



## **Determination of the risk of vehicles instability exposed to flooding**

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River overflows can significantly affect vehicles that are circulating or parked in the flood prone area. Vehicle dragging has not only an economic impact but also, and more important, the potential loss of human lives. Hence, the identification of dangerous and safe areas for vehicles during floods and the actual risk is very important to the proper management of these events. The loss of stability of a vehicle can be generated by the hydrodynamic mechanisms of floating and/or sliding, which interact with each other. An additional possible failure mechanism is represented by toppling, which occurs when vehicles have already been washed away. After a literature review, the conclusion was that stability of the vehicles is a function on one hand of depth and velocity of water flow (representing the hazard) and, on the other hand, the vulnerability is defined by the main dimensions of the vehicle, the specific weight and weight distribution of the vehicle, the orientation of the vehicle with respect to the flow and the consideration or not of vehicle watertightness.

The case study was Rambla del Poyo, which can flood some southern parts of the metropolitan area of Valencia (Spain). Hazard was established considering the hydrodynamic characteristics of flood events for return periods fluctuating between 10 and 500 years. We used four different representative types of vehicles for Spain and a methodology developed in recent years by Arrighi et al. (2016) to determine car stability, i.e. their vulnerability.

With the hazard and the vulnerability of each type of vehicle, it is possible to estimate in space the specific risk for each one, considered as the spatial probability of vehicle instability at each pixel. It was found, for this case study, that vehicles lose their stability mostly by flotation. Also, there are small differences in the spatial specific risk for the different types of vehicles: from compact cars to medium SUV. For the final risk, it is necessary to introduce the exposition of vehicles to hazard, using the car density in the flooded area and the current car distribution. This risk is defined as the number of dragged vehicles per year and unit area for each pixel for all cars that are parked or are circulating in the studied area. In this way, the more problematic areas are highlighted, which can be useful to define evacuations plans and design and implement actions to reduce the vehicles instability risk.