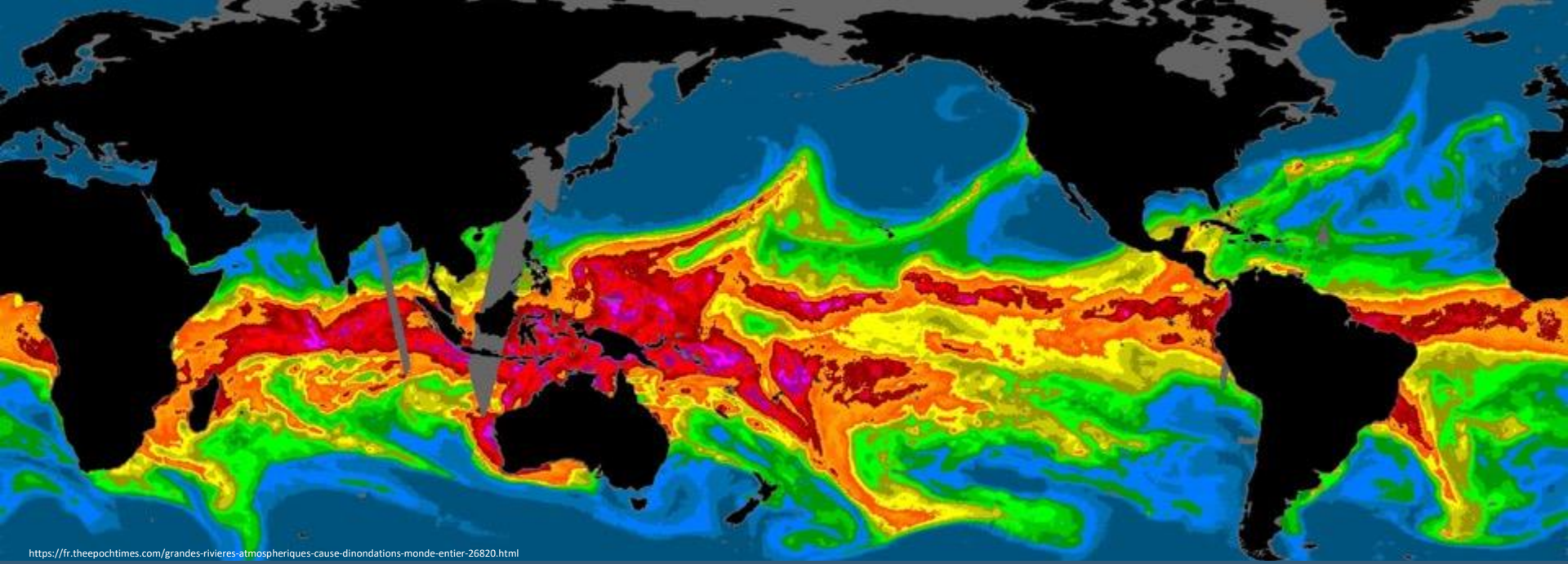




<https://fr.theepochtimes.com/grandes-rivieres-atmospheriques-cause-dinondations-monde-entier-26820.html>

Evidence for the Courts: Emerging Issues in Climate Science



Ben Santer

Program for Climate Model Diagnosis
and Intercomparison

NASEM workshop on Emerging Areas of
Science, Engineering, and Medicine for
the Courts

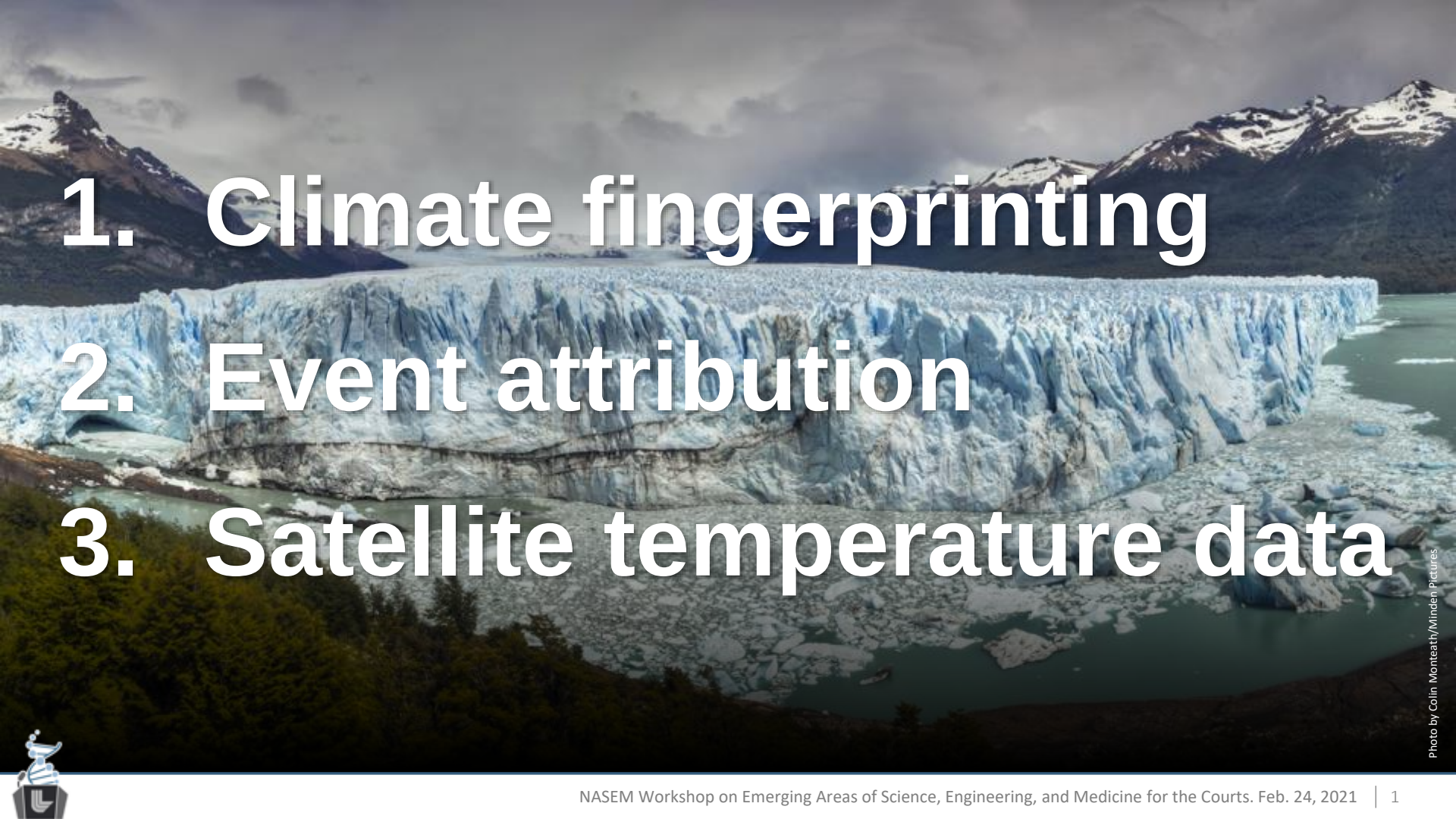
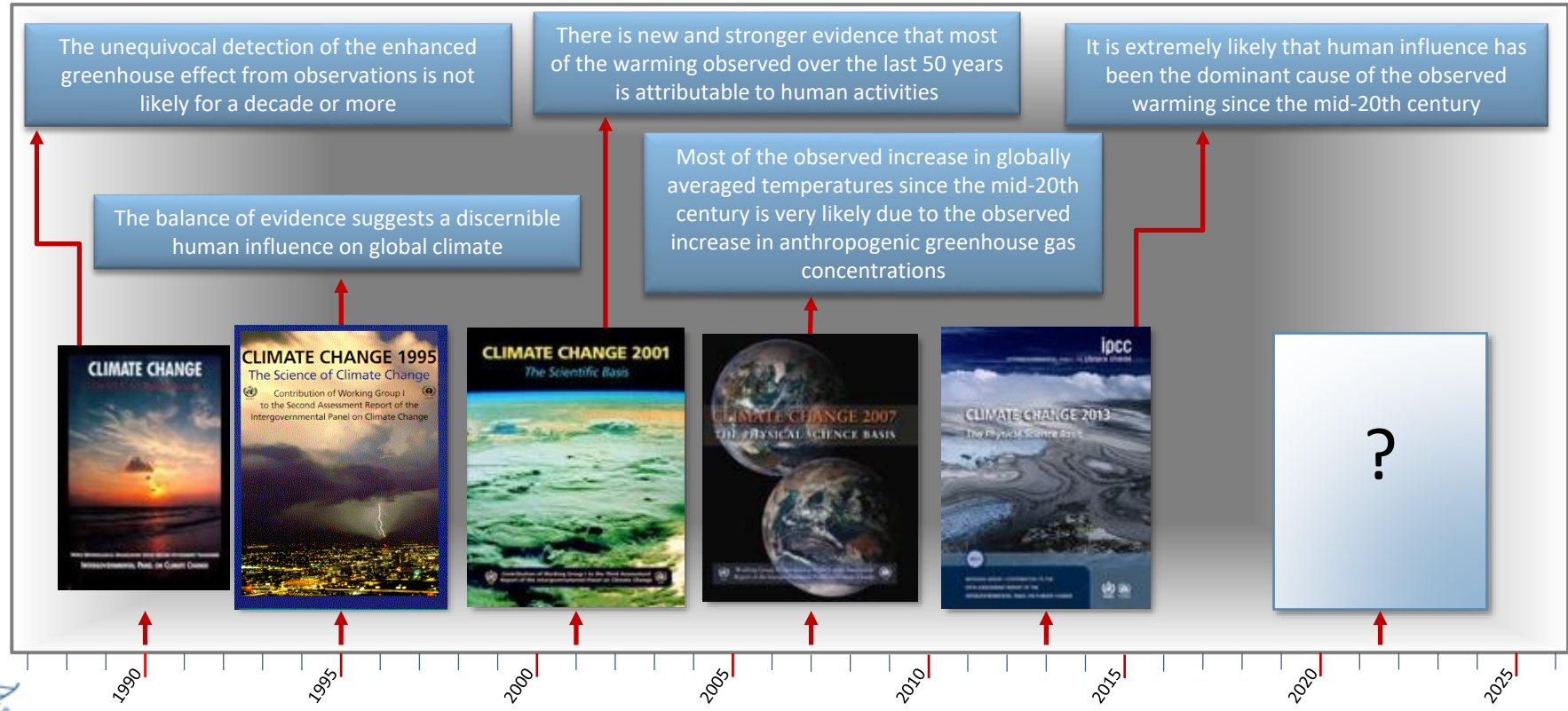
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1. Climate fingerprinting
 2. Event attribution
 3. Satellite temperature data

Photo by Colin Monteath/Minden Pictures



The arc of history bends towards increased scientific understanding of human effects on climate



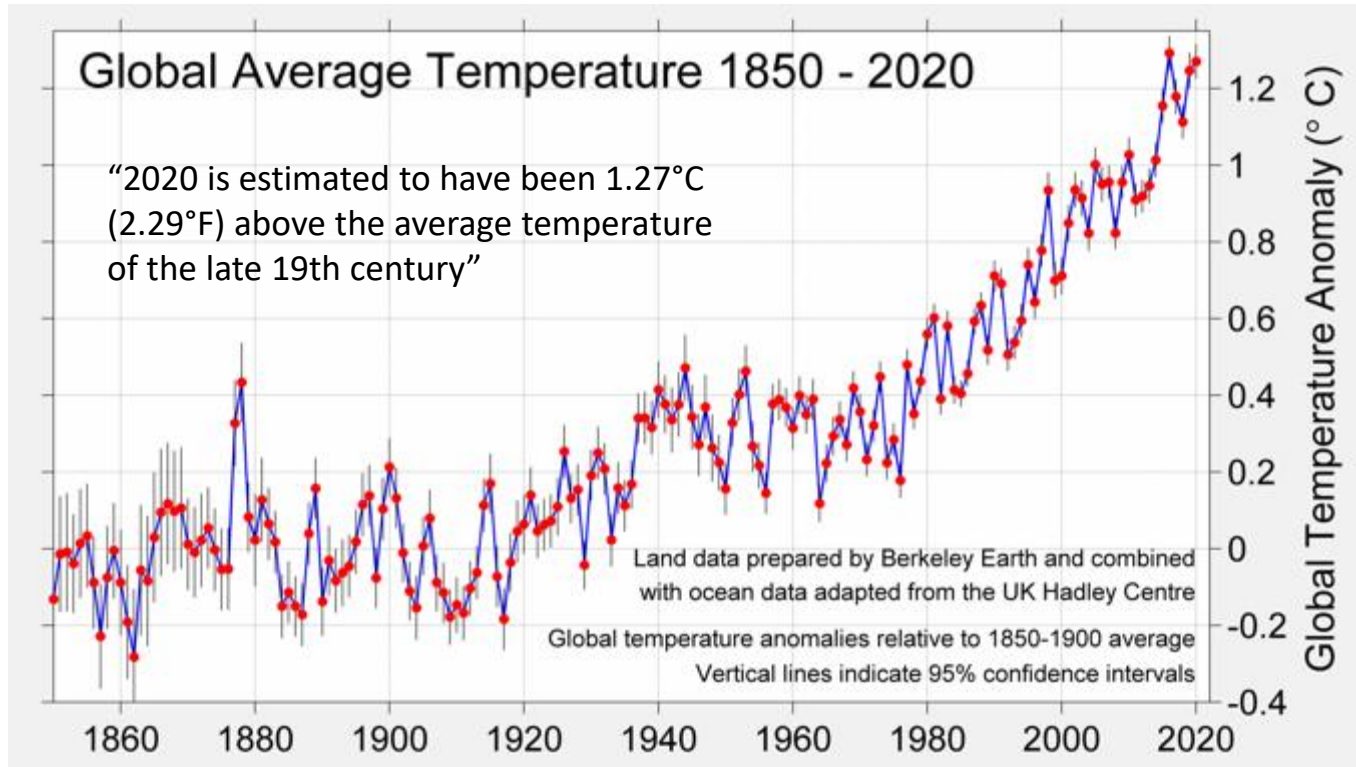
What is “climate fingerprinting”?

- Basic idea:

- Different influences on climate have different characteristic signatures
- Signatures are easier to discern if scientists study patterns (“fingerprints”)

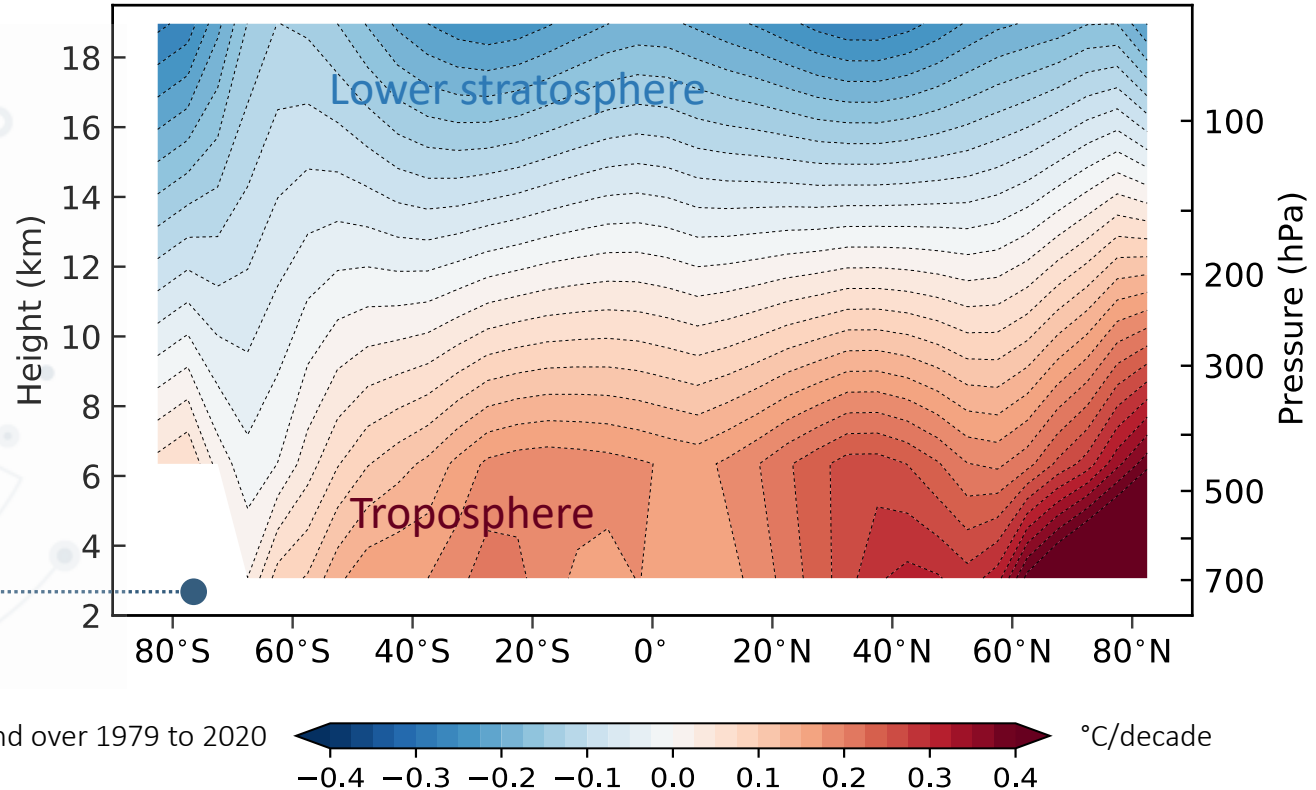


The power of fingerprinting

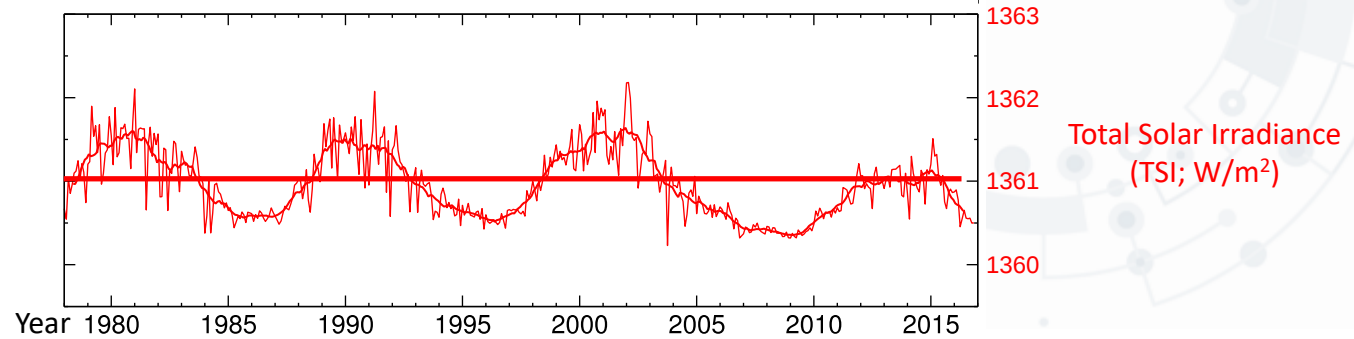


Satellite data show a temperature fingerprint that is inconsistent with natural causes

Satellite
observations
(Santa Rosa, CA)

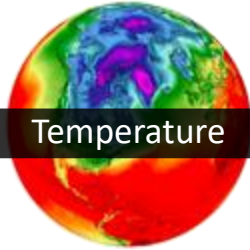


Complementary evidence...

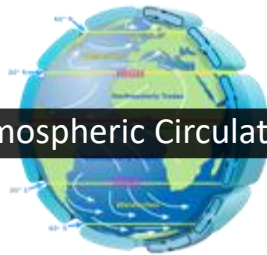


Human fingerprints on climate are ubiquitous

- Climate scientists have identified human “fingerprints” in many different aspects of the climate system – not just in temperature



Temperature



Atmospheric Circulation



Hydrological Cycle



Snow and Ice

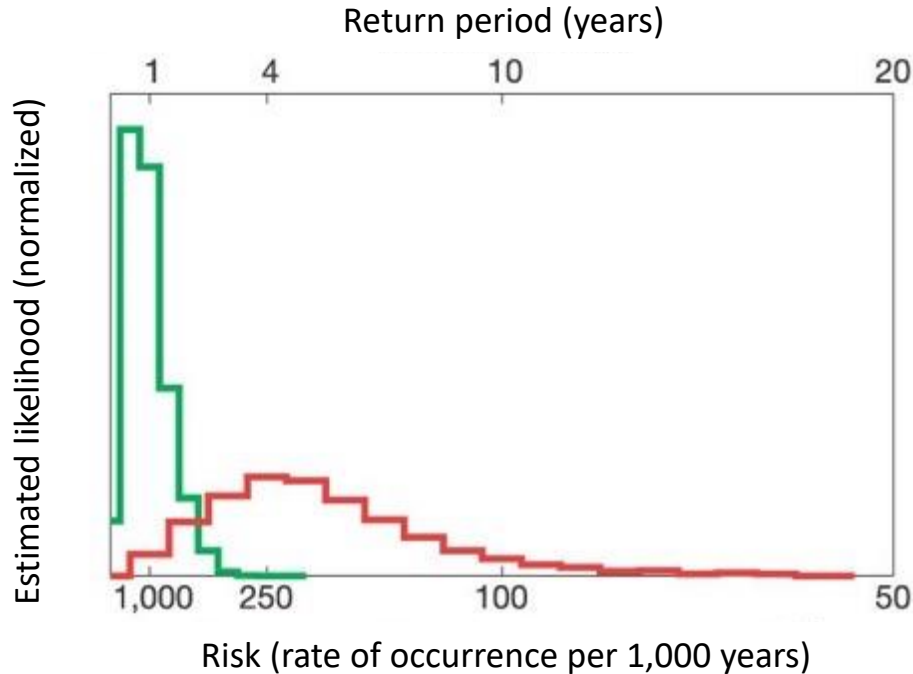
- Changes in different climate variables are physically and internally consistent, and are independently monitored with a wide range of instruments

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Event attribution: The case of the 2003 European summer heatwave

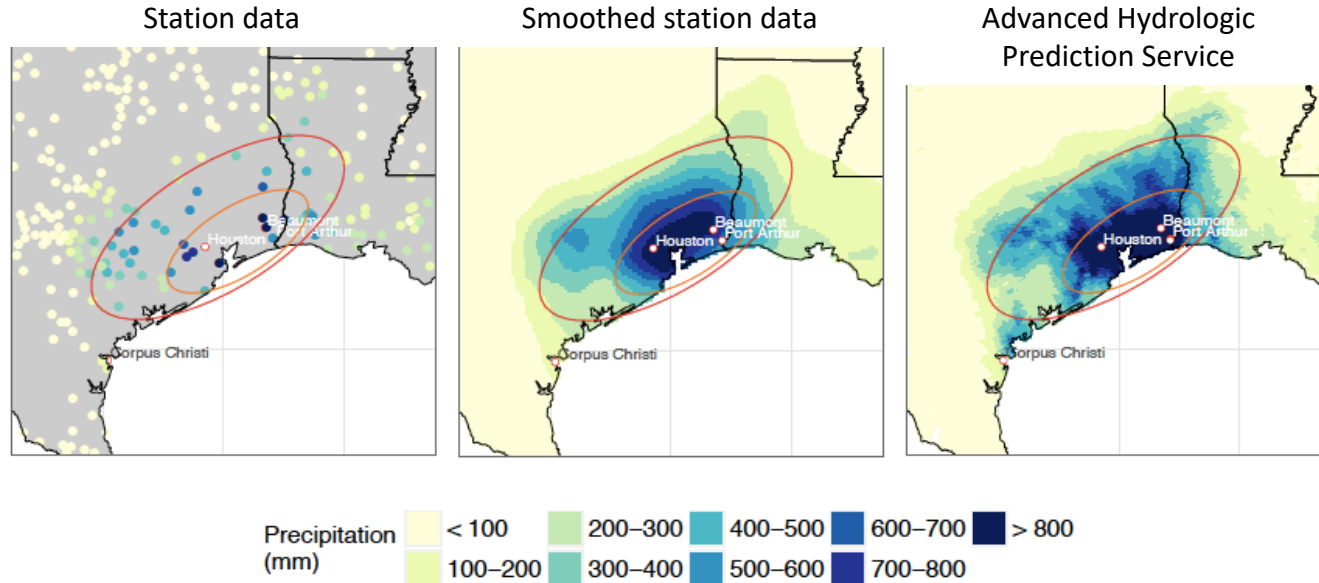


Histogram of return periods without human-caused climate change

Histogram of return periods with human-caused climate change

“ We estimate it is very likely (confidence level >90%) that human influence has at least doubled the risk of a heatwave exceeding this threshold magnitude. ”

Risser and Wehner, 2017: Human-caused intensification of hurricane rainfall



“...Anthropogenic climate change *likely* increased Hurricane Harvey’s total rainfall by at least 19% with a best estimate of 38%”

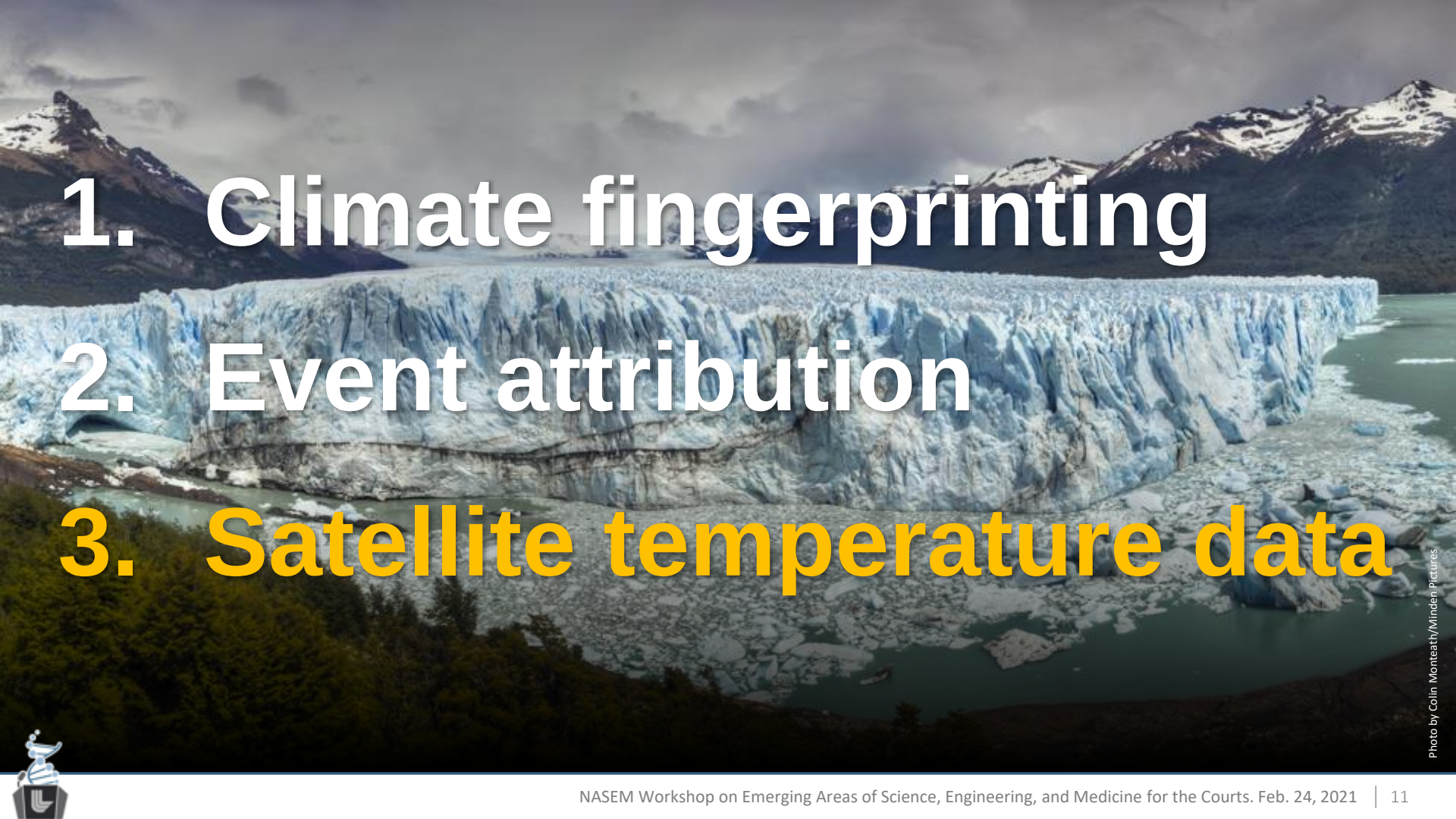
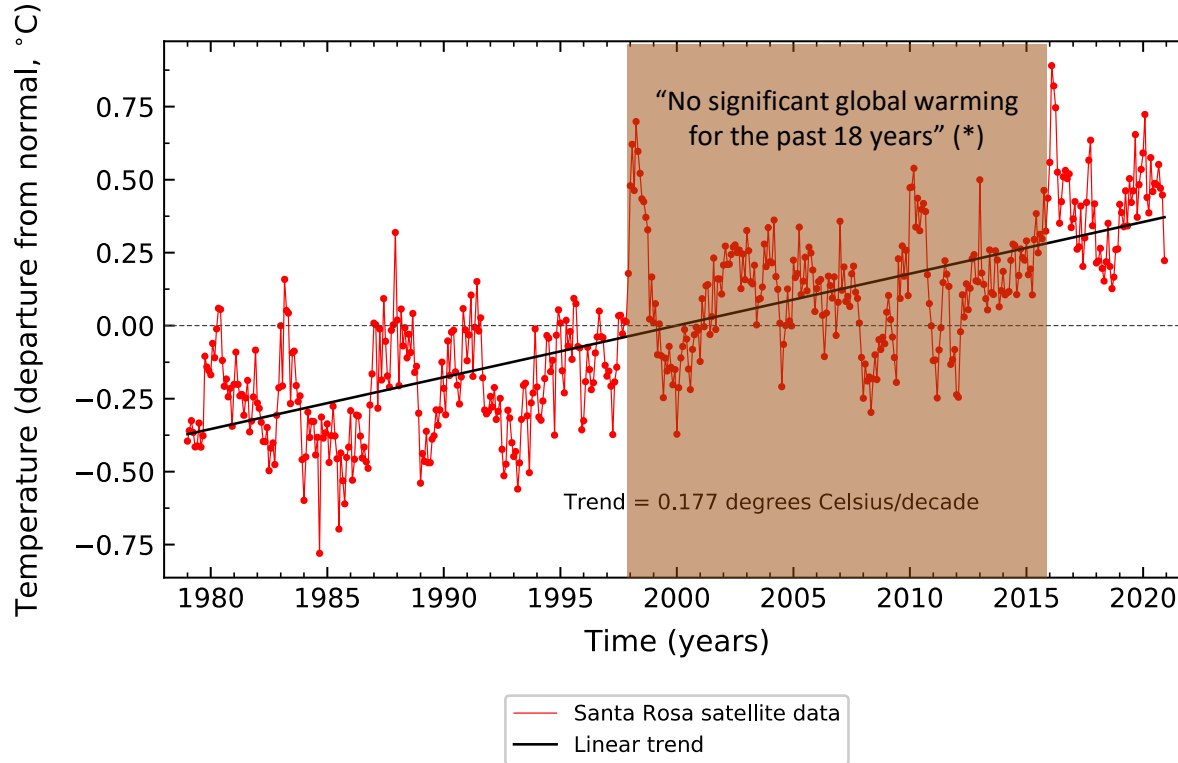
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Satellite temperature data



Final points



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Climate change as hazard: Relevant legal issues and questions

- Where and when is the hazard/harm likely to occur? Did it already occur?
- Scientific confidence in projected climate change hazard:
 - Is hazard robust across models?
 - Is hazard physically interpretable?
 - Is hazard readily observable?
- Can we reliably estimate human contribution to the change in the hazard's likelihood?
- Are there reliable damage estimates for the hazard?
- Are key uncertainties well-quantified?





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