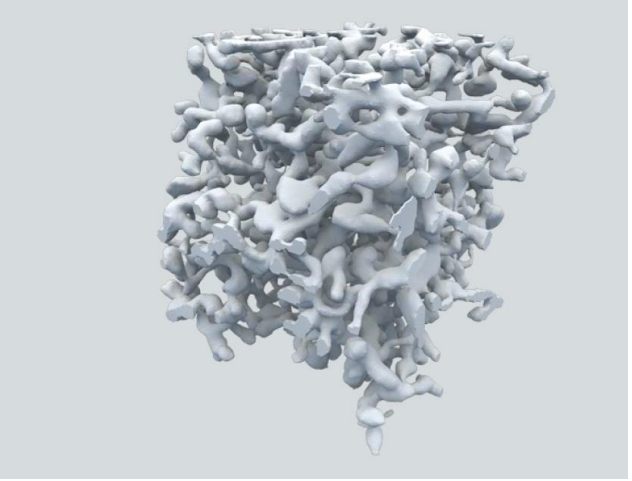


Using AI to detect and forecast snow avalanches

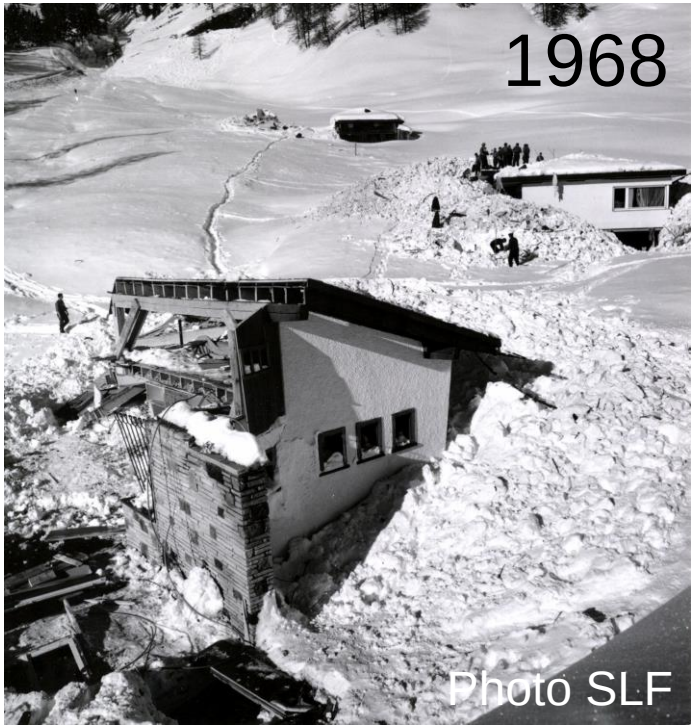
Alec van Herwijnen

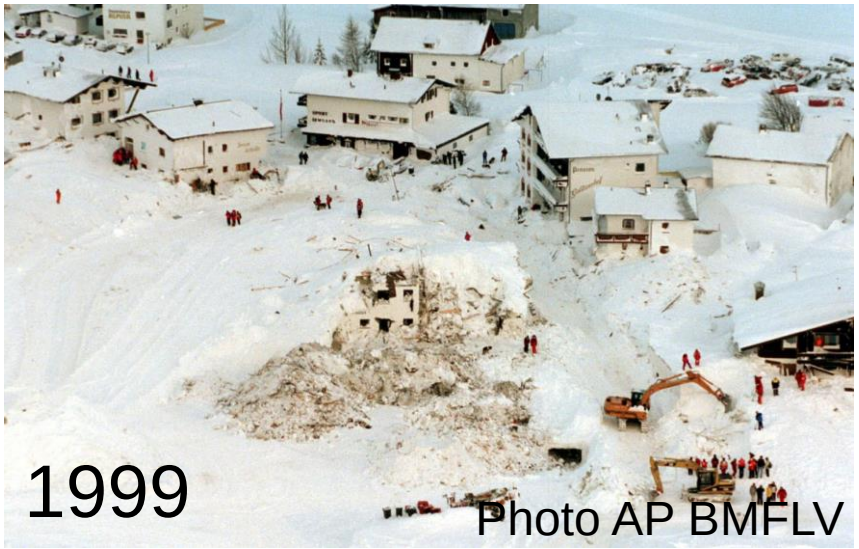
WSL Institute for Snow and Avalanche Research SLF

Snow avalanches

Photos: SLF / Alec van Herwijnen

Snow avalanches





Avalanche recipe

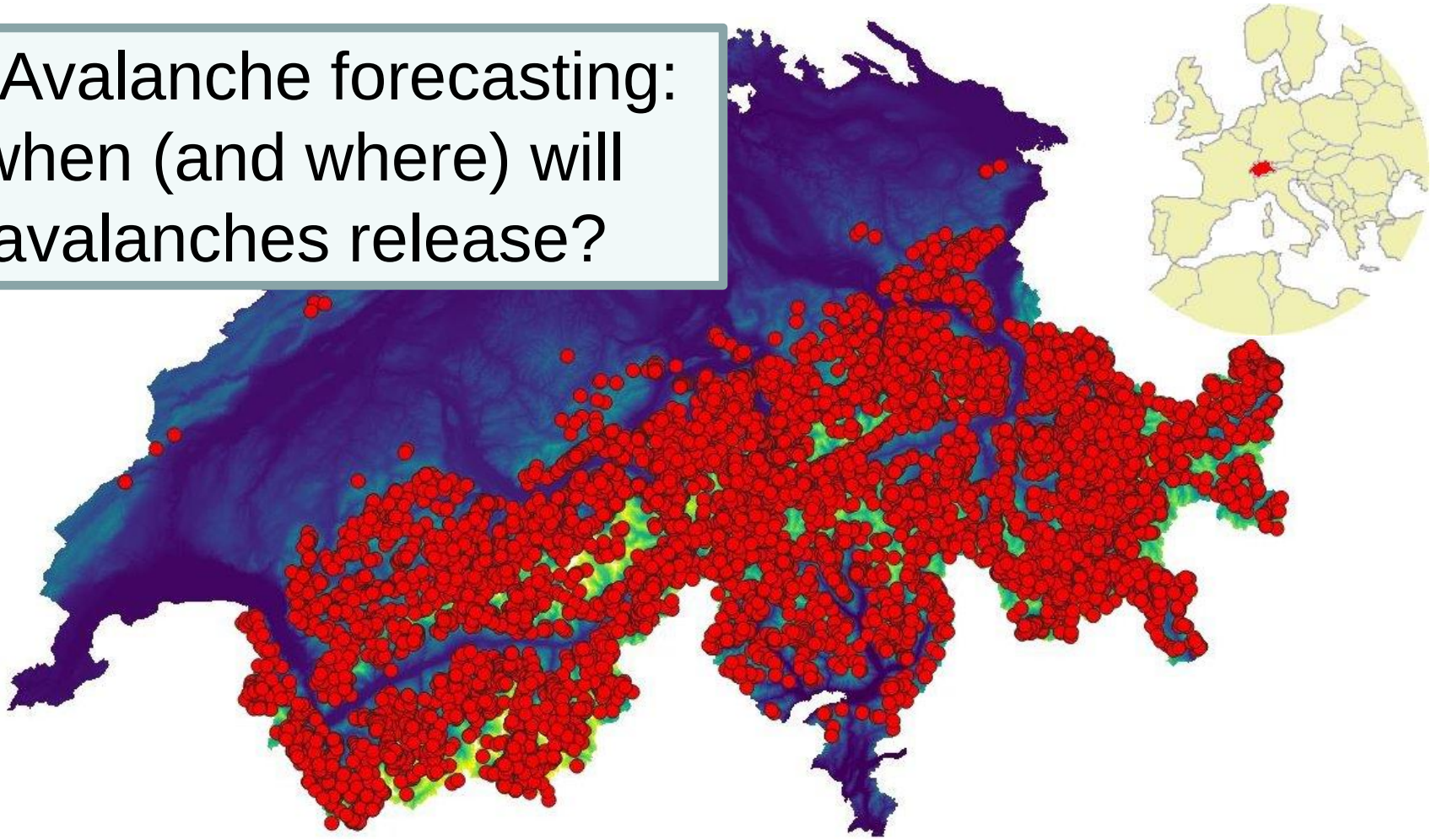
- Steep slope
- Snow
- Trigger

→ Any place that has mountains and snow

Snow avalanches in Switzerland

- Destructive snow avalanches last 50 years

→ Avalanche forecasting: when (and where) will avalanches release?

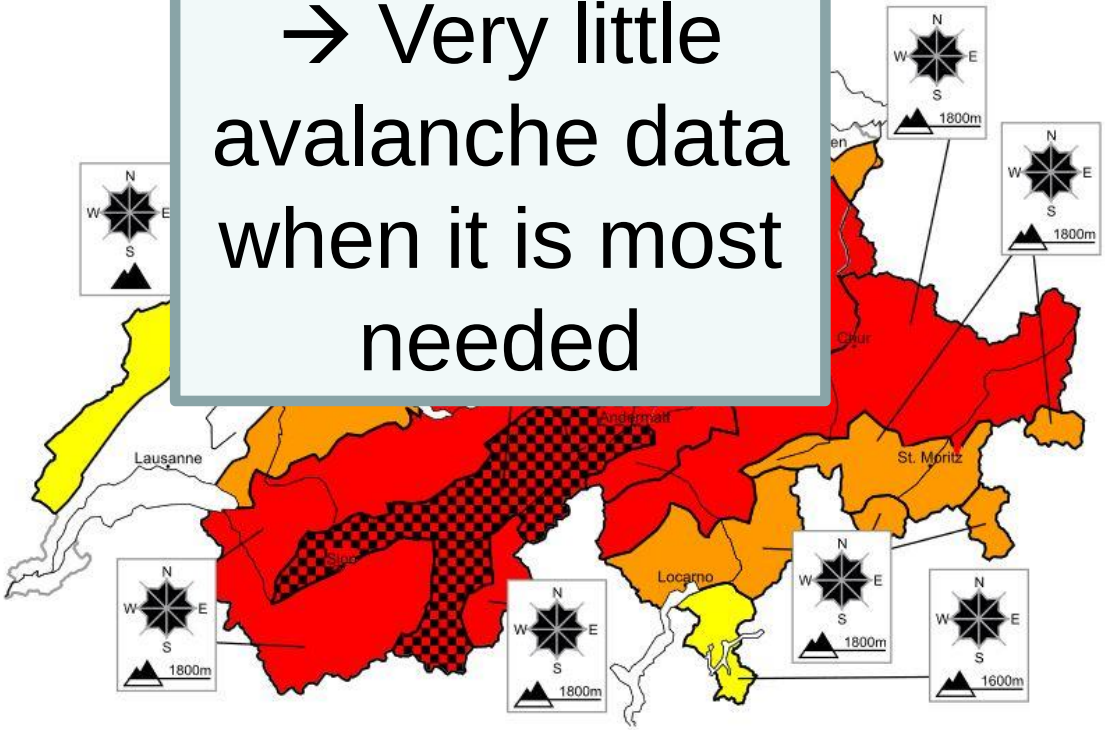


Avalanche forecasting

To warn the public about the avalanche danger level requires data on:

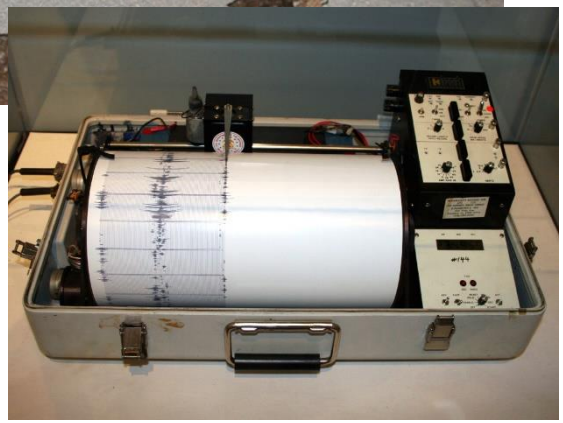
- Weather
- Snow stratigraphy
- Avalanches

→ Very little avalanche data when it is most needed



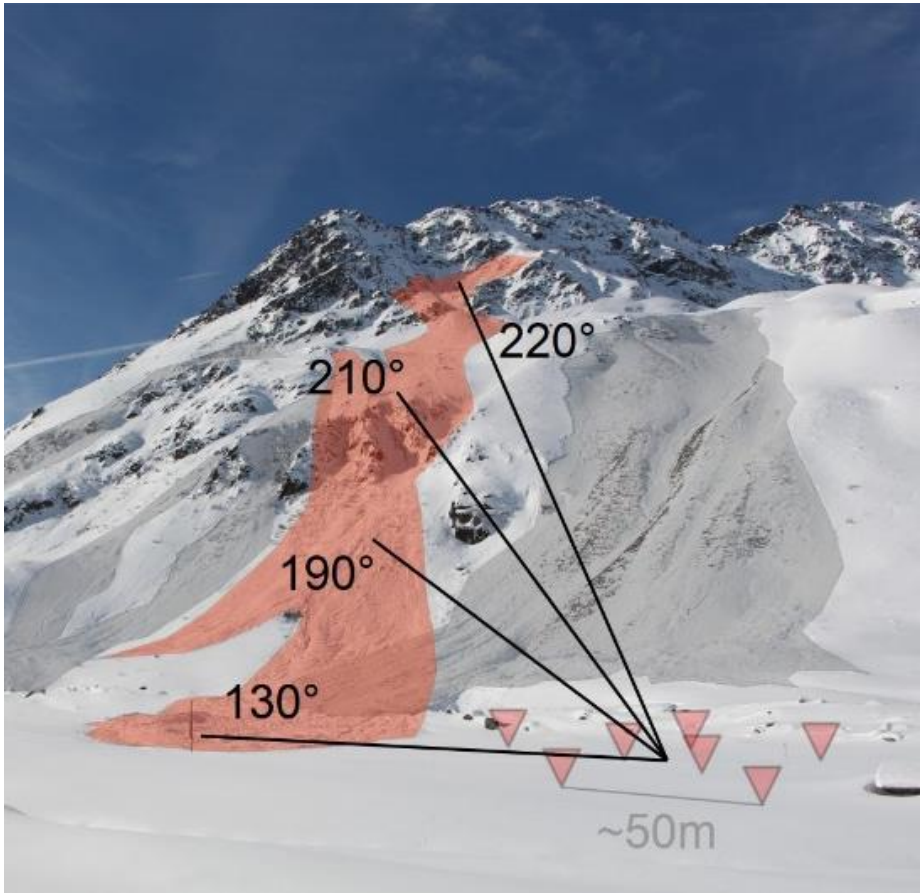
Remote avalanche detection

- Seismic monitoring systems

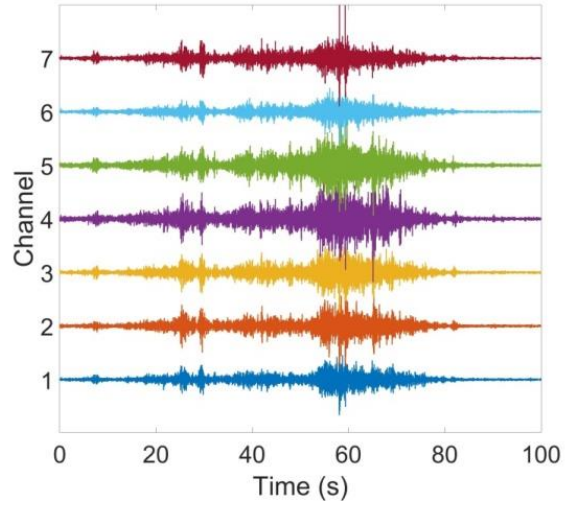


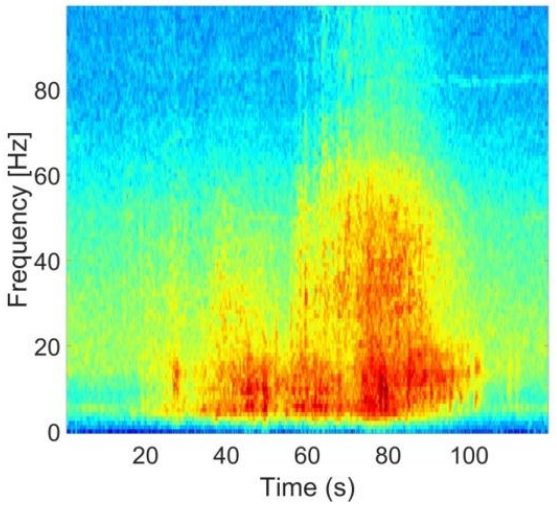
Remote avalanche detection

- Seismic monitoring systems



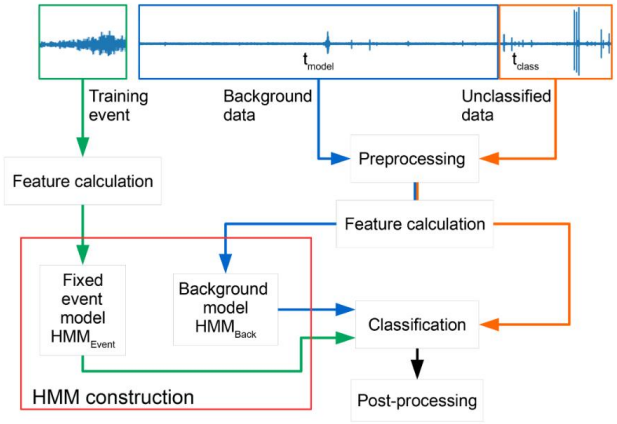
Heck et al., 2019

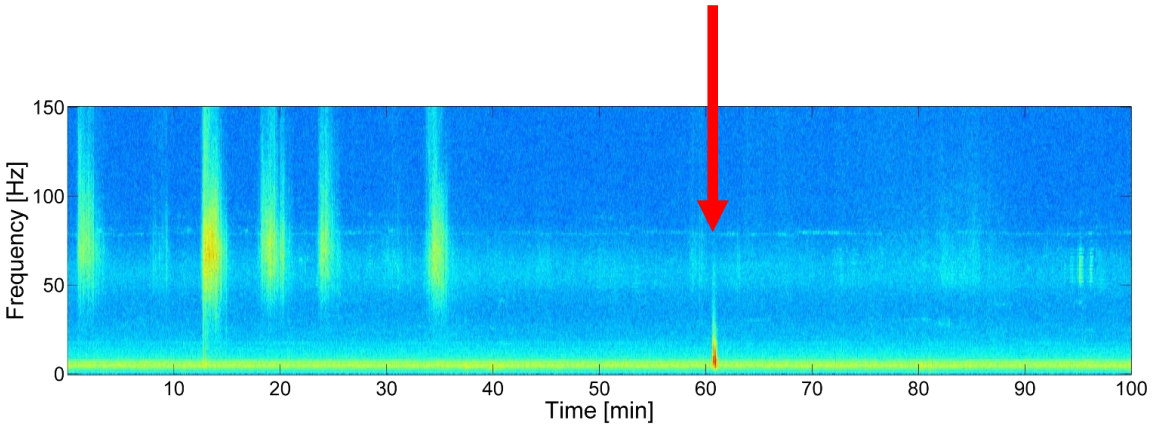


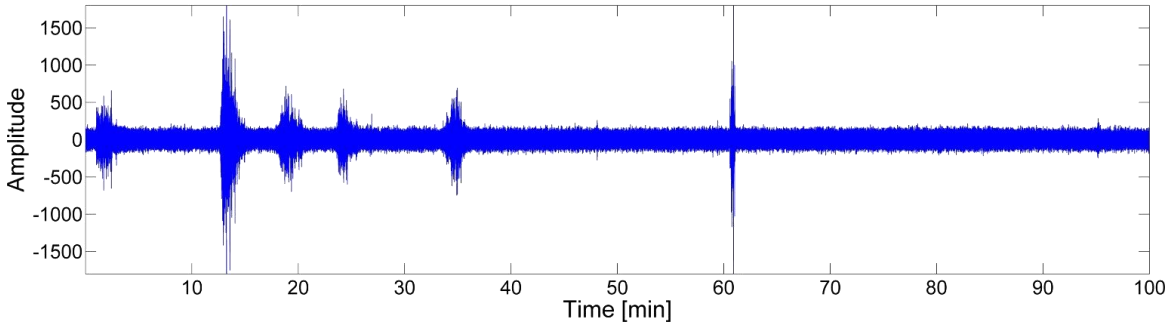


Automatic avalanche detection

- Supervised machine learning to automatically find signals generated by avalanches







Automatic avalanche detection

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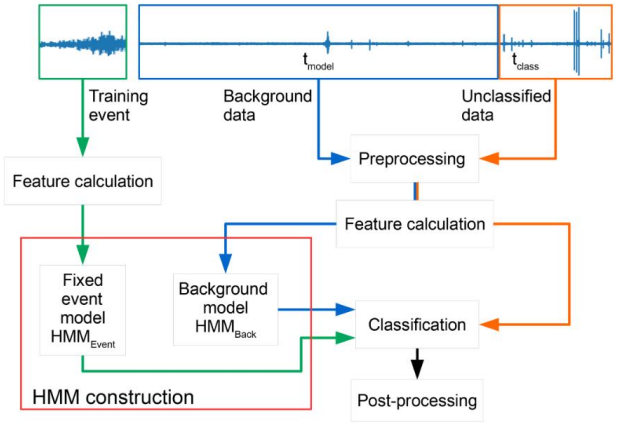
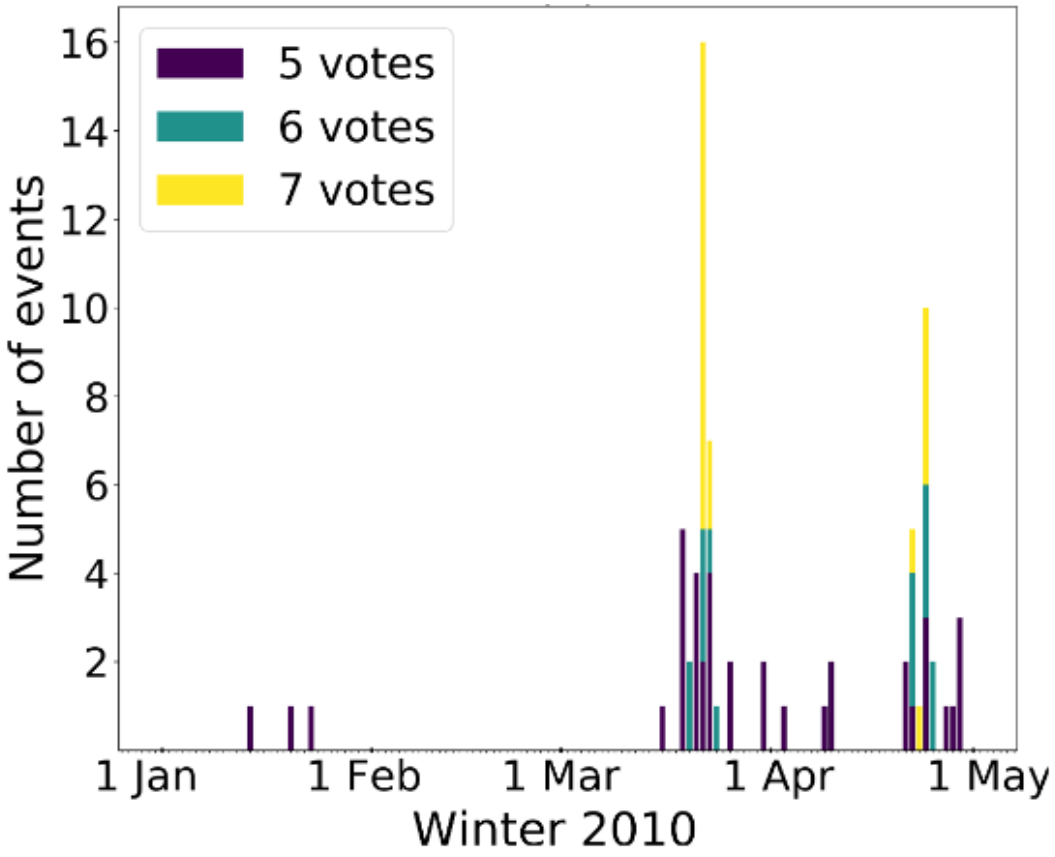


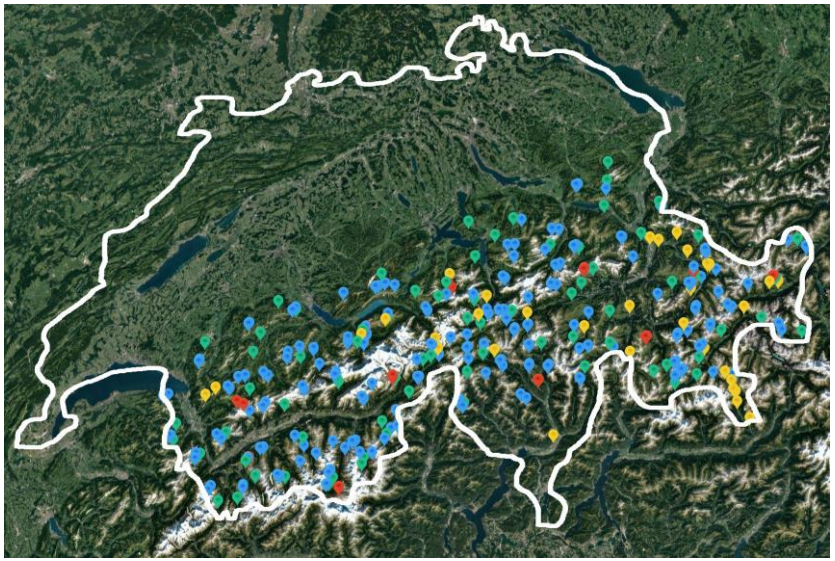
→ Accurate avalanche data potentially in real-time

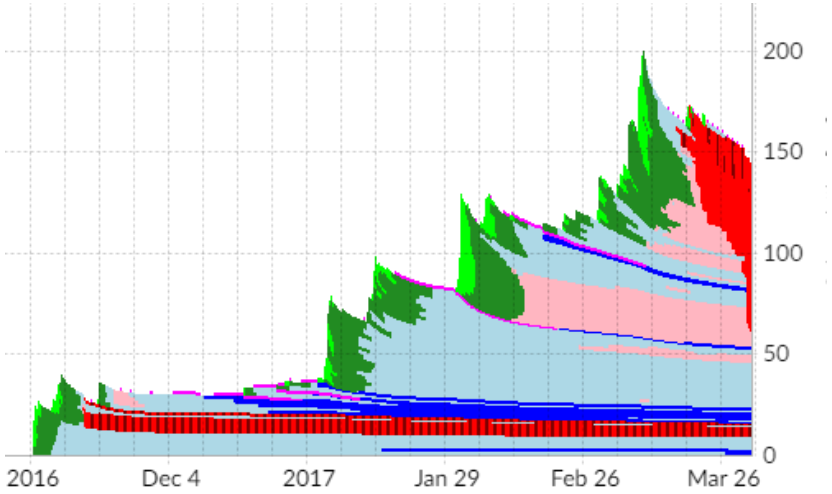


Heck et al., 2018

Automatic weather stations

- Over 130 stations in the Swiss Alps ( )
- Real-time data
- Snowpack modelling





Automatic danger level prediction

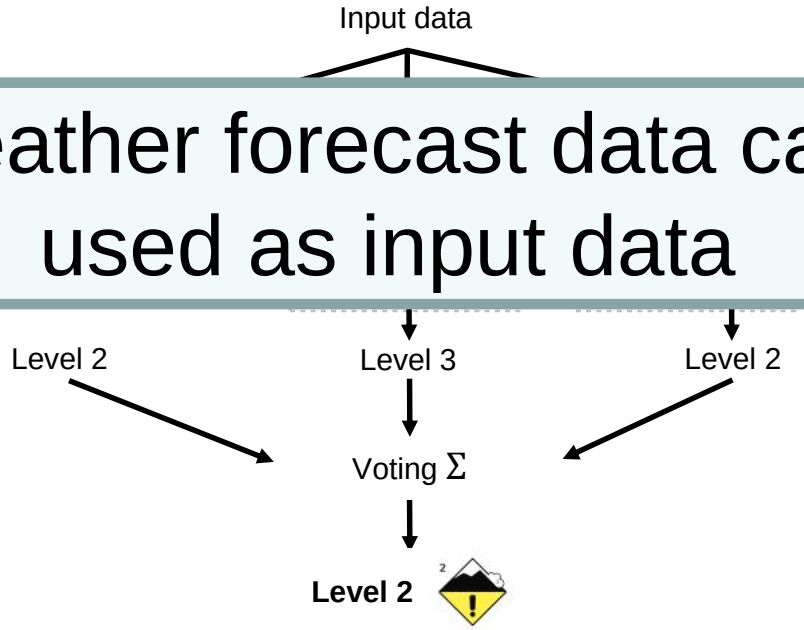
Input data:

Weather data: air and surface temperature, wind speed,,…

SNOWPACK data:new snow, wind drift index, stability indiced…

Supervised machine learning:

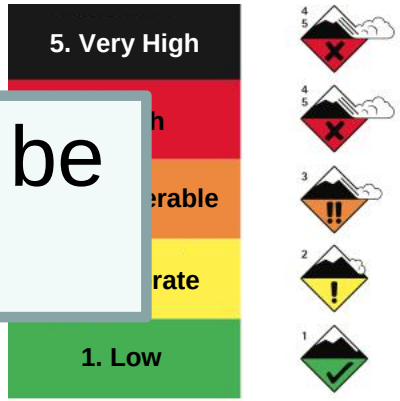
Random Forest



→ Weather forecast data can be used as input data

Output:

Danger scale

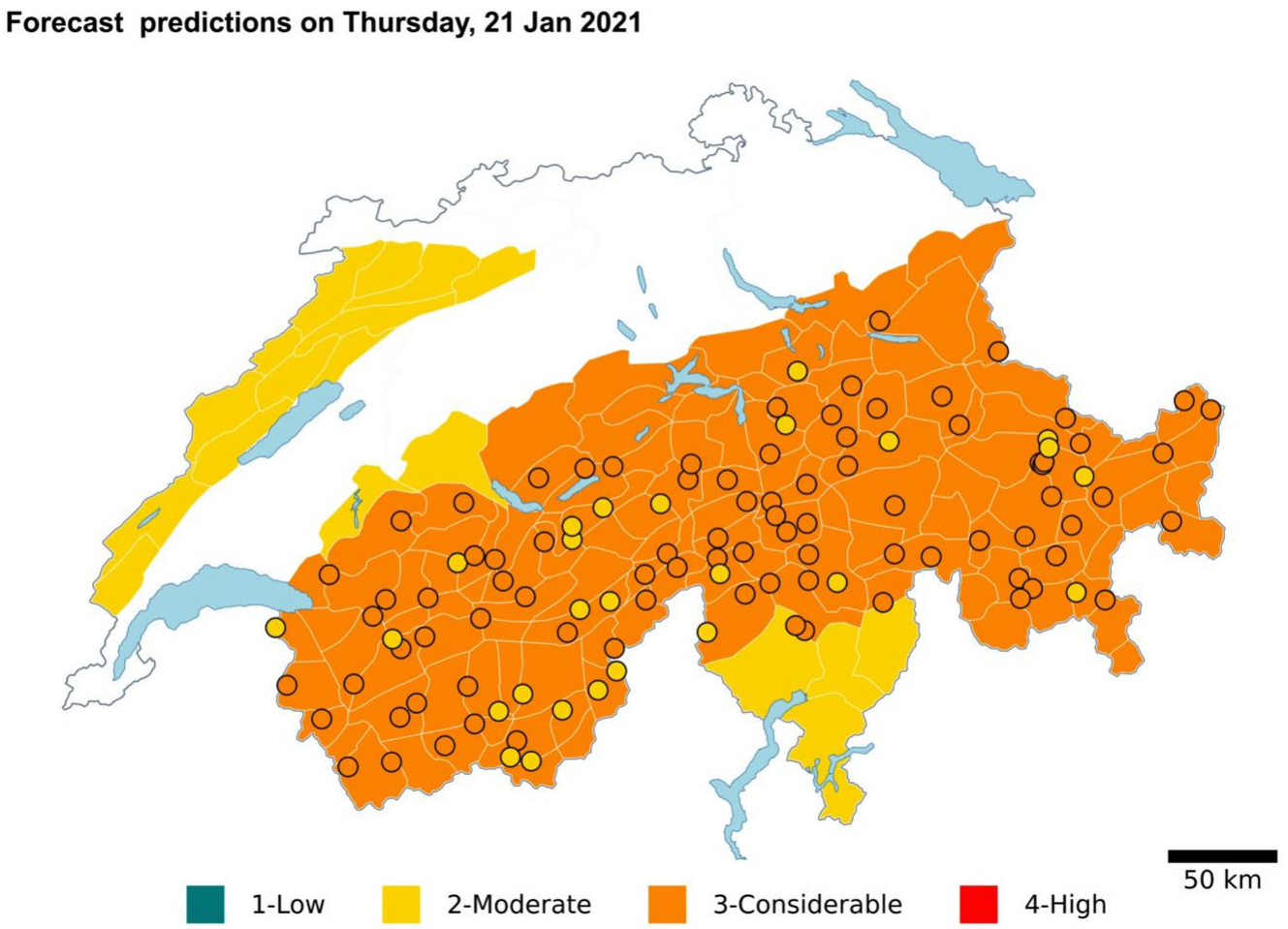


Regional danger level

Pérez-Guillén et al., 2021

SNOWPACK: Danger level prediction

All weather stations in Switzerland

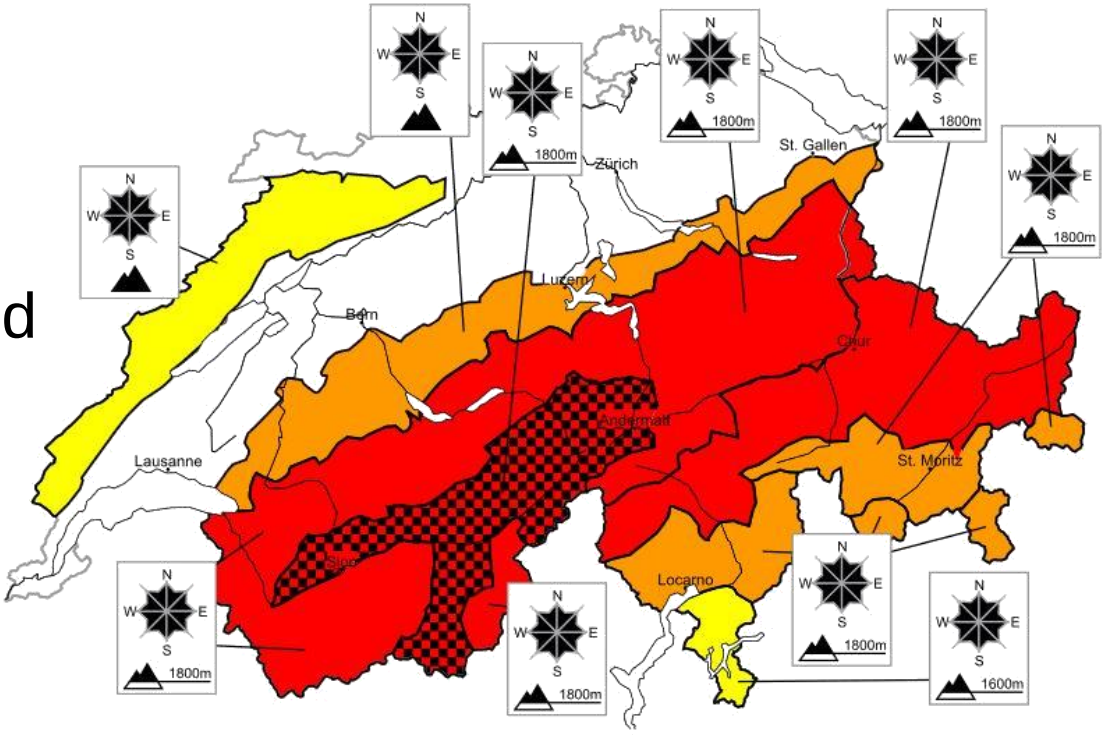


Pérez-Guillén et al., 2021

AI and avalanche forecasting

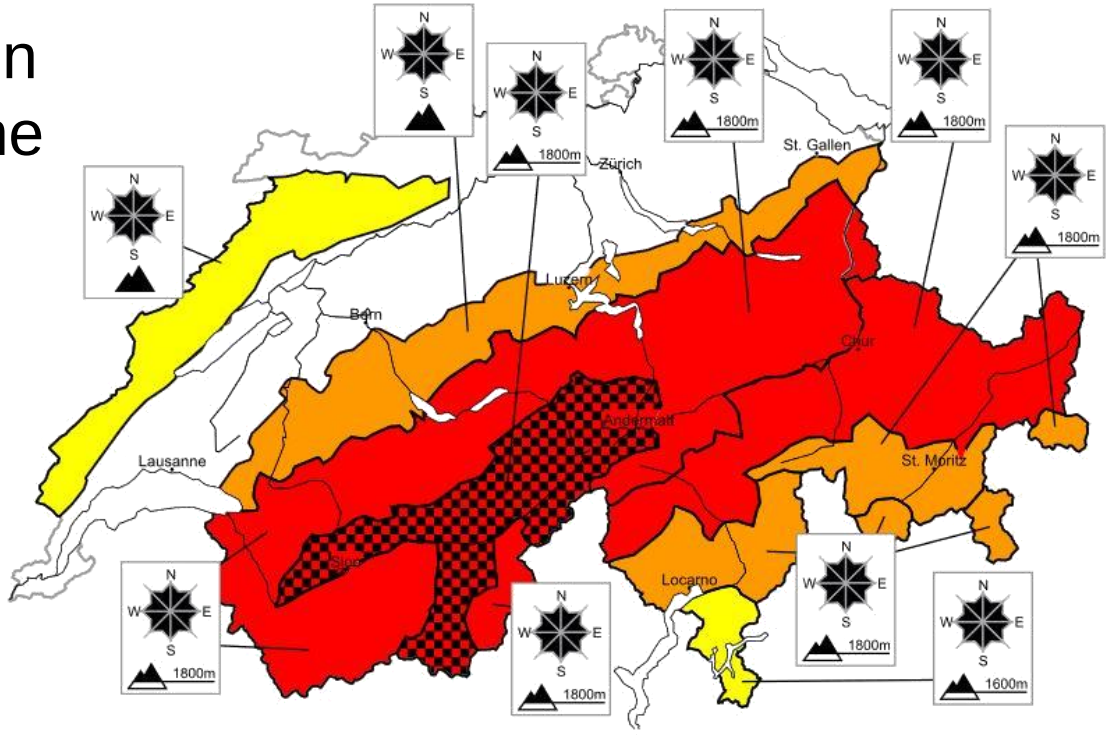
Machine learning will improve avalanche forecasting:

- Provide near real-time avalanche data
- Objective analysis of large data volumes
- Improve the spatial and temporal resolution of forecasting products



Challenges to implement AI in operational avalanche forecasting

- Data availability and reliability (data sparse areas)
- Reliable training data for avalanche detection systems and avalanche forecasting
- Extreme weather events are becoming more common



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Pérez-Guillén, C., Hendrick, M., Techel, F., van Herwijnen, A., Volpi, M., Tasko, O., Pérez-Cruz, F., Obozinski, G., and Schweizer, J., 2021. Data-driven automatic predictions of avalanche danger in Switzerland, EGU General Assembly 2021, online, 19–30 Apr 2021, EGU21-6154, https://doi.org/10.5194/egusphere-egu21-6154