

### Summary of author's response:

In response, to **reviewers 1 and 3** comments related to the novelty of using ANN and previous work using ANN to predict river bedload, we expanded the literature review to more clearly articulated the reasoning behind the choice of an ANN approach and previous applications of ANN to bedload transport. (Lines 115-175).

In response to **reviewer 2**, we expanded the introduction to more thoroughly review previous efforts to reliably predict bedload transport (Lines 15-70). We also emphasize then known sources of variability related to bedload transport measurements, including but not limited to sediment supply, variability in erosion thresholds, and spatially variable flow (Lines 45-65). Additionally, we cite the reviewer's suggested publications where appropriate throughout the manuscript.

We corrected the grain size input data from BedloadWeb and re-trained and tested the ANN, updating all figures and values associated with model output, where those values changed (throughout the manuscript). We also provided additional information regarding the nature of the model input data (e.g. grain size fractions from direct measurements vs. interpolation methods) in Lines 190-200. We also provide additional details related to the preparation and screening processes for the test data (Lines 210-215).

We've added text to clarify that the aim of inter-model comparison is to demonstrate the utility of ANN performance when no site-specific calibration data is available. We clarify that our aim is only to place the ANN performance into context rather than evaluate any existing model (Lines 250-260).

We also expand our discussion of the robust performance of the trained ANN relative to other models in the context of the known variability in bedload transport rates both in space and time, a concern raised by **reviewer 2** (Lines 635-645). Rather than focusing specifically on sediment supply (the main source of variability as cited by the reviewer) we broaden this discussion to encompass any potential source of variability as also described in our expanded introduction (Lines 45-65)

To address questions from **reviewer 4** regarding the potential for model overfitting, we expanded the error analysis that we performed and describe the range of ANN model errors relative to measured variability in the original dataset (Lines 340-365). We also incorporated additional error analysis for all presented models to better weight under and over-predictions by different approaches (throughout results).

We also added the suggested citations from **reviewer 4** throughout the manuscript where relevant. Further, following the suggestion of the reviewer we have posted the trained model and a step-by-step introductory script on Zenodo under a GNU General Public License at <https://zenodo.org/record/7641313#.Y-vfbezMleY>.

