**Review of "Sediment transport in Indian rivers high enough to impact satellite gravimetry" by Alexandra Klemme et al.**

The manuscript evaluates the potential impact of erosion on gravity changes measured by GRACE and GRACE Follow-on with the aim to better decipher mass redistribution due to hydrological processes from mass redistribution due to erosion. The study focuses on the Himalayan region and the catchments of the Ganges, Brahmaputra, Meghna and Indus rivers, where sediment discharge rates are amongst the highest on Earth and where hydrological processes are also active and responsible for most of the gravity variations. The work is centered on compiling all available information regarding sediment discharge rates in the area, converting them into "GRACE-like" signals (commonly expressed in equivalent water height) and comparing such effects to the actual GRACE observation. The authors eventually derive erosion-induced gravity effects that should be accounted for when interpreting GRACE time series in the region, especially when one wants to properly quantify groundwater depletion and other processes that redistribute water.

The topic is interesting and within the scope of Hydrology and Earth System Sciences. The paper is concise and well-written, the compilation of sediment discharge data represents significant work, but the method should be improved and the leading hypotheses of the work should be clarified because one could argue that no net sediment mass loss may exist at all in the studied area. These two aspects, method and hypotheses, are major weaknesses that the authors must address. I presently do not recommend the paper for publication but would be happy to review an improved version of the manuscript.

I will develop my comments below.

**Major comments**

*About the working hypothesis:*

Since the Himalayan orogenesis is still active, can one really expect to observe a net sediment loss in the area? The paper should clearly state whether the time scales considered in the study (GRACE times scales, i.e. 20 years) is appropriate to assume that only erosion processes are at work in the area, without any mass gain due to the orogenic process itself. All the processes are presented as continuous in time and studied in linear trends (gravity changes, sediment discharge). So in the same logic, there should exist in this region a continuous trend of mass increase sustained by the collision between the Indian and Eurasian plates. The study tacitly assumes that there is no equilibrium orogeny/erosion over the study period. That is a very strong hypothesis that must be extensively argued.

*About the method:*

P3 L69-70: I don't understand the separation in catchment fractions. I agree that it is important to spatialize the quantifications, especially given the rather high-resolution of the GRACE solutions you use, but the distinction agricultural vs mountain is not obvious and not explained in the text. Also what about the remaining area, are they just by-pass areas where no erosion/sedimentation occurs? The study would benefit from more elaborated spatialization methods, e.g. using the concept of topographic index, which quantifies if an area is prone to accumulate or loose materials (originally developed water). See eg

https://topotoolbox.wordpress.com/ and DEM such as SRTM to infer such a parameter and proceed with a potentially refined spatialisation of the study.
It would be eventually very interesting to assess the spatial distribution of sediments mass variations over the entire catchment, converted to the same spatial scale and units as the GRACE data. This would help to highlight the specific regions where effects of erosion must be accounted for when studying GRACE time series.

The modeling of erosion effect on the GRACE signal should be improved by accounting for seasonality. At page 7 line 121, the seasonality of sediment discharge is dismissed from the analysis. I found this decision a bit drastic, especially in light of the efforts you showed in the appendix to describe this seasonality. It is possible to redistribute the sediment discharge over the monsoon periods only, and proportionally to the change of EWH. Then how are the GRACE rates altered?

Still on this seasonality aspect, several hydrological models exist are often compared to GRACE. They often miss interannual features (1) but are usually performing well at seasonal time scales (2). I think these seasonal hydrological aspects must be investigated, because they will interfere significantly with sediment discharge. For instance:

- How are linear trends altered by such hydrological corrections?
- What are the seasonal residuals after such models have been removed and what would be the relative part of the sediment mass variation in these residuals?

Other questions may arise depending on how the residuals look.
(1) https://doi.org/10.1073/pnas.1704665115
(2) https://doi.org/10.5194/hess-21-821-2017

**Minor comments**
Table 1: the catchments areas in the first row don't add up in GBM and Total

P10 L174 and a few other places: Use "decrease/negative linear trend" or any other terms that is more explicit than "anomaly".

Following my first main comment about the time scale of the study: Ideally, the time needed for the eroded materials to travel from their sources to outside their catchment basin should also be taken into account, but this may go beyond the scope of the study.