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Dataset on multiscale spatial snow data

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Description of the data

During the winters of 2006-2007 to 2008-2009 we collected field data on the spatial variability of the snowpack using a digital penetrometer (SMP). The SMP consists of a probe which is driven into the snow cover at a constant speed of 20 mm/s. Changes in hardness are recorded with a cone shaped tip with a diameter of 5 mm connected to a piezo-electric force sensor (Schneebeli and Johnson, 1998). In all, during these three years, close to 1000 micro penetrometer measurements of the snow cover were made in 21 spatial grids.

Data were collected using a sampling design which is shown in Figure 1 (Bellaire and Schweizer, under review). In the centre of each spatial grid a manual snow profile was observed. Two compression tests (Jamieson, 1999) were performed next to the manual snow profile and an SMP measurement was made. SMP profiles were measured at 45 positions throughout the grid. Two compression tests were also performed at 9 locations throughout the grid within a distance of 30 cm of a SMP profile.

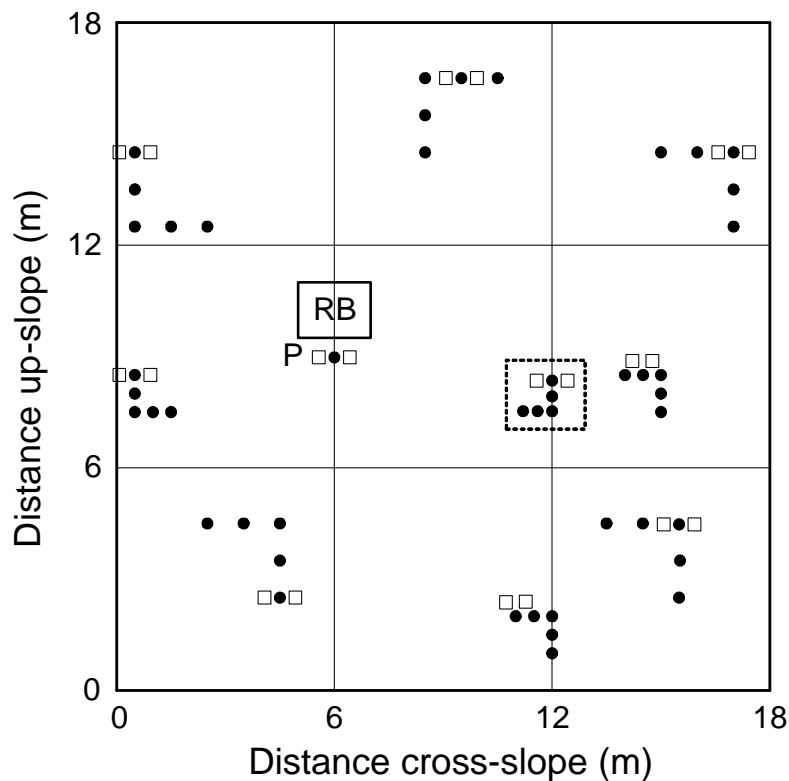


Figure 1: Sampling design. Dots indicate locations of SMP measurements, squares location of compression tests adjacent to the SMP measurement. The position of the manual profile is indicated by “P”, where two additional compression tests and a SMP measurement were performed. “RB” locates the position of the rutschblock test. The SMP measurements within the dashed square are 0.25 m apart; the other ones are up to scale (0.5 and 1 m apart).

Here we present data from three such spatial grids on slopes around Davos, Switzerland. The three grids are typical examples of snow conditions associated with "poor" (grid 1), "fair" (grid 2) and "good" (grid 3) stability. An overview of the location of the measurements and prevailing snow conditions is given in Table 1.

Table 1: Summary information for the three grids. Beside date and location (Swiss grid), aspect slope angle and type of weak layer (grain type according to the ICSSG by Fierz et al., 2009) are given as well as the profile stability (PT), the rutschblock score (RB) and release type (RT) and the mean compression test score.

No.	Date	Coordinates		Aspect	Slope angle (°)	WL grain type	PT	RB	RT	mean CT
		X (m)	Y (m)							
1	15 Mar 2007	778'650	185'970	N	33	DHcp(FCxr)	2	3	wb	12
2	17 Jan 2008	779'515	186'529	N	32	RGsr	3	5	wb	11.5
3	26 Feb 2009	779'194	186'530	SW	21	FCxr(DHcp)	4	6	wb	18

The spatial data for each grid are shown in Tables 2 to 4. For the weak layers and the slab layers the layer thickness, the mean penetration resistance (F) and the parameter Ψ (Bellaire et al., 2009) are given.

Table 2: Spatial snow cover data for Grid 1.

Grid ID	No. Meas.	Weak layer					Slab layer		
		X (m)	Y (m)	Thickness (mm)	F (N)	PSI (kPa)	Thickness (mm)	F (N)	PSI (kPa)
1	1	15.5	3	9.2	0.14	19.7	78.1	0.73	90.9
1	2	15.5	4	11.8	0.16	29.9	72.3	0.91	110.9
1	3	15.5	5	11.1	0.14	33.4	71.4	0.80	95.1
1	4	14.5	5	11.3	0.14	27.1	68.4	0.66	84.1
1	5	13.5	5	10.1	0.14	22.3	65.3	0.62	82.3
1	6	12	2	6.3	0.26	48.5	80.5	0.98	119.6
1	7	12	2.5	3.1	0.09	40.1	80.6	0.84	112.1
1	8	12	3	3.6	0.01	24.0	75.9	0.73	93.1
1	9	11.5	3	9.4	0.14	37.2	70.0	0.64	88.3
1	10	11	3	9.3	0.19	36.9	69.2	0.69	94.4
1	11	4.5	3	8.2	0.02	14.2	40.1	0.38	50.0
1	12	4.5	4	6.3	0.17	15.5	38.6	0.78	51.4
1	13	4.5	5	7.7	0.10	12.3	36.7	0.34	49.2
1	14	3.5	5	6.1	0.12	6.9	27.2	0.31	43.1
1	15	2.5	5	5.2	0.13	5.2	22.3	0.21	27.6
1	16	1.5	8	5.9	0.13	3.1	15.1	0.29	27.1
1	17	1	8	6.9	0.04	4.0	13.9	0.32	49.8
1	18	0.5	8	11.1	0.08	21.6	13.8	0.29	27.5
1	19	0.5	8.5	10.0	0.14	28.3	15.2	0.43	40.6
1	20	0.5	9	5.4	0.01	2.8	15.1	0.10	12.5
1	21	6	9	5.3	0.17	8.6	38.3	1.12	16.2
1	22	11.5	8.5	7.1	0.21	20.6	62.1	0.75	58.2
1	23	11.75	8.5	12.0	0.27	20.5	61.1	0.43	58.1
1	24	12	8.5	7.6	0.36	20.8	61.6	0.45	58.1
1	25	12	8.75	6.7	0.15	13.4	60.4	0.47	63.6
1	26	12	9	1.5	0.00	8.0	62.6	0.41	59.1
1	27	15	8	4.7	0.22	16.4	69.3	0.69	80.4
1	28	15	8.5	4.5	0.15	21.6	67.7	0.82	104.9
1	29	15	9	9.4	0.19	31.3	64.5	0.66	84.1
1	30	14.5	9	14.8	0.17	37.8	64.4	0.65	87.7
1	31	14	9	9.7	0.13	35.6	65.5	0.58	74.2
1	32	17	13	8.0	0.20	29.3	63.4	0.95	55.6
1	33	17	14	1.3	0.05	13.7	62.0	0.54	76.5
1	34	17	15	1.8	0.14	17.9	57.7	0.55	79.7
1	35	16	15	8.9	0.13	44.7	55.7	0.62	91.2
1	36	15	15	1.6	0.10	11.0	53.8	0.44	65.3
1	37	8.5	15	3.9	0.03	4.4	40.4	0.22	25.6
1	38	8.5	16	4.6	0.16	15.5	38.2	0.27	34.3
1	39	8.5	17	4.2	0.14	14.5	38.0	0.22	26.2
1	40	9.5	17	5.5	0.11	11.6	42.1	0.36	42.2
1	41	10.5	17	4.3	0.13	12.1	48.2	0.30	39.8
1	42	2.5	13	10.2	0.25	13.1	11.6	0.24	16.1
1	43	1.5	13	3.3	0.13	34.5	9.9	0.54	124.6
1	44	0.5	13	7.4	0.01	7.9	7.2	0.42	82.7
1	45	0.5	14	8.9	0.05	12.5	8.6	0.32	59.3
1	46	0.5	15	9.4	0.08	10.0	9.0	0.24	25.0

Table 3: Spatial snow cover data for Grid 2.

Grid ID	No. Meas.	Weak layer					Slab layer		
		X (m)	Y (m)	Thickness (mm)	F (N)	PSI (kPa)	Thickness (mm)	F (N)	PSI (kPa)
2	1	15.5	3	1.1	0.28	37.0	22.5	0.29	30.8
2	2	15.5	4	1.0	0.32	44.7	22.0	0.18	19.8
2	3	15.5	5	0.3	0.40	57.7	21.5	0.33	39.8
2	4	14.5	5	1.1	0.39	54.2	20.6	0.23	26.2
2	5	13.5	5	1.5	0.42	61.0	21.8	0.22	25.9
2	6	12	2	0.8	0.32	50.5	22.3	0.28	37.7
2	7	12	2.5	1.1	0.39	52.5	20.2	0.47	66.9
2	8	12	3	0.4	0.28	36.7	21.4	0.42	58.2
2	9	11.5	3	0.5	0.23	29.5	22.7	0.38	52.4
2	10	11	3	0.2	0.33	50.4	23.7	0.36	46.9
2	11	4.5	3	0.2	0.29	33.6	25.3	0.60	82.0
2	12	4.5	4	0.4	0.36	49.4	27.0	0.57	72.9
2	13	4.5	5	0.4	0.37	57.1	27.2	0.50	63.4
2	14	3.5	5	0.4	0.62	89.6	26.8	0.60	75.8
2	15	2.5	5	1.0	0.30	43.1	25.8	0.73	98.6
2	16	1.5	8	0.5	0.42	51.5	27.3	0.57	71.6
2	17	1	8	0.4	0.40	53.5	26.9	0.56	70.9
2	18	0.5	8	0.4	0.65	86.7	25.8	0.71	91.8
2	19	0.5	8.5	0.5	0.33	47.6	28.9	0.77	96.8
2	20	0.5	9	0.4	0.42	55.8	27.7	0.76	95.4
2	21	6	9	1.1	0.69	104.7	25.6	1.00	126.0
2	22	11.5	8.5	0.6	0.58	81.5	21.3	0.49	61.9
2	23	11.75	8.5	0.6	0.39	51.9	21.9	0.55	69.6
2	24	12	8.5	0.5	0.56	66.6	21.5	0.51	66.6
2	25	12	8.75	0.8	0.12	11.9	21.4	0.68	77.6
2	26	12	9	0.9	0.27	36.5	20.1	0.52	65.9
2	27	15	8	1.8	0.30	44.5	22.8	0.44	52.0
2	28	15	8.5	0.6	0.58	73.0	22.2	0.48	59.1
2	29	15	9	0.3	0.22	29.7	23.7	0.47	59.9
2	30	14.5	9	1.4	0.35	45.9	20.0	0.44	58.0
2	31	14	9	0.8	0.43	65.8	21.4	0.48	65.6
2	32	17	13	0.5	0.42	55.3	20.7	0.46	57.9
2	33	17	14	0.3	0.54	55.0	19.3	0.65	81.7
2	34	17	15	0.4	0.39	42.5	17.2	0.58	72.0
2	35	16	15	0.3	0.91	113.3	16.5	0.69	86.6
2	36	15	15	0.4	0.45	53.7	18.0	0.40	50.7
2	37	8.5	15	0.6	0.30	34.8	20.0	0.64	83.7
2	38	8.5	16	0.9	0.33	46.9	19.3	0.51	68.3
2	39	8.5	17	0.6	0.30	31.9	16.3	0.39	51.0
2	40	9.5	17	0.8	0.21	25.3	16.2	0.46	56.0
2	41	10.5	17	0.2	0.64	64.3	17.4	0.74	92.4
2	42	2.5	13	0.2	0.52	61.8	22.7	1.20	156.4
2	43	1.5	13	0.5	0.73	122.1	22.8	1.08	142.9
2	44	0.5	13	0.5	1.13	162.2	25.2	1.42	173.9
2	45	0.5	14	0.8	0.63	89.0	25.7	1.12	143.6
2	46	0.5	15	0.2	0.63	100.1	24.6	0.97	127.0

Table 4: Spatial snow cover data for Grid 3.

Grid ID	No. Meas.	Weak layer					Slab layer		
		X (m)	Y (m)	Thickness (mm)	F (N)	PSI (kPa)	Thickness (mm)	F (N)	PSI (kPa)
3	1	15.5	3	1.5	0.19	22.7	81.2	0.80	94.2
3	2	15.5	4	0.6	0.11	18.2	80.4	0.60	80.7
3	3	15.5	5	1.9	0.11	34.1	83.4	0.61	83.3
3	4	14.5	5	1.1	0.13	15.1	79.9	0.62	83.5
3	5	13.5	5	1.3	0.12	21.1	78.7	0.65	94.8
3	6	12	2	1.9	0.13	23.9	68.7	0.53	78.8
3	7	12	2.5	1.9	0.10	19.5	68.8	0.52	80.0
3	8	12	3	2.2	0.10	21.9	67.9	0.52	82.3
3	9	11.5	3	1.8	0.07	17.4	66.9	0.46	76.2
3	10	11	3	1.6	0.09	22.5	65.6	0.46	76.6
3	11	4.5	3	1.4	0.06	15.8	66.0	0.41	74.6
3	12	4.5	4	0.9	0.09	23.2	70.1	0.46	80.7
3	13	4.5	5	1.8	0.10	25.5	70.6	0.48	84.2
3	14	3.5	5	1.0	0.11	11.7	72.4	0.51	39.9
3	15	2.5	5	2.2	0.15	4.9	72.0	0.55	66.3
3	16	1.5	8	1.7	0.12	6.8	78.4	0.58	63.5
3	17	1	8	2.4	0.12	23.2	77.6	0.56	83.8
3	18	0.5	8	1.5	0.11	1.6	77.2	0.57	22.8
3	19	0.5	8.5	1.8	0.12	5.3	77.7	0.54	20.0
3	20	0.5	9	2.1	0.14	2.7	77.5	0.58	24.2
3	21	6	9	1.1	0.12	16.9	81.4	0.56	65.7
3	22	11.5	8.5	2.1	0.12	29.4	82.5	0.53	79.4
3	23	11.75	8.5	2.1	0.11	26.6	83.4	0.56	73.7
3	24	12	8.5	1.4	0.13	26.4	84.2	0.60	86.3
3	25	12	8.75	1.3	0.10	13.3	84.8	0.59	85.9
3	26	12	9	1.7	0.13	18.4	84.5	0.59	85.5
3	27	15	8	0.5	0.28	30.8	92.7	0.91	94.7
3	28	15	8.5	1.4	0.15	30.8	92.9	0.76	99.4
3	29	15	9	1.6	0.18	33.9	94.0	0.78	98.9
3	30	14.5	9	1.6	0.18	28.7	93.3	0.80	104.3
3	31	14	9	1.4	0.12	35.5	92.2	0.71	98.4
3	32	17	13	0.8	0.19	26.9	91.9	0.78	92.5
3	33	17	14	1.6	0.32	84.0	101.1	0.73	103.6
3	34	17	15	1.8	0.12	23.6	88.4	0.66	91.3
3	35	16	15	1.4	0.25	74.2	97.5	0.68	91.1
3	36	15	15	1.0	0.16	42.2	89.4	0.66	88.8
3	37	8.5	15	2.4	0.14	17.4	83.2	0.65	66.5
3	38	8.5	16	2.6	0.08	13.2	81.3	0.62	47.5
3	39	8.5	17	1.6	0.06	11.8	81.6	0.62	60.8
3	40	9.5	17	2.9	0.07	11.9	81.9	0.60	50.1
3	41	10.5	17	1.8	0.10	3.7	84.6	0.65	28.1
3	42	2.5	13	1.9	0.13	5.0	84.5	0.67	21.9
3	43	1.5	13	1.6	0.11	23.3	83.3	0.66	81.4
3	44	0.5	13	1.4	0.10	8.3	82.3	0.71	51.4
3	45	0.5	14	2.4	0.11	24.6	83.9	0.77	70.5
3	46	0.5	15	2.3	0.14	30.5	87.4	0.78	98.8

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