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## Managing flood risk: more realistic models need to take account of spatial differences

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**Effective flood-risk management requires accurate risk-analysis models.** Conventional analysis approaches, however, are based on the evaluation of spatially homogenous scenarios, which do not account for variation in flooding across a river reach/ region. Since flood events are often spatially heterogeneous (i.e. unevenly distributed), this paves the way for error. Now, scientists have developed a novel framework for risk analysis that accounts for their heterogeneity, and successfully demonstrated the accuracy of the approach by applying it in a proof-of-concept exercise in Vorarlberg, Austria. By facilitating improved prediction and quantification of flood events, this model is likely to inform future flood-risk management and related decision-making.

**Floods can significantly impact on the lives and livelihoods of populations in affected regions.** For this reason, the European Union Floods Directive[1] stipulates that Member States must design and implement risk-oriented flood-management approaches aimed at minimising the negative consequences of flooding. However, conventional analysis models are limited in their ability to accurately assess and evaluate flood risk in large-scale study areas. Tools that can provide information on possible flood scenarios, including their likelihood and potential consequences, are needed to enable effective planning.

One reason that conventional flood-risk analysis approaches are limited is that they are based on the evaluation of spatially homogeneous flood scenarios, whereas flood events tend to be spatially heterogeneous. This is especially true when one is considering large study areas or mountainous regions. To solve this problem, Austrian scientists have developed a new framework for the probabilistic risk analysis of river flooding that accounts for the spatially heterogeneous nature of flood events.

The model is composed of three modules:

i) A **hazard module** (HM) that evaluates potential flood hazard. After analysing observed flood events, it generates a large set of possible future events across the river network and determines flood risk for specific sections of the network.

ii) An **impact module** (IM) that characterises the potential negative consequences of flooding. It examines three impact indicators — unit of flood hazard (the number of sites affected by flooding); potential affected buildings; and potential direct monetary building damage — to ascertain the impact on specific areas or communities along the river network.

iii) A **risk-assessment module** (RM) that combines and statistically analyses the results of the first two modules to quantify the expected annual flood impact (in terms of expected annual damage) and calculate the probability that various levels of loss will be exceeded.

To demonstrate the applicability of this new framework and its suitability for mid-to-large-scale applications, researchers used the model to quantify flood risk in Vorarlberg, an Austrian province in the Eastern Alps that is vulnerable to flooding. Although flood-risk estimations are generally based on extremes, and so are associated with large uncertainties, for most individual components, the simulated flood risk for Vorarlberg matched well with observed data.

This new approach, which considers flood events as spatially heterogenous, has the potential to improve the prediction and quantification of flood risk in regions of interest, facilitating the more realistic flood-risk estimations required for advanced flood-defence planning. As such, this research is likely to be of interest to stakeholders involved in flood-risk management, including policymakers, risk analysts and insurance providers.

1. EU Floods Directive: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32007L0060

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