frontiers in Water

EDITORIAL
published: 25 January 2022
doi: 10.3389/frwa.2021.738493

Editorial: Urban Flood Resilience and Sustainable Flood Management Strategies in Megacities

Faith Ka Shun Chan [1,2]*, *James Griffiths* [3]*, *Yanfang Sang* [4,5]*, *Daisuke Komori* [6]* and *Alessandro Pezzoli* [7]*

[1] School of Geographical Sciences, University of Nottingham Ningbo, Ningbo, China, [2] Water@Leeds Research Institute, University of Leeds, Leeds, United Kingdom, [3] National Institute of Water and Atmospheric Research Ltd. (NIWA), Christchurch, New Zealand, [4] Key Laboratory of Compound and Chained Natural Hazards Dynamics, Ministry of Emergency Management of China, Beijing, China, [5] Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China, [6] Department of Civil Engineering, Tohoku University, Sendai, Japan, [7] The Inter-university Department of Regional & Urban Studies and Planning (DIST), Politecnico di Torino and Università degli Studi di Torino, Torino, Italy

OPEN ACCESS

Edited by:
Mariele Evers,
University of Bonn, Germany

Reviewed by:
Ashraf Dewan,
Curtin University, Australia
Ibidun Adelekan,
University of Ibadan, Nigeria

***Correspondence:**
Faith Ka Shun Chan
faith.chan@nottingham.edu.cn
James Griffiths
James.griffiths@niwa.co.nz
Yanfang Sang
sangyf@igsnrr.ac.cn
Daisuke Komori
daisuke.komori.e8@tohoku.ac.jp
Alessandro Pezzoli
alessandro.pezzoli@polito.it

Specialty section:
This article was submitted to Water and Human Systems, a section of the journal Frontiers in Water

Received: 08 July 2021
Accepted: 23 December 2021
Published: 25 January 2022

Citation:
Chan FKS, Griffiths J, Sang Y, Komori D and Pezzoli A (2022) Editorial: Urban Flood Resilience and Sustainable Flood Management Strategies in Megacities. Front. Water 3:738493. doi: 10.3389/frwa.2021.738493

Keywords: urbanization, sustainable flood risk management, flood resilience, megacities, climate change

Editorial on the Research Topic

Urban Flood Resilience and Sustainable Flood Management Strategies in Megacities

INTRODUCTION

Many megacities (including coastal megacities) that already support the population of 10 million (UN-HABITAT, 2008), and continue to undergo rapid urbanization and socio-economic growth. This means that flood risk will continue to be usually high in megacities, because of higher population and real estate. Moreover, many megacities are located in areas of high flood risk due to their geography and climate. For example, we are increasingly witnessing severe urban floods in coastal and inland megacities caused by cyclonic effects (Typhoons in Asia and W Pacific; Hurricanes in the U.S and elsewhere) and enhanced coastal storm surges (Varis et al., 2012; Emanuel, 2017). This phenomenon is likely to increase as is illustrated in future projections by the IPCC AR4 and AR5 reports (Akter et al., 2019; Hamin et al., 2019). Many past extreme events [e.g., Typhoon Fitow enhanced storm surge in Ningbo and Zhejiang Province, East Coast China, 2013; intense rainfall in Wuhan 2016 and 2020; and Typhoon Hato and Mangkhut in 2017 and 2018 in Hong Kong, Guangzhou, and Greater Bay Area (GBA), South China] have caused severe flood impacts (**Figure 1**). These coastal and urban floods have shown that current practices such as urban land drainage systems and coastal flood defense mechanisms, cannot cope with these challenges, which result in significant economic cost, severe human injuries, and multiple causalities. For example, there were 12 deaths and hundreds of injuries caused by coastal floods during Typhoon Mangkhut in September 2018 in Macao and GBA cities, South China. Lately, Typhoon In-Fa has also caused E Chinese coastal cities such as Ningbo, Hangzhou, and Shanghai with social-economic impacts during July 2021 (Chan et al., 2021). These impacts are increasing in global megacities and even next-level cities (Griffiths et al., 2019; Meng et al., 2019; Lo et al., 2020). In response, we have witnessed substantial investment in infrastructure over the last few decades *via* drainage and flood defense engineering projects (Chan et al., 2018; Meng et al., 2019). However, now is the time to rethink how to achieve more sustainable and improved flood resilience, which considers social, economic, and environmental aspects with equal emphasis.

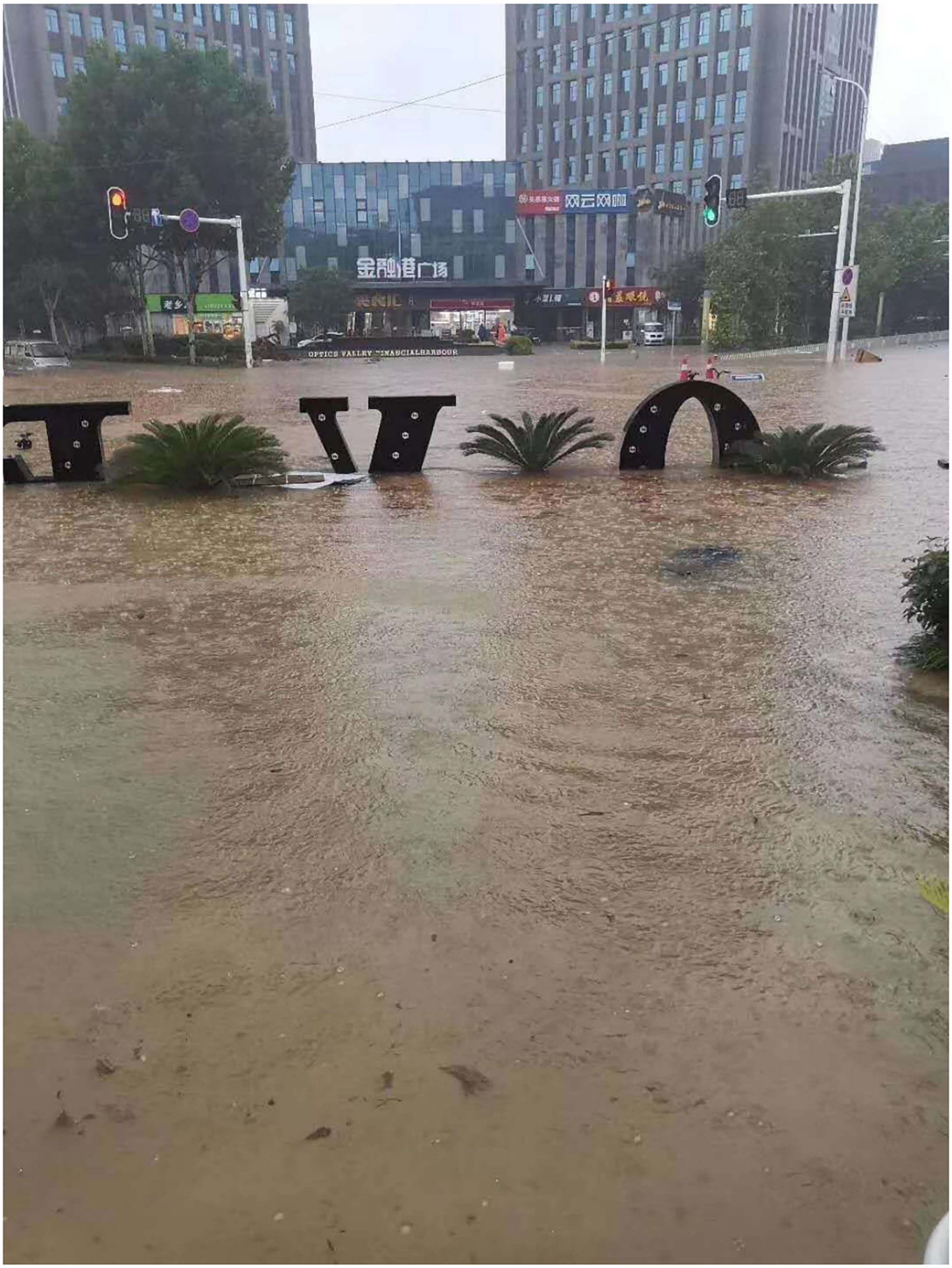

FIGURE 1 | Urban flood at Wuhan on 6–7 July 2021 after intensive rainfall. Source (authors).

Confronted with uncertain climates, urban planners, water, and civil engineers are necessarily gathered synergies and co-production for improving climate adaptations and resilience, alongside implementing urban sustainability for our next generations. The initiation of Sustainable urban stormwater management concept with various practices worldwide, such as Blue-Green Infrastructure (Cao et al., 2021), Low-Impact Development (Pour et al., 2020), Nature-Based Solution (Ferreira et al., 2020; Huang et al., 2020; Chen et al., 2021; Spyrou et al., 2021), and Sponge City Program (Griffiths et al., 2020). These practices address urban stormwater management by using nature-based approaches such as increasing urban vegetation coverage, reducing impervious concrete surface and restoring the soil-water infiltration, and retaining the urban hydrological cycle to reduce urban runoff volume and peak discharge. These practices also delivered multiple benefits to enhance urban ecosystem services and provide cost-effective, climate-resilient, and social well-being (by increasing recreation measures). Whilst, keeping up with technologies and up-to-date tools such as providing adequate and precise flood hazard mapping and modeling (i.e., Flood Hazard Modeling—FHM) and information tools (i.e., Humanitarian Aid Information System—HAIS) to improve preparedness and awareness for actors that includes according to stakeholders and communities. These practices are effectively reducing flood impacts with identified potential flood hazardous areas and ensuring adequate time for the response measures from the decision-makers and communities on pluvial (urban) and coastal flood conditions (Dewan et al., 2006; Rahman et al., 2021).

These practices are increasingly significant in addressing synergies and techniques for strengthening urban flood resilience and exploring how future practice can enable us to deliver long-term sustainable flood management strategies in megacities. This Research Topic, theme, "*Urban Flood Resilience and Sustainable Flood Management Strategies in Megacities*" is targeted to expand upon our scientific knowledge related to understanding the challenges, barriers, and solutions or lessons for improving urban flood resilience and flood management strategies accordingly.

The focus is to provide the opportunity to share knowledge on sustainable and long-term solutions for urban flood management strategies by gathering worldwide practices, latest research outputs, and lessons and synergies, which can be helpful for stakeholders to improve current practices for facing future challenges on climate and human-induced factors.

In this Research Topic, we have received researchers that contributed their latest research findings related to urban flood resilience and techniques to conduct improved long-term sustainable FRM practice under cost-effective conditions. In addition, researchers comment on achieving an improved understanding of flood information with Geographical Information System (GIS) and topographical analyses. In this Research Topic, we also address flood risk awareness and public perception, of human safety and well-being to protect vulnerable communities *via* the Urban Flood Risk Mitigation (UFRM) assessment model. Finally, we also consider the role of NBS in addressing urban flood issues in megacities and cities and how they can contribute to nature and urban-based ecosystem services.

OVERVIEW OF THE ARTICLES

As guest editors, we would like to thank the authors who worked hard to submit very interesting articles for this Research Topic. Following some collaboration between the reviewers and authors, we have included four research articles in this SI, which are summarized below.

In the first paper "*Exploring the Development of the Sponge City Program (SCP): The Case of Gui'an New District, Southwest China,*" the author's Qi et al. offer a holistic view on the consequences of urban floods in Chinese cities through the case of Guiyang, SW China. For example, rapid urbanization and inadequate flood protection on land drainage systems (1-in-1 return period) were unable to cope with urban runoff and peak discharge. The paper described the latest development of SCP in the case of Guiyang that aligns with NBS and Low Impact Developments (LIDs) *via* Blue-Green Infrastructure (e.g., urban wetlands, ponds, green parks, swales, etc.). These measures have significantly addressed urban water issues include urban stormwater management and related water issues (i.e., water pollution). These practices can be seen to deliver multiple benefits (e.g., increasing ecosystem services and social well-being) as well as achieving long-term sustainable development goals. Whilst, this study has also illustrated exemplars for other Chinese and Asian cities from the lessons and experiences of SCP from the case of SW China.

The second paper by Quagliolo et al. is titled "*Experimental Flash Floods Assessment through Urban Flood Risk Mitigation (UFRM) Model: The Case Study of Ligurian Coastal Cities.*" The paper discusses the fact that traditional flood risk classifications are not only able to address all elements of flood impacts (e.g., spatial knowledge of the hazardous events/vulnerabilities) through modeling scenarios at the urban level, which is not fully understood. The article describes the development of the innovated "*Urban Flood Risk Mitigation*" (UFRM) model and the integration with the "*Integrated Evaluation of Ecosystem Services and Trade-off*" (InVEST) that makes use of Geographical Information System (GIS) tools integrated with the UFRM approach. The model application adopted, *via* the case of three urban coastal areas in the Liguria Region in Italy, considers the implications of Natural Water Retention Measures (NWRM) on various land use types. This study addressed and improved flood resilience on site-specific urban runoff reduction that coping with local rainfall variation through local sensitivity analysis of the UFRM model.

In the third article, "*How Does Residential Property Market React to Flood Risk in Flood-Prone Regions? A Case Study in Nagoya City*" Inoue and Hatori in Japan. This study recognized flood resilience (i.e., prevention and preparedness) through the real estate market as a reflection of flood risk on property values through the case in Nagoya, Japan. The article provided a good argument that previous studies only focused on the recent flood impacts. However, these studies neglected the behavior of communities and residents in flood-prone regions. The study found that the residential property values are related to historical flood damages in Nagoya, therefore, the information of flood disasters (i.e., flood risk information) are highly relevant to the devaluation of properties. The property values are also connected to public awareness, preparedness, and response. These findings contribute a valuable perspective for other populous Asian coastal megacities.

In the fourth paper, "*Topographical Characteristics of Frequent Inland Water Flooding Areas in Tangerang City,* *Indonesia*" Djamres et al. offered a techno-fixed approach to deal with the perception and understanding of according flood risk information, which is based on statistical analyses and GIS computation on frequent inland water flooding areas in Tangerang city, Indonesia (2008–2015). In this study, topographical characteristics of frequent inland water flooding areas are extracted and principal component analysis is then used to find its main characteristics. The research findings illustrate the importance of understanding accurate topographical, geographical, and meteorological information, before addressing other flood information (e.g., flood types, flood-impacted areas, etc.). That said the field surveys, governmental data, and relevant support are vitally important to understand the local flood risk and conditions.

The editors of this Research Topic believe that science should be a domain for further discussion and development, and we welcome further debate and your viewpoints and opinions that will surely contribute toward more resilient and sustainable urban FRM strategies and practices in megacities, cities, and elsewhere. We invite your response to this Research Topic and suggest that you feel free to use and discuss these articles—their definitions, findings, and propositions, and we will be grateful for improvements that come from the critical and constructive debate in this field of research.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

ACKNOWLEDGMENTS

We would like to send our gratitude for the support from the National Natural Science Foundation of China (NSFC) (Grant number: 41850410497); the National Key R&D Program of China (Grant number: 2019YFC1510400); the University of Nottingham (UNUK) project (Grant number: E01200500006); the Foundation of Science and Technology Department of Guizhou Province (Grant number: 20192879); the Institute of Asia Pacific Studies research funding for the Environmental Security and Sustainability; the Cultural and Creative Industries Research Priority Areas of University of Nottingham Ningbo China.

REFERENCES

Akter, M., Jahan, M., Kabir, R., Karim, D. S., Haque, A., Rahman, M., et al. (2019). Risk assessment based on fuzzy synthetic evaluation method. *Sci. Tot. Environ*. 658, 818–829. doi: 10.1016/j.scitotenv.2018.12.204

Cao, X., Huang, N., Chen, R., Jiang, Y., and Shi, Y. (2021). Evaluating rainwater storage capacity of green infrastructure for urban flood management. *Urb. Water J*. 2021, 1–8. doi: 10.1080/1573062X.2021.1925704

Chan, F. K. S., Chuah, C. J., Ziegler, A. D., Dabrowski, M., and Varis, O. (2018). Towards resilient flood risk management for Asian coastal cities: lessons learned from Hong Kong and Singapore. *J. Clean. Prod*. 187, 576–589. doi: 10.1016/j.jclepro.2018.03.217

Chan, F. K. S., Gu, X., Qi, Y., Thadani, D., Chen, Y. D., Lu, X., et al. (2021). Lessons learnt from Typhoons Fitow and In-Fa: implications for improving urban flood resilience in Asian Coastal Cities. *Nat. Hazard*. doi: 10.1007/s11069-021-05030-y

Chen, V., Bonilla Brenes, J. R., Chapa, F., and Hack, J. (2021). Development and modelling of realistic retrofitted nature-based Solution scenarios to reduce flood occurrence at the catchment scale. *Ambio* 50, 1462–1476. doi: 10.1007/s13280-020-01493-8

Dewan, A. M., Kankam-Yeboah, K., and Nishigaki, M. (2006). Using synthetic aperture radar (SAR) data for mapping river water flooding in an urban landscape: a case study of Greater Dhaka, Bangladesh. *J. Jap. Soc. Hydrol. Water Resour*. 19, 44–54. doi: 10.3178/jjshwr.19.44

Emanuel, K. (2017). Assessing the present and future probability of Hurricane Harvey's rainfall. *Proc. Natl. Acad. Sci. U. S. A*. 114, 12681–12684. doi: 10.1073/pnas.1716222114

Ferreira, S. C., Mourato, S., Kasanin-Grubin, M., Ferreira, J. D. A., Destouni, G., and Kalantari, Z. (2020). Effectiveness of nature-based solutions in mitigating flood hazard in a mediterranean peri-urban catchment. *Water* 12:2893. doi: 10.3390/w12102893

Griffiths, J., Chan, F. K. S., Shao, M., Zhu, F., and Higgitt, D. L. (2020). Interpretation and application of Sponge City guidelines in China. *Philos. Trans. A Math. Phys. Eng. Sci*. 378:20190222. doi: 10.1098/rsta.2019.0222

Griffiths, J. A., Zhu, F., Chan, F. K. S., and Higgitt, D. L. (2019). Modelling the impact of sea-level rise on urban flood probability in SE China. *Geosci. Front*. 10, 363–372. doi: 10.1016/j.gsf.2018.02.012

Hamin, E. M., Abunnasr, Y., and Ryan, R. L. (2019). *Planning for Climate Change: A Reader in Green Infrastructure and Sustainable Design for Resilient Cities*. New York, NY: Routledge. doi: 10.4324/9781351201117-22

Huang, Y., Tian, Z., Ke, Q., Liu, J., Irannezhad, M., Fan, D., et al. (2020). Nature-based solutions for urban pluvial flood risk management. *WIREs Water* 7:e1421. doi: 10.1002/wat2.1421

Lo, A. Y., Liu, S., Cheung, L. T. O., and Chan, F. K. S. (2020). Contested transformations: sustainable economic development and capacity for adapting to climate change. *Ann. Am. Assoc. Geogr*. 110, 223–241. doi: 10.1080/24694452.2019.1625748

Meng, M., Dabrowski, M. M., Tai, Y., Stead, D., and Chan, F. (2019). Collaborative spatial planning in the face of flood risk in delta cities. *Environ. Sci. Pol*. 96, 95–104. doi: 10.1016/j.envsci.2019.03.006

Pour, S. H., Wahab, A. K. A., Shahid, S., Asaduzzaman, M., and Dewan, A. (2020). Low impact development techniques to mitigate the impacts of climate-change-induced urban floods: current trends, issues and challenges. *Sustain. Cities Soc*. 62:102373. doi: 10.1016/j.scs.2020.102373

Rahman, M., Chen, N., Islam, M. M., Mahmud, G. I., Pourghasemi, H. R., Alam, M., et al. (2021). Development of flood hazard map and emergency relief operation system using hydrodynamic modeling and machine learning algorithm. *J. Clean. Prod*. 311:127594. doi: 10.1016/j.jclepro.2021.127594

Spyrou, C., Loupis, M., Charizopoulos, N., Apostolidou, I., Mentzafou, A., Varlas, G., et al. (2021). Evaluating nature-based solution for flood reduction in spercheios river basin under current and future climate conditions. *Sustainability* 13:3885. doi: 10.3390/su13073885

UN-HABITAT (2008). *State of the World's City Report*, Nairobi: United Nations.

Varis, O., Kummu, M., and Salmivaara, A. (2012). Ten major rivers in monsoon Asia-Pacific: an assessment of vulnerability.

Appl. Geogr. 32, 441–454. doi: 10.1016/j.apgeog.2011.05.003

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's Note: All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.