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Compartmentalization: reducing risk and overcoming uncertainties

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The current flood policy in the Netherlands is based on the principle that the coastal defence systems should be strong enough to resist a, probability based, critical water level. The Dutch policy of probability based flood security includes many uncertainties caused by statistical analysis used to determine the critical water level and by insufficient knowledge about dike failure mechanisms. By introducing flood risk as an additional norm to assess flood security, a third uncertainty is introduced, since there are not only uncertainties in the probability but also in the consequences of the flood, like the economical and societal damage. This paper analyses and assesses compartmentalization as a flood risk reduction strategy. The strategy has to be sufficiently robust to overcome the present and the future uncertainties. Robust flood security strategies will reduce the importance of uncertainties, because they should decrease the economic and societal damage whatever the circumstances. Compartmentalization either or both protects critical functions in the flood-prone area and reduces the flooded surface area. It diminishes the flood effects by dividing the area into compartments with the use of dikes. Four types of compartmentalization strategies are developed: a secondary dike to confine the flood to the coastal area, partition dikes to divide the region into smaller areas, value protection of towns and value protection of towns and villages. To reduce building of new dikes, existing line elements are used as much as possible. Using existing line elements reduces the implementation costs and simplifies the fitting in the landscape. The study area is dike ring 6, which consists of the two most northern provinces of the Netherlands (total surface area of 5100 km2).

The strategies are analyzed by means of a 1D2D hydraulic model, to simulate flood patterns, water depths and velocities. A victim and damage model is used to assess the strategies on their ability to reduce the societal en economical damage. The results of the strategies are compared to the present situation. The robustness of the strategies is assessed by using two different storm scenarios. The storm surge of the first storm scenario is as high as the present design water level and the second storm scenario has a higher mean sea level and increased storm intensity. The second storm scenario is used to assess the effects of sea level rise and climate change on the compartmentalization strategies. Compartmentalization reduces the flood damage and the number of victims. The secondary dike and partition strategy reduce the flooded area and thereby reduce the damage. The two value protection strategies do not reduce the flooded area to a large extent. However, damage reduction is gained by these strategies, by protecting the areas with the highest economical value per hectare and the highest population density. All compartmentalization strategies cause a more heterogeneous damage distribution than without compartmentalization strategies. This heterogeneity is not just found in the spatial distribution, but also in the damage distribution between economic sectors. The secondary dike strategy reduces damage most in the agricultural sector. The value protection strategies most reduce the damage to real estate and the number of victims. The damage and victims model is based on the present land use. If the implementation of the compartmentalization strategies is coupled with changes in land use, the damage reduction can be larger, because the land use can be adapted to flooding. More inland situated compartmentalization dikes score better on robustness, since these strategies have fewer changes in the amount of damage and victims by a change in storm surge scenario. This is caused by the fact that higher storm surges at sea have a larger impact on near-sea located dikes than on more inland ones. Besides, the effect of higher water levels will be subdued more inland. Therefore heightening of the inland dikes is not demanded in case of increased storm surges.