Climate change

Climate Change

Who is to blame ?

Climate change

One world
One ocean
One atmosphere

The Earth's atmosphere consists, from the ground up, of :

Troposphere (Three quarters of the atmosphere lies within the troposphere, and the depth of this layer varies between 17 km at the equator and 7 km at the poles.)

Stratosphere (The stratosphere contains the ozone layer at altitudes of 15 to 35 km. Te ozone layer absorbs ultraviolet energy from the Sun.)

Mesosphere

Thermosphere (contains the ionosphere and exosphere which can extend from 500 up to 10,000 km above the surface. The Kármán line, located within the thermosphere at an altitude of 100 km, is commonly used to define the boundary between the Earth's atmosphere and outer space.)

Magnetosphere

Earth atmosphere
Atmospheric gases scatter blue light more than other wavelengths, giving the Earth a blue halo when seen from space.

Climate change

Escape

Surface gravity, the force that holds down an atmosphere, depends on the seize of the planet. The large gravitational force of the giant planet Jupiter retains light gases such as hydrogen and helium that escape from smaller planets.
The distance from the sun determines the energy available to heat atmospheric gas to the point where its molecules' thermal motion exceed the planet's escape velocity, the speed at which gas molecules overcome a planet's gravitational grasp. Thus, the distant and cold Titan, Triton, and Pluto are able to retain their atmospheres despite relatively low gravities. Interstellar planets, theoretically, may also retain thick atmospheres.

Venus and Mars may have both lost much of their water when, after being photodissociated into hydrogen and oxygen by solar ultraviolet, the hydrogen escaped. Earth's magnetic field helps to prevent this, as, normally, the solar wind would greatly enhance the escape of hydrogen. However, over the past 3 billion years the Earth may have lost gases through the magnetic polar regions due to auroral activity, including a net 2% of its atmospheric oxygen. [1]

Other mechanisms that can cause atmosphere depletion are solar wind-induced sputtering, impact erosion, weathering, and sequestration - sometimes referred to as "freezing out" - into the regolith and polar caps.

[1] http://en.wikipedia.org/wiki/Atmospheric_escape

Climate change

The atmosphere:

- Absorbes ultraviolet solar radiation.
- Keeps the surface warm through heat retention (greenhouse effect).
- Reduces temperature extremes between day and night.
- Provides oxygen for respiration.
- Pressurises the environment.

Composition of dry air (by volume)

nitrogen	78 %
oxygen	21 %
argon	0.93 %
carbon dioxide	0.038%
small amounts of other gases.	

Air also contains a variable amount of water vapour, on average around 1%.

Climate change

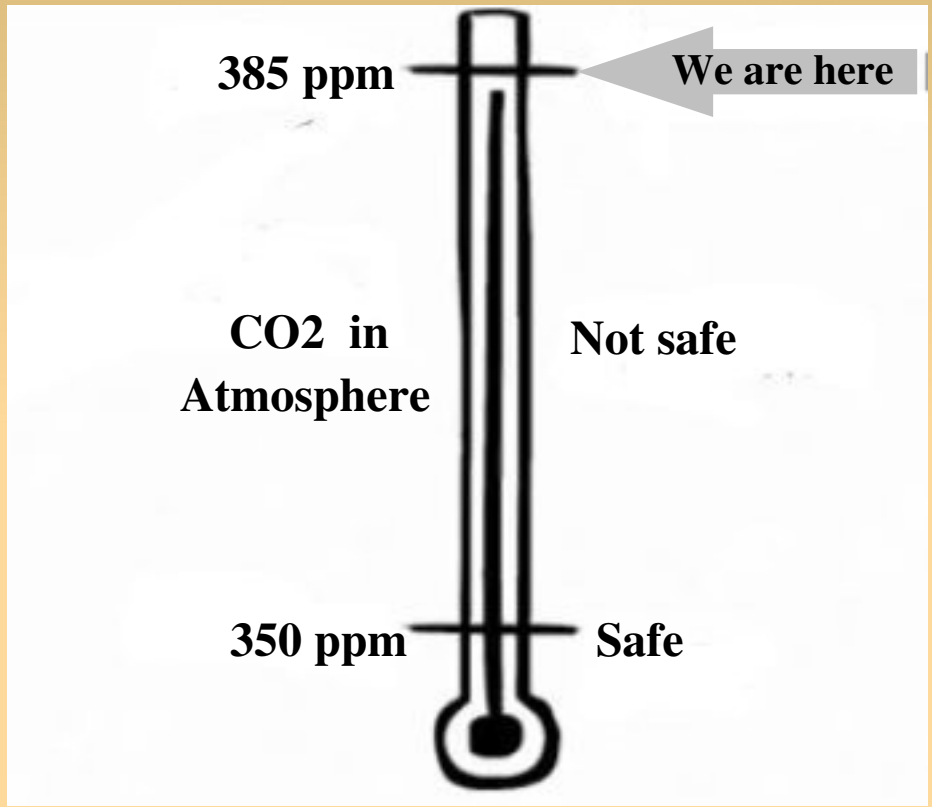
Earth atmosphere

ppmv: parts per million by volume (note: volume fraction is equal to mole fraction for ideal gas only

Gas	Volume
Nitrogen (N_2)	780,840 ppmv (78.084%)
Oxygen (O_2)	209,460 ppmv (20.946%)
Argon (Ar)	9,340 ppmv (0.9340%)
Carbon dioxide (CO_2)	387 ppmv (0.0387%)
Neon (Ne)	18.18 ppmv (0.001818%)
Helium (He)	5.24 ppmv (0.000524%)
Methane (CH_4)	1.79 ppmv (0.000179%)
Krypton (Kr)	1.14 ppmv (0.000114%)
Hydrogen (H_2)	0.55 ppmv (0.000055%)
Nitrous oxide (N_2O)	0.3 ppmv (0.00003%)
Xenon (Xe)	0.09 ppmv (9×10^{-6}%)
Ozone (O_3)	0.0 to 0.07 ppmv (0% to 7×10^{-6}%)
Nitrogen dioxide (NO_2)	0.02 ppmv (2×10^{-6}%)
Iodine (I)	0.01 ppmv (1×10^{-6}%)
Carbon monoxide (CO)	0.1 ppmv
Ammonia (NH_3)	trace
Not included in above dry atmosphere:	
Water vapor (H_2O)	~0.40% over full atmosphere, typically 1%-4% at surface

Climate change

The unbounded rising of consume increases the emission of greenhouse gases



N_2O_2 = around 270 ppb (parts per billion) between 1000 and 1700, rising to **310 ppb in 2000.**

Methane, CH4 between 1000 and 1750 at 750 ppb, **rising to over 1600 ppb in 2006.**

Climate change

Greenhouse gas emissions: Global carbon dioxide emissions from fossil fuels in 2008 were nearly 40% higher than those in 1990.

Melting of ice-sheets, glaciers and ice-caps: The Greenland and Antarctic ice-sheets are losing mass at an increasing rate.

Arctic sea-ice decline: Summer-time melting of Arctic sea-ice has accelerated far beyond the prediction from IPCC AR4 climate models.

Sea-level rise: Sea-level rise of 3.4 mm/yr over the past 15 years is about 80% above IPCC predictions, and mayl exceed 1 meter. The upper limit has been estimated as ~ 2 meters sea level rise by 2100.

Risks irreversible damage: The risk of transgressing critical thresholds ("tipping points") increases strongly with ongoing climate change.

The turning point must come soon: To stabilize climate, a decarbonized global society – with near-zero emissions of CO2 and other long-lived greenhouse gases – needs to be reached well within this century. The average annual per-capita emissions will have to shrink to well under 1 metric ton CO2 by 2050. This is 80-95%.

The Copenhagen Diagnosis: Climate Science Report
http://www.ccrc.unsw.edu.au/Copenhagen/Copenhagen_Diagnosis_LOW.pdf

Climate change

Tiping Points

Arctic sea ice, Antarctic and Greenland ice sheet Loss: Melting sea ice exposes a dark ocean surface, which absorbs more solar radiation and thus amplifies the warming. The complete collapse of the Greenland ice sheet would cause a global sea level rise of 7 m.

Methane Escape from Thawing Permafrost Regions: Terrestric methane will emanate from thawing permafrost areas in Siberia and Northern America.

Boreal Forest Dieback: Northern boreal forests account for almost one third of the global forest inventory. Their dieback release enormous amounts of carbon dioxide enhancing climate change.

Darkening of the Tibetan Plateau: Melting of the snow cover of the Tibetan territory exposes dark rock surface will amplify regional warming and may affect the Indian monsoon system. Succession of intensified and weakened monsoons in South Asia causing extreme droughts and floods.

Re-Greening of the Sahara: Higher precipitation may re-green the Sahel region sealing major sources of dust that is blown across the Atlantic and fertilizes South American ecosystems.

Dieback of Amazon Rainforest: The reduction of regional rainfall in a warming climate, connected to El Niño/Southern Oscillation, and forest fragmentation due to human activity may cause the Amazon forest dieback.

Southern Pacific Climate Oscillation: An increased frequency and/or intensity of El Niño conditions in the Southern Pacific may cause droughts in South-East Asia and many other regions.

Disruption of Marine Carbon Pump: Increased ocean acidification and stratification owing to rising atmospheric CO2 levels, impeding plankton algae and corals, to build their skeletons, which bind carbon.

Antarctic Ozone Hole: Emissions of chlorofluorocarbons in the past, have threatened the ozone layer which is now regenerating after these chemicals have been banned. Global warming may widen the ozone hole over the Antarctic once again.

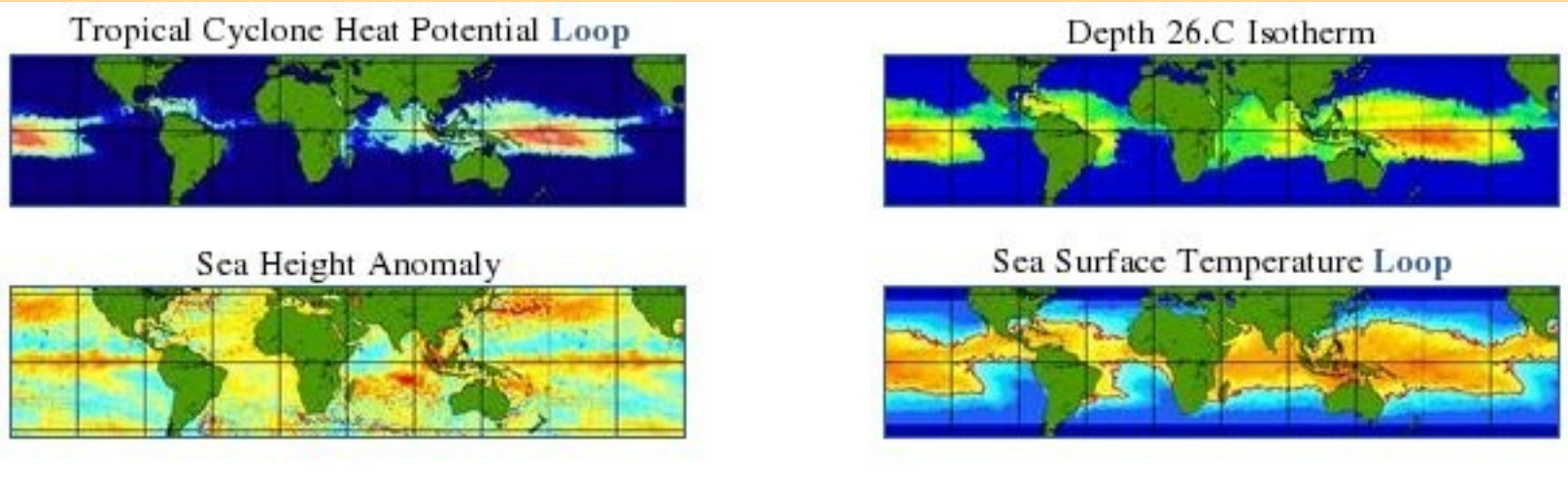
Climate change

The tropical cyclone heat potential (hereafter TCHP), is defined as a measure of the integrated vertical temperature from the sea surface to the depth of the 26°C isotherm. This parameter is computed globally from the altimeter-derived vertical temperature profiles estimates in the upper ocean (Shay et al., 2000).

Depth 26.C. Isotherm: Daily global fields of TCHP are obtained integrating the thermal structure derived from the satellite observations down to the 26°C isotherm. In the Gulf of Mexico, high values of TCHP are typically associated with the Loop Current and Anticyclonic Rings

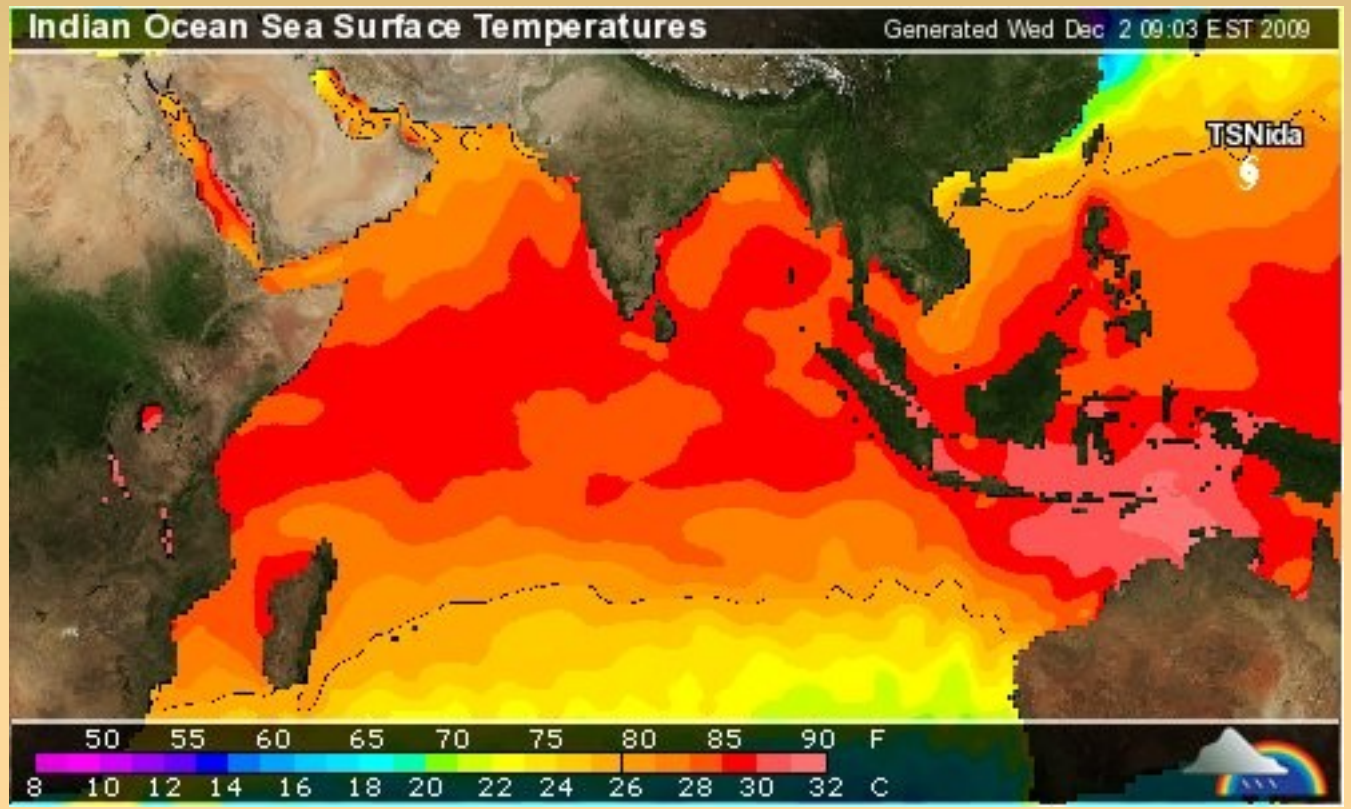
The sea height anomaly (SHA) represents the deviation of the sea height with respect to its mean. Sea height anomaly fields from the altimeter constellation, are used.

Sea surface temperature (SST) provides a measure of the surface ocean conditions, however no information about the subsurface ocean thermal structure (approximately the upper 50 m of the ocean) can be derived from SST alone.



http://www.aoml.noaa.gov/phod/cyclone/data/method.html

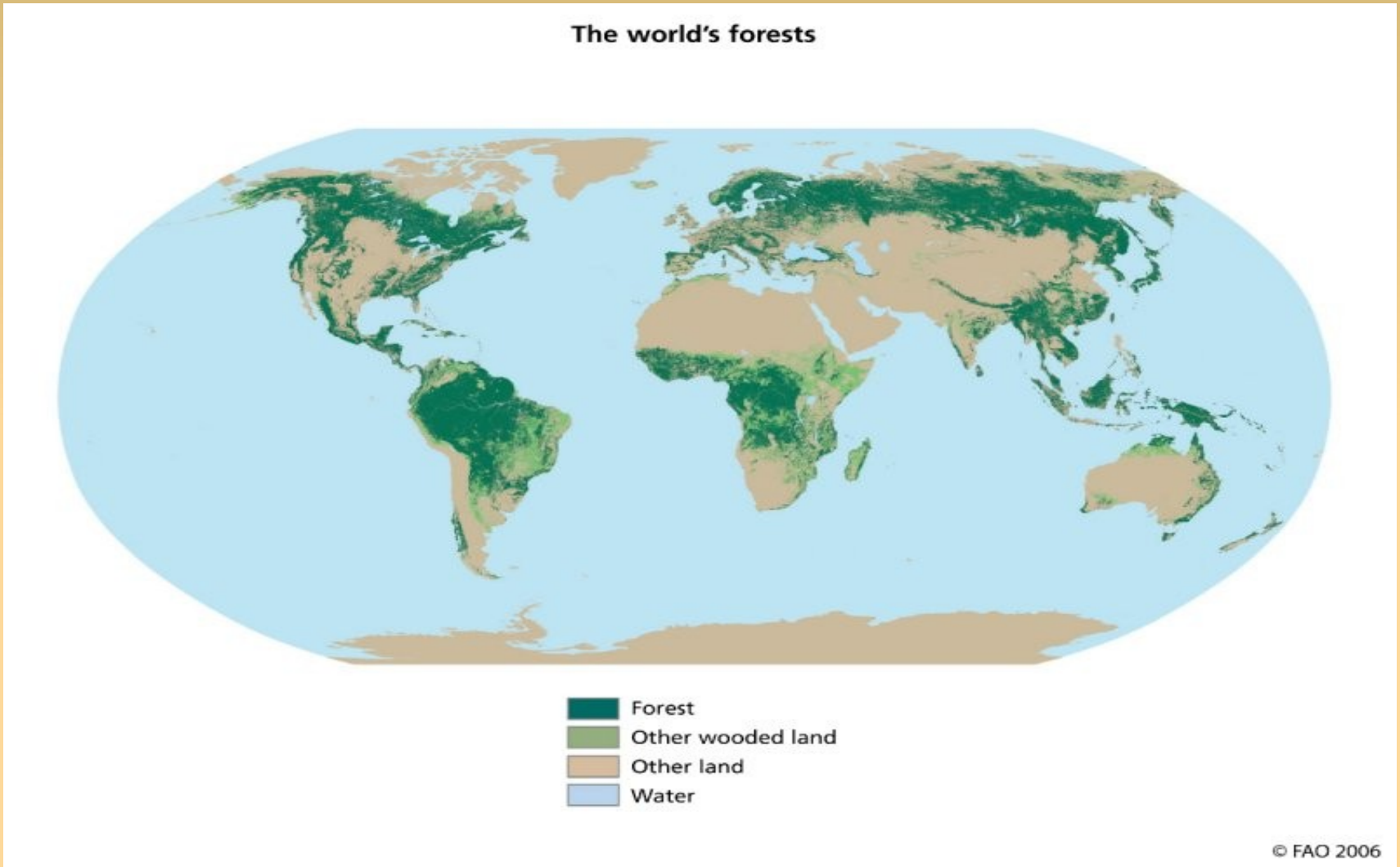
Climate change



Climate change

China and U.S. : Heavy industry and traffic have a direct impact on air we breathe.

Decarbonizing fuel diminishes pressure on climate, spares valuable resources and opens a new field of economy.



Climate change

Climate is linked to complex global systems with local impact:

Here an actual example:

" The sea surface temperature of the northern Arabian Gulf. between 1985 and 2002, has steadily increased at a rate of 0.6 (±0.3)°C/decade. This trend was three times greater than the concurrent global average. A relatively low summertime peak during 1991 in the aftermath of Iraqi invasion of Kuwait is considered to be the result of atmospheric dimming brought about by dense smoke that persisted in the region for most of that year. "

Thamer B. Al-Rashidi, Hamdy I. El-Gamily, , Carl L. Amos and Karim A. Rakha: Sea surface temperature trends in Kuwait Bay, Arabian Gulf. *Natural Hazards.* Volume 50, Number 1/July 2009. Doi:10.1007/s11069-008-9320-9
http://www.springerlink.com/content/81328pp44gnl1u23/

Climate change

Regulations regarding hazardous waste shipments [1]

There are efforts being made to reduce export of hazardous materials between countries which have no facilities to cope with the recycling of these materials. This is most important for countries in Africa and Asia which "recover" electronic devices waste from industrial countries, burning the isolation material at open air.

Existing Resource Conservation and Recovery Act (RCRA) regulation regarding the transboundary movement of hazardous wastes for recovery among countries belonging to the OECD ensure that hazardous wastes are returned to the country of export in a more timely and documented manner.

RCRA regulations for spent lead-acid batteries (SLAB) to add export notification and consent requirements to provide stricter controls and greater transparency for exports of SLABs to any country, and should ensure that the batteries are sent to countries and reclamation facilities in those countries that can manage the SLABs in an environmentally sound manner.

Computer waste "Recycling in South China: This waste is being imported from Europe and USA.

[1] EPA Strengthens Transboundary Hazardous Waste Shipment Regulations Release date: 12/28/2009
http://yosemite.epa.gov/opa/admpress.nsf/d0cf6618525a9efb85257359003fb69d/72250553b794b30685257696005e68c6!OpenDocument

Climate change

The Kyoto Protocol

The Kyoto Protocol was unable to reduce greenhouse gases emission, in fact, a rise of 30 per cent took place. Germany could achieve its goal of minus 21%, however, countries like Austria (+ 13), Spain (+47%). USA and China made no efforts on the issue.

The Clean Development Mechanism (CDM)

The Clean Development Mechanism (CDM), despite all failures, initiated a series of good activities in southern states.

The Cap and Trade System

The Cap and Trade system, was launched by the EU in 2005. It offers financial advantage for every ton of CO2 which is not emitted, decreasing the permitted emission continuously. A post-Kyoto regulation is needed to have its validity secured throughout the globe.

http://www.wir-klimaretter.de/index.php?option=com_content&task=view&id=4326&Itemid=68

Climate change

The Africa Factbook 2009 reveals that while Africa's population grew from 287 million to 902 million people between 1961 and 2005, the amount of biocapacity (food, fiber and timber resources that are renewably available) per person decreased by 67 percent during this same time period.

"Development that ignores the limits of our natural resources ultimately ends up imposing disproportionate costs on the most vulnerable," said Global Footprint Network President Mathis Wackernagel. He noted that Africa is a region where ecological deficits can translate most directly into resource conflicts and shortages of food, fuel and other basic necessities for survival.

http://www.footprintnetwork.org/en/index.php/newsletter/bv/africa_factbook_tracks_trends_in_footprint_human_development

Climate change

Marine ecology represents 99% of the biosphere of our world.97% of all species live here, ranging from protozoic zooplankton to the biggest animal, the blue wale.
Climate severely influences deep-sea diversity, even at tropical latitudes.

A benthic microfaunal record from the equatorial Atlantic Ocean demonstrates unexpected instability and high amplitude fluctuations of species diversity in the tropical deep ocean that are correlated with oscillations in global climate: Species diversity is low during glacial and high during interglacial periods.

The dynamic of species variety require reconsideration of current ecological hypotheses about the generation and maintenance of biodiversity as they apply to the deep sea, and underscore the potential vulnerability and conservation importance of tropical deep-sea ecosystems.

[1] Yasuhara M, Hunt G, Cronin TM, Okahashi H.: Temporal latitudinal-gradient dynamics and tropical instability of deep-sea species diversity. Proc Natl Acad Sci U S A. 2009 Dec 14.
http://www.ncbi.nlm.nih.gov/pubmed/20018702

Climate change

Fish consumption during pregnancy an example of gradual food safety impairment[1]
Evidence supports the benefits of fish consumption during pregnancy, primarily because of the effects of n-3 polyunsaturated fatty acids on the neurodevelopment of the fetus. Many fish may also be potent sources of methylmercury and polychlorinated biphenol exposure, which have been shown to have severe negative impacts on both the mother and fetus. Therefore, all women of childbearing age should be informed of both the benefits and risks of fish consumption.

Low prices affect global sustainability. Environmental skandals are all linked to competitive cost reductions.

[1] Dovydaitis T.: Fish consumption during pregnancy: an overview of the risks and benefits. J Midwifery Womens Health. 2008 Jul-Aug;53(4):325-30.
http://www.ncbi.nlm.nih.gov/pubmed/18586185

Climate change

Three visions of growth

The limits to Growth: Five variables were examined in the original model, on the assumptions that exponential growth accurately described their patterns of increase, and that the ability of technology to increase the availability of resources grows only linearly. These variables are: world population, industrialization, pollution, food production and resource depletion. The authors intended to explore the possibility of a sustainable feedback pattern that would be achieved by altering growth trends among the five variables.

The most recent updated version was published on June 1, 2004 by Chelsea Green Publishing Company and Earthscan under the name Limits to Growth: The 30-Year Update. Donnella Meadows, Jørgen Randers, and Dennis Meadows have updated and expanded the original version. They had previously published Beyond the Limits in 1993 as a 20 year update on the original material.[2][3][4]

In 2008 Graham Turner at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia published a paper called "A Comparison of `The Limits to Growth` with Thirty Years of Reality".[5][6] It examined the past thirty years of reality with the predictions made in 1972 and found that changes in industrial production, food production and pollution are all in line with the book's predictions of economic and societal collapse in the 21st century.

Climate change

Dennis Meadows published in 1972 a study in the name of the Club of Rome intitled "The Limits to Growth". Meadows and his team used computer simulations to analyse the future of the world stressing the global of the industrialisation and the growth of the population.

Five variables were examined in the original model, on the assumptions that exponential growth accurately described their patterns of increase, and that the ability of technology to increase the availability of resources grows only linearly. These variables are: world population, industrialization, pollution, food production and resource depletion. The authors intended to explore the possibility of a sustainable feedback pattern that would be achieved by altering growth trends among the five variables.

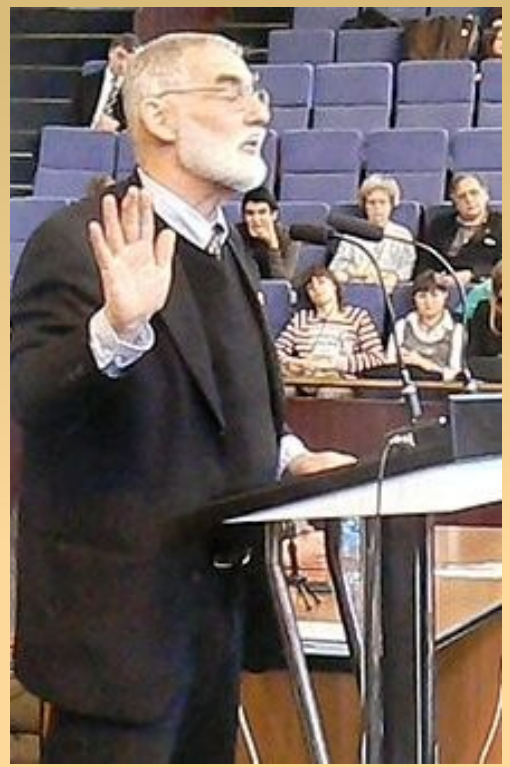
Meadows says:
"Our conclusions haven't changed in 34 years but the world has changed. In 1972 global population and use of materials were still under longterm limits of the planet. Then the goal we promoted was to slow down, to try to reduce the growth of industry and population before they exceeded the limits. Global society and economy did not slow down. Now they are past the limits, above longterm possibilities."

The eventual purpose of The Limits to Growth was not to make specific predictions, but to explore how exponential growth interacts with finite resources. Because the size of resources is not known, only the general behaviour can be explored.

Climate change

Limits to Growth
There has been a major cultural shift in the thinking about global processes in the last three decades of the 20th century, Meadows explaines:

"In 1972 it was inconceivable to most people that the physical impact of humanity's activities could ever grow large enough to alter basic natural processes of the globe. But now we routinely observe, acknowledge, and discuss the ozone hole, destruction of marine fisheries, climate change and other global problems."



In their 1972 publication Limits to Growth their recommendations where focussed on "how to slow growth". In the 2004 Limits to growth : the 30-year update the message has changed. Meadows explained: "Now we must tell people how to manage an orderly reduction of their activities back down below the limits of the earth's resources."

http://clubofrome.at/events/2006/vienna/dennis_meadows.html

Climate change

The existing economic model is unsustainable.

No one denies that development is essential for poorer nations.
But in the advanced economies there is mounting evidence that ever-increasing consumption adds little to human happiness and may even impede it.

More urgently, it is now clear that the ecosystems that sustain our economies are collapsing under the impacts of rising consumption.
Unless we can radically lower the environmental impact of economic activity we will have to devise a path to prosperity that does not rely on continued growth. We need to overhaul the economic model.

Jackson, Tim: Prosperity without Growth. Economics for a Finite Planethttp://www.earthscan.co.uk/ProsperityWithoutGrowth/tabid/102098/Default.aspx

Climate change

Jackson argues that one of the main problems with the current setup is that ever-increasing personal consumption gives the individual a social status that is utterly unrelated to its environmental cost.

Breaking that link and substituting it with a system that gives value to family, health and happiness, among other things, he argues, is at the core of the revolutionary economic rethink he proposes.

"Prosperity today means nothing if it undermines the conditions on which prosperity tomorrow depends. And the single biggest message from the financial meltdown of 2008 is that tomorrow is already here."

Embedded Carbon

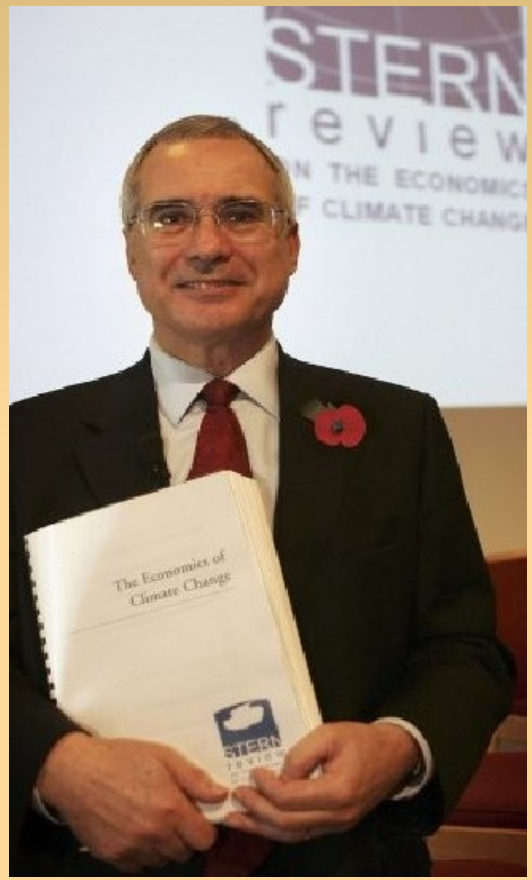
Embedded carbon, whereby importing nations fail to account for the carbon content of the goods they buy from abroad, despite the fact that in the past they would have made those products themselves and therefore have included their emissions in the national total.

China is a particular case in point. Some estimates suggest that up to one-quarter of China's carbon emissions come from goods exported to places like the United States and Europe.

New York Time: Can we hawe prosperity without growth? November 17. 2009.
http://www.nytimes.com/cwire/2009/11/17/17climatewire-can-you-have-prosperity-without-growth-10334.html

Climate change

The Stern Analysis
The Economics of Climate Change
There is plenty of analysis, from Lord Stern's report on the economics of climate change, to show how CO2 emissions can be cut to keep global warming within reasonable limits while the world economy continues to grow.



http://www.ft.com/cms/s/2/5be351c4-d568-11de-81ee-00144feabdc0.html

Climate change

In May 2007 every waterhole in a 30 kilometre radius of Docker River was dried out and filled with thousands of camels that had died of thirst.

These waterholes, rockholes and watercourses are also important for the wonderful native fauna, but the landscape is under so much pressure that we're losing those native species at a rapid rate.

Disease with local importance will spread to other regions due to rising temperatures.

Krim-Kongo-Fever,
Chikungunya-Fever
Dengue-Fever.
Cholera (contaminated water)
Malaria which with mosquito as vector
Toscana virus
Leishmania
Disease of Chagas (transmitted by food)

The End

ABC News: Rotting camels pollute sacred waterholes. December 3, 2009.
http://www.abc.net.au/news/stories/2009/12/03/2760546.htm