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Use of modeled and satelite soil moisture to estimate soil erosion in central and southern Italy.

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This study presents an accurate comparison between two different approaches aimed to enhance accuracy of the Universal Soil Loss Equation (USLE) in estimating the soil loss at the single event time scale. Indeed it is well known that including the observed event runoff in the USLE improves its soil loss estimation ability at the event scale. In particular, the USLE-M and USLE-MM models use the observed runoff coefficient to correct the rainfall erosivity factor. In the first case, the soil loss is linearly dependent on rainfall erosivity, in the second case soil loss and erosivity are related by a power law. However, the measurement of the event runoff is not straightforward or, in some cases, possible. For this reason, the first approach used in this study is the use of Soil Moisture For Erosion (SM4E), a recent USLE-derived model in which the event runoff is replaced by the antecedent soil moisture. Three kinds of soil moisture datasets have been separately used: the ERA-Interim/Land reanalysis data of the European Centre for Medium-range Weather Forecasts (ECMWF); satellite retrievals from the European Space Agency – Climate Change Initiative (ESA-CCI); modeled data using a Soil Water Balance Model (SWBM). The second approach is the use of an estimated runoff rather than the observed. Specifically, the Simplified Continuous Rainfall-Runoff Model (SCRRM) is used to derive the runoff estimates. SCRMM requires soil moisture data as input and at this aim the same three soil moisture datasets used for the SM4E have been separately used. All the examined models have been calibrated and tested at the plot scale, using data from the experimental stations for the monitoring of the erosive processes “Masse” (Central Italy) and “Sparacia” (Southern Italy). Climatic data and runoff and soil loss measures at the event time scale are available for the period 2008-2013 at Masse and for the period 2002-2013 at Sparacia. The results show that both the approaches can provide better results than the USLE. Specifically, the SM4E model has proven to be particularly effective at Masse, providing the best soil loss estimations, especially when the modeled soil moisture is used. In this case, the RSR index (ratio between the Root Mean Square Error and the Observed Standard deviation) is equal to 0.94. Instead, the SCRRM is able to better estimate the event runoff at Sparacia than at Masse, thus resulting in good performances of the USLE-derived models using the estimated runoff; however, even at Sparacia the SM4E with modeled soil moisture gives the better soil loss estimates, with RSR = 0.54. These results open an interesting scenario in the use of empirical models to determine soil loss at a large scale, since soil moisture is a not only a simple in situ measurement, but only a widely available information on a global scale from remote sensing.