

Identifying meteorological release factors of glide avalanches with multivariate statistical analysis



Elisabeth Kindermann¹, Andreas Gobiet², Arnold Studeregger², Ingrid Reiweiger³

¹ Ludwig Maximilian University (LMU), Munich, Germany

² Zentralanstalt für Meteorologie und Geodynamik (ZAMG), Graz, Austria

³ BOKU University of Natural Resources and Life Sciences, Institute of Mountain Risk Engineering, Vienna, Austria



Introduction

Glide avalanches currently pose one of the most difficult avalanche type to predict where especially the exact time of the final release is subject to uncertainty.

Within this study, glide avalanche activities and meteorological parameters were recorded for five winter seasons at Planneralm, Styria and evaluated related to statistically significant differences of avalanche days (AD) and non-avalanche days (nAD). A random forest model approach was tested with the goal to correctly predict AD/nAD based on the most significant parameters.

Can specific weather conditions be differentiated between observed AD/nAD?

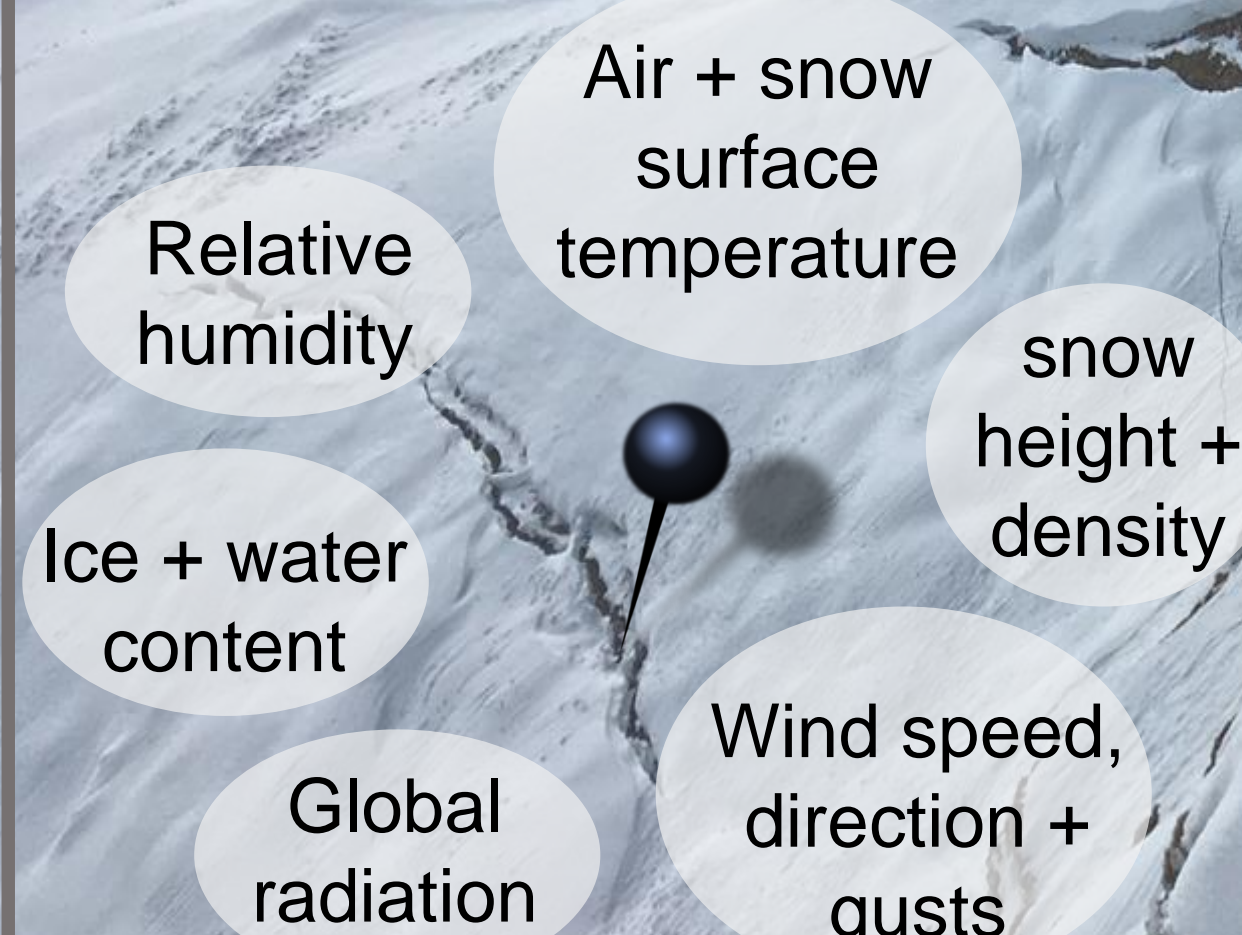
?

Is it possible to predict AD/nAD with a random forest model correctly?

Field Methods



Measurements:



Statistical Methods

Univariate

Visual time series, boxplots & histograms for AD/nAD

Multivariate

- Random forest model development within R
- Backwards elimination defining the most significant meteorological parameters
- Application at an unseen data set

Validation

- 10-fold cross validation
- Receiver operator characteristic (ROC)

Model Results

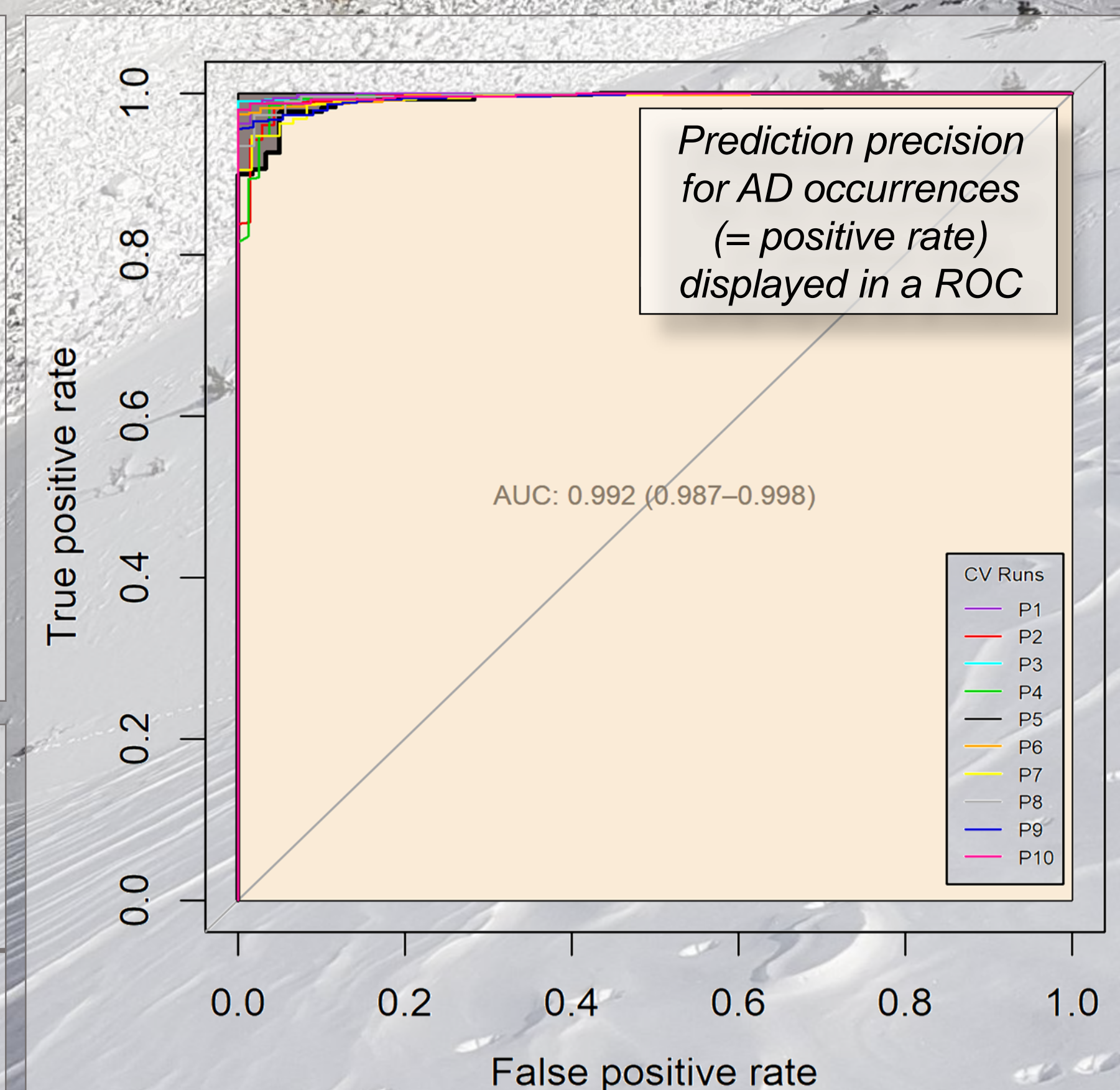
KEY FINDING:

Hourly resolution significantly increases predictive power

Most significant meteorological parameters for best model results:

- Mean air temperature
- Maximum snow temperature
- Snow height
- Δ 5-day snow height accumulation

Confusion matrix for model results	observed		Error rate
	AD	nAD	
predicted AD	227	21	0.07
predicted nAD	46	2553	0.02



Discussion & Outlook

The model results show high potential for implementing random forest as a supporting tool in avalanche forecasting services. Nevertheless, further research with extended data and for other regions is recommended for validation purposes.