Develop a reduced-complexity model – SCM4OPT v3.0 for integrated assessment-optimization

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The Simple Climate Model for Optimization version 2.0 (SCM4OPT v2.0) is one of the contributors to the Reduced Complexity Model Intercomparison Project Phase 2 (RCMIP2). However, low effective radiative forcing is emulated in SCM4OPT v2.0, which is driven by the strong negative aerosol effective radiative forcing and considered to be an outlier compared to other models. In addition, the carbon cycles and climate system in SCM4OPT v2.0 are calibrated based on the outputs from Coupled Model Intercomparison Project Phase 5 (CMIP5), which cannot reflect the latest Earth system model results. In this study, we update the reduced-complexity model to SCM4OPT v3.0. First, we re-calibrate the carbon cycles, including land carbon-cycle and ocean carbon-cycle, and the climate system according to 32 coupled atmosphere-ocean general circulation models (AOGCMs) with selected experimental outputs in the latest CMIP6; Second, we fix the aerosol forcing by introducing a constrain in the light of the IPCC AR5 aerosol forcing. We retain the lightweight and efficient nature of this model, in order to make it suitable to be involved in a large-scale optimization process. Using SCM4OPT v3.0, we produce a new set of scenario simulations by using the dataset of harmonized emissions used in CMIP6 and compare with other reduced-complexity models. SCM4OPT v3.0 is expected to simulate climate-related uncertainties regarding the latest understanding of climate change.