Biogeosciences Discuss., 10, C5414–C5418, 2013
www.biogeosciences-discuss.net/10/C5414/2013/

Biogeosciences Discussions
Open Access

Interactive comment on "Long-term dynamics of buried organic carbon in colluvial soils" *by* Z. Wang et al.

Anonymous Referee #2

Received and published: 27 September 2013

Summary/General Comments

The manuscript submitted by Wang et al. describes the role of soil organic carbon (SOC) burial in colluvial soils and its potential influence on landscape-scale C budgets. The authors collected soil cores from three colluvial sites and used a combination of techniques to establish chronologies for the soil cores and also estimate the amount of buried SOC that may be susceptible to respiration over time. By comparing against properties of SOC from cores collected from reference sites (no-erosion) the authors concluded that colluvial SOC burial efficiency eventually reached about 17% by about 1000-1500 years post-burial. In general, the methods are appropriate and I believe that the conclusions are supported by the data (see, however, my comments below). Following the publication by [Van Oost et al., 2012], this work represents some of the

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

only insight into longer-term dynamics of buried SOC (by anthropogenic scandards). This has important implications for understanding landscape response to management practices over time periods relevant to development and expansion of agriculture. For this reason, I believe this work is suitable for eventual publication and will be of wide interest to the broader Biogeosciences audience.

Specific Comments

There are some assumptions in the methodology that I feel need additional discussion and detail; specifically:

Establishing sedimentation chronology by P profiles. The authors rely on P enrichment as a marker for the past 100 years owing to industrial development of P fertilizer. This approach seems to rely on the assumption that 1) no other form of P was ever used to support agriculture, and 2) P application always occurred in excess of agronomic demands – resulting in P buildup. While the assumption of excess P application is reasonable, it is very likely that pre-industrial P fertilizer (manure) has also been used and this makes the identification of the 1910 horizon much more speculative. This introduces additional uncertainty into sedimentation rates estimated via this method.

The authors state that 137Cs is employed as a marker for 1954. However, atmospheric testing of thermonuclear bombs continued (and increased) until the nuclear test ban treaty went into effect in late 1963. Atmospheric fallout from bomb testing is more generally regarded as a marker for 1963-1964. Sediment accumulation rates should be recalculated to reflect this. (Refer to [Ritchie and McHenry, 1990]).

The application of d13C values as a proxy for SOC quality is questionable. Firstly, at least some decomposition studies have shown the opposite to be true; i.e., d13C values decreased with decomposition (not increased as stated by the authors in this study). A classic example is shown by [Benner et al., 1987]. Second, the vegetation and cropping history of the study area includes a mixture of C3 (wheat, sugar beets) and C4 plants (maize) which have dramatically different bulk d13C values. Third differ-

BGD
10, C5414–C5418, 2013

ent plant tissues can exhibit slightly different d13C values (again, see [Benner et al., 1987] as an example) and colluvial SOC in deeper soil layers is likely comprised by a greater proportion of aboveground plant tissues than SOC from reference sites (which are more likely to reflect root-derived precursors). Given all of these factors, I do not think that bulk 13C values can be realistically employed as a proxy for SOC quality.

Were incubation experiments only performed on profiles with only a 50 yr. deposition history? If so, how might this influence interpretation of respiration rate results on BGE for soils with 1500 year deposition histories?

Minor Comments and Technical Corrections

Abstract needs information about timescales relevant to BGE in this study.

Line 111: was there no agriculture at this site prior to 1950?

Line 116: provide the depths to which cores were collected. How did you correct for compaction that typically occurs during core collection?

Line 117: provide more detail about core collection. What is a rammer? (hydraulic-driven probe?, hand driven?, other. . .?)

Line 119: mode details about reference sites are needed. Slope, upland contributing area, location coordinates (a study area figure would be helpful).

Line 129: more instrumentation, calibration, and standard-correction details are needed for d13C measurements.

Line 131: Was the HCl fumigation also performed on these samples?

Line 133: replace “methods” with “instruments”

Line 136: what was the mass of sample used?

Line 138: how was this amount of water determined? (based on mass?)

Line 146: if the samples were in air-tight jars, how could there be any water loss during

BGD
10, C5414–C5418, 2013

incubation?

Lines 153-157: see my comments above about P and 137Cs.

Line 167: replace “mode” with “made”

Lines 169-171: can’t you just report the instrument minimum detectable activity? Also, report this error.

Lines 181-182: report this error.

Line 197: to be accurate, 14C data only provide information about the age of C-fixation. Sedimentation age may be younger, but not older than the age suggested by 14C.

Line 224: it would be more accurate to state that you are quantifying the sensitivity of the uncertainty.

Line 251: provide references.

Lines 275: did you measure bulk density?

Lines 300-302: provide references.

Lines 305-306: provide data or a reference to support this.

Line 337: do you mean to say monotonically?

References:

Benner, R., M. L. Fogel, E. K. Sprague, and R. E. Hodson (1987), DEPLETION OF C-13 IN LIGNIN AND ITS IMPLICATIONS FOR STABLE CARBON ISOTOPE STUDIES, Nature, 329(6141), 708-710, doi:10.1038/329708a0.

Ritchie, J. C., and J. R. McHenry (1990), APPLICATION OF RADIOACTIVE FALLOUT CESIUM-137 FOR MEASURING SOIL-EROSION AND SEDIMENT ACCUMULATION RATES AND PATTERNS - A REVIEW, Journal of Environmental Quality, 19(2), 215-233.

Van Oost, K., G. Verstraeten, S. Doetterl, B. Notebaert, F. Wiaux, N. Broothaerts, and J. Six (2012), Legacy of human-induced C erosion and burial on soil-atmosphere C exchange, Proceedings of the National Academy of Sciences of the United States of America, 109(47), 19492-19497, doi:10.1073/pnas.1211162109.

Interactive comment on Biogeosciences Discuss., 10, 13719, 2013.