Response Letter

We thank the reviewer for the insightful and constructive comments and corrections, which helped us to greatly improve the manuscript. We address their concerns point by point, and highlight implemented changes in the manuscript.

Comments with line number on the revised manuscript:

12 – remove “, homogenous” - I'm not sure that is true at any scale!

Response: We revised the sentence as follows:

“Badland landscapes formed in highly erodible substrates have the potential to respond to individual events on scales that are rapid enough for direct observation.”

17 – this sentence isn’t clear. Which dominates the weathering signal? Rephrase the second part.

Response: We removed the redundant sentence.

“Evaporite weathering at peak rainfall is succeeded by peak silicate weathering at maximum discharge.”

Equation 9 – “carb” instead of “crab”

Response: We corrected the typo.

207 – specify that the model used via Meandir

Response: We revised the sentence as follows:

“Table 1 Input end-members for the MEANDIR inversion model.”

367 – reporting the flux during the typhoon is not the same as the typhoon contributes to the silicate weathering flux – see discussion in Calmels et al., 2011, Earth & Planetary Science Letters. I would rephrase – the typhoon provides the mechanism to mobilise weathering products from the catchment. The timescale of precipitation to water flow is much too short to have silicate mineral dissolution, and so it is important to consider instead the role the typhoon plays in the hydrological mobilization of weathering products.

Response: We agree with this reviewer on this important point. So, we revised the sentence as follows:

“Our results show that the typhoon is responsible for mobilizing 16.8 ton/km^2/yr of dissolved solutes derived from silicate weathering during the course of the event, and this flux corresponds to 16.6% of the annual silicate weathering flux (Table S3).”

380 – again this is potentially misleading – silicate weathering at these magnitudes and rates cannot be happening during the typhoon which lasts hours? – flood events mobilise older water from catchments and move it to the outlet (e.g. Calmels et al., 2011), meaning a large proportion of solutes are not produced during the event

Response: We agree with this reviewer on this important point.

So, we revised the sentence as follows:

" We also observe a 10–18% loss in the individual concentrations of Ca, Na, Al, and Sr in the suspended sediment during the course of the typhoon event, whereas concentrations of Fe, K, Mg, and Mn increase by 3-10% (Table S6). The dissolution kinetics of silicate weathering are multiple orders of magnitude slower than carbonate or evaporite weathering (Meybeck, 1987), suggesting that significant weathering of fresh silicate minerals over the course of a single typhoon event is unlikely. Thus, the observed changes in ion concentrations during the event are likely to arise from heterogeneities in the bedrock composition or the input of previously weathered silicate minerals from a deeper groundwater reservoir (Calmels et al., 2011), which is different from groundwater source of baseflow during non-typhoon period. However, quantifying the role of a deeper groundwater inputs is difficult in the absence of isotope data."

381 – you cannot use sediment concentration data the way shown here to look at "loss" during weathering. See comment on Table S6 below. Please update appropriately.

Response: We agree with this reviewer on this important point.

So, we added other elements to table S6 and recalculate total loss of mobile element by Anderson et al (2002).

394 – what is the reduced mass ?– is this relating to Table S6 – if so see comment below.

Response: we revised the sentence as follows:

"We suggest that high suspended sediment concentrations, combined with high energy flow during the typhoon, caused increased silicate input from the weathered silicates in the suspended sediment, which has also been observed in typhoon-driven silicate chemical weathering from silicate minerals at surface (Meyer et. al., 2017)."

417 – what about the mechanical properties of these rocks and the fact that typhoons deliver very intense precipitation – I think these would overshadow these chemical effects?

Response: We agree that physical erosion caused by typhoon rainfall may exceed chemical erosion. Our focus is not to compare the magnitude of the two types of erosions. Rather, we highlight the significance of chemical erosion resulting from the dissolution of evaporites, which is often overlooked in mudstone regions. Several studies have demonstrated that the presence and distribution of evaporites on slopes can influence the development of gullies.

Figure S1 – please give approximate location of the images taken with reference to the map figure 1.
Response: We added the geographic reference of Figure S1 into the caption.
"Fig. S1. (a) Aerial view of mudstone badlands landscape taken from Guting (GT) Bridge (Figure 1)…."

Table S6 – Why is only Ca and Na concentrations on the solids provided? It would be useful to provide an overview of the sediment chemistry if it was measured with standards and quality control, as it is suggested it was measured by OES.
Response: We added other elements to table S6 as follows:
Table S6 the sediment chemistry of Guting Bridge.

duration	Ca	Na	Al	Fe	K	Mg	Mn	Ti	Sr
hr					μg/g				
5.5	10914	9981	78214	42084	23413	11294	524	4901	101
41.5	9833	8919	86454	48893	28034	13157	552	5319	99
Total loss, τ (%)	-17	-18	-17	7	10	7	3	-	-10

Second, and more importantly, this loss ratio is potentially misleading. Changes in solid concentration of an element could reflect relative loss of gain (as interpreted here). But it could also reflect i) heterogeneities in the bedrock composition, which could easily by >10%; ii) changes in the relative role of mineral grains – e.g. both Ca and Na could decrease while Al or Si increase, as the proportion of different dominant phases shifts. Therefore, with concentration alone, you cannot report a "loss" from the sediments. To do that, studies will often normalize the mobile element (Ca or Na) to an immobile element (e.g. Zr, Ti, or Al). See work by Brantley and co-workers at the Shale Hills CZO for a number of examples, and then please re-phrase.
We agree with this reviewer on this important point. We recalculate total loss of mobile element by Anderson et al (2002) which method was applied to Kim et al (2018). Notably, we do not use the parent rock as a reference when calculating the total loss, but the suspended sediment before the typhoon event as the reference. Given that the change in total loss less than ±20%, we agree that the differences should be due to parent rock heterogeneity or dissolution of weathered material. So, we revised the relevant sentence based on the statement.