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कॉन्टैक्ट

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...on a mission for transferring technology through education, research and capacity building

CONTENTS

EDITORIAL

An efficient and effective disaster management requires infusion of space technology, which is developing at a rapid pace due to both technological advancements and greater demand caused by emerging business opportunities and security concerns. The global community has experienced the benefit of space technology in disaster management support through various national, regional and global efforts including International Charter for Space and Major Disasters. One of the most critical elementsfor infusion of the right kind of space technology in disaster management support requires appropriate research and capacity building in this new domain of scientific endeavor. It involves real time to near real time processing of satellite and other sensor data and derivation of knowledge products that would serve a variety of disasters in different stages of disaster management. Due to recent advances of sensor technology starting from high resolution optical imaging to LIDAR and space-based geophysical observations including space gravity and magnetism, it is imperative that sufficient research and capacity building is developed to enable these technologies meet the dual requirement of disaster risk reduction and sustainable development -the main agenda ofthe Sendai Framework for Disaster Risk Reduction 2015-2030. Under this programme, four priorities have been identified to be addressed at local, national and global levels: a) understanding disaster risk, b) risk governance, c) investing in DRR and d) enhancement of disaster preparedness, space and allied spatial technology.

IIRS, an ISRO organization mandated for capacity building through research and education, has initiated several short term and long term training and education programmes on natural hazards and disaster risk management. Education and training in this rapidly growing space technology field cannot exist without research initiatives. Under various research initiatives of IIRS including Disaster Management Support Programme (DMSP) of ISRO, issues related to sustainable development, mountain ecosystem, infrastructure development and natural hazards are addressed in a complementary as well as integrated manner. In the present issue of CONTACT, an attempt has been made to present some of the important accomplishments and recent initiatives related to disaster management support. Additionally, several important technological and scientific endeavours have been listed that can directly and indirectly support natural hazards and disaster management studies. I hope, through this special issue, students and researchers and IIRS alumni members would get a feel of recent research and capacity building in space technology and its applications at national and international levels.

A. Senthil Kumar
Director, IIRS

TECHNICAL COMMUNICATIONS

Numerical Simulation and Modeling of Debris flow at Tangni (Pagal Nala), Joshimath, Uttarakhand using Earth Observation Data

Debris flows are kind of mass movements that cause significant damage to property and loss of lives and pose a serious threat to the tectonically fragile Uttarakhand Himalaya. Comprehensive assessment of landslide hazard, pertinently, requires process-based modeling using simulation methods. Objectivity is further added, especially if the simulation is executed by numerical methods. However, development of precipitation triggered debris flow simulation models of real events are still in a budding stage in India. A highly objective simulation technique has therefore been envisaged in this study to model the debris flow run-out that took place in Tangni, close to Joshimath town in Uttarakhand. This landslide has been reported to frequently affect the Badrinath highway for last few decades, almost in every rainy season. Literature revealed this old landslide as Pagal Nala or Pagal Jhora also as the nala flows through the very heart of the landslide and joins river Alaknanda. The simulation technique takes cues from a basic high-resolution DEM (10m), LISS-IV (5.8m) satellite image and other ancillary ground data including geotechnical and frictional parameters. The algorithm is based on Voellmy frictional parameters (dry and turbulent frictional coefficients, m and x respectively) of debris flow with pre-defined release area identified on high resolution satellite images. The model provides critical quantitative information on flow 1) velocity, 2) height, 3) momentum, and 4) pressure along the entrainment path (Figure 1). The simulated velocity was modelled to be 9m/s at the base. The simulated maximum height was around 8m which gradually declined to 3.7m near the zone of deposition. At the road (Badrinath highway) cross cut, the values of velocity and height are 20m/s and 4.5m respectively. The simulated output can be visualized on 3D perspective with animations and geotagged on google earth platform with relevant projections. These results can be very useful in engineering intervention like construction of check dams to digest the initial thrust of the flow and other remedial measures designed for vulnerable slope protection.

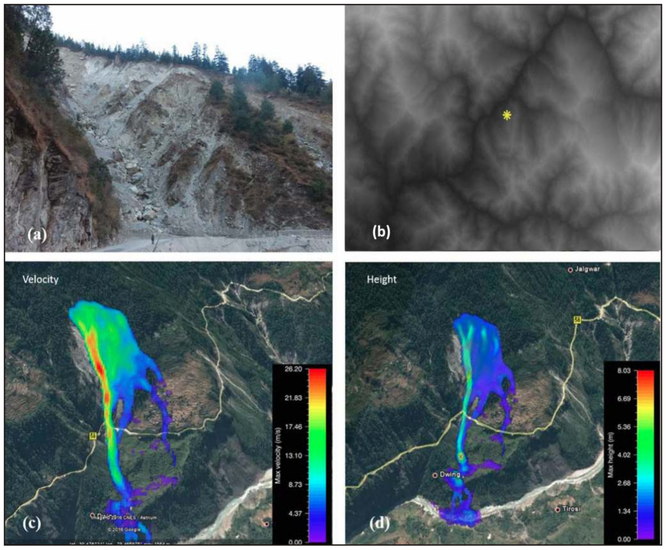


Fig. 1: (a) Field photo of Tangni Landslide (upper half) (as on March, 2017); (b) Subset of ALOS PALSAR DEM of Tangni area (location of Tangni marked by yellow point); (c-d) Spatial variation of velocity and height along the debris flow runout.

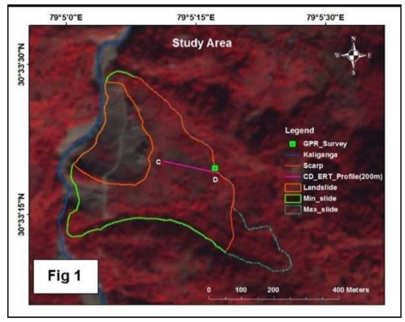
- Sanjay P., Shovan L. Chattoraj, P.K. Champati ray and Suresh Kannaujiya

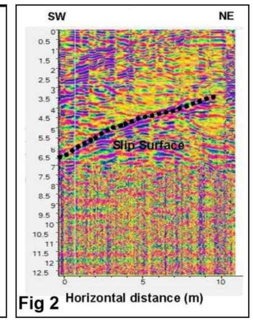
Landslide Characterization using Remote Sensing and Advanced Geophysical Techniques at Kunjethi Village, Kalimath, Garhwal Himalaya

During the extreme precipitation event of 15^{th}-17^{th} June 2013 in Garhwal Himalaya, Glacial Lake Outburst Flooding (GLOF) accompanied by numerous landslides, river erosion caused wide spread deaths and destruction in the Mandakini valley. This event also had an adverse impact on stability of hill slopes and steep riverbanks. Quick survey aided by satellite image analysis helped to identify many such vulnerable slopes marked by subsidence, ground rupture, development of fractures and scarps.

One such spectacular scarp of approximately 685 m in length had developed in river Kali Ganga on the left bank close to Kalimath village (Figure 1). In order to assess the landslide risk, the depth of failure plane, zone of accumulation of water/ moisture zone, a highly cost effective and faster non-invasive geophysical technique viz. two-dimensional electrical resistivity tomography (ERT) and ground penetrating radar (GPR) were used. By using 2D ERT profiles across the developed scarp obtained by pole-dipole configuration of 40 electrodes at an interval of 5 m, weighted average depth of the slip surface was estimated. This was aided by a GPR profile obtained by using 100 MHz antenna.

The slip surface has been interpreted to be at weighted average depth of 18 m approximately (Figure 3). High resolution GPR radargram profile (Figure 2) which was carried out at location marked on the ERT profile (Figure 3), has clearly identified the slip surface at the depth of 6.5 m. The average depth to slip surface obtained in same location from ERT profile is same as the depth obtained from GPR radargarm. Therefore presence of slip surface was confirmed by both the geophysical methods. Studies on relationship between landslide event, 3 day cumulative and 15 day antecedent rainfall data revealed that the high precipitation event of 15th - 17th of June 2013 acted as the main triggering factor for formation of the scarp and initiation of the landslide. This study has established that earth observation tools in integration with faster and cost effective geophysical techniques can establish the subsurface characters of potential landslides, which is an essential information required for landslide disaster risk management.





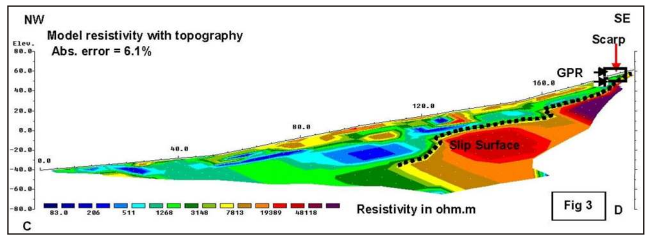


Fig. 1: Landslide scrap near Kalimath Village; Fig. 2: High resolution radargram profile of landslide; Fig. 3: Detection of slip surface

- Suresh Kannaujiya, Dilhani R.K. Jayalath, Shovan Lal Chattoraj and P. K. Champati ray

Avalanche Hazard Site Mapping in Alaknanda Basin

Avalanche mapping and hazard assessment was attempted using Digital Elevation Model (DEM) and satellite imagery in Alaknanda Basin, Uttarakhand. SRTM DEM of 30m resolution was used to extract the terrain attributes like slope, elevation, aspect, and curvature. Land cover map was prepared using the Landsat-8 OLI imagery at a spatial resolution of 30m. Derived thematic layers were integrated using GIS-based Analytical Hierarchical Process (AHP) model to develop an avalanche susceptibility map. The reclassified thematic layers were given separate ratings using a scale varying from 1 to 9. Successively, these thematic layers are integrated into a preference matrix to calculate weight values for each factor and the values in the preference matrix are given using a scale from 1 to 9 (Table 1). The maximum weight was given to the slope factor, followed by

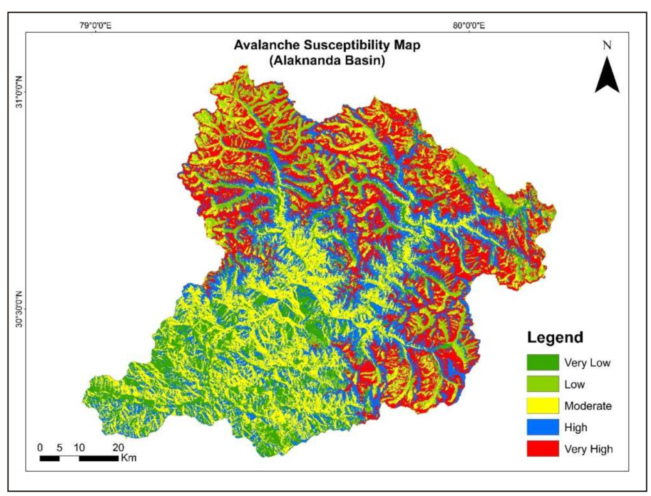


Fig. 1: Avalanche susceptibility map of Alaknanda basin