CRC for
Water Sensitive Cities

Program B: Water Sensitive Urbanism | Project B1.1 | Project duration: July 2012-December 2014

Cities as water supply catchments – Urban rainfall in a changing climate

Overview

Throughout its history, Australia has faced a highly variable natural climate with extreme weather events such as droughts, floods and bush fires. A changing climate will likely exacerbate this situation in terms of frequency and intensity of events and place more stress on communities, infrastructure, food production and ecosystems. This will also mean that the performance of stormwater treatment and harvesting systems as part of a sustainable urban water management system may be impacted heavily. Resilience to a changing climate, i.e. the ability to perform well under a variety of different scenarios, is therefore a necessary component of any infrastructure development, particularly one that seeks to harvest rainfall. With that comes the need to better understand rainfall patterns and develop enhanced tools for rainfall projections at the scale relevant to the design of stormwater systems. In particular, it is necessary to include a quantitative prediction of the uncertainties in the projections so that the systems can be designed to match our true knowledge of rainfall changes.

This project aims to develop a comprehensive model to simulate probable rainfall in Adelaide, Brisbane, Melbourne and Sydney at a small enough scale (~ 2 kilometres) that would reliably support rigorous design of stormwater treatment and harvesting systems. The project also aims to provide reliable quantitative estimates of the uncertainties in such projections.

Key outcomes

This model is the first of its kind that combines statistical information from historical weather radar observations on local rainfall distribution with dynamical information of larger-scale weather patterns. The project will deliver an insight into what the current most important large-scale weather conditions for rainfall in the chosen cities are, how well global and regional climate models are able to simulate these conditions, and how these large-scale weather patterns will change with climate change. This information will then feed a comprehensive statistical model of the space-time distribution of rainfall at small scales to provide the information needed to model the stormwater system performance.

This model will help urban planners and designers in government and industry better predict future rainfall in Australian cities to ensure that new or alternative urban stormwater management systems are environmentally and economically resilient to the uncertainties and extremes of a changing climate.

Key findings on weather regimes

A key innovation in the approach developed in this project is the use of weather regimes when deciding on model parameters. Each of the major Australian cities has a unique set of regimes associated with its rainfall with different rainfall amounts and different spatial patterns of rainfall. Figure 1 (over page) illustrates this for Melbourne. Once the days with no rain at all in the Melbourne area (about 40% of all days) are removed, five main rainfall patterns emerge.

It ranges from widespread light rainfall (left, 71% of all rain days) to widespread heavy rainfall (right, 1.5% of all rain days) with medium amounts of various spatial distributions in-between (middle 3 panels). The mountains and hills to the east and southwest of Melbourne are a prominent feature in several of the rainfall patterns. Each of the five patterns corresponds to a different meteorological situation, a fact that will be exploited when determining this "weather state" from climate models.

An Australian Government Initiative

CRC AUSTRALIA

Project design

The central theme of this research project is to provide high-resolution projections of future rainfall for Adelaide, Brisbane, Melbourne and Sydney together with reliable estimates of the uncertainty in these projections. To achieve this the project quantifies the range of uncertainty in the climate simulations of rainfall over Australia using a range of currently available models, and then uses this information to drive a statistical model of the space-time distribution of rainfall at a city- and suburb-scale. To do so more reliably the key weather regimes for each city are identified and the capabilities of current climate models to simulate these regimes are evaluated. Models that pass the test will be selected.

Their simulations of changes in key weather regimes in future climates will provide the foundation for the small-scale rainfall projection tool that results in a large ensemble of projected rainfall for each of the cities selected. The ensemble of possible outcomes provides not only the most likely rainfall change, but also contains the full range of uncertainty, enabling different decision-making approaches. As predictions will cover the entire city area, users can choose which part of the city to consider selecting areas as small as 2x2 square kilometres.

Outlook

The project will be completed by the end of 2014 when the model developed to assess all future rainfall scenarios for the end of 2014 when all future rainfall scenarios for Adelaide, Brisbane, Melbourne and Sydney will be made available to the CRC for Water Sensitive Cities.

The project team is working with national and state governments and other agencies that deliver climate scenarios in Australia, such as the Bureau of Meteorology, to discuss the possible adoption of the model in their future programs and activities.

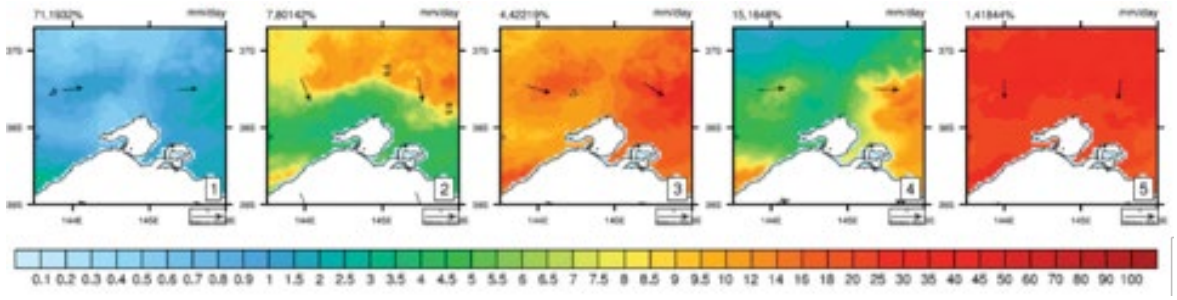

Figure 1. The five main rainfall patterns for Melbourne.

About the Cooperative Research Centre for Water Sensitive Cities

The Cooperative Research Centre for Water Sensitive Cities (CRCWSC) brings together interdisciplinary research expertise and thought-leadership from Australia and the world to address current urban water management challenges facing our cities and regions. In collaboration with over 80 research, government and industry partners, it develops and synthesises knowledge into powerful tools and influences key players aiming to achieve sustainable, resilient and liveable water sensitive cities.

Further information

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