A COMPARISON OF ALTERNATIVE TECHNIQUES FOR DERIVING EXTREME RAINFALL STATISTICS IN THE CONTEXT OF CLIMATE CHANGE

ONTARIO CLIMATE CONSORTIUM

Project Update Briefing

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Research Purpose

The overall goal of this study is to develop information on the level of uncertainty associated with future intensity-duration-frequency (IDF) curves so practitioners can determine how data should, or should not, be used in design and management applications under a changing climate. More specifically, this study compares how the selection of different global climate models and downscaling techniques influences future IDF statistics in two study areas in Ontario: The Greater Toronto Area (GTA) and Essex Region.

Context

In Ontario, rainfall IDF statistics are used extensively in the hydrologic design of drainage and other forms of public infrastructure, and in studies of riverine flooding and flood risk. Given the anticipated impacts of climate change on extreme rainfall, there is a great deal of interest by municipalities, conservation authorities, provincial agencies, infrastructure proponents, and risk managers in developing future extreme rainfall statistics that reflect anticipated future climate conditions, so that these can be reflected in design and analysis.

There are a number of methods for applying climate model output to derive future extreme rainfall statistics, known as IDF curves. Within the existing literature on this topic, different studies have used varying combinations of global climate models, downscaling techniques, spatial and temporal scales, emission scenarios and curve-fitting methods. There are however, a number of challenges involved in the derivation of future IDF statistics. Chief among these is the fact that current climate modelling techniques do not natively produce short-term, localized rainfall output that can be reliably used to derive IDF statistics at a temporal resolution greater than one day. Even at the daily interval, there are many assumptions that climatologists must make in interpreting GCM output, for example the threshold used for delineated dry versus wet days. Downscaling of climate model output is thus required, which may be done using a variety of approaches, all of which require assumptions to be made that add additional uncertainty to the process.

The result of past work deriving IDF statistics has been divergent or inconsistent results among future IDF datasets, even for the same study area, making it difficult for practitioners to use this information in the design of infrastructure and management programs in the context of climate change. This raises the question as to how the level of uncertainty associated with future IDF curves influences their use in infrastructure design and risk management in the context of climate change adaptation.

Project Background

As interest and experience in using future IDF curves has grown, questions on the use of this information have grown within the climatology, hydrology and water resource communities. Some of these questions include:

[see over…]

- Given the non-stationarity associated with climate change, but the reliance on a normal period to generate IDF statistics, is this a valid approach to extreme rainfall risk management?[1]
- Since climate models have been shown to poorly represent local-scale extreme precipitation, how should such data be used in future IDF curve derivation?

As a result of these discussions, in January 2014, the project partners decided to take a first step in addressing these questions through this collaborative project.

Project Tasks, Deliverables and Timelines

Task 1	**Literature Review and Selection of IDF Curve Generation Techniques for Comparison** **Deliverable 1:** Spreadsheet summarizing techniques reviewed and selected	✓
Task 2	**Observed Dataset Collection, Processing, and Analysis of Statistical Distributions** **Deliverable 2:** Summary report on identified historical distributions and data gaps	✓
Task 3	**Application of Selected Techniques Using Future Climate Datasets** **Deliverable 3:** Summary report on comparative validation results	✓
Task 4	**Compile Results and Prepare Draft Final Report** **Deliverable 4:** Draft final Report	✓
Task 5	**Conduct Peer-Review; Revise Draft Report; Prepare and Share Final Report** **Deliverable 5:** Final Project Report	**In progress**

Future Climate Datasets

The project will compare the following future climate datasets and downscaling techniques: (A) bias correction and delta change downscaling (B) CRCM3-CGCM3, CanRCM4-CanESM2, HRM3-HadCM3 regional climate models and (C) HadGEM2-ES and MIROC-ESM global circulation models.

Project Participants and Funders

The project is being coordinated by the OCC and led by TRCA and ERCA with funding support from the County of Essex, the Towns of Amherstburg, Essex, Kingsville, LaSalle, Tecumseh, the Cities of Windsor, Toronto and the Regions of Peel and York. The two Principal Investigators are Dr. Paulin Coulibaly from McMaster University and Dr. Donald Burn from the University of Waterloo.

Key Audiences (Users)

Practitioners interested in future extreme rainfall statistics and risk management. Over the last several months, the project has been discussed at several forums, including the Municipal Stormwater Group and the Ontario Climate Advisory Committee. Through this consultation, we hope the project can be used to help inform guidance on extreme rainfall risk management and infrastructure design in Ontario.

Contact

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[1] See: Galloway, G E. 2011. "If Stationarity is Dead, What Do We Do Now?" *J. of Amer. Water Res. Ass.* 47, 563–570.
Milly, P C D et al. 2008. "Stationarity Is Dead : Whither Water Management?" *Science* 319, 573–574 (2008).