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DESIGNING CLIMATE STABILIZATION SCENARIOS VIA OPTIMAL CONTROL THEORY

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Solar radiation management (SRM) by injection of aerosols into the stratosphere is one of the most promising solutions to decelerate the global warming and stabilize the Earth's climate. Implementing SRM project, we aim to achieve the desired target temperature change in a certain final time, say in 2100, by manipulating the aerosol emission rates. However, designing a control law (the aerosol emission rate as a function of time) remains so far an open issue. To handle the climate response uncertainties and then designing the scenarios for SRM, the consideration of the Earth's climate as a control system with feedbacks has been suggested previously. To carry out SRM projects and therefore, to achieve the project goal, various resources are required. Usually, considering climate as a control system, these resources are formulated in general terms and mathematically not subject to some constraints. Therefore, the obtained control may not be optimal in a certain sense, and it is not obvious that resources required to achieve the project goal can be allocated. In this talk, we move one-step forward introducing an optimal control theory-based method to designing SRM scenarios. By considering the Earth's global climate as controlled system, we can approach the SRM from the perspective of optimal control theory. Within this framework, the goal of SRM can be formulated in terms of extremal problem, which entails finding control parameters and the corresponding state of climate system that minimize or maximize a certain objective function subject to a number of constraints. Illustrative results are calculated for the period of 2020-2100 for which the total radiative forcing was specified based on the Representative Concentration Pathways. The obtained optimal solutions can serve as a basis for developing SRM scenarios to simulate and predict the consequences of climate engineering operations using general circulation models.

Biography

S. SOLDATENKO has completed his PhD in Atmospheric Sciences from Aerospace Academy and Doctor of Sciences in Math and Physics from St. Petersburg University. He is a Senior Fellow of Saint Petersburg Institute for Informatics and Automation of the Russian Academy of Sciences and Distinguished Professor of the Russian Federation. He has published more than 200 papers in reputed journals and has been serving as an editorial board member of repute.

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