Response to Interactive comment on "SHORT COMMUNICATION: Massive Erosion in Monsoonal Central India Linked to Late Holocene Landcover Degradation" by Liviu Giosan et al. by Anonymous Referee

We thank the referee for his/her suggestions:

This manuscript presented the sediment flux and age offset (TOC radiocarbon age off- set relative to depositional age) records since the Holocene from a sediment core in the Bengal Fan. Combined with previous precipitation and ecology reconstructions based on pollen and leaf wax carbon isotopes of the same core, they suggested strengthened human activity on the Deccan Plateau increased soil erosion and the age of exported organic carbon, which were recorded in the offshore sediment proxies of sediment flux and age offset. In general, the data is very interesting and impressive, the paper is well written and thus I recommend it to be published in Earth Surface Dynamics. However, there are some serious issues, such as provenance, effect of sealevel change, and estimate of age offset, which are not clearly illustrated in current MS. Thus I suggest a major revision. My comments are as follows:

1. The discussion about the provenance is very unclear. The authors only provided a figure with final result of percent of Deccan contribution by Nd isotope. However, there are no details how they estimated. At least they should provide information about the Nd isotopes of two end-members they used in the estimation. Moreover, it's more common to use Sr-Nd isotopes set to constrain sediment provenance rather than only Nd isotope, which is not convincing. To my knowledge, they should first compare all the potential river sources including Bramaputra and Ganges, not only Godavari River. Although the first two rivers are relatively a little far from the study core, however, they still possibly delivered suspended sediment to the core and they have at least 20-times higher sediment flux than Godavari River. This means that any small changes in the relative contribution between these two end-members will significant change the Nd isotopes seen at the core. I really don't think that the increasing Nd isotopes must indicate the higher sediment flux from Deccan Plateau. If this is the case, any changes of proxies at the core not necessary related to environment changes in source region, but also possible links to the relative contribution of two different end-members in different rivers. I strongly suggest the authors add Sr isotopes and constrain the provenance tougher by more clear end-members. This is the basis of this study must be carefully revised.

Our response to this point:

1. Isotopic end-members have already been noted in text and Fig. 1. A simple two end member mixing model wss used and we add new info in the supplementary on that:

   "The average εNd for the Deccan basalts is +1 ± 5 and for the Indian craton is -35 ± 8 (GEOROC Database, Geochemistry of Rocks of the Oceans and Continents, Max Plank Institute for Chemsitry, Mainz, Germany, http://georoc.mpch-mainz.gwdg.de/). The measured εNd value of a sample was expressed as a simple mixture of sediment derived from the two end-members:

   $$\varepsilon\mathrm{Nd}_{\ Sample} = f \cdot \varepsilon\mathrm{Nd}_{\ Deccan} + (1-f) \cdot \varepsilon\mathrm{Nd}_{\ Craton}$$

   Where (f) is the fraction of Deccan derived sediments, ($1-f$) the fraction of Craton derived sediments in the mixture, and f is a number between 0 and 1. "

2. We understand that some would think that presenting combined Nd and Sr is needed as a rule but that is not the case, neither is the way the radiogenic fingeprinting method has been employed here. There are many radiogenic isotope tracers that can be used in certain conditions for fingerprinting sources (Nd, Sr, Pb, Hf,…). However in our clear-cut case where sediment sources are so distinct Nd suffices. Sr would add an un-needed layer of complexity and uncertainty as it is affected by weathering and non-conservative. Weathering may be sometimes ignored but in the Godavari system it may not.

3. Input from distant sources such as the Ganges and Brahmaputra as the referee suggests can be safely ignored because (a) to our knowledge the core we study is by design the closest-positioned continental margin core to any river mouth ever to be studied, receiving input directly from the plume; (b) sedimentation rates are extreme and any external component would be highly diluted; (c) studies show that suspended sediments from northern peninsular rivers do not reach as far south (e.g., Bejugam and Nayak, 2017); (d) assuming that by some unknown and extreme mechanism Ganges-Brahmaputra material would reach the site, the discharge from Ganges-Brahmaputra decreased drastically 7000 years ago (Goodbred et al, 2000), which would likely registered in εNd at our site or, if not, happened much earlier than the events we are addressing with our Nd measurements in late

Holocene; (f) other works using independent proxies show a late Holocene increase in Deccan input – see response to another comment.

2. The possible effect of sea-level change on sediment proxies was not discussed. Although I agree with the authors that increased human activity and decreased landcover would potentially increased erosion. However, on the timescale since about 11 ky, the influence of sea-level must be considered. In my view, the general decreasing or increasing trend of all proxies occurred since about 8-11 ky, rather than only since about 2ky. This cannot be ascribed to authigenic influence, which only became evident since about 2ky. The influence of sea-level on sediment flux may be indirectly through upper current or coastal current, which possibly changed the relative contribution from different river sources. Please consider more thoroughly.

The events we describe and are of interest to this paper take place from mid to late Holocene after sea level stabilization at a location where the shelf edge is unusually narrow. We do not understand what the reviewer means by “authigenic” (definition: of minerals and other materials formed in place). If he/she refers instead to “autogenic” the comment still remains obscure to us. However, we added the following to clarify:

“Offshore from the Godavari mouth, a persistent sediment plume extends over 300 km during the monsoon season when over 90% of the fluvial sediment is discharged (Sridhar et al., 2008). Because the shelf in front of the delta is unusually narrow (i.e., under 10 km at our core location) copious sediment deposition takes place directly on the continental slope, resulting in sediment accumulation rates as high as 250 cm/kyr; Ponton et al., 2012). Owing to the narrow shelf, changes in sea level would also have minimal effects on sediment deposition at our site, especially after early Holocene when the global sea level reached within a few meters of modern values (Lambeck et al., 2014).”

3. The estimation of age offset is not clear. For example, they applied a equation as “error offset= ((err. TOC 14C measurement)2+(max. err. Foram 14C measurement)2)1/2” . Why? Where is the reference? Why not directly use offset between ages of TOC 14C and Foram 14C?

We used the equation mentioned to calculate the error and not the offset. The offset was calculated as the reviewer describes: “The age of the bulk TOC at the time of their deposition was estimated by taking the offsets between their radiocarbon content and the interpolated reservoir-corrected foraminifera-based radiocarbon age”.

In addition, the supplementary table 1, 2, 3 wrongly wrote "yr" as "kyr". Table1, no errors provided for Nd isotopes. Table3, unclear for the captions of the age columns

We corrected kyr to yr.

The error of measuring Nd is already in the supplementary text.

In Table 3 but we made a modification that may help: instead of "14C age" we now use "TOC 14C age".

Refs:

Bejugam, P., Nayak G.N., 2017, Source and depositional processes of the surface sediments and their implications on productivity in recent past off Mahanadi to Pennar River mouths, western Bay of Bengal, Palaeogeography, Palaeoclimatology, Palaeoecology 483 (2017) 58–69

Goodbred Jr., S.L., Kuehl, S.A., 2000. Enormous Ganges–Brahmaputra sediment discharge during strengthened early Holocene monsoon. Geology 28, 1083–1086.

Lambeck, K., Rouby, H., Purcell, A., Sun, Y., and Sambradge, M., 2014, Sea level and global ice volumes from the Last Glacial Maximum to the Holocene, Proc. Natl. Acad. Sci. USA, 111, 15296–15303.