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# Climate change signal of thunderstorm frequency using high-resolution COSMO-CLM simulations

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It is generally assumed that temperature increase associated with global climate change will lead to increased thunderstorm intensity and associated heavy precipitation events. In the present study it is investigated whether the frequency of thunderstorm occurrences will in- or decrease and how the spatial distribution will change for the A1B scenario. The region of interest is Saar-Lor-Lux region (Saarland, Lorraine, Luxembourg) with a focus on Rhineland-Palatinate.

Hourly and daily model data of the COSMO-CLM is used with a horizontal resolution of 4.5km and 1.3km. The simulations were carried out for three different decades: 1991-2000 (C20), 2041-2050 (A1B) and 2091-2100 (A1B). Thunderstorm indices are calculated to detect potential thunderstorms and differences in their frequency of occurrence in the three decades. The indices used are CAPE (Convective Available Potential Energy), SLI (Surface Lifted Index), and TSP (Thunderstorm Severity Potential), which combines deep-layer-shear and the maximum vertical velocity. The significance of a potential climate signal was tested with a t-test and a power analysis was performed to quantify the uncertainty of the signal.

The investigation of the present and future thunderstorms shows that the regional averaged frequencies will decrease in general, but several regions like the Saarland and especially elevated areas will have a potential increase in thunderstorm occurrences and intensity. Statistically, nearly none of the signals is significant and the power analysis yields low power to detect changes of severe thunderstorms but high power for classes with no to light thunderstorms. Therefore it can be concluded that the frequency of severe thunderstorm is not likely to increase.