

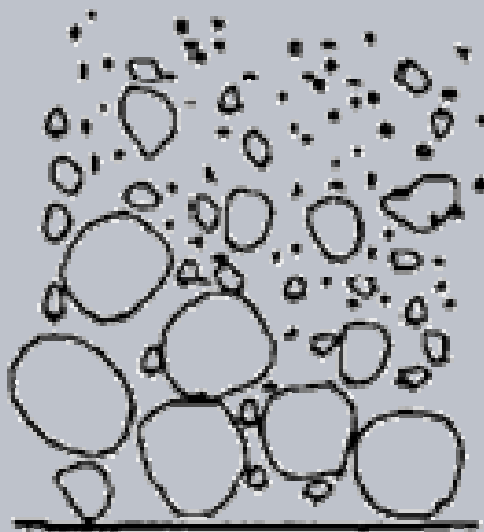
Three different shapes of avalanche balloons a pilot study

M. Biskupic¹, J Richnavsky¹, M.Lizuch¹, F. Kyzek¹, I. Ziak¹, E. Procter², Pawel
Chrustek³

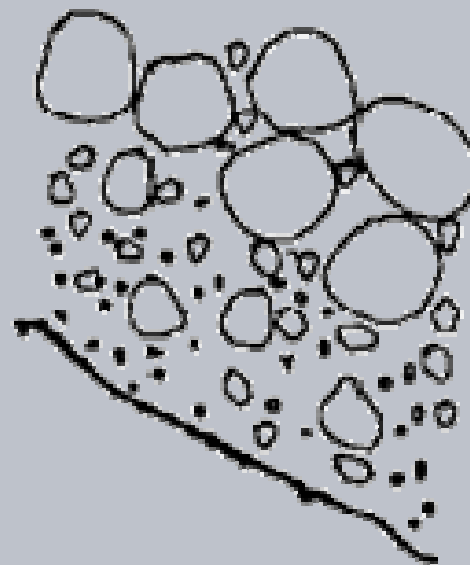
¹Avalanche Prevention Center, ²EURAC - Institute of Mountain Emergency
Medicine, ³Anna Pasek Foundation, Cracow, Poland

Background

- Avalanches = gravitational granular flow
- Specific sedimentation (Inverse grading)



(a)



(b)

(source: Vulliet et al. 2000)

Previous field studies

- 1975 – 79 (Hohenseter)
- 1978 (Alianz technology center)
- 1980 – 81 (Canada Park Service, Banf)
-
- 1994 – 1995 ABS mono airbags (Tschirky and Schweizer 1996)
 - 0 fully, 4 partially – critically, 1 partially – not critically, 1 not buried
 - No balloons: 4 fully, 2 partially – critically, 2 partially – not critically
- 2001 ABS mono airbags, ABS dual airbags and Avagear collar mono type airbag vest (Kern et al. 2002)
 - 3 fully, 3 partially, 1 not buried
 - No balloons: 5 fully, 1 partially
- 2011 ABS dual airbags and Snowpulse collar type mono airbags (Meier and Harvey, 2012).
 - Dummies with airbags were burried significantly less deeper

None of the balloon was completely buried. All visible



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Josef Honenseter (1973)



(source: Kroell, 2012)

2012



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Aims

- Investigate the behavior of each inflated system in an avalanche.
- Observe if the shape may have influence on burial degree.



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Methods and test site instrumentation

- 3 differently shaped balloons (Mammut Lifebag Guide 30, BCA Float 18, ABS Vario 25,)
- Human like dummies (crash test dummies, 80kg)
- Tested in avalanche, triggered by explosives (50kg)
- Backpacks were deployed 60 seconds prior to the avalanche release.
- The position of the dummies was measured with high accuracy GPS (<1m) before and after the avalanche.
- Burial degree assessed (Observational Guidelines for Avalanche Programs in the United States, Greene et al. 2010)
- Several cameras and point of view cameras were placed either in the track or across the track



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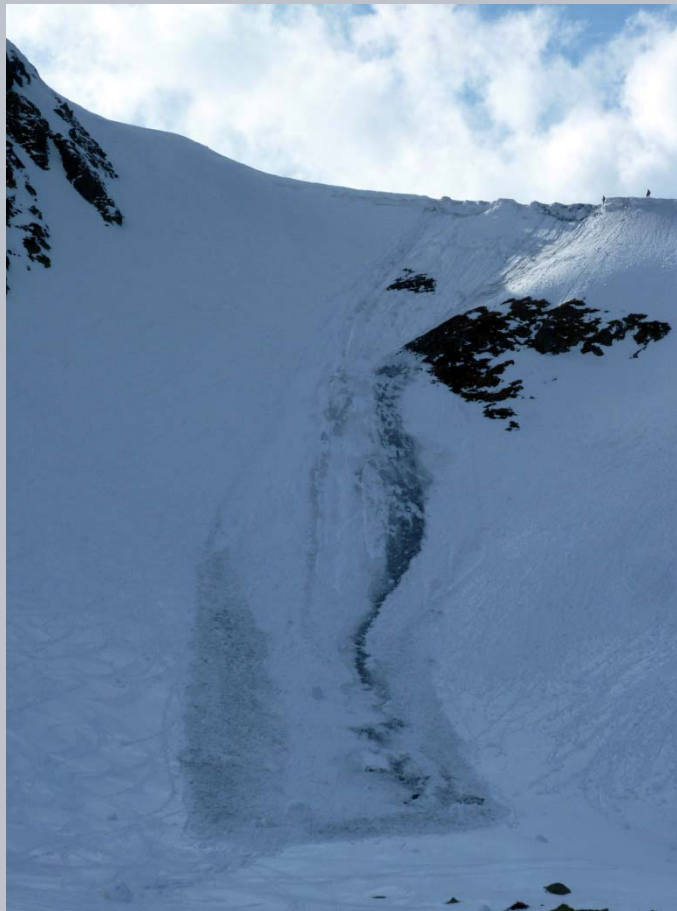
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About the avalanche



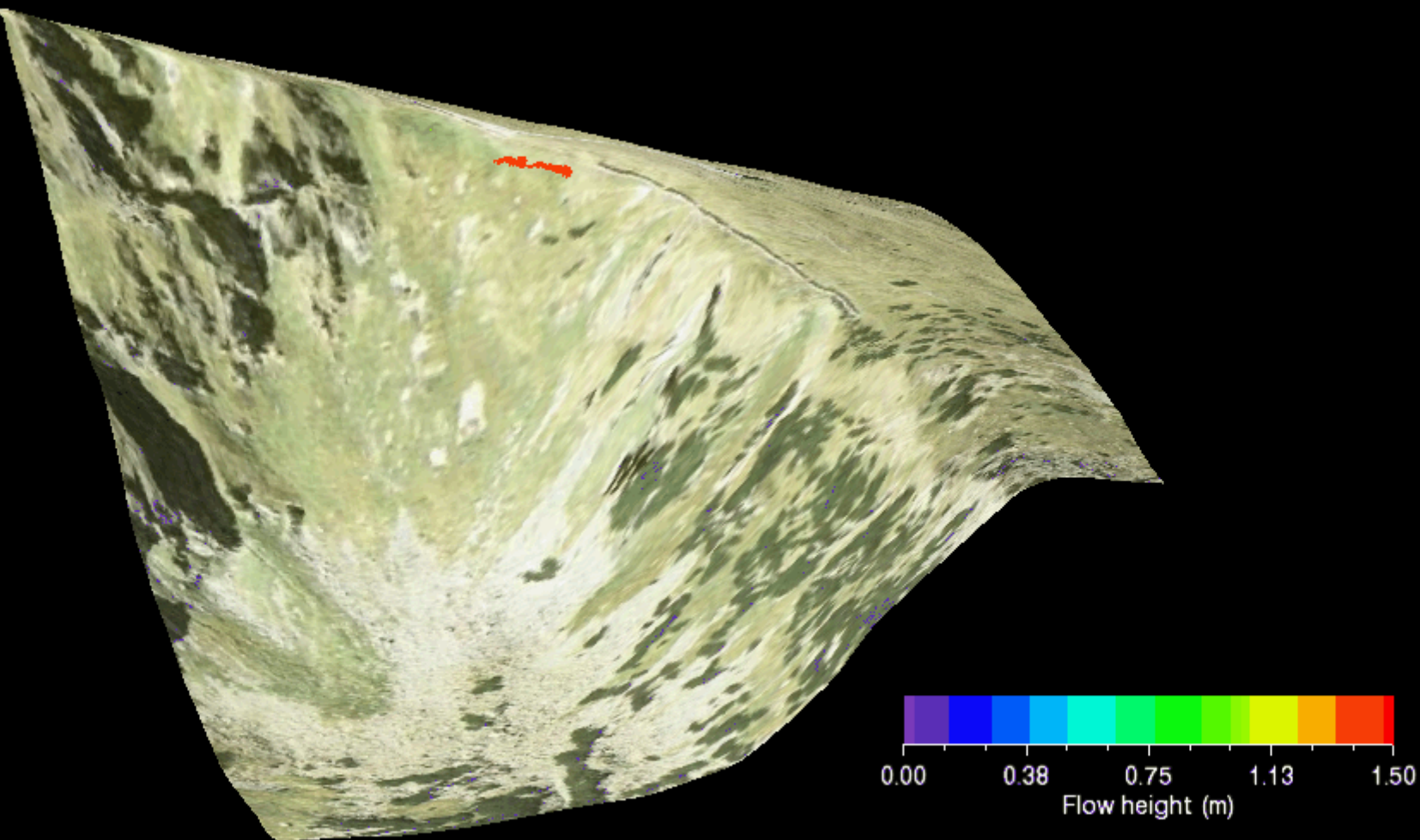
Initial snow volume	Track	Avg. deposition depth	Max. pressure	Max. speed	Run-out size
280m ³	250m	1,5m	125,13 kPa	18.6ms ⁻¹	130m x 30m



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About the avalanche



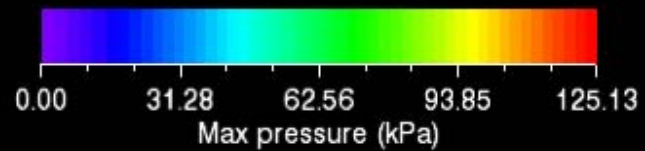
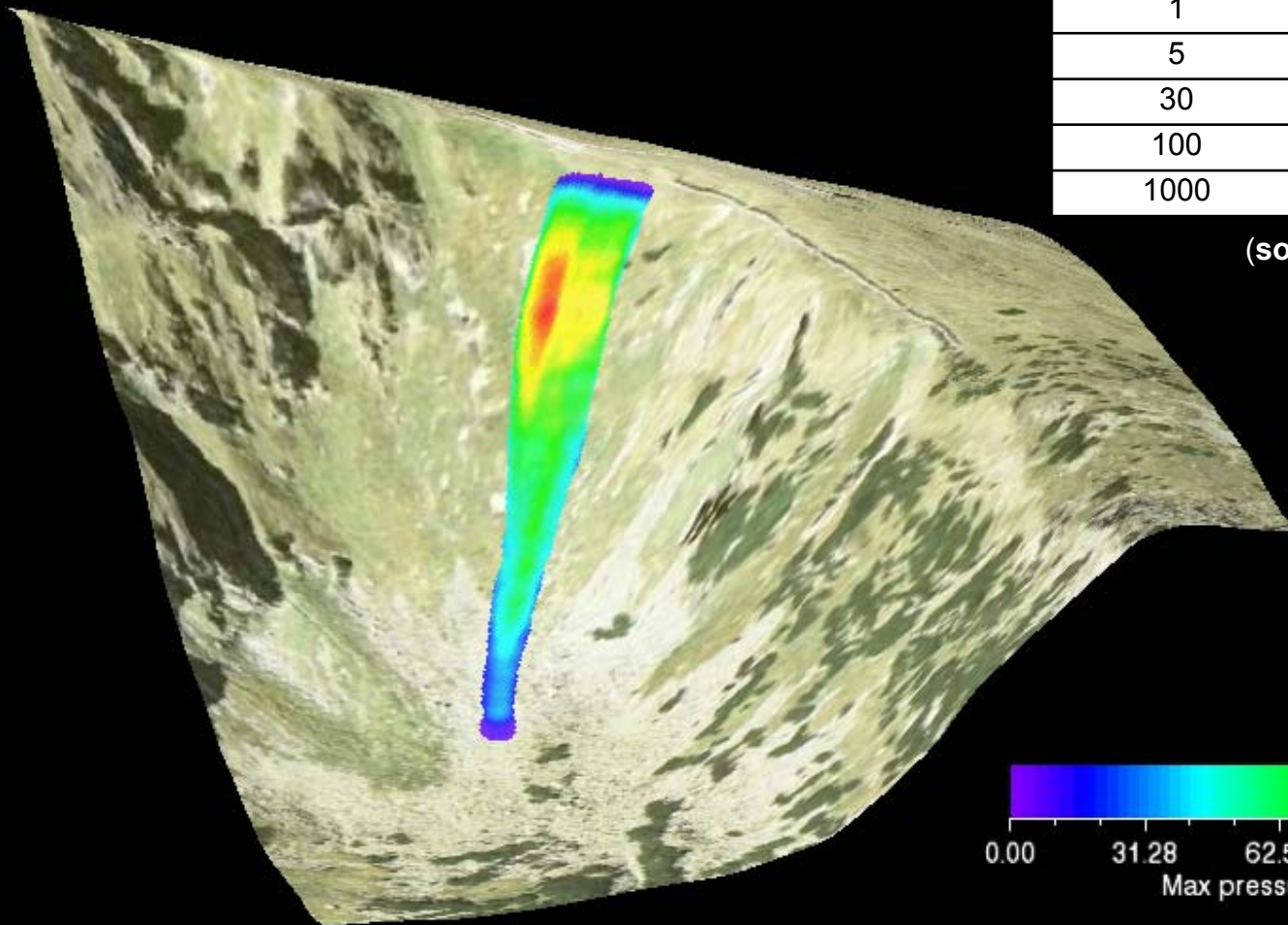
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About the avalanche

pressure (kPa)	Potential damage
1	Break windows
5	Push in doors
30	Destroy wood framed structures
100	Uproot mature spruce
1000	Move concrete structures

(source: McClung and Shear 2011)





partially/not buried





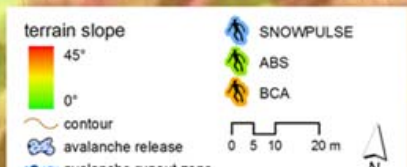
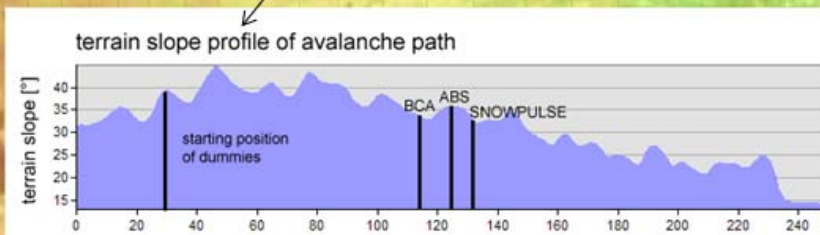
partially buried—not critically

not buried

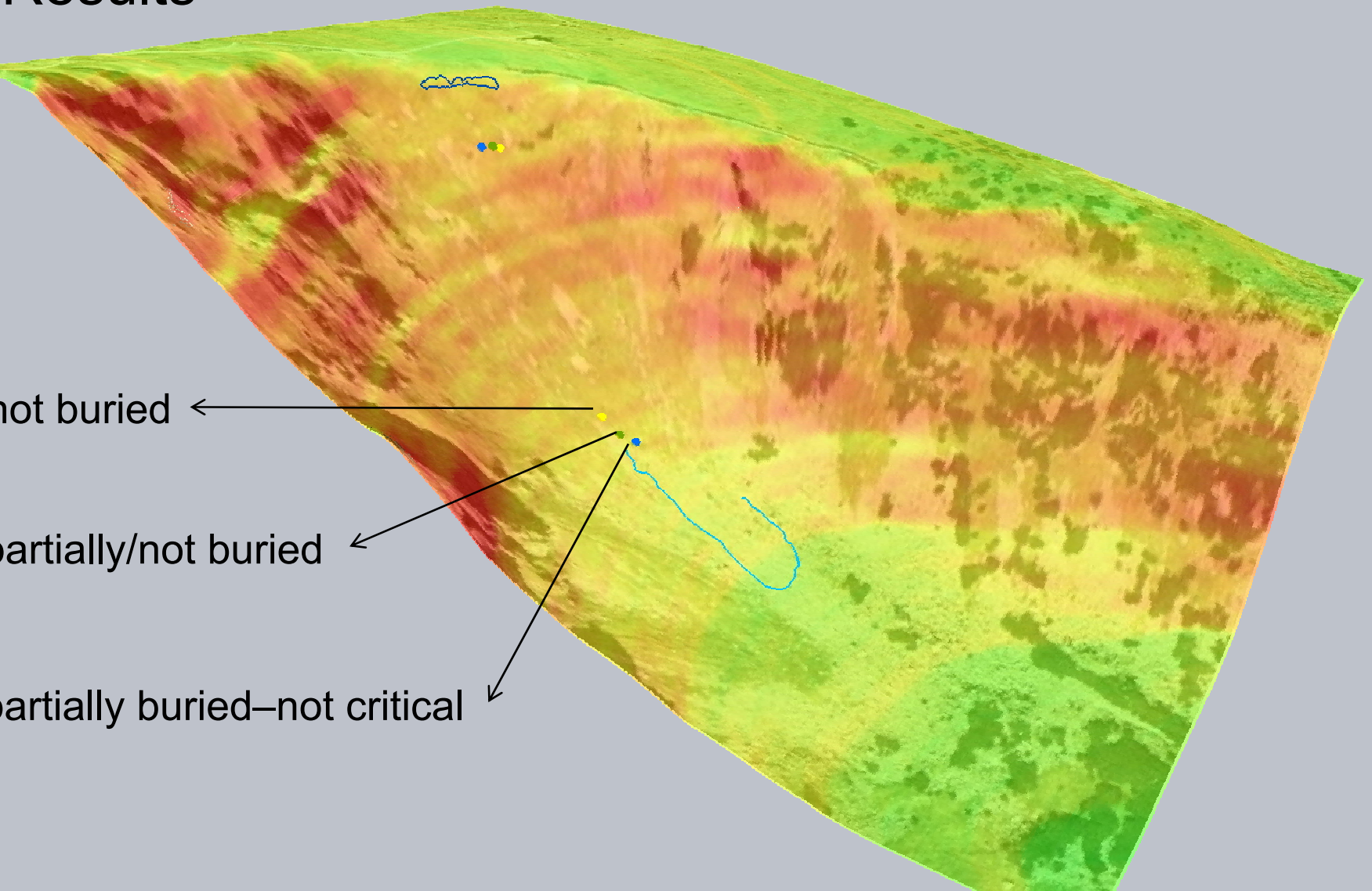


Results

Dummy with:	Movement duration	Track	Average speed	Max. speed	Acceleration	Grade of burial
BCA Float 18L	14 s	114 m	8.1 ms ⁻¹	16.8 ms ⁻¹	3.72ms ⁻²	not buried
ABS Vario 25L	18 s	124 m	6.9 ms ⁻¹	18.6 ms ⁻¹	3.36ms ⁻²	partially/not buried
Mammut Lifebag 30L	20 s	132 m	6.6 ms ⁻¹	17.8 ms ⁻¹	3.56ms ⁻²	partially buried–not critical



Results



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Results

- 1st field test with three different shapes of the balloons
- None of the dummy was fully or critically buried, all balloons visible
- The farther the dummy was carried \longrightarrow it was buried more seriously
- We are not able to judge the efficiency and floating capabilities of the used avalanche backpacks
- Further testing necessary (field trials, simulations...)

Limitations:

- One trial
- The results are valid only for this particular avalanche

Can be the shape of the balloon improved?



ON THE EFFECTIVENESS OF AVALANCHE BALLOON PACKS

Pascal Haegeli, Benjamin Zweifel, Frédéric Jarry,
Spencer Logan, Marek Biskupič, Hanno Bilek,
Hermann Brugger and Markus Falk

Avisualanche Consulting, Vancouver BC, Canada

WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland

National Association for Snow and Avalanche Studies (ANENA), Grenoble, France

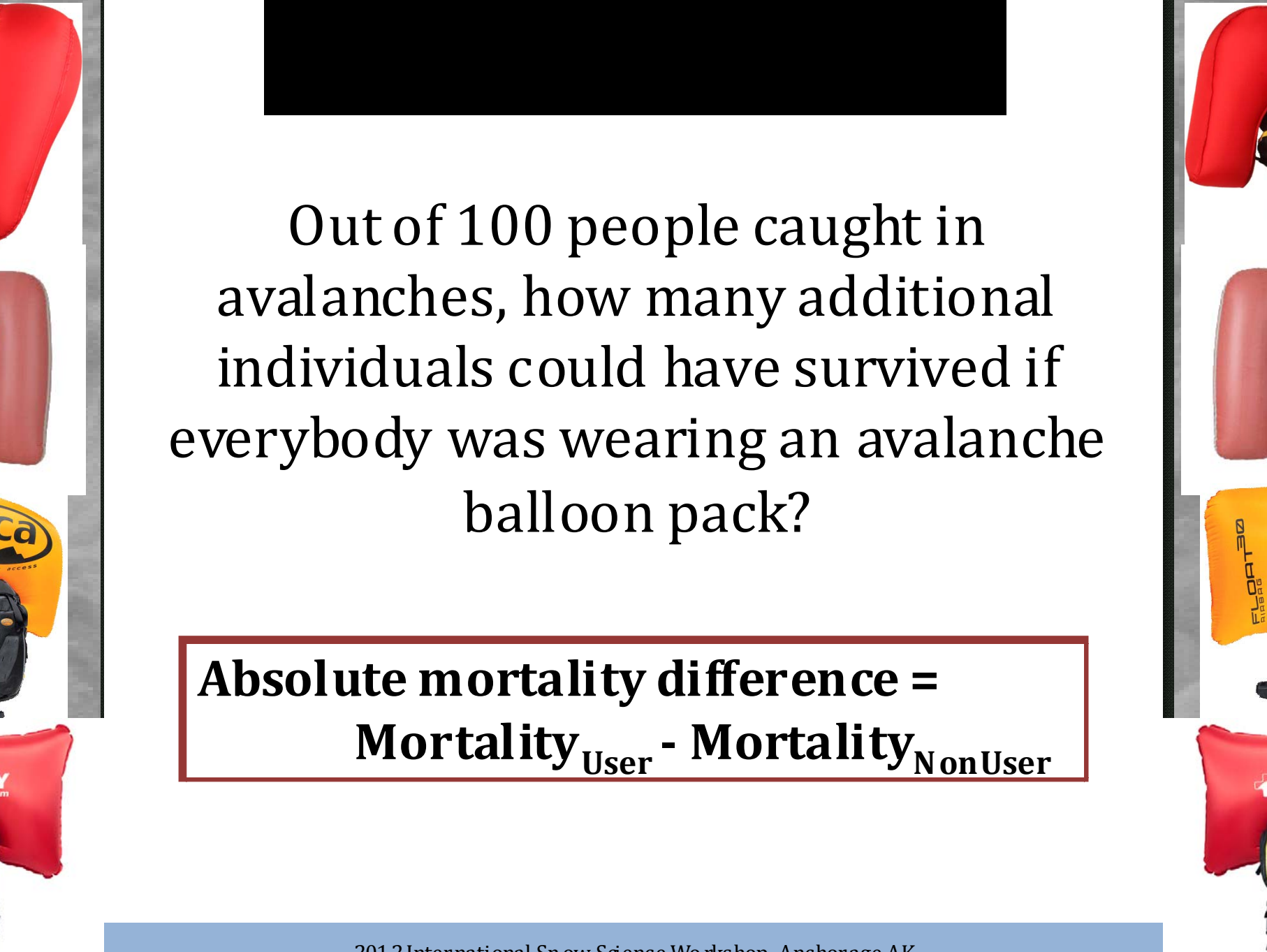
Colorado avalanche Information Center, Boulder CO, USA

Österreichisches Kuratorium für Alpine Sicherheit, Innsbruck, Austria

Avalanche Prevention Center, Jasna, Slovakia

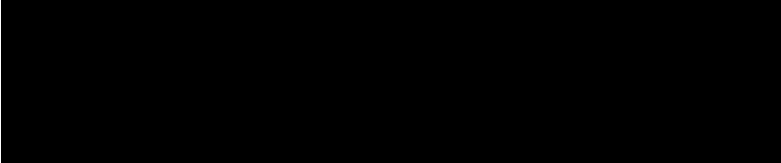
Institute of Mountain Emergency Medicine, European Academy, Bolzen/Bolzano, Italy

Inova Q Inc., Bruneck/Brunico, Italy

The slide is decorated with various avalanche safety equipment. On the left side, there is a red pack, a red pack, a yellow pack with a black helmet, and a red pack. On the right side, there is a red pack, a red pack, a yellow pack with the text 'ELOAT 30 AIRBAG', and a red pack. At the top center, there is a solid black rectangular area.

Out of 100 people caught in avalanches, how many additional individuals could have survived if everybody was wearing an avalanche balloon pack?

$$\text{Absolute mortality difference} = \text{Mortality}_{\text{User}} - \text{Mortality}_{\text{NonUser}}$$

- 
- Benjamin Zweifel: Swiss WSL Institute for Snow and Avalanche Research SLF
 - Frédéric Jarry: French National Association for Snow and Avalanche Studies (ANENA)
 - Spencer Logan: Colorado Avalanche Information Centre (CAIC)
 - Marek Biskupic: Slovakian Avalanche Prevention Center
 - Pascal Haegeli: Canadian Avalanche Association
 - Hanno Bilek: Austrian Institute for Alpine Safety



All known **well-documented** avalanche accidents involving avalanche balloon packs where ...

- Destructive size of **avalanche was = 2.0**
- Individuals were **seriously involved** in the flow of the avalanche and/or partially or completely buried.



Any additional inputs are welcome
For further information please contact

Pascal Haegeli :

pascal@avisualanche.ca

Results: IKAR 2013

A wide-angle photograph of a snowy mountain slope. In the foreground, a large, bright red inflatable object, possibly a rescue sled or a large air bag, is partially buried in the snow. In the middle ground, a group of about seven people in winter gear are gathered on the snow. Some are standing, while others appear to be working with equipment. A white dog is also visible near the group. The background shows a vast, snow-covered mountain range under a clear blue sky. The overall scene suggests a high-altitude winter or alpine environment.

Thank you for
attention!