A peek into the future

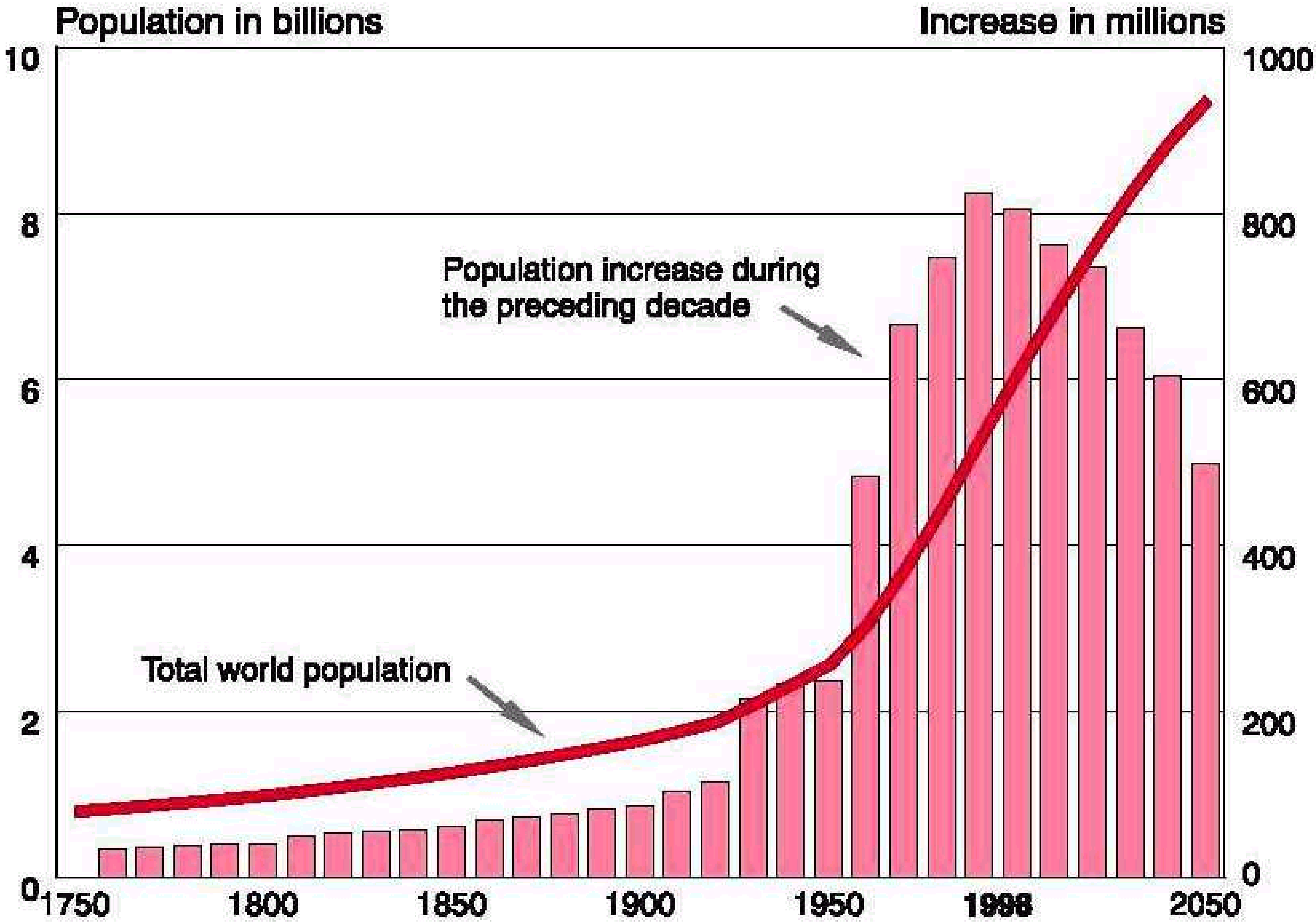
1. Sustainability
2. State of the Planet
3. The Tragedy of the Commons?

TABLE 14.1 Estimates of the Global Flux in the Biogeochemical Cycles of Certain Elements, Illustrating the Human Impact

Element	Juvenile flux[a] (1)	Chemical weathering (2)	Natural cycle[b] (3)	Biospheric recycling ratio[c] 3/(1+2)	Human mobilization[d] (4)	Human enhancement 4/(1+2)	Reference for global cycle
B	0.02	0.19	8.8	42	0.58	2.8	Park and Schlesinger (2002)
C	30	210	107,000	446	8700	36.3	Chapter 11
N	5	20[e]	9200[f]	368	221	8.8	Chapter 12
P	~0	2	1000	500	25	12.5	Chapter 12
S	10	70	450	5.6	130	1.6	Chapter 13
Cl	2	260	120	0.46	170	0.65	Figure 3.16
Ca	120	500	2300	3.7	65	0.10	Milliman et al. (1999), Caro et al. (2010)
Fe	6	1.5	40	5.3	1.1[g]	0.14	Muller et al. (2006)
Cu	0.05	0.056	2.5	23.6	1.5[g]	14.2	Rauch and Graedel (2007)
Hg	0.0005	0.0002	0.003	4.3	0.0023	3.3	Selin (2009)

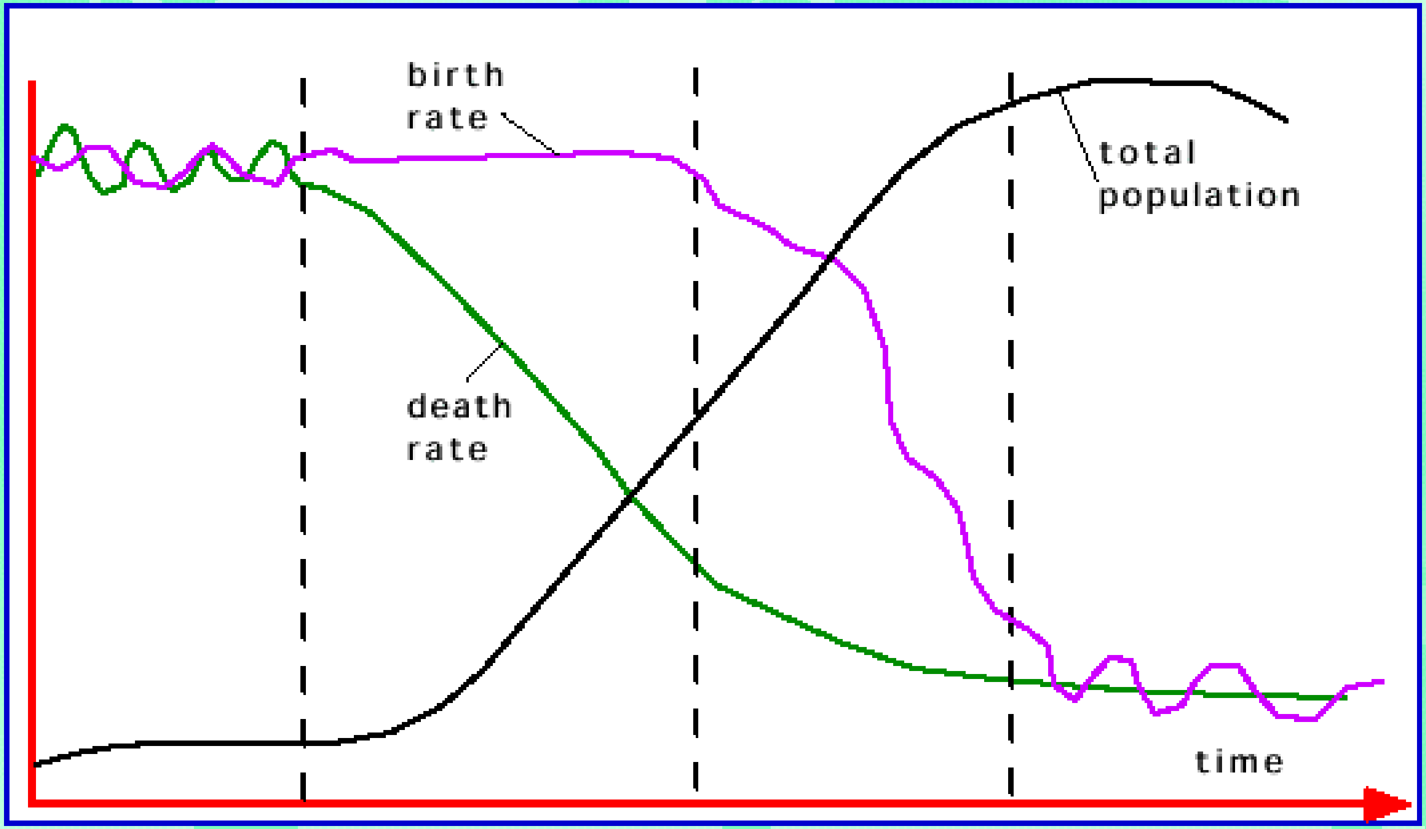
Note: All data 10^{12} g/yr.

[a] *Degassing from the Earth's crust and mantle; sum of volcanic emissions to the atmosphere (subaerial) and net hydrothermal flux to the sea (Elderfield and Schultz 1996) and for N, fixation by lightning (Chapter 12).*



Population in billions
Increase in millions
10
8
6
4
2
0
1000
800
600
400
200
0
1750
1800
1850
1900
1950
1998
2050
Population increase during
the preceding decade
Total world population

The Demographic Transition

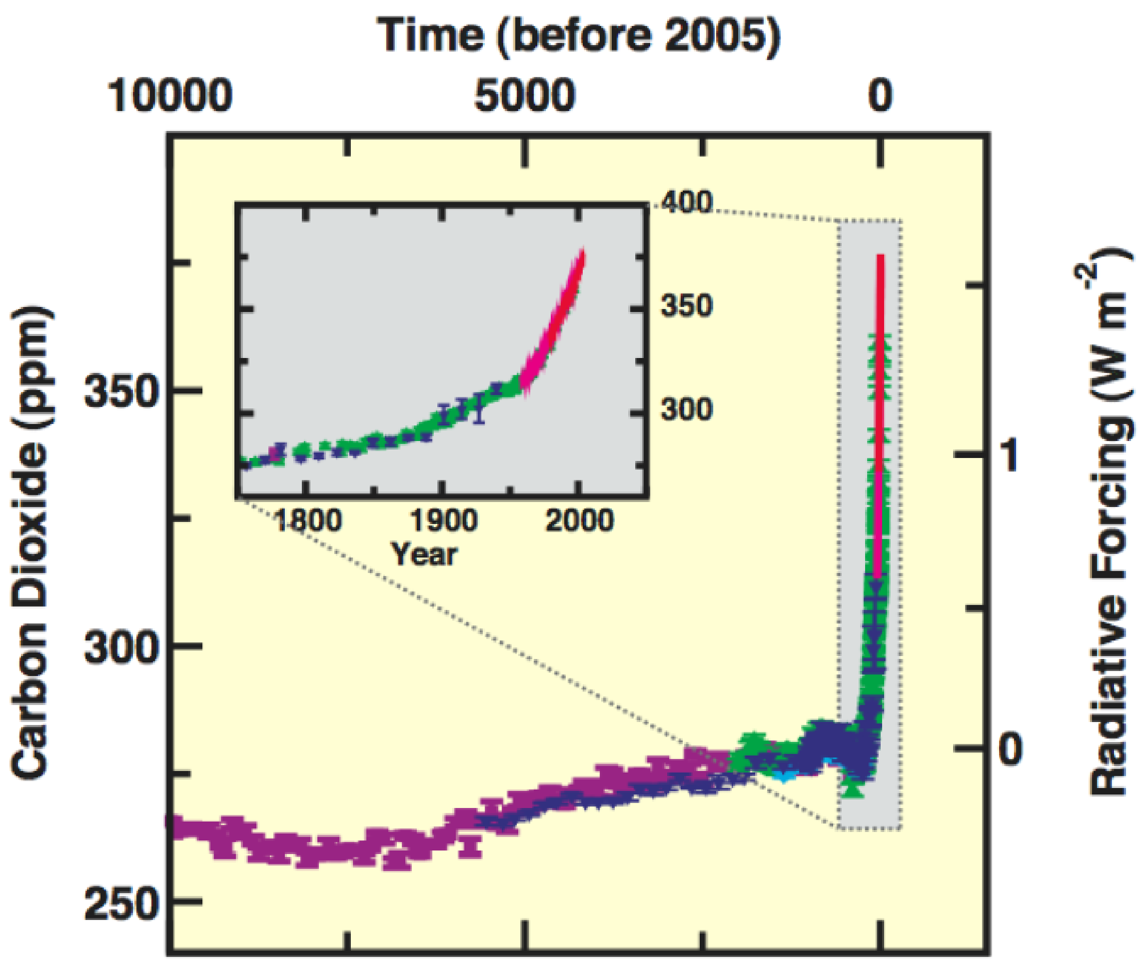


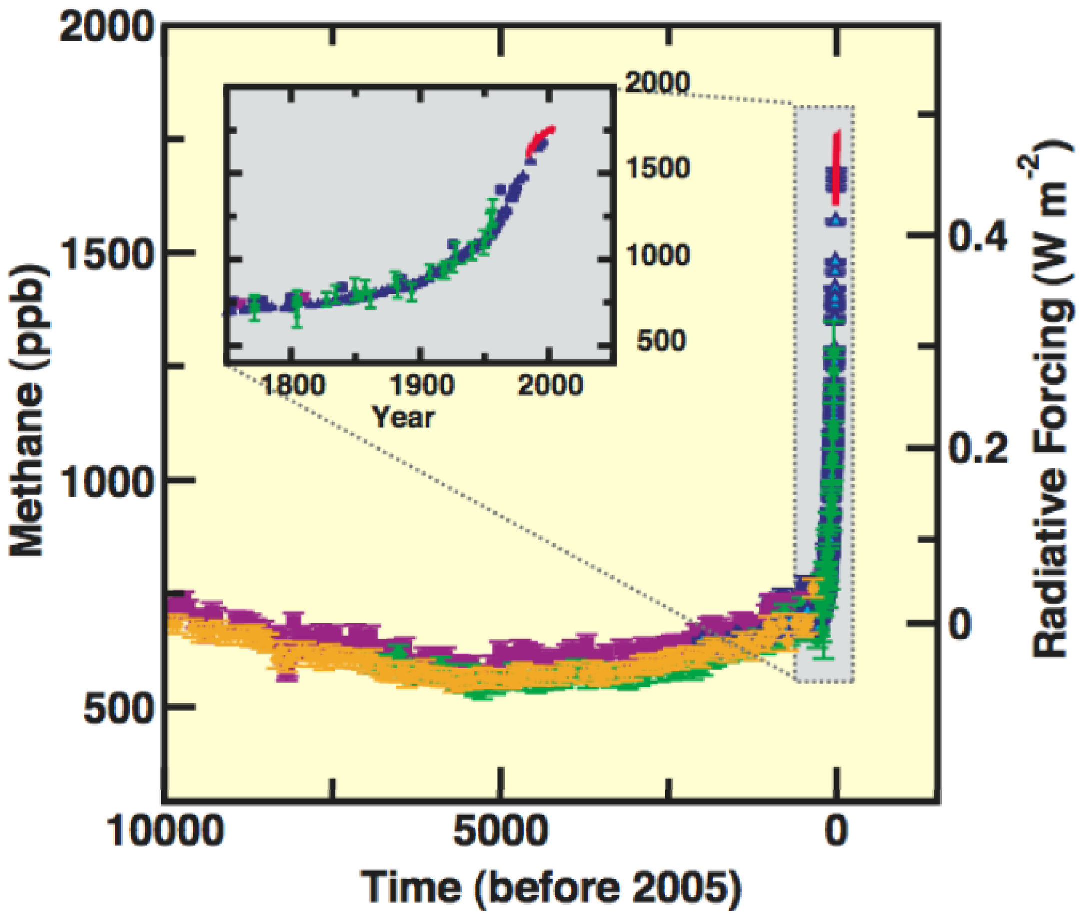
Stage 1	Stage 2	Stage 3	Stage 4
High birth rate high, but fluctuating death rate	Declining death rates and continuing high birth rates	Declining birth and death rates	Low death rates and low, but flutuating birth rates

Is this sustainable?

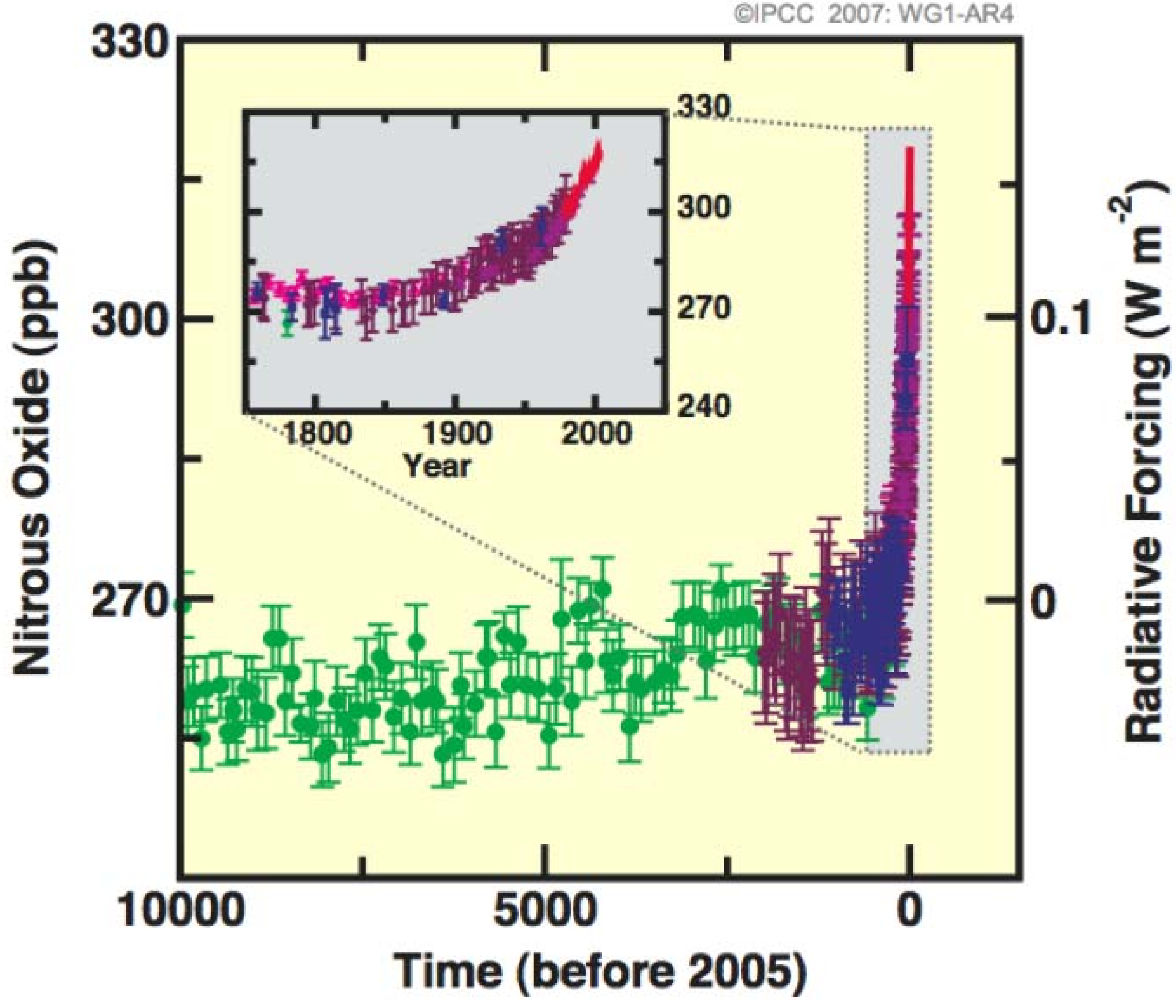
Is there a carrying capacity?

Changes in Greenhouse Gases from ice-Core and Modern Data





2000
1500
1000
500
Methane (ppb)
10000
5000
0
Time (before 2005)
0.4
0.2
0
Radiative Forcing (W m^-2)
1800
1900
2000
Year
2000
1500
1000
500



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330
300
270
Nitrous Oxide (ppb)
0.1
0
Radiative Forcing (W m^{-2})
10000
5000
0
Time (before 2005)
330
300
270
240
1800
1900
2000
Year

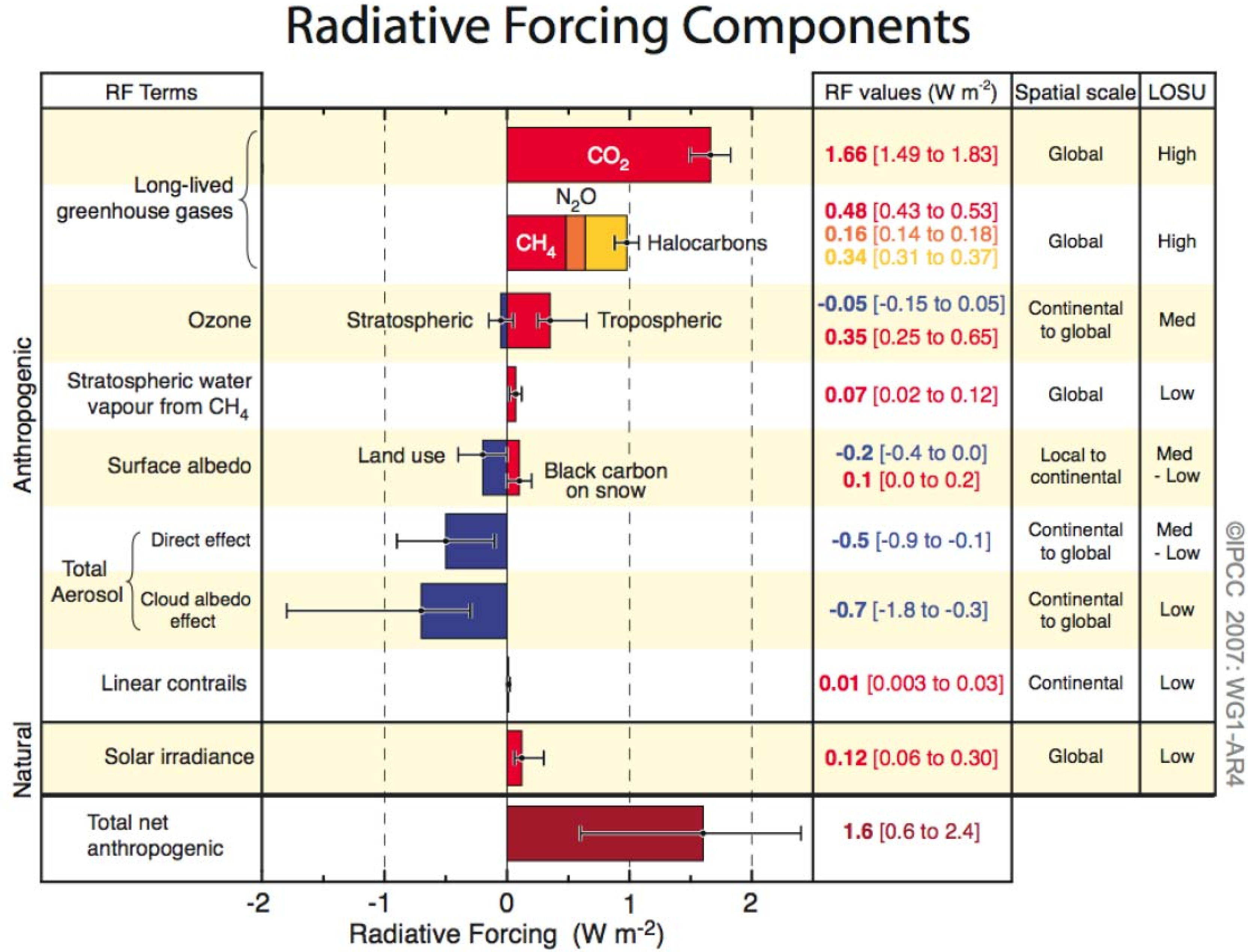
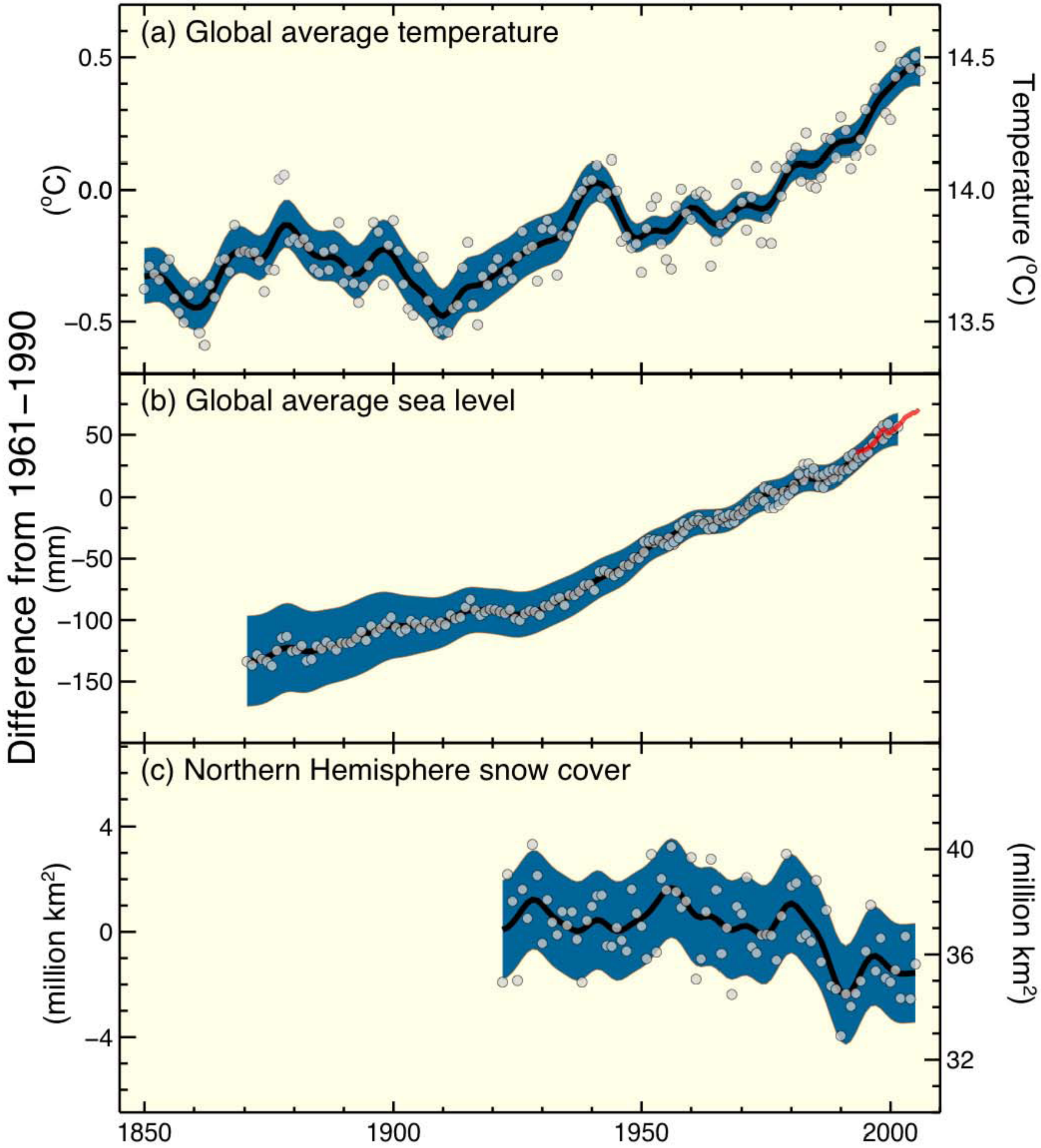


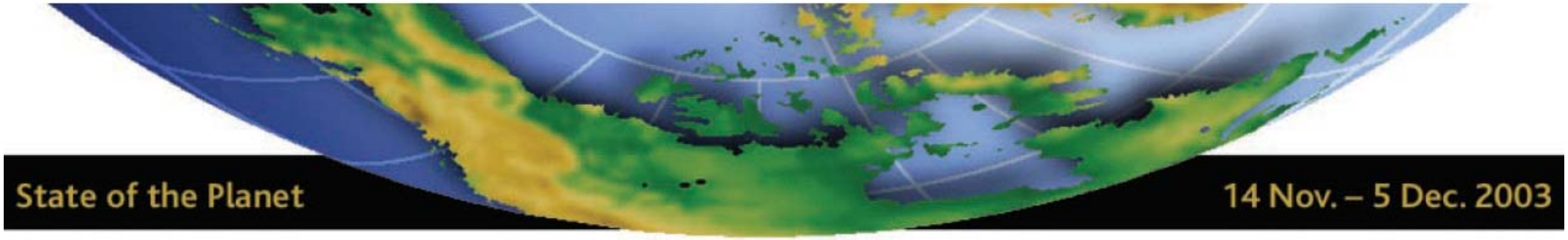
FIGURE SPM-2. Global-average radiative forcing (RF) estimates and ranges in 2005 for anthropogenic carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and other important agents and mechanisms, together with the typical geographical extent (spatial scale) of the forcing and the assessed level of scientific understanding (LOSU). The net

Changes in Temperature, Sea Level and Northern Hemisphere Snow Cover



Baseline=1961-1990;
dots are yearly data,
lines are decadal averages;
shade=uncertainty

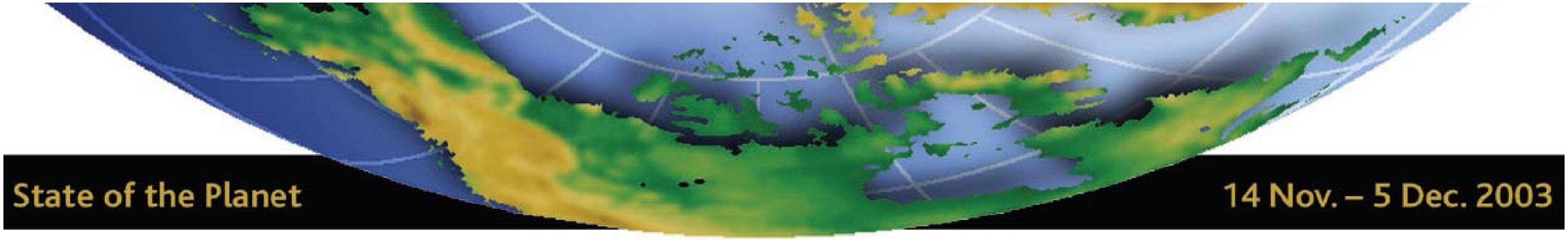
Think of tomorrow?



Human Population: The Next Half Century

Joel E. Cohen

By 2050, the human population will probably be larger by 2 to 4 billion people, more slowly growing (declining in the more developed regions), more urban, especially in less developed regions, and older than in the 20th century. Two major demographic uncertainties in the next 50 years concern international migration and the structure of families. Economies, nonhuman environments, and cultures (including values, religions, and politics) strongly influence demographic changes. Hence, human choices, individual and collective, will have demographic effects, intentional or otherwise.



Energy Resources and Global Development

Jeffrey Chow, Raymond J. Kopp, Paul R. Portney

In order to address the economic and environmental consequences of our global energy system, we consider the availability and consumption of energy resources. Problems arise from our dependence on combustible fuels, the environmental risks associated with their extraction, and the environmental damage caused by their emissions. **Yet no primary energy source, be it renewable or nonrenewable, is free of environmental or economic limitations.** As developed and developing economies continue to grow, **conversion to and adoption of environmentally benign energy technology will depend on political and economic realities.**

Energy Resources and Global Development

Jeffrey Chow, Raymond J. Kopp, Paul R. Portney

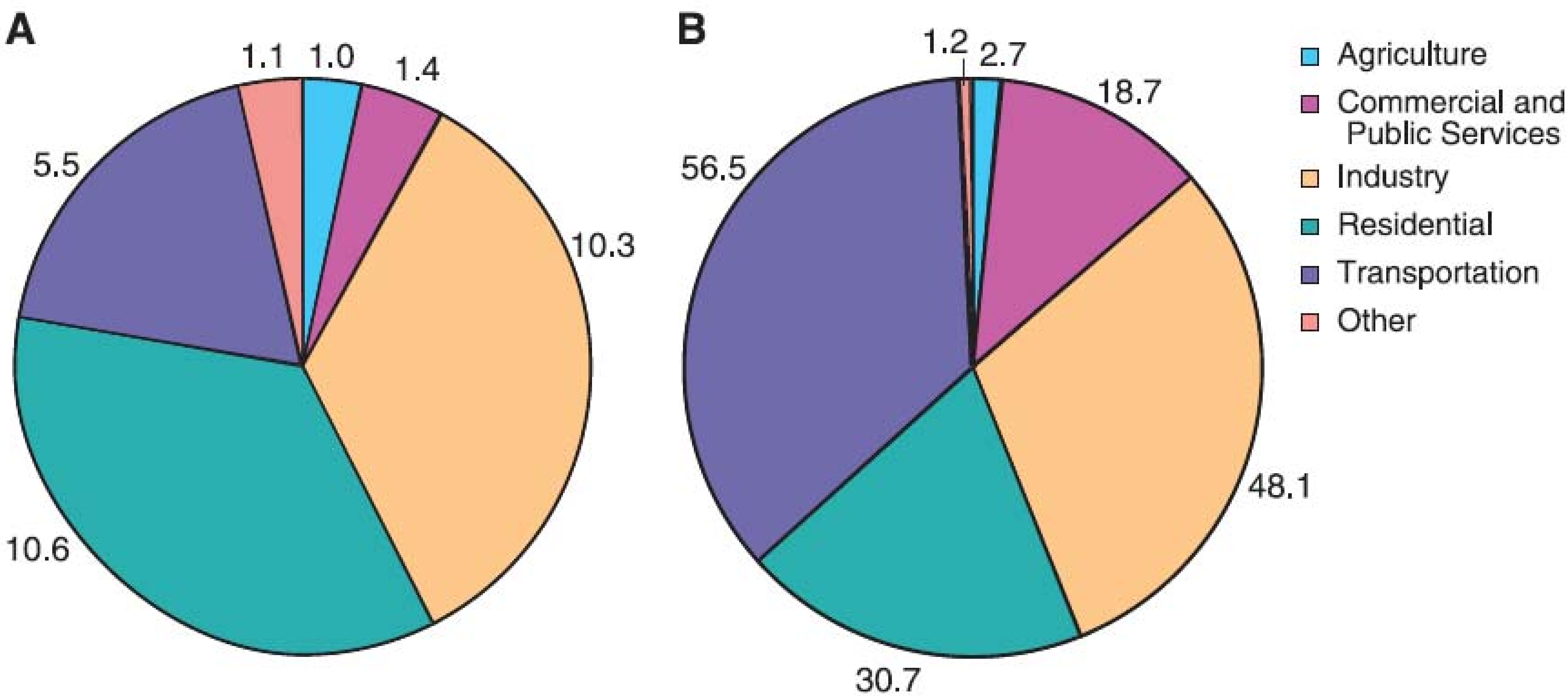
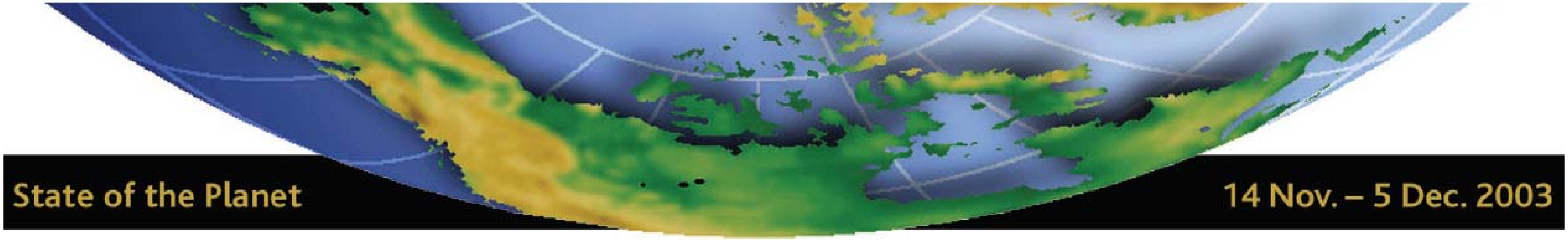


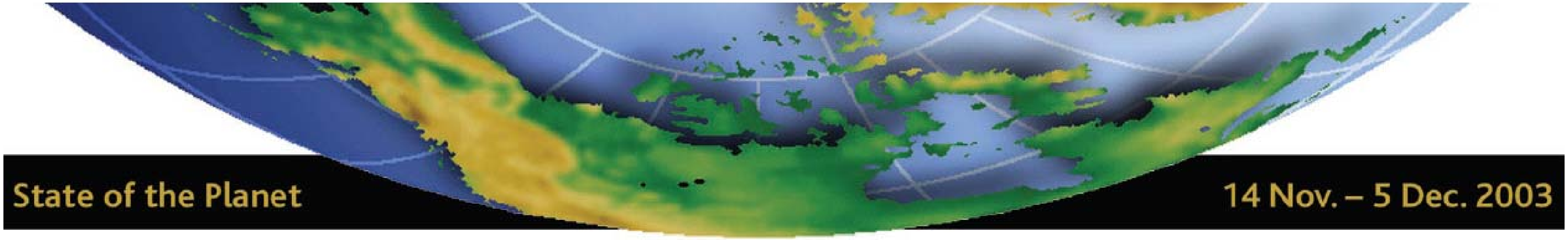
Fig. 1. Per-capita energy consumption by sectoral end use in (**A**) the developing world and (**B**) the developed world (in gigajoules)



Global Freshwater Resources: Soft-Path Solutions for the 21st Century

Peter H. Gleick

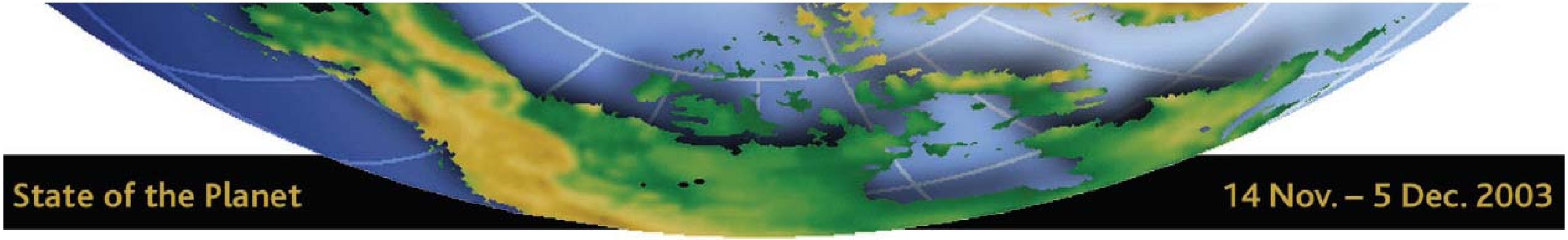
Twentieth-century water policies relied on the **construction of massive infrastructure** in the form of dams, aqueducts, pipelines, and complex centralized treatment plants to meet human demands. These facilities brought tremendous benefits to billions of people, but they **also had serious and often unanticipated social, economical, and ecological costs.** Many unsolved water problems remain, and past approaches no longer seem sufficient. A transition is under way to a “soft path” that **complements centralized physical infrastructure with lower cost community-scale systems, decentralized and open decision-making, water markets and equitable pricing, application of efficient technology, and environmental protection.**



Tropical Soils and Food Security: The Next 50 Years

M. A. Stocking

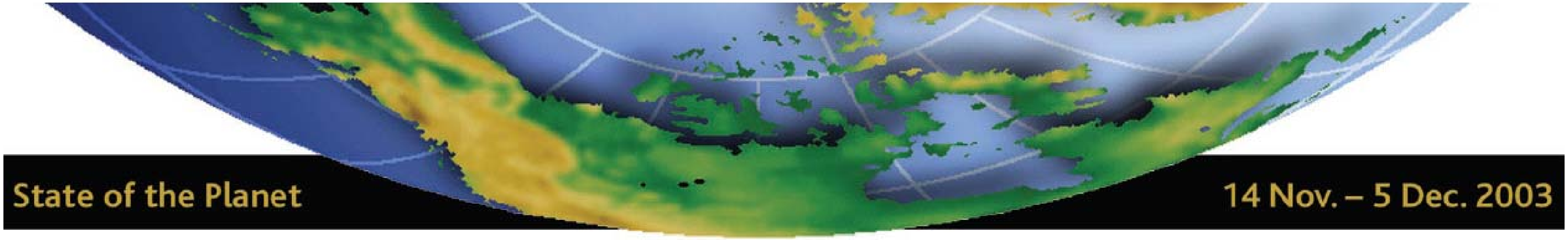
An appreciation of the dynamism of the links between soil resources and society provides a platform for examining food security over the next 50 years. Interventions to reverse declining trends in food security must recognize the variable resilience and sensitivity of major tropical soil types. **In most agroecosystems, declining crop yield is exponentially related to loss of soil quality.** For the majority smallholder (subsistence) farmers,investments to reverse degradation are primarily driven by private benefit,socially or financially. “Tragedy of the commons” scenarios can be averted by pragmatic local solutions that help farmers to help themselves.



Prospects for Biodiversity

Martin Jenkins

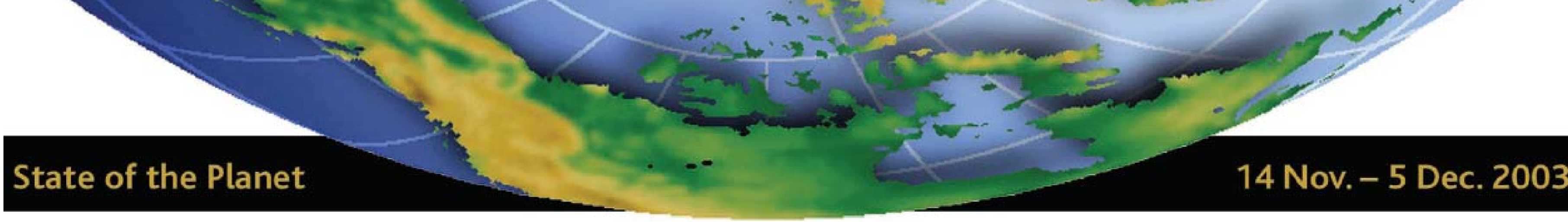
Assuming no radical transformation in human behavior, we can expect important changes in biodiversity and ecosystem services by 2050. A considerable number of species extinctions will have taken place. Existing large blocks of tropical forest will be much reduced and fragmented, but temperate forests and some tropical forests will be stable or increasing in area, although the latter will be biotically impoverished. Marine ecosystems will be very different from today's, with few large marine predators, and freshwater biodiversity will be severely reduced almost everywhere. **These changes will not, in themselves, threaten the survival of humans as a species.**



Global Air Quality and Pollution

Hajime Akimoto

The impact of global air pollution on climate and the environment is a new focus in atmospheric science. **Intercontinental transport and hemispheric air pollution by ozone jeopardize agricultural and natural ecosystems worldwide and have a strong effect on climate**. Aerosols, which are spread globally but have a strong regional imbalance, change global climate through their direct and indirect effects on radiative forcing. In the 1990s, nitrogen oxide emissions from Asia surpassed those from North America and Europe and should continue to exceed them for decades. International initiatives to mitigate global air pollution require participation from both developed and developing countries.



Modern Global Climate Change

Thomas R. Karl[1] and Kevin E. Trenberth[2]

Modern climate change is dominated by human influences, which are now large enough to exceed the bounds of natural variability. The main source of global climate change is human-induced changes in atmospheric composition. These perturbations primarily result from emissions associated with energy use, but on local and regional scales, urbanization and land use changes are also important. Although there has been progress in monitoring and understanding climate change, there remain many scientific, technical, and institutional impediments to precisely planning for, adapting to, and mitigating the effects of climate change. There is still considerable uncertainty about the rates of change that can be expected, but it is clear that these changes will be increasingly manifested in important and tangible ways, such as changes in extremes of temperature and precipitation, decreases in seasonal and perennial snow and ice extent, and sea level rise.

Anthropogenic climate change is now likely to continue for many centuries. We are venturing into the unknown with climate, and its associated impacts could be quite disruptive.

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The Challenge of Long-Term Climate Change

K. Hasselmann,[1,2*] M. Latif,[3] G. Hooss,[4] C. Azar,[5] O. Edenhofer,[1,6] C. C. Jaeger,[1,6] O. M. Johannessen,[1,7] C. Kemfert,[1,4] M. Welp,[1,6] A. Wokaun[1,8]

Climate policy needs to address the multi-decadal to centennial time scale of climate change. Although the realization of short-term targets is an important first step, to be effective climate policies need to be conceived as long-term programs that will achieve a gradual transition to an essentially emission-free economy on the time scale of a century. **This requires a considerably broader spectrum of policy measures than the primarily market-based instruments invoked for shorter term mitigation policies. A successful climate policy must consist of a dual approach focusing on both short-term targets and long-term goals.**

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The Struggle to Govern the Commons

Thomas Dietz,[1] Elinor Ostrom,[2] Paul C. Stern[3]*

Human institutions—ways of organizing activities—affect the resilience of the environment. Locally evolved institutional arrangements governed by stable communities and buffered from outside forces have sustained resources successfully for centuries, although they often fail when rapid change occurs. Ideal conditions for governance are increasingly rare. Critical problems, such as transboundary pollution, tropical deforestation, and climate change, are at larger scales and involve nonlocal influences. Promising strategies for addressing these problems include dialogue among interested parties, officials, and scientists; complex, redundant, and layered institutions; a mix of institutional types; and designs that facilitate experimentation, learning, and change.

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Managing Tragedies: Understanding Conflict over Common Pool Resources

William M. Adams,[1*] Dan Brockington,[2] Jane Dyson,[1] Bhaskar Vira[1]

Conflicts over the management of common pool resources are not simply material. They also depend on the perceptions of the protagonists. Policy to improve management often assumes that problems are self-evident, but in fact **careful and transparent consideration of the ways different stakeholders understand management problems is essential to effective dialogue.**

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New Visions for Addressing Sustainability

A. J. McMichael,[1*] C. D. Butler,[1] Carl Folke[2]

Attaining sustainability will require **concerted interactive efforts among disciplines**, many of which have not yet recognized, and internalized, the relevance of environmental issues to their main intellectual discourse. The inability of key scientific disciplines to engage interactively is an obstacle to the actual attainment of sustainability. For example, in the list of Millennium Development Goals from the United Nations World Summit on Sustainable Development, Johannesburg, 2002, the seventh of the eight goals, to “ensure environmental sustainability,” is presented separately from the parallel goals of reducing fertility and poverty, improving gains in equity, improving material conditions, and enhancing population health. A more integrated and consilient approach to sustainability is urgently needed.

Social Capital and the Collective Management of Resources

Jules Pretty

The proposition that natural resources need protection from the destructive actions of people is widely accepted. Yet communities have shown in the past and increasingly today that they can collaborate for long-term resource management. **The term social capital captures the idea that social bonds and norms are critical for sustainability.** Where social capital is high in formalized groups, people have the confidence to invest in collective activities, knowing that others will do so too. Some 0.4 to 0.5 million groups have been established since the early 1990s for watershed, forest, irrigation, pest, wildlife, fishery, and microfinance management. These offer a route to sustainable management and governance of common resources.

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Tales from a Troubled Marriage: Science and Law in Environmental Policy

Oliver Houck

Early environmental policy depended on science, with mixed results. Newer approaches continue to rely on science to identify problems and solve them, but use other mechanisms to set standards and legal obligations. Given the important role that science continues to play, however, several cautionary tales are in order concerning **"scientific management," "good science," the lure of money, and the tension between objectivity and involvement in important issues of our time.**

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Climate Change: The Political Situation

Robert T. Watson

Please read this short article if you want to know why the US are not part of the Kyoto Protocol yet at this point.

EDITORIAL

Sustainability and the Commons

The big question in the end is not whether science can help. Plainly it could. Rather, it is whether scientific evidence can successfully overcome social, economic, and political resistance. That was Hardin's big question 35 years ago, and it is now ours.

Donald Kennedy

Editor-in-Chief

A summary?

You should have written your own summary now!