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The Influence of elevated atmospheric CO2 on the hydrological Cycle via stomatal Closure

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Plants optimise their photosynthetic yield in terms of transpiration costs by actively regulating their leaf stomatal openings. Therefore todays rising atmospheric CO2 concentration acts directly on vegetation and the hydrological cycle. We investigate this land - atmopshere mechanism by a series of experiments conducted with the climate model ECHAM5 coupled to the recently developed modular land surface representation JSBACH. The CO2 radiative forcing was unchanged (380 ppm) throughout all model runs, whereas the CO2 concentration within the routine calculating photosynthesis and canopy conductance was set in the range 280 - 1000 ppm. By elevating atmospheric CO2 in such a way we simulate FACE experiment conditions, but also include large scale hydrological interactions with the atmosphere. These build counteractive feedback loops: On the one hand stomatal closure reduces transpiration, which increases soil moisture. On the other hand less transpiration also reduces atmospheric humidity, cloud cover and therefore precipitation. Additionally less clouds enhance solar irradiation, which in turn increases transpiration. Nevertheless soil moisture as well as the ratio between sensible and latent heat flux increases considerably for high CO2 on a global scale, but more regionally some arid areas show further drying due to a pronounced decrease in precipitation.