Comment 1

The ms describes a new and valuable approach to estimating topsoil erosion and the associated carbon sink for the Loess Plateau area. My substantive comment is that the error figures for the erosion estimates are not justified. There are presumably errors associated with the regression equations, with the interpretation of spatial sampling, with scaling the slope estimates and perhaps others. It would be helpful to run the reader through how the estimates were obtained.
an error on p8, l 2 - presumable 'square root of slope length...'

Reply:

(1) The ms describes a new and valuable approach to estimating topsoil erosion and the associated carbon sink for the Loess Plateau area. My substantive comment is that the error figures for the erosion estimates are not justified. There are presumably errors associated with the regression equations, with the interpretation of spatial sampling, with scaling the slope estimates and perhaps others. It would be helpful to run the reader through how the estimates were obtained.

We appreciate this comments which indeed points to a crucial component of our analysis. In the revised manuscript we have now included a section describing how we estimated the uncertainties on our calculations. Below we give a short overview as to how the uncertainties discussed by the reviewer are dealt with: these procedures are now also described in the manuscript (see section 2.3 of the MS)

- Spatial sampling: we used the plot data as a sample to estimate the mean (and variance) of a given subsample of land, such as land under permanent vegetation and grassland. For arable land the procedure was somewhat more complicated: here we used the measured plot values *for given slope gradient class* to calculate a mean and a variance.
- Spatial sampling: we used the information obtained from the GEps to estimate variances of slope length and the proportion of land terraced. Again we simply used the observed mean and variance from the subsample we sampled. As the latter is unbiased, these estimates should represent an unbiased estimate of the mean and variance for the whole population.

- The calculated variances for the plot data were subsequently used to estimate uncertainties for our area-wide estimates through a Monte Carlo simulation. We have attempted to clearly describe in the text how this was done.
- Gully proportion: we used observations from the GEps to calculate the uncertainty on the area that is gullied and used the observations in agricultural catchments to estimate the uncertainty on the ratio of erosion in gullies vs topsoil erosion.
- We used similar procedures to derive estimates of SOC mobilisation from erosion rates. Again we used measurements as reported in the literature to derive a mean and variance and used Monte Carlo simulations to assess the impacts of these uncertainties on the final result.

We do believe that the approach we adopted allows us to account for the most important error sources in our calculations. The outcomes are relatively robust because we focus on averages rather than predictions for individual cells/fields: this aggregation implies that the relative error load can be substantially reduced.

(2) an error on p8, l 2 - presumable 'square root of slope length...'

We have corrected the mistake in the revised manuscript (see P8 L63 of MS).

Comment 2

This paper estimates the soil erosion rate and erosion-induced carbon sink using a new approach, and distinguish the contribution from topsoil erosion, gully erosion and landslides. The role of conservation programs on reducing soil erosion is also assessed. Special comments: 1. The abstract is too long and needed to be simplified. Besides, as the soil erosion rate estimated in this paper is much lower than the results from previous studies, the difference of the methods and the progressiveness of this study should be clarified in the abstract. 2. The authors reported the soil erosion rate and topsoil mobilization with uncertainty. How is the uncertainty calculated? And what are the factors influencing the uncertainty? 3. The author calculated the erosion-induced carbon sink in CLP. What does the amount of this sink mean? I suggest comparing with erosion-induced carbon sink in other regions and other carbon sink like rock efflorescence. 4. Figure 2: The meaning of the x-axis is not clear.

Reply:

(1) The abstract is too long and needed to be simplified. Besides, as the soil erosion rate estimated in this paper is much lower than the results from previous studies, the difference of the methods and the progressiveness of this study should be clarified in the abstract.

We do agree with the reviewer that the abstract needed some revision but we felt we could keep the current length as (i) this is within the guidelines of the journal and (ii) our paper deals with various aspects of erosion on the CLP and these need to be addressed in the abstract. We have tried to clarify the abstract and have tried to incorporate the concerns of the reviewer.

(2) The authors reported the soil erosion rate and topsoil mobilization with uncertainty. How is the uncertainty calculated? And what are the factors influencing the uncertainty?

We kindly refer the reviewer to our response on the comment of reviewer 1 (see above) who asked a similar question.

(3) The author calculated the erosion-induced carbon sink in CLP. What does the amount of this sink mean? I suggest comparing with erosion-induced carbon sink in other regions and other carbon sink like rock efflorescence.

We thank the reviewer for this constructive comments on the comparison of our estimated erosion-induced carbon sink with other regions. We added one paragraph to compare our results about erosion-induced carbon sink on the CLP with other regions in the revised manuscript. As we estimated the maximum erosion-induced carbon sink on the CLP, the carbon sink strength critically depends on the erosion rate and carbon fraction in topsoil. In general, larger erosion rates and/or higher soil organic carbon contents will induce higher maximum erosion-induced carbon sink. We have now detailed these calculations more extensively and have added several statements specifying the limitations of our estimates.

We now have also included estimates of SOC mobilisation and the strength of the erosion-induced carbon sink on a per unit area basis and compare these estimates with those obtained by other researchers (see P19 L1-13 of MS)

(4) Figure 2: The meaning of the x-axis is not clear.

Figure 2 is the cumulative distribution of erosion rate on different land use measured from erosion plot. Therefore, the *x* axis is the cumulative probability of the distribution of erosion rate. We specified this in our revised manuscript.

References

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