Universiteit Utrecht

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Physical Geography

Explaining the spatial pattern of the debris flow and flood hazard in High Mountain Asia

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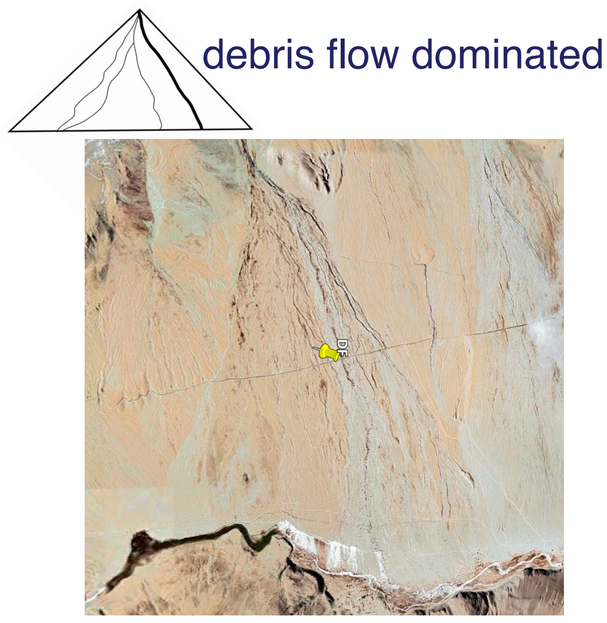
- Estimated probabilities of the catchment being debris flow vs flood dominated
- Area, Melton ratio, mean/median slope and some permafrost conditions are important
- Climate does not add a lot of new information to the classification



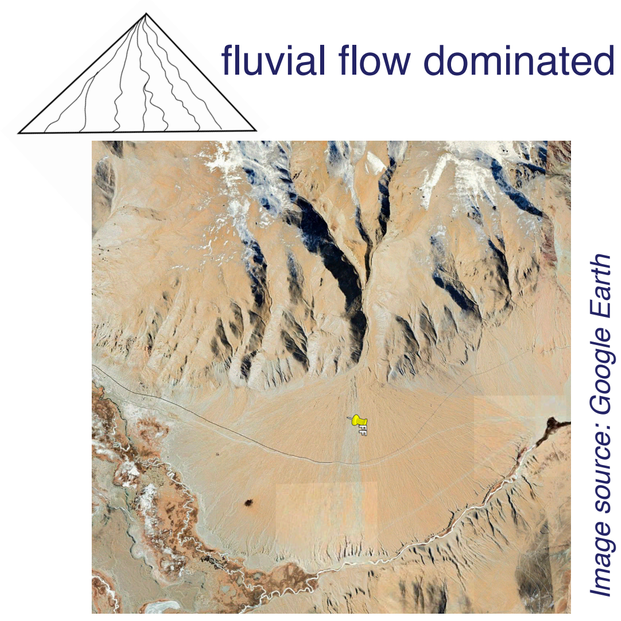


Image source: Google Earth

I. Data:

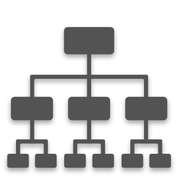
Target values (Y):

- manually identify the catchments, based on the shape of the alluvial fan ("target value")
- build a dataset with the characteristics of these catchments (features) for each catchment

Features (X):

- morphimetric (resamble the shape of the catchments)
- climatic (describe the temperature and precipitation regime) - from ERA5-Land
- glaciers (RGI v6.0)
- permafrost (Obu et al., 2018)

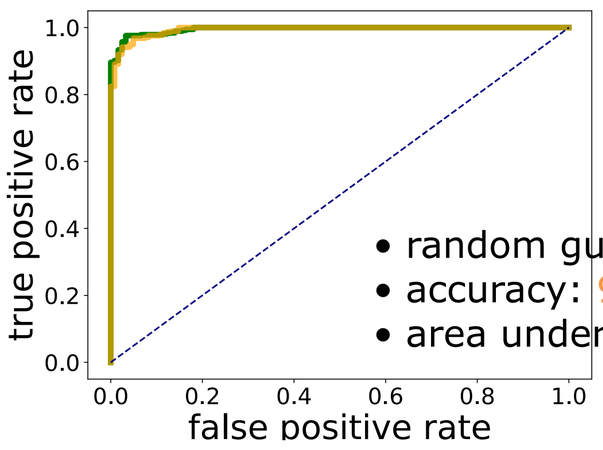
II. Methods:



Build the model:

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

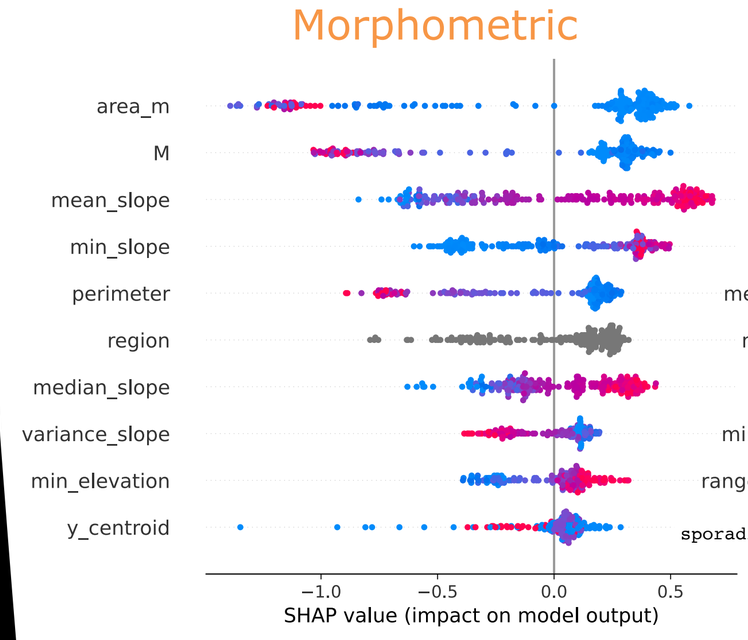
Evaluate the model:

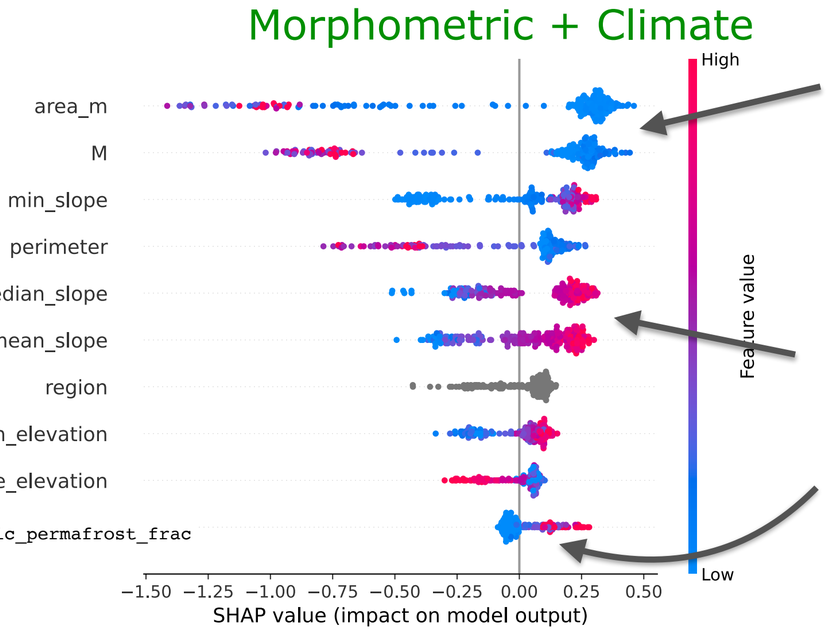


- random guess accuracy: 75.7%
- accuracy: 91%, 92%
- area under ROC curve: 0.91, 0.92

Some more details here:

III. Results: Feature importance. How did model make this prediction?





- small areas, small Melton ratio (relief*area$^{0.5}$) make it more likely to be classified as "debris flow" (1)
- high mean and median slope bring the model result closer to the "flood" class (0)
- low fraction of sporadic permafrost drags the model towards "flood" (0) class

IV. Next steps:

- Expand the dataset to cover more areas
- Add vegetation coverage as predictor
- Apply the model beyond the training dataset
- Explore the regional differences and spatial patterns
- Asses the climate change impact ("forse" the model with climate scenarios)