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3D climate simulations of an Earth-like circumbinary planet

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Planets orbiting close binary-star systems experience strong variations in insolation that are due to the non-trivial evolution of the distance between the planet and the two stars. Previous studies have suggested that these variations in insolation could influence the habitability of Earth-like circumbinary planets. In contrast to previous work using one-dimensional models that lack important climate dynamics, we performed for the first time simulations of a hypothetical Earth-like circumbinary planet with a three-dimensional atmospheric general circulation model coupled to an analytical orbital propagator. We choose a Kepler-35-like setup without the gas-giant that is present in the actual system in order to investigate the effects of the variable total solar irradiance (TSI) originating from the double star on the planet's climate. For fixed CO_2 concentrations we find that an aqua-planet (a fully water-covered planet) can maintain a habitable climate at TSI values similar to those an identical planet receives orbiting our sun. The variations in TSI have, however, various effects on the climate of the planet. Signatures of these periodic variations are clearly visible in important climate indicators such as surface temperature and precipitation. Moreover, the periodic forcing leads to a cooling of the mean climate, especially in cold climate regimes.