

## **A complex systems perspective on changing flood risks**

*A. Zischg<sup>1</sup>. (1) University of Bern, Institute of Geography, Oeschger Centre for Climate Change Research, Mobiliar Lab for Natural Risks. Hallerstrasse 12, 3012 Bern, Switzerland, [andreas.zischg@giub.unibe.ch](mailto:andreas.zischg@giub.unibe.ch)*

In a constantly changing and interconnected world, flood risk management becomes increasingly complex. Flood risks result from different components ranging from environmental aspects, such as the hazard, to social and economic aspects, such as exposure and vulnerability. All of these parameters influence flood risk in space and time. Therefore, flood risk is expected to change as well over time and in space. Several drivers of change are intertwined and changes of one parameter may trigger changes to other parameters, often non-linearly. Risk parameters may independently evolve in the long-term or co-evolve. Out of the interconnected slowly changing parameters, sudden system behavior change may emerge. On top of slowly changing environmental and social drivers of flood risk change, flood events suddenly influence social behavior and may trigger the implementation of flood risk reduction measures. These human modifications of the river systems and adaptation measures in turn feed back to environmental and other social changes. Structural flood protection measures have long life cycles and thus the solutions of problems of the past (e.g., early 19th century river regulations) are still determining nowadays problems and decisions. This path dependency must also be considered for our nowadays solutions for flood risk management and their effects on future problems. Moreover, flood risks become systemic, e.g., the dependence of our society on the functioning of traffic networks and power grids or communication networks is increasing. New risks emerge with socio-technical developments and developments of floodplains.

In addition, flood risk management is sensitive to context. The implementation of flood risk reduction measures often depends on local conditions of nature protection, water quality acts, hydropower installations, preservation of historical monuments, traffic network, NGO's and local societal powers or elites. Flood risk management is implemented together by different levels of societal and political organization. Thus, adaptive behavior and patterns of self-organization are to be expected. Furthermore, climate change will increase uncertainties and limits long-term planning by incomplete knowledge of future developments and deep uncertainties.

In summary, rivers and floodplains together with the human settlements can be considered as complex adaptive systems. Hence, looking to the flood risk management strategies in the 21st century, we must find ways for overcoming the reductionist approach and for considering the underlying complexity of changing flood risks. In the presentation, I will outline a perspective on confronting complexity in modelling flood risk change.