

# 21<sup>st</sup> Century Climate Change as Assessed by IPCC in AR4 (2007)

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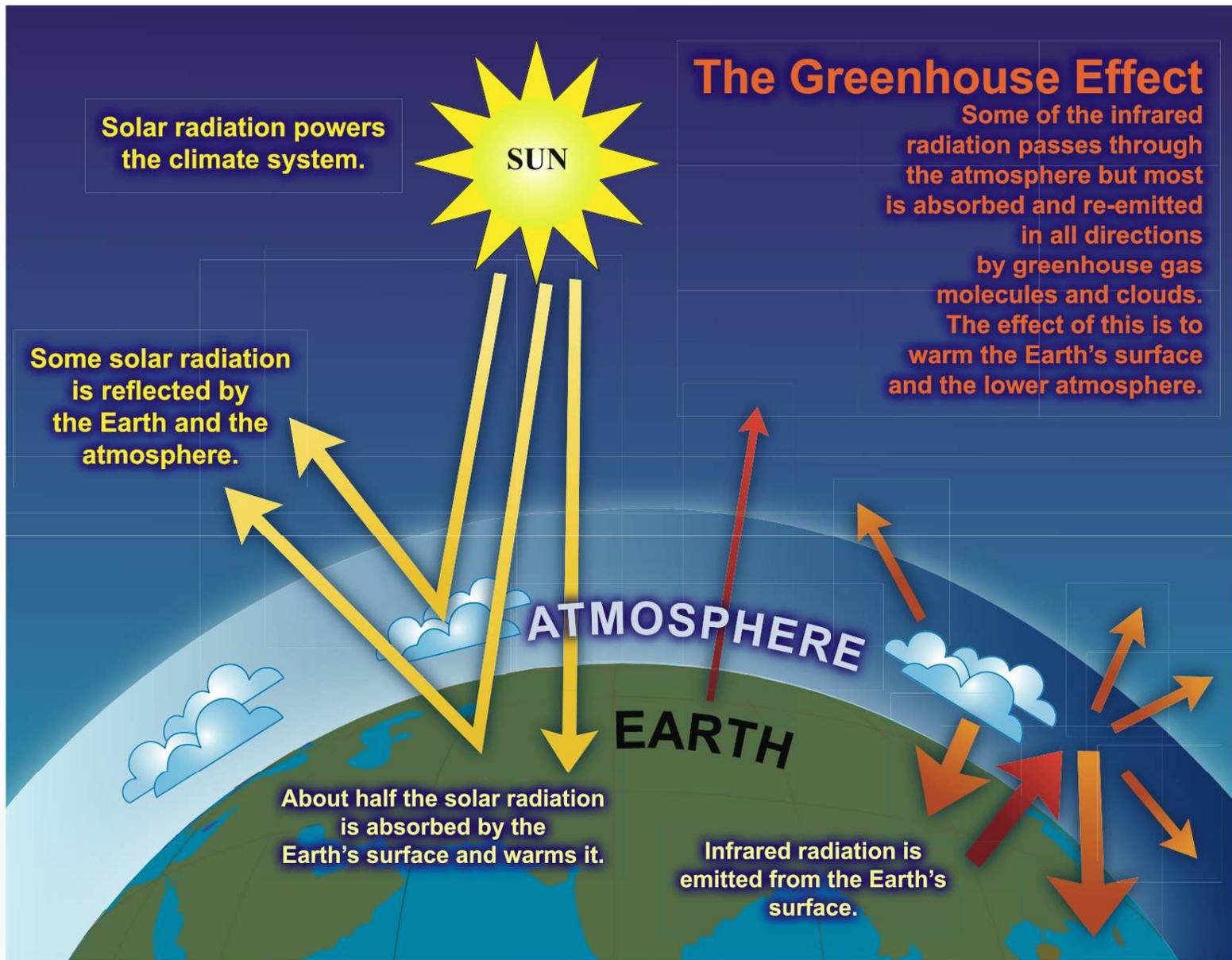
<http://richardsomerville.com>

Cargèse, Corsica, France, 16 September 2009

What is the Intergovernmental Panel on Climate Change (IPCC)?

What were the main conclusions in the IPCC Fourth Assessment Report (AR4), published in 2007?

The IPCC has existed since 1988. How have its findings changed?



Solar radiation powers the climate system.

### The Greenhouse Effect

Some of the infrared radiation passes through the atmosphere but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.

Some solar radiation is reflected by the Earth and the atmosphere.

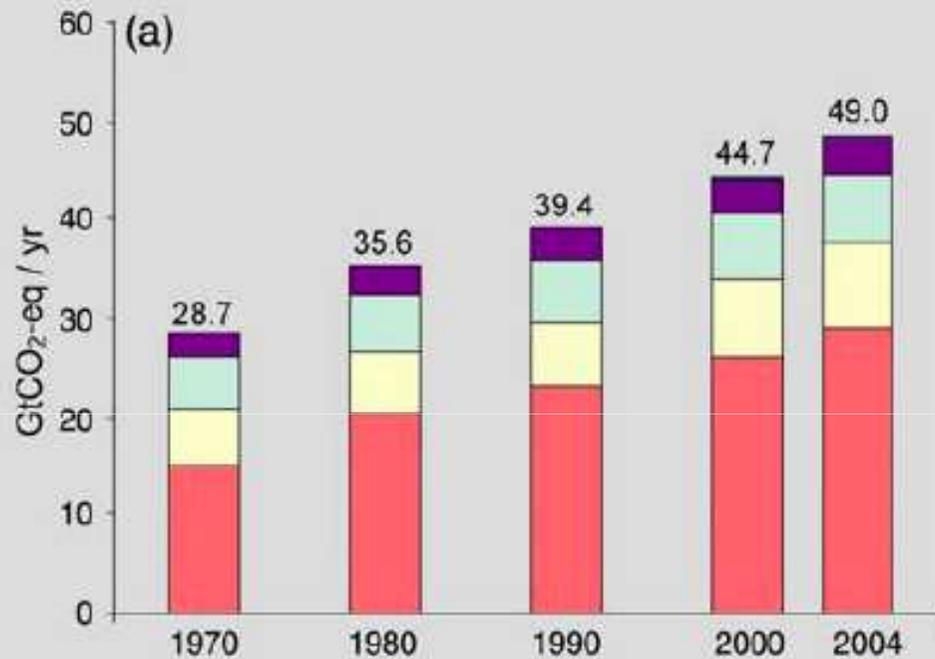
ATMOSPHERE

EARTH

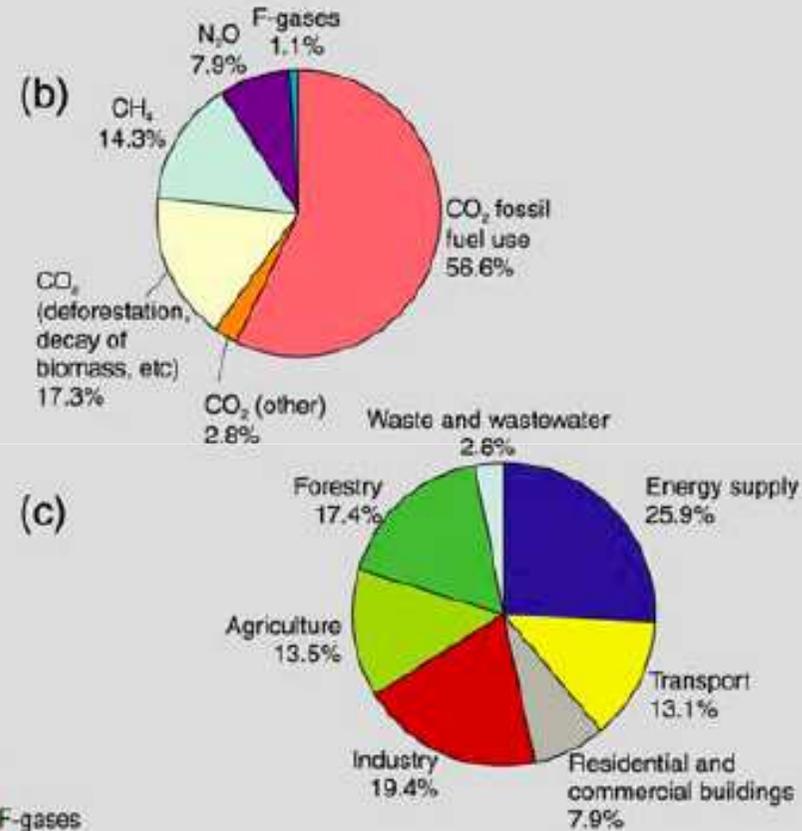
About half the solar radiation is absorbed by the Earth's surface and warms it.

Infrared radiation is emitted from the Earth's surface.

## Global anthropogenic GHG emissions



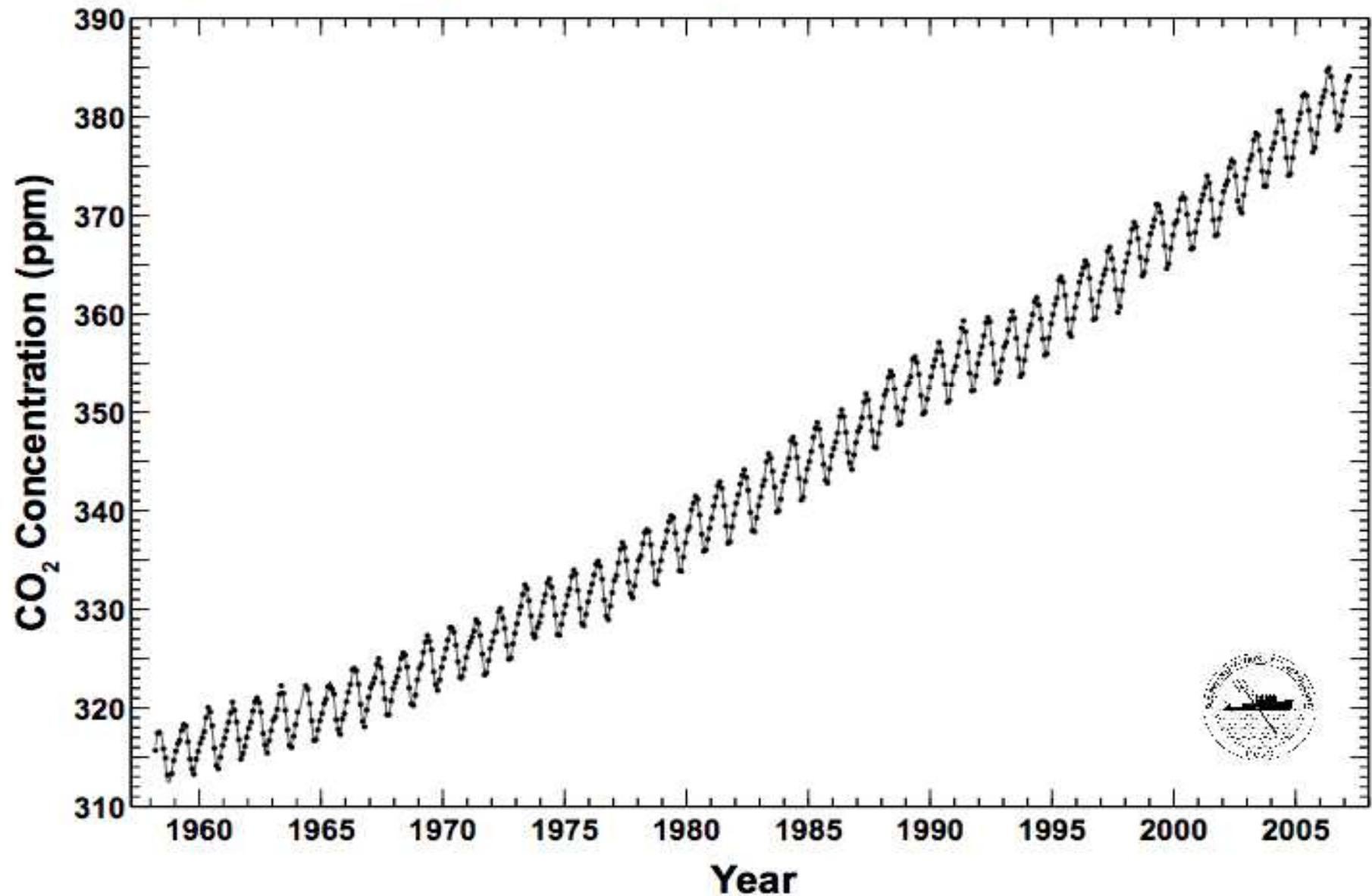
■ CO<sub>2</sub> from fossil fuel use and other sources   
 ■ CO<sub>2</sub> from deforestation, decay and peat  
■ CH<sub>4</sub> from agriculture, waste and energy   
 ■ N<sub>2</sub>O from agriculture and others   
 ■ F-gases



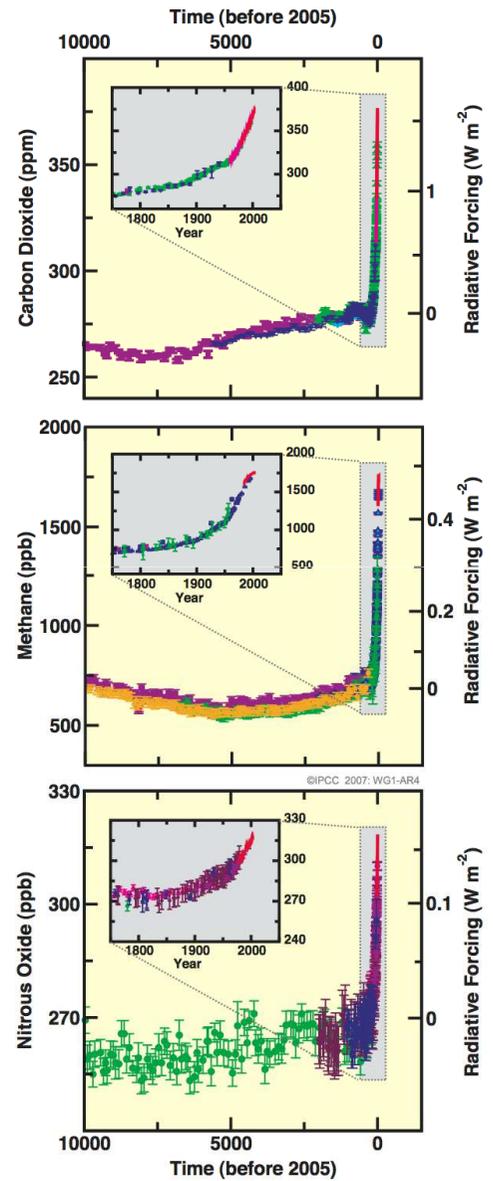
# Mauna Loa Observatory, Hawaii Monthly Average Carbon Dioxide Concentration

Data from Scripps CO<sub>2</sub> Program

Last updated March 2007



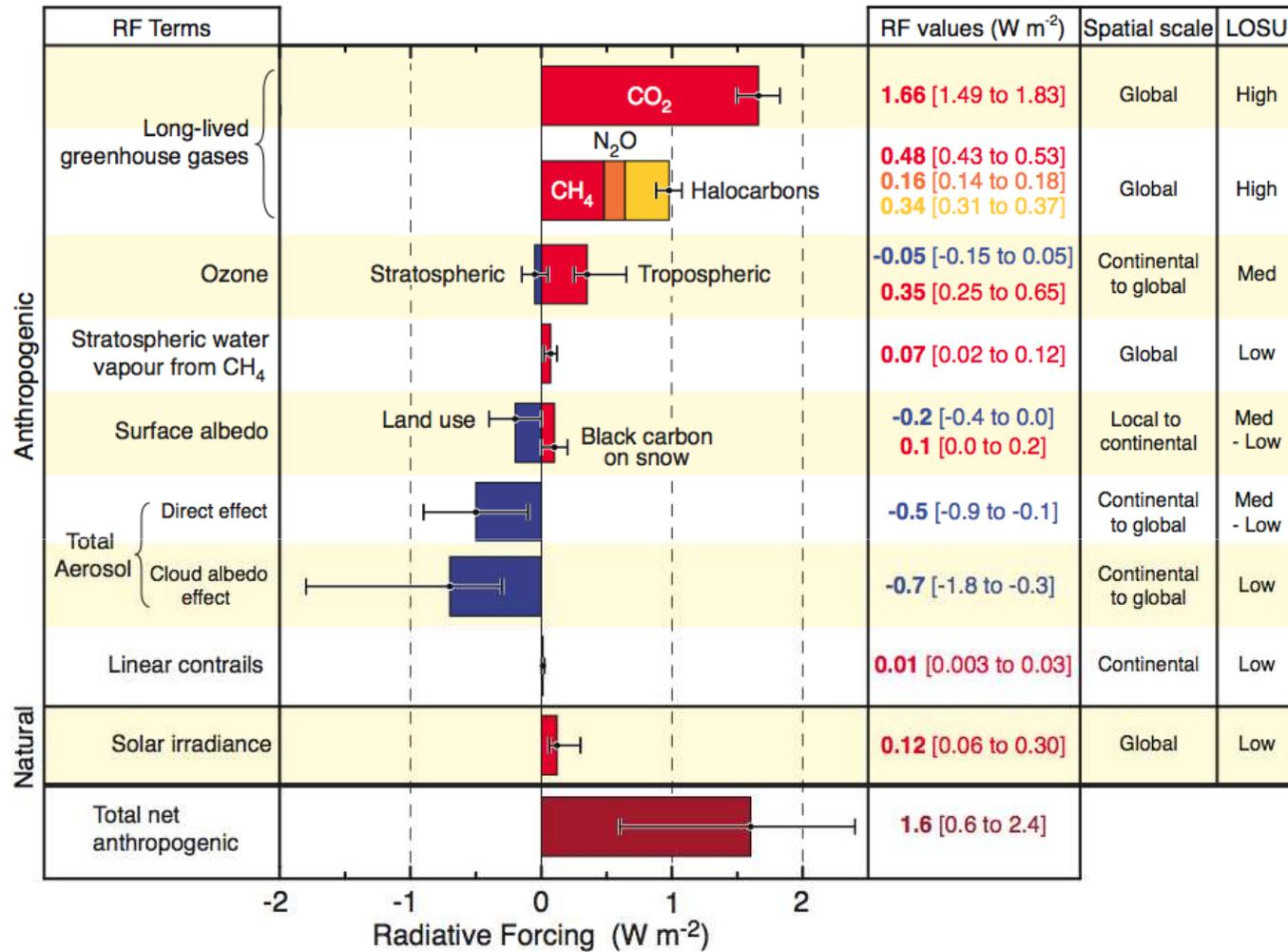
Changes in Greenhouse Gases  
from ice-Core and Modern Data



*Updated:  
PLENARY*

Figure SPM-1

# Radiative Forcing Components



©IPCC 2007: WG1-AR4

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Figure SPM-2

## **AR4: observational evidence of climate change**

CO<sub>2</sub> growth rate is largest in the most recent decade.

Earth is now 0.76 deg C warmer than in 1860.

North Atlantic hurricanes have intensified since 1970.

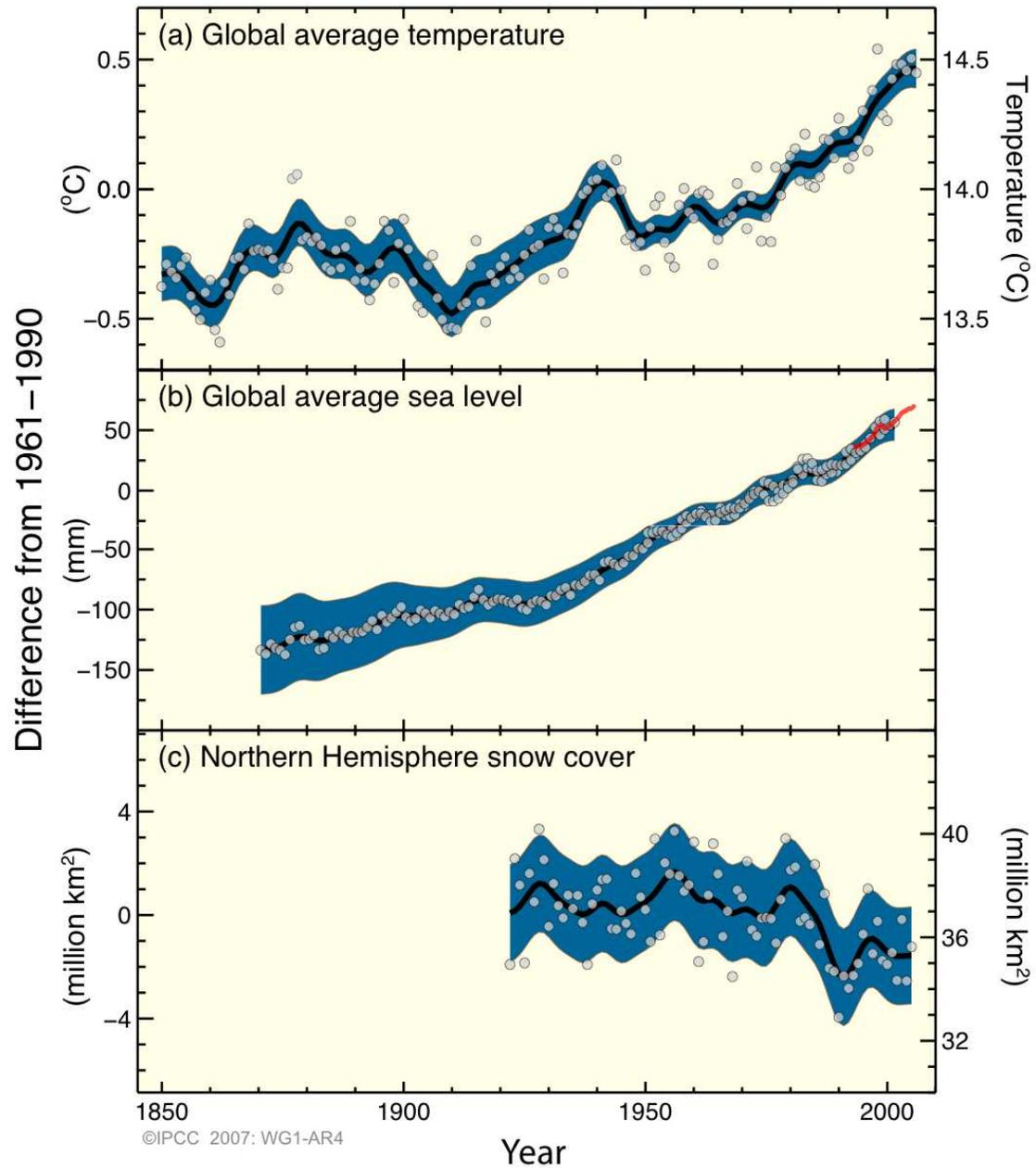
Arctic temperatures increased at twice the global rate.

Arctic sea ice has shrunk by 2.7% per decade.

11 of the last 12 years are among the 12 warmest.

The ocean is warming to depths of 3 kilometers.

# Changes in Temperature, Sea Level and Northern Hemisphere Snow Cover



*Updated:  
13 Feb 07*

Figure SPM-3

IPCC has produced four major  
Assessment Reports (AR):

1990: First AR (FAR)

1995: Second AR (SAR)

2001: Third AR (TAR)

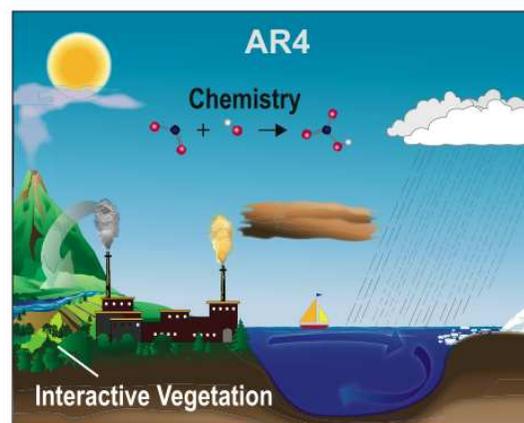
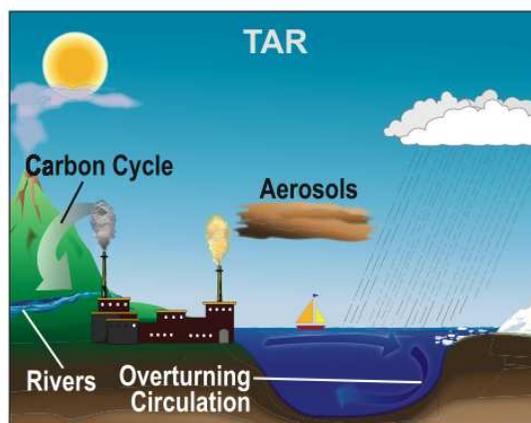
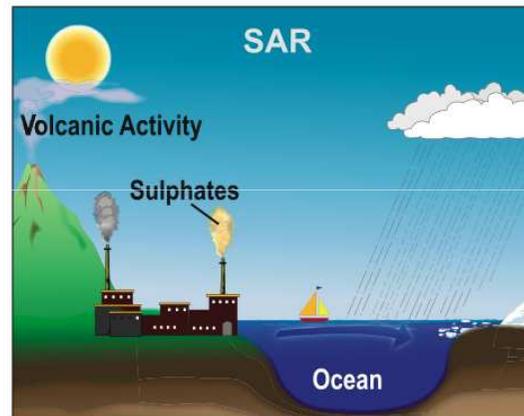
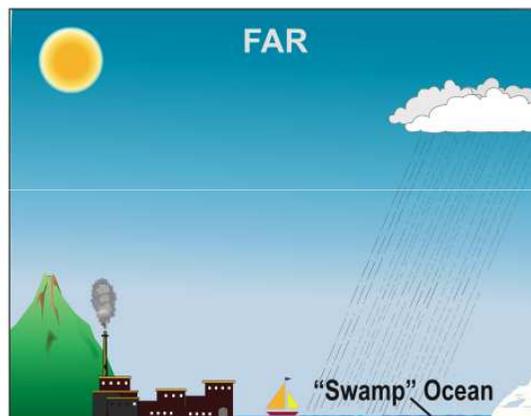
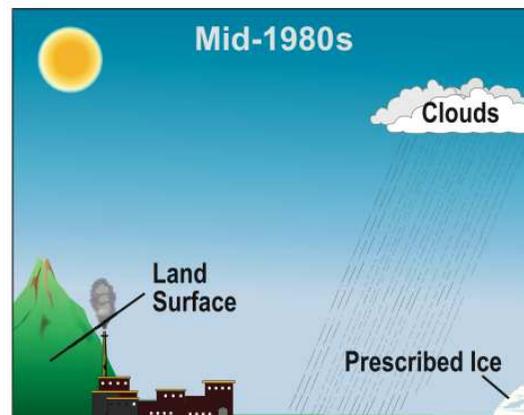
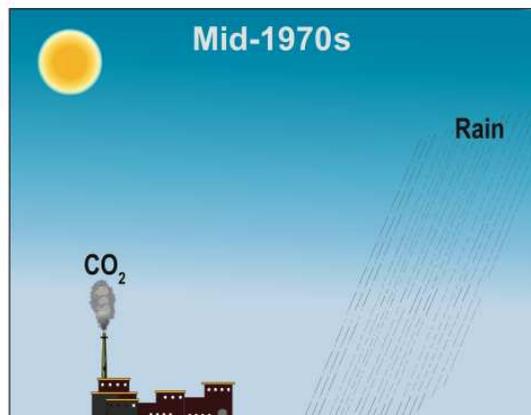
2007: Fourth AR (AR4)

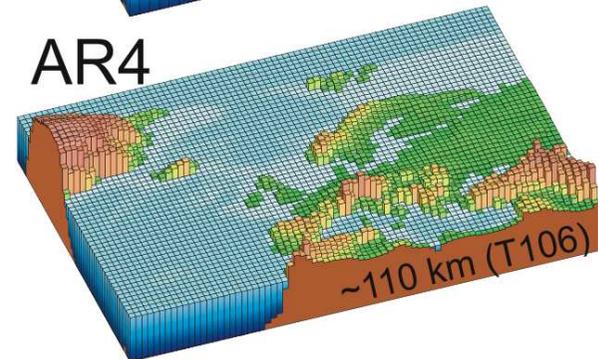
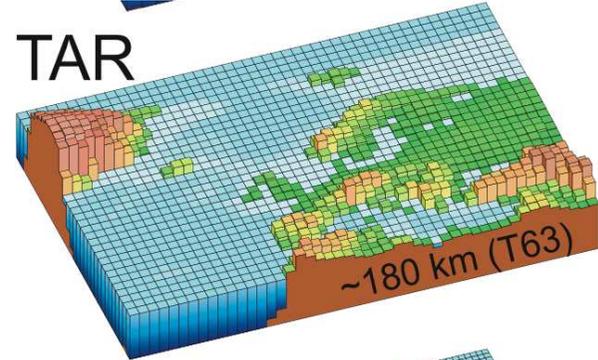
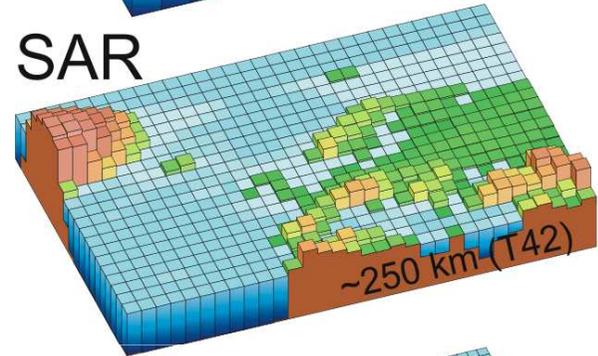
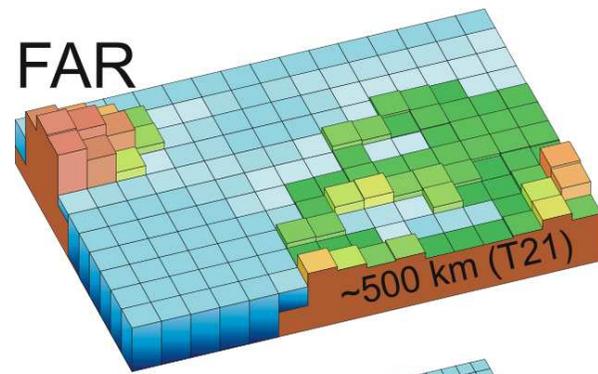
2013: Fifth AR (AR5) expected.

“The balance of evidence suggests a discernible human influence on global climate.” - IPCC SAR (1995).

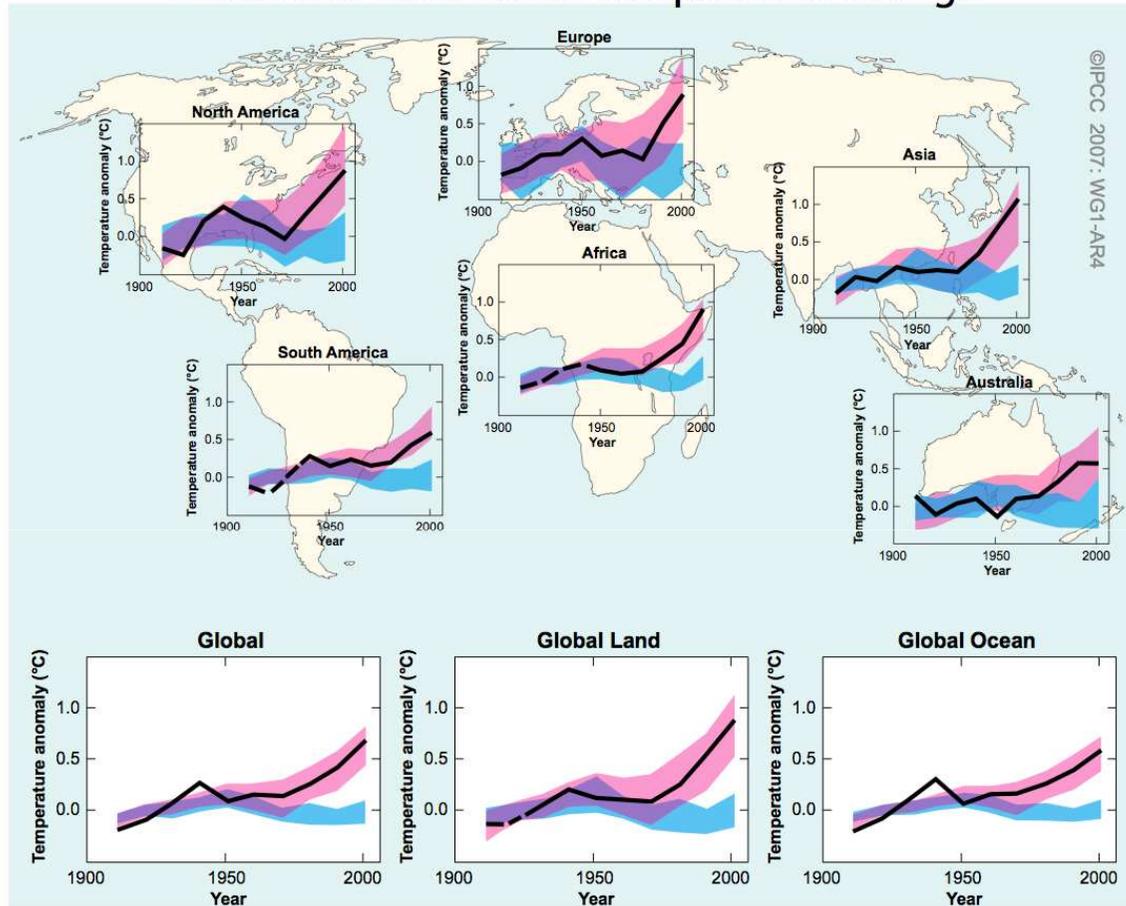
“There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.” - IPCC TAR (2001).

# The World in Global Climate Models





# Global and Continental Temperature Change



*Updated:  
PLENARY*

Figure SPM-4

“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 average sea level.”

- IPCC, AR5, Paris, 2 February 2007.

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

- IPCC, AR5, Paris, 2 February 2007.

(‘*very likely*’ means at least 90% probable)

IPCC reports are available free at:

[www.ipcc.ch](http://www.ipcc.ch)

and are also published by  
Cambridge University Press

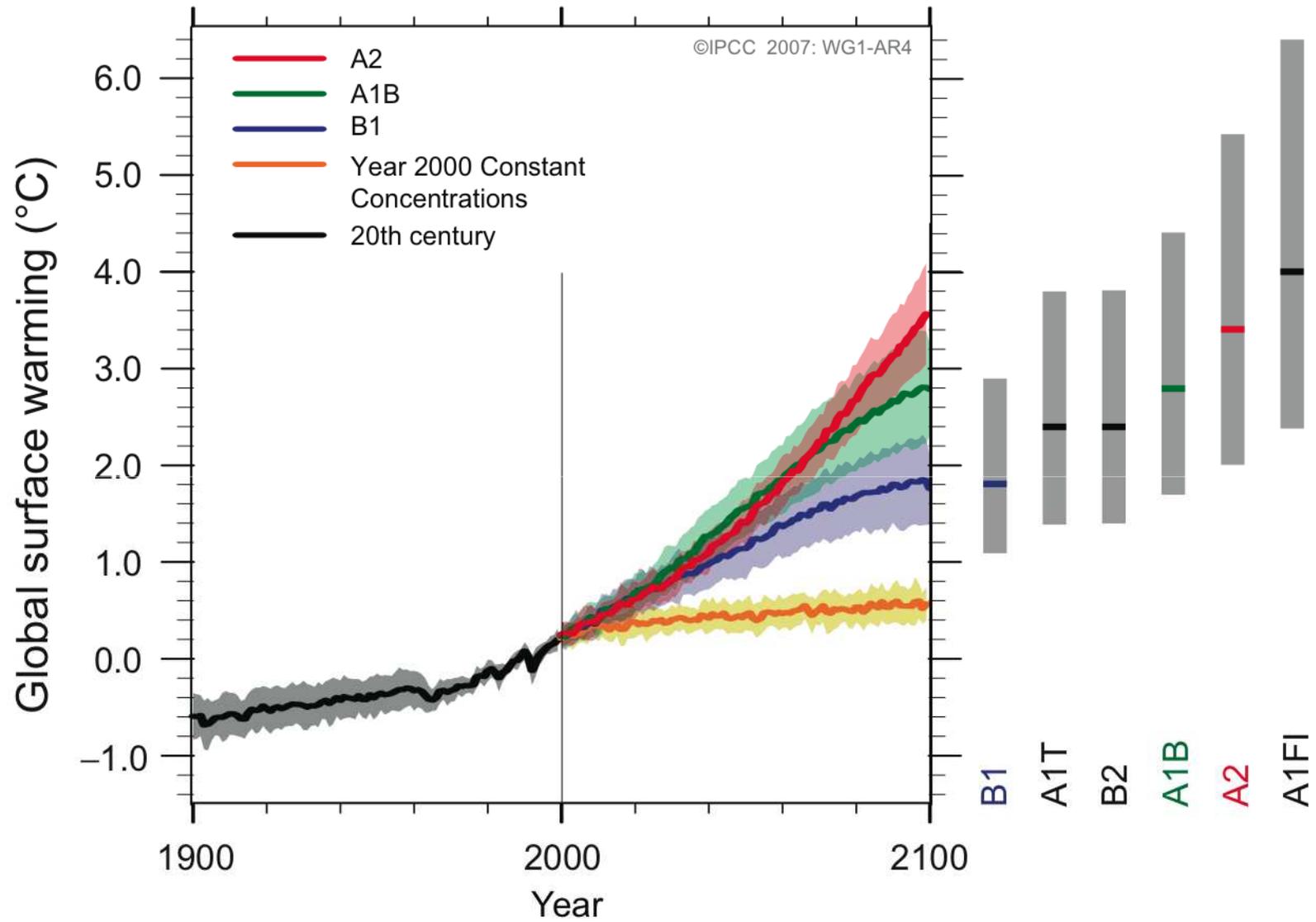
## **AR4: projections of future climate change**

Sea level will rise 0.2 to 0.6 meters in the 21st century (with caveats).

Larger values cannot be excluded.

Over the next 20 years, expect 0.2 deg C per decade further warming.

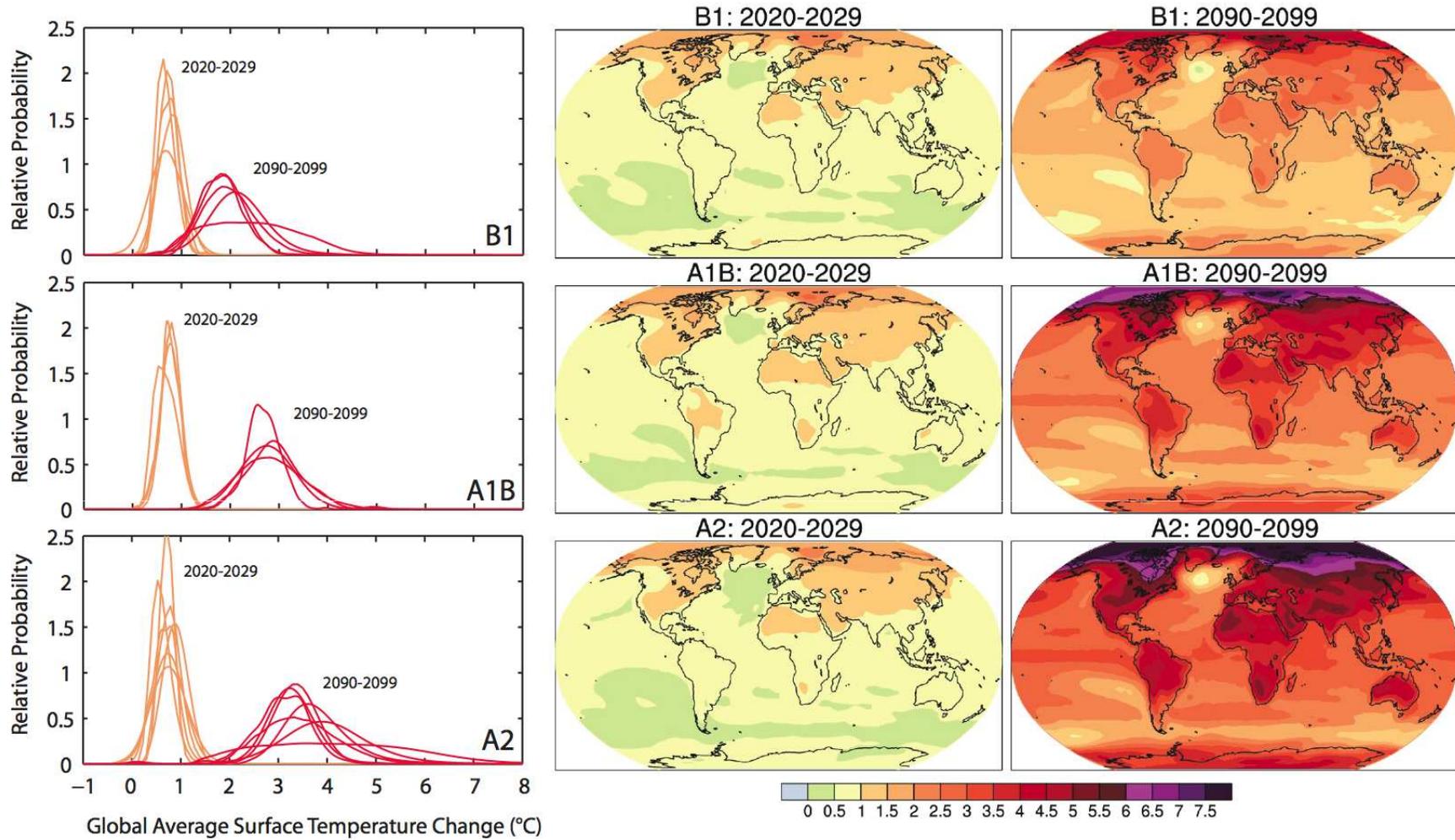
# Multi-model Averages and Assessed Ranges for Surface Warming



*Updated: 13 Feb 2007*

Figure SPM-5

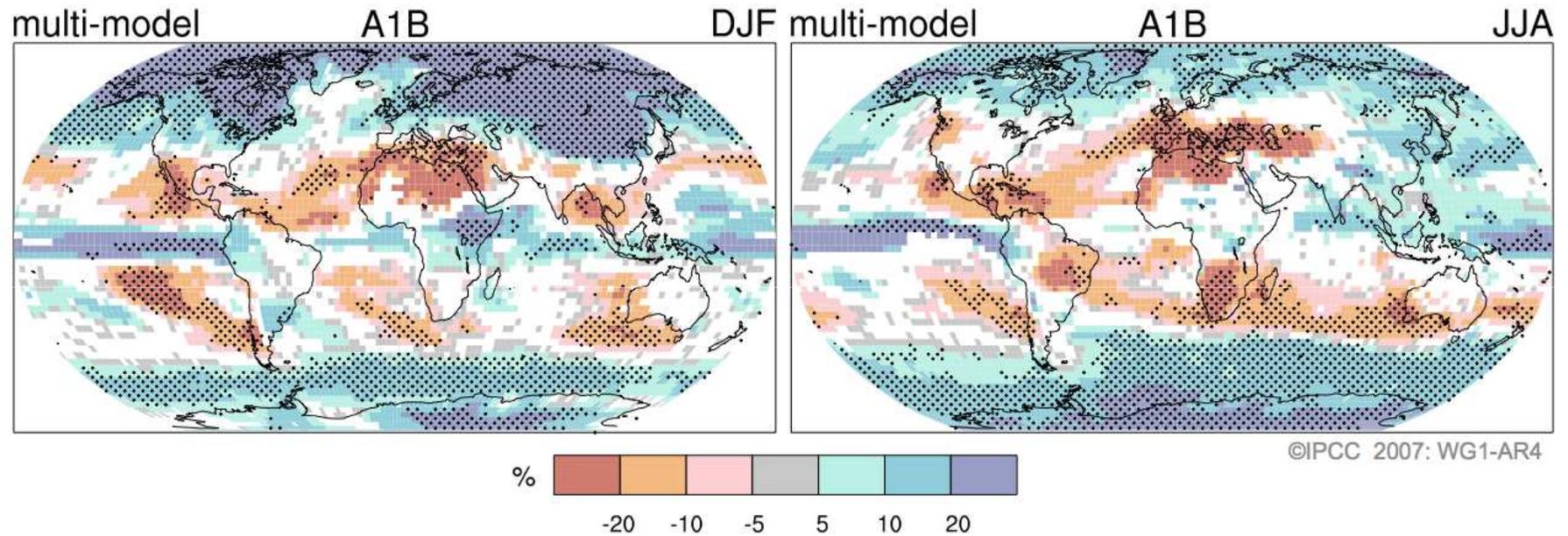
# AOGCM Projections of Surface Temperatures



©IPCC 2007: WG1-AR4

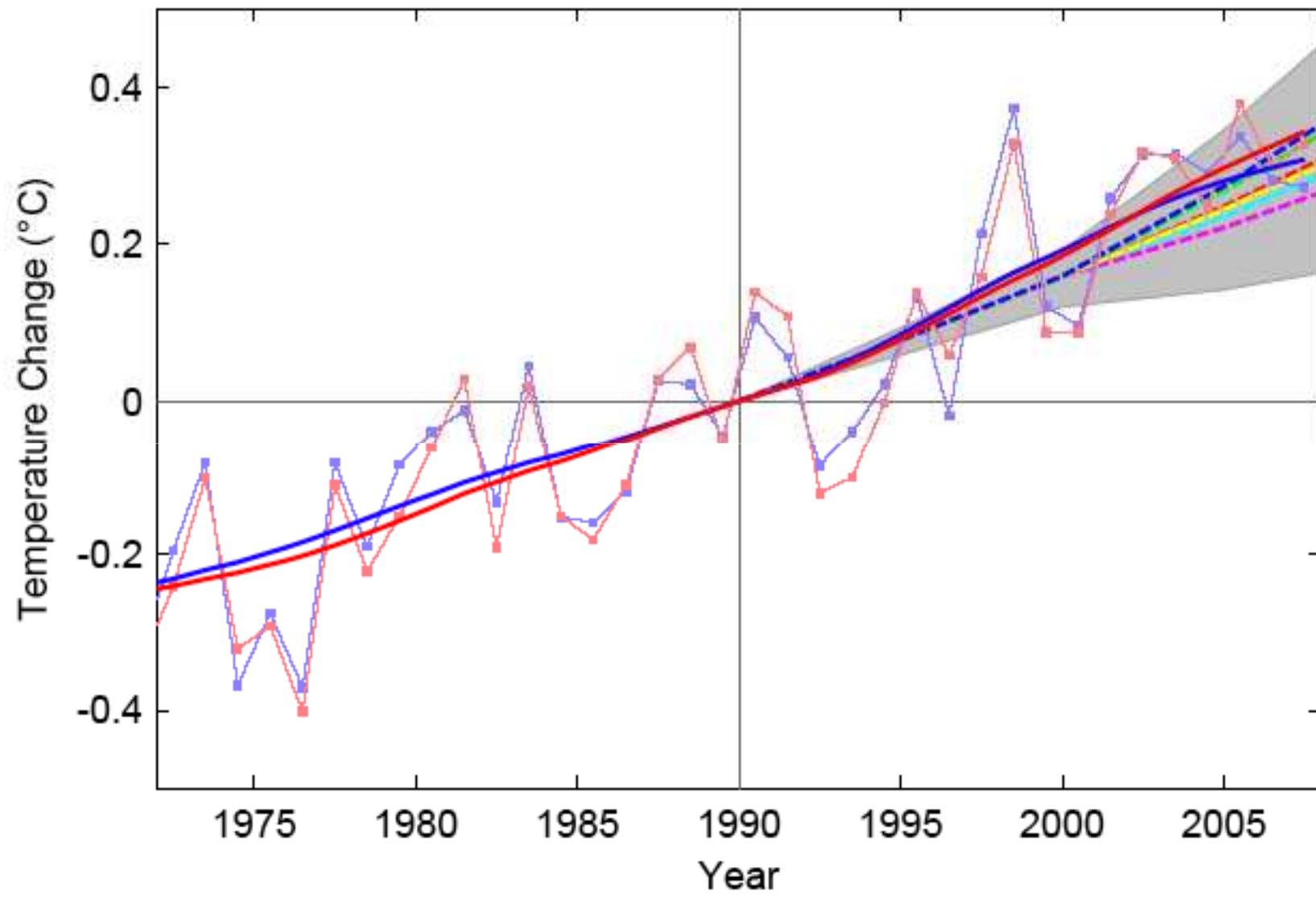
*Updated:*  
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Figure SPM-6

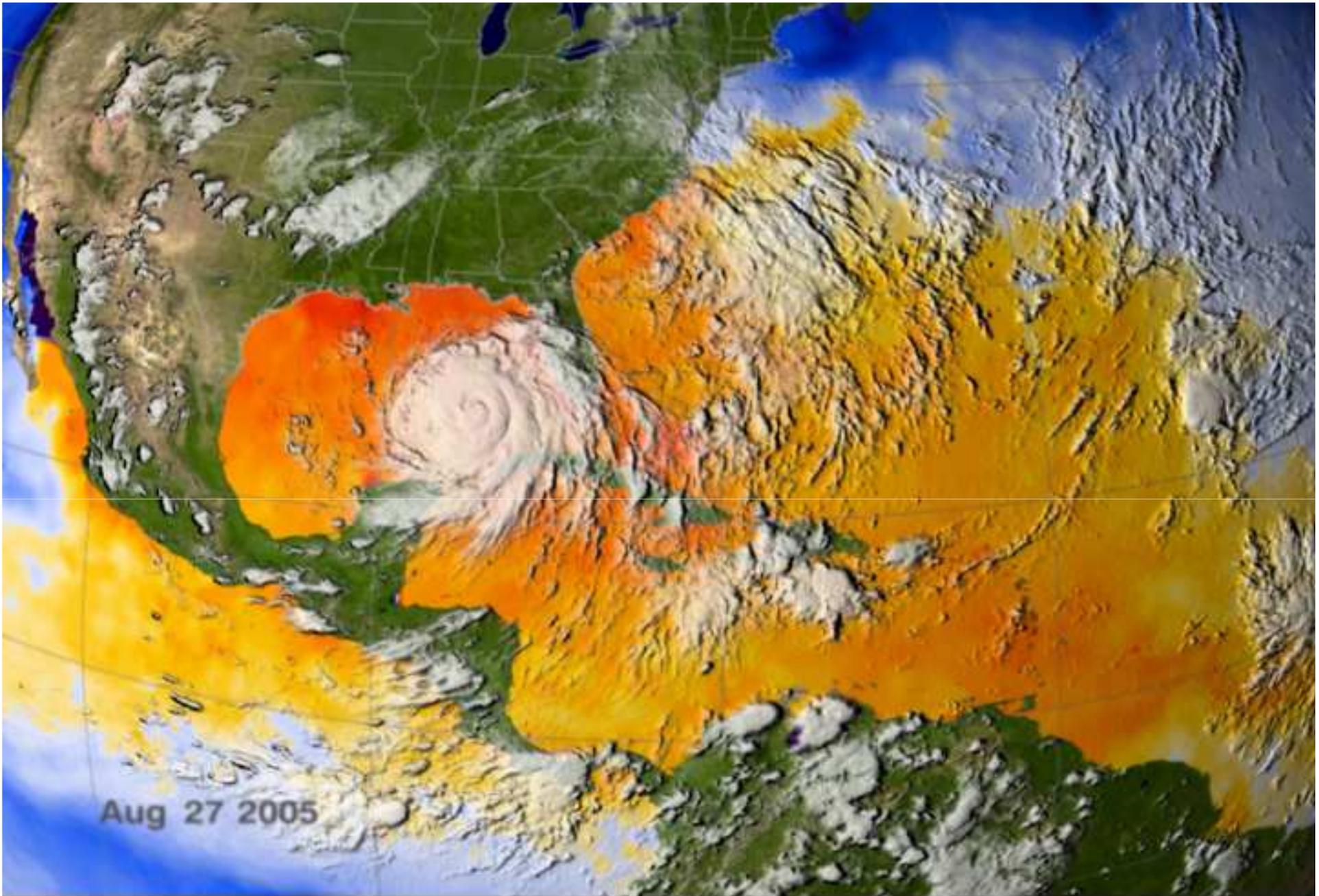
# Projected Patterns of Precipitation Changes



*Updated:  
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Figure SPM-7





Aug 27 2005

Sea Surface Temperature



# Relating greenhouse gases to global warming

CO <sub>2</sub> concentration at stabilization (2005 = 379 ppm) <sup>(b)</sup>	CO <sub>2</sub> -equivalent Concentration at stabilization including GHGs and aerosols (2005 = 375 ppm) <sup>(b)</sup>	Peaking year for CO <sub>2</sub> emissions <sup>(a, c)</sup>	Change in global CO <sub>2</sub> emissions in 2050 (% of 2000 emissions) <sup>(a, c)</sup>	Global average temperature increase above pre-industrial at equilibrium, using "best estimate" climate sensitivity <sup>(d), (e)</sup>	Global average sea level rise above pre-industrial at equilibrium from thermal expansion only <sup>(f)</sup>
ppm	ppm	Year	Percent	°C	metres
350 – 400	445 – 490	2000 – 2015	-85 to -50	2.0 – 2.4	0.4 – 1.4
400 – 440	490 – 535	2000 – 2020	-60 to -30	2.4 – 2.8	0.5 – 1.7
440 – 485	535 – 590	2010 – 2030	-30 to +5	2.8 – 3.2	0.6 – 1.9
485 – 570	590 – 710	2020 – 2060	+10 to +60	3.2 – 4.0	0.6 – 2.4
570 – 660	710 – 855	2050 – 2080	+25 to +85	4.0 – 4.9	0.8 – 2.9
660 – 790	855 – 1130	2060 – 2090	+90 to +140	4.9 – 6.1	1.0 – 3.7

Policymakers must decide what actions to take. Science can predict how climate will respond.



What will this picture look like in 2020 or 2050 or 2100? What will the climate be? 25

**\*\*\*FREE\*\*\* EXTRA MINI-TALK on IPCC**

The Intergovernmental Panel on Climate  
Change (IPCC)

*assesses*

climate change science  
in a policy-relevant but  
not policy-prescriptive way

The IPCC reports fairly summarize the mainstream scientific consensus.

They have been endorsed by major scientific professional societies and national academies of science in many countries.

They are the definitive "gold standard."

Somehow, policymakers must sort through evidence, weigh costs and benefits, evaluate risks, and decide on action.

Science has a role in informing wise policy.

Because the stakes are high and the system complex, policymakers cannot rely on any single expert viewpoint.

Policymakers need an objective source of the most widely accepted scientific information about climate change.

The IPCC was established in 1988 to meet this need.

Both governments and scientists were involved in creating the IPCC and deciding how it would work.

The World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) jointly established the IPCC.

It is important to understand that the IPCC is both governmental and scientific.

Example: Writing the summary statements.

IPCC does not conduct new research.

Its mandate is to assess, on a comprehensive, objective, open and transparent basis, the available scientific information in peer-reviewed literature.

IPCC reports are policy-relevant but not policy-prescriptive or policy-driven.

The IPCC places great emphasis on the accurate characterization of scientific uncertainty.

It uses carefully calibrated and consistent language in its reports.

Sometimes uncertainty is a matter of expert judgment, sometimes not.

The IPCC reports allow informed policymakers to see the consequences of alternative decisions.

In this sense, the IPCC can help provide sound scientific input to the making of wise policy.

Some issues facing the IPCC in the past:

Governments and scientists disagreeing.

Threats to divert the IPCC from climate science to other agendas.

Disinformation by climate skeptics.

Issues likely to face the IPCC in the future:

Extra work for the science community.

IPCC effect on the research agenda.

Need for faster responses, and for better communication with the public.

