Learning About Cloud Brightening under Risk and Uncertainty: Whether, When and How to do Field Experiments

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**Background and Aim**

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.

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**Preliminary study on Climate Engineering by cloud seeding: Statistical analysis of satellite data.**

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**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