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Impacts of climate model parametric uncertainty in an MPC implementation of the DICE integrated assessment model

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Integrated assessment models (IAMs) are a key tool in studying the interdependence of the global economy and the climate system. For example, the dollar value of carbon dioxide emissions due to anthropogenic climate damages, known as the social cost of carbon (SCC), can be computed using the widely used DICE (Dynamic Integrated model of Climate and the Economy) IAM by solving an open-loop optimal control problem. The results of such an open-loop decision-making strategy, however, do not fully reflect the impacts of uncertainty in the dynamic response of the global climatic system to radiative forcing. An implementation of the DICE IAM based on model predictive control (MPC) is proposed. This MPC-based approach draws a clear distinction between the climate model used by DICE for mitigation planning purposes, and the "true" global climate captured by a low-order emulation of a model drawn from a state-of-the-art climate model ensemble (CMIP5, the fifth phase of the Coupled Model Intercomparison Project). The closed-loop control methodology quantifies the impact of parametric climate model uncertainty (plant-model mismatch).

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