Point-by-point response to editor's and reviewers' comments

Part 1: Author's Responses to Comments from Editor Sven Fuchs

Comments made by the editor are shown in black text.
Author responses are provided in blue text.

Comments: Editor Decision: Publish subject to minor revisions (review by editor) (20 Mar 2019) by Sven Fuchs Comments to the Author:
Dear colleagues, thank you for submitting your manuscript for consideration as a short comment in NHESS. I kindly would like to confirm you the suitability of the topic for the target journal. Moreover, we now received the two comments of the referees as well as your answer to these comments though the open discussion phase.

Based on both I decided that your manuscript needs minor revisions before final acceptance in the "brief communication" section of NHESS. Even if you already uploaded a track-change (comment #3) and clean version (comment #4) of your revised work, I would like to ask you to go once again over the material and check for updates. Please also double-check references in the text body (e.g., Roger Pielke vs. Pielke).

I am looking forward to receiving your finally revised version of nhess-2018-394 as soon as possible. Please do not upload the revised version in the discussion section, but following the link provided in this e-mail.

Accepted: Thanks for confirming the suitability of our manuscript and the suggestions for further improvement. We have thoroughly checked our paper, based on the version we published in the Interactive Discussion Section. Specifically, we further improved our figures and double-checked the references.

Part 2: Author's Responses to Comments from the Anonymous Referee 1

Comments made by Anonymous Referee 1 are provided in black text.
Author responses are provided in blue text (line and page numbers refer to the clean version).

General Comments. This manuscript presents the brief communication of the 1998 flood in China. This topic is related to the scope of this journal. The authors discussed the rapid urbanization and climate change pose new challenges and rethink whether China is prepared for the next mega-flood. However, this manuscript still need to addresses and clarifies several points before it can be accepted. The following comments may help enhancing the quality of this work.
Accepted: Thanks for confirming the relevance of our manuscript and the suggestions for

further improvement. We have thoroughly revised our paper, addressing your valuable comments and suggestions.

Detailed Comment 1. Scientific writing: The manuscript must be professionally proofread and edited. In addition, the authors may pay attention to some aspect of the conventional research writing. Although it is a brief communication, the structure of the manuscript should be enough, especially the connection between the sentences, the components/structure of the key parts (Abstract, Introduction, body, Conclusion).

Accepted: Thanks for the suggestion. After revising the manuscript, an additional, thorough, proofreading of the manuscript has been carried out by one of the co-authors (Ward), who is a native English speaker and has extensive publication experience in scientific journals. Furthermore, in the revised version we improved the following aspects:

- We rewrote the Abstract to make it more self-explanatory (also following your *Detailed Comment 4*).
- We have improved the connections between sentences and sections to enhance the logical flow. With regards the structure, we checked the journal's guidelines and several recent papers of the type 'Brief Communication', and found that the structure is in accordance with these. This structure is typical for an opinion paper with a 'Brief Communication' type; several similar examples are listed below (Please check the references below).

Reference:

Aerts, J. C. J. H.; Botzen, W. J. W., Brief communication "Hurricane Irene: a wake-up call for New York City?". Nat. Hazards Earth Syst. Sci. 2012, 12 (6), 1837-1840.

Mysiak, J., Surminski, S., Thieken, A., Mechler, R., and Aerts, J.: Brief communication: Sendai framework for disaster risk reduction – success or warning sign for Paris?, Nat. Hazards Earth Syst. Sci., 16, 2189-2193, 2016.

Mysiak, J.; Castellari, S.; Kurnik, B.; Swart, R.; Pringle, P.; Schwarze, R.; Wolters, H.; Jeuken, A.; Linden, P. v. d., Brief communication: Strengthening coherence between climate change adaptation and disaster risk reduction. Nat Hazard Earth Sys 2018, 18 (11), 3137-3143.

Detailed Comment 2. This brief communication discussed the 1998 flood in China, how about the recent flood, such as flood in 2018 in China. The southern China suffered server floods in 2018. It is suggested to make a comparison between the 1998 flood and 2018 flood in China. The flowing references may be help to strengthen this study. "Flooding hazards across southern China and prospective sustainability measures."

Accepted: Thanks for this suggestion. We have added references to the floods that occurred in 2018 and in other recent years in the revised manuscript. First, we now discuss how the severe floods in 2018, particularly in western China, were an alarm for the arid/semi-arid region to increase risk awareness and improve adaptation (lines 4–5 on page 5). Second, the revised manuscript includes a new reference to the massive evacuation in Shanghai for Typhoon Anbi on July 22nd, 2018 as an example of the huge effects that China has made to improve evacuation (lines 18–19 on page 3). Third, we include new information on flood protection investments from 1998 to 2016 at lines 9–13 on page 3 and in the revised Figure 2 (lines 20–22 on page 3). We also included information on the changes in flood losses between the 1990s and 2010s at lines 2–10 on page 4 and in the revised Figure 1 (lines 8–9 on page 2). Some of the details of the 2018 flood are not included in the figures and the comparison, because detailed data for flood protection investments and flood losses in 2018 have not yet been released. Please note the 2018 flood losses were lower than the past five-year average (The Central Government of PR China, 2019).

Additionally, we added the insightful reference you recommended as further evidence of increasing flood risk in China (lines 8–9 on page 4) and the strategies China should adopt to address the emerging challenges (lines 16–21 on page 5).

Reference:

The Central Government of PR China. 2019. The 2018 natural disaster losses are lower than the average of the past five years. http://www.gov.cn/xinwen/2019-01/10/content_5356406.htm (accessed on February 24, 2018)

Detailed Comment 3. The short communication should discussion the persective of flood disaster management, e.g. flood risk assessment and prediction. The following publications are refered: “Flood risk assessment in metro systems of mega-cities using a GIS-based modeling approach” “Assessment of geohazards and preventative countermeasures using AHP incorporated with GIS in Lanzhou”

Accepted: We enhanced the discussion on flood management with the information of the recommended papers, and added one of them as reference. Note the limited number of references (up to 20) allowed in ‘Brief Communications’.

Detailed Comment 4. The abstract is too short. Although this is a short communication, the problem, method and results should be included in the abstract.

Accepted: Thanks for this comment. Following your suggestion, we rewrote the Abstract. Note that there is a 100-word maximum limit, which explains the brevity. It now has 100 words and reads as follows:

> “A mega-flood in 1998 caused tremendous losses in China and triggered major policy adjustments in flood-risk management. This paper aims to retrospectively examine these policy adjustments and discuss how China should adapt to newly emerging flood challenges. We show that China suffers annually from floods, despite large-scale investments and policy adjustments. Rapid urbanization and climate change will exacerbate future flood risk in China, with cascading impacts on other countries through global trade networks. Therefore, novel flood-risk management approaches are required, such as a risk-based urban planning and coordinated water governance systems with public participation, in addition to traditional structural protection”.

Part 3: Author's Responses to Comments from the Anonymous Referee 2

Comments made by Anonymous Referee 2 are shown in black text.
Author responses are provided in blue text (line and page numbers refer to the clean version).

***General comment*:** This paper reviewed a mega-flood in 1998 which caused tremendous losses in mainland China. Since rapid urbanisation and extreme climate result in great challenges, novel flood risk management is in urgent need. The findings of this study seem to have a guiding role for efficient flood risk management, but there're some issues need to be addressed prior to the acceptance of paper publication in NHESS. Additionally, the authors may pay attention to some aspect of the conventional research writing, especially the connection between the sentences, the components/structure of the key parts (Abstract, Introduction, Body, and Conclusions). I suggest the authors may read the following references to modify the paper accordingly. Glasman-Deal, H. (2010). Science Research Writing for non-native speakers of English. Imperial College Press, London, 228p.
Accepted: Thanks for the acknowledgement of the importance of our manuscript and the suggestions for further improvement. We made a thorough revision, performed additional proof reading, and in particular improved the connections between sentences and sections to enhance the logical flow. Note that the chosen structure is typical of the 'Brief Communication' papers in NHESS; several similar examples are listed below, which are also used in other NHESS papers (Please check the references below).

Reference:
Aerts, J. C. J. H.; Botzen, W. J. W., Brief communication "Hurricane Irene: a wake-up call for New York City?". Nat. Hazards Earth Syst. Sci. 2012, 12 (6), 1837-1840.
Mysiak, J., Surminski, S., Thieken, A., Mechler, R., and Aerts, J.: Brief communication: Sendai framework for disaster risk reduction – success or warning sign for Paris?, Nat. Hazards Earth Syst. Sci., 16, 2189-2193, 2016.
Mysiak, J.; Castellari, S.; Kurnik, B.; Swart, R.; Pringle, P.; Schwarze, R.; Wolters, H.; Jeuken, A.; Linden, P. v. d., Brief communication: Strengthening coherence between climate change adaptation and disaster risk reduction. Nat Hazard Earth Sys 2018, 18 (11), 3137-3143.

Detailed comment 1. China's mega-flood in 1998: The objectives of this study should be inserted into an appropriate place. This may significantly enhance the readability of this paper.
Accepted: Thanks for the good suggestion; we have included the objective more clearly in the revised Abstract and in the manuscript at lines 12–13 on page 1 and lines 6–7 on page 2.

Detailed comment 2. Fig. 1: The authors present the variations in the flood protection and others' investments against the time. However, the data source has not clearly reported yet, which causes a difficulty in convincing general readers to conduct further analysis and/or comparison by retrieving the data presented. Please clarify.
Accepted: The data source is: Ministry of Water Resources: China Water Statistical Yearbook 2017, China Water Power Press, Beijing, 2017. The reference has been added in the revised version (lines 20–22 on page 3).

Detailed comment 3. Fig. 2: The data source again has not reported yet. Please provide where the data come from and indicate whether the presented data are retrieved from other research.

Accepted: The data source is: Ministry of Water Resources: China Water Statistical Yearbook 2017, China Water Power Press, Beijing, 2017. The reference has been added (lines 8–9 on page 2).

Detailed comment 4. P4, L7-9: The authors indicated that during 2016-2035, China is expected to suffer two-thirds of the global direct production losses caused by floods, US$389 billion, with an indirect impact of about US$300 billion to other countries. No data source available.

Accepted: The data source is: Willner, S. N., Otto, C., and Levermann, A.: Global economic response to river floods, Nature Climate Change, 8, 594-598, 2018. The reference has been added (line 23 on page 4).

Detailed comment 5. Future adaptation: The presence of the new challenges forces the development of countermeasures. The authors also list their suggestions against mage flood. Notwithstanding that, details in regard with the mega flood hazard prevention and mitigation are missing. Please elaborate with the details necessary.

Accepted: Thank you for the good suggestion. In the revised version, we have added the following sentences with regards suggestions for flood hazard prevention and mitigation (lines 9–11 on page 5):

> "One component of the new policies could be enhanced flood protection systems, especially in urban areas with high economic values and large exposed populations (Ward et al., 2017). However, structural measures can also release the 'levee effect', further stimulating exposure in protected areas".

Detailed comment 6. References: State-of-art researches should be cited and by comparing with the state-of-art researches, the significance of this study should be highlighted. The following research articles would help to make the manuscript more professional and sound;

1. Lyu, H.M., et al. (2018). Flooding hazards across Southern China and perspective sustainability measures. Sustainability-Basel, doi: 10.3390/su10051682.
2. Wang, Z.F., et al. (2018). Investigation into geohazards during urbanization process of Xi'an, China. Natural Hazards, doi:10.1007/s11069-018-3280-5.

Clarified: Thanks for recommending the insightful papers, which we have used to strengthen our manuscript. We have added one of them to the reference list, due to the limited number of references (up to 20) allowed in 'Brief Communications'.

Brief communication: Rethinking the 1998 China flood to prepare for a nonstationary future

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Abstract. A mega-flood in 1998 caused tremendous losses in China~~,~~ and triggered major policy adjustments ~~large investments~~ in flood ~~-~~risk management~~ (Bryan et al., 2018)~~. ~~However, rapid urbanization and climate change pose new challenges and it is time to rethink whether China is prepared for the next mega-flood.~~ This paper aims to retrospectively examine these policy adjustments and discuss how China should adapt to newly emerging flood challenges. We show that China suffers annually from floods, despite large-scale investments and policy adjustments. Rapid urbanization and climate change will exacerbate future flood risk in China, with cascading impacts on other countries through global trade networks. ~~In China's fast growing economy, with rapid urbanization~~Therefore, novel flood ~~-~~risk management approaches are required, such as a risk-based urban planning and coordinated water governance systems with public participation, in addition to traditional ~~reinforcing~~ structural protection~~, such as levees. These include a risk-based urban planning and a coordinated water governance system with public participation~~.

1. China's mega-flood in 1998

In 1998, a mega-flood swept through China's major river basins, including the Yangtze, Songhua, Nei, Min, and Pearl Rivers. In the Yangtze and Songhua Rivers, floodwaters exceeded historical maximum heights and overtopped 300 km of dikes, and ~~about~~led to 15,000 dike segments ~~were~~being put in an emergency state~~,~~ and having to be reinforced by 8 million rescuers. Nationwide, the floods affected 186 million people, caused 4,150 deaths, and led to total economic losses of US$ 70 billion (in 2015 US$) (Ministry of Water Resources (MWR), 1999). Whilst the mega-flood of 1998 had particularly severe impacts, the ~~entire~~ 1990s also saw large losses. On average, economic damages from floods in the ~~decade~~1990s were around US$ 40 billion per year, accounting for 2.3~~28~~% of China's GDP (Fig. 1a).

The main drivers of the disastrous 1998 flood are considered to be land use change and poor ~~bad~~ maintenance of levees, as well as ~~apart from the~~ extreme weather conditions (MWR, 1999). With respect to land use change, China extensively exploits its land to feed 21% of the world's population, whilst having only 6% of the world's total water resources and 9% of the world's arable land. This has resulted in a rapid degradation of the forested upper catchments, disrupting the functioning of reservoirs through enhanced peak flows and increased soil erosion. In the middle and lower reaches, wetlands and ~~waterbodies were~~water-bodies have been reclaimed as polders for farmlands or fishponds. As a result, the capacity of wetlands and waterbodies to store and to convey floodwaters has declined. ~~To~~Furthermore, to protect polders against rising floodwaters, lakes and tributaries ~~were~~have been further disconnected from river channels by ~~flood gates~~floodgates. For example, the lake surface area connected to the Yangtze River reduced from 17,198 km^2 in the 1950s to 6,000 km^2 in 1998 — this led to increased flood water levels in 1998 by approximately one meter ~~(Ministry of Water Resources, 1999).~~ (MWR, 1999). This paper aims to retrospectively examine policy adjustments taken following the 1998 floods and discuss how China should adapt to newly emerging flood challenges.

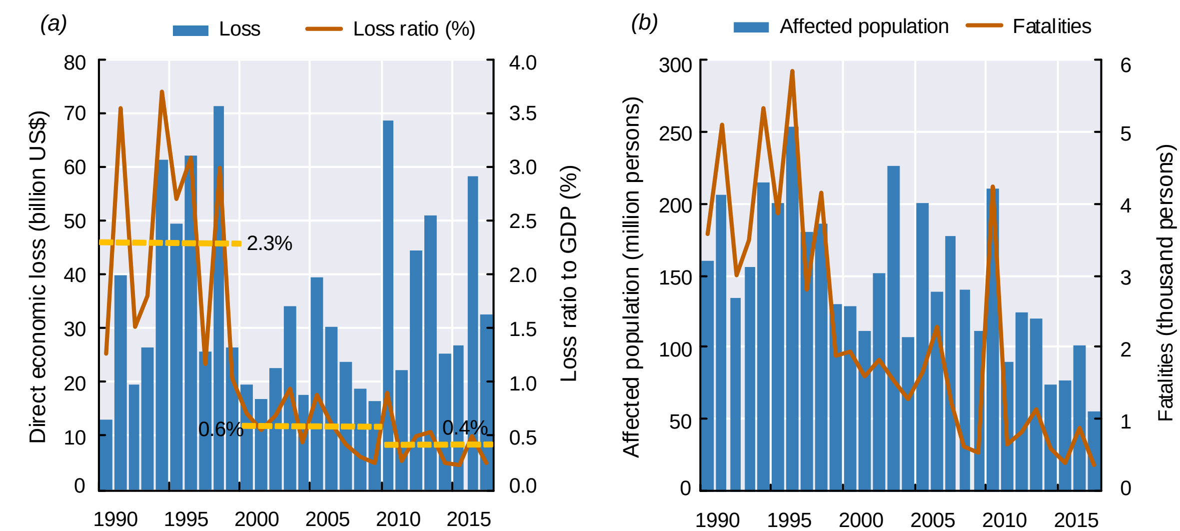


Figure 1 Flood losses (a, in 2015 US$) and flood fatalities (b) in China from 1990–2017 (Data source: MWR, 2017)

2. China's response to the 1998 flood

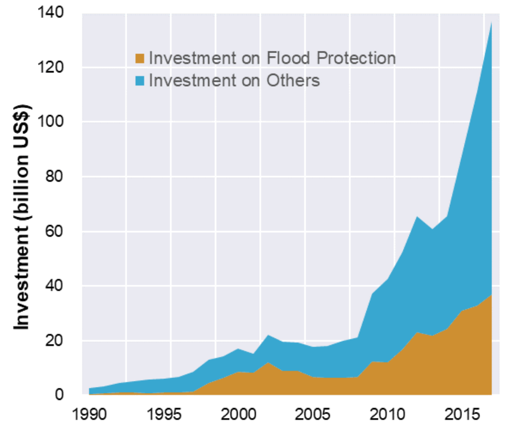
In response to the 1998 mega-flood, China adopted a series of integrated flood management policies, focusing on three major issues: 1) conserving soil and water through forest protection and reforestation; 2) returning reclaimed lands to open waters and wetlands~~,~~; and~~;~~ 3) enhancing both levee and reservoir systems to increase flood protection and control. In the years after the 1998 flood, 16 major sustainability programs were launched (Bryan et al., 2018)~~ were launched. ~~. For instance, the Grain for Green Program (1999–2020) aims to prevent soil erosion and mitigate flooding by converting cropland and wasteland on hillslopes into natural forests and grasslands. The programs related to runoff and erosion invested a total of 114.2 billion US$

~~from~~between 1998–2015, accounting for 32.5% of the total sustainability program investment (Bryan et al., 2018). These efforts reduced soil erosion by 12.9% nationwide~~ with 12.9% between 2000 to 2010, and with,~~ 58.8% in the Yangtze river basin, and 27.0% in the ~~Yangtze and~~ Yellow river ~~basins, respectively~~basin between 2000 and 2010 (Deng et al., 2012). Furthermore, the capacity of wetlands to temporarily store flood waters ~~improved~~increased by 12.7% (Ouyang et al., 2016).

China also required local communities to convert polders into wetland areas and lakes for capturing floodwaters. From 1998~~–~~ to 2002, 1,461 polders were removed and 2.4 million people were relocated elsewhere in the Yangtze River basin. This increased the inland water area by 2,900 km^2 and added a storage capacity of 13 billion m^3 ~~(Ministry of Water Resources, 2015).~~(MWR, 2015). However, efforts to restore and protect open ~~water~~waters, such as lakes and ponds, deteriorated over time~~ (Cheng and Li, 2015),~~, and by 2015 there ~~are~~were still 406 polders in the main channels of Yangtze River and 133 polders in the Dongting- and Poyang lake regions, with a total population of 1.9 million ~~(Ministry of Water Resources, 2015).~~(MWR, 2015). Nationwide, the population living in floodplains increased by 1.1% per year over the period 1990–2015, which is much faster than the population ~~increase~~growth outside floodplains (0.4% per year) (Fang et al., 2018).

The impact of the 1998 floods also led to a new flood protection program~~, and~~. China invested a total of US$ 294 billion on structural ~~technical~~ protection during 1998–2017, accounting for more than a third of ~~the~~ total ~~investment on~~investments in water engineering~~ that~~, which also ~~includes~~include water supply and hydropower generation (Fig. ~~1~~2). As a result, the lengths of the river banks protected by ~~up-to-standard~~well-maintained dikes ~~rose~~increased from 76,532 km in 1998 to 201,124 km in 2016, and~~ the~~ reservoir capacity increased from 493 trillion to 897 trillion m^3 (MWR, 2017) ~~(Ministry of Water Resources, 2017)~~. An ~~For~~ example of the latter is~~,~~ the well-known Three Gorges Dam, which was completed in 2006 and~~,~~ has a capacity of 39.3 billion m^3~~.~~. At Jingzhou, a weak point in the Yangtze river downstream from the dam,~~and increases~~ the protection standard was increased from a 10-year- to a 100-year flood~~ at Jingzhou, a weak point in the Yangtze river downstream from the dam~~ (Mei, 2010).

Finally, China has also made huge efforts to improve evacuation~~, and in~~. In the 2010s, China ~~annually~~ evacuated an average of 9.9 million people per year and called in 10.8 million rescuers for emergencies. For example, 190,000 people were evacuated in Shanghai for Typhoon Anbi on July 22th, 2018.



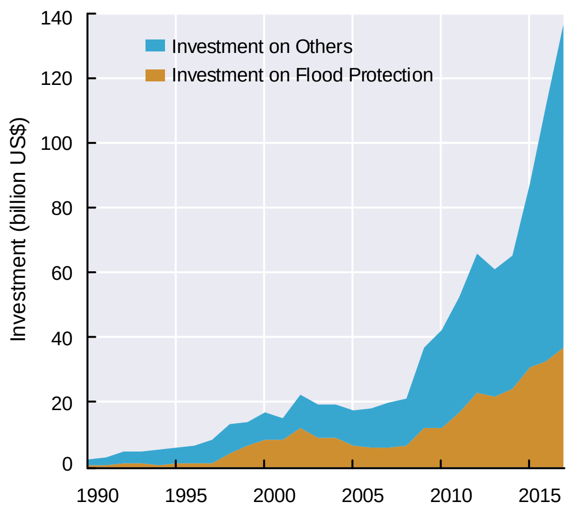


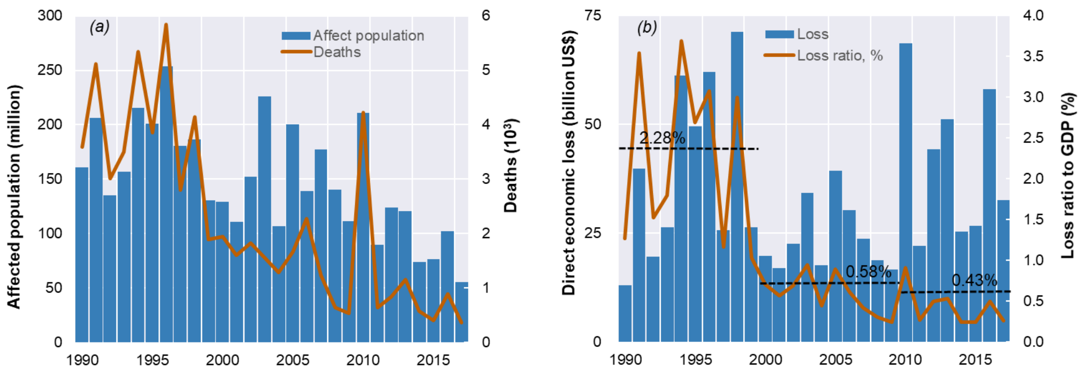
Figure ~~1~~2~~:~~ Investment in flood protection and other water engineering programs (e.g. water supply and hydropower) in China (in 2015 US$; data source: MWR, 2017)

3. Societal effects of response measures after 1998

~~All~~The flood management efforts taken after the 1998 flood initially decreased the annual flood fatalities from 3909 in the 1990s to 1454 in the 2000s, but the number levelled off at 1134 in the 2010s (Fig. ~~2~~1 ~~a~~b). ~~Furthermore, medium~~Medium- and small-size basins ~~are~~ disproportionally ~~suffering~~suffer flood fatalities, with 15,662 deaths in the 2010s (72.6% of the total flood fatalities in China~~).~~) (MWR, 2017). For instance, a local-scale catastrophe in Zhouqu ~~of~~, western China, led to 1765 fatalities on August 8th, 2010, marking 2010 as the worst year since 1998 in terms of flood fatalities.

Furthermore, despite the large investments in flood management ~~investments~~, flood damages reached a new peak during the 2010s~~,~~ (Lyu et al., 2018b), with US$ 41.1 billion per year~~, exceeding~~. This exceeds the long~~-~~-term average annual

~~averages~~damage of US$ 24–39 billion in the 1990–2000s (in 2015 US$; Fig. ~~2b~~1a). While the ratio of economic losses from flooding to GDP ~~dropped~~decreased from 2.3% in the 1990s to 0.6% in the 2000s, and to 0.4% in the 2010s, the current loss ratio (0.4%) is much larger than in ~~developed~~high-income countries (e.g. <0.05% in the USA (Pielke, 2015)). ~~When focusing on flood risk in Chinese cities, F~~Ffloods have annually hit about 157 cities since 2006, and this number is increasing. Flood events in highly urbanized areas have caused large indirect economic ripple effects~~,~~ and there are recent examples of paralyzed cities in China due to flood impacts ~~to~~ on critical infrastructure (Lyu et al., 2018a). In recent years, this has ~~annually~~ interrupted ~40,000 factories per year, affected electricity supply ~20,000 times, and shut down 166 airports and seaports (~~Ministry of Water Resources~~MWR, 2017).



~~**Figure 2:** Flood fatalities (a) and flood losses (b) in China from 1990–2017~~

4. Future challenges to flood management in China

It is expected that future urbanization and climate change will further increase economic flood damage by 263%–331% in the Yangtze ~~River in the year~~river basin from 2010 to 2080 (Winsemius et al., 2016)~~, as compared to 2010 levels.~~. For China as a whole, it is expected that economic production losses from floods will increase more rapidly than other countries (Willner et al., 2018). If the world's second largest economy continues suffering huge flood damages, the impacts could be felt worldwide and may hamper the global economy. During 2016–2035, China is expected to suffer two-thirds of the global direct production losses caused by floods, totalling US$389 billion, which can further propagate an indirect impact of about US$300 billion to other countries through the global trade and supply network~~.~~ (Willner et al., 2018).

Flood management in China, and in particular in urban areas, could be better prepared for these ~~trends.~~future challenges. Urbanization in Chinese floodplains continues to increase, ~~for example~~and 80.0% of China's total population is projected to live in cities by 2050, which represents an increase from 33.5% in 1998 and 55.5% in 2015. Urban land in floodplains has expanded at a rate of ~~20,600~~1,210 km^2/year ~~over the period 1998 and 2015~~between 1998–2015, and is expected to increase by another 16,900 km^2 by 2050 (Du et al., 2018). ~~, and by 2050, it is expected that 80.0% of China's total population will live in~~

~~cities, rising from 55.5% in 2015 (Population Division of United Nations, 2018) — with an additional of 172.8 million people in floodplains (Fang et al., 2018).~~ These numbers will probably be even higher due to the ending of the 'one-child' policy.

Another challenge is to ensure that ~~keep up~~ flood protection standards keep up with the rate~~pace~~ of urbanization and climate change. A survey in 2013 ~~(Cheng and Li, 2015)~~ showed that 50% (or 321) of the 642 Chinese cities did not reach the required flood protection standards~~,~~ and that 44% (or 284) of the cities did not complete or update flood management plans (Fang et al., 2018). This especially holds for cities in the semi-arid north-western part of China, which have a slower economic development~~,~~ and generally ~~have~~ limited flood protection. However, many of those cities are rapidly growing in the floodplains (Du et al., 2018; Fang et al., 2018)~~,~~ and are expected to experience increasing extreme precipitation events (Zhou et al., 2014). The floods in Lanzhou, Ningxia, and Xining in 2017 and 2018 are wakeup calls about rising flood risk in this area.

5. Future adaptation

Novel flood adaptation policies are required to ~~anticipate~~address these (uncertain-) future challenges. Such policies should be based on a well-established and up~~-~~-to~~-~~-date risk assessment, which ~~account~~accounts for future changes in climate and socioeconomic conditions. ~~On~~One component of the new policies could be enhanced flood protection systems, especially in urban areas with high economic values and large exposed populations (Ward et al., 2017). However, structural measures can also release the 'levee effect', further stimulating exposure in protected areas. Hence, additional measures and regulations are required to solve this paradox between urban development and structural protection, to sustain and enhance environmental values, and to reduce flood risk in areas where dikes are not cost-effective.

Integrate flood management into urban planning: The 1998 floods ~~once~~ triggered a large scale conversion of ~~returning~~ farmlands and settlements to wetlands and inland water areas, which was unprecedented in this populous country. However, the awareness gained in the aftermath of the 1998 catastrophe seems to be dissipating over time: ~~as~~ cities are again reclaiming lands from natural floodplains and urban exposure is again rising~~.~~ in vulnerable areas (Lyu et al., 2018b). New spatial planning policies, such as zoning and building codes, could be developed and reinforced to reduce local flood risk, involving households and communities. In addition, the importance of ecosystems and 'nature based solutions' should be increasingly acknowledged in reducing flood risk (Lyu et al., 2018b). For this latter aspect, China has nominated 1,060,000 'river chiefs' ~~by June 2018~~ to protect the natural processes of storing and discharging flood waters~~,~~ from expanding cities ~~(Smith, 2018)~~. Balancing the huge development pressure and restoring spaces for floodwaters is a challenge, but is critical for integrating flood management into urban planning (Opperman et al., 2009).

Strengthen governance and coordination: Another challenge is to improve the development of integrated flood risk management plans and designs, preferably involving all responsible stakeholders ~~(Aerts et al., 2014; Rijke et al., 2012).~~(Aerts et al., 2014). However, flood risk management in China is still characterized by a top-down administration that is divided in different governmental organizations~~ (Kobayashi and Porter, 2012).~~. At national level, for instance, dike design and maintenance is the responsibility of the ~~Ministry of Water Resources (~~MWR~~),~~, wetland protection is managed by the Ministry of Ecology and Environment~~ (MEE),~~, the land use master plan falls within the realm of the Ministry of Land and Resources ~~(MLR),~~, and the urban~~-~~-oriented 'Sponge City' program is coordinated by the Ministry of Housing and Urban-Rural Development~~ (MHURD).~~. In this multi-jurisdiction setting, a new governance structure is needed to effectively coordinate water-soil conservation, wetland protection, dike design, and urban planning for reducing flood risk ~~(Cheng and Li, 2015).~~(Cheng et al., 2018). Such a new governance system should address decentralized governance approaches, involving the heterogeneities of China's communities. Furthermore, attention should be paid to resolve upstream and downstream conflicts~~,~~ and differences in protection levels between urban- and rural areas (Cheng et al., 2018).

Improve information sharing and public participation: Flood risk information for the public is currently scarce in China. Flood hazard maps were produced during 2011–2016, and China plans to invest in high resolution flood information, for example ~~such as~~ from remote sensing. The sharing of flood risk information, as ~~Following the~~ recommended~~ations~~ by ~~of~~ the UNISDR Sendai ~~f~~Framework~~ (Mysiak et al., 2016)~~, ~~flood risk information sharing~~ facilitates public participation and stimulates a "bottom-up" process to raise awareness and promote local action for flood adaptation (Haer et al., 2019). In addition, the information on the cost and benefit of wet/dry flood-proofing buildings and other flood adaptation measures must be improved, to demonstrate what local stakeholders can do themselves in terms of flood adaptation. Public participation can also support policy makers in developing adaptation measures that have support from the public.

Author contribution. All authors contributed to the preparation of this paper.

Competing interests. The authors declare that they have no conflict of interest.

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~~*Author contribution*. Shiqiang Du designed this study and collected the needed information. Shiqiang Du and Jeroen C. J. H. Aerts prepared the manuscript with contributions from all co-authors.~~

~~*Competing interests*. The authors declare that they have no conflict of interest.~~

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