Geophysical Research Abstracts
Vol. 12, EGU2010-4946, 2010
EGU General Assembly 2010
© Author(s) 2010

Challenges in understanding, modelling, and mitigating Lake Outburst Flood Hazard: experiences from Central Asia

Martin Mergili (1), Demian Schneider (2), Norina Andres (2), Raphael Worni (3), Fabian Gruber (1), and Jean F. Schneider (1)

(1) Institute of Applied Geology, Department of Civil Engineering and Natural Hazards, University of Natural Resources and Applied Life Sciences (BOKU), Peter-Jordan-Strasse 70, A-1190 Vienna, Austria (martin.mergili@boku.ac.at), (2) Glaciology, Geomorphodynamics and Geochronology, Department of Geography, University of Zurich, Winterthurerstrasse 190, CH-8057 Zurich, Switzerland, (3) Laboratory for Dendrogeomorphology, Institute of Geological Sciences, University of Berne, Baltzerstrasse 1-3, CH-3012 Berne, Switzerland

Lake Outburst Floods can evolve from complex process chains like avalanches of rock or ice that produce flood waves in a lake which may overtop and eventually breach glacial, morainic, landslide, or artificial dams. Rising lake levels can lead to progressive incision and destabilization of a dam, to enhanced ground water flow (piping), or even to hydrostatic failure of ice dams which can cause sudden outflow of accumulated water. These events often have a highly destructive potential because a large amount of water is released in a short time, with a high capacity to erode loose debris, leading to a powerful debris flow with a long travel distance. The best-known example of a lake outburst flood is the Vajont event (Northern Italy, 1963), where a landslide rushed into an artificial lake which spilled over and caused a flood leading to almost 2000 fatalities.

Hazards from the failure of landslide dams are often (not always) fairly manageable: most breaches occur in the first few days or weeks after the landslide event and the rapid construction of a spillway - though problematic - has solved some hazardous situations (e.g. in the case of Hattian landslide in 2005 in Pakistan). Older dams, like Usoi dam (Lake Sarez) in Tajikistan, are usually fairly stable, though landsildes into the lakes may create floodwaves overtopping and eventually weakening the dams.

The analysis and the mitigation of glacial lake outburst flood (GLOF) hazard remains a challenge. A number of GLOFs resulting in fatalities and severe damage have occurred during the previous decades, particularly in the Himalayas and in the mountains of Central Asia (Pamir, Tien Shan). The source area is usually far away from the area of impact and events occur at very long intervals or as singularities, so that the population at risk is usually not prepared.

Even though potentially hazardous lakes can be identified relatively easily with remote sensing and field work, modeling and predicting of GLOFs (and also the outburst of landslide-dammed lakes) remains a challenge:

• The knowledge about the onset of the process is often limited (bathymetry of the lakes, subsurface water, properties of dam (content of ice), type of dam breach, understanding of process chains and interactions).

• The size of glacial lakes may change rapidly but continuously, and many lakes break out within a short time after their development. Continuous monitoring is therefore required to keep updated on the existing hazards.

• Also the outburst of small glacial lakes may lead to significant debris floods or even debris flows if there is plenty of erodible material available.

• The available modeling software packages are of limited suitability for lake outburst floods: e.g. software developed by the hydrological community is specialized to simulate (debris) floods with input hydrographs on moderately steep flow channels and with lower sediment loads. In contrast to this, programs for rapid mass movements are better suited on steeper slopes and sudden onset of the movement. The typical characteristics of GLOFs are in between and vary for different channel sections.

In summary, the major bottlenecks remain in deriving realistic or worst case scenarios and predicting their magnitude and area of impact. This mainly concerns uncertainties in the dam break process, involved volumes, erosion rates, changing rheologies, and the limited capabilities of available software packages to simulate process interactions and transformations such as the development of a hyperconcentrated flow into a debris flow.

In addition, many areas prone to lake outburst floods are located in developing countries with a limited scope of

the threatened population for decision-making and limited resources for mitigation.