Geomorphic response of streams to neotectonic deformation in low relief areas: case study of Bilogora Mt. (NE Croatia)

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Understanding about tectonic and surface processes which control topography and development of landscape features represents the core for many quantitative morphotectonic investigations using nowadays widely available digital elevation models (DEMs).

This work is aimed to identify areas with neotectonic deformation signature in Bilogora Mt. area by means of DEM based morphometric analysis combined with geological, geophysical and seismotectonic data (Prelogović & Velić, 1988 & Herak et al., 2009).

Bilogora Mt. (average elevation <300 m) represents c. 90 km long and 10 km wide hilly terrain along the southwestern margin of the Drava River basin in northern Croatia. According to recent studies it formed due to transpression along the Drava basin boundary fault system that was inverted from previously normal into predominantly dextral sense of slip during Pliocene and Quaternary times (e.g. Prelogović et al., 1998). Bilogora Mt. is composed of deformed Neogene and Quaternary clastic series highly variable in thickness, covering pre-Neogene basement units (e.g. Prelogović & Velić, 1988). Database on historical seismicity reports rare occurrences of moderate earthquakes with intensity of VI°-VIII° MCS concentrated in the northwestern part of the area, close to towns of Koprivnica and Virovitica (Herak et al., 2009).

In order to analyze a potential geomorphic response of streams to ongoing tectonic activity we employed a DEM raster with cell resolution of 10 m modeled according to procedure described in Matoš et al. (2012). Study area was truncated into 130 drainage units (Figure 1, Table 1), each unit was analyzed by computing its morphometric parameters that include:
hypsometric integral- \( Hi \), absolute asymmetry factor- \( AF(abs) \) and statistical parameters of longitudinal stream profiles (Figure 2, Table 1), i.e. maximal concavity- \( C_{\text{max}} \), distance from the source- \( \Delta l/L \) and concavity factor- \( C_f \).

![Figure 1: DEM hillshade of Bilogora Mt. area with analyzed drainage units.](image1)

![Figure 2: Normalized longitudinal stream profile with statistical parameters.](image2)

Calculated \( Hi \) values range between 0.12-0.55 (Table 1) and shows that most catchments in a young stage of landscape evolution with highest values of \( H_i \geq 0.50 \) are recorded in NW and central part of Bilogora Mt. (catchments No. 5, 8, 16-17, 19, 27-32, 34-39, 41, 43, 45-47), while in SW and SE part only three catchments (No. 97, 98 and 119) obtained the same value. Extrapolation of \( AF(abs) \) was addressed to recognition of
possible active tectonic block tilting. Very high values of Af(abs)≥0.25 pointed out to several catchments in NW part (No. 11-12, 23, 37, 122 and 128), central part (No. 54, 106 and 109) and SE part (No. 81, 87 and 99) of Bilogora Mt. Finally, parameters $C_{max}$, $\Delta I/L$ and $C_f$ have been used to identify on-going tectonic warping of main streams. Obtained values of $C_f$≤32.16% and $C_{max}$≤0.265 positioned ($\Delta I/L$ in upper reach of streams suggests that those streams (No. 4, 8, 14, 19, 27-30, 32, 36-40, 43-44, 46-47, 49A, 56, 97-98) are less graded and in non-equilibrium state, probably as a result of on-going tectonic deformation. Based on obtained values of geomorphic indices (including slope and elevation data), combined and correlated with results of previous studies we conclude that catchments in NW part (No. 4-5, 7-8, 17-19, 29-32, 36-39 and 41), in central part (No. 44-49, 52 and 56), and in SE part of Bilogora Mt. (No. 89, 95, 97-99) correspond to areas of possibly on-going tectonic deformation that is reflected in a present-day landscape geomorphology.

<table>
<thead>
<tr>
<th>No.</th>
<th>Drainage unit</th>
<th>Hi</th>
<th>Af (abs)</th>
<th>Cmax</th>
<th>$\Delta I/L$</th>
<th>$C_f$ (%)</th>
<th>No.</th>
<th>Drainage unit</th>
<th>Hi</th>
<th>Af (abs)</th>
<th>Cmax</th>
<th>$\Delta I/L$</th>
<th>$C_f$ (%)</th>
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Table 1: Drainage units with calculated and highlighted anomalous values of morphometric parameters referring to possible on-going tectonic active areas.

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REFERENCES


