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High Mountain Plateau Margin Critical Zone Observatory, Kaligandaki River Nepal

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Mountains are hotspots for earth surface processes, with very fast erosion rates, mass movements, catastrophic flooding and enhanced geochemical weathering rates. These landscapes respond quickly to external forcing by tectonics and/or climate. As a consequence, the hazard potential in mountains is very high, and mountains produce a wide range of large catastrophes which often have wide-reaching impacts on infrastructure and human lives. Furthermore, mountains can be considered as the water towers of the world, as they are very effective at harvesting water from the atmosphere, storing it, and redistributing it to the adjacent lowlands. The key role of mountain regions can be extended endlessly to other disciplines such as ecology, climatology, social sciences and so forth. Yet, despite their importance, high mountains remain inaccessible and notoriously understudied. High elevation terrains are only lightly covered by monitoring systems, with elevations >2500 m asl. widely underrepresented in global monitoring networks (Shahgedanova et al., 2021). The Himalayan mountains are particularly poorly covered by coordinated monitoring observatories.

In this contribution we present the set up and overview results of the ~last 10 years of integrated critical zone monitoring in the Kaligandaki Catchment in the central Himalayas in Nepal.

Motivated by fundamental research questions on coupled surface process and the high mountain water cycle in the Himalayan mountain range, we began observation in the Kaligandaki Catchment with two major stations for climatological and hydrological monitoring that have operated continuously over the past 10 years. At each location trained personal conducted manual river water sampling for river water geochemistry and suspended sediment monitoring as well as water discharge and bulk meteorological parameters. These observations were complemented by targeted short-term deployments and field sampling campaigns to cover the full spatial extent as well as the seasonal variability. Research question range from organic carbon export, climate and erosion feedback as well as water pathways in high mountains to large mass-movements and

intramountain sediment storage and feedbacks with landscape evolution.

Our findings from the past 10 years of monitoring motivate the development of a more substantial observatory in the Kaligandaki catchment, which is particularly suited as a critical zone observatory in the Himalayas. The Kaligandaki is a trans-Himalayan river that connects the Tibetan Plateau through the Himalaya to the low elevation foreland. The river crosses distinct climatological, ecological, tectonic, and geomorphic zones, including the arid high elevation plateau, the rapidly uplifting high Himalaya and monsoon precipitation maxima, and the middle hills. The river corridor is highly prone to flood and landslide hazards, and is experience increasing development and human impact, particularly road construction and hydropower. In addition, the river basin is highly sensitive to changing precipitation patterns, which have brought anomalous rainfall and flooding in recent years, and to changing melting patterns, which affect water resources. Together with local partners and the international research community we are proposing this unique catchment as potential integrated mountain critical zone observatory in order to close the monitoring gap in the highest mountain range on Earth.

Literature:

Shahgedanova, M., et al. 2021, https://doi.org/10.1659/MRD-JOURNAL-D-20-00054.1