PREFACE

Geoengineering: taking control of our planet’s climate?

Concerns about the likely consequences of continuing climate change have greatly increased interest in geoengineering – whether the Earth’s climate could be deliberately modified to counteract global warming due to anthropogenic greenhouse gas emissions. In November 2010, the Royal Society hosted a Discussion Meeting: ‘Geoengineering: taking control of our planet’s climate’ that critically assessed many of the schemes currently being considered. The meeting also took stock of the relationship of geoengineering to conventional greenhouse gas mitigation as well as how geoengineering is perceived by the public. Papers in this issue directly reflect the outcome of that Discussion Meeting.

Technical understanding of proposed geoengineering techniques is progressing rapidly, to the extent that prototypes now exist of key components required for capturing CO₂ from ambient air [1]. Importantly, assessment is moving away from purely theoretical and abstract; for instance, by carrying out single-parameter change experiments in global climate models, to consideration of practical engineering issues and the sort of ‘real-world’ environmental conditions that exist and might render schemes non-viable. For example, research into the potential for achieving surface cooling by ‘brightening’ (enhancing the albedo of) marine clouds is now focusing on the details of cloud microphysics and using high-resolution cloud modelling to understand the lifetime and dynamics of droplets [2]. For injecting aerosols into the stratosphere to create surface cooling, the feasibility of using tethered high-altitude balloons has been explored and engineering challenges assessed [3]. With respect to the potential for raising the albedo of crops to produce regional-scale cooling [4], the variation in reflectivity that exists between commercially available varieties is currently being experimentally determined, with field measurements of albedo differences under ‘real’ growing conditions planned as the next logical step. It is also becoming possible to make detailed costings [1]—ultimately one of the most critical pieces of information in terms of the feasibility of carrying out geoengineering.

In contrast to the recent rapid developments in engineering design and better understanding of the costs, practical limitations and potential climate impacts and side-effects, the international governance arrangements for the possible future implementation of geoengineering are only poorly developed [5].
Provision of clear and quantitative information on the rationale for geoengineering and engagement with the public and policy-makers has also lagged behind [6]. This has resulted in a polarization of views, with technology enthusiasts, sometimes holding patents into the techniques they are promoting, juxtaposed against environmental pressure groups who are strongly opposed to any attempt to address the climate problem by geoengineering, considering it unethical and diverting resources from mitigation. This difference of opinions can be exasperated by the media, who often focus on the ‘wackier’ ideas, presenting geoengineering research as impossible science fiction. Yet scientists and engineers are far from blameless in how geoengineering is perceived, particularly in a tendency to frame specific proposals as a single ‘cure-all’ for future climate change. As reliance on any one technology for climate mitigation effectively creates a single point of failure, it should not be surprising that a reactionary fear of risky interference in the climate system by geoengineering arises, further complicating the debate.

We might take lessons from conventional mitigation and frame the potential role of geoengineering in terms of ‘wedges’—i.e. aiming to build up a desired climate mitigation via a suite of diverse technologies and approaches. Wedges could be regional and seasonal in their climate mitigation as much as global and with a more constant effect, targeting either full or partial mitigation of specific adverse global warming impacts, such as Greenland ice mass loss (and sea-level rise) or regional summer heat waves. Geoengineering and conventional greenhouse gas mitigation are not mutually exclusive of each other [7], and in avoiding severe global environmental impacts in the future, wedges might involve both emission reductions and geoengineering. Planned reforestation, for example, is effectively both. Ideally, geoengineering wedges might be biased towards the carbon side of the equation [1,8]. Removing CO2 also helps directly mitigate ocean acidification [9] and its potential marine ecological impacts, and is addressing the cause rather than simply the consequence of greenhouse gas emissions.

Geoengineering is no longer the realm of science fiction, with key technologies necessary to make some of the schemes work emerging and understanding of climate impacts improving. Geoengineering represents a new wave in a process through which human society has been progressively changing the albedo and hydrology of the land surface for thousands of years as agriculture has developed and the population urbanized, and more recently, changing the greenhouse composition of the atmosphere and chemistry of the ocean as societies have industrialized. The manipulation of global climate by alternating both surface short-wave budgets and atmospheric long-wave radiation budgets is hence not an alien activity to us. Knowing full well, as we do now, of the climate implications of vegetation cover changes and increased greenhouse gas concentrations, we can hardly claim innocence of the climate changes wrought by our continuing global-scale engineering. We are missing only the explicit intention to change climate that is specific to geoengineering.

While progress in conventional emission mitigation and a transition towards more sustainable and less intensive energy use remain the priority, if there are additional means of helping counter some of the more undesirable impacts of a progressively warming world, we should not blindly rush into ruling them
out without having fully evaluated a cost–benefit analysis of the proposals. The papers in this issue represent another step towards this goal of scientific understanding.

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References


