

Modelling the contribution of ice cliff melt to glacier mass loss at the catchment scale

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[Buri et al., GRL \(2021\)](#)



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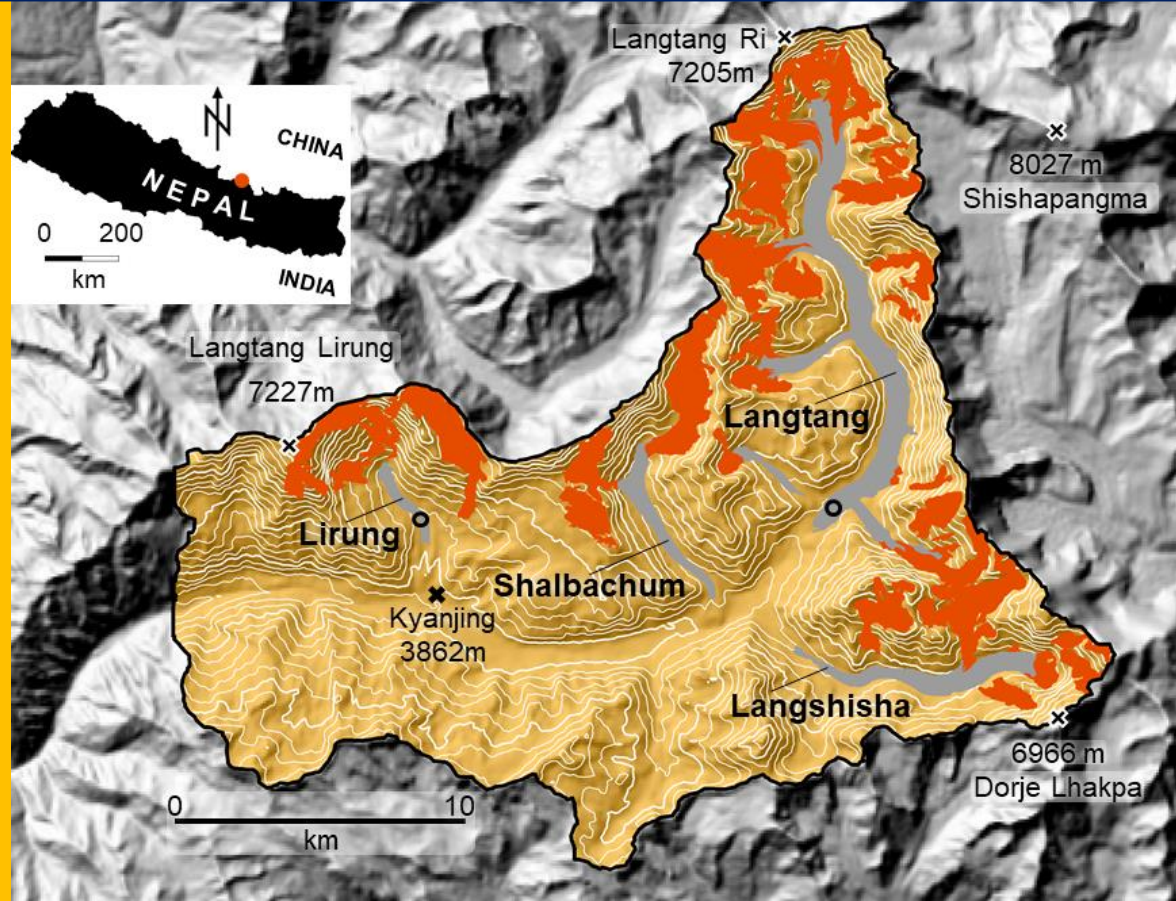
Motivation:

- Ice cliffs are abundant on most debris-covered glaciers
- They melt much more than ice under debris
- How much do they contribute to glacier melt?



Our study:

- Simulate ice cliff backwasting & melt for each ice cliff in the Langtang catchment (350km², 5 debris-covered glaciers) over one melt season (2014)
- Compare to geodetic glacier mass balance estimates



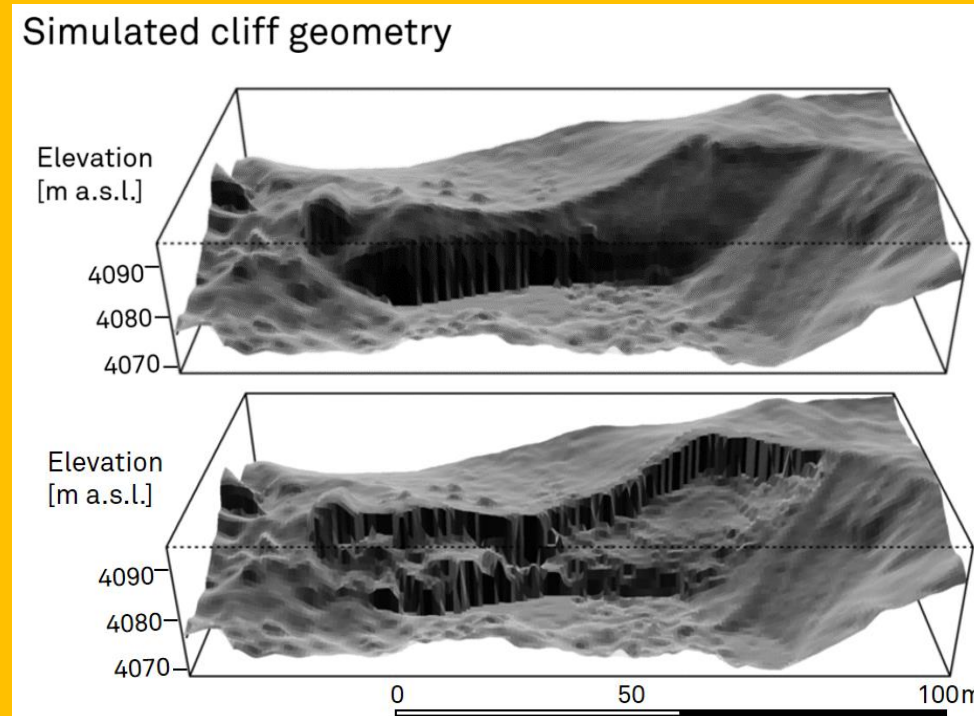
Ingredient I: Ice cliff melt estimates

- Process-based ice cliff backwasting model^{*}
- Forced with hourly on-glacier meteo-data, high-resolution DEMs & outlines of initial cliffs^{**}

Reality



Model



Timestep 0

Timestep N

^{*} [Buri & Pellicciotti \(PNAS, 2018\)](#)

^{**} [Steiner et al. \(JG, 2019\)](#)

Ingredient II: Glacier mass balance estimates

- Geodetic mass balance 2006-2015^{*} (ensemble mean 2006-2015)
- Emergence flow estimates^{**}

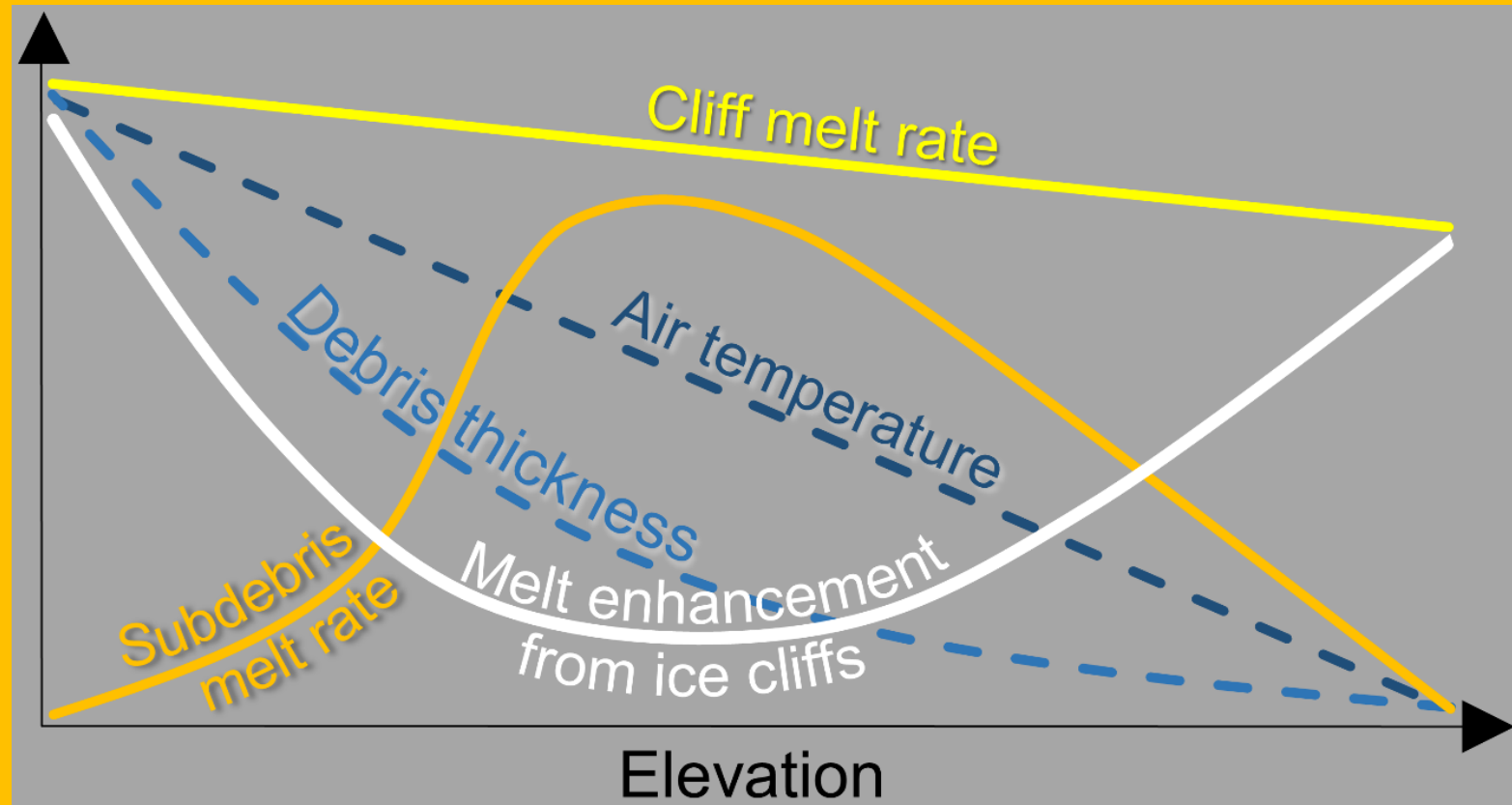
^{*} [Ragettli & al. \(TC, 2016\)](#)

^{**} [Miles et al. \(GRL, 2018\)](#)

Conclusion I:

Ice cliffs enhance melt where other processes would suppress it:

- at high elevations with low air temperatures
- at low elevations where debris is thick

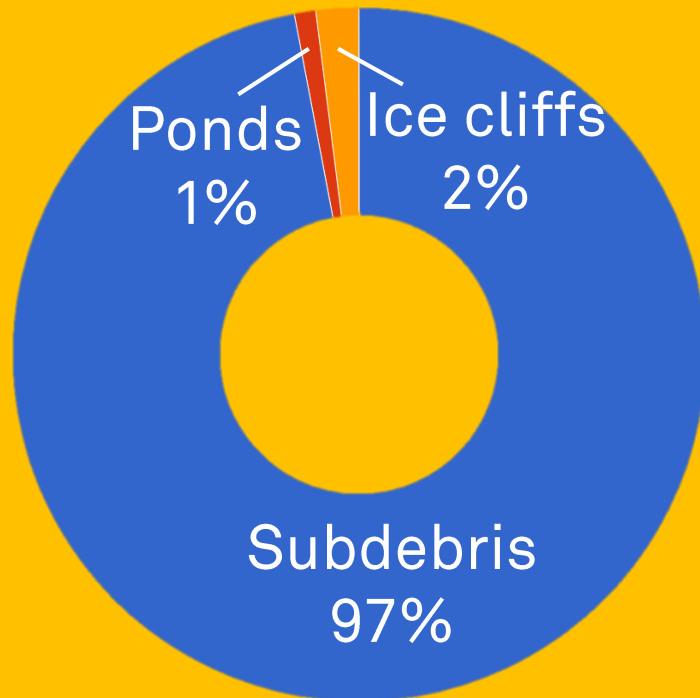


Conclusion II:

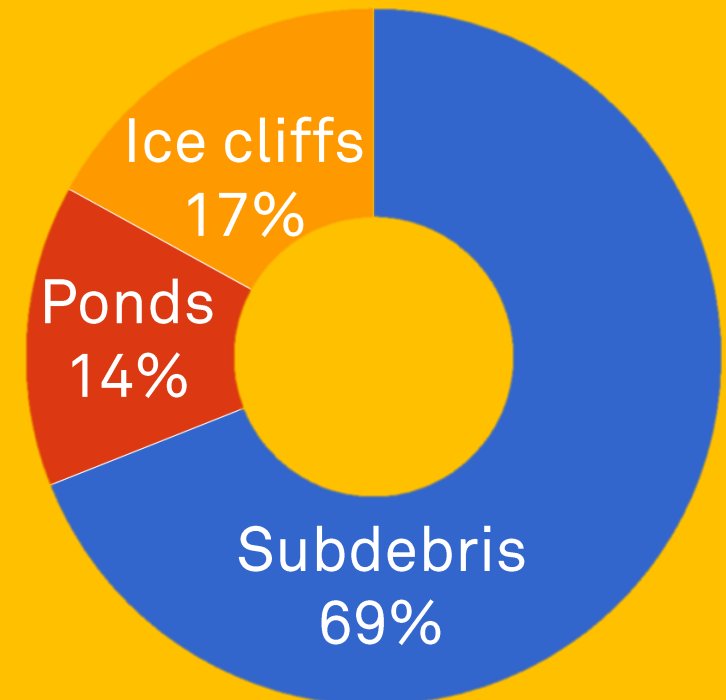
Ice cliffs cover 2% of debris covered tongues,
but cause 17% of their annual ice loss

Conclusion III:

Areal coverage:



Melt contributions:





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Buri et al., 2021

Geophysical Research Letters

*Supraglacial Ice Cliffs Can Substantially Increase the
Mass Loss of Debris-Covered Glaciers*

