

Transport of granular materials in turbulent flows (or sand in streams)

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The notion that the kinematics of sediment transported in streams is well-represented by quasi-random motions amenable to Smoluchowski-type diffusion was first proposed by Hans Albert Einstein at his renowned father's suggestion. Since then, there have been attempts to adapt formalisms of diffusion and anomalous diffusion developed for thermodynamic systems to the start-and-stop and spatially variable behavior of sediment transport. New high-resolution measurements of sediment particle motions in laboratory flumes indicate that the mean squared displacement of tracer particles, when treated as a plume reflects a nonlinear increase in the variance in hop distances with increasing travel time. Ensemble calculations of MSD indicates a transition from correlated random walks to normal diffusion. Normal behavior also is reflected in the particle velocity autocorrelation function. Spatial variations in particle entrainment produce a flux from sites of high entrainment toward sites of low entrainment; thus, an entrainment form of flux and continuity equations are used for describing statistically expected transport behavior.

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