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The hour-glass: comparisons of discrete granular flow and continuum plastic flow. PIERRE-YVES LAGREE, LYDIE STARON, CNRS, AURELIEN GRABSH, ENS Cachan, STEPHANE POPINET, NIWA, D'ALEMBERT COLLABORATION, NIWA COLLABORATION — A hour-glass is a fascinating way to measure time, surprisingly the flow is not function of the filling height as in a clepsydra. The discharge of a granular silo implies a constant rate, dictated by the size of the aperture, but independent of the height of material stored (the Berveloo law). This observation is often understood as resulting from the friction forces mobilized at the walls of the silo, which decrease the apparent weight of the material, and screen the bottom area from the pressure, (Janssen effect). This explanation fails however in the case of wide systems for which walls are distant from several times the height of material stored. In this contribution, we simulate the continuum counterpart of the granular silo by implementing the plastic (I)-rheology in a 2D Navier-Stokes solver (Gerris) and compare with Contact Dynamics simulations. Velocity field and the pressure field are compared and discussed in the light of the two simulation methods. We recover the Berverloo scaling relating discharge rate and aperture size. This result points at the existence of a yield stress, rather than at the mobilization of friction forces at walls, as controlling the discharge of the granular silo.

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