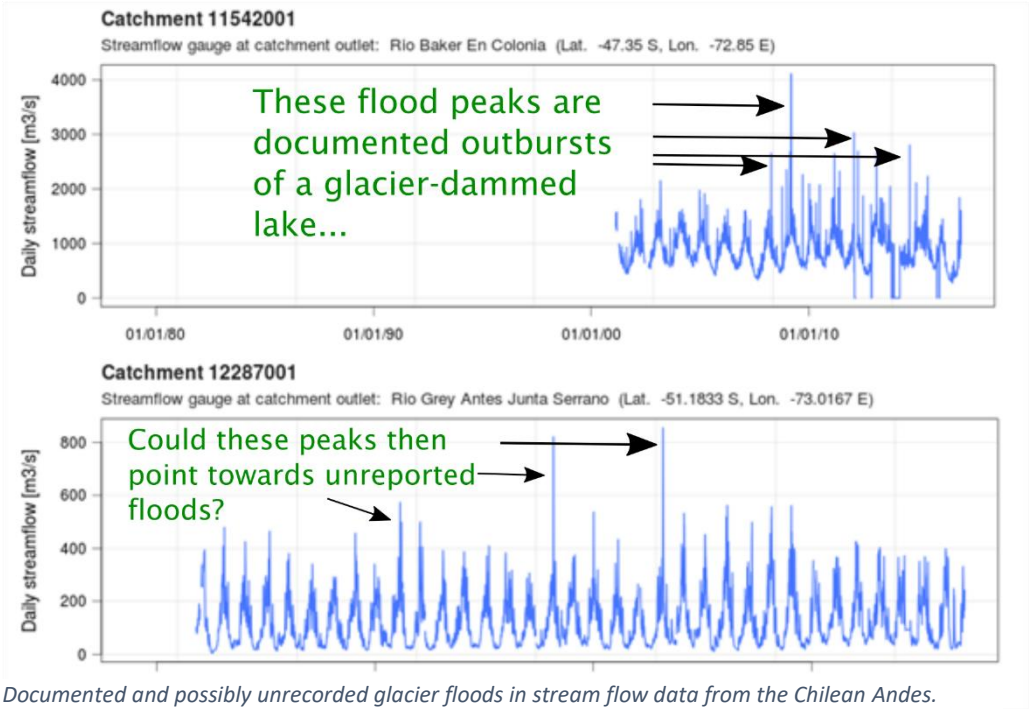
Master theses:
Hidden glacier lake outburst floods in Chile?

Downstream impact from a glacier flood in Peru in the wake of a moraine dam failure. Source: Adam Emmer (http://glofs-database.org/)

Floods from glacier- or moraine-dammed lakes have repeatedly claimed human lives and damaged farmland and infrastructure in the Chilean Andes. Despite the hazard that these floods pose, data on their occurrences have been collated largely unsystematically. Yet, the handful of case studies show that glacier floods in this region rank among the largest historically reported floods on Earth, each transporting millions of cubic meters of water, sediment, and woody debris within hours[1].

Assessing hazard and risk from glacier floods demands robust baseline data that describe how frequently these floods occur in a given region and how large (in terms of volume or maximum discharge) they are. Because of their origin in remote locations, many glacier floods may have eluded documentation by scientists or public authorities. Several decades of freely available streamflow data and satellite images could help to detect previously unrecorded cases. Such an updated inventory of glacier floods allows to test whether flood frequency and magnitude have changed in the Andes, possibly as an effect of atmospheric warming in recent decades.



Documented and possibly unrecorded glacier floods in stream flow data from the Chilean Andes. Source: http://camels.cr2.cl/

The working group ‘Natural hazards’ offers

two Master theses

to systematically analyse the distribution of glacier floods in the Southern Andes.

Master thesis 1 will focus on extending the inventory of glacier floods in the Chilean Andes using streamflow data and Landsat images. The Master student will search for tell-tale flood spikes in daily streamflow data from selected gauging stations[2], and cross-check with Landsat images and other meteorological data (temperature, rainfall) to exclude other meteorological floods. Ideally, she or he will develop a tool for automatically identifying the signature from glacier floods in stream flow data, which allows to efficiently calculate peak discharge and flood volume. The ideal candidate will bring advanced expertise in analysing and visualising univariate time series in a statistical programming language (R, Python, Matlab, or equivalent). The candidate will have a good command in a GIS environment (ArcGIS, QGIS, SAGA-GIS, or equivalent) to verify and display impacts from glacier floods.
Master thesis 2 aims at generating a consistent database of glacier floods in the Chilean Andes. The candidate will expand current glacier flood inventories[3–5], scanning scientific and public reports for floods occurrences and associated characteristics, ideally incorporating the results from Master thesis 1. She or he will test whether flood frequency or magnitude have changed, and correlate this finding with freely available meteorological data to trace the effects of atmospheric warming. The ideal candidate has expertise in a statistical programming language (R, Python, Matlab, or equivalent) to analyse and visualise time series of documented floods. Good command in (reading) Spanish will be an asset.

The working group ‘Natural hazards’ is a small team of innovative data scientists, working at the interface between natural hazards, geomorphology, and hydrology. We offer close and regular supervision of the Master students’ projects. We thus encourage interested students to present and discuss their progress in our weekly group seminar.
Interested? Please contact Georg Veh via e-mail (georg.veh@uni-potsdam) for further questions. Work on the theses can start immediately, given that all data are freely available and no field work is required.

Potsdam, 08 June 2020

Further reading:

1. Jacquet, J. *et al.* Hydrologic and geomorphic changes resulting from episodic glacial lake outburst floods: Rio Colonia, Patagonia, Chile: CHANGE RESULTING FROM RIO COLONIA GLOFS. *Geophys. Res. Lett.* **44**, 854–864 (2017).
2. Alvarez-Garreton, C. *et al.* The CAMELS-CL dataset: catchment attributes and meteorology for large sample studies – Chile dataset. *Hydrol Earth Syst Sci* **22**, 5817–5846 (2018).
3. Wilson, R. *et al.* Glacial lakes of the Central and Patagonian Andes. *Glob. Planet. Change* **162**, 275–291 (2018).
4. Carrivick, J. L. & Tweed, F. S. A global assessment of the societal impacts of glacier outburst floods. *Glob. Planet. Change* **144**, 1–16 (2016).
5. Iribarren Anacona, P., Mackintosh, A. & Norton, K. P. Hazardous processes and events from glacier and permafrost areas: lessons from the Chilean and Argentinean Andes. *Earth Surf. Process. Landf.* **40**, 2–21 (2015).