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Hydrology and Earth System Sciences Discussions

Interactive comment on "A novel algorithm with heuristic information for extracting drainage networks from raster DEMs" *by* W. Yang et al.

S. Grimaldi

salvatore.grimaldi@unitus.it

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Authors described an interesting algorithm to define DEM flowdirection in flat areas. The topic is surely important and interesting.

In this short communication I am going to generally comment the paper without analyzing the manuscript as a reviewer.

The artifact DEM correction is a complex problem difficult to solve and the approaches described in literature can be grouped in the following three points:

1)flow direction definition in DEM without flat areas or pits; 2)flow direction definition in flat areas; 3)flat area and pit removal problem.

1) Literature is full of flowdirection methods and usually the main hypothesis is that the DEM is pit or flat areas free. There are single-flow methods (O'Callaghan & Mark, 1984; Jenson & Domingue, 1988; Fairfield & Leymarie, 1991; Costa-Cabral & Burges, 1994; Garbrecht & Martz, 1997a; Orlandini et al., 2003) and multi-flow methods (Freeman, 1991; Quinn et al., 1991; Lea, 1992; Costa-Cabral & Burges, 1994; Holmgren, 1994; Quinn et al., 1995; Tarboton, 1997; Pilesjo et al., 1998; Lindsay, 2003, Seibert & McGlynn, 2007) D8 is the common approach (implemented in ArcGIS) but can often provide wrong results (straight and parallel bluelines).

2) Concerning flow direction definition in flat areas the most common approach (implemented in ArcGIS) is described in Jenson & Domingue, 1988

3) Flat area and pit removal problem. This is a very important point. Pit and consequently flat areas, do not allow either to correctly define the flowdirection (causing straight and parallel bluelines) and to have a correct blueline altrimetric profile. This latter point is serious since the 5-10% of cells are usually affected by slope=0 value. There are some approaches available in literature...among others: Garbrecht & Martz (1997a,b) Grimaldi et al., 2007. In Nardi et. al 2008 a complete review and comparison among several methods are provided. One conclusion of this paper is that that effect of flat area removal approach overcomes the choice of the flowdirection method. If the analyst removes the flat areas he will have also a reasonable planimetric blueline representation.

Therefore, the general comment to the submitted manuscript: it is better to modify the DEM flat area elevation (in order to eliminate slope=0 cells) instead to propose a new flowdirection algorithm for flat areas.

In any case, I think that the paper could be of interest if Authors improve the manuscript adding:

- a better description of literature in the introduction; a better description of the problem to allow the reader to understand in which contest the proposed method can give an

added value; a better description of the method. A simple, didactic case study (just few cells) would help to understand it; a better description of the results:...comparing if possible the application of the proposed approach with and without the application of a flat removal method; a better description of results in any case....in the manuscript the comparison is done just visually while some useful indexes can be used (see Nardi et al. 2008 and Santini et al. 2009).

REFERENCES

O'Callaghan, J. F. & Mark, D. M. (1984) The extraction of drainage networks from digital elevation data. Comput. Vision Graphics Image Processing 28, 323–344.

Orlandini, S., Moretti, G., Franchini, M., Aldighieri, B. & Testa, B. (2003) Path-based methods for the determination of nondispersive drainage directions in grid-based digital elevation models. Water Resour. Res. 39(6), 1144. doi:10.1029/2002WR001639.

Jenson, S. K. & Domingue, J. O. (1988) Extracting topographic structure from digital elevation models. Photogramm. Eng. Remote Sensing 54, 1593–1600.

Fairfield, J. & Leymarie, P. (1991) Drainage networks from grid digital elevation models. Water Resour. Res. 27, 709–717.

Costa-Cabral, M. C. & Burges, S. J. (1994) Digital elevation model networks (DEMON): A model of flow over hillslopes for computation of contributing and dispersal areas. Water Resour. Res. 30(6), 1681–1692.

Garbrecht, J. & Martz, L. W. (1997a) The assignment of drainage direction over flat surfaces in raster digital elevation models. J. Hydrol 193, 204–213.

Garbrecht, J. & Martz, L. W. (1997b) TOPAZ: An automated digital landscape analysis tool for topographic evaluation, drainage identification, watershed segmentation and subcatchment parameterization. In: TOPAZ User Manual. ARS Publ. GRL 97-4, US Dept Agric., Agric. Res. Service, Grazinglands Research Laboratory, El Reno, Oklahoma, USA.

Freeman, T. G. (1991) Calculating catchment area with divergent flow based on a regular grid. Comput. Geosci. 17, 413–422.

Quinn, P., Beven K. J., Chevallier P. & Planchon, O. (1991) The prediction of hillslope flow paths for distributed hydrological modeling using digital terrain models. Hydrol. Processes 5, 59–79.

Lea, N. L. (1992) An aspect driven kinematic routing algorithm. In: Overland Flow: Hydraulics and Erosion Mechanics (ed. by A. J. Parsons & A. D. Abrahams), . Chapman & Hall, New York, USA.

Holmgren, P. (1994) Multiple flow direction algorithms for runoff modelling in grid based elevation models: an empirical evaluation. Hydrol. Processes 8, 327–334.

Quinn, P., Beven, K. J. & Lamb, R. (1995) The ln(a/tanB) index: how to calculate it and how to use it within the TOPMODEL framework. Hydrol. Processes 9, 161–182.

Tarboton, D. G. (1997) A new method for the determination of flow directions and upslope areas in grid digital elevation models. Water Resour. Res. 33, 309–319. Pilesjo, P., Zhou, Q. & Harrie, L. (1998) Estimating flow distribution over digital elevation models using a form-based algorithm. Geographic Information Sciences 4(1–2), 44–51.

Lindsay, J. B. (2003) A physically based model for calculating contributing area on hillslopes and along valley bottoms. Water Resour. Res. 39(12), 1332. doi:10.1029/2003WR002576.

Seibert, J. & B. L. McGlynn (2007) A new triangular multiple flow direction algorithm for computing upslope areas from gridded digital elevation models. Water Resour. Res. 43, W04501. doi:10.1029/2006WR005128

Grimaldi, S., Nardi,F., Di Benedetto, F., Istanbulluoglu, E. & Bras, R. L. (2007) A physically-based method for removing pits in digital elevation models. Adv. Water Resour. 30, 2151–2158.

Nardi F., S. Grimaldi, M. Santini, A. Petroselli and L. Ubertini “Hydrogeomorphic properties of simulated drainage patterns using digital elevation models: the flat area issue" Hydrological Science Journal, 53(6) December 2008.

Santini M., Grimaldi S., Rulli M.C., Petroselli A., Nardi F., “ Pre-Processing algorithms and landslide modelling on remotely sensed DEMs” Geomorphology, vol. 113, pages 110-125, doi: 10.1016/j.geomorph.2009.03.023 - 2009

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