Deglaciation and debris flow dynamics:
how does glacier retreat affect debris flow activity in High Mountain Asia?

Varvara Bazilova[1], Leon Duurkoop[1], Jacob Hirschberg[2], Tjalling de Haas[1], and Walter Immerzeel[1]

[1] *Utrecht University, Department of Physical Geography, Utrecht, Netherlands*

[2] *ETH Zürich, Department of Earth Sciences, Zürich, Switzerland*

Universiteit Utrecht

Faculty of Geosciences

Physical Geography

v.bazilova@uu.nl

@varyabazilova

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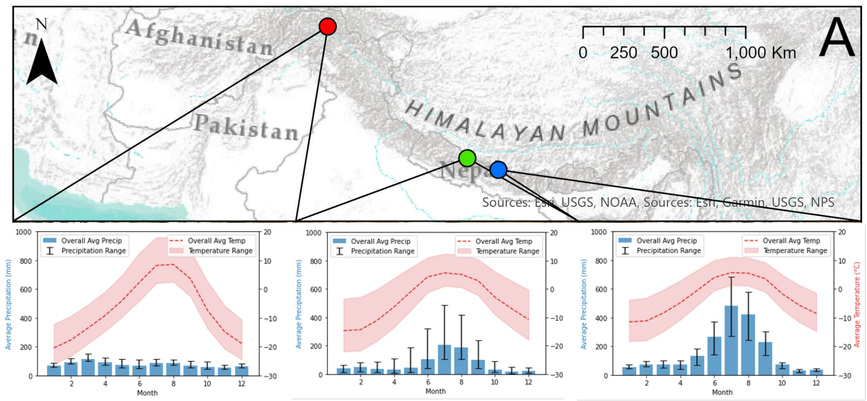
- Extended SedCas model to investigate the interplay between deglaciation and mountain greening in relation to the sediment yield and debris flow activity
- High % of glaciation together with low % of vegetation gives an optimum situation for the debris flow activity
- In the sediment-limited systems sediment storage builds up over winter months, followed by debris flow event in spring

I. Problem setting



Bagrot (Karakoram) *Mustang (Himalaya)* *Langtang (Himalaya)*

(i) 3 locations with different climates

- We choose 3 locations with contrasting climate (especially focusing on precipitation regime)

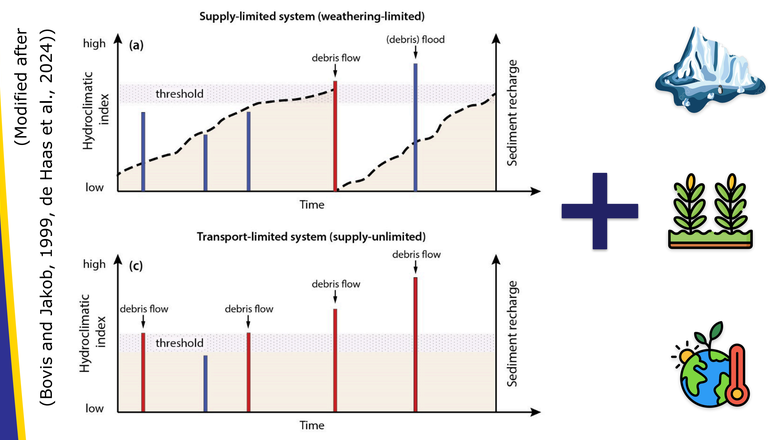
(ii) Different experiments

- We set up different modeling experiments with SedimentCascade model (SedCas) (Bennet et al., 2014, Hirschberg et al., 2021) to find out, how different geomorphological systems behave in different climate regimes
- We test changes in land cover in both transport and supply limited setting and different recharge rates for the supply limited case

(iii) Magnitude frequency under different conditions

- We evaluate how the frequency/magnitude relationship changes with the change of conditions

II. Experiments: SedCas model



To initiate a debris flow the system requires sufficient sediments and enough enough water to trigger and transport it. We design experiments to test how the retreat of glaciers and mountain greening (changes in the land cover) affect the debris flow activity and sediment yield in different systems: transport limited (= limited only by the availability of water) and supply limited (= limited also by sediment recharge rate)

(i) Land cover change:

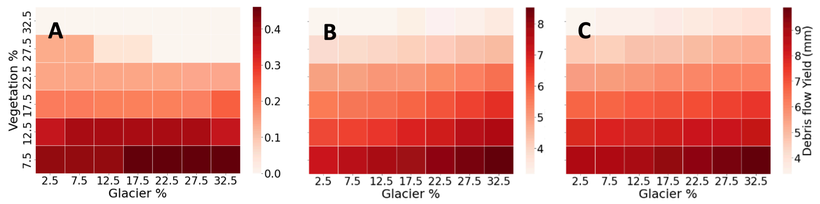
- Decrease in glacier cover, increase in vegetation cover

(ii) Sediment recharge:

- Constant daily sediment input, based on the mean annual potential sediment yield
- Limiting the mean annual sediment yield by 25-50-75%

(iii) Combination of both

III. Deglaciation vs Greening?

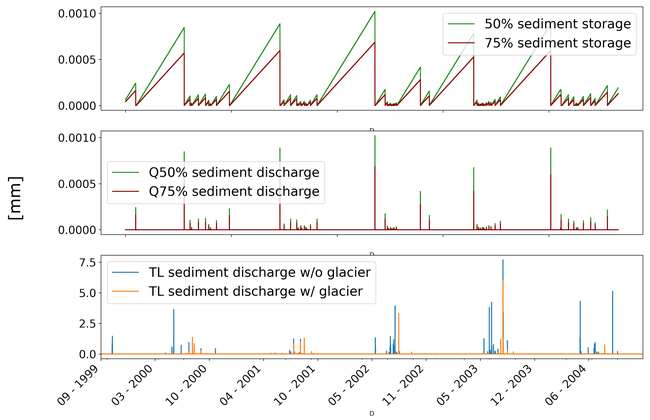


- High % of glaciation -> higher potential sediment yield
- High % of vegetation -> lower potential sediment yield

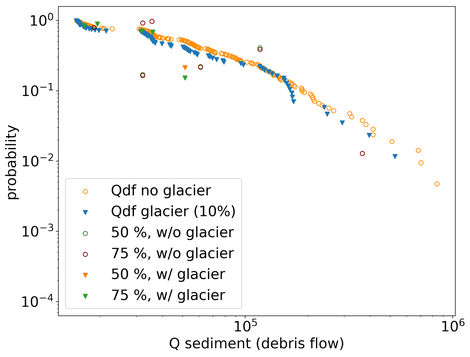
What is next?

- Transport vs supply limited systems? Where does HMA stands and how can we conceptualize it better
- How much every component of a changing climate (glacier retreat, mountain greening, waring temperatures, changing in precipitation patterns) affect the debris flow hazard?
- Still more questions…

IV. Langtang: Sediment availability



V. Langtang: what about magnitudes?



- Limiting the sediment input -> fewer events and les sediment yield overall
- 10% glacier cover in the catchment -> smaller debris flows
- 25 % sediment input -> no sediment yield