A Climate Change Primer
The IPCC Fourth Assessment Report

Richard McGehee

Seminar on the Mathematics of Climate Change
School of Mathematics
October 31, 2007

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2007 Nobel Peace Prize

http://nobelprize.org/nobel_prizes/peace/laureates/2007/

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What is the IPCC?

"The World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established the **Intergovernmental Panel on Climate Change (IPCC)** in 1988. The role of the IPCC is to assess 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, its potential impacts and options for adaptation and mitigation."

http://www.ipcc.ch/

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What is the IPCC?

130 countries
800 authors
2500 scientific experts

huge bureaucracy

political considerations

not prone to hyperbole

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Progression of Stridency

1990 (First Assessment Report): "The ***unequivocal*** detection of the enhanced greenhouse effect is not likely for a decade or more."

1995 (Second Assessment Report): "The balance of evidence suggests a discernible human influence on global climate."

2001 (Third Assessment Report): "There is new and stronger evidence that most of the warming observed over the past 50 years is attributable to human activities."

http://en.wikipedia.org/wiki/IPCC

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Progression of Stridency

2007 (Fourth Assessment Report)

"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." (p. 5)

"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." (p. 10)

Summary for Policy Makers, IPCC AR4
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_SPM.pdf

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Public Reaction

"A United Nations report issued today by the world's top climate scientists said global warning was 'very likely' man-made and would bring higher temperatures and a steady rise in sea levels for centuries to come regardless of how much the world slows or reduces its greenhouse gas emissions. ... 'Warming of the climate system is unequivocal ... .'"

USA Today, February 1, 2007
http://www.usatoday.com/weather/climate/globalwarming/2007-02-01-ipcc-report_x.htm

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Public Reaction

'Global warming is here and humans are "very likely" the blame, an international group of scientists meeting in Paris, France, announced Friday. "The evidence for warming having happened on the planet is unequivocal," said U.S. government scientist Susan Solomon, who also is a member of the Intergovernmental Panel on Climate Change.'

CNN, February 2, 2007
http://www.cnn.com/2007/TECH/science/02/02/climate.change.report/index.html?iref=newssearch

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Public Reaction

Climate Change Verdict: Science Debate Ends, Solution Debate Begins
by David Biello

The debate over whether Earth's climate is changing and if humanity is responsible for that change closed in Paris on February 2. The Intergovernmental Panel on Climate Change (IPCC) released its summary for policymakers—a summation of the salient science in its much longer report due in May—in which it said that climate change is "unequivocal" and estimated the chances of humans being behind it at 90 percent, or "very likely."

Scientific American Online, February 8, 2007
http://www.sciam.com/article.cfm?articleID=A1E03678-E7F2-99DF-349533FA77189693

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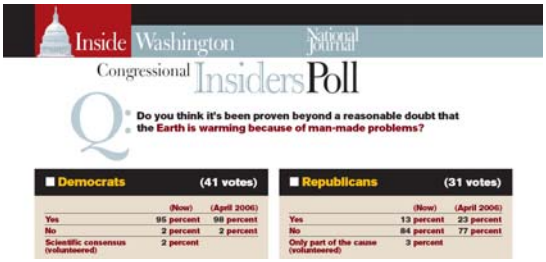
Public Reaction



National Journal, Feb 3, 2007
http://syndication.nationaljournal.com/images/203Insiderspoll_NJlogo.pdf

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Terminology

Likelihood Terminology	Likelihood of the occurrence/ outcome
Virtually certain	> 99% probability
Extremely likely	> 95% probability
Very likely	> 90% probability
Likely	> 66% probability
More likely than not	> 50% probability
About as likely as not	33 to 66% probability
Unlikely	< 33% probability
Very unlikely	< 10% probability
Extremely unlikely	< 5% probability
Exceptionally unlikely	< 1% probability

Technical Summary, IPCC AR4, p.23
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf

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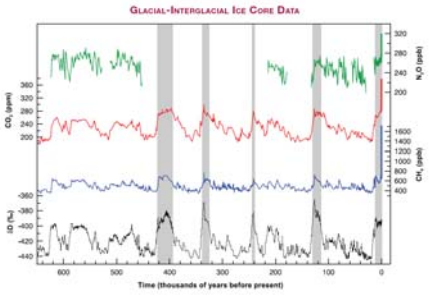
Greenhouse Gases



Technical Summary, IPCC AR4, p.24
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf

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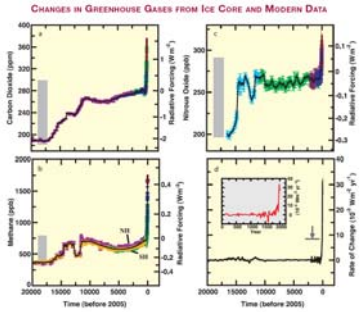
Radiative Forcing by Greenhouse Gases



Technical Summary, IPCC AR4, p.25
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf

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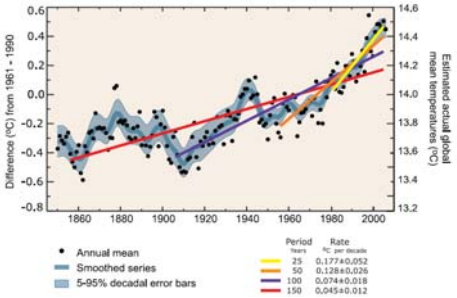
Global Mean Temperature



Technical Summary, IPCC AR4, p.37
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf

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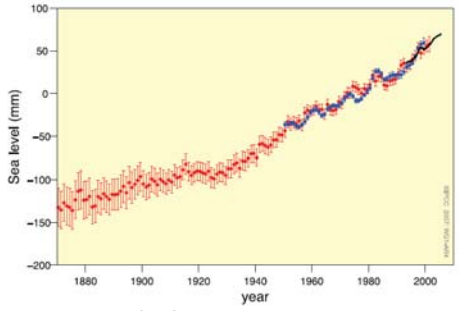
Global Mean Sea Level



Technical Summary, IPCC AR4, p.49
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf

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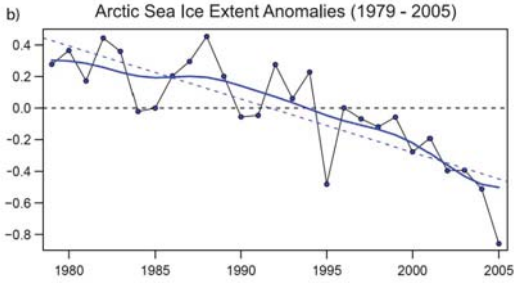
Arctic Sea Ice



Technical Summary, IPCC AR4, p.45
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_TS.pdf

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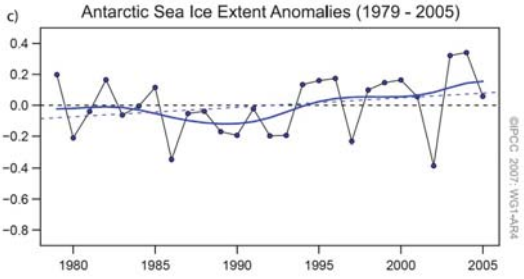
Antarctic Sea Ice



Technical Summary, IPCC AR4, p.45
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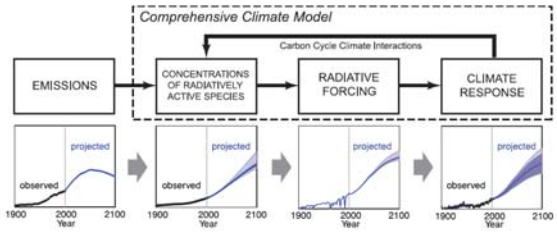
Prediction Methodology



Global Climate Projections, IPCC AR4, p.753
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_CH10.pdf

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Emission Scenarios

"Emission scenarios" for the 21st century are derived from "storylines." Complex economic models are fed storyline inputs. The outputs are predictions for greenhouse gas emission throughout the 21st century.

The storylines used for the fourth annual report have the labels A1B, A1FI, A1T, A2, B1, and B2.

The storylines and scenarios are described in the IPCC *Special Report on Emission Scenarios*.

http://www.grida.no/climate/ipcc/emission/089.htm

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SRES Storylines

The A1 storyline and scenario family describes a future world of very rapid economic growth, low population growth, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. The A1 scenario family develops into four groups that describe alternative directions of technological change in the energy system.

etc.

http://www.grida.no/climate/ipcc/emission/091.htm#4.2.1.

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SRES Storylines

The A1 scenarios are of a more integrated world. The A1 family of scenarios is characterized by:

- •Rapid economic growth.
- •A global population that reaches 9 billion in 2050 and then gradually declines.
- •The quick spread of new and efficient technologies.
- •A convergent world - income and way of life converge between regions. Extensive social and cultural interactions worldwide.

http://en.wikipedia.org/wiki/Special_Report_on_Emissions_Scenarios

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SRES Storylines

There are subsets to the A1 family based on their technological emphasis:

- A1FI - An emphasis on fossil-fuels.
- A1B - A balanced emphasis on all energy sources.
- A1T - Emphasis on non-fossil energy sources.

http://en.wikipedia.org/wiki/Special_Report_on_Emissions_Scenarios

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SRES Storylines

The A2 scenarios are of a more divided world. The A2 family of scenarios is characterized by:

- •A world of independently operating, self-reliant nations.
- •Continuously increasing population.
- •Regionally oriented economic development.
- •Slower and more fragmented technological changes and improvements to per capita income.

http://en.wikipedia.org/wiki/Special_Report_on_Emissions_Scenarios

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SRES Storylines

The B1 scenarios are of a world more integrated, and more ecologically friendly. The B1 scenarios are characterized by:

- •Rapid economic growth as in A1, but with rapid changes towards a service and information economy.
- •Population rising to 9 billion in 2050 and then declining as in A1.
- •Reductions in material intensity and the introduction of clean and resource efficient technologies.
- •An emphasis on global solutions to economic, social and environmental stability.

http://en.wikipedia.org/wiki/Special_Report_on_Emissions_Scenarios

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SRES Storylines

The B2 scenarios are of a world more divided, but more ecologically friendly. The B2 scenarios are characterized by:

- •Continuously increasing population, but at a slower rate than in A2.
- •Emphasis on local rather than global solutions to economic, social and environmental stability.
- •Intermediate levels of economic development.
- •Less rapid and more fragmented technological change than in B1 and A1.

http://en.wikipedia.org/wiki/Special_Report_on_Emissions_Scenarios

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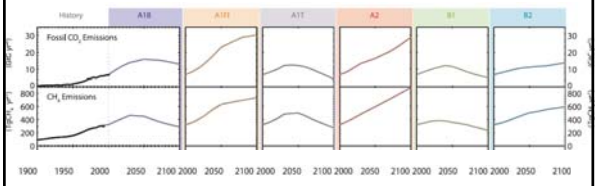
Emission Scenarios



Global Climate Projections, IPCC AR4, p.803
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_CH10.pdf

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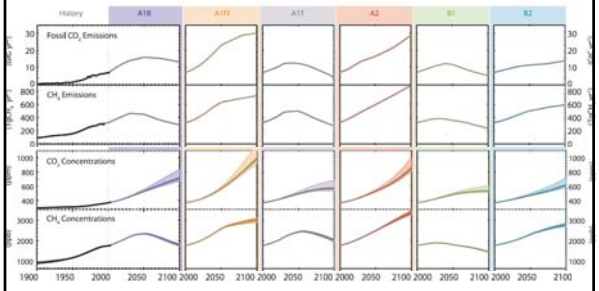
Greenhouse Gas Predictions



Global Climate Projections, IPCC AR4, p.803
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_CH10.pdf

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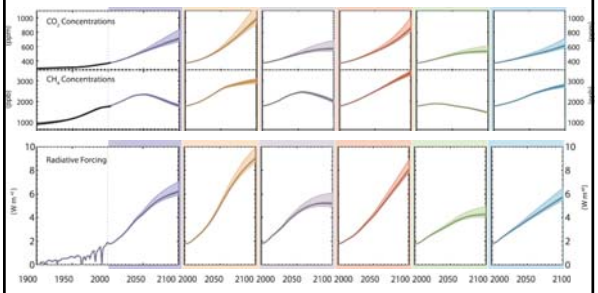
Radiative Forcing Predictions



Global Climate Projections, IPCC AR4, p.803
http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_CH10.pdf

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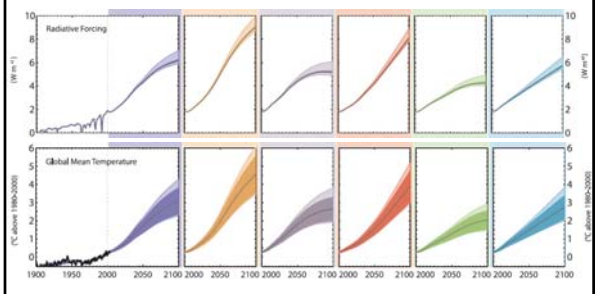
Global Mean Temperature Predictions



Global Climate Projections, IPCC AR4, p.803
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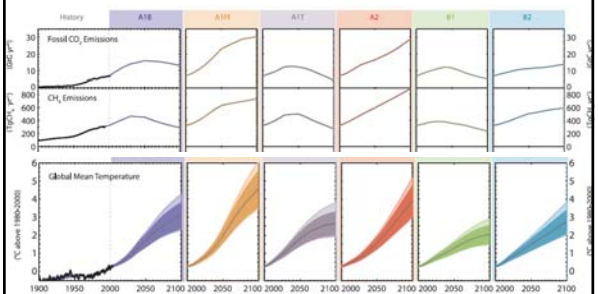
Global Mean Temperature Predictions



Global Climate Projections, IPCC AR4, p.803
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