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Gravitational wet-avalanche pressure on pylon-like structures

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Low-speed wet-avalanches exert hydrostatic forces on structures which are surface-dependent, however neither the pressure amplification experienced by smaller structure has been quantified and the causes of the amplification understood. In particular, recent wet-snow avalanche pressure measurements, performed with small cells at the "Vallée the la Sionne" test site, indicate significantly higher pressures than those considered by engineering guidelines and common practice rules based only on the contribution of inertial forces. In order to gain a deeper understanding and investigate the relevance of these measurements for structural design, we analyze data collected at the "Vallée the la Sionne" on obstacles of different shapes and dimensions. We show that, the pressure measured on a 1 m^2 pressure plate is, on average, 1.8 times smaller than the pressure measured on a 0.008 m^2 piezoelectric cell, installed on a 0.60 m wide pylon, and 2.9 times smaller than the pressure measured on a 0.0125 m^2 cantilever sensor, extending freely into the snow. The different pressures encountered by the different obstacles is quantitatively explained with a granular force model, assuming the formation of a mobilized volume of snow granules extending from the obstacle upstream. The results underscore the fundamental influence of the dimension of the sensor and the obstacle on pressures. Our study highlights the difficulties that appear in the estimation of forces in the gravitational flow regime, for which force amplification may be caused by this mobilized volume at the scale of the whole structure, but also by plastic wedges, or small dead zones, at the scale of the sensor mounted on a wider structure.