Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

The mystery of Coulomb friction in sediment transport[1] THOMAS PHTZ, Ocean College, Zhejiang University, ORENCIO DURAN, MARUM-Center for Marine Environmental Sciences, University of Bremen — Nearly all analytical models of sediment transport in Newtonian fluid (e.g., air or water) are based on Bagnold's assumption of a constant Coulomb friction coefficient (particle-shear-pressure-ratio, μ) at the interface (z_b) between sediment bed and transport layer. In fact, this assumption is the main reason why these models predict the sediment load (and subsequently the sediment transport rate) to be proportional to the excess shear stress ($\tau - \tau_t$), a scaling which has been confirmed in many wind-tunnel and flume experiments. Attempts to explain why $\mu(z_b)$ is constant have usually been based on the sliding-friction analogy or rheology arguments. However, here we analytically derive $\mu(z_s) \approx \sqrt{3}-1$, where z_s is the location at which the production rate of particle fluctuation energy is maximal. Our derivation is based on the assumption that the rate of collisional transfer of horizontal into vertical kinetic energy is typically much larger than the rate of energy dissipation. Using state-of-the-art numerical simulations of sediment transport in Newtonian fluid, we validate all assumptions and approximation involved in our derivation. Interestingly, the location z_s can significantly deviate from z_b depending on the simulated conditions.

[1]We acknowledge support from grants National Natural Science Foundation of China (Nos. 1151101041 and 41376095) and Natural Science Foundation of Zhejiang Province (No. LR16E090001).

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Date submitted: 04 Nov 2015 Electronic form version 1.4