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Equilibrium climate sensitivity tied to hydrological sensitivity by temperature-mediated low cloud feedbacks

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It is well recognized that spread of equilibrium climate sensitivity (ECS) in climate models arises largely from different values of climate feedbacks. On one hand, the climate feedbacks are measured by changes in the TOA energy budgets to surface temperature increase. On the other hand, changes in the atmospheric energy budgets determine how much precipitation can increase per 1K warming, i.e. hydrological sensitivity (HS). It has been difficult to relate the two types of sensitivities as different radiative components drive them. Here we show using a series of AMIP4K experiments with perturbed surface evaporation efficiency that low cloud feedback, known as a heart of climate feedback uncertainty via shortwave radiation, can systematically alter the HS via longwave radiation. We found a clear anti-correlation between ECS and HS in a model, with a physically plausible mechanism. This provides potentially useful information to constrain the upper and lower bounds of ECS from HS, or vice versa.