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Reply on RC2

Yutian Ke et al.

Author comment on "MOdern River archivEs of Particulate Organic Carbon: MOREPOC" by Yutian Ke et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2022-161-AC2, 2022

Dear Reviewer 2,

Thanks for the detailed comments and recommendations. We hope MOREPOC can benefit the Earth Science community, in particular, researchers interested in understanding OC-related Earth surface processes and carbon cycling at different time- and spatial scales. Now the compilation includes more data entries with 265 more radiocarbon activity ($\Delta^{14}C$) values, providing exciting observations.

We provide our reply to your comments below.

Data Comments

- A readme file with information on variables and units was added to the database and is now available on Zenodo too. Equations for parameter definition and conversion were included.
- These variable names were changed to a more intuitive term ("riv_na" to "bas_id", "bas_na" to "riv_id").
- Uncertainties were added for elemental and isotopic carbon values if available. “perc_poc_1sd”, ”d13C_1sd”, and ” D14C_1sd” columns were added to provide analytical uncertainties for POC content, $\delta^{13}C$ and $\Delta^{14}C$ data, respectively.
- We added extra fields to clarify which variable was given in which paper. The columns “para_m” and “para_c” were added to clarify the sources of parameters in MOREPOC v1.1: data entries of some parameters were directly taken from the cited references, while some were obtained through later calculations and conversions.
- As explained above, we added two columns to clarify the sources of the compiled data.

For references only reporting POC wt.% and concentration, we did use the two parameters to derive SPM concentration. Parameters obtained from this conversion were clarified.

- Format problems: We did not change “modern” to “0”, since some high ^{14}C activity data are because of the influence of the bomb carbon effect. As a consequence, we would like to have users decide how to use these values themselves. However, we changed the field name as suggested. For ‘values’ in data fields, we converted strings to a numeric format, and eliminated the use of brackets, points, commas, or empty spaces.
- Country information is now included in a new column “country”.

Article Comments

L21: We added a sentence on the role of alteration and degradation on fluvial POC goes during transport in terrestrial environment before entering the coastal environment and being buried in the ocean.

L24: We clarified this statement about the composition of biospheric OC. Riverine authigenic POC is now mentioned to partly explain the depleted ^{13}C signals in riverine POC (section 3.1).

L32: We now refer to the global POC_{bio} burial in the ocean, as well as to the oxidation of POC_{petro}. The terrestrial POC_{bio} burial can be up to around 70 MtC/yr considering an average burial efficiency of 30% to an input of ~110-230 MtC/yr (Blair and Aller, 2012; Burdige, 2005; Galy et al, 2015), while the oxidation of POC_{petro} in sedimentary rocks can contribute ~40-100 MtC/yr to atmospheric CO_2 (Petsch, 2014; Hilton and West, 2020).

L35: Rephrased.

L47-48: We highlighted that the input of aged biospheric OC from thawing permafrost is the major reason (Wild et al., 2019; Hilton et al., 2015). Besides, we extended the discussion on permafrost-derived fluvial POC in section 3 (in particular section 3.2) and figures 6 and 7.

L50-51: We agree that sediment dynamics and oxygen availability in marine environments are important factors (Blair and Aller, 2012). However, in this paragraph, we want to discuss how POC can be altered in terrestrial settings before entering the marine environment. We do emphasize the importance of sediment dynamics in the terrestrial environment due to the different tectonic settings.

L54: Reference added. Besides, we also added some clarification on how human activities influence erosion and on the resulting changes in the fluxes of sediments and associated POC.

L61-62: We added a sentence on the improvement of water quality datasets and increasingly sophisticated models of riverine carbon cycling as you suggested.

L65: We added more explanation for D14C and Fm14C in section 2.7.

L79: This is based on non-numeric string detection in value fields, categorical summarization, and extreme numbers detection. We were wrong here to use the term – statistical examinations, so we deleted this expression.

L155: We added explanations on why Al/Si ratio is an important parameter that is included in MOREPOC as follows:

"Lastly, if available, the aluminum-to-silicon mass ratio (Al/Si) is also provided in MOREPOC v1.1. This elemental ratio is an efficient proxy for the particle size of riverine sediment, allowing to characterize the particle size effect of sediments on POC loading in fluvial delivery (Galy et al., 2008b; Bouchez et al., 2011; Hilton et al., 2015). The mineralogy and particle size of sediments are generally not totally independent of each other, coarse particles tend to be quartz-rich (low Al/Si ratios) and fine particles tend to be clay-rich (high Al/Si ratios) (Galy et al., 2008b). POC contents are usually positively correlated with proportions of fine-grained fractions (Mayer, 1994; Galy et al., 2008b; Bouchez et al., 2014)."

L158: We added this information "The MOREPOC database also indicates the lack of study

on POC in fluvial systems in high-latitude regions such as the Antarctic and Greenland, as well as in arid regions including Australia or vast areas spanning from northern Africa to middle east Asia (Figure 1)."

L178-179: We added this information: "Around the Qinghai-Tibet Plateau, where most large river systems in eastern and southern Asia share similar high-elevation headwaters, POC is usually characterized by relatively depleted ^{14}C signals due to strong erosion of sedimentary rocks, such as the Ganges-Brahmaputra (Galy et al., 2007) or the Changjiang (Wang et al., 2012; Wang et al., 2019), and to the erosion of soil, pre-aged OC, *e.g.* the Huanghe (Tao et al., 2015)."

L197: Net primary production does not show any clear relation with ^{14}C in fluvial POC nor with the relative abundance of biospheric OC. It is rather the erosion rate of the catchment which controls the flux of biospheric OC (Galy et al., 2015). We added additional explanations for this trend: "This might reflect the existence of major POC components: 1) for rivers dominated by POC_{bio}, the combined effects of increasing coverage of C4 plants towards tropical regions and the input of pre-aged OC_{bio} from C3-derived OC from degrading permafrost at high latitudes (Cerling et al., 1997; Still et al., 2003); 2) for rivers dominated by POC_{petro}, for example in mountainous regions, strong erosion of ^{13}C-enriched petrogenic OC (Hilton et al., 2010; Galy et al., 2007). In addition, in-river ("authigenic") POC production can be an important mechanism contributing ^{13}C-depleted and ^{14}C-enriched POC (Longworth et al., 2007; Marwick et al., 2015; Wu et al., 2018)."

Figure 2: We did not add different potential endmembers because we want users to interpret possible sources for fluvial POC.

L211: Potential explanations for this observation were added.

L216: This occurrence was not about carbon loading, we are sorry about the confusion caused. We were talking about the POC flux that is loaded in a specific SPM concentration. It is now clarified in the text.

L219: We added a figure as suggested, providing POC concentration vertical variation in the water column as obtained from depth profiles in large rivers. Selected depth profiles are from the Yukon (Holmes et al., 2022), Mackenzie including Peel and Arctic Red (Hilton et al., 2015), Amazon (Bouchez et al., 2014), and Ganges-Brahmaputra-Meghna systems (Galy et al., 2007, 2008b).

L221: We found this sentence was not correct under certain circumstances, so we reworded it to "Small SPM concentrations (less than 10 mg/L) are generally found in rivers in frozen seasons or rivers draining either high-latitude or tropical areas characterized by low-relief settings, in which POC content is relatively high (Gao et al., 2007; Holmes et al., 2022)."

L235: Added.

L244: Good point, we now refer to petrogenic OC mobilization. However, this paragraph is focused on the erosion of sediments and aims to explain the depleted ^{14}C nature of fluvial POC observed in some conditions. As a consequence, the role of oxidation of petrogenic OC is not mentioned in the text.