

# Socio-ecological research on geoengineering:

## Current status and future possibilities

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# Outline

- The past: State of ecological research, state of social science research — and where the two intersect (or don't)
- The present: Opportunities for integrating existing research
- The future: Opportunities for transdisciplinary research going forward

# Ecological research\*

\* from a sociologist's reading

SRM	CDR
<ul style="list-style-type: none"><li>- A few studies on crop impacts</li><li>- A few studies examining SRM impacts upon coral ecosystems</li><li>- Maybe 1-2 studies on effect of termination shock upon species</li><li>- ...?</li></ul>	<ul style="list-style-type: none"><li>- Literature on biofuels applicable to BECCS</li><li>- Existing literature on afforestation, blue carbon, ocean fertilization all applicable to some degree</li><li>- Direct air capture, enhanced weathering - very little literature?</li></ul>

Sociologist's question: Why is there so little research on geoengineering from ecology, conservation biology, etc.?

Hypothesis 1 - values of the discipline, H2 - disciplinary methods

# Social science research on SRM: ~30 empirical studies (2009 – present)

- About half large-n studies
  - Surveys, experimental studies
  - Germany, US, Canada, UK, New Zealand...
    - Recently, 6-country comparison by Visschers et al (2017), including China
- About half deliberative, small-n studies
  - Focus groups, public engagement workshops
  - UK, Sweden, Japan

# Social science relevant to CDR: varies by method

- BECCS - very few papers (building on existing social science research on bioenergy, CCS)
- Afforestation - many papers, because of REDD+
- Soil carbon sequestration - few papers
- **Enhanced weathering - 0 social science studies**
  - \$60-\$600 trillion to draw down 50 ppm CO<sub>2</sub>, (Taylor et al, 2016); significant energy demands
- **Direct air capture - 0 social science studies**



# “Traditional” social science research questions on SRM:

- How widespread is public knowledge of solar geoengineering?
- How does the public perceive solar geoengineering?
- What factors drive public perceptions of solar geoengineering? (Merk et al, 2015)
- How convincing is the moral hazard argument? Does it interfere with willingness to mitigate? (Merk et al, 2016)
- Does considering geoengineering galvanize support for existing climate policies rather than reduce it? (Corner and Pidgeon, 2014)
- Does hearing about SRM affects people’s support for higher energy taxes, or their trust in climate science? (Fairbrother, 2016)
- Do framings of geoengineering as “natural” affect support for it? (Corner and Pidgeon, 2015)

# But this research isn't conclusive, because...

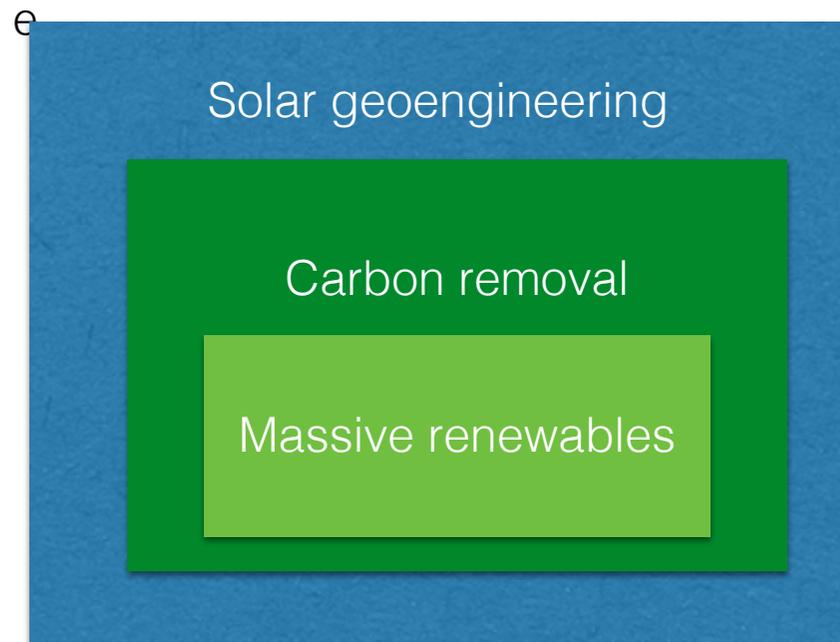
- Since people don't know what geoengineering is, they probably aren't going to form a reliable opinion on it from reading a paragraph in an Internet survey (first impression is not so useful)
- People have different opinions about the technologies based upon the context in which they would be employed
- Survey research risks being instrumentalized (i.e. used as justification for a particular research path/project)
- Even if you gauge “perceptions”, “acceptance”, or “support” — how is that going to affect what actually happens? Is there a real relationship between support and policy action?
  - Scalar mismatch - “Perceptions” research more operationally useful on the local scale (i.e. siting a BECCS facility)
  - Not evident that it's useful on the global scale, because decisions are often made by nation-states and other actors, not individuals

# Does it make sense to research SRM + CDR together? From a social science standpoint, not always

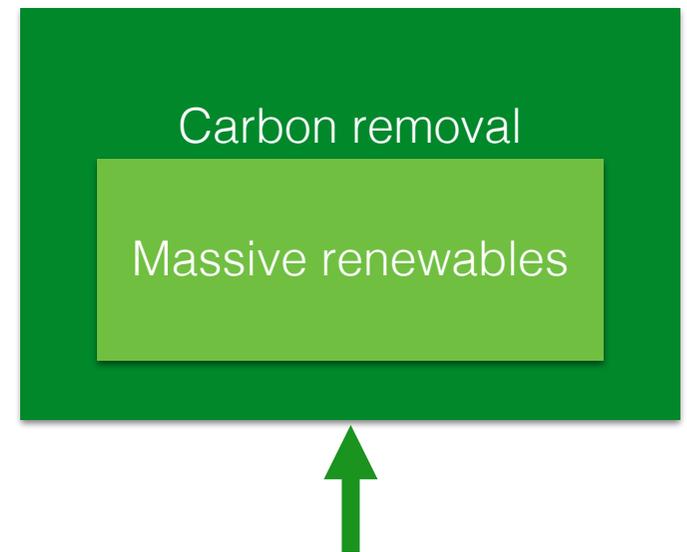
Even though they both are intended for a similar goal (reducing climate suffering), they have very different governance needs, and interact with social systems in very different ways. But —

## ***Solar geoengineering implies carbon removal which implies renewable energy***

(carbon removal because of the termination effect; renewables because removing carbon takes energy)



If you're examining solar geo, you need to **also think about CDR + renewables**



But you could also just start here

# Existing socio-ecological research

	Impacts of geoengineering	Drivers of geoengineering
Past		
Future	Impact assessment via modeling studies (e.g. land use req's of BECCS)	

# Suggested **opportunities** for socio-ecological research

	Impacts of geoengineering	Drivers of geoengineering
Past	<p>(1) <b>Synthesis research</b> - lessons from recent history</p> <p>Impact assessment via modeling studies (e.g. land use req's of BECCS)</p>	
Future	<p>(3) <b>Landscape-level analysis</b></p>	<p>(2) <b>Policy-maker knowledge / demand research</b></p> <p>(4) <b>Citizen-level demand research</b></p>

# 1. Synthesis research

**Review and synthesis** research that **integrates existing knowledge** of fields that aren't tagged with "geoengineering"

Sample socio-ecological research questions:

How did the 2007-8 biofuel boom change community land use, access to water, and use of fertilizers?

How have forest carbon projects impacted how communities interact with forests, and forest health?

What factors influence landholder adoption of different land use practices / technologies?

Where have new energy technologies successfully transferred into different cultural contexts?

Why has CCS adoption failed to date? (What would be the ecological impacts of new infrastructure?)

How do new energy technologies cross the gap between demonstration and commercial scale?  
(Where have they successfully done so without harming biodiversity?)

**These are relatively well studied, but the knowledge has not been applied to climate intervention approaches**

**Methods:** *Collaborative, synthetic reviews*

## 2. Policymaker knowledge and demand research

Research questions:

- What do policymakers already know about solar geoengineering?  
Carbon removal?
  - On varying scales
  - In varying cultural contexts...
  - About the considerations of these technologies for ecosystems  
(Are they thinking about the risks or benefits for nonhuman life as a rationale for researching / not researching climate intervention?)
- What do they *want* to know? What drives their demand for knowledge?

**Methods:** *Stakeholder workshops, questionnaires*

### 3. Landscape-level analysis

Even though geoengineering is global-scale, implementation would happen on regional and landscape scales

Look at the landscape-level to get insights into the actual feasibility of climate interventions, their local and regional drivers, and how they would play out *on the ground*

***Methods:*** Collaborative and participatory work with people who live in the landscapes, who will have the best knowledge of how they may change

# 3. Landscape-level analysis

**Example 1:** We know BECCS is only carbon-*negative* in certain situations.

“Key levers: (1) measuring and limiting the impacts of direct and indirect land use changes, (2) using carbon neutral power and organic fertilizers, (3) prioritizing sea and rail over road transport, (4) increasing the use of carbon negative fuels, and (5) exploiting alternative biomass processing options, e.g., natural drying or torrefaction.” (Fajardy and Mac Dowell, *Energy Environ. Sci.*, 2017)

— What determines what crops farmers in this landscape are inclined to grow? What are their feelings about organic fertilizers? Why might people choose road over rail to transport their feedstock? etc.

-> Look at this whole social picture systematically before laying down tax breaks & incentives for a BECCS power plant, for example

**Methods:** *Collaborative and participatory work with people who live in the landscapes, who will have the best knowledge of how they may change*

# 3. Landscape-level analysis

Example 2: The DECIMALS fund, for example, will fund researchers in developing countries to study SRM impacts

-> But only the people in the landscapes have an idea of what impacts matter most - maybe having rain during one particular month is crucial for their main crop, and that matters more to them than average temperature shifts. Or maybe one particular plant or animal is really important to them culturally and it would be worth studying the impacts upon that species.

-> Talking with people in the communities, in conjunction with modeling research, will help get a picture of what the social impacts really are of proposed solar geoengineering interventions

**Methods:** *Collaborative and participatory work with people who live in the landscapes, who will have the best knowledge of how they may change*

# 4. Citizen demand research

Current social science framing: “support”, “acceptance”, or “social license to operate”

But ... Most carbon removal strategies face a lack of demand — the technologies aren't even likely to get off the ground without significant popular support

Some approaches *are* experiencing a level of popular interest (e.g. regenerative agriculture / carbon farming, “drawdown” discourse)

Research could examine in what contexts these are interesting for different citizen groups, and to what degree that interest might translate into policy changes in specific places

***Methods:*** Stakeholder workshops, focus groups, questionnaires, ethnographic research

# Key take-aways

- Need to go beyond socio-ecological **impacts**, and look also at social **drivers**
- Need to go beyond “public perceptions” or “social license” investigations of “technologies”, because the social and political **context** in of possible geoengineering is important for people
- Need a **socio-ecological systems framework** (feedbacks, not one-way impacts)
- Reconsider treating SRM & CDR together under “geoengineering” — different scales of implementation mean the risks are quite different, and carbon removal may be too broad to deal with productively under one umbrella term
- Good idea to incorporate social science **in the proposal stage**, not as an add-on after the fact