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Integrated methodologies for flood risk management practice in European pilot sites

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Flood risk management is a societal challenge: It encompasses the analysis of risk generation in complex human-environment systems, the evaluation of the tolerability of risk as well as the design and implementation of risk reduction measures. Multiple actors are involved in the process of collecting information, decision making and acting. Science may support this endeavour by specific natural and social science investigations and software tool developments. The complex levels of flood risk management, however, require a comprehensive understanding of the entire issues and special methodologies for the emergent tasks.

The paper presents results from developing and testing integrated methodologies to support flood risk management in European pilot sites of the FLOODsite project. Based on a conceptual framework of the societal flood risk management it illustrates how significant advances can be made by context-specific integrated approaches. The framework describes flood risk management from the perspective of multiple decision makers and experts who are responsible for dealing with flood risk as a real-world problem and related management tasks. Moreover, it explicates the management process itself considering the context and process dimension in addition to the contents.

Following this framework, integrated methodologies and their contributions to flood risk management practice are shown from seven European pilot sites, the Elbe River basin, a network of European flash flood basins, the Tisza River basin, the Thames River estuary, the Scheldt River estuary, the Ebro River Delta coast and the German Bight coast. With respect to the first task of risk management, which is *risk analysis*, it is shown how coupled modelling of flood hazards and flood vulnerabilities can improve the societal understanding of riverine, estuarine and coastal flood risk systems and their dynamic. Major features of the different approaches are detailed, as well as, their potential role in supporting the implementation of the Floods Directive.

For the second task of risk management, *risk evaluation*, an overview is given on findings regarding appropriate criteria and methods. This covers both the ex post and ex ante risk evaluation of the flood risk system. It also deals with the performance of *risk reductions* options, which links to the third task of risk management. In this respect, the meaning of certain physical measures and policy instruments for the pilot sites is explained and possible improvements for selected measures are derived.

For the interface between these three tasks and the *flood risk management process*, decision support tools play an increasing role. Different software tools have been developed and applied at three pilot sites. Principle differences between these tools are explained and briefly discussed in the light of their functionality and societal applicability. Based on this, results from site-specific investigations on risk perception, strategic planning and stakeholder involvement lead to the initial presumption that science needs also to address the social challenge of flood risk management. Investigations suggest significant differences between the requirements of the various actors of flood risk management and the people at risk. Final conclusions are thus drawn, with respect to the future elaboration of flood risk management plans and public involvement according to the Floods Directive.

Keywords: Flood risk management, methodologies, risk analysis, risk evaluation, risk reduction, pilot sites



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