Geophysical Research Abstracts
Vol. 14, EGU2012-13606, 2012
EGU General Assembly 2012


# Multiscale Metrics to Assess Flood Resilience: Feedbacks from SMARTesT

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The goal of the FP7 SMARTesT project is to greatly improve flood resilient technologies and systems. A major difficulty is that hydrological basins, in particular urban basins, are systems that are not only complicated due to their large number of components with multiple functions, but also complex. This explains many failures in flood management, as well as to assess, including with the help of numerical simulations, the resilience of a flood management system and therefore to optimize strategies.
The term resilience has become extremely fashionable, although corresponding operational and mathematical definitions have remained rather elusive. The latter is required to analyse flood scenarios and simulations. It should be based on some conceptual definition, e.g. the definition of "ecological resilience" (Hollings 1973).
The first attempt to define resilience metrics was based on the dynamical system approach. In spite of its mathematical elegance and apparent rigor, this approach suffers from a series of limitations. A common limitation with viability theory is the emergence of spatial scales in systems that are complex in time and space.
As recently discussed (Folke et al., 2010), "multiscale resilience is fundamental for understanding the interplay between persistence and change, adaptability and transformability". An operational definition of multiscale resilience can be obtained as soon as scale symmetries are considered. The latter considerably reduce the space-time complexity by defining scale independent variables, called singularities. Ae scale independent resilient metrics should rely on singularities, e.g. to measure qualitative changes of their distribution. Incidentally, singularities are more and more used to analyse urban floods e.g. with the help done for climate scenario analysis. A radical point of view would correspond to define the scale independent analogues of the viability constraint set, viability kernel and resilient basin for singularities.