



State of the Climate Debate

Judith Curry



John Kerry: “climate change” is perhaps “the world’s most fearsome weapon of mass destruction.”

Hillary Clinton: climate change is “the most consequential, urgent, sweeping collection of challenges we face as a nation and a world.”



President’s Climate Action Plan



UNFCCC Treaty (1992):

The UNFCCC established a goal of stabilization of atmospheric greenhouse gases to prevent dangerous climate change

IPCC:

1. Anthropogenic climate change is real
2. Anthropogenic climate change is dangerous
3. Action is needed to prevent dangerous anthropogenic climate change

Recent Headlines:

Climate scientists scrambling for explanations on lack of warming

Global temperature drops below IPCC projection range

The Arctic sea ice spiral of death seems to have reversed

How global warming policies have led to global insecurity

The 8% Consensus: Only 11 of 144 Countries have Backed the Kyoto Protocol's Extension.

United States Senate
Environment and Public Works Committee

Minority Report
(Updated for 2014)

Critical Thinking on Climate Change



*Empirical Evidence to Consider Before Taking
Regulatory Action and Implementing Economic
Policies*

September 4, 2014

Tame Problem

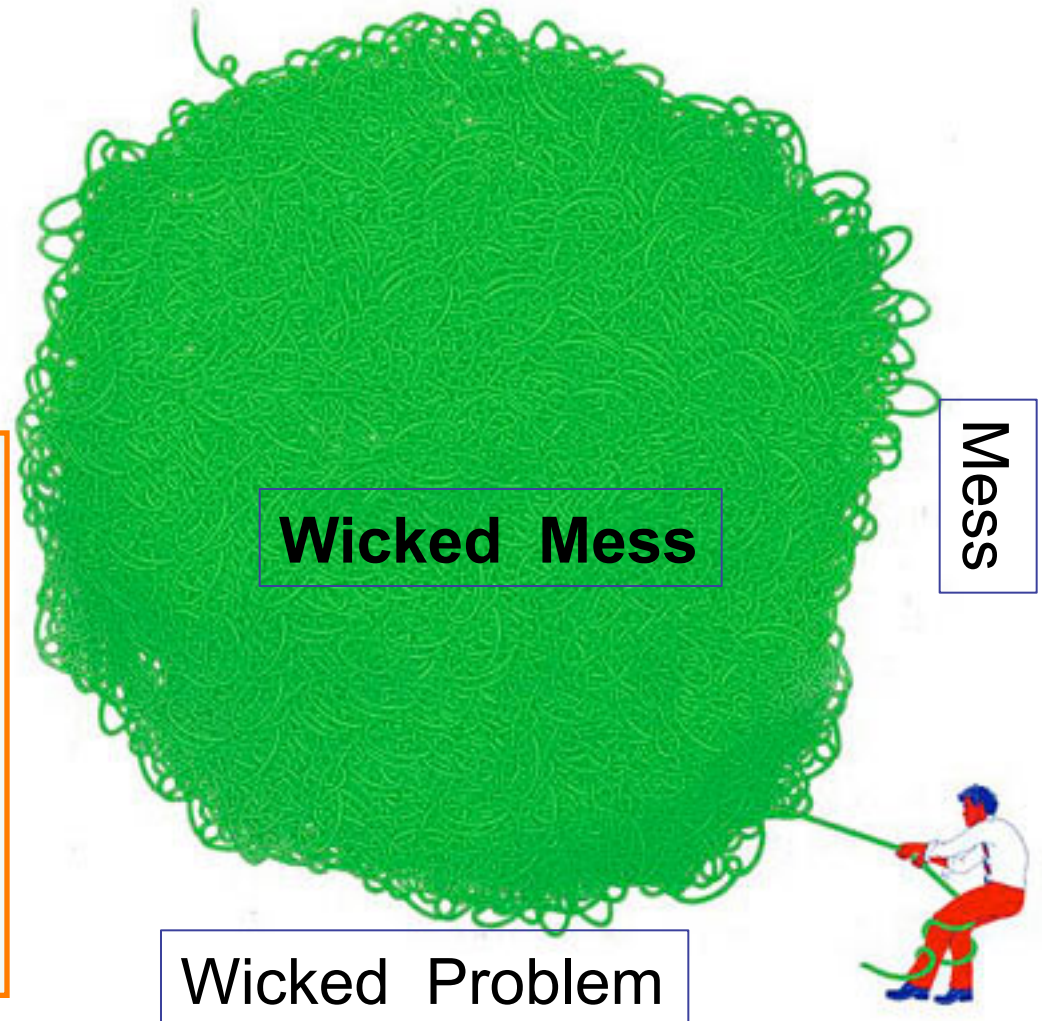


President Obama: “We don’t have time for a meeting of the Flat Earth Society”

versus

JC: The climate change problem and its solution have been vastly oversimplified.

The climate science-policy interface is badly broken



Wicked Mess

Mess

Wicked Problem

Putting the policy cart before the scientific horse

1988 Hansen's testimony

FAR 1990: “The size of this warming is broadly consistent with predictions of climate models, but also of the **same magnitude as natural climate variability**”

1992 UNFCCC Treaty

SAR 1995: “The balance of evidence suggests a **discernible** human influence on global climate.”

1997 Kyoto Protocol

TAR 2001: “There is new and stronger evidence that **most** of the warming observed over the last 50 years is attributable to human activities.”

You find what you shine a light on . . .

Solar indirect effects

Unknown unknowns

Long-term ocean
oscillations

Volcanoes



Greenhouse gases

Underwater volcanoes

Land use

Solar system gravitational
& magnetic interactions

Aerosols

JC's punch line

The early articulation of a preferred policy option by the UNFCCC has:

- marginalized research on broader issues surrounding climate change
- resulted in an overconfident assessment of the importance of greenhouse gases in future climate change
- stifled development of a broader range of policy options.

Wall Street Journal

February 2, 2006

Cold Front

Debate Shatters Civility of Weather Science

Hurricanes Worsened by Global Warming?

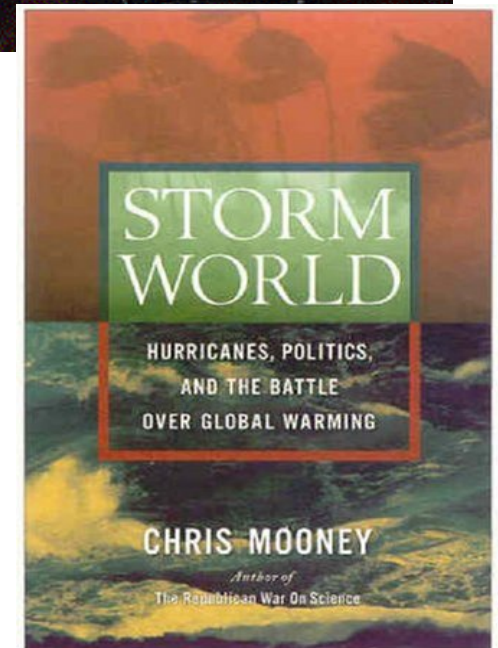
Spats are so tempestuous,
sides are barely talking

Charge of “brain fossilization”



Mixing Politics and Science in Testing the
Hypothesis That Greenhouse Warming Is
Causing a Global Increase in Hurricane Intensity

BY J. A. CURRY, P. J. WEBSTER, AND G. J. HOLLAND





JC' s concerns: Our core scientific research values became compromised in the “war against the skeptics”:

- the rigors of the scientific method (incl reproducibility),
- research integrity and ethics
- open minds and critical thinking.

Climate Heretic: Judith Curry Turns on Her Colleagues

Why can't we have a civil conversation about climate?

October 25, 2010



Agreement:

- Surface temperatures have increased since 1880
- Humans are adding carbon dioxide to the atmosphere
- Carbon dioxide and other greenhouse gases have a warming effect on the planet

Disagreement:

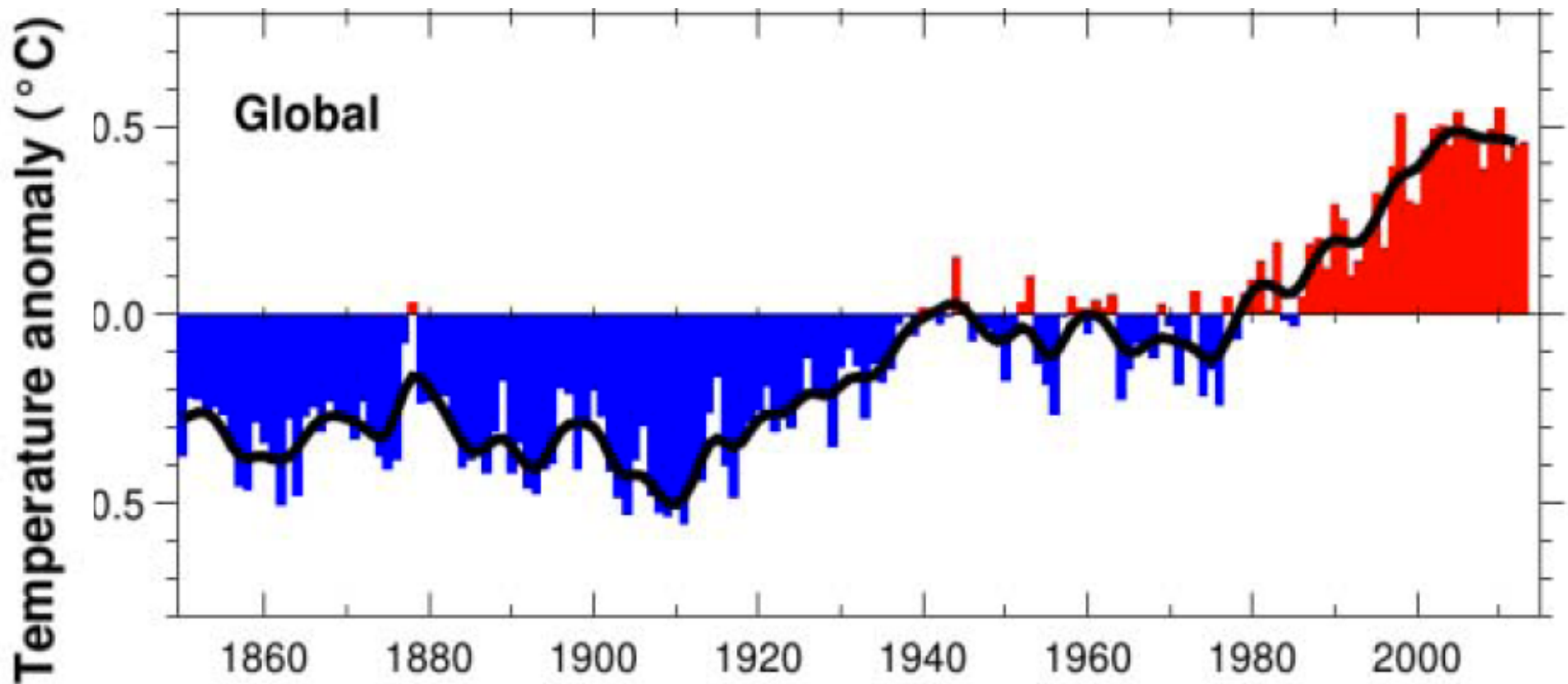
- Whether the warming since 1950 has been dominated by human causes
- How much the planet will warm in the 21st century
- Whether warming is ‘dangerous’
- Whether we can afford to radically reduce CO₂ emissions, and whether reduction will improve the climate



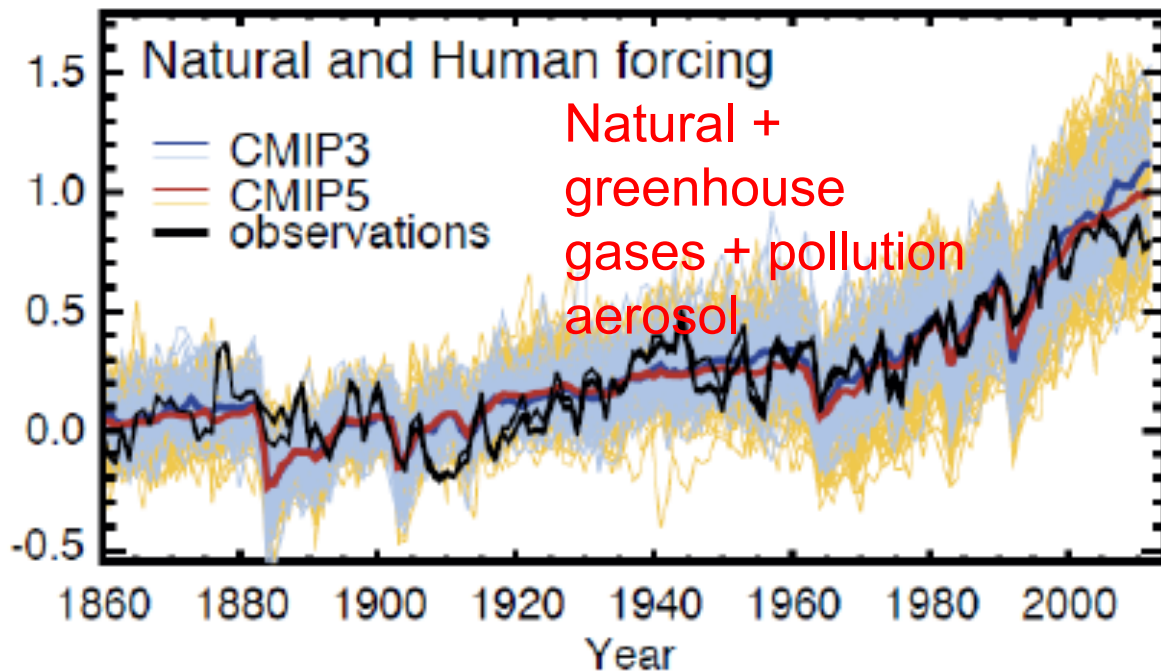
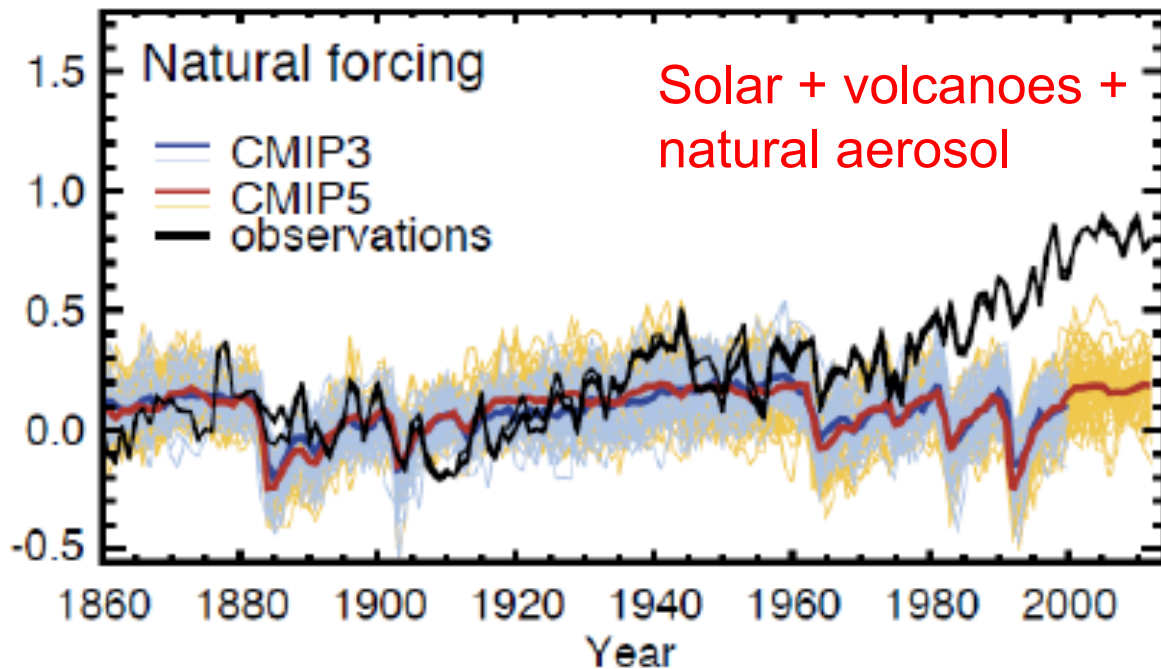
Why do scientists disagree?

- Insufficient observational evidence
- Disagreement about the value of different classes of evidence (e.g. models)
- Disagreement about the appropriate logical framework for linking and assessing the evidence
- Assessments of areas of ambiguity and ignorance
- Belief polarization as a result of politicization of the science

Global surface temperature anomaly



IPCC AR5: *It is **extremely likely** that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused [humans]. The best estimate of the human induced contribution is similar to the observed warming over this period.*



What has caused the warming?

Warming since 1950:
IPCC - Human forcing

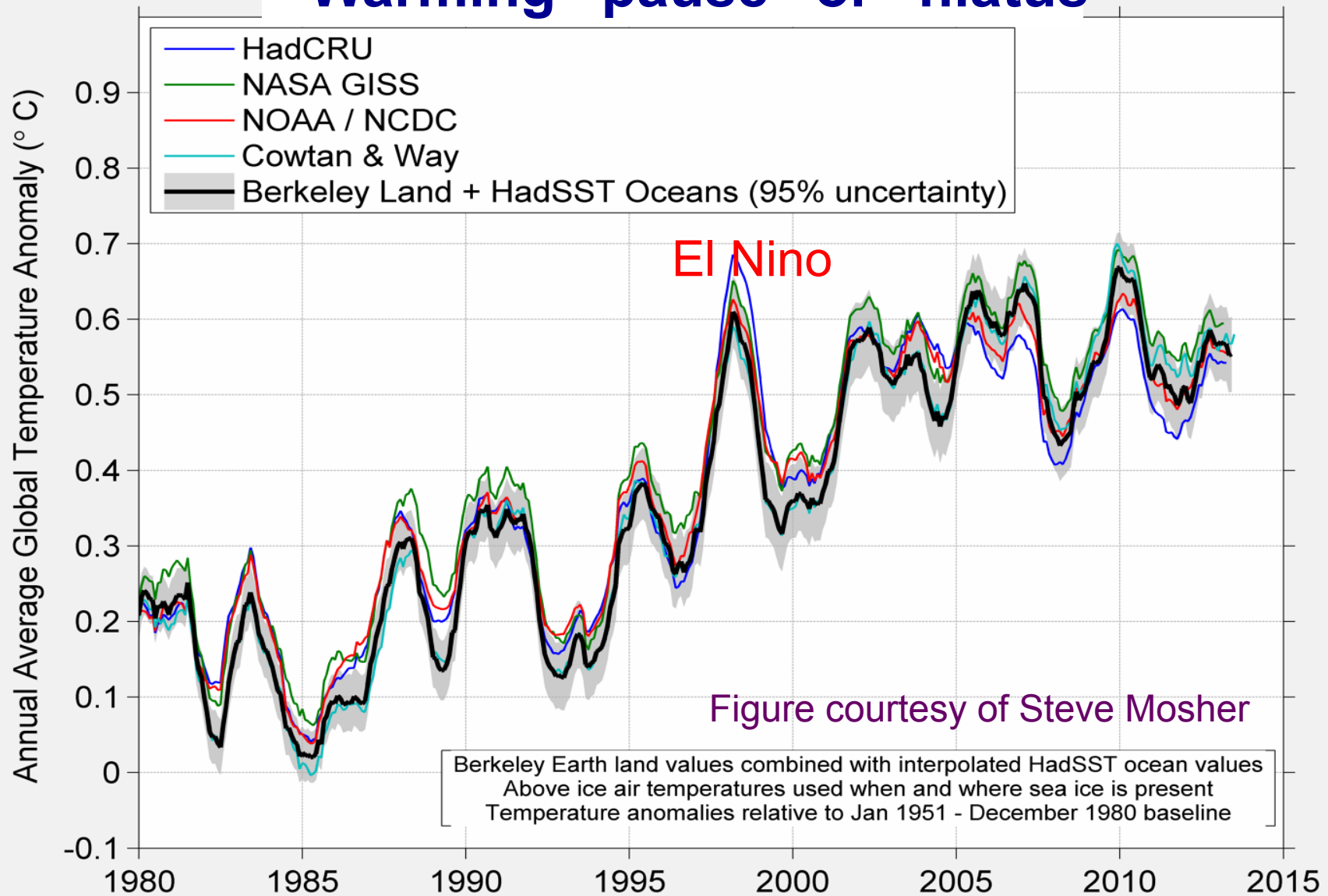
Warming 1910-1940:
Models produce slight warming due to reduced volcanic activity and small human effects

Cooling 1940-1975:
Not reproduced by the models

Flat in 21st century: Not reproduced by models

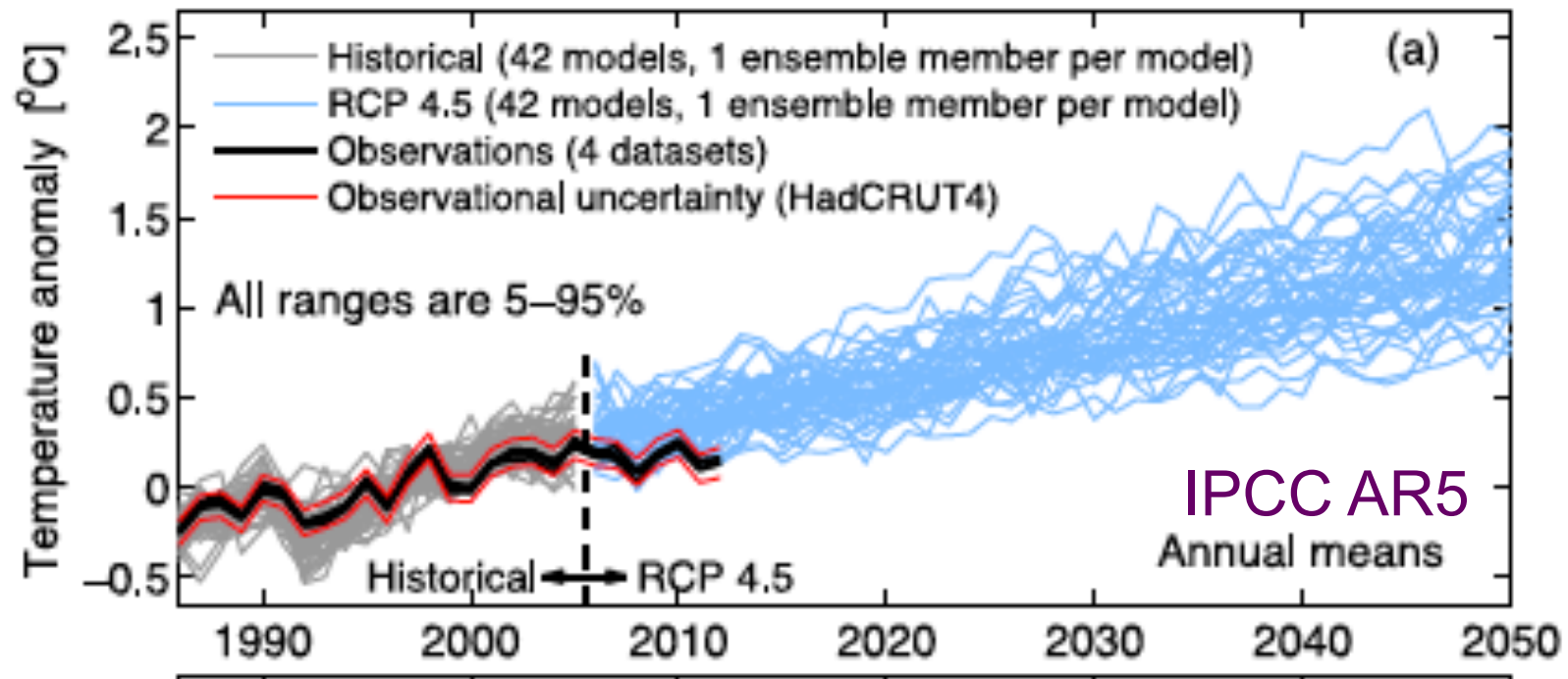
IPCC AR5 Chapter 10

Warming 'pause' or 'hiatus'



IPCC AR4: Surface temperature expected to increase 0.2°C/decade in early 21st century

Significance of the 'pause' since 1998



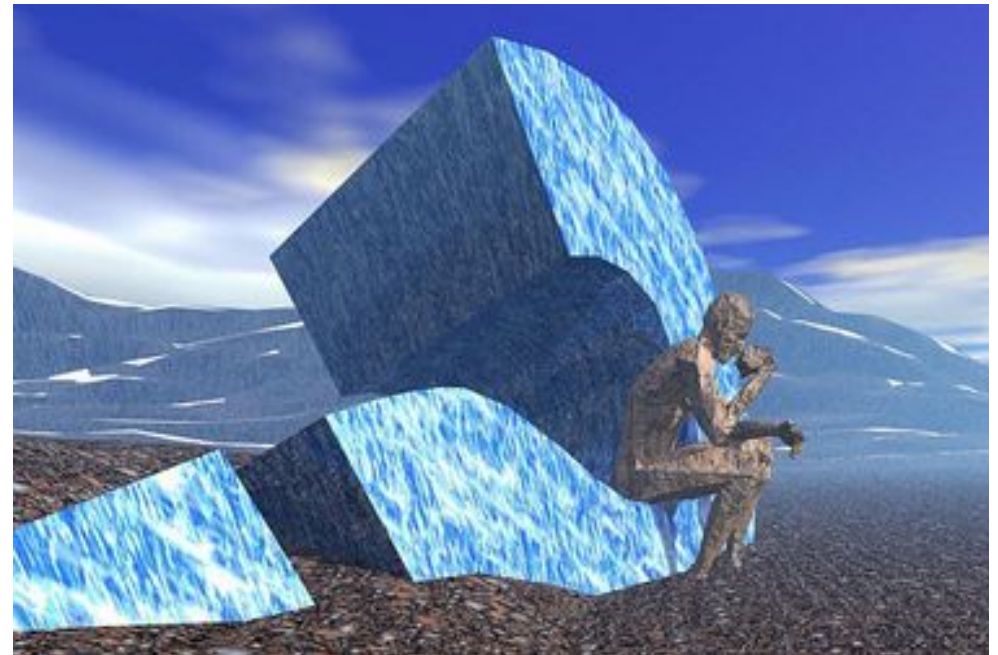
CO₂ concentration since 1998: ~ +25% of total human impact

Under conditions of human-caused greenhouse forcing:

- modeled 'pauses' longer than 15 years are rare;
- probability of a modeled pause exceeding 20 yrs is vanishing small

Questions raised by the discrepancy between models & observations

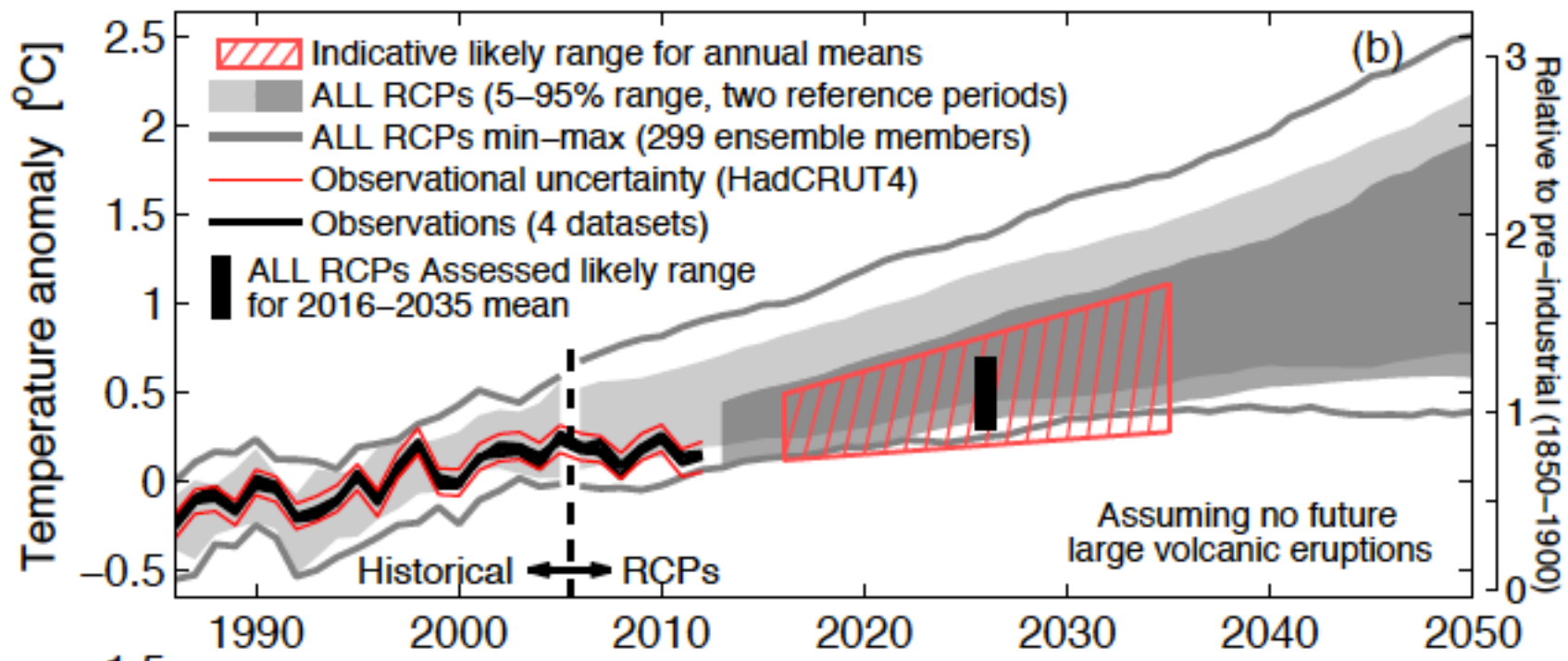
- Are climate models too sensitive to greenhouse forcing?
- Is climate model treatment of natural climate variability inadequate?
- Are climate model projections of 21st century warming too high?



Implications for the future:

I. Consensus IPCC view

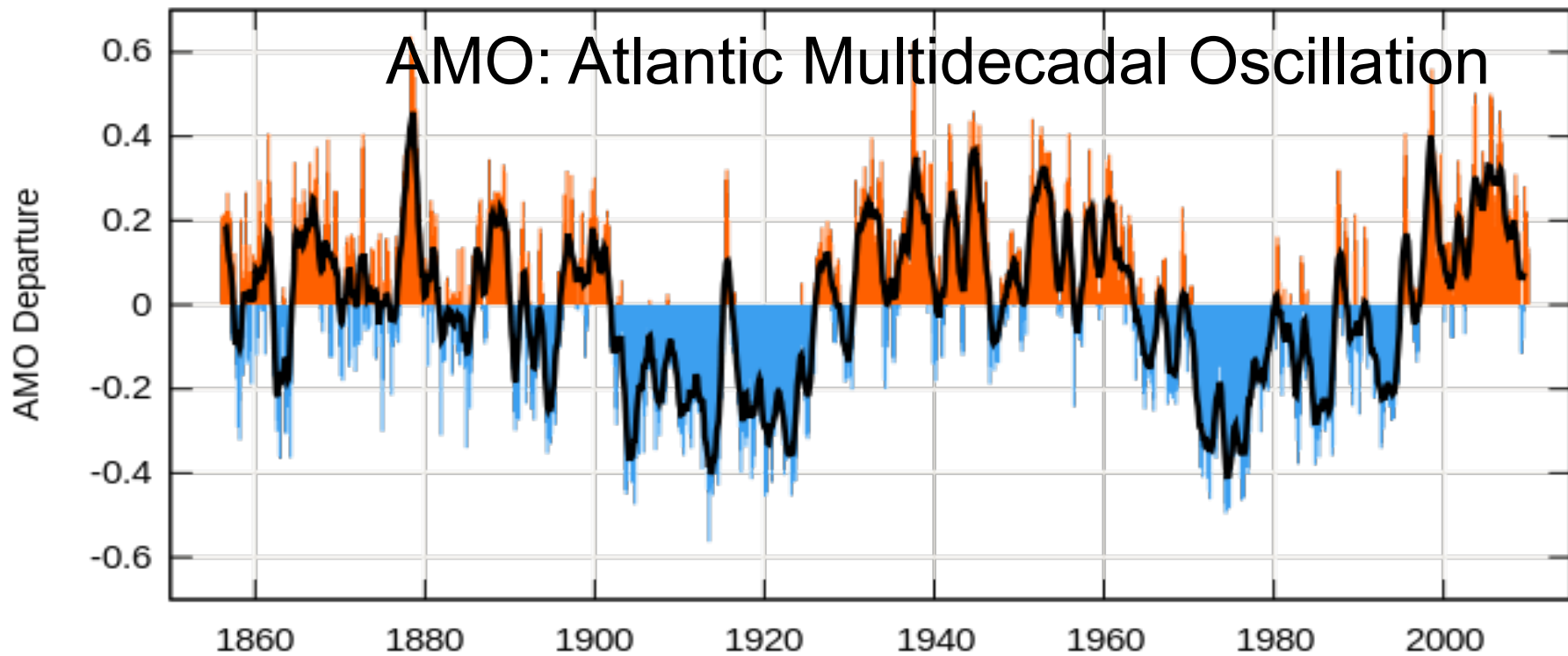
- The 'pause' will end soon, with the next El Nino



Implications for the future:

II. View emphasizing natural variability

- The 'pause' will continue at least another decade (into the 1930's?); El Ninos weak and infrequent
- 'Pause' persistence beyond 20 years: serious problems with the climate models
- Climate models are too sensitive to human forcing; 21st century warming will be on the low end of IPCC projections (or even below)
- Solar variations and volcanoes are a wild card; most are predicting solar cooling in the near term
- Can't rule out unforeseen surprises

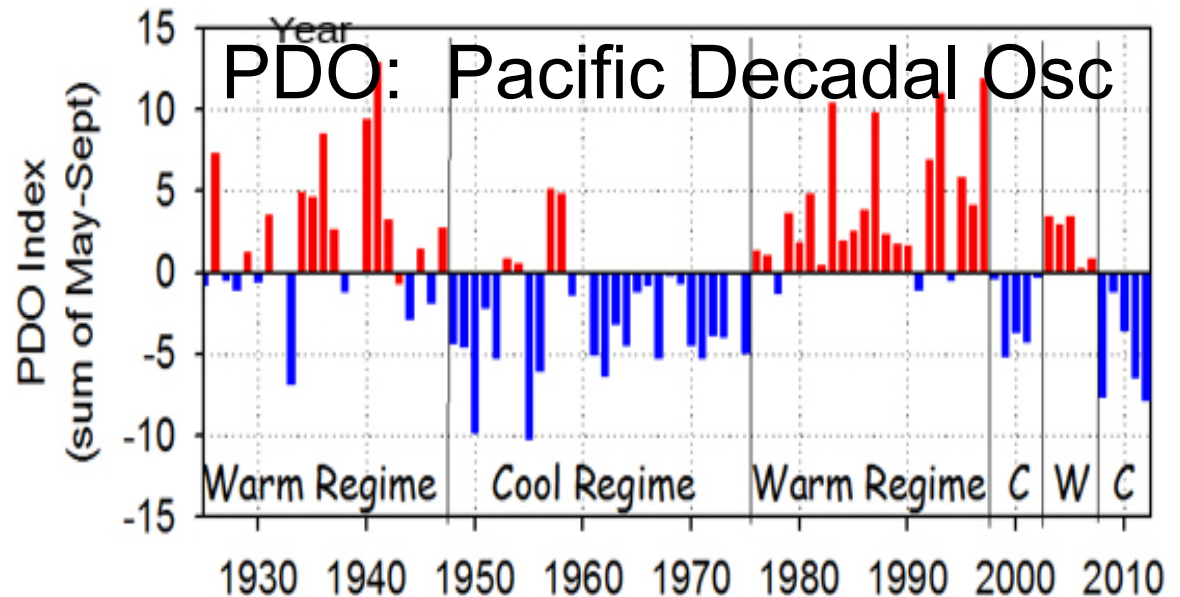


Currently:

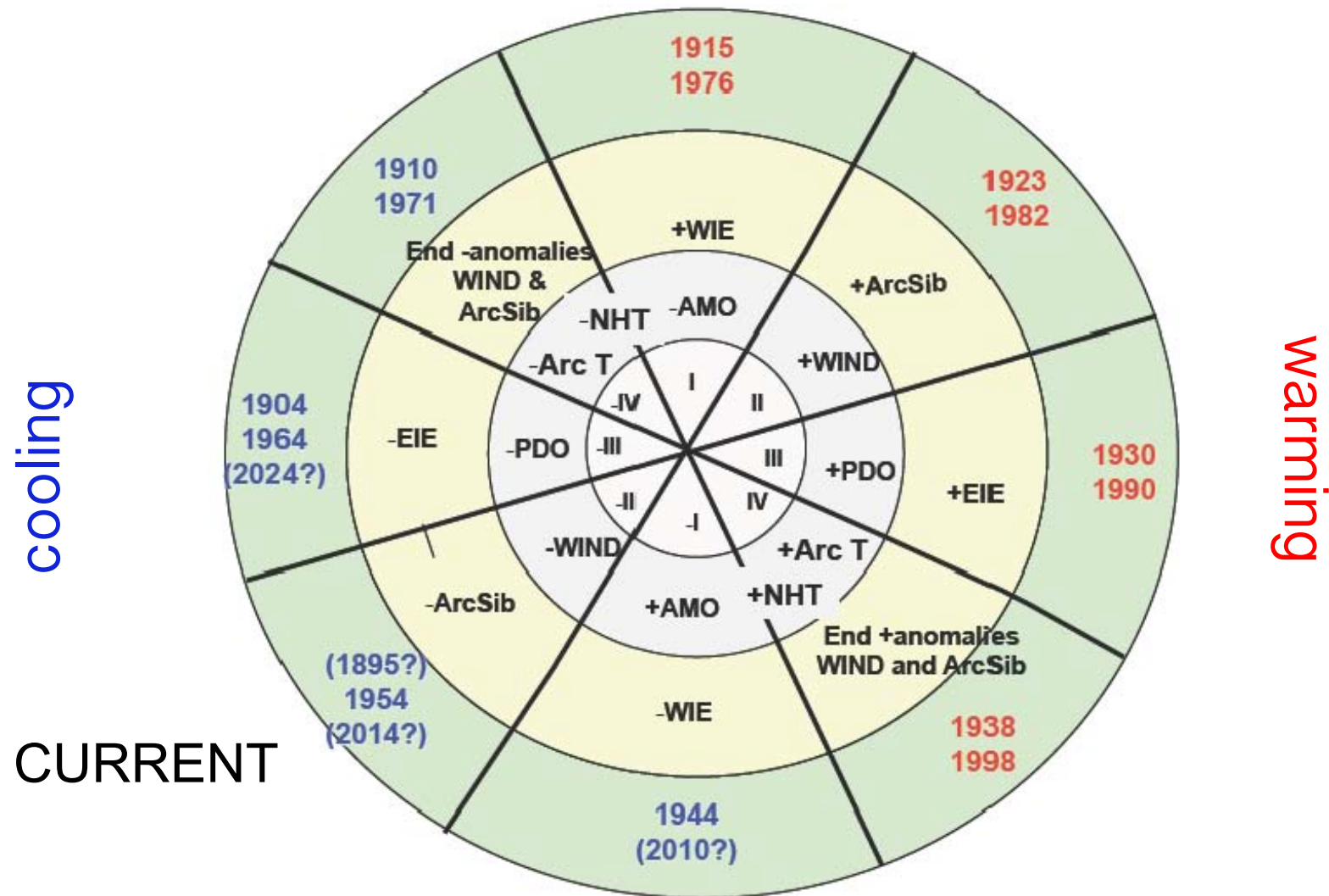
- Warm AMO
- Cool PDO

Previous analogue:

- 1946-1964

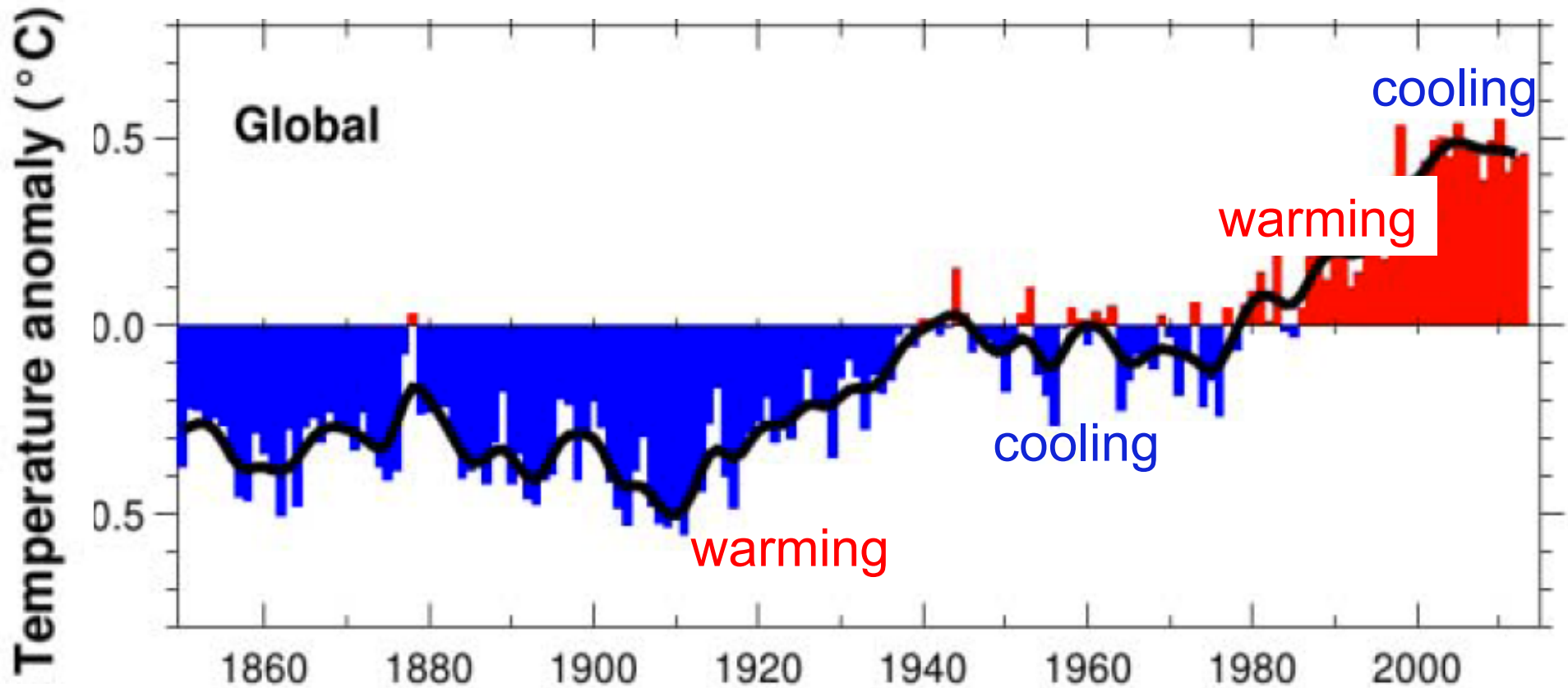


Stadium Wave Wheel Wyatt & Curry, 2013



- 19th & 20th century tempo of 60-64 years.
- Continued cool phase into the 2030' s

Global surface temperature anomaly

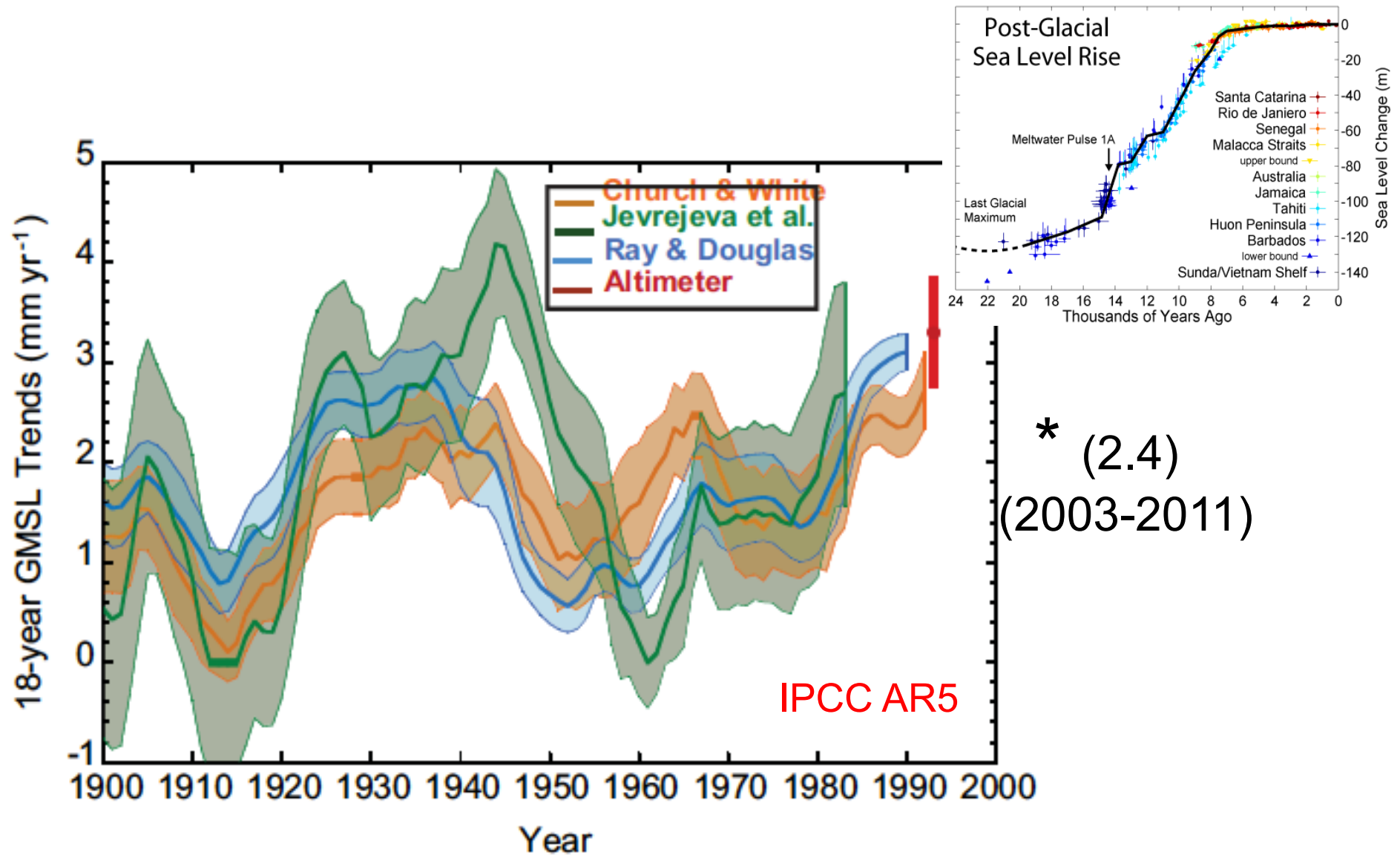


Natural variability as per the stadium wave provides for a stair step evolution against background of overall warming trend

Human impact on warming apparent post 1980

Vulnerabilities & Consequences of Climate Change





IPCC AR5: “Since the early 1970’ s, glacier mass loss and ocean thermal expansion from warming together explain about 75% of the observed global sea level rise (high confidence)”



Confounding factors:

- Geological sinking/rising
- Ground water withdrawal
- River engineering

with arrows representing the direction and magnitude of change. Click on an arrow to access additional information about that site.

Sea Level Trends mm/yr (feet/century)

15 to 21 (5 to 7)	6 to 9 (2 to 3)	-3 to 0 (-1 to 0)	-12 to -9 (-4 to -3)
12 to 15 (4 to 5)	3 to 6 (1 to 2)	-6 to -3 (-2 to -1)	-15 to -12 (-5 to -4)
9 to 12 (3 to 4)	0 to 3 (0 to 1)	-9 to -6 (-3 to -2)	-18 to -15 (-6 to -5)

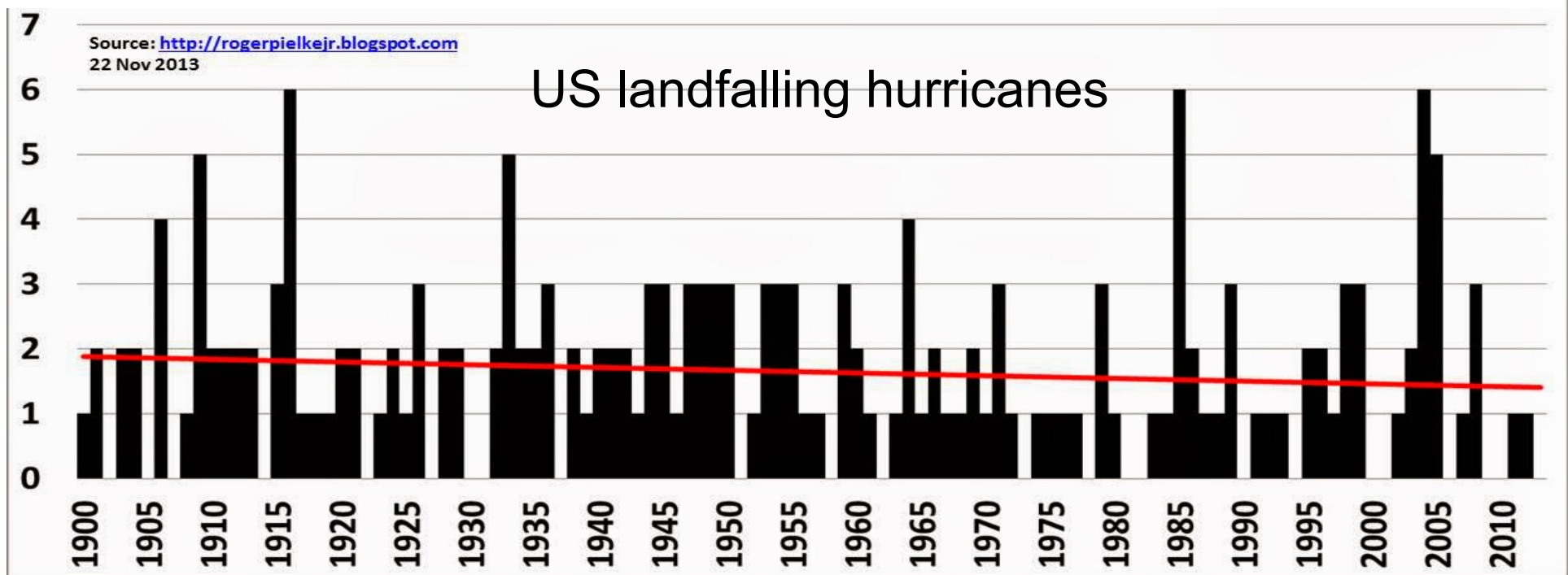
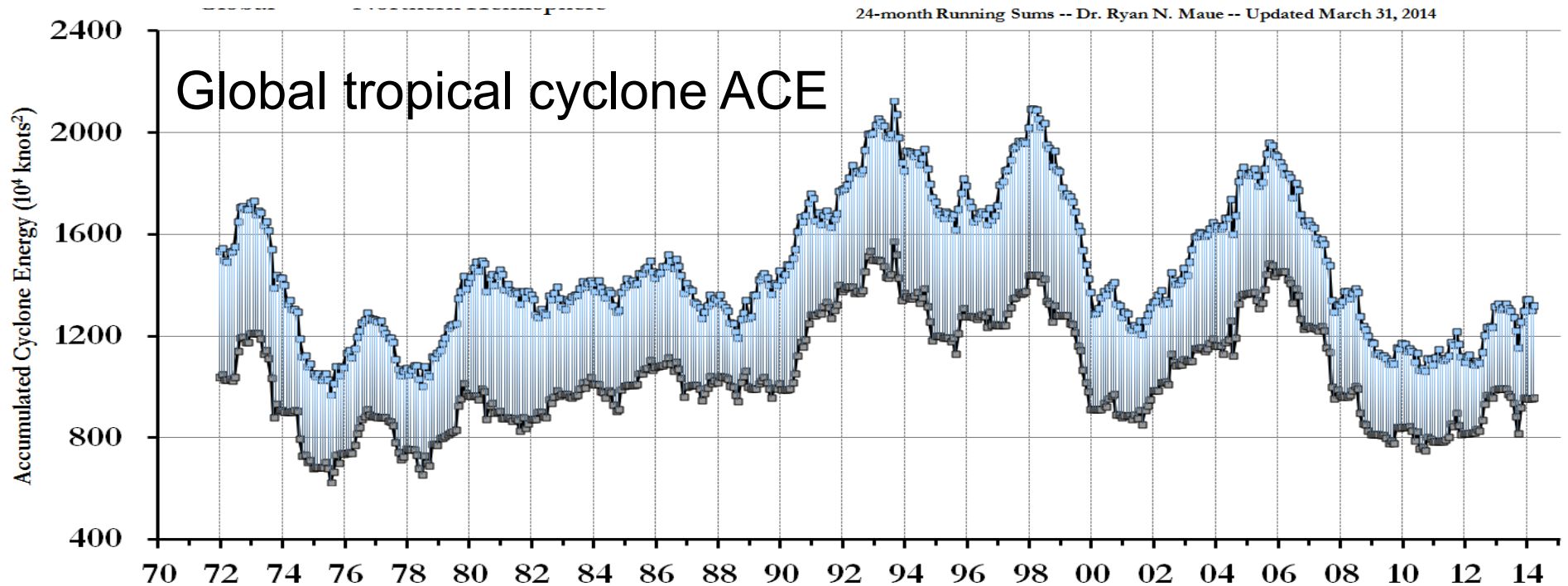
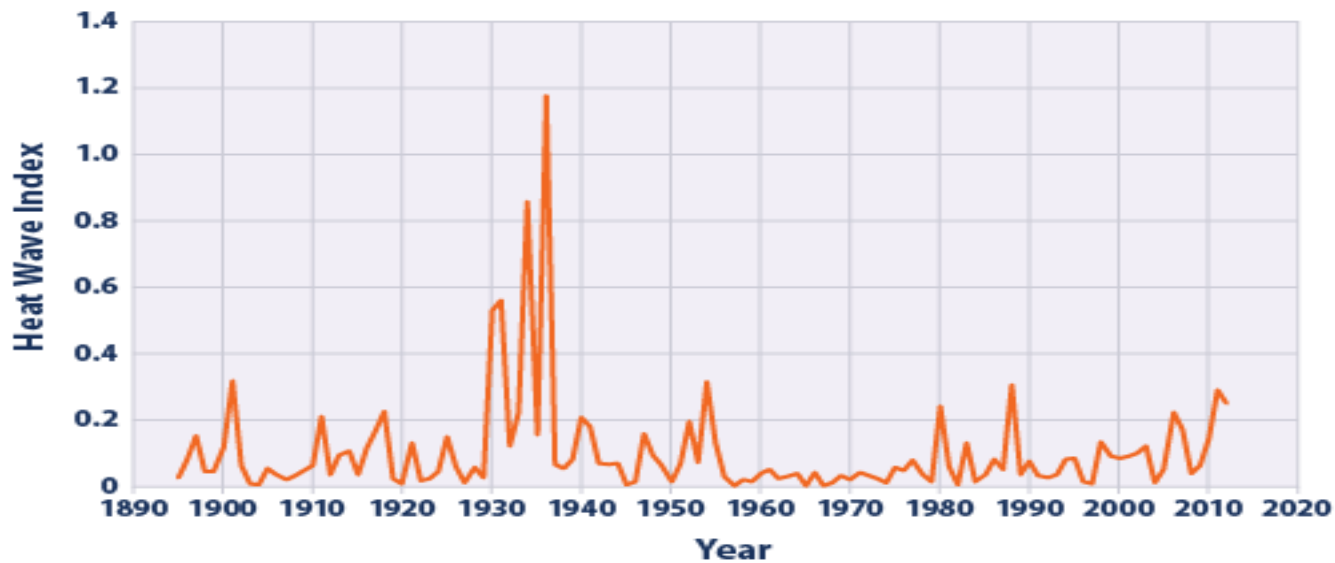
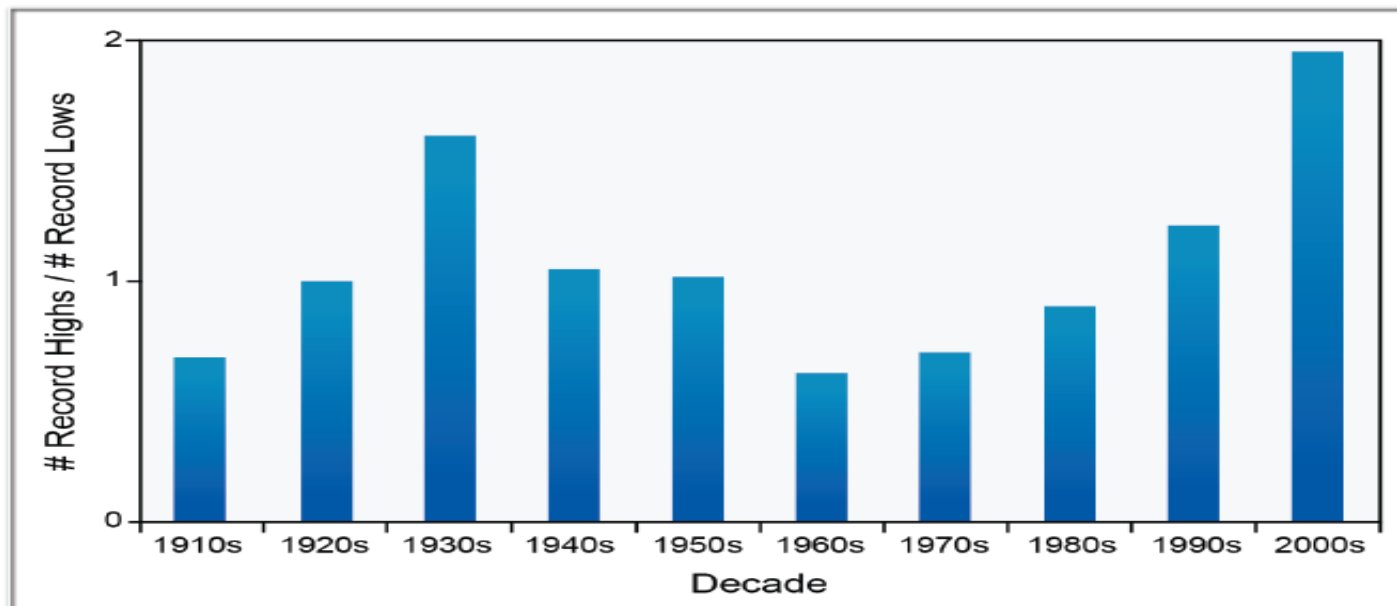


Figure 1. U.S. Annual Heat Wave Index, 1895–2012



EPA

Ratio of Record Daily High to Record Daily Low Temperatures



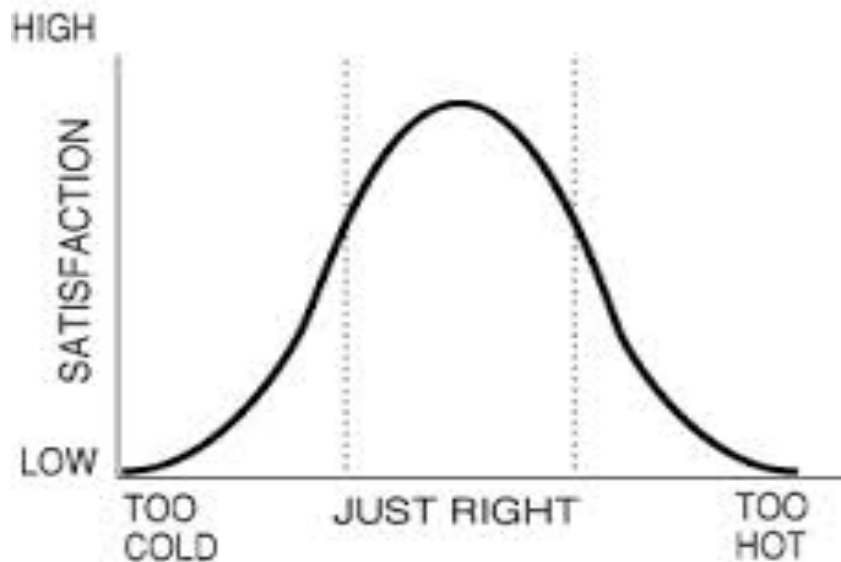
US National
Climate
Assessment

Goldilocks climate

What climate do we want? Winners and losers.

To what extent and on what timescales can humans influence climate?

Goldilocks Principle



Conflict of values

Survival

Outlast

Better than
dead

Try for personal
survival: group
or nation

Meet basic
needs

Sustainable

Maintain

Endure in a
stable world

Able to maintain
at a given rate,
level over time

Mitgate damage
sacrifice,
austerity,
obligations

Resilience

Bounce back

Recover quickly
from difficult
conditions

Survive longer in
changing world

Adaptation,
redundancy

Thrivability

Bounce forward

Prosper, thrive,
develop
vigorously

Strive for
greatness

Anti-fragile,
generate,
transform

Climate science supporting decision making

Survival	Sustainable	Resilience	Thrivability
Tactical adaptation	IPCC	Tactical adaptation	Financial risk mgt
Weather fcsts: week to season	Global climate models	Xtreme event return times & clustering	Weather fcsts: week to season
Saving lives & property from xtreme weather	Climate sensitivity	Identification of possible/ plausible worst case scenarios	Decadal Scenarios
Cropping and agriculture decisions	Emissions stabilization targets		Xtreme scenarios

Uncertainty & decision making

Survival

Risk Mgt

Probability
forecasts
day to season

Xtreme event
scenarios

Sustainable

Deep uncertainty

**Precautionary
Principle**

No/low regrets

Robust decisions

Resilience

Risk mgt on
shorter time
scales

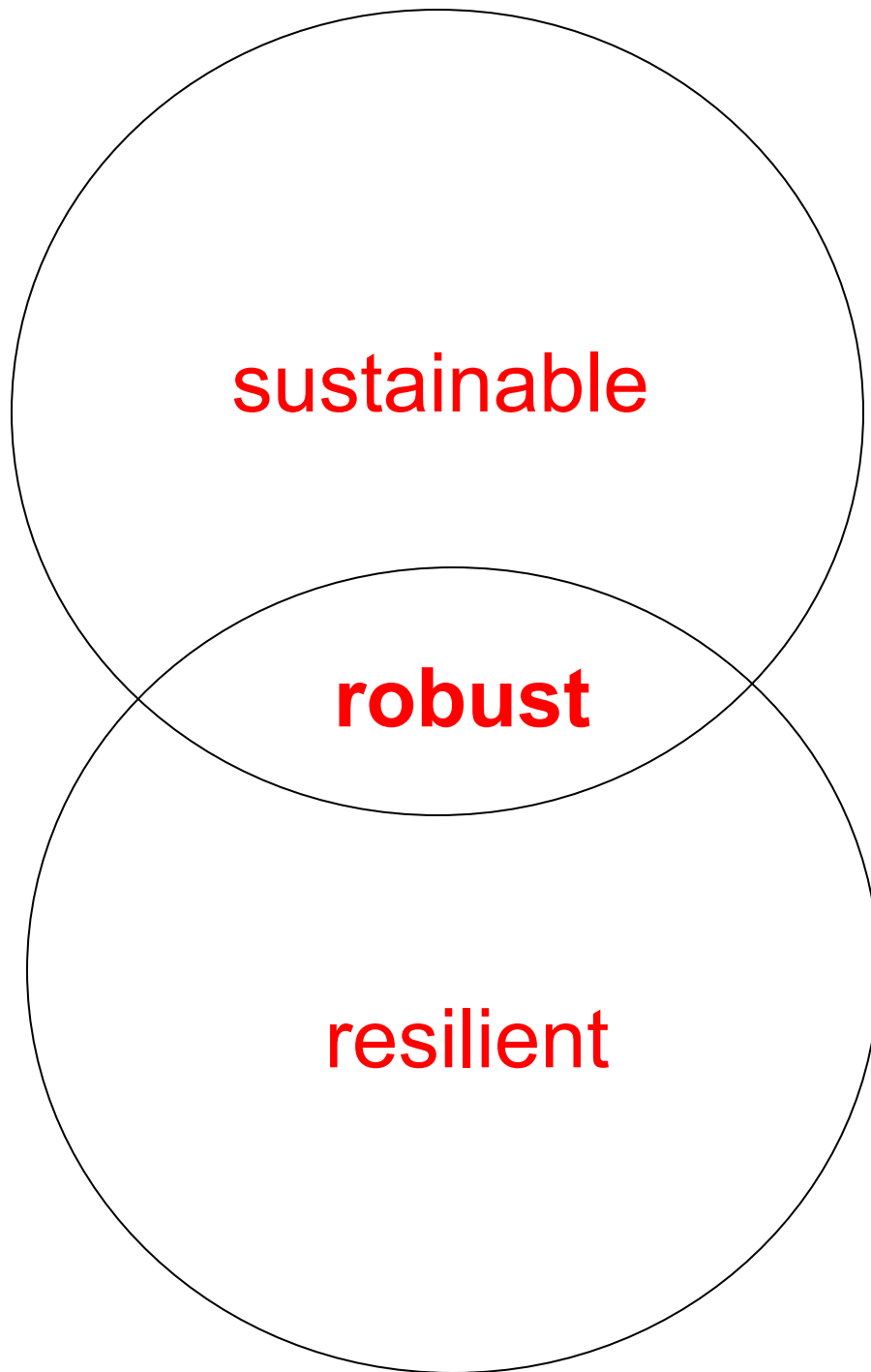
Decadal
scenarios for
infrastructure
decisions

Thrivability

Financial risk
Management

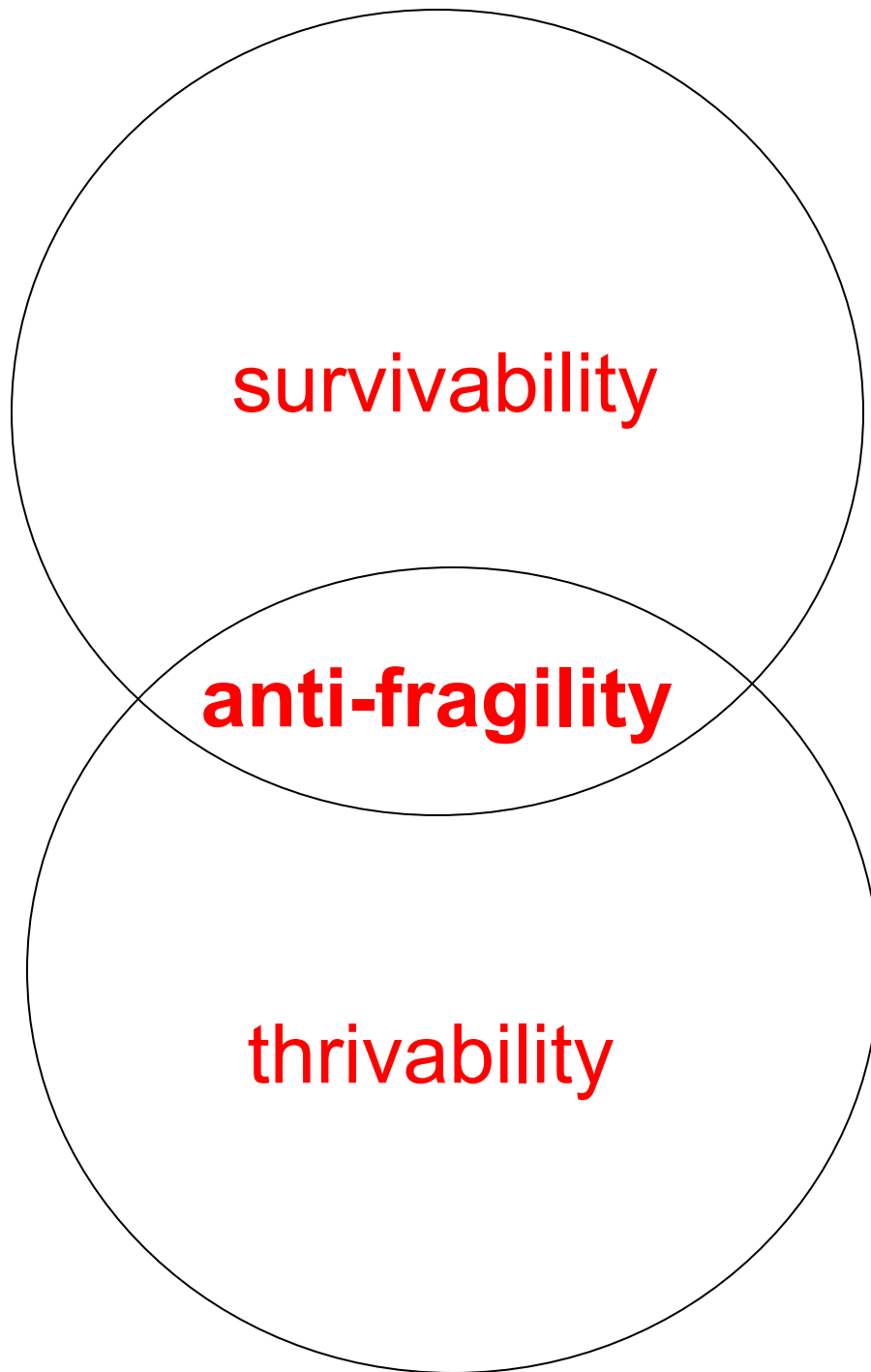
Climate informed
decision analysis

Transformative
ideas???



Robust strategies (multiple benefits with little downside):

- Water resource management
- Infrastructure security
- Agricultural productivity
- Ecological conservation and restoration
- Resource conservation & reuse
- Energy research



Antifragility learn and grow from volatility and unexpected events:

- Economic development
- Reduce the downside from volatility
- Optionality
- Small experiments; tinker
- Transformative ideas

Oversimplification:

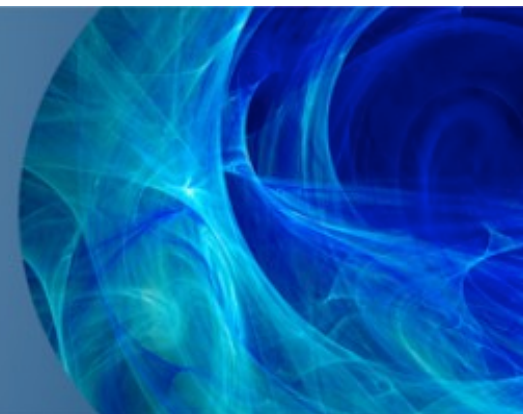
- undercuts the political process and dialog necessary for real solutions in a highly complex world
- torques scientific research through politicization and funding priorities



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Climate Etc.

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Climate Etc. provides a forum for technical experts and the interested public to engage in a discussion on topics related to climate science, its impacts and policy options.

Climate Forecast Applications Network (CFAN) translates knowledge from weather and climate research to decision processes that are impacted by weather and climate.

survivability • resilience • thriving

