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comment

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

Anonymous Referee #1

1   General Comments

This is an original and innovative paper; to my knowledge it is the first manuscript submitted to a peer-reviewed journal that describes the use of a network representation of sediment cascades derived from a geomorphological map, and its analysis using tools of graph theory. Such analysis has been suggested in the literature, and there are very few studies along these lines that have been presented at scientific meetings. The authors make use of a didactic example for the computation of graph theoretic centrality and accessibility measures, and develop a connectivity index that is based on the two measures. The approach is then applied to a case study of sediment cascades in a

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Discussion paper

catchment in the French Alps. The topic is highly interesting for the scientific community investigating sediment budgets, cascades and connectivity. However, I have several comments and concerns that should be addressed before the manuscript can be recommended for publication.

My major concerns are (1) The structure of the paper. It does not follow the 'normal' scheme; therefore, the introductory/review part and the development part plus the case study need to be better separated in my opinion. Graph theory, a central topic of this paper, is introduced in the state-of-the art section, together with the Borselli-Cavalli index in 2.1, and then more specifically with respect to undirected graphs in 2.2. Chapter 3 is termed "methods to assess structural connectivity" (Borselli's IC is one, right?), followed by specific analyses related to directed graphs in 3.1 and 3.2 before you propose your own index in 3.3. My suggestion would be to cut down on the review part and to write a more specific introduction to graph theoretical methods related to connectivity, both in the undirected and directed case. In my opinion, the analysis of potential flows goes beyond structural connectivity, and recent modelling studies using graphs as the 'spatial backbone' to model sediment fluxes through a catchment should be addressed, c.f. Rafael's comments. Generally, the graph theoretic measures such as centrality, accessibility etc. should be accompanied by references. The Borselli or Cavalli index could be described in the introduction to section 2, and with less detail unless more references to this index is made in the remaining text, for example by highlighting similarities and differences, or by discussing amendments to the proposed graph-theoretic index along the lines of parameters contained in the Borselli-Cavalli index. The main section could then be devoted to the development of 'your' index (and should be termed accordingly). (2) A poor linkage between the text, tables 1-3 and figures 1+2; this is evident in the flow index (Fig. 1C, Tab. 2) not being mentioned in the text, and in an error in Fig 1B (see specific comments). (3) The didactic example does not account for divergent flow; transferred to the real case study, I think it is doubtful whether a landscape element in the order of 100 m (the discretisation applied to the geomorphological map) can always be linked exclusively to one single downslope neighbour, thus

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producing a network that is entirely convergent. Consider, for example, a talus cone whose one half is connected to the channel network through undercutting, and the other is buffered through a fluvial terrace. Then there would have to be two linkages from the cone, one to the fluvial system and one 'dead end' on the terrace; a single linkage would suggest in your model that all the material is transferred to the fluvial system. This issue needs to be discussed, if not accounted for at least in the didactic example. In case you choose to stick to the network representation with exclusively convergent pathways, this assumption needs to be stated and discussed. (4) Finally, there are several English language issues that I feel need to be corrected because they obscure the points being made.

2 Specific Comments and Technical Corrections

I have added specific comments in the attached PDF document

Please also note the supplement to this comment:
http://www.earth-surf-dynam-discuss.net/esurf-2016-55/esurf-2016-55-RC1-supplement.pdf

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