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Spatially Distributed Modelling of Soil Erosion and Sediment Yield at Regional Scales in Spain.

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Triggered by the quest to quantify erosion rates and the impacts of global changes on erosion, and in the absence of monitoring of sediment transport in most rivers, several attempts have been made to apply erosion models at regional scales. However, these attempts have often been directed towards on-site soil erosion estimates, emphasising sheet and rill erosion processes, and disregarding gully erosion, channel erosion and sediment transport. These models are therefore of limited use for the assessment of sediment yield, off-site impacts of erosion, and for the development of environmental management to control these impacts at regional scale. This study analyses and compares three spatially distributed models for the prediction of soil erosion and/or sediment yield at regional scales: the WATEM-SEDEM model that is based on the empirical Revised Universal Soil Loss Equation (RUSLE) in combination with a sediment transport equation, the physics-based Pan European Soil Erosion Risk Assessment model (PESERA), and a newly developed Spatially Distributed Scoring model (SPADS). The three models were applied to 61 Spanish drainage basins and model predictions were evaluated against data on measured reservoir sedimentation rates. Global data sets on land use, climate, elevation and soil characteristics were used as model input for WATEM-SEDEM and SPADS, whereas published soil erosion estimates of PESERA at 1 km^2 resolution were used directly. SPADS and WATEM-SEDEM provided best results after separate calibration for basins with a Sediment Delivery Ratio (SDR) higher than five percent and those with a SDR lower than five percent. In this way, SPADS explained 67 percent of variation in sediment yield, while WATEM-SEDEM explained 48 percent of the variation. PESERA repre-

sents a promising alternative to the use of empirical models at the regional scale as it can be applied to very diverse environments with little calibration. However, PESERA provides soil erosion rates and not sediment yield estimates. For most basins PESERA soil erosion rates vary between fifty and close to zero percent of total sediment yield. Two major factors may explain this discrepancy between modelled soil erosion rates and sediment yield. First, it may be that PESERA underestimates soil erosion under Mediterranean conditions. Second, gully-, river channel erosion and sediment transport processes may be much more important than sheet- and rill erosion for regional scale sediment yield in these environments. These issues therefore require further attention in future model development. Although spatially lumped models provide better predictions of sediment yield at the basin scale, and while validation of the predicted spatial patterns of sources and sinks of sediment requires further research, spatially distributed models are expected to be of value to support management decisions regarding the assessment of on-site and off-site impacts of erosion at the regional scale in gauged and ungauged basins.