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Comment on esurf-2022-29

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Referee comment on "Geomorphic signature of segmented relief rejuvenation in the Sierra Morena, Betic forebulge, Spain" by Inmaculada Expósito et al., Earth Surf. Dynam. Discuss., https://doi.org/10.5194/esurf-2022-29-RC1, 2022

This manuscript provides a geomorphic analysis of the Sierra Morena region in southern Spain. The main parts of the analysis are performed with the help of the TopoToolbox software. The observations from geomorphology are supported by structural geology.

Being not very familiar with the geology of Spain, the introduction (Sect. 1) and the description of setting and region (Sect. 2) were very useful for me. These sections are well written. This also holds for parts of the description of the methods (Sect. 3), except for the chi-transform (Sect. 3.2, see below).

However, my positive impression dropped when reading the results section (Sect. 4). First, I found it a bit hard to follow. As a serious problem, however, I feel that the results of the geomorphic analyses are rather non-unique or even somewhat weak. This does not mean that the conclusions are wrong, but I am not convinced that they can be drawn from the results in a solid way.

Let me briefly explain my concerns about the different investigated topographic properties.

(1) Smf values (Sect 4.2)
These values just describe the shape of the mountain front and are not very meaningful in the context of relief juvenation.

(2) Vf values (Sect. 4.2, Fig. 5a)
The values shown in Fig. 5a just show that the valleys are deeply incised in the mountains and rather flat in the alluvial plain. This is not very surprising and immediately recognized in the topography.

(3) Hypsometric curves and HI values (Sect. 4.2, Fig. 5b+c)
Some of the hypsometric curves are indeed convex upward. However, we have to be careful with the interpretation. The "default" S-shaped curve relies on the stream-power law being applicable to the entire area, so also for very small catchment sizes. As soon as hillslope processes come into play, the relief at small catchment sizes decreases, which also causes a convex upward shape. So interpreting these curves and the respective HI values is difficult. Comparing individual sub-catchments as shown in Fig. 5c may be helpful. However, the variation among the sub-catchments seems to be somewhat unsystematic, although the location of the sub-catchments is not visible. So placing the

rather tentative conclusions drawn here on solid ground would require a more thorough analysis.

(4) Knickpoints (Sect. 6)
The analysis of knickpoints seems to be a central component. However, the results are very non-unique here. I only recognize a clear clustering of knickpoints in the chi-plot only for catchment S2, so at the Viar fault system. For the other catchments, which are related to the Sierra Morena rupture, I do not recognize any clear evidence for a rejuvenation in the knickpoint pattern.

(5) Drainage divide network asymmetry (DAI, Sect. 6)
The results on the drainage divides are interesting. To my understanding, however, relief juvenation should rather affect the lower parts of the catchments than the drainage divides. So I would think that the DAI reflects the long-term activity rather than a juvenation.

In sum, I am not convinced that the results of the geomorphic analyses are strong enough to support the conclusions about relief rejuvenation. It might, however, be possible to strengthen this part. Finding clearer evidence in some properties might be sufficient. Provided that this is possible, a revised version would make sense, and I would be happy to review it. In this case, some other points should also be addressed:

Sect. 3.1
I am not familiar with the valley floor-to-height ratio Vf. How is the width of the valley floor determined?

Sect. 3.2
The description of the chi-transform is quite wrong. It is not a linearization and has nothing to do with n = 1. And Eq. (4) relies on specific conditions.

Sect. 6
Why are the m/n ratios in Table 2 negative? This does not make sense. And I guess that all considered catchments are similar concerning their fluvial erosion characteristics. So fitting different m/n ratios for the individual catchments is also not very useful. In particular, the small ratios of S3 and S4 seem to be an artifact. So we should either fit one common value to all catchments or -- if we want a simple solution -- say that the big catchments are consistent with the widely used reference value m/n = 0.45. And maybe it would be clearer to use the concavity index (theta) instead of m/n.

Best regards,
Stefan Hergarten