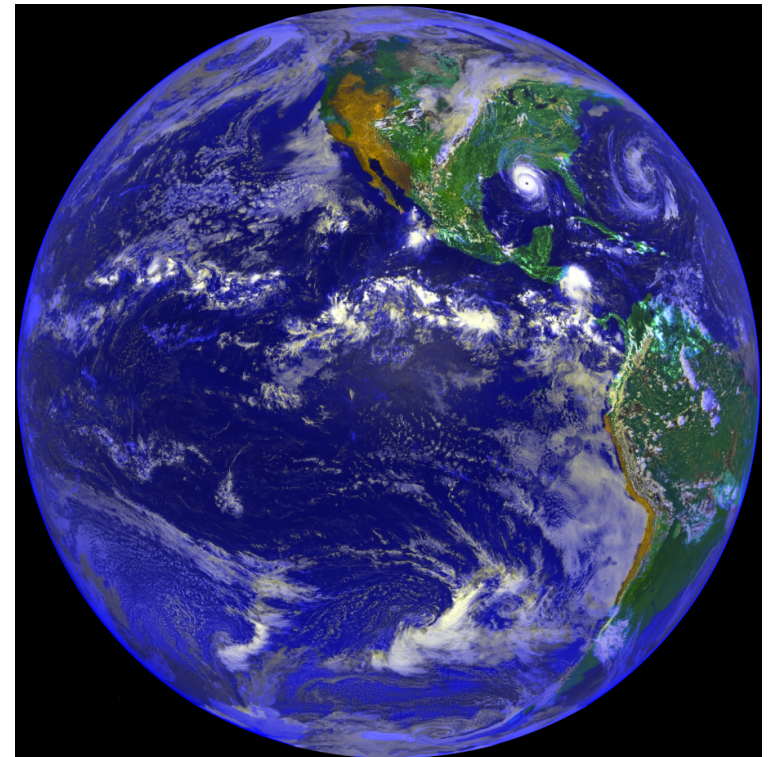
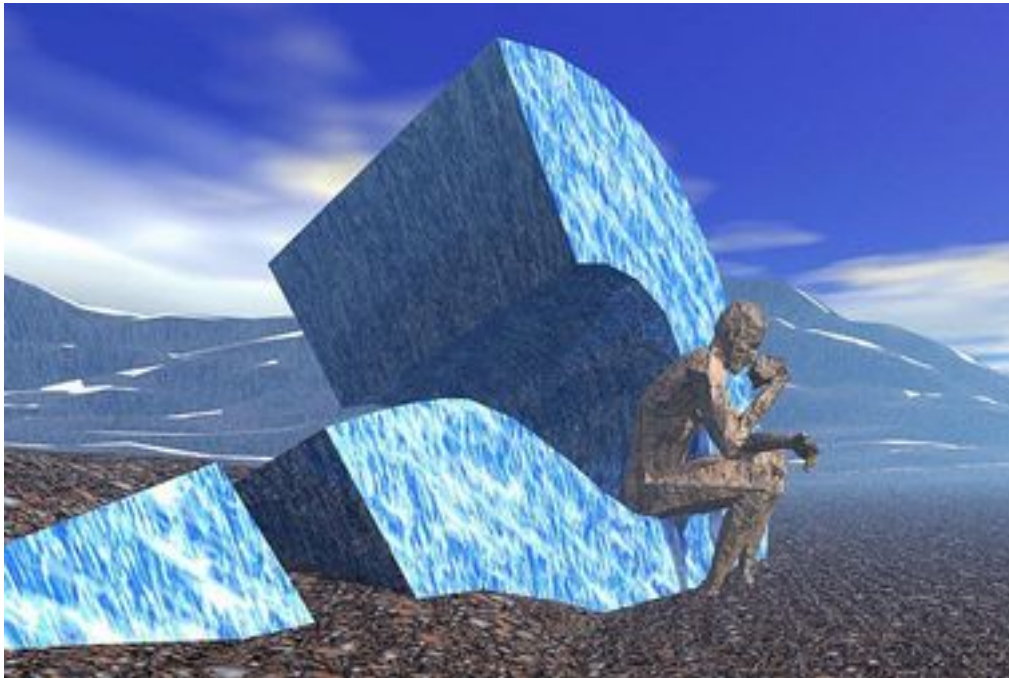


Climate Science and the Uncertainty Monster

Judith Curry



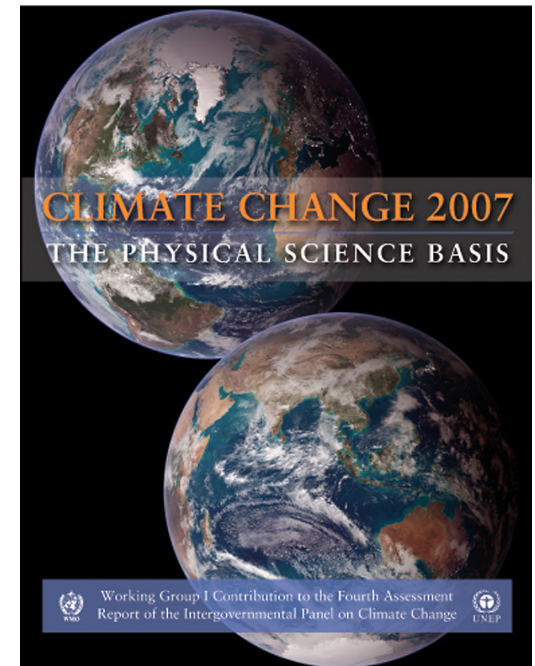


INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



Key finding of the IPCC AR4:

“Most of the observed increase in global average temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic greenhouse gas concentrations.”

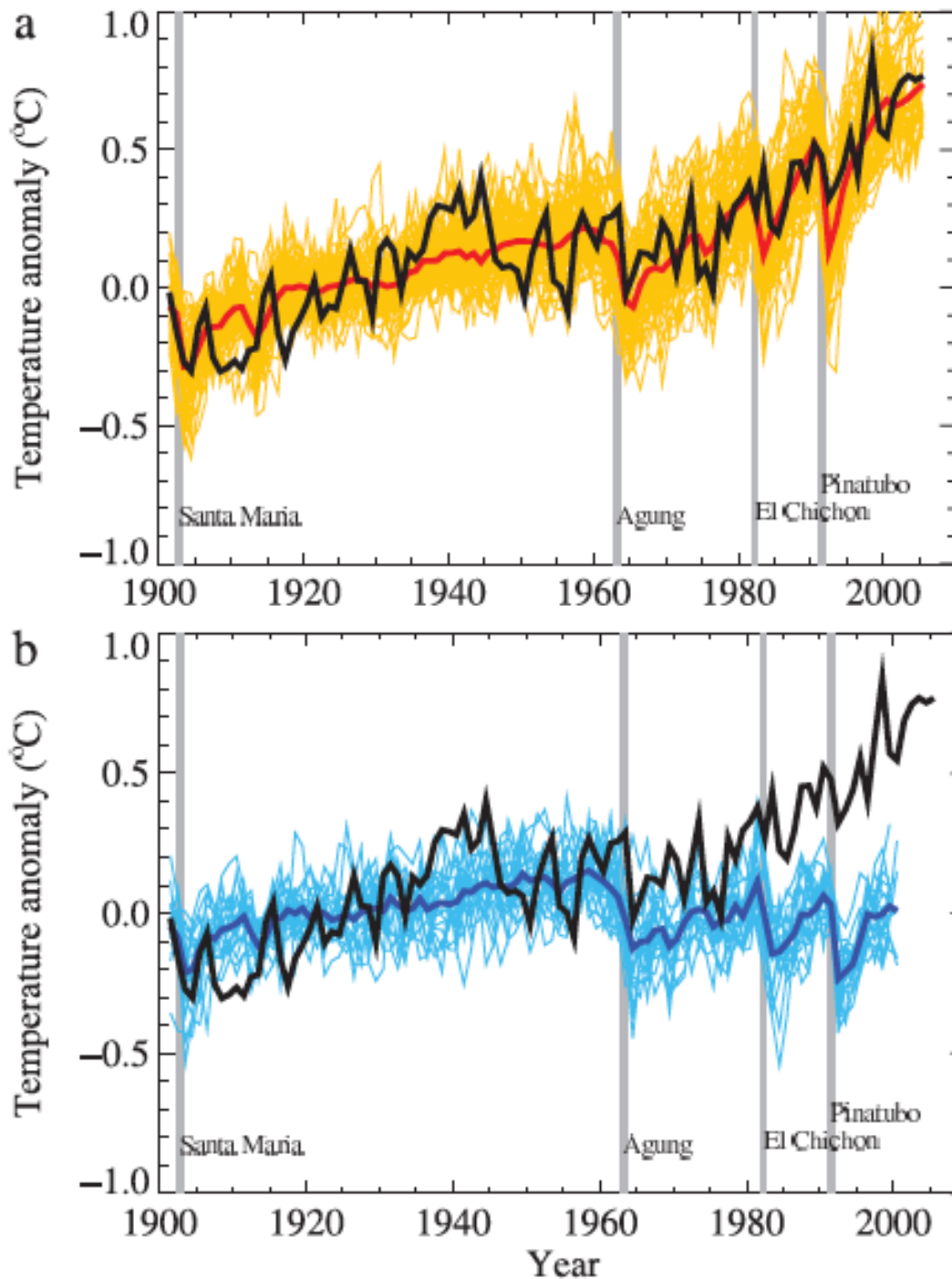


97% of climate experts agree with this statement
(Anderegg et al. 2010; Doran 2009)

Why is there such strong belief in the IPCC's attribution statement?

This talk addresses two issues:

- 1) Scientific uncertainties that enter into the attribution argument, ambiguities in the attribution statement and apparent circular reasoning, and lack of traceability of the assessment.
- 2) The social psychology of consensus building and public debate on a policy relevant scientific topic - in the context of the “uncertainty monster” metaphor

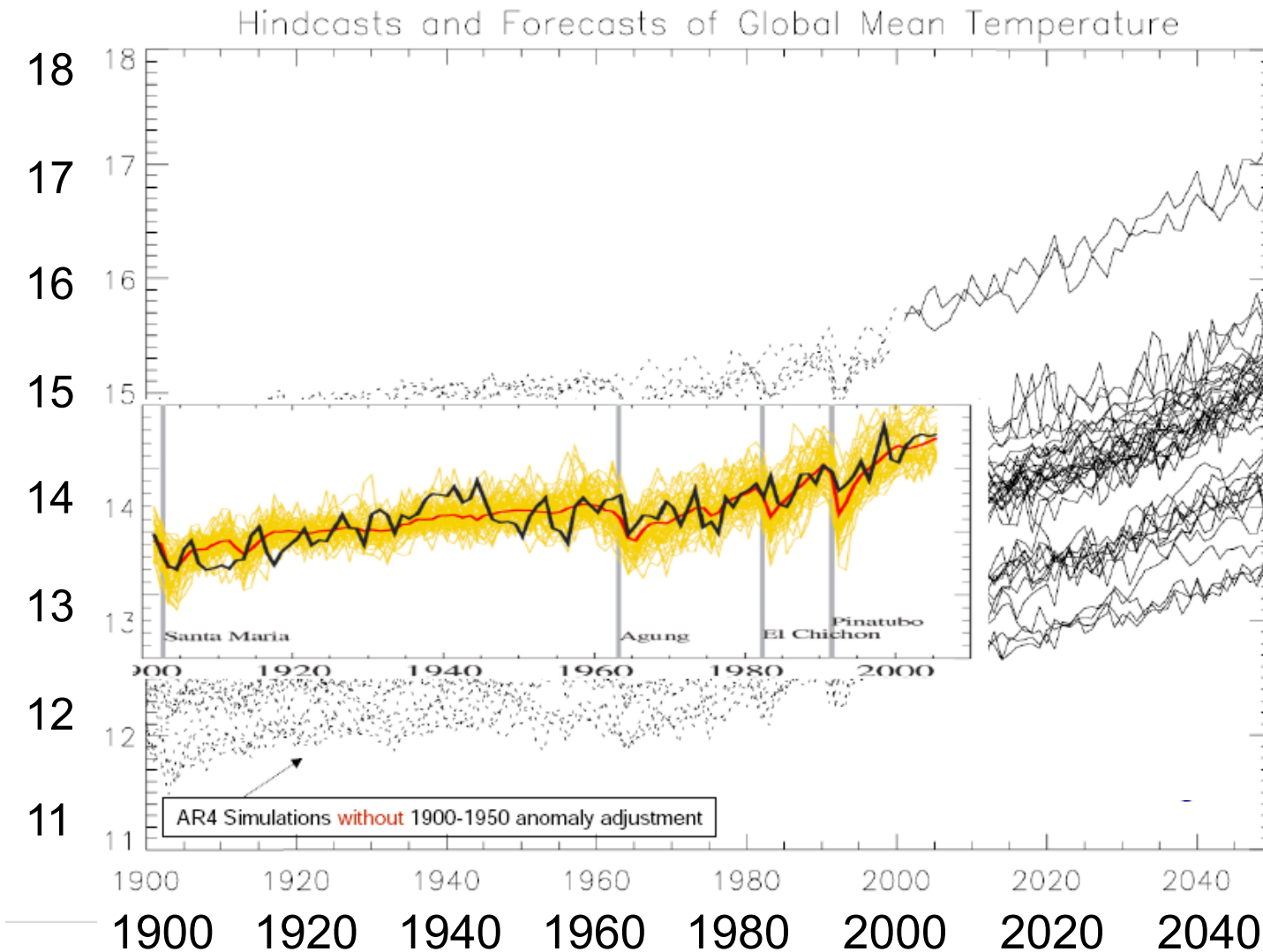


The strong agreement between observations and model simulations that combine both natural and anthropogenic forcing provide confidence that:

- observations are correct
- external forcing data is correct
- climate model is correct
- sensitivity of the climate models to increasing CO₂ is correct

Figure 9.20, IPCC AR4 WG I

AR4 simulations without anomaly adjustment



Slide courtesy of Leonard Smith

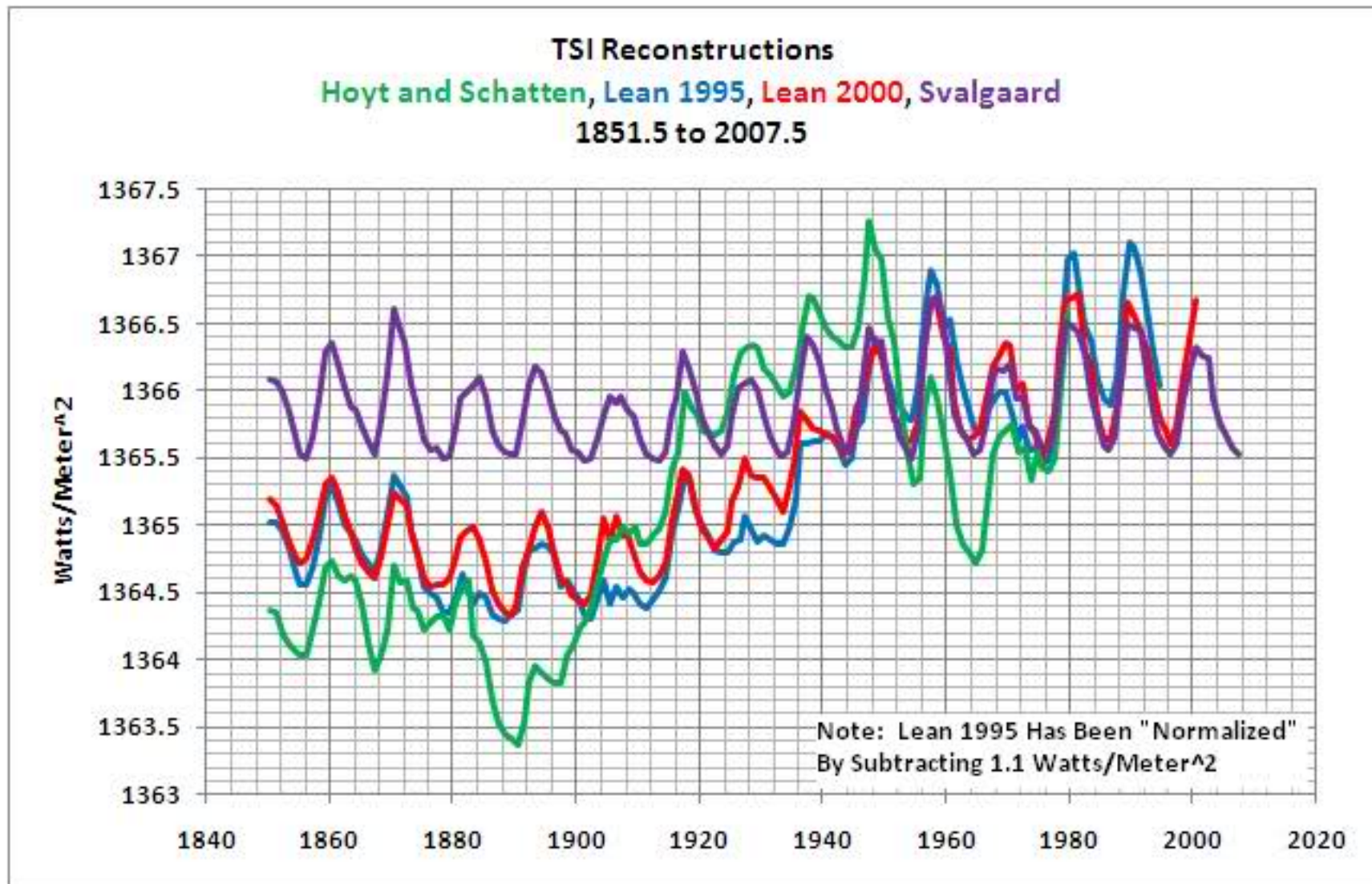
Sources of Uncertainty: External Forcing

The level of scientific understanding of radiative forcing is ranked by the AR4 as high only for the long-lived greenhouse gases, but low for solar irradiance, aerosol effects, and others

Simulations for the AR4 used outdated solar forcing (identified from Chapter 2).

Large uncertainties particularly in aerosol forcing.

Modeling groups selected their preferred forcing data sets using *inverse modeling*, whereby the magnitude of “uncertain parameters is varied in order to provide a best fit to the observational record.”



Current understanding of the solar forcing is **Svalgaard**

Sources of Uncertainty: Aerosol Forcing

- ***IPCC AR4:*** The net aerosol forcing over the 20th century likely ranges between -1.7 and -0.1 W m^{-2}
- ***Morgan et al. (2006) expert elicitation:***
 -2.1 to -0.25 W m^{-2} with a much greater range of uncertainty (as high as 7 W m^{-2})
- ***For reference:*** 20th century CO₂ forcing is 1.7 W m^{-2}

Sources of Uncertainty: Model Sensitivity

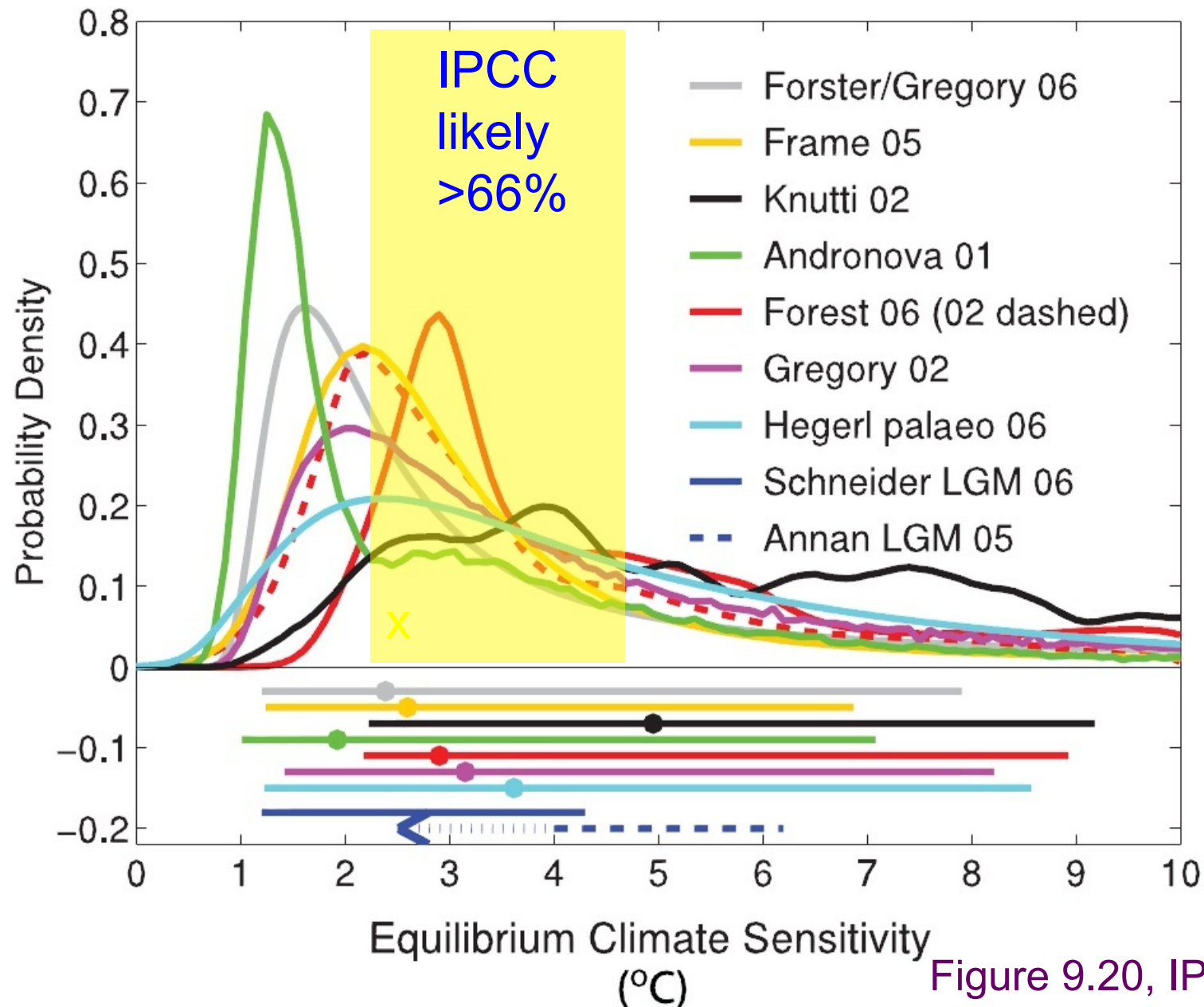
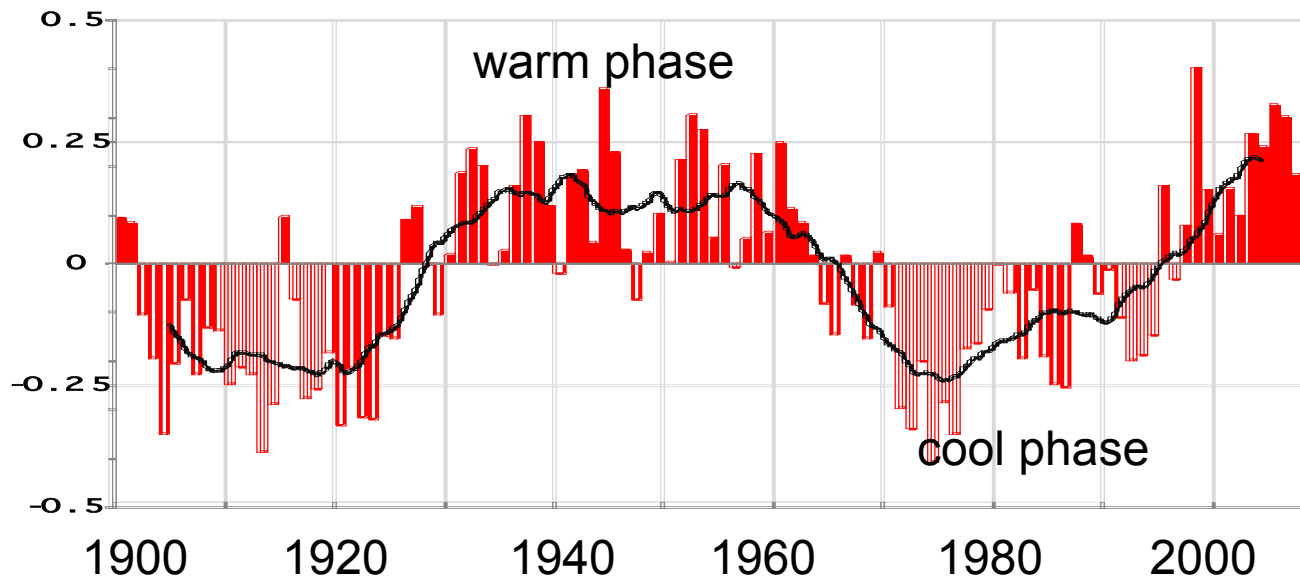


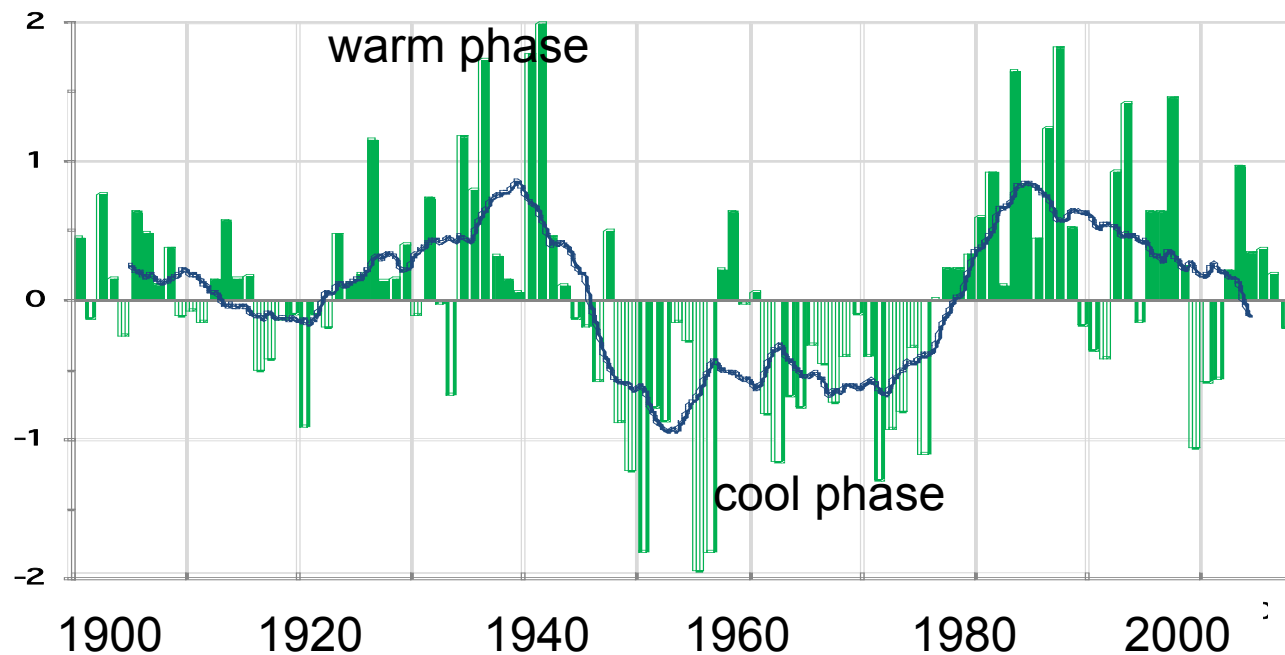
Figure 9.20, IPCC AR4 WG I

Sources of Uncertainty: Natural Internal Variability



**Atlantic
Multidecadal
Oscillation (AMO)**

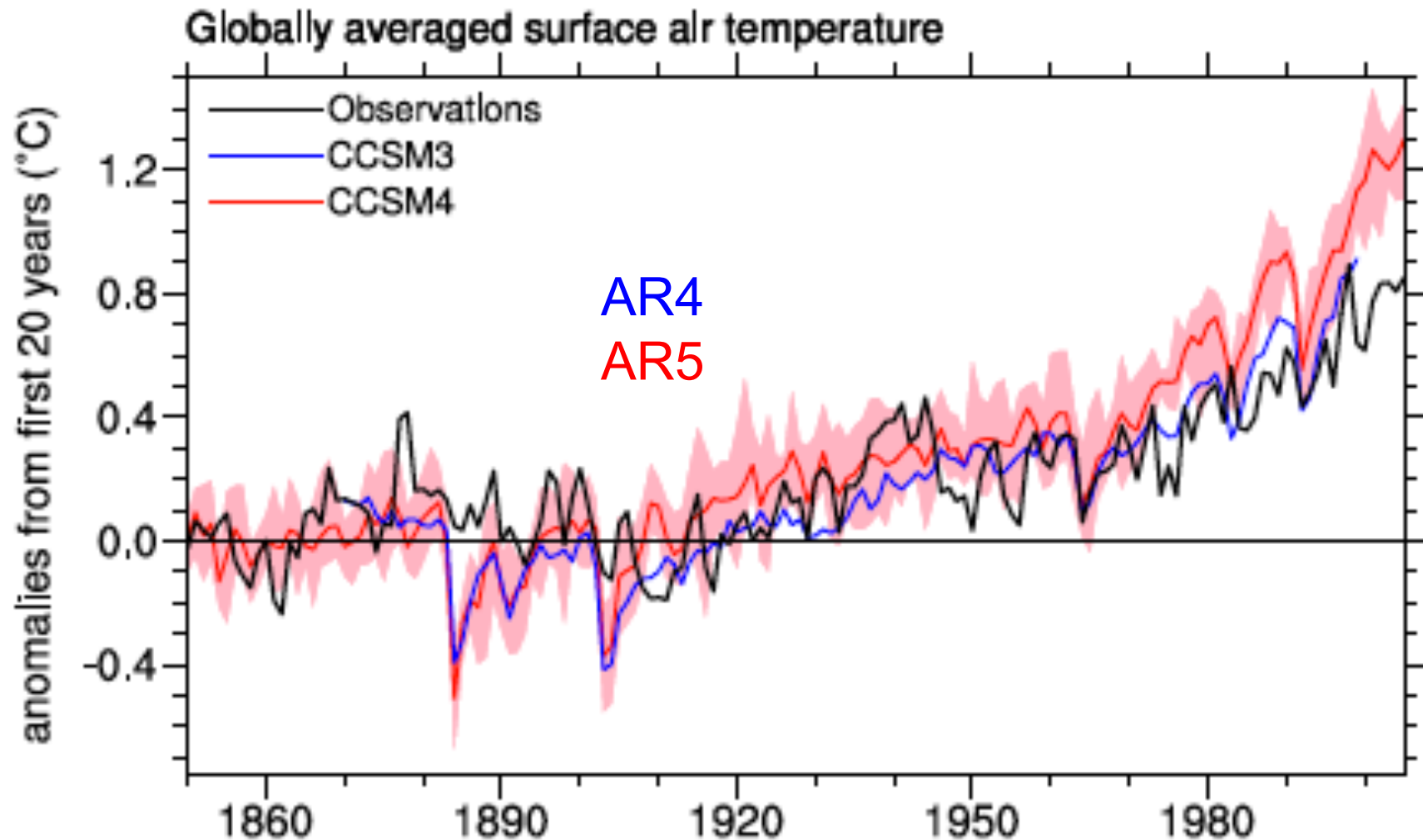
In warm phase
since 1995



**Pacific Decadal
Oscillation (PDO)**

Just entering
cool phase

NCAR climate model simulations for the IPCC



Why the difference in NCAR's AR4, AR5 simulations?

- ***NCAR AR4 simulations:*** Model parameters and forcing tuned to the 20th century observations, hence strong agreement with 20th century observations
- ***NCAR AR5 simulations:***
 - Many improvements to the model, and many aspects of the simulations are more realistic.
 - Model parameters were tuned to pre-industrial simulations
 - Specified best estimates of external forcing were used

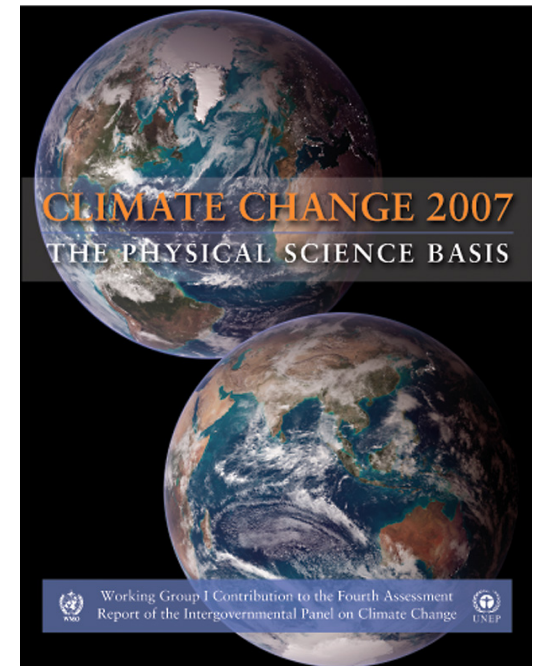


INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE



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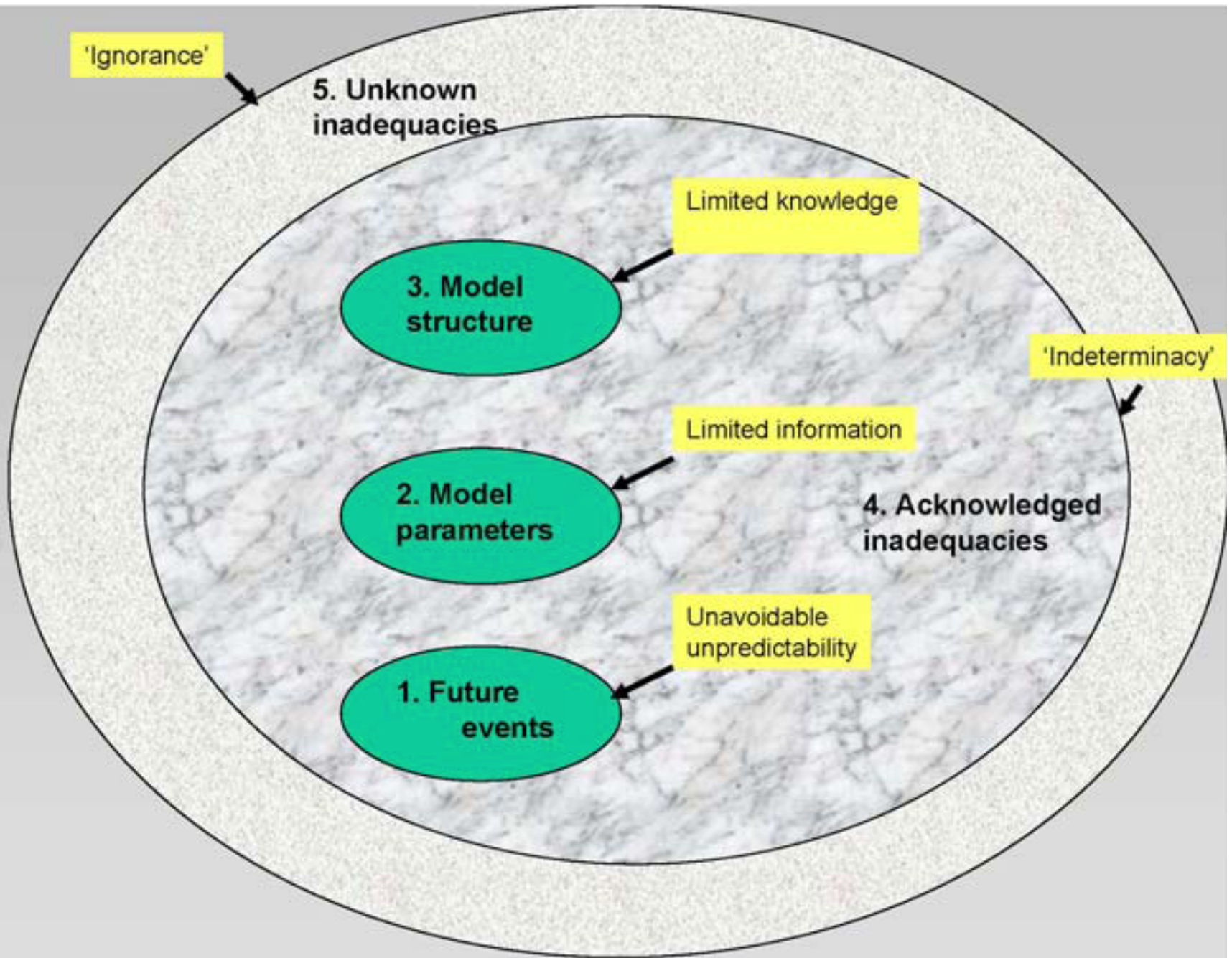


97% of climate experts agree with this statement
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Why we should be skeptical of the IPCC AR4 attribution statement

- Lack of traceability in the “expert judgment” assessment
- Circular reasoning associated with tuning model parameters and forcing to agree with 20th century observations
- Bootstrapped plausibility of the models, forcing data, and observations
- High precision and confidence [*very likely*] in a non quantitative and imprecise statement [*most*].





Spiegelhalter and Reisch (2011)

Uncertainty Monster

The “monster” is a metaphor used in analysis of the response of the scientific community to uncertainties at the science-policy interface.

Confusion and ambiguity associated with:

- knowledge versus ignorance
- objectivity versus subjectivity
- facts versus values
- prediction versus speculation
- science versus policy



Why is there such strong belief among scientists in the IPCC attribution statement?

Some hypotheses:

- Groupthink in context of a consensus building process
- Confidence in, and authority of, the IPCC
- Given the high salience of the issue, it is difficult not to take a stand, even if an individual scientist is not personally knowledgeable about the topic
- Solidarity among scientists against a perceived “war on science”
- Defense of the status quo (which includes strong funding for climate research)
- Personal and political sympathies for the agenda of the environmental movement
- Lack of scientific solidarity will reduce the impetus for policy action

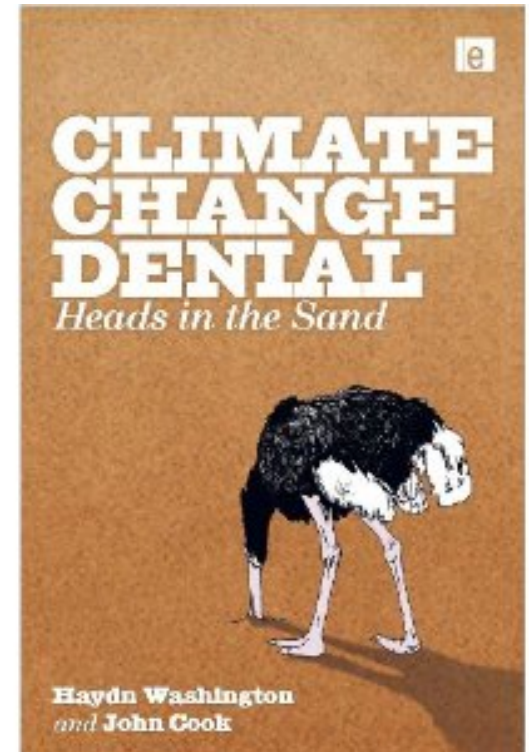
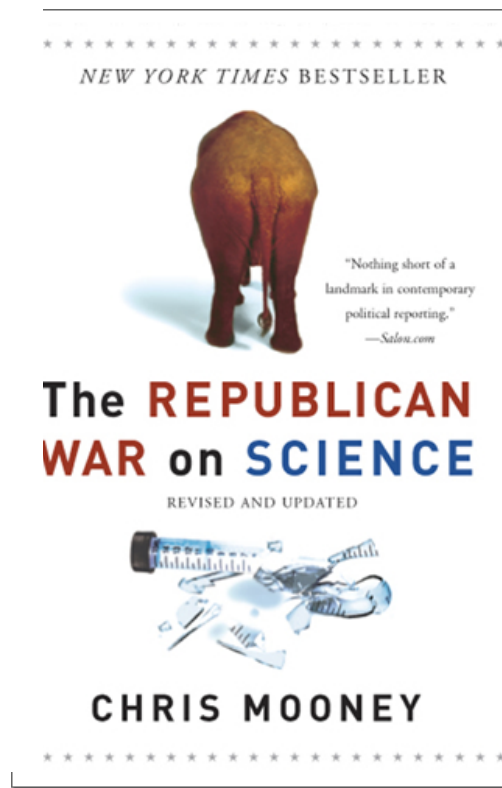
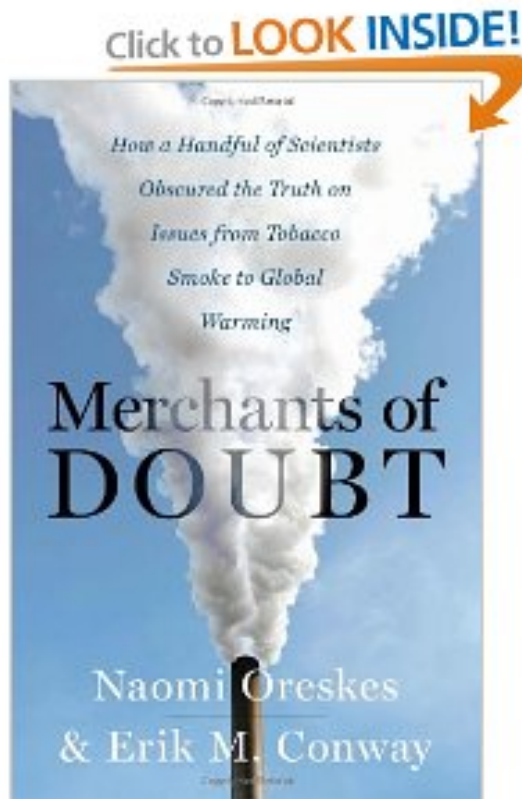
* Reasons for JC's belief ca. 2007

Decision Making Under Uncertainty



"OK, all those in favour of delegating decision-making, shrug your shoulders"

“War on Science” and “Deniers”



Concern that climate science is being rejected for the same motives as the rejection of the theory of evolution and/or issues associated with harm from tobacco smoke.

Uncertainty monster coping strategies

Monster hiding. Never admit error strategy motivated by a political agenda or fear of being judged as poor science.

Monster exorcism. Reducing uncertainty through more research.

Monster simplification. Subjectively quantifying and simplifying the assessment of uncertainty.

Monster detection. Scientists, auditors, merchants of doubt.

Monster assimilation. giving uncertainty an explicit place in the contemplation and management of environmental risks.



Decision making under deep uncertainty

Options for decision makers confronted with deep uncertainty:

- Delay to gather more information and conduct more studies in the hope of reducing uncertainty across a spectrum of risk
- Target critical uncertainties for priority further analysis, and compare technology and development options to determine whether clearly preferable options exist for proceeding
- Enlarge the knowledge base for decisions through lateral thinking and broader perspective
- Invoke the precautionary principle
- Use an adaptive management approach
- Build a resilient society

Smithson and Brammer (2008)



Climategate as a symptom of an enraged uncertainty monster



Credit: Minnesotans for Global Warming



Climategate from the scientists' perspective :

- The “climate denial machine” trying to derail climate science
- Scientists acting with the best of intentions; bad things happen to good people
- Fighting a valiant war to keep bad science from being published/publicized
- Embattled scientists circling the wagons to fight off malicious interference
- Focusing on moving the science forward rather than on the scientific janitorial work of record keeping, documentation, archiving metadata and computer programs, etc
- We’ re the experts, trust us



JC’ s comment: Our core scientific research values became compromised in the “war against the skeptics”: the rigors of the scientific method (including reproducibility), research integrity and ethics, open minds, and critical thinking.

Climategate as a crisis of public credibility in climate research

- Dismissal of skeptics by *ad hominem* and appeal to motive attacks; tribalism that excluded skeptics
- Involvement of leading climate researchers in explicit climate policy advocacy
- Hubris with regards to a noble (Nobel) cause
- Alarmism motivated by policy makers failing to recognize the plain and urgent truth as the scientists understood it
- Arrogance of the defense by the scientists and their institutions: appealing to their own authority
- Motivated by obtaining research \$\$\$
- Lack of transparency in data, methods, models
- Inadequate attention to uncertainty, complexity, model verification and validation



Credit: problogger.net

Scientific perils of overconfidence and uncertainty hiding/simplification

- Explicit consensus building processes can enforce overconfidence and belief polarization.
- A tendency of beliefs to serve as agents in their own confirmation
- Dismissal of skeptics and skepticism is operating to the substantial detriment of progress in climate science
- Disagreement provides a basis for focusing research in a certain area, and so moves the science forward.
- Overreliance on expert judgment assessment of uncertainty and confidence introduces biases
- Lack of traceability in expert judgment assessments may very well reflect shortcuts in reasoning and hidden biases



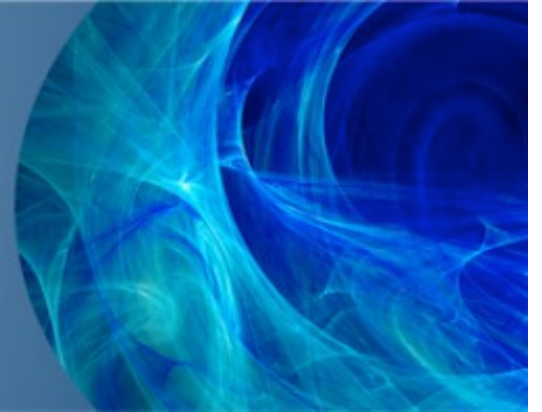
Getting climate science back on track

- Get rid of the consensus seeking approach to climate assessments
- Bring considerations of doubt, uncertainty, and ignorance to the forefront of the climate debate
- Recognize that at the science-policy interface, an understanding of uncertainty and ignorance is of paramount importance
- Remind ourselves that debate and disagreement are the spice of academic life



<http://judithcurry.com>

Climate Etc.



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