

How a Sentence Changed Science: Lessons Learned from the 1995 Climate Report



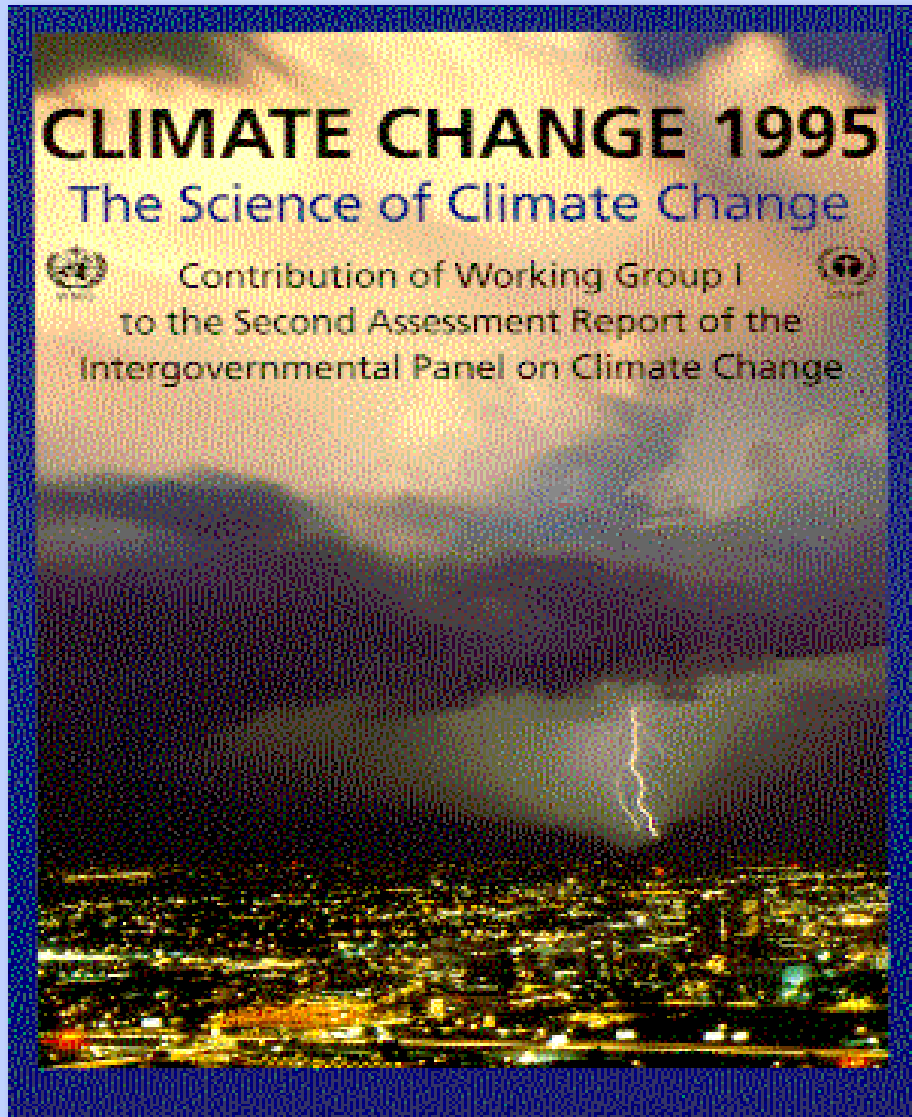
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Walter Orr Roberts Memorial Lecture, Aspen Center for Environmental Studies, August 1, 2017



Over 21 years after “... a discernible human influence on global climate”



“The balance of evidence suggests a discernible human influence on global climate”

Who was involved with the 1995 IPCC Working Group I report?



- 78 Lead Authors from 20 countries
- Over 400 contributing authors from 26 countries
- Over 500 reviewers from 40 countries



Structure of 1995 IPCC Working Group I Report

- 1 The climate system: an overview
- 2 Radiative forcing of climate
- 3 Observed climate variability and change
- 4 Climate processes
- 5 Climate models - evaluation
- 6 Climate models - projections of future climate
- 7 Changes in sea level
- 8 Detection of climate change and attribution of causes
- 9 Terrestrial biotic responses to environmental change and feedbacks to climate
- 10 Marine biotic responses to environmental change and feedbacks to climate
- 11 Advancing our understanding



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A key event in the IPCC process: A meeting in Madrid in November 1995



http://www.visualphotos.com/photo/2x2007507/palacio_de_congresos_madrid_spain_cd225066.jpg



What was the purpose of the Madrid IPCC meeting?

- “Approval” of the draft Summary for Policymakers of the IPCC Working Group I Second Assessment Report
- “Acceptance” of the 11 chapters on which the Summary for Policymakers was based



What did the debate in Madrid focus on?

- During the Madrid plenary sessions, the Lead Authors and IPCC delegates in attendance spent many hours discussing Chapter 8
- The major issues were:
 - ➔ **Attribution:** Difficulties in conveying information about probabilities
 - ➔ **Quantification:** If scientists to date haven't succeeded in reliably estimating the size of a human effect on global climate, does that necessarily mean that any human effect must be trivially small?
 - ➔ **Semantics:** How does one discuss scientific uncertainties in a way that minimizes distortion (for example, use of the word "preliminary")

Bottom-line statements before and after Madrid

STATEMENT A

- “Taken together, these results point towards a human influence on climate” (Oct. 9, 1995; draft of Chapter 8 sent to Madrid participants)



STATEMENT B

- “Nevertheless, the balance of evidence suggests that there is a discernible human influence on global climate” (Nov. 29, 1995; final approved version of Summary for Policymakers)

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STATEMENT A

- “Taken together, these results point towards a human influence on climate” (Oct. 9, 1995; draft of Chapter 8 sent to Madrid participants)



STATEMENT B

- “Nevertheless, the **balance of evidence** **suggests** that there is a **discernible** human influence on **global** climate” (Nov. 29, 1995; final approved version of Summary for Policymakers)



Alternative language discussed in Madrid

“The **balance of evidence** **suggests** a **discernible**
human influence on global climate”

balance of evidence?

suggests?

discernible?

weight of evidence?

indicates?

significant?

preponderance of evidence?

demonstrates?

detectable?

identifiable?

measurable?

appreciable?



The aftermath of Madrid: Key allegations

- “Corruption of peer-review process”
- “Political tampering”
- “Scientific cleansing”
- “Discernible human influence” finding based on two papers



Lesson 1: Words can change the world

- “It (the Madrid Plenary meeting) was a stunning success and produced the single most important paragraph in assessment history...”§

“Our ability to quantify the human influence on global climate is currently limited because the expected signal is still emerging from the noise of natural variability, and because there are uncertainties in key factors. These include the magnitude and patterns of long-term natural variability and the time evolving pattern of forcing by, and response to, changes in concentrations of greenhouse gases and aerosols, and land surface changes. **Nevertheless, the balance of evidence suggests that there is a discernible human influence on global climate.**”§

§Source: Steve Schneider, “Science as a Contact Sport”, chapter 5 (“The battle heats up, and so does the world”), page 141



Lesson 2: Respond to criticism with sound science

“Never engage in ‘science by eminence of position’. Do the science necessary to address the criticism”

“The ‘balance of evidence’ finding was based on studies of surface temperature only”

“The troposphere cooled over the satellite era”

“Global warming stopped in 1998”

“Climate models overestimate (by a factor of three or more) the warming caused by greenhouse gas increases”

“All warming is caused by the Sun or natural cycles”

“Satellite data show no significant warming over the last 18 years”

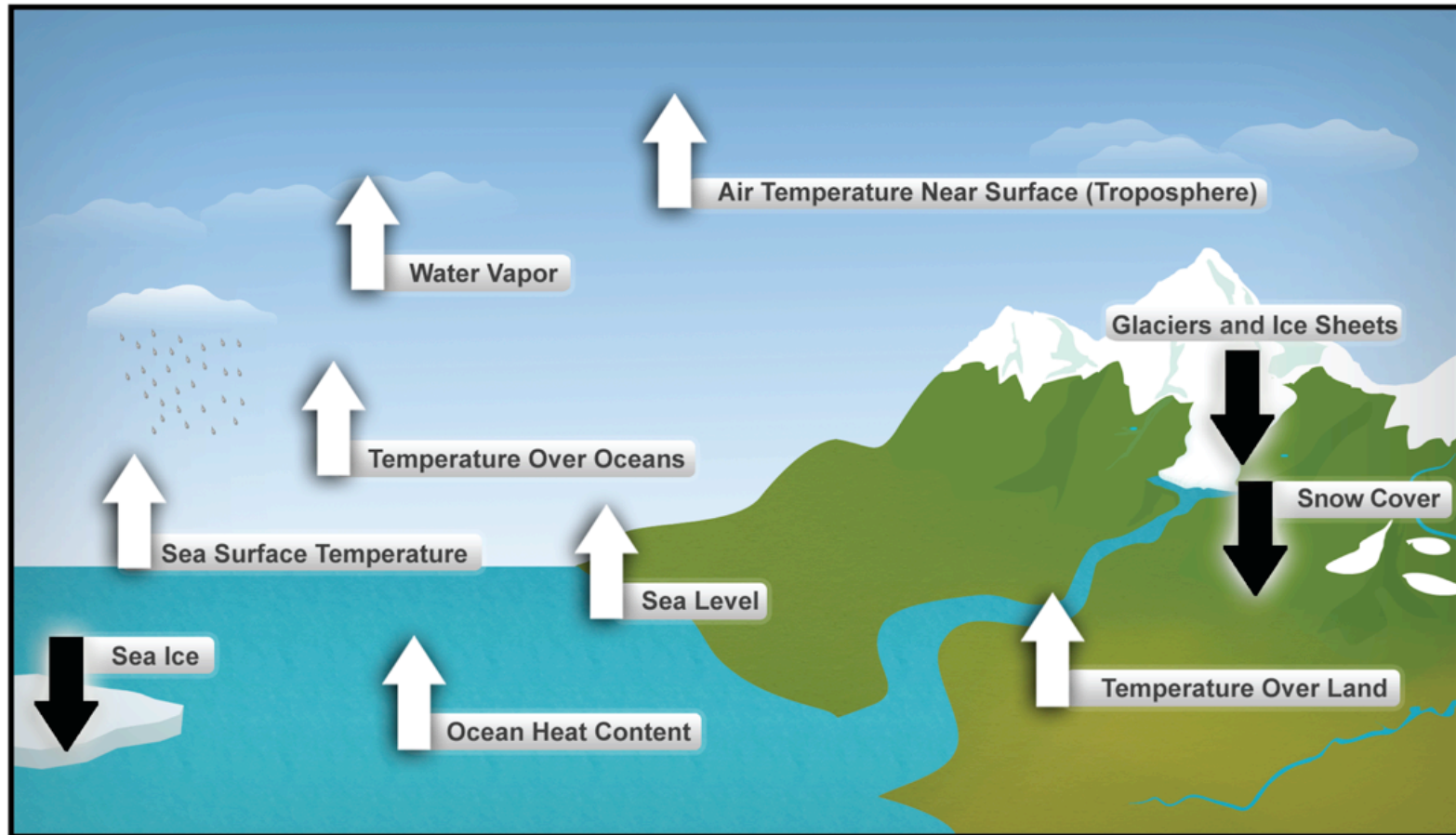


Lesson 2: Respond to criticism with sound science

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Human fingerprints are identifiable in many aspects of the climate system – not just in surface temperature



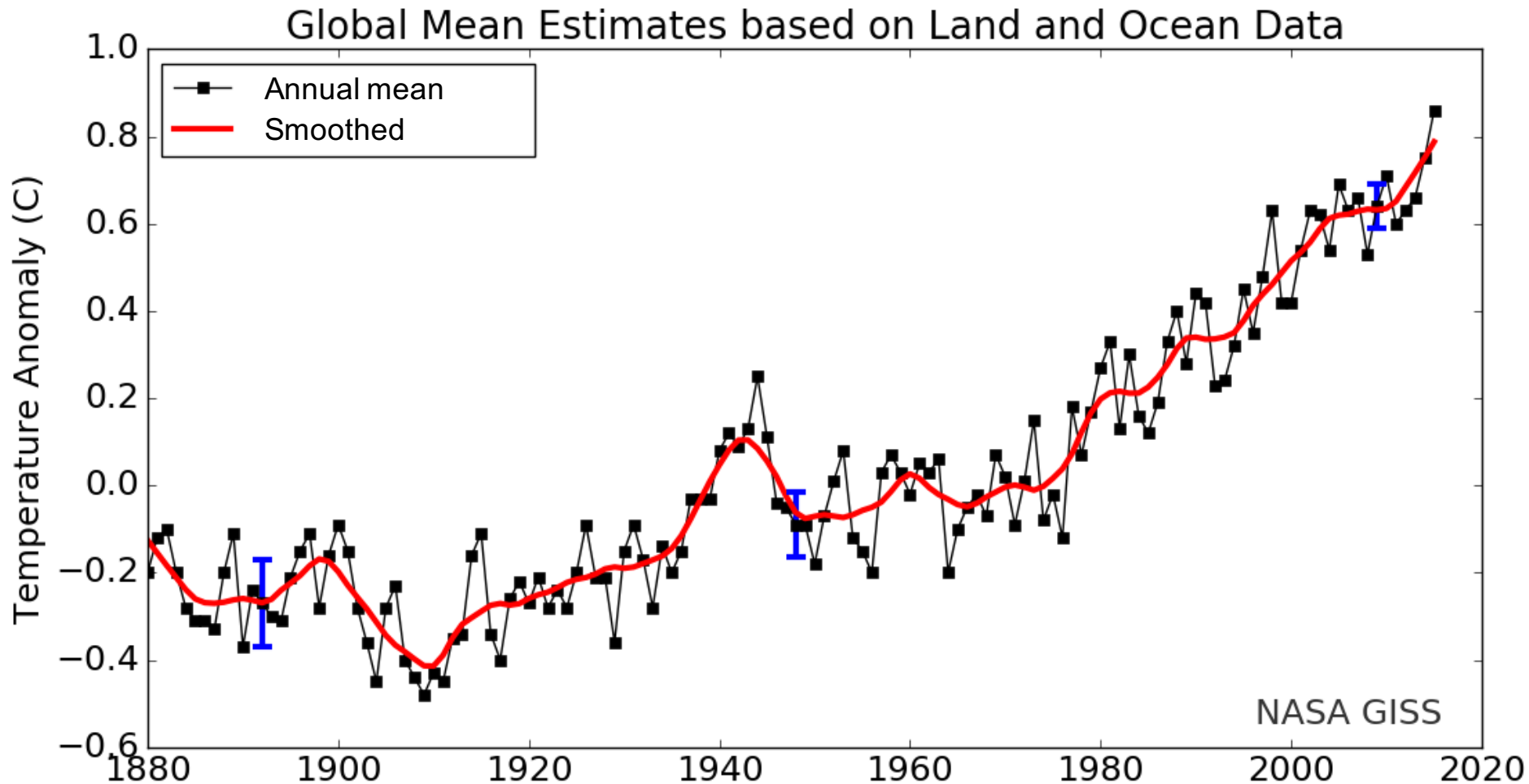


Lesson 2: Respond to criticism with sound science

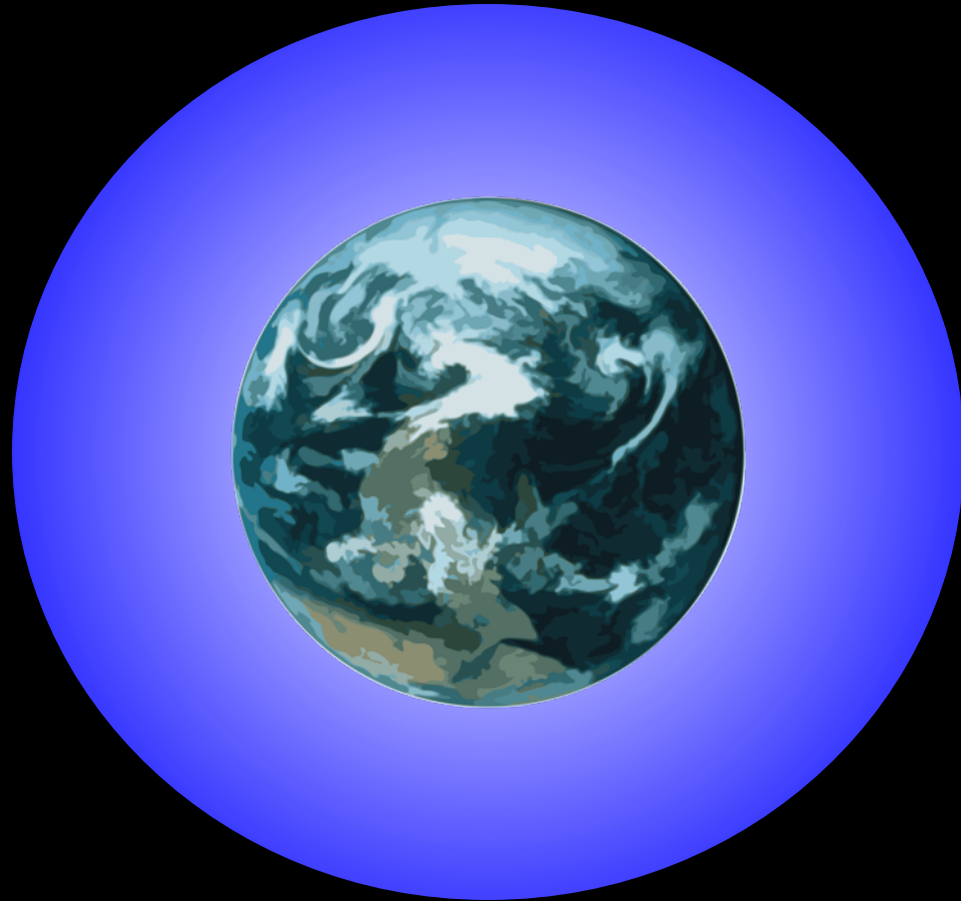
“Never engage in ‘science by eminence of position’. Do the science necessary to address the criticism”

“All warming is caused by the Sun or natural cycles”

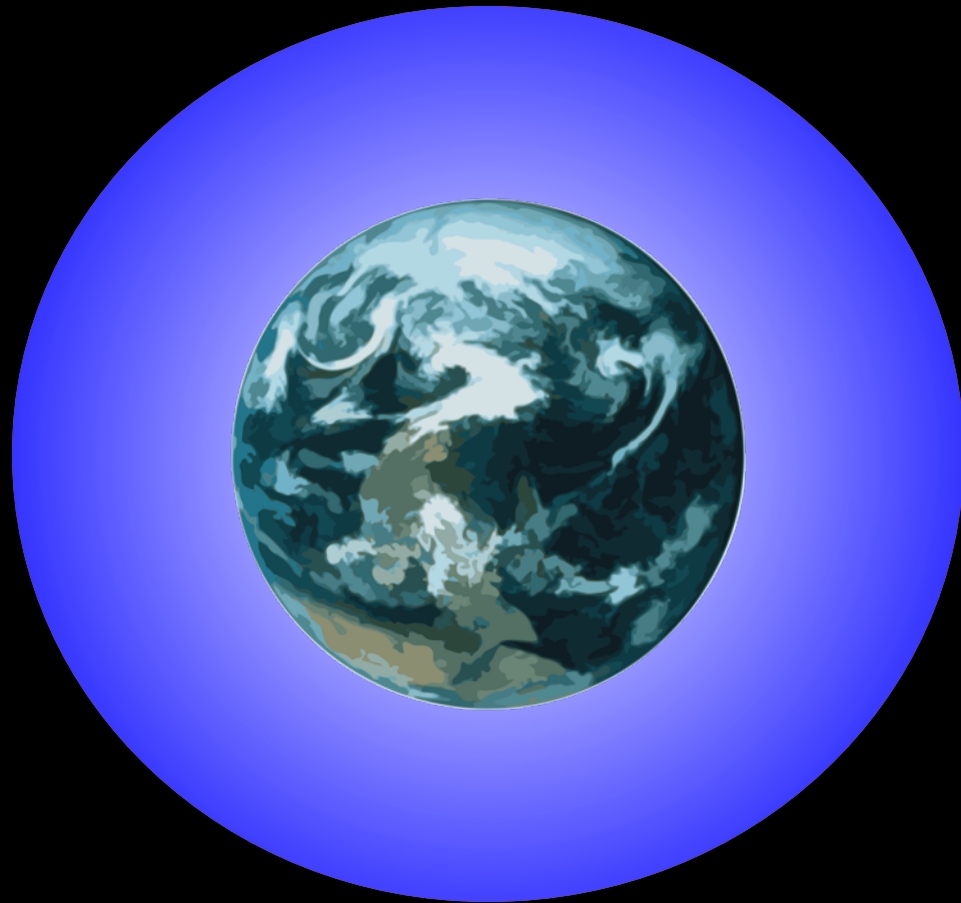
How might fingerprinting help to address claims that all warming over the last 130 years is due to the Sun?



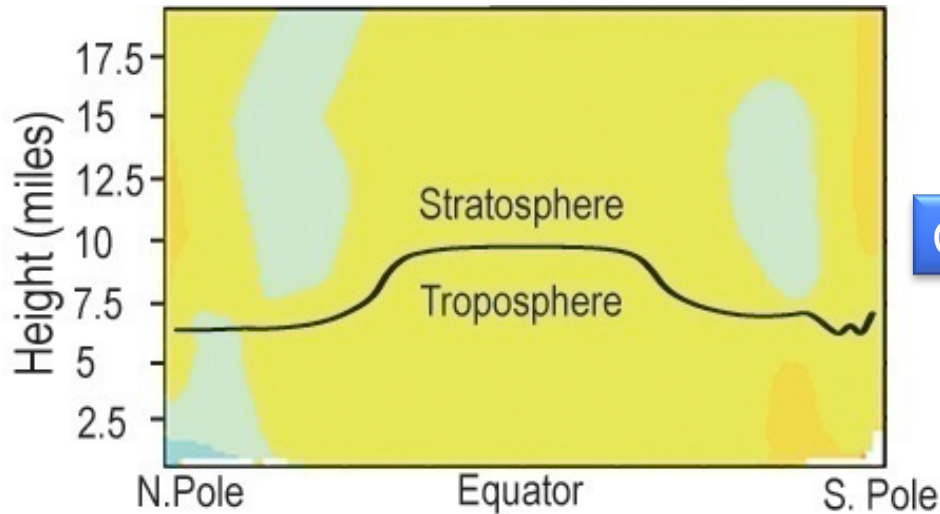
“All of the surface warming over the last 120 years is caused by the Sun...”



“All of the surface warming over the last 120 years is caused by the Sun...”

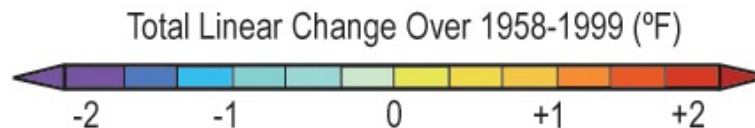


The “fingerprints” of changes in the Sun’s energy output and human-caused changes in greenhouse gases

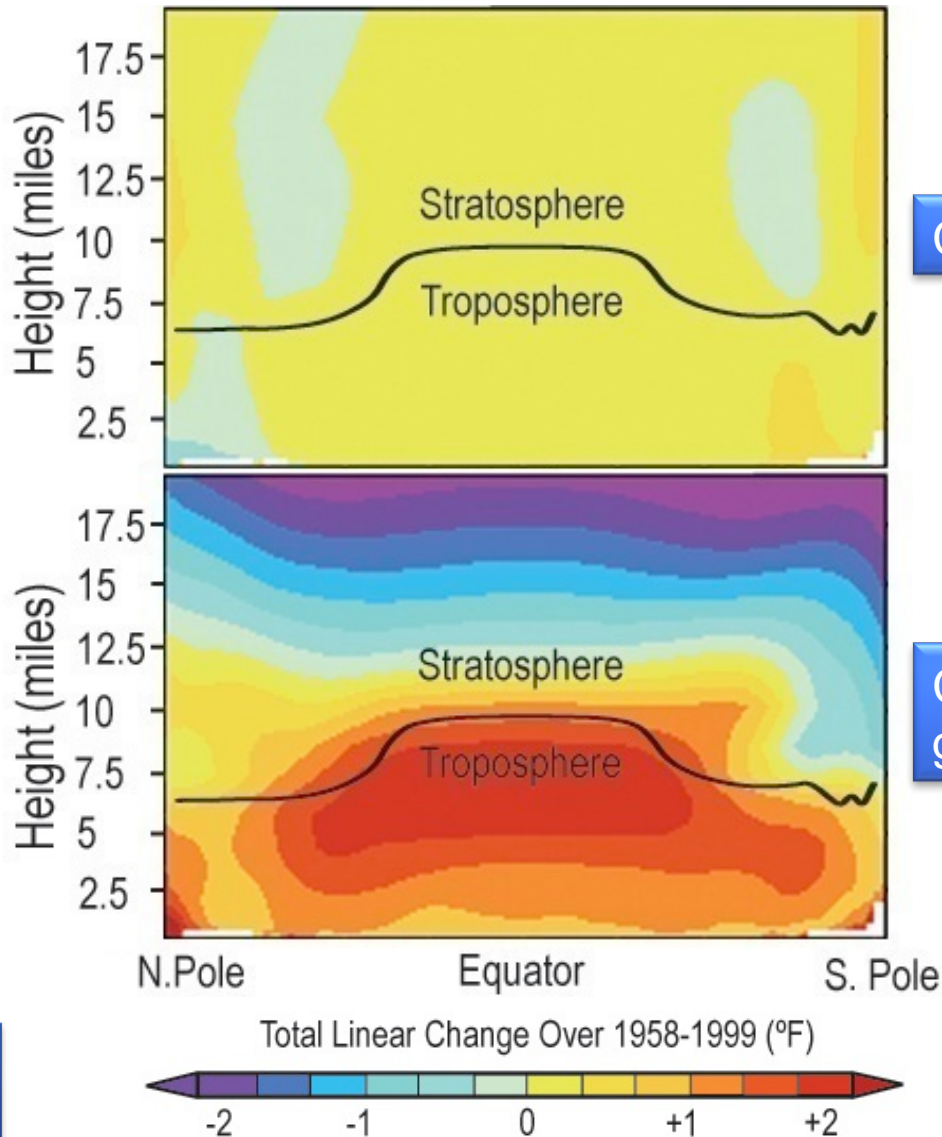


Changes in the Sun

Source: Global Climate Change Impacts in the United States (Karl *et al.*, 2009; modified from Santer *et al.*, *Nature*, 1996)



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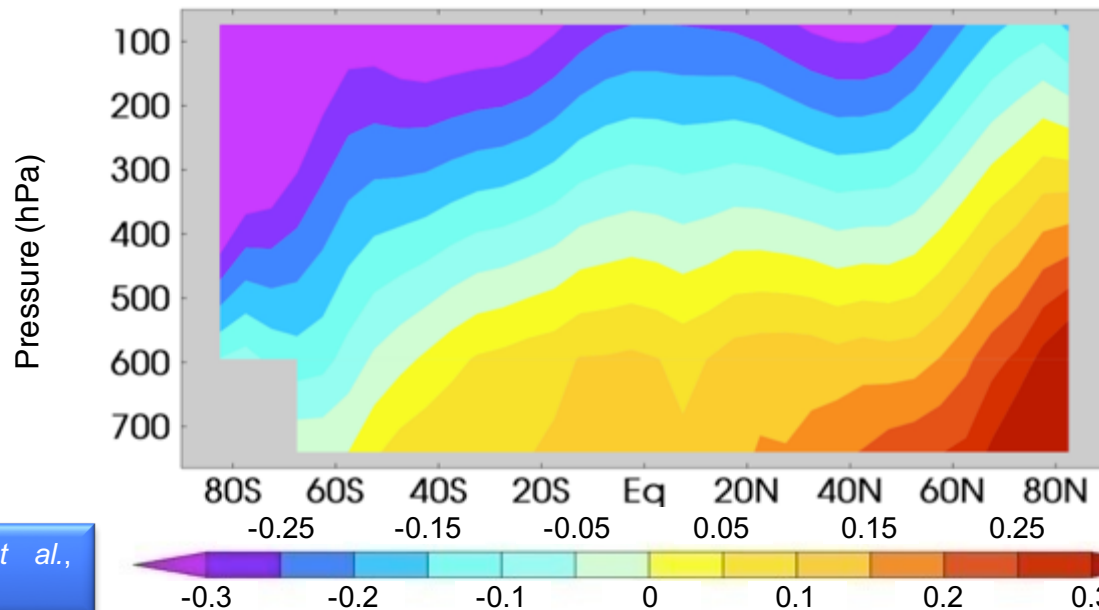


Changes in the Sun

Changes in well-mixed greenhouse gases

Source: Global Climate Change Impacts in the United States (Karl *et al.*, 2009; modified from Santer *et al.*, *Nature*, 1996)

Observed atmospheric temperature changes do not look like the “Solar effects only” fingerprint

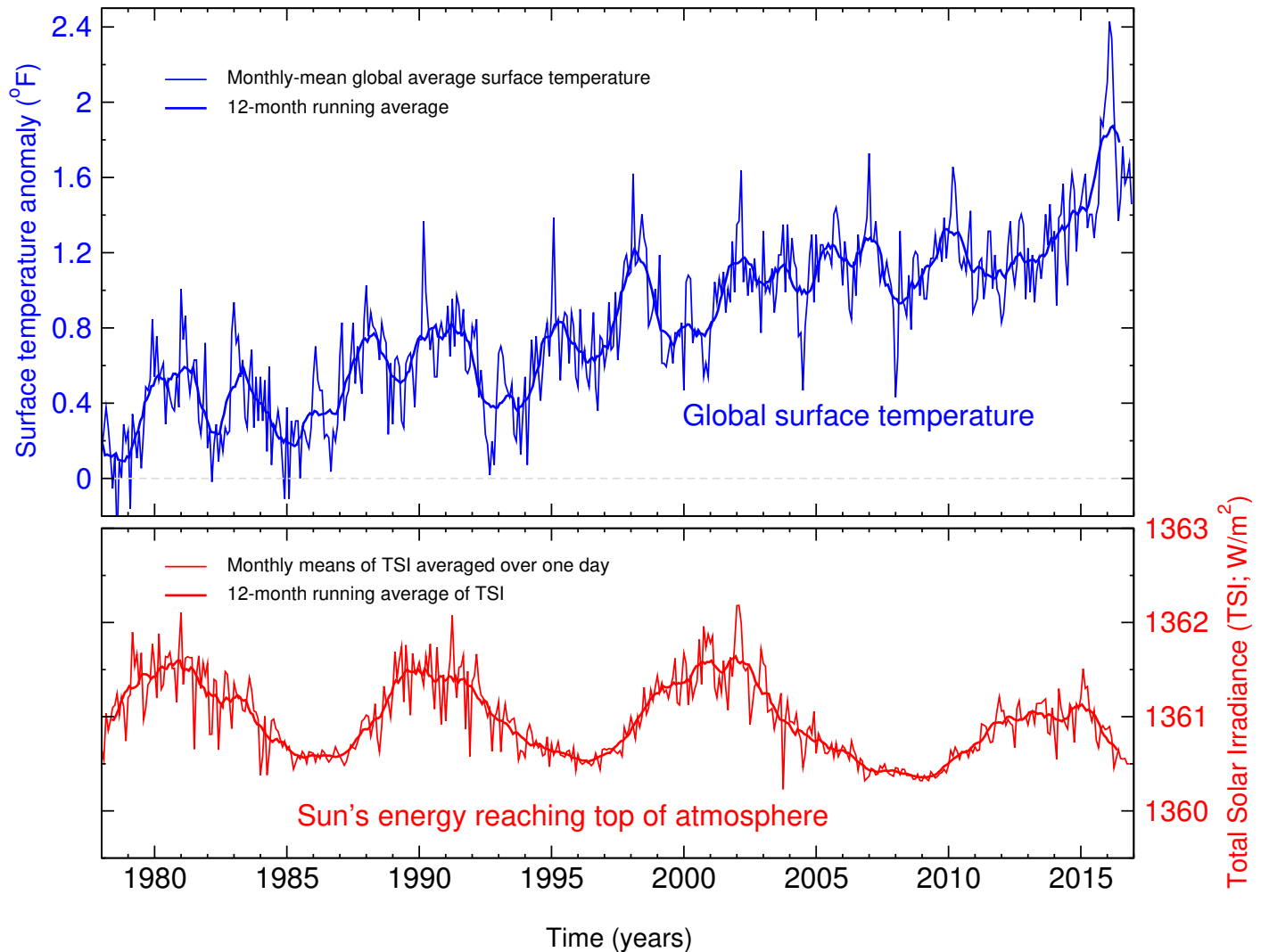


Observations
(Santa Rosa)

Source: Santer *et al.*,
PNAS (2013b)

Trend (°C/decade
over 1979 to 2012)

Earth's temperature has increased over the last 38 years, despite no overall increase in the Sun's energy output



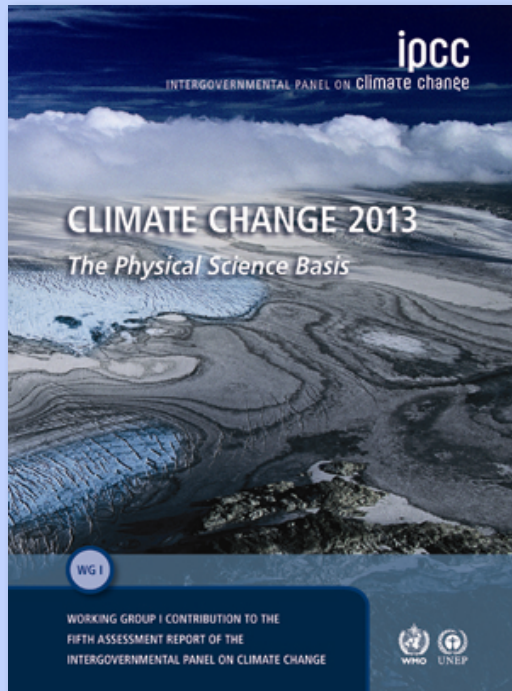


Lesson 3: If you have a voice, use it

“Climate scientists don’t have the luxury of remaining silent ”



Lesson 4: If your scientific findings are robust, others will confirm them



“Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes... It is *extremely likely* that human influence has been the dominant cause of the observed warming since the mid-20th century” *

*Summary for Policymakers, IPCC Fifth Assessment Report (2013)



Lesson 5: Don't just preach to the choir

“Engage audiences who mistrust or deny scientific findings of a ‘discernible human influence’ on global climate. Give them pause for thought”





Lesson 6: Declare values

“In presentations of climate science to the public, don’t just talk about the science. Declare your values – who you are, and what you stand for”















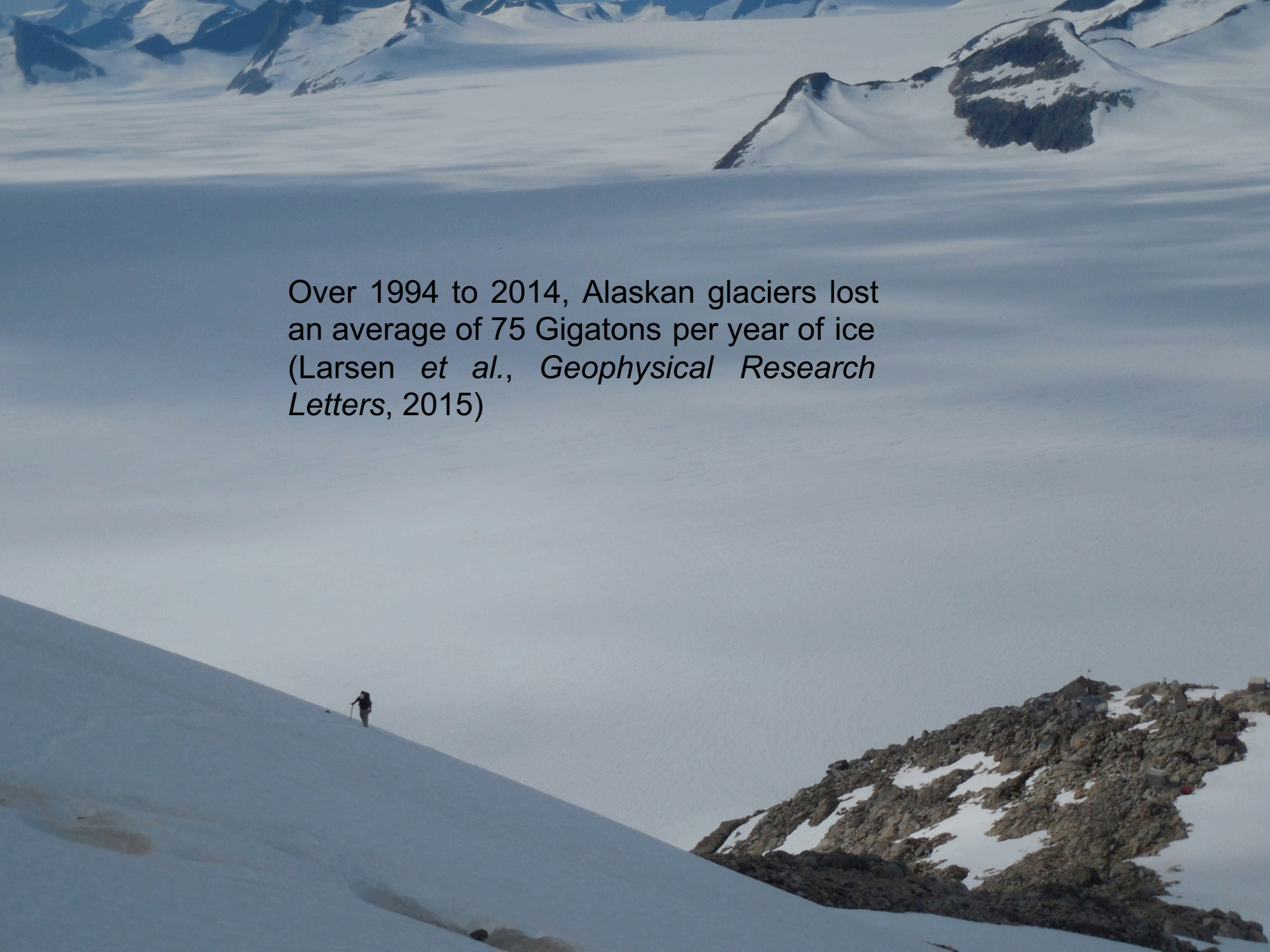








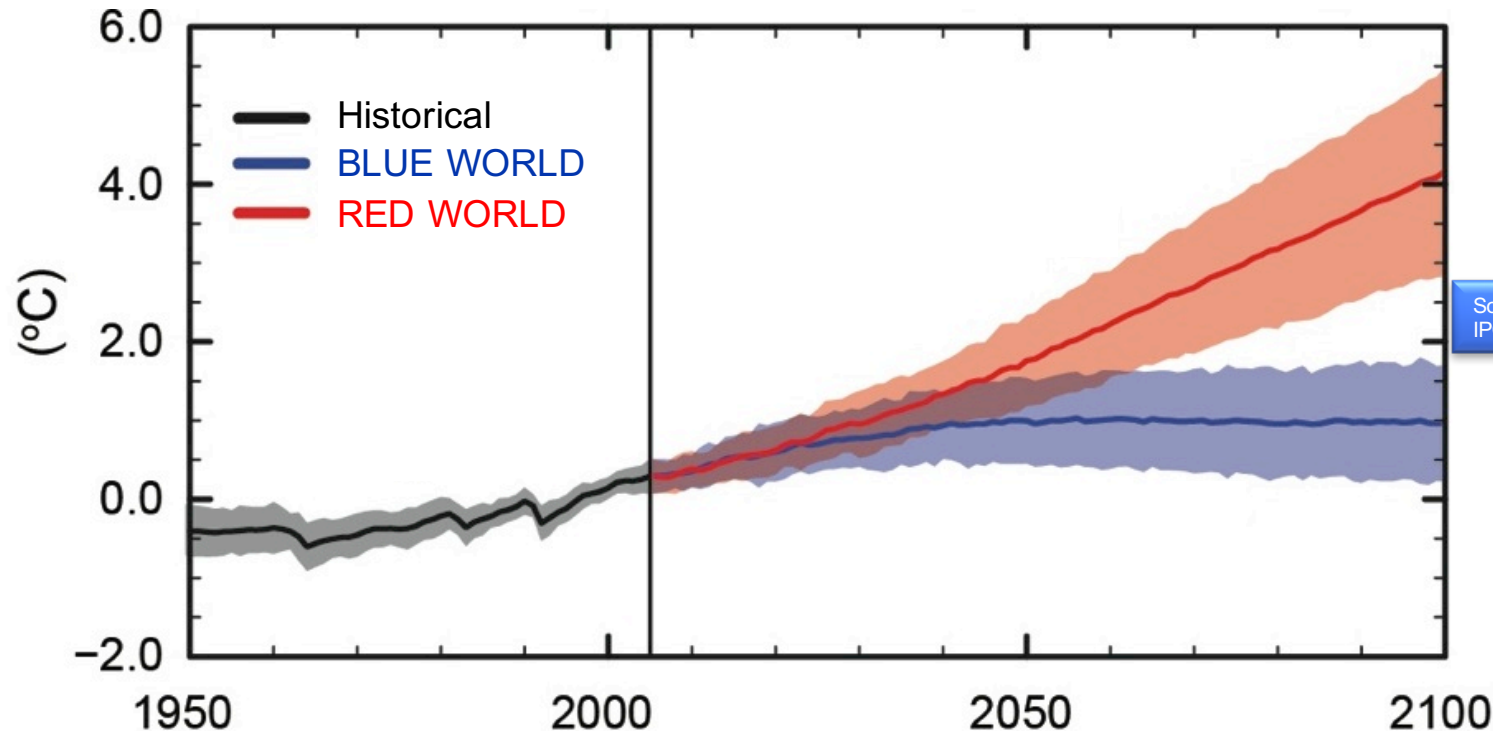
Photo courtesy of Kurt Kleman (2016)



Over 1994 to 2014, Alaskan glaciers lost an average of 75 Gigatons per year of ice (Larsen *et al.*, *Geophysical Research Letters*, 2015)



Humanity at the crossroads: Projected changes in global average surface temperature



BLUE WORLD ("Enlightened humanity")

Global annual greenhouse gas emissions peak between 2010 to 2020, and decline thereafter

Projected temperature increase:

0.5°F to 3.1°F (2081-2100 relative to 1986-2005)

RED WORLD ("Business as usual")

Global annual greenhouse gas emissions increase throughout the 21st century

Projected temperature increase:

4.7°F to 8.6°F (2081-2100 relative to 1986-2005)

A teachable moment



<https://www.youtube.com/watch?v=0ULE6v6h2Oc>

EXTRA SLIDES



EXTRA SLIDES

What is the Intergovernmental Panel on Climate Change?



- The IPCC was established by the World Meteorological Organization and the United Nations Environment Programme in 1988:
 - ➔ To assess available scientific information on climate change
 - ➔ To assess the environmental and societal impacts of climate change
 - ➔ To formulate response strategies

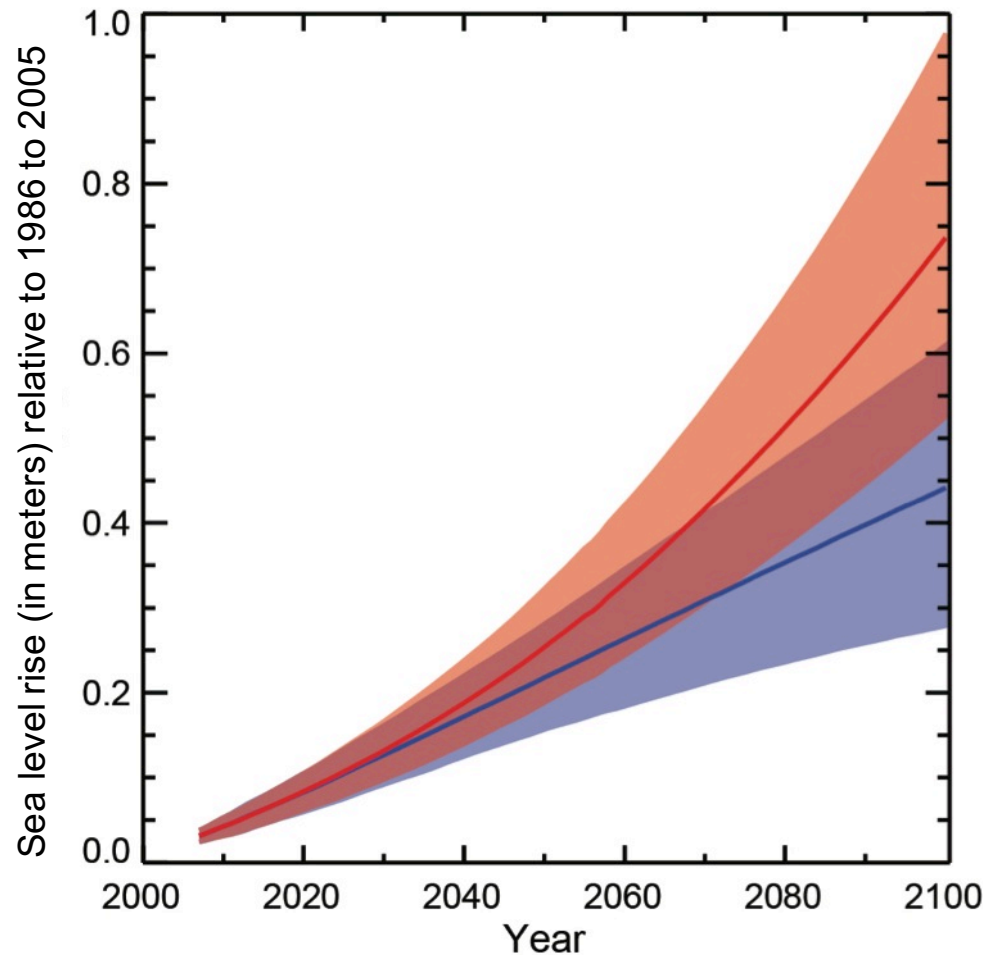
[§] Source: Foreword to 1995 IPCC Working Group I Report, by G.O.P. Obasi, WMO, and E. Dowdeswell, UNEP



Structure of IPCC Working Groups

- Working Group I: The Science of Climate Change
- Working Group II: Impacts, Adaptations and Mitigation of Climate Change
- Working Group III: Economic and Social Dimensions of Climate Change

The blue pill or the red pill? Projected changes in sea level



RED WORLD

Projected sea-level increase:

20.5 to 38.6 inches (2081-2100 relative to 1986-2005)

BLUE WORLD

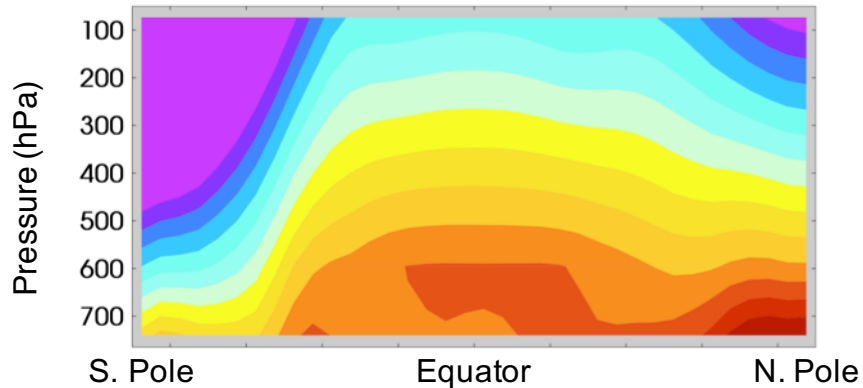
Projected sea-level increase:

10.2 to 21.7 inches (2081-2100 relative to 1986-2005)

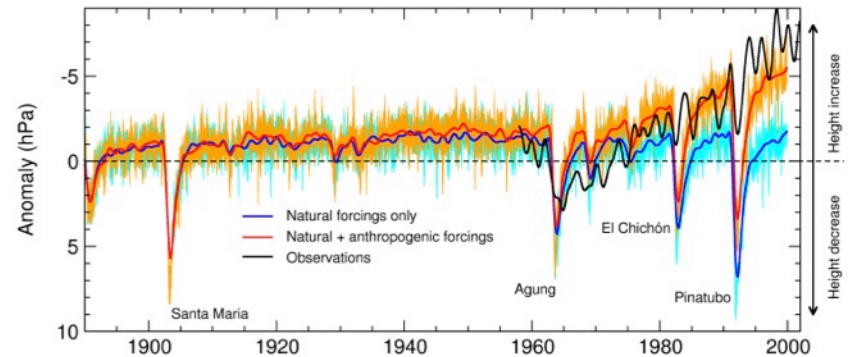
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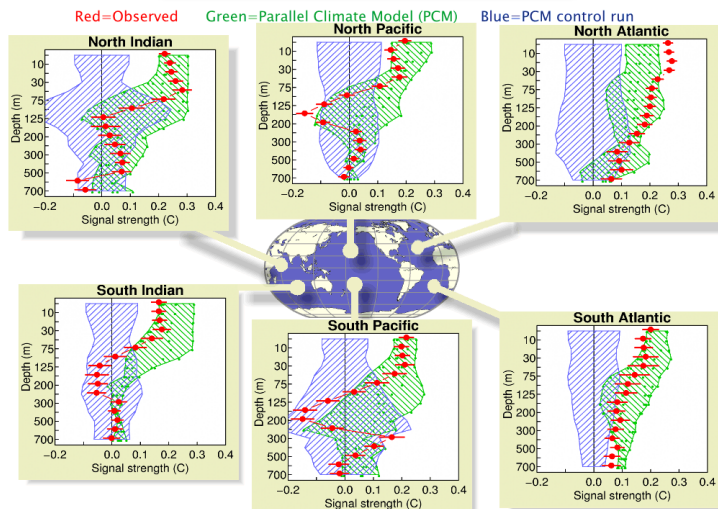
Atmospheric temperature



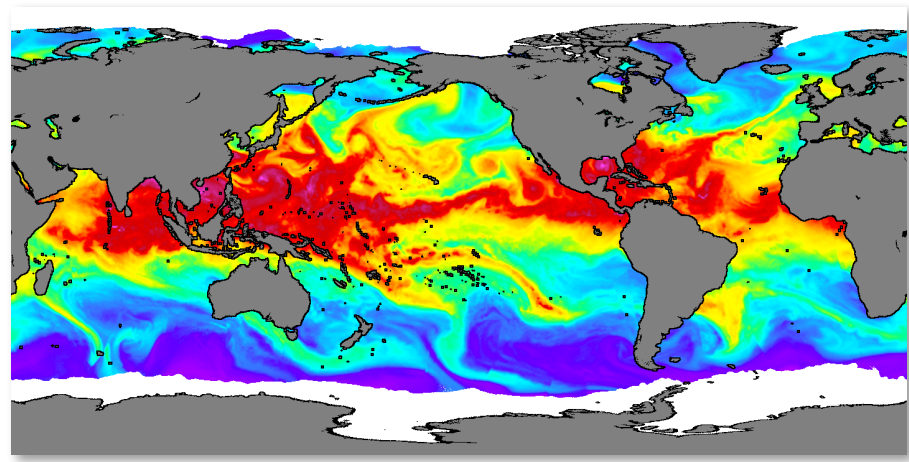
Tropopause height



Ocean temperature



Water vapor over oceans





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Who I am and what I stand for:

- I am not just a climate scientist – I am also a mountaineer
- In my lifetime, I’ve witnessed large changes in high-Alpine environments around the world
- If we lose these places, we are diminished
- We need to be good stewards of this planet

MADRID, DAY 3: Discussion of “the balance of evidence” statement in final Plenary session§



- KEVIN TRENBERTH: We’re talking about a sizeable human influence, one which has emerged from the noise. It really needs a qualifier – some kind of word needs to be in there to say this (signal) is large enough to have actually emerged from the noise. It should say “an identifiable human influence.”
- SIR JOHN HOUGHTON: I think Sweden had a proposal that (global climate) “is being measurably affected by human activities”. A significant number of people want it stronger, there are others who want caveats in it, particularly the Saudi Arabian delegation.
- NEW ZEALAND: I think the correct word to put in front of the human influence is “detectable.”
- GERMANY: “Detectable” doesn’t say if we have detected something. It’s only that we are able to do that, and not if we have done it.

MADRID, DAY 3: Discussion of “the balance of evidence” statement in final Plenary session§



- NORWAY: We can go along with the word “indicates” instead of “points towards”. But we will certainly not use the word “suggests”.
- CANADA: We would like to keep the words that were suggested by our U.S. colleagues, that is: “Nevertheless, the weight of evidence now indicates that the global climate is being measurably affected by human activities.”
- BEN SANTER: What we actually have in the executive summary of Chapter 8 is a sentence which is pretty close to what we’re talking about now: “Taken together, these results point towards a human influence on climate.” I prefer something without any kind of qualifier, but I realize that other people interpret the scientific evidence somewhat more strongly. Perhaps I’m too close to this to make a decision.

MADRID, DAY 3: Discussion of “the balance of evidence” statement in final Plenary session[§]



- BERT BOLIN: After discussions with many here, I think we would serve our purposes best if you could modify that sentence (the “balance of evidence” sentence) slightly. I’ve had contact with many here, not least with Saudi Arabia, and they are willing to accept this as an extraordinary measure. It’s essentially only to change “appreciable” to “discernible”.
- SIR JOHN HOUGHTON: I think we were searching for a word and the word has been found. Bert’s found the word; thank you very much Bert for finding that.
- BERT BOLIN: No, the U.K. did it for me. English is not my mother tongue.
- SIR JOHN HOUGHTON: O.K., good old U.K. Thank you to the U.K. delegation.