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Spatial repeatability of experiments using an outdoor nozzle-type rainfall simulator for soil erosion studies at the Masse station (Italy)

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A rainfall simulator was recently installed at the Masse experimental station (Italy). This site includes some USLE plots of different length and width oriented parallel to a 16 % slope. The rainfall simulator is placed over two micro-plots of 1mx1m each and can house up to four full-cone spray nozzles for each micro-plot. The nozzles are positioned at the angles of a 0.18 m square, centred over the plot at a height of 2.7 m above the ground and the experiments are contemporary replicated in the two micro-plots. Changing the number and type of activated nozzles, a range of rainfall intensities can be obtained. As shown in a previous work, the three nozzles currently mounted (Jet Systems 2.8 EEW, 14 FFWSQ, 30 FFWSQ) ensure a range of intensities between 16 and 140 mm/h with a very high uniformity (Christiansen coefficient > 93%).
The simulator was recently employed in two experiments principally aimed to assess the influence of micro-topography on the variables associated with the soil erosion process in bare soils. Each experiment started from a just ploughed surface and included 3 simulations carried out in the range of few days. Each test included a wetting phase (W) of 30 min with intensity of about 40 mm/h (14 FFWSQ) followed by the simulation (E) with intensity of about 65 mm/h (30 FFWSQ) having a duration between 60 and 75 min.
This contribution focuses on an ancillary objective of these experiments, i.e. the evaluation of the actual similitude of soil and rainfall characteristics in the two adjacent micro-plots during the simulations. This objective was pursued by comparing the two plots in terms of rainfall intensities, soil water content and bulk density. The intensity (I) was directly measured at the beginning and at the end of both the W and E phases, by collecting the whole amount of water fallen over the plot area for 5 min by using specifically-designed caps covering exactly the 1mx1m plot.
The measures of soil water content (SW) and bulk density (BD) in the first 5 cm-depth were obtained using a sampler of 100 cm3 at the beginning (pre-wetting), at the beginning (initial) and at the end (final) of the simulation.
Results show a general agreement between the values of I, SW, BD of the two plots. However, the intensities in plot 2 are systematically and significantly higher than those of plot 1 for both the 14 FFWSQ and 30 FFWSQ (+4.5% and +9.8% respectively). This could be dependent on technical differences of the nozzles or on other hydraulic components (after the common line). Moreover, this difference can explain the slightly higher SW values observed in P2 (statistically significant). BD values are similar in plot 1 and plot 2, but they are characterized by a relevant variability and uncertainty, due to the rough sampling techniques. In conclusion, the simultaneous treatments in the two plots can be considered similar, but not statistically the same.