PALEOCLIMATE

Monsoon misery

SCIENCE / AAAS

Science **322,** 940–942 (2008)

China's Ming Dynasty once commanded a million-man standing army and a fleet of treasure ships. But still more powerful, suggests new research, was the Asian Monsoon. Natural fluctuations in the seasonal wind appear to have triggered the Mings' overthrow and other historic milestones — but during the last 50 years, human influences have taken over as the driver of monsoonal changes, say scientists.

In a Chinese cave on the fringes of the monsoon's range, a team led by Hai Cheng of the University of Minnesota, found a 1,810-year-old stalagmite that proffers an unusually detailed record of past monsoon seasons. By analysing a range of isotopes from the stalagmite's layers, Cheng's team found that for centuries the strength of the monsoon was associated with natural factors such as solar variation and average Northern Hemisphere temperatures. The timing of major monsoonal shifts coincided with the rise and fall of several Chinese dynasties, implying that these societies' agricultural foundations were at the mercy of changing rainfall. The tables turned, however, at around 1960, say the researchers, when the correlation between the Asian Monsoon and temperature switched.

The authors conclude that from the mid-twentieth century, human-induced climate change has superseded natural variation as the dominant influence on the monsoon.

Anna Barnett

BIODIVERSITY AND ECOLOGY

Shrooms shrivel

STEVEN ALLISON

Global Change Biology
doi:10.1111/j.1365-2486.2008.01716.x (2008)

Mushrooms growing in northern forests may provide a helping hand in combating climate change. As soils heat up, the fungi that feast on dead plant material can wither away and emit less carbon dioxide, new research suggests. Such changes in northern forests and tundra, which store an estimated 30 per cent of terrestrial carbon, could substantially alter atmospheric levels of the greenhouse gas.

In a spruce forest near Fairbanks, Alaska, Steven Allison and Kathleen Treseder of the University of California, Irvine, measured a literal greenhouse effect, enclosing plots of soil in plastic structures that trapped heat but let in rain. The greenhouse plots averaged 0.5 °C warmer than controls, and over three years lost 22 per cent of their moisture — and more than half of their bacteria and fungi, according to DNA analyses. The fungal group most affected includes mushroom species thought to produce high carbon emissions. The release of carbon dioxide from the covered plots fell by up to 50 per cent as soils dried at the end of each growing season.

The authors say the results were unexpected, and suggest they are specific to the type of environment they studied: a well-drained forest with no permafrost, such that the soil dries easily.

Anna Barnett

ATMOSPHERIC SCIENCE

Assessing ethane

123RF.COM / DAVID GAYLOR

J. Geophys. Res. **113,** D21306 (2008)

Methane emissions from energy production in the United States could be as much as 50 to 100 per cent higher than current estimates suggest. A potent greenhouse gas, methane is generated from the production of fossil fuels — mostly natural gas, as well as from biomass burning, agriculture and as from natural sources such as wetlands.

Ethane, released during the production of fossil fuels, is strongly correlated with methane in the atmosphere and as such can be used as an effective tracer of the greenhouse gas. Xiao Yaping, of Harvard University, and colleagues used a chemical transport model to evaluate a global inventory of ethane, verifying the model simulations with observations taken from surface sites and aircraft missions worldwide. They derived a global ethane inventory of 13 million tons per year. The majority of emissions, some 8 million tons per year, came from fossil fuel production, with 90 per cent emitted in the Northern Hemisphere. The team estimated US ethane emissions at 2.4 million tons per year for the 1990s, four times higher than the official inventory from the US Environmental Protection Agency for the same period.

This, they say, suggests a significant under-estimation of methane emissions from energy production in the US.

Olive Heffernan

EARTH SCIENCE

Gas copies carbon

ISTOCKPHOTO.COM / OCOYOC

Science **322,** 1085-1088 (2008)

Carbon dioxide sucked up by plants during photosynthesis is accompanied by another gas that could be used to trace the captured carbon, suggests new research. Carbonyl

sulphide (COS) will allow improved estimates of global photosynthetic activity, an important buffer against human-caused CO_2 emissions that has been notoriously difficult to quantify.

J. Elliott Campbell of the University of Iowa and colleagues looked at measurements of atmospheric COS, which photosynthesizing plants take up in a similar manner to carbon dioxide, from an airborne experiment across the central and eastern United States during July and August 2004. They found plants drew down 4.2 times the amount of COS predicted by past models, which assumed that both photosynthesis and respiration would control COS levels in the air. The data instead matched a new model, drawn from recent laboratory experiments, in which photosynthesis alone is the main influence.

The finding that COS, unlike CO_2, is not released back to the atmosphere through respiration makes the gas ideal for tracking photosynthesis, the group concludes. COS-based photosynthesis estimates could clarify the relationships between plant growth, CO_2 levels and climate change, adding precision to climate models.

Alicia Newton

ANTHROPOGENIC CHANGE

Water vapour warming

ISTOCKPHOTO.COM/AVTG

Geophys. Res. Lett. **35,** L20704 (2008)

Scientists have obtained the most detailed ever measurements of atmospheric water vapour — an abundant greenhouse gas — from unique sensors aboard a NASA satellite. The observational data validate what scientists have inferred from climate models for some time — that the heat-trapping properties of water vapour could double the effect of greenhouse warming from other sources such as carbon dioxide.

A team led by Andrew Dessler at Texas A&M University used data measured by the Atmospheric Infrared Sounder (AIRS) on NASA's Aqua satellite from 2003 to 2008 to calculate the amount of water vapour throughout the lowest 10 miles of the atmosphere. AIRS is the first instrument capable of differentiating the amount of water vapour at different levels in the atmosphere, enabling these detailed observations. Dessler and colleagues combined the satellite data with global-average surface temperature readings for the same period to determine how water vapour both affects, and responds to, temperature. They found that if the Earth warms by 1 °C, rising humidity will trap an additional 2 Watts of energy per square metre, similar to the estimates simulated by climate models.

The results suggest that the feedback effect of water vapour on climate warming is both large and positive.

Olive Heffernan

CLIMATE IMPACTS

Fiery forecast

ISTOCKPHOTO.COM/BRASIL

Global Biogeochem. Cycles **22,** GB4007 (2008)

Fires fanned by drought and deforestation could consume much of the Amazon rainforest over the twenty-first century, reports a new study. Numerous climate models project worsening dry seasons in the Amazon, but the impact on fire risk, and its interaction with deforestation, is less well-understood.

Nicola Golding and Richard Betts, of the Met Office Hadley Centre, UK, combined a global climate model with a fire danger index to simulate changes in fire risk in the Amazon until 2090. According to the model, an area of high fire risk could spread along southeast Amazonia as early as the 2020s; by the 2080s, at least 50 per cent of the forest — up to 93 per cent in some model runs — lies in the danger zone. Compounding the threat, growing areas of fire risk in eastern Amazonia are likely to overlap with expanding areas of slash-and-burn forest clearing, raising the chances that intentional fires will spread.

The researchers warn that if the regional climate changes simulated for Amazonia hold true and deforestation continues, the entire eastern portion of the rainforest could be at risk by 2080. The loss of forest cover might further intensify regional droughts, they note, and would remove one of the planet's sizeable carbon sinks.

Anna Armstrong