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TOWARDS AN UNIVERSAL CRITERION FOR TOTAL TURBULENCE SUPPRESSION IN PARTICLE-DRIVEN WALL-BOUNDED FLOWS

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Abstract. Particle-driven turbulent wall-bounded flows exhibit fascinating physics as their sustained propagation depends on a tight interplay between the suspended particles and turbulence. If resuspension dominates over deposition the intensity of the flow will increase. If deposition dominates over resuspension the flow could laminarize inducing massive particle settling and, eventually, the flow extinction. Snow avalanche, pyroclastic flows, turbidity currents and dust storms are some examples of such flows. This work explores the phenomenon whereby turbulence in a particle-driven wall-bounded flow is abruptly extinguished either due to a decrease in the external driving potential (decrease in slope), or due to increased stratification from particle settling. Three parameters control the flow dynamics: Reynolds number (Re_t), Richardson number (Ri_t) and particle settling velocity (V). The condition for total turbulence suppression can be expressed as a critical value for Ri_t V, which has a logarithmic dependence on Re_t.