Describing concurrent flood hazards in a risk assessment decision framework using a bayesian network methodology

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Abstract
Sewage is a mirror of society. In sewage-based epidemiology, scientists analyse sewage samples to retrieve information, for example to estimate illicit drug consumption at the community level. This research field was, and still is, driven by analytical chemists. With this article, we demonstrate that there is ample opportunity of fascinating research in this field for both urban drainage experts and environmental engineers. Their expertise in pollutant dynamics and sewer properties is important to update sampling and characterise catchments. Together with sewage treatment plant and sewer operators, they can provide valuable meta-information for a meaningful interpretation of data and a realistic quantification of methodological uncertainty. We present a unique time series on daily cocaine loads to illustrate pollutant dynamics related to illicit drugs and their implication on the design of monitoring campaigns. Additionally, we highlight why it is important to obtain estimates and associated uncertainties for (i) total daily sewage volumes, (ii) the number of people contributing to a sample and (iii) assessing transformation of targeted substances in sewers. The truly transdisciplinary field of sewage-based epidemiology will develop in the future and expand from illicit drugs to assess numerous other aspects of public health.

Keywords
Sewage-based epidemiology, monitoring design, reducing overall uncertainty

Risk Management Analysis

2491284

Robust Cost-Benefit Analysis to Assess Urban Flood Risk Management: A Case Study on Ho Chi Minh City

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Abstract
Ho Chi Minh City (HCMC), a fast-growing city located in the lowlands of South Vietnam, experienced record high flood levels in recent years. As HCMC accounts for 23% of the national GDP, increasing HCMC's level of protection against flooding is of vital importance. Many flood risk mitigation strategies have been proposed to protect HCMC. This paper describes a cost-benefit analysis of a selection of these strategies, including a probabilistic risk analysis and a robustness analysis. Probabilistic modelling has been applied in addition to regular hydraulic modelling to provide reliable flood maps of HCMC and to provide input for the flood risk estimation. In the cost-benefit analysis, flood risk reduction is considered as the main benefit of the strategy investment. To test the robustness of a flood risk mitigation strategy, a sensitivity analysis has been carried out to obtain insight into the impact of a number of uncertainties on the outcome of the Cost-Benefit Analysis (CBA). With this HCMC case, we demonstrate a successful application of a framework for robust Cost-Benefit Analysis in urban flood risk management taking into account future uncertainty ranging from climate change, sea level rise and land subsidence to investment costs, phasing of the investment and macroeconomic growth.

Keywords
Urban flood risk management, depth-damage function, cost-benefit analysis, robustness

2517610

Describing Concurrent Flood Hazards in a Risk Assessment Decision Framework Using a Bayesian Network Methodology

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Abstract
In this study we outline a risk-based decision-making framework for flood management purposes using a Bayesian network methodology. Flood risk assessments are often based on single hazard events. We acknowledge that with a changing climate, flood risk assessments need to be extended to consider several hazards and their possible simultaneous occurrence. Further, we argue that there is a need to include additional drivers of extreme events into a risk assessment in order to obtain a robust description of the occurrence of these events. It is widely accepted that large-scale weather systems influence local climate, and this addition to a risk assessment can ensure a more complete description of different flood inducing events. In our case study we focused on describing how our Bayesian method can assess the probability of concurrent events. We analysed high sea water level and precipitation events and used different threshold combinations of these hazards to assess the daily probability of concurrent events in Aarhus—the second largest city in Denmark. The results were validated though comparison of observed concurrent events in Aarhus. We showed that there was a clear variation in seasonal probabilities of concurrent events and distinguish weather systems with high probability of concurrent events.

Keywords
Bayesian influence diagram, Lamb weather classification, flood risk assessment

2528985

Risk Governance in the Water Sensitive City: Diverse Systems, Diversified Risk and Practitioners' Trust

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Abstract
In the water sensitive city, a hybrid mix of centralised and decentralised water systems and sources will operate at a range of scales to provide fit-for-purpose water services that will safeguard environmental quality, intergenerational equity and landscape amenity. Governance of these systems is likely to differ from the traditional arrangement, involving multiple stakeholders who must work together to manage risk. Trust will be essential to effective governance. This study explored attitudes of Australian urban water practitioners towards ownership and management of different water systems that might comprise the water sensitive city, including who they would trust to manage the associated risk. Results support the status quo, in which risk management responsibilities lie with state and local government or corporatised water utilities. Although practitioners support ownership and management of lot-scale water systems by homeowners, they trust them only to manage the risks associated with rainwater tanks. These results can be interpreted as risk perceptions, which are influenced