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Air temperature evolution during dry spells and its relation to prevailing soil moisture regimes

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The complex interplay between land and atmosphere makes accurate climate predictions very challenging, in particular with respect to extreme events. More detailed investigations of the underlying dynamics, such as the identification of the drivers regulating the energy exchange at the land surface and the quantification of fluxes between soil and atmosphere over different land types, are thus necessary. The recently started DROUGHT-HEAT project (funded by the European Research Council) aims to provide better understanding of the processes governing the land-atmosphere exchange. In the first phase of the project, different datasets and methods are used to investigate major drivers of land-atmosphere dynamics leading to droughts and heatwaves. In the second phase, these findings will be used for reducing uncertainties and biases in earth system models. Finally, the third part of the project will focus on the application of the previous findings and use them for the attribution of extreme events to land processes and possible mitigation through land geoengineering.

One of the major questions in land-atmosphere exchange is the relationship between air temperature and soil moisture. Different studies show that especially during dry spells soil moisture has a strong impact on air temperature and the amplification of hot extremes. Whereas in dry and wet soil moisture regimes variations in latent heat flux during rain-free periods are expected to be small, this is not the case in transitional soil moisture regimes: Due to decreasing soil moisture content latent heat flux reduces with time, which causes in turn an increase in sensible heat flux and, subsequently, higher air temperatures. The investigation of air temperature evolution during dry spells can thus help to detect different soil moisture regimes and to provide insights on the effect of different soil moisture levels on air temperature. Here we assess the underlying relationships using different observational and remote-sensing based datasets of temperature, precipitation and soil moisture on European and global scale. We thereby derive quantitative estimates of parameters determining these interactions. First results indicate that the air temperature evolution during dry spells indeed shows a distinct behaviour depending on the prevailing soil moisture regime.