COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY

Project 5.2
National Data Bank of Stochastic Climate and Streamflow Models

Project Objectives

One of the major gaps identified by industry and researchers is the need to quantify the uncertainty in hydrologic systems caused by climatic variability. This project aims to develop a robust set of stochastic models for the generation of climate and streamflow data anywhere in Australia at different time scales.

Expected Outcomes

- An agreed protocol for testing algorithms for stochastic data generation of climate and streamflow
- Algorithms for stochastically generating point daily rainfall and other climate variables for any location in Australia
- A suite of computer programs for generating point or spatial climate and streamflow data that can be easily applied by practitioners on a personal computer

Target problems

Australia's climatic variability imposes uncertainty in hydrologic systems, whether the systems are complex water resources projects, or simple planning models of catchment behaviour. For very simple systems analytical techniques of estimating uncertainty may suffice but for the majority of the problems one has to resort to system simulation using stochastically generated data.

What is stochastic data? Stochastic data are random numbers that are modified so that they have the same characteristics (in terms of mean, variance, etc and auto-correlation structure) as the data set on which they are based. For example, in 1954 Frank Barnes of the then Melbourne Metropolitan Board of Works generated 1000 years of stochastic (or synthetic) annual streamflows for the Upper Yarra Dam investigation. He did this by assuming the annual flows were independent and normally distributed and used a table of random numbers to generate the long time series. This was the first occasion in Australia in which stochastic data were used in hydrologic investigation.

Even though there are a number of stochastic models available in the literature, most of them have not been adequately tested with regard to characteristics at different time scales or at a number of locations with different climates. For instance, a proper daily model should preserve the monthly and annual characteristics in addition to preserving the daily characteristics. Moreover, estimation of the parameters for the models is not a trivial task.

Research Plan

Following a one-day workshop with stakeholders to select the range of rainfall and other climatic variables to be modelled, a literature review will be undertaken of recent Australian and overseas research on point stochastic climate models, and on the application of Bayesian analysis to quantify uncertainties in model parameters. This review will short-list the most promising daily time-step climate models.

The Cooperative Research Centre for Catchment Hydrology is a cooperative venture formed under the Commonwealth CRC Program between:

- Brisbane City Council
- Bureau of Meteorology
- CSIRO Land and Water
- Department of Land and Water Conservation, NSW
- Department of Natural Resources, Qld
- Department of Natural Resources and Environment, Vic
- Goulburn-Murray Water
- Griffith University
- Melbourne Water
- Monash University
- Murray-Darling Basin Commission
- Southern Rural Water
- The University of Melbourne
- Wimmera Mallee Water

Associates:

- Hydro-Electric Corporation, Tas
- SA Water
- State Forests of NSW

The selected models will be tested against historical data using a suitable protocol and then developed further for about 20 sites distributed across Australia. A Bayesian framework will be used to derive posterior probability distributions for the model parameters. The outcome from this step will be a model for the generation of daily rainfall and climate data.

This model would then be run for about 300 sites around Australia to assess performance, and it will be refined if necessary. The parameters would be regionalised and finally, using independent data for a number of locations, the interpolated parameter sets would be tested.

Key Research Tasks - 2000-2003

- Assess priorities for the climatic variables to be modelled
- Review literature for point stochastic climate models and test selected models
- Select and further develop a daily model and test for about 20 sites throughout Australia
- Incorporate a Bayesian framework and test over about 300 sites
- Regionalise models and test against independent data

Linkages

The generated stochastic data are fundamental inputs to the following CRC for Catchment Hydrology projects:

- Project 1.1 Development of a catchment modelling toolkit
- Project 2.3 Predicting the effects of land use changes on catchment water yield and stream salinity (particularly for the Murrumbidgee catchment)
- Project 4.1 Stormwater pollutant sources, pathways, and impacts

In addition the stochastic data will be of value to projects involving water allocation modelling.

End users and Stakeholders

The primary end users requiring the output from this project are the principal researchers in CRC for Catchment Hydrology Projects 1.1, 2.3, and 4.1. It is also envisaged that potential users will be the resource agencies and their staff, and environmental /water engineering consultants.

Staff Involved

Project Leader	Prof. Tom McMahon (The University of Melbourne)
Researchers	Dr Sri Srikanthan (Bureau of Meteorology) Dr Francis Chiew (The University of Melbourne) Dr Rob Vertessy (CSIRO Land and Water)

Participating Organisations

Bureau of Meteorology • CSIRO Land and Water • The University of Melbourne

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