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Basal fluid pore pressure observations in debris flows at the field scale

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We report on observations of basal shear and normal forces and basal fluid pore pressure measured at the Illgraben debris flow observation station, Canton Wallis, Switzerland. One cross section is instrumented with a 2 m long, 4 m wide force plate, installed at the brink of a check dam, to measure vertical and shear forces produced by debris flows. Flow depth is estimated using a laser and basal fluid pore pressure is measured near the center of the force plate. Additionally, the vibrational intensity of the flow is recorded using a geophone, where the signal is processed in a way to estimate the number of impulses per second. A single-surge granular debris flow with a front velocity= 1.4 m/s, maximum flow depth= 1.15 m, and flow duration= 1000 s was observed on 2 Aug. 2005. Video recordings show that the event had a relatively dry granular front followed by a saturated granular body. Maximum depth, shear and normal stresses were observed during the passage of the granular front. The maximum fluid pore pressure lags behind the peak flow depth, reaching a relatively constant value about 10 s after the flow depth reaches a similar plateau. Total fluid pore pressure is decomposed into hydrostatic and dynamic components. The dynamic component correlates well with the number of impacts on the plate per second, supporting the hypothesis that the granular shearing motion in the flow increases the fluid pore pressure near the front of debris flows, thereby enhancing the mobility of the coarse particles.