



# Glacier frontal retreat using Deep Learning

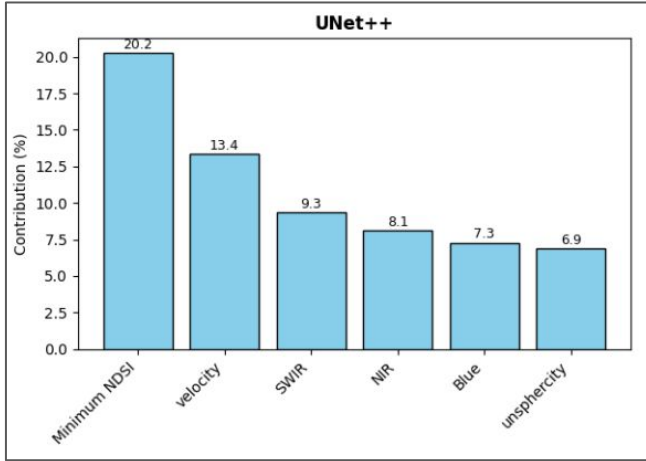
**Sarvesh Kumar Verma**

**21910081**

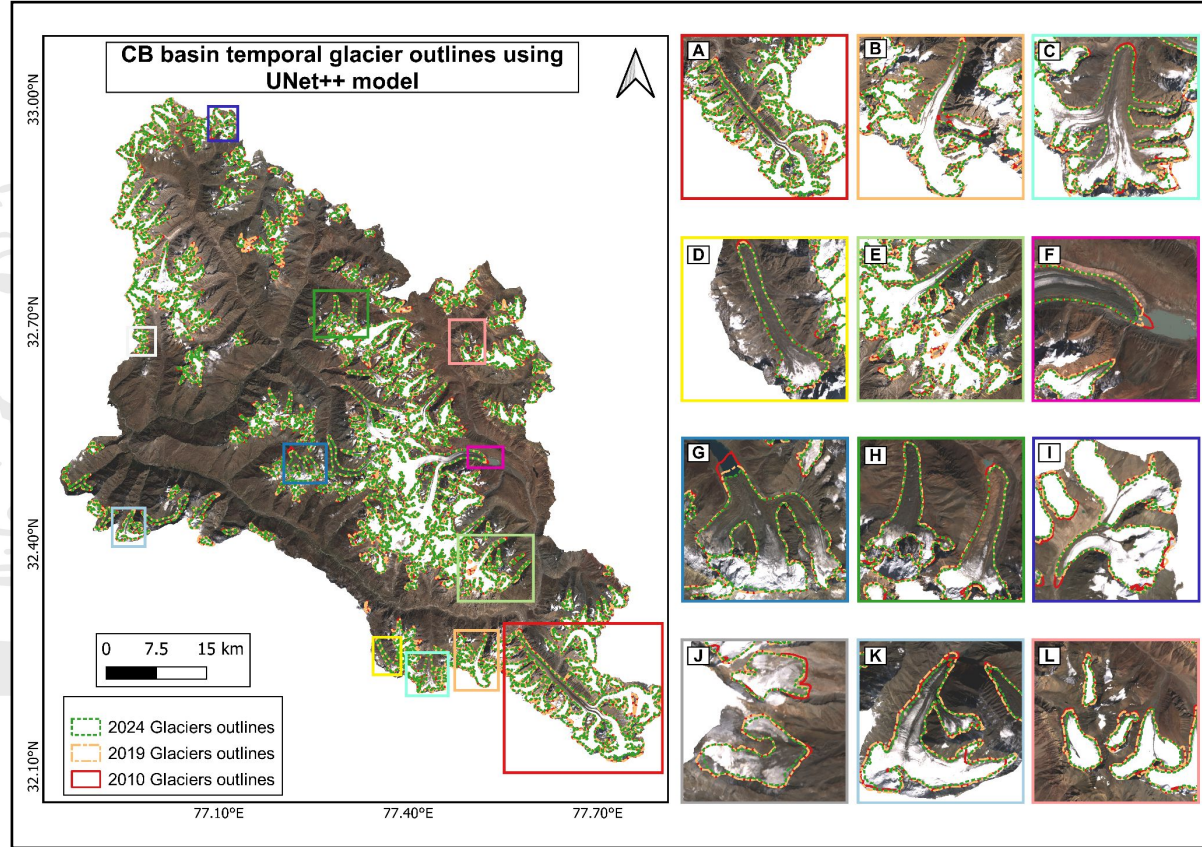
**Geomatics Engineering**



# Time-Series of Glacier Outlines of 2010, 2019, and 2024



From 5 models, we are getting UNet++ as best model to derive multi-time period outlines. Since, we have trained our model using Sentinel-2 for 2019 outlines, so we derive 2024 outlines using sentinel-2. But for year 2010, we do not have Sentinel-2, so we trained our model using Landsat-7 after destrip processing on 2019 and then detected outlines for year 2010.



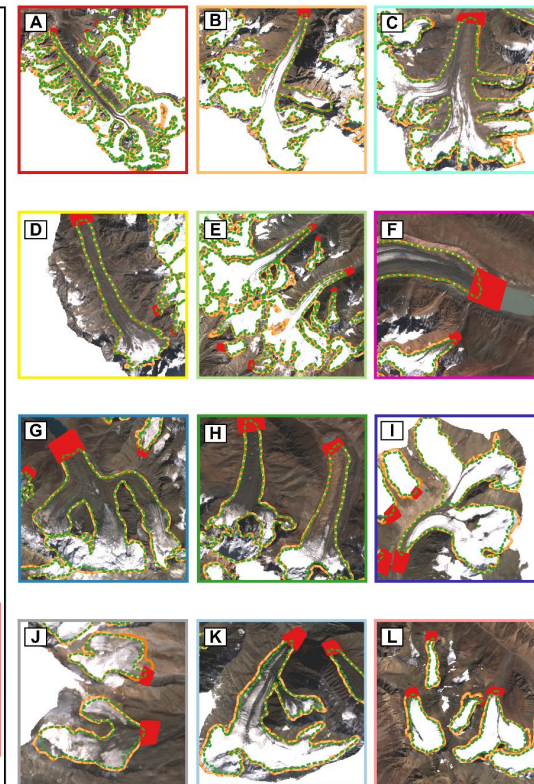
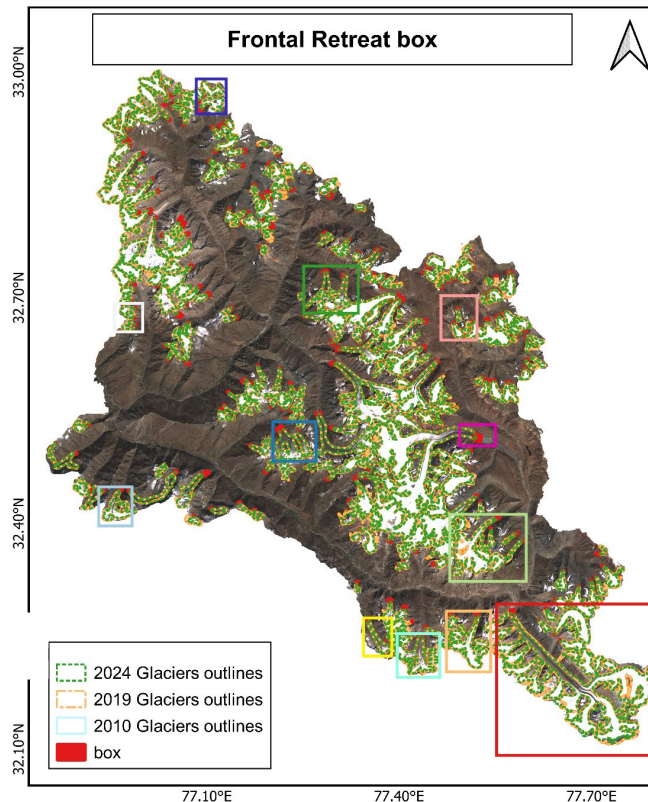
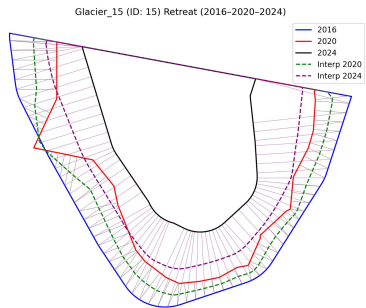
# Calculation of frontal retreat



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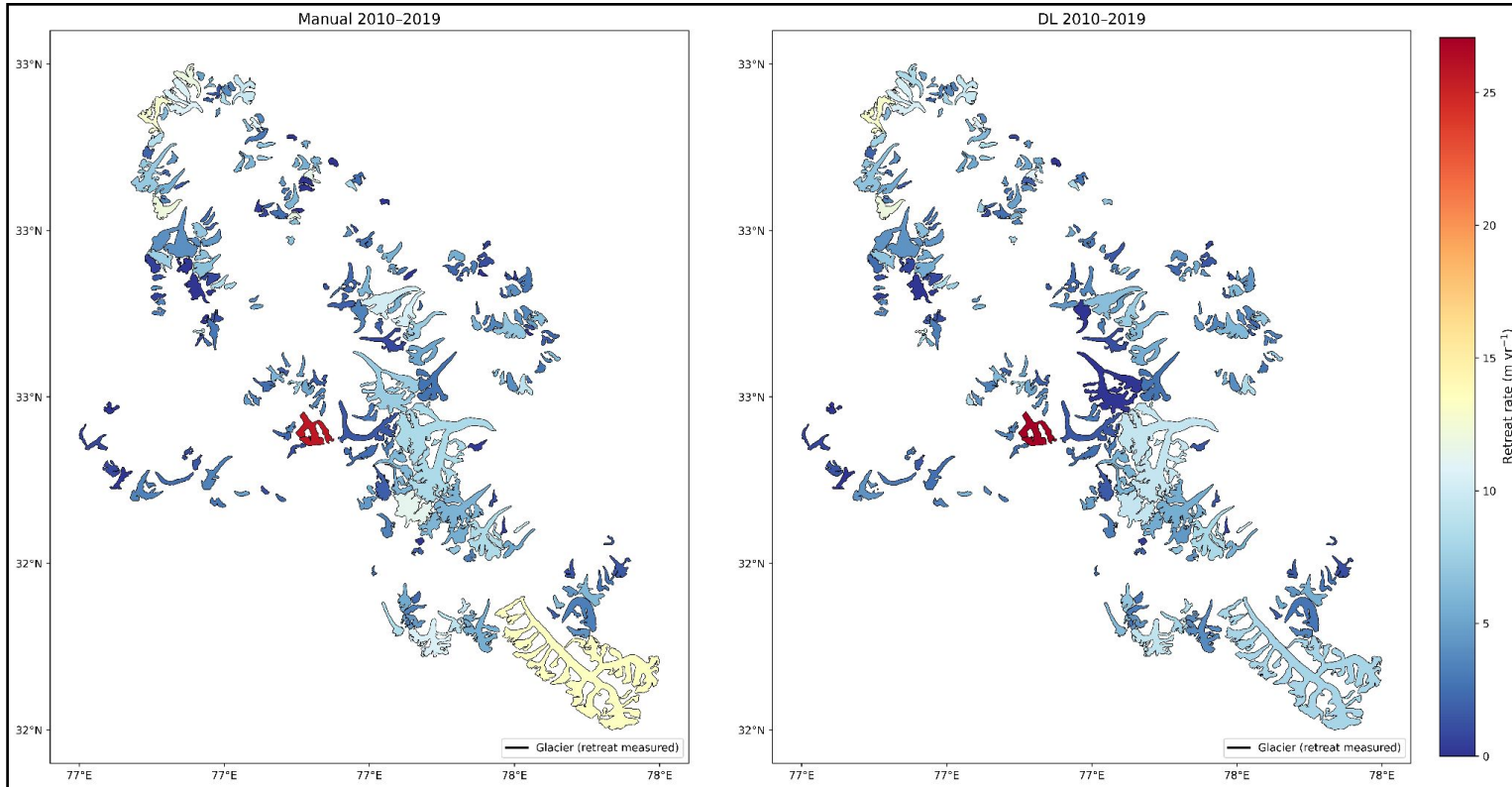
Research paper  
 A GIS tool for two-dimensional glacier-terminus change tracking

Jacek Andrzej Urbanski<sup>\*</sup>  
 GIS Centre, University of Gdańsk, 80-952 Gdańsk, Poland



Referring to this paper, and using this model we calculated out the frontal retreat. The red box in right figure shows 2 time period manual outlines and 2 time period DL based outline after all the correction (manual, hole filling, smoothing, terminus improvement). The red box cover all these 4 outlines, then retreat is calculated within the box only.

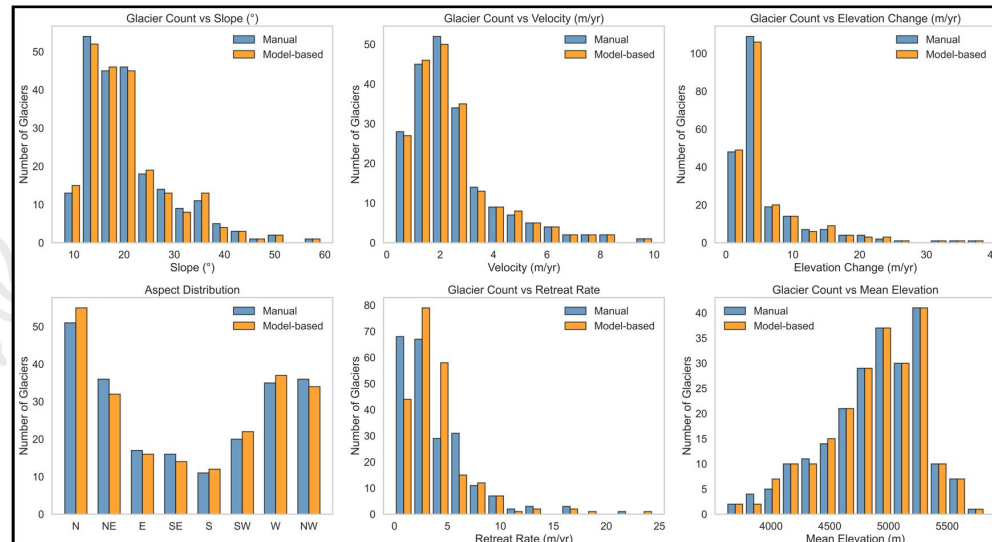
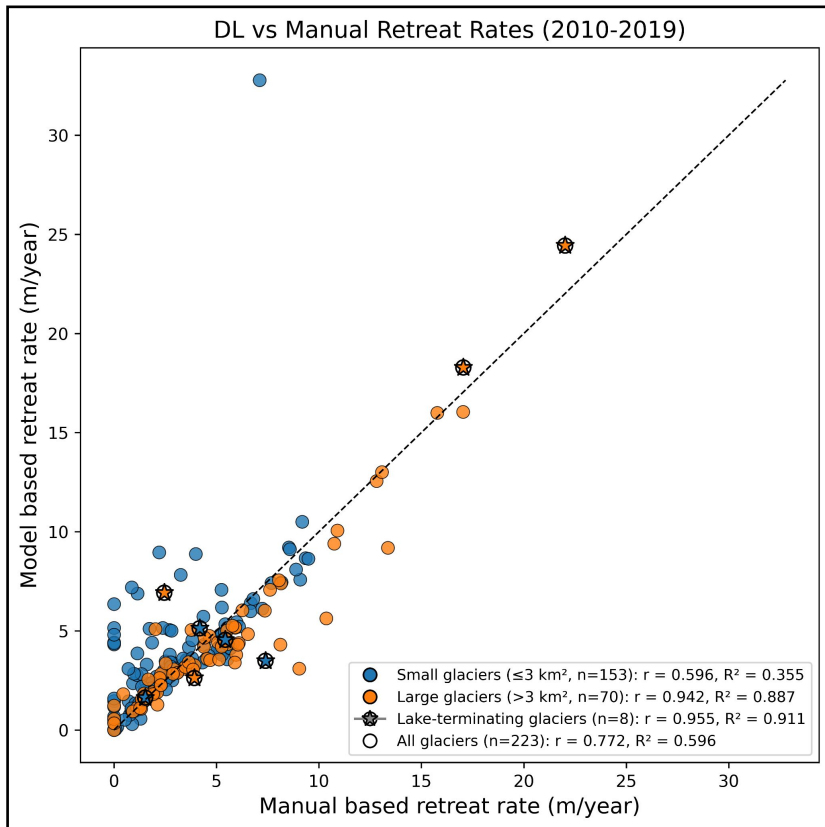
# Chandra Bhaga basin retreat rates (10 years)



The outlines taken here are 2010 and 2019 manual outlines from Vatsal (2022). So frontal retreat is shown on each glacier.

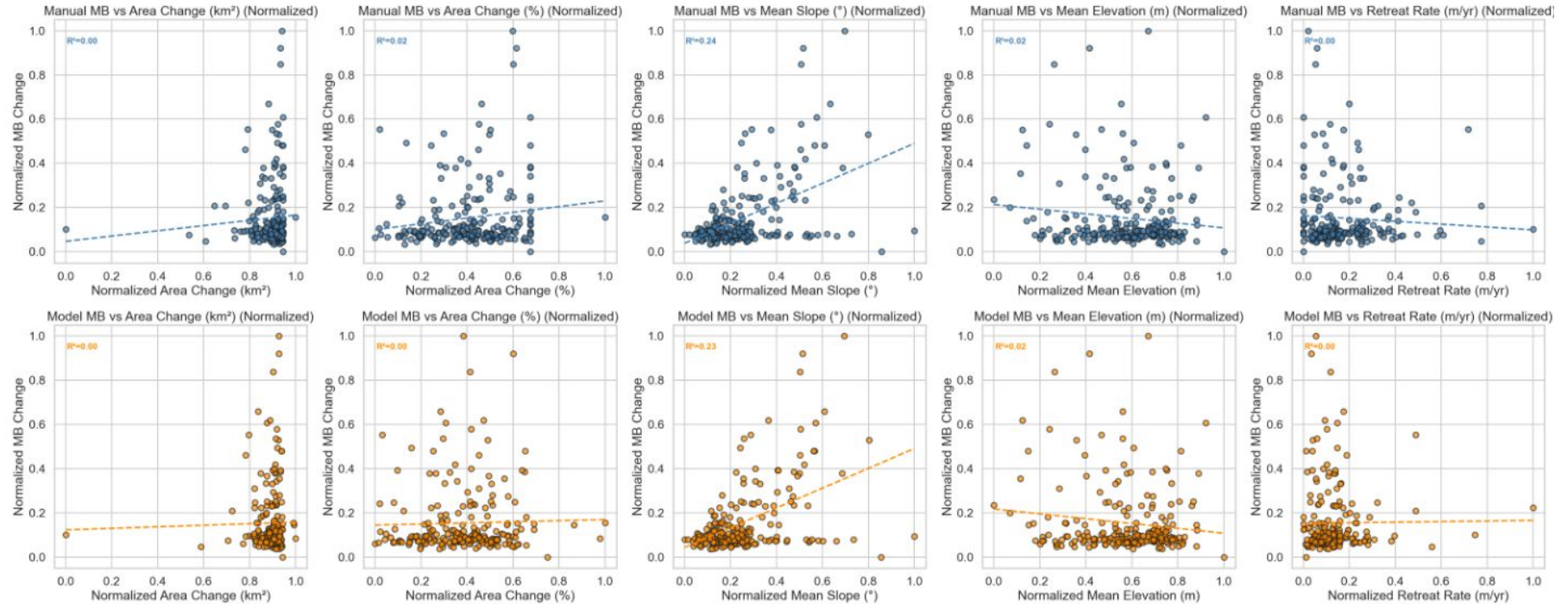
Similar processing need to be done on Alaknanda and bhagirathi basin, Pongang basin, Chombu basin in Sikkim.

# Frontal retreat comparison



Derived the relationship for small and large glaciers in Chandra Bhaga basin between manual and DL based outlines. But when I am trying to show the relationship with slope, velocity, elevation change and mass rates change, we are not getting any strong relationship. So how to show these relationship, we are R-sq even less than 5%. So how to show these relationships?

# MB relationship with frontal retreat (all within red boxes)



I am trying to show the relationship with slope, velocity, elevation change and mass rates change, we are not getting any strong relationship. So how to show these relationship, we are R-sq even less than 5%. So how to show these relationships? Need help in this.