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Natural Hazards and Earth System Sciences
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Discussions

Interactive comment on "Landslides distribution at tributaries with different evolution stages in Jiangjia Gully, southwestern China" *by* Xia Fei Tian et al.

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The lithology in this region is weak as a whole, it undergoes active neotectonic movement, faults, and folds; and rocks are dominated by slate, dolomite, limestone, basalt and breccia rocks, which are easily weathered (Gabet and Mudd, 2006). The exposed strata in this gully is mainly shallow metamorphic rocks of the lower proterozoic Kunyang group, accounting for about 80% of the gully area (Wu et al., 1990). Rainfall, as an incentive factor, mainly promotes the occurrence of landslides activity, but has little effect on the storage state of materials in the tributary. In addition, landslide susceptibility assessment is of great significance for the disaster prediction and prevention.

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Discussion paper

At present, most studies used statistical methods by the influence factors of landslide distribution, or based on physical models to determine the assessment result, the research of these methods is mainly focused on the gully scale. At the same time, these methods do not focus on the specific principle of material storage. In this paper, the surface erosion index, being the integral of the hypsometric curve, is adopted to explore the landslides distribution characteristics in different tributaries of the gully.

1. Line 32, add some most relevant reference for the EI index. Some relevant references have been added. 2.Line 38, Hamza et al., 2018, delete "V" and check the citation form throughout the text for consistence. The citation form throughout the text has been checked and modified. 3.Line 57, you state 'Moreover, the debris flow behaviors in JJG are representative and similar phenomena are subsistent in other parts of the world', how do you know that? Debris flow phenomena is subsistent in other parts of the world, they are intermittent, and debris flow behaviors in JJG are complete and various, so this research is carried out in JJG. 4. Line 94, provide information about data source of 10 m DEM applied in this study. This has been added in the paper, the DEM was purchased in the Sichuan surveying and mapping bureau. 5.Lines 95–96, how to divide the tributaries based on field investigation? The tributaries are divided based on field investigation result that each tributary is a complete unit for observable landslides and debris flows, also according to the fact that debris flows are prone to occur instead of direct extraction based on the same water collection threshold. In other words, these tributaries are all conspicuous in surface mass movement and loose materials are distinguishable on its slope. The tributaries are extracted from the DEM using GIS tool and also with artificial correction to ensure the accuracy of boundaries. In principle, the gully can be divided further into smaller tributaries, but that makes little difference for the present purpose as to distinguish tributaries in evolution. Some tributaries in field are displayed in Fig. 2, obviously, there are significant differences among these tributaries. 6.Line 135, the area of landslide is 0.38 m2? Is this really a landslide? and, how can you identify this in such a resolution? The data has been checked and modified. As two topological surfaces overlap and form a slight superposition, all

the topological surfaces of the landslides were checked and modified. 906 landslides have been identified, with area ranging of 2.53 × 102 ∼ 6.7 × 105 m2. 7.Line 136, what is the meaning of accuracy here? 89.21% of the identified landslides have been observed in the field? We mainly in the field observed the location of 100 landslides, and the area of some landslides we estimated. The accuracy of the landslides location and area reaches 89.21%. 8.Line 147, why do you define the curves like this, and what is the meaning of this equation. This is a fitting curve, this equation is used for fitting the curve, and the fitting effect of this equation is suitable, the fitting parameter reaches 90% above. 9.Line 161, scale parameter of 0.58 and shape parameter of 6.08 are inconspicuous in Figure 6. More descriptions in detail are needed. The small value of scale parameter means that EI is much concentrated and EI of most tributaries in JJG is mainly between 0.5 and 0.6. The shape parameter is more than 1 and the frequency of the tributaries changes rapidly with the increasing of the EI, indicating that there is a great difference among the active tributaries. According to the frequency distribution of EI, the tributaries of JJG is generally in mature and youthful evolution stages, that is the reason why high frequency debris flow occurred in JJG in the past several decades. 10.Line 182, you claim that 'For a given elevation of point, larger area above it means strong slope process in the upstream'. Do you have some references or evidence to support it? This part has been rewrited as following. For a given elevation of point, larger area above means that more material are concentrated. For example, inflection points in EI between 0.45∼0.55 are generally higher than those in EI below 0.45, indicating that more material concentrates in such tributaries, which are more prone to debris flow activities. Correspondingly, the lower the hypsometric curve is, the more concave the curve is presented, and the smaller the a/Aip is, which indicates that the elevation changing in unit area is small, such a tributary is not conducive to the occurrence of landslides and debris flow activities.

Figures: 1.I suggest to delete Figure 8, as the same spatial distribution of the landslides can be better shown in Figure 9. This is a general landslides distribution figure, and the other is landslides distribution figure in tributaries of different EI divisions. In this paper, the general distribution of landslide is firstly written, and then the landslides distribution characteristic in different evolutionary periods is displayed, which is better to understand the structure of the paper, so these two figures are both kept. 2.Figures in similar pattern can be merged, such as Figures 10 and 11, Figures 14 and 15, Figures 16 and 17. Figures 10 and 11, Figures 16 and 17 (preceding) has been merged, now is Fig. 12 and Fig. 14, and Figures 14 represents the landslides distribution characteristic of the whole gully, and overall landslides distribution is mainly compared with other regions in the paper. Therefore, Figures 16 (preceding), representing landslides distribution characteristic of tributaries, has been deleted.

Fig. 12 Relationship between landslides and EI in subregions.

Fig. 14 The variation of the tributary morphological feature in different evolution stages. 3.Figure 1, the extracted river network is not precise, especially in the downstream; what is the meaning of the dividing line of three segments, and how do you define the location of these two lines, e.g., elevation or distance from the river mouth? The river network has been extracted and modified, as shown in Figure 1.

Fig. 1 The location of JJG. a The location of Dongchuan in China. b Dongchuan Debris Flow Observation and research stations. c Deposition of surges.

The line of the three segments divided is based on the difference of elevation, the three segments is upstream, midstream and downstream of the gully, respectively. 4. Figure 2, where did you take the picture? Mark the location in the index map, e.g., Figure 1. This picture was taken in the field survey, it is in the Menqian gully, close to the mouth of the Menqian gully and Duozhao gully, the location is shown in the following figure and indicated by the yellow arrow. The phenomenon can be found in other location of the gully, this is just one of them and is used to illustrate the phenomenon of debris flow surges and variety of material accumulation.

Fig The location of debris flow surges and variety of material accumulation 5. Add coordinates in Figures 3, 5, 8 and 9. 6. Figure 7, provide more details about definition and meaning of ‘inflection points’ in hypsometric curves. You mentioned 5 stages in the text. but, only 4 in the figure. All figures have been remade, and the coordinates have been added in the figures. More details about definition and meaning of ‘inflection points’in hypsometric curves have been provided in the following. Obviously, the hypsometric curves exhibit different shapes, which can be featured by the inflection point, defined as the zero point of the second derivative of the fitting curve (Eq. 2): ïijĹ2ïijĽ where x denotes a/A, and y=0 determines the inflection point at a/Aip. It is found that the a/Aip varies with EI in a power law form (Fig. 6), meaning that the bigger the evolution index is, the lower the inflection points of the curves are. The higher the EI value the lower the inflection point, and this implies that there should be more material accumulated in the lower part of the tributary, which are relatively easy to join the the debris flow.

Fig. 6 The relationship between the inflection point and and EI. Moreover, we display the hypsometric curves of different evolution stages in Fig. 7; in particular, the inflection points of the curves (the rectangle in each plot) are displayed in different position of the curves. The inflection point indicates the elevation of a tributary with area varing. It can be seen in Fig. 7, which shows that the larger of the EI is, the smaller of the a/Aip is. When the point is high, the changing occurs at the high elevation, i.e., mainly in the upstream of the tributary. Since there is no evolution area more than 0.75 in JJG, four major evolution divisions are analyzed.

Fig. 7 Hypsometric curves of different EI divisions The evolution curve changes from concave to convex with the increasing of evolution value, and the convex form of the tributary is more conductive to the material movement of the tributary and more loose materials are produced. For a given elevation of point, larger area above means that more material are concentrated. For example, inflection points in EI between 0.45∼0.55 are generally higher than those in EI below 0.45, indicating that more material concentrates in such tributaries, which are more prone to debris flow activities. Correspondingly, the lower the hypsometric curve is, the more concave the curve is presented, and the smaller the a/Aip is, which indicates that the elevation changing in unit area is small, such a tributary is not conductive to the occurrence of landslides and debris flow activities. Some landslides distribution of tributary in different evolutionary periods is shown in Fig. 8. In the tributary within the EI range of 0.35-0.45, the landslides distribution is scattered with the large area and low number, and the tributary is generally concave, which is not conductive to the materials movement. In addition, with the increasing of the evolutionary value, the landslides number is increasing and the area is decreasing, and the tributary in high EI division is convex, which is conductive to the materials movement.

Fig. 8 Some landslides distribution tributaries of different EI divisions

Please also note the supplement to this comment:
https://www.nat-hazards-earth-syst-sci-discuss.net/nhess-2019-90/nhess-2019-90-AC1-supplement.pdf

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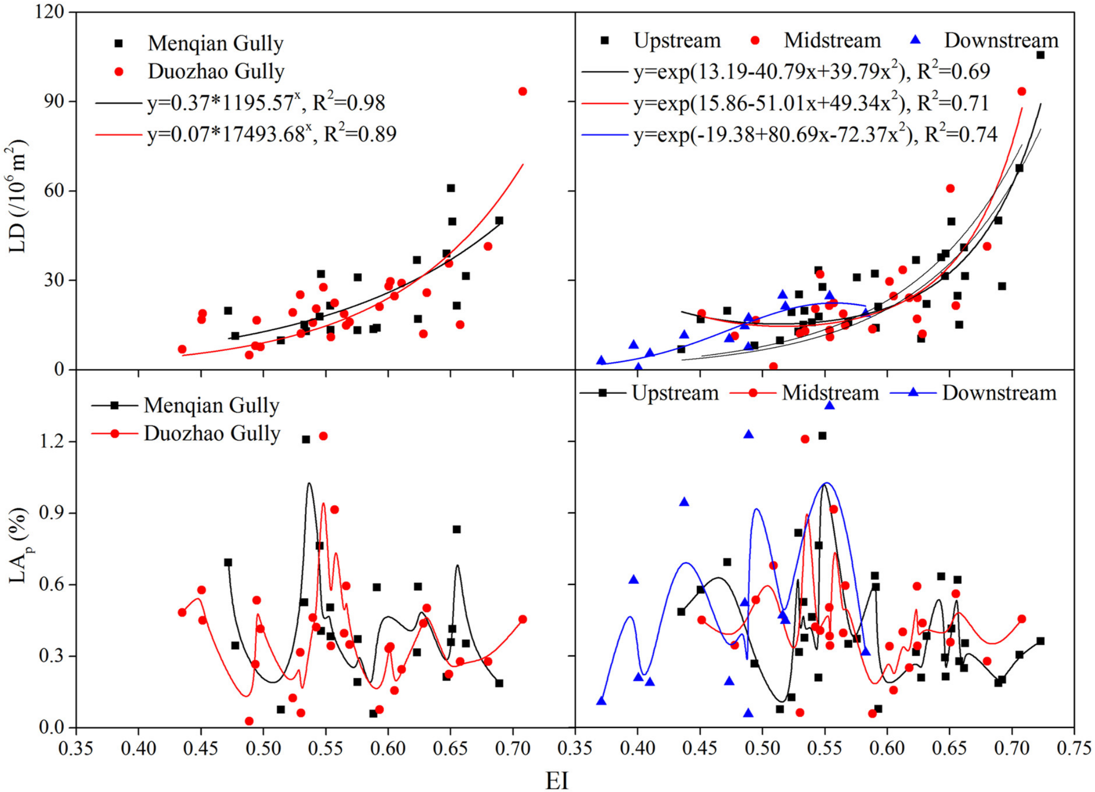

Fig. 1.

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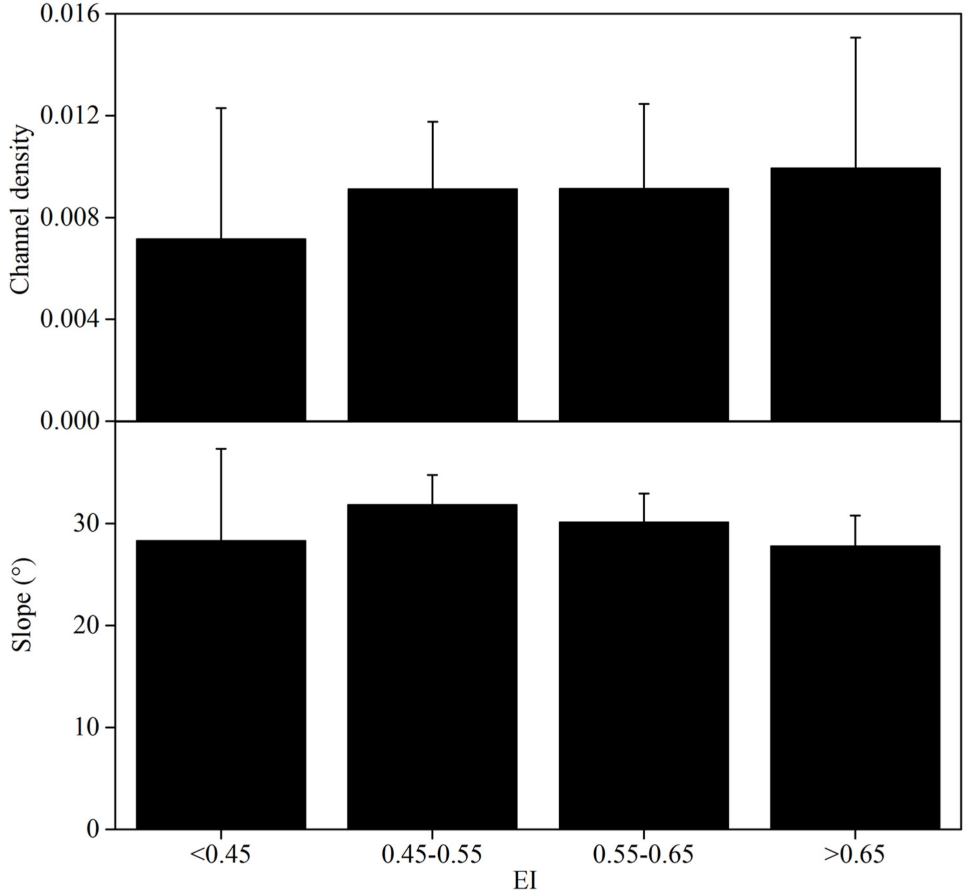

Fig. 2.

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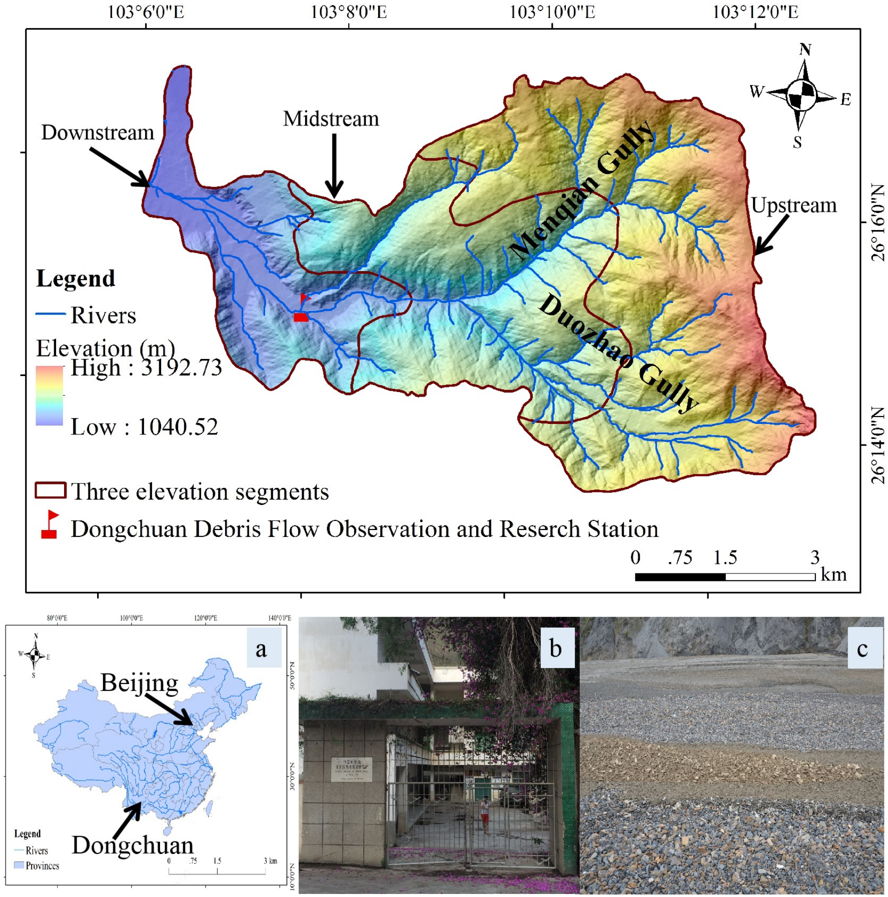

Fig. 3.

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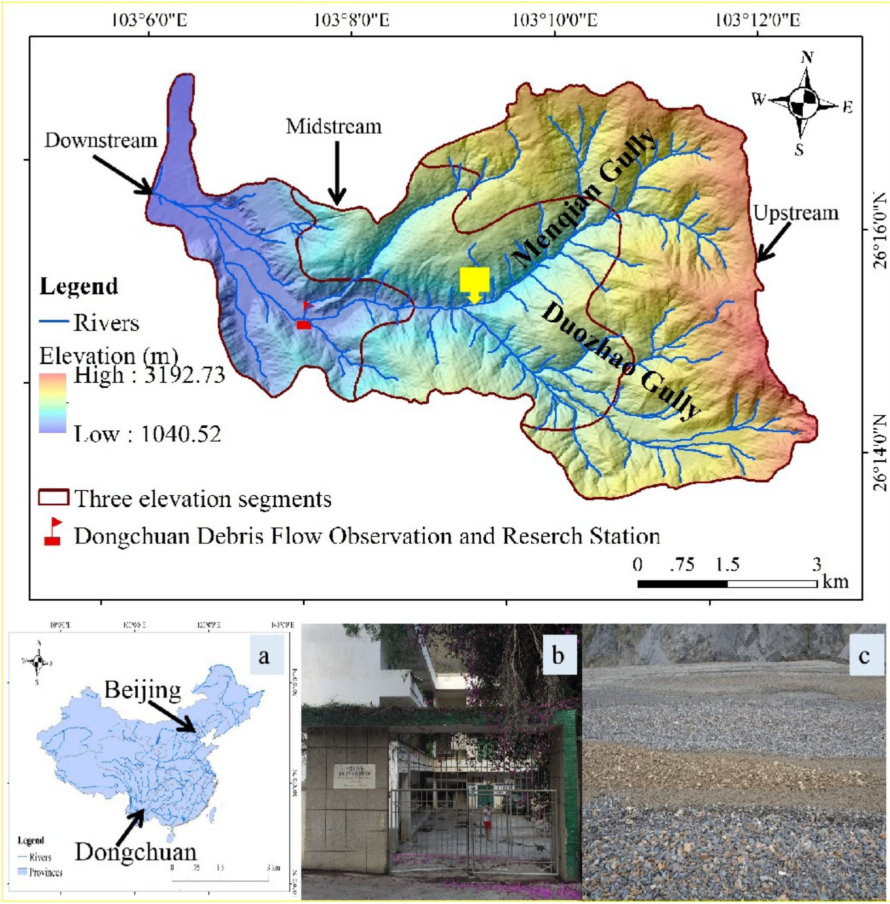
103°6'0"E
103°8'0"E
103°10'0"E
103°12'0"E
26°16'0"N
26°14'0"N
N
W
E
S
Downstream
Midstream
Upstream
Menqian Gully
Duozhao Gully
Legend
Rivers
Elevation (m)
High : 3192.73
Low : 1040.52
Three elevation segments
Dongchuan Debris Flow Observation and Reserch Station
0 .75 1.5 3
km
a
Beijing
Dongchuan
b
c

Fig. 4.

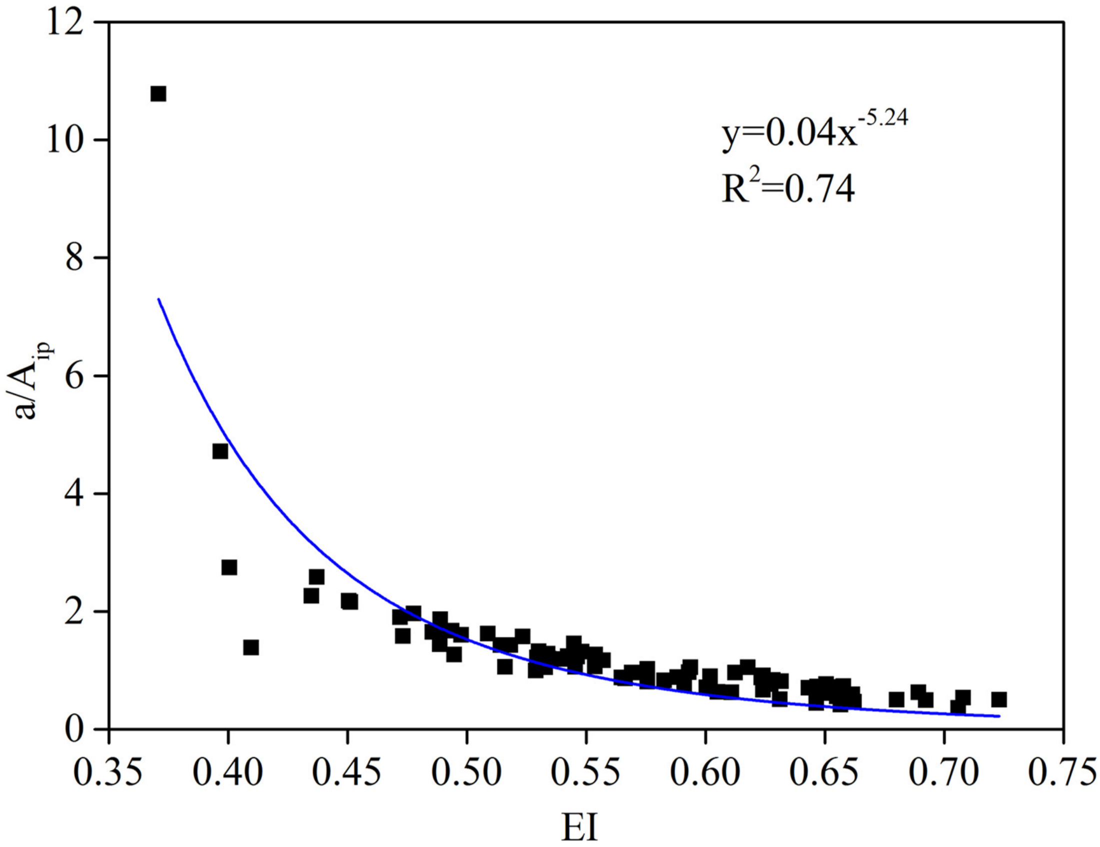

Fig. 5.

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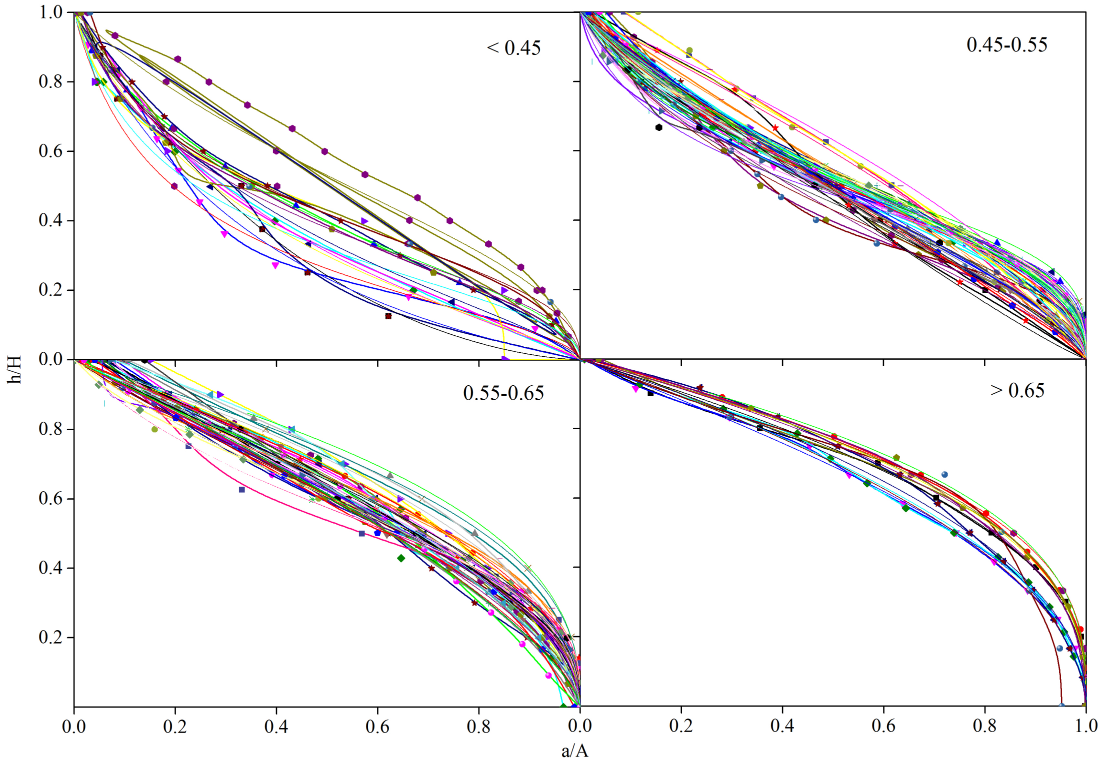

Fig. 6.

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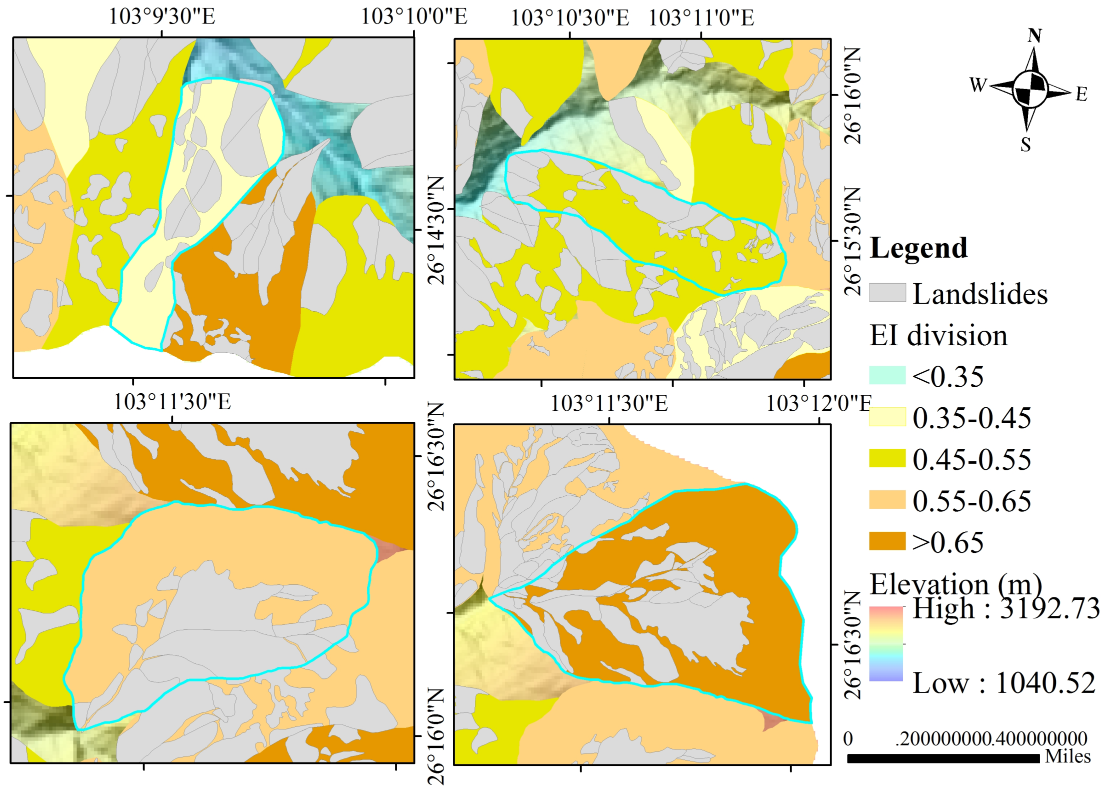

Fig. 7.

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