Hillslope erosion modeling
---A case study in China Loess Plateau region

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1. Introduction

Previous researches have found that coefficient or index, which is defined as a constant in an erosion model actually changes over space and time, but there is not any ideal explanation. The Modified Remote Sensing Information Model of Water Erosion on Hillslopes(MRSIMWEH) proposed in this paper tries to give a reasonable explanation.

2. MRSIMWEH

MRSIMWEH is written as:

$$E_{sl} = x_0 I_{30}^{x_1} h_{sl} K^{x_2} (sin\,2\alpha)^{x_3}\ exp(-x_4 S_{vc}) \qquad (1)$$

where E_{sl} (mm) is the erosion depth on hillslopes; I_{30} is the maximum 30-minute rainfall intensity (mm min^{-1}); h_{sl} (mm) is the depth of overland flow; K ((t hm^2 h) (hm^{-2}·MJ^{-1}·mm^{-1})) is the soil erodibility factor defined in USLE; α is the gradient (radian); S_{vc} (%) is vegetation coverage; x_0 is geoscientific coefficient and x_1, x_2, x_3, x_4 are geoscientific indices.

Note that $x_0 \cdots x_4$ in Equation (1) are set as variables. Actually, Equation (1) integrates MDL as the model coincides with three main laws of dialectics as presented by Engels in The Dialectics of Nature. These laws are the unity of opposites(Fig. 1), the transformation of quantity into quality(Fig.2) and the negation of the negation(Fig. 3).

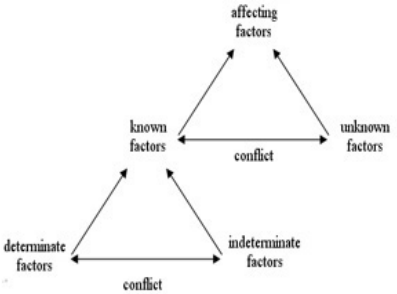

Fig. 1 The unity of opposites

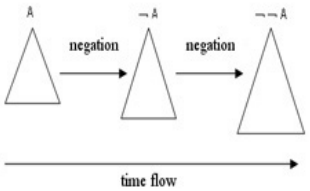

Fig. 3 The negation of the negation(Sawamura 2002)

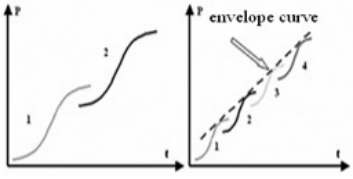

Fig. 2 The transformation of quantity into quality (Petrov 2002)

3. Case study

Wufendigou is one small watershed in China Loess Plateau region. It is located between latitudes 39°43′37″- 39°46′28″N and longitudes 111°7′6.9″-111°9′13.7″E, with an area of 3.85 km^2. We got data of 26 rainfall events occurring from June 1987 to August 1994, which was measured from 24 small experimental plots on the hillslopes. The area of each plot is equal to or less than 100 m^2. One pixel in this research is 5m × 5m. We use 140 measured data(rainfall events × plots). Among them, 75.7% are selected for modeling and the accuracy is 72.64% after model calibration; 24.3% are selected for model verification and the accuracy reaches 74.15% as shown in Fig. 4.

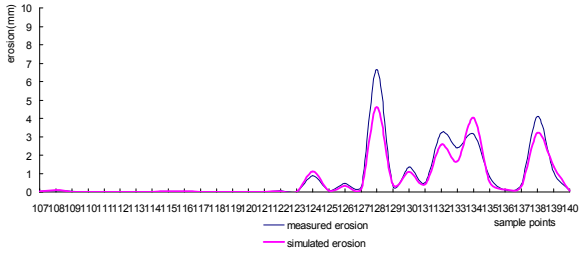

Fig. 4 MRSIMWEH verification

4. Conclusion

MRSIMWEH is a MDL based hillslope erosion model, where coefficient and index are all defined as variables, which will change over large space or long duration. But inside a small space and short duration, they can be set as constants. Moreover, MRSIMWEH is pixel based. Selecting Wufendigou watershed as a research object, we calculate MRSIMWEH based on measured data. The calculation results show that MRSIMWEH can serve the practices of water and soil conservation.