Hydrol. Earth Syst. Sci. Discuss., 9, C1494–C1499, 2012
www.hydrol-earth-syst-sci-discuss.net/9/C1494/2012/

Hydrology and Earth System Sciences Discussions

Interactive comment on "A comparison of the soil loss evaluation index and the RUSLE Model: a case study in the Loess Plateau of China" *by* W. W. Zhao et al.

W. W. Zhao et al.

zhaoww@bnu.edu.cn

Received and published: 15 May 2012

We acknowledge the work done by reviewers very much. We have gone through all the comments and will amend the original manuscript base on the suggestions and comments. In the following lines we provide answers to the reviews comments.

Reviewer: The irrational land use practice is the cause of severe soil erosion especially on the Loess Plateau of China. Chinese scientists work hard to obtain a straight way like the index in this paper to help land use planning and control soil erosion. A kind of

model (SLsw) designed by the authors was compared to RUSLE to illustrate the validity of SLsw to find the place need urgent optimization.

It is much easier to find out the differences such as purpose, scale and calculation procedures of two models. But output comparison and the interpretation are not sufficient leading to a great suspicion of reliability of the model in the paper. The science foundation of the model structure failed to present clearly and also the verification as a model is missing, so it is difficult to justify its correctness and accuracy.

Authors: Loess Plateau of China suffers from the most severe soil erosion in the world. Because of the different types of soil erosion and high soil loss rate, it is a big challenge to predicate soil loss rate accurately with erosion models at large scale in the hilly area of the loess plateau. So, it is helpful for land use planning and soil erosion control to find some easy way to discuss the relationship between land use and soil erosion. Based on the scale-pattern-process theory in landscape ecology and calculation methods of RUSLE, multiscale soil loss evaluation index was created and applied in Yanhe watershed.

Based on the relationships between land use and other erosion factors and soil loss processes, , the basic understandings can be gained(Fu et al., 2006): (1) At the slope scale, land use structure, slope gradient changes and distance from the slope base affect soil losses. For a given type of land use, the steeper its corresponding slope is and the nearer it is to the slope base, the more contributions it will make to soil erosion and the sediments that flow out of the slope. Otherwise, the contributions will be smaller. The slope-scale soil loss evaluation index should take comprehensive account of the factors of land use structure, slope gradient and distance from slope base. (2) At the small watershed scale, when a certain type of land use has a steeper slope and is closer to the drainage network, it will make more contributions to the sediment output of the small watershed. Otherwise, its contributions will be smaller. The small watershed-scale soil loss evaluation index should give comprehensive consideration to such factors as slope, horizontal distance from river and vertical distance from river.

The above understandings are the part of the science foundation of SL. More detail can be found in the paper by Fu et al.(2006): "A multiscale soil loss evaluation index" (Chinese Science Bulletin 2006 Vol.51 No.4: 448-456).

Verification is important for a model application indeed. But, model verification is a challenge for SLsw so far. The reasons are as follows. On one hand, for a given watershed, SLsw value is dimensionless, but the soil loss rate is not dimensionless. On the other hand, there are several factors, such as rainfall, topography, soil, and the irrational land use pattern, contribute to high soil erosion. It is difficult to identify how much contributions have been done by land use pattern to soil loss rate. While, the purpose of SLsw is to reflect the effects of land use pattern on soil erosion; it is incorrect to use the monitoring data of gauge station to verify the SLsw value directly. Maybe, it could help verifying SLsw by comparing with the some well accepted model, but it is difficult to find the well accepted model for Loess Plateau of China so far.

Reviewer: Furthermore the Fig. 8 in the paper gives wrong information about the soil erosion rate in the study area. The paper needs a major revision to give more clear explanation.

Authors: Combined the suggestions of reviewers, the revised manuscript will focus on the comparison between SLsw and the C factor from RUSLE. The soil erosion rate will not be discussed. Accordingly, Fig. 8 will be removed in the revised manuscript.

While, as for the soil erosion rate, it was calculated based on RUSLE, and more detail can be seen in the paper by Fu et al. (2005): "Assessment of soil erosion at large watershed scale using RUSLE and GIS: a case study in the Loess Plateau of China (Land Degrad. Dev., 16, 73–85).

Reviewer: In the construction of SLsw model, the authors adopt four factors and their equations from RUSLE model, see the part of 2.2.4. Because the cover and management practices factors (C) is referred to the land use pattern and most concerned in the

paper, it is necessary to state clearly what the relationship of C factor used here and the land use pattern the paper mentioned are, and to make it easier to understanding the results and conclusion in this paper (see note 5 below).

Authors: Yes, it is necessary to state the relationship of C factor and SLsw. Combined the suggestions of reviewers, the paper name will be changed from “A comparison of the soil loss evaluation index and the RUSLE Model: a case study in the Loess Plateau of China” into “A comparison of the soil loss evaluation index and the C factor from RUSLE: a case study in the Loess Plateau of China”. The paper content will focus on the difference between SLsw and C factor, and the relationship will be discussed.

Reviewer: Equation (4) was used to standardize the results from two models. But what is the scope of Xmax and Xmin? Of the sub watershed or whole watershed? How to trans- form the result of RUSLE into the standard level? Please describe it briefly and clearly in the paper.

Authors: Combined the suggestions of reviewers, the research contents will discuss the relationship between soil loss evaluation index and the C factor from RUSLE, and the equation(4) will not appear in the revised manuscript.

In the original manuscript, xmax and xmin represent the maximum and minimum values of the soil loss rate for the whole watershed respectively. By using Equation(4), the evaluation results of RUSLE and SLsw will be transformed into the scope of [0, 1], and will be helpful for the model comparison.

Reviewer: The authors constructed the model like part of 3.1.5 of the paper shows the application result of SLsw. As a semi-empirical model, its purpose is to guide land use planning. Although the model is constructed in the basis of erosion processes and USLE, it is necessary to test its correctness and accuracy and strengthen the reliability.

Authors: It is necessary to test new model correctness and accuracy. But, model verification is a challenge for SLsw so far (the reasons have been explained above). The revised manuscript will compare SLsw and the C factor from RUSLE, and give the explanations for their difference.

Reviewer: The criteria to divide the sensitive or non-sensitive area need clearly explanation and verification in the part of 3.3. From the paper it is only the comparative conception limited for the study area, not for the indicative region and for the whole Loess Plateau. If the SLsw indexes in the study area have a low coefficient of variation, but a high average, that means all the study area are probably so called sensitive area, but only part of them could be identified based on the paper. Such an evaluation is suspected its value and ability to guide the land use planning on the Loess Plateau.

Authors: Yes, the criteria to divide the sensitive or non-sensitive is suspected to guide the land use planning on the Loess Plateau. The method will not be used to divide the study area into sensitive or non-sensitive area.

Reviewer: The mean annual soil erosion modulus of 29884 Mg.km-2.yr-1 in Fig 8 is near the ultimate value (30000 t.km-2.yr-1) which ever occurred based on the records of gauge station in the river with much severe soil erosion than the study area in the paper on the Loess Plateau. Such soil modulus happened in the middle and the southeast parts of the Yanhe River based on the statement in the paper. The first location is generally consistent with the identification from the SLsw model. But the latter one shows the huge difference. The southeast part of the Yanhe River with high soil loss rate up to near 30000 t/km2/year from RUSLE in Fig 8 and Fig 9, is not only the non-sensitive area, also the lowest value identified by SLsw model in Fig7 and 10. The agreement of first location between two models means that irrational land use resulted in the severe soil erosion, but the disagreement of the second is stated that the sever soil erosion is caused by the factors such as rainfall, topography and soil, not by ir-

rational land use by human people. Is that true? Which one is more reliable? It is necessary for authors to give more clear and sound explanation, not only the simple guess in the paper. The detailed data in the paper would support the analysis.

Authors: The purpose of SLsw is to reflect the effects of land use pattern on soil erosion, higher value of SLsw means the land use pattern will lead to high soil loss, but it cannot get soil erosion modulus. So, if one area has low SLsw value and high soil erosion modulus, it means that it is the other factors, such as rainfall, topography and soil, not the irrational land use pattern, leads to high soil erosion for the area. But, it is difficult to judge which factor lead to high soil erosion exactly. So, it is necessary to give more date and sound explanation for these kinds of situation indeed.

While, Combined the suggestions of reviewers, the research contents will discuss the relationship between soil loss evaluation index and the C factor from RUSLE, the comparison of SLsw and RUSLE result will not appear in the revised manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 2409, 2012.