Abstract Submitted
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Strain-hardening evolution on sediment transport under cyclic laminar shear[1] FERNANDO CEZ, ERICK M. FRANKLIN, University of Campinas (UNICAMP), MORGANE HOUSSAIS, Levich Institute, City College of CUNY, PAULO E. ARRATIA, DOUGLAS J. JEROLMACK, University of Pennsylvania — Fluid-driven granular flows are common in nature and industry, yet difficult to understand. We present experiments using an annular flume that mimics an infinitely-long river, filled with refractive-index matched, sedimenting particles sheared by a laminar flow; this allows visualization of particle transport throughout the bed. We introduce stepped cycles of fluid shear and examine the downward propagation of an "unjamming" front, which marks the boundary between a granular fluid and a creeping solid. Repeated shear cycles give rise to strain hardening, as the fluidized layer thins over progressive cycles to an eventual steady state. Strain hardening results from two effects: isotropic compaction, and formation of anisotropic grain fabric structures aligned with the applied shear. When shear direction is reversed, the bed recovers some (but not all) of its initial mobility. Strain hardening, associated compaction and grain-fabric formation, occur in the observed creep regime. Beyond a critical shear rate, grains are fluidized resulting in dilation and destruction of granular fabrics. Results explain puzzling observations of bed-load hysteresis in natural rivers and delineate the transport regimes under which memory is created and destroyed in sedimentary beds.

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