EARTH SCIENCE

Leaf-level warming

JULES MONTGOMERY / VIACREATIVA

Geophys. Res. Lett. **36,** L02703 (2009)
By losing less water, plants could worsen warming in a high-CO_2 world, finds a new study. Stomata — the tiny pores on leaf surfaces that permit the exchange of water and gases with the atmosphere — close under elevated CO_2 concentrations, returning less water to the atmosphere through the process known as transpiration.

Marie Doutriaux-Boucher of the Met Office Hadley Centre, UK, and colleagues used a coupled carbon–climate cycle model to examine the effect of suddenly doubling or quadrupling atmospheric CO_2 concentrations on plant-induced changes in climate over a five-year period. To distinguish plant-mediated from non-plant-mediated effects on climate, they ran model simulations in which plants were exposed to or shielded from increased carbon dioxide. When plants were exposed to elevated CO_2, global surface warming was increased by 13 and 16 per cent in the doubling and quadrupling experiments, respectively.

The increase in surface warming results from a rapid reduction in low-level cloud cover over mid-high latitude forests and the Amazon, according to the model results. The decline in cloud cover is probably due to a decline in water loss by plants under high-CO_2 conditions, say the researchers.

Anna Armstrong

CLIMATE IMPACTS

No going back

JTYLER / ISTOCKPHOTO.COM

Proc. Natl Acad. Sci. USA **106,** 1704–1709 (2009)
The warming, droughts and swollen seas caused by human-generated carbon dioxide are essentially irreversible, say scientists, and will not subside for at least 1,000 years even if emissions cease. It has long been known that a fraction of emitted CO_2 lingers in the atmosphere and perpetuates the greenhouse effect for millennia after the bulk of emissions have been absorbed by the ocean.

Now, researchers led by Susan Solomon of the US National Oceanic and Atmospheric Administration in Boulder, Colorado, take a look at how long the effects of that lingering CO_2 would last if emissions were abruptly cut off at various atmospheric carbon dioxide concentrations. Using climate projections through 3000 AD, the group estimates that if the atmospheric concentration of CO_2 peaked at 600 parts per million, the Mediterranean and western Australia would see centuries of drought, with rainfall down by 13–16 per cent — more than the 10-per-cent drop that caused the 1930s 'dust bowl' in the United States. Slow thermal expansion of the ocean would ultimately raise seas 0.4–1 metres.

Larger responses are possible, as the models don't include ice sheet loss and other important feedbacks. Geoengineering schemes still on the drawing board could offer relief, but were not included in the study.

Anna Barnett

BIODIVERSITY AND ECOLOGY

Invaders retreat

BETHANY BRADLEY

Glob. Change Biol.
doi:10.1111/j.1365-2486.2008.01824.x (2009)
Climate change might give unexpected help to conservationists by banishing stubborn invasive plants from some regions, say scientists. Ecological disturbances in the next century are widely expected to worsen invasions by foreign species, but the potential negative impacts of climate change on invaders have received little study.

Bethany Bradley of Princeton University in New Jersey and colleagues focused on five of the most problematic invasive plants in the western United States, sometimes called 'kudzus of the west'. They studied the species' climate envelopes — the temperature and rainfall levels where the plants now thrive — and used global climate models to project where these conditions would occur in 2100, given a moderate emissions scenario. Yellow starthistle and tamarisk are likely to expand their ranges with climate change. But spotted knapweed, cheatgrass and leafy spurge are expected to shift towards cooler regions, leaving only 0–19 per cent of the ecosystems they now occupy at high invasion risk in 2100.

Although invasive plants will threaten new areas, some native ecosystems left behind could be restored. The researchers note that wildlife managers might have to act quickly to find species able to survive in the altered climate, before new invaders turn up to occupy open niches.

Anna Barnett

EXTREME EVENTS

Waning attraction

KAZMANIAC / ISTOCKPHOTO.COM

Science **323,** 753 (2009)
The break-up of the West Antarctic Ice Sheet could cause a disproportionate amount of sea level rise along coastlines in North America and the Indian Ocean. Typical analyses suggest that if the ice sheet melted, it would raise average global sea level by five metres — but this may understate

the impacts on some regions, according to a new study.

Jerry Mitrovica of the University of Toronto and colleagues used a technique called sea level fingerprinting to assess the potential impacts of a catastrophic loss of the ice covering West Antarctica. This technique, most commonly used to pinpoint the source of major flooding in the past, works on the principle that massive ice sheets, such as those covering Antarctica, exert a gravitational pull on seawater. When the ice is gone, so is the attraction; consequently, seawater begins to migrate away from the site of the former ice sheet.

If the ice sheet melted completely, the resulting changes in gravitational shift, in uplift of the region and in the Earth's rotation could cause an additional 1.3 metres of flooding in North American cities such as Washington DC. However, concurrent ice loss in Greenland and East Antarctica could further alter these patterns of changing sea level.

Alicia Newton

SOCIETY

Failing fisheries

DNDAVIS / 123RF

Fish Fisheries
doi:10.1111/j.1467-2979.2008.00310.x (2009)

The world's poorest nations will bear the brunt of climate change impacts on fisheries, suggests new research. Despite the large body of evidence that warming and related impacts will alter the distribution and productivity of individual fisheries, how this will affect national economies has remained unclear.

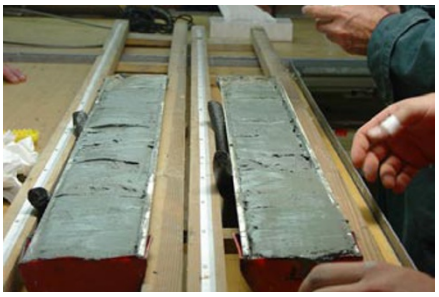
Now, an international team of scientists led by Edward Allison of the WorldFish Center in Penang, Malaysia, has carried out the first systematic global assessment of the economic impacts of climate change on fisheries. Allison and colleagues used an indicator-based approach to identify which of 132 nations are most vulnerable to projected climate impacts on capture fisheries — those harvested from the wild. Countries' vulnerability was assessed on the basis of three factors: exposure to climate change, the relative importance of fisheries to the national economy and diet, and the societal capacity to adapt to change — for example, through alternative employment opportunities. Of the 33 nations identified as being most vulnerable, 22 were least-developed countries.

These least-developed nations rely on fish for 27 per cent of their dietary protein and produce 20 per cent of global fishery exports, say the authors, who warn that climate-related changes in fisheries could exacerbate hunger and poverty.

Olive Heffernan

PALEOCLIMATE

Ancient acidification



ELISABETH SIKES

Paleoceanography
doi:10.1029/2008PA001676 (in the press)

Earth's climate warmed for unknown reasons about 40 million years ago, in the middle of a long-term cooling trend. Scientists now report that this temperature spike was accompanied by deep ocean acidification, suggesting that a transient increase in atmospheric carbon dioxide was to blame.

Steven Bohaty of the University of California at Santa Cruz and colleagues used marine sediment cores from the Atlantic, Pacific and Southern Oceans to reconstruct ocean temperature and chemistry for millions of years surrounding the warm period, which is known as the Middle Eocene Climatic Optimum. From the carbon and oxygen isotope compositions of the sediments, the team estimated that both surface and deep ocean temperatures around the world rose by up to 6 °C over 500,000 years, with peak warmth lasting about 50,000 years. Cores from the deepest sites show that during the warm interval less carbonate accumulated, which the researchers attribute to ocean acidification caused by rising atmospheric CO_2 levels.

The group concludes that during this period of Earth's history, changing concentrations of greenhouse gases were the primary cause of short-term climate variations. The ancient warm spell may therefore shed light on future climate change.

Alicia Newton