IAGP

Integrated Assessment of Geoengineering Proposals

EVALUATING GEOENGINEERING AS A POTENTIAL RESPONSE TO CLIMATE CHANGE: WHAT NEEDS TO BE CONSIDERED?

The first of a set of four Briefing Notes summarising the findings of the Integrated Assessment of Geoengineering Proposals

The Integrated Assessment of Geoengineering Proposals (IAGP) research project has brought together a broad range of expertise, from climate modelling to philosophy and from engineering to public perceptions, to situate the assessment of geoengineering within wider societal values

BRIEFING NOTE 1

Geoengineering proposals aim to intentionally manipulate the Earth's climate at large scales and have been suggested as a possible response to climate change. The potential societal consequences of both geoengineering and climate change are significant. It is therefore essential that geoengineering proposals are comprehensively evaluated in context with the impacts of climate change, mitigation and adaptation.

Is all geoengineering alike?

A range of geoengineering proposals have been suggested (Box 1). These proposals would typically need further – often substantial – development to get them to a stage where they could operate in the real-world.

Geoengineering proposals can be broadly divided into two categories:

Carbon dioxide removal aims to cool the Earth by removing some of the greenhouse gas carbon dioxide (CO_2) from the atmosphere.

Solar geoengineering aims to cool the Earth by reflecting more of the Sun's warming radiation back to space.

- As carbon dioxide removal and solar geoengineering work differently, they would alter the climate in different ways.
- Carbon dioxide removal would alter the climate slowly whilst solar geoengineering could cool the Earth rapidly. However, if solar geoengineering were stopped, the climate would warm very quickly which would be hazardous to humans and ecosystems.
- Changes in the climate caused by solar geoengineering would not match the changes caused by CO_2-driven climate change. Solar geoengineering would therefore alter patterns of rainfall across the Earth and ocean acidification would persist.
- Carbon dioxide removal and solar geoengineering have different impacts and implications, but no geoengineering proposal is without risks and side-effects.
- Carbon dioxide removal and solar geoengineering are perceived differently by the public and other stakeholders (see Briefing Note 2).

What role could geoengineering play in responding to climate change?

The potential need for geoengineering depends on the **amount** and **speed** of:

- climate change deemed acceptable by society
- adaptation society is able to undertake
- mitigation society can achieve

For example:

- In the longer term (~100 years), keeping global average warming below 2°C above pre-industrial times with current levels of mitigation would need large-scale carbon dioxide removal
- In the shorter term (~50 years), keeping to 2°C target with no strengthening of mitigation would more likely also need solar geoengineering

IAGP research shows that starting stronger mitigation promptly can be more effective at reducing atmospheric CO_2 than all but the most intense types of carbon dioxide removal.

Examples of geoengineering proposals

Carbon dioxide removal

- Capturing CO_2 directly from the air and storing it underground
- Fertilising the ocean to increase CO_2 uptake
- Large scale afforestation

Solar geoengineering

- Forming reflective particles in the stratosphere
- Increasing the reflectivity of low level marine clouds
- Altering crops to make them more reflective

Box 1

How might geoengineering interact with mitigation and adaptation?

- Some argue that the possibility of geoengineering may shift efforts away from emissions reductions.
- Certain carbon dioxide removal proposals can be thought of as forms of mitigation, e.g. the Intergovernmental Panel on Climate Change (IPCC) includes 'bio-energy with carbon capture and storage' (BECCS) as a form of future mitigation.
- The cooling associated with solar geoengineering would only last for up to a few years. In the absence of sufficient mitigation or carbon dioxide removal, solar geoengineering would need to be continued indefinitely.
- Some suggest that solar geoengineering could be used temporarily to provide more time to mitigate and adapt to climate change. In this case, carbon dioxide removal would also need to be implemented to avoid the rapid warming associated with stopping the solar geoengineering.
- Adaptation will always be necessary to some extent in the future. For example, even with strong mitigation and carbon dioxide removal, the slow thermal response of oceans will likely cause sea levels to continue to rise until next century.

Framework for evaluating geoengineering proposals

Storyline

- What is the objective?
- What are the motivations?
- Are there other ways to achieve the objectives?
- What do others think?

Assumptions

- Future scenarios of emissions and climate change
- Temporal and spatial scales of assessment
- Definition of the proposal

Criteria

- Society
- Environment
- Economics

Box 2

What needs to be considered when evaluating geoengineering proposals?

IAGP have developed a framework for evaluating geoengineering proposals (Box 2). It is designed to be flexible and accessible. By working through the themes in the framework, users are encouraged to:

- consider geoengineering within the **broader context of mitigation and adaptation**
- consider and acknowledge the broader **storyline** *e.g. is it intended to be carried out for profit or for the benefit of a single nation? Could the objective be achieved through mitigation alone?*
- communicate underlying **assumptions**
- broaden the spectrum of **criteria** and how these are decided upon *e.g. expanding the evaluation beyond 'technical' considerations*
- acknowledge that **uncertainties** are pervasive, quantifying and communicating them whenever possible
- **revisit** and **reflect** on their evaluation as conditions, knowledge and attitudes change

What does the IAGP project recommend?

The IAGP project recommends that:

- Geoengineering should be discussed and evaluated within the context of mitigation and adaptation measures.
- It should be understood that the 'carbon dioxide removal' and 'solar geoengineering' forms of geoengineering are distinct and offer very different potential benefits and challenges.
- The magnitude and time-scales of targets for mitigation should be recognised as important for determining whether geoengineering is considered necessary.
- Evaluations of geoengineering proposals should be reflexive and transparent, exploring diverse criteria, assumptions and perspectives, e.g. through public and other stakeholder engagement.
- Geoengineering research should be interdisciplinary.

Further resources

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http://www.iagp.ac.uk/publications/

About us

The IAGP project has been carried out by researchers at Cardiff University, Lancaster University, Met Office, Tyndall Centre for Climate Change Research, University of Bristol, University of East Anglia, University of Leeds and University of Oxford. The IAGP project has received funding from the Engineering and Physical Sciences Research Council (EPSRC) (EP/I014721/1) and the Natural Environment Research Council (NERC) and support from Living With Environmental Change (LWEC).

Project Website

www.iagp.ac.uk

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