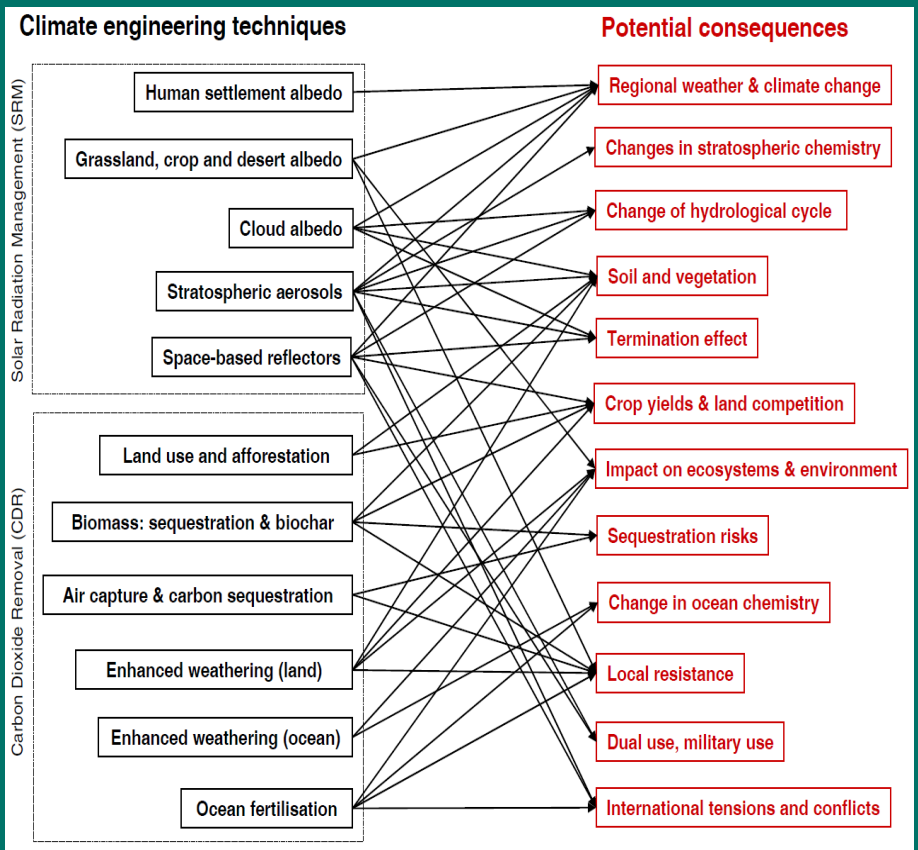
Potential Pathways, Consequences and Risks of Climate Engineering

Jürgen Scheffran

Research Group Climate Change and Security (*CLISEC*), KlimaCampus, University of Hamburg, Email: juergen.scheffran@zmaw.de



Possible consequences and risks

Little experience with CE and large-scale CE tests: Study of consequences and risks quite hypothetical yet

Systematic approach to restrain possibilities looks at impact chains and action pathways in certain environments.

Risks: expected loss and probability of events

Consequences: events or sequences induced by CE:

- Plausibility based on experiences and logical reasoning
- Relevance of events for the actors

1. **Direct impacts on local environments** to which CE measures are applied (atmosphere, ocean, water cycle, biodiversity, forests, agriculture, cities).
2. **Implications from intended impact on climate system**: expected and foreseeable impacts, side-effects, externalities (e.g. cooling or changing rainfall patterns from aerosol emissions, ecosystem change, demographic patterns).
3. **Unintended impacts on the climate system**: unexpected and unforeseeable side-effects and externalities due to uncertainties and complexities that exceed prediction.
4. **Consequences from CE implementation process:**
   - CE requires infrastructure and considerable efforts and activities which change natural and social systems
   - Opportunity costs compared to alternative investments
   - Resource competition: need for energy, land, other resources
   - Additional pollution from CE in conflict with environmental law
   - CE implications for climate policy (e.g. blocking mitigation & adaptation strategies)
   - Protests and conflicts at each stage of implementation (anticipation, research, development, testing, deployment)
5. **Responses and interactions in the international system**:
   - World regions affected differently by climate change and CE
   - Asymmetric distribution of benefits, costs and risks
   - Resistance of States feeling threatened or at disadvantage
   - Security dilemmas, tensions, disruption of cooperation

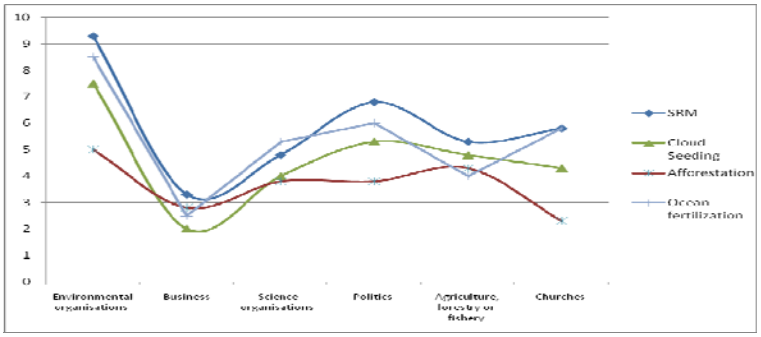
The climate engineering discourse

United Kingdom: The British Natural Environment Research Council (NERC), together with other organisations, conducted a public dialogue on CE, to provide qualitative insights into public priorities and opinion formation to support future decision-making.(NERC 2010). During the dialogue, views on geoengineering became more sophisticated and discriminating. Support for some CE approaches increased, for others declined. Most participants were not opposed to CE technologies in general, but were deeply concerned about some of their implications. Most accepted the potential need for CE in case of ineffective mitigation or combine CE approaches with mitigation efforts.

Carbon Dioxide Removal (CDR)	Solar Radiation Management (SRM)
Consistently highlighted as preferred method of geoengineering. ***Afforestation*** and ***Biochar*** were seen as "natural" approaches and preferred for this reason.	Less support for SRM overall, as it was perceived not to tackle the root cause of climate change (which participants considered to be greenhouse gases).
Level of support for ocean based methods such as ***Iron Fertilisation*** and ***Liming*** was low, though at the reconvened event participants became more prepared to consider these.	***Cloud Whitening*** and ***Sulphate Particles*** were the most positively received of the SRM technologies, but were not endorsed by a majority.
Support for ***Air Capture*** increased through the events. Participants welcomed the fact that this CDR technology could be carried out on a local level without the need for international regulation required, and that results may be seen more quickly than with afforestation.	***Mirrors in Space*** were seen as expensive and risky, and ***White Roofs*** were viewed as likely to be ineffective and not feasible. Both received little support.

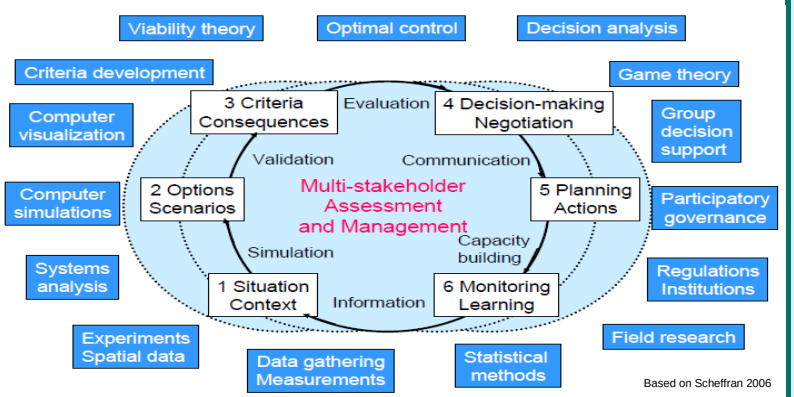
Based on NERC 2010

Germany: As part of the BMBF study, a Delphi expert survey was conducted to improve understanding about the potential for future resistance, protest and conflict (Rickels et al 2011, Renn et al. 2011) Twelve experts agreed that CE experiments have the potential to engender conflict. Most controversial would be large-scale CE field experiments on atmospheric modification with sulfur particles, followed by ocean fertilization, while cloud seeding had medium and afforestation low conflict potential. In the case of all technologies, the conflict potential increased closer to the deployment site and reached high scores for initiatives in or above Germany or against the will of the UN and developing countries. The Delphi participants expected the greatest conflict potential from environmental organizations and other NGOs that vehemently protest against SRM.



Delphi score of conflict potential for actor groups (average from low 1 to high 10) (based on Renn et al. 2011)

Framework of multi-stakeholder assessment & management



Based on Scheffran 2006

Literature:

NERC 2010: Experiment Earth? Public Dialogue on Geoengineering. Natural Environment Research Council, www.nerc.ac.uk/about/consult/geoengineering-dialogue-final-report.pdf

Renn, O.; N. Brachatzek, S. Hiller (2011) Climate Engineering: Risikowahrnehmung, gesellschaftliche Risikodiskurse und Optionen der Öffentlichkeitsbeteiligung. Kiel: BMBF scoping report.

Rickels, W. et al. (2011) Large-Scale Intentional Interventions into the Climate System? Scoping report for the German Federal Ministry of Education and Research (BMBF), Kiel Earth Institute.

Royal-Society (2009) Geoengineering the climate: science, governance and uncertainty, Royal Society, London.

Scheffran, J. (2006), Tools in Stakeholder Assessment and Interaction, in: S.Stoll-Kleemann, S. Welp (eds.)., Stakeholder dialogues in natural resources management and integrated assessment, Springer, Berlin.

Scheffran, J.; M. Broszka, H.G. Brauch, P.M. Link, J. Schilling (eds.) (2012) Climate Change, Human Security and Violent Conflict: Challenges for Societal Stability, Berlin: Springer.

Scheffran, J., Cannaday, T. (2012) Resistance Against Climate Change Policies: The Conflict Potential of Non-fossil Energy Paths and Climate Engineering, in: B. Balazs, C. Burnley, I. Comardicea, A. Maas, R. Roffey (eds), Global Environmental Change: New Drivers for Resistance, Crime and Terrorism?, Baden-Baden: Nomos (forthcoming).

UBA (2011) Geo-Engineering: effective climate protection or megalomania?, Umweltbundesamt, Dessau.