

Oceans of change – what's in store for the world's oceans?

26 August 2004

Increasing greenhouse gases in the atmosphere will do much more than warm the oceans, says ocean biologist Professor Katherine Richardson speaking at this year's EuroScience Forum in Stockholm.

According to Richardson, Science Ambassador for IGBP* and Professor of biological oceanography at Aarhus University in Denmark, increasing carbon dioxide in the atmosphere is making the oceans more acidic, affecting sea life and altering the ocean's role in the global carbon cycle.

"We focus on the carbon (CO₂) in the atmosphere but we forget that is 50 times more carbon in the oceans than in the atmosphere and that the carbon constantly exchanges between the ocean and the atmosphere. What happens to carbon in the oceans greatly influences what happens to carbon in the atmosphere. We cannot hope to predict the climate consequences of increasing CO₂ in the atmosphere without taking into account what happens to carbon in the ocean".

Richardson explains how more acid oceans may alter carbon cycles: "Some of the tiny planktons in the ocean (phytoplankton) produce calcium carbonate (chalk) shells. When these shells sink, they move massive amounts of carbon to the ocean bottom. In a more acid ocean, it is more difficult for organisms to make chalk. As the ocean becomes more acid, the amount of carbon settling to and being stored in the ocean floor can be expected to decrease.

Thus, a more acid ocean may have major implications for climate change and ocean biodiversity as major changes in the ocean carbon cycle could accelerate global warming.

Global warming is not the only issue, though, says Professor Richardson.

"Many sea creatures will potentially suffer in more acidic waters". For example, corals also produce calcium carbonate. It will also be more difficult for them to survive in more acid water and it has been predicted that by 2065, there will be almost no region of the world's ocean where corals can be expected to thrive," she says.

The total amount of primary production (plant production forming the base of the food web and, ultimately determining the amount of fish and other animals in the ocean) in the oceans is expected to decrease as a result of increasing acidity and warming. There is also expected to be a change in the distribution of this production brought about by climate change, with arctic regions becoming more productive and temperate and tropical regions less productive.

A redistribution of, in particular, fish production would also have major implications for people who rely on fish protein for their survival, especially in societies with insufficient social and economic stability to adapt to such changes. Thus, global change in the ocean is predicted to bring with it dramatic socio-economic consequences.

The Sahara Desert and Amazon Basin – “Achilles’ heels” in Earth’s armour

25 August 2004

What do the Amazon Basin and Sahara Desert have in common? They are intricately linked by dust and climate and both belong to a family of hotspots or “Achilles’ heels” that have a profound impact on the global environment, says Professor John Schellnhuber, speaking at the EuroScience Forum in Stockholm this week.

Dust from the Sahara Desert fertilises the Amazon, increasing the abundance of life there, says Professor Schellnhuber, IGBP* Science Ambassador and Director of the UK-based Tyndall Climate Centre. “This process has been going on for thousands of years and is one reason why the Amazon Basin teems with life”.

Both regions are also being affected by climate change, though in opposite ways. It is predicted that global warming will reduce rainfall in the region initiating a major dieback of the forests in the Amazon. Once begun, this process will be extremely difficult, if not impossible, to reverse. Deforestation through human land use is also exacerbating the process.

For the Sahara, though, current climate models predict that global warming could trigger a greening of the desert, reducing the amount of dust that it produces.

“This creates the peculiar and disturbing prospect that one day the relationship between the Sahara and the Amazon could be reversed, though wind currents will probably make a different part of the world the beneficiary of Amazonian dust,” says Schellnhuber.

Human behaviour is also directly influencing the ancient relationship between the two regions. Four-wheel drive vehicles are churning up the Sahara Desert causing a surge in the amount of dust produced. This sounds like a good thing for the Amazon, and in the long run the extra dust may offset the impact of a greening of the desert.

“On the other hand, global dust is becoming a major problem in terms of climate change,” he says. “As with many regions of the world, we don’t know which areas will be ‘winners’ and which will be ‘losers’. My sense is that the Amazon will be a major loser”.

The relationship between the Amazon and Sahara illustrates the complexity and intertwined nature of the Earth System and draws attention to another affiliation between the two regions - both belong to a family of “hotspots” that act like massive regulators of Earth’s environment, says Professor Schellnhuber.

They are amongst a dozen such hotspots that scientists have located so far. According to Schellnhuber, these hotspots (also known amongst scientists as Earth’s “Achilles’ heels”), are critical regions of the Earth that, if stressed, could trigger large-scale rapid changes across the entire planet.

A good example is the North Atlantic Current, the ocean circulation pattern responsible for bringing warmer air to northern Europe. The collapse of this current could lead to a massive regional shift in climate. Other examples include the Asian monsoon system and the West Antarctic Ice Sheet.

Professor Schellnhuber likens these spots to vital organs in the body. "The Earth is in many ways similar to a human body. All parts of the planet are interconnected and, just like the heart, lungs and brain etc, the "vital organs" of the Earth must be kept in good health," he says.

However, not enough is known about these vital points to be able to predict when critical thresholds are reached. "We have so far completely underestimated the importance of these locations. What we do know is that going beyond critical thresholds in these regions is could have dramatic consequences for humans and other life forms".

Professor Schellnhuber calls for a coordinated global effort to better understand and monitor the Earth's "Achilles' heels". "Such an effort is every bit as important as NASA's valuable asteroid spotting programme designed to protect the planet from collisions," he says.

"If we can afford to gaze up at the sky looking for asteroids, we should be able to watch our own planet with as much care".

* International Geosphere-Biosphere Programme (www.igbp-kva)

John Schellnhuber is speaking at:

"Beyond global warming: where on Earth are we going?"

Thursday 26 August, 9.30 -12.30

The minisymposium is being held as part of the EuroScience Forum (www.esof2004.org) and is organized by the International Geosphere-Biosphere Programme with support from the Swedish Research Council (FORMAS).

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Hotspots in the Earth System. See "Global Change and the Earth System: A Planet Under Pressure", Executive Summary (Steffen et al 2004)



Euroscience Open Forum 2004, Stockholm Sweden

Beyond global warming: where on Earth are we going?

9.30 am – 12.30 pm, Thursday 26 August,
Norra Latin Room 361

- 9.30 am *Opening remarks from the moderator*
Professor Kevin Noone, Incoming Director, International Geosphere-Biosphere Programme
- 9.35 am *How stable is the Earth System?*
Dr Will Steffen, Chief Scientist, International Geosphere-Biosphere Programme
- 9.55 am *The Planet's Achilles' heels*
Professor John Schellnhuber, Director, Tyndall Centre for Climate Impact Research, University of East Anglia, UK
- 10.15 am *Atmospheric Chemistry in the Anthropocene*
Professor Paul Crutzen, Max-Planck Institute for Chemistry, Germany
- 10.35 – 10.50 am Discussion
- 10.50 – 11.10 am Coffee break**
- 11.10 am *Global change and the future of the oceans*
Professor Katherine Richardson, Department of Marine Ecology, Aarhus University, Denmark
- 11.30 am *Abrupt climatic change: are the Pentagon and Hollywood right?*
Professor Stefan Rahmstorf, Potsdam Institute of Climate Impact Research, Germany
- 11.50 am *Institutional challenges: preparing science to tackle abrupt changes*
Professor Uno Svedin, International Group of Funding Agencies
- 12.10 – 12.30 pm Discussion and concluding remarks

A minisymposium organised by:

International Geosphere- Biosphere Programme

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