Thoughts on the physical effectiveness and political feasibility of SRM: A reply to 'climate engineering reconsidered'

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Barrett et al.[1] argue that, given the challenges with solar radiation management (SRM) geoengineering, "when the use of geoengineering is politically feasible, the intervention may not be effective; and […] when the use of geoengineering might be effective, its deployment may not be politically feasible". We believe the first part of this conclusion depends upon a relatively narrow definition of efficacy that may not reflect the real concerns that would motivate a potential deployment of SRM, whereas the second part of the conclusion lacks evidence and therefore is speculative at this stage.

Although the evidence from model studies about the impacts of SRM geoengineering is at present limited, the initial evidence broadly indicates that SRM deployed to cool the climate could potentially reduce many of the physical impacts of climate change as well as the risk of crossing tipping points, as Barrett et al. acknowledge[2-4]. This is because many climate impact drivers depend directly on temperature, such as high temperature extremes, the thermal expansion of water, the melting of snow and ice, and the intensity of precipitation[2-5].

Barrett et al. argue that these benefits could not be secured due to political controversy around regionally differentiated effects and fears of becoming "addicted" to SRM. Whilst there are undoubtedly regional differences in the climate response to SRM , the general reversal of temperature increases would be felt world-wide, as would some benefits like reductions in sea-level rise [2,4,6]. To argue that SRM deployment is politically infeasible due to its differentiated regional effects, which will be challenging to predict in detail, it would have to be demonstrated that regional considerations would trump the benefits of an overall reduction of physical climate impacts in shaping states' preferences. The claim that the fear of becoming addicted to SRM would make SRM politically infeasible would similarly need to be substantiated by theoretical considerations and evidence from analogous cases.

Barrett et al. claim that as a response to crossing a tipping point, SRM would be politically feasible but ineffective. However, they fail to acknowledge that whilst SRM may not reverse the changes following the passing of a tipping point, in many cases it could reduce the rate of change and hence reduce some of the harms that the passing of a tipping point would cause[7].

SRM is no panacea; it would introduce new risks and would shift the overall burden of risks, which might pose substantial political problems, as Barrett et al. indicate. It is also clear that in order to minimize the risks posed by climate change, mitigation will need to be pursued vigorously. Whilst much is uncertain about the potential impacts of SRM, we must at least seriously consider how the world would react if SRM were to eventually prove to be a highly effective means of reducing the physical risks of climate change. In this case, SRM geoengineering would indeed be a game-changer.

1 Barrett, S. *et al.* Climate engineering reconsidered. *Nature Clim. Change* **4**, 527-529, doi:10.1038/nclimate2278 (2014).
2 Irvine, P. J., Sriver, R. L. & Keller, K. Tension between reducing sea-level rise and global warming through solar-radiation management. *Nature Clim. Change* **2**, 97-100, doi:10.1038/nclimate1351 (2012).
3 Curry, C. L. *et al.* A multi-model examination of climate extremes in an idealized geoengineering experiment. *Journal of Geophysical Research: Atmospheres*, 2013JD020648, doi:10.1002/2013JD020648 (2014).
4 Kravitz, B. *et al.* Climate model response from the Geoengineering Model Intercomparison Project (GeoMIP). *Journal of Geophysical Research: Atmospheres*, n/a-n/a, doi:10.1002/jgrd.50646 (2013).
5 Smith, J. B. *et al.* Assessing dangerous climate change through an update of the Intergovernmental Panel on Climate Change (IPCC) "reasons for concern". *Proceedings of the National Academy of Sciences of the United States of America* **106**, 4133-4137, doi:10.1073/pnas.0812355106 (2009).
6 Irvine, P. J., Ridgwell, A. J. & Lunt, D. J. Assessing the regional disparities in geoengineering impacts. *Geophysical Research Letters* **37**, doi:10.1029/2010gl044447 (2010).
7 Irvine, P. J., Lunt, D. J., Stone, E. J. & Ridgwell, A. J. The fate of the Greenland Ice Sheet in a geoengineered, high CO2 world. *Environmental Research Letters* **4**, doi:10.1088/1748-9326/4/4/045109 (2009).