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Earth Surface Dynamics Discussions

Interactive comment on "Influence of topography and human activity on erosion in Yunnan, SW China" *by* Amanda H. Schmidt et al.

Anonymous Referee #2

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This manuscript is generally well-written and it was interesting to read this work which highlights the influence of topographical and climatic factors, and human intervention on catchment-wide erosion rates measured using in-situ produced cosmogenic 10Be. In the paper, authors have attempted to evaluate the control of climate, topographic steepness (mean basin slope, mean basin relief and normalized channel steepness) and land use changes that had occurred over a period of 30 years from 1950 to 1980 in the Yunnan River basin of SW China. They have selected three catchments within this large river basin, which is characterized by different geomorphological settings, a significant gradient in the precipitation pattern from the upper part (north) to lower part (south) and a noteworthy increase in human disturbances from the north to the south. Erosion rates in this river basin have been measured in fluvial sediments sampled from 52 small catchments. These samples represent a large array of topographic setting,

different rainfall regimes and end member as well as mixed situations of land use types. Locations for the sampling sites have been perfectly selected, which complies with the main scope of the research. Topographic parameters in the river basin have been derived digitally with the aid of a digital elevation model. Following a wide statistical analysis, correlations between the measured erosion rates and topographic factors, land use types and mean annual precipitation have been deduced.

Even though the rainfall significantly varies from north to south of the river basin, a control of mean annual precipitation on erosion rates has not been detected in this landscape. Overall, they have found a correlation between the erosion rates and topographic factors and land use types for the entire river basin. Correlation between the topographic steepness and erosion rate is strong for the Yongchun catchment, which is situated in the north, and then it has decreased from the north-most catchment (minimally disturbed by the agriculture) to the south-most catchment (significantly disturbed by agriculture). They have found that in the south-most catchment (Nankai), there is no significant influence of topography on cosmogenic nuclide derived erosion rates suggesting that erosion in this catchment is mainly controlled by human perturbation since it is the highest disturbed catchment for agriculture. Further, they claim that cosmogenic nuclide derived erosion rates in small catchments within the Nankai catchment have increased up to 2.5 as a result of agricultural land use. Subsequently, the main conclusion of this research points to small catchments in the river that are under intensified agriculture erode sediments below the mixed layer of the landscape by exporting sediments to the fluvial system with low cosmogenic nuclide concentrations. However, they have not adequately discussed on how this mixed layer is developed within the landscape and then become homogenized in in-situ cosmogenic nuclides. This is the main theoretical outline of their finding, which should be highlighted. Nevertheless, they have not cited the relevant papers in the literature that discuss the same phenomenon in many landscapes elsewhere in the world. Even though their correlation analyses support this argument of sending sediments below the mixed layer, which is not connected to the field observations. Therefore, more explanations on catchment charac-

teristics and especially hillslope erosional mechanisms and how these sediments are derived below the mixed layer need to be presented to strengthen their argument.

I would like to give following three main suggestions to further enhance the quality of their manuscript.

1. Include additional information on In-situ produced cosmogenic nuclide method / Formation of mixed layer / Possibility of eroding sediments below the mixed layer in agricultural catchments referring to the literature.

Cosmogenic nuclide derived erosion rates have been used as background erosion rates even in the perturbed catchments because sediments are usually derived below the mixed layer in many landscapes worldwide. Presence of mixed layer in a few landscapes is documented in previous studies, thickness of this layer is considered as 50-100 cm in the tropics but can be up to 3–4 m (van Breemen and Buurman, 1998; Wielemaker, 1984). At steady state, the cosmogenic nuclide concentration of the mixed layer becomes equal to that of its surface (Brown et al., 1995; Granger et al., 1996). In situ produced cosmogenic homogeneity in this mixed layer was experimentally illustrated in many landscapes (Braucher et al., 2000, Small et al., 1999; Schaller et al., 2002b). Deriving of sediments below the mixed layer in perturbed catchments, and if so, possibility of estimating higher apparent erosion rates have also been discussed in previous studies (von Blanckenburg et al., 2004). Therefore, authors are advised to revisit the relevant literature since this paper is biased to the fact that sediments are eroded below the mixed layer in highly agricultural catchments.

2. Provide more catchment characteristics/ Erosional mechanisms.

Since the main aim of this manuscript is to show that cosmogenic-nuclide derived erosion rates in some small catchments are affected by recent changes in land use, it is important to present more field evidences to support this hypothesis. For example, it would be interesting if you are able to show that sediments in these disturbed catchments are now derived below the mixed layer either by sheet erosion or they are eroded

below the mixed layer via linear erosion (rills, gullies or landsliding). In the latter case, an appropriate portion of the catchment should be eroding under linear processes to increase the catchment-wide erosion rates in the perturbed catchment by a factor 2.5. This phenomenon has been revealed by Von Blanckenburf et al., 2004 using a simple model. It would be important for authors to elaborate the mechanisms of how the sediments with low cosmogenic nuclide concentrations are derived below the mixed layers in the agricultural catchments.

3. Provide details of Quaternary alluvial deposits.

Under geology, authors have simply mentioned that Yongchun and Nankai catchments are largely covered by Quaternary alluvial sediments. But, it has not been mentioned whether sediments are also derived or not from these Quaternary formations. If the catchments contain large quantities of recent sediments, there is a possibility of reworking these alluvial sediments from the storages to the river in addition to delivering sediments from hillslopes. If the sediment storage within the catchments is large and occurs for a longer period it does significantly affect the net cosmogenic concentration that you have measured in fluvial sediments. This is because sediments sampled from rivers (point bars, mid channel islands, river bed, etc.) should have accumulated additional cosmogenic nuclides by storing within the catchment. In contrast, there is a possibility for sediments to lose their concentration by radioactive decay during burial in alluvial deposits depending on their age. Therefore, if your sediments were not contaminated with sediments from alluvial storages, it is important to mention. This justification will build up the forcefulness of your subsequent analyses to evaluate how erosion rates are affected by topography, climate and land use.

Minor Comments P1, line 24 – What is the depth of tillage? It should be very deep if you argue that sediments are derived below the mixed layer by tillage. P 2, Line 2 – I don't think that the readers who are not much familiar in cosmogenic nuclide method will really understand what is meant by mixed layer. P2 Line 4 – this is not an assumption. Cosmogenic nuclide homogenization has been experimentally demonstrated in many

landscapes elsewhere. P2, Lines 31-32 Need more details about Quaternary alluvium P2, lines 33 and P3, line 24-25– Why the authors are concerned to know the relative distribution of quartz in the watershed. I don't think that geological map will provide this information. P 6, lines 1-2 – Not clear P6, line 29, Authors have used the term "long-term erosion rates" through the manuscript. I think this term is relative, hence may not be appropriate to use since they don't have any short-term erosion rate presented in the manuscript. For those who work on much longer time scales, cosmogenic nuclide-derived erosion rates seem to be short-term. Therefore, the term "cosmogenic nuclide-derived erosion rate" may be more appropriate than 'long-term erosion rate". P 8, line 13-15, This looks like an assumption. This fact can be justified using data/filed observation. P8, line 30, I think that these depth of the mixed layer should be garter than 30-60 cm. P9, line 4, For larger watershed, there are some other issues when the cosmogenic method is applied. Temporary storage of sediments in larger watershed has to be considered. P 13, Figure caption – (a), (b) and (c) should be capitalized P 21, Figure 07 has not been sufficiently discussed in the text

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