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On the modeling of the bottom particles segregation with non-linear diffusion equations: application to the marine sand ripples

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The elliptical motion in surface waves causes an oscillating motion of the sand grains leading to the formation of ripple patterns on the bottom. Investigation how the grains with different properties are distributed inside the ripples is a difficult task because of the segration of particle. The work of Fernandez et al. (2003) was extended from one-dimensional to two-dimensional case. A new numerical model, based on these non-linear diffusion equations, was developed to simulate the grain distribution inside the marine sand ripples. The one and two-dimensional models are validated on several test cases where segregation appears. Starting from an homogeneous mixture of grains, the two-dimensional simulations demonstrate different segregation patterns: a) formation of zones with high concentration of light and heavy particles, b) formation of «cat's eye» patterns, c) appearance of inverse Brazil nut effect. Comparisons of numerical results with the new set of field data and wave flume experiments show that the two-dimensional non-linear diffusion equations allow us to reproduce qualitatively experimental results on particles segregation.