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Earth Surface Dynamics Discussions

Interactive comment on "Statistical modelling of co-seismic knickpoint formation and river response to fault slip" *by* Philippe Steer et al.

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Steer et al. analyse how seismic fault slip translates into the formation of knickpoints along fault-crossing rivers. Combining a stochastic model of earthquakes, earthquake ruptures, and seismic and aseismic slip with a deterministic model of river profile evolution, they present a number of interesting simulation results that can be readily tested in the field or with digital elevation models.

Major comments

(1) I really like the comprehensive review of the existing body of literature on knickpoints in river profiles. This is a very helpful resource for anyone who works on this topic. Yet, this entails that the manuscript is quite lengthy at times. I do not consider this as a

significant weakness of the paper, however.

(2) The major part of the methods chapter is concerned with the seismic model. In comparison, the description of the fluvial model is rather terse. This imbalance is also reflected by the code that the authors make available on github. I think that this imbalance arises from the very simplistic treatment of fluvial processes. Please correct me if I am wrong, but isn't the profile just a linear transformation of cumulative slip along the fault? In other words: If knickpoint migration rate is constant in space, then the profile is a linearly scaled timeseries of cumulative slip. Now, constant knickpoint migration rates do make sense in this context, unless we are dealing with catchments of only a few square kilometers area. However, you are raising interesting points in the discussion that you could actually pick up in your study. In particular the nonlinear stream power incision model with exponents unequal to one would be interesting to tackle. Why? Because, if $n>1$ then knickpoints with larger step heights would travel faster, and potentially coalesce with smaller ones. Now if that is the case, then traces of smaller earthquakes are obliterated by larger ones. This would have severe implications for the inference of fault activity and earthquakes from knickpoints. I am not an expert in Lagrangian numerical models and meshfree simulations, but I guess that the nonlinear model should not be too hard to implement.

Overall, I found the paper a very interesting read. It provides an excellent overview on knickpoint migration and offers an innovative approach to modelling the interaction between fault activity and the fluvial system. However, I think that there is likely a lot to be learnt if running the simulations with the nonlinear stream power incision model, too, and encourage the authors to implement this model.

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