Earth Surf. Dynam. Discuss., 3, C308–C309, 2015
www.earth-surf-dynam-discuss.net/3/C308/2015/

ESurfD

3, C308–C309, 2015

Interactive Comment

Interactive comment on "Experimental migration of knickpoints: influence of style of base-level fall and bed lithology" *by* J.-L. Grimaud et al.

J.-L. Grimaud et al.

jgrimaud@umn.edu

Received and published: 16 September 2015

We agree that quantifying background erosion is a requirement for understanding processes within the flume as well as upscaling the results. The term 'clear water' refers to water that has a bedload of around qs $\sim$ 3 g. min-1. We postulated in the manuscript that this amount provides the tools for a minimum erosion rate; in the current version of the paper this has not been quantified. We thank the referee for giving us the opportunity to clarify this point.

Looking at Fig. 4a, one can see the evolution in our experimental flume between 105 and 130 min. During this phase, no knickpoint is observed and the bedrock is eroded up to 10mm in the downstream part and about 5 mm in the upstream part. The erosion in this case is triggered by clear water and thus we can use these observations to estimate local incision rates between 0.4 and 0.2 mm.min-1. Because downstream bedload is increased by remobilization of the alluvium in the flume, we suggest that the upstream 0.2 mm.min-1 is the most realistic assessment of this background erosion rate.

In comparison, the erosion rate associated to knickpoint retreat, calculated after 10 minutes, is $\sim$ 1.5 mm.min-1, i.e. almost an order of magnitude higher than the 'background' rate. The corresponding bedload calculated over this 10 minute time period is $\sim$ 30 g. min-1. To first order, these results seem coherent, i.e. erosion rate increases by roughly the same factor as bedload. One has to keep in mind, however, that loads are local and that, after the plunge pool forms, most sediments cover the bedrock surface, preventing further erosion. Also, one key aspect for a correct upscaling is to quantify the bedload vs suspended load during knickpoint propagation. The difficulty here is that, at this point, it is still unclear how much of the sand is in suspension in the plunge pool.

Finally, we did observe variation of knickpoint retreat rate, i.e. retreat rates increased in the first portion ($\sim$100 mm) of the flume, reached a maximum in the middle, and then, with further upstream movement, decreased or remained steady. We relate the former to the carving of the plunge pool (p. 784, line 28), and believe that the associated increase in sediment production (e.g. Bennett et al., 2000) is a consequence and not the cause of this deepening. In general, we found that the knickpoint retreat in the flume is responsible for bedload increase only at the plunge pool, as opposed to the studies of Jansen et al. (2011) and Cook et al. (2012), where additional bedload is transported from upstream. For this reason, it is not clear that knickpoint retreat speed has been affected by sediment evacuation from the bed during our experiments.

Interactive comment on Earth Surf. Dynam. Discuss., 3, 773, 2015.