Earth Surf. Dynam. Discuss.,
doi:10.5194/esurf-2016-55-SC2, 2016

Earth Surface Dynamics Discussions

Interactive comment on "Assessment of structural sediment connectivity within catchments: insights from graph theory" *by* Étienne Cossart and Mathieu Fressard

R. J. P. Schmitt

schmittrjp@gmail.com

Received and published: 15 November 2016

Sediment connectivity poses a great potential to understand the connected functioning of sediment cascades at various scales. The paper "Assessment of structural sediment connectivity within catchments: insights from graph theory" by Cossart and Fressard provides a potentially valuable contribution to that field by deriving new, bi-directional indicators of structural landscape sediment connectivity. However, I suggest to revise the framing of the article, especially in the abstract, add some relevant references, and clarify some parts of the methodology in order to better support the scientific contribution.

Regarding the framing, the research question and/or the objective of this study are

not very clear. It would help if the authors would point out one key result and how it helped to answer the research question. This is because otherwise some results seem trivial, e.g., that nodes that are closer to the outlet are better connected or that better connected areas can translate change faster to the outlet (see paragraph 20).

The paper provides a good review on literature to provide justification, pointing out works by, .e.g., Walling, Fryirs and Brierley, and Bracken et al. [5] that clarify how connectivity can be a valuable concept to understand complex sediment transfers in space and time and on the scale even arge basins. The authors claim that their article focusses on structural (i.e., as opposed to functional) connectivity. However, recent years saw many models published that allow to study also functional connectivity on the scale of large networks [1,2,3,4]. It would be of great value if the authors would try to put their article in relation to these approaches, either in the introduction or the discussion. It is a common feature for [1 -4] that these models derive local process-rates from empirical formulations and apply them in a graph-based routing framework to derive network scale estimates of sediment connectivity and the functioning of network sediment cascades. This has been used to study both the complex timing [2-4], and the spatial patterns of sediment connectivity [1] which emerges from sediment transport along multiple sediment cascades in a river network. The authors do, indeed, use a virtual sediment volume and a homogenous scaling of edges for the sake of this numerical demonstration. It would be interesting (and help the reader to put the article in the perspective of other state-of-the-art literature) if the author could comment on how and if that virtual volume and the edge-scaling could be coupled with afore mentioned [1-4], process based estimates of connectivity.

With regard to methodology, it would be helpful if some information on the derivation of the graph could be given. Looking at Figure 6, the graph was presumably derived from the flow directions, that were derived from a DEM. It would help to state which type of input data where used and how they were processed, or make a clearer reference on where the data were derived from. Were the barriers that are shown in Figure 6 derived

from a DEM or was the graph manually modified ex-post in order to represent the barriers? Would it be possible to also represent a partial disconnection of a sediment cascade, i.e., that a sediment cascade is only partially is blocked?

Figure 6 would need a better legend that explains all the different types of symbols used on the map. Figure 6 C shows the reconnection of the Guyard catchment, but in this case it might be good to remove the barrier at the lower end of the Guyard catchment from the figure, or mark that it was locally breached. From Figure 5 it shows that the major part of the basin is glaciated. That should also show up in Figure 6. I assume that Figure 5 was taken from another article, or was the sediment cascade (right panel of Figure 5) derived for this article? In case it was taken from another article this should be mentioned in the caption of Figure 5.

[1] Schmitt, R.J.P., Bizzi, S., Castelletti, A., 2016. Tracking multiple sediment cascades at the river network scale identifies controls and emerging patterns of sediment connectivity. Water Resour. Res. 3941–3965. doi:10.1002/2015WR018097

[2] Czuba, J.A., Foufoula-Georgiou, E., 2015. Dynamic connectivity in a fluvial network for identifying hotspots of geomorphic change. Water Resour. Res. 51, 1401–1421. doi:10.1002/2014WR016139

[3] Gran, K.B., Czuba, J.A., 2015. Sediment pulse evolution and the role of network structure. Geomorphology. doi:10.1016/j.geomorph.2015.12.015

[4] Czuba, J.A., Foufoula-Georgiou, E., 2014. A network-based framework for identifying potential synchronizations and amplifications of sediment delivery in river basins. Water Resources Research 50, 3826–3851. doi:10.1002/2013WR014227

[5] Bracken, L.J., Turnbull, L., Wainwright, J., Bogaart, P., 2015. Sediment connectivity: a framework for understanding sediment transfer at multiple scales. Earth Surface Processes and Landforms 40, 177–188. doi:10.1002/esp.3635

Interactive comment on Earth Surf. Dynam. Discuss., doi:10.5194/esurf-2016-55, 2016.