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Interactive comment on "Short Communication: Increasing vertical attenuation length of cosmogenic nuclide production on steep slopes negates topographic shielding corrections for catchment erosion rates" *by* R. A. DiBiase

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Invited Review of esurf-2018-48

The contribution by R. DiBiase addresses a methodological issue in calculating catchment-averaged erosion rates from cosmogenic nuclide concentrations in river sediments that has been largely overlooked in the past. The paper is well written, the figures are informative and relevant references are given. Overall, I agree with the previous reviewers that this is a great paper that should be published after some

(minor) clarifying revisions.

My main point is in line with what reviewer #1 already mentioned. I think it is important to emphasize that the reference frame, in which the attenuation length increases with increasing slope angle, is vertical with respect to the geoid and not the surface itself. That basically means that we assume that all particles approaching the Earth's surface follow trajectories that are normal to the geoid. While this assumption appears reasonable for hillslope angles <30° or so, to me it appears unreasonable for very steep hillslope angles, where the described effect is most pronounced. When standing in front of a rock face that is inclined 60° or more, I guess that most people would think the rock wall retreats and not that it lowers. The resulting particle trajectories would thus be less steeply inclined with respect to the surface and the effective attenuation length would not be that large. As a result, the shielding effect would likely be significant, hence lowering the surface production rates; but there would be no counter-acting effect due to increasing attenuation length. Dylan Ward and Bob Anderson, for example, looked at steep hillslopes in glaciated landscapes and assume slope-normal trajectories (Ward and Anderson, 2010, Earth Surf. Process. Landforms 36, 495-512). I think this is an important point that needs to be better exposed in the beginning and discussed later on.

My second point is related: is it meaningful to show on Figure 4, curves for inclinations up to 80°? I would argue that there hardly exist catchments with mean hillslope angles of >40°. Such angles may exist locally, but are they relevant for the problem that you discuss? One solution could be to have the y-axis in log scaling, to emphasize the curves with angles <40°, which currently are hard to decipher. As you rightfully note in your discussion, the effect of topographic shielding is small in most cases. All the curves >40° are thus steering the readers attention towards cases that actually don't matter.

A few more minor points:

P2, Line 18: You cite Norton and Vanacker (2009), but you don't discuss the main point of their paper in any detail later one. I think you should, because they propose that topographic shielding measured from coarse DEMs may underestimate the actual shielding. If that were true, does it mean that, after taking different attenuation lengths into account, there might still be a net shielding effect?

P3, Line 28: Probably here you could mention more explicitly the assumed particle trajectory. You actually say "vertical depth below the surface", but that's ambiguous. Vertical with respect to the surface or the geoid?

P4, Line 12: Mention here already if the model valley is inclined?

P5, Line 11: How good is this approximation?

P8, Line 17: The factor 3 emerges only for hillslopes >80°. I think it would be better here to refer to commonly observed hillslope angles, given the title of this chapter, and not extreme cases.

Figure 5: I'm curious whether it is ok to refer to mean hillslope angles? Pixel-based hillslope angles are often measured using the steepest descent algorithm. In other words, this algorithm will give you always the maximum slope angle possible. Is that the one you want to have for inferring attenuation length effects? Or would you rather want to refer to hillslope angles measured by fitting a plane to each pixel and its surrounding neighbors, or something like this?

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