How might Climate Engineering Influence Precipitation Patterns and Soil Moisture?

**Abstract:**
As global anthropogenic emissions of greenhouse gases continue to rise, there is an increasing risk of serious disruptions in ecosystems and society due to global warming. As a consequence, research on climate engineering (CE) is receiving growing attention, also among climate scientists (e.g., IPCC AR5). But, even basic CE research using Earth System Models (ESMs) raises a series of ethical questions that need to be considered. Also, any CE technique carries a risk of causing serious side effects, e.g., through disruptions of the hydrological cycle.

Climate engineering can be divided into Greenhouse Gas Removal (GGR) and Radiation Management (RM). RM here refers to deliberate modifications of either incoming solar radiation or outgoing terrestrial radiation. We will start by reviewing the basic principles of proposed RM techniques – stratospheric sulfur injections, marine sky brightening, cirrus cloud thinning, desert brightening. We review some robust results concerning precipitation changes that have recently emerged from multi-model ESM experiments within the Geoengineering Model Intercomparison Project (GeoMIP). We then demonstrate that the precipitation changes depend strongly on which RM technique is applied. We show how that finding can be explained from atmospheric energy budget considerations.

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