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Prediction of debris flow deposition based on particle segregation

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Predicting the deposition of debris flow is of great significance for hazard mapping, disaster reduction designing, construction of engineering, and settlements in vulnerable areas. There are many factors affecting debris flow deposition, such as landform, geological structure, debris flow characteristics, etc. However, these factors are finally realized by changing the migration and redistribution of particles in debris flow (particle sorting effect), and then through pore water pressure, shear force, friction resistance and momentum transfer. To this end, the laboratory flume experiments were conducted, focusing on the runout distance, deposit area, and maximum height, under different initial and boundary conditions such as water mass fraction and particle size. The experimental results reveal that the deposit morphology (e.g., runouts distance, deposit depth, and deposit width) of debris flow is closely related to the degree of particle size-segregation. Increasing water content first increase the degree of particle size-segregation which leads to longer longitudinal distance, however, too much water then reduced the degree of particle size-segregation, thus decreased the deposit distance. That is, the optimal water fraction corresponds to the well-distributed particle size-segregation, resulting in the longest deposit distance. In this condition, the friction among particles causes coarse particles to tend to move upward and forward, eventually accumulating at the front and surface, whereas fine particles tend to flow backward and downward, finally accumulating at the bottom and middle. Changing coarse particles size can only increases runout a little. However, well-distributed coarse particles can promote runout significant. The research can improve the understanding of debris flow accumulation and have important significance for quantitative risk assessment and risk zoning of debris flow.