



Exploring space and time dimensions of indirect impacts of floods

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Models for the assessment of direct flood impacts are widely applied, while models for indirect impacts and cascading effects are still in a theoretic and demonstration phase. The division of damage into direct and indirect is commonplace, but interpretations and delineations of what is considered a direct and indirect impact differ. Direct damages are usually associated with the physical contact with flood water, thus almost instantaneous, and generally estimated by stage-damage functions. All the consequences beyond the physical damage are considered indirect impacts and include effects occurring outside the inundated area in space and time. This work presents two modelling frameworks capable of describing the space and time dimensions of indirect flood impacts. The first model simulates the water supply system (WSS) of a metropolitan area and the effect of the service disruption for users in case of floods. The second model simulates the recovery after a flood and it is specifically tailored for describing resilience of art cities, where cultural heritage makes the difference in socio-economic impacts. Both models are applied to the metropolitan area of Firenze (Italy) as a proof of concept. The results show how significant space and time extents of indirect impacts are, when compared to direct ones and this drive the need for a better understanding of system perspectives in flood risk management.