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Climate sensitivity and convective parameterization in the Earth system model of intermediate complexity PlaSim

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Earth system models of intermediate complexity, like the Planet Simulator (PlaSim), can be used for studying the long-term climate response to external forcing, for example, from greenhouse gas emissions. The equilibrium climate sensitivity (ECS) quantifies this response and is one of the most important parameters to project future global warming. Convective parameterization plays a key role for the hydrological cycle of a model, but its influence on ECS remains uncertain. The aim of this study is to investigate the influence of two different convection schemes on the ECS in PlaSim. To achieve this goal, we implement the Tiedtke convection scheme in PlaSim and tune the model. The results show that the new scheme reduces the ECS compared to the operational Kuo scheme. Six of eight configurations yield ECS values which are within the likely range obtained from more complex climate simulations. In addition to the convection scheme, we identify other parameters, like the horizontal heat diffusion that influence the ECS in PlaSim.

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