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Hydrology and Earth System Sciences Discussions

Interactive comment on "Influence of basin connectivity on sediment source, transport, and storage within the Mkabela Basin, South Africa" *by* J. R. Miller et al.

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General Comments

The primary question that is raised pertains to the extrapolation of the fingerprinting-mixing model results obtained for the upper subcatchment and upstream-most section of the middle subcatchment to other parts of the study area. Although clarification of this fact is required, we do not attempt to extrapolate the results of the mixing model to lower-subcatchment areas. Ideally, we would have performed the analysis on the downstream-most core, but financial constraints, particularly the costs of analyzing a

larger number of upland samples, inhibited our ability to do so. We suspect that the relative contributions of sediment from the defined sediment sources will change downstream to a limited degree as a result of (1) minor changes in the spatial distribution of primary soil and land-use types between the upper, middle, and lower subcatchments, (2) sediment storage within downstream reservoirs, and (3) differences in the relative percentage of runoff contributed to the channel from the upper, middle, and lower subcatchment areas. With regards to the latter, stable isotopic data (H, O), not presented in this paper, show that between 22 % and 75 % of the discharge in the channel near the coring site within the lower subcatchment is derived from basin areas located downstream of the reservoirs. Although we were unable to define statistical relations between event type or antecedent moisture conditions and percent contribution of flow from the downstream portion of the catchment, the isotopic data suggest that a non-negligible portion of the sediment is likely to be derived from downstream areas during at least some flows. However, while the relative percentages of sediment derived from each source may change along the channel, the primarily conclusions put forth in the paper are likely to apply to the entire catchment that was studied. These conclusions include (1) that fine-grained sediment within the wetlands and reservoirs are primarily derived from fine-grained lowland soils frequently used for vegetable plots and pastures, (2) that sand-sized sediment is geochemically distinct from sampled fine-grained sediment, and is predominantly derived from coarse-textured soils found on steep slopes, (3) that the coarser sand-sized particles are transported to and through the drainage system during relatively moderate to high magnitude runoff events, and (4) that the construction of a ditch through the upstream most wetland led to a significant and abrupt change in the source of sediment to all downstream areas of the drainage system.

Cu and Zn were used as a tracer to gain insights into the geomorphic connectivity of the entire drainage system that was studied with regards to the transport of sediment. Because these two elements are primarily associated with soil amendments used on vegetable fields concentrated in headwater areas, they presumably represent a trace that

can be used to assess the downstream movement of sediment through the drainage system. The observed similarities in elemental concentrations as a function of depth within cores from the upper subcatchment wetland, the middle subcatchment reservoir, and the lower subcatchment riparian wetland suggest that sediment was transported through the drainage system during runoff events. Thus, some degree of geomorphic connectivity must have existed. One cannot determine, however, the relative percentage of the sediment that was transported along the channel, or that was deposited within the reservoirs. This point will be clarified within the revised manuscript.

Specific Comments

We thank the reviewer for the provided comments and, with a few minor exceptions, will incorporate the suggestions into any revision that is developed. The comments pertaining to the figures were particularly helpful. The few exceptions that exist are discussed below.

P 10156: We believe that the definition and characterization of the process zones (as presented in Table 1) represent an outcome of the analysis and, therefore, should be presented in the results section. However, an attempt will be made to clarify the concept of a process zone within the methods section, and Fig. 2 will be deleted from the text. P 10157 L 8-28: In hind sight the section does appear out-of-place. Rather than move it to the introduction, we believe the section would be more effective if included within the discussion.

P 10168 L27: To reduce costs, it is standard practice to analyze only one sample for 226Ra (usually a sample at depth) to determine background levels of 210Pb. Certainly this can be described in the methods section. Note that the analysis was contracted out to Flett Analytical, a lab that specializes in 210Pb and 137Cs dating.

P10170 L19-29: Actually, both units are present on Figure 6. The statement regarding the mapped soil units will be clarified.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 10151, 2012.