The First Wetting of Snow: Micro-Structural Hardness Measurements Using a Snow Micro Penetrometer

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Wet snow avalanches are responsible for avalanche fatalities but more frequently they threaten infrastructure, as mountain pass roads, in spring. A weak snowpack base consisting of persistent grains is considered one of the causes for these avalanches. In three field experiments in the Grisons Mountains in eastern Switzerland the evolution of water flow and the loss of micro-structural hardness with first wetting were investigated focusing on layers of facets and depth-hoar crystals. The Snow Micro Pen (SMP) measures the micro-structural hardness (bond strength) of snow. Based on a total of 91 SMP measurements, snow hardness always decreased at water contents of about 3%. The loss in snow hardness was significant in a facet grain - depth hoar layer reaching 16% of initial dry snow hardness (water content < 6 %). The two other investigated layers also showed changes: hardness reduced by 36% to 21% (water content < 3%). These results indicate that the loss of strength with first introduction of water begins at very low water contents. Rapid hardness decrease may influence wet snow stability and be indeed one of the keys for deep wet slab avalanche release during spring snow melt.