Abstract Submitted for the MAR15 Meeting of The American Physical Society

Creep and Dynamical Heterogeneities of Fluid-Driven Granular Flows CARLOS ORTIZ, MORGANE HOUSSAIS, DOUGLAS DURIAN, DOU-GLAS JEROLMACK, Univ of Pennsylvania — Earth's surface is a fluid-sediment interface evolving through fluid-driven granular flow. To probe long-time dynamics, we construct an annular chamber that mimics an infinitely-long river channel. We use non-Brownian, spherical plastic grains, fully submerged in a less dense indexmatching fluid. We drive the packs with a laminar flow and record dynamics by laser scanned particle tracking. "Bed load" grains near the surface exhibit relatively fast shear. By long-time averaging grain trajectories, we find that grains deep in the pack, which appear frozen by eye, exhibit a slow creep dynamics. The transition between bed load and creep occurs at a critical value of the local relaxation time, characterized by a critical dimensionless shear rate, the viscous number. We also characterize the important length and time scales for dynamical heterogeneities as a function of depth and find that grain dynamics are spatiotemporally heterogeneous at all depths. The dynamics slow down monotonically as a function of depth, but the domain size is largest at the transition to creeping. We propose a new phase diagram for fluid-sheared granular transport, where "bed load" sediment transport is defined as a dense granular flow driven by fluid shear from above and granular creep from below.

> Carlos Ortiz Univ of Pennsylvania

Date submitted: 14 Nov 2014

Electronic form version 1.4