

## ***Interactive comment on “Uncertainties associated with digital elevation models for hydrologic applications: a review” by S. Wechsler***

### **Anonymous Referee #2**

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Review of Uncertainties associated with digital elevation models for hydrologic applications: a review by S. Wechsler

Uncertainties in digital elevation models are an important issue and the authors provide a comprehensive review of the DEMs, uncertainty and hydrological applications. The author tries to cover a lot of issues. By doing so, I am afraid, the main issue, namely uncertainties in DEMs, gets a bit lost and important points are missing. I hope the comments below can help to improve the paper. With an improved structure and clearer messages the paper will make a useful contribution.

There is no clear discussion on what is meant by 'DEM error';, it would be good to

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distinguish, for between errors such as elevation errors (z-direction), positional errors (x and y directions) and errors due to too coarse resolution (topographic features not correctly represented).

Part 2 (DEM error) is central, but unfortunately just this chapter is quite short and important points are missing. This would be the place to discuss different measurement and computation techniques used to generate DEMs and what kind of errors (both source, size and spatial structure) are associated with these techniques. Honestly, this would be the key contribution I would have expected from the title of the paper. Unfortunately nowhere in the paper I could see, for instance, a number on how large errors might be.

"Knowledge about the spatial structure of error is an important component for gaining an understanding of where errors arise and uncertainty is propagated. Methods should accommodate detailed DEM error information when available, yet provide mechanisms for addressing uncertainty in the absence of this information. "(p. 2348, line 2ff)

I agree, this is really a key point. Users of DEMs need to understand the errors and their spatial structure. I agree that information of this kind is difficult to obtain for DEM users, but this is exactly why I would like to see this type of information here.

In part 3 different topographic indices are discussed. The point that there are different algorithms for most such indices is true, but I would say beyond the scope of this paper. This is a large issue on its own and there are more studies than those cited here which have looked on the effect of different algorithms.

The issue of DEM resolution (part 4) addresses a different type of error, i.e. features which are missed due to a too coarse resolution. It would be important to distinguish between different types of errors.

Part 5 about interpolation should rather be included in part 2 (how the DEM is generated). Also note: in the case of LIDAR data we usually have to do less interpolation

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but rather aggregation to come from several points per m<sup>2</sup> to a DEM with (usually) less resolution (p. 2353, lines 1-2).

In part 6 sinks are discussed. Here more reference to the work by Lindsay could be made (see references below), also Rodhe and Seibert suggested an alternative approach to treat sinks. Stream burning is only discussed shortly, but would probably deserve more space. Here advantages and problems with the burning should be considered, if there is really no literature about this, the review could at least discuss these issues.

Obviously errors in the DEM affect distributed hydrological models (part 7). For this article, I guess one should leave it at this statement, getting more into modelling would probably require a review article on its own.

Part 8 is partly difficult to follow. Some figures would certainly help here. Generally it is a bit surprising that there is hardly any figure, I am pretty sure that this is the first paper on DEM-related issues without any map-figure that I have seen. Many of the issues addressed in the paper would be more appealing and easier to understand when there were some figures.

In the conclusions I am missing some clear messages on how to move forward beyond the obvious ‘we have to be aware of the errors’. What guidelines should be followed? Where is a need for further research?

The reference list is impressively long, but the text would at several places benefit from focusing on key publications.

At several points references is made to previous studies but results are not fully reported. As example see p. 2356, line 7f: ‘As would be expected, the number of depressions found was related to grid cell resolution’, How was the number of depressions linked to resolution? Decreasing or increasing? The reader should not be required to revisit the original paper to get this information.

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## Relevant references:

Lindsay, 2006 'Sensitivity of channel mapping techniques to uncertainty in digital elevation data', *International Journal of Geographical Information Science*, 20(6): 669-692.

Lindsay, 2006 'Distinguishing between artefact and real depressions in digital elevation data', *Computers & Geosciences*, 32(8): 1192-1204. doi: 10.1016/j.cageo.2005.11.002 (with I F Creed).

Lindsay, 2005 'Removal of Artefact Depressions From Digital Elevation Models: Towards a minimum impact approach', *Hydrological Processes*, 19(16): 3113-3126 (with I F Creed).

Rodhe, A. and Seibert, J., 1999, Wetland occurrence in relation to topography - a test of topographic indices as moisture indicators, *Agricultural and Forest Meteorology* 98-99: 325-340

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