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Exploring vulnerability to flash floods in a water-scarce MENA city: Challenges and possible solutions

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Jordan is one of the water scarcest regions worldwide, but regularly hit by severe flash floods caused by heavy rainfall events. Such events will likely intensify in future and increase flash flood damages, especially in rapidly developing urban areas. Therefore, flood vulnerability analysis and assessment are urgently needed to improve urban risk management and to protect the local population. To date, however, such analyses in Jordan, as in many other MENA regions, have been hampered by the lack of spatial and temporal high-resolution climate, economic and social data. Furthermore, conducted hydrological analyses have only considered physical parameters in assessing flash flood risk.

Our aim is to investigate the vulnerability in a data scarce urban region and find solutions to overcome the challenges by combining different disciplinary perspectives with local knowledge. Jordan's capital, Amman was selected as study region, which is a prime example of a rapidly growing city in the MENA region.

To analyze and assess the vulnerability of people, infrastructure and ecosystem to flash flood events in a watershed of Amman, a mixed-method approach was applied within a transdisciplinary research project called CapTain Rain (Capture and retain heavy rainfall in Jordan). To gain insights into flash flood risks, we explore the vulnerability dimensions exposure and sensitivity from the hydrological, hydraulic and social perspectives, and the adaptive capacity of the local population. For the assessment of each vulnerability dimension, different physical, social and ecological indicators were used. Several indicators, such as damage potential, were adapted to local conditions based on focus group discussions with Jordanian stakeholders.

The vulnerability dimensions exposure, sensitivity and adaptive capacity were assessed for the current situation and several possible scenarios with changing future conditions in climate (intensity of rainfall) and land cover (urbanization trends). As one sensitivity indicator the damage potential was analyzed. The resulting damage potential map shows e.g. the locations of critical infrastructure, and also includes the word heritage sites, which were identified as vulnerable infrastructure of high importance by the Jordanian stakeholders. Regarding future scenarios our

first hydrological and hydraulic modelling results show that a moderate climate change of 20% more intense rainfall has a stronger influence compared to land cover changes. Land cover changes with more sealed surfaces have little influence on the runoff caused by the low infiltration capacity of soils in the area according to the available data.

Through interdisciplinary collaboration and local stakeholder engagement, this work demonstrates a noteworthy strategy to addressing flash flood risks in situations where data is limited. The results of the integrated scenario analysis and vulnerability assessment serve as a decision-support tool for urban planning.