



Received: 2020.05.04

Accepted: 2020.08.23

***DEM and GIS Base Mapping of Stream – Length Gradient Index (SL)  
For Active Tectonic Assessment  
Case Study: North of Damghan***

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**Abstract**

**1-Introduction**

The effects and evidence of tectonic activity can be seen in most parts of the planet; particularly if these activities have occurred during the Quaternary period and thereafter, the evidence would be readily recognizable (Guarnieri and Pirrotta, 2008:264). Iran is tectonically an active region. Many indices have been developed, tested and validated for quantitative geomorphic analyses to identify topographic fingerprints of surface and sub-surface processes. Morphometric analyses of river networks, drainage basins and relief using geomorphic indices, as well as geostatistical analyses of topographical data have become useful tools for investigating landform evolution. GIS platforms and high-resolution digital elevation models (DEM) facilitate the computation and charting of this type of information (Hayakawa & Oguchi, 2009:31). The stream length gradient index (SL), describes the morphology of the drainage network using a topographic gradient along a river. This index is sensitive to tectonic and lithology activities and is used as an indicator for tectonic areas. In this study, the morphometry of the catchment in north of Damghan was estimated and their stream – length gradient (SL) indexes have been mapped using GIS.

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## 2-Methodology

The studied area is located in northern mountain range of Damghan (East Alborz). In order to study the morphometry and tectonic indexes of the area, geological maps (1:100000), topographic maps (1:25000), and DEM 12.5m were used. The computation of SL was based on the interpolation of a discrete value. For a segment of a given river, the SL has been defined as:  $SL = (\Delta H / \Delta L) L_{tc}$ , where  $\Delta H$  is the variation of elevation,  $\Delta L$  is the length of the segment, and  $L_{tc}$  is the total channel length from the midpoint of the segment where the index is calculated from upstream to the divide; actually,  $(\Delta H / \Delta L)$  is the slope of the considered segment. The drainage network was automatically delineated from the DEM, and SL was computed using ArcGIS 10.6® with the Spatial Analyst® extension, supported by several freeware packages including Arc Hydro Tools and ET Geowizard. The obtained point dataset of SL was interpolated using the ordinary kriging (OK) algorithm to estimate the spatial distribution of SL for the whole river basin.

## 3-Results and Discussion

Geologically, the studied area is located on the southern slopes of Eastern Alborz. The southern parts of the area are located between the two structural units of Alborz and Central Iran. This has caused the complexity of this part, lithologically and tectonically. A large part of the studied area consists of the Mesozoic formations, especially Jurassic. These formations consist mainly of sandstone, coal shale and gray to dark-colored limestone. Tectonically, the area is active and there have been several earthquakes in and around this area. The main systems of the faults of the region are thrusts and then strike-slip faults. In sub basins, the hypsometric integral values range from 0.18 to 0.66. Unlike the average height of the sub-basins, which has a natural trend, the hypsometric integral in the region is heterogeneous and has been distributed depressively. The average slope of the sub-basin is 18 degrees and its maximum slope is 33 degrees. The values of SL index range from 72 to 985 m. High values of SL are observed in the center,

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east and southwest of the region. The core of the high values is located in the center of the region, where major and minor faults are observed.

#### **4- Conclusion(s)**

The purpose of this study was to provide a map of SL index in northern mountain of Damghan. The indicators used in this research, such as slope, hypsometric integral, longitudinal elevation and river gradient, were automatically calculated using GIS and digital elevation models. The results showed that the presence of faults and their uplift were related to the high values of the SL, indicating a different uplift in hole parts of the region. The maximum values of the SL index were observed around the faults, especially in the central part of the studied area. The results also showed that sub-basins with high slopes also had high hypsometric integral values. This can also indicate the high degree of erosion processes. Considering that in this study DEM, topographic maps and interpolation methods were used to calculate the longitudinal gradient of the river, it seems to be more comprehensive than the longitudinal profile of the river, and provides a broad view of the geomorphological processes of basins and sub-basins

**Keywords:** Active Tectonic, Hypsometry Integral, SL index, North Damghan rivers

**5-References**

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