SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Physical Geography

has the honor to invite you to the public defence of the PhD thesis of

Lander Van Tricht

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Glacier observation and modelling at local to regional scales in the Tien Shan, Central Asia

Promotor:
Prof. dr. Philippe Huybrechts

The defence will take place on

Friday, December 8, 2023 at 16h in D2.01

The defence can also be followed through a live stream: https://shorturl.at/BKN48

Members of the jury

Prof. dr. Benoît Smets (VUB, chair)
Prof. dr. Harry Zekollari (VUB, secretary)
Prof. dr. Ann Van Griensven (VUB)
Prof. dr. Walter Immerzeel (Utrecht University, the Netherlands)
Prof. dr. Martina Barandun (University of Fribourg, Switzerland)

Curriculum vitae

In 2018, Lander Van Tricht graduated with distinction as Master of Science in Geography, specialising in Earth and Climate from the KUL/VUB. Subsequently, he pursued a PhD at VUB's Geography Department, funded by the Research Foundation Flanders (FWO). In 2022, he secured an FWO grant for a research stay at ETH Zürich. Lander published eight papers and authored a quality brief on glaciers changes. His work extends to manuscript reviews and presentations at over 15 conferences. Beyond academia, Lander demonstrates proficiency in science communication, sharing his cryospheric science expertise through outreach activities and media interviews. As a licensed drone pilot, he contributed significantly to field campaigns and guided multiple thesis students.

Abstract of the PhD research

The Tien Shan mountain range in Central Asia is home to approximately 15.000 glaciers which play a crucial role in providing water during dry summer periods when other water sources have dried up and precipitation is scarce. The glaciers release meltwater that supports agriculture, industry, hydropower production and daily life, acting as natural water reservoirs. However, the effects of global climate change have led to an alarming rate of glacier melt in the Tien Shan, posing a significant threat to the region's water supply.

This PhD project aimed to understand the present state and future evolution of the Tien Shan glaciers. It involved fieldwork and delving into historical and ongoing monitoring efforts, focusing on mass balance, ice thickness and thermal conditions. Six glaciers in Kyrgyzstan were selected for detailed analysis, due to their inclusion in monitoring initiatives. Our team conducted more than 1.600 ice thickness measurements, revealing a maximum ice thickness of 201 ± 12 m. Comparing these measurements with global estimates made without in-situ data provided a reasonable estimate of the ice volume, though local ice thickness varied notably. Mass balance observations over the past two decades showed a strong negative signal under the present climate. Examining the thermal structure of the glaciers revealed distinct thermal regimes, primarily influenced by variations in snow cover, ice thickness and refreezing meltwater.

We refined, calibrated and applied a 3D ice flow and 1D energy balance model to these glaciers using collected and existing data. Future glacier evolution was simulated under various climate scenarios, whereas a comparison between the results of detailed versus simplified models served to assess the impact of simplifications on future ice volume. At the end of this project, we employed GloGEMflow to estimate future changes of all Tien Shan glaciers, focusing on future glacial runoff in various Tien Shan basins.

Our results show that under moderate warming, most Tien Shan glaciers are projected to significantly retreat. This will heavily impact glacial runoff, yielding peak water in all basins before 2050, followed by a strong decline of on average 35% relative to current quantities. Additionally, the annual runoff peak is anticipated to shift from summer to late spring, distancing from dry summer months characterised by highest water demand. These findings underscore the urgency of implementing strategies in agricultural, industrial and energy sectors to secure long-term water resources and prevent water conflicts in the Tien Shan region.