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Earth Surface Dynamics Discussions

Interactive comment on "Computing water flow through complex landscapes, Part 2: Finding hierarchies in depressions and morphological segmentations" *by* Richard Barnes et al.

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In the second part of their multipart paper, Barnes et al. describe data structures and algorithms to identify and organize internally drained basins in digital elevation models (DEMs). Their approach derives hierarchies of depressions and flow directions. Being a reviewer of the first part of this multipart paper (Callaghan and Wickert, 2019), I commented that water flow through complex terrain with internally drained basins could be tackled using a network of sinks. I am glad to see that the multipart paper develops into this direction, in particular, because the computational advantages are obvious.

Overall, the paper is very well written and organized. It is a very technical paper and

focuses on a thorough description of the developed algorithms. I have no major comments on the algorithms and software implementation. A minor issue is that I found the algorithms easier to understand when reading the captions of the figures. Perhaps, the extensive captions might be better placed in the main text.

My concern is that the paper may be too technical for the readership of ESURF. While I see that the authors are planning a third part that will highlight how the developed software can be used to accelerate hydrological models, I think that the paper would benefit from more illustrations/examples/interpretations of the output of these algorithms. How do sink networks differ between different regions (glacially sculpted low-land regions vs. dryland regions) or different DEMs? Illustrating potential geomorphological applications would be a nice addition to the paper and would considerably widen its readership.

Finally, the empirical tests are done on an high-performance computer. Why? As far as I understand, the code is not (yet) fully optimized for using parallel infrastructure. I wonder how timings of the algorithm would scale on "normal" desktop computer.

All in all, this paper presents an important advance in computational geomorphometry. A demonstration of the geomorphic applications of the developed algorithms would make it even stronger. Such demonstration might be substantial work. Thus, I recommend major revisions although the paper has a very high quality at this stage already.

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