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A preliminary numerical model on the incipient motion conditions of flooded vehicles

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The constant increase of the population living in cities and the concerns related to the climate change make flood risk in urban areas a crucial issue in terms of potential damages, casualties and injuries to the people. Vehicles are generally recognized as one of the most aggravating factors in case of floodings in the urban environment. On one hand they interact with the flow modifying locally flood parameters or causing obstructions, on the other hand they are indirectly responsible of many fatalities. According to many studies, most of deaths for drowning occurs in the cars and this drives the need to better understand the conditions in which the vehicles become unstable and consequently dangerous for people and infrastructures. In the view of better assessing the vulnerability during a flood, a deepening in the knowledge of this phenomenon is required. The approach proposed consist of a 3D numerical model able to clarify the occurrence of these conditions and the interaction between flood and vehicles. The model relies on the experimental data provided in literature. In this preliminary study the traditional approach typically used for the incipient motion threshold conditions of river sediments is adapted for the specific geometry of a vehicle. The dimensional analysis of the existing experimental data, is the preliminary step in order to design numerical simulations. The proposed conceptual model is the basis for the numerical analysis aiming at the generalization of empirical results. The dimensionless graph coming from the experiments shows a significant difference between vehicles with a density lower (empty car) than water and larger (filled by floodwater) than water. These behaviors represent both realistic conditions during a sudden flood. The 3D numerical simulation clarifies flow behavior around the obstacle and allows some hints on new approaches for flood modeling in the urban environment.