Geophysical Research Abstracts,
Vol. 11, EGU2009-7678-2, 2009
EGU General Assembly 2009
© Author(s) 2009

Climate Engineering Responses to Climate Emergencies

J. J. Blackstock

Risk and Vulnerability Program, International Institute for Applied Systems Analysis, Laxenburg, Austria (jjb@iiasa.ac.at)

Although international efforts to stabilize CO2 concentrations may well prove sufficient to prevent or delay severe climate impacts, there is already a non-negligible possibility that the climate system will respond rapidly and non-linearly to present concentrations. If the climate sensitivity is at the high end of current estimates, it may be too late to avert dramatic consequences for human societies or natural ecosystems even with immediate and aggressive mitigation efforts.

Climate engineering interventions that induce rapid changes in the climate system might limit the risks posed by such "climate emergencies." But, large uncertainty in the climatic response to specific interventions makes it difficult to estimate the risk-effectiveness of such interventions. In August of 2008, ten scientists gathered for a one-week intensive study to explore the question: What program of comprehensive technical research over the next decade would maximally reduce the uncertainties associated with climate engineering responses to climate emergencies? This presentation will summarize the findings of this one-week study.

The implicit requirement to achieve decadal-timescale (or faster) climatic impact focused our study on concepts for manipulating incident short-wave solar radiation. To facilitate rigor and depth of analysis, we further took as an example case the injection of aerosols into the stratosphere to increase the Earth's short-wave albedo. Our forthcoming report includes both an agenda of technical research for significantly reducing uncertainty that is specific to stratospheric aerosols, along with a range of insights and conclusions that can be generalized for the evaluation of solar short-wave climate engineering concepts.

Basic physical science considerations, exploratory climate modelling, and the impacts of volcanic aerosols all suggest that SWCE could partially compensate for some effects—particularly net global warming—of increased atmospheric CO2. However, existing data also reveal important limits to the range of CO2-impacts that SWCE could ameliorate; for example, ongoing ocean acidification would not be affected, and some categories of climate emergency scenario might prove unresponsive to SWCE. Moreover, significant uncertainty presently surrounds the spatial and temporal response of numerous climate and ecological parameters to SWCE, making the near-term deployment of large-scale SWCE extraordinarily risky.

Components of any comprehensive research agenda for reducing these uncertainties can be divided into three progressive phases: (I) Non-Invasive Laboratory and Computational Research; (II) Field Experiments; and (III) Monitored Deployment. Each phase involves distinct and escalating risks (both technical and socio-political), while simultaneously providing data of greater value for reducing uncertainties.

The core questions that need to be addressed can also be clustered into three streams of research: Engineering (intervention system development); Climate Science (modelling and experimentation to understand and anticipate impacts of the intervention); and Climate Monitoring (detecting and assessing the actual impacts, both anticipated and unanticipated). While a number of studies have suggested the engineering feasibility of specific SWCE proposals, the questions in the Climate Science and Climate Monitoring streams present far greater challenges due to the inherent complexity of temporal and spatial delays and feedbacks within the climate system.

Our study developed and applied these two frameworks to structure the comprehensive research agenda for stratospheric aerosol SWCE outlined in our forthcoming report and summarized in this presentation. For the Engineering stream, current understanding, questions and methods guiding the necessary research into aerosol material, stratospheric lofting and dispersion are all defined. For the Climate Science and Climate Monitoring streams, emphasis is placed on identifying, predicting and monitoring the response of important climate parameters across four broad categories: Radiative, Geophysical, Geochemical and Ecological. Finally, the components within each stream are identified as belonging to Phase I or II research, and the that limits placed by the natural variability of the climate system places on what can be learned from low-level Phase II field-testing are roughly assessed.