Precipitation stable isotopic signatures of tropical cyclones in Metropolitan Manila, Philippines show significant negative isotopic excursions

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Reply to reviewer's comments:

General Comments:

In this paper, Jackisch et al. use shifts in δ18O values over a period of 19 months to look for tropical cyclone (TCs) signals in precipitation. This length of records may not be enough for a robust baseline, but still shows some interesting results which can be useful to better understand tropical cyclones in Southeast Asia. Although the use of isotopes to reconstruct TC signals is not new, I believe that research studies like this help reinforce and learn more about patterns and the use of O isotopes in paleotempestology in different regions and at different latitudes. This study also strengthens the fact that we may still be a way from using O isotope depletion as a reliable (or individual) proxy for TCs. I think there may be a slight disconnect between this study and the use of O isotopes in paleotempestology. The authors discuss paleo reconstructions using isotope depletion (eg. Miller et al., 2006; Frappier et al. 2007) but then conclude "Based on our findings we conclude that the location of sample collection needs to be chosen strategically." When reconstructing paleo storms, researchers may not know or have geological evidence of precise movement and path of a TC. Making it potentially difficult to differentiate TCs from other precipitation events. See Oliva et al. (2017) for use of these proxies in plaeotempestology.

Response: Dear reviewer, thank you very much for your detailed and helpful review, which is very useful for improving our paper. We greatly appreciate your feedback and incorporated your comments and remarks into the manuscript.

Regarding your general comment, we thank you for highlighting the scientific significance and scientific contribution of our work. We agree with your remark that researchers may not know the precise path of a TC, but we do no think that our conclusion is a contradiction to this. However, such limitations are now included in the manuscript with reference to the work of Oliva et al. (2017) and we added the following at line 396: Nevertheless, it is important to consider possible limitations at the study site that arise in paleotempestology, such as sea level change or disruption of sedimentological records through floods or tsunamis. These need to be evaluated when comparing precipitation isotopes related to TCs with other proxy records such as speleothems and coastal deposits and when choosing the study area (Oliva et al., 2017).

At line 73 we added the reference of Oliva et al., 2017.

Specific Comments:

Line 43. Ensure this is still true, I believe it is widely accepted that there is likeliness in increase in intensity but not necessarily in frequency. See Woodruff et al. (2013)"At the end of the twenty-first century there will probably be fewer, but stronger, storms globally." Also see IPCC.

Line 52-56 Same as above. Also a graph or figure could be helpful to visualize this.

Response: Thank you, we rewrote this accordingly and changed it to the following two statements at line 42 and 52: Changing climate and associated warming of the surface ocean, will likely increase the intensity of tropical cyclones in the future (Emanuel, 2005; Webster and Holland, 2005; Woodruff et al., 2013). Eighty percent of the strongest typhoons making landfall in the Philippines over the last three decades developed during higher than average sea surface temperatures (SST), which supports evidence that TC intensities are projected to rise in the future due to an increase in global temperatures (Guan et al., 2018; Webster and Holland, 2005; Takagi and Esteban, 2016).

Section 2.1. This section does not describe the sampling sites, it describes the Philippines. I am more interested about details of sample locations. Section 2.2 talks about sampling at 14.654◦N, 121.068◦E- Were there any obstructions? Any other potential sources of contamination? Was it on a roof or at ground level? Near other potential sources of water?

Response: Thank you for indicating this, we have added more specific information at line 133 for readers to get a better understanding of the sampling site: The rain collection station was installed on the rooftop of the Marine Science Institute (14°39'02.5"N, 121°04'08.6"E), which is centrally situated in the campus and surrounded by trees and various green spaces. The rooftop location proved ideal for rainwater collection as it allowed for unobstructed access to rainwater without any potential sources of contamination.

Line 205. Figure 2 shows that all nine typhoons left distinct, or at least depleted isotope signatures. Why are they not all in the results? The way it is written, it seems like Rammasun and Kalmaegi, along maybe with Hagupit are the only ones to leave such a signature. You hint at the reason at Line 336 but the values should still be presented objectively in the results.

Response: Thank you for noticing this. The values are already presented in the result section with reference to figure 2. However, we have made it clearer and now show the isotope value in the text for each TC at lines 196, 197, 201 and 202. We further added the following section at line 202: The other TCs that occurred during the study period and were investigated by us were Mekkhala (Fig.2, point e, -10.77 ‰), Twelve (Fig.2, point g, -7.7 ‰) and Mujigae (Fig. 2, point h, -7.5 ‰).

Line 226. What were the values? 'relatively isotopically enriched' does not mean much.

Response: Thank you, we have added them correspondingly at line 226: As the Rammasun storm center tracked towards the northwest and away from Metropolitan Manila, our precipitation samples were relatively isotopically enriched for the following two days, namely -9.12 ‰ on 17 July and -6.26 ‰ on 18 July.

Line 301. I do not think you can consider these outliers, there are more of these values than ones associated to TCs.

Response: Thank you, this is correct. These outliers are not considered as they are not related to TC activities. We had identified these outliers as produced by convective precipitation events using IMERG satellite data.

Technical Corrections:

General comment. Author should review and ensure the use the units and symbols. For example, the authors use d◦m' at line 115 and dd.ddd◦at line 132.

Response: Thank you, we have revised it throughout the manuscript and made it uniform to d◦m'.

Line 35. A reference here would be helpful to support such a statement.

Response: We agree and have added Cinco et al., 2014 as reference.

Line 40. "Nine TCs per year made landfall on [...] Philippine waters is 19.4 per year." Consider revising wording, slightly confusing.

Response: Thank you, we changed it to the following: Nine TCs per year made landfall on average between 1951 to 2013 in the Philippines. The number of TCs not making landfall but reaching Philippine waters is substantially higher with 19.4 per year (Cinco et al., 2016).

Line 123. add year of census to population.

Response: Thank you for the suggestion, we have added the year of census at line 123: 101 million 2017 census

Line 134-137. I suggest removing commercial URLs. It is enough to say the Brand and model.

Response: Thank you, we have removed commercial URLs at line 134 and 137.

Line 149; 158 URL should be in reference list, not in-text.

Response: Thank you, we have removed these URLs from the text at line 149 and 158.

Lines 343 -347. I believe you mean r2 (not r), also should all be in presented the same way, not some in-text and some in parentheses. Section 4.4, and in general.

Response: Thank you for indicating this, we have made it uniform and now present these values in text and not in parentheses at line 343, 345, 346 and 347.

The discipline of using paleoarchives to reconstruct TC activity is called paleotempestology.

Response: Thank you, we have put more emphasis on this and properly mention paleotempestology several times throughout the text. We have added it at line 79, 396, 402 and 463.