An Update on Progress and Plans in IPCC WG1

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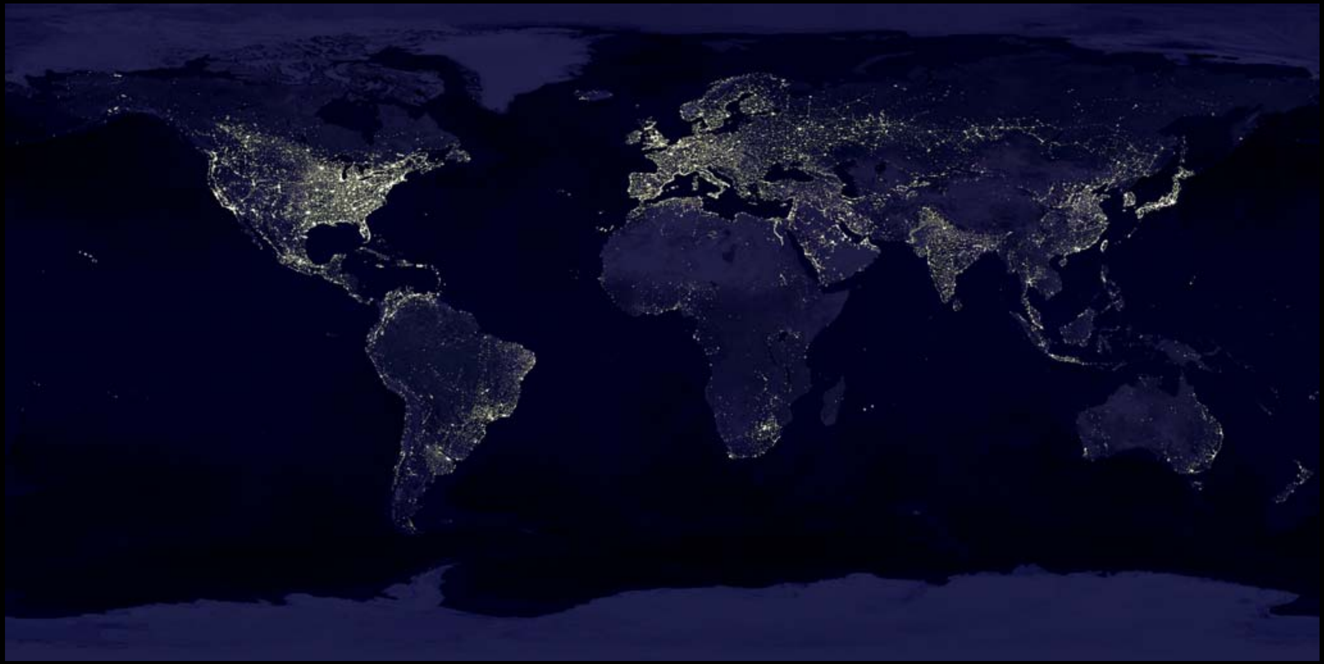
and Senior Scientist, NOAA Aeronomy Laboratory



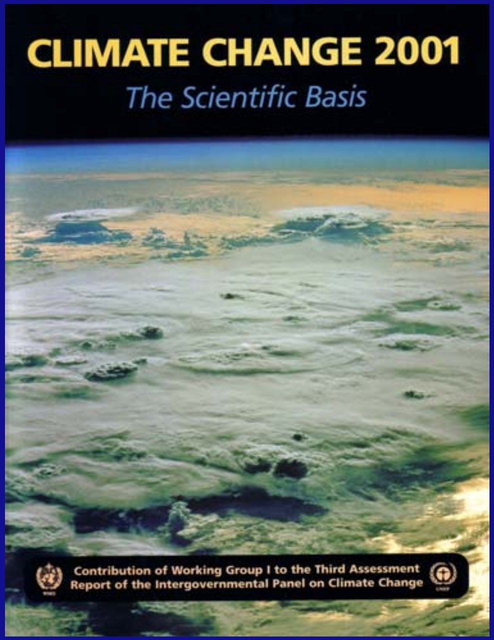
Intergovernmental Panel on Climate Change (IPCC)

- Established in 1988 jointly by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP).

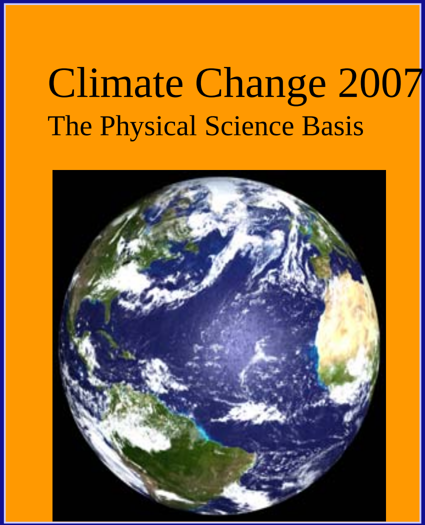
- International participation from over 150 countries.

- Assesses on a comprehensive, objective, open, and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change (WG1), its potential impacts (WG2), and options for mitigation and adaptation (WG3).

- This talk: (1) IPCC's planning, structure, review process; (2) some key inputs including our climate sensitivity workshop and some illustrative developments in the literature; (3) Solomon's draft assessment rules



IPCC (2001): Houghton (UK) and Ding (China) co-chairs



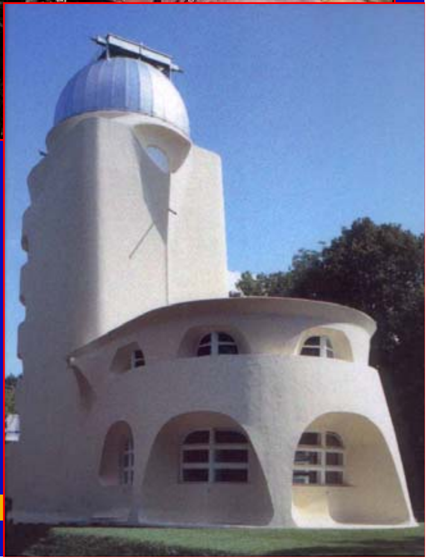
IPCC (2007):

Solomon (USA) and Qin (China), co-chairs

News you can use: policy-relevant but not policy-prescriptive reviews of the state of scientific understanding.

Consultation, Scoping, and Some Procedural Matters of the AR4

- Government suggestions on outline solicited (twice)
- Two scoping meetings: Participation by 42 distinguished scientific experts (including chairs of World Climate Research Program and International Geosphere Biosphere Program) from 19 countries, with leadership by WG co-chairs.
- Outline formally approved by Govts in Nov, 2003
- Authors nominated by Govts, chosen by WG1 Bureau; 25% of WG1 authors have had their highest degree for less than 10 years and 75% of them were not authors of the TAR.   There are 35% more DC/EIT authors among them than in TAR.
- Technical Support Unit organizes meetings, collates comments, provides editorial support, etc.



Preparation and Review of the WG1 AR4

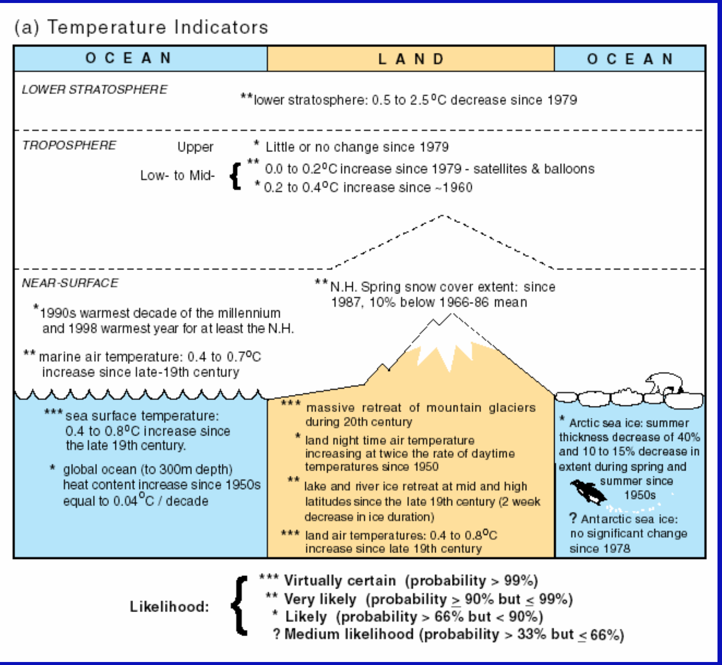
- Each report is an assessment of the state of understanding based upon peer-reviewed published work.
- Informal ZOD prepared, comments sought from 6-12 outside experts for each chapter (Oct 2004 - Mar 2005).
- Formal first order draft (FOD) reviewed by about 600 reviewers worldwide (Sept 9-Nov 4, 2005).
- Formal second order draft (SOD) to be prepared by March, 2006, will be reviewed by many hundreds of experts worldwide and many governments.
- WG1 expects to receive many thousands of comments from the hundreds of reviewers (compare this to a typical scientific paper, normally reviewed by 2-3 experts).

Preparation and Review of the WG1 AR4

- Comprehensive bibliography is achieved by the end of the process (many reviewer comments focus on ensuring that the authors consider the full range of available work). Coverage is shaped by the review.
- The many comments reflect a diverse variety of views. Balance in content is shaped by the review.
- Many comments focus on issues of scientific confidence and uncertainty. Uncertainty issues are shaped by the review.
- Review Editors ensure that comments are afforded appropriate consideration by the authors. Comments are formally archived.
- A scientific process is ensured by the fact that the comments and responses are open.
- The breadth of the author teams and the breadth and depth of the review is not achieved by any other process. Thus assessed findings in a final IPCC report are not the views of any individual scientist and reflect a far broader process.

Observations

Ch. 6 Paleo



Ch. 3 Observations: Atmosphere and Surface

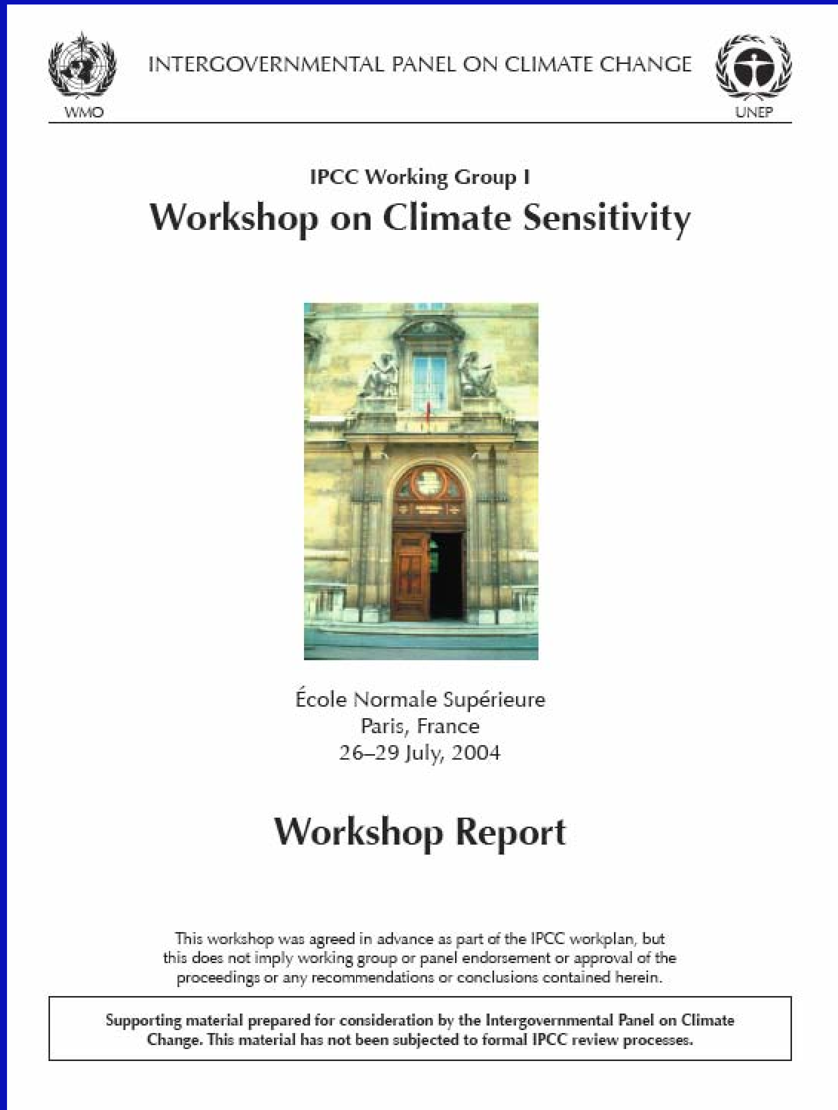
Ch. 4 Observations: Ice

Ch. 5 Observations: Oceans and Sea Level

Paleoclimate, sub-surface ocean, and ice components dealt with separately, but coordinated -> enhance discussion of paleo methods (tree rings, ice cores), clarify ocean and ice messages.

AR4 WG1 Report Structure

- **Introduction: How has the understanding of the scientific basis of climate change advanced since IPCC began?** *(Chap 1)*
  Describe context and reasons for changes in understanding
- **Radiative forcing and observations: Can humans affect the climate system? What changes in climate have been observed?** *(Chaps 2,3,4,5)*
  Human and natural influences on climate, followed by observed variability and trends: atmosphere, ice and frozen ground, oceans including sea level
- **Past and present climate change and couplings to biogeochemical cycles: How well do we understand human contributions to past and present climate change?** *(Chaps 6,7,8,9)*
  Paleoclimate, roles of biogeochemical cycles and human effects upon them, evaluation of models, understanding and attributing observed changes
- **Future projections: How is climate projected to change in the future?** *(Chaps 10,11)*
  Projections of future climate change globally and regionally, on time scales from decades to centuries.


INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

WMO

UNEP

IPCC Working Group I

Workshop on Climate Sensitivity

École Normale Supérieure
Paris, France
26–29 July, 2004

Workshop Report

This workshop was agreed in advance as part of the IPCC workplan, but this does not imply working group or panel endorsement or approval of the proceedings or any recommendations or conclusions contained herein.

Supporting material prepared for consideration by the Intergovernmental Panel on Climate Change. This material has not been subjected to formal IPCC review processes.

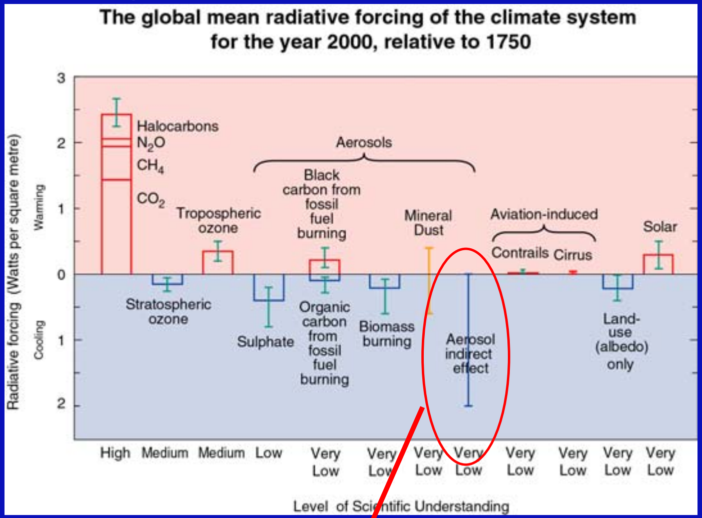
Paris, July 2004

A running start on one of the key central issues for AR4, a broad one that brought together models, observations, etc.

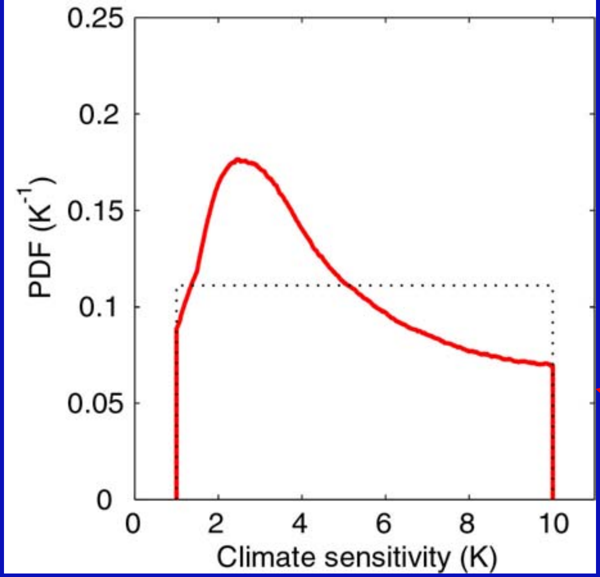
Climate sensitivity defined here as the equilibrium temperature change for CO_2 doubling

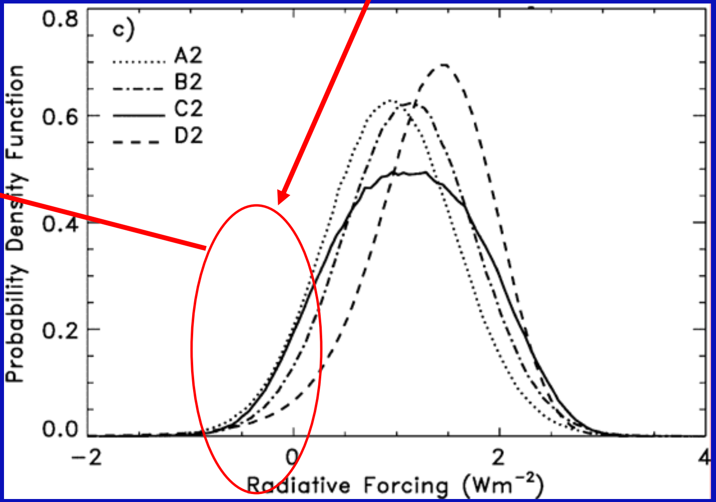
(1.5-4.5° in TAR…and SAR…and FAR)

Bounding climate sensitivity using forcing and 20th century trends



What limits the utility? Uncertainty in aerosols. But there are still limits that can be determined......





Parameter Perturbations: Probing Model Space in a New Way

Large Scale Cloud

- Ice fall speed
- Critical relative humidity for formation
- Cloud droplet to rain: conversion rate and threshold
- Cloud fraction calculation

Convection

- Entrainment rate
- Intensity of mass flux
- Shape of cloud (anvils)
- Cloud water seen by radiation

Radiation

- Ice particle size/shape
- Sulphur cycle
- Water vapour continuum absorption

Sea ice

- Albedo dependence on temperature
- Ocean-ice heat transfer

Boundary layer

- Turbulent mixing coefficients: stability-dependence, neutral mixing length
- Roughness length over sea: Charnock constant, free convective value

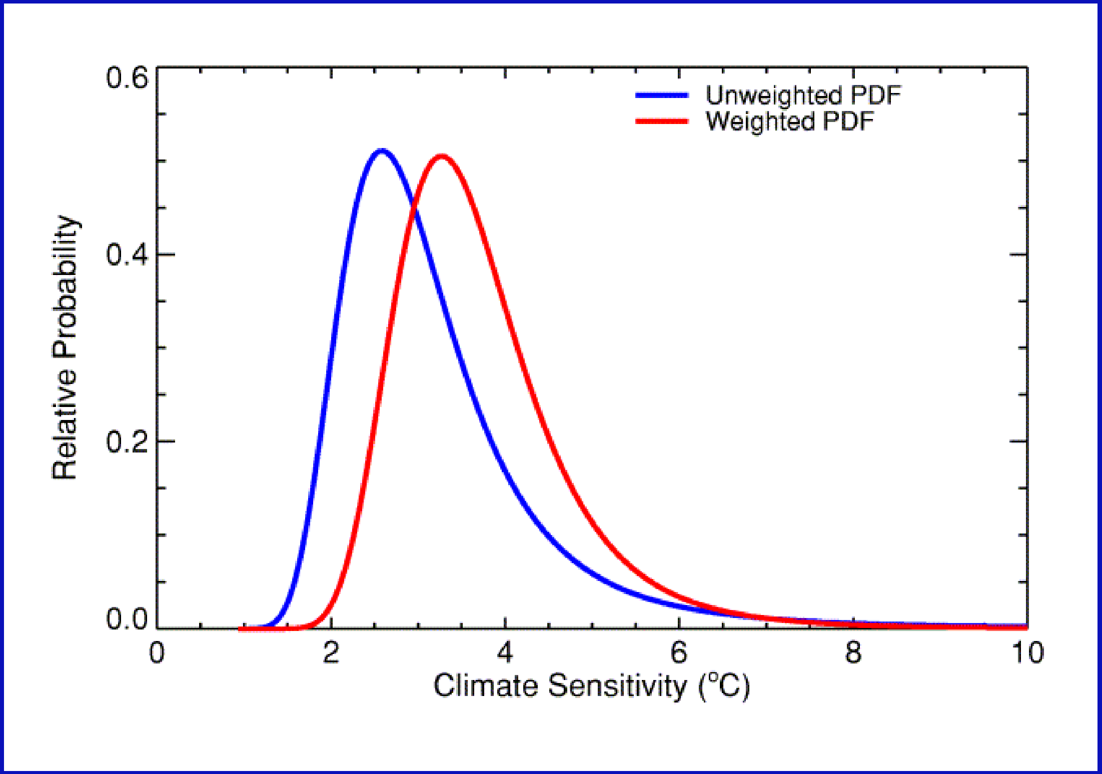
Dynamics

- Diffusion: order and e-folding time
- Gravity wave drag: surface and trapped lee wave constants
- Gravity wave drag start level

Land surface processes

- Root depths
- Forest roughness lengths
- Surface-canopy coupling
- CO_2 dependence of stomatal conductance

Estimated probabilities for climate sensitivity



Murphy et al, Nature, 2004

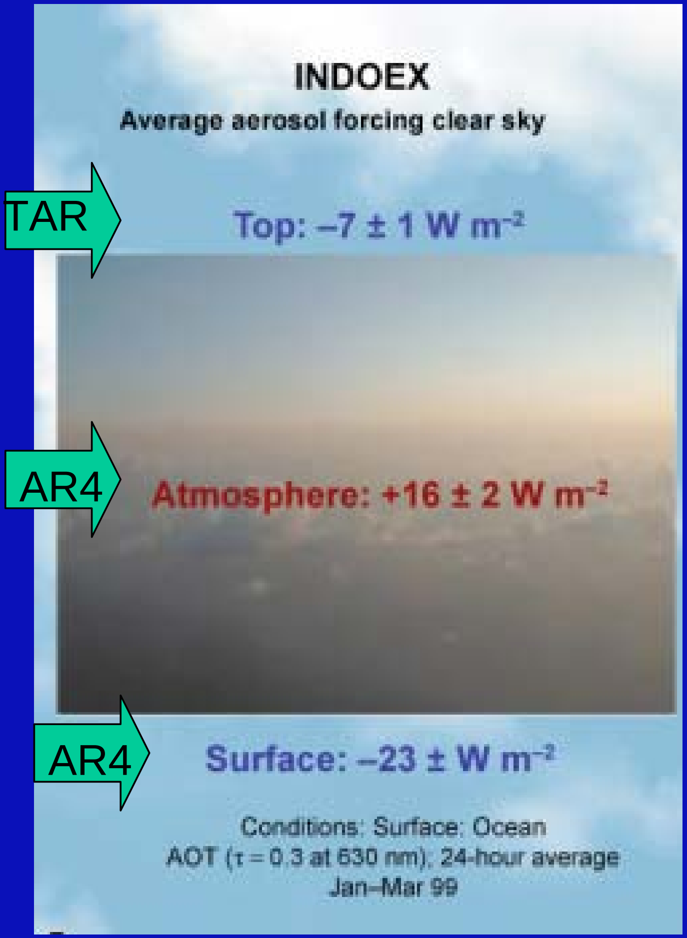
In progress: improved estimates of climate sensitivity range

Many Advances in RF and Response: Surface Energy Budget

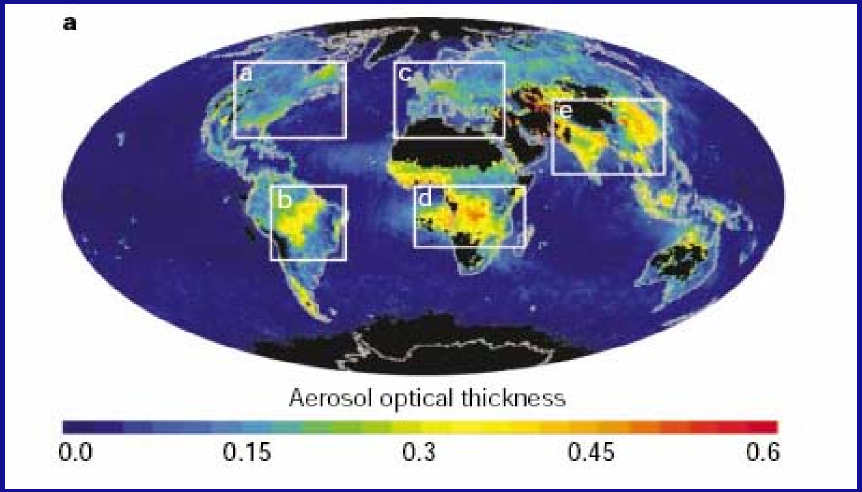
Surface energy budget issues have been illuminated in many recent papers

Effects on temperature profile?

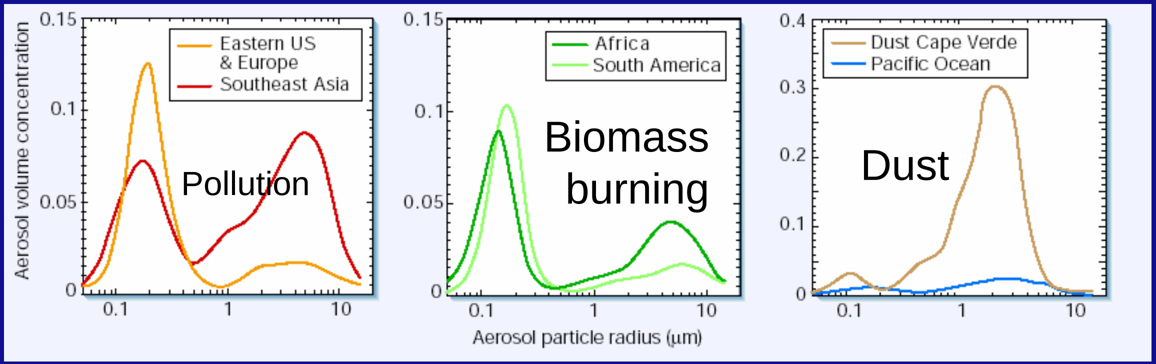
Effects not just on temperature but also on precipitation?



Radiative Forcing: Spectacular information on aerosols and tropospheric chemistry from space



Global distribution of aerosol optical thickness showing pollution mainly from large cities in areas a, c, and e; biomass burning in areas b and d.



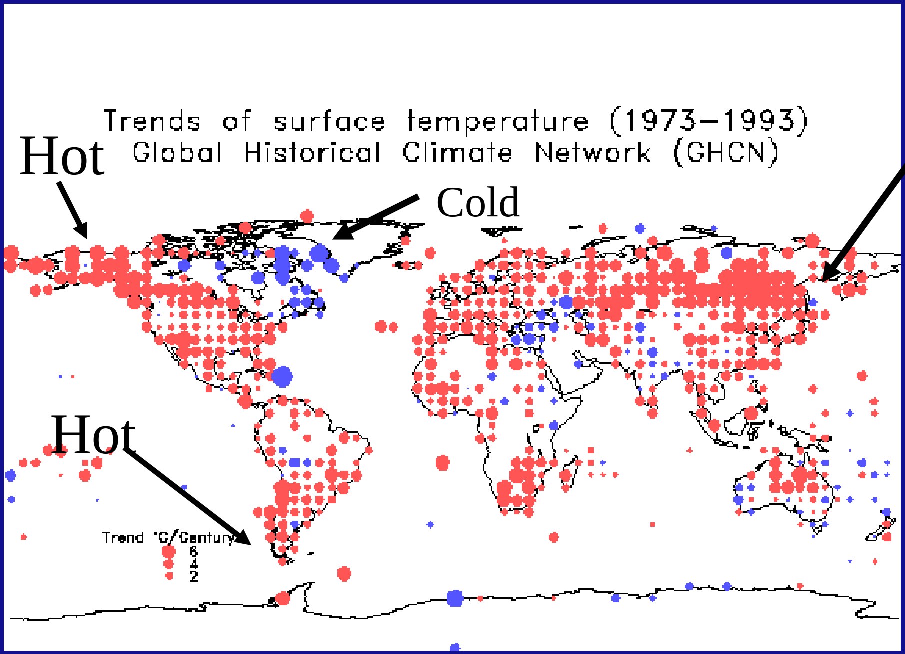
Satellites can now distinguish many aerosol types (soot, sulfate, dust….) and sources. The mix of aerosols and the direct forcing is better understood and quantified.

(Figures from Kaufman et al, Science 2002)

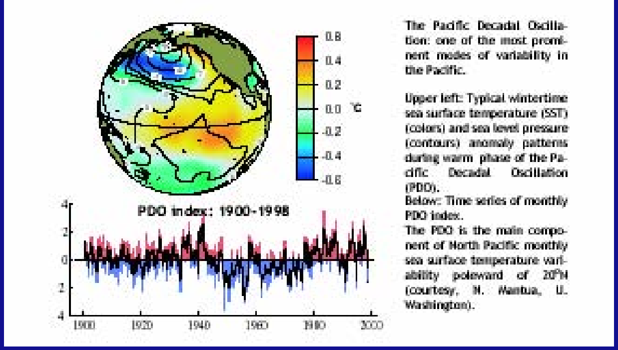
Indirect effects, role of clouds are key.

Atmosphere and Surface

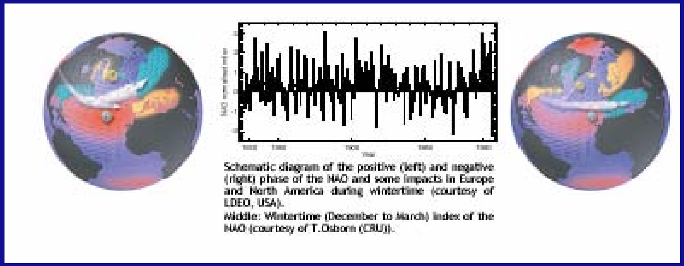
Temperature….and much more



Hot



PDO?

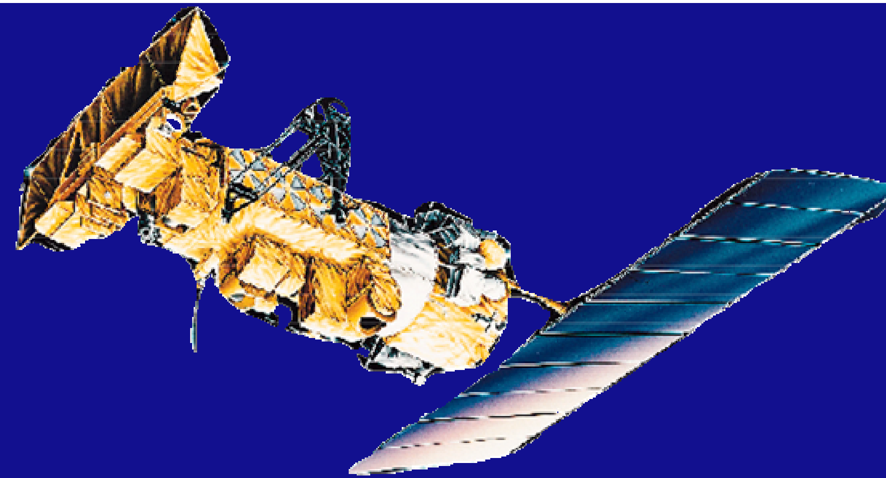


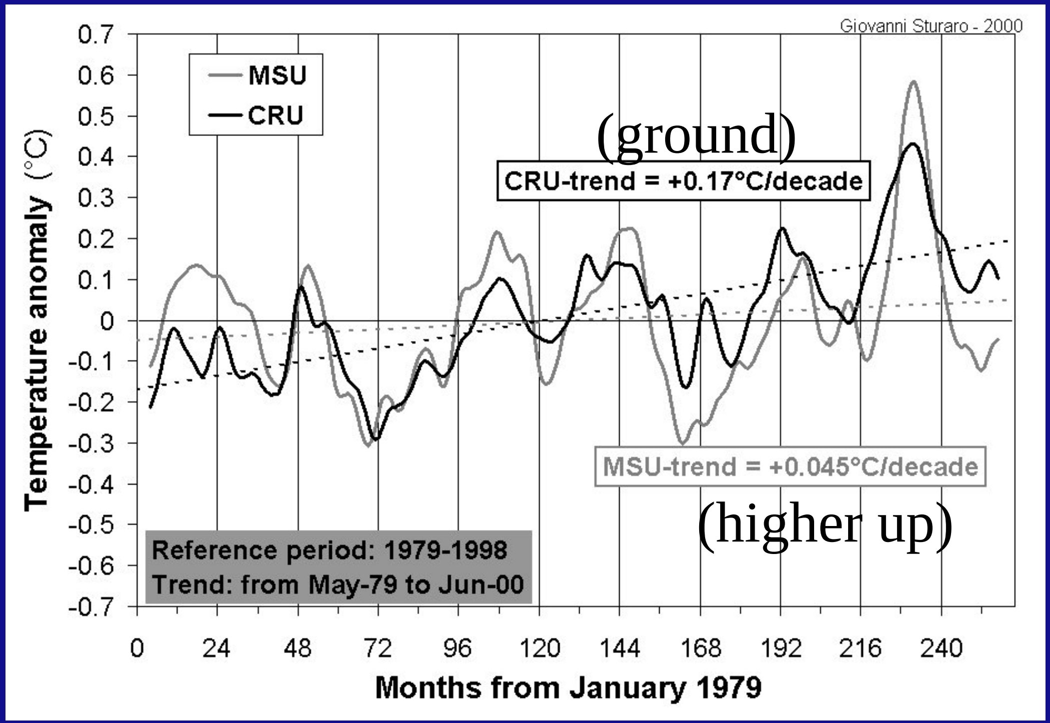
NAO?

Can we do more to explain the linkages between climate variability and <u>processes causing</u> regional trends in patterns?

New information on key points - to be assessed

There are some problems illuminated in previous reports that will need to be re-assessed carefully. A famous one is the difference between temperature trends at the ground and a little higher up.





CCSP assessment; will be a help to IPCC

The Perfect Ocean for Drought

Martin Hoerling[1*] and Arun Kumar[2]

The 1998–2002 droughts spanning the United States, southern Europe, and Southwest Asia were linked through a common oceanic influence. Cold sea surface temperatures (SSTs) in the eastern tropical Pacific and warm SSTs in the western tropical Pacific and Indian oceans were remarkably persistent during this period. Climate models show that the climate signals forced separately by these regions acted synergistically, each contributing to widespread mid-latitude drying: an ideal scenario for spatially expansive, synchronized drought. The warmth of the Indian and west Pacific oceans was unprecedented and consistent with greenhouse gas forcing. Some implications are drawn for future drought.

The ocean temperatures may affect land temperatures and precipitation in many areas.

How do the warmth of today’s oceans influence climate around the world?

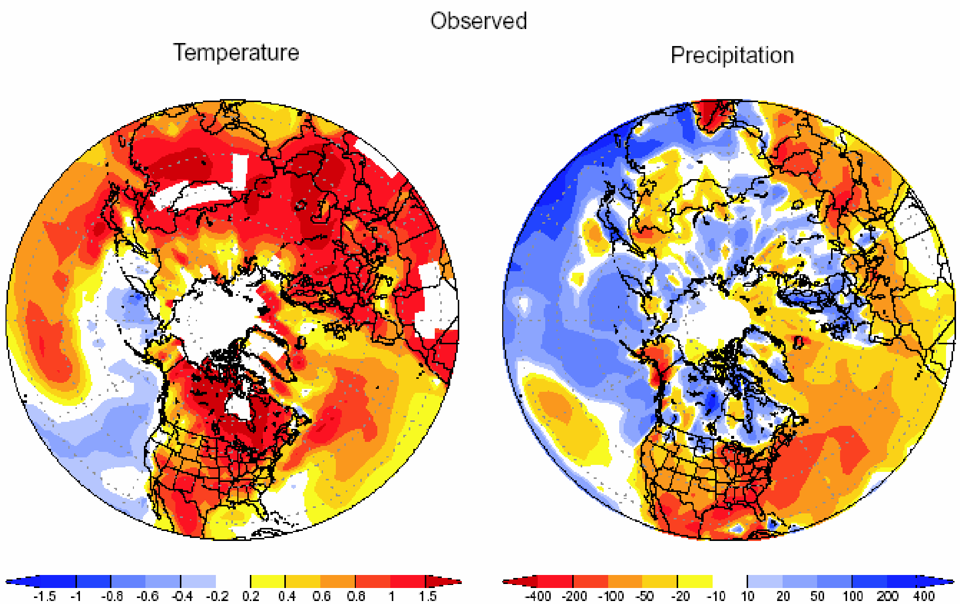
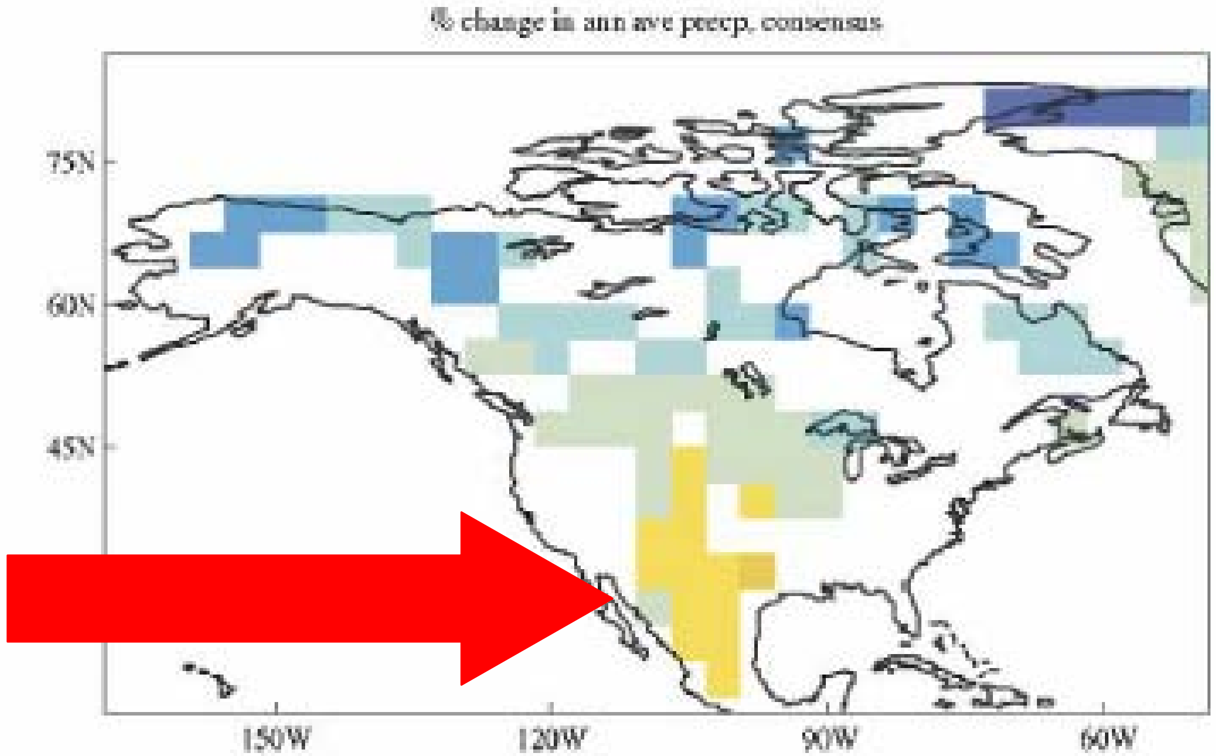


Fig. 1. Observed, annually averaged surface temperature (**left**) and precipitation (**right**) anomalies during the 4-year period June 1998–May 2002. Temperature departures are degrees Celsius computed relative to a 1971–2000 climatology. Precipitation departures are mm/year computed relative to a 1979–1995 climatology. The largest warm and dry departures are highlighted in red.

Future Changes…Mean Precipitation?



Groisman et al., J. Clim, 2005

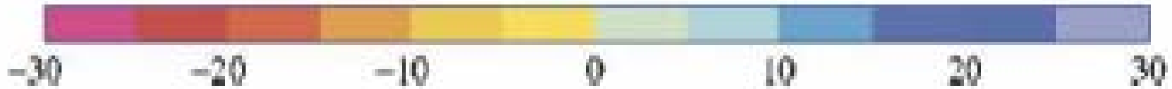


FIG. 13. Consensus estimates of changes in mean annual precipitation in the 2 × CO_2 experiments from CGCM1 and HadCM3 GCMs over North America. The red end of the scale depicts decreases and the blue increases. The pattern shows the average precipitation change between the models, it is only shown where the simulations with each model are consistent with the respective other model at the gridpoint level.

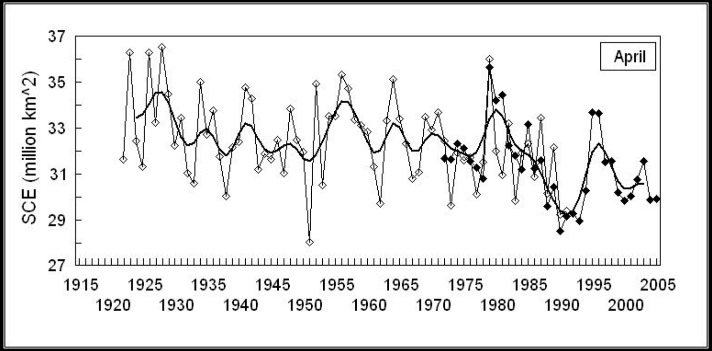
More heavy precipitation <u>and</u> more droughts?

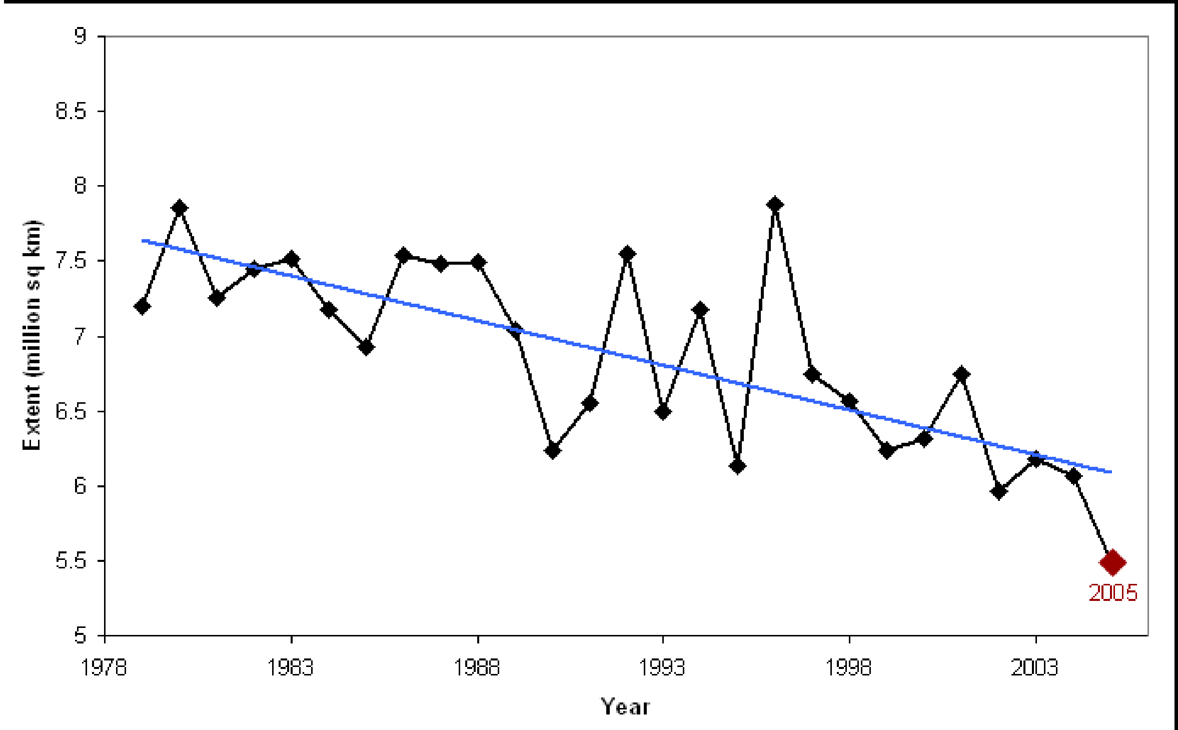
• Warmer world implies more evaporation - more water goes to the atmosphere where water is available on the ground (e.g., oceans). The atmosphere therefore will contain more water vapor available to rain out. And most places receive the majority of their moisture in heavy rain events, which draw moisture from a big area.

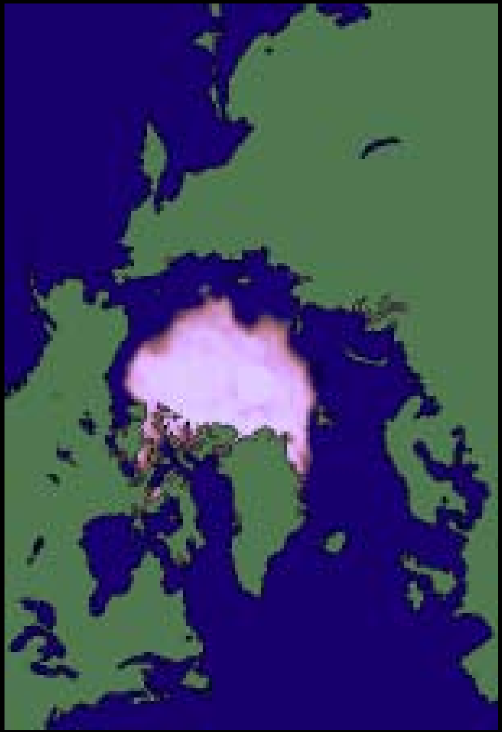
• Warmer world implies more evaporation - but soils will dry out as a result. So dry regions in mid-continents will get drier unless storm tracks shift in a lucky way.

• "wet get wetter, dry get drier" - S. Manabe

Evidence for a changing cryosphere







Oceans and sea level

New global observations by satellite

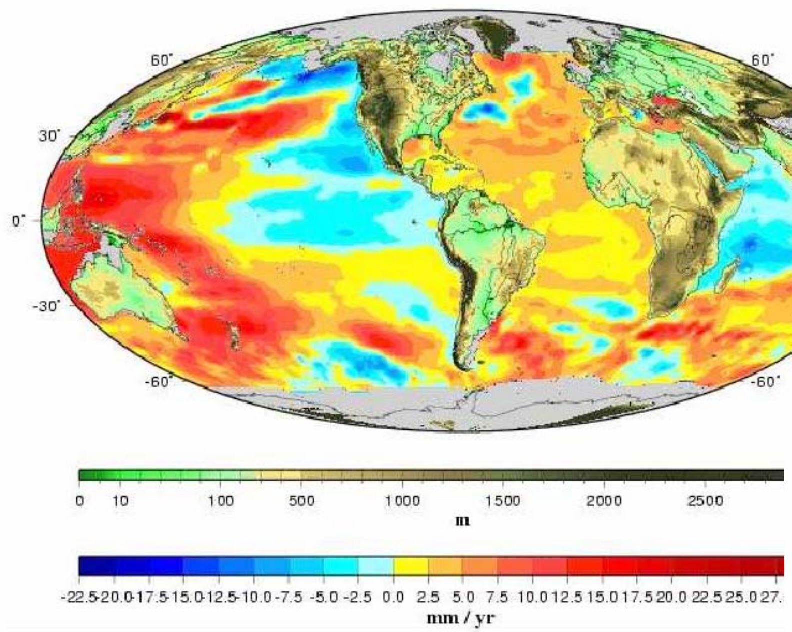


Figure 7. Sea level trends over 1993-2003 from the T/P mi

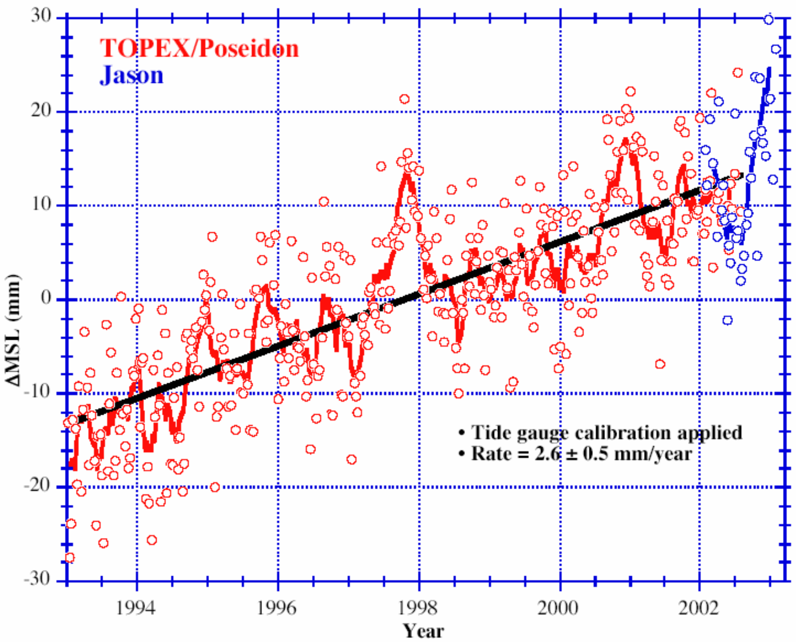
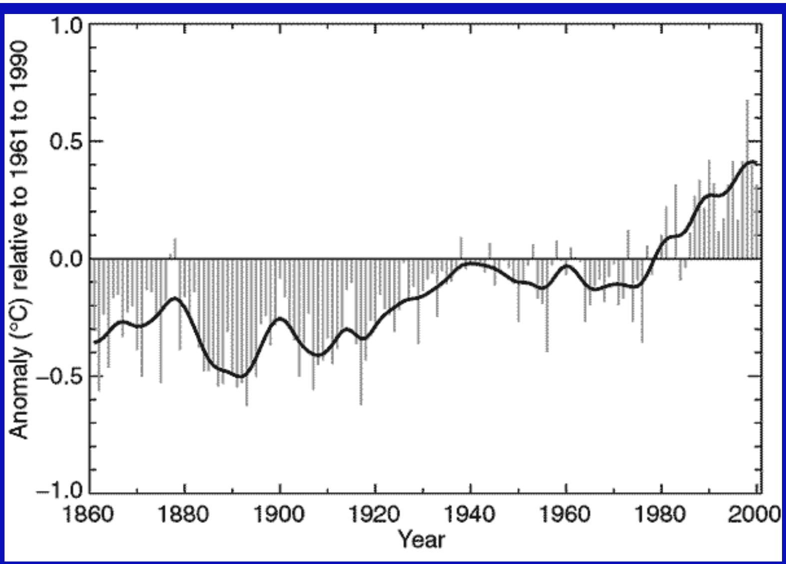


Figure 5. Global mean sea level variations from T/P and Jason.

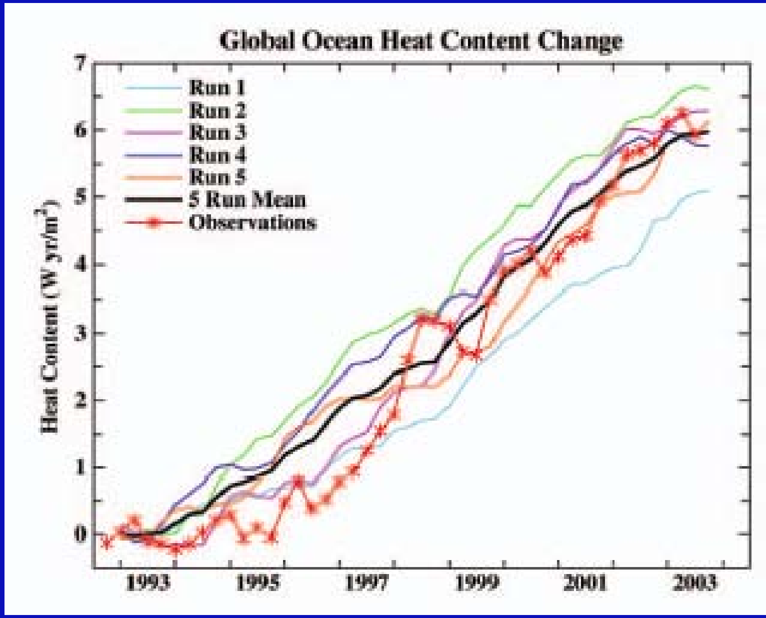
Observed sea level rise. Thermal expansion is likely to be a major factor. Connect to *in-situ* ocean heat content and other data. Integrate these findings in one chapter.

[Figures from Cazenave and Nerem, 2004]



Global mean surface air temperatures are rising

Global ocean heat content is also increasing



So the atmosphere did not get hotter at the expense of the ocean.

Role of global energy budget change, radiative forcing due to increases in GHG; *Hansen et al., Science, 2005.*

Probability Distributions

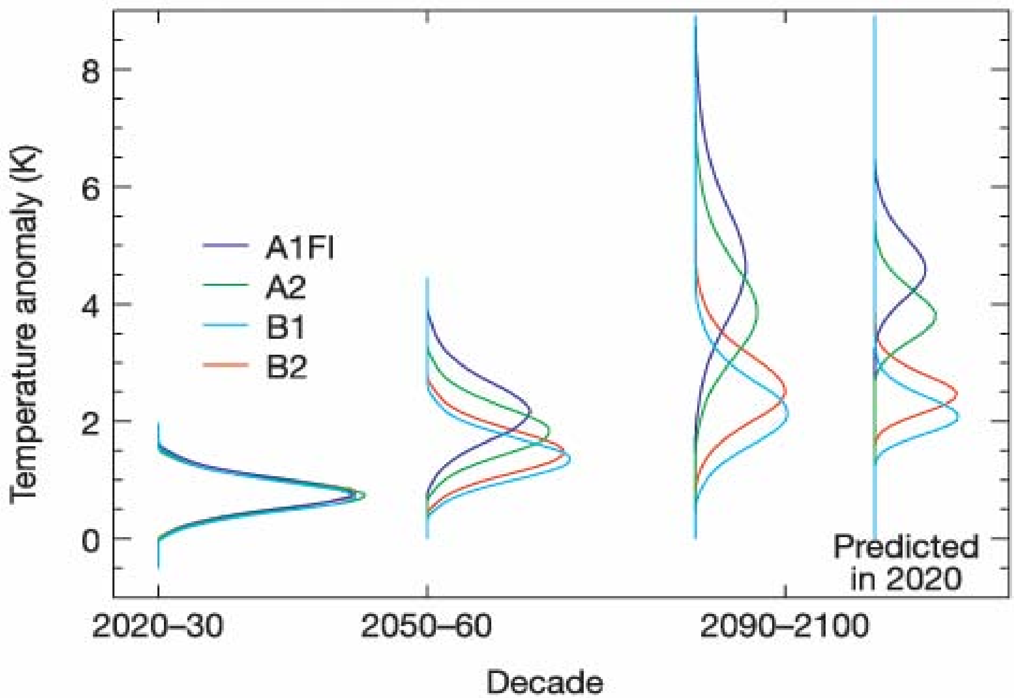
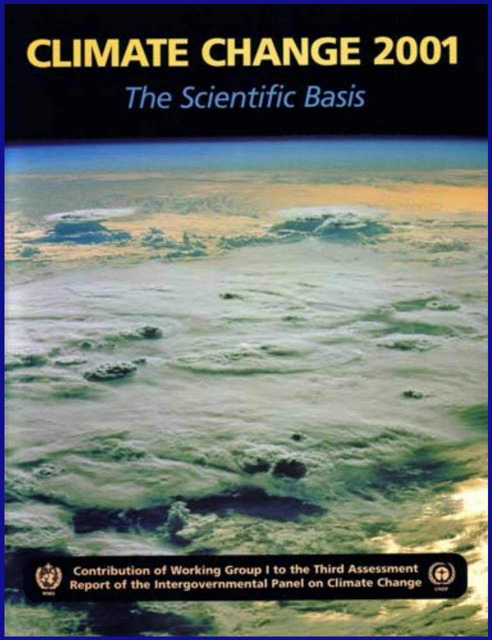


Figure 2 Probability density functions (PDFs) of temperature change. Shown are PDFs for four SRES scenarios (A1FI, A2, B1 and B2) for 2020–30, 2050–2060 and 2090–2100 decades relative to the 1990–2000 decade, calculated by constraining HadCM3 simulations to the observed temperature change over the 1900–99 period. The PDFs at the far right are for the 2090–2100 decade calculated by constraining HadCM3 simulations to be consistent with the observed temperature change over the 1920–2019 period, where the observations are assumed to follow a B2 scenario prediction after 1999.

Probability distributions can provide more specific information on commitment due to past emissions, versus scenarios, and clarify model results.

Stott and Kettleborough, Nature, 2002



Solomon's (Draft) Rules of Successful Assessment

1) **The product must be designed (and proven) to be useful….for <u>both</u> the stakeholders and the science community that produces it**

2) **There must be a clear demarcation of roles and procedures between the stakeholder/Governments and the scientists who produce the report**

3) **The report must go through several staged and different rounds of careful review by a very broad range of experts and stakeholders.**

4) Scientific judgment must be the guiding force and final arbiter in the content and in responses to the review process. Authors must have "author"-ity.

5) The author teams must have adequate time. Never rush an assessment.

6) The assessment conclusions must be fully grounded in well-documented peer-reviewed literature.

7) Stakeholder inputs must be provided in open yet formal forums (e.g., the IPCC plenary).

8) Clear science leadership must be provided by the chairs and lead author team, who are internationally known and respected scientists.

Rules for an IPCC co-chair to live by:

1) …..an IPCC assessment doesn't drive the research (organizations like WCRP and IGBP should and do).
2) …..force no consensus before its time.
3) ……policy-relevant but not policy-prescriptive assessment can be achieved because the best science is always highly self-critical and highly objective. Rely on the scientific culture and ethic (which works well when it operates objectively within its own standards) and communicate this clearly to authors, governments, and others. We are here to seek understanding, and only understanding.

Uphold these rules for assessment vigorously.

What’s next for IPCC (2007)?

Apr 2003	**First scoping meeting**
Sep 2003	**Second scoping meeting**
Nov 2003	**Panel approval of outlines for reports**
Apr 2004	**Lead author teams selected**
Sep 2004	**Lead Author meeting 1 (Trieste)**
Feb 2005	Zero order draft complete
May 2005	**Lead Author meeting 2 (Beijing)**
Aug 2005	**First draft complete**
Dec 2005	Lead Author meeting 3 (Christchurch)
Feb 2006	Second draft complete
Jun 2006	Lead Author meeting 4 (TBD)
Jan 2007	WGI panel

We are here: Sincere thanks to everyone who is helping write or review the WG1 AR4.

Time when SYR work begins

Time when TS work begins

Cited material must be in press or published