Data sets on snow instability

These data on snow instability include three data subsets:

RB: Data on the results of Rutschblock snow stability tests with selected concurrently recorded snow stratigraphy data, mostly derived from snow micro-penetrometer (SMP) measurements (*N* = 62)

PST: Data on results of Propagation Saw Test (PST) experiments with selected concurrently recorded snow stratigraphy data, mostly derived from snow micro-penetrometer (SMP) measurements (*N* = 77)

SOI: Data on observations of signs of instability recorded at the same day and in the same area as the RB and PST data were acquired (*N* = 122)

The three datasets were analyzed and the results published by Reuter and Schweizer (2018) who suggest a new framework on how to describe snow instability by failure initiation, crack propagation and slab tensile support.

In the following we describe the data column by column and indicate which figure in Reuter and Schweizer (2018) the data were used for.

Column	Name	Unit	Label	Description	Figure
1	Date	-	Date	Date of measurements, given as yymmdd	-
2	Data set	-	Data set	Indicates which subset (RB, PST, SOI) the data belongs to.	-
3	r_c^{OBS}	m	Measured critical crack length	Measurements of the crack length when the crack starts propagating in a PST experiment.	2b
4	r_c^{SMP}	m	Modeled critical crack length	Modelled critical crack length, equivalent to above measurement; the critical crack length is modeled based on FE simulations and snow properties derived from the SMP penetration resistance profile according to Reuter et al. (2015), but using the expression for the mechanical energy presented by van Herwijnen et al. (2016).	2b, 3a, 3b
5	E_{SMP}	Pa	Effective elastic modulus of slab	The effective elastic modulus of the slab is derived from the SMP penetration profile. For each slab layer the modulus is derived. Then the effective modulus is determined with the help of a FE model.	2b
6	w_f	J m^{-2}	Weak layer fracture energy	The specific fracture energy of the weak layer was calculated by integrating the penetration resistance over the moving windows of width w (=2.5 mm, 50% overlap) and searching for the window within the weak layer with the lowest value (Reuter et al., 2015; Eq. 4)	2b
7	RB	-	RB score	Observed score (1 to 7) in a rutschblock snow instability test (see e.g. Schweizer and Jamieson, 2010).	2a

8	S		Modeled failure initiation criterion	The modeled failure initiation criterion describes the propensity of the weak layer to fail in the case of additional loading (Reuter et al., 2015; Eq. 6).	2a, 3a, 3b
9	σ_{WL}	Pa	Weak layer strength	The strength of the weak layer is approximated by the micro-mechanical strength derived from the SMP signal in the weak layer (Reuter et al., 2015; Eq. 3).	2a
10	H	m	Slab thickness	The thickness, measured normal to the snow surface, of the snow layers between the snow surface and the weak layer. Determined from the SMP signal.	2a, 2c
11	PROP	-	Observation of propagation in PST or RB (1=partial; 0=full)	Observation of propagation, i.e. in case of a PST whether the crack propagated to the very end of the column, in case of the RB whether the whole block fractured and released (see e.g. Schweizer and Jamieson, 2010).	2c
12	T	-	Modeled slab tensile criterion	The slab tensile criterion is expressed as the thickness of the slab layers h with a critical value T_{i} and normalized to the total slab thickness H; the tensile criterion T_{i} relates the tensile strength of each slab layer to the maximum tensile stress in each layer as obtained with a FE simulation (at the onset of crack propagation) (Reuter and Schweizer, 2018; Eq. 1).	2c, 3a, 3b
13	ρ_{s}	kg m^{-3}	Slab density	Average density of slab calculated from the SMP-derived densities of each slab layer.	2c
14	SOI	-	Observation of signs of instability (noinfo=not reported; none=no signs; all=all signs; wum=whumpf; scr=shooting cracks)	Observations of signs of instability: either whumpfs, shooting cracks or recent avalanches. These observations were made on the field day in the surroundings of the measurement site. These observations are considered as indications of unstable snow conditions (see e.g. Schweizer and Jamieson, 2010).	3a, 3b

References

Reuter, B. and Schweizer, J., 2018. Describing snow instability by failure initiation, crack propagation and slab tensile support. *Geophys. Res. Lett*., 45. https://doi.org/10.1029/2018GL078069

Reuter, B., Schweizer, J. and van Herwijnen, A., 2015. A process-based approach to estimate point snow instability. *Cryosphere*, 9: 837-847.

Schweizer, J. and Jamieson, J.B., 2010. Snowpack tests for assessing snow-slope instability. *Ann. Glaciol.*, 51(54): 187-194.

van Herwijnen, A., Gaume, J., Bair, E.H., Reuter, B., Birkeland, K.W. and Schweizer, J., 2016. Estimating the effective elastic modulus and specific fracture energy of snowpack layers from field experiments. *J. Glaciol.*, 62(236): 997-1007.

Davos, 23 June 2018/Sz/rb