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The economics and ethics of aerosol geoengineering strategies

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Anthropogenic greenhouse gas emissions are changing the Earth's climate and impose substantial risks for current and future generations. What are scientifically sound, economically viable, and ethically defendable strategies to manage these climate risks? Ratified international agreements call for a reduction of greenhouse gas emissions to avoid dangerous anthropogenic interference with the climate system. Recent proposals, however, call for a different approach: geoengineering climate by injecting aerosol precursors into the stratosphere. Published economic studies typically neglect the risks of aerosol geoengineering due to (i) a potential failure to sustain the aerosol forcing and (ii) due to potential negative impacts associated with aerosol forcings. Here we use a simple integrated assessment model of climate change to analyze potential economic impacts of aerosol geoengineering strategies over a wide range of uncertain parameters such as climate sensitivity, the economic damages due to climate change, and the economic damages due to aerosol geoengineering forcings. The simplicity of the model provides the advantages of parsimony and transparency, but it also imposes considerable caveats. For example, the analysis is based on a globally aggregated model and is hence silent on intragenerational distribution of costs and benefits. In addition, the analysis neglects the effects of future learning and is based on a simple representation of climate change impacts.

We use this integrated assessment model to show three main points. First, substituting aerosol geoengineering for the reduction of greenhouse gas emissions can fail the test of economic efficiency. One key to this finding is that a failure to sustain the aerosol forcing can lead to sizeable and abrupt climatic changes. The monetary damages due to such a discontinuous aerosol geoengineering can dominate the cost-benefit analysis because the monetary damages of climate change are expected to increase with the rate of change. Second, the relative contribution of aerosol geoengineering to an economically optimal portfolio hinges critically on deeply uncertain estimates of the damages due to aerosol forcing. Even if we assume that aerosol forcing could be deployed continuously, the aerosol geoengineering does not considerably displace the reduction of greenhouse gas emissions in the simple economic optimal growth model until the damages due to the aerosol forcing are rather low. Third, deploying aerosol geoengineering may also fail an ethical test regarding issues of intergenerational justice. Substituting aerosol geoengineering for reducing greenhouse gas emissions constitutes a conscious risk transfer to future generations, for example due to the increased risk of future abrupt climate change. This risk transfer is in tension with the requirement of intergenerational justice that present generations should not create benefits for themselves in exchange for burdens on future generations.