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Erosion dynamics of powder snow avalanches - model of frontal entrainment

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We analyze entrainment at the head of powder snow avalanches (PSA) behaving as an eruption current. Instead of invoking an erosion model or other fitted parameters, the analysis assumes that erosion is sustained by a massive blow-out arising as the snow cover is fluidized by the very pore pressure gradients that the avalanche induces within the snow pack. The stability of a mass balance involving snow cover and flow in the PSA's head region then sets frontal speed, height, mixed-mean density, snowpack fluidization depth, frontal impact pressure and static pressure. We show that acceleration of the front is insensitive to local slope, but effectively depends on the rate of change in cloud width. We compare predictions with data collected at the Vallee de la Sionne.