Use of Space Technology In Glacial Lake Outburst Flood Mitigation: A case study of Imja glacier lake

Abstract:

Glacial Lake Outburst Flood (GLOF) triggered by the climate change affects the mountain ecosystem and livelihood of people in mountainous region. The use of space tools such as RADAR, GNSS, WiFi and GIS by the experts in collaboration with local community could contribute in achieving SDG-13 goals by assisting in GLOF risk identification and mitigation. Reducing geographical barriers, space technology can provide information about glacial lakes situated in inaccessible and high altitudes. A case study of application of these space tools in risk identification and mitigation of Imja Lake of Everest region is presented in this essay.

Article:

Introduction

Climate change has emerged as one of the burning issues of the 21st century. According to Inter Governmental Panel for Climate Change (IPCC), it is defined as ' a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods' (IPCC, 2020). Some of its immediate impacts are increment of global temperature, extreme or low rainfall and accelerated melting of glaciers leading to Glacial Lake Outburst Flood (GLOF). The local people in the vicinity of potential hazards are the ones who have to suffer the most as a consequence of climate change. It would not only cause economic loss but also change the topography of the place, alter the social fabrics and create long-term livelihood issues which might take generations to recover.

As the technology has advanced, the barriers like remoteness of fields and difficulties in collecting data from higher and inaccessible altitudes are easily diminished by the assistance of space tools such as Remote Sensing, RADAR, GNSS, GIS. Likewise, LANDSAT satellites have the optimal ground resolution and spectral bands to efficiently track land use and to document land change due to climate change, urbanization, drought, wildfire, biomass changes and a host of other natural and human-caused changes. (USGS, 2020) Thus, space tools could contribute in achieving the objectives of SDG-13 goal.

Challenges of GLOF

The countries in mountainous region face the threat of Glacial Lake Outburst Floods (GLOF) way beyond imagination. The end moraine (a loose mix of rock debris) of these lakes makes them potentially unstable as the volume of lake water increases and the moraine dam is stressed which eventually may give way to hydrostatic pressure releasing much or all of the lake water. (Rai, 2015) The resultant sudden flood water becomes disastrous to people and settlements along the downstream.

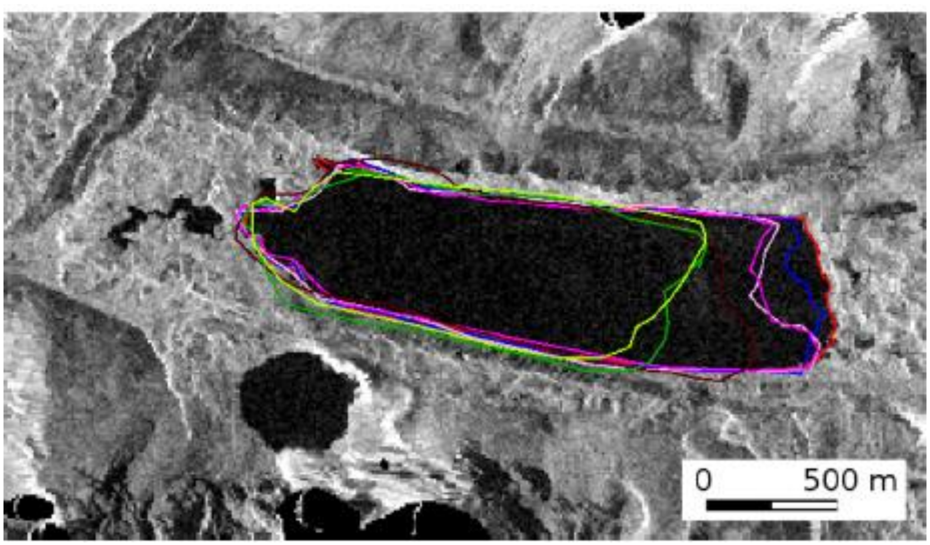
Clearly, a case study of Imja lake GLOF risk identification in the remote Himalayas of Nepal could be one of the instances to analyze the contribution of space tools in disaster mitigation. The lake is located at 27° 53' 55" N latitude, 86° 55' 20" E longitude and at an altitude of 5010 m in the Everest region. It has been identified as one of the glacial lakes with high potential of bursting. (ICIMOD, 2020) It is estimated that sudden burst of Imja lake will cause extensive damage along the entire length of the Imja Khola down to the confluence with Sun Koshi, an overall distance of about 90 km washing away several villages in the downstream (Budhathoki, et al., 2010) .

Like many other glacial lakes in the Himalayan region, Imja lake is also situated in remote mountainous land. So, it is not possible to collect information regularly at the site. This is precisely where space tools play the pivotal role and make the tasks rather easy, convenient and accurate. The collaboration of local youth, experts and analysts can contribute to accomplish the task.

Proposal for development of GLOF early warning system:

Being a third world nation, Nepal generally doesn't have a very high-speed internet required for downloading space-based data. It is proposed to set up a very high-speed internet at an academic institution since single RADAR data can be in range of few Gigabytes. The institution will be dedicated to the analysis of space-based data where analysis of flooding due to the outburst of Imja lake can be a part of it. Alternatively, Sentinelhub, which provides server space (primarily to European institutions) and tools for preliminary analysis such as data clipping, preprocessing etc. can be approached.

Satellite Image



Outlines of Imja derived from ERS-1/2 SAR data of May 1992 (light green), April 1996 (green), July 2001 (brown), ALOS PALSAR data of November 2007 (violet), May 2008 (pink), TerraSAR-X data of April 2009 (blue) and October 2009 (red). Background image is TerraSAR-X data of October 2009 (Strozzi, et al., 2012)

Likewise, it is necessary to set up computers with high processing power with accessibility from multiple client computers for regular processing and analysis of imagery. The author of this article, having experience in the field of GIS, civil engineering and disaster risk management, will collaborate among graduates, professionals and faculties to develop tools to analyze and disseminate information.

As a matter of fact, this whole process of risk identification and mitigation requires the inclusive participation of the local people. So, it is proposed to involve the local community in the leadership of skilled youth member to send geotagged photographic data regularly which can be analyzed by professionals. The most vulnerable section of population as per the proximity to intense GLOF and low economic status will be identified and mapped with community participation.

Several Nepalese faculties working in the field of information science, disaster risk management, water flow modeling can be involved to develop tools to analyze the data collected from space. It is necessary to use multiple radar data as well as imagery from passive sensors to analyze and predict surface area and depth of the lake. As some of these data might need proposal submission, academic institutions will put forward the required proposal for which this author will collaborate.

Finally, the scenarios for the level of dangers for the glacier lake outburst will be prepared in advance. Before the lake reaches the danger of outburst, it is possible to reduce the water level by using siphons and other accessible technology which has already been experimented in Tshorolpa lake. In case of imminent danger of outburst, the communities in the downstream will be warned according to predicted time of river breach at each location.

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Conclusion:

In conclusion, the use of space technology and tools in collaboration with local community to map and monitor glacial lakes assists in coping with GLOF and enhance the disaster resilience approach. This would add further bricks in the foundation of SDG-13 goals to address climate change.

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