



Coping with exponential increases of pluvial flood risk in urban areas

Arnbjerg-Nielsen, Karsten; Merz, Bruno; Löwe, Roland

Publication date:
2019

Document Version
Version created as part of publication process; publisher's layout; not normally made publicly available

[Link back to DTU Orbit](#)

Citation (APA):
Arnbjerg-Nielsen, K., Merz, B., & Löwe, R. (2019). *Coping with exponential increases of pluvial flood risk in urban areas*. Abstract from International Forum on Engineering Decision Making 2019, Manly, New South Wales, Australia.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Coping with exponential increases of pluvial flood risk in urban areas

Karsten Arnbjerg-Nielsen*, Bruno Merz**, Roland Löwe*

* Technical University of Denmark, Denmark, ** GFZ German Research Center for Geosciences, Potsdam, Germany

Studies on changes in damage arising from climate-related natural hazards indicate that the upward trends of the past decades vanish when the time series are normalized with economic growth in society (e.g. Weinkle et al., 2018). The increase in assets has thus dominated risk changes in the past, and a climate signal could not be detected. However, for the future the expected increases in occurrences and magnitudes of events might lead to much stronger damage increases than that of the economic growth. In the case of urban flood risk it is generally acknowledged that systematic reduction of the risk only occurs shortly after events with significant damages, while risk generally increases during urban development as a result of decreasing awareness over time and subsequent unintended increases of the risk (e.g. Aerts et al., 2018; Merz et al., 2015). All in all, the current paradigm for flood risk management seems to be completely inadequate in order to cope with future challenges.

Feasibility studies of investments in reducing flood risk are generally carried out by cost-benefit analyses comparing the capital costs of investments in increasing infrastructure (or restrictions of different land use) to the benefit of reduction of the expected annual damages over the lifetime of the infrastructure. Intuitively this is the optimal approach, but there are a number of shortcomings:

- The analysis will only be carried out if the awareness of the risk is sufficiently high. However, high awareness seems to require that an event has occurred recently. Hence it is likely that the analyses will not be carried out or the results ignored. Catastrophic events in The Netherlands (1953), New Orleans (2005), and Sendai (2011) showcase that lock-in situation occurs in practice.
- The actual benefits are difficult to project, both because of the inherent uncertainty of projecting future extremes and because of the deep uncertainties in projecting future risks due to city development and societal preferences.
- The analysis may be questioned by decision makers who have to choose between investment options where the alternatives do not suffer from the large uncertainties of projecting future extremes but rather offer immediate returns on, e.g., welfare.

Many scientific fields (aviation, chemical industry etc.) have come far by implementing Safety Management Systems (Li and Guldenmund, 2018) where black boxes are installed that can yield detailed information about individual events and – more importantly – have a structured process for minimizing future risks both locally and globally. The Sendai Framework can be viewed as an attempt of promoting this approach, but with very limited power and vague suggestions.

A case study of exploring efficiencies of different strategies of urban development and the subsequent impact on urban flood risk show that some strategies are efficient over a wide range of scenarios and further highlight that these strategies in particular are efficient in reducing the worst case scenarios. These strategies are however also quite costly and hence not always favourable if assessed in a cost-benefit analysis (Löwe et al., 2017). Based on this and other studies the talk will review how risks from natural hazards in general and urban pluvial risk in particular can be managed in a more sustainable way. A key element is to enable communities to adapt a learning oriented approach to city development as part of flood risk management.

References.

- Aerts, J.C.J.H., Botzen, W.J., Clarke, K.C., Cutter, S.L., Hall, J.W., Merz, B., Michel-Kerjan, E., Mysiak, J., Surminski, S., Kunreuther, H., 2018. Integrating human behaviour dynamics into flood disaster risk assessment. *Nat. Clim. Chang.* 8, 193–199.
- Li, Y., Guldenmund, F.W., 2018. Safety management systems_ A broad overview of the literature. *Saf. Sci.* 103, 94–123.
- Löwe, R., Urlich, C., Sto. Domingo, N., Mark, O., Deletic, A., Arnbjerg-Nielsen, K., 2017. Assessment of urban pluvial flood risk and efficiency of adaptation options through simulations - A new generation of urban planning tools. *J. Hydrol.* 550, 355–367.
- Merz, B., Vorogushyn, S., Lall, U., Viglione, A., Blöschl, G., 2015. Charting unknown waters—On the role of surprise in flood risk assessment and management. *Water Resour. Res.* 51, 6399–6416.
- Weinkle, J., Landsea, C., Collins, D., Musulin, R., Crompton, R.P., Klotzbach, P.J., Pielke, R., 2018. Normalized hurricane damage in the continental United States 1900–2017. *Nat. Sustain.* 1, 808–813.