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Extreme future central European summer droughts in a high-resolution global climate model

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Future climate change is projected to induce strong central European summer drying. Using high resolution (∼25 km) global climate simulations we have investigated the occurrence of droughts at the end of the 21th century under a RCP4.5 emission scenario. Dynamical features, like persistent blocking circulations over Europe, are expected to be more realistically modelled in a global model with such high spatial resolution.

Dynamic mechanisms and local feedbacks are responsible for a strong increase of extreme droughts in central Europe. This increase is much larger than for the standard (∼150 km) resolution of the same model. The dynamical cause is a stronger anomalous high over the UK in late spring that induces enhanced subsidence with reduced precipitation. This reduces the soil moisture content, thereby pre-conditioning the occurrence of local feedbacks that enhance the drought conditions. These local feedbacks are a reduction of the evaporative fraction that induces an enhancement of surface temperature, increase of dry days and solar radiation.

The pre-conditioning and enhancement by local feedbacks induce a clustering of extreme droughts and is a source of predictability. The extreme character of the droughts affects the ground water storage and the run-off in the following year. An additional effect of the increase of drought induced summer temperatures is that a larger fraction of the precipitation falls as heavy rain.