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The Dynamics of Floodplains as Human-Water Systems

Floodplain areas offer favorable conditions for economic development and are home of around one-sixth of the world population. As a result, flood disasters currently affect more than 100 million people a year. Flood fatalities and damages are likely to increase in the near future because of population growth as well as changes in climate and land-use.

Given the relevance of floodplain systems, many hydrological studies have investigated the impact of human activities (e.g. land-use changes, urbanization, river training) on the frequency and magnitude of floods. Meanwhile, a number of social studies have examined how the frequency and severity of flooding often determine whether human developments in floodplains are desirable or not.

As a matter of fact, as human activities significantly change the frequency and severity of flooding, the frequency and severity of flooding affect human developments in floodplain regions. Yet, these dynamic interactions between floods and societies and the associated feedback mechanisms remain largely unexplored and poorly understood. In hydrology, for instance, we typically consider humans as external forcing (or boundary condition) without representing the relevant feedback loops. Hence, our predictions of future trajectories are extremely limited.

This presentation shows a first attempt to understand the behavior of floodplains as coupled human-water systems. In particular, we analyzed a number of long time series of hydrological and population data to explore the feedback mechanisms, reciprocal effects, surprises, and threshold mechanisms, taking place in floodplain systems. The results of the study enable a better understanding of how the occurrences of floods shape human developments while, at the same time, human activities shape the magnitude and frequency of floods. We also discuss the opportunities offered by the growing availability of global space-borne data to track the dynamics of floodplains as human-water systems. In particular, we can nowadays carry out global observations of floodplain topography and inundation patterns as well as human population dynamics. It is expected that these innovative observations will help understand the dynamics of floodplain systems across scales, hydro-climatic conditions, gradients of human impacts, and modes of governance. Such an advanced understanding will allow better predictions of future trajectories and therefore contribute to the reduction of flood risk.