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Future changes in intense precipitation over Europe at the daily and sub-daily time scales

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Heavy precipitation is a major hazard over Europe. It is well established that climate model projections indicate a tendency towards more extreme daily rainfall events. It is still uncertain, however, how this changing intensity translates at the sub-daily time scales. The main goal of the present study is to examine possible differences in projected changes in intense precipitation events over Europe at the daily and sub-daily (3-hourly) time scales using a state-of-the-art climate model. The focus will be on one Representative Concentration Pathway (RCP8.5), considered as illustrative of a high rate of increase in greenhouse gas concentrations over this century. There are statistically significant differences in intense precipitation projections (up to 40%) when comparing the results at the daily and sub-daily time scales. Over north-eastern Europe, projected precipitation intensification at the 3-hour scale is lower than at the daily scale. On the other hand, Spain and the western seaboard exhibit an opposite behaviour, with stronger intensification at the 3-hour scale rather than daily scale. While the mean properties of the precipitation distributions are independent of the analysed frequency, projected precipitation intensification exhibits regional differences. This finding has implications on the extrapolation of impacts of intense precipitation events, given the daily time scale the analyses are usually performed at.