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ESURFD_Log

Interactive comment on "Topography-based flow-directional roughness: potential and challenges" *by* S. Trevisani and M. Cavalli

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I have enjoyed reviewing this paper and recommend it be published by ESURF, subject to some minor revisions. The authors demonstrate that the use of anisotropic surface roughness calculated from high-resolution topographic data could provide a useful metric in the analysis of the spatial extent and type of flow-driven processes operating in a landscape. They apply this approach to demonstrate that directional roughness improves predictions of landscape connectivity in areas of the landscape that are eroding (Fig. 17d). This could lead to a better understanding of parts of the landscape that are actively providing and routing sediment. The authors also demonstrate that differences between isotropic and flow directional roughness may have potential in automated feature extraction, highlighting morphological features that are transverse to

slope direction, such as bedrock outcrops, roads, agricultural boundaries etc. The authors critique their own analyses and highlight where further work is needed, particularly in terms of optimising the detrending of the DTM, selecting appropriate scale parameters for roughness calculations, and the choice of routing algorithms. I agree that these are good avenues for future work, building on the study presented here, as discussed in the manuscript.

I have some minor suggestions to improve the manuscript and data presentation. In particular, I suggest the use of tables to present data that would be much better plotted graphically be addressed. The figures plotting spatially distributed results are consistently too small to identify details discussed in the text. Perhaps the authors might need to review the figure guidelines in terms of figure size, resolution and font size, the editor can also advise.

I attempted to download the MAD software from the 2015 paper in Computers and Geosciences but found that the zip file was invalid. I would suggest the authors correct this and provide the link somewhere, or alternatively providing a link to the github page where the code is maintained so that other scientists can apply these methods. A "code and data availability" statement with the acknowledgements will suffice for this.

Specific Comments:

P1401 L5: I suggest changing "Ad hoc" to "bespoke"; Similar P1404 L 11.

P1402 L20: Could also cite DiBiase et al. 2010 and Milodowski et al. 2016 (currently an ESURF discussion paper) have used isotropic surface roughness map bedrock outcrops.

P1404 L16: A physical description of what h represents is required. By "lag" do you mean the search distance in the local neighbourhood? Or is it the search direction? I find the way these methods are presented difficult to penetrate but conceptually relatively simple. I think the authors could spend some time refining the description of the

methodology.

P1404: Eq 1: \alpha is not defined anywhere Figures

P1406 L1-2: This smoothing method will result in systematic bias on ridges and in valleys towards positive and negative residuals respectively, since smoothing will lower ridgelines and raise valleys.

P1406 L7: “any direction” should be all directions.

P1406 L9: So are Riso and Rflow both just values of MAD but changing the neighbourhood search to only look in the D8 flow direction for the latter? This is not clear.

P1406 L11: D8 limits the flow directional analysis to 8 directional, 45 degree bins. This is a significant limitation that should be discussed further. There are plenty of alternatives (e.g. polynomial-derived aspect, or d-inf).

P1411 L2: Was this done? I presume this is a qualitative confirmation process. Please be more specific, or delete this.

P1412 L27: “have to be evaluated critically” so where the differences are on the order of the DTM accuracy then roughness differences could just be artefacts. Earlier you reported the vertical accuracy at 0.15m-0.3m depending on the dataset, so should you consider roughness differences at smaller values than this?

P1413 L1-2: Difficult to see this without a nice plot to look at. Please plot this data. What does a positive skew mean in terms of the landscape? Flow direction roughness tends to be lower than isotropic? That’s neat if I’ve interpreted correctly so you could make more of this result.

P1416 L22-24: I disagree with this statement. Looking at Fig 14b there are areas of both high and low relative differences adjacent to the channel and towards the divides headwaters.

P1417 L1: Does your method predict a more or less connected landscape overall?

It’s obvious from fig 17d that it predicts greater connectivity but you should state this explicitly if so.

P1418 L12: e.g. Wavelets (Lashermes et al 2007) or FFT (Perron et al 2008).

P1418 L5-25: Discussion of future research avenues should come at the end of the discussion. This is not a conclusion of your work. The conclusion should highlight your main findings.

Fig 4: Figure text to small.

Fig 8: There seems to be significantly more negative residual than positive (I can’t see many white pixels but there are plenty near-black). This may be my eyes! A colour image rather than grey-scale would be helpful and a CDF plot (i.e. showing the data in table 1) would also be helpful.

Fig 10-13: These are difficult to interpret when printed as too small, and not high enough resolution when zoomed on a comp. I would want these will be bigger/higher resolution in the final paper.

Fig 13: Caption “hortophotos” typo.

Fig 14 and 15: What is the blue line? Channels defined how?

Fig 17: This really demonstrates the application of your approach nicely!

Table 1: This could be better represented with a box and whisker or a cumulative probability plot, perhaps as an inset to Figure 8.

Table 2: Again I’d like to see a plot of CDF with different coloured lines for each method.

Table 3: Plot the data!

Table 4: CDF plots or similar

Interactive comment on Earth Surf. Dynam. Discuss., 3, 1399, 2015.