Session: C45 Poster: TH175B

Optimizing geoengineering with multiple degrees of freedom

Douglas MacMynowski[†]; David Keith; Ken Caldeira
[†] Caltech, USA
Leading author: macmardg@cds.caltech.edu

One of the concerns with implementing some form of solar radiation management (SRM) is that even if the resulting climate is closer to the pre-industrial climate over many regions of the planet, there will be some regions that do not benefit or may even be harmed. A related question is "who's hand is on the dial"; the desired level of SRM for one region may not be the same as for another. We explore whether additional spatial and temporal degrees of freedom can be used to optimize the distribution of temperature and precipitation effects from SRM, e.g. to allow retention of Arctic sea ice while minimizing the disruption of the Indian monsoon. We vary the latitudinal and seasonal distribution of idealized forcing in the HadCM3L general circulation model (GCM) to obtain the response patterns for each case, and consider several optimization scenarios. We weight temperature and precipitation differences relative to pre-industrial by the standard deviation of natural variability for each of 21 Giorgi regions. A single spatially- and temporally-uniform degree of freedom can be used to reduce the weighted differences by close to 90% relative to a 2xCO2 world, while using only 3 additional degrees of freedom can reduce the residual by an additional factor of two. Further degrees of freedom do little to further reduce the residual. While the resulting "optimal" spatio-temporal distribution of SRM may not be practically achievable, this suggests the potential for using spatial and temporal forcing variations to reduce a few of the undesired consequences of SRM.