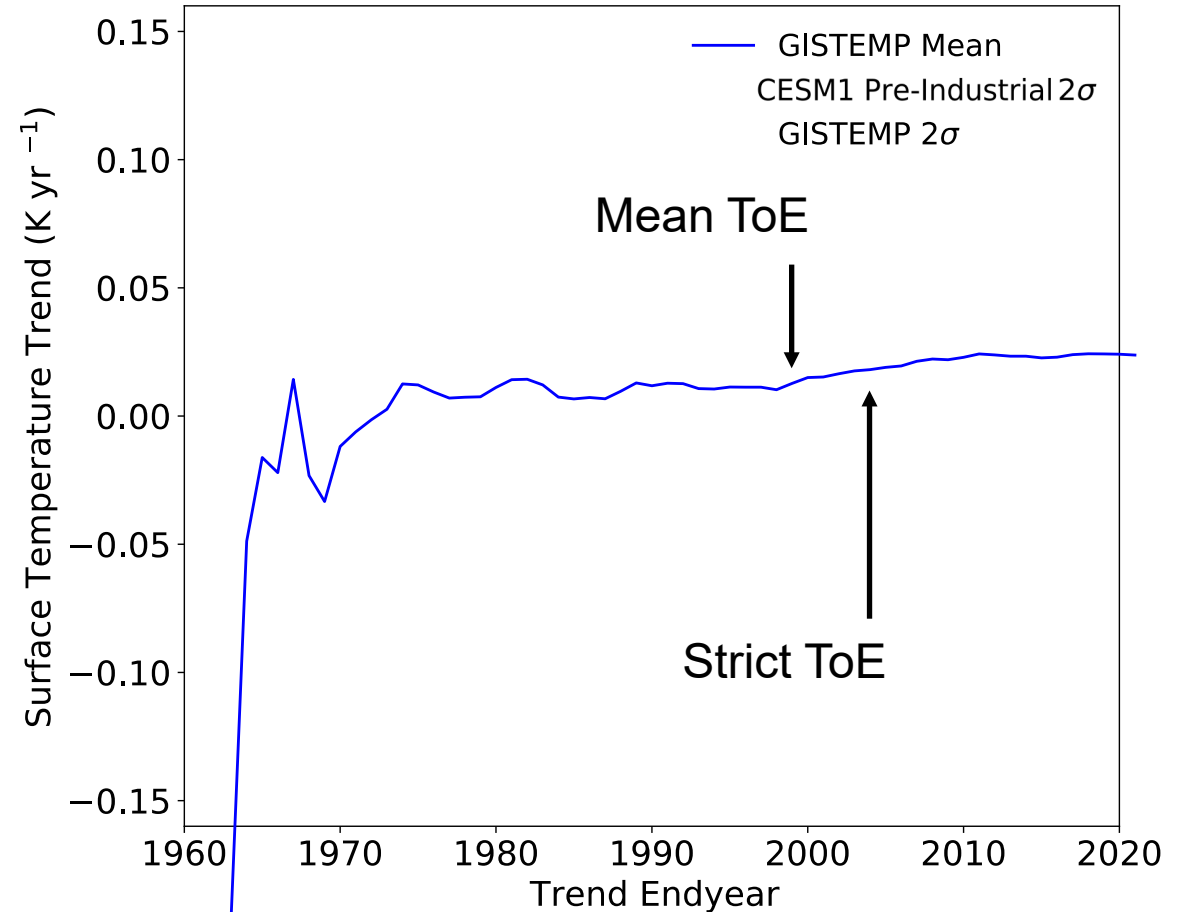
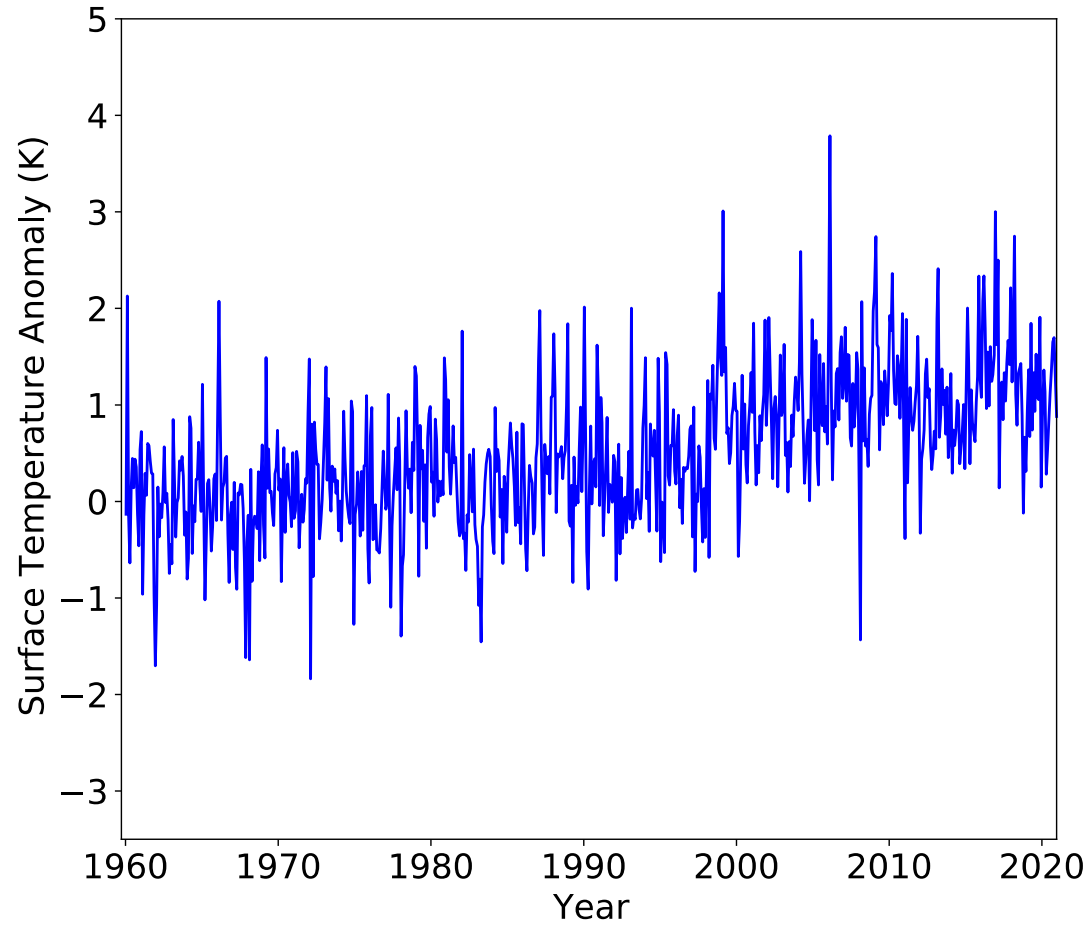
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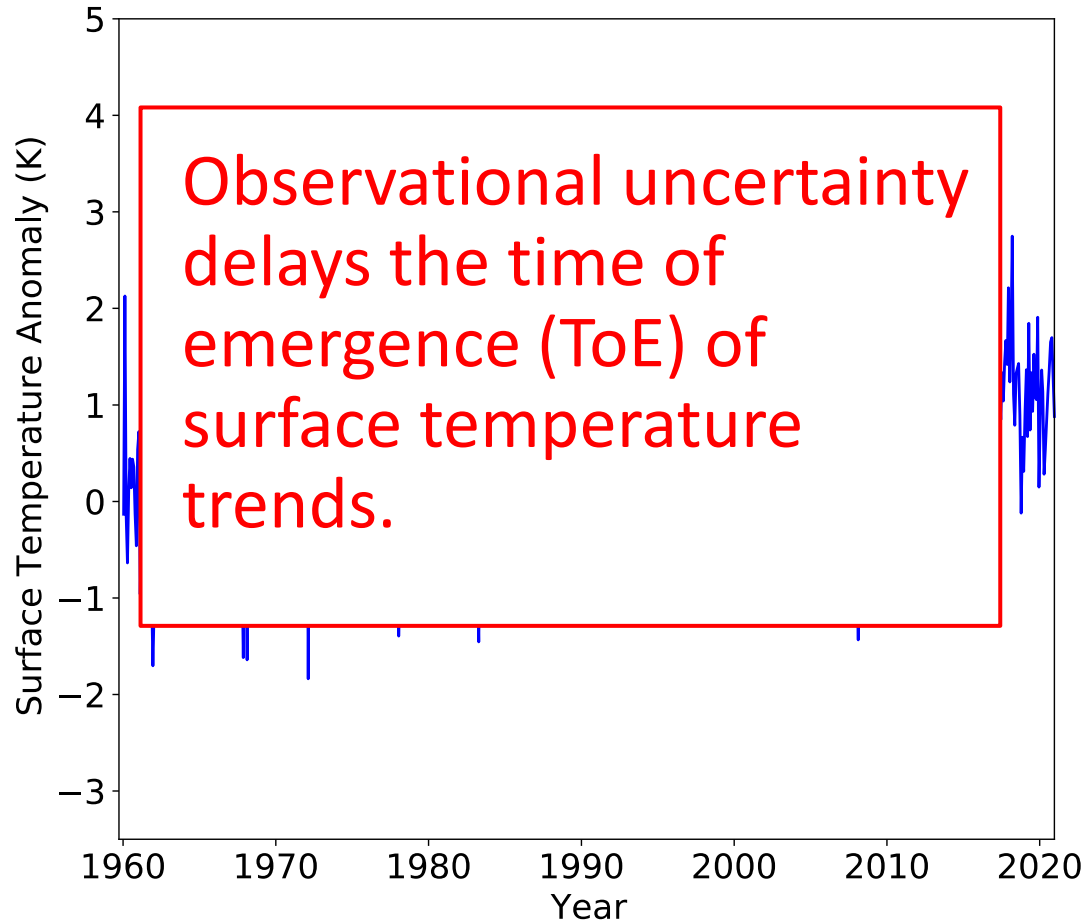
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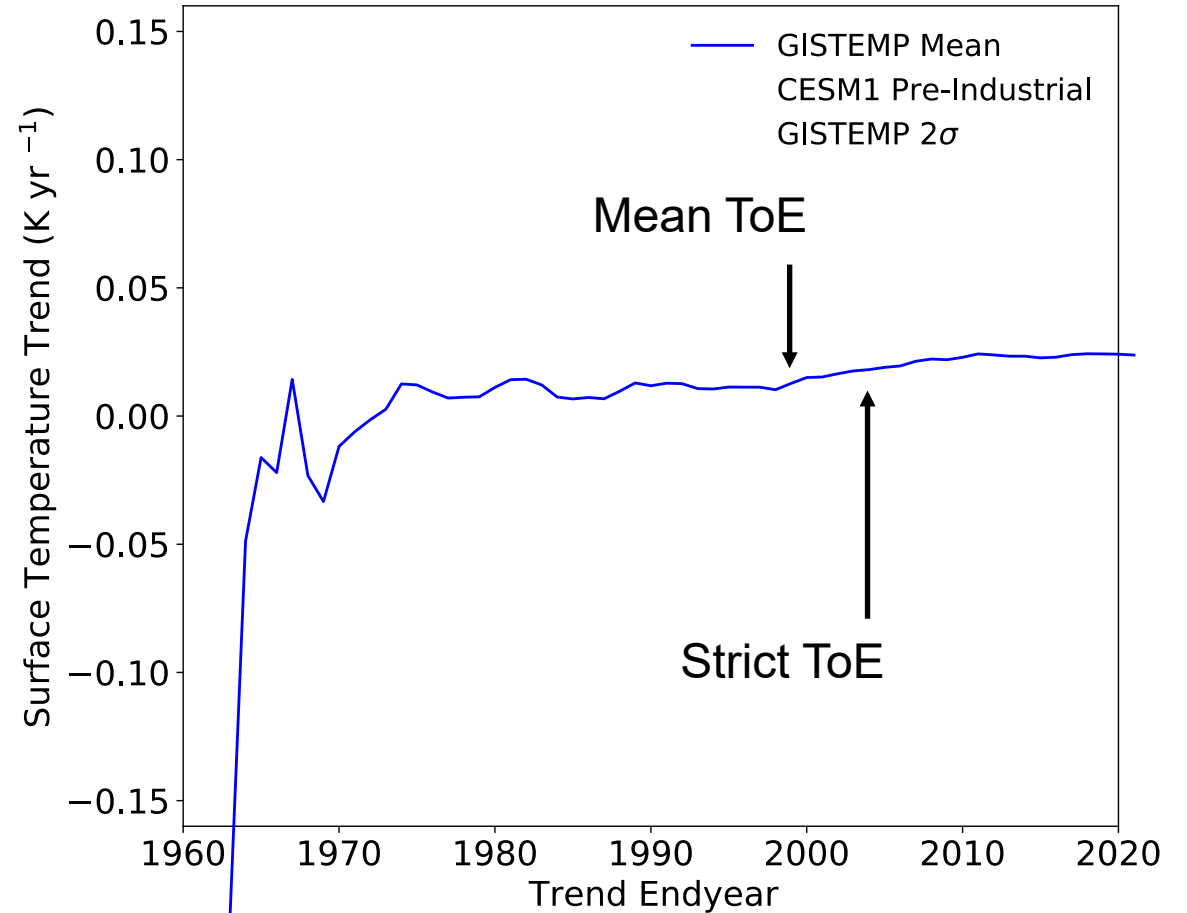
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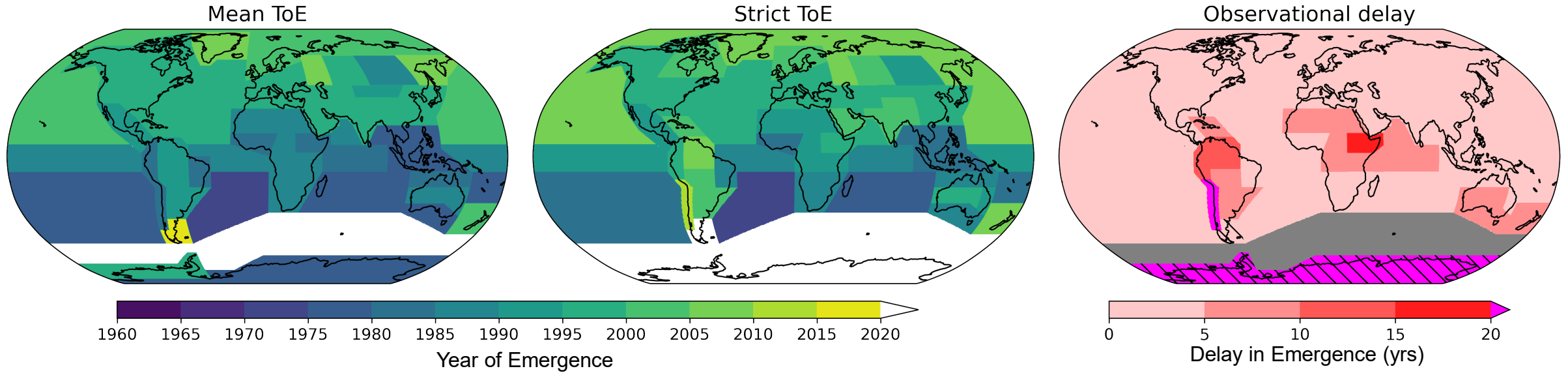
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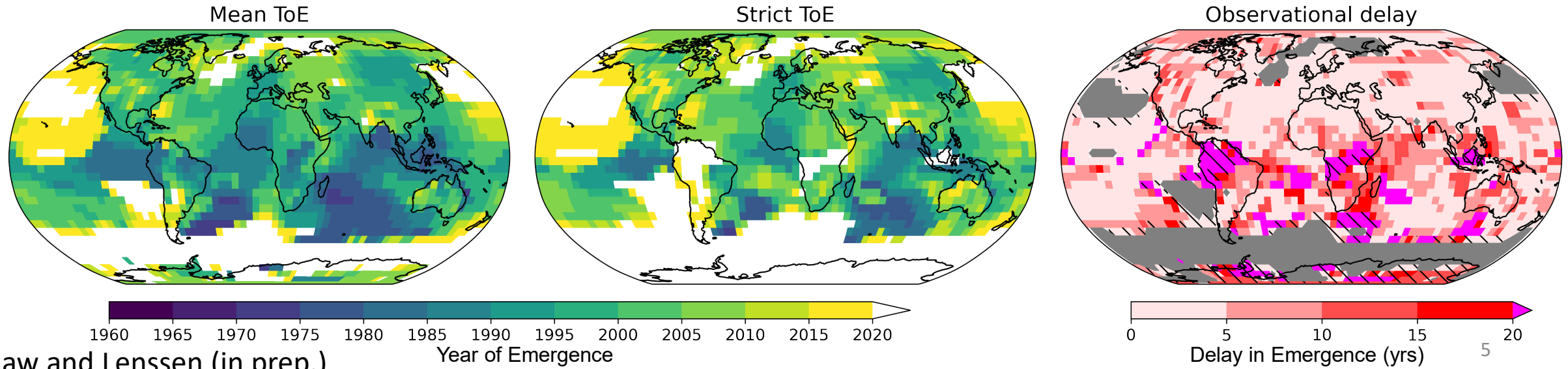
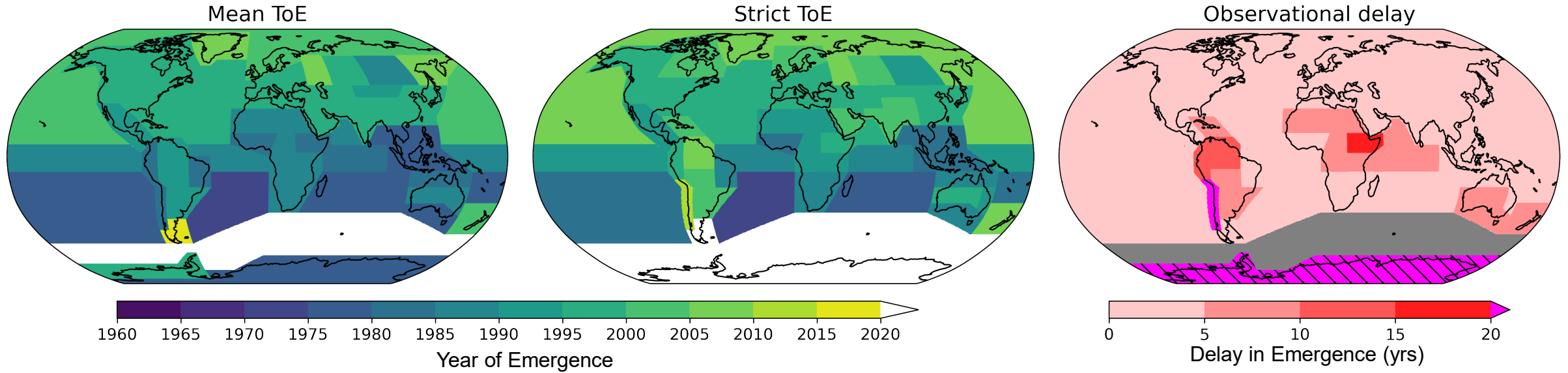
Tibetan-Plateau. Mean ToE: 1999, Strict ToE: 2003



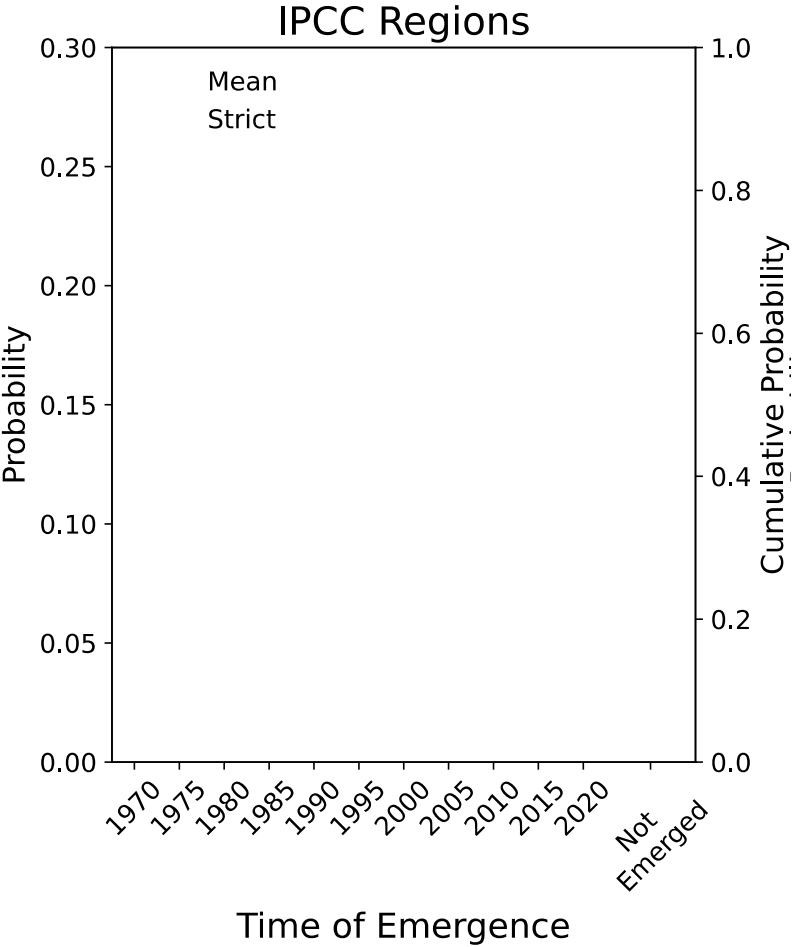
Where does observational uncertainty delay climate change detection?



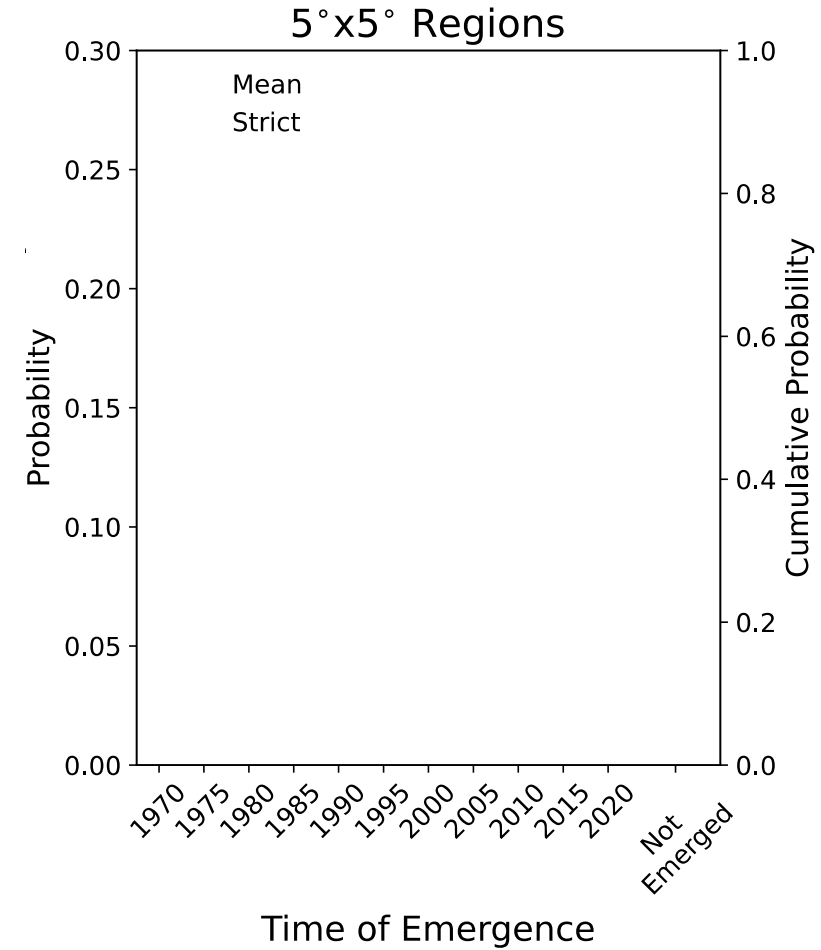
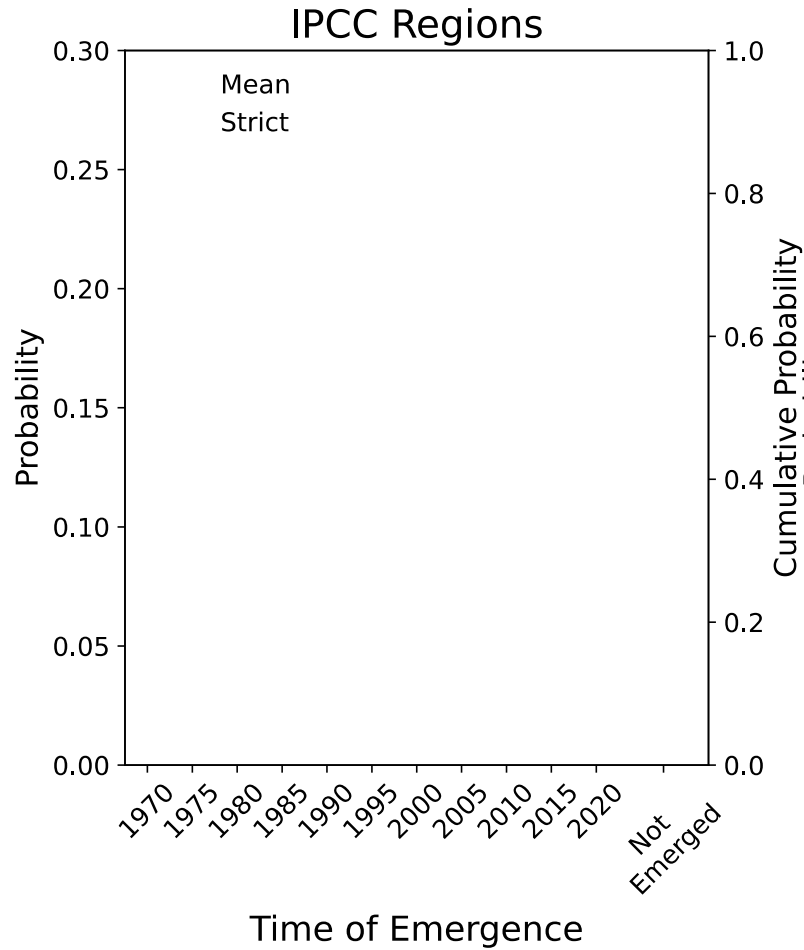
How does spatial averaging influence climate change detection?



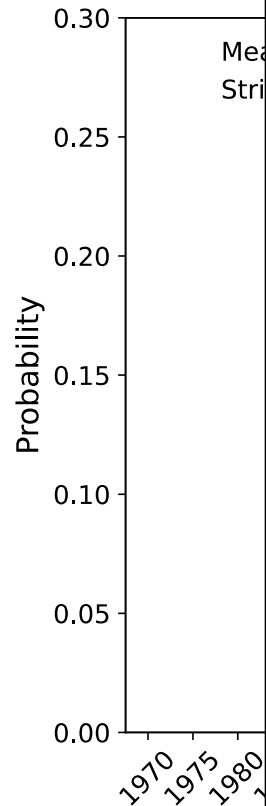
How does accounting for observational uncertainty delay our ability to detect warming?



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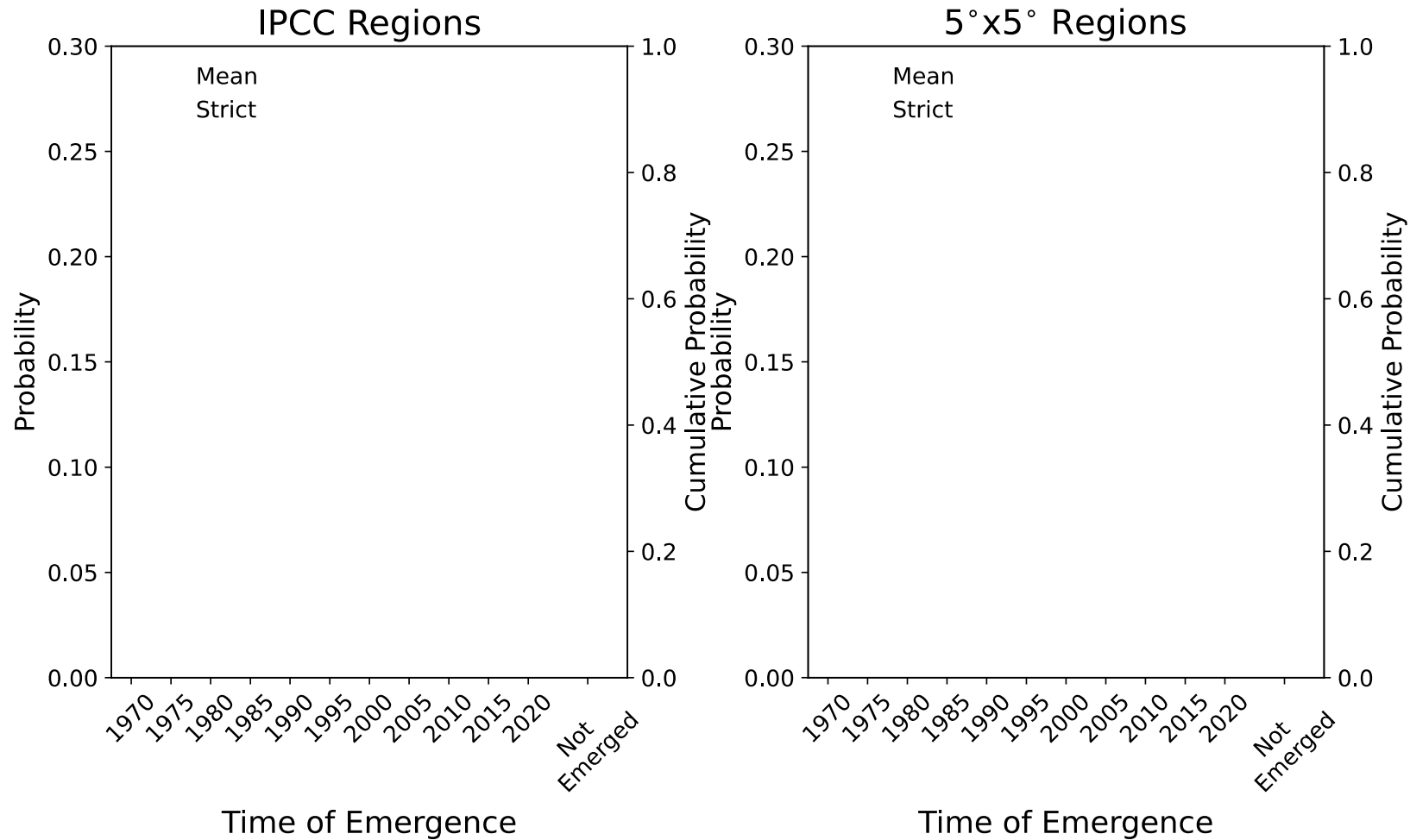


Time of Emergence calculations are repeated with:

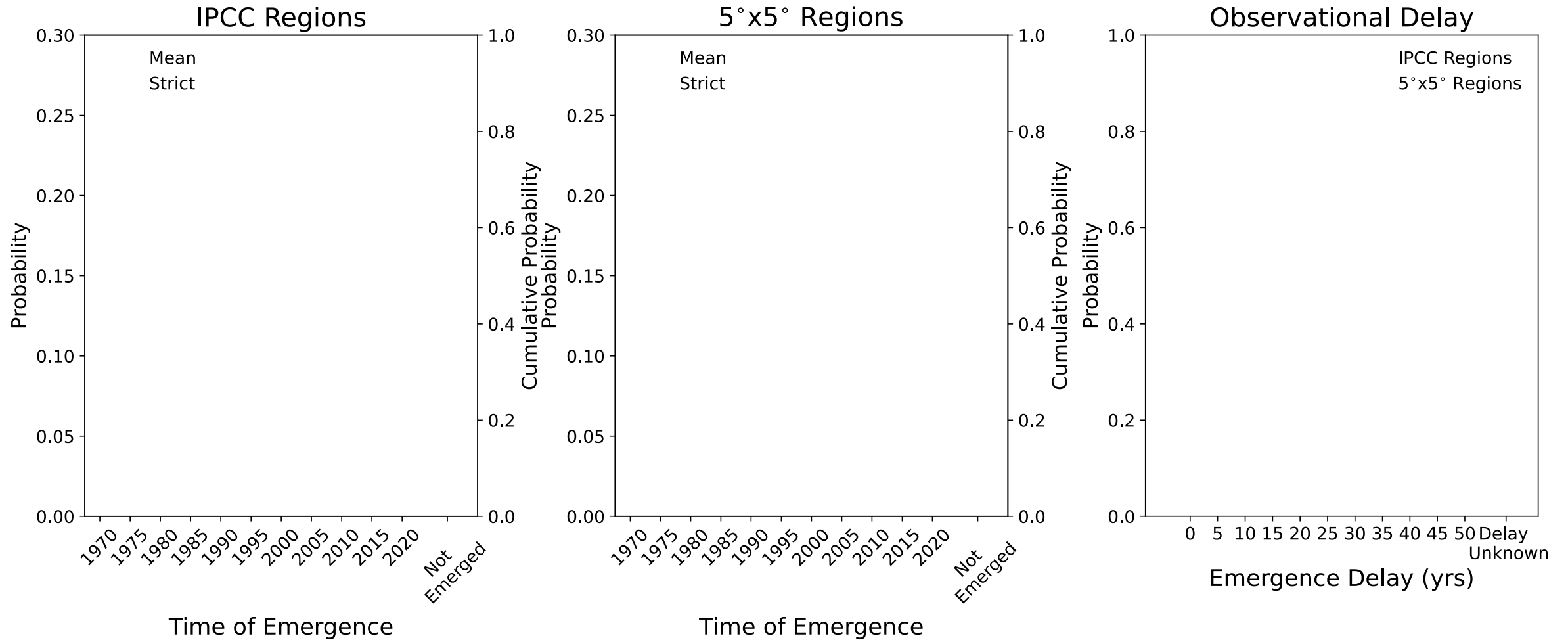
- 2 separate observational uncertainty products
- 4 climate models estimating internal climate variability
- 1 observational product estimating internal climate variability

$2 \times (4+1) = 10$ ways of estimating time-of-emergence

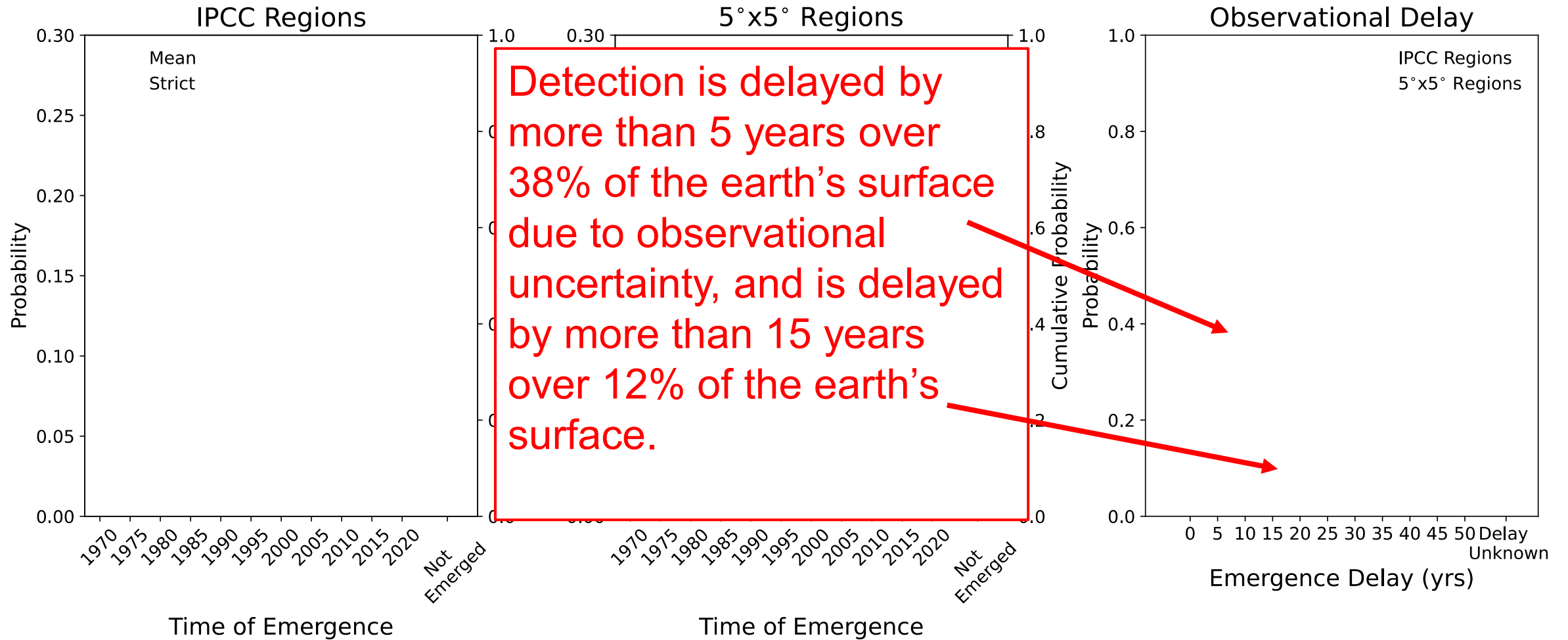
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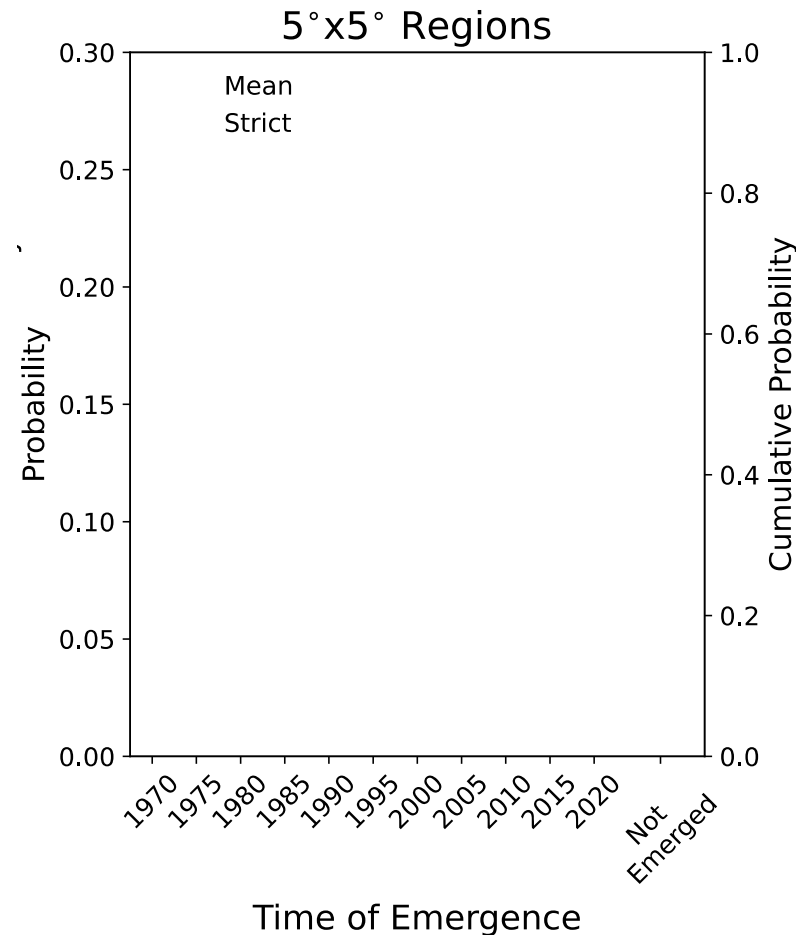
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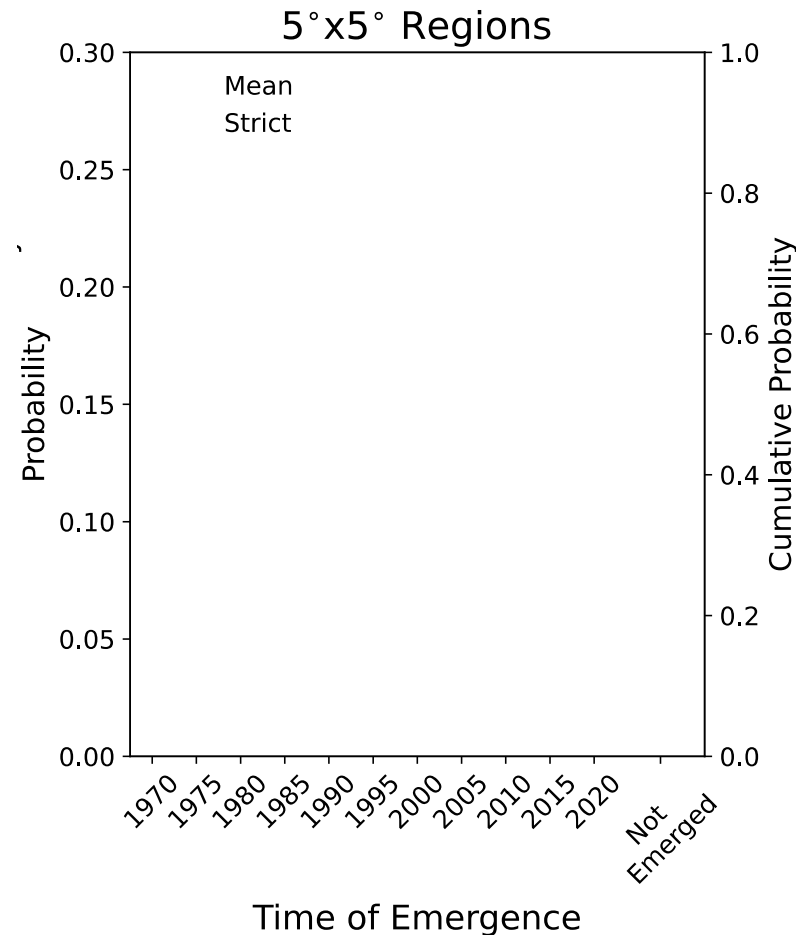


TAKEAWAY: Delays are significant, but warming is still widely detected



- Global warming is widely detectable over the earth's surface even when observational uncertainty is accounted for.
- Observational uncertainty delays detection by 5+ years over 38% of the earth's surface and by 15+ years over 12% of the earth's surface.
- Observational uncertainty ensembles make it possible to estimate the uncertainty of observed trends.

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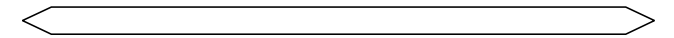
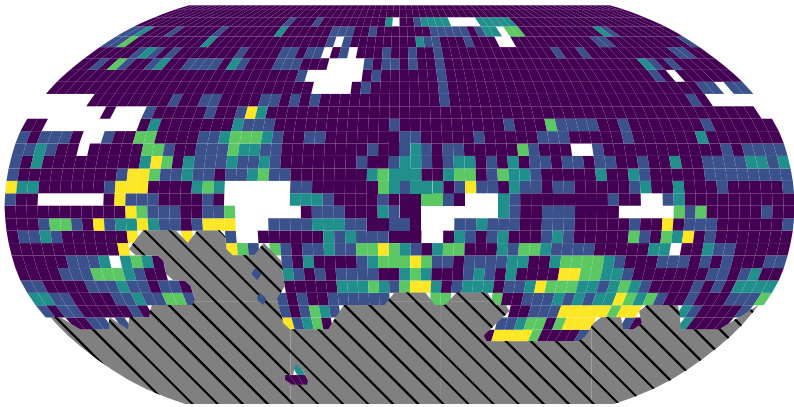


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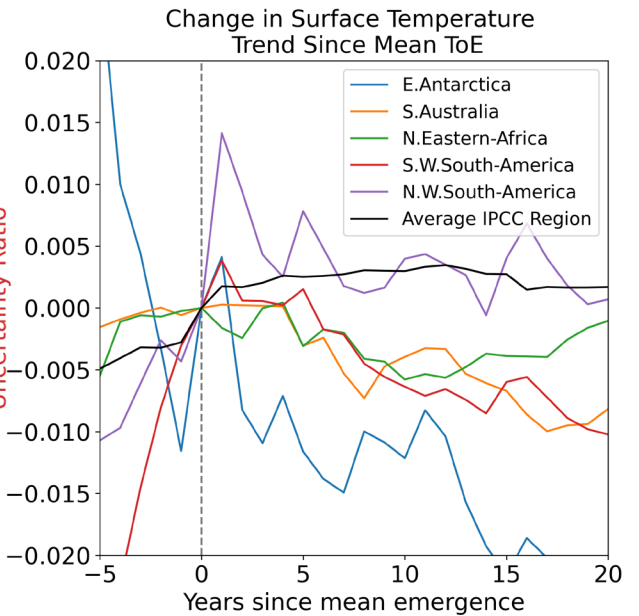
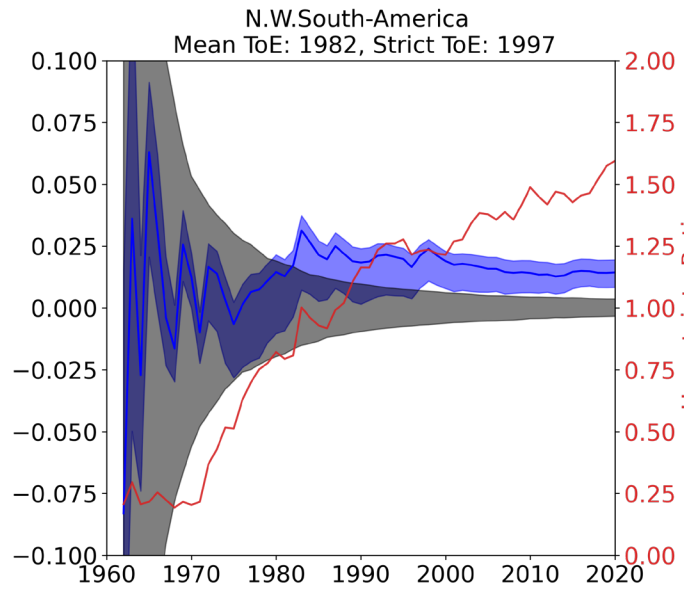
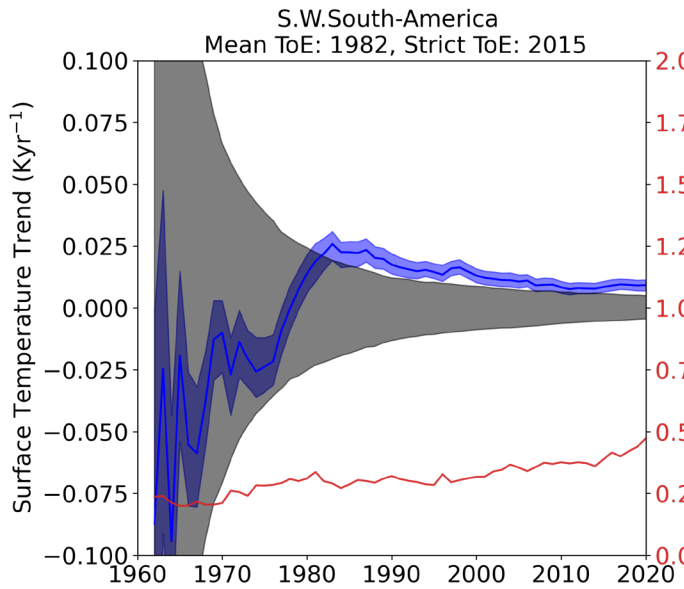
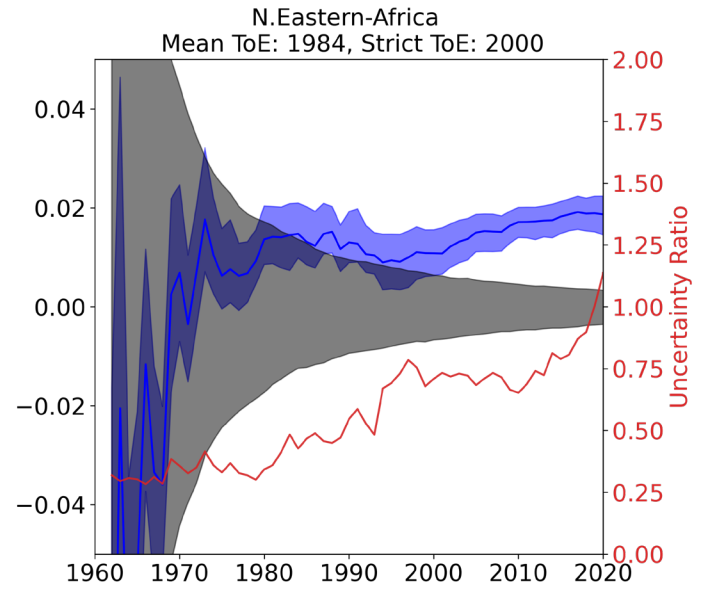
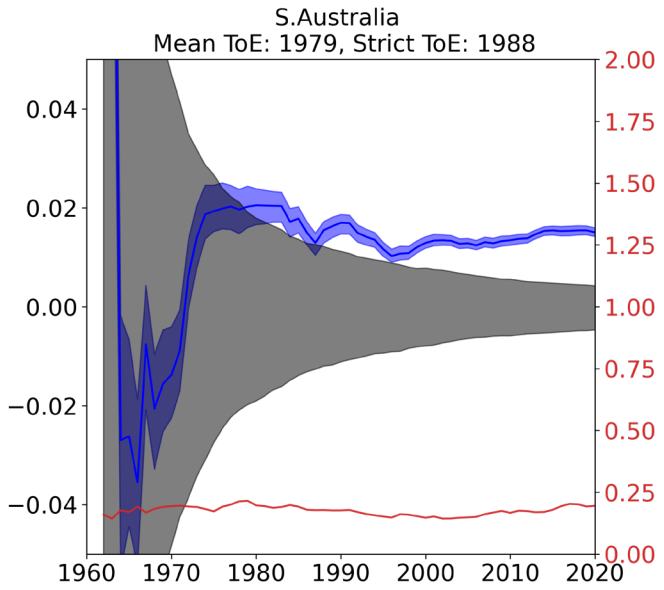
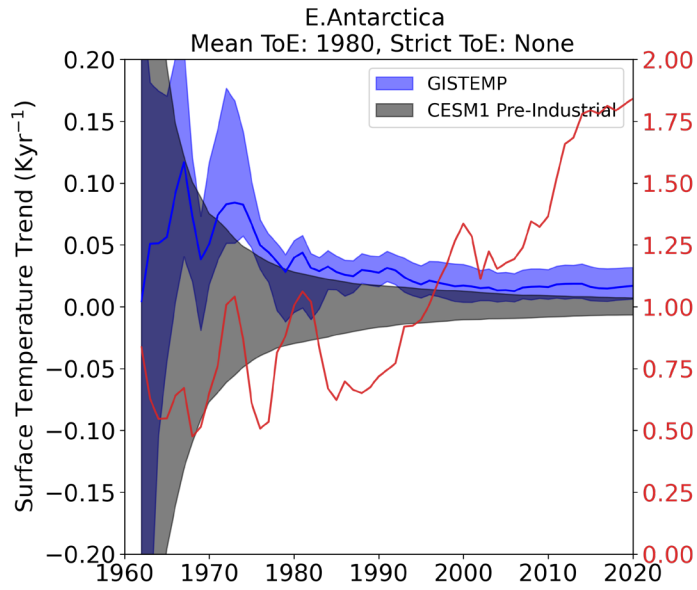
jonah.shaw@colorado.edu

Where do models contribute uncertainty? Where do observational products contribute uncertainty?

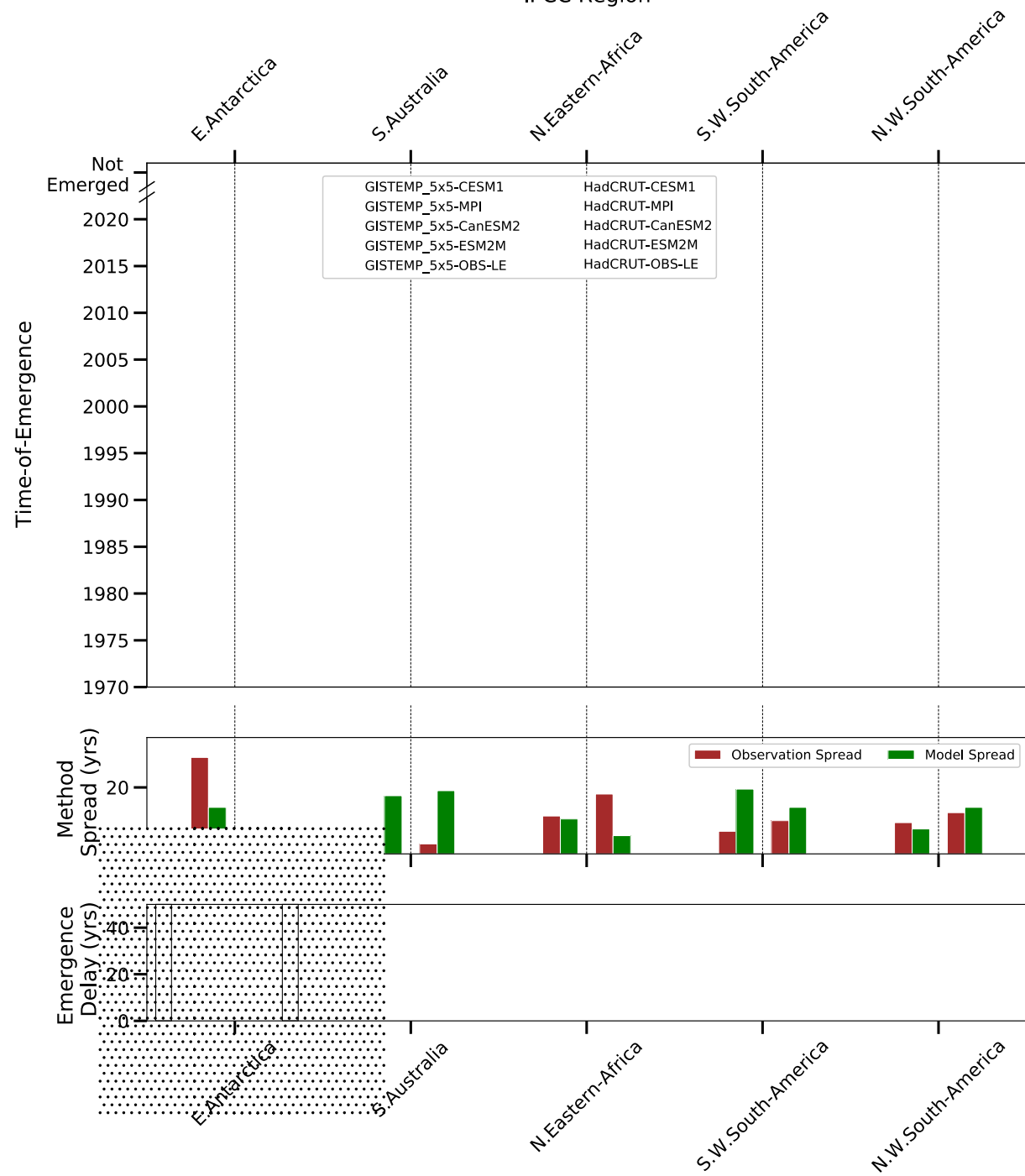
Method Spread



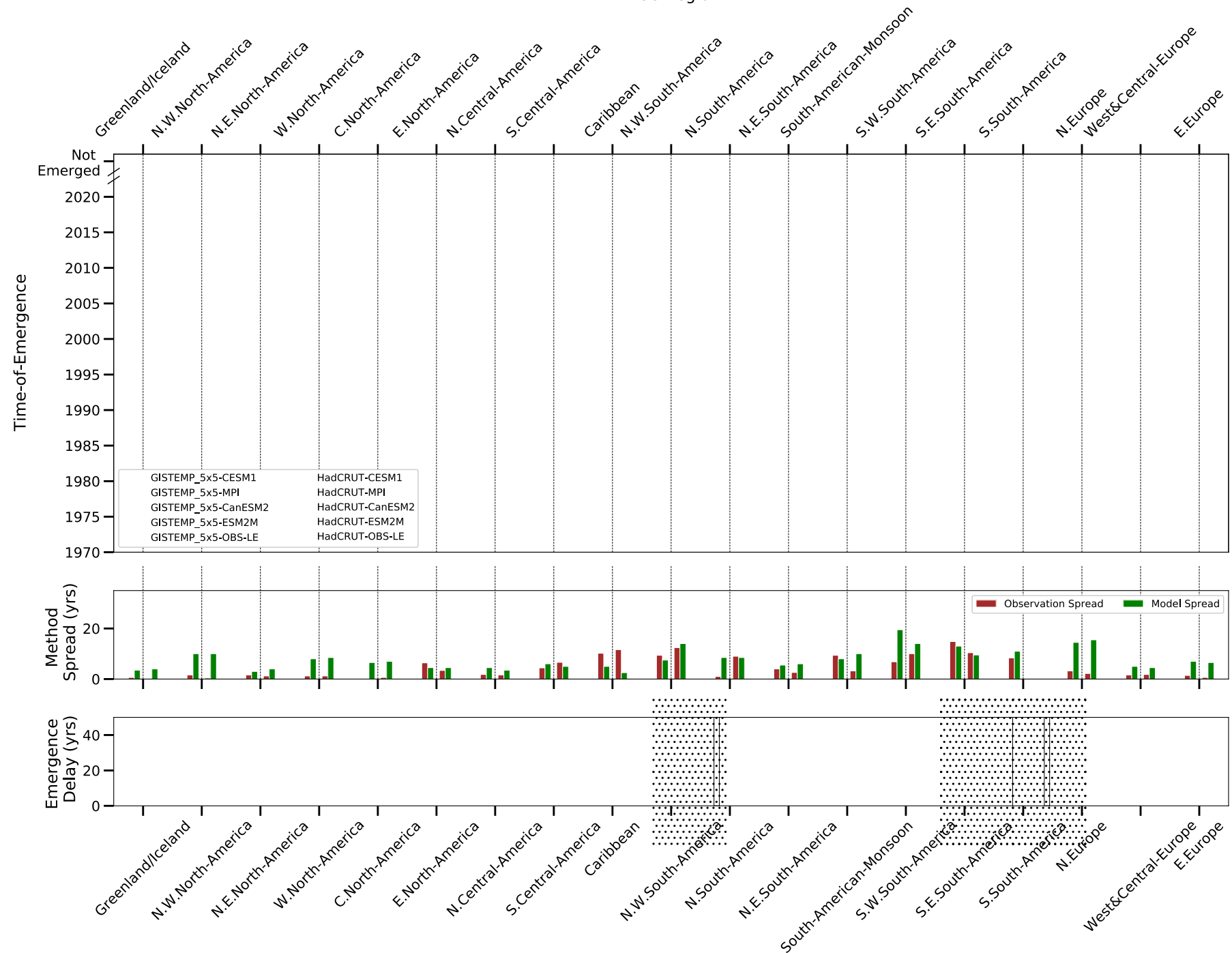
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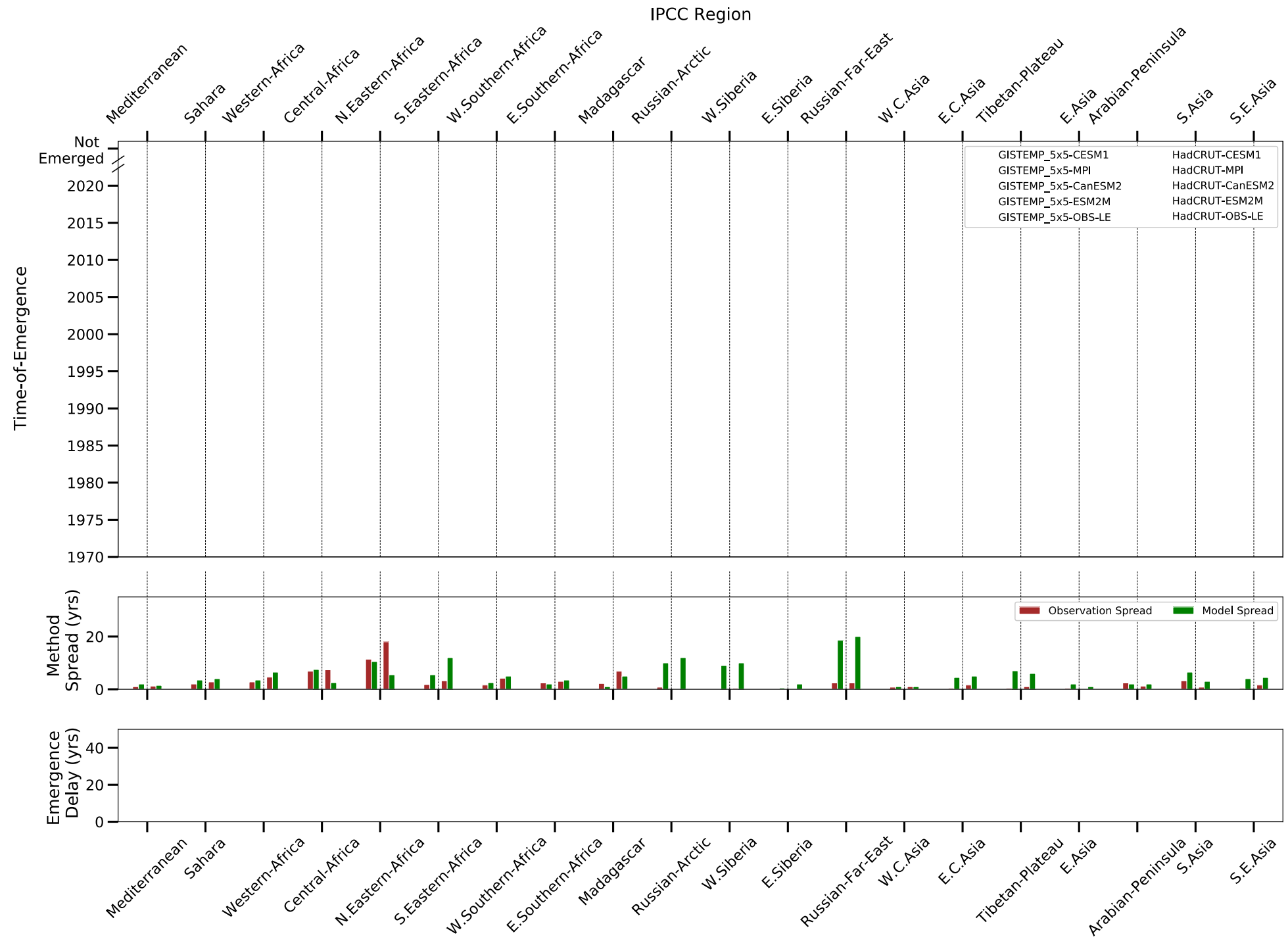


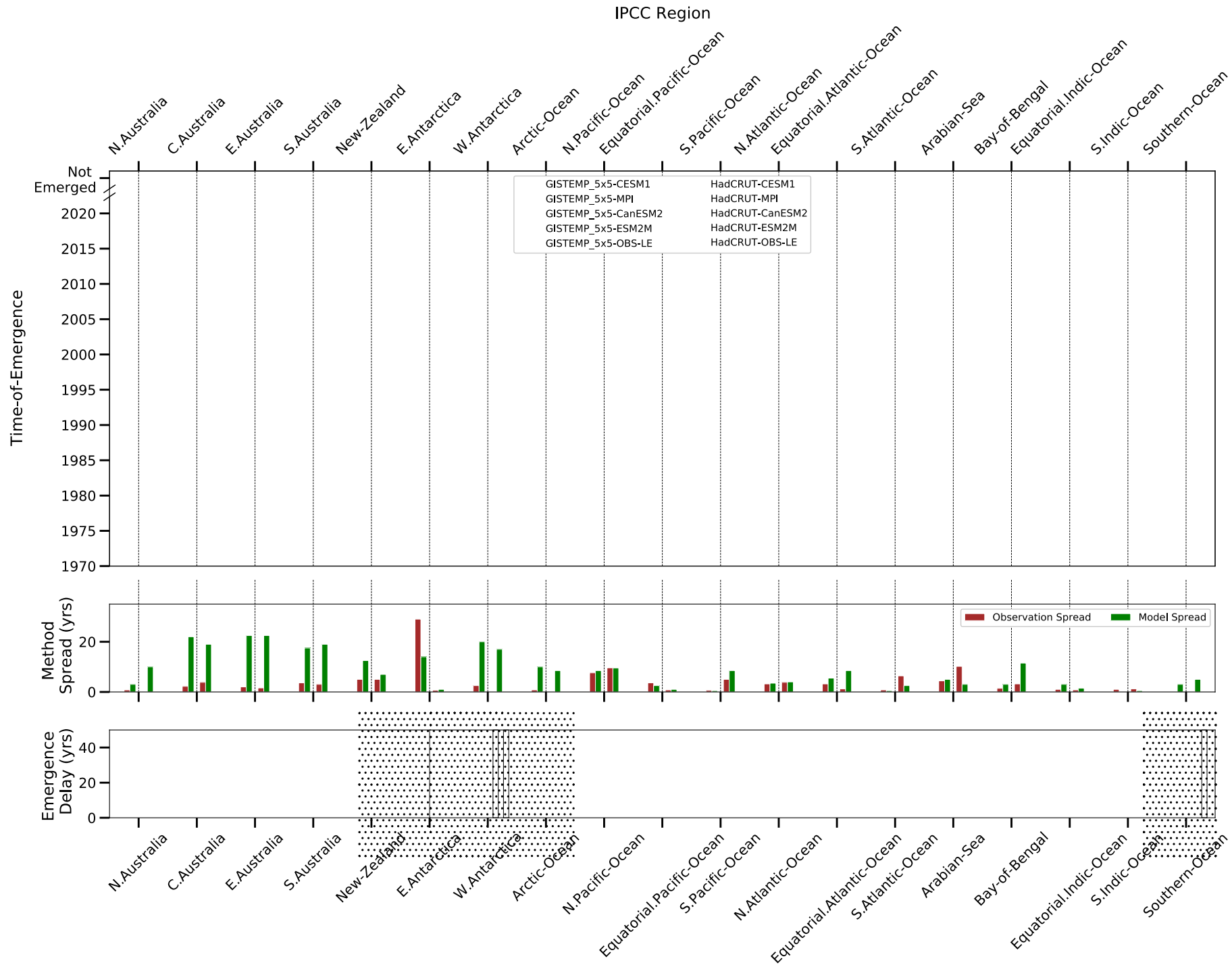
IPCC Region



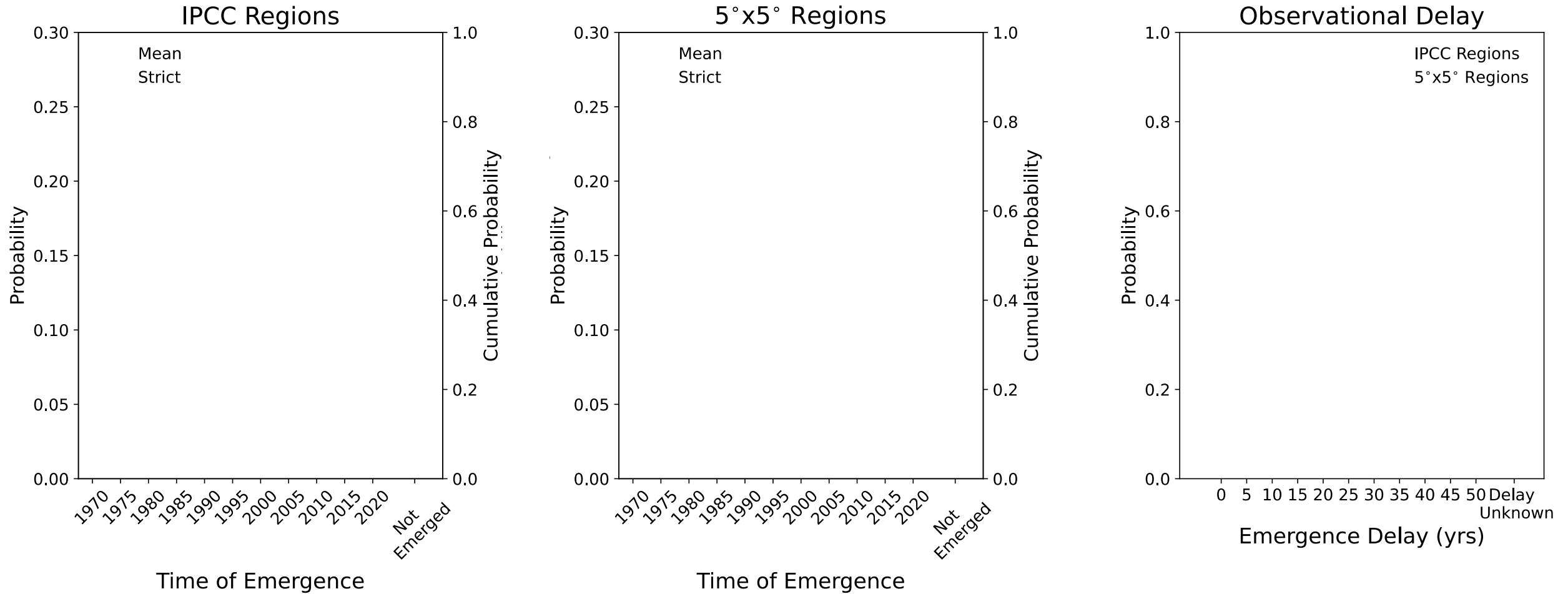
IPCC Region







How does accounting for observational uncertainty delay our ability to detect warming? (CESM1-GISTEMPv4)



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Misleading?

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Observations detect regional surface warming trends, even when accounting for observational uncertainty.

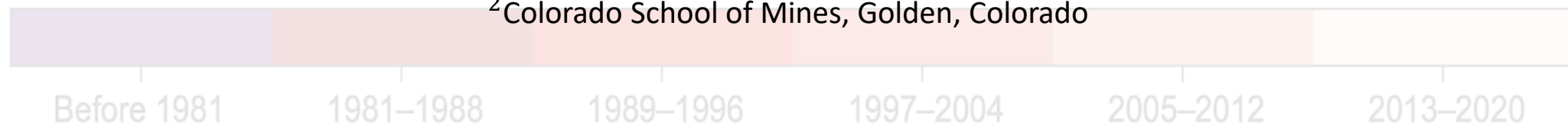
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