



Hot and cool summers: multiple equilibria of the continental water cycle

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Large variations in soil water reserves and surface temperature over the continents are linked to a positive feedback between precipitation and soil moisture. This mechanism can generate bimodal distributions of soil moisture. Here, we show that bimodality results from the existence of multiple equilibria in the continental water balance, considering the coupled system including the upper soil layer and the atmospheric planetary boundary layer. This mechanism is described with an idealized box model, that includes convergence and divergence of moisture fluxes, convection, precipitation and evapotranspiration. The existence of two equilibria is associated with the variation of precipitation efficiency, which depends on convection intensity. The two regimes correspond to realistic values of climatic variables associated with mean wet or dry summers, and can persist for the whole summer season when forced by a stochastic moisture convergence flux. This suggests that a key role for midlatitude continental summer climate is played by the continental soil water content.