Avalanche fatalities in the European Alps
long-term trends and statistics

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Starting position

Interpretation of avalanche accident data is often complicated

Statistics highly influenced by:

- small number of events
- underreporting of non-fatal accidents
- single multi-fatality accidents
- extreme years
- random effects

⇒ we addressed this issue by investigating and comparing data from 7 alpine countries (CH, FRA, AUT, ITA, DEU, LIE, SVN)
Previous study

• Etter et al. (2004):
  – Statistics from all ICAR countries (including North America)
  – Deduced trends based on a 20-year time series (1984–2003)

→ Increased fatality numbers in Austria and Switzerland (probably large influence of catastrophic winter 1998/1999).
# The dataset

| Country | Period      | Data source                                                                 | Mountain regions excluded                | Proportion of Alpine surface |
|---------|-------------|-----------------------------------------------------------------------------|-------------------------------------------|------------------------------|
| AUT: Austria | 1950–2015 | various sources*                                                           |                                            | 28.7%                        |
| CHE: Switzerland | 1937–2015 | WSL – Institut für Schnee- und Lawinenforschung (SLF)                        | Jura                                      | 13.2%                        |
| DEU: Germany   | 1967–2015 | Lawinenwarndienst Bayern                                                    | Black Forest                              | 5.8%                         |
| FRA: France    | 1970–2015 | Association Nationale pour l’Étude de la Neige et des Avalanches (ANENA)   | Pyrenees, Vosges, Jura, Massif Central, Corsica | 21.4%                        |
| ITA: Italy     | 1967–2015 | Associazione Interregionale Neve e Valanghe (AINEVA); Centro Valanghe di Arabba | Apennines, Mediterranean islands         | 27.2%                        |
| LIE: Liechtenstein | 1970–2015 | Amt für Bevölkerungsschutz Liechtenstein                                   |                                            | 0.08%                        |
| SVN: Slovenia  | 1950–2015 | Anton Melik Geographical Institute, Research Centre of the Slovenian Academy of Sciences and Arts |                                            | 3.6%                         |
The dataset

- Three subsets
  - 79 years period: CHE
  - 66 years period: CHE, AUT, SVN
  - 46 years period: European Alps (CHE, FRA, AUT, ITA, DEU, SVN, LIE)
Classification of the terrain

Controlled terrain

✓ within settlements or in isolated buildings
✓ on transportation corridors (roads, railways, ski runs, hiking trails)

⇒ safety measures are incorporated to reduce risk
⇒ mostly natural released avalanches
Classification of the terrain

Uncontrolled terrain

- outside settlements or buildings
- away from transportation corridors

⇒ mostly of recreational type
⇒ individuals are responsible for their personal safety
⇒ mostly unintentionally triggered avalanches
Results
Results

CHE – 1937-2015:

✓ annual mean of 24.8 fatalities/year
✓ no significant trend of the overall number of fatalities, but:

⇒ **Controlled terrain:** significant decreasing trend from 1970

⇒ **Uncontrolled terrain**
  • significant increasing trend from 1953 to 1986
  • no statistically significant trend since 1986
Results

CHE, AUT, SVN: years 1950–2015

- Mean
- tp-mean
- Median
- tp-median
- Controlled
- Uncontrolled
Results

CHE, AUT, SVN – 1950-2015:

- annual mean of 56.5 fatalities/year
- no significant trend of the overall number of fatalities, but:

⇒ Controlled terrain: significant decreasing trend since 1984

⇒ Uncontrolled terrain
  - significant increasing trend (X2) from the 60s to the late 80s
  - no statistically significant trend since the late 80s
Results
Results

European Alps – 1970-2015:

- 4750 people killed in avalanches
- annual mean of 103 fatalities/year
- no significant trend of the overall number of fatalities
Results

European Alps – 1970-2015:

⇒ Controlled terrain

- significant decreasing trend during all the period
- countries with the most fatalities (AUT, CHE, FRA, ITA) with similar inter annual variability
Results

European Alps – 1970-2015:

- Uncontrolled terrain
  - worst years in the second half of the period
  - 15-years median reached a minimum in the 90s (AUT, CHE, FRA, ITA)
  - Inter-annual variability was significantly larger in the three easternmost countries (AUT, DEU, SVN)
Conclusions

Controlled terrain
Number of fatalities has **reduced drastically** since the 1970s in all Alpine countries.

→ Successful implementation of prevention measures (avalanche defence structures, regulations, active and passive measures, ...)

WSL  SLF  anena
Conclusions

Uncontrolled terrain

- Number of fatalities almost doubled between the 60s and the 80s.
- Since the 80s number of fatalities relatively stationary despite a large increase in number of recreationists.

→ Technological developments in avalanche rescue (transceivers, mobile phones, helicopters) and education
Conclusions

• Shift towards avalanche fatalities almost exclusively occurring in uncontrolled terrain.

• Swiss dataset correlated best with other Alpine countries and may be considered as a long-term indicator roughly reflecting the development in other Alpine countries.
Conclusions

- Statistics from countries with very few incidents should be analyzed together with those from neighboring countries exhibiting similar economical and structural characteristics.
