OCEAN SCIENCE

Shutting out sun

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Proposals to cool the planet using geoengineering — for example, by pumping reflective aerosols into the upper atmosphere — have been criticized on the basis that they would do little to solve ocean acidification. Acidic waters pose a threat to marine organisms that build their shells from carbonate compounds such as aragonite.

New research suggests that although climate engineering could moderately dampen ocean acidification, it would not reduce damage to marine calcifiers. Damon Matthews of Concordia University in Montreal and colleagues used an Earth-system model to examine how engineered reductions in solar radiation would affect pH and levels of aragonite in the ocean over the twenty-first century. According to their simulations, if climate engineering reduced surface air temperatures to pre-industrial levels, it could also increase ocean pH by 0.05 units at 2100, relative to a world without climate engineering. But this reduction in ocean acidity would occur only if there was an increase in the amount of carbon absorbed on land, say the authors.

Although geoengineering could reduce acidity, Matthews and colleagues say it would not prevent concentrations of aragonite in the ocean from falling as a result of escalating CO_2 emissions, suggesting that engineering alone cannot protect marine ecosystems.

Anna Armstrong

CHEMISTRY

Abnormal nitrogen

MEREDITH HASTINGS

Science **324,** 5932 (2009)

Nitrate concentrations in Greenland ice have almost doubled since the onset of the Industrial Revolution, according to scientists. The rise in nitrate is accompanied by a sharp drop in the isotopic signature of the nitrogen, beginning just as humans started pumping nitrogen oxides into the atmosphere.

Meredith Hastings of Brown University and colleagues used a 100-metre-long ice core from Summit, Greenland, to track changes in nitrogen composition over the past three centuries. Beginning in 1850, the isotopic ratio of the nitrogen, which in part reflects the source of the nitrate, began to decline, just as greenhouse gas concentrations were starting to rise in response to the widespread burning of fossil fuels. The sharpest jump in the isotopic ratio came between 1950 and 1980, when emissions also soared. This overall trend would be difficult to explain through changing chemical processes in the snow or atmosphere alone, leaving fossil fuel combustion as the most likely driver.

Nitrogen oxides are among the six greenhouse gases regulated under the Kyoto Protocol. The team hopes that further work will allow them to determine how changes in climate influence natural nitrogen oxide sources.

Alicia Newton

EARTH SCIENCE

Fallow fields

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Glob. Biogeochem. Cycles
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Farming on river-fed floodplains cuts their carbon storage, suggests a new study. These floodplains are highly productive ecosystems covering more than 1.3 per cent of the Earth's surface, but little is known about the quantities of carbon cycling through them.

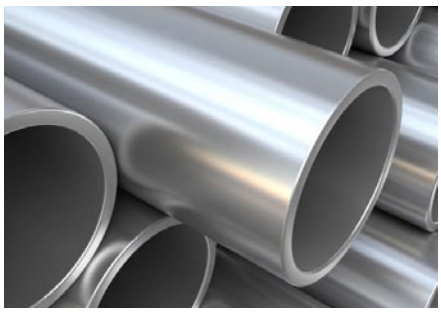
In 2004, Georg Lair of the University of Natural Resources and Applied Life Sciences in Vienna and colleagues measured the organic carbon content of floodplain soils surrounding the Danube River in Austria. They found that the youngest soils — those less than 100 years old — sequester more than 100 grams of carbon per square metre each year. As undisturbed floodplains are regularly replenished by fresh, nutrient-rich sediments, they could maintain this high carbon uptake for centuries, the authors suggest. In intensively farmed floodplains, however, young soils take up much less carbon annually, making croplands significantly weaker carbon sinks than uncultivated ground.

Over 70 per cent of European floodplains and 46 per cent of North American floodplains have already been converted to cropland. The researchers warn that uncultivated plains should be preserved if we are to make the most of these carbon sinks.

Anna Armstrong

MITIGATION

Pipe dreams



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J. Geophys. Res.
doi:10.1029/2008JC004792 (in the press)

A scheme to fertilize the ocean is unlikely to make any real contribution to carbon sequestration, scientists report. In 2007, James Lovelock and Chris Rapley proposed using floating pipes to bring deep, nutrient-rich sea water to areas of the ocean that are devoid of life. The scheme would fuel productivity by boosting the growth of

phytoplankton, which transport carbon to the deep sea.

But an analysis by Andrew Yool of the National Oceanography Centre, Southampton, UK, and colleagues suggests the concept is little more than a pipe dream. Using a numerical model to test the efficiency of such a nutrient transfer system, they found that the overall effect on sequestration was minimal. Nutrient-rich water piped to the surface would enhance productivity surrounding the pipes, but because of its high CO_2 concentration it is likely to release the greenhouse gas back to the atmosphere. In the simulation, pipes located in the tropics were the most successful at transferring atmospheric carbon dioxide to the deep ocean.

The researchers conclude that an unfeasible 189 to 776 million pipes would need to be scattered throughout the low-nutrient waters of the tropics for the scheme to make any significant dent in atmospheric carbon dioxide levels.

Alicia Newton

BIODIVERSITY AND ECOLOGY

Exit obstructed

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Proc. Royal Soc. B
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Natural barriers could stop African birds winging it away from climate change. A new large-scale study finds that features such as rough mountain terrain and the borderlines between grassland and jungle are more important than temperature in limiting species' ranges.

Lynsey McInnes and colleagues at Imperial College, London, examined the ranges of all 2,075 terrestrial bird species in the African tropics and found that their range boundaries fall in clusters. Ranges tend to end in heterogeneous environments with steep elevation changes or a variety of landscape types, such as the Eastern Arc Mountains of Kenya and Tanzania or places where central African rainforests give way to savannah. Even the widest-ranging species often appear unable to spread beyond such barriers; many species with tiny ranges make use of specialized niches within them.

The authors say combining information on environmental barriers with projections of African climate change and species ranges could show which birds are most at risk of getting stuck. This could help conservationists plan for assisted migration and other schemes to help sensitive species move on. Consideration also has to be given to the fact that some of the barriers themselves are likely to move as a result of climate change.

Anna Barnett

ATMOSPHERIC SCIENCE

Reappraising aerosols

NASA

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Atmospheric aerosols may be offsetting greenhouse warming to a lesser extent than previously thought, suggests a new study. The Intergovernmental Panel on Climate Change currently estimates, albeit with large uncertainty, that direct cooling from aerosols can counteract almost one-third of the warming caused by carbon dioxide.

But by resolving an existing discrepancy between satellite-derived and modelled estimates of the effect of aerosols, Gunnar Myhre of the Centre for International Climate and Environmental Research-Oslo finds that the true value is likely to be much lower. Myhre calculated the radiative forcing of aerosols — a measure of their impact on the balance between radiation coming into and going out of the atmosphere — using estimates from both a global model and satellite-derived data. He then reconciled the difference between the two estimates by including some vital information. Assuming that aerosols are globally ubiquitous, he included modelled aerosol data in regions where satellite data is currently unavailable. He also accounted for the substantial change in aerosol optical properties that has occurred since pre-industrial times, which largely results from the disproportionate increase in black carbon.

Myhre's revised estimate suggests that the direct aerosol effect offsets only ten per cent of the warming of greenhouse gases.

Olive Heffernan