Response to Decision Letter

Dear Dr. Paolo Tarolli,

Thank you for your comments concerning our manuscript entitled *"Dangerous degree forecast of soil and water loss on highway slopes in mountainous areas using Revised Universal Soil Loss Equation model"* (ID: nhess-2017-406). Those comments are all valuable and very helpful for revising and improving our paper, as well as the important guiding significance to our researches. We have studied your comments carefully and have made revision which marked in red in the paper. We have tried our best to revise our manuscript according to the comments which we hope meet with approval.

Thank you very much for your consideration.

Best regards!

Yours sincerely,

*Corresponding Author: Shi Qi

P.S.

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Response to editor's comments for nhess-2017-406

Comment 1:

After my check on the revised version of the manuscript and on your responses provided at the last review stage, I found a few further issues to be fixed before the final publication. Few of these seem typos, few are some necessary changes, and several are technical corrections on figures; please check carefully all these issues, since they can be critical; the paper cannot meet the high-scientific standards without clarification on these points.

Response 1:

Thanks very much for your kind work and consideration on publication of our paper! We have studied your comments carefully and have made revision which marked in red in the paper.

Comment 2:

Minor corrections/typos in the text:

In the captions of figures 15 and 16 you corrected with “return period”, but in revised text (line 487, line 500, line 504, line 505, line 563, line 564) still you are repeating "20-year rainfall" and "1-year rainfall”; the question is: referring to the text (not to the captions) which kind of rainfall is this? Return period? Cumulated rainfalls? Others? Please correct;

Response 2:

Thank you for your patience and careful work! We have followed your advice to revise it. Details are in the following paragraph and manuscript.

The total soil erosion amount of each prediction unit for the 20-year return period rainfall data was obtained by simulation according to the classification standards of soil erosion intensity.

The risk of soil erosion is high in these units. For example, from K134+500 to K135+500 (1000 m), the average soil erosion amount on both sides of the slope for the 20-year return period rainfall amount reached 1757 $t \cdot km^{-2} \cdot a^{-1}$.

Similarly, the risk of soil erosion was analysed according to the grading standard of soil and water loss risk under the 20-year return period rainfall condition. This analysis was performed by simulating the soil erosion amount of each prediction unit for the 1-year return period rainfall amount (Figure 16).

The risk grades of soil and water loss along the slope of Xinhe Expressway were divided into 20- and 1-year return period rainfall conditions based on simulated predictions.

Comment 3:

Equation (1): maybe there are few typos here, please also check in literature, but what is “t/hm2”? Is the "time" unit missed? Usually it is written as (t ha−1 yr−1); in general I recommend to check all the unit of measures written in this work, in order to be consistent with the RUSLE literature (and SI system) (“ha” is for hectare, “y” for years); see also fig. 12-13-14: what is “a” in the t km-2 a-1?

Response 13:

Thank you for your patience and careful work! We have followed your advice to revise it. Details are in the following paragraph and manuscript.

where A is the average soil loss per unit area by erosion ($t/ha^2 \cdot y$), R is the rainfall erosivity factor ($MJ \cdot mm / (ha^2 \cdot h \cdot y)$), K is the soil erodibility factor ($t \cdot ha^2 \cdot h / (ha^2 \cdot MJ \cdot mm)$)

"a" refers to anniversary

Comment 4:

in the equation (7) and (8) for the unit of the slope you wrote (°), however, in the literature, several scientists referred it as (%) or a-dimensional; which unit is this?

Response 4:

Thank you for your comment! We checked the relevant literature carefully and ensured that this unit is correct.

References:

Mccool, D. K., Brown, L. C., Foster, G. R., Mutchler, C. K., and Meyer, L. D.: Revised slope steepness factor for the universal soil loss equation. Transactions of the ASAE-American Society of Agricultural Engineers (USA), 30(5): 1387-1396, 1987.

Liu, B. Y., Nearing, M. A., Shi, P. J., and Jia, Z. W.: Slope length effects on soil loss for steep slopes. Soil Science Society of America Journal 64(5): 1759-1763, 2000.

Comment 5:

Some small changes in the English and structure of the sentences need to be provided at the beginning of the chapter 3.2.3. Here my suggestions: line 356 (rephrase saying "slope length factor"), line 364-365 (rephrase with "flowacc is the total number of upstream/contributing pixels for each pixel"), line 365 (rephrase with "…and cell size refers to the DEM resolution (0.5 m). m is a variable length-slope exponent")

Response 5:

Special thanks to you for your good comments! We have made correction according to your comments.

On the basis of the topographic map (1:2000 scale) and highway design of Xinhe Expressway, the slope length factor of the slope catchment was calculated by using DEM data with 0.5 m spatial resolution generated by ArcGIS.

λ is the slope length, *flowacc* is the total number of contributing pixels for each pixel that is higher than the pixel and cell size refers to the DEM resolution (0.5m). m is a variable length-slope exponent.

Comment 6:

In the title and in the text: you can delete “water loss”, here you are discussing soil loss;

Response 6:

We are in complete agreement with your comment. We have followed your advice to revise it. Details are in the following paragraph and manuscript.

1. Therefore, predicting soil loss on highway slopes is important in protecting infrastructure and human life.
2. The partition of the prediction units of soil loss on the expressway slope in the mountainous area and the spatial distribution of rainfall on a linear highway are studied.
3. Given the particularity of the expressway slope in the mountainous area, the model parameter is modified, and the risk of soil loss along the mountain expressway is simulated and predicted under 20- and 1-year rainfall return periods.
4. (1) Natural watersheds can be considered for the prediction of slope soil erosion to represent the actual situation of soil loss on each slope.
5. Keywords: Soil loss; highway slopes; mountainous areas; RUSLE; dangerous degree forecast
6. The soil loss of roadbed slopes differs from the soil loss in woodlands and farmlands.
7. Soil erosion on roadbed side slopes affects not only soil loss along highways but also road operation safety (Gong and Yang, 2016; Jiang et al., 2017).
8. However, the research on soil loss of highways hardly meets the requirements of practical work (Xu et al., 2009; Bakr et al., 2012).
9. Related literature indicates that research on soil loss in highways has the following limitations.
10. After estimating the historical soil loss of each slope prediction unit, the results were compared with data from the three monitoring plots along the side slope of Xinhe Expressway (Figures 10–12).

11. Figure 15(a)(b). Risk analysis of soil loss under 20-year return period rainfall conditions
12. The grading results showed that the percentage of prediction units classified as having low and mild risks of soil loss was 88.60%.
13. Similarly, the risk of soil erosion was analysed according to the grading standard of soil loss risk under the 20-year return period rainfall condition.
14. Figure 16(a)(b). Risk analysis of soil loss for the 1-year return period rainfall amount
15. Slope is the main factor of the soil and water loss caused by highways. Thus, slope is crucial for prediction and early warning systems.
16. In the process of predicting soil loss in engineering slopes by using the RUSLE model, the correction of the conservation support factor (i.e. cement block and hexagonal brick) is often ignored (Zhang, 2011; Morschel et al., 2004; Correa and Cruz, 2010).
17. The method of soil loss prediction adopted in this work generally has a smaller error and higher prediction accuracy than other models, and it can satisfy prediction requirements.
18. The risk grades of soil loss along the slope of Xinhe Expressway were divided into 20- and 1-year return period rainfall conditions based on simulated predictions.

Comment 7:

I would finally suggest a further improvement of the conclusions: provide at the beginning a sentence that describes the purpose of the work and a sentence that describe the study area.

Response 7:

We greatly appreciate your valuable suggestion concerning improvement to this paper. We have followed your advice to revised it. Details are in the manuscript.

In this study, we used the revised universal soil loss equation as the prediction model for soil loss on slopes, predicting the soil loss on highway slopes and simulating the risk of soil loss along the mountain expressway. We not only scientifically predict the amount of soil erosion caused by highway construction in mountain areas but also provide a scientific basis for the prevention and control of soil erosion and rational allocation of prevention and control measures. The error analysis of the actual observation data showed that the overall average absolute error of each monitoring area was 38.65 $t \cdot km^{-2} \cdot a^{-1}$, the average relative error was 31.18%, the root mean square error was between 20.95 and 65.64 and the Nash efficiency coefficient was 0.67…

Comment 8:

in the maps, when you are showing colours of a gradient (not in the case of rainfall), better to use also a gradient of these (e.g. from blue to red, where red is the maximum or high risk)

Response 8:

Thank you for your patience and careful work! We try to use dark legend to indicate high risk, but considering the color matching and visibility of the whole graph, we do not follow the rule of color gradient from blue to red completely. We sincerely hope to meet the publishing requirements!

Comment 9:

I would suggest avoiding to put the legend of colours (and also scale bars) into the figures when there is a background colour (it is very difficult to read it and to understand); this is the case of figure 6a and 6b, but also 15 and 16;

Response 9:

We are in complete agreement with your comment. We have followed your advice to adjust it. Details are in the following paragraph and manuscript.

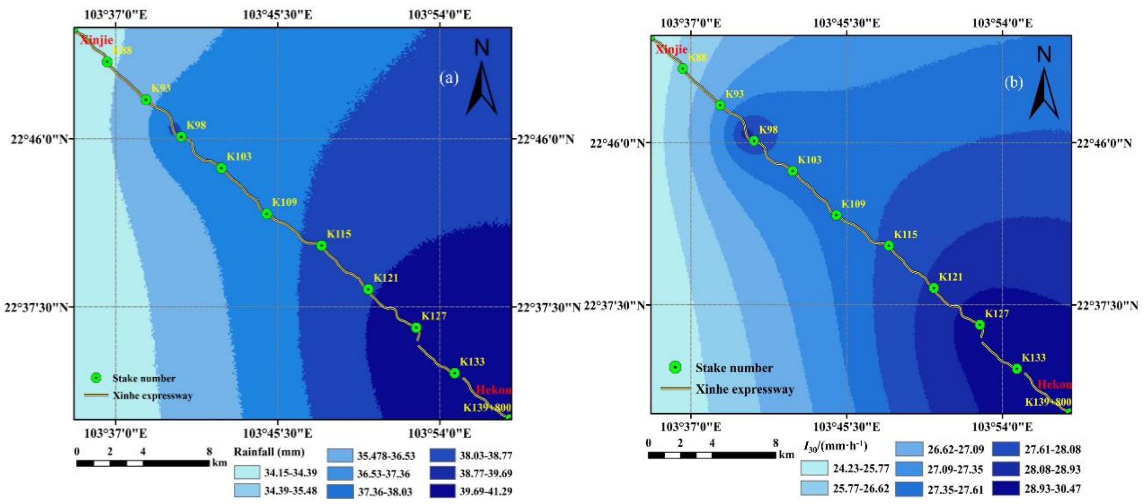
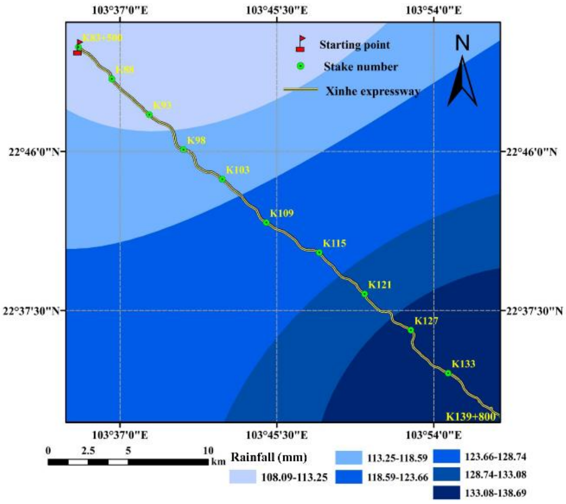


Figure 4(a). Interpolation results of secondary rainfall for June 5, 2014

Figure 4(b). Interpolation results of I_{30} for June 5, 2014



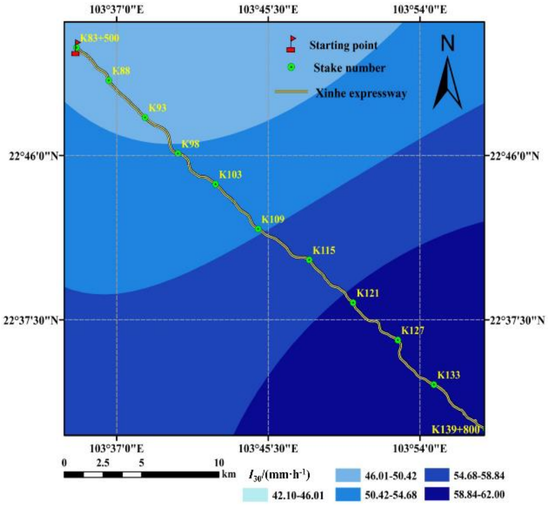


Figure 13. Rainfall interpolation results under 20-year return period

Figure 14. Rainfall intensity interpolation results under 20-year return period

Comment 10:

figure 2-3-4 can be merged in one figure since now they cover too much space; if you provide this, then you need to change then also the figure citation in the text;

Response 10:

Thank you for your comment. We have followed your advice to adjust it. Details are in the following paragraph and manuscript.

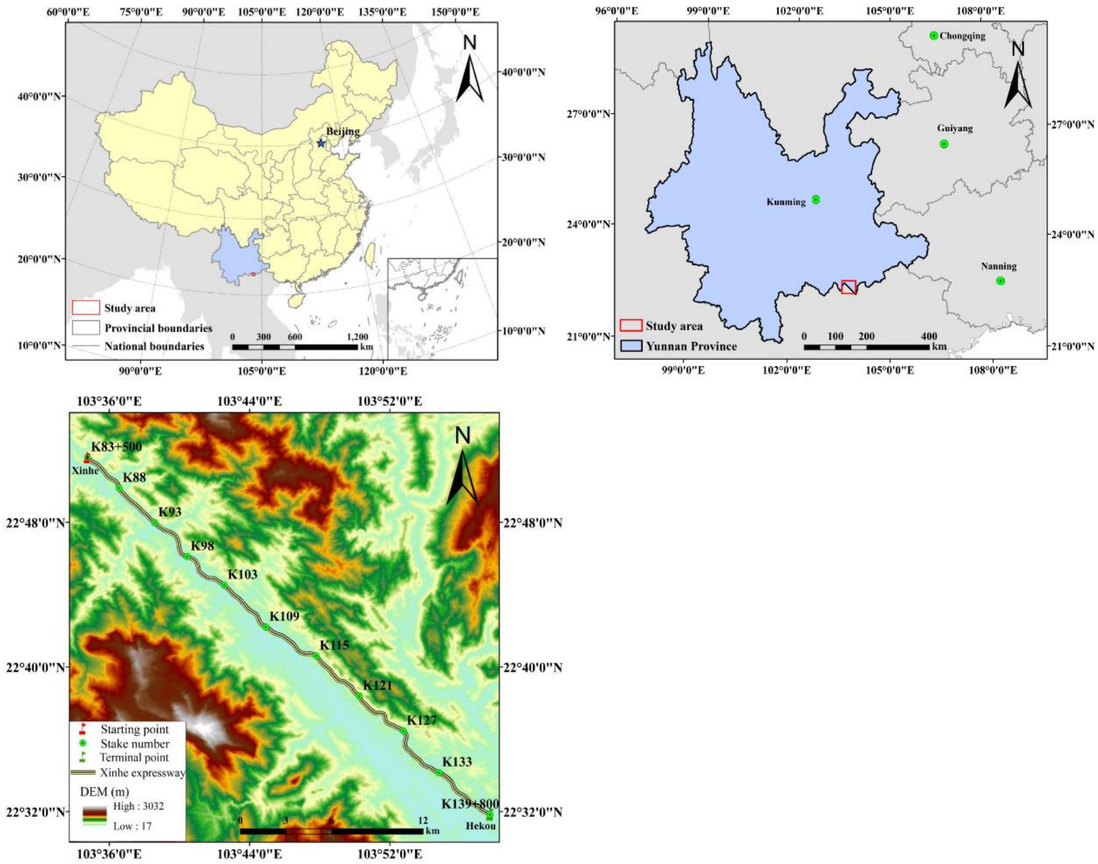


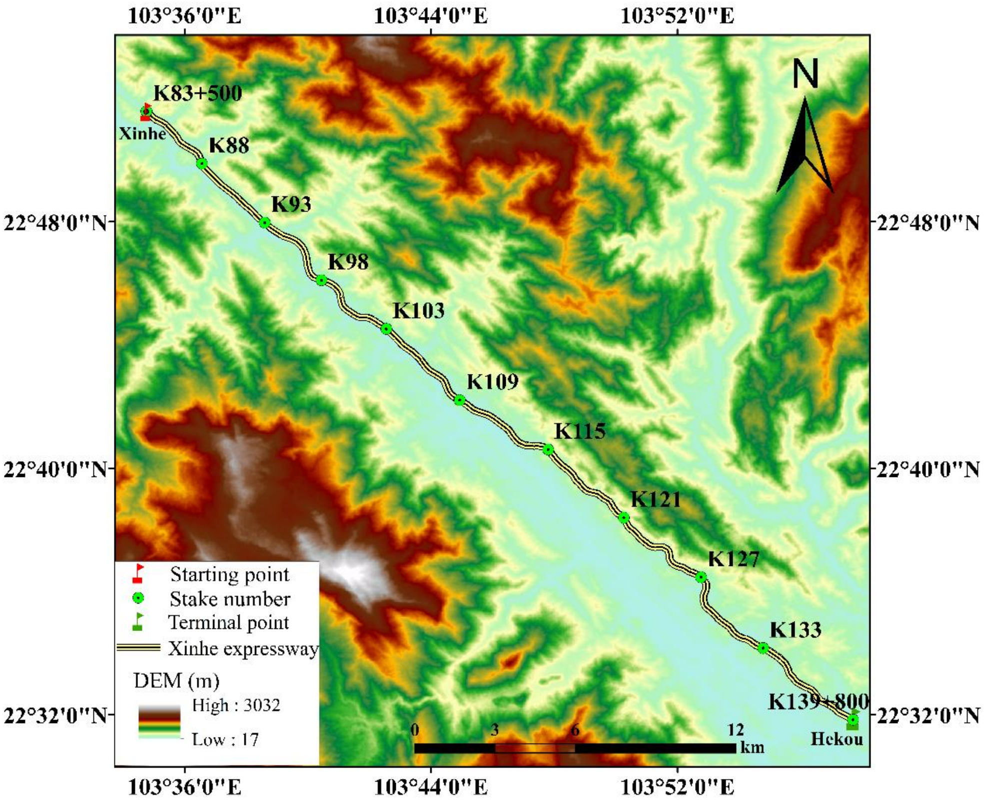
Figure 2. The location and the overview of the study region

Comment 11:

I printed figure 4 to check quality; it seems that you used a very coarse DEM where one can note several strips; surely this is not the DEM you used in your analysis, please re-style it (here, only for the visualization and purpose of the figure, you can just use the new global 30m DEM);

Response 11:

Thank you for your comment. We have followed your advice to adjust it. Details are in the following paragraph and manuscript.



Comment 12:

for figures 7,8,9,11, try to use a font size of the numbers and words smaller (maybe avoiding to use bold), to improve the visualization of the area (you did it well with 18 and 19);

Response 12:

Thank you for your comment. We have followed your advice to adjust it. Details are in the following paragraph and manuscript.

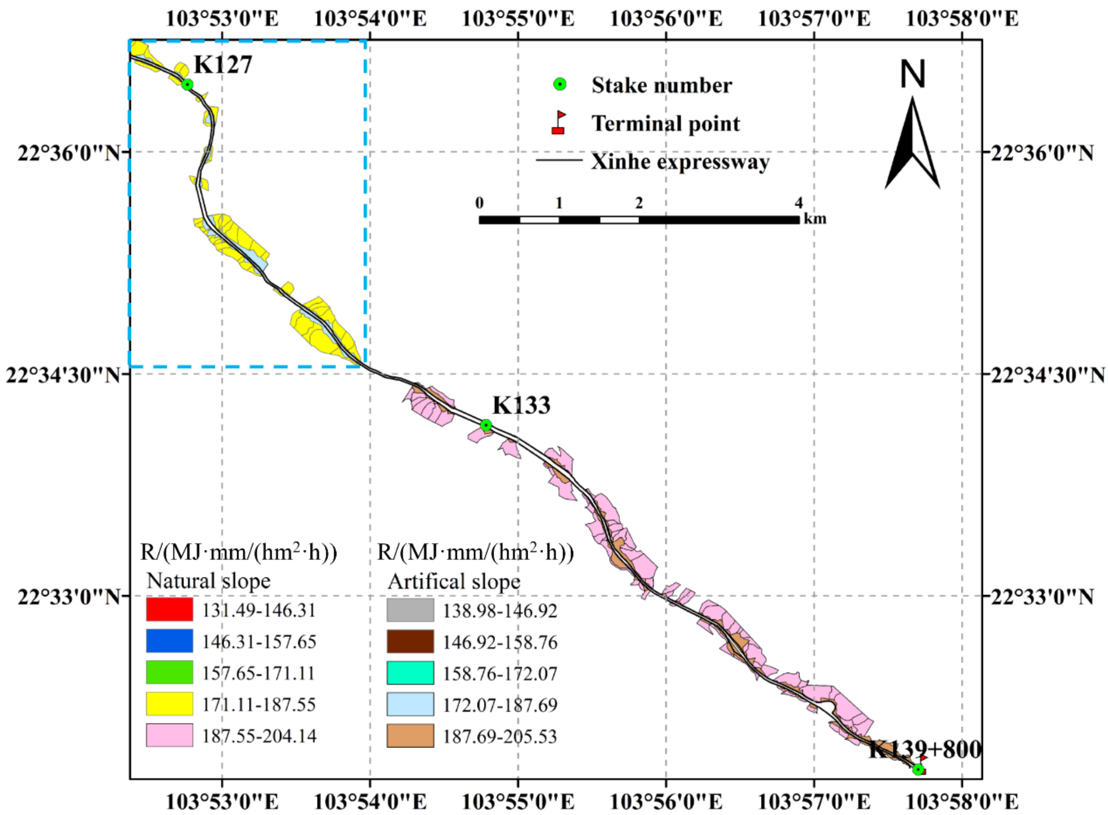


Figure 5. Spatial distribution map of rainfall erosivity factors (K127–K139+800)

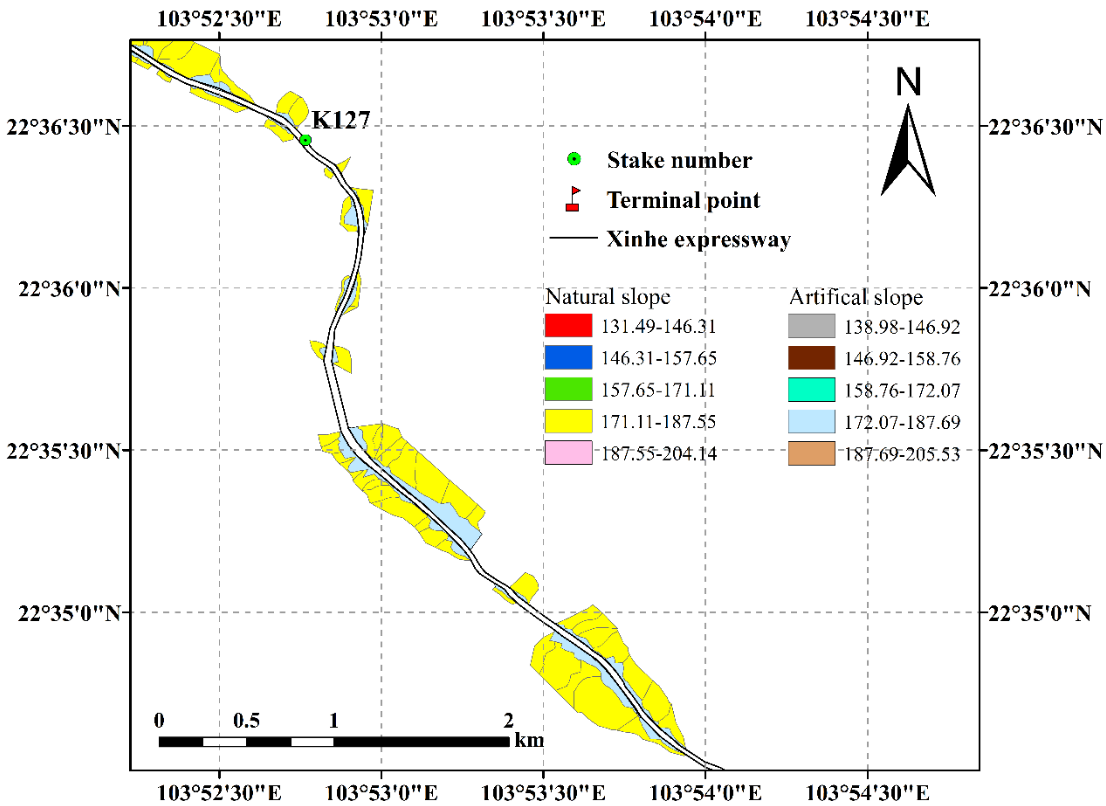


Figure 6. Spatial distribution of rainfall erosion factor in typical a section of a highway

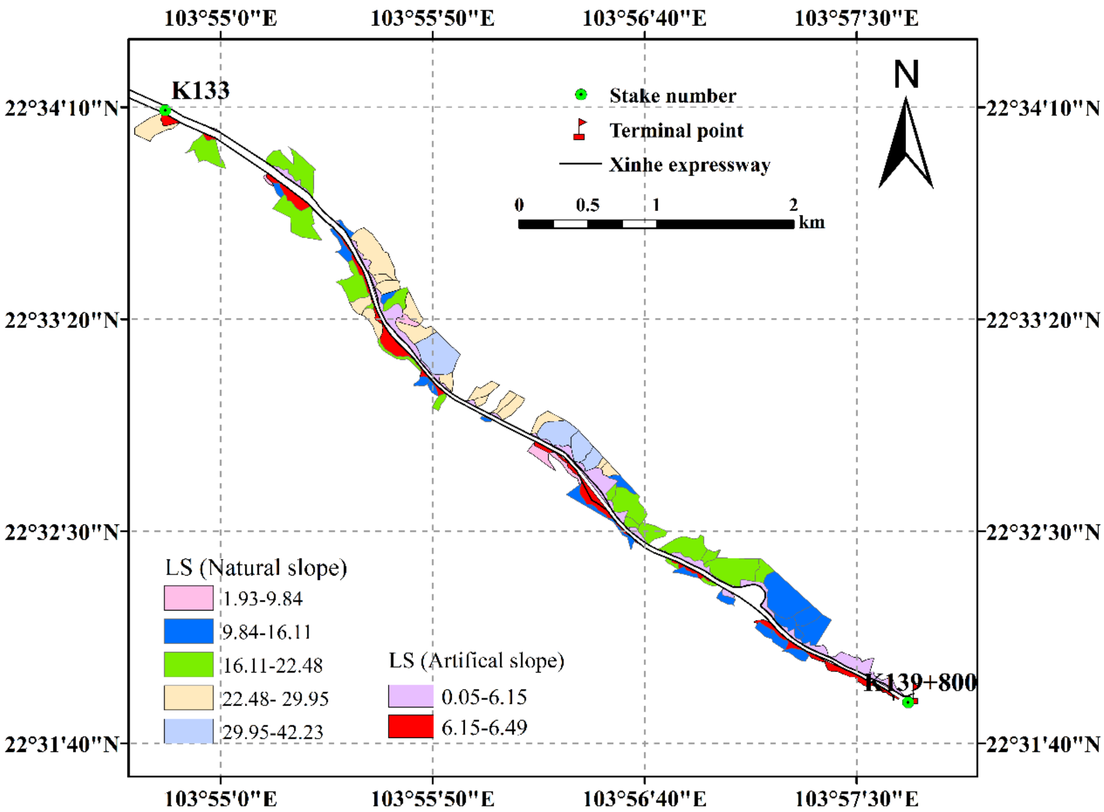


Figure 7. Spatial distribution map of topographic factors (K134–K139)

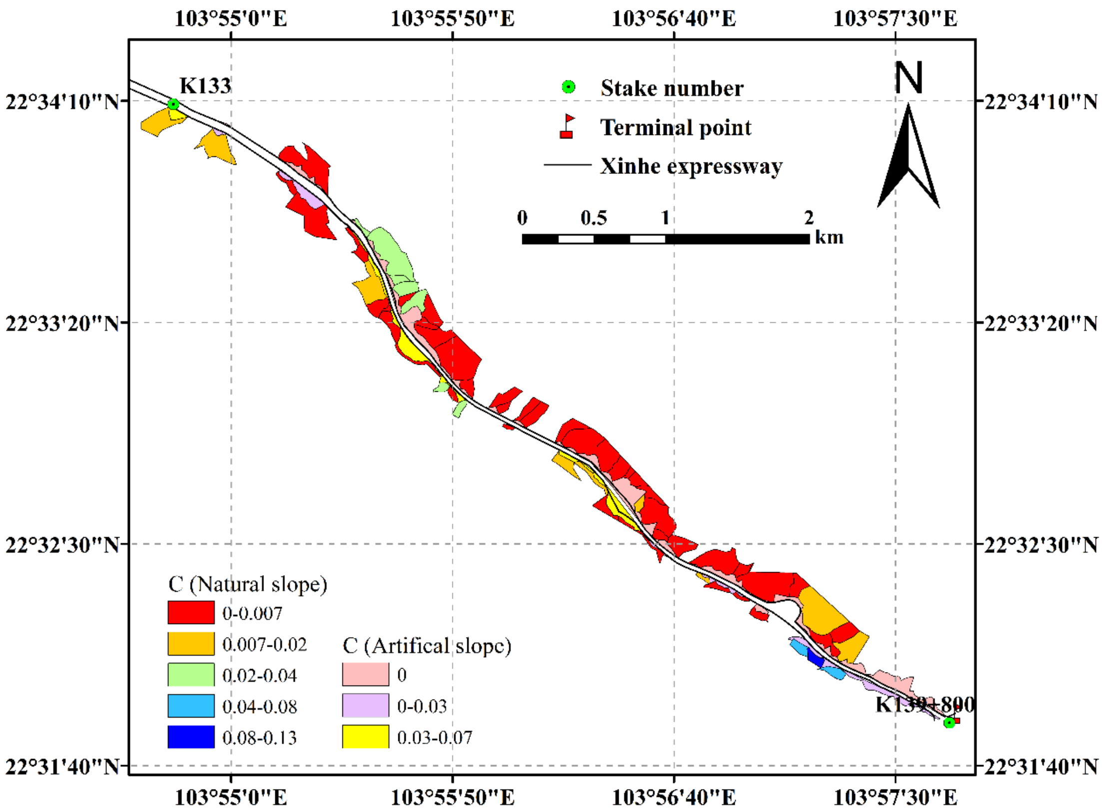


Figure 9. Spatial distribution map of the cover and management practice factor

Comment 13:

figure 17 and 18: delete in both the blue arrows, while adding (a) and (b), so they can be 17(a) and 17(b), 18(a) and 18(b), change the captions and in the text accordingly;

Response 13:

We are in complete agreement with your comment. We have followed your advice to revise it. Details are in the following paragraph and manuscript.

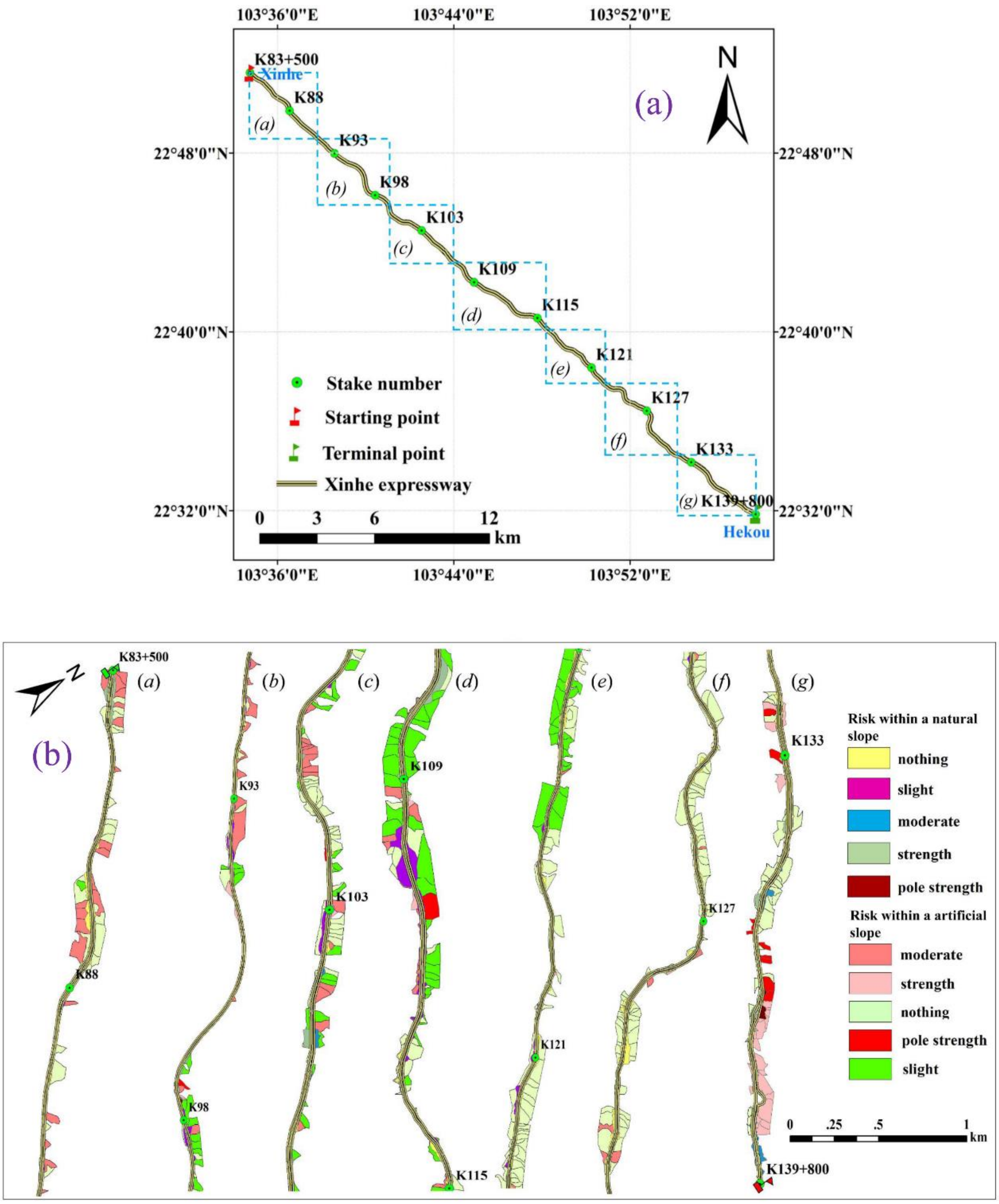


Figure 17(a)(b). Risk analysis of soil loss under 20-year return period rainfall conditions

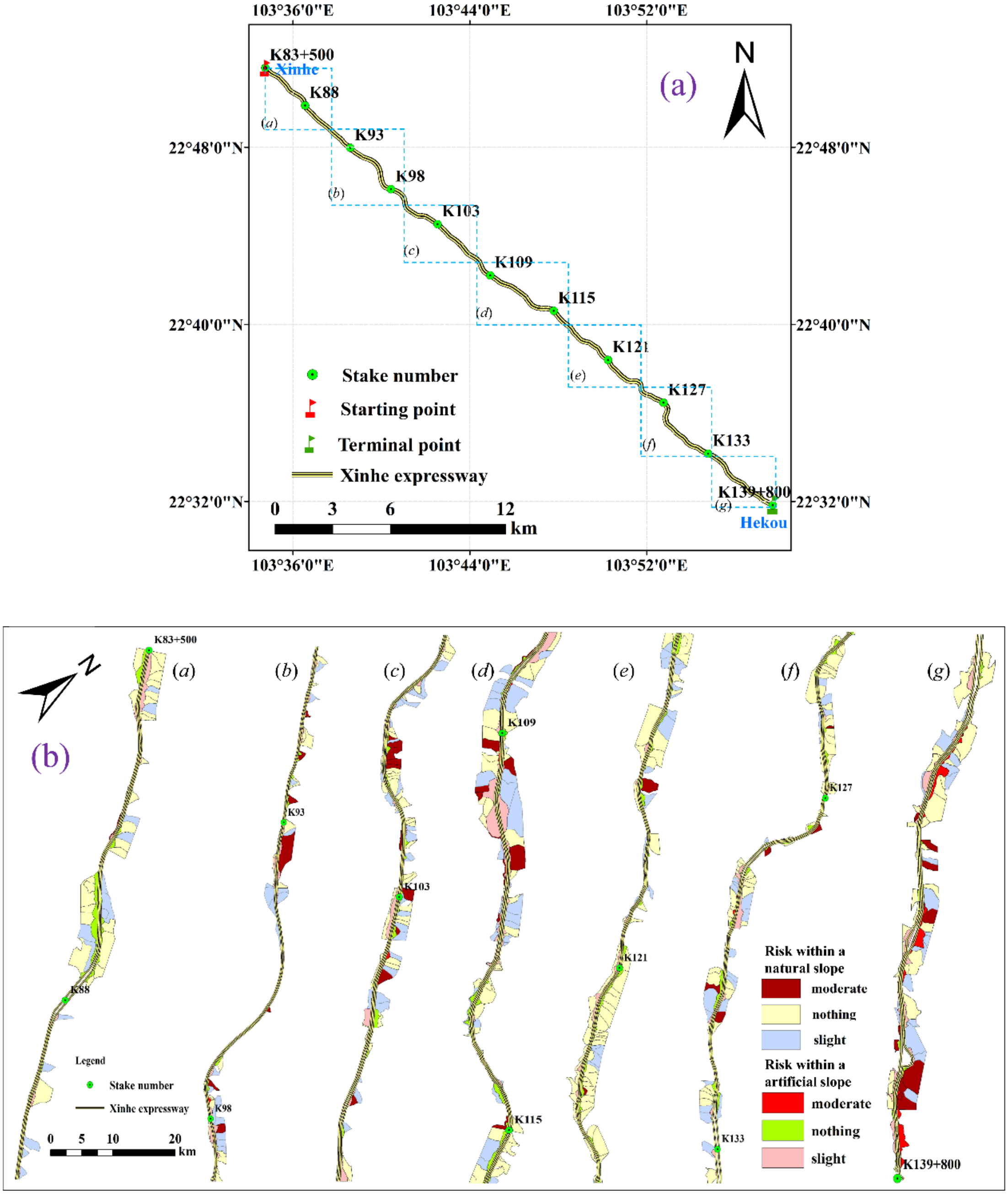


Figure 18(a)(b). Risk analysis of soil and water loss for the 1-year return period rainfall amount