Evidence of human influence on the environment

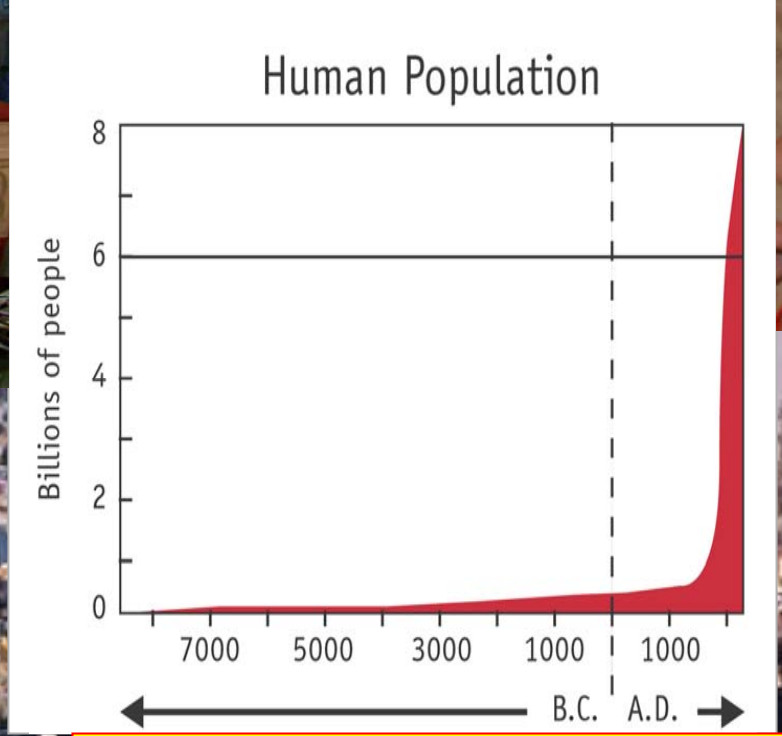
Global Environmental Change Science

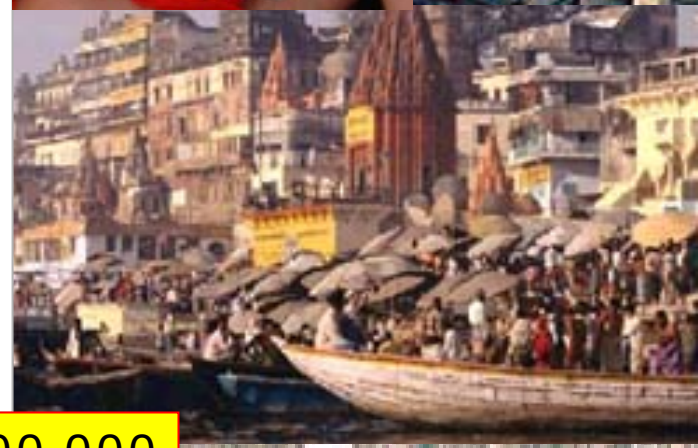
Relation to International Environmental Assessments and Conventions

Kevin. E. Trenberth

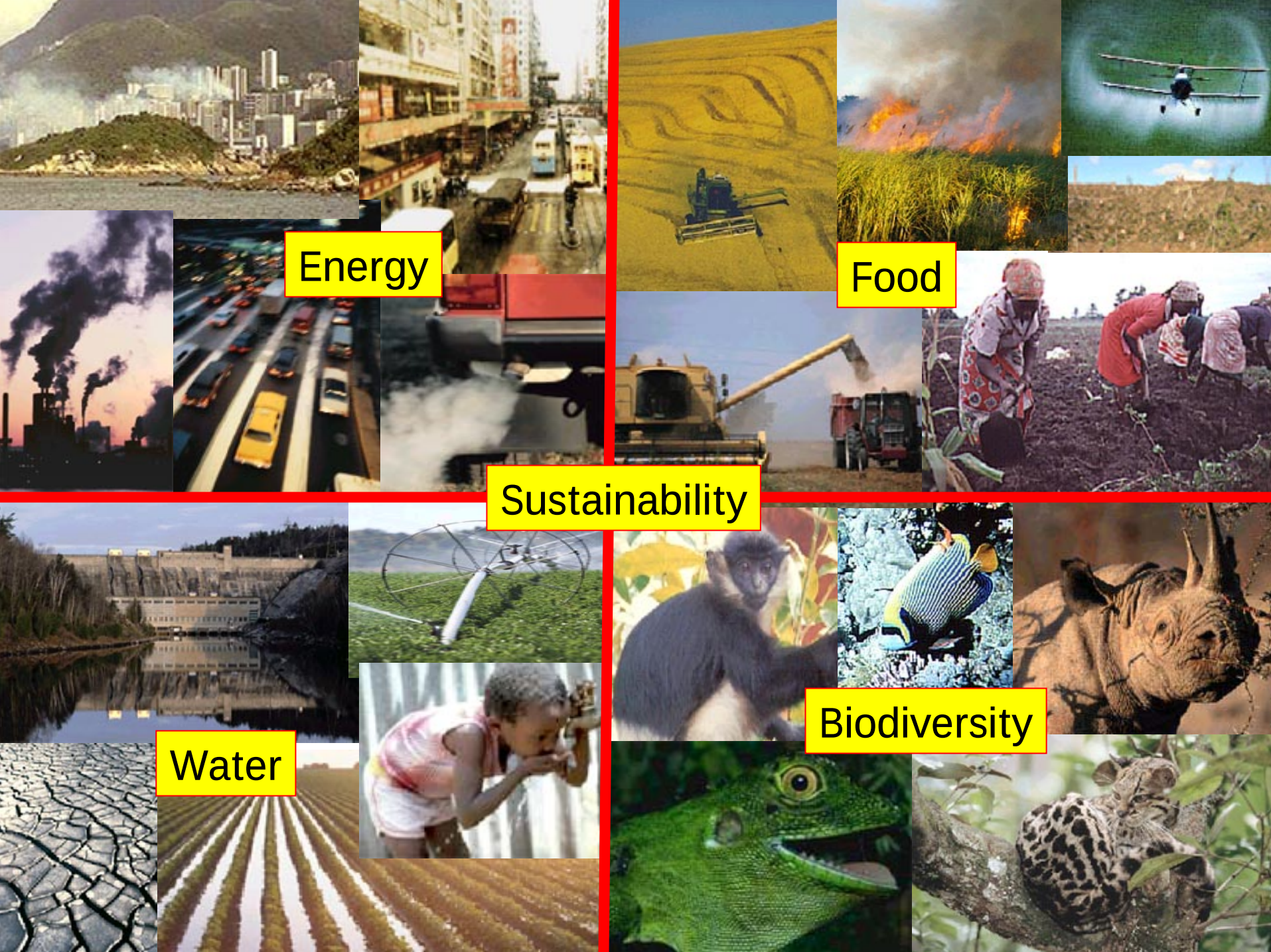
http://visibleearth.nasa.gov/images/1438/earth_lights.jpg

NCAR





World Population 6,640,000,000


Energy
Food
Sustainability
Water
Biodiversity

Fundamental Earth Science Questions

- How is the global Earth system *changing*?
- What are the primary *forcings* of the Earth system?
- How does the Earth system *respond* to natural and human-induced changes?
- What are the *consequences* of changes in the Earth system for human civilization?
- How well can we *predict* future changes in the Earth system?
- Can effective *action* be taken in response to the findings?

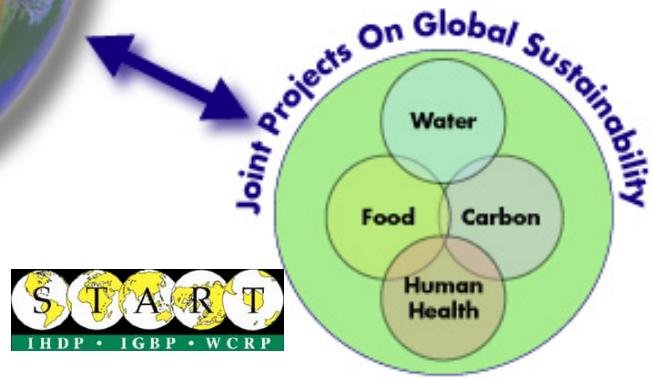
Earth System Science Partnership

IPCC

Intergovernmental Panel on Climate Change

The IPCC claims that “it doesn’t do science”. So who does?

We do!



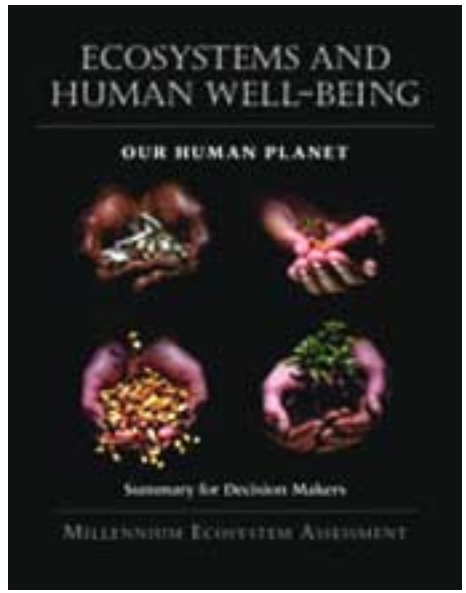
START
IHDP • IGBP • WCRP


IPCC Assessment
Millennium Ecosystem Assessment
Ozone Assessment
GCOS Adequacy Report
Best available scientific information
IHDP
WCRP
Diversitas
IGBP
NCAR


IPCC 2000
EMISSIONS REPORT 99
CLIMATE 2050
IPCC 1992
CLIMATE 2030
KYOTO
IPCC 1996

NCAR

Millennium Ecosystem Assessment



Begun 2001, completed in March 2005:
Series of reports:

Ecosystems & Human Well-being:

- :Synthesis
- :Biodiversity Synthesis
- :Desertification Synthesis
- :Opportunities & Challenges for Business & Industry
- :Wetlands & Water
- :Health

1300 experts from 95 countries

NCAR

Millennium Ecosystem Assessment

"Any progress achieved in addressing the goals of poverty and hunger eradication, improved health, and environmental protection is unlikely to be sustained if most of the ecosystem services on which humanity relies continue to be degraded".

"Ongoing degradation of ecosystem services is a road block to the Millennium Development Goals agreed to by the world leaders at the United Nations in 2000."

From the Synthesis Report

"The MA has provided a road map, now we need to start the journey." Carpenter et al. 2006 *Science.*

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Ozone assessments

1985: Ozone hole discovered

1986: First ozone assessment. Others followed: 1988, 1989, 1991, 1994, 1998, 2002, (2006 underway).

1986-89: Scientific explanation

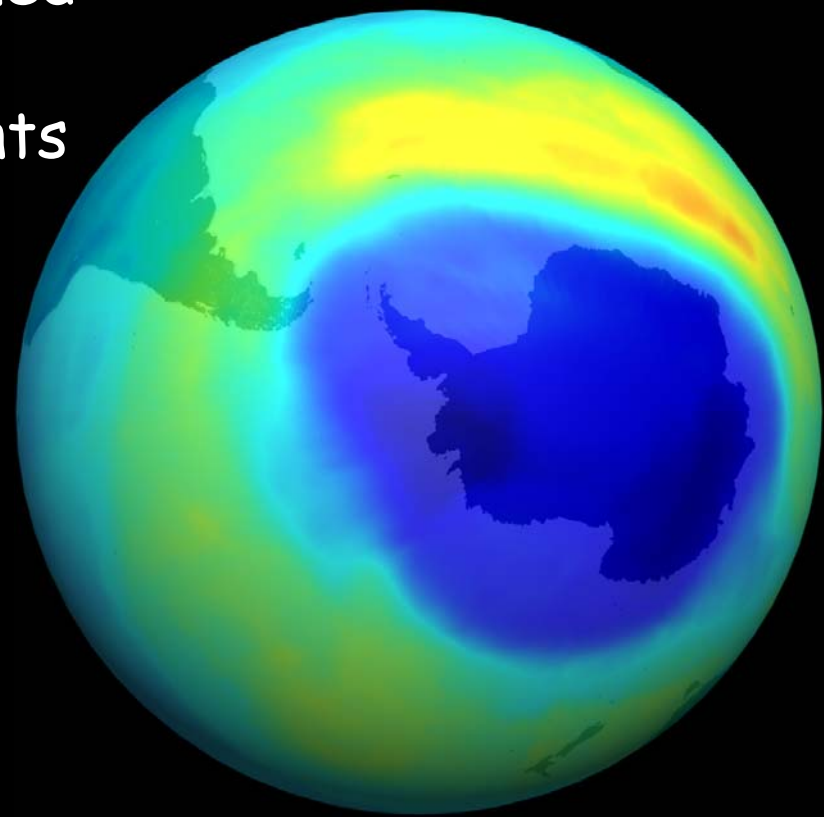
1987: Montreal Protocol signed

1990: London amendments

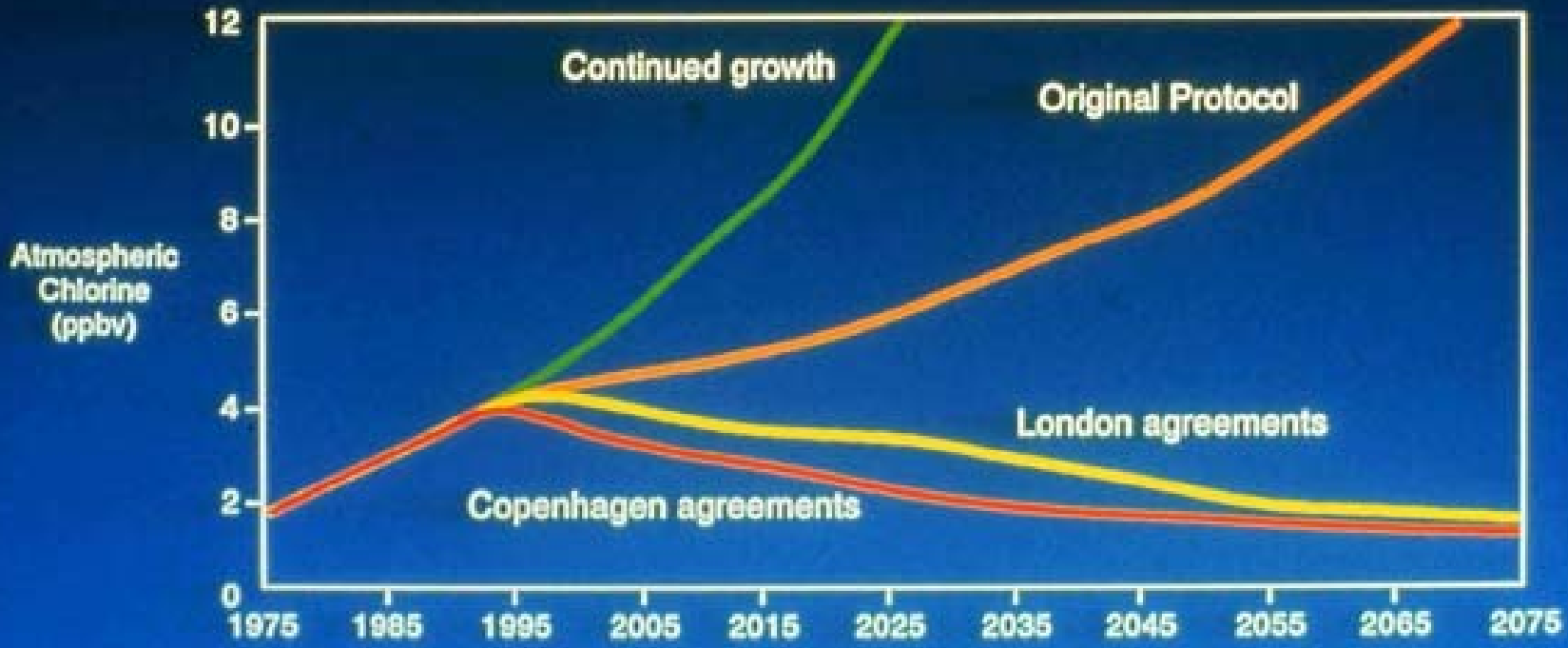
1992: Copenhagen amendments

1999: Beijing amendments:

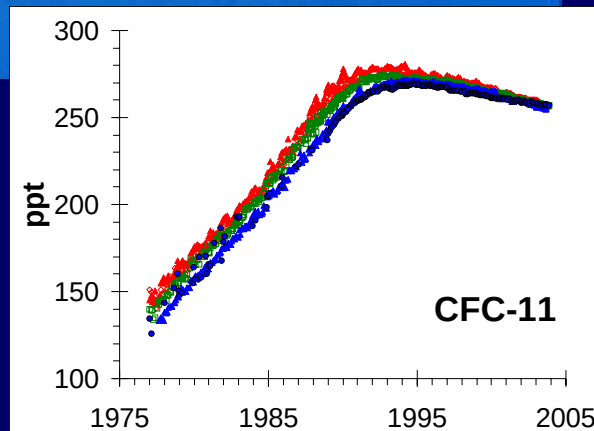
each decreasing the amount of ozone depleting material allowed to be emitted as evidence became more widespread of ozone depletion elsewhere as well.



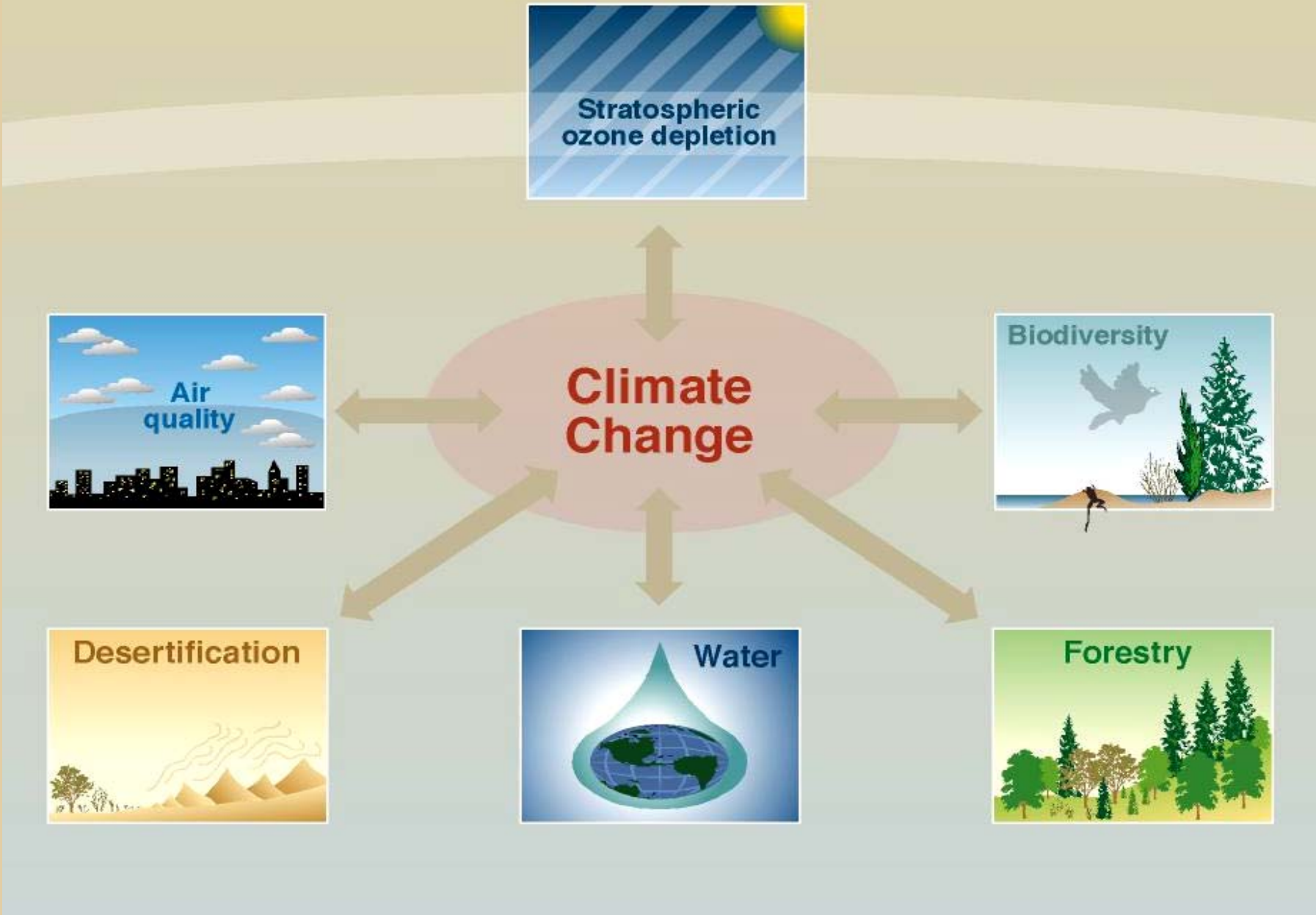
Atmospheric Chlorine



What the world decided to do about it.



Climate change & other environmental issues are inter-linked



Agricultural Lands | Coastal Zones | Forest Lands | Freshwater Systems | Arid Lands Grasslands

Food and Fiber Production

Provision of Clean and Sufficient Water

Maintenance of Biodiversity

Maintenance of Human Health

Storage and cycling of Carbon, Nitrogen, Phosphorus

Climate change will affect the ability of ecological systems to provide essential ecological goods and services

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1988 - The establishment of the IPCC
WMO, UNEP

1990 - First IPCC Assessment Report

1992 - IPCC Supplementary Reports

1992- Adoption of the UNFCCC
1994- Entry into force of the UNFCCC
Ratified by 189 countries

1994 - IPCC Special Report

1995 - Second IPCC Assessment Report

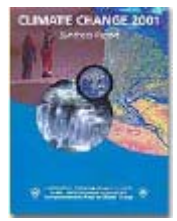
1996 - COP-2, 1997 - COP-3

1997- Adoption of Kyoto Protocol at COP-3
2005 Feb 16- Kyoto Protocol ratified by 164 countries
(But not by USA or Australia)

2001 - Third IPCC Assessment Report

2002 - COP-8, 2003 - COP-9

2007 - Fourth IPCC Assessment Report



UNFCCC ARTICLE 2: OBJECTIVE

The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

1988 - The establishment of the IPCC

Role of the IPCC:

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.
Review by experts and governments is an essential part of the IPCC process.

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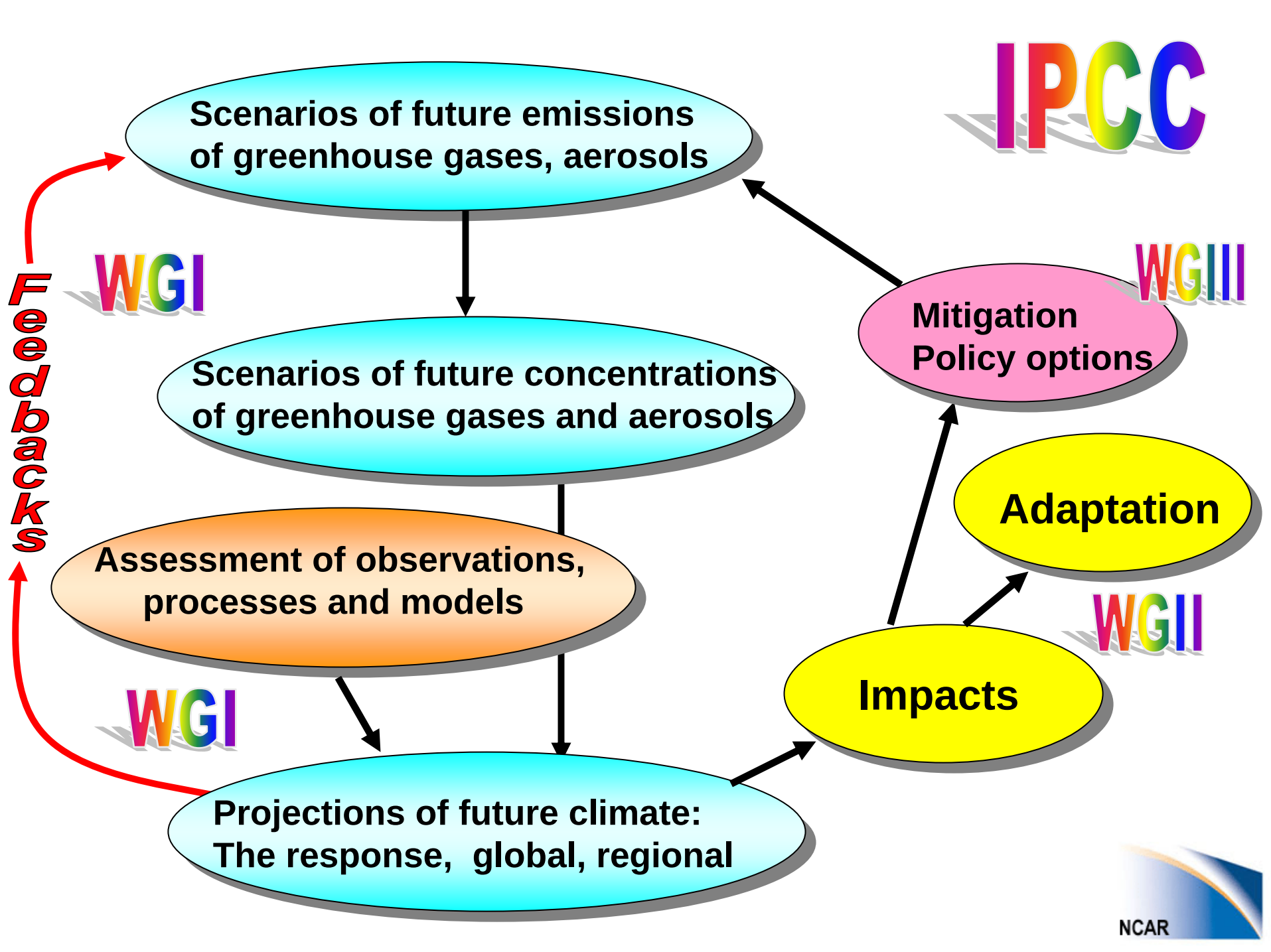
IPCC
Scenarios of future emissions of greenhouse gases, aerosols
WGI
Scenarios of future concentrations of greenhouse gases and aerosols
Assessment of observations, processes and models
WGI
Projections of future climate: The response, global, regional
Feedbacks
WGIII
Mitigation Policy options
Adaptation
WGII
Impacts
NCAR

The role of the IPCC

is to provide **policy relevant** but not **policy prescriptive** scientific advice to policy makers and the general public.

IPCC scientists with all kinds of value systems, ethnic backgrounds, and from different countries, gather together to produce the best **consensus** science possible, and with appropriate statements about confidence and uncertainty.

Scientists have become accustomed to this role and many find it hard to become **advocates** for particular courses of action, and have often been criticized as a result.

It is a difficult balancing act to be an **unbiased scientist** at work and an advocate in one's own time.

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A major strength of the IPCC process has been the **intergovernmental** process, through reviews and then approval of the **Summary for Policy Makers** on a word-by-word basis. This provides ownership.

But it has also been subject to much criticism as it is much more political. In principle, this process is designed to provide a report in which the content is **determined by the science** while **how it is stated** is determined jointly with the governments. Hence it aids communication between scientists and politicians.

NOTE: **In terms of impact of the report, the process is as important as the report itself.**

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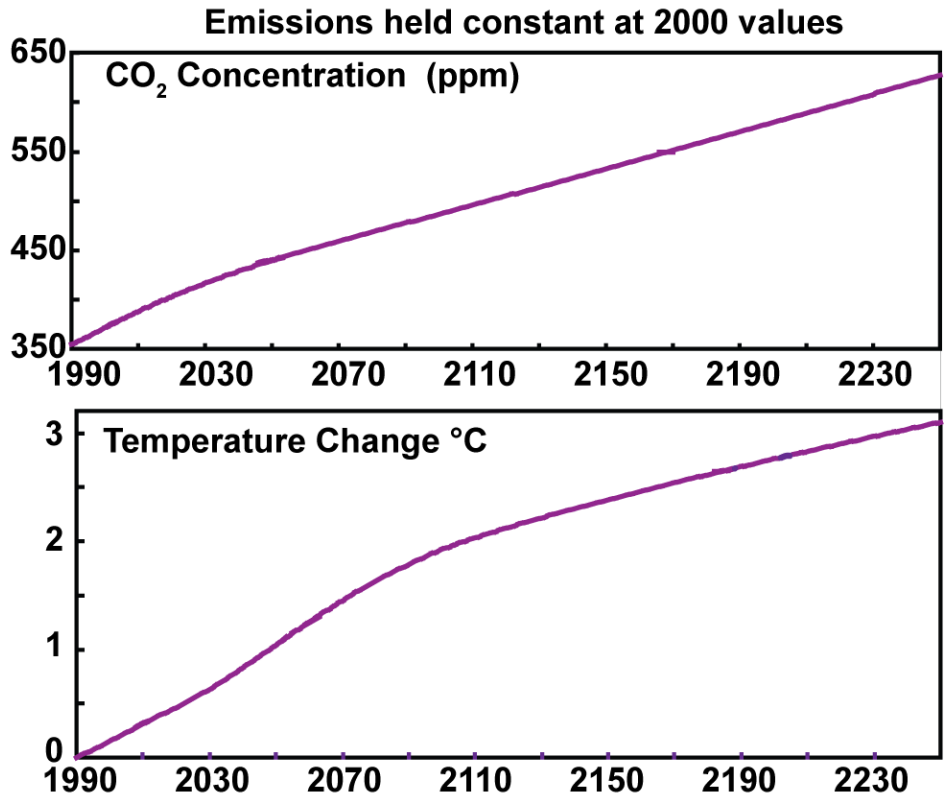
Global Warming

The **Kyoto Protocol** basically calls for a freeze on emissions to 1990 levels for developed countries. Similarly, the Montreal Protocol for ozone depletion initially called for a freeze on CFC emissions and only later was this changed to a phase out.

A freeze on emissions means that concentrations of carbon dioxide continue to increase. Climate continues to change, temperatures rise and sea level continues to rise.



Global Warming

Global climate change from human influences is already with us. **The long lifetime of Carbon Dioxide and other GHGs means that there is already a commitment to further climate change of at least 0.6°C.**

We can not stop it: we can slow it down! That is highly desirable as it allows greater time for planning and adaptation. Disruption arises more from rapid change than from the climate per se.

However, mitigation effects mainly payoff beyond 2050. So we must adapt to climate change: we will adapt, whether unplanned (disruptive untold damage and loss of life), autonomously, or planned.

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Global Warming

Climate change is not necessarily bad! Rapid change is: because we are adapted to our current climate. Increasingly, **the climate of the past is not a good guide to the future**. But that is what is widely used for planning and design: water use, buildings, energy, agriculture…

All climate change has a cause, even if natural.
E.g., It is possible for the atmosphere to warm at the expense of cooling the oceans. But we can track, in principle, what is happening to the oceans and they too are warming.

The **imperative** is to build an observing and information system to better plan for the future.

NCAR

The climate is changing: It is likely to continue to change!
Regardless of the success of mitigation actions:

We need a comprehensive information system to:

- Observe and track the climate changes and forcings as they occur.
- Analyze global products (with models)
- Understand the changes and their origins
- Validate and improve models
- Initialize models; predict future developments
- Assess impacts regionally: on environment, human activities and sectors such as agriculture, energy, fisheries, water resources, etc.

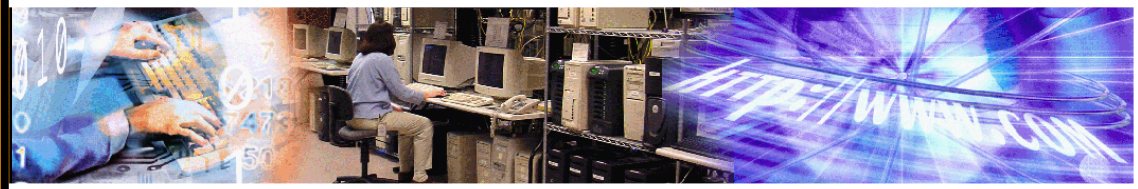
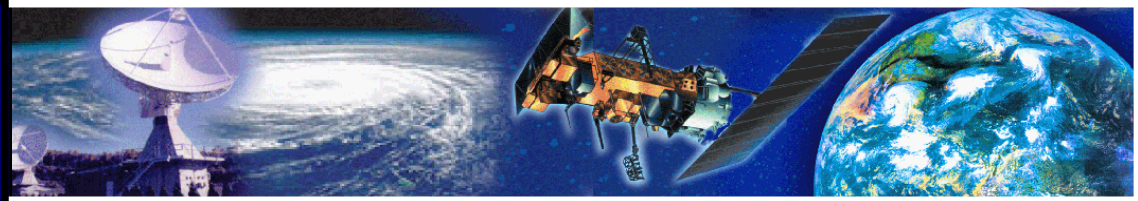
Such a system will be invaluable regardless of magnitude of global warming

NCAR

We have some Global Earth Observations We don't have:

Discipline Specific View

Whole System View

Atmospheric Observations		
Data Systems		
Ocean Observations		
Space Observations		
Technology Development	Innovations Breakthrough Efficiencies Cost Mass Productions	Breakthrough Innovations Efficiencies Cost Mass Productions

20th Century 21st Century

OBSERVING SYSTEM TIMELINE

Courtesy:Tom Karl

GEOSS: A possible way to implement?

Natural & Human Induced Disasters

Water Resources

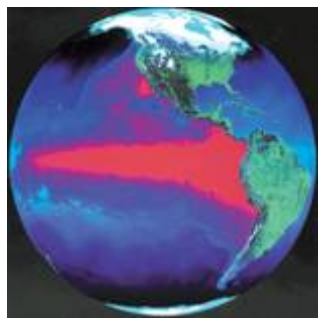
Terrestrial, Coastal & Marine Ecosystems

Human Health & Well-Being

Energy Resources

Sustainable Agriculture & Desertification

Weather Information, Forecasting & Warning



Climate Variability & Change

Biodiversity

We need to do it!

The Challenge:
Sustainable Management of an Ever-Changing Planet

A view of AR4

Every five years a conclave forms

Climate scientists gather in storms

Increased greenhouse gases abound

No obvious solution can be found.

The IPCC report is clear

Global Warming, year after year !

Puff of white smoke (cloud)

K. Trenberth May 2005, Beijing LA mtg; time new Pope selected