PALEOCLIMATE

Mammoth's last stand

PLoS Biol. **6,** e79 (2008)
The extinction of the woolly mammoth some 3,600 years ago was driven by the disappearance of its icy habitat combined with the emergence of human hunters, scientists have confirmed. The relative importance of climate and hunting for the mammoth's fate has long been debated but rarely assessed quantitatively.

David Nogués-Bravo of the National Museum of Natural Sciences in Madrid, Spain, and colleagues combined climate and population models to unravel the roles of natural and human factors in the demise of the herbivorous mammal. They first inferred the mammoth's 'climate envelope' — the temperature

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and precipitation limits within which the animals could survive — from simulated paleoclimate data corresponding to the locations and ages of mammoth fossil finds. This defined a tundra environment widespread across northern Eurasia during the mammoth's ice-age heyday 42,000 years ago, which by 6,000 years ago had dwindled to a few isolated outposts as glaciers withdrew.

Although mammoths had weathered similar warm conditions during the previous interglacial period, this time the encroaching warmth brought humans with it. Connecting the habitat map with a mammoth population model, the researchers found that only slight hunting pressure, as little as one kill per year per 200 humans, could have sufficed to destroy the mammoths' few interglacial holdouts.

Anna Barnett

CRYOSPHERE

Seismic slippage

IAN JOUGHIN, UW POLAR SCIENCE CENTER

Science doi:10.1126/science.1153360 (2008)
Science doi:10.1126/science.1153288 (2008)
Summer meltwater draining from the surface of the Greenland Ice Sheet down to the bedrock below can cause seismic shifts in the ice. Yet despite the dramatic drainage — in one case exceeding the flow of Niagara Falls — seasonal streams have little effect on the descent of glaciers into the sea, show two new studies.

Both were led by Sarah Das at Woods Hole Oceanographic Institute in Massachusetts and Ian Joughin at the University of Washington. The researchers first monitored a large surface lake that formed near the edge of the Greenland Ice Sheet and drained through deepening cracks. Once the fissures spread down through all 980 metres of the ice sheet, the two-kilometre-wide pool was sucked dry within 90 minutes — moving more water per second than the famous falls, and shifting the sheet by 1.2 metres.

Using radar and GPS measurements across a range of Greenland sites, however, they then found that coastal glaciers dumping icebergs into the ocean are relatively insensitive to such summer meltwater pulses. Inland ice sheets slid up to twice as fast in the melt season, but coastal glaciers increased their speed by less than 15 per cent. The coastal glaciers' remarkable recent acceleration seems instead to result from melting of their front edges, possibly in response to declining sea ice.

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EARTH SCIENCE

Sandy storehouse

DOUG DOLDE

Global Change Biol.
doi:10.1111/j.1365-2486.2008.01593.x (2008)
Deserts may be a much more important storehouse for carbon dioxide than previously thought, suggests a new study of the Mojave Desert in the southwestern United States. The retention of atmospheric carbon dioxide in desert soils, which cover more than 30 per cent of the Earth's surface, is often assumed to be low owing to the characteristic sparse vegetation.

Georg Wohlfahrt at the Universität Innsbruck, Austria, and colleagues from the Desert Research Institute in Nevada measured carbon exchange between the desert ecosystem and the atmosphere during 2005 and 2006. By combining measurements of atmospheric carbon dioxide and vertical wind speed, they quantified the net carbon dioxide consumed by the ecosystem's biomass, from shrubs to microscopic organisms living in the soil. The annual removal of the greenhouse gas from the atmosphere was upwards of 100 grams of carbon per square metre, on a par with some temperate forests, with the majority being consumed during spring months.

As this amount of carbon dioxide is not being stored in desert plants alone, however, the authors suggest that a significant portion could be stored in the biological crusts, such as blue-green algae, lichens and mosses, that cover most desert soils.

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OCEAN SCIENCE

Northward bound

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New research challenges the assumption that an increase in ocean temperatures associated with climate change will promote future jellyfish outbreaks. A spate of recent blooms

has raised concerns that the gelatinous creatures are on the rise and could pose a serious threat to commercial fisheries.

Richard Brodeur at the US National Oceanic and Atmospheric Administration's Northwest Fisheries Science Center in Newport, Oregon, and colleagues analysed the factors influencing jellyfish abundance in the eastern Bering Sea before, after and during one such outbreak in the 1990s, which saw a threefold increase in the number of jellyfish caught. Using a statistical approach known as 'generalized additive modelling', they found that jellyfish abundance was affected regionally by interacting variables — in particular, ice cover, sea surface temperature, currents and wind mixing. Food availability, however, was also key to jellyfish survival, and decreased under warmer ocean conditions.

Outbreaks are the result of a suite of influences, conclude the authors. This suggests that, unlike temperate species, which generally multiply as temperatures rise, jellyfish at high latitudes may not thrive in warming seas. Instead, the authors anticipate that jellyfish populations could move northward into the Arctic Ocean as the ocean warms.

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EXTREME EVENTS

This year's model

NASA

Bull. Am. Meteorol. Soc. **89,** 347–367 (2008)

A new modeling technique devised by atmospheric scientist Kerry Emanuel of the Massachusetts Institute of Technology and colleagues indicates that if the planet continues to warm, hurricane frequency will go down globally, although storms are projected to become more intense in some locations.

Climate models are complex beasts and are not geared to predict something as small as the birth of a hurricane, so Emanuel's team took a creative approach by seeding large, low-resolution climate models with the detailed physics of hurricanes. This 'mash-up' allowed them to run thousands of synthetic storms within the models, enough to make credible estimates of hurricane activity. The technique proved accurate when tested on climate data during 1986–2006, and when used to project future trends, it estimated an overall decrease in global storm activity between now and the period 2181–2200.

The projected increases in storm power are, surprisingly, more modest than the increases witnessed in the past 25 years, suggesting either that the recent changes are not largely driven by global warming or that the climate models suffer some systematic deficiency. Though Emanuel warns the results are preliminary, he says the uncertainties should fade away as global models improve.

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ATMOSPHERIC SCIENCE

Ozone anxieties

US GEOLOGICAL SURVEY

Science doi:10.1126/science.1153966 (2008)

Proposed 'geoengineering' schemes to counteract climate change could pose a serious threat to the Earth's ozone layer, warn scientists. One of the more popular ideas for rapidly cooling the planet involves simulating a volcanic eruption by releasing bursts of sulphur into the atmosphere to increase the amount of sunshine reflected back into space.

Now Simone Tilmes of the National Center for Atmospheric Research in the US and colleagues have calculated the impact on polar ozone of a sulphur injection large enough to compensate for the warming effect of doubling atmospheric carbon dioxide levels. They base their estimates on historical records of the relationship between ozone loss and atmospheric aerosols in polar regions, as well as accounting for anticipated future depletion of ozone by anthropogenic pollutants such as halogens, expected to decline in coming years owing to a prohibition on their use.

Assuming the scheme began in 2010 and steadily saturated the atmosphere with sulphate over the following five years using annual injections, it would greatly enhance ozone loss over the Arctic during the next century, especially if winters were cold, they found. In addition, they say the recovery of the ozone layer over the Antarctic could be delayed by 30 to 70 years.

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