Learning on cloud brightening under risk and uncertainty: Whether, when and how to do a field experiment (LEAC)

Project within DFG Priority Programme 1689 "Climate engineering: risks, challenges, opportunities?"

Abstract

No consensus has been achieved in science, society and politics even about the question whether in-depth research in the form of field experiments on climate engineering should be conducted. This projects aims at theoretical clarification of this question without actually doing experiments.

Cloud seeding:

- Climate engineering by injection of aerosol which would serve as cloud condensation nuclei and thus increase cloud brightness
- May enable field experiments which are scalable in intensity as well as spatial and temporal extent.

Research questions

- How large are the physical uncertainties on cloud seeding?

- To which extent could field experiments reduce these uncertainties, depending on intensity and spatial and temporal extent of the experiment?

- Which detrimental side effects would cloud seeding have? Which climate damages (e.g., precipitation patterns, ocean acidification) would not be mitigated?

- At which level of climate change would such a climate engineering be part of a economically optimal climate policy?

- Under which circumstances should a field experiment on cloud seeding be implemented? If implemented, how should it be done?

- How do these decisions depend on social risk- and time preferences?

Approach

1. Quantification of the uncertainty of the radiative forcing by cloud seeding.

2. Estimate how this uncertainty could be reduced depending on intensity as well as spatiotemporal extent of a possible field experiment.

3. Characterisation of an optimal climate policy for given uncertainties and different social risk- and time preferences.

4. Characterisation of the optimal learning by field experiments for different social risk- and time preferences.

Methods

The project will apply or develop
- satellite data
- a global aerosol-climate model (ECHAM6-HAM2)
- an integrated assessment model for climate system and economy (IAM),
  extended by
    - effectiveness and cost of climate engineering by cloud seeding
    - Bayesian learning on probability distributions of climate engineering damages
    - hyperbolic time preferences