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Interactive comment on "Bedload transport controls intra-event bedrock erosion" *by* A. R. Beer and J. M. Turowski

Anonymous Referee #1

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In this article the authors compare the predictions of an extensive list of incision models to the measurement of the bedrock erosion rate in a mountain stream during a flood event. The results show that models including the tools effect are much better suited to describe the time evolution of bedrock erosion. The approach is interesting in the systematic comparison of models to a measurement at the scale of one event, and the paper deserves to be published in Earth Surface Dynamics.

In some cases, the presentation of methods and results lacks clarity (see detailed comments below). Indeed, it is sometimes hard to follow between the many model classes, model names, studied periods, exponent values..., and the main conclusions are not always easy to identify. In section 3, the variables that are directly measured on site, or extrapolated from various assomptions, should be more clearly listed (a table

would be appreciated).

I also regret that the actual value of the erosion rate (that is, the parameter K) is not discussed throughout the paper. Though the relative influence of the 4 different parameters is certainly of importance, an accurate prediction of E would also be strong criterion to discriminate between models (in particular, the time-integrated prediction of models with no tools effect could differ more significantly from measurements).

Below are some more detailed remarks or questions about the article:

Section 1

p55 l26: "the suspension effect term regulates the fraction of particles in suspension": what does "regulates" mean here? Is S_e equal to this fraction, or how does it depend on it?

Section 2

For sake of self-completeness of the article, it would be easier for the reader if a few more words were added about the studied stream (typical width, slope, pebble size...).

p57 l18: the sentence "can be determined to 1kg" is not clear to me.

p57 l24: it does not seem relevant to give 3 significant figures for the peak discharge if the expected uncertainty is 15%.

Section 3

p58 l18: since H_y is said to be the "hydraulic parameter", it sounds weird to see it listed amongst the "sediment effects", even if it can include motion threshold.

p59 l1: "as representative of other members..." would be lighter.

p59 l16-17: the units of the bedload transport rate and discharge are incorrect. Shouldn't the unit stream power be expressed directly in W.mˆ{-2}?

l.18: Shields take a capital S. The Shields number should be quickly defined.

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p 59 l20 to 22: I do not understand that l20 the authors "focus on continuous bedload" but shorty after that they "focus on transient behaviour".

Section 4

In figure 1, is the grey region "bedload transport" an observation or the outcome of a model?

p60 l16: "wavy" pattern does not sound very precise.

p60 l18-22: this paragraph about the threshold of motion is not very clear.

p60 l26: how is the value of S_e obtained?

p61 l 4-5: the sentence "there was negligible time of full bed cover..." does not sound clear to me.

Section 5

p63 l28: "the ratio of active over critical shear stress": I think that this is the parameter that is commonly defined as the transport stage. It would be clearer to define it explicitly by an equation.

p64 l10-15: it seems normal that the cover effect has no influence in the measurement over a short event and a localized spot. Since the erosion rate is normalized to 1, only the influence of the time variations of F_e (and not the value of F_e itself) can be assessed. Since F_e appears to vary over a rather narrow range during the event, the extracted value for the exponent c is certainly dubious. Therefore it seems too bold to conclude that there is "an absence of the cover effect". This could be discussed more extensively.

p64 l20: according to table 2, in the TO model optimized for "the erosion period" the erosion rate scales as Qsˆ{1.9} rather than Qsˆ1. This nonlinearity is of potential interest, since it would increase the influence of large hydraulic events on bedrock incision; this could be discussed, even if the results presented here are for the "long

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period".

Appendix A

In the list of all model classes, it would be clearer to state for each of them the common form of equation (1).

p68 l7 not all four terms are between brackets

p68 l18 "...were based on the following reasons..."

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