



Simulating avalanche problem types to assess avalanche climate zones in the French Alps

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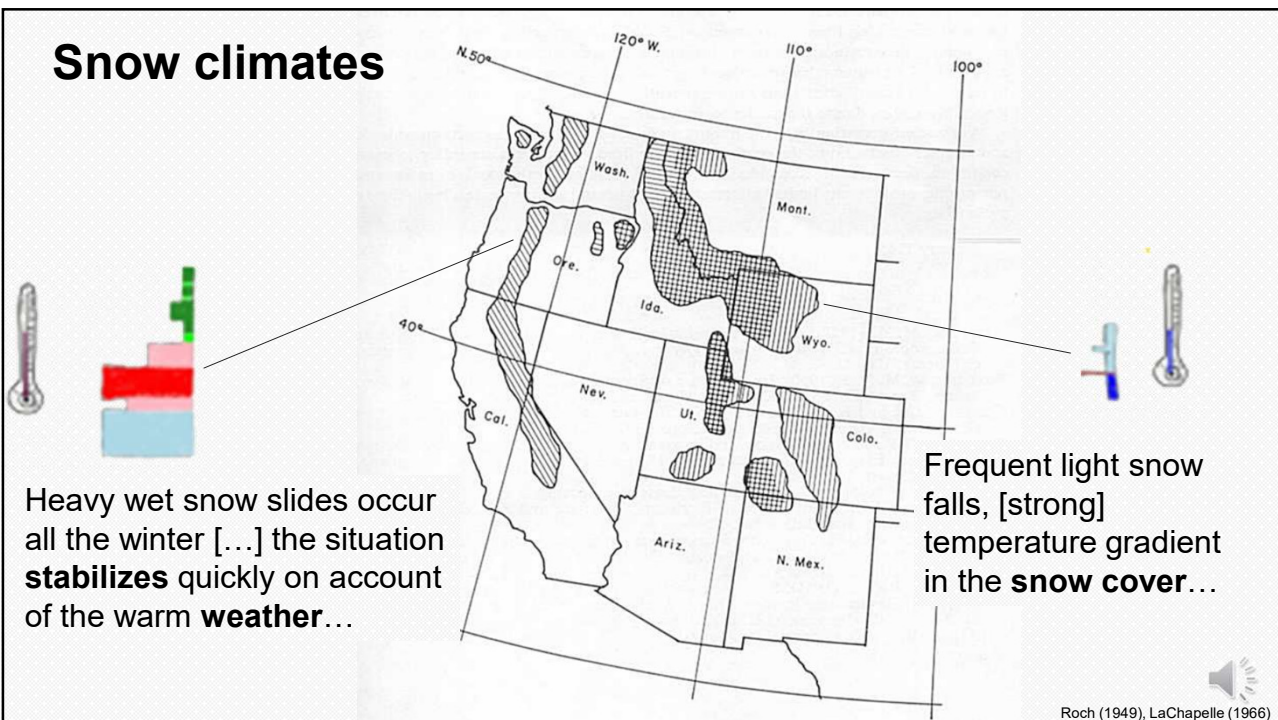
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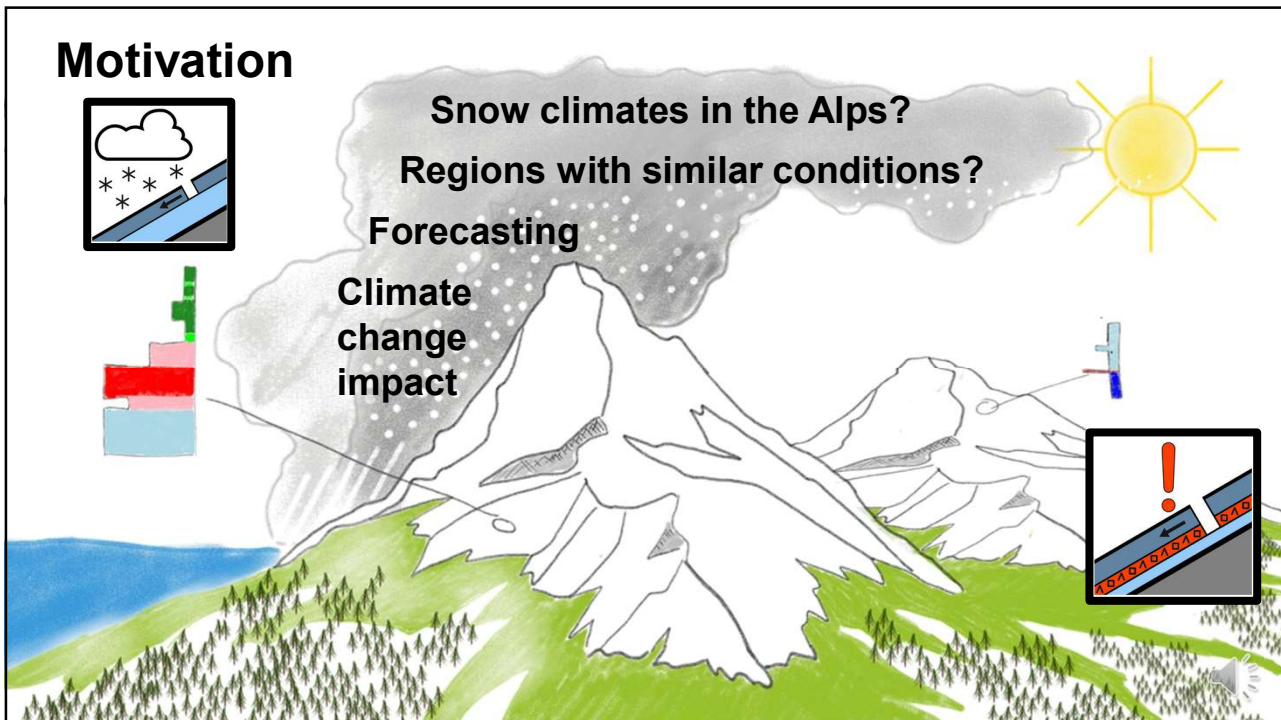
³ Univ. Grenoble Alpes, INRAE, ETNA, Grenoble, France



Snow climates



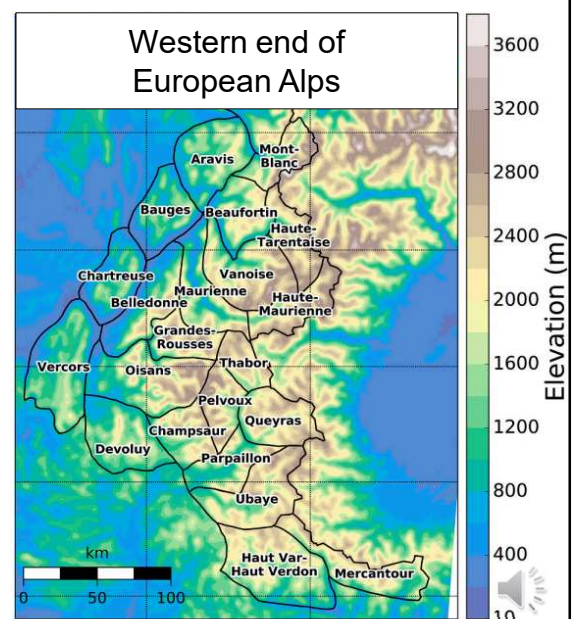
Motivation



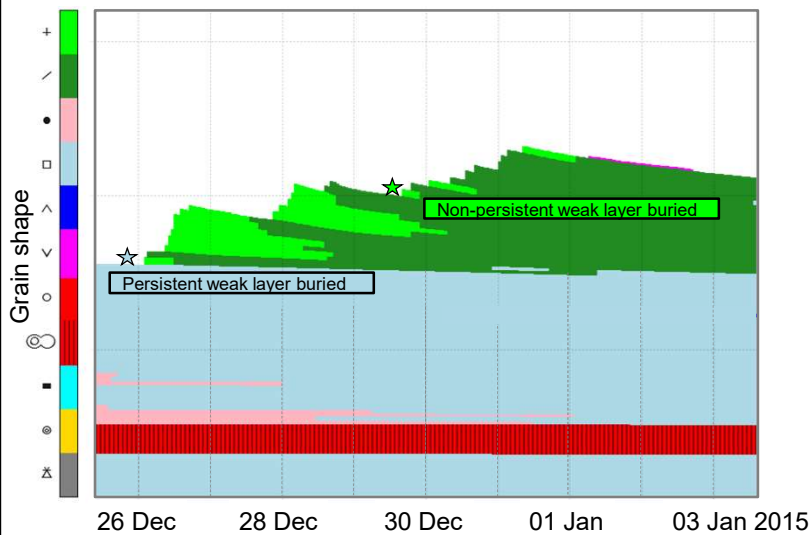
Methods

- S2M reanalysis
 - 23 regions in French Alps
 - 60 seasons: 1958 – 2020
- Crocus simulations
 - in every region
 - at typical elevation of release areas

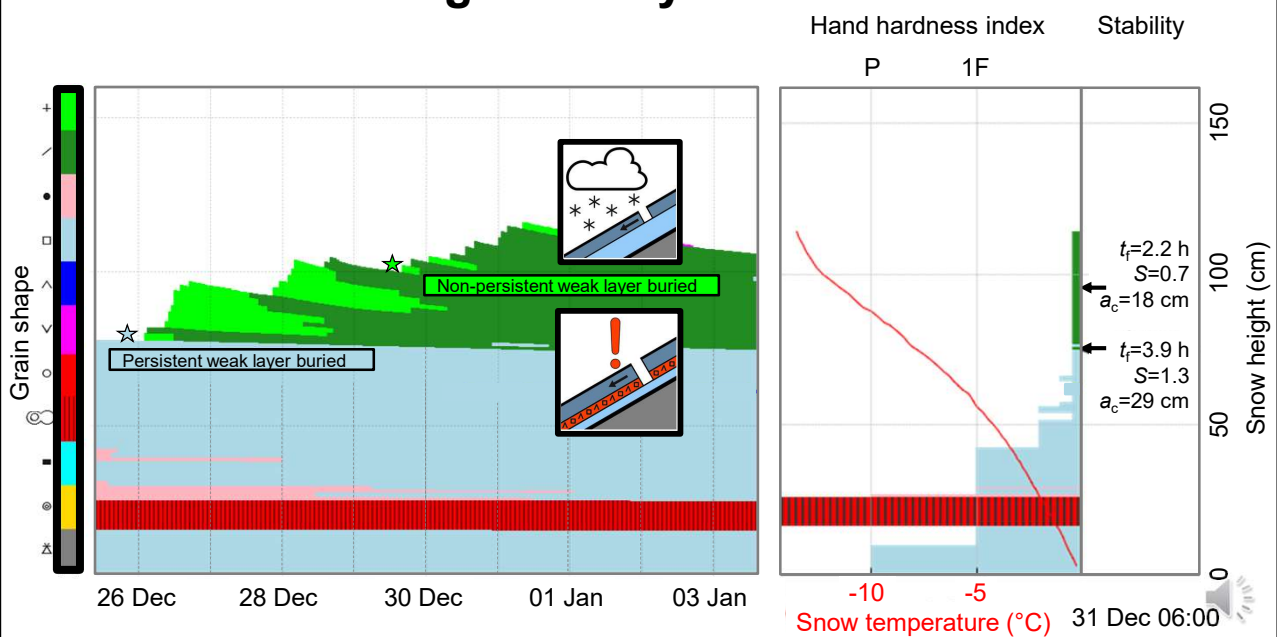
→ Avalanche problem types



Methods: Snow cover modelling

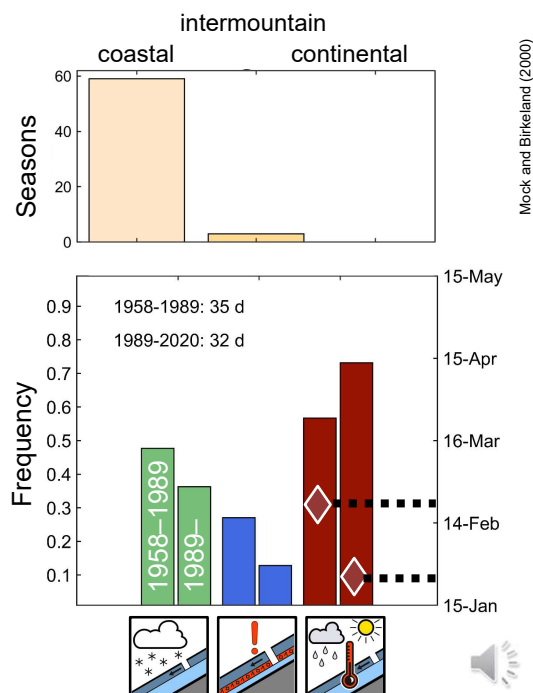
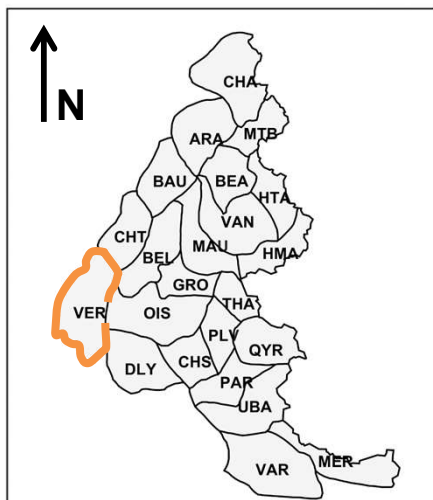


Methods: Tracking weak layers



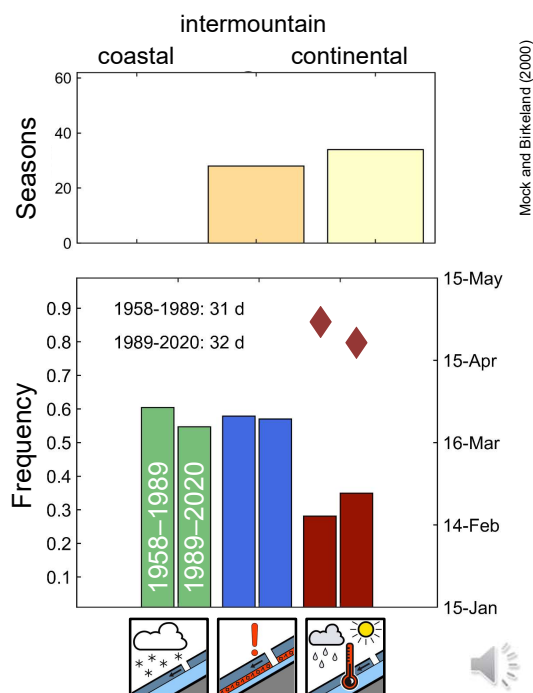
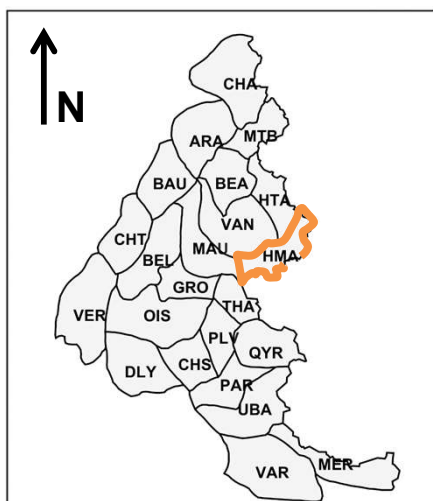
Avalanche problem types

Vercors (front-range region)

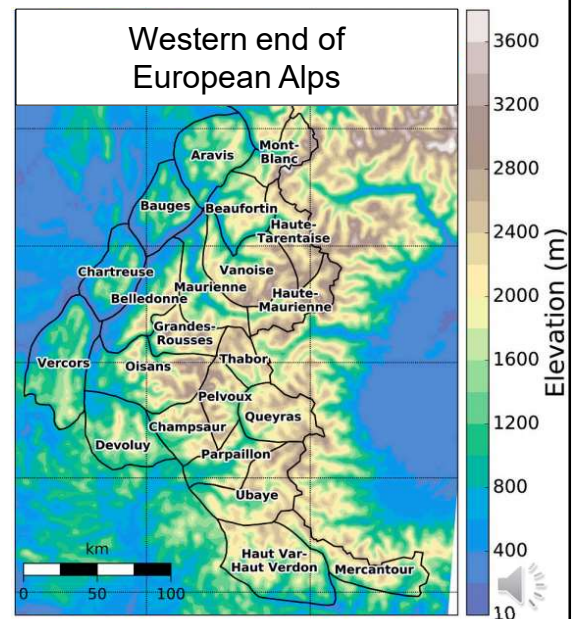
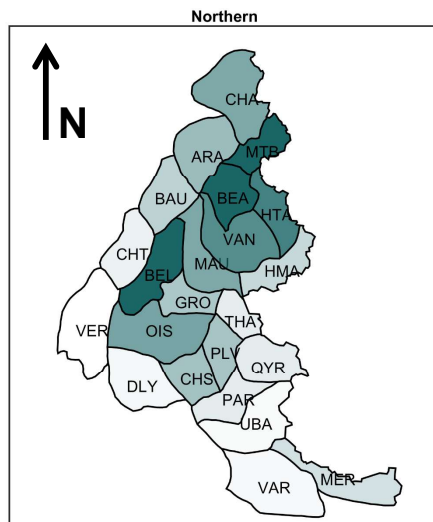


Avalanche problem types

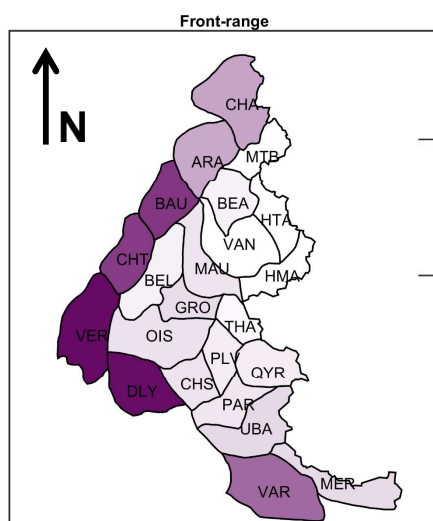
Haute Maurienne (inner-alpine region)



Clusters of avalanche problem types



Clusters of avalanche problem types



	Few days (<6) with new snow		Many days (>5) with new snow	
Many (>18) cases with persistent weak layers	Wet snow onset mostly after 1 April		Few data	Few data
Few (<19) cases with persistent weak layers	Wet snow onset before 28 February	Wet snow onset after 1 March	Few data	Wet snow onset after 6 April



Conclusions on Results

- In French Alps 4 clusters of avalanche problem types
 - Relate to orography
 - Complement snow climate classification
 - Universal method to assess avalanche problems from snow cover simulations
- Assess temporal change and climate impact
- Identify powerful tools for local forecasting

