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A Semi-Automated Approach for Mapping Geomorphology in Mountainous Terrain, Ferozpora Watershed (Kashmir Himalaya)

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Abstract: Mapping geomorphology in a mountainous terrain is very critical for understanding various land surface processes for their accurate quantification and prediction on different spatial and temporal scales. In the present study, geomorphological mapping was carried out in Ferozpora watershed of Jhelum using remotely sensed data supported by extensive field observations. Three approaches were adopted for mapping geomorphology of Ferozpora watershed. A geomorphological mapping model, Topographic Position Index (TPI), on Screen Image Interpretation (OSII) of satellite data and a hybrid approach utilizing information from TPI and OSII of satellite data were employed. Geomorphology of the area, mapped using the three approaches, was cross checked and verified with the ground data collected by extensively surveying the area and recording the geo-location of the geomorphological features using GPS. Overall, 12 different landforms were mapped which include Alluvial plains, Deeply incised streams, Glacial terrain, Highly dissected hills, Karewa, Fluvial landforms, Moderately dissected hills, Mountain ridges, River channel and U-shaped valleys. The study revealed that Hybrid approach, using inputs from TPI, OSII and field observations, is appropriate in mapping different geomorphological features in this topographically complex terrain with an overall accuracy of 91.53% as compared to TPI (45.56%) and OSII (77.82%) approaches. The study could be extrapolated to other parts of topographically complex Himalayan terrain so as to bring about a very high resolution geomorphological map of Himalayas which could aid policy makers, planners and earth scientists in better modelling the earth surface processes like soil erosion, landslides, hydrology, etc. in the region.

Keywords: Geomorphology, Himalaya, Geoinformatics, Topographic position index, Hybrid approach, On-screen image interpretation, Kashmir.

INTRODUCTION

Geomorphology is concerned with the study of surface features of earth's surface involving interpretative description of landforms, their origin and nature and mechanism of geomorphological processes(Strahler 1957; Blaszczynski 1997; Singh 1998). The recent advances in remote sensing technology have added new dimensions to the mapping of the geomorphological features from space (Bishop et al. 2012; Walsh et al 1998). Information extracted from remote sensing data provide a synoptic view of terrain features and enable mapping of inaccessible terrain in a timely and cost efficient manner (Baker 1986; Hengl and Reuter 2009; Pike 2000; Shroder and Bishop 2003). Remote sensing data, analysed in a GIS environment, is very useful in mapping geomorphology (Liang 2007; Smith and Pain 2009; Tarolli et al. 2009). An up-to-date geomorphological information of an area can serve as an important input for better understanding earth surface process like landslides, floods, erosion, glaciations (Sharma and Owen 1996; Naithani et al. 2001; Reddy and Maji 2003; Bolch et al. 2005; Kaushal and Singh 2006; Nainwal et al. 2008). Topographic information from satellites, called Digital Elevation Models (DEM), in recent years have been extensively used for various earth system science studies like morphological characterization (Fielding et al. 1994; Philip and Sah 1999), tectono-geomorphic studies (Dar et al. 2013; Dar et al. 2014), crustal deformation (Bilham et al. 1998; Lave and Avouac 2000) and seismic hazard mapping (Raj and Nijagunappa 2004; Sitharam and Anbazhagan 2007). Recently, geospatial models, with inputs from remotely sensed data mainly DEMs, have been developed for characterizing geomorphology of an area (Guisan et al. 1999; Jones et al. 2000). However, accuracy and validation of geomorphology derived from satellite platforms remains a major concern for geomorphologists.

As of now, there is not a single high resolution geomorphological map for Himalayas, although very coarse