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

Gian Darms, Fred Jarry, Frank Techel

ICAR Bulgaria 2016
Paper in Geographica Helvetica

Authors

Frank Techel
Frédéric Jarry, Georg Kronthaler, Susanna Mitterer, Patrick Nairz, Miha Pavšek, Mauro Valt and Gian Darms

Data from:

- SLF
- anena
- österreichisches kuratorium für alpine sicherheit
- Centro Valanghe di Arraba
- Slovenian Academy of Sciences and Arts
- tirol Unser Land
- Lawine
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)

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

<table>
<thead>
<tr>
<th>Country</th>
<th>Period</th>
<th>Data source</th>
<th>Mountain regions excluded</th>
<th>Proportion of Alpine surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUT: Austria</td>
<td>1950–2015</td>
<td>various sources*</td>
<td></td>
<td>28.7%</td>
</tr>
<tr>
<td>CHE: Switzerland</td>
<td>1937–2015</td>
<td>WSL – Institut für Schnee- und Lawinenforschung (SLF)</td>
<td>Jura</td>
<td>13.2%</td>
</tr>
<tr>
<td>DEU: Germany</td>
<td>1967–2015</td>
<td>Lawinenwarndienst Bayern</td>
<td>Black Forest</td>
<td>5.8%</td>
</tr>
<tr>
<td>ITA: Italy</td>
<td>1967–2015</td>
<td>Associazione Interregionale Neve e Valanghe (AINEVA); Centro Valanghe di Arabba</td>
<td>Apennines, Mediterranean islands</td>
<td>27.2%</td>
</tr>
<tr>
<td>LIE: Liechtenstein</td>
<td>1970–2015</td>
<td>Amt für Bevölkerungsschutz Liechtenstein</td>
<td></td>
<td>0.08%</td>
</tr>
<tr>
<td>SVN: Slovenia</td>
<td>1950–2015</td>
<td>Anton Melik Geographical Institute, Research Centre of the Slovenian Academy of Sciences and Arts</td>
<td></td>
<td>3.6%</td>
</tr>
</tbody>
</table>
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

CHE: years 1937-2015

- Mean
- tp-mean
- Median
- tp-median

Controlled
Uncontrolled

Fatality


0 15 30 45 60
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
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

European Alps: years 1970–2015

- Mean
- tp-mean
- Median
- tp-median
- Controlled
- Uncontrolled
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, ...)

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.
Questions?