

# Stephen H. Schneider\*

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Environmental Studies,  
Professor, Department of Biological Sciences  
Senior fellow, Woods Institute for the Environment  
Stanford University

## Report of the Intergovernmental Panel on Climate Change (IPCC)

2008 ESRI International User Conference

August 5, 2008

8:30-9:45am

Room 32 A/B

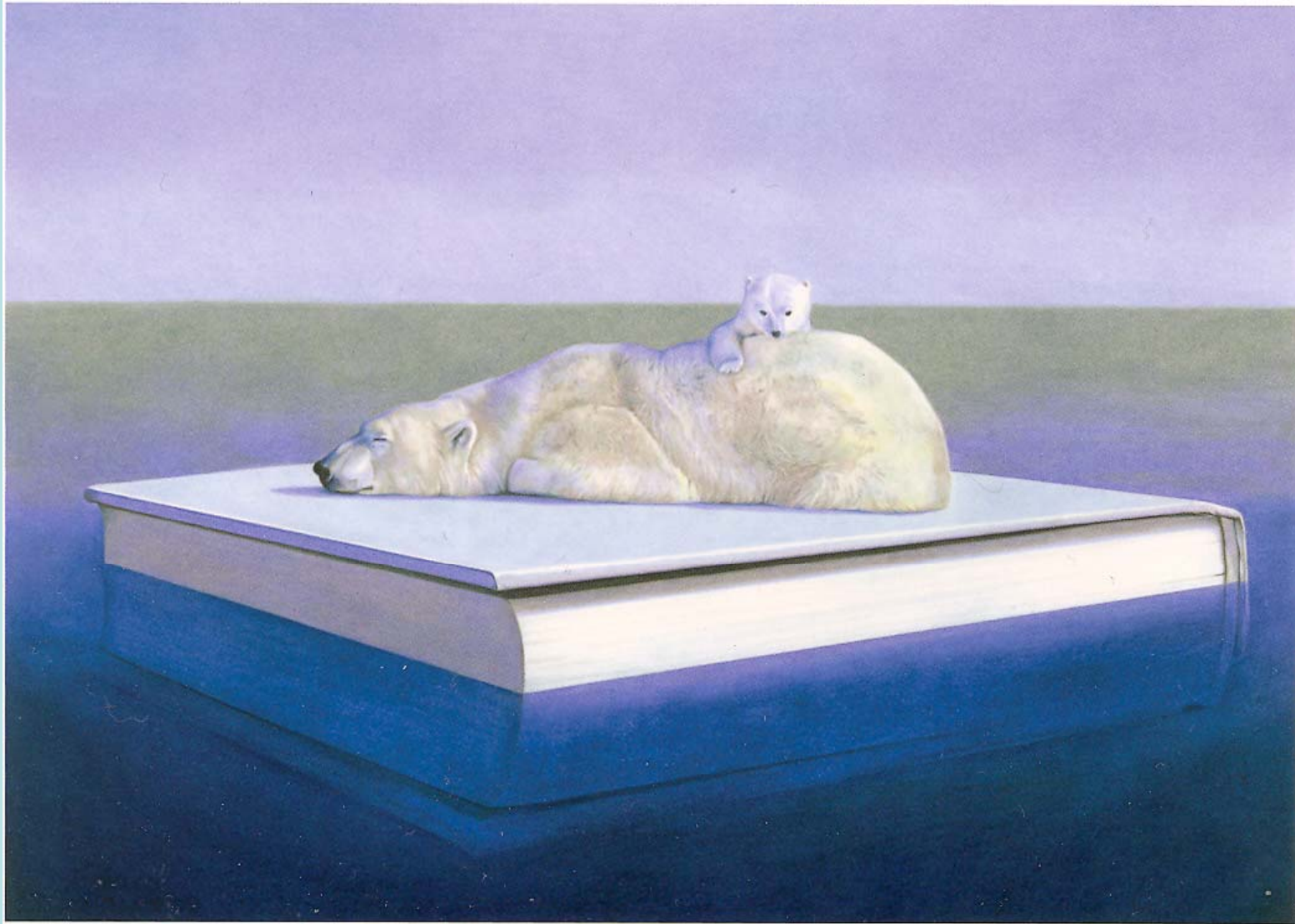
\*[Website for more info: [climatechange.net](http://climatechange.net).]



“It’s The  
Preponderance,

“It’s The  
Preponderance,  
Stupid!!!”\*

\*With apologies to James Carville



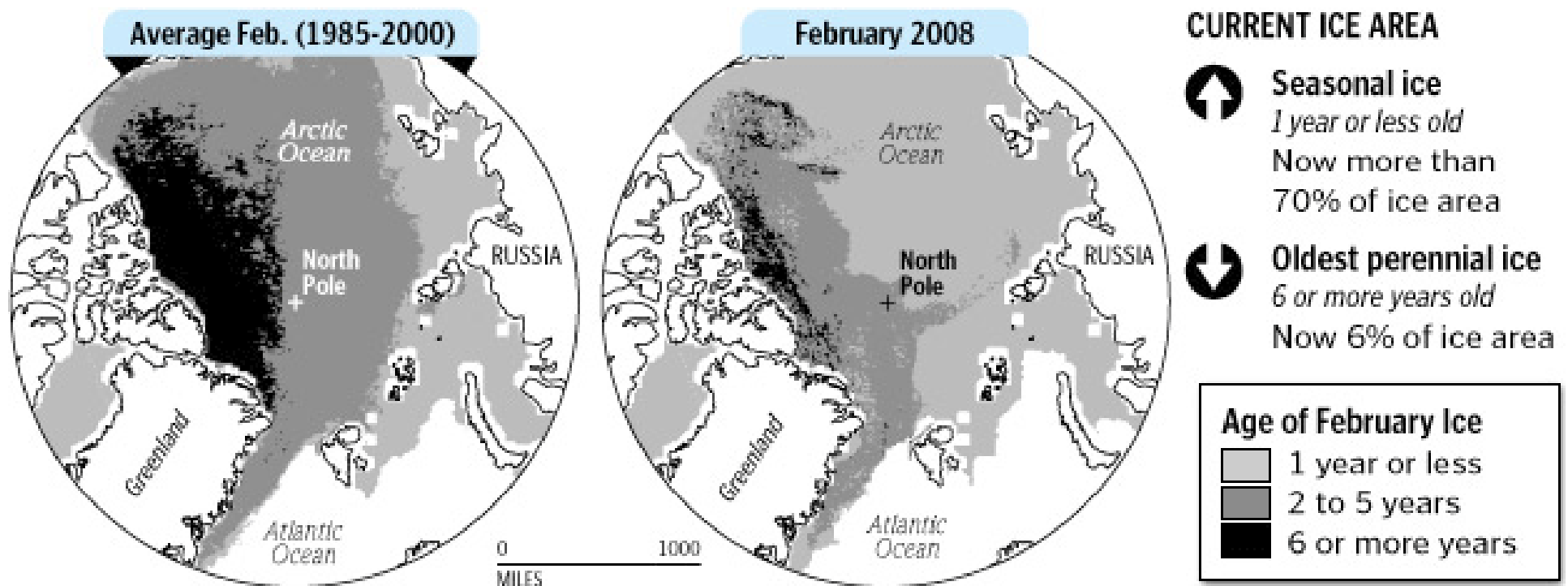
"PASSAGE 2" DON SIMON 2006

## Graphic:

<http://www.washingtonpost.com/wp-dyn/content/article/2008/03/18/AR2008031802903.html>

## Thinner and Newer

A cool Arctic winter has brought sea ice back to broad expanses that melted clear during last summer's unusual warmth. However, the amount of thick "perennial ice" has declined sharply across the Arctic, and climate experts say that global warming is the cause.



# The “Real” Cause of Global Warming



# The “Real” Cause of Global Warming



Victims As  
Villains





Is The Science  
“Settled”?

# Is The Science “Settled”?

- Well-established components
  - Competing Explanations
  - Speculative components

# Global Warming is Happening NOW:

“Warming of the climate system is **unequivocal**, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level (see Figure SPM-3). {3.2, 4.2, 5.5}.”

*IPCC, Summary for Policymakers, Contribution of Working Group I to the Fourth Assessment Report, February, 2007*



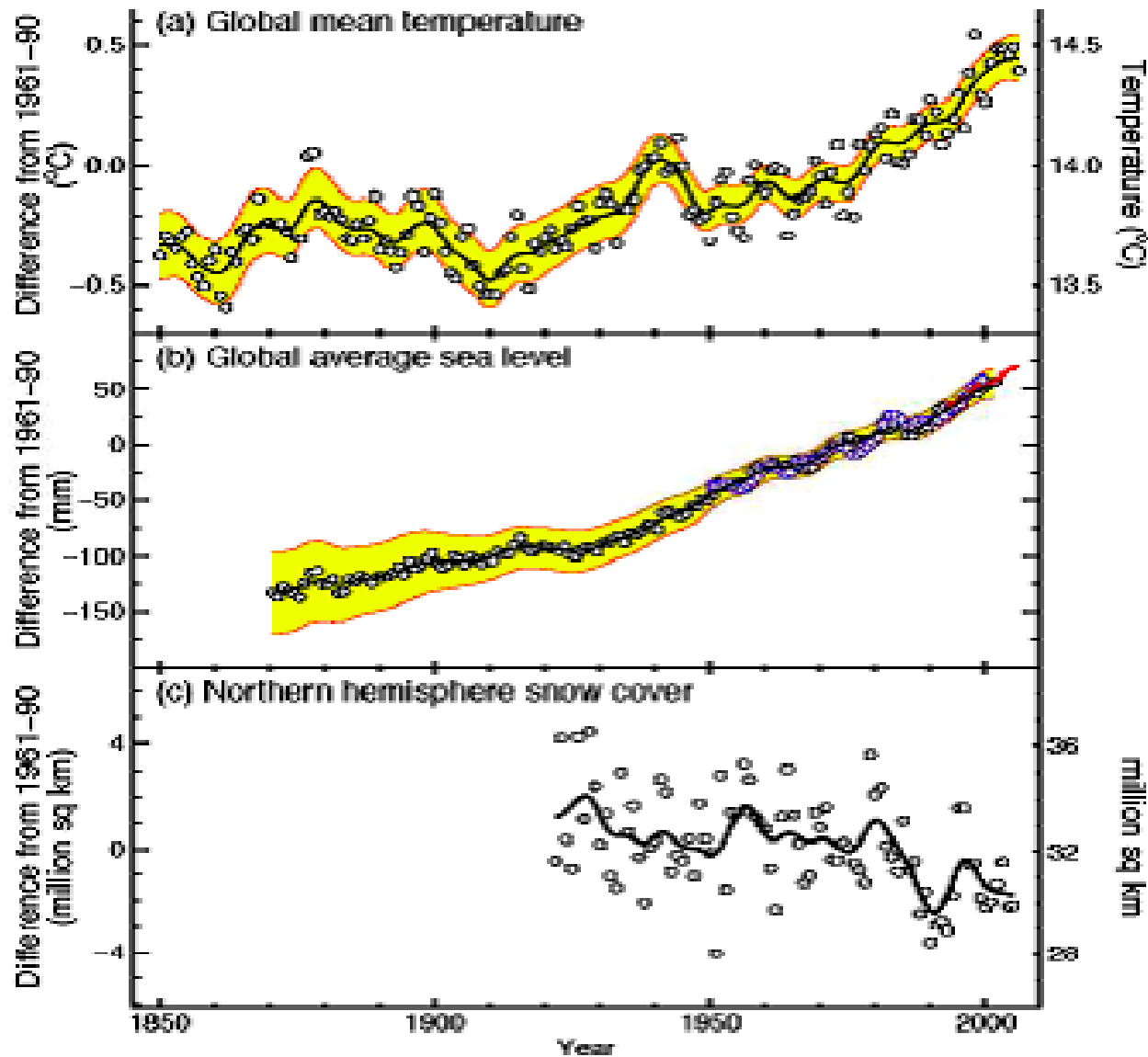


Figure 1.1. Changes in global mean temperature, sea level, and snow cover area. Panel (a) shows global mean temperatures as annual values (open circles) and a smoothed curve (black line) with uncertainty in the smoothed curve shown by the yellow shaded area. Panel (b) shows global mean sea level from tide gauge data (circles) and recent satellite measurements (red line). Panel (c) shows April Northern Hemisphere snow cover area each year (circles) with smoothed values (black line). [WGI Figure SPM-3]

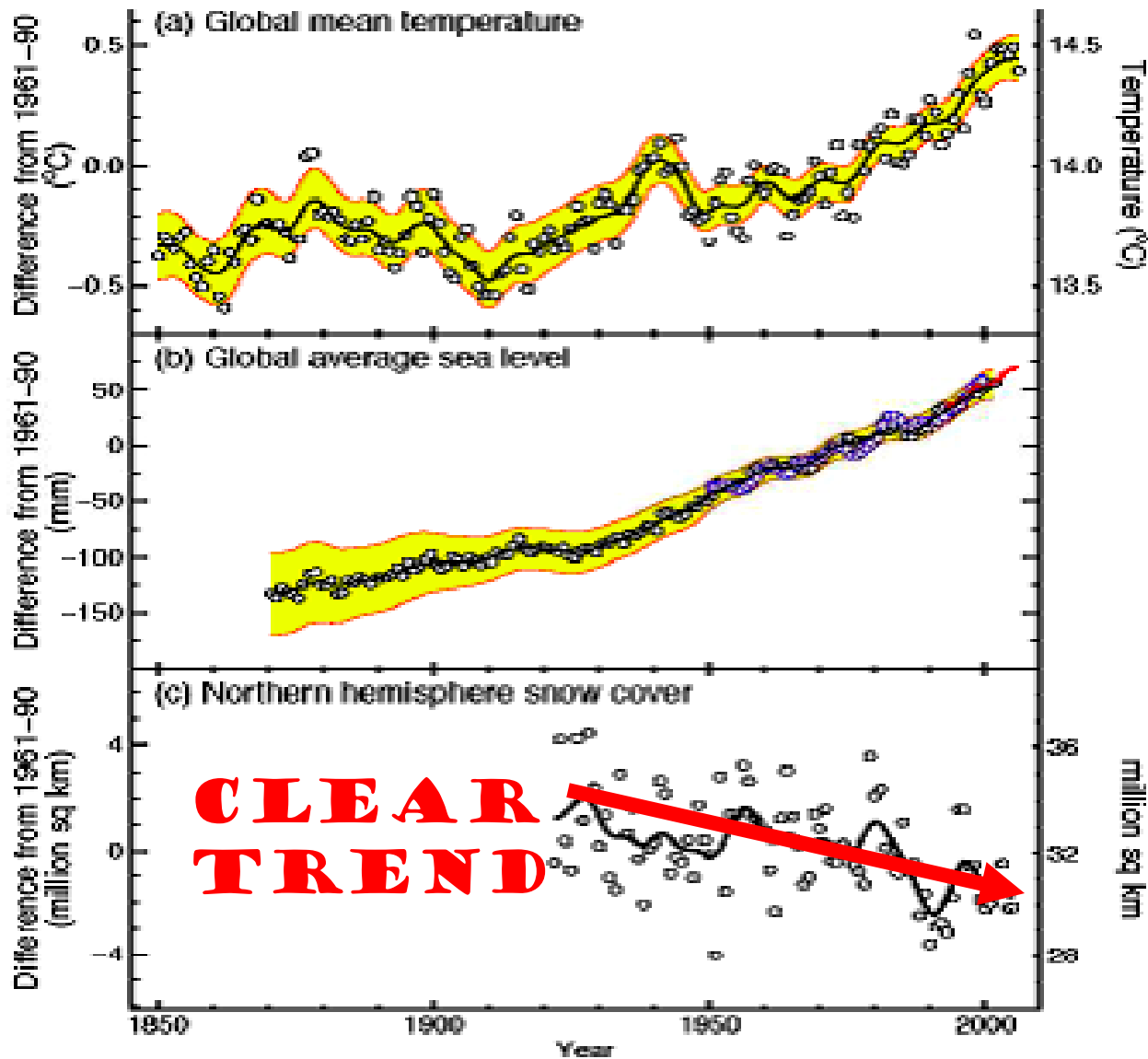


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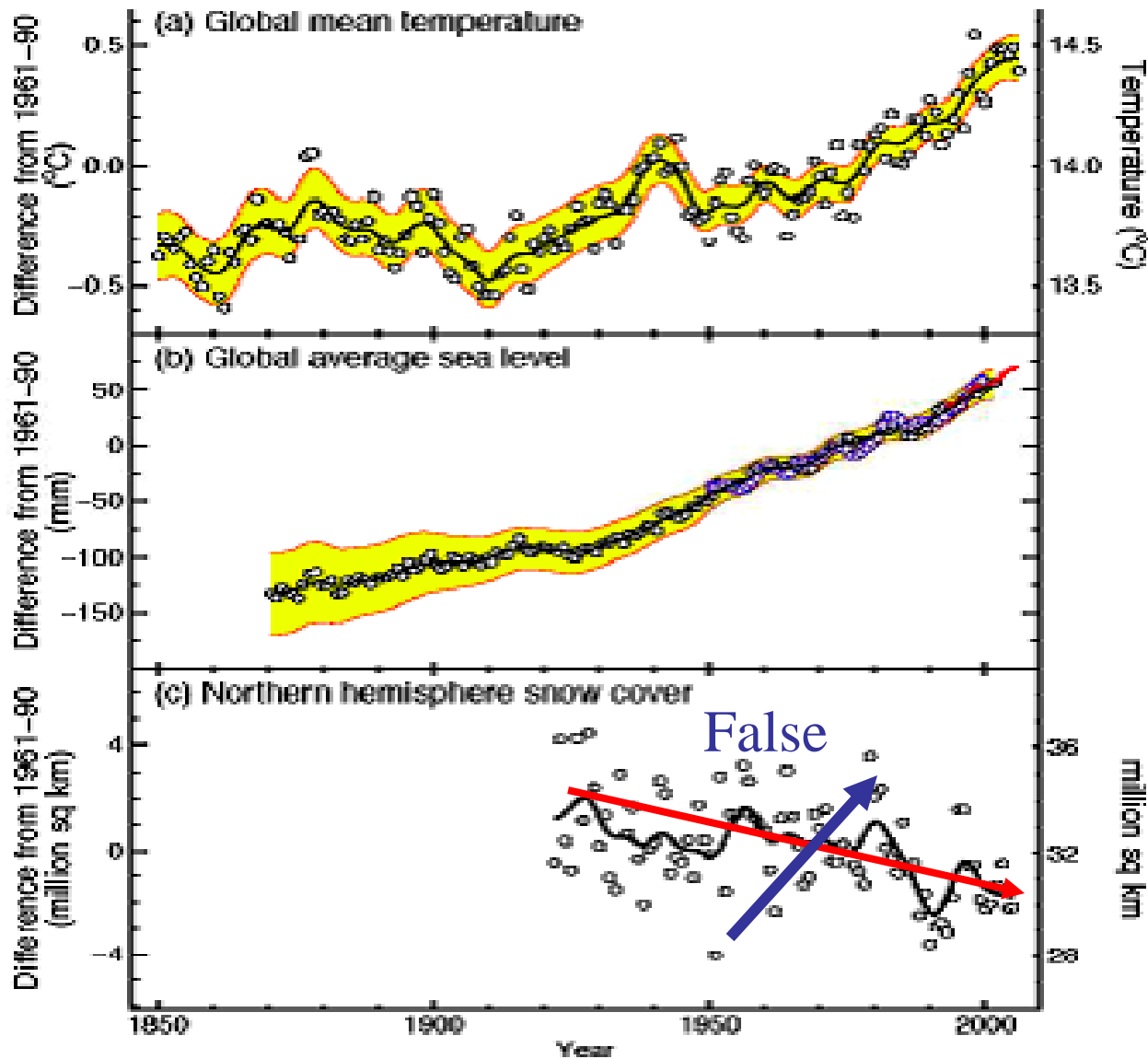


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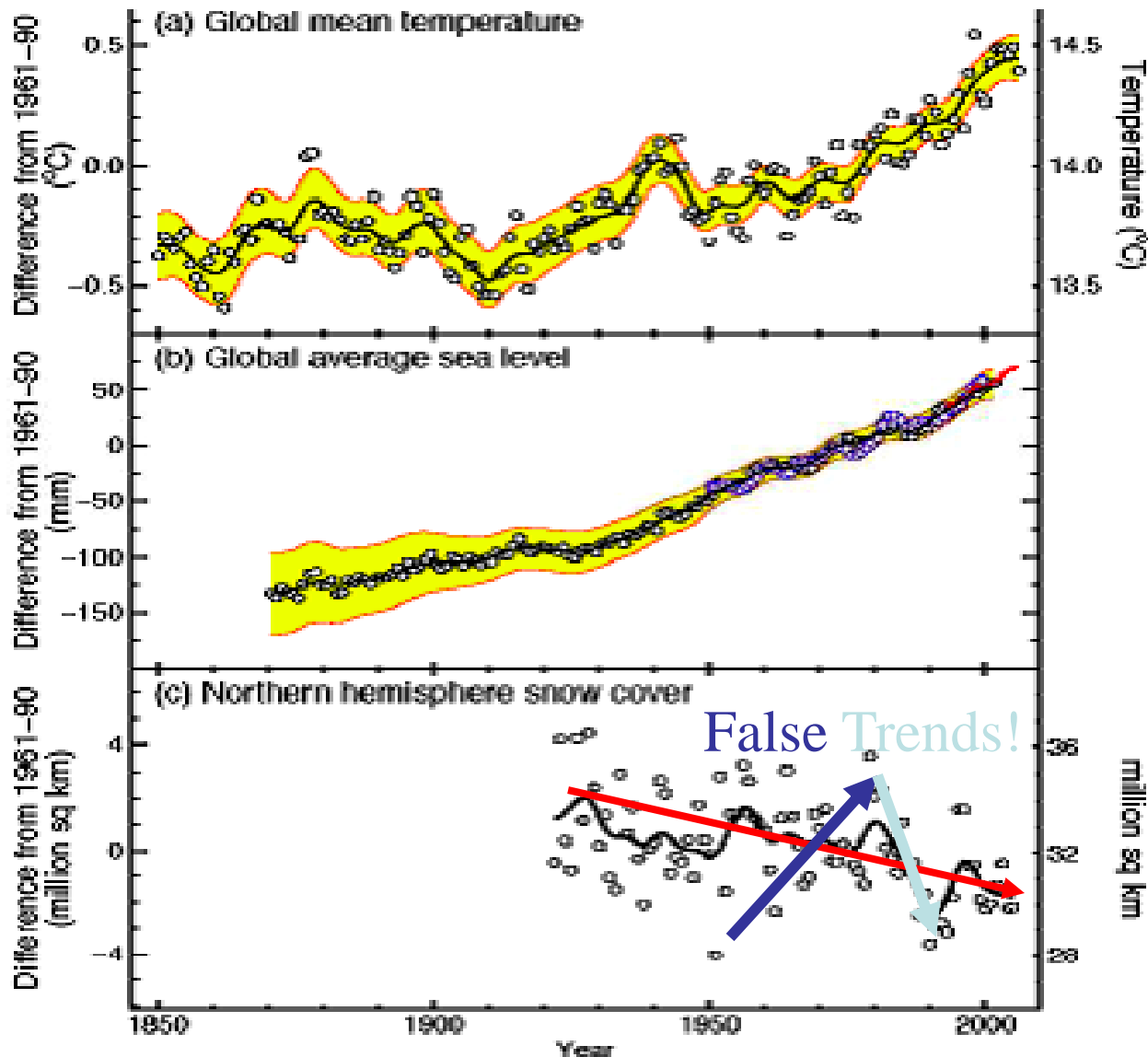


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## Global and continental temperature change

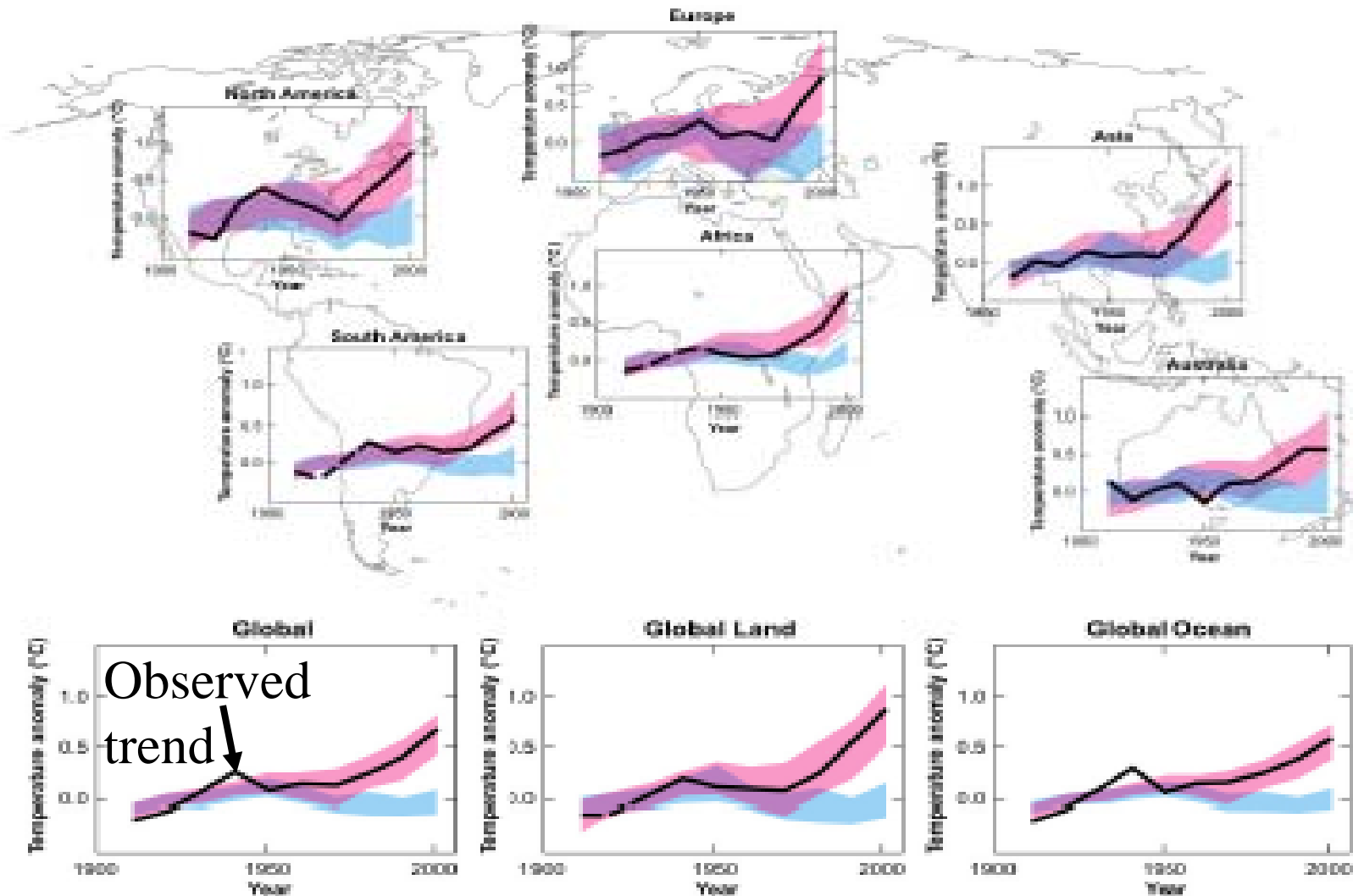


Figure SPM-4. Comparison of observed continental- and global-scale changes in surface temperature with results simulated by climate models using natural and anthropogenic forcings. Decadal averages of observations are shown for the period 1906-2005 (black line) plotted against the centre of the decade and relative to the corresponding average for the 1901-1950. Lines are dashed where spatial coverage is less than 50%. Blue shaded bands show the 5-95% range for 19 simulations from 5 climate models using only the natural forcings due to solar activity and volcanoes. Red shaded bands show the 5-95% range for 58 model simulations from 14 climate models using both natural and anthropogenic forcings. [Figure 2.5]

## Global and continental temperature change

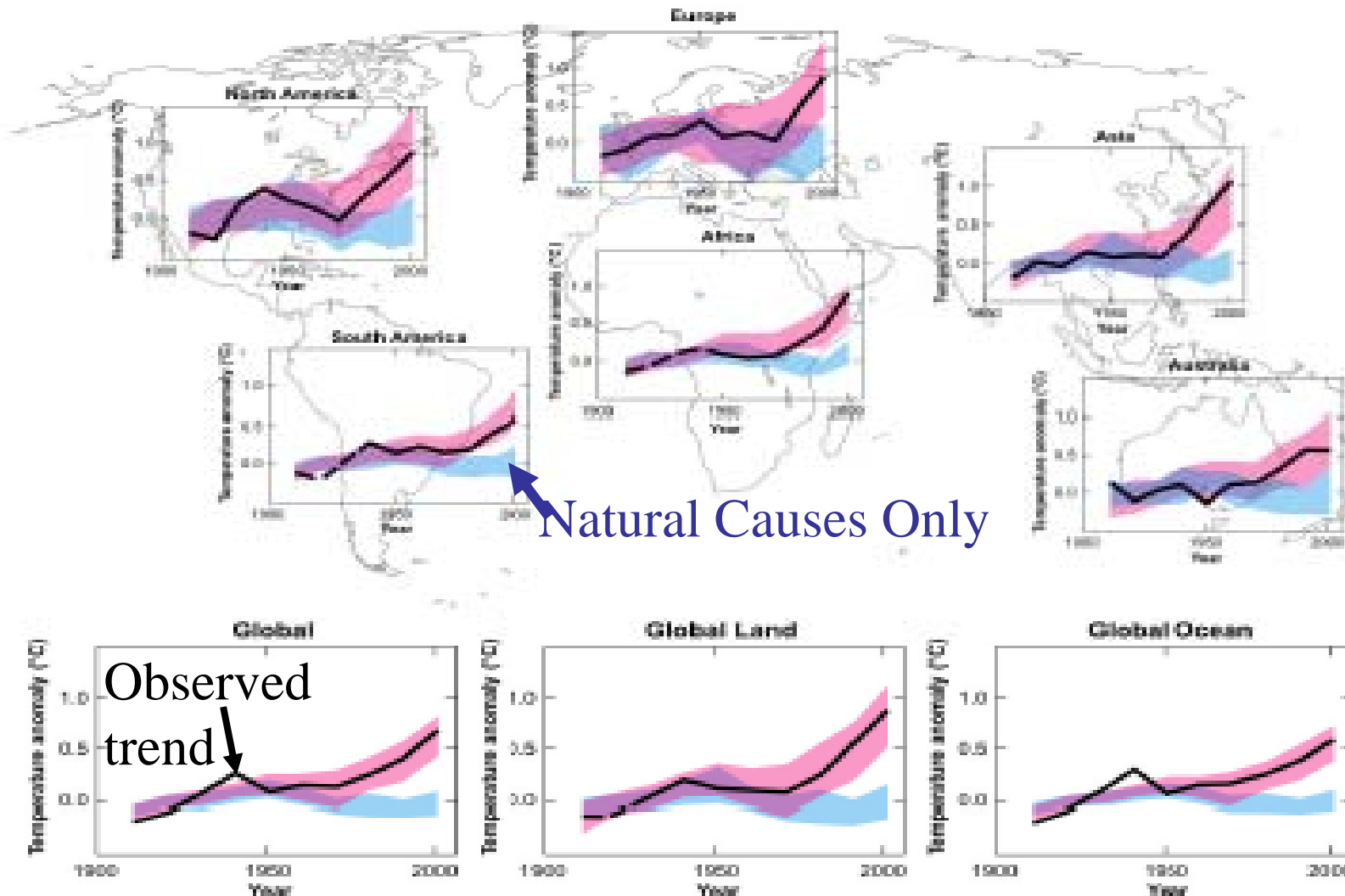


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## Global and continental temperature change

IPCC: "Very Likely"  
humans caused most of  
recent warming

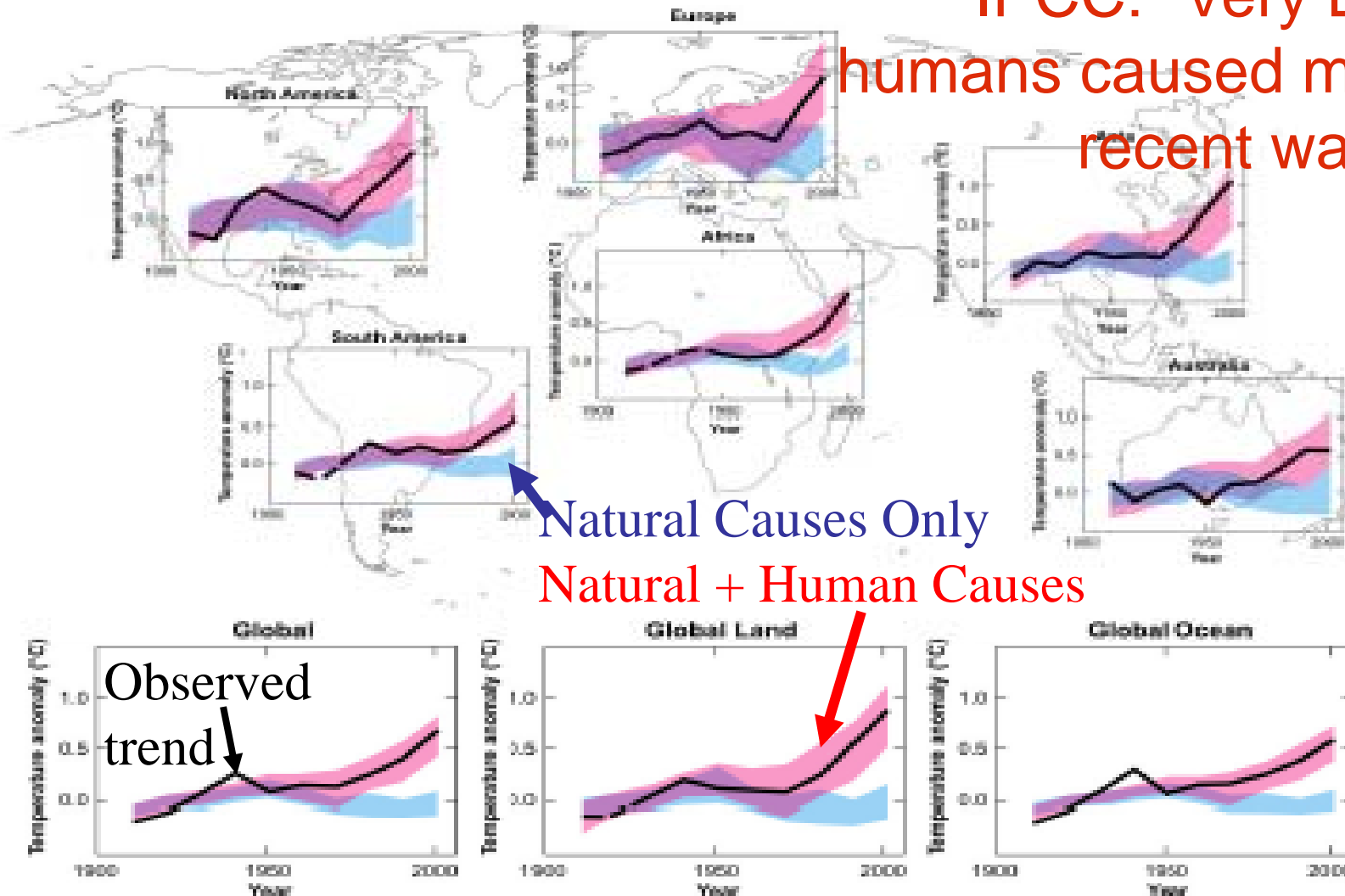
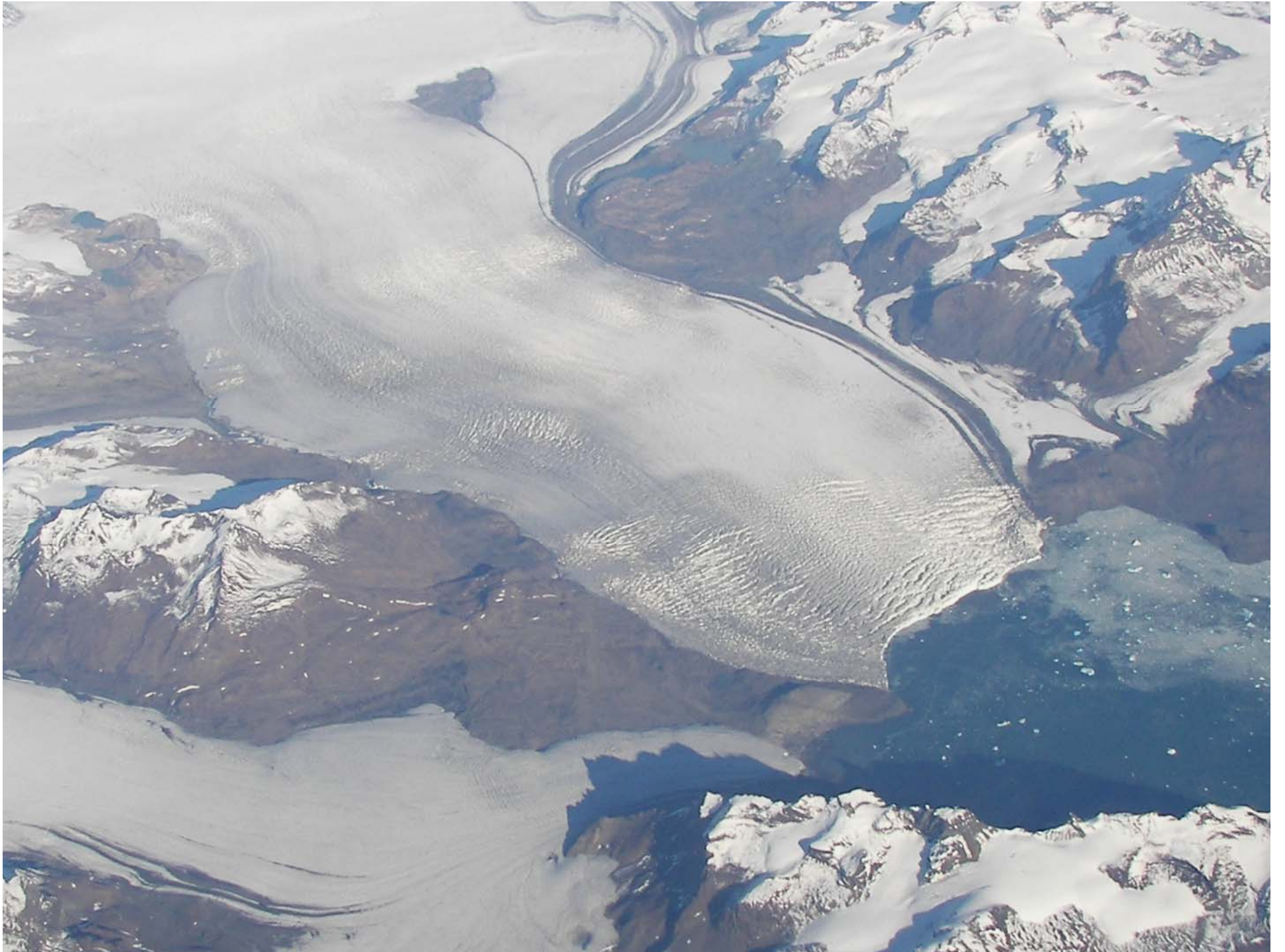


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**GREENLAND**



**ATLANTIC**



Munich Re:

“We need to stop this dangerous experiment humankind is conducting on the Earth’s atmosphere.”

# Characterization of Climate Problem:

- \*Potential For Significant Risks

  - \*Deep Uncertainties

  - \*Normative Judgments

- \*\*"Optimal" Solutions Tenuous

\*\*\*\*\*

➔ "Risk/Management Framework

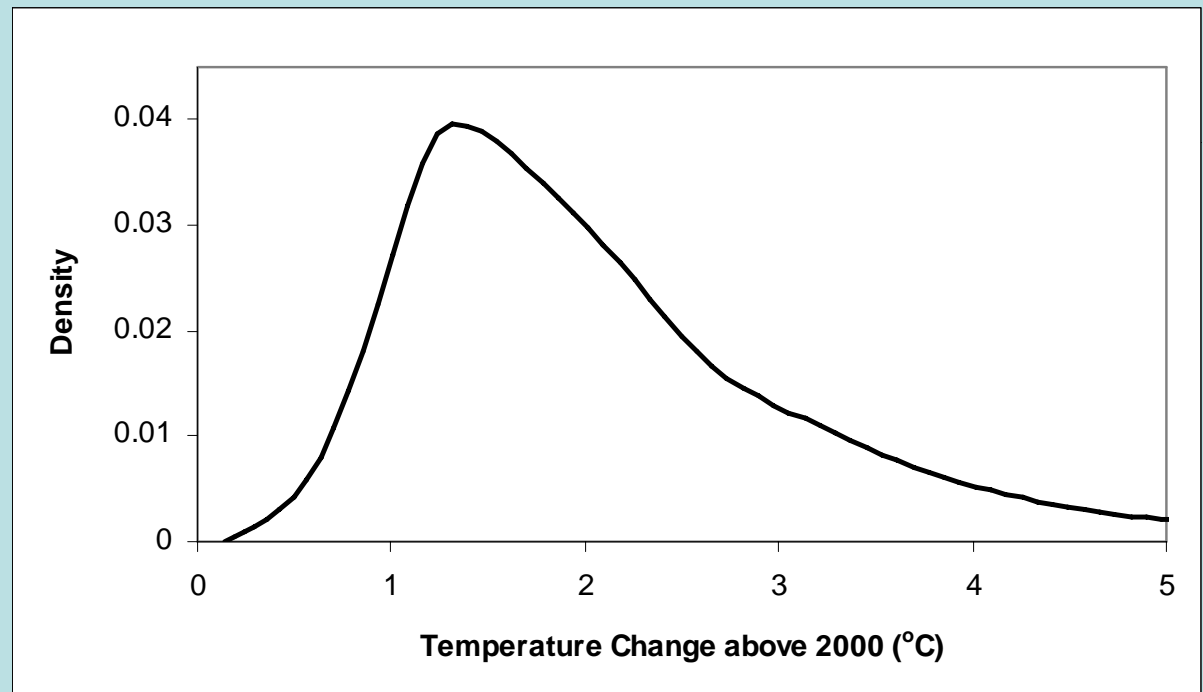


# Risk Management Requires PDFs

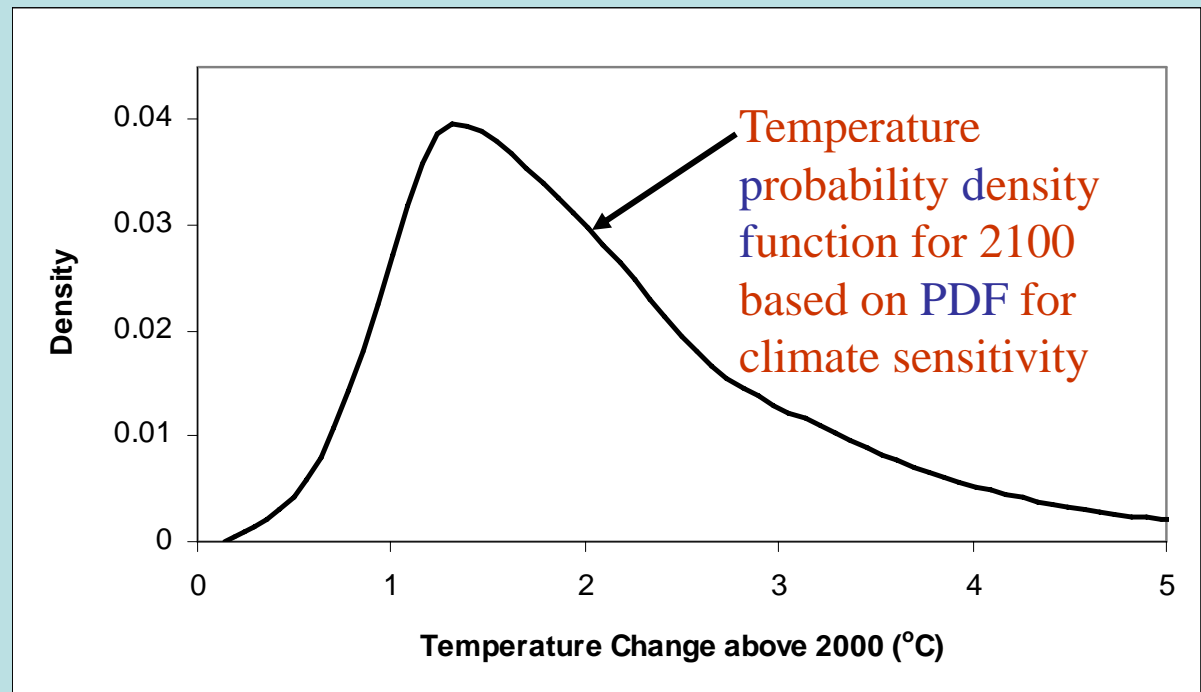
# Climate Uncertainty



# Climate Uncertainty



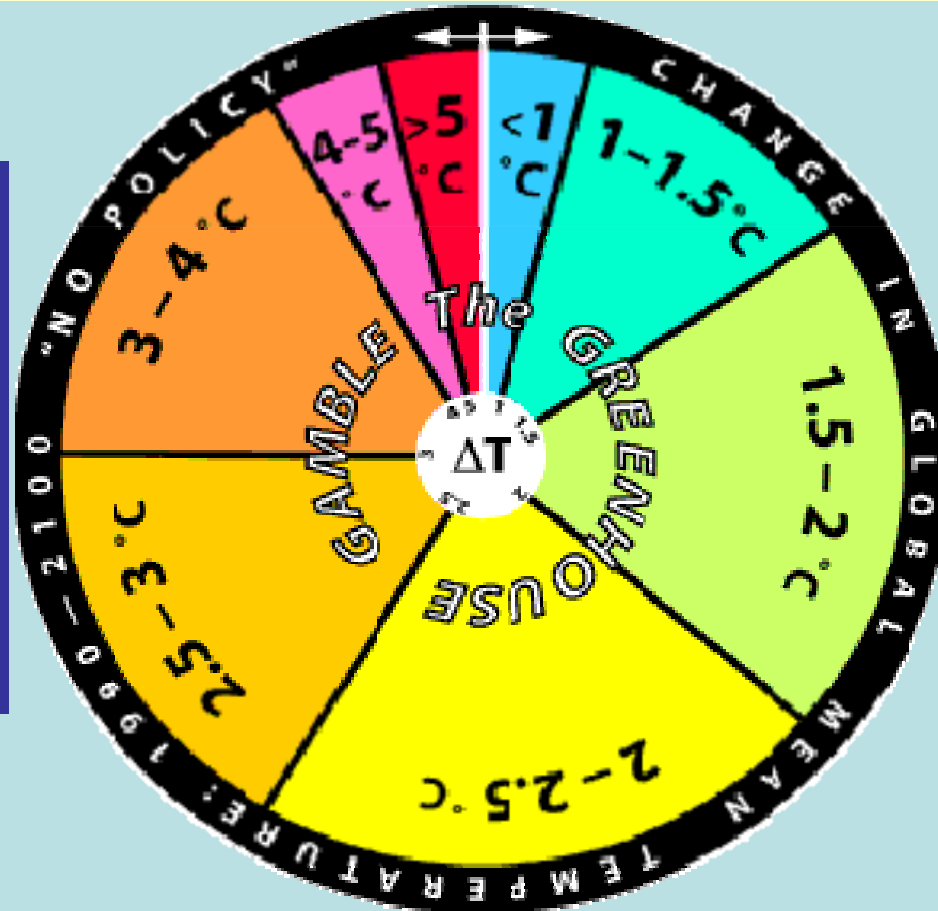
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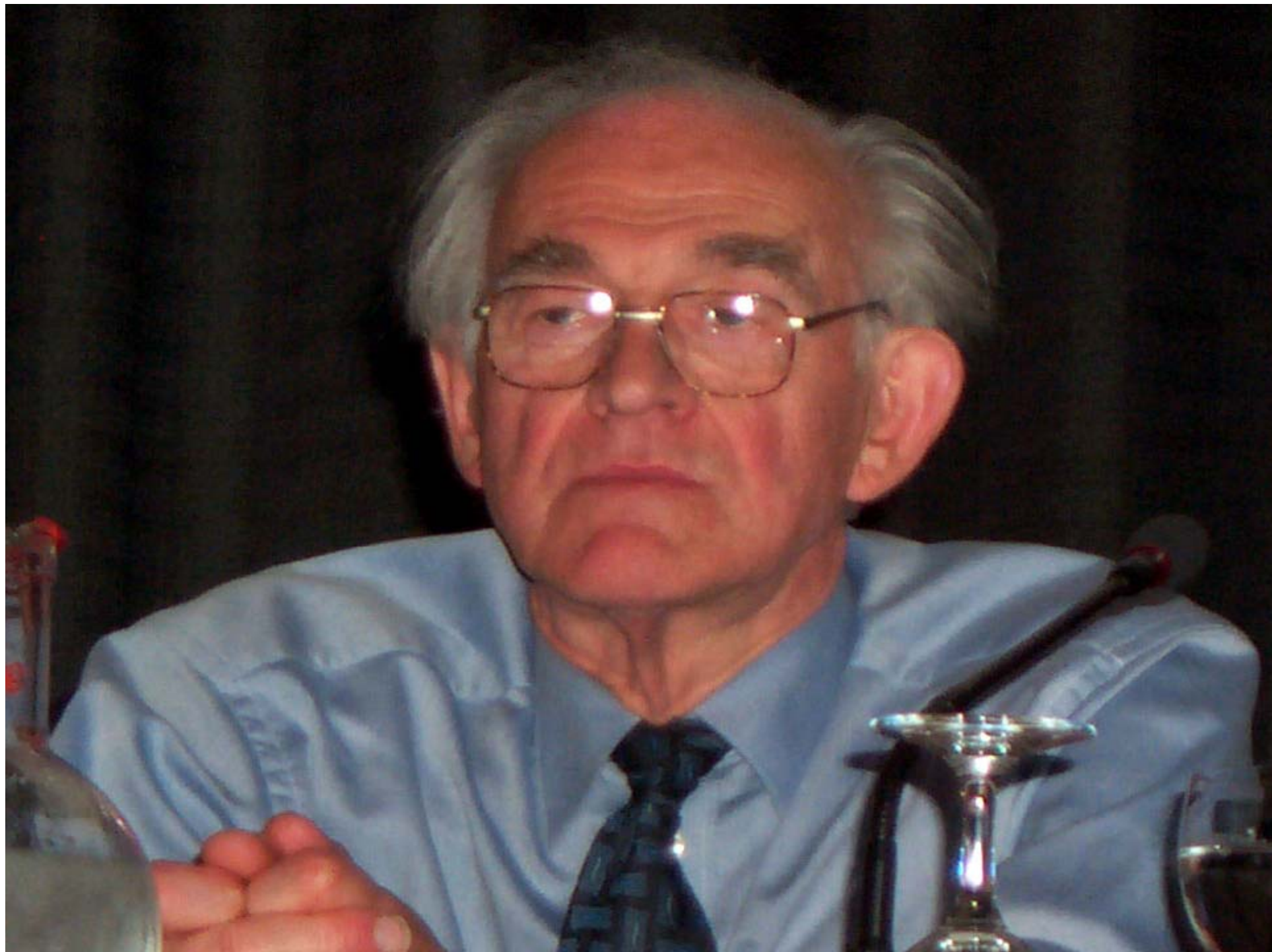
Most sensible decision paradigm?: Risk-management.

# The great “greenhouse gamble” ...

<1°C	(4.1%; 1 in 24 odds)
1 to 1.5°C	(11.4%; 1 in 9 odds)
1.5 to 2°C	(20.6%; 1 in 5 odds)
2 to 2.5°C	(22.5%; 1 in 4 odds)
2.5 to 3°C	(16.8%; 1 in 6 odds)
3 to 4°C	(16.2%; 1 in 6 odds)
4 to 5°C	(4.6%; 1 in 22 odds)
>5°C	(3.8%; 1 in 26 odds)



Source: MIT Joint Program on the Science and Policy of Climate Change















## The “PAO”:

### APPENDIX 2

# OUTLINE FOR THE IPCC WORKING GROUP II CONTRIBUTION TO THE FOURTH ASSESSMENT REPORT CLIMATE CHANGE 2007: IMPACTS, ADAPTATION AND VULNERABILITY Agreed by Plenary XXI, Vienna, 2004

## 19. Assessing Key Vulnerabilities and the Risk from Climate Change

- Methods and concepts: **issues relating to Article 2 of the UNFCCC**; reasons for concern; measuring damage; identifying key impacts and vulnerabilities, and their risk of occurrence
- Approaches to determining levels of climate change for key impacts
- Assessing key global risks
- Assessing key risks for regions and sectors
- Assessment of **response strategies** to avoid occurrence: **stabilisation scenarios**; **mitigation**/adaptation strategies; avoiding irreversibilities; role of sustainable development; treatment of uncertainty
- Uncertainties, unknowns, priorities for research



Those managed and human systems where there is some evidence of effects from ~~regional~~ increases in temperature include the following:

- ~~some coastal zones affected by erosion due to sea-level rise [1.3];~~
- effects on agricultural and forestry management at Northern Hemisphere higher latitudes, such as earlier spring planting of crops, and ~~alterations in disturbance regimes of forests due to fires and pests~~ changes in forest fires and pests [1.3]













WHAT ARE THE FUTURE  
IMPLICATIONS OF POPULATION,  
AFFLUENCE AND  
TECHNOLOGY GROWTH  
PROJECTIONS?

\*\*\*\*\*

HOW CAN THE FUTURE BE  
SCIENTIFICALLY ANALYSED?

# NOSTRADAMUS PREDICTS HOTTEST SUMMER IN HISTORY

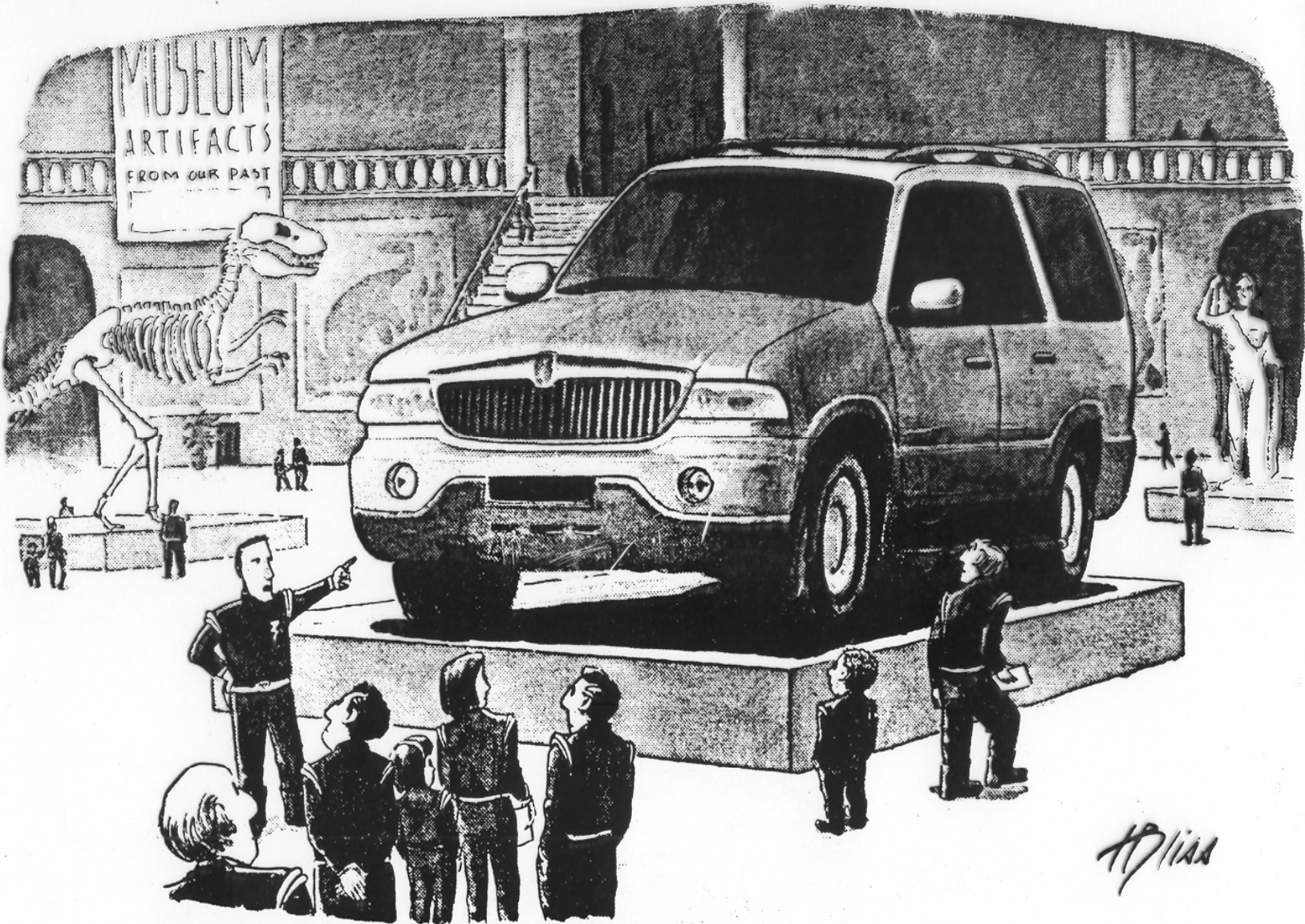


FAMOUS seer Nostradamus wrote a clear and specific poem that reveals the horrors of our upcoming weather.









*"We're not certain why they disappeared, but archeologists speculate that it may have had something to do with their size."*



# Large Vehicles Are the Solution, Not the Problem

By SAM KAZMAN

If you listen to journalists, you'd think sport-utility vehicles were more dangerous than Saddam Hussein. SUVs supposedly deplete the Earth's resources, poison its atmosphere and encourage rude driving. Worst of all, because of their size they allegedly pose a grave collision threat to just about anyone who ventures outdoors. According to a recent New York Times report, the worst safety hazard is yet to come—once these "expensive toys" depreciate and are sold by the "responsible family people" who now drive them, they'll be bought by teenagers who'll handle them even more recklessly.

These threats have been wildly overstated. And the solution proposed by many SUV critics, raising the federal fuel economy standards, would mean expanding a regulatory program that has already caused thousands of traffic deaths.

The federal Corporate Average Fuel Economy standards, enacted in the wake of the mid-1970s oil shocks, require each auto maker's annual output of new cars to meet a set fuel economy level. The current passenger-car CAFE standard is 27.5 miles per gallon; for light trucks, the standard is a more lenient 20.7 mpg.

The easiest way for car makers to meet ever-rising CAFE standards has been through continued car downsizing. As the National Highway Traffic Safety Administration itself noted, "weight reduction is probably the most powerful technique for improving fuel economy. . . . Each 10 percent reduction in weight improves the fuel economy of a new vehicle design by approximately 8 percent." The result was a CAFE-driven downsizing of approximately 500 pounds per car.

Smaller cars, however, are less crash-worthy than similarly equipped large cars in practically every type of accident. According to a 1989 Harvard-Brookings study, CAFE-induced downsizing has increased car occupant fatalities by between

14% and 27%; that translates to between 2,000 and 4,000 extra deaths a year.

You'd think that NHTSA, an agency whose middle name is safety, would have brought this issue to the forefront of public attention. But instead NHTSA has repeatedly claimed that CAFE has no safety effect. In a 1992 court case brought by the Competitive Enterprise Institute and Consumer Alert, a panel of federal appeals judges blasted NHTSA's position as "fudged analysis," "statistical legerdemain" and "bureaucratic mumbo-jumbo."

If CAFE had been a privately produced product, it would long ago have been recalled as defective and its producer, NHTSA, jailed for the coverup. But because CAFE is a product of Washington rather than Detroit, it remains in place; worse yet, it threatens to expand in the face of the SUV "threat."

The overblown nature of that threat is demonstrated by a study issued last month by the Insurance Institute for Highway Safety. Journalists widely reported the study as re-emphasizing the need for action against SUVs, but its findings indicate otherwise. What the institute found was that collisions between cars and SUVs account for only 4% of car occupant fatalities.

Cars are most vulnerable in side impact collisions. According to the institute, in fatal collisions involving cars that are hit on the side by SUVs, the relative risk that the death will be in the car rather than the SUV is an apparently lopsided 27-to-1. But when this relative risk is broken down by car weight categories, it turns out that car-SUV mismatches are frequently outweighed by other common collision disparities. For example, the occupants of a light car struck in the side by a heavy car

face a greater relative risk of death than when a heavy car is side-impacted by an SUV. That is, there is a greater mismatch between light cars and heavy cars than there is between heavy cars and SUVs.

What this means is that upsizing the car fleet may well be the most important step we could take toward improving safety. But upsizing, of course, is what CAFE currently restricts.



You're safer in a sport utility vehicle.

The same conclusion emerges from a 1997 NHTSA study, which was similarly characterized as indicting SUVs but which turns out, on closer analysis, to indict CAFE. A NHTSA press release touted the study's finding that a 100-pound decrease in SUV weight would prevent 40 fatalities per year, most of them in cars colliding with SUVs. But according to the study itself, this conclusion was not statistically significant; there might even be a net loss of life from downsizing, and on balance the overall effect would be "negligible." More important, those minimal effects paled in comparison to the effects of a 100-pound increase in passenger car weight—a saving of over 300 lives a year. And the effect of this passenger car upsizing was found to be statistically significant, unlike the SUV downsizing.

Upsizing, however, would entail relaxing CAFE rather than tightening it—a move that would be totally alien to this administration and to its environmentalist supporters. The Sierra Club, for example, claims that higher CAFE standards would be "the biggest single step to curbing global warming." In their 1992 campaign book, Bill Clinton and Al Gore recommended raising CAFE to 40 mpg by 2000—a level whose potential safety consequences add more than a little irony to the book's title, "Putting People First."

SUV critics argue, to use Consumer Reports' words, that "most people who buy an SUV don't need one." But what one person doesn't need is largely a matter of another person's opinion. In the early 1800s the Duke of Wellington complained that the new railroads would "only encourage the common people to move about needlessly." Today the elitist view is that the

he bought it for safety, to distinguish himself from "some teenager" trying "to be cool." Too bad his regulatory approach doesn't do much for other people's safety.

In fact, much of the SUVs' recent popularity stems from CAFE itself. CAFE's restrictions took their greatest toll on large cars and station wagons. As economist Paul Godek pointed out in a study published last fall, light trucks were the only real alternative for consumers concerned about safety and seating capacity. In effect, he concludes, most of the weight forced off the passenger car fleet by CAFE has reappeared in the light truck fleet.

So the real problem is CAFE, not SUVs. The next time you hear the term SUV, remember: The "S" might as well stand for scapegoat.

Mr. Kazman is general counsel of the Competitive Enterprise Institute in Washington.

March 13, 1999

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But is it not absolute weight, but DIFFERENTIAL weight that affects two car crash consequences—so ALL cars on a diet would improve safety [and sustainability] by “leveling the playing field”. Should ability to pay allow one the right to endanger others? Not primarily an economics, but ethics, question!

**‘The words of the prophet are  
written on the...?’**



MELTING  
DOES WELL AT THE POLES.



THE NEW H2.

**HUMMER** LIKE NOTHING ELSE

VIACOM



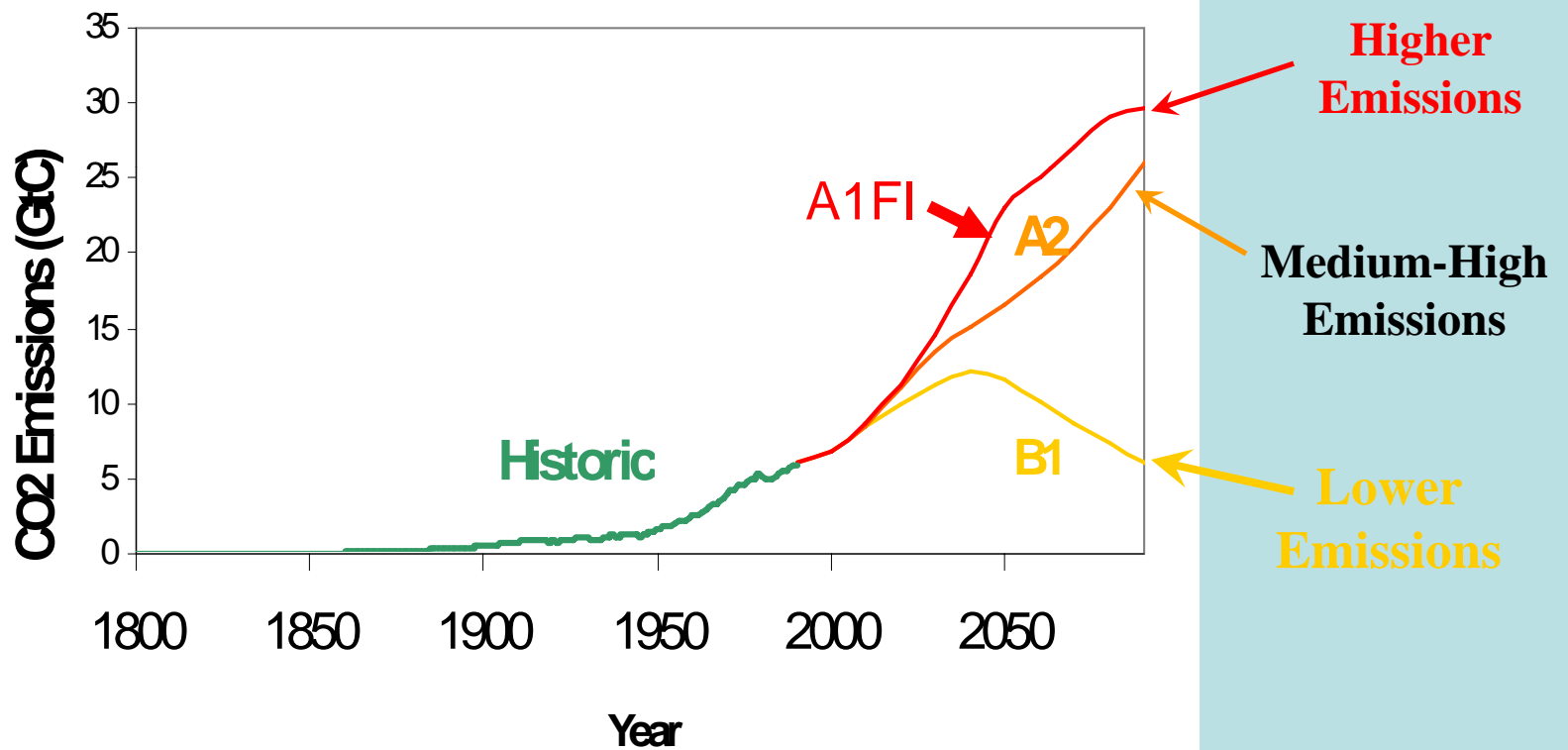






# We can Choose our Emissions Future

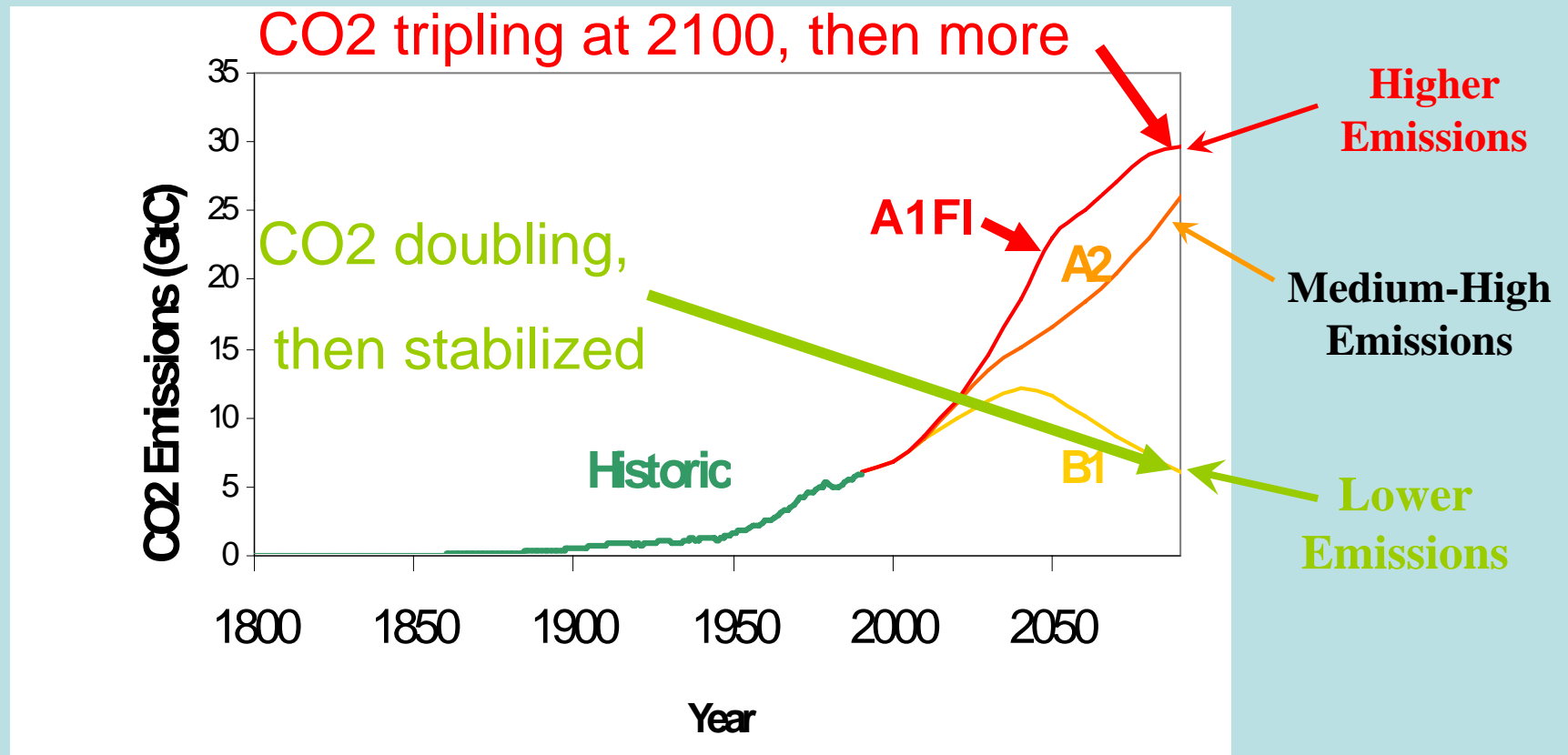
(Intergovernmental Panel on Climate Change Emission Scenarios)



Just fossil fuel emissions shown in graphic.

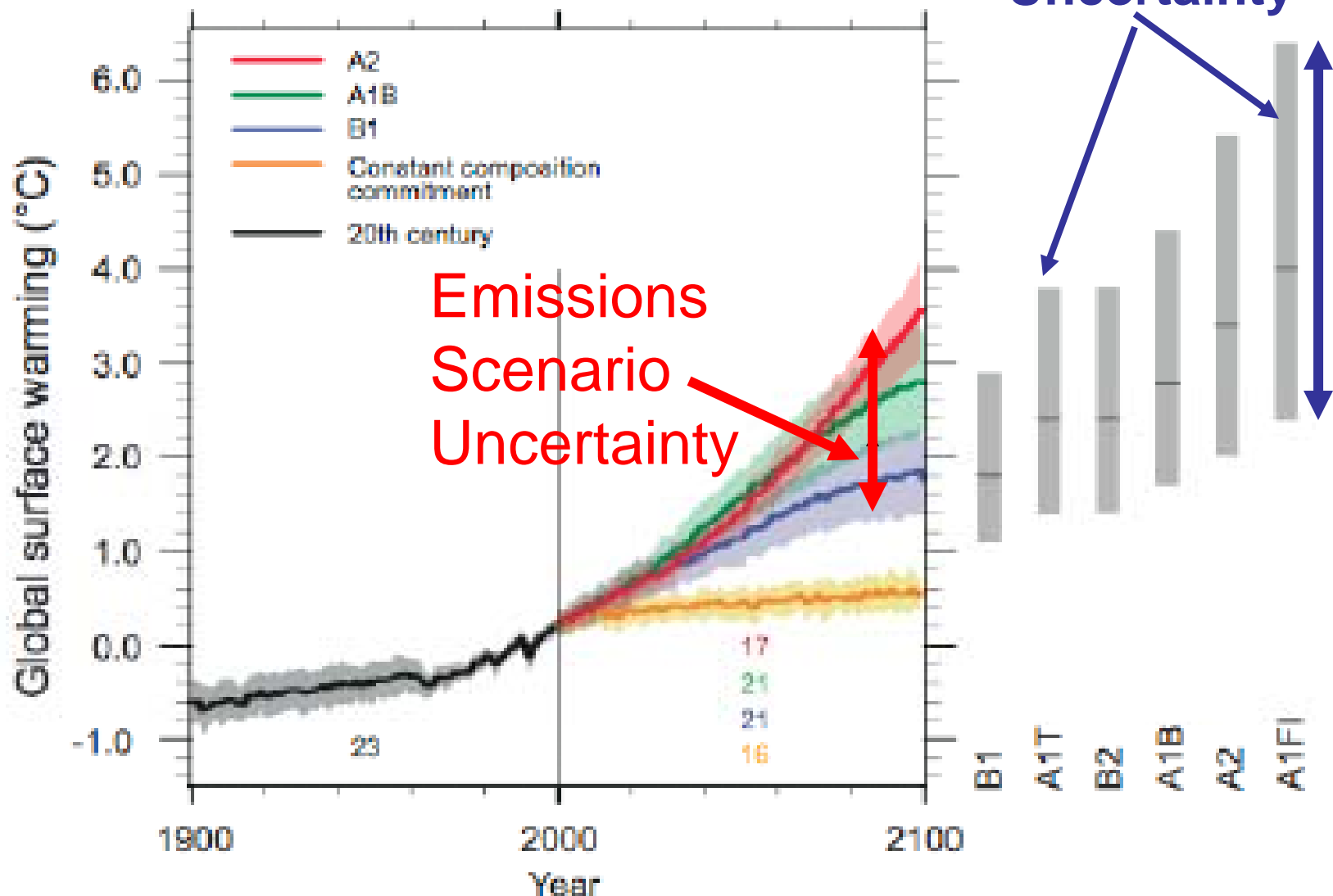
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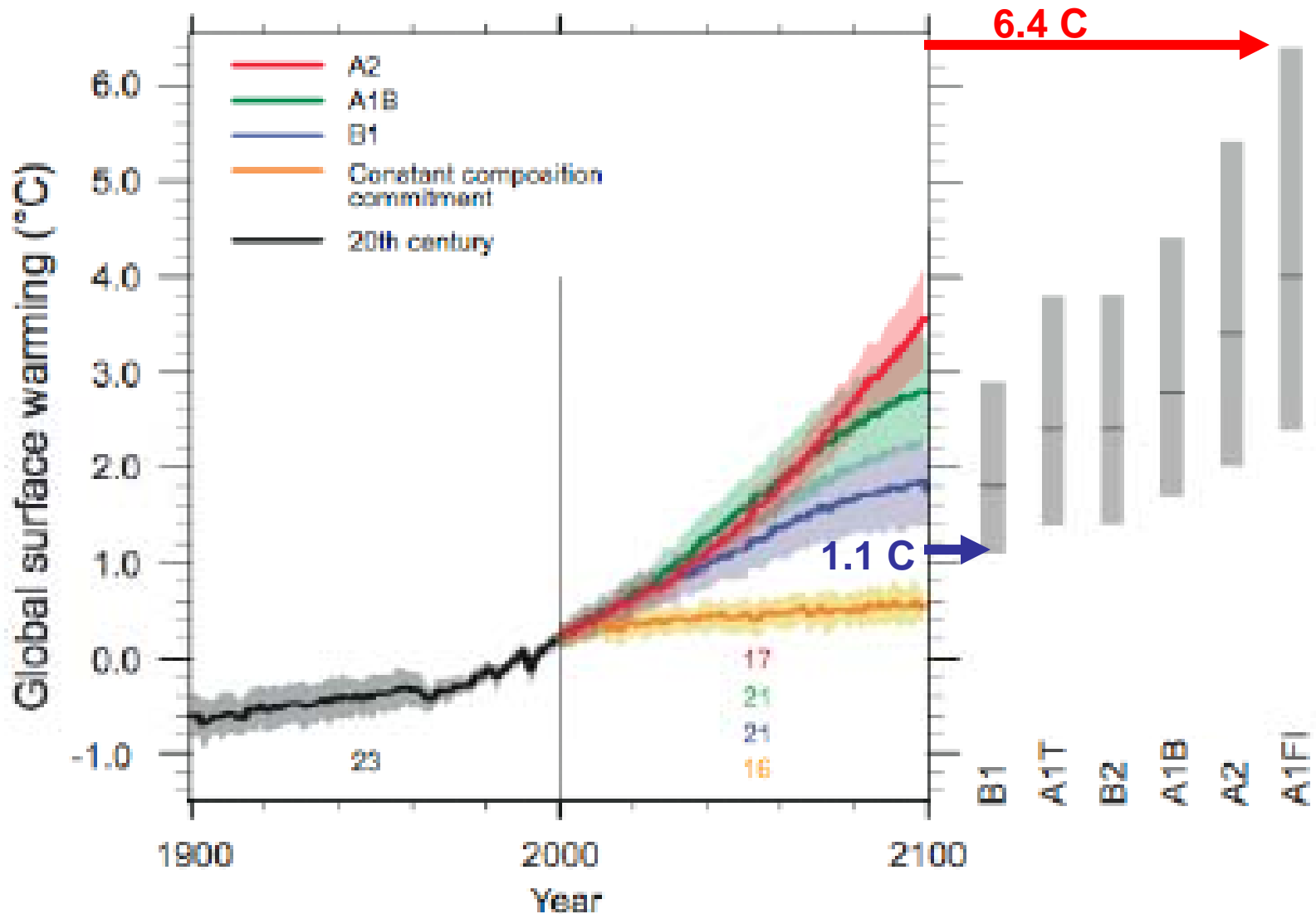
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# Calculating The Range of Warming



Source: IPCC, WG 1, AR4, 2007

# Warming Very Likely—But How Much?: Wide Range



Source: IPCC, WG 1, AR4, 2007



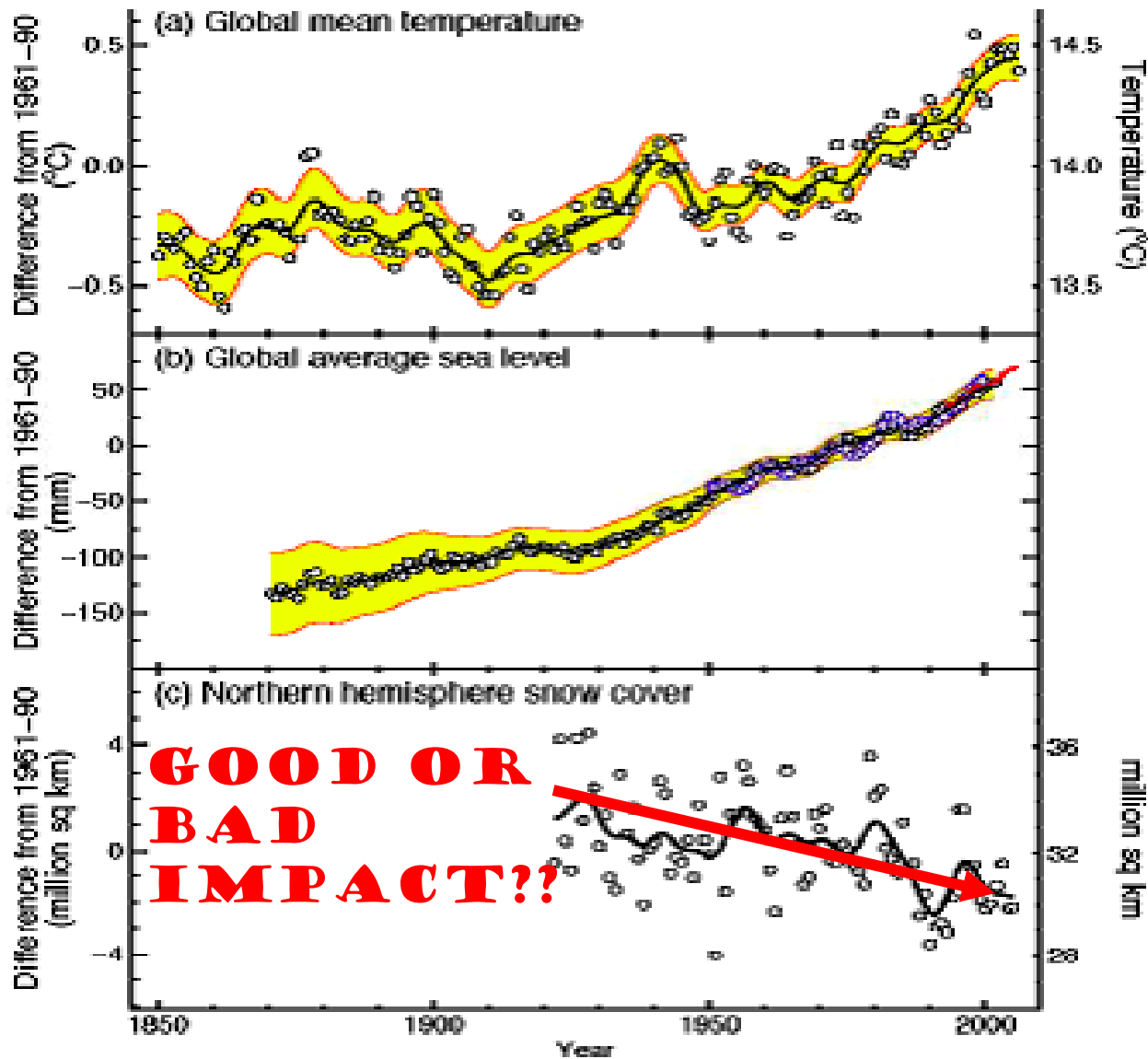
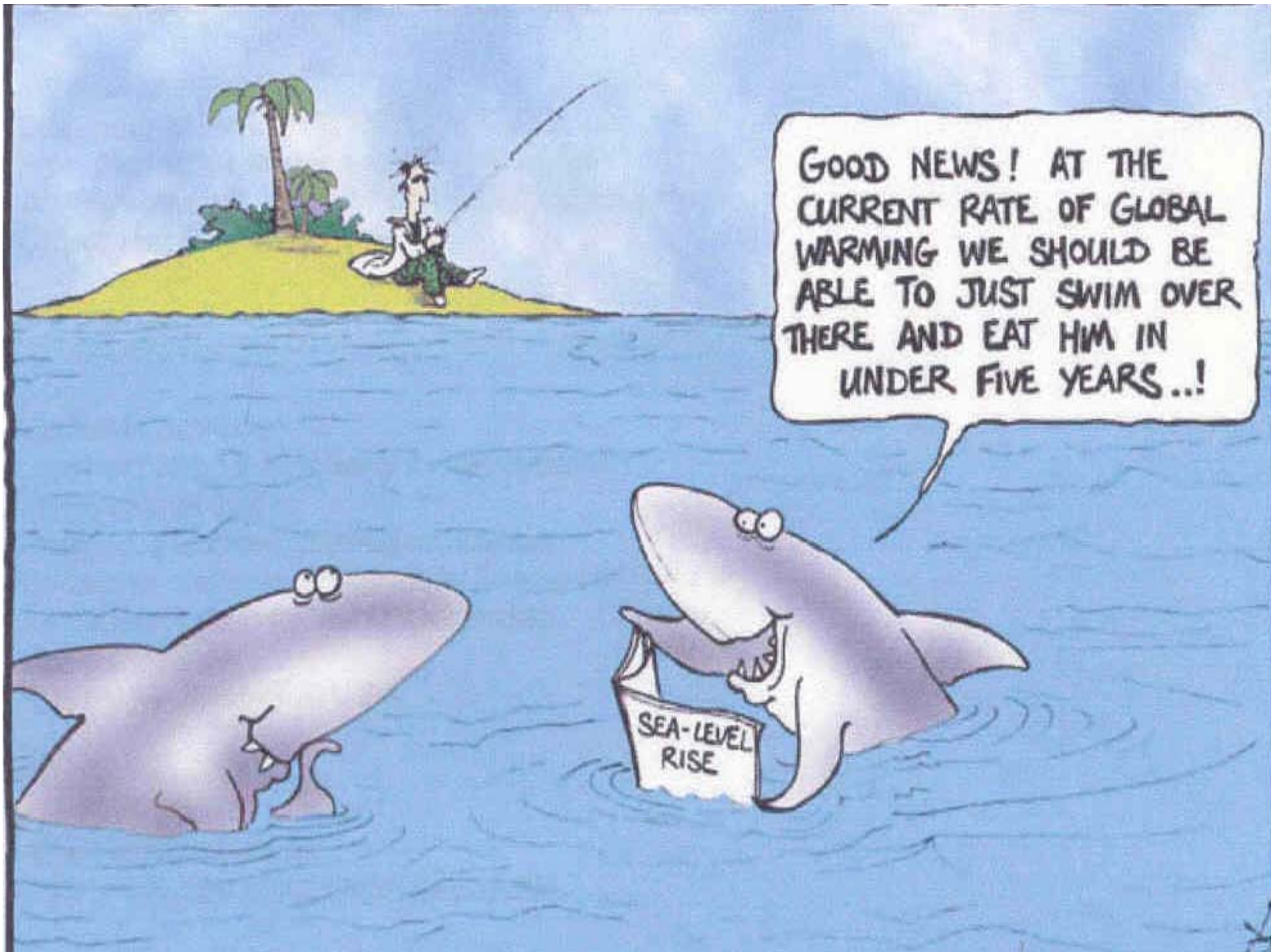


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GOOD NEWS! AT THE  
CURRENT RATE OF GLOBAL  
WARMING WE SHOULD BE  
ABLE TO JUST SWIM OVER  
THERE AND EAT HIM IN  
UNDER FIVE YEARS...!

SEA-LEVEL  
RISE

# “Very High Confidence”\* Global Warming Impacts

- North American Impacts Projected
  - Water Impacts: “Warming in western mountains is projected to cause decreased snowpack, more winter flooding, and reduced summer flows, exacerbating competition for over-allocated water resources.”

*IPCC, Summary for Policymakers, Working Group II Contribution to the Fourth Assessment Report, April, 2007*

\*Very High Confidence in the IPCC AR4 is defined as greater than 9 out of ten chance of occurrence

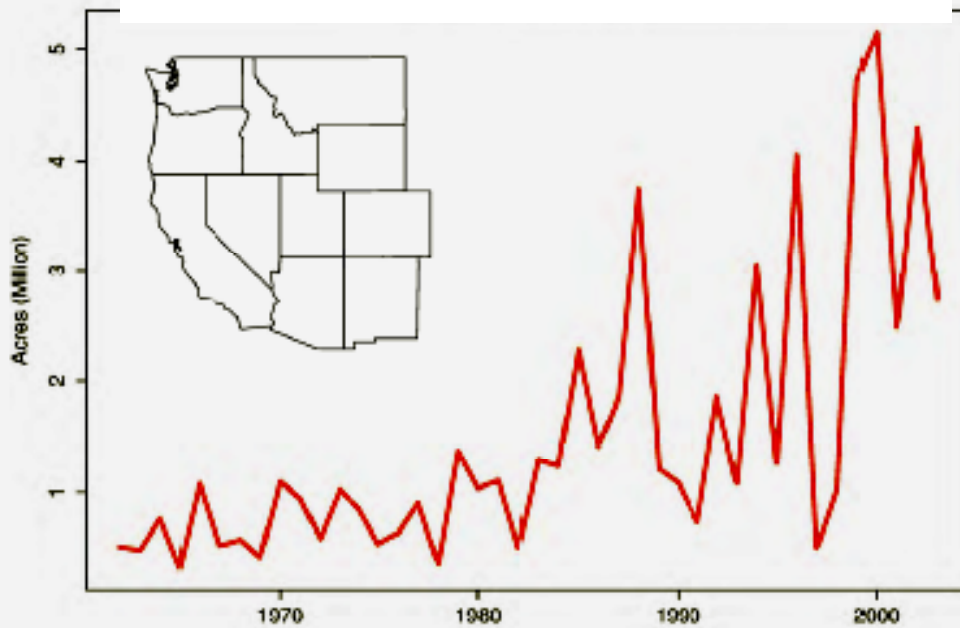
# “Very High Confidence” Global Warming Impacts

- North American Impacts Projected (cont'd)
  - Fire & Pest Impacts: “Disturbances from pests, diseases, and fire are projected to have increasing impacts on forests, with an extended period of high fire risk and large increases in area burned. “

*IPCC, Summary for Policymakers, Working Group II  
Contribution to the Fourth Assessment Report, April, 2007*

# Wildfires Frequency increased four fold in last 30 years.

Western US area burned



Source: Westerling et al. 2006



# “Very High Confidence” Global Warming Impacts

- North American Impacts Projected (cont'd)

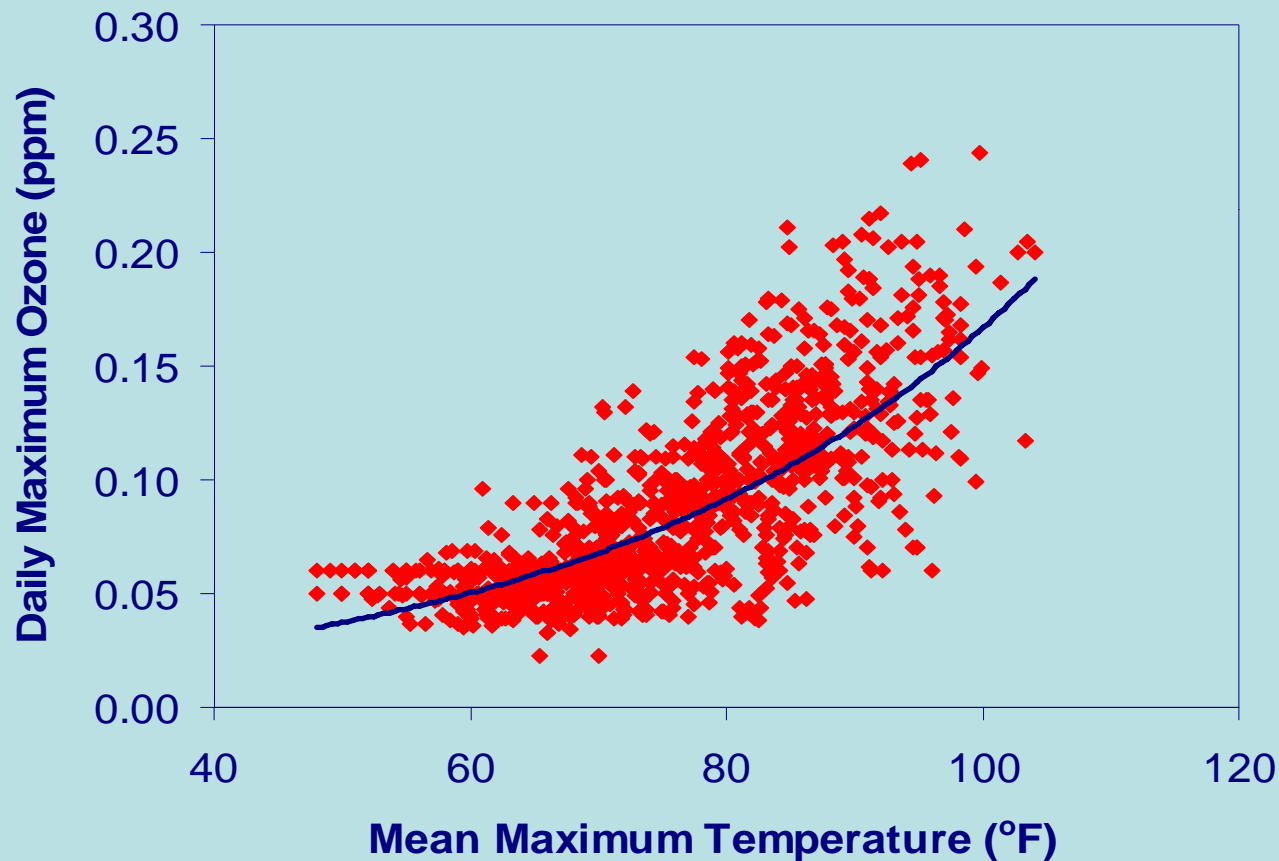
Heat Wave/Public Health Impacts: "Cities that currently experience heat waves are expected to be further challenged by an increased number, intensity and duration of heat waves during the course of the century, with potential for adverse health impacts. The growing number of the elderly population is most at risk."

*IPCC, Summary for Policymakers, Working Group II  
Contribution to the Fourth Assessment Report, April, 2007*



# Extraordinary & Compelling Conditions

## Hotter Days Lead to More Smog



**South Coast Air  
Basin  
Ozone Levels  
(1996-1999)**

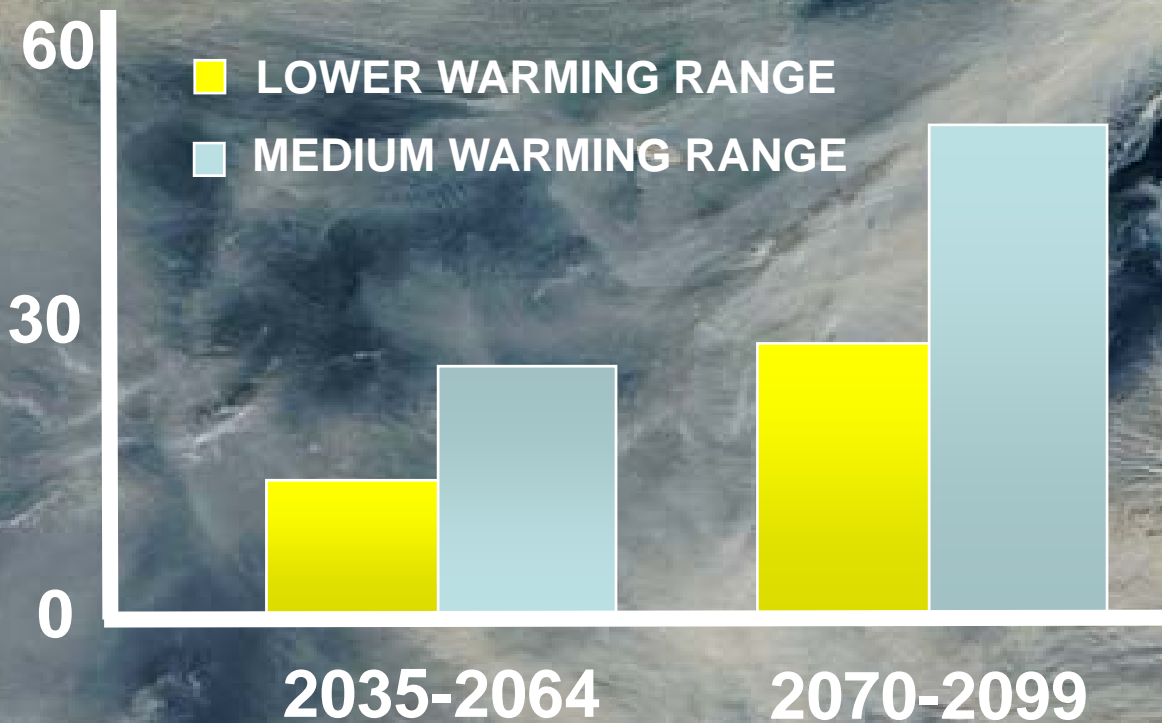
Our Changing Climate: Assessing the Risks to California (2006),

[www.climatechange.ca.gov](http://www.climatechange.ca.gov). Source: Air Resources Board, 2000

# Increase in Wildfires

Pollution in Plumes

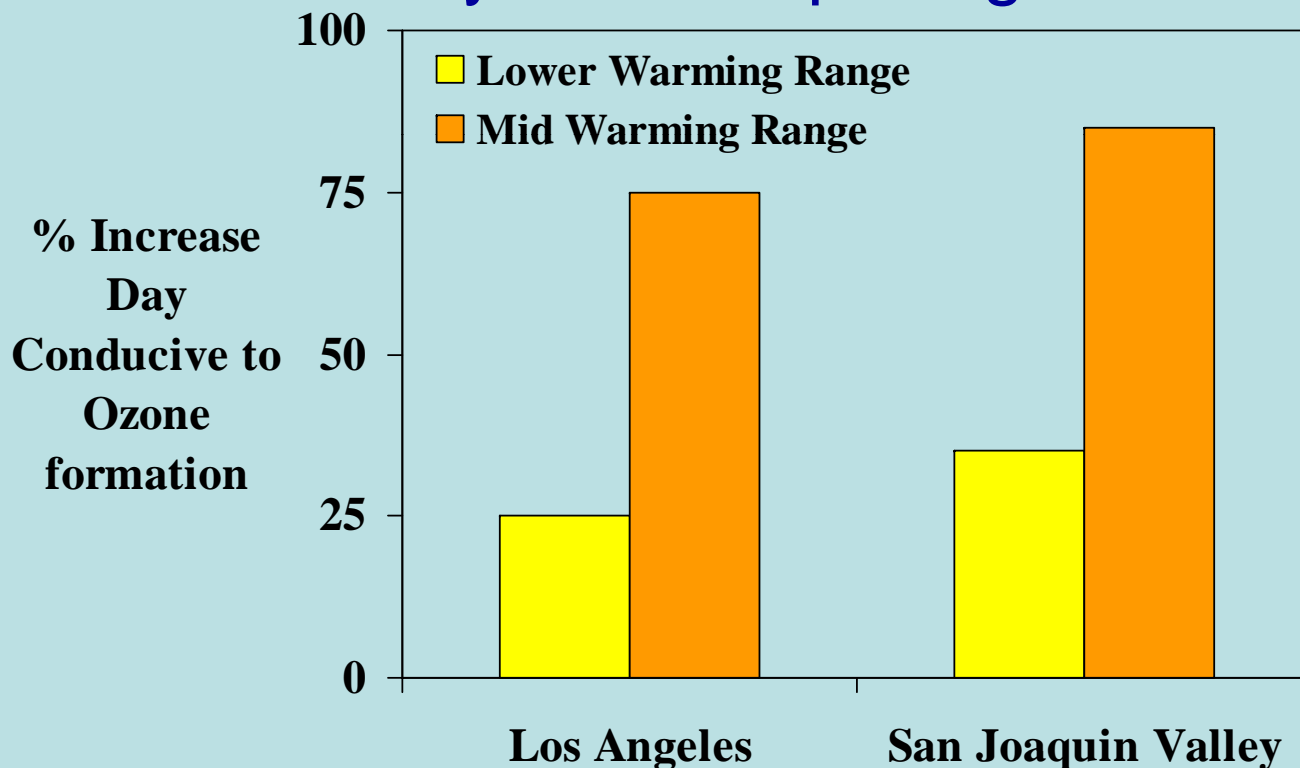
% CHANGE IN EXPECTED MINIMUM  
NUMBER OF LARGE FIRES PER YEAR



Source of data : Westerling and Bryant, "Climate change and wildfire in and around California: Fire modeling and loss modeling" (2006), [www.climatechange.ca.gov](http://www.climatechange.ca.gov)

# Extraordinary & Compelling Conditions

More Smog Likely: Section 209(b) clearly covers this extraordinary and compelling condition



Our Changing Climate: Assessing the Risks to California (2006),  
[www.climatechange.ca.gov](http://www.climatechange.ca.gov)

Data from GFDL B1 and A2 runs. SOURCE: Kleeman et al. 2006

# “Very High Confidence” Global Warming Impacts

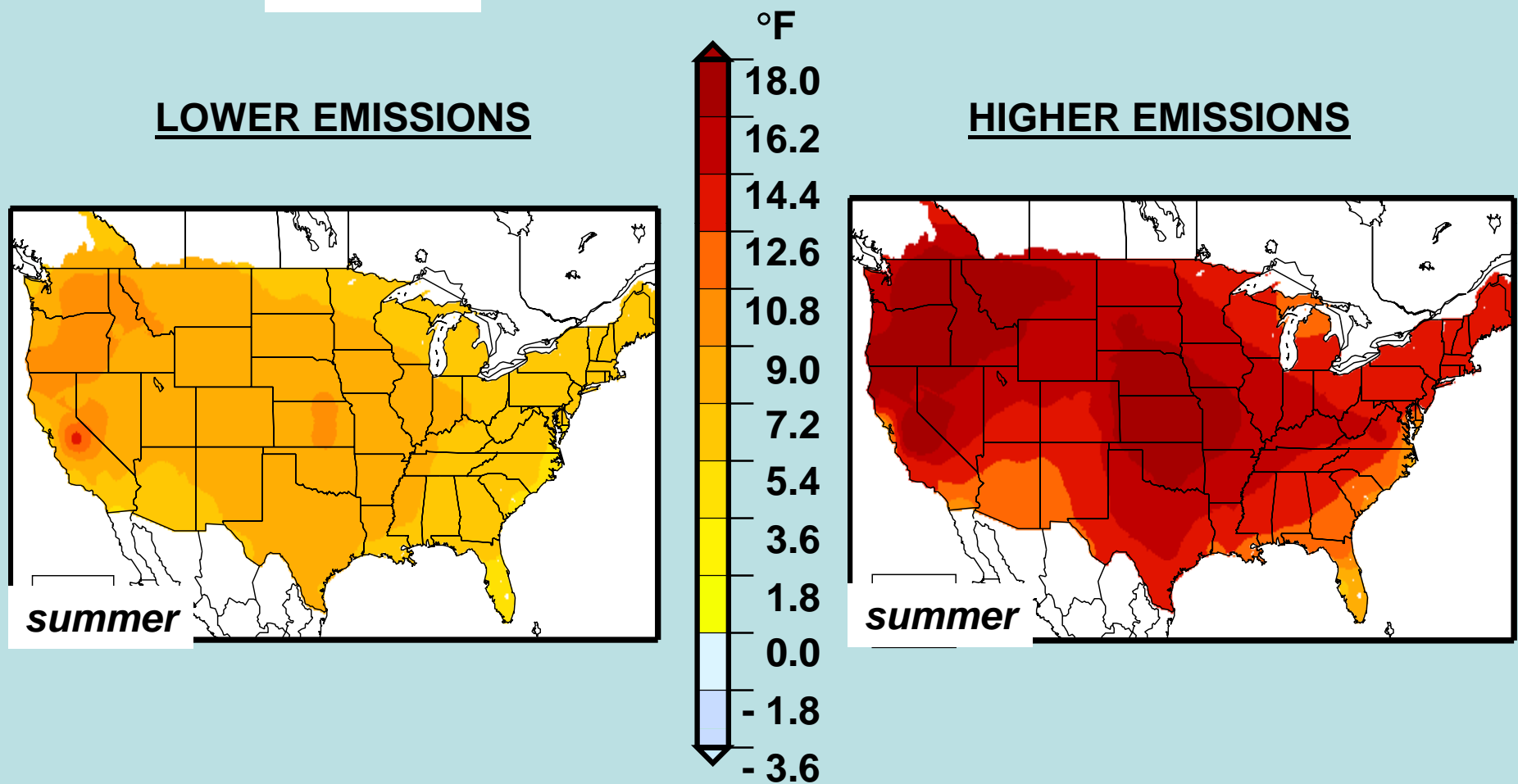
- North American Impacts Projected (cont'd)
  - Coastal Impacts : “Coastal communities and habitats will be increasingly stressed by climate change impacts interacting with development and pollution. Population growth and the rising value of infrastructure in coastal areas increase vulnerability to climate variability and future climate change, with losses projected to increase if the intensity of tropical storms increases. Current adaptation is uneven and readiness for increased exposure is low.”

*IPCC, Summary for Policymakers, Working Group II  
Contribution to the Fourth Assessment Report, April, 2007*



# Rising Temperature

## *End of Century Increases (Summer Average)*



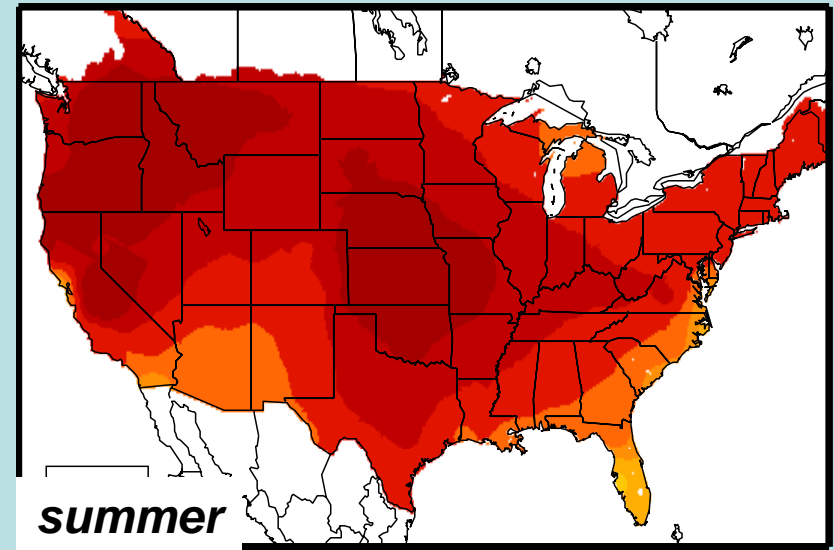
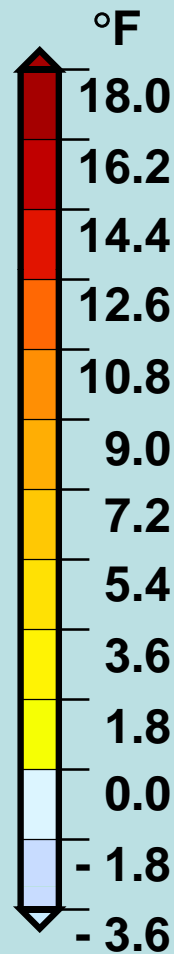
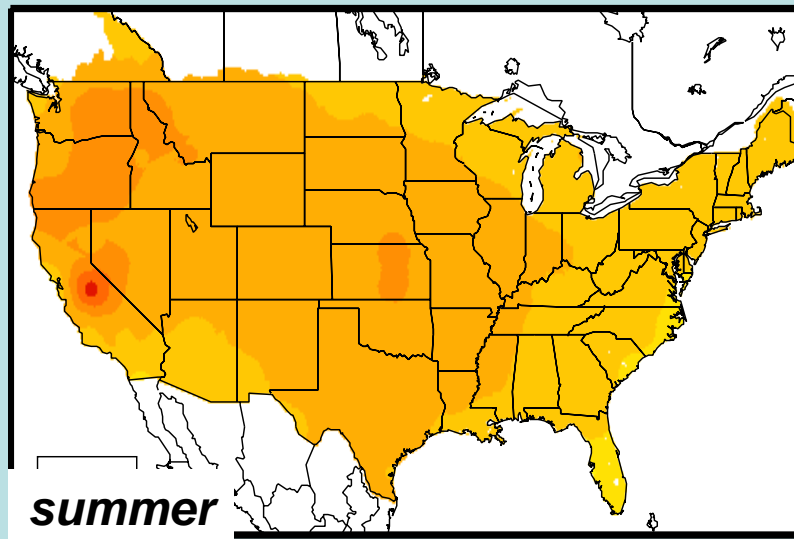
Notes: HadCM3 model results for 2070-2099 vs. 1961-1990. Higher emissions = A1fi; lower emissions = B1 scenarios from IPCC Third Assessment Report. Downscaled results from E. Maurer (<http://www.engr.scu.edu/~emaurer/index.shtml>).

# Rising Temperature

## **EMISSIONS MATTER!**

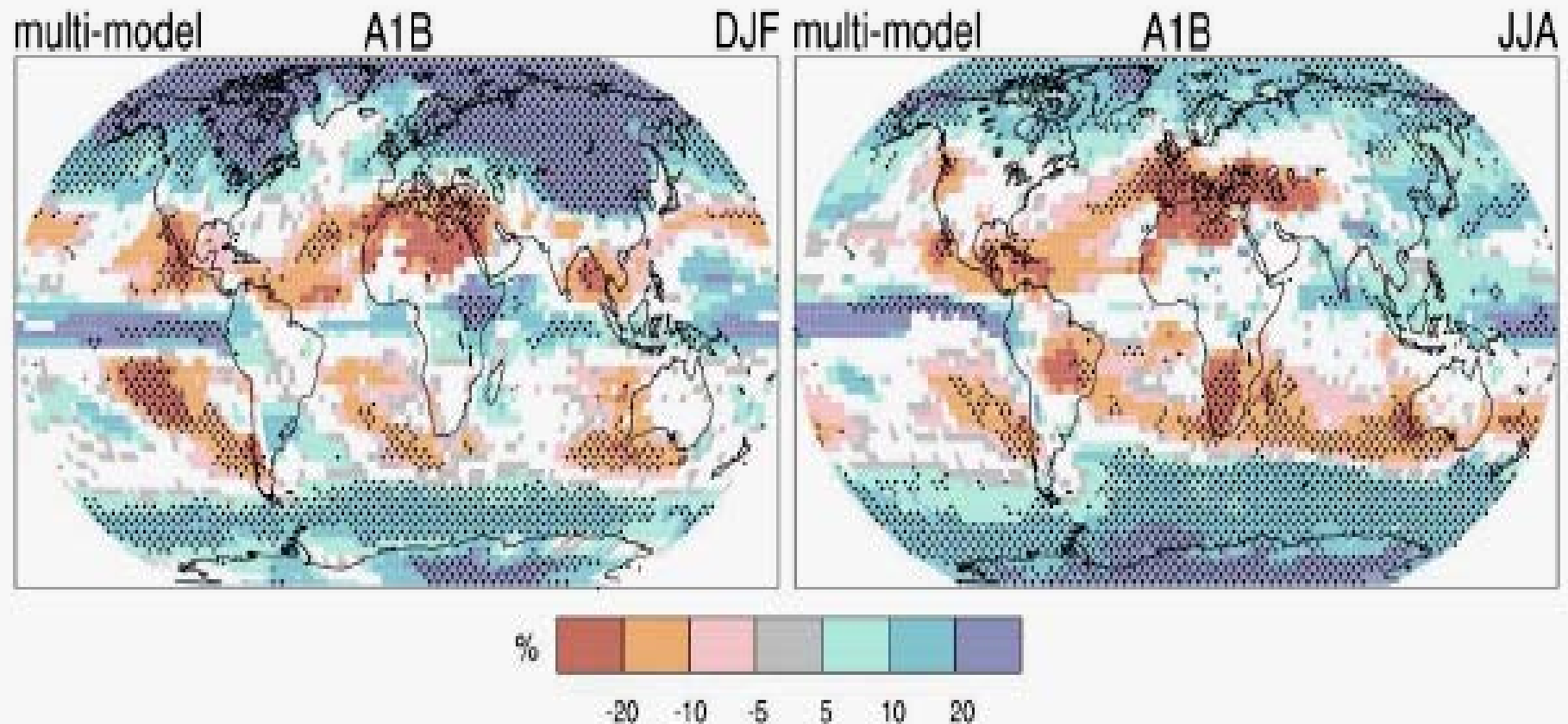
LOWER EMISSIONS

HIGHER EMISSIONS



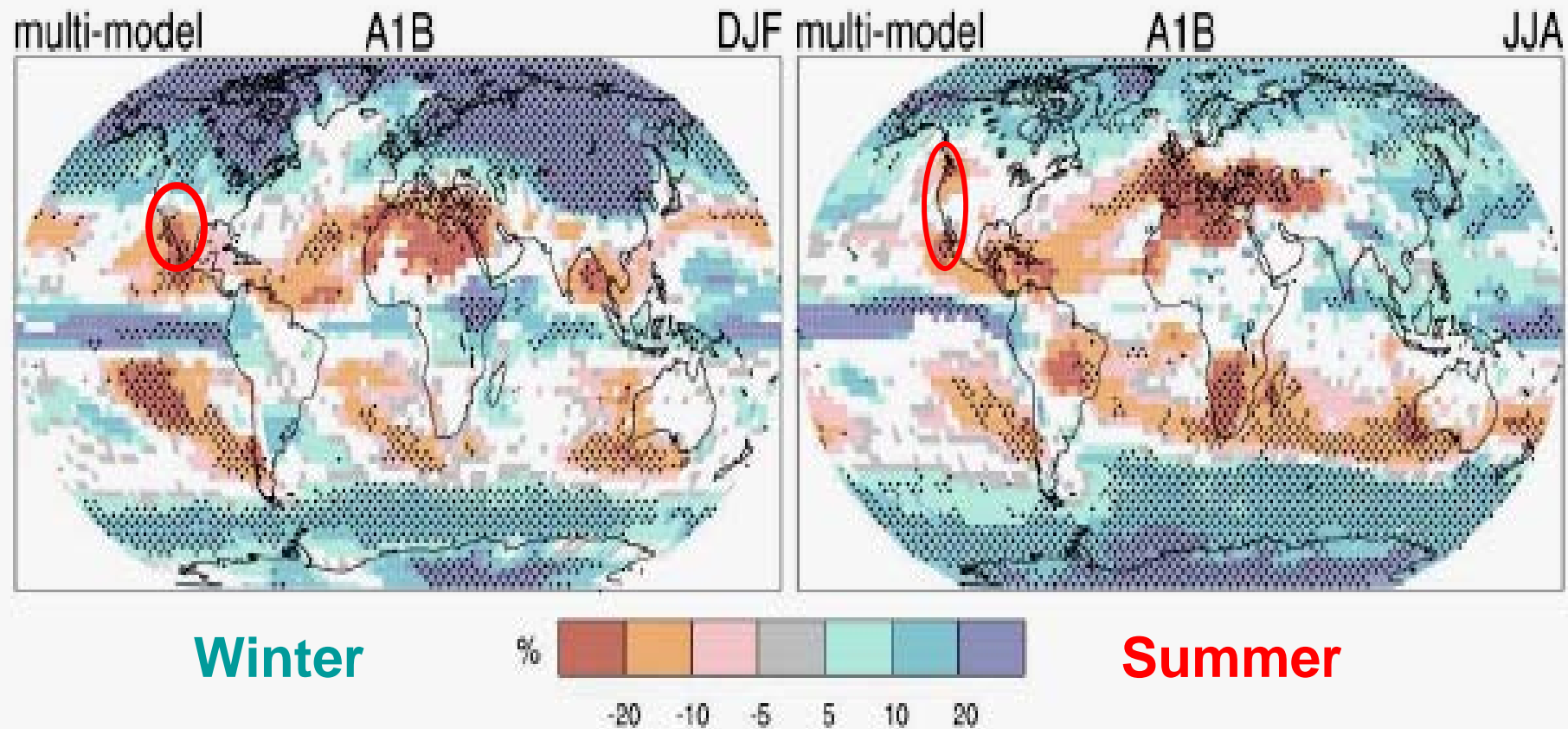
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## Projected patterns of precipitation changes **Any US Robust Conclusions?**



**Figure 3.3.** Relative changes in precipitation (in percent) for the period 2090–2099, relative to 1980–1999. Values are multi-model averages based on the SRES A1B scenario for December to February (left) and June to August (right). White areas are where less than 66% of the models agree in the sign of the change and stippled areas are where more than 90% of the models agree in the sign of the change. [WGI Figure 10.9]

# Projected patterns of precipitation changes **Yes (unfortunately) in California**

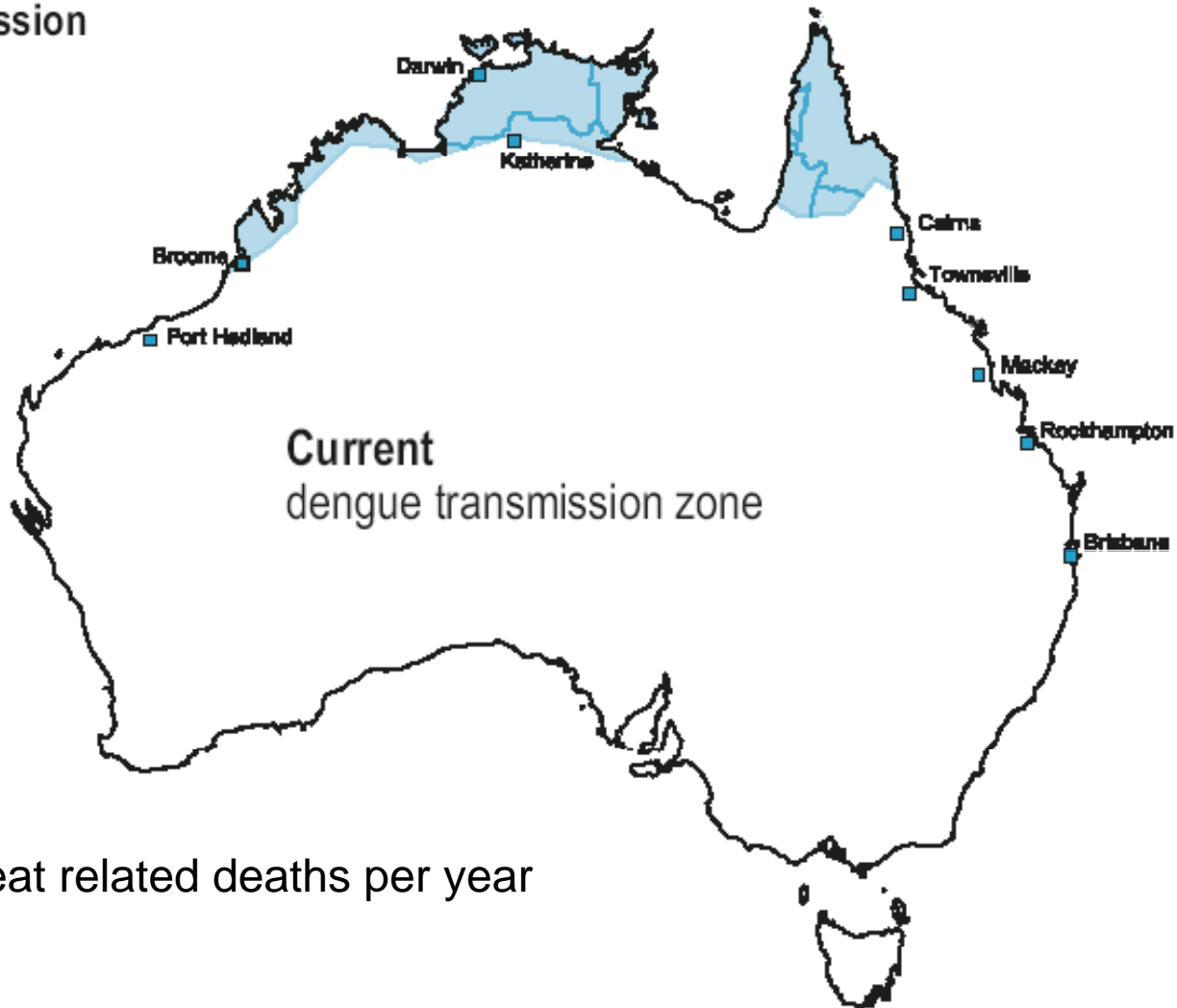


**Figure 3.3.** Relative changes in precipitation (in percent) for the period 2090–2099, relative to 1980–1999. Values are multi-model averages based on the SRES A1B scenario for December to February (left) and June to August (right). White areas are where less than 66% of the models agree in the sign of the change and **stippled areas are where more than 90% of the models agree in the sign of the change.** [WGI Figure 10.9]



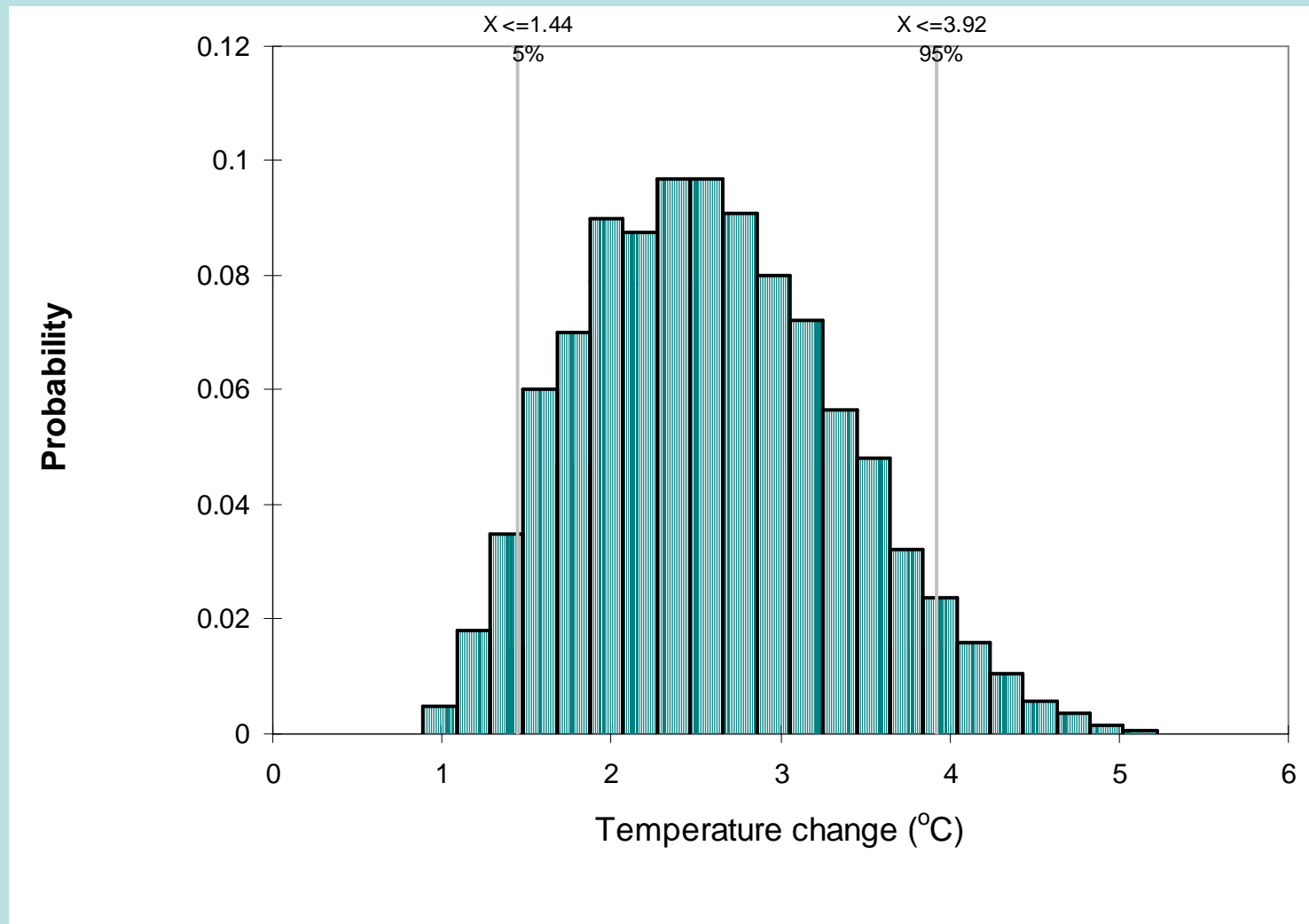


 Dengue transmission zone

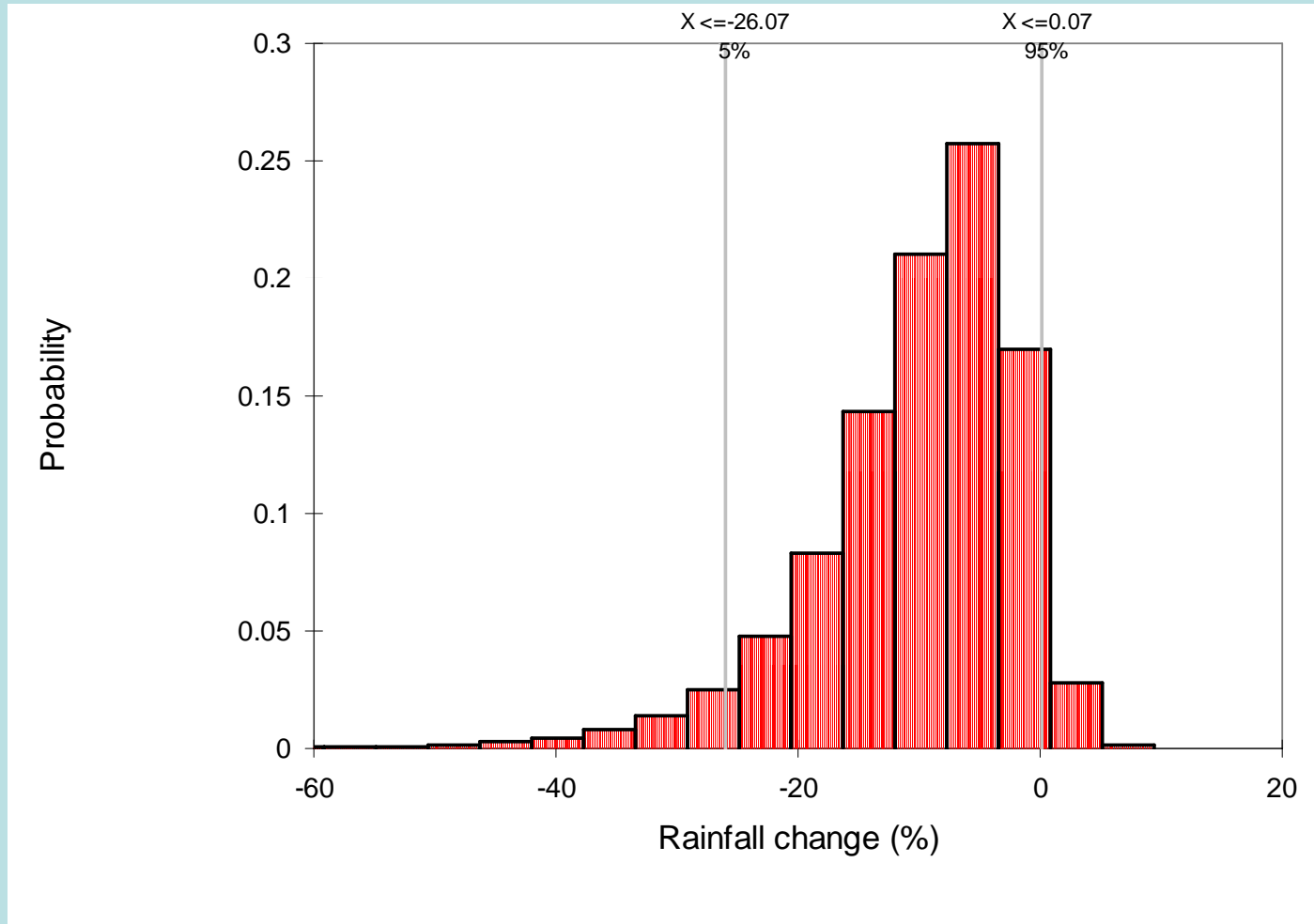


- and 1,100 heat related deaths per year

# Temperature changes: 2070

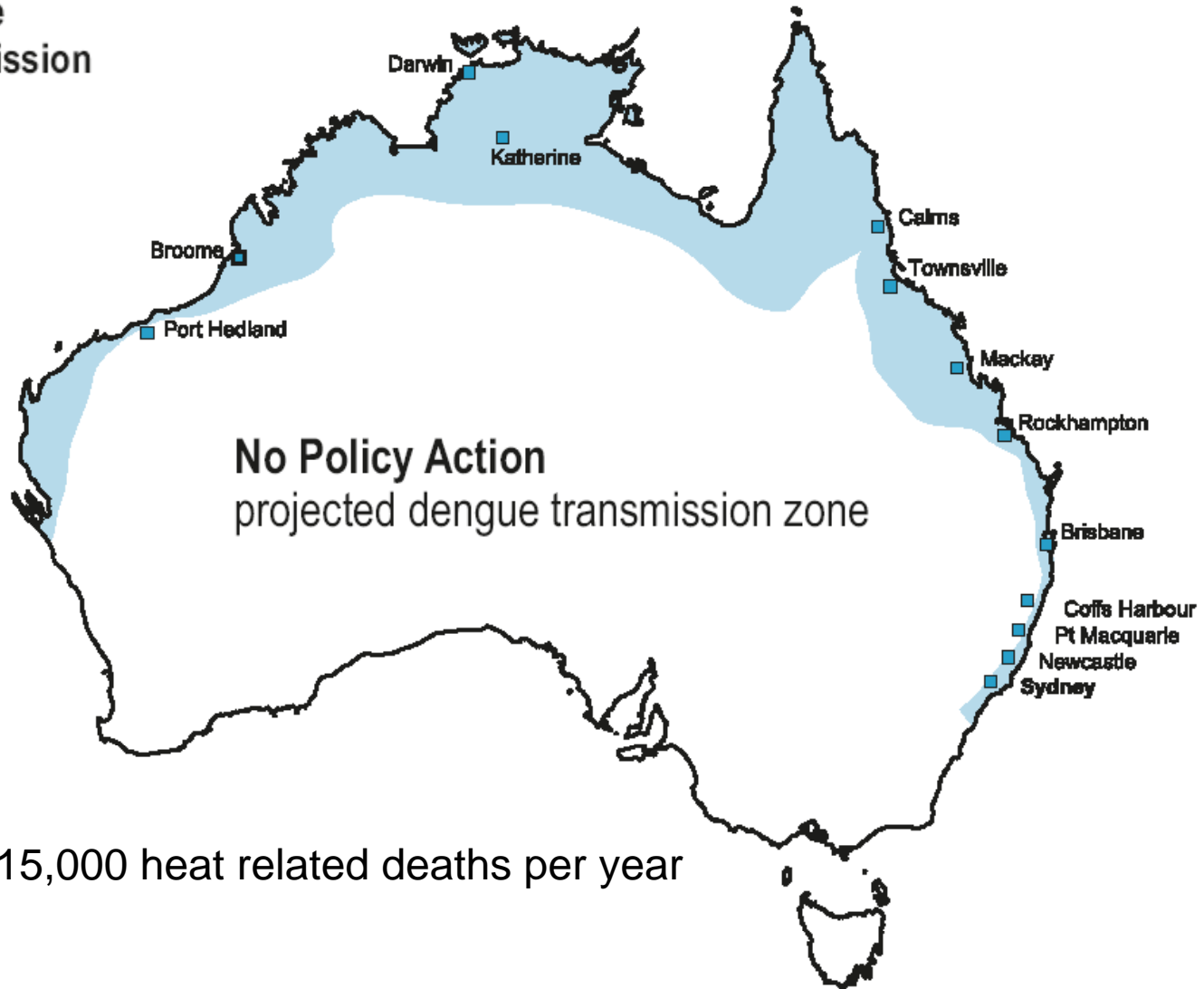


# Rainfall changes: 2070





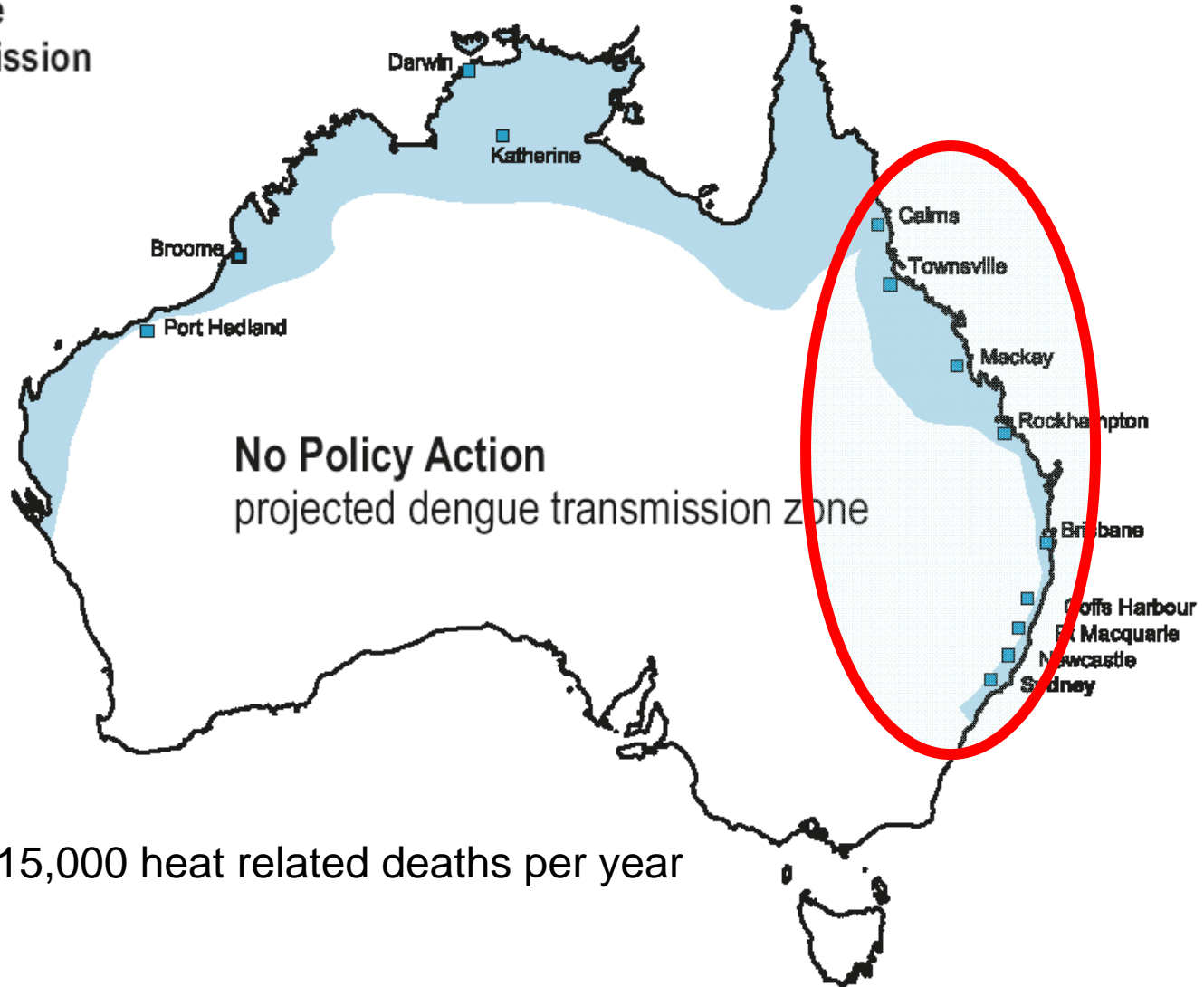
 Dengue transmission zone





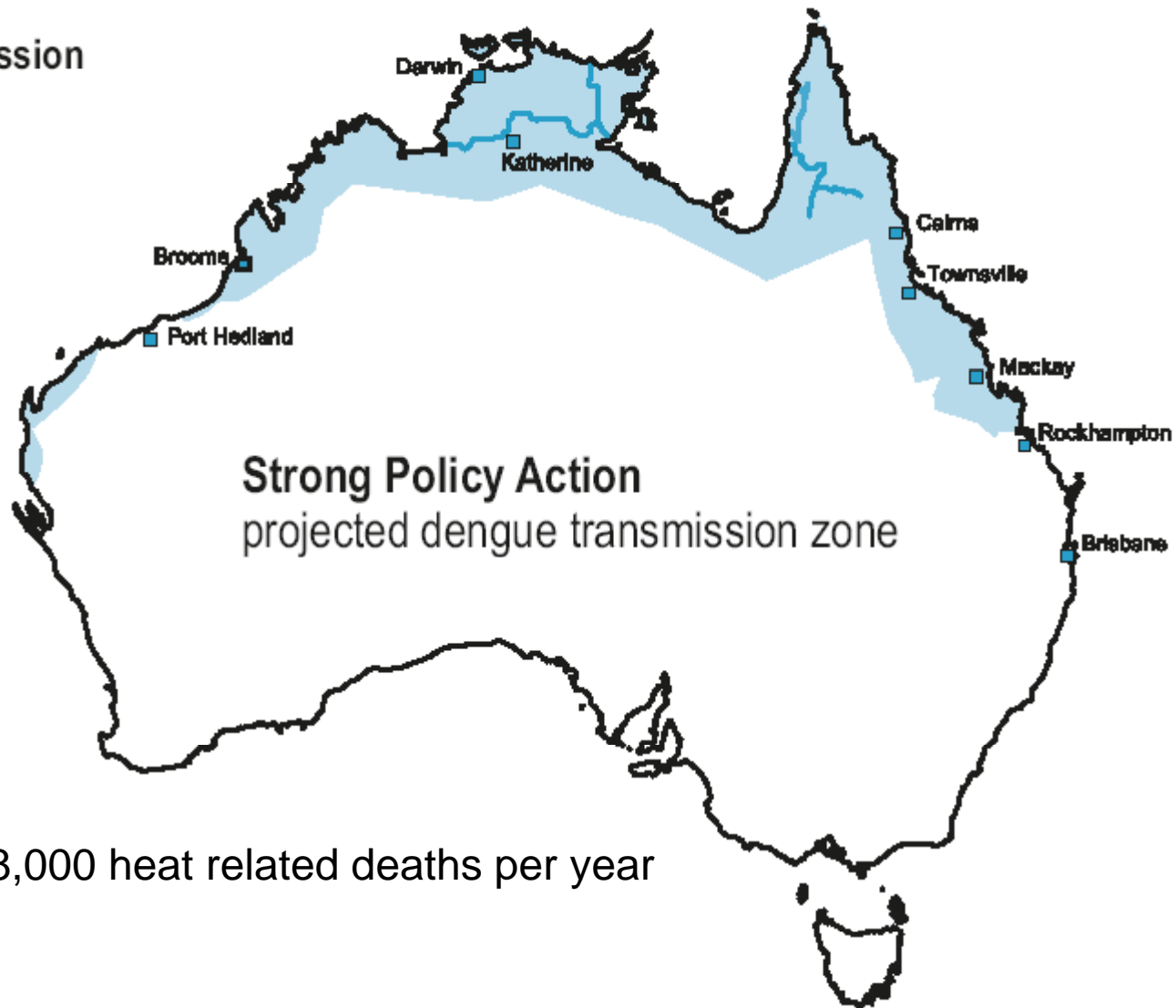


Dengue transmission zone





Dengue transmission zone



- and 4,000 - 8,000 heat related deaths per year

# PARADIGMATIC DILEMMA (All language is from IPCC SPMs):

Risk management framework emerges as a useful framework to address key vulnerabilities.

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Risk management framework emerges as a useful framework to address key vulnerabilities.

“versus”

However, the assignment of probabilities to specific key impacts is often very difficult due to the large uncertainties involved.





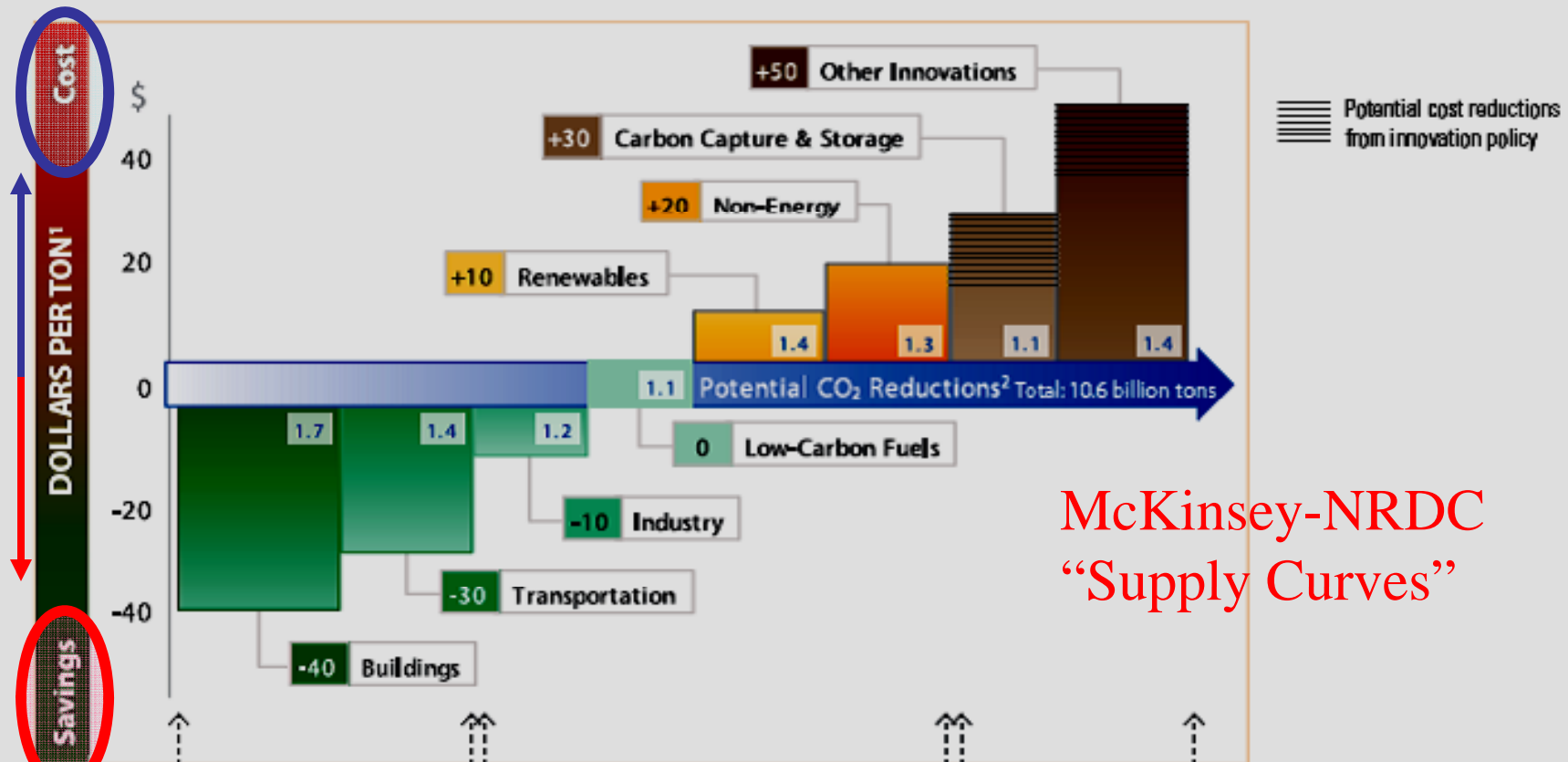
**Governor of  
California:  
80% reduction in  
emissions by 2050**

\*The “Two percent  
Solution”

# \*The “Two percent Solution”

\*But overshoots are inevitable, so do as much as possible as fast and as fairly as can be reasonably achieved.

## Cutting U.S. Global Warming Pollution 80% by 2050: Cost and Payoff by Sector



McKinsey-NRDC  
 “Supply Curves”

1. Mainly efficiency to be unlocked by **policies and standards** that overcome non-price market barriers such as lack of consumer information and split incentives

2. Mainly relatively mature renewables (e.g., wind), forestry, and industrial efficiency to be **unlocked by a federal emissions cap** that puts a price on global warming pollution

3. Mainly emerging renewables and carbon capture to be unlocked by **innovation policy**, e.g., R&D and commercialization incentives

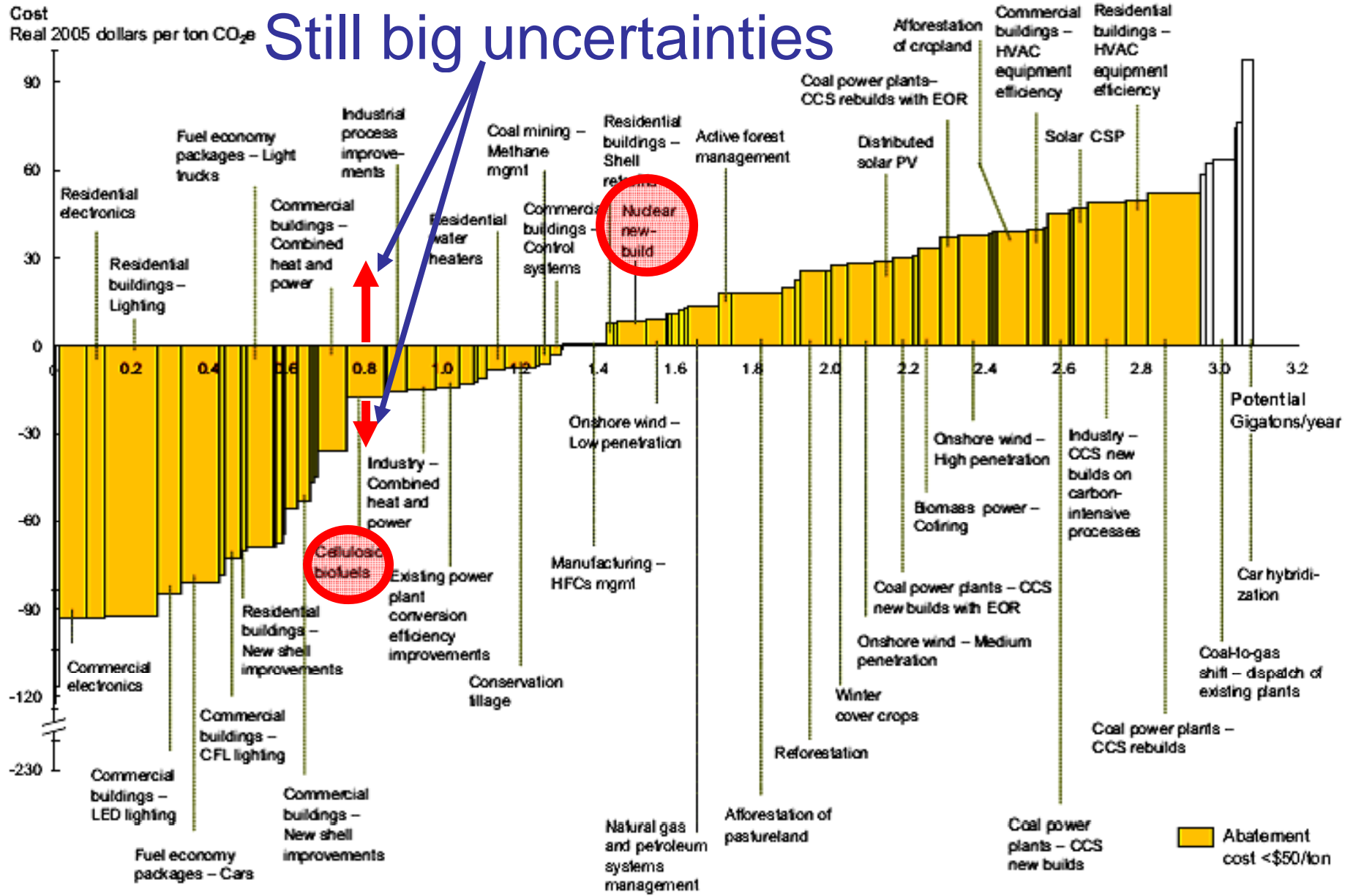
1. Dollars per ton of cuts in emissions of CO<sub>2</sub>e (CO<sub>2</sub> plus other greenhouse gases)

2. Billions of tons CO<sub>2</sub>e per year, in 2050

Note: The scenario above is based on NRDC analysis, including extrapolations from 2030 cost estimates done by McKinsey & Company. For information about our methodology, visit <http://www.nrdc.org/global-warming/blueprint/methodology.asp>



# U.S. Mid-Range Abatement Curve - 2030



Source: McKinsey analysis

Note: The McKinsey report only examines scenarios through 2030. NRDC recommends a goal of 80 percent emissions reductions by 2050.

# Policy Sequence:

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1-Adaptation to change already in the pipeline

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3-Public private partnerships  
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# Policy Sequence:

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- 4-Shadow price on carbon (polluter pays--with equity side payments)

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- 1-Adaptation to change already in the pipeline
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- 5-Geoengineering

Questions??

Comments???