Improving remote sensing techniques for glacial hazard assessment (KTP.3742)

Outbursts from glacial lakes, formed as glaciers retreat in response to climatic changes, are a threat to lives, livelihoods, industry and infrastructure in many high-mountain regions (OECD, 2003). Techniques for the assessment of such hazards using remote sensing data have been developed through this three-year Knowledge Transfer Partnership (KTP) in association with the Institute of Geography and Earth Sciences, University of Wales, Aberystwyth.

Glaciers and glacial lakes were visited in Nepal and Peru to collect field data used to calibrate and constrain analyses from several different types of remote sensing data (aerial photographs, multispectral satellite imagery, microwave radar data). Using these data, key aspects of glacier-lake systems have been investigated resulting in analytical procedures for application to hazard assessments and monitoring projects.

GLACIER & LAKE INVENTORY COMPILATION

Accurate and up-to-date recording of glaciers and their lakes is seen as the first step in their assessment. For this project, analyses have been focused on automatic versus manual classifications of glaciers and lakes, the accuracy of satellite-derived elevation data for collecting essential statistics, and protocols for the inclusion of multiple datasets within Geographical Information System (GIS) databases.

ASSESSING GLACIER DYNAMICS

Offset tracking and differential interferometry techniques to measure glacier velocities from satellite radar data have been developed. These have been applied to debris-covered glaciers for the first time and are being used to look at the relationship between glacier stagnation and lake development. Glacier velocities and lake development are also linked to the surface gradient of glaciers, which have been mapped and analysed using segmentation relation analyses. These approaches have resulted in a predictive procedure to determine the likelihood of lake formation on debris-mantled glaciers.
CHARACTERISING MORAINE DAMS

The geometry of lake dams have been analysed using topographic data and rule-based classifications. This information allows RGSL to make quantitative assessments of those lakes at greatest risk of outburst, and where points of dam overtopping are most likely to occur. Furthermore, assessments of the rate of change of dams (e.g. subsidence of dams due to the melting of buried ice) and glacier surfaces (e.g. downwasting) are possible through the high-resolution digital photogrammetric methods developed.

Reynolds Geo-Sciences Ltd is now equipped with a powerful suite of tools to study and visualise glacial environments remotely. These bespoke techniques allow, for the first time, systematic regional mapping studies to assess and routinely monitor hazardous glacial lakes (below left), and the identification of glaciers with the potential to develop dangerous lakes (below right).

INTEGRATED REGIONAL STUDIES

Reference:


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