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Supplement of

Dynamic crack propagation in weak snowpack layers: insights from high-resolution, high-speed photography

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Supplement A:

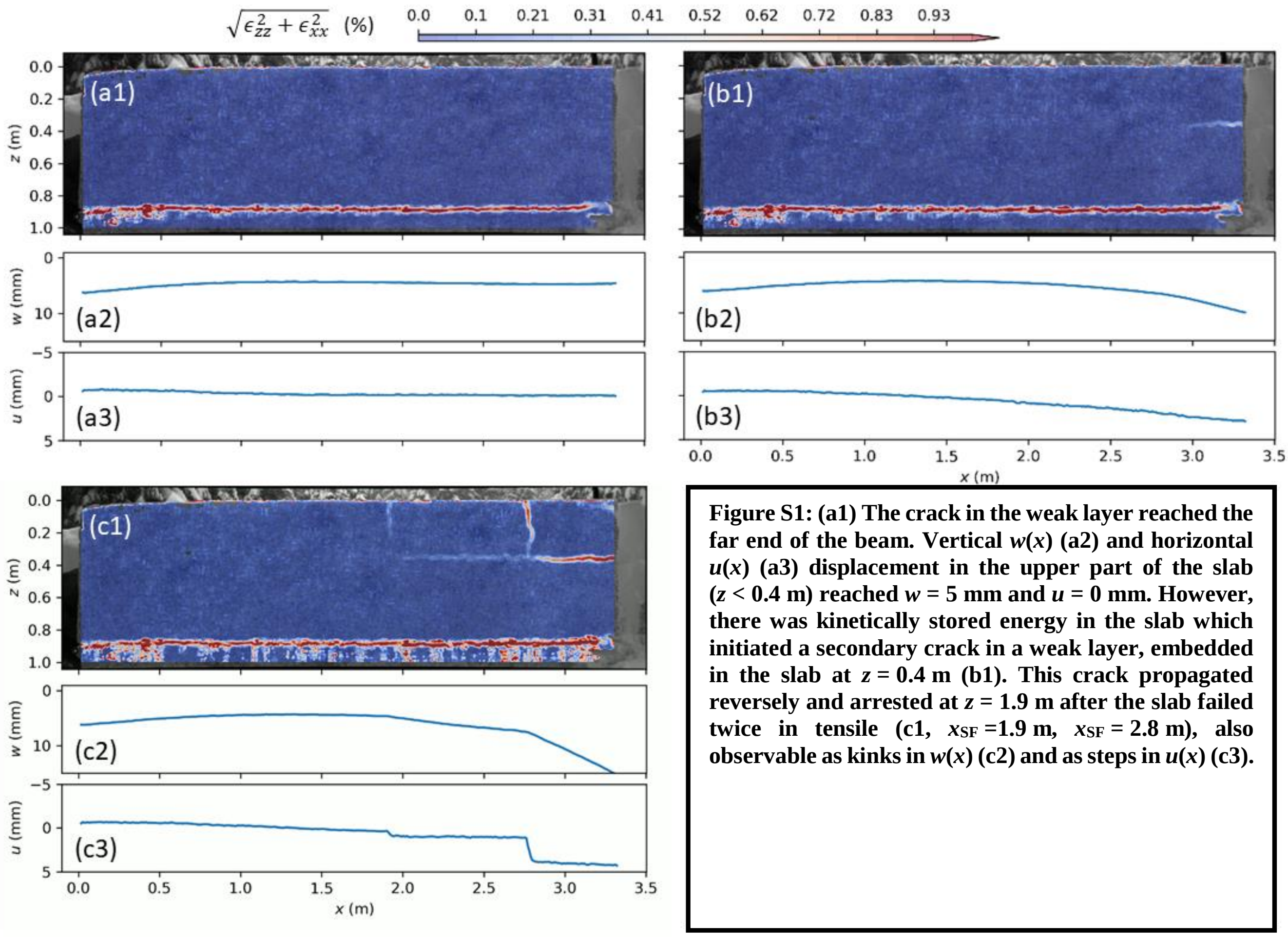
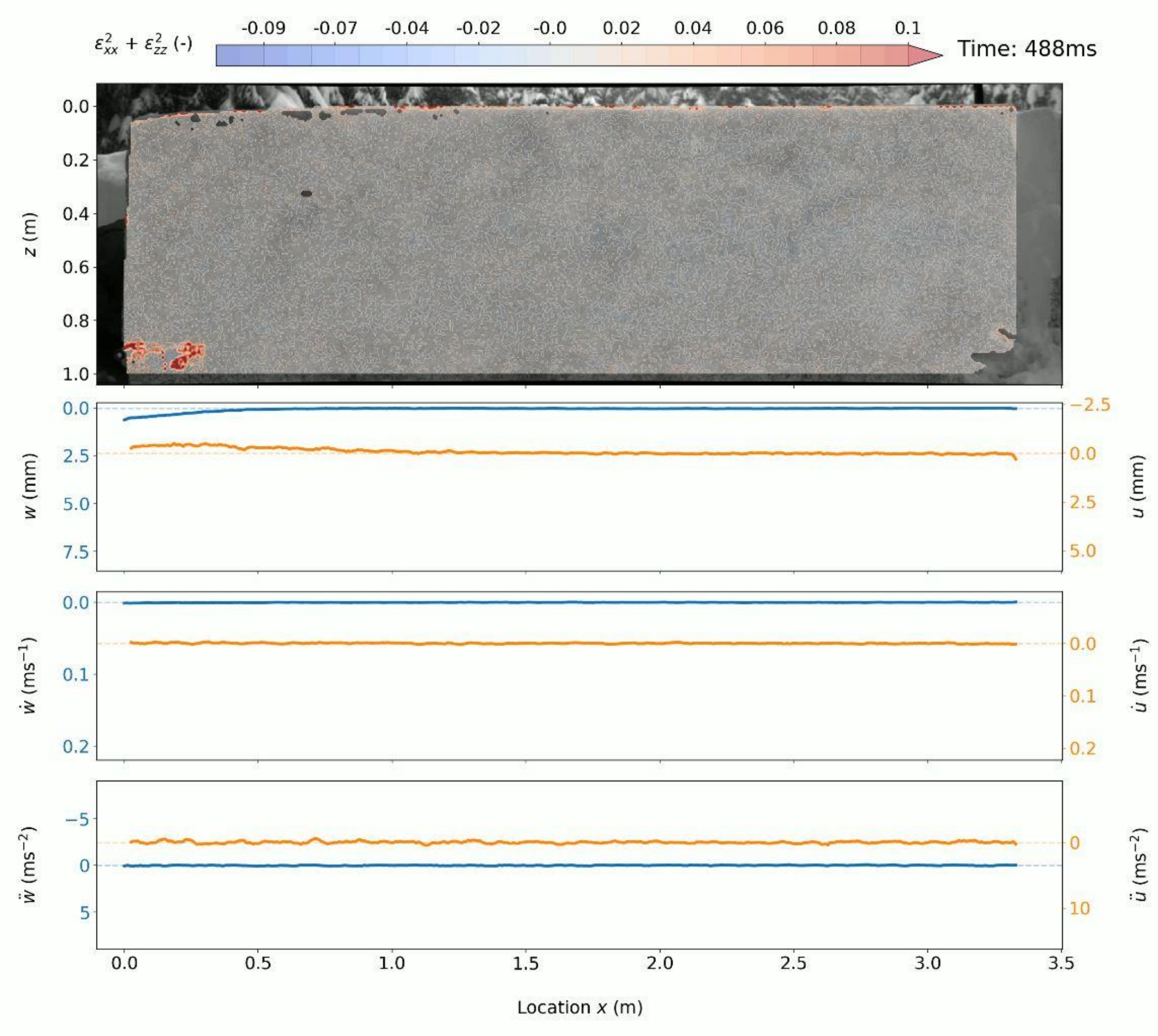


Figure S1: (a1) The crack in the weak layer reached the far end of the beam. Vertical $w(x)$ (a2) and horizontal $u(x)$ (a3) displacement in the upper part of the slab ($z < 0.4$ m) reached $w = 5$ mm and $u = 0$ mm. However, there was kinetically stored energy in the slab which initiated a secondary crack in a weak layer, embedded in the slab at $z = 0.4$ m (b1). This crack propagated reversely and arrested at $z = 1.9$ m after the slab failed twice in tensile (c1, $x_{SF} = 1.9$ m, $x_{SF} = 2.8$ m), also observable as kinks in $w(x)$ (c2) and as steps in $u(x)$ (c3).



Video S1: First frame of a video showing crack propagation in PST3. The videos for the tree example PSTs are available on EnviDat (*doi:10.16904/envidat.231*). For PST3, the strain magnitude shows a propagating strain concentration around the weak layer at z = 0.9 m (upper panel) while the vertical displacement w of the slab consecutively increases (blue line, second panel) and the horizontal displacement u(z = 0.1 m) indicates slab bending (orange line, second panel). At the same time, the third and fourth panel show the (vertical, horizontal) velocity ($\dot{w}, \dot{u}$) and acceleration ($\ddot{w}, \ddot{u}$) computed as the first and second time derivative of the displacements, respectively. At a time t = 740 ms a secondary crack in a weak layer, embedded in the slab at z = 0.4 m was initiated and propagated reversely after it is stopped as a consequence of two slab fractures (x_{SF} =1.9 m and x_{SF} = 2.8 m).

Supplement B:

We used the snow micro-penetrometer (SMP) to assess variations in snow properties along the PST beams. From the SMP signal an effective elastic modulus of the slab and the weak layer specific fracture energy can be derived. These two values were included in chapter 3.2. Additional, SMP based, parameters of PST3 are provided in Table A2.1 below.

Table S1: Values derived from SMP signals that were measured along PST3. Snow instability metrics include failure initiation criterion (INI), critical crack length (m) (PRO) and slab tensile criterion (TCR). Snow mechanical properties include weak layer shear strength (Pa) (TAU_p), effective slab modulus (MPa) (E_effslab), slab thickness (m) (HSLAB) and average slab density (kg m^{-3}) (RHOSLAB) as previously computed by Reuter and Schweizer (2018).

FILE	INI	PRO	TCR	TAU_p	E_effslab	HSLAB	RHOSLAB
264	5.137	0.3	0.43	801.9	2.96E+06	0.81	155.85
265	4.159	0.18	0.55	602.1	2.37E+06	0.82	143.56
266	4.211	0.26	0.55	627.7	2.64E+06	0.84	146.22
267	3.961	0.27	0.56	621.4	2.70E+06	0.85	147.11
268	4.264	0.3	0.41	694.9	2.73E+06	0.84	147.57