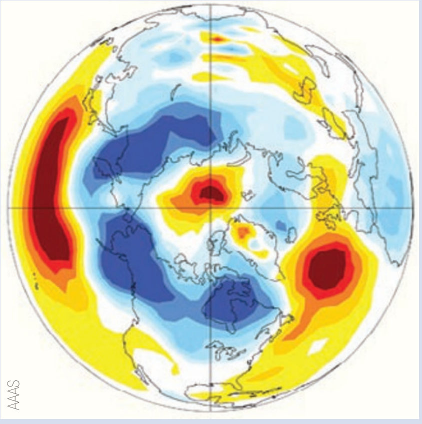
PALEOCLIMATE

Past perspective



AAAS

Science **326,** 1256-1260 (2009)

Periods of relative coolness or warmth in the Earth's past can be used to garner clues about future climate change. One such episode, dubbed the Medieval Warm Period, saw a spell of mild weather in Europe from the 900s through to the 1300s and was followed by a drawn-out dip in temperature known as the Little Ice Age.

Michael Mann of Pennsylvania State University and colleagues have now analysed global surface temperature over the past 1,500 years in unprecedented spatial detail. Using more than a thousand proxy records, including tree ring, ice core, cave deposit, coral and sedimentary data, they show that the climate was not globally uniform during these anomalous events. During the Medieval Warm Period, for example, southern Greenland may have been as warm as today, but a large area covering much of the tropical Pacific was unusually cold owing to the prevalence of La Niña conditions, which cause extensive cooling of the Pacific Ocean.

The researchers conclude that regional variations in past climate were largely the result of natural factors such as volcanic activity and climatic cycles. The results may help to refine regional climate model projections, they say.

Alicia Newton

BIODIVERSITY AND ECOLOGY

Carbon offsets

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Science **326,** 1399–1354 (2009)

Scientists have long known that nitrogen pollution from sources such as fertilizer can reduce plant diversity. Now researchers have discovered that an increase in atmospheric carbon dioxide could counter this effect.

In a ten-year field experiment, Peter Reich at the University of Minnesota, Saint Paul, monitored the response of 48 open-air perennial grasslands, planted with 16 different species, to combinations of ambient and elevated soil nitrogen and atmospheric carbon dioxide concentrations. Over a decade, plant diversity in grasslands with high nitrogen levels decreased by 16 per cent with ambient CO_2, but only by 8 per cent when both nitrogen and CO_2 levels were high. The altered nitrogen and carbon dioxide regimes had significant, interactive effects on plant diversity within two years.

The results suggest that predicting the response of biodiversity to atmospheric changes may be challenging at the local level.

Olive Heffernan

OCEAN SCIENCE

Consider the lobster

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Geology **37,** 1131–1134 (2009)

The lobster is one creature that could fare better in an acidic ocean. Experimental evidence has shown that the sea's shelled inhabitants, and those with exoskeletons, could struggle to survive as CO_2 continues to invade the ocean. But in fact there will be winners and losers, finds a new study.

Justin Ries of the University of North Carolina at Chapel Hill and colleagues reared 18 species of 'marine calcifiers' for 60 days in experimental seawater tanks that had uniform temperature but varied in acidity and in the availability of the carbonate ion used by calcifiers to build their shells and skeletons. Ries and colleagues found that 10 of the 18 species were less able to build their encasings in acidic seawater than in regular seawater. For four of the species tested — limpets, purple urchins, and red and green algae — the ability to calcify improved in waters of intermediate acidity but worsened in highly acidic waters. Lobsters, crabs and shrimp, however, were unexpectedly able to build more shell as the acidity of the seawater increased.

The results suggest that the impacts of ocean acidification on marine life may be more complex than previously thought.

Olive Heffernan

BIODIVERSITY AND ECOLOGY

Aspen explosion

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Glob. Change Biol. doi:10.1111/j.1365-2486.2009.02103.x (2009)

Escalating carbon dioxide emissions have boosted the growth rate of quaking aspens — one of North America's most important deciduous trees — by a whopping 50 per cent over the past 50 years. Scientists have previously shown that CO_2 enhances aspen growth in experiments, but a new study is the first to show that aspens are responding to the greenhouse gas in their native environment.

Christopher Cole of the University of Minnesota at Morris and colleagues measured the growth rates of 919 individual aspen in Wisconsin forests. The growth rate of aspen was variable throughout the past few decades, but overall it rose by 50 per cent between the 1960s and the present day. The team looked at whether genetic diversity or regional changes in precipitation and length of the growing season could have caused the trend. Comparing tree-ring data, a measure of annual growth, with records of atmospheric carbon dioxide, they found that a substantial amount of the increased growth was spurred by elevated CO_2 concentrations.

The findings suggest that aspen forests will continue to be important sinks for carbon dioxide, at least in the short term. But rapid expansion of these pioneering trees could have untold ecological consequences, say the researchers.

Alicia Newton

ATMOSPHERIC SCIENCE

The long and the short

© ISTOCKPHOTO / IAKOV KALININ

Nature Geosci. doi:10.1038/ngeo706 (2009)

Climate scientists have long held that the global temperature would rise by about 3 °C if atmospheric concentrations of CO_2 doubled from pre-industrial levels. But new research suggests that the Earth's temperature might be as much as 30–50 per cent more sensitive to atmospheric greenhouse gases than previously thought.

While conventional estimates of climate sensitivity have focused on factors that influence temperature in the short term, such as cloud and snow cover, a team of scientists led by Daniel Lunt at the University of Bristol, UK, have devised a new estimate — termed 'Earth system sensitivity' — that also accounts for factors that affect temperature in the long term, such as land ice and vegetation. They used a state-of-the-art climate model to analyse the events that gave rise to a warm period about 3 million years ago, and they then compared these to actual temperature reconstructions derived from 3-million-year-old sediments on the ocean floor. Their analysis suggests that fast- and slow-adjusting components of the climate system will have an important influence on the extent of warming.

The findings should send a strong message to policymakers, as they show that deeper emissions cuts will be needed to avoid dangerous climate change in the long term.

Olive Heffernan

CRYOSPHERE

Arctic mix-up

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Geophys. Res. Lett. doi:10.1029/2009GL041291 (2009)

The traditionally quiescent Arctic Ocean may soon become a more active environment owing to its diminishing sea ice. Floating ice impedes winds from transferring energy to the ocean, thereby minimizing waves both on and beneath the surface. Subsurface internal waves have an important role in mixing water between various depths, but this process occurs less in the Arctic than in other ocean basins.

In 2002 and 2003, University of Washington researchers Luc Rainville and Rebecca Woodgate moored instruments at 70 and 110 metres below the surface in the Chukchi Sea, north of the Bering Strait, an area typically iced over in winter and ice-free in summer. They found that storms with winds stronger than ten metres per second occurred all year, but they generated significant internal waves only in the absence of sea ice. The mixed layer of water resulting from those waves grew rapidly during summer.

As Arctic ice continues to decline year-round, the researchers anticipate increased mixing from internal waves. This could affect the success of phytoplankton blooms, the base of the Arctic food web. It may also affect exchanges of water between the Arctic and other oceans, with implications for climate connections to more southerly regions.

Harvey Leifert