However, further changes in agricultural land use, such as the introduction of non-native crops and the development of widespread and intensive livestock grazing eventually reduced the build-up of biomass. Marlon and colleagues suggest that this reduction in fuel, along with the implementation of fire suppression policies in some regions, caused the reduction in biomass burning in the period after 1870, despite a warming climate. Ice core records of $\delta^{13}CH_4$ and CO (ref. 8), which have been suggested to be proxies of biomass burning, provide additional support for their fire reconstruction.

There are geographic gaps in the data set, but the authors suggest that they have a good coverage of climatic zones, except for grassland and dry shrubland. Although reconstructions of fires in these regions are difficult to construct owing to minimal charcoal production during burning, such fires are important for global biomass burning estimates. Grassland fires[9] produce large amounts of emissions, including greenhouse gases and particulates[4]. Rare records of charcoals from lake sediments and reconstructions from black carbon and carbon isotopic data from deep-sea cores may provide a way to fill this gap.

These gaps also extend to two potentially important regions. One is the Amazon, which has recently suffered massive biomass burning at the hands of its inhabitants[10]. Local pressure on the use of its resources is in conflict with the global need to reduce CO_2 emissions and preserve the rich forests of the region as a carbon sink. Tropical peatlands such as those found in Indonesia are similarly missing from the database. Increasing burning of these vast carbon stores — started by humans and fuelled by drought — is making a significant contribution to global greenhouse emissions[11].

The work by Marlon and colleagues highlights the need for an expanded database, collected from new areas and time slices — not an easy task when current funding favours the investigation of big questions over the collection of primary data. The nature of the relationship between charcoal production, transport and sedimentation, and the effect of this relationship on our interpretation of the charcoal record, also needs our attention.

Another area where our understanding could be improved is the prehistoric use of fire by humans, including landscape burning. How did the use of fire by the first human populations of North America affect vegetation? What were the effects of the burning of savannas by Aboriginal populations in Australia, and how might we recognize these impacts using the fossil charcoal record? In addition, we need a better idea of natural fire systems, before the advent of humans, in order to understand the full impact of humans on biomass burning.

An integration of field data and modelling as used by Marlon and colleagues is an important contribution to our understanding of the relationship between fire, climate and man. But only time will tell if they have the correct answers.

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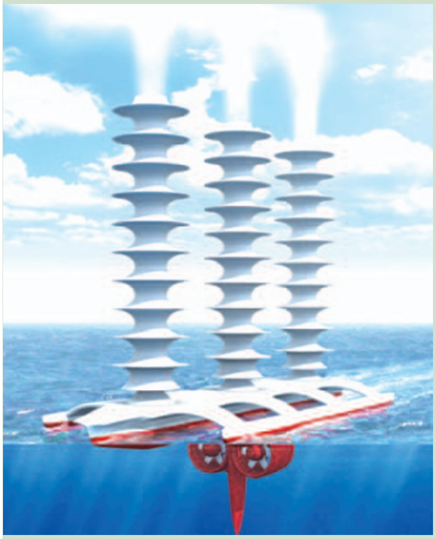
CLIMATE CHANGE

Cool spray


JOHN MACNEILL

The reality of anthropogenic-induced climate change is no longer in question. Nevertheless, the amount of carbon dioxide vented into the atmosphere each year as a result of human activities shows no sign of levelling off (let alone decreasing). As a result, geoengineering solutions are beginning to look more attractive, at least as a last resort. Proposals come in many flavours of expense, impact and economic viability, with ocean fertilization, the injection of sulphate aerosols into the upper atmosphere and carbon sequestration being some of the more prominent ideas.

Writing in a special issue on "Geoscale engineering to avert dangerous climate change", John Latham and colleagues propose a different way of cooling the Earth, which involves seeding low-level maritime clouds with seawater particles (*Phil. Trans. R. Soc. A* doi:10.1098/rsta.2008.0137; 2008). The scheme aims to exploit the Twomey effect, in which an increase in the number of cloud condensation nuclei — seawater particles in this case — leads to more, but smaller, cloud droplets. The resulting brighter clouds reflect more sunlight back into space, leading to the desired cooling effect.

In a companion paper, Stephen Latham and colleagues suggest a relatively low-cost engineering solution to the challenge of injecting the seawater particles into the marine boundary layer. They propose that wind-driven vessels (see image), based on a 1920s design forgotten during the turmoil of the 1929 economic depression, could spray seawater into the atmosphere (*Phil. Trans. R. Soc. A* doi:10.1098/rsta.2008.0136; 2008).

The beauty of the proposal is its relative simplicity. The resources required are just seawater and wind, the vessels should not need much maintenance, and the effect of cloud albedo increases could be quite large compared with the effort needed to generate the spray.

As with all geoengineering proposals, more research needs to go into both the efficiency of the scheme at an industrial scale and the possible (unexpected) side effects. The injection of seawater into the atmosphere could be stopped immediately should undesirable effects develop, such as substantial reductions in precipitation over populated land areas. But, as the authors concede, the response of the Earth system could linger much longer.

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