Hydrol. Earth Syst. Sci. Discuss., 9, C962–C964, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C962/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Coupling the modified SCS-CN and RUSLE models to simulate hydrological effects of restoring vegetation in the Loess Plateau of China" *by* G. Y. Gao et al.

Anonymous Referee #1

Received and published: 17 April 2012

This paper contributes to prediction of soil erosion rates by simple approaches based on not novel but still widely used methodologies. In my opinion, the approach developed by the Authors is generally correct and interesting. In general, the manuscript represents a valuable contribution to soil loss prediction by technicians and professionals, although the results have only a local validity. I believe that a few points should be better discussed. Some improvements and developments are also necessary.

I am a little puzzled about measurement of runoff and soil loss. A reason is that the Authors do not give any information on the characteristics of the system used to both intercept and store runoff and the associated sediments. Another reason is that a

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drying period of eight hours at 105 °C could be too short to remove all water from the collected sediments. Did the Authors control that this duration was appropriate?

The Authors should justify the choice of plot lengths varying from 5 to 13 m, also taking into account that different erosive mechanisms can be expected in the different plots. In particular, occurrence of interrill erosion alone can be presumed for the shortest plots whereas both rill and interrill processes are expected on the longest plots.

According to the USLE/RUSLE scheme, soil loss per unit area should increase with plot length but scientific literature shows many examples of situations where this increasing relationship was not detected. The data collected by the Authors are usable to check the soil loss per unit area vs. plot length relationship in the sampled area. This point should be examined to establish consistency of the data with the USLE/RUSLE model. Maybe, the Authors could give a look at the following papers which, in my opinion, are very interesting: Moreno-de las Heras M., Nicolau J.M., Merino-Martín L., Wilcox B.P. (2010) Plot-scale effects on runoff and erosion along a slope degradation gradient. Water Resources Research, 46, W04503, and Yair A., Raz-Yassif N. (2004) Hydrological processes in a small arid catchment: scale effects of rainfall and slope length. Geomorphology, 61, 155-169.

Another point related to plot length to be discussed is the suitability of the data to check the applicability of the different versions of the SCS-CN model. More precisely, the Authors should support the suitability of data collected on very short plots (e.g., 5 m) to check the model.

Another question still concerning plot lengths is that the Authors successfully developed a modified SCS-CN model but the applicability of this and alternative SCS-CN models was assessed only with reference to short plots (i.e., not longer than 13 m). There is some evidence that runoff decreases with plot length (examples are Joel, A., Messing, I., Seguel, O., Casanova, M. (2002) Measurement of surface water runoff from plots of two different sizes. Hydrological Processes 16, 1467-1478, and Parsons,

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A.J., Brazier, R.E., Wainwright, J., Powell, D.M. (2006) Scale relationships in hillslope runoff and erosion. Earth Surface Processes and Landforms 31, 1384-1393). Moreover, agricultural fields are generally longer, even much longer, than 13 m. Therefore, some comment on the applicability of the developed model on relatively long fields should be included.

Eq.(14) by the Authors differ from both the USLE-M by Kinnell and the USLE-MM by Bagarello et al.. In the USLE-M, the proportionality between soil loss per unit area (Ae) and the erosivity term QREI30 is direct, i.e. the coefficient "b" is equal to one. In the USLE-MM, "b" is greater than one but the "a" coefficient is considered to be representative of soil erodibility. Eq.(14) has a "b" value greater than one but it also considers separately soil erodibility. In other terms, the erosivity index is QREI30 according to Kinnell, (QREI30)ˆb according to Bagarello et al., and a(QREI30)ˆb according to the Authors. This point should be considered and discussed also taking into account that, according to Kinnell and Risse (1998: USLE-M: Empirical modelling rainfall erosion through runoff and sediment concentration. Soil Science Society of America Journal, Vol.62, 1667-1672), changing the erosivity term implies that the original soil erodibility factor, and other original factors of the USLE, cannot be used to predict soil loss.

In any case, I have seen that the "b" exponent by the Authors (1.55) is close to the "b" value obtained by Bagarello et al. (2010) in Italy on plots varying in length from 11 to 44 m (1.47). Probably, this point needs some comment by the Authors.

In the manuscript, the Authors tested eq.(14) with only the estimated QR. In my opinion, also using the equation with the measured runoff ratio is necessary to separately establish the approximations attributable to the model's structure (i.e., eq.14) and the ones due to the unavoidable uncertainties associated with runoff estimation.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 4193, 2012.