

Report on SOLAS OSC 2015 Discussion Session: SOLAS research into the effects of potential Geoengineering

Thursday, September 10, 2015

Chairs: Cliff Law & Philip Boyd

Rapporteur: Lisa Miller

In the absence of action to decrease CO₂ emissions, “it is increasingly likely that we will need to deploy some form of CDR [Carbon Dioxide Removal] to avoid the worst impacts of climate change” (US National Academy). Consequently the potential for geoengineering (GE) is receiving increased attention, for example by the IPCC in the 2014 5th Technical Assessment Report. Over the last decade SOLAS has contributed to the debate around GE, primarily as a result of the fundamental research carried out on phytoplankton growth limitation during the mesoscale iron addition experiments. This research subsequently informed international policy and legislation (via a Summary for Policymakers commissioned by the IOC, and amendment to the London Convention/Protocol on Marine Dumping) on the potential application and impacts of iron fertilisation. There are now a number of other potential GE approaches being considered, including both Solar Radiation Modification (SRM) and CDR. Some of these may be implemented in, or impact upon, the SOLAS domain, and the environmental effects of GE has been identified as a research area of societal relevance in the *SOLAS 2015-2025 Science Plan & Organisation*. With these issues in mind, the question for the SOLAS science community is, where do we position our research and activities in relation to GE?

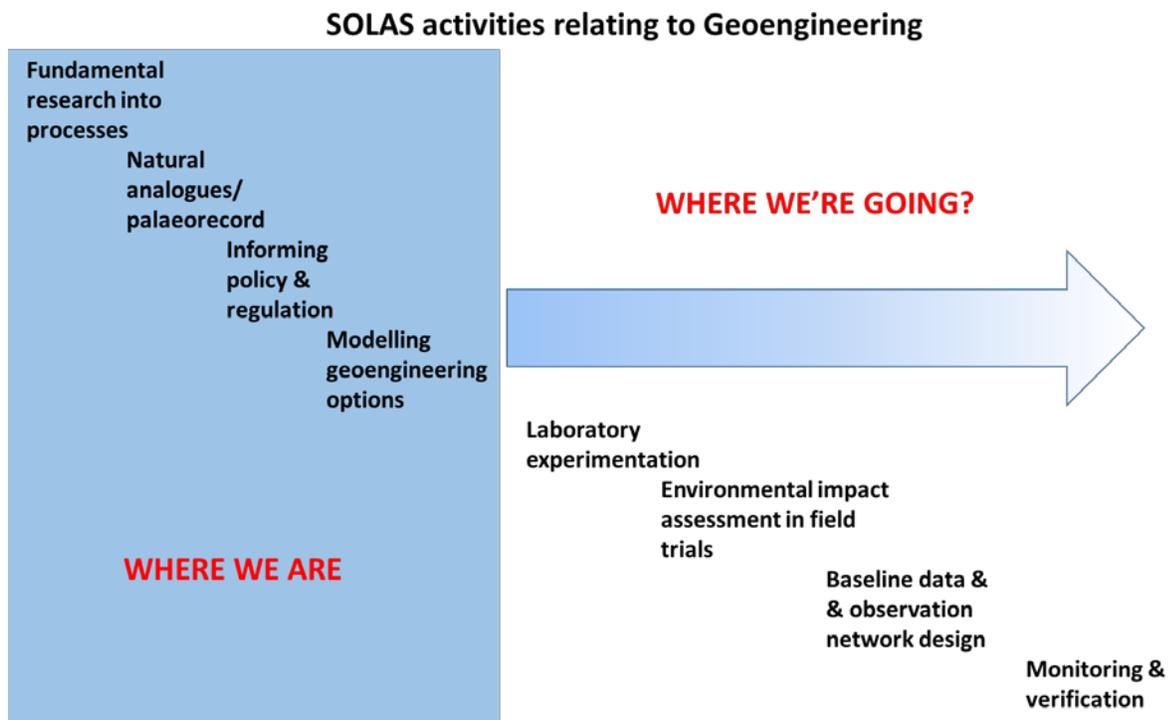
The debate at the Kiel OSC began with a discussion of whether GE should even be considered as a response to climate change. A popular viewpoint was that GE should not be carried out, supported by the observation that humankind is not good at “managing the planet”, and so SOLAS scientists should not engage with GE-related research. Alternative approaches included the SOLAS community issuing a clear message that a) a more acceptable approach to climate change would be to reduce emissions rather than implement GE b) that as time is running out, any investment or activity should be into alternative energy options and c) that GE not be pursued. A potential issue for SOLAS is that GE is highly political, and it was considered unlikely that SOLAS could stay out of the political debate if it engaged with GE.

A list of the rationales and concerns for research into GE (provided by P. Williamson) was considered. This initiated discussion on the scientists’ dilemma of balancing ethical considerations against scientific understanding. One line of thought presented was that SOLAS scientists should provide impartial information and advice on the fundamental science relevant to GE, and not be led by ethical judgements. Should SOLAS Scientists avoid the GE issue, or do they have a responsibility to contribute their knowledge where possible to the debate? Whereas SOLAS scientists may object to GE on ethical principles, global organisations are promoting GE options and may well start applying them. For example, GE may be implemented if climatic conditions become seriously degraded, or alternatively in response to a climate-related disaster as a ‘possible emergency response’ (IPCC Working Group III, 2014). If such a

scenario were to occur it would be better to be informed on the potential impacts and options of GE.

It was reiterated that SOLAS has carried out fundamental research that has informed both policy and international regulation on GE with the ocean fertilisation studies, and in doing so, was the first organisation to “pierce the knowledge vacuum” of the policy discussion around GE. Furthermore the ocean fertilisation experiments informed the GE discussion without diverting from the SOLAS goal of carrying out fundamental science. SOLAS research is highly relevant to some of the issues – such as reversibility of impacts, baseline scenarios, environmental risk, and detection and attribution – identified in the IPCC GE common framework criteria. SOLAS Science has also generated information on the economics of reducing emissions vs. GE and, that with the SRM and CDR communities proceeding independently, SOLAS is in a pivotal position, at the interface of ocean and atmosphere, to bring them together.

In response to a question whether any of the GE options would actually work, it was suggested that the options put forward to date are so fraught with unknowns that this could have a positive effect in developing more willingness to limit CO₂ emissions. There are papers published on the state of knowledge for different GE techniques, with a literature review in prep which will address which techniques have potential for effective climate modification & where future research should be pursued.



Conceptual figure of SOLAS research activities relating to GE. Note that *in situ* GE is currently limited by the UN CBD de facto moratorium, which would affect activities on the right hand side of the figure.

What research activities should SOLAS undertake in relation to GE? A conceptual figure (see above) was presented showing the “slippery slope” from past and current SOLAS research to potential future activities. Discussion ensued regarding how comfortable SOLAS scientists were in moving from left to right in this figure. It was suggested that, on ethical grounds, SOLAS should not carry out large-scale in situ experiments, although laboratory based experiments and activities such as modelling and providing expert statements were acceptable. However the opposing viewpoint was also raised, that it is a significant step from experimental laboratory to in-situ responses – for example, our knowledge about ocean fertilisation would be considerably diminished if the iron addition experiments had not been carried out - and so there is a need for in situ experimentation. However, due to non-linear artefacts that influence responses at the mesoscale, there may be little value in repeating in situ experiments on this scale. Studying natural analogues of ocean fertilisation was identified as a low-cost and effective way to contribute information to the debate, whilst generating fundamental science insights.

The Haida Gwaii Fe-fertilization on the west coast of Canada was discussed as an example of a large-scale ocean fertilisation that had proceeded contrary to international legislation, and with minimal scientific involvement & measurement. Commercial entities were able to convince lay-people that it was possible to generate an increase in salmon stocks and carbon sequestration by iron addition. Although recent publications provide some evidence of positive responses by the biota regionally the direct links to the fertilisation are tenuous. With a proper scientific framework, some useful information might have been obtained from this release of iron.

As earth systems are complex there will always be uncertainties, and so it was questioned whether SOLAS scientists would be able to give definitive statements on the effects of GE. This comes down to the issue of “known unknowns and unknown unknowns”. It was clarified that SOLAS would neither validate or recommend GE techniques (or GE as an approach to Climate Change), and would only provide scientific information on environmental effects and risk. Public perception was also noted as an important consideration, partly to ensure SOLAS neutrality, and more broadly as public perception ultimately drives policy. In response to a question regarding public attitudes to GE, conclusions from a survey in the Baltic Sea coastal region (as part of a German Priority Program) found that, although GE was considered dangerous and that the potential impacts needed to be firmly understood, it was also recognised that if GE was the only way to “save the planet” it should perhaps be implemented.

Recommendations

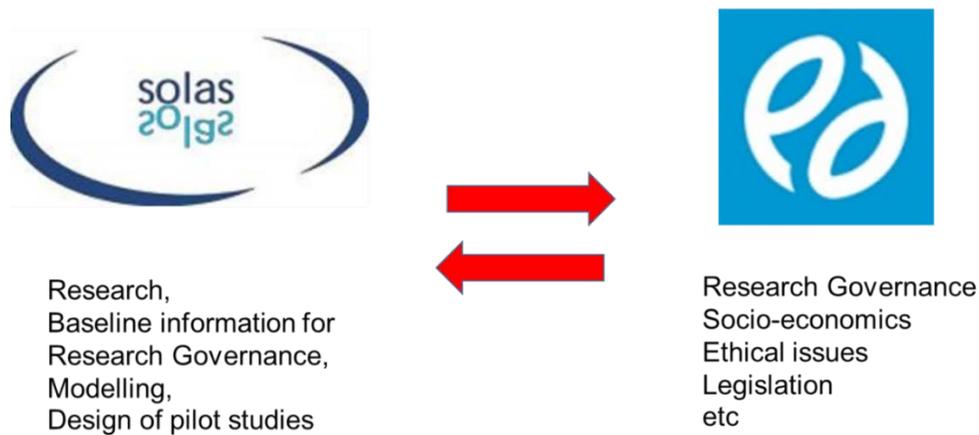
Protocols and Advice

The Discussion group were most comfortable with SOLAS operating as a source of advice around GE. Mechanisms to achieve this could include:-

- a) A SOLAS position statement that includes:
 - that, in view of the uncertainties around GE, international efforts should focus on reduction in emissions.

- that, if an organisation is assessing/implementing a marine GE technique, then SOLAS should be consulted for advice (for example, on monitoring). This should also include a precautionary warning emphasising the negative impacts of GE.
- b) SOLAS provides research protocols, framework or criteria for implementation strategies. An example of SOLAS activities here is the IOC Summary for Policymakers, which led to international regulation including a framework for assessment of future in situ addition experiments and a moratorium on addition for carbon sequestration & credits.
- c) SOLAS provides expert reviewers and/or advice. For example, following the amendment on ocean fertilisation to the London Convention/Protocol the SSC discussed whether SOLAS should facilitate the assessment process by providing reviewers.

A Geoengineering KAN (Knowledge Action Network)?



A Future Earth KAN (Knowledge-Action-Network)

It was suggested that SOLAS could be proactive via Future Earth, in informing future investigations & reports. A potential forum or mechanism for maintaining SOLAS focus on the fundamental science, whilst engaging with broader socio-economic aspects, could be achieved via a KAN on GE within Future Earth (see Figure 2 above). This could provide a link to economic considerations, which would be necessary as long-term technical investment would be required for any GE. However, addressing GE as a community may be less controversial, particularly if carried out in a broader context of addressing other components of the climate problem, such as emission pathways and approaches to emissions reductions. In this case a more appropriate Future Earth KAN could be ‘Transformations’, rather solely GE, which would allow SOLAS to focus on our science, with the KAN serving as the knowledge ‘translator’.

Addendum

Subsequent to the discussion, the following abstract has been submitted to the session “Ocean-Atmosphere System Geoengineering: Benefits and Detriments” at the 2016 Oceans Sciences meeting:-

SOLAS Science and the environmental impacts of geoengineering

C.S. Law & P.W. Boyd

SOLAS (Surface Ocean Lower Atmosphere Study) has played a major role in establishing the elemental and ecosystem responses in the *in situ* mesoscale iron addition experiments. The outcomes of these experiments have included a Summary for Policymakers and an amendment on ocean fertilisation in the London Convention on marine dumping, which have informed both the debate and international regulation on this potential geoengineering approach. As part of Future Earth the next ten years of SOLAS Science will develop understanding and fundamental science in 5 major themes, including Greenhouse Gases and the Ocean, Interconnections between Aerosol, Clouds and Ecosystems, and Ocean Biogeochemical Controls on Atmospheric Chemistry. This poster will review the SOLAS science areas that provide fundamental knowledge on processes and ecosystem impacts, which is required for the robust assessment of potential Solar Radiation Management and Carbon Dioxide Removal techniques.