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EGU

Outstanding Student & PhD candidate Presentation contest

Spatial distribution and changes in the debris flow hazard across High Mountain Asia

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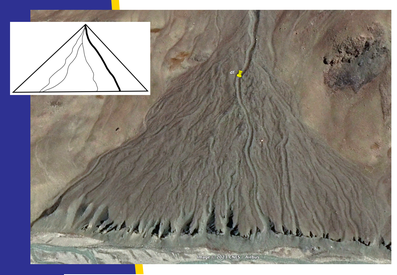
- Estimated probabilities of the catchment being a debris flow dominated vs flood dominated)
- Slope, area, perimeter and region (mountain range) are important for predictions
- Climate data adds new information to the classification and it important to include

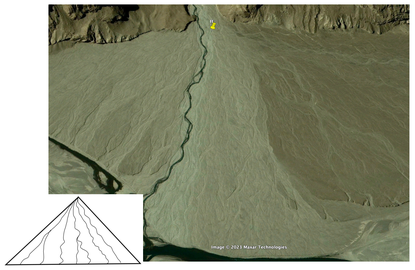
I. Data

Target variable (Y): 1806 points across HMA

- Manually identify catchments, based on the properties of the alluvial fan (Google Earth)
- Build a dataset* with the characteristic (features) for each catchments



Debris flow dominated



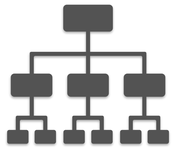
Flood dominated

Features (X)*:

- Morphometric (shape of the catchment). Do not change in time.
- Climatic (precipitation and temperature regimes, affects water and sediment availability), downscaled ERA5 Land
- Vegetation (based on ndvi)
- Glaciers (RGI v6.0)
- Permafrost (Obu et al, 2019)

*We build 2 datasets: with Morphometric and Morphometric + Climatic features to evaluate the climatic drivers of the DFs and compare our methods with the previous assessments.

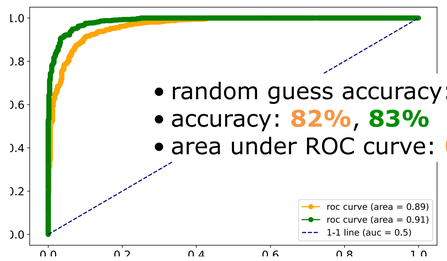
II. Methods



Building the model:

- Catboost (gradient boosted trees)
- 2 separate models (**Morphometric** and **Morphometric + Climatic** features as an input

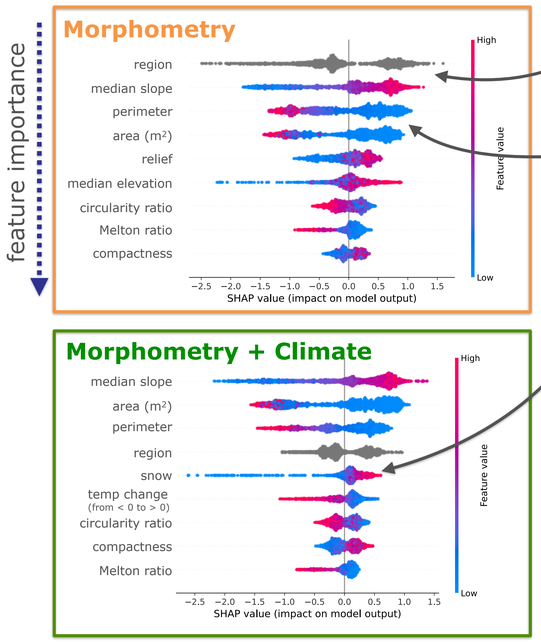
Evaluating the model:



- random guess accuracy: 59.2%
- accuracy: **82%**, **83%**
- area under ROC curve: **0.89**, **0.91**

III. Results

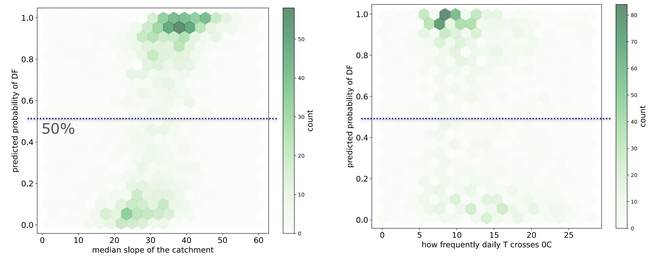
(1) how did the model make predictions?



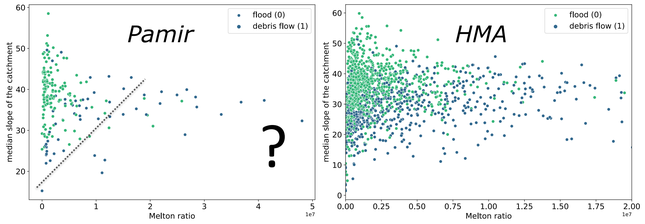
- *region* is a "category" -> no numeric value
- small perimeter, small area and large slope make model output closer to the Debris Flow class (1)
- small amount of snowfall per year drags the model towards Flood (0) class

"Traditional" methods usually mean separating data based on the relationship between some morphometric parameters (e.g. slope and Melton ratio (Bertrand et al., 2013)) This approach has been proven to work reasonably well on a small scale studies, but there is no clear separation on the HMA-scale

(2) comparison with "traditional" methods



Distribution feature values plotted agains predicted probability of catchment being classified as a Debris Flow dominated (>50% is classified as DF)



Clustering of data based on relationship between morphometric features

IV. Conclusions and Prospective

- Machine learning models improve classification of Debris flow dominated catchments, providing the probability
- Climate data adds information to the model accuracy and has predictive power: important to include!
- Important features control sediment production (frost cracking, snowpack) and sediment delivery (slope) which matches studies, focused on physical processes
- Climate change scenarios? How will debris flow susceptibility change in the future?
- Explore more the regional differences in the feature importance: does the climate matter more where there is the strongest change?