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ORIGINAL PAPER

An intercomparison of different topography effects on discrimination performance of fuzzy change vector analysis algorithm

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Abstract Detection of snow cover changes is vital for avalanche hazard analysis and flood flashes that arise due to variation in temperature. Hence, multitemporal change detection is one of the practical mean to estimate the snow cover changes over larger area using remotely sensed data. There have been some previous studies that examined how accuracy of change detection analysis is affected by different topography effects over Northwestern Indian Himalayas. The present work emphases on the intercomparison of different topography effects on discrimination performance of fuzzy based change vector analysis (FCVA) as change detection algorithm that includes extraction of change-magnitude and change-direction from a specific pixel belongs multiple or partial membership. The qualitative and quantitative analysis of the proposed FCVA algorithm is performed under topographic conditions and topographic correction conditions. The experimental outcomes confirmed that in change category discrimination procedure, FCVA with topographic correction achieved 86.8% overall accuracy and 4.8% decay (82% of overall accuracy) is found in FCVA without topographic correction. This study suggests that by incorporating the topographic correction model over mountainous region satellite imagery, performance of FCVA algorithm can be significantly improved up to great extent in terms of determining actual change categories.

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1 Introduction

Satellite remote sensing data delivers a rapid way to monitor various features of environmental structure over larger area alike Northwestern Indian Himalayas. Such regions are generally covered with snow and become a natural resource in runoff of water channels but unpredictable fluctuations in snow may lead to snow avalanche or flash floods (Ramamoorthi and Haefner 1991; Gurung et al. 2011). To acquire or monitor the snow cover information over such inaccessible Northwestern Himalayan mountain ranges, multitemporal change detection is a significant method to analyze consistent variations over thousands of square kilometers. Hence, accurate and efficient change detection of such activities are essential to deliver: (a) better understanding of interactions between human and natural phenomena, (b) up-to-date information of snow and water equivalence, (c) monitoring and prediction of snow melt runoff, and (d) scientific solutions to manage renewable resources (Lu et al. 2004; Coppin and Bauer 1996; Gillanders et al. 2008; Almutairi and Warner 2010; Chen et al. 2011; Chunyang et al. 2013).

Since past few decades, a synoptic review of various change detection techniques was summarized (Lu et al. 2004). Amongst different algorithms, a conceptual extension of image differencing technique, named as change vector analysis (CVA) provides level headed capability of describing change in terms of both magnitude and direction in multispectral space (Lambin and Strahler 1994; Jensen 1996). Initially, Malila (1980) developed CVA for detecting

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