EGU24-6144, updated on 24 Jul 2024
https://doi.org/10.5194/egusphere-egu24-6144
EGU General Assembly 2024

Idealized modeling of uncooperative two-actor SRM deployment

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Potential SRM deployment scenarios are increasingly discussed in the literature and an effort to construct plausible scenarios is underway in the scientific community. Such deployment scenarios underpin the design of possible governance mechanisms of SRM. A wide range of possible scenarios can be envisaged, including unilateral deployment by one actor, uncooperative multi-actor deployment, global centralized deployment or a global moratorium. In order to inform the current dialogue on governance, we explore in this work the behavior of a system where two uncooperative actors deploy SRM. We rely on a simple four-box climate model that responds to stratospheric aerosol injection (SAI) in the northern and southern hemispheres, including the oceanic response. The stratospheric aerosol optical depth has been parameterized with impulse response functions fitted on IPSL-CM6A-LR runs with injections at different latitudes. We couple this model to a control module in order to investigate different controlled SRM deployment strategies, reflecting potential governance scenarios. The two actors inject varying amounts of aerosols in the stratosphere to reach their own climate target which is unknown by the other actor. The climate target can be a temperature target (change of the temperature with respect to the initial state) or a monsoon target (variability of the monsoon index). Depending on the objectives and the characteristics of the deployment strategies by the two actors, we construct several experiments that result in i) involuntary cooperation between the two actors, ii) conflicting behaviors, or ii) one actor taking advantage of the other (free riding). We have also constructed experiments mimicking political decision-making timescales and potential perceived failure of SRM, causing more or less random interruptions of the injections. Although the scenarios are highly idealized and do not represent a realistic implementation of SRM, they help to understand the potential, synergies, risks and challenges of a decentralized, uncooperative deployment of SRM. We will discuss how the analysis of this type of experiments can inform the discussion on potential SRM governance strategies. Our future plans include adding a parametrization of the sea level rise and of ocean acidification into the model to investigate the behavior of these parameters as a result of the different SRM deployment and governance strategies. The simple model could also be used for educational purposes, for example to inform and to train decision-makers on SRM climate intervention and its effects and consequences.