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Longterm and seasonal trends in rainfall erosivity – analysis of a set of high-resolution precipitation time-series (1937–2007) from Western Germany

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In Central Europe, rainfall is the main driver of soil erosion. Consequently, to evaluate the impact of climate change on erosion, precipitation depths and intensities have to be examined to assess the developement of rainfall erosivity. To this end, this study analyses longterm precipitation time-series with a high temporal resolution. The central questions adressed are whether there are trends in "annual" (Apr.–Nov.) and seasonal erosivity as well as in the magnitude and frequency of erosive events.

The data set consists of 10 time-series ranging from 1937 to 2007 with a temporal resolution of 5 minutes. The stations are all located in the central Ruhr area in Western Germany (elevation 33 m to 123 m a.s.l., max. distance between stations approx. 60 km). Different statistical analysis methods have been applied in order to examine longterm trends and shifts in seasonal distribution of erosivity. To assess changes in the magnitude of erosive events, trends in different size classes of events have been studied.

The analyses show an altogether positive trend in erosivity that is divided into two periods of increase with a short period of decline inbetween. The positive trend is especially pronounced in the period of 1973 to 2007 (approx. 100% increase, $R^2 = 0.4$, $p < 0.01$). The trends in annual erosivity correspond with the trends in annual precipitation. However, the ratio of erosivity to precipitation is not constant, but increases with increasing total precipitation. The positive trend in rainfall erosivity can partially be attributed to an increase in magnitude and frequency of extreme events. It can also be observed that the increase in erosion is not distributed equally throughout the year, but has a distinct seasonal pattern with maxima in May–July and Sep.–Oct. It is especially noteworthy that the increase in erosivity in early summer (June–July) does not correspond to an increase in precipitation.

The results of this study show that climatic change may have a significant impact on soil erosion. The seasonal pattern of the increase in erosivity (especially in May and Sep.–Oct.) will lead to a higher erosion risk for certain agricultural crops (e.g. maize, winter crops). Therefore, changes in seasonality should particularly be taken into account for future landuse management and planning.