A preliminary analysis of climate change effect on long-term risk-based design of flood defense

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The lifetime of a flood defense usually lasts for decades or centuries. The future flood probabilistic distribution is not stationary due to climate change. Therefore in the long-term design of flood defense systems, the effect of climate change should be taken into account. The design height of Bengbu dike segment (about 10 km) along Huai River in China is studied as an example to explore the potential effects of climate change on long-term risk-based design.

The economic-optimal design height of the dike is determined based on cost-benefit analysis. In this analysis the incremental investments in more safety are balanced with the reduction of the risk. Since climate change will result in the change of flood probability and hence the change of flooding risk, the optimal height might be shifted. To describe the possible future climate, the ensemble prediction of Global Climate Models (GCMs) is used in the study. River runoff series, which is required in deriving annual probability of peak runoff, is obtained by forcing a hydrological model with each GCM climate prediction. Then the probability of high water level in the river is derived based on the relationship between water level and peak runoff. The probability of flooding is assumed to equal to the exceedance probability of the high water level in the river. The possible future flood risk is calculated based on the flooding probability estimates, and is corresponding to each member of the GCMs ensemble.

The result will provide information about the significance of potential effects of climate change on the long-term design of flood defense. With comparison to the baseline period, the shift of risk curve in future will be shown on the cost-benefit diagram as well as the change of economic optimal design dike height. As it is a preliminary analysis in this study a sensitivity analysis will be carried out. The sensitivity of use of GCMs ensemble, the damage value and the investment cost will be investigated.