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Shannon and Tsallis entropy results for particle resting times and jump lengths in river bedload

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Sediment transport in rivers consists, at a moderate discharge stage, of individual grains that undergo a series of step movements and rest periods (bedload). In this study, we exploited available data representing resting time and jump length of particles involved in bedload processes. Following the entropy approach based on Shannon and Tsallis theories, we got formal probability functions describing the distribution of the above-mentioned kinematic quantities. Finally, accepting the Einstein assumptions and exploiting the experimental data, we found the values of the constants involved in the entropy functions and complete the analysis. A comparison between experimental and theoretical distributions is showing encouraging matches.

An indirect, but quite relevant, way to prove the validity of the obtained probability distribution, is worked out by looking at the dispersion of traced grains, originally located in well-bordered pillows at different depths within the bed. The application of a stochastic model able to move the grains of the bed with prescribed frequencies in space and time allowed us to further appraise a good behavior of the entropy-based distributions versus the experimental ones.

Future directions of this research would address the important goal nested in the detection of river flow with or without bedload, by using entropy information based on the measurement of velocity field and/or flow depths over cross-sections.