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Improving the global applicability of the RUSLE model – Adjustment of the topographical and rainfall erosivity factors

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There exist large uncertainties in estimating the rates and extend of soil erosion by surface runoff on a global scale, which limits our understanding of the global impact that soil erosion might have on agriculture and climate. The RUSLE model is a frequently used tool in estimating soil erosion on large spatial scales, so an accurate implementation of this model on global scale is crucial. This study aims at improving the global applicability of the RUSLE model by adjusting the topographical and erosivity factors, and testing the adjusted model to extensive empirical databases on soil erosion from the USA and Europe. Our results showed that applying the fractal method to scale slope from a coarse resolution global digital elevation model to a higher resolution significantly improved the topographical detail. Applying the linear multiple regression method to adjust erosivity for various climate zones resulted in values that were in good comparison with high resolution erosivity data for different regios. This method accounted for total annual precipitation, mean elevation, and the simple precipitation intensity index, indicating that other parameters beside the total precipitation are essential in estimating more accurate erosivity values. Especially the simple precipitation intensity index, which is a simplified and coarse scale representation of high resolution precipitation intensity, was found to be an important explaining factor for most climate zones. This method of adjusting erosivity needs to be extended to or improved for other climate zones, such as the polar and tropical climates, for which erosivity is biased due to the lack of high resolution erosivity data. After adjusting the topographical and rainfall erosivity factors, the RUSLE model showed not only a global higher mean soil erosion rate as compared to the unadjusted version of the model but also more variability in the soil erosion rates. When comparing these results with erosion rates from the empirical datasets of the USA and Europe, the adjusted RUSLE model was able to decrease the very high soil erosion rates in most hilly regions that were originally seen in the unadjusted RUSLE model. However, the comparison with erosion rates for Europe was not as good as for the USA, which indicates that the RUSLE model has to be improved further in order to be fully applicable on a coarse resolution on a global scale. Other RUSLE factors such as soil, land use and land management, which were not the focus of this study, need to be investigated in more detail on a global scale. However, results from this study indicate that the methods used here seem to be a promising tool in improving the applicability of the RUSLE model on a coarse resolution on global scale.