

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

# Fingerprinting the Climate System

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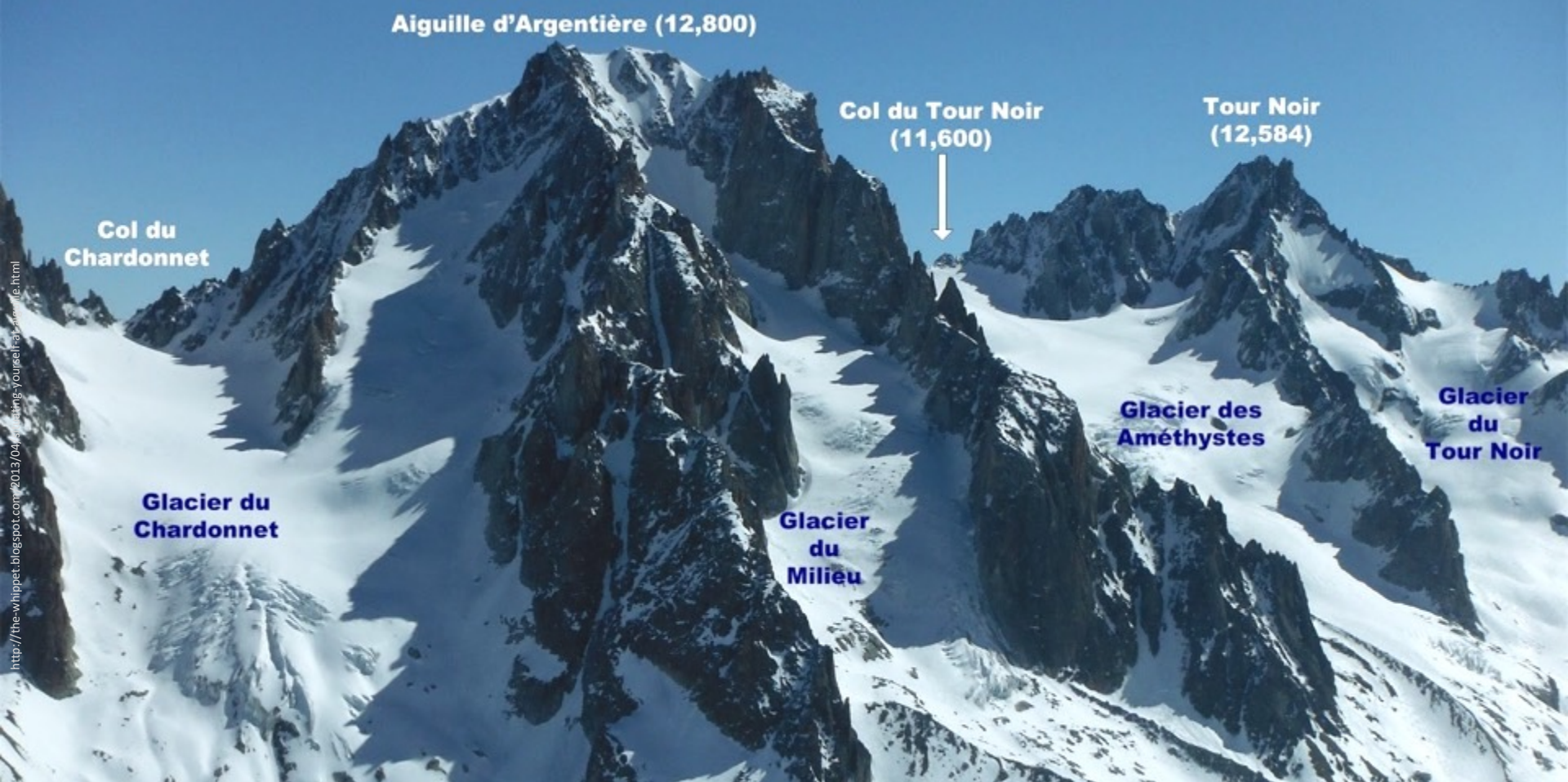
CCL meeting, Oct. 12, 2021



# Epiphany

Photo by Colin Montearth/Minden Pictures

# Event 1: Chamonix, 1977



**Aiguille d'Argentière (12,800)**

**Col du Tour Noir  
(11,600)**

**Tour Noir  
(12,584)**

**Col du  
Chardonnet**

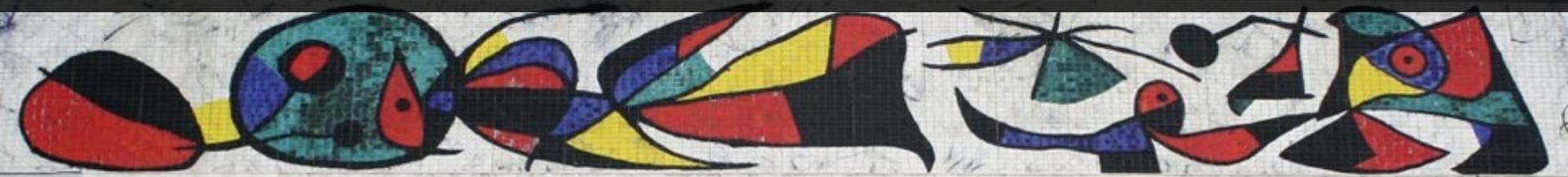
**Glacier du  
Chardonnet**

**Glacier  
du  
Milieu**

**Glacier des  
Améthystes**

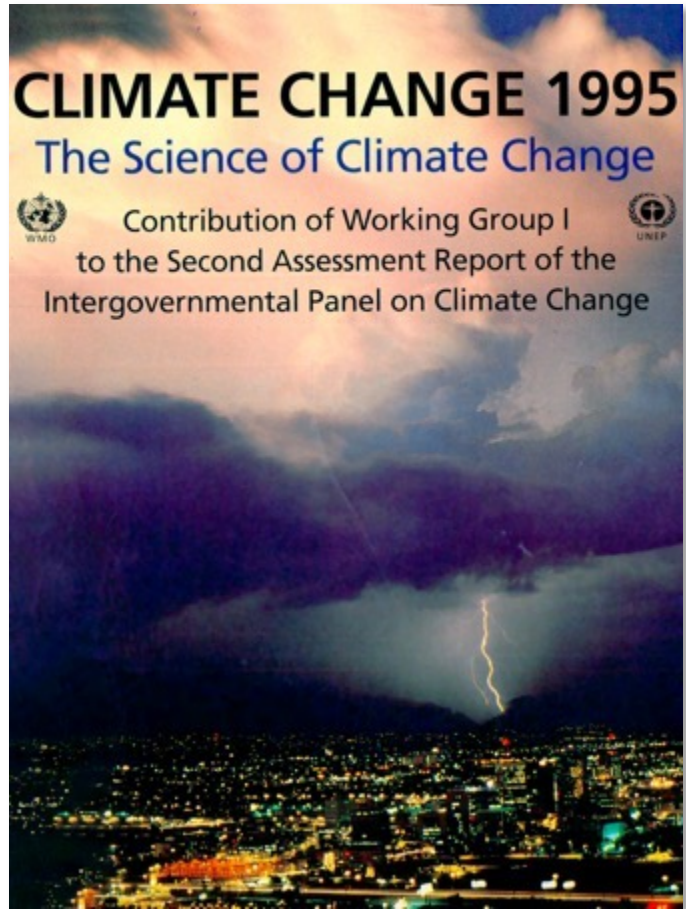
**Glacier  
du  
Tour Noir**

# Event 2: Madrid, 1995



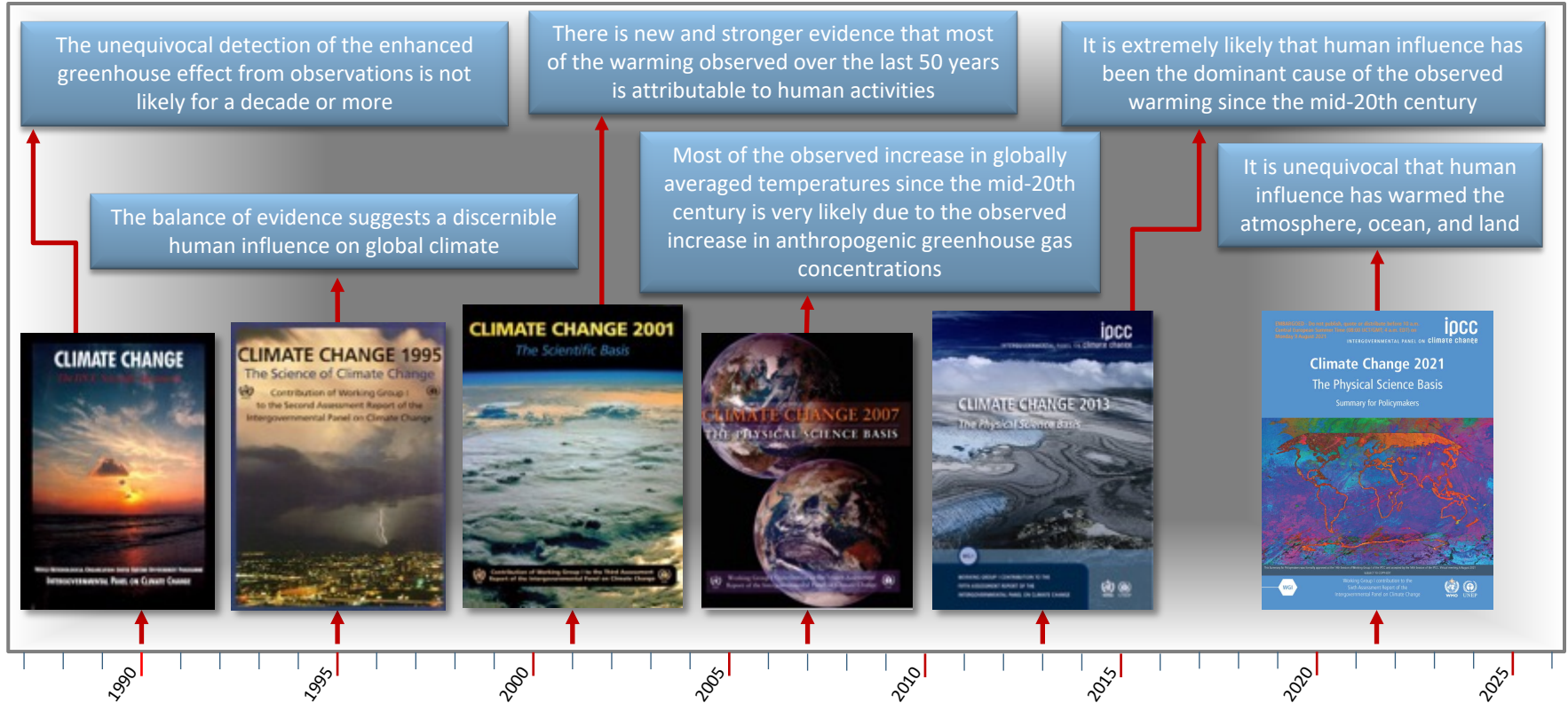
PALACIO DE CONGRESOS DE MADRID





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

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



# How was scientific progress made?

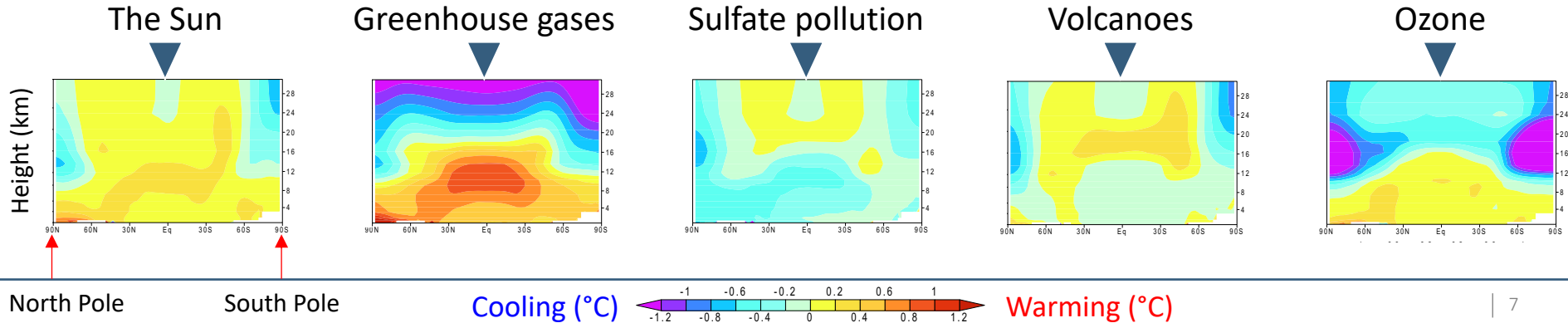
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- Improved (and more) climate models
- Better understanding of “forcings” that affect climate
- Improved (and longer) observed climate records
- Community-wide analysis of climate model results
- Infrastructure for sharing climate model output
- “Climate fingerprinting”

# What is “climate fingerprinting”?

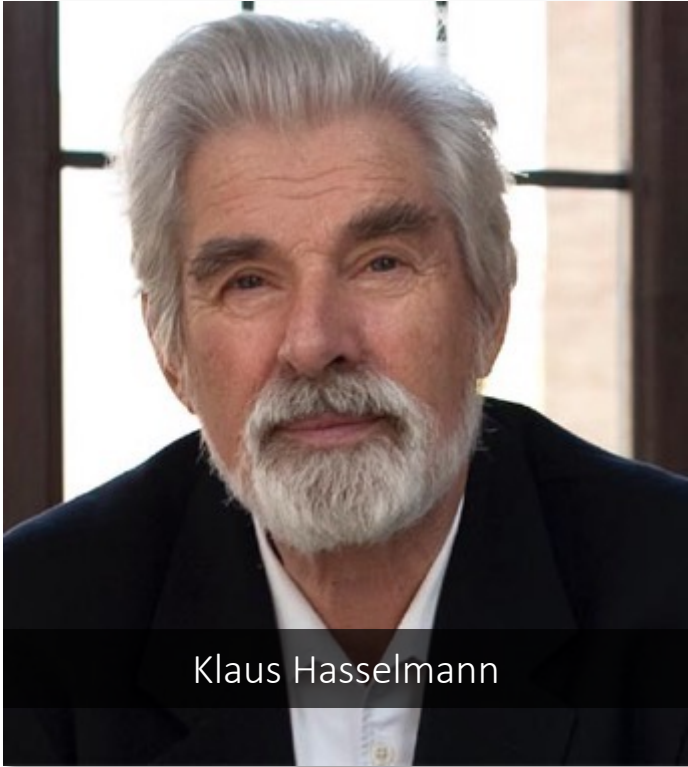
## ■ Basic idea:

- Different influences on climate have different signatures
- Signatures are easier to discern in patterns (“fingerprints”)



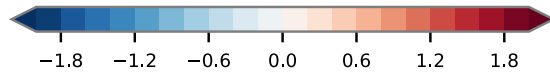
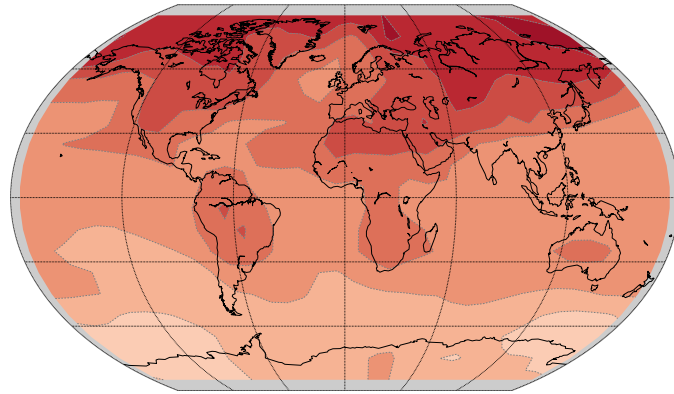


# Hasselmann: The power of patterns



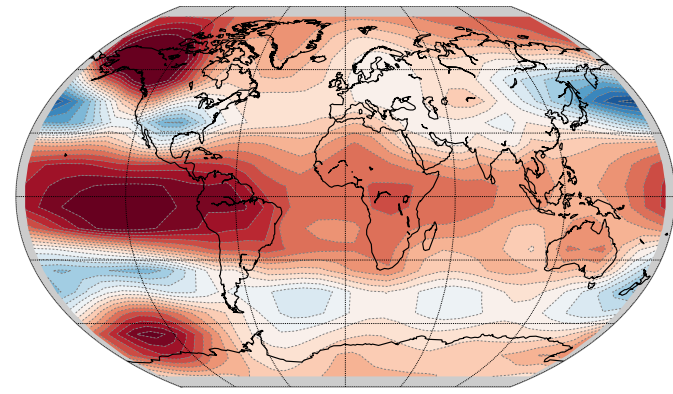
# Using patterns to discriminate between human and natural effects on climate

## Human fingerprint



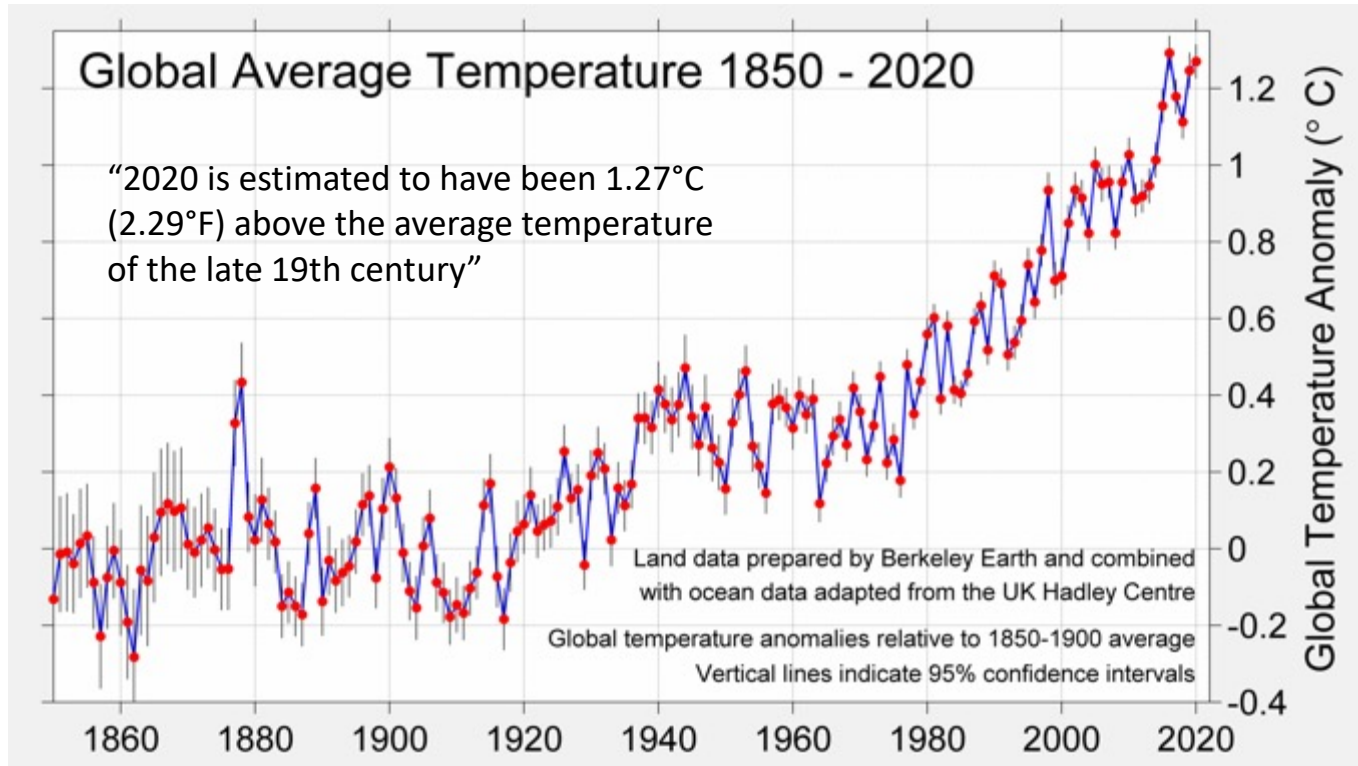
Pattern amplitude

## Natural climate variability

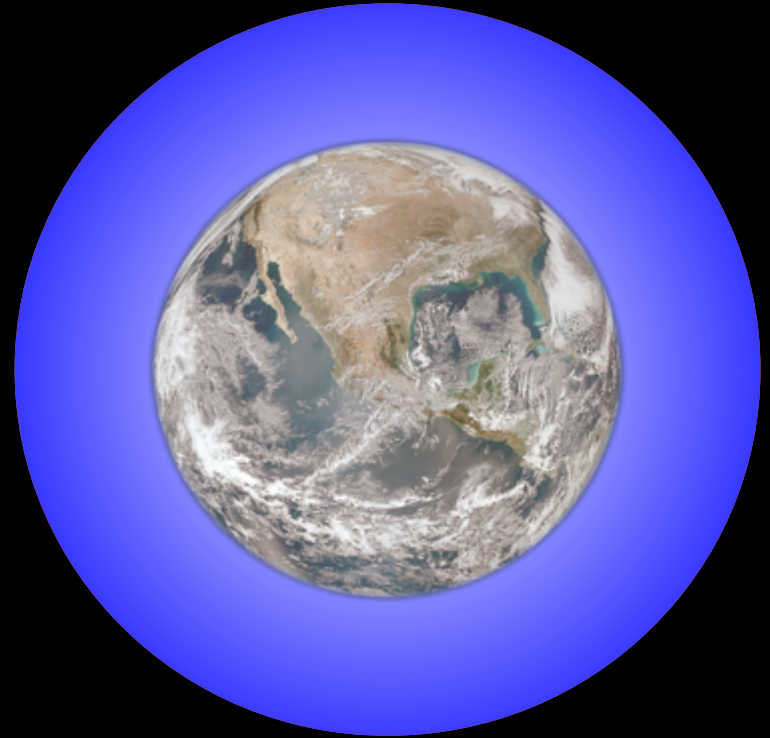


Pattern amplitude

# The power of fingerprinting

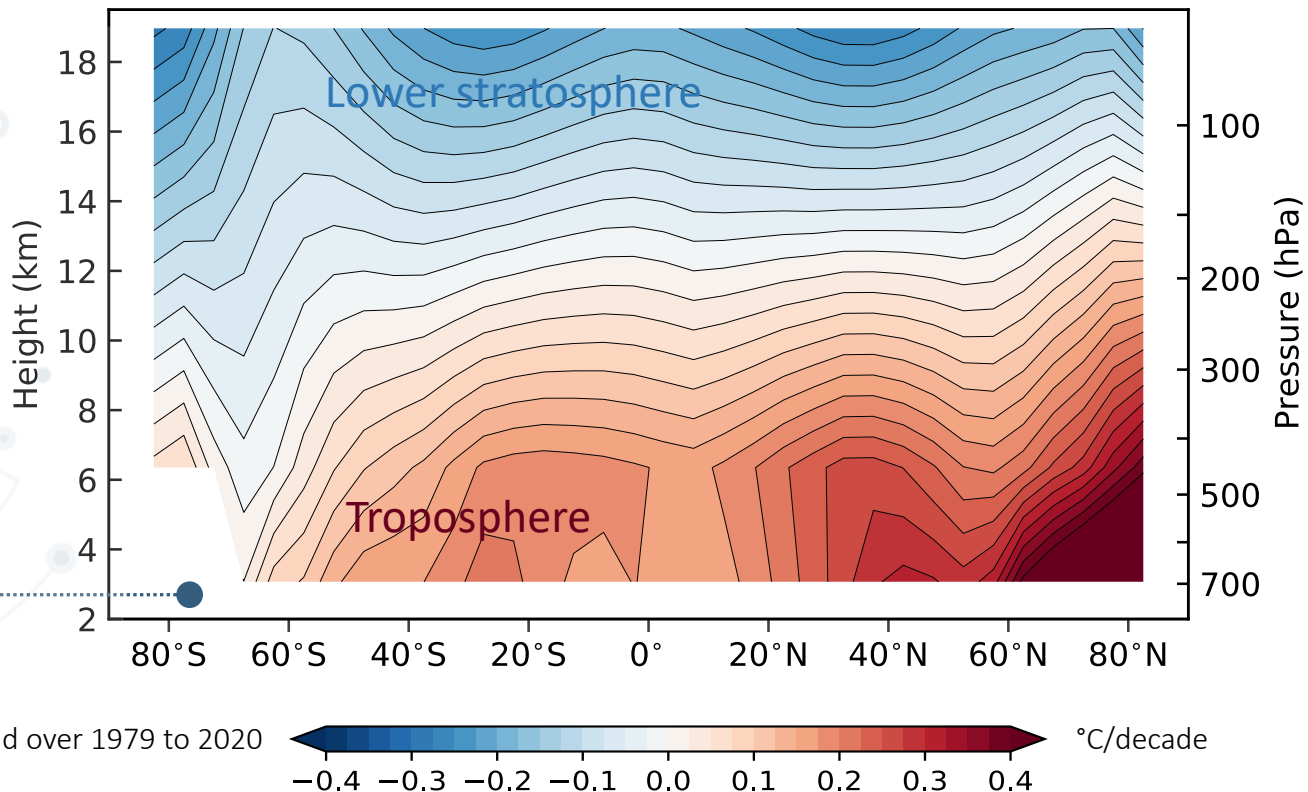


Testing claims that the surface warming of the last 140 years is all due to changes in the Sun



# Satellite data don't fit the hypothesis that changes in the Sun explain global warming

Satellite observations  
(Santa Rosa, CA)



# This “human influence” fingerprint on atmospheric temperature was predicted over 50 years ago



## Thermal Equilibrium of the Atmosphere with a Given Distribution of Relative Humidity

SYUKURO MANABE AND RICHARD T. WETHERLAND

*Geophysical Fluid Dynamics Laboratory, ESSA, Washington, D.C.*

(Manuscript received 2 November 1966)

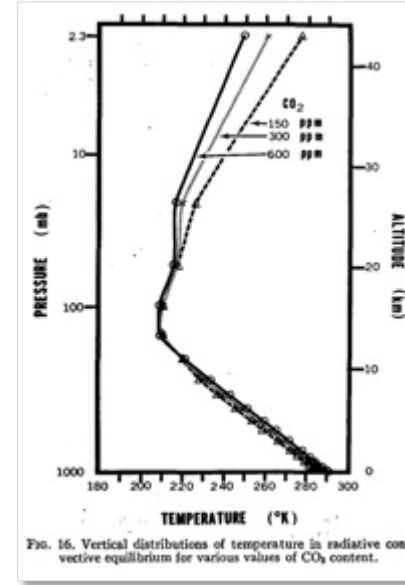
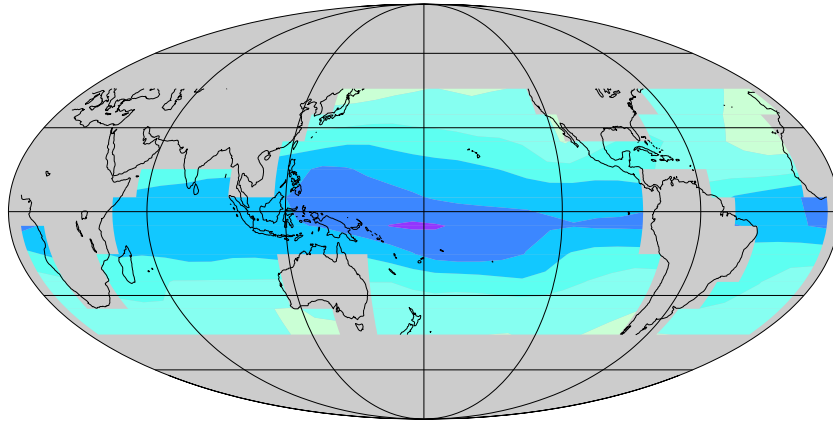


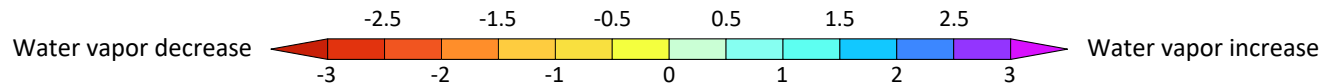
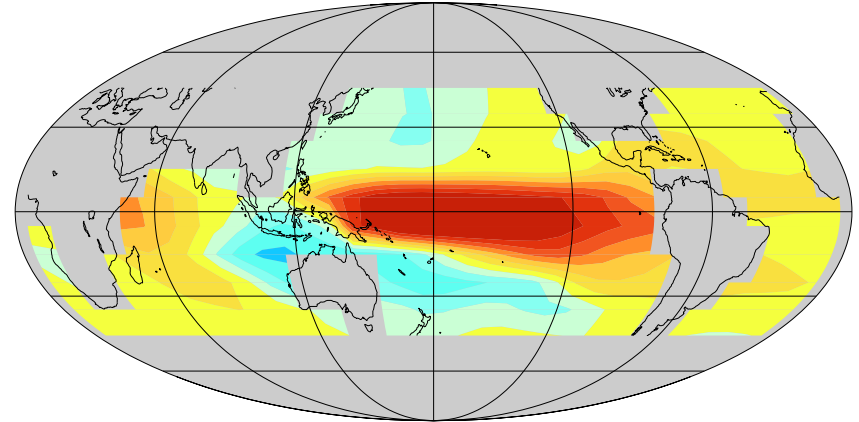
FIG. 16. Vertical distributions of temperature in radiative convective equilibrium for various values of CO<sub>2</sub> content.

# Moving beyond fingerprinting with temperature: the case of atmospheric water vapor

Human fingerprint



Natural climate variability



An aerial photograph of Madrid, Spain, taken at sunset. The sky is filled with soft, orange and pink clouds. In the foreground, a large, ornate building with a prominent golden dome and a statue on top is illuminated. The city's dense architecture, with many buildings featuring balconies and red-tiled roofs, stretches out towards the horizon. The overall atmosphere is warm and scenic.

# Lessons learned from Madrid



# Lesson 1: Speak science to power



## Lesson 2: Declare your values

