

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

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Data from :

SLF

anena

LAWINEN-WARNDIENST BAYERN

österreichisches kuratorium für alpine sicherheit

Centro Valanghe di Arraba

AINEVA Associazione Interregionale Neve e Valanghe

Slovenian Academy of Sciences and Arts

tirol Unser Land Lawine

WSL

SLF

anena

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 adressed 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

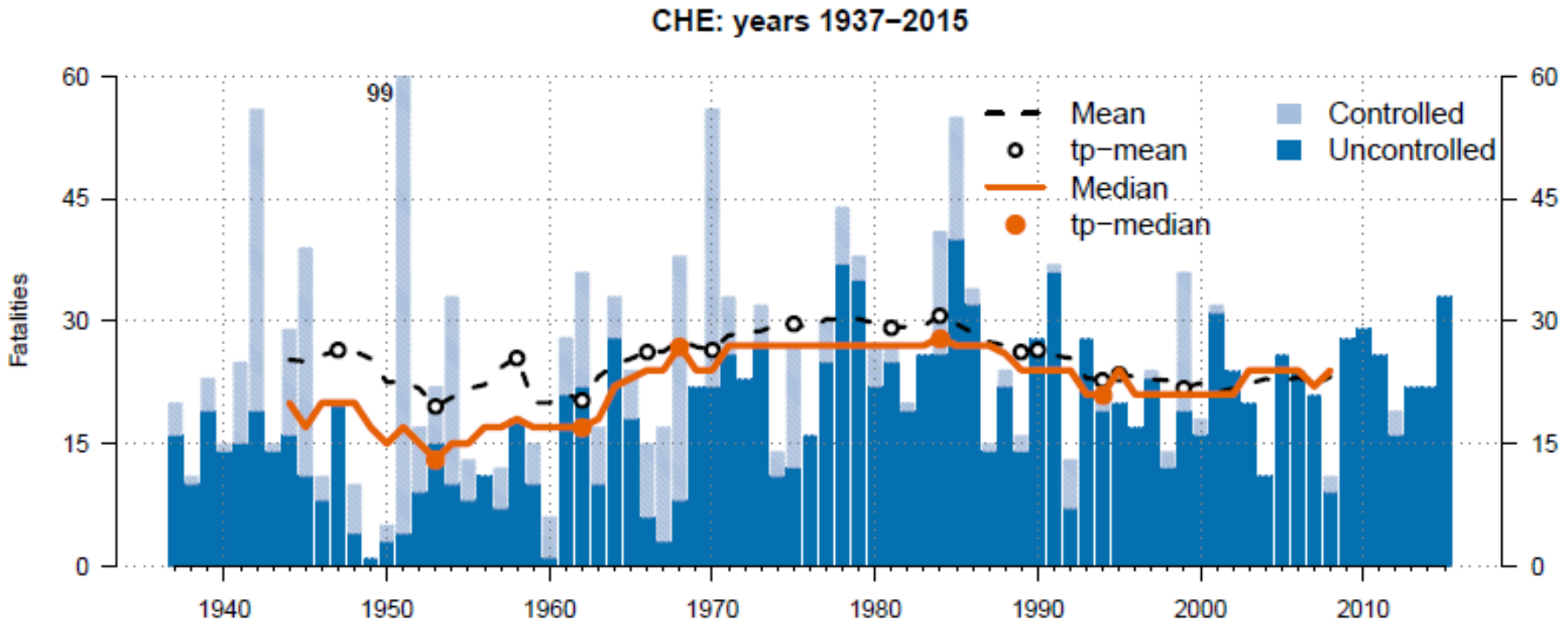
Classification of the terrain

Uncontrolled terrain

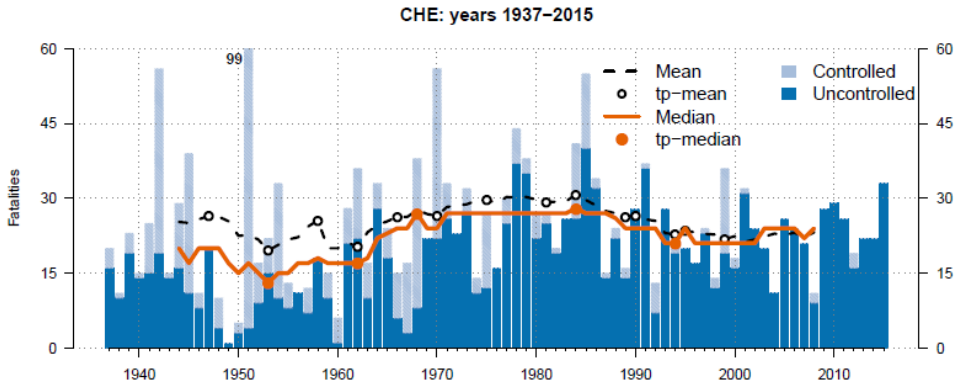
✓ outside settlements or buildings
✓ away from transportation corridors

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

Results


CHE: years 1937–2015
Fatalities
99
Mean
tp−mean
Median
tp−median
Controlled
Uncontrolled
60
45
30
15
0
1940
1950
1960
1970
1980
1990
2000
2010

Results



CHE – 1937-2015:

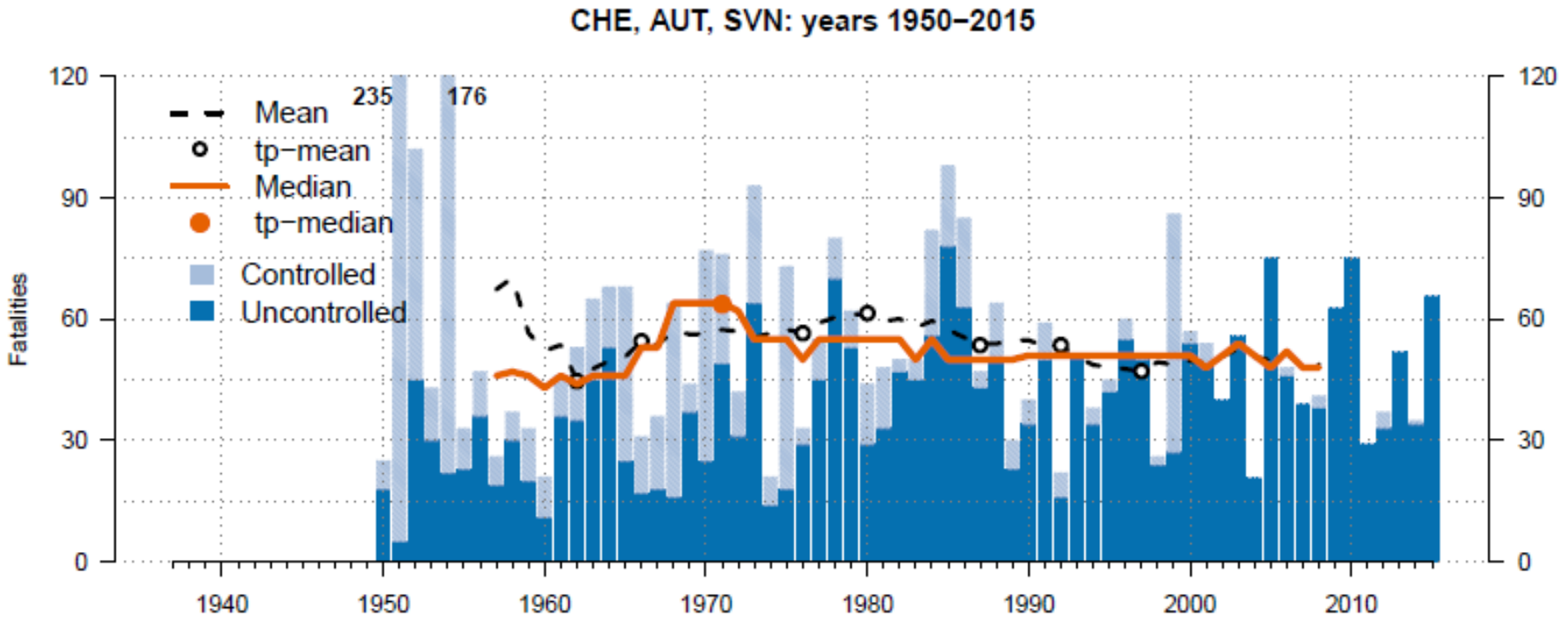
✓ annual mean of 24,8 fatalities/year
✓ no significant trend of the overall number of fatalities, but:

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

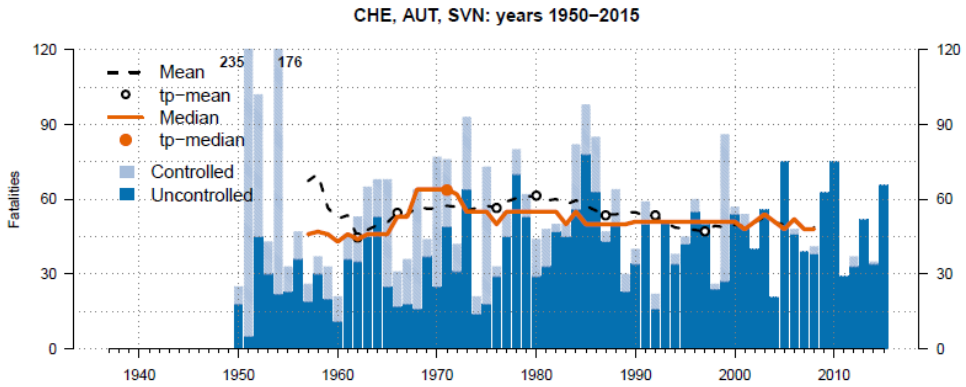
⇒ **Uncontrolled terrain**

- significant increasing trend from 1953 to 1986
- no statistically significant trend since 1986

Results


CHE, AUT, SVN: years 1950–2015
Fatalities
120
90
60
30
0
235
176
Mean
tp–mean
Median
tp–median
Controlled
Uncontrolled
1940
1950
1960
1970
1980
1990
2000
2010

Results



CHE, AUT, SVN – 1950-2015:

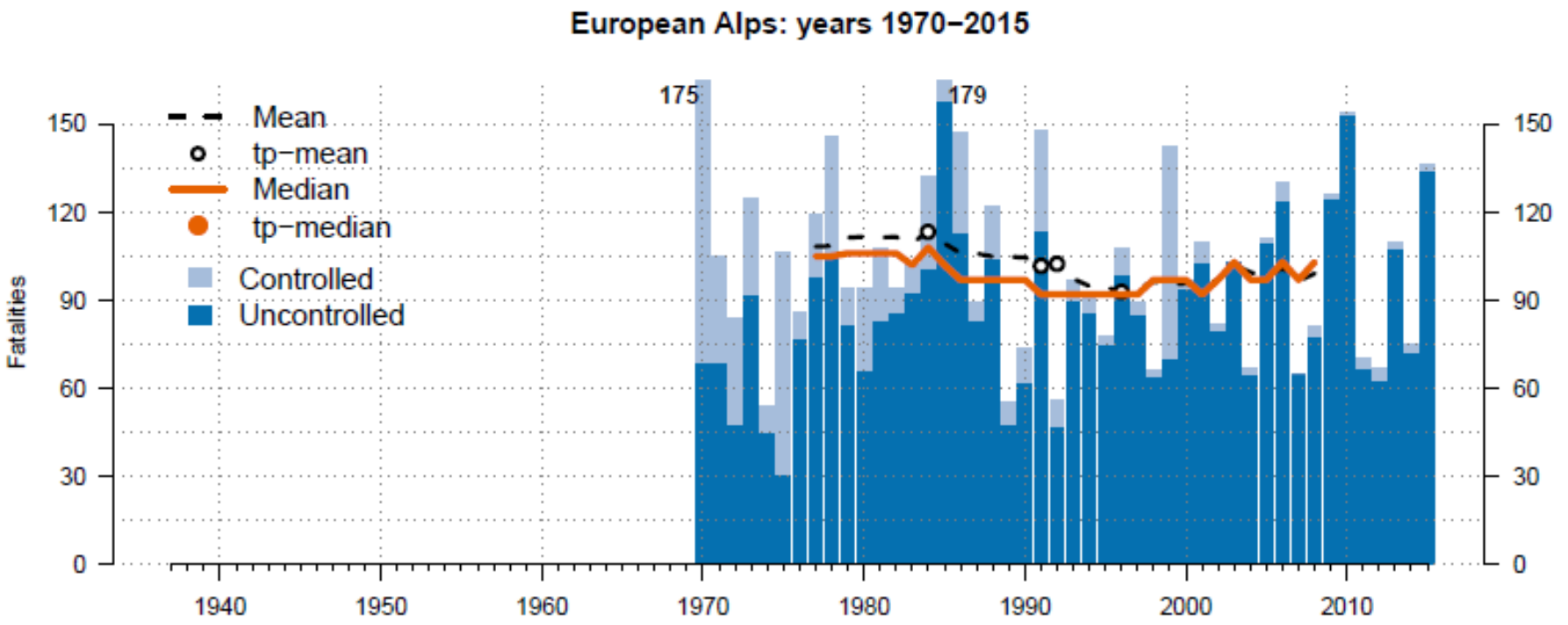
✓ annual mean of 56,5 fatalities/year
✓ no significant trend of the overall number of fatalities, but:

⇒ **Controlled terrain:** significant decreasing trend since 1984

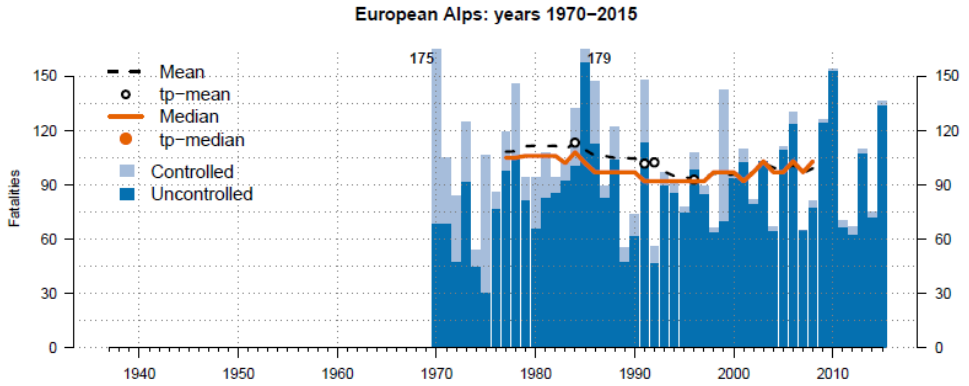
⇒ **Uncontrolled terrain**

- 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
175
179
Mean
tp−mean
Median
tp−median
Controlled
Uncontrolled
Fatalities
150
120
90
60
30
0
1940
1950
1960
1970
1980
1990
2000
2010

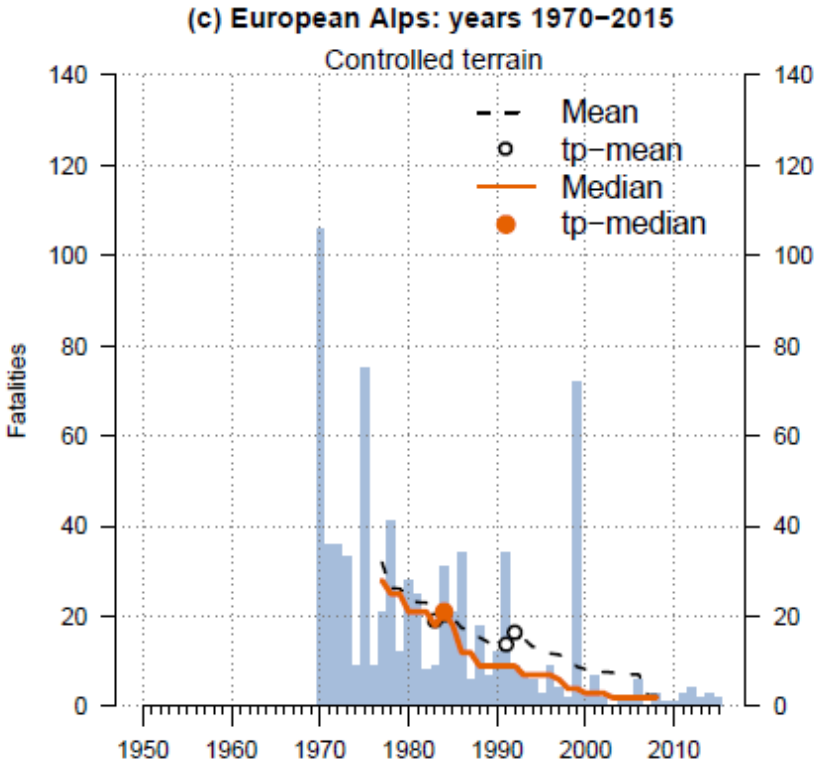
Results



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

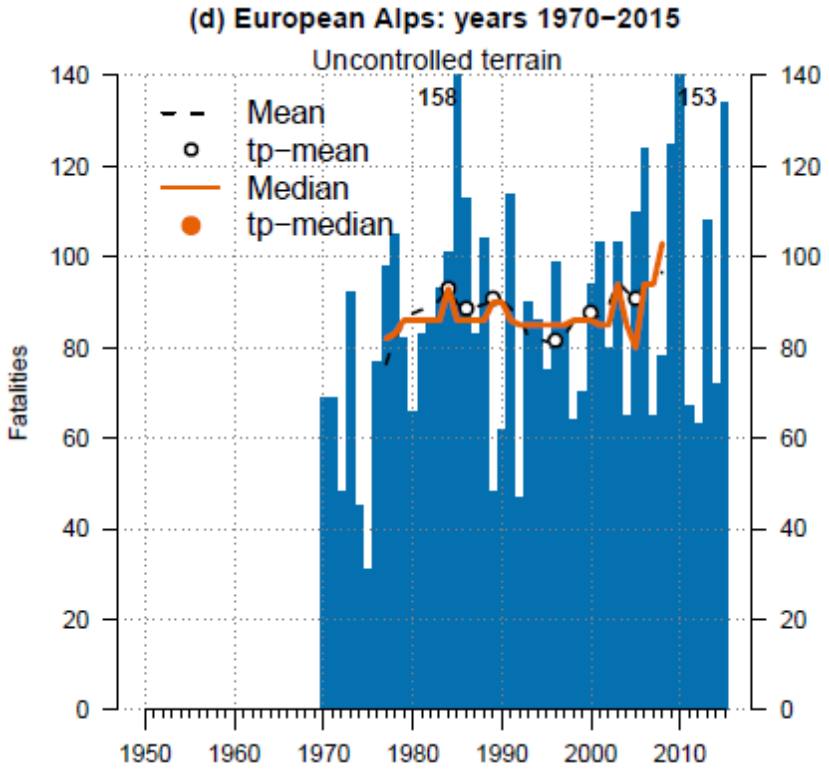


European Alps – 1970-2015:

⇒ **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?