Scale effect matters when investigating spatial heterogeneity and driving factors of urban flooding

November 1 2022, by Zhang Nannan

Credit: Pixabay/CC0 Public Domain

Urban flooding is a natural disaster event that occurs in cities when short-term rainstorm or continuous heavy rainfall exceeds the drainage

capacity of a city. Urban floods frequently occur worldwide. In China, it causes major economic losses every year, especially in megacities such as Beijing, Shanghai and Guangzhou.

With accelerated urbanization, the two-dimensional (2D) and three-dimensional (3D) landscape patterns of megacities have become more complex, which increases the uncertainty in characterizing spatial heterogeneity and driving factors of urban flooding and brings a challenge to urban flood mitigation planning.

Led by Dr. Li Chunlin, an associate professor from the Institute of Applied Ecology (IAE) of the Chinese Academy of Sciences (CAS), researchers investigated the spatial heterogeneity of urban flooding and its driving factors in nine megacities in central and eastern China.

By performing multiple-scale and multidimensional analyses, the researchers determined the relative importance of five categories of potential determinants, including 2D and 3D landscape patterns, topography, drainage and meteorology, to urban flooding at the scales of 1 km, 3 km and 5 km.

The researchers found that compared with coastal cities, inland cities had a higher probability of flooding. They also found that flooding occurred in inland cities showed a "single-core" and multilevel spatial aggregation pattern, while urban flooding in coastal areas was characterized by multicore aggregation and multipoint occurrence.

Of all the five categories of potential drivers of urban flooding, the determinant roles of 2D and 3D landscape pattern indices (e.g., patch density, density of buildings and building shape coefficients) were generally stronger than that of topography, drainage and meteorology, regardless of scales of analyses.

When considering the explanatory power of a certain category of these factors on urban flooding, the researchers confirmed that the scale effect are important. With the change of the scale of analyses from 1 km to 5 km, the determinant roles of 2D and 3D landscape pattern indices increased, while that of topography, drainage and meteorology decreased.

The study indicates that scale effect matters when investigating spatial heterogeneity and driving factors of urban flooding, and that an appropriate research scale can provide more useful information for establishing the relationship between urban flooding and its predictors.

The multiple-scale and multidimensional analysis approach used by the researchers also gave an insight into urban planning and early warning of urban flooding problems.

This study has been published in the *Journal of Hydrology* and is entitled "Spatial characteristics and driving factors of urban flooding in Chinese megacities."

More information: Yongheng Wang et al, Spatial characteristics and driving factors of urban flooding in Chinese megacities, *Journal of Hydrology* (2022). DOI: 10.1016/j.jhydrol.2022.128464

Provided by Chinese Academy of Sciences