Earth **Surface**
Dynamics
Discussions

ESurfD

Interactive
comment

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

Étienne Cossart and Mathieu Fressard

etienne.cossart@univ-lyon3.fr

Received and published: 18 November 2016

First of all, we would like to thank Mr. Rafael Schmitt for the precise comments he provided.

1/ Regarding the comments on the methodology:

The graph presented on figure 6 was actually derived automatically from the flow direction raster extracted from the national French DEM originally provided at 25m resolution. Then, the barriers were manually digitalized based on field surveys and geomorphological interpretation of stereoscopic aerial photographs.

The technical comments regarding figures 5 and 6 will be integrated. Figure 5 is indeed

redrawn (and slightly modified) from a former paper: Cossart (2016), as mentioned in the text. Nevertheless, it will be also mentioned in the legend. In figure 6 a legend of barriers, blankets and buffers will be drawn, while the connection at Guyard catchment outlet (figure 6C) will be suggested by a specific pattern.

These points will be expanded to provide more details in the revisited version of the paper.

2/ Many comments address the scientific contribution of this paper. As mentioned in the title, we seek at measuring the structural connectivity within sediment cascade. Of course we can mention the recent developments on functional connectivity in the state-of-art, and we thank Mr. Schmitt for suggesting the citation of recent papers. We would insist that the first step of this research is to document the role of spatial patterns of fluxes on the functioning of the sediment cascade. The main contribution is methodological: we develop new indices that seek to be less empiric than previous ones, to ensure their robustness and reproducibility. We aim at explaining in depth the calculations steps that lead to the indices: each step is detailed to make it fully reproducible by new authors. These indices are developed to compare various sediment cascades/catchments in both space and time. Here we demonstrate that the indices provide a good hierarchy of vertices. The hierarchy is not seen as a direct influence of the sediment discharge at the outlet, but an influence on the (dis)organization of the whole system. More specifically, the hierarchy exhibits how the vertices may imply a (dis)connection of many independent subcatchments, and how large are the subcatchments. To be more explicit, the structural connectivity of a vertex is proportional to the number of subcatchments that may be disconnected by the vertex disruption, and to the surface area of these subcatchments. The thematic results regarding geomorphic functioning of sediment cascade are not fully explored here since it would conduct to a too long paper. The example is developed as an illustration of indices robustness.

Enriching the discussion by a development on functional connectivity can be indeed fruitful. The structural connectivity, as discussed in this paper, depicts a "binary" spa-

tial organization of hydrological fluxes. Nevertheless, additional developments are still in progress to link structural and functional connectivity using graph theory. These developments will allow to reply the question of partially (dis)connected compartments of catchments. We assume that these are beyond the scope of this paper and that their integration would have been too long for a single article.

Lastly, we are sorry but, at this step, we are not convinced by a substantial modification of the abstract. Maybe we can rephrase the last sentence, reinforcing the idea that this paper is a methodological paper.

Sincerely,

Étienne Cossart and Mathieu Fressard

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