Modelling the interaction between flooding events and economic growth

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Socio-hydrology describes the interaction between the socio-economy, water and population dynamics. Recent models analyze the interplay of community risk-coping culture, flooding damage and economic growth (Di Baldassarre, 2013, Viglione, 2014). These models descriptively explain the feedbacks between socio-economic development and natural disasters like floods. Contrary to these descriptive models, our approach develops an optimization model, where the intertemporal decision of an economic agent interacts with the hydrological system. This is the first economic growth model describing the interaction between the consumption and investment decisions of an economic agent and the occurrence of flooding events: Investments in defense capital can avoid floods even when the water level is high, but on the other hand such investment competes with investment in productive capital and hence may reduce the level of consumption. When floods occur, the flood damage therefore depends on the existing defense capital. The aim is to find an optimal tradeoff between investments in productive versus defense capital such as to optimize the stream of consumption in the long-term. We assume a non-autonomous exogenous periodic rainfall function (Yevjevich et.al. 1990, Zakaria 2001) which implies that the long-term equilibrium will be periodic .
With our model we aim to derive mechanisms that allow consumption smoothing in the long term, and at the same time allow for optimal investment in flood defense to maximize economic output. We choose an aggregate welfare function that depends on the consumption level of the society as the objective function. I.e. we assume a social planer with perfect foresight that maximizes the aggregate welfare function. Within our model framework we can also study whether the path and level of defense capital (that protects people from floods) is related to the time preference rate of the social planner. Our model also allows to investigate how the frequency and the intensity of floods influence the investment behavior (i.e. the division between investing in productive versus defense capital).