Cryosphere and related hazards in High Mountain Asia in a changing climate
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Permafrost dynamics and its risk to downstream infrastructure over north-western Himalayas
Presentation Outline

- Knowledge Background-Study area: KNOWN
- LST variations and Rock Glaciers: UNKNOWN
- In situ observations
- Vulnerable glacial lakes and settlements
- Preliminary findings/Conclusions
Existing knowledge

- Landscapes that remain frozen for at least two consecutive years.
- Least researched component of Himalayan cryosphere (especially contribution to stream flows).
- Remote sensing, modeling and in situ observations
- Destabilization can lead to potential hazards:
  - Rock ice avalanches
  - Debris/Mud flows
  - Associated cascading hazards
Scar indicating lake drainage

Glacier-Proglacial lake/Rock glacier-Lake continuum

Asthal village
Study area

Rock glacier and rock glacier complexes (Left)
Permafrost+Road infrastructure in Jammu and Kashmir (Right)

Source: Gruber 2012
Land surface temperature variations

Permafrost Index (LST °C)
- Permanent Permafrost (<-3)
- Unstable Permafrost (>3 - 2)
- Moderately Unstable Permafrost (>2 - 1)
- Highly Unstable Permafrost (>1 - 0)
- Non Permafrost (>0)
- J&K Boundary
Rock glacier mapping

- Minimum RGE 3307 m asl
- HP 3052 m asl (Pandey 2019)
- Nepalese 3225 m asl (Jones et al. 2018)

- Jammu and Kashmir
- Rock Glacier

- Tongue shaped
- Lobate

4735

769
Contribution to streamflows unknown...
In situ temperature observations
Vulnerable glacial lakes and settlements

Number of households: ~38,000
Number of glacial lakes: ~220
Conclusions

- LST data indicates that around 25% of the area is under permafrost, however, satellite derived LST may need bias-corrections to come up with more reliable estimates of permafrost in the region.

- While rock glacier have been comprehensively mapped from high-resolution satellite data more information is needed about understanding their dynamics using other remote sensing techniques like InSAR.

- The ice content is rock glaciers is not known. Glaciohydrological and isotopes based studies can help better understand the contribution of melt waters from rock glaciers.

- Permafrost dynamics and its degradation should be mandatory part of any EIA process in mountain regions to avoid damages to infrastructure and loss of lives.