EGU21-2514, updated on 18 May 2021
https://doi.org/10.5194/egusphere-egu21-2514
EGU General Assembly 2021

The mitigation effect of urban green infrastructure (UGI) on urban waterlogging

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With the acceleration of urbanization, the impervious surfaces of urban areas have increased dramatically, changing the natural water cycle of the city. It is of great significance for the improvement of urban living environment and the risk management of urban waterlogging to fully understand and play the positive role of UGI in alleviating urban waterlogging. This study attempts to identify the critical factors that alleviate urban waterlogging and examine the effectiveness and stability of UGI in mitigating urban waterlogging in multiple locations. We looked at two highly-urbanized Chinese cities (Guangzhou and Shenzhen) in a comparative study. The waterlogging records from 2009 to 2015 were obtained from the local water authority and the UGI was extracted from the 0.5-m resolution remote sensing images. The complex relationship between urban waterlogging and green infrastructure was quantified and compared through partial redundancy analysis and piecewise linear regression after controlling the conditions of topography, precipitation, and drainage network. The results indicated that the spatial distribution of urban waterlogging events presents a strong agglomeration effect, while the clustering pattern varies in different cities. Furthermore, after controlling the impact of elevation, rainfall, and drainage network, the area percentage and biophysical parameters of green infrastructure are the two most important factors to alleviate urban waterlogging. The influence of these two factors on urban waterlogging is consistent in different cities. This result indicates that more attention should be paid to the area size of green infrastructure and its vegetation biophysical parameters to mitigate urban waterlogging magnitude to the greatest extent. However, the area of green infrastructure must be controlled within a certain range in order to play a corresponding role in alleviating urban waterlogging. We also found that the spatial configuration of UGI also matters. Holding UGI's composition constant, the degree of urban waterlogging can be reduced by optimizing the spatial configuration of UGI. This finding provides additional insights that the urban waterlogging can be alleviated by balancing the relative composition of UGI as well as by optimizing their spatial configuration, which is particularly important for a highly urbanized area where land resources for UGI are scarce. This study expands our understanding of the complex mechanism of UGI on urban waterlogging mitigation and provides beneficial enlightenment for the design of UGI.