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Interactive Comment

Interactive comment on "Topographic roughness as a signature of the emergence of bedrock in eroding landscapes" *by* D. T. Milodowski et al.

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We thank Reviewer #1 for their positive review of our work. We agree that the topographic roughness is a potentially powerful tool in the geomorphic analysis of high resolution topographic data. We are also grateful to the reviewer for highlighting a series of relevant papers that had been overlooked in our original manuscript. Their inclusion will provide a broader context for this contribution, and highlight some important points.

The specific points raised by Reviewer #1 are addressed below: 1) "The Evan's 1980 approach was not just applied in Hurst et al. 2012, but also in several others works (i.e. Pirotti and Tarolli, 2010; Tarolli et al., 2012; Lin et al., 2013; Sofia et al., 2011, 2014), using also larger moving windows."

These studies illustrate a range of applications of the polynomial surface fitting method for calculating topographic derivatives, primarily curvature, described by Evans (1980) in order to identify a number of geomorphic features.

Pirotti and Tarolli (2010) and Sofia et al. (2011) both focus on extraction of channel networks from high resolution data; both discuss the impact of kernel scale on calculated topographic metrics.

Tarolli et al. (2010) and Lin et al. (2013) extract geomorphic features associated with landslides based on topographic curvature in two different settings.

Sofia et al. (2014) successfully utilise the curvature of residual topography to map anthropogenic features on a floodplain.

Together these papers illustrate the utility and flexibility of the Evans (1980) approach. In Section 2, we will add a sentence to this effect, referring to the above studies.

2) "The surface roughness calculation from a DTM, using high-resolution topography derived by LIDAR, was also proposed in Cavalli et al. (2008). These authors calculated the surface roughness as the standard deviation of the residual topography (elevation and slope) within a n-cells moving window."

We thank the reviewer for bringing this paper to our attention. Several “roughness” metrics have been utilised previously (see also Whelley et al., 2014); an assessment of different measures of topographic roughness and their suitability for extracting different geomorphic features would make an interesting future study. We have included a couple of sentences into Section 2, highlighting the two above studies as instances where other measures of surface roughness have been used successfully in other settings.

3) "The scale effect is an issue underlined by multiple authors (i.e. Pirotti and Tarolli, 2010; Tarolli et al., 2012; Lin et al., 2013; Sofia et al., 2011, 2014)."

The papers listed here provide further illustration of the impact of kernel scale on fea-

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ture extraction. Moreover they highlight that successful feature extraction is dependent on the kernel size approximately matching the scale of the feature of interest.

"As well, other works dealt with the scale issue and errors connected to the use of the Evan's 1980 equation (Albani et al., 2004; Sofia et al., 2013). They showed that the smallest window sizes were the most affected by errors."

The two papers mentioned here deal explicitly with the impact of DEM errors. Albani et al. (2004) propagate errors through the surface fitting procedure, illustrating that their effect is greatest in the case of small kernel sizes. Similar results were obtained by Sofia et al. (2013), who simulated the effect of common DEM errors on derived topographic metrics, demonstrating that when using small kernels, feature extraction is particularly prone to noise. We discuss this effect in some detail in Section 3.5; in the revised manuscript, we add a couple of sentences to explicitly discuss the impact of noisy data and scaling the surface fitting kernel. Moreover, an interesting point of discussion is that the kernel size for surface fitting needs to be appropriate for the scale of the feature to be extracted. In the case of hillslope characteristics, such as rock exposure, roughness is often expressed at the metre-scale; however these shorter wavelengths are susceptible to noise. This highlights the requirement for high quality, high resolution surveys, which permit accurate discrimination of vegetation and ground returns prior to surface creation. We make a statement to this effect in the Overall discussion and conclusions. We add references to Albani et al. (2004) and Sofia et al. (2013) to this section to highlight this.

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