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An integrated approach to evaluate soil erosion by means of direct field measurements and indirect estimations in a small Mediterranean catchment: the case of the Rivo basin (Molise, Southern Italy)

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Soil erosion and its consequences on the agricultural productivity is becoming one of the main environmental problems both at a global and local scale. In Italy it represents a growing alert in particular for some regions such as Molise (Southern Italy) as large portions of its territory are characterized by more or less intensive agricultural practices.

To contribute to the understanding of erosion processes and consequent soil loss with particular reference to its spatial distribution, rates and control factors, we started our researches in Molise in 1999. Beginning with the geologic-environmental characterisation of the Molise territory which allowed to individuate the most sensible sectors to soil erosion, a test area for experimental activities on soil erosion was chosen. The selected test area is represented by a little tributary basin of the Trigno valley which has an extension of about 80 kmq and is drained by the Rivo torrent. This pilot basin, thanks to its main physical characteristics (climate, geologic setting, altitude, acclivity, land use, etc.), is largely representative for the whole hilly to low mountainous sector present along the Adriatic flank of the Molise territory. In its head water portion a test area, made of three 4^{th} to 5^{th} sub-basins with a total extension of about 23 kmq, was instrumented for the continuous measurement of climatic parameters and solid and liquid discharges, allowing real time automatic data acquisition both at a test plot and catchment scale. The measurements of soil loss at a test plot scale, related to slope wash and rillying, are carried out in the test plot station of Morgiapietravalle, where

three permanent plots with different land use (two of them alternatively cultivated with wheat and legumes, the third one left uncultivated) were set up. The weather station located within the test plot station provides to collect data about precipitations, wind speed and direction, air temperature, and soil moisture, and is integrated by other two rain gauge stations located within the Rivo basin. In 2005, the tanks which collect liquid and solid discharges coming from the test plots, were modified to allow the measurement of soil loss due to single rainfall events. At the catchment scale, liquid discharges and suspension loads are measured at the outlets of the monitored sub-basins and at two minor outlets located inside of one of them.

Data records coming from the test plot station and the hydrometric measure stations were extended by means of a GIS to areas having similar characteristics, so as to evaluate their contribution to cumulative soil erosion at the catchment scale.

The data collected during the last six years show no general and easy relationship between rainfall amounts, connected erosivity and related soil loss, as the latter appears to be characterized by an appreciable spatial and temporal variability, and to depend on several meteorological and soil parameters. Between the three test plots, the uncultivated one shows a weak linear correlation between rainfall erosivity and soil loss, while the cultivated plots appear to be affected by more uncertainty, showing a greater variability, mainly depending on seasonal but also local differences in soil moisture, and on some stochastic factors.

The results of the experimental activities are referred to soil loss on gentle to moderately steep slopes which represent about 34% of the entire catchment, while soil loss rates on steep slopes, caused by gullying or mass wasting, are yet unknown. Measured mean annual soil loss oscillates between 0.18 and 1.03 t/ha/yr but, in spite of such relatively low soil loss rates, top soils frequently appear to be degraded (low organic matter, abundant Ca^{++}, very low Na^{+} and K^{+}). Furthermore, even though the calculated rates are close to the theoretical soil loss tolerance for cultivated fields as proved for other countries, the results of this study suggest that such tolerance rates must be verified for Mediterranean basins. To do this, since 2005 an integrated approach has been developed, aimed to calibrate on the basis of the experimental data some of the most commonly used empirical methods for soil loss estimation. Among the considered methods, the Gavrilovich-Bazzoffi approach showed the best capacity to predict the observed data.