International Association of Geomorphologists

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and

ICG2026 Young Geomorphologists Training Program
"Methods for assessing geomorphic processes and change"

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Report

Elok Surya Pratiwi

Research Center of Land Resource Management, Universitas Gadjah Mada, Indonesia
Pratiwi.eloksurya@gmail.com

Geomorphology is a study of landforms and their evolution through time. Consequently, for a geomorphologist, understanding various methods used to observe and assess geomorphic processes and landscape change is essential. The theme of the Young Geomorphologist Training Program 2026, held in Christchurch, New Zealand, emphasized the introduction of diverse techniques for observing geomorphic processes and landform changes over time. This program provided a highly valuable experience for me as an early-career researcher who had only recently completed my doctoral degree at the beginning of 2025. The training program associated with the International Conference on Geomorphology 2026 was organized in three main formats: a pre-conference field trip, laboratory-based courses, and conference sessions.

A. Pre-conference Field Trip

The field trip for young geomorphologists was conducted prior to the conference in the Cass region and its surrounding areas (**Figure 1**). This field area represents a landscape shaped by the interaction of tectonic activity, climatic conditions, and glacial history, creating one of the most dynamic alpine environments in New Zealand. Evidence of tectonic processes that have contributed to the formation of the mountain landscape can be observed at the first stop site near Porter's Pass. Although the fault structure cannot be directly observed in the field, oblique aerial photographs clearly reveal a geomorphic lineament that has been dissected by the Porter's Pass Fault, one of the major active faults in the region.

The second stop introduced us to karst landforms located within the Castle Hill Basin. Karst landforms are unique landscapes formed through dissolution processes acting on carbonate rocks. The presence of karst landforms within mountainous terrain provides important insights into the geological and geomorphological evolution of the region. Carbonate rocks such as limestone originate from the accumulation of marine organisms,

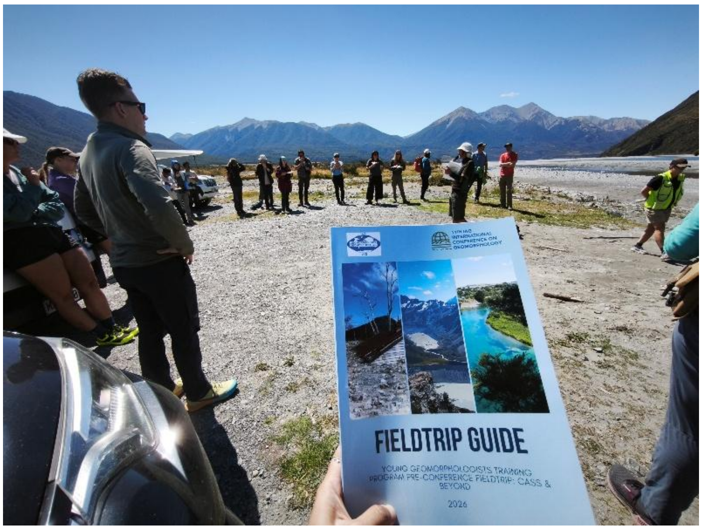


Figure 1. Pre-conference fieldtrip for young geomorphologist in the Cass region and beyond.

including coral deposits, indicating that the present mountainous landscape was once a shallow marine environment. Radiometric dating suggests that submarine deposition occurred during the Oligocene epoch. Subsequent tectonic uplift raised these marine sediments to high elevations. Once exposed at the surface, the limestone interacted with climatic and biological factors, allowing dissolution processes to occur and gradually shaping the spectacular karst landscape observed today, characterized by prominent limestone tors (**Figure 2**).

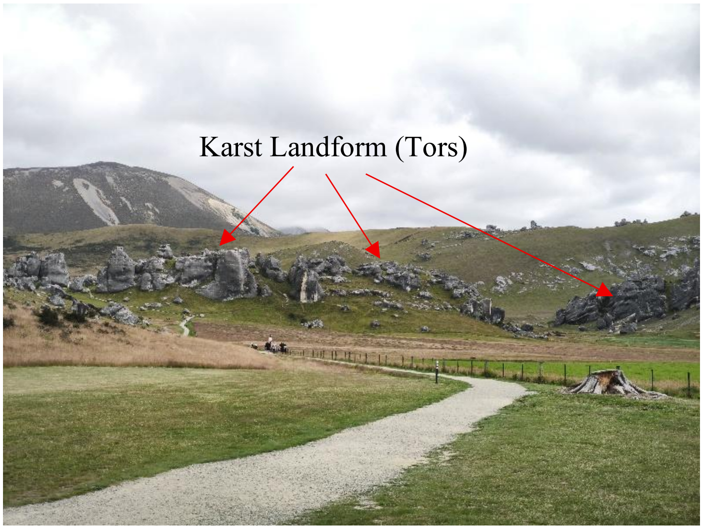


Figure 2. Tors, the spectacular karst landform found in the trip area.

The third stop focused on the Waimakariri River, which exhibits a braided river system typical of the South Island of New Zealand. The development of such a multi-channel river system is strongly controlled by the geological and geomorphological setting of the surrounding alpine environment. First, the mountain ranges are largely composed of sedimentary rocks, including marine sandstone and greywacke, which are relatively susceptible to weathering and therefore act as significant sources of loose sediment. Second, the steep slopes of the mountain terrain promote frequent mass movement processes, such as debris flows and the formation of alluvial fans, along tributary valleys. These processes supply large volumes of sediment to the river system. Finally, the river valley itself is highly erodible, providing sufficient space for channel migration and lateral mobility. Due to this high level of channel mobility, monitoring changes in river channels and discharge is critically important, particularly because flood events pose potential hazards to infrastructure and densely populated areas located downstream.

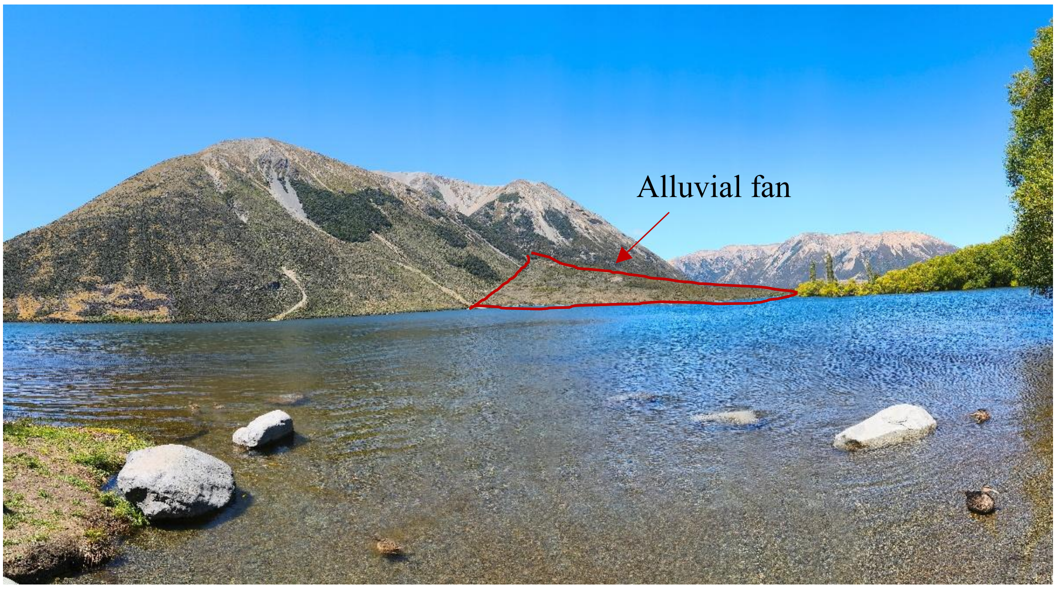
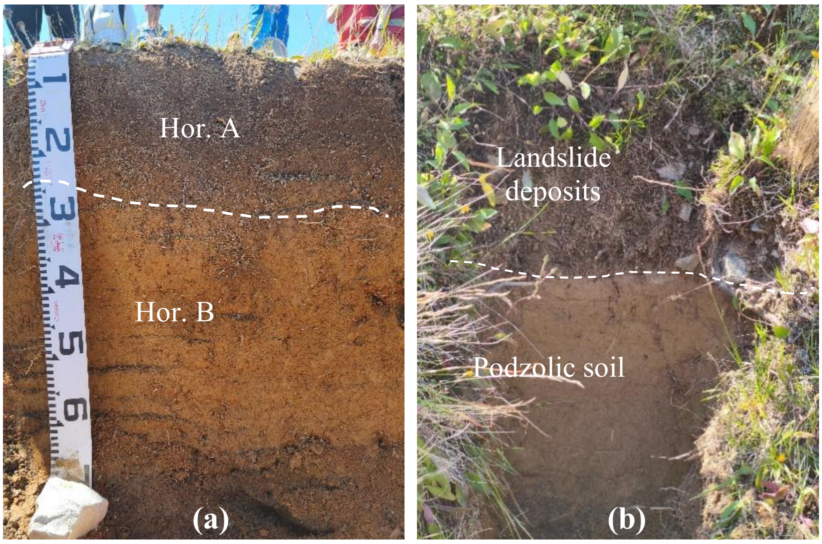


Figure 3. Alluvial fan as one of the most common fluvio-gravitational process in the trip area

The fourth stop examined the processes responsible for the formation of alluvial fans and debris flows, two types of mass movement landforms that continue to actively reshape the mountainous landscape. Both landforms are produced by the downslope movement of sediment, but they differ in the dominant driving forces involved. Debris flows are primarily driven by gravitational forces acting on water-saturated sediment, whereas alluvial fans are more strongly influenced by fluvial processes. These two landforms can also be distinguished by their morphology. Debris-flow deposits typically form steeper conical slopes, while alluvial fans tend to have gentler gradients. Furthermore, the stronger influence of flowing water in alluvial fan systems results in sediments that are generally finer and better sorted compared with debris-flow deposits, which are typically coarser and poorly sorted due to the dominance of gravitational transport. In some cases, alluvial fan deposits extend into river valleys and partially obstruct river flow, forming lakes such as Lake Pearson (**Figure 3**).

At the final stop, we explored how soils can provide valuable information about the long-term evolution of landforms. Soil formation, or pedogenesis, results from the interaction of several key factors: climate, organisms, parent material, relief, and time. Therefore, differences in soil characteristics or stages of soil development often indicate that geomorphic processes have altered one or more of these controlling factors over time. For example, along a topographic cross-section of the Red Hill Stream terrace, we observed several stages of soil development that reflect the geomorphic dynamics occurring after the formation of the terrace surface. At the first observation point, we encountered a well-developed podzolic soil characterized by a relatively thick B horizon underlying an A horizon rich in organic matter. At a second location nearby, we found a podzolic soil profile that had been buried by a poorly sorted sediment deposit (**Figure 4**). The contrast between these two soil profiles suggests different geomorphic histories: the first site appears relatively stable and has not been significantly affected by mass movement processes, whereas the second site indicates that a landslide event deposited new material and buried the older soil horizon. This example clearly demonstrates how soil science provides valuable insights for geomorphologists in reconstructing landform evolution.



Fugure 4. Soil profile observations reflecting recent geomorphic dynamics within terrace landforms. (a) A well-developed podzolic soil formed on the terrace surface. (b) A buried podzolic soil indicating that part of the terrace has been covered by landslide deposits.

B. Geomorphic Change Detection (GCD) Software Course

During the training program, I also participated in a short course on the use of Geomorphic Change Detection (GCD) software (**Figure 5**). This software is primarily designed to quantify and analyze topographic change by comparing elevation differences derived from Digital Elevation Model (DEM) datasets collected at different times. This approach, commonly referred to as the DEM of Difference (DoD), allows researchers to identify and quantify areas experiencing erosion or sediment deposition as a result of geomorphic processes. Through the analysis of DoD, areas undergoing erosion can be identified by a decrease in elevation between two temporal DEM datasets, while areas experiencing sediment deposition are indicated by an increase in elevation. This method is particularly useful for studying fluvial processes, where river channels continuously adjust through erosion, sediment transport, and deposition.

During the course, I had the opportunity to directly practice using the GCD software to analyze sediment dynamics in a braided river system near Christchurch. The training focused on several key steps required to conduct a reliable geomorphic change analysis. First, it is essential to obtain multi-temporal DEM datasets that have already undergone co-registration, ensuring that the spatial alignment between datasets is accurate. Proper co-registration is critical because even minor spatial offsets between DEM datasets can lead to significant errors in the resulting DoD analysis.

The next step involves identifying and quantifying the uncertainty or error associated with each DEM dataset. Understanding DEM error is crucial for evaluating the reliability of the calculated topographic changes and for distinguishing actual geomorphic change from noise or measurement uncertainty. In fluvial environments, an additional step is required to separate areas located above the water surface from those beneath it. Sediments located below the water surface are typically represented using bathymetric DEM data, which capture underwater channel morphology.

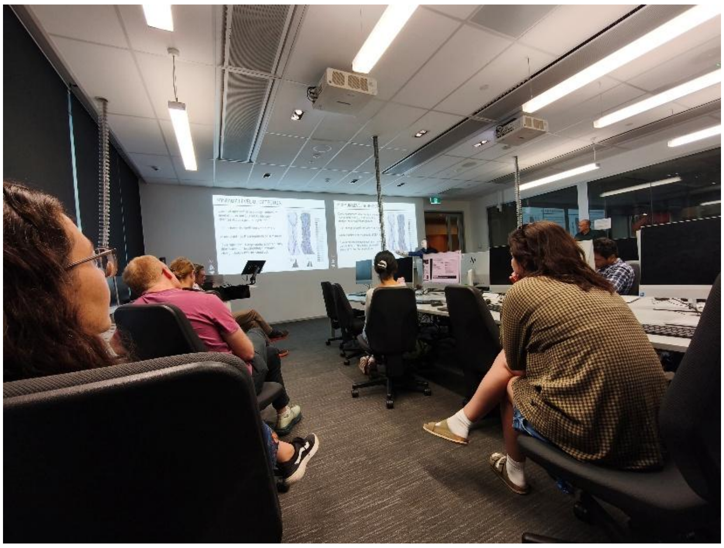


Figure 5. Geomorphic Change Detection course held at the University of Canterbury as part of the Young Geomorphologists Training Program.

Once these datasets and error parameters are properly defined, the temporal DEMs are imported into the GCD software to generate the DoD analysis. The results are presented in both graphical outputs and spatial DEM products. The graphical outputs quantify the volume of sediment eroded and deposited within the study area, while the spatial DoD map highlights the specific locations where erosion and sedimentation have occurred.

This course provided valuable insight into one of the most widely used methods for detecting and quantifying geomorphic change. By applying such techniques, geomorphologists can better understand how geomorphic systems evolve through time and how sediment is redistributed within landscapes. Furthermore, this type of analysis can support hazard assessment by helping researchers identify where geomorphic processes are likely to intensify and potentially threaten infrastructure or communities. In the context of fluvial systems, for example, understanding sediment dynamics is essential for anticipating flood-related hazards and channel instability.

C. The 2026 International Conference of Geomorphology

During the ICG 2026, I had the opportunity to participate as a poster presenter (**Figure 6**). My presentation was scheduled in the third poster session, where I presented findings from my PhD research entitled “Visual Story-based Geomorphological Maps (VSGM): An Innovative Tool for Enhancing Landslide Risk Communication in Indonesia.”. The session provided an excellent opportunity to interact with researchers from different countries and disciplinary backgrounds.

In addition to presenting my research, I was also very pleased to participate in the full conference program over four days. The conference brought together a wide range of studies addressing various themes in contemporary geomorphology, including landscape evolution, fluvial processes, tectonic geomorphology, and environmental change. Attending these sessions provided valuable insights into current research trends and methodological developments within the field.

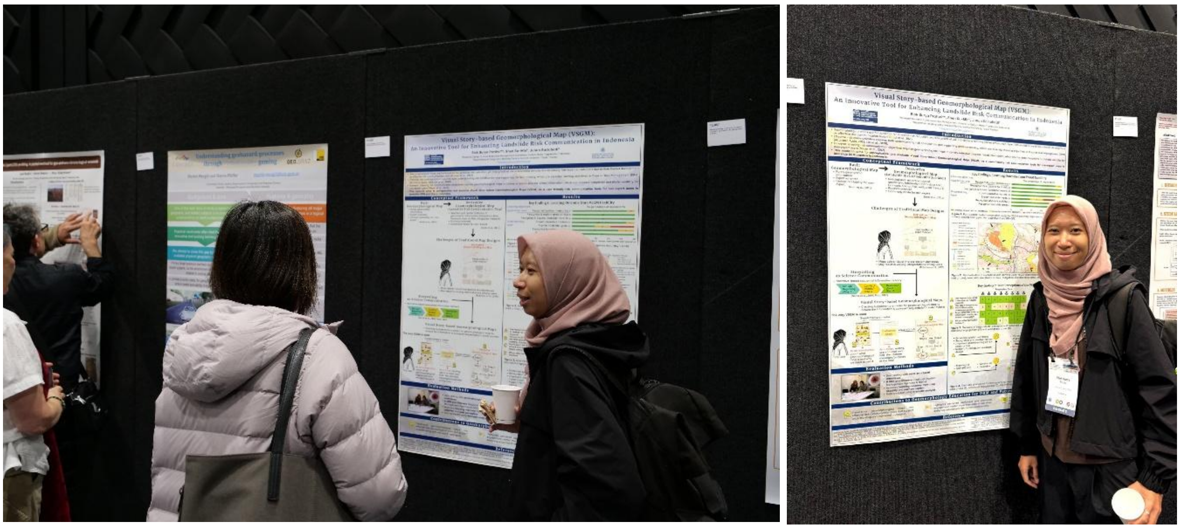


Figure 6. Poster presentation at the International Conference on Geomorphology 2026.

Overall, the conference was a highly inspiring experience. It not only broadened my scientific perspective but also encouraged me to reflect on potential future research directions. Exposure to diverse research topics, innovative methodologies, and international collaborations motivated me to further develop my work as an early-career geomorphologist, particularly in the area of geomorphological science communication and its role in improving public awareness of natural hazards.