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Simulating Land Use Change to Explore Sustainable Urban Renewal Strategies in the Context of Flood Risk

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In highly developed countries like the Netherlands, strategies aimed at reducing flood risk have hitherto focused on reducing the chances of flooding, e.g., by building extensive flood defense systems (levies etc.). These systems, however, are never completely flood-proof. Further increasing their defensive capacities is getting increasingly difficult. At the same time, the economic value behind many of these barriers is growing. Depending on the (political) question of what chances and damage would be 'acceptable', this might justify a shift of focus from minimizing (regional) chances of flooding to adaptation to its potential (local) effects. The question is how much, where, and at what costs damage reduction could thus be achieved. The focus of this paper is on the reduction of potential flood damage to houses, particularly through 'flood proof urban (re)development', e.g., by constructing new houses on poles or other elevated constructions like parking garages.

The potential damage reduction that could thus be attained is very uncertain, especially on the local scale. It depends on a wide range of interrelated processes, most importantly those driving future urbanization. This paper introduces a land use model framework which is able to simulate urbanization on a 100 x 100 meter scale, including residential density changes occurring within urban areas. The specific policy instruments which' effects can be explored are, amongst others, regional urban intensification targets and local zoning. The strength of the model framework lies in the fact that it is able to integrate model specifications related to different processes (e.g., housing markets, land markets) operating on different spatial and temporal scales, and visualize their ultimate spatial-temporal consequences in a 100 x 100 m grids, in time steps of one year, allowing both the consistency (input) and validity/plausibility (output) to be checked rigorously.

The paper demonstrates that spatial policies could indeed significantly reduce potential flood damage to houses. It shows that most damage reduction could be attained in scenarios of high socio-economic growth. In this scenario, if urban intensification measures and zoning measures Would be combined, total damage could drop by almost one third from 2008 to 2050. All in all, the paper shows that the model framework can be a useful tool to help planners explore where, to what extent, and under which specific circumstances (scenario's, policy packages) potential flood damage to housing could be reduced.