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Potential future changes of the diurnal precipitation properties over Sweden

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In this study we investigate potential future changes of the diurnal rainfall cycle over Sweden in the summer season (AMJJAS). Rainfall extremes are one of the most significant natural hazards related to climate. Precipitation characteristics strongly influence crops, soil properties, run-off and erosion, as well as human infrastructure such as the drainage systems in urban areas. The investigation of sub-daily rainfall records makes it possible to get detailed information about the diurnal precipitation cycle. A high-quality 1-hourly precipitation database covering 13 years of observations from 93 stations is available. In previous studies it could be shown that there is a distinct temporal and spatial pattern of the diurnal rainfall cycle. The performance of the Rossby Centre regional climate model (RCA3) in terms of simulating the observed diurnal cycle was investigated and the simulations quite realistically captured the general characteristics of the diurnal cycle. The diurnal cycle can be characterized by the presence of a peak, its timing and its shape. A higher and narrower peak means higher rainfall intensity on a shorter timescale. In contrast, a flatter and wider peak reflects a smaller temporal diurnal variability and lower rainfall intensity.

Potential future changes of the diurnal rainfall cycle properties are investigated employing RCA3 simulations forced with boundary conditions taken from 6 GCMs. The GCMs used are BCM, CCSM3, CNRM, IPSL, ECHAM5 and HadCM3 run with the A2 or A1B scenario at 50km horizontal resolution. The 2086-2098 period (future climate) is compared to 1996-2008 used as control period. In general, the models relatively well capture the principal shape of the diurnal cycle observed, i.e. there is one distinct peak simulated for inland stations all over Sweden. However, all simulations overestimate the precipitation amount and the peak-timing is about 3-4 hours earlier than observed. The simulations produce a diurnal cycle with quite similar shape even though they largely differ in terms of rainfall amounts. Despite the inter-model variability a consistent signal from all future climate vs control-run comparisons can be detected. The amplitude of the future diurnal cycle, i.e. the range between the lowest and highest values throughout the day, gets weaker. This is due to increased average rainfall amounts during night-time, i.e. between 18-08 LST. The strong afternoon peak, both its timing, strength and shape, remain quite unchanged.