Geophysical Research Abstracts,
Vol. 11, EGU2009-13592, 2009
EGU General Assembly 2009

The importance of gradients in particle activity during sediment transport: Insights from a probabilistic description of particle motions

D J Furbish

Department of Earth and Environmental Sciences, Vanderbilt University, Nashville, Tennessee, USA

Sediment particles transported by rainsplash, by bioturbation, and as bedload in turbulent flows, undergo motions that are quasi-random in magnitude and direction. Moreover, these motions characteristically are intermittent, in that particles are mostly at rest most of the time, and heterogeneous, in that the volumetric or areal concentration of particles in motion at any instant is spatially patchy. These particle motions can be formulated as a stochastic processes involving both advective and dispersive parts. By taking into account the intermittent activity of particles, and separating this activity from the physics of motion in the parametric description of transport, the formulation indicates that gradients in particle activity can have a key role in transport. The formulation illustrates, for example, how the growth of soil mounds beneath desert shrubs involves differential rainsplash that initially causes more grains to be splashed inward beneath protective shrub canopies than outward. This 'harvesting' of nearby soil material, including nutrients, means that shrubs locally participate in regulating the rate sediment transport down a hillslope. With soil bioturbation, spatial variations in the disturbance frequency strongly influence the mixing of soil constituents, including distinct particle fractions (such as specific size or mineral fractions, seeds, or debitage), or elements and compounds adsorbed to particles. The formulation also provides a probabilistic version of the Exner equation. During bedload transport, gradients in particle activity, through both advective and dispersive effects, may contribute importantly to the local divergence of the particle flux, thereby influencing initial bedform growth.