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Improving flood risk evaluation and communication by mapping the loss probability of pedestrians

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A proper evaluation and an effective communication of flood risk are important aspects to reinforce flood preparedness and to reduce the impacts of future flooding events. In particular, communicating the expected flood risk to different categories of people (i.e., non-technician, of different age and formation) is recognized as a real challenge.

Flood maps typically present flood scenarios using spatially distributed flow depth and velocity, which are unable to convey intelligible information on the associated hazard to the general public. Similarly, hazard indexes meant to express flood hazard by combining flow depth and velocity have important intrinsic limitations. These indexes were developed to identify the critical thresholds for human instability in floodwaters, based on experimental data or conceptual models. Accordingly, they can be used to detect flood-prone areas where pedestrians cannot cope with floodwaters, but they are unable to rate intermediate hazard degrees correctly. This is because a linear relationship between flow velocity and hazard is assumed, which is an oversimplification given that human stability in floodwaters is a matter of forces, which depends on the square of the velocity.

We propose using the concept of loss probability of people in floodwaters, LP, to pursue an intelligible and effective communication of flood risk. Defined as the probability of a pedestrian to be swept away by floodwaters, LP accounts for both hazard and vulnerability in a physics-based and data-consistent fashion. Its spatial distribution can be easily computed as a function of water depth and velocity.

A real case study application highlights that, in slow shallow waters, hazard indexes overestimate the risk perception, whereas LP correctly predicts low risk levels. On the other hand, LP identifies high risk conditions in slow and deep waters, for which hazard indexes generally provide a severe underestimation of the real danger.