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Assessment of the risk of destabilization of vehicles at crossing points between streams and roads

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River floods can cause the destabilization of vehicles and vehicles can increase the negative impacts of floods when they are mobilized by the flow, causing economic and life losses. Because of this, integral flood management requires the identification and assessment of the risk to which vehicles are subjected at the crossing points between water currents and roads. In the present investigation a methodology was developed to calculate this risk based on the characteristics of vehicles, floods and traffic. The risk at each stream crossing is calculated by means of the statistical integral of the vehicle vulnerability given the actual exposition and hazard.

Hazard corresponds to the probability that flow causes the destabilization of each type of car and is determined from the hydrodynamic characteristics of the floods and the implementation of a stability criterion for partially submerged cars, through which a hazard index is established. Hazard is obtained through the combination of the probability that the flood event occurs with the values that the hazard index would take. The vulnerability of a given type of car is determined by means of a damage function defined from the values of the hazard index. The exposure is established based on the traffic characteristics and the driver behavior.

The methodology developed was applied in the municipality of Godolleta (Spain), finding that in approximately a quarter of the 25 intersections between streams and roads, the risk of vehicles due to flooding is relatively high, since it exceeds 0.2 vehicles per year. In approximately half of the intersections the risk is relatively low since it is less than 0.1 vehicles per year. Additionally, it was found that the risk of vehicles in stream crossings due to flooding is highly sensitive to the magnitude of the water level from which drivers decide to interrupt vehicle traffic through flooded crossing. The magnitude of the risk grows as drivers assume less conservative behavior, that is, when they decide to drive with higher water levels.

Key words

Risk of vehicles due to floods

Stability of cars partially submerged

Vulnerability of vehicles to floods