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Exploring the impacts of changes in solar radiation on ecohydrological variables

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Several geoengineering projects are designed to modify solar radiation to limit global warming. These changes in solar radiation can have impacts on ecohydrological systems which are poorly quantified. In this study, CMIP6 outputs were used to calculate sensitivities of global and local near-surface meteorological variables to solar radiation changes. These sensitivities were applied to the currently observed climate to perturb meteorological variables in response to changes in solar radiation. These new conditions were used as inputs to a mechanistic ecohydrological model (T&C) to analyze the partitioning and changes in energy and water fluxes and the response of vegetation productivity in different biomes and climates. Specifically, we run two simulation scenarios to understand the solar radiation impacts on ecohydrological systems. The first scenario focuses only on changes in solar radiation, while the second scenario considers the combined effects of solar radiation changes and its climate feedback. The results show that, in the absence of climate feedback, changes in solar radiation are mainly reflected in changes in sensible heat, with less impact on the hydrological cycle, and vegetation productivity is positively and linearly correlated with changes in solar radiation. When climate feedback is included, the effects on latent heat and hydrologic variables are more pronounced, and the response of vegetation productivity to negative and positive solar radiation changes tend to be asymmetric. These results provide a basis for how land-surface processes could respond to regional brightening and dimming and future solar geoengineering programs.