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Temporary flood intervention planning under uncertainty

Mengke Ni and Tohid Erfani
University College London, Civil, Environmental and Geomatic Engineering, United Kingdom (mengke.ni.16@ucl.ac.uk)

Flooding has always been one of the most severe disaster throughout the world. Flood risk management involves identifying economically effective interventions to ensure an acceptable and reliable flood protection. Climate change is an important factor to be considered in flood protection systems as the influence of rainfall on water level is uncertain. Adaptation to changing future conditions is important in strategic flood protection planning.

Temporary flood protections are increasingly playing a significant role in effective flood risk management, especially for communities that currently cannot make a larger capital investment scheme work at the occurrence of flooding. The effective protection is often reliant on the deployment of temporary defences. However, due to rainfall uncertainty involved, it is difficult to identify what intervention to be deployed at what capacity in a most cost-effective and reliable way in order to increase the chance of successful intervention. Inadequate protection could lead to major flooding disruption while excessive protection may lead to waste of resources.

We propose a multi-objective mathematical planning model with multi-protection interventions considering uncertain rainfall to account for the optimal temporary flood planning; to minimise the cost, maximise the affected sites' successful intervention, and maximise the resilience of the flood defences. Our model is based on mixed integer stochastic programming incorporating real option analysis. We apply scenario tree to represent the uncertain rainfall for the real option analysis. The efficiency of the proposed model is evaluated by a UK flooding case study and sensitivity analysis is performed to account for the model parameters variabilities.