Earth Surface Dynamics Discussions

Earth Surf. Dynam. Discuss., referee comment RC1
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Comment on esurf-2022-53

Anonymous Referee #1

Referee comment on "Mobile evaporite enhances the cycle of physical–chemical erosion in badlands" by Ci-Jian Yang et al., Earth Surf. Dynam. Discuss., https://doi.org/10.5194/esurf-2022-53-RC1, 2022

General Comments

Overall, I found the study interesting and well written. I think that a lot of work that needs to be done linking event-scale weathering to long-term dynamics, and this paper does a good job at bridging a knowledge gap. I particularly liked the idea that rapid dissolution of evaporites causes enhances physical weathering. To me, this seems a novel and important finding. One area, however, that I feel this study could improve upon is the discussion of the feedback between physical and chemical weathering. Throughout the paper, there were a several inconsistent descriptions of the mechanism driving enhanced chemical weathering. Clarifying this mechanism will enhance the overall impact of the paper.

Specific Comments

Lines 56-58 – This sentence is confusing. Do you mean that if you assume the mudstone is primarily comprised of silicate minerals then you expect the silicate weathering rate to co-vary with Na concentrations from evaporite weathering? Or do you mean that you expect concentrations of SiO2 and SSC to covary with Na?

Lines 64-65 – Here you say that you expect that Na enhanced physical erosion will enhance chemical weathering in the dry season by exposure of fresh silicate minerals. Wouldn't you expect new evaporite minerals to be re-precipitated in

the dry season at the surface? I understand that enhanced physical erosion in the wet season could expose fresh minerals in the dry season, but I suspect water throughput, not mineral availability is limiting in the dry season.

Lines 169, 181, 189 – I think the endmember values would be more helpful in a table.

Line 164 – More details on your use of MEADIR would be helpful. After reading through the methods, it looks like you are only using MEADIR to apportion Ca and Mg? It is a little confusing because you assign all of the Na that is not rain or evaporite to silicates, but then give a Ca/Na ratio for carbonates. It seems slightly contradictory, but maybe the math works out such that the Na from carbonates is negligible. Nonetheless, more explanation regarding the mixing model would assuage my worries.

Lines 155, 205- You wrote that SAR > 13 causes soil particles to repel each other, preventing the formation of soil aggregates. In the results and Fig. 2, SAR rarely goes above this threshold. Does this pose an issue for the interpretations that evaporite weathering enhances physical denudation through disaggregation/deflocculation?

Paragraph starting at Line 234- This section is talking about enrichment and dilution of different sources with time. I think this section would benefit of thinking about these enrichments and dilutions as a function of discharge. There are many papers that have looked at concentration-discharge behaviors during flood pulses. Discussion of how these findings compare to others would strengthen this analysis.

- Knapp, J. L., von Freyberg, J., Studer, B., Kiewiet, L., & Kirchner, J. W. (2020). Concentration–discharge relationships vary among hydrological events, reflecting differences in event characteristics. *Hydrology and Earth System Sciences*, *24*(5), 2561-2576.
- Moatar, F., Abbott, B. W., Minaudo, C., Curie, F., & Pinay, G. (2017). Elemental properties, hydrology, and biology interact to shape concentrationâ□□discharge curves for carbon, nutrients, sediment, and major ions. *Water Resources Research*, *53*(2), 1270-1287.

Line 262- the title of this section is evaporite dissolution over time, but you discuss carbonate and silicate weathering here as well. Consider re-naming this section to more accurately reflect its contents.

Lines 285- 287 - I thought that you already determined the mixing by MEANDIR. What is gained by also looking at mixing with Sr?

Fig. 5- I find this figure difficult to follow and it is not totally clear to me what new information the figure is conveying that is not already shown in Fig. 3a-c.

Line 338- Is this true? I thought that evaporite-derived solute fluxes were larger than the silicate-derived fluxes.

Lines 346-348- Your mixing calculations should tell you the proportion of Ca and Mg from carbonate and silicate weathering. It is unclear to me how the enriched ratio of carbonate Ca means that it is not a contributor to weathering fluxes.

Line 357 – I am a little lost here. Are you suggesting that increased erosion on the hillslope increases silicate weathering in the river channel via abrasion of sediments in the river channel?

Line 365 – Your flux is comparable in what way? Same magnitude?

Lines 369-370 – I don't think this is true. In my experience, most global weathering calculations account for evaporite weathering.

Lines 411-412- Again, I do not think your data supports this. Table S3 shows that at baseflow, carbonate-, silicate-, and evaporite-derived fluxes are roughly equal and during the typhoon, silicate- and evaporite-derived fluxes are roughly equal.

Technical Comments

Line 9- "manifestations" is an awkward word choice, consider rewording

Line 49- "SW" needs to be defined. Intuitively this means "southwest", but its

better to define here and abbreviate after.

Line 62- I would add the total length of time here. "… a temporal resolution of 3-hours collected over XX hours."

Line 207- It might be good to define D50 in the methods for grain size.

Line 275- are the values in parentheses correlation coefficients?