OLLI WEST: EARTH CLIMATE – WEEK 6

Future Promise:

- Fusion
- Geoengineering (SRM, CDR, Carbon negative technologies);
- economics

Tuesday October 21st, 2014

Paul E. Belanger, Ph.D.

- **Fusion breakthrough**
  - http://www.lockheedmartin.com/us/products/compact-fusion.html
  - http://aviationweek.com/blog/high-hopes-can-compact-fusion-unlock-new-power-space-and-air-transport
  - **http://aviationweek.com/fusion-podcast**

Naomi Oreskes

Slides excerpted from:

Changing Planet: Past, Present, Future
Lecture 4 – Climate Change: How Do We Know We're Not Wrong?
by Naomi Oreskes, PhD

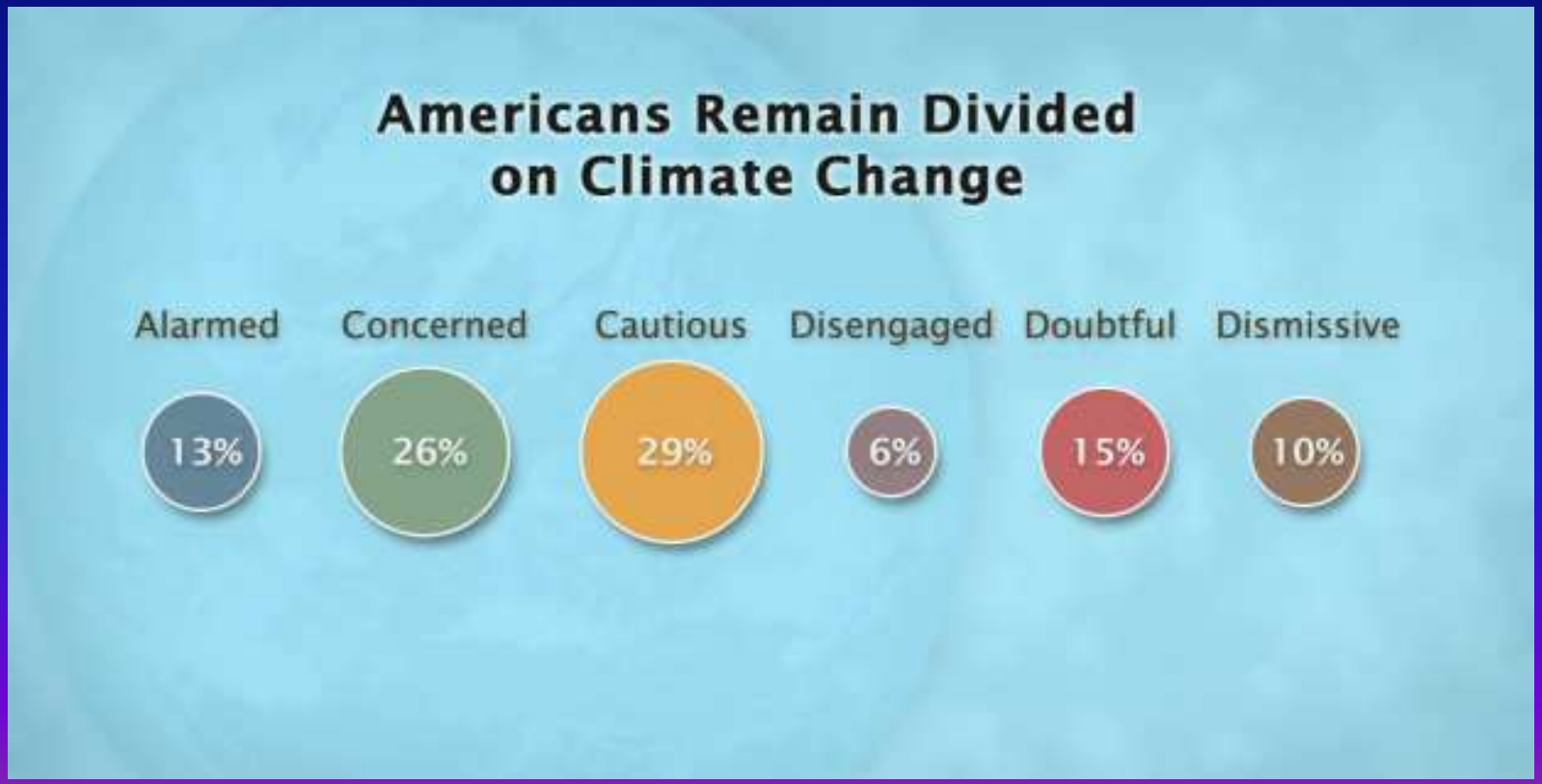
http://www.hhmi.org/biointeractive/climate-change-how-do-we-know-were-not-wrong

http://media.hhmi.org/hl/12Lect4.html

Polls on climate change:

(on evolution ~ half don't believe in evolution)

See National Center for Science Education (NCSE):
http://ncseprojects.org/ on climate: http://ncseprojects.org/climate



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Got to ask why, no?

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Do We Have an Information Deficit?

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We try!

Community Response to Perceived "Information Deficit"

- K-12 science education
- Public outreach and informal efforts
- Statements on web pages
- Improved uncertainty estimation (IPCC, NRC, etc.)
- Howard Hughes Medical Institute lectures

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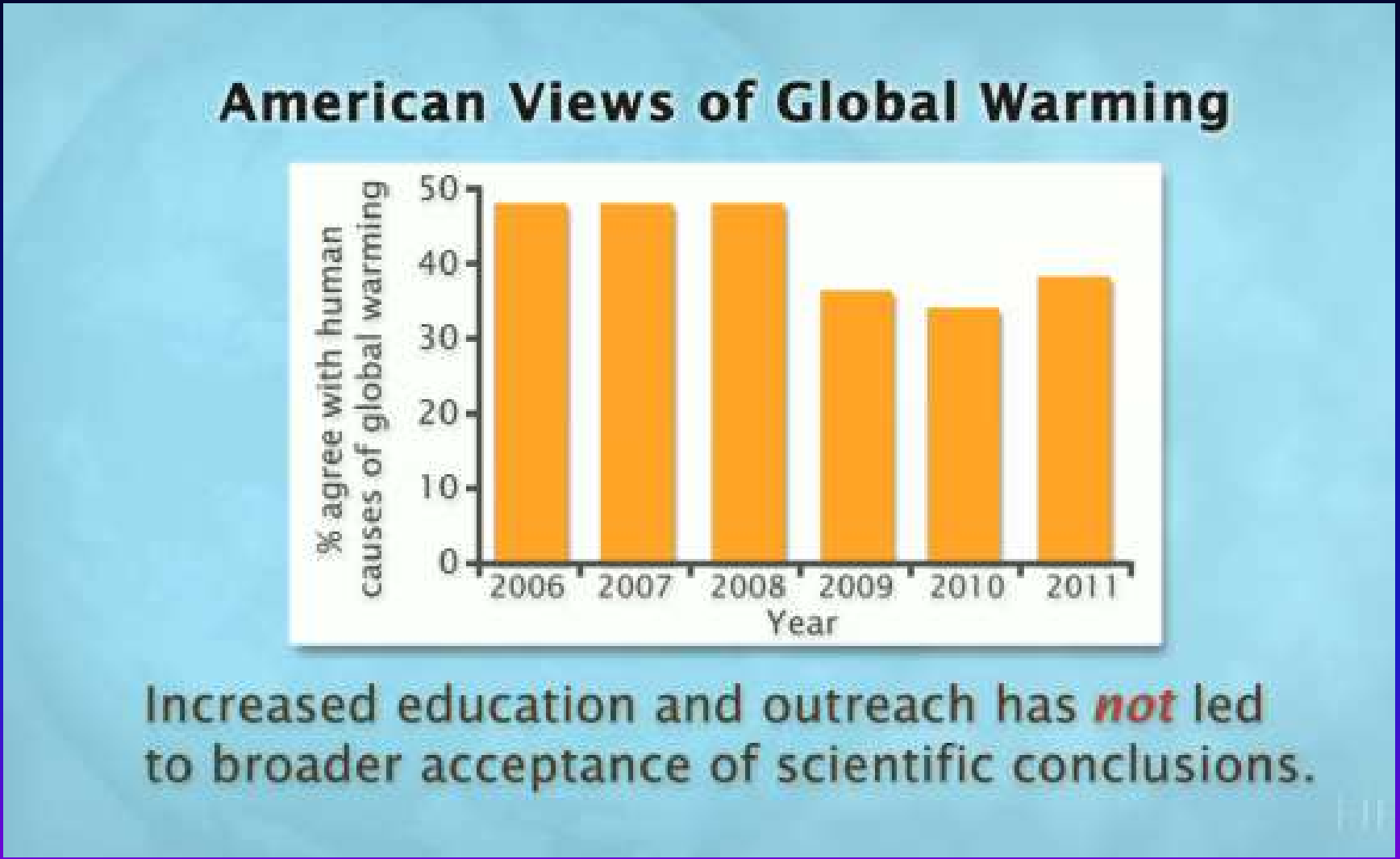

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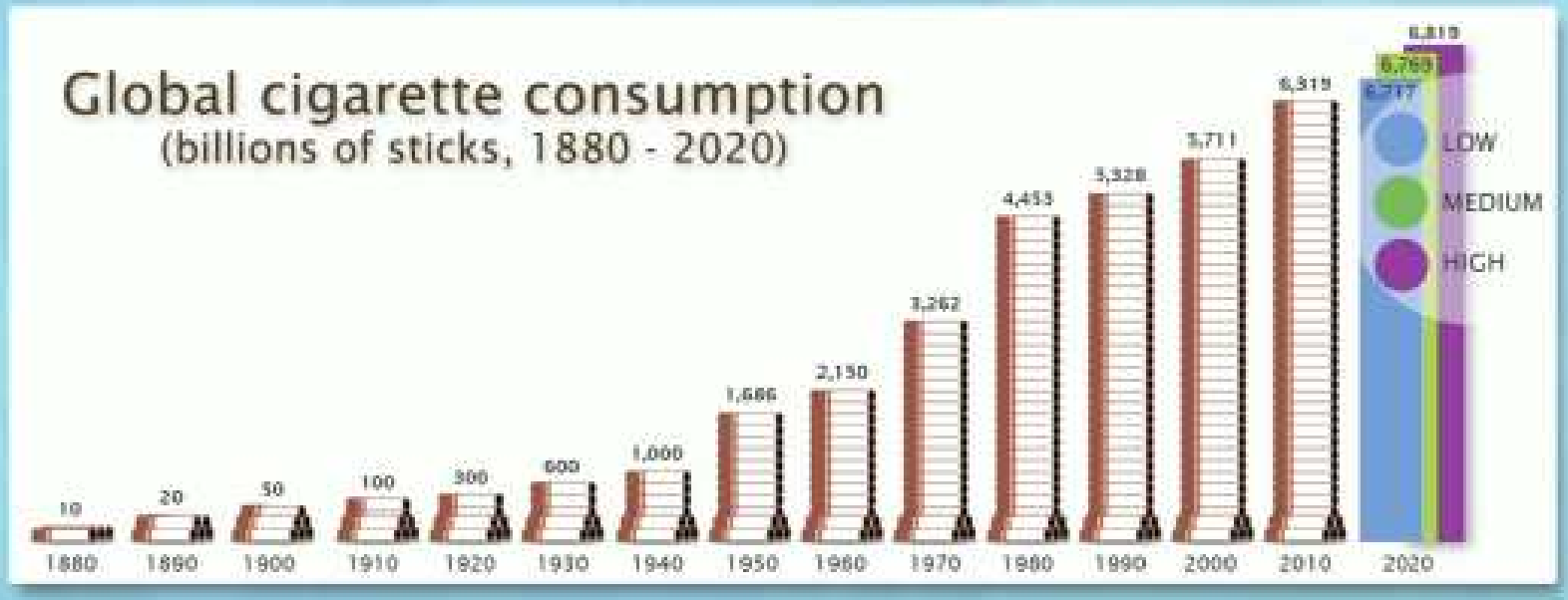
More Examples of Knowledge ≠ Action



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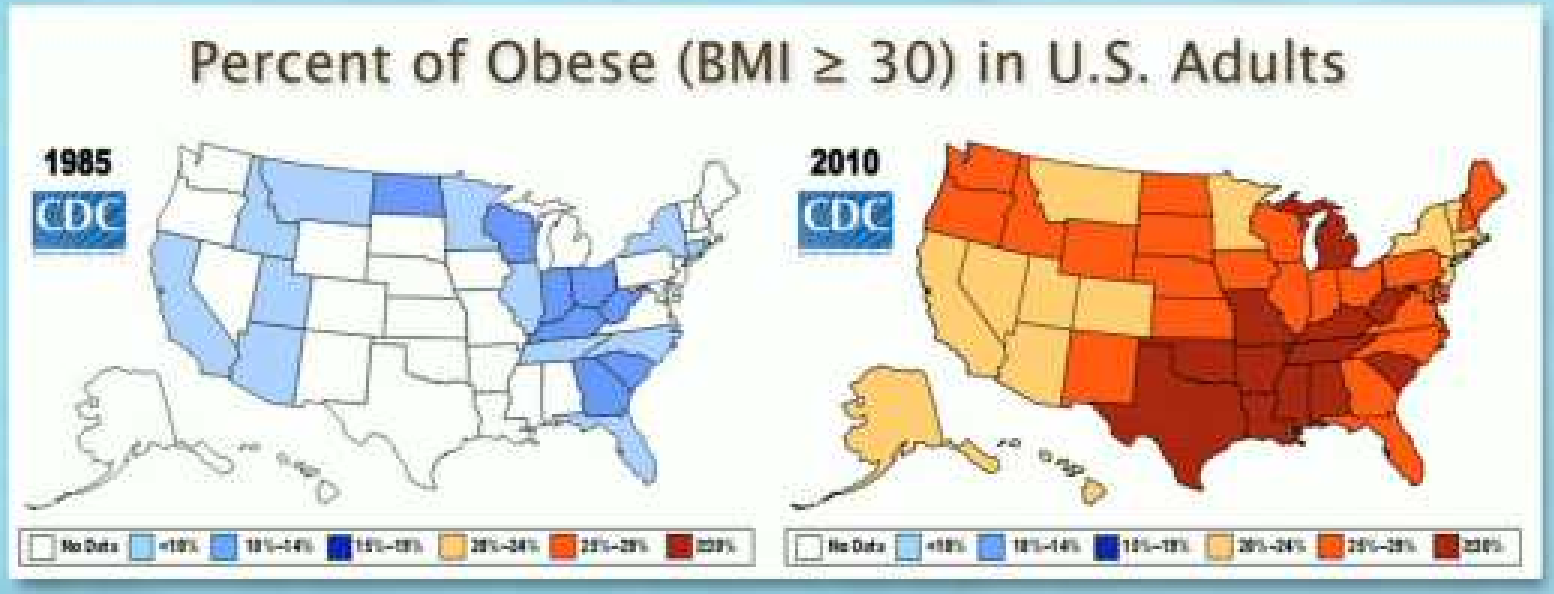
More Examples of Knowledge ≠ Action



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There must be another explanation for why people have rejected climate science.

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It started with the Marhall Institute

Organized Resistance: George C. Marshall Institute

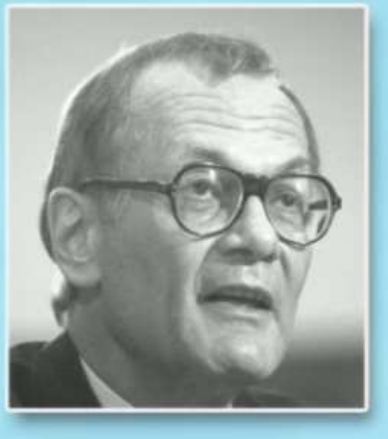
William Nierenberg

Nuclear physicist and long-time director of Scripps Institution of Oceanography

Frederick Seitz

President of NAS, Rockefeller University, and consultant to R J Reynolds Tobacco

Robert Jastrow



Astrophysicist, head of Goddard Institute for Space Studies

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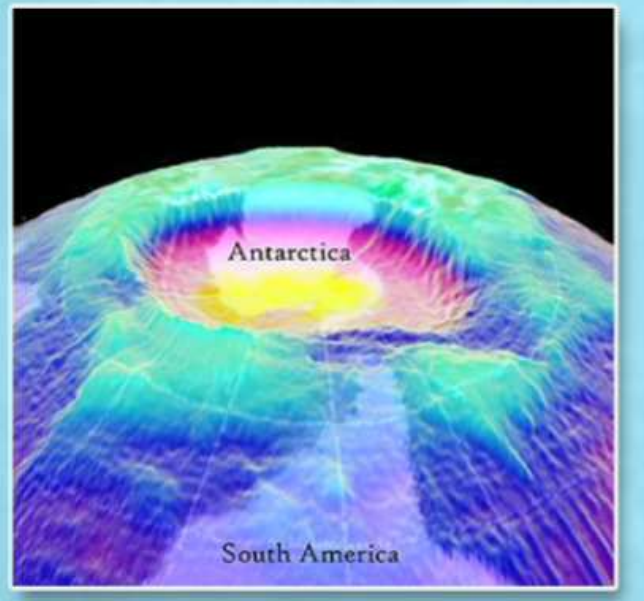
After the cold war ended, they went after perceived internal “threats”

Over Twenty Years Challenged Scientific Evidence on a Host of Issues



Ozone depletion

Harmful effects of tobacco smoke

Acid rain

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We Can Prevent These Harms in a Variety of Ways

Tobacco: Heavy taxation, limits on advertising (free speech), and in some cases, outright bans

Acid Rain: An Emissions Trading Scheme Under Clean Air Act Amendments (1990)

Ozone Hole: International Treaty to Ban CFCs

These are all government interventions in the marketplace, which put limits on business activities and personal freedom.

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It comes down to ideology, not science!

The Marshall Institute Opposes These Form of Government Interventions

Their method: challenge the scientific evidence that demonstrates the need for these interventions.

In some cases, they even attacked the *scientists*.

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And it “mushroomed”

Network of Think-Tanks and Organizations Who also Spread Doubt About Climate Science

American Enterprise Institute
Competitive Enterprise Institute
Heartland Institute
Alexis De Tocqueville Institute
Heritage Foundation
Acton Institute
Hudson Institute
Atlas Economic Foundation
Americans for Prosperity
Frontiers of Freedom
Committee for a Constructive Tomorrow
Institute for Public Affairs (Australia)
Let Freedom Ring

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The Marshall Institute and More Than Two Dozen Other Think Tanks

These think tanks don't do scientific research.

None of them are scientific research organizations.

It is legitimate to have a conversation about policy issues.

It is not legitimate to fabricate evidence or make claims without any evidence.

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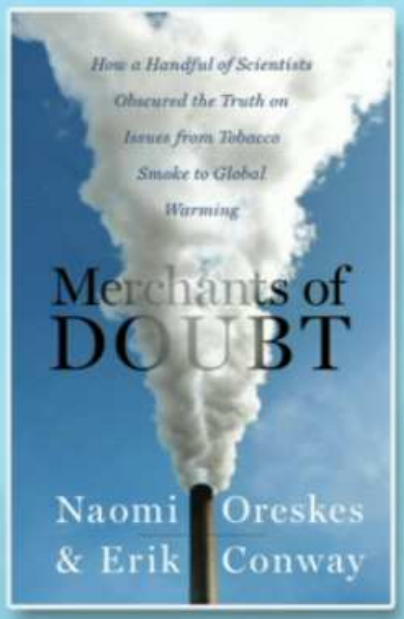
Implicatory Denial

Rejection of climate science—like acid rain, ozone depletion, tobacco use—was not about science.



It was about its implications.

1. Free market capitalism had produced serious problems that the "invisible hand" was not solving.

2. The American way of life might need adjustment.

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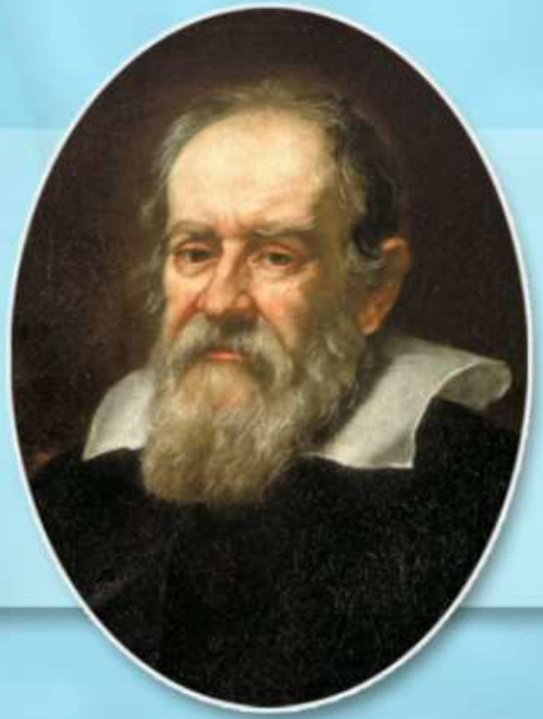
Catholic Church Rejected Galileo Because They Did Not Like the Implications

Not because his science wasn't right, but because it implied that the Catholic Church wasn't infallible



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Dealing with Climate Change Will Require Big Decisions

Therefore, it is appropriate to turn a critical eye to the science to try to make sure it is not wrong.

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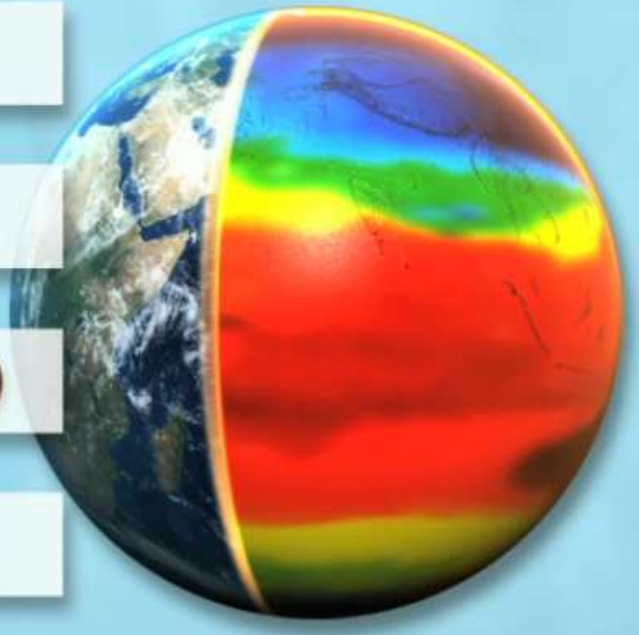
Criteria By Which We Can Judge the Science

- Methodological standards
- Evidential Standards
- Performance standards (models)
- Is there an expert consensus?



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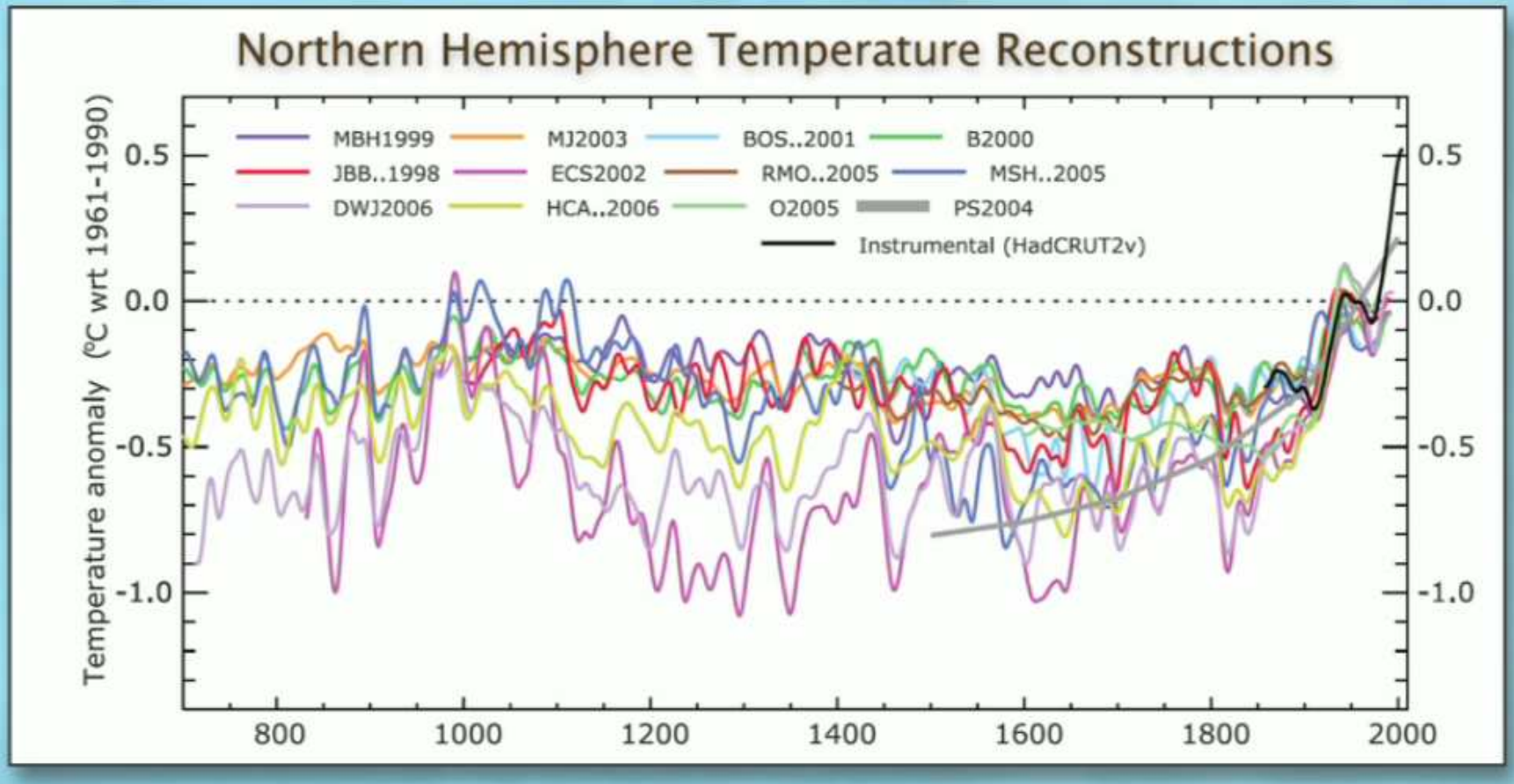
Independent Corroboration



Multiple data sets show the same general trends.

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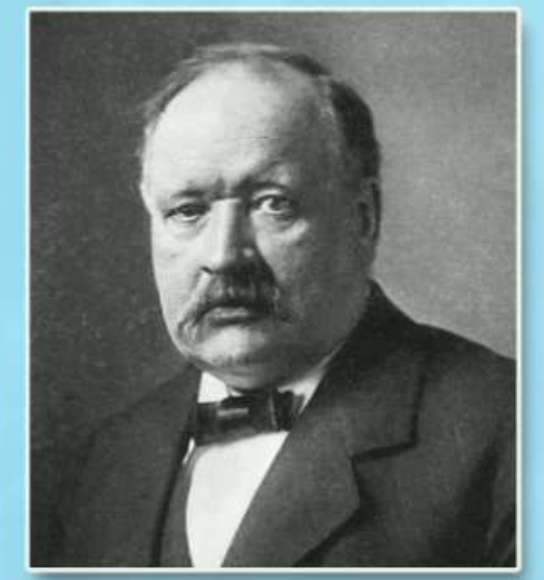
Alternatively, Start with a Theory and See If Observations Fit

Example

CO_2 is a greenhouse gas.

If CO_2 rises, then temperature should also rise.



Arrhenius made this prediction in 1896.

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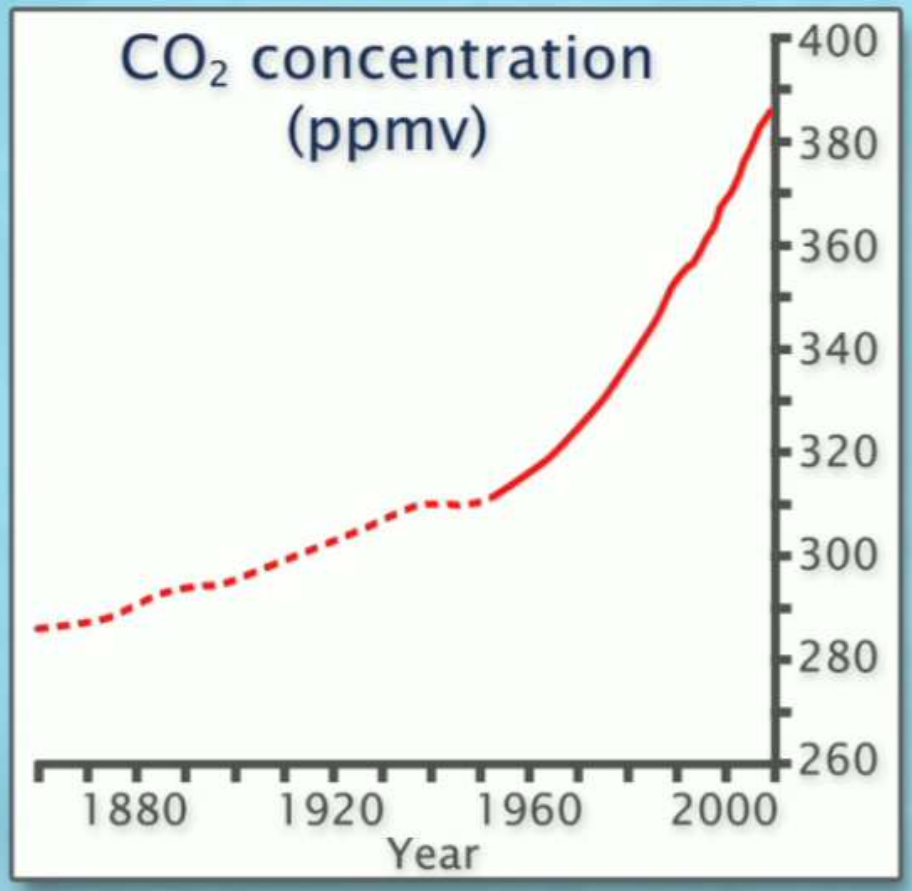
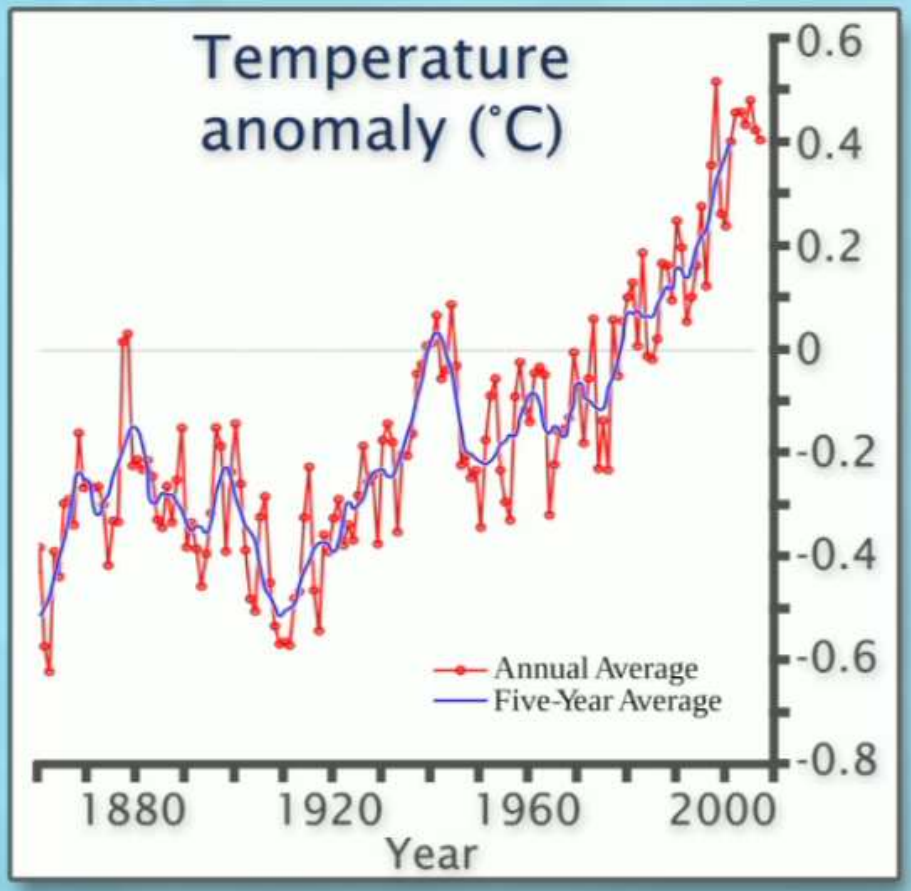
As CO_2 Level Rose, Temperature Rose





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Science Is Falsifiable

This means that if the claim is false, then that can be demonstrated by experiment and/or observation.

Example

Observation:
CO_2 levels are rising

Hypothesis:
Volcanoes are the source of that CO_2

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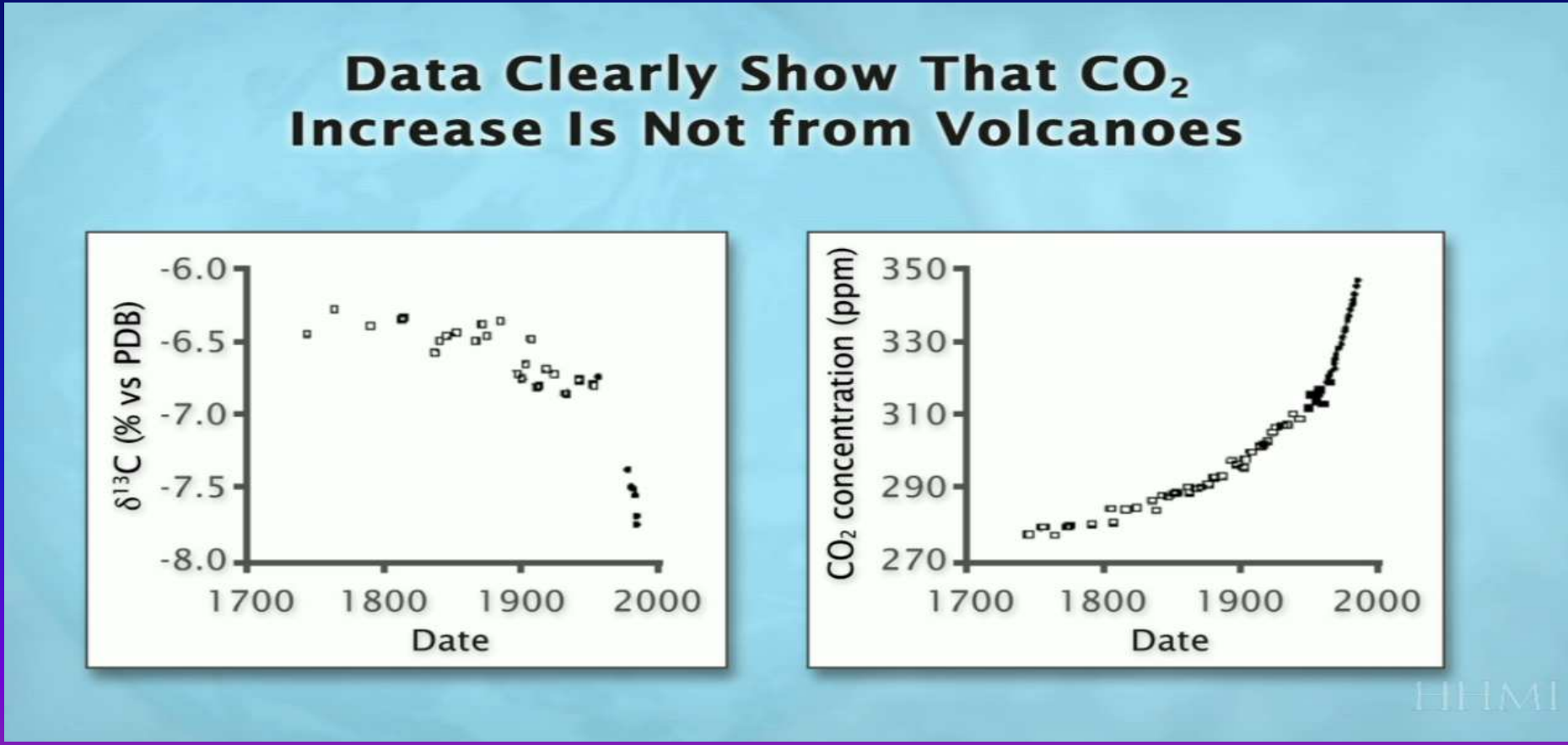
How to test the hypothesis

Inorganic CO2 from volcanoes are isotopically more positive; organic matter depleted in C13 = Fossil carbon is negative

"To claim otherwise:

Confused, ignorant or lying"



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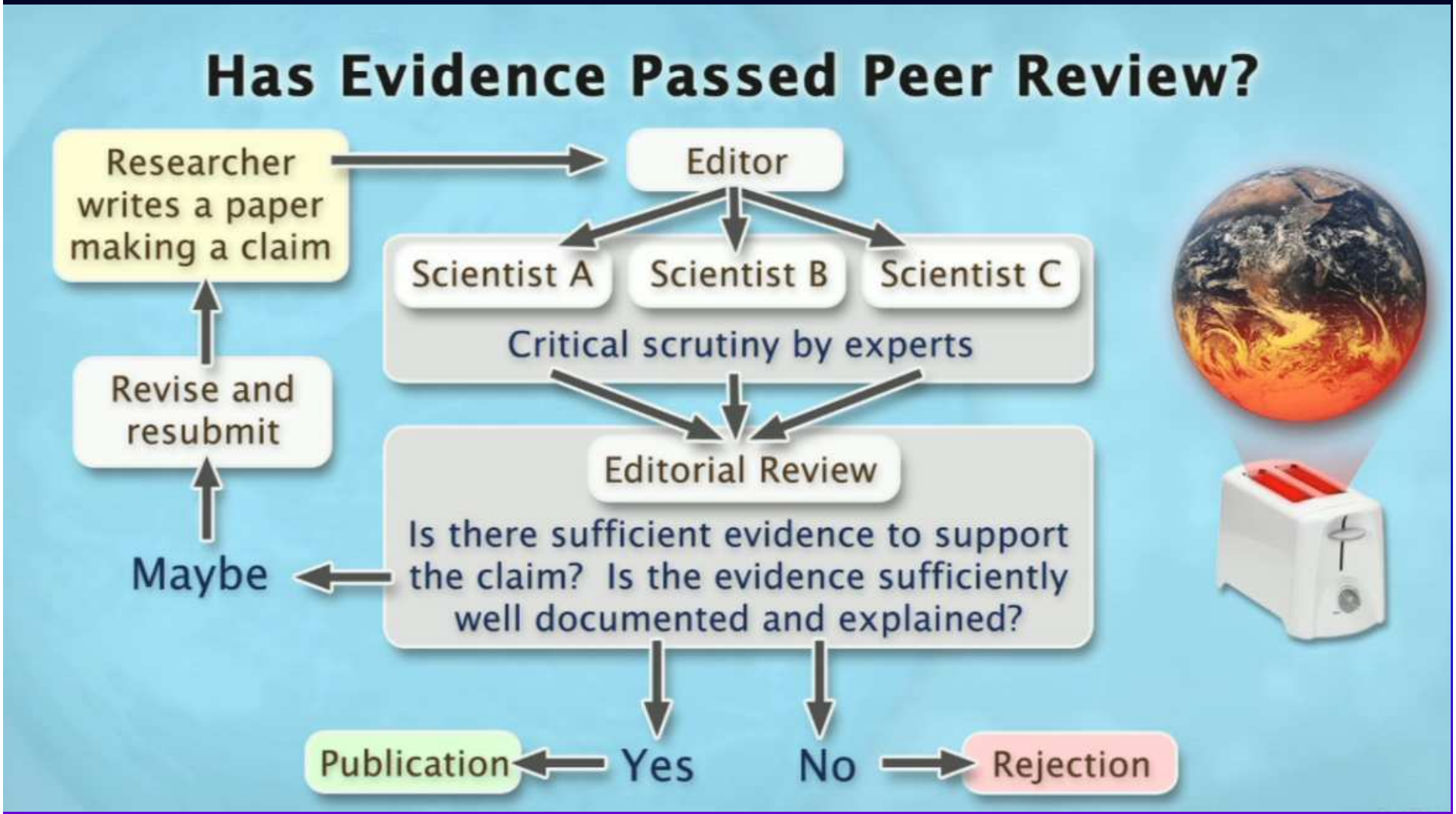
How peer review works



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Intergovernmental Panel on Climate Change (IPCC)

Thousands of scientists

195 countries

Open process

An unprecedented level of review and inclusivity

Climate science has passed an unprecedented level of peer review.

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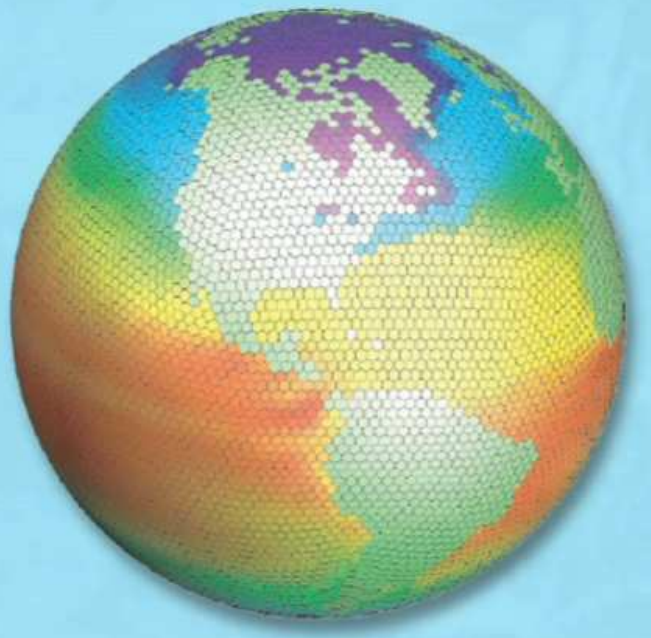
Performance



Global climate model
geodesic grid

Climate models are extremely complex systems.

A good model should be consistent with what we see in the real world.

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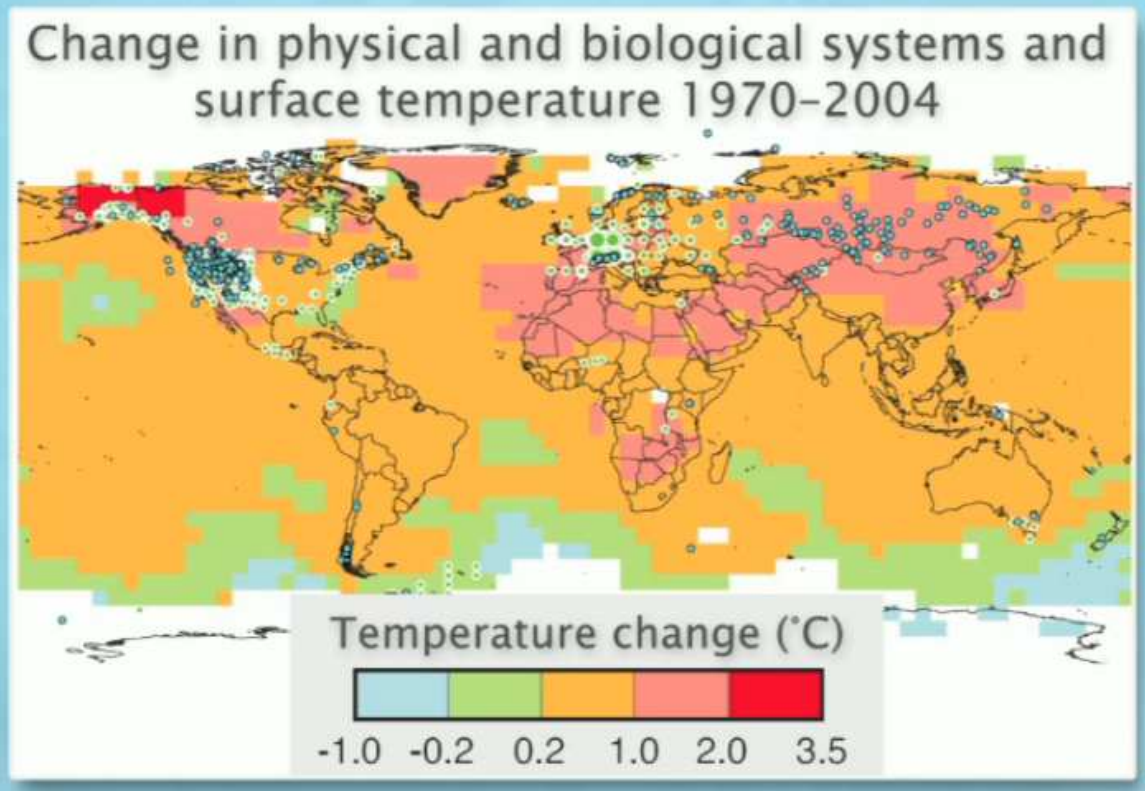
IPCC Summary: A Vast Number of Observations Fit the Climate Models



Global

Physical	Biological
765 significant observed changes	**28,671** significant observed changes
94% significant changes consistent with warming	**90%** significant changes consistent with warming

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Consensus

ESSAY

BEYOND THE IVORY TOWER

The Scientific Consensus on Climate Change

Naomi Oreskes

Without substantial disagreement, scientists find human activities are heating the Earth's surface.

Review of 928 papers

75% supported the conclusion that anthropogenic climate change was under way

25% focused on paleoclimate or other technical aspects and took no position

No peer-reviewed papers refuted the consensus view

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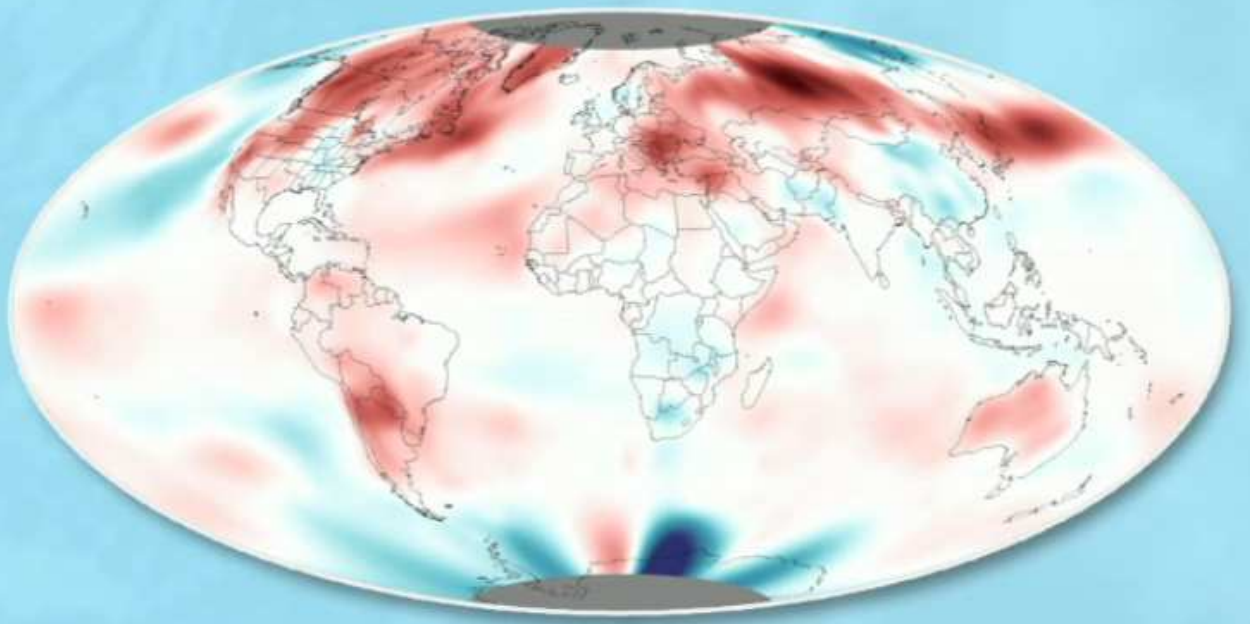
The Science Is Settled and Passes All the Tests That We Can Subject It To

The globe is warming and the climate is changing.



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Obama quoted in episode of Years of Living Dangerously (paraphrased): “It’s difficult in a Democracy to do something/pass something where the pay-back is 10 or more years out”

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End or class PowerPoint week 6;

Go back to syllabus