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DEPARTMENT OF
SCIENCE & TECHNOLOGY

UNIVERSITY OF KASHMIR

Cryosphere and related hazards in High Mountain Asia in a changing climate

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Date: 3 November 2022

Catchment-scale modelling of current and future glacial retreat and lake development over northwest Himalaya under changing climate

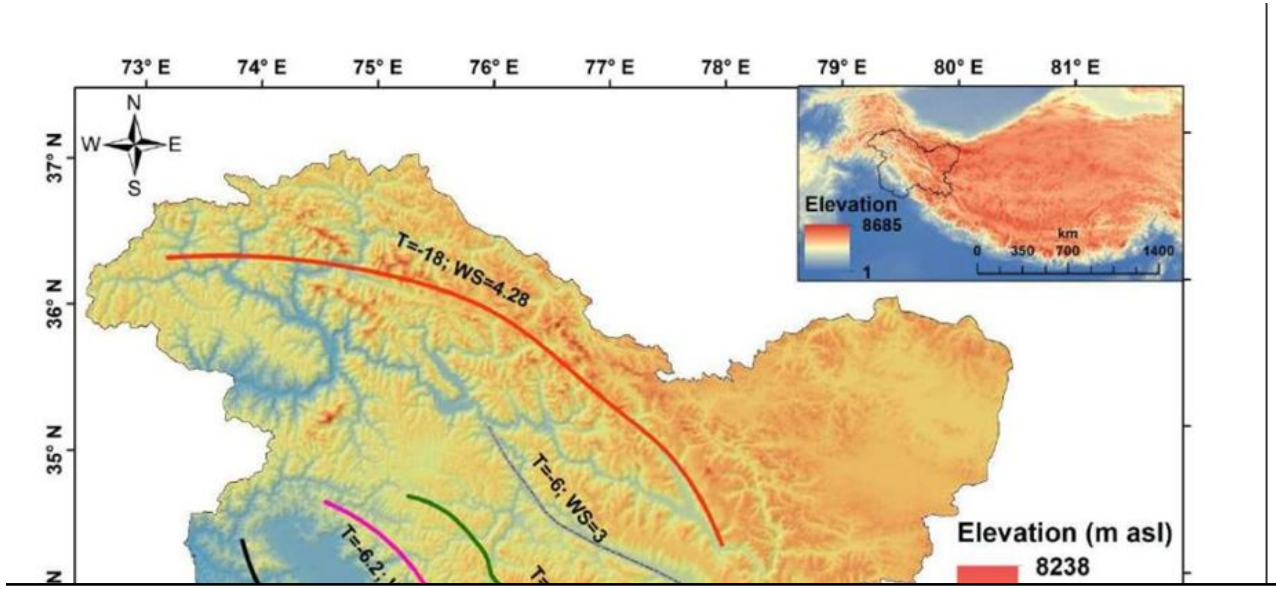
Presentation Scheme

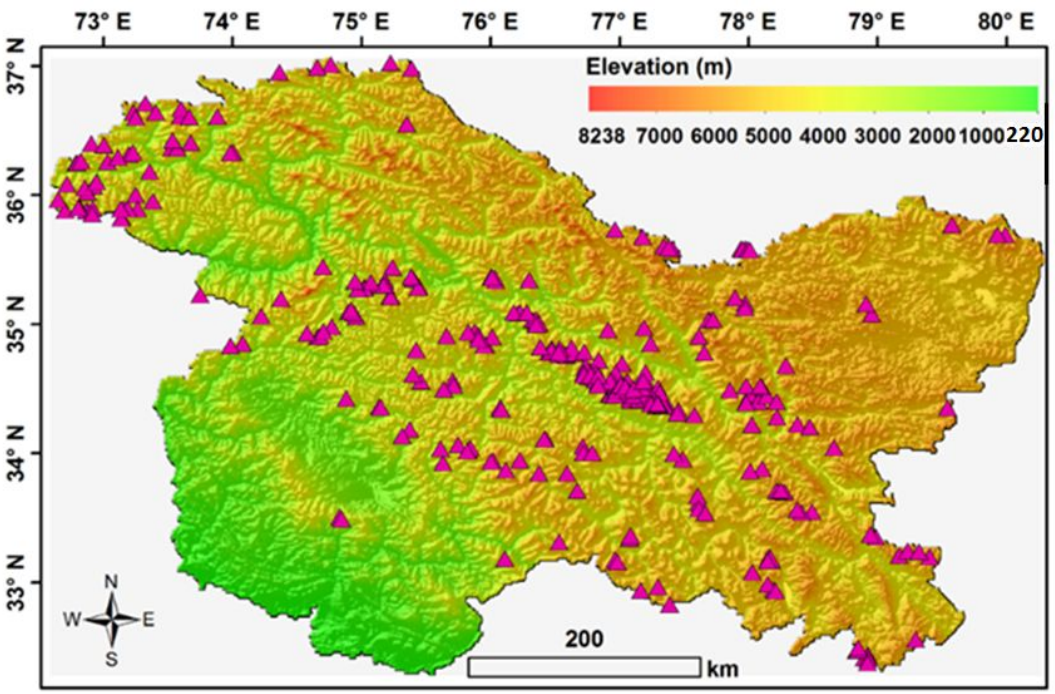
- Rationale
- Study area
- Methods
- Results
- Conclusions

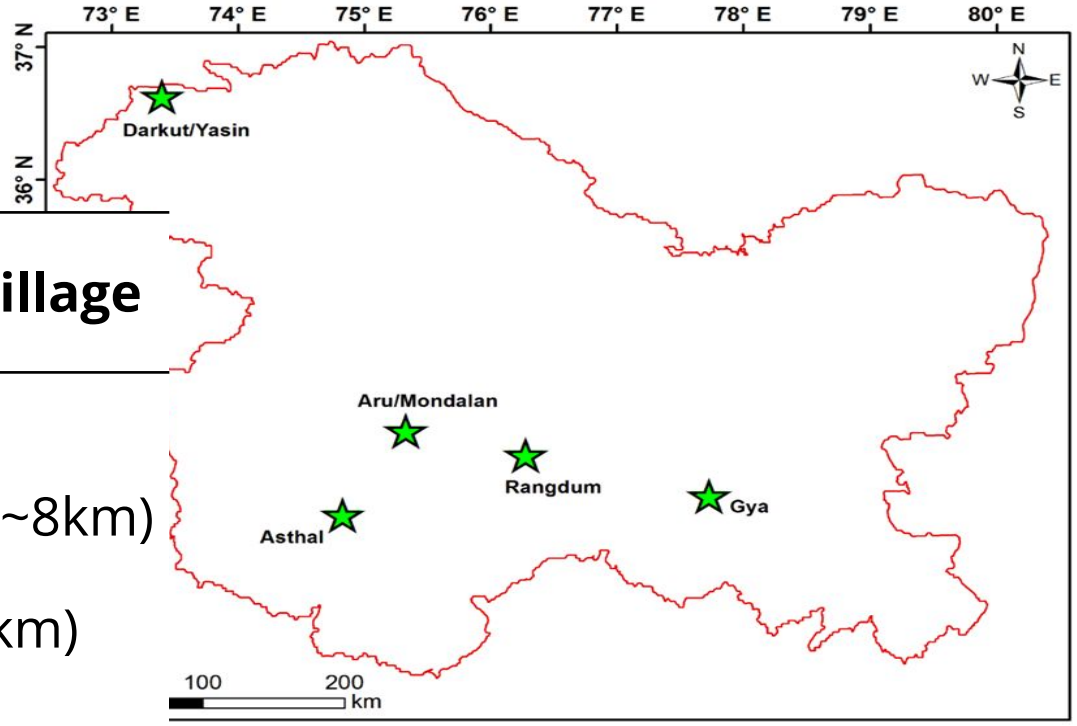
Rationale

- The present study makes use of two warming scenarios to predict glacier retreat and associated proglacial lake expansion.
- The growth of already existing proglacial lakes can lead to a shift in the hazard zones and consequently lead to an increase in the GLOF risk to the downstream population.

Study area



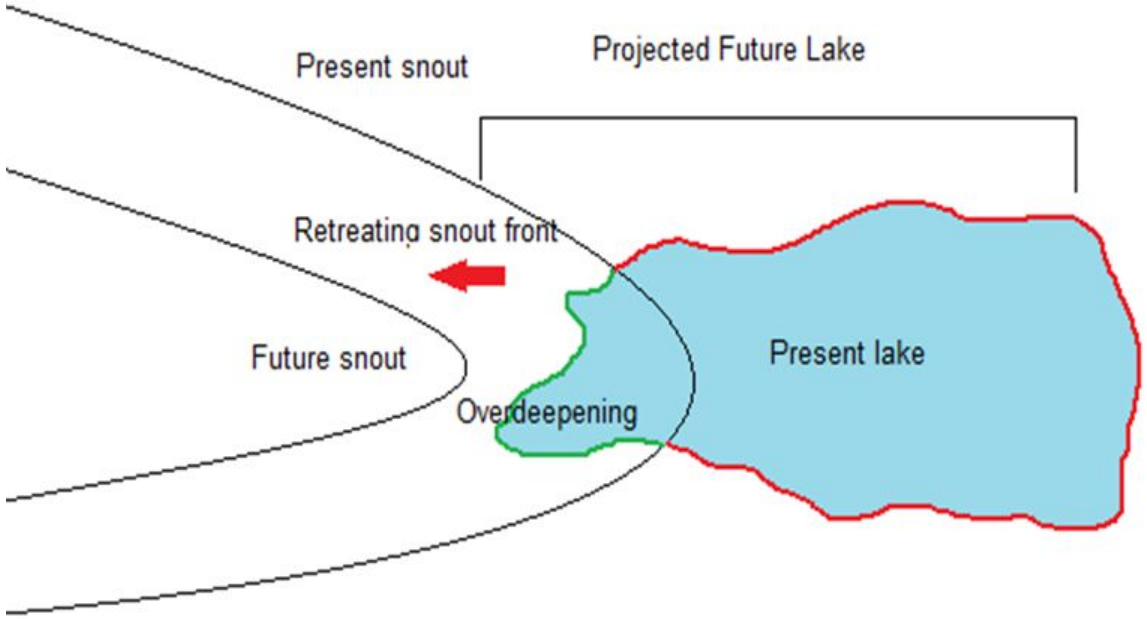




Range	Associated glacier	Downstream village
Pir Panjal	Barhma Sakli II	Asthal (~25 km)
Greater Himalaya	Girwar	Aru/Mondalan (~8km)
Zanskar	Dalung	Rangdum (~21 km)
Ladakh	Gya	Gya (~14 km)

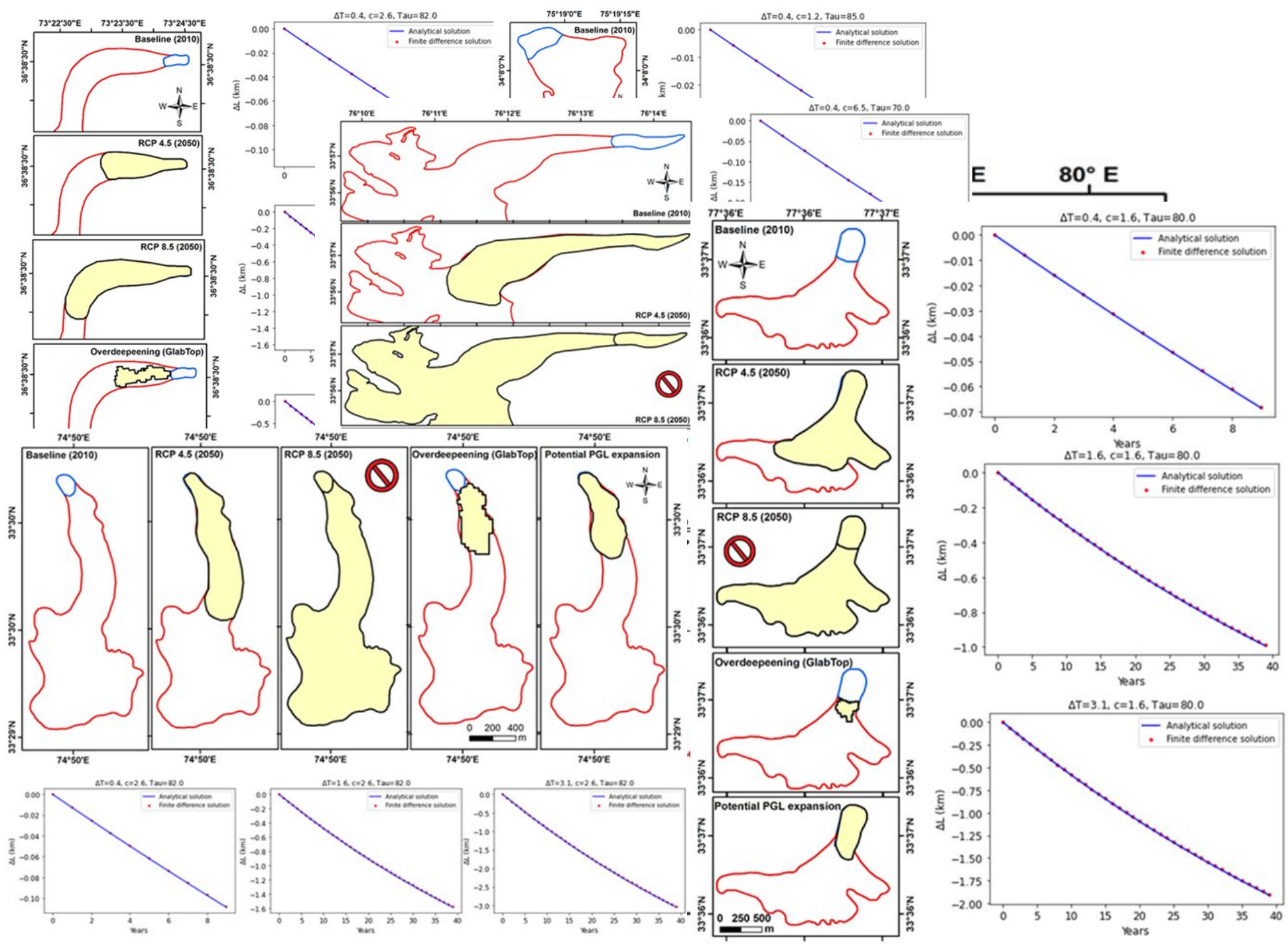
Methods

- We modelled the glacier bed-overdeepenings using a distributed ice thickness model - GlabTop.
- The present study makes use of two IPCC RCP scenarios (RCP 4.5 and RCP 8.5) to predict the glacier retreat by 2050.
- The glacier retreat will consequently lead to proglacial lake expansion, wherever the glacial-bed topography permits.

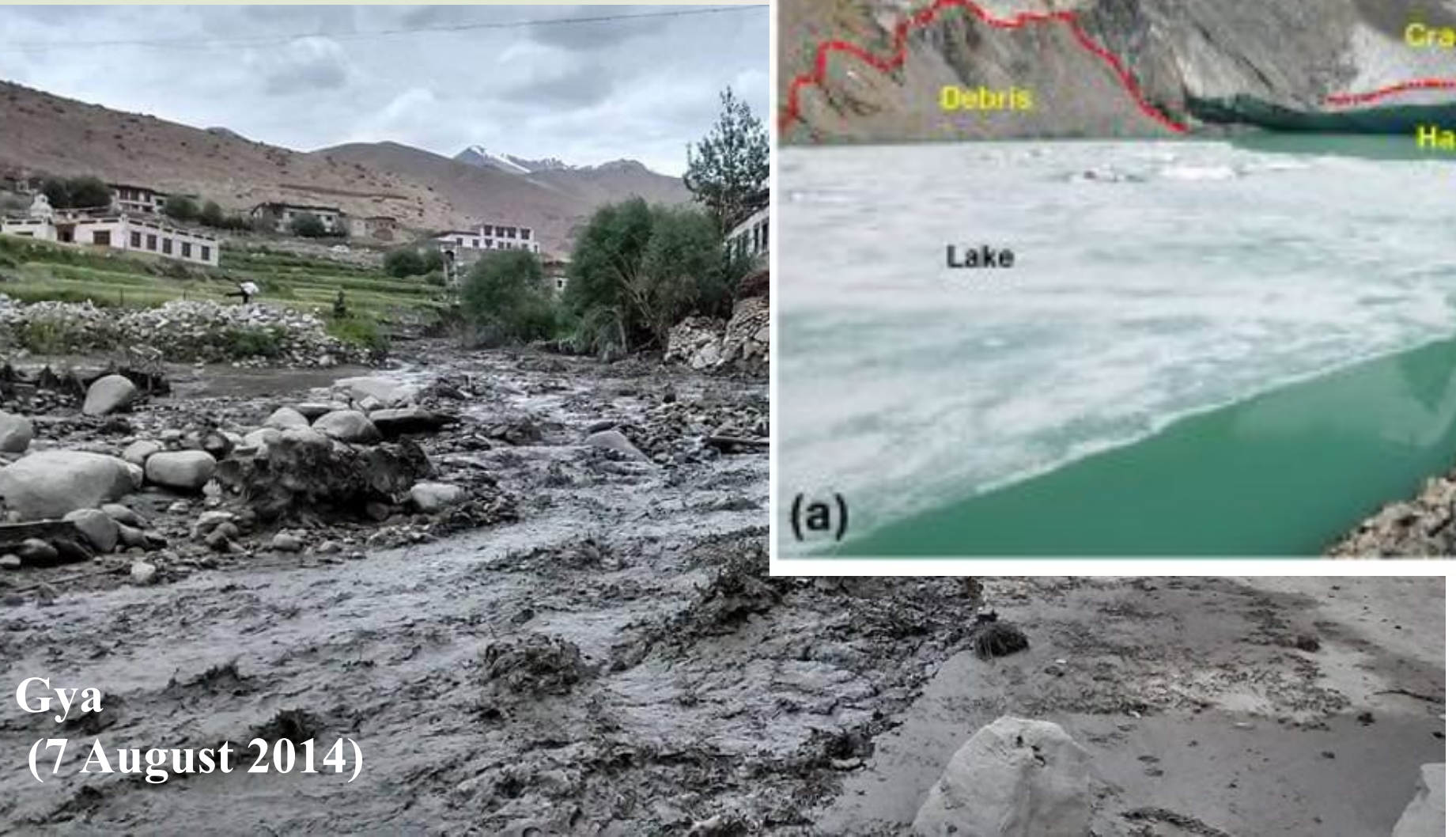


The future lake expansion was taken as an intersection of bed-overdeepenings simulated by GlabTop and length-reconstruction model suggested by Oerlemans (2005).

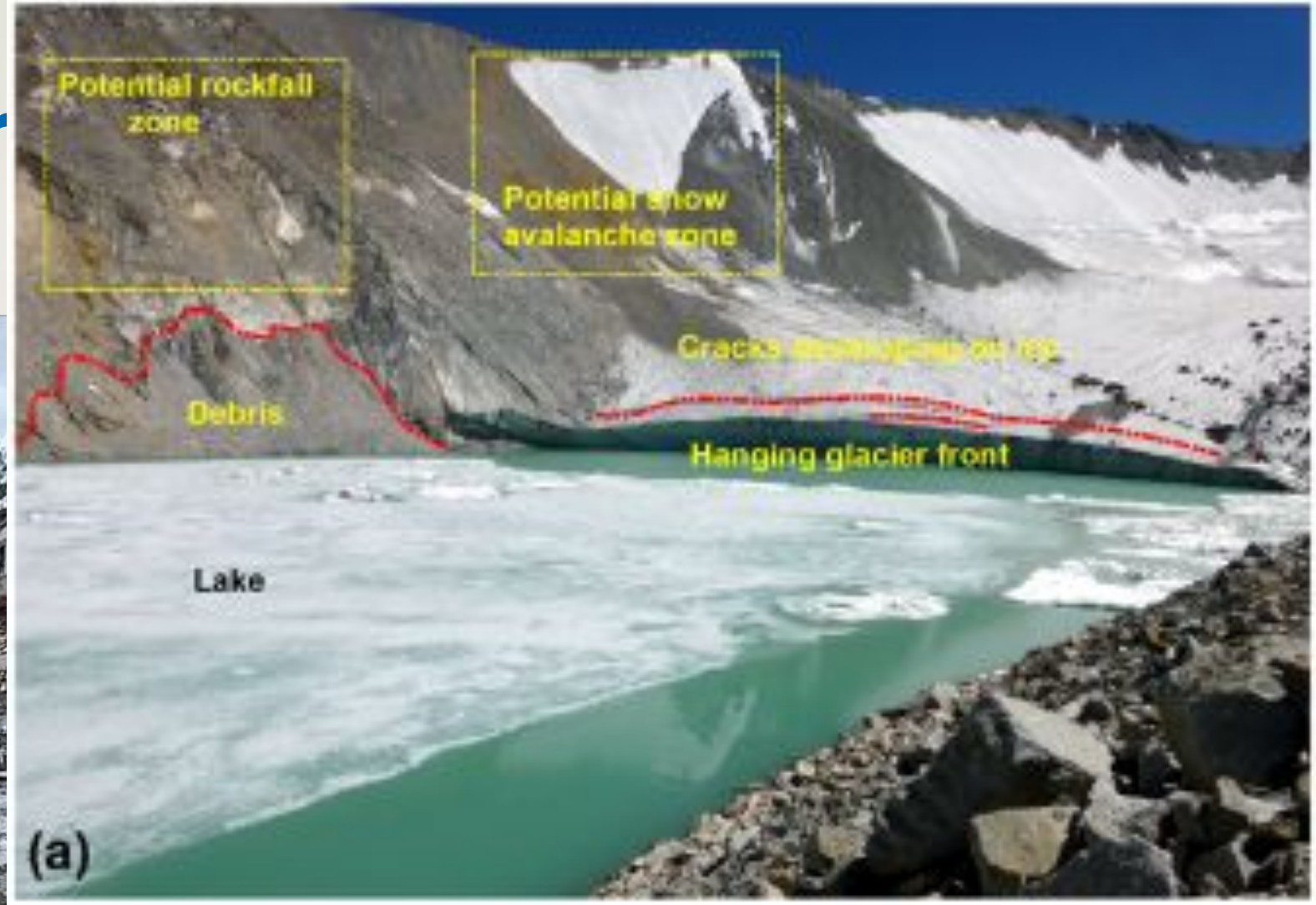
$$T'(t) = -\frac{1}{-}[L'(t) + \frac{\tau dL'(t)}{\quad}]$$


Baseline (2010)
RCP 4.5 (2050)
RCP 8.5 (2050)
Overdeepeening (GlabTop)
Potential PGL expansion
Analytical solution
Finite difference solution
ΔT=0.4, c=2.6, Tau=82.0
ΔT=0.4, c=1.2, Tau=85.0
ΔT=0.4, c=6.5, Tau=70.0
ΔT=0.4, c=1.6, Tau=80.0
ΔT=1.6, c=1.6, Tau=80.0
ΔT=3.1, c=1.6, Tau=80.0
ΔL (km)
Years
80° E
0 200 400 m
0 250 500 m

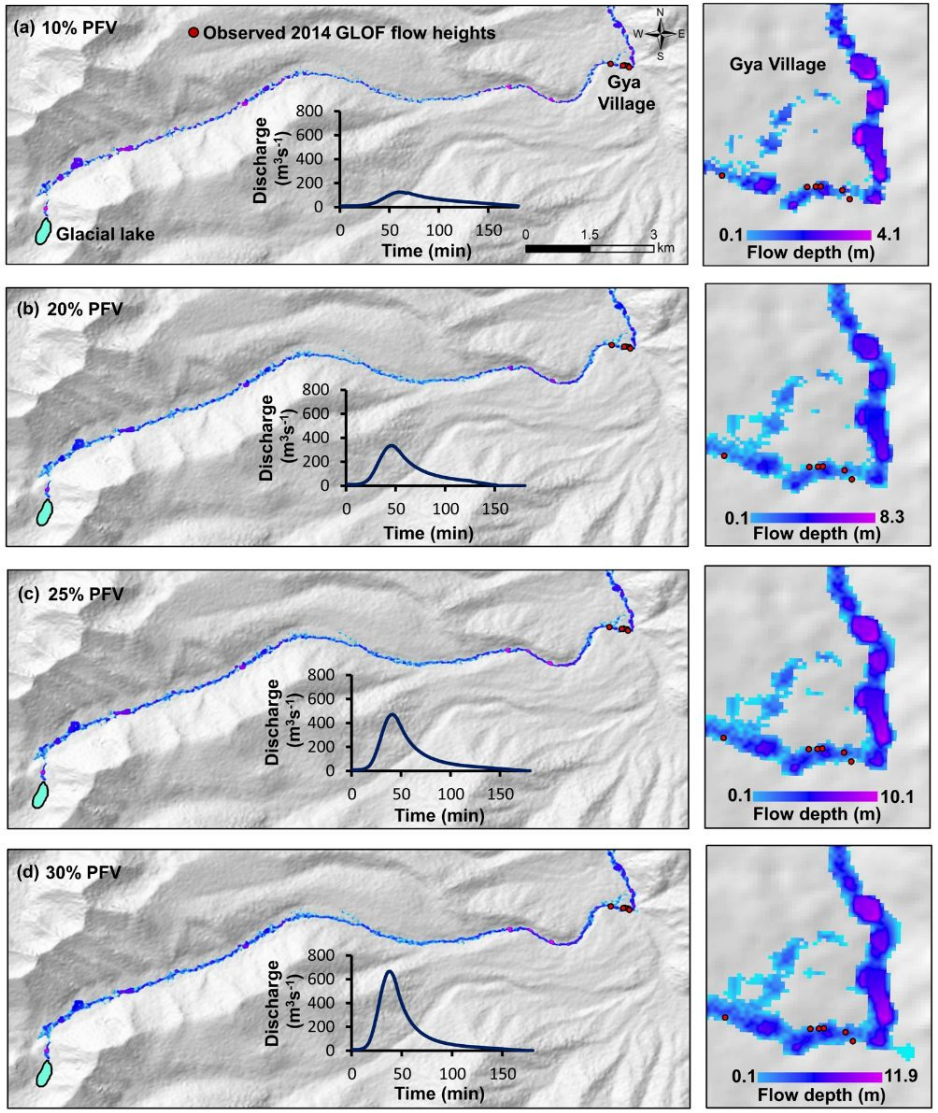
From ground zer

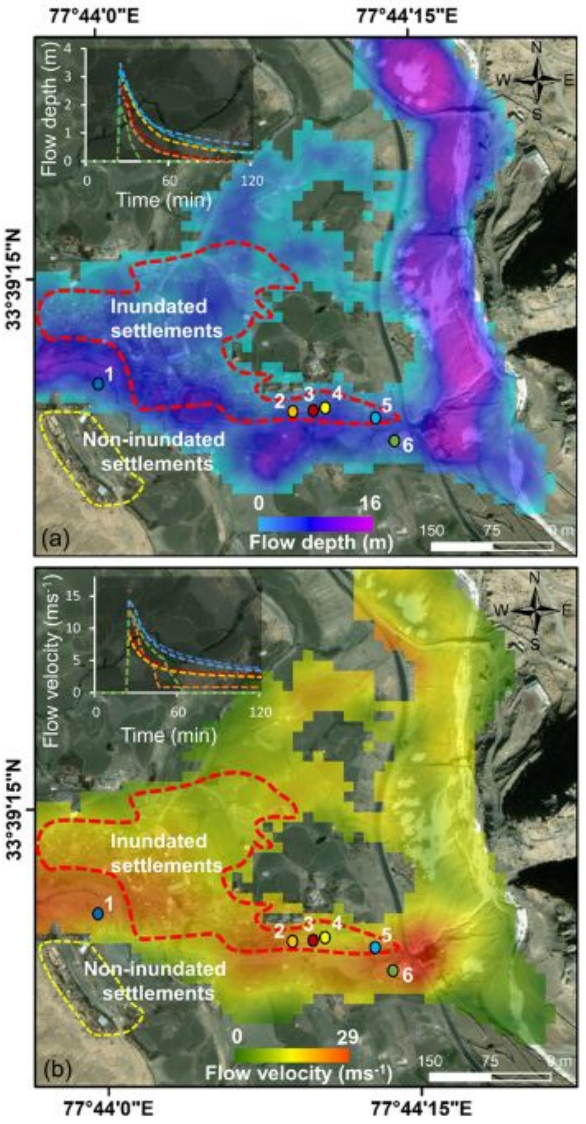


Gya
(7 August 2014)



The 2014 GLOF of Gya Village





Conclusions

- The glacial lakes would expand by 760% in Darkut glacier (Karakoram), followed by 67% in Barhma Sakli II (Pir Panjal), 58% in Dulung glacier (Zanskar), 48% in Gya glacier (Ladakh) and 22% in Girwar glacier (Greater Himalayan range of Kashmir) by the end of 2050.

- The growth of already existing proglacial lakes can lead to a shift in the hazard zones and consequently lead to an increase in the GLOF risk to the downstream population.

- Our study is in harmony with the emerging trends in GLOF research that aims to characterize and identify specific areas for future lake formation and expansion.

Thank you

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