Extreme precipitation in a future climate-assessing climate factors at sub-daily scales from regional climate model projections

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Climate Change Impact on Dhaka's Urban Drainage System—Case Study of Kallyanpur System

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Abstract
A MIKE Urban model has been used to study potential climate change impacts and effectiveness of various adaptation options on the Kallyanpur area of Dhaka. The Kallyanpur system is located in the western part of Dhaka, which represents the typical drainage problems found in the city. This 27.8 km^2 urbanised area relies on a pumped drainage system during the monsoon.

Simulation of a 341 mm/24 hour event in 2050 socio-economic and drainage conditions found that additional improvements are required to satisfy a set drainage criteria of 90% of administrative areas to be free from maximum flooding of >0.25 m depth and no area should have flooding of >12 hours duration. The improvement measures included deepening of selected retention ponds, laying of new drainage pipes and increasing several drainage pump capacities. Then the storm was intensified for 2050 A1FI scenario to see the impact on the improved drainage system. It was found that adaptation measures were required to reduce the flooding extent and duration to acceptable limits. The adaptation measures included increasing of drainage pump capacities. The next step of the study will be to conduct cost and benefit analyses of the structural measures and analyse institutional issues and soft adaptation measures.

Keywords
Urban flooding, extreme rainfall events, Dhaka, A2 scenario, adaptation measures

2518324

Extreme Precipitation in a Future Climate—Assessing Climate Factors at Sub-daily Scales From Regional Climate Model Projections

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Abstract
The anticipated increase in extreme precipitation is expected to be one of the most important impacts of climate change in Danish cities. Hence, guidelines on how these changes can be incorporated in urban design practice are required. This paper compiles all the new information available on climate projections at sub-daily scales and re-evaluates the current guidelines. The information compiled includes three statistical downscaling methods, an ensemble of regional climate models (RCMs) and four different emission scenarios. This study highlights that a relatively large amount of the data available is not suited to the needs of urban drainage design. Therefore, statistical downscaling methods that can accommodate these needs are necessary. The three statistical downscaling methods used here agree on an expected increase of extreme precipitation at both sub-daily and daily scales. However, the changes estimated are subject to large uncertainties, mainly arising from the RCMs and emission scenarios. To account for the uncertainties, both mean and high climate factors are provided in the new guidelines. This study discusses the difficulty of an objective selection of recommended changes and emphasises the need of expert knowledge to combine all the information and account for uncertainties.

Keywords
Climate change, extreme precipitation, sub-daily, RCM, statistical downscaling

2518352

Selection of Predictors for Statistical Downscaling Using Wavelet Techniques

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Abstract
Selection of predictors for statistical downscaling is crucial as the relationship between the predictors (temperature, humidity and geopotential height) and predictands (local scale meteorological variables such as rainfall) forms the basis of statistical downscaling. While selection of predictors based on correlation analysis is common for statistical downscaling, the traditional correlation analysis has limited ability for interpreting non-stationary and non-linear relationships. Wavelet coherence analysis can be used for identifying the strength of the relationship between two time series for both the time and frequency domains simultaneously.

In this study a methodology has been developed to identify the potential predictors for statistical downscaling using continuous wavelet transforms (CWT) and square wavelet coherence (WTC). First CWT was used to identify the dominant periodicity in the predictand series and then the predictors were selected by examining the WTC between the predictors and predictands for that dominant periodicity. Scale average wavelet coherency (SAC) was found to be useful for selecting the predictor domain. It was also observed that CWT is useful for identifying the predictors for which the predictor-predictand relationship is nearly stationary over a long period, which is an important criteria for predictor selection. For a case study, monthly rainfall from nine rainfall stations in the Onkaparinga catchment in South Australia was considered as the predictands whereas NCEP/NCAR reanalysis variables were considered as the predictors. Overall, the methodology introduced in this study could be applied for selecting potential predictors for statistical downscaling of hydro-climatic variables.

Keywords
Statistical downscaling, predictor-predictand relationship, continuous wavelet transforms, square wavelet coherence

2518554

Combined Effects of High Water Level and Precipitation on Flooding of Gothenburg, Sweden

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