Rainfall Erosivity in the Western Balkans – Towards a Sustainable Soil Erosion Evaluation and Control

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Estimation of rainfall erosivity (R-factor) is essential for understanding the complex relationships between hydrological and soil erosion processes. Therefore, the two main objectives of this research were to estimate the spatial-temporal rainfall erosivity across the Western Balkans (WB) region by applying the RUSLE and RUSLE2 methodology with data for the period 1991–2020 and to apply cluster analysis to identify the places of greatest erosion risk. To achieve these goals, the ERA5 reanalysis with hourly precipitation data resolution was used. The research showed that: 1) hourly precipitation intensity and monthly precipitation totals exhibit pronounced variability over the study area, with highest values observed in the SW (>0.3 mm h^{-1} average), while the least precipitation was seen in the Pannonian Basin and on the far south (0.1 mm h^{-1} average); 2) R-factor variability was very high for both the RUSLE and RUSLE2 methods. The mean R-factor calculated by RUSLE2 was 790 MJ mm ha^{-1} h^{-1} yr^{-1}, a 58% higher than the mean R-factor obtained from RUSLE (330 MJ mm ha^{-1} h^{-1} yr^{-1}). The analysis of the R-factor at decadal timescales suggested a rise of 14% in the 2010s; 3) the k-means algorithm generated maps of homogeneous areas for the R-factor values. This study also provided useful information for more detailed and dynamic soil erosion assessments, as well as for the analysis of extreme erosive events on a regional scale. The rainfall erosivity maps presented in this research can be seen as useful tools for the assessment of soil erosion intensity and erosion control works, especially for agriculture and land use planning. As the RUSLE-type models have been extensively used as the most employed erosion-by-water modeling tool during the past decades, parameters as the R-factor are key features for the estimation of soil-erosion rates in the WB region.