A new test apparatus for studying the failure process during loading experiments of snow

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We developed a new apparatus for fully load-controlled snow failure experiments. The deformation and applied load are measured with two displacement and two force sensors, respectively. The loading experiments are recorded with a high speed camera, and the local strain is derived by a particle image velocimetry (PIV) algorithm. To monitor the progressive failure process within the snow sample, our apparatus includes six piezoelectric transducers that record the acoustic emissions in the ultrasonic range. The six sensors allow localizing the sources of the acoustic emissions, i.e. where the failure process starts and how it develops with time towards catastrophic failure.
The quadratic snow samples have a side length of 50 cm and a height of 10 to 20 cm. With an area of 0.25 m^2 they are clearly larger than samples used in previous experiments. The size of the samples, which is comparable to the critical size for the onset of crack propagation leading to dry-snow slab avalanche release, allows studying the failure nucleation process and its relation to the spatial distribution of the recorded acoustic emissions. Furthermore, the occurrence of features in the acoustic emissions typical for imminent failure of the samples can be analysed. We present preliminary results of the acoustic emissions recorded during tests with homogeneous as well as layered snow samples, including a weak layer, for varying loading rates and loading angles.