Responses to the Reviewer 3:

► Comment 1 ***(General comment)***

There are a number of significant problems with this paper that would need to be addressed before it could be considered for publication, so I think it should be rejected in its current form.

a) Even if one believes that the sediment-delivery ratio is physically meaningful, rather than an artefact of the ways erosion rates have been analyzed historically (Parsons et al. doi: 10.1002/esp.1395), the fact that the paper considers them to be a good test of the modelled rates of erosion is highly problematic. There are common factors in the numerator and denominator of equation (12) that will lead to issues of spurious correlation. The “test” seems to be a comparison of whether the new model can fall somewhere within the bounds of the SDR estimated elsewhere, which is a target of over an order of magnitude. This target is missed in a non-negligible number of cases, and the text then turns to special pleading of why specific datasets are problematic. Either you believe your data or you don’t!

b) I do not see the rationale for the structure of the regression model in equation (3). There are many critiques in the literature of the structure of (R)USLE. Furthermore, this is not the same structure, as it is the product of powers of the original variables.

c) Although the “proposed model” has a better RMSE, it seems to have more bias than the other models, overpredicting lower values, and underpredicting higher ones.

d) The description of “data mining” to produce alternative model structures is minimal and wouldn’t allow the approach to be replicated. In the results, “meaningful parameters” are mentioned, but it is not clear what meaning they have. In particular, what is the physical meaning of “lowest elevation”?

The overall aim and rationale of the paper is vague. There seems to be an invaluable dataset underlying the paper that could be much better employed in estimated sediment fluxes in different locations.

Response ◄

We really appreciate the editor's and reviewer's effort in evaluating our manuscript. Your comments were extremely helpful in improving our paper. Following the editor's and reviewer's suggestions, we conducted thorough revision, and the point-by-point responses to each comment and suggestion are addressed below.

The major objectives of this study are

- Estimate the specific degradation of South Korean rivers and reservoirs
- Developing an empirical model for specific degradation using recent and large amount of data (entire sediment data in South Korea)
- Evaluating the proposed model through geospatial analysis considering resolution effects; SDR is additionally used for evaluating the suggested model

(Conclusion) The suggested methodologies could be utilized for erosion and sediment management to understand the mechanisms of these processes in South Korea.

River managers and geomorphologists should use an efficient and simple method for predicting sediment load. We consider that the suggested models could be useful for South Korean rivers. It could be used for sustainable erosion and sediment management (for gauged watershed). The proposed model could also be used to predict a specific degradation in ungauged watershed in South Korea.

To predict the sediment discharge for ungauged watershed, the method applied in South Korea can be classified into four methods: 1) River sediment data (FD-SRC), 2) Reservoir surveys (sediment deposition), 3) Empirical methods, and 4) sediment discharge at nearby watershed (similar watershed characteristics). Additionally, RUSLE results are occasionally used, when the data for above methods are not available. This study is a comprehensive study involving five methods.

We partly agree with your opinion that considering SDR as a good test could be problematic. However, it is difficult to get data of sediment discharge at the ungauged watershed. However, data of watershed characteristics (could also use for RUSLE) are available.

Furthermore, as the watershed area affects the shapes of the curves of flow duration, water and sediment discharge, it can provide a first approximation for erosion and sedimentation processes.

These methodologies could be considered an evaluation method of the empirical catchment model for the ungauged watershed.

b) The structure of equation (3) is the most common form of empirical regression model for sediment discharge. (Kang et al., 2019 and 2021 represented many existing regression models, most of them were developed using this form).

Although there are many critiques in the literature regarding the structure of (R)USLE, it has been widely used worldwide to estimate annual soil erosion from hill slope and gross erosion for sediment yield. In terms of terminology of "RUSLE structure," the response for the Comment 9 from Reviewer 1 would be sufficient.

c) We have a different opinion regarding your review that the proposed model have more bias than other models. The existing model which was developed in the previous study (Kang et al., 2019) provided good predictability. It was developed with only 28 SD values for rivers. The existing model exhibited optimal performance for the SD of streams (in mountainous watershed). The proposed model could also provide better accuracy for predicting upstream SD values of the reservoir. In figure 4 (a) and (b), the predicted SD for stream (blue) from the proposed model is higher than the predicted SD for stream from the existing model.

d) We will provide additional details about "data mining" process.

In terms of meaningful parameters, we have provided the reason why they are deemed "meaningful".

(1) drainage area, (2) mean annual precipitation

: They are the common parameters which are used in the empirical model of specific degradation.

(3) percent urbanized area, (4) percent water, (5) percent wetland and water

: We provided the details through the geospatial analysis.

(6) percent sand at effective soil depths of 0–10 cm, (7) slope of the hypsometric curve, and

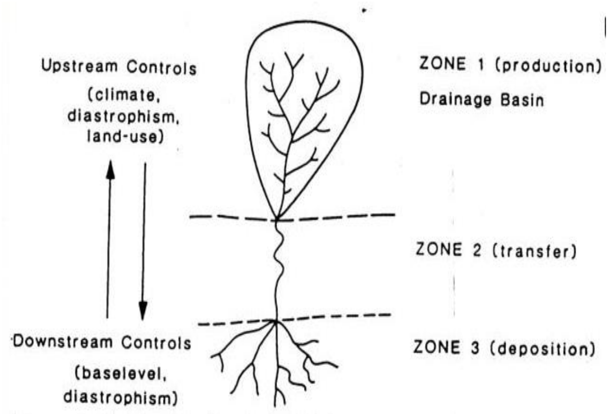
: In the previous study, we explained the reason why they are considered meaningful parameters. We will briefly introduce them in the revised manuscript.

(8) watershed minimum elevation ("Low elevation")

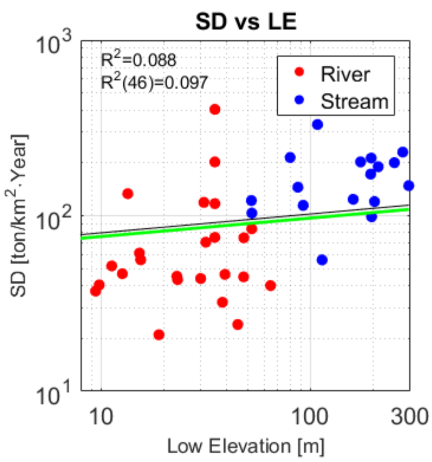
: The fluvial system can be conceptually classified into three zones (Fig. (a)). Zone 1 represents the erosional zone in upland areas with sediment production into steep bed streams and rivers. Mountain streams flow rapidly through steep slopes in a V-shape valley. In the case of South Korean rivers, numerous upstream mountain headwaters flow directly into bedrock streams. Zone 2 represents a transport zone of water and sediment with long sand-bed river. This study primarily focuses on Zones 1 and 2, and most channels in Zone 1 can be considered as streams and those in Zone 2 can be considered as rivers. The geospatial analysis all delineates it well.

In every watershed, the gauging station, which is the outlet of the watershed, is located at the watershed minimum elevation. Although some gauging stations are in transfer zone between Zones 1 and 2, the low elevations efficiently classified the rivers and streams (Fig. (b)).

We will add this description in the revised manuscript.



(a)



(b)

Overall, the revised paper will clearly provide the objective of this paper.