

Interdisciplinary Science Applications to Glacier and Alpine Hazards in Relation to Development and Habitation in the Hindu Kush-Himalaya



Imja Lake in Nepal is expanding due to increased glacial melt Credit: Daniel Byers

Why is the AST pursuing this project? Agricultural land, crucial infrastructure, villages, and small cities in the Hindu Kush-Himalaya (HKH) region are vulnerable to evolving alpine disasters. Such disasters include ice avalanches, landslides and rockfalls, glacier lake outburst floods (GLOFs) and associated debris flows, and dam/inundation floods. It is important to understand the dynamics associated with development of these alpine hazards in the HKH in order to accurately identify areas of potential risk.

What does this project do? Focusing on specific glacier-lake systems and glacier-fed landslide dammed lakes identified by regional experts, this project identifies and researches areas that already have, or are likely to, develop hazardous conditions in the near future. These areas include the Seti River Basin, which experienced a deadly flood event in May of 2012, and the large and highly threatening glacier-dammed Thulagi lake, among others.

How will the AST perform this project? The team will perform multispectral image-change analysis on images from NASA's ASTER sensor and process very high-resolution commercial satellite imagery of glacier lakes and hazardous or disaster sites to characterize the state and dynamics

of glaciers and glacier lakes. The team will analyze the topography to (1) identify points that might dam due to landslides impacting glacier meltwater streams or due to glaciers advancing into streams, (2) assess how these phenomena might impact lake areas and volumes, and (3) assess glacier thickness changes and mass balance. Regional institutions will provide data for historical streamflow and glacial melt assessment. The project team will then model the complete basin hydrology (including glacial melting and runoff), which is dependent upon factors like debris cover, altitude, topographic setting, and weather conditions that can vary within a single glacier lake basin.

Accomplishing this assessment down to the damming points of lakes will then allow for experimental modeling of basin lake inflow and outflow conditions during typical and anomalous (above or below average dryness/wetness) years, for peak monsoon conditions, and also for future climate conditions. This basin lake modeling can help in assessing dam stability and the likelihood of GLOF occurrence. The team will also conduct field work in conjunction with ICIMOD and local experts to investigate sites that might be rapidly and perhaps dangerously changing or that have been identified previously as possibly approaching failure. Such field work will provide the data necessary for the team to analyze the hazard level of the selected glacial lake basins and model the possible hydrographs due to outburst floods. These hydrographs will graph the rate of flow (discharge) versus time past a specific point in a river and can help specify the volume of water that could flood near a village and how quickly such flooding would take place. Thus they can support preventative actions for flooding events.

Training, education, and public outreach can equip policy makers and emergency management officials with the project findings and future climate projection impacts. The resulting increased awareness can facilitate disaster preparation. Through SERVIR-HKH, the project team will work with regional institutions to discuss the development of low-tech local disaster warning systems to signal imminent danger when flooding events occur.

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Where is this project used? Alpine regions of Hindu Kush-Himalaya

When will it be available? 2016

Who are the co-developers?

Who are the contributors/partners? University of Arizona, ICIMOD for lake basin selection and available glacier lake datasets, University of Dayton, University of Colorado-Boulder, The University of Alberta, University of Minnesota, HYDRONALIX, Inc., The Regents of the University of Colorado, Society for Ecological Restoration-Nepal

Who uses it? Public safety authorities in Bhutan, Nepal, India, and Pakistan

What Earth observations and NASA products contributed to this application? Ikonos multispectral and panchromatic imagery and other commercial satellite sensor data, ASTER and landsat sensor images, Advanced Spaceborne Thermal Emission and Reflection Radiometer Global Digital Elevation Model (ASTER GDEM) data and GDEM2, Shuttle Radar Topography Mission (STRM) topography, local hydrographic and climate data, field data collected, during this project including Lake Bathymetry and Lakebed Sonar Imaging

For more information:

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