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On the role of atmospheric forcings and local soil moisture on precipitation

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The impact of land surface processes in the recent heat waves in Europe has been extensively studied in the last couple of years, particularly after the summer 2003 episode. Albeit the onset of a heat wave is caused by anomalous atmospheric circulation, the amount of water in the soil (soil moisture) affects the intensity and duration of such episodes via the control of the surface energy fluxes. In this work, we use a conceptual model to estimate the role of the atmospheric forcings and soil moisture on precipitation for each 4.5° x4.5° grid boxes in Europe and Africa during the JJA season. In a control simulation (CTRL), the conceptual model was forced with realistic moisture convergence and radiation calculated from extended time series (10,000 years) of ERA-INTERIM. The role of the forcings was assessed by calculating the change in asymmetry and scale of the precipitation distribution between CTRL and an idealized experiment where perfect gaussian forcings (GAU) were created with identical mean and standard deviation as in CTRL. The role of the soil was assessed by turning off the soil-atmosphere interaction by repeating CTRL and prescribing daily soil moisture climatology (PRESC) derived from CTRL. In southern Europe, soil moisture does affect the precipitation probability distribution. This also applies for the Sahel and the central part of Africa. For the same areas, these feedbacks increase the standard deviation of precipitation, but this effect is much smaller than the influence of the skewed forcing. Both factors affect the likelihood of extreme precipitation, but soil-atmosphere interaction plays a relatively minor role.