Project 5.1
Modelling and Forecasting Hydroclimate Variables in Space and Time

Project Objectives

In Australia, the management of land and water resources is compounded by the high variability of rainfall and streamflow. This project aims to reduce management uncertainty by developing space-time rainfall models for Australia, and methods for forecasting rainfall and streamflow several hours to several months ahead.

Expected Outcomes

- Computer software for a space-time rainfall model and a statistical method for forecasting seasonal streamflow
- Improved representation of surface hydrology in numerical weather prediction models leading to more accurate forecasts of rainfall and other climate variables up to several days
- A suite of approaches for forecasting rainfall and streamflow several hours to several months ahead

Target problems

The management of land and water resources in Australia involves designing and operating to cope with the high variability of the climate. The ability to forecast climate and streamflow days to months ahead would be invaluable.

The consideration of spatial and temporal characteristics of rainfall has become increasingly important in hydrological modelling. The use of spatial and temporal rainfall data compared to a lumped catchment-average rainfall will allow a better representation of surface hydrology and runoff generation processes. The use of space-time rainfall models will also lead to a more realistic estimation of design storm and flood, and areal reduction factors for rainfall.

Research Plan

The short-term rainfall forecast model (up to several hours ahead) will be based on a multiplicative cascade space-time rainfall model and the standard approach of observing the detailed rainfield (using a radar) and propagating the rainfield forward in time.

The Australian Bureau of Meteorology, like most national weather services, operates a suite of numerical weather prediction (NWP) models. The Bureau's global model is run twice daily and provides forecast of up to eight days, while its regional mesoscale model which has a horizontal grid spacing of 12.5 km provides forecast up to 36 hours. This project will attempt to improve the surface hydrology in the NWP models so that the models can give more accurate weather forecasts.

This project will also develop statistical methods for forecasting seasonal streamflow from the serial correlation in streamflow and the teleconnection between streamflow and indicators of El Nino/Southern Oscillation. Accurate forecasts of rainfall and streamflow several months ahead will benefit agricultural and resource management and allow decisions on irrigation and environmental water allocation to be more realistically based.

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

Key Research Tasks - 2000-2003

- Develop models for characterising the spatial and temporal properties of rainstorms for various climate regions of Australia
- Develop 'now-casting' models for forecasting spatial rainfall up to several hours ahead
- Assess the sensitivity of numerical weather prediction models to surface hydrology and improve the representation of surface hydrology in numerical weather prediction models
- Develop downscaling techniques that relate large-scale atmospheric variables in climate models to local scale variables (e.g., catchment rainfall)
- Develop statistical methods for forecasting seasonal rainfall and streamflow
- Assess the benefits and risks of using seasonal forecasts in the management of water resources system

Linkages

- Computer software for the space-time rainfall model and seasonal streamflow forecast model will be developed by software engineers in CRC Project 1.1 (Development of a catchment modelling toolkit)
- The research on improving surface hydrology in numerical weather prediction models is strongly linked to CRC Project 1.2 (Scaling procedures to support process-based modelling at large scales) with some shared resources
- The space-time rainfall models will be used in CRC Project 5.2 (National data bank of stochastic climate and streamflow models) to stochastically generate spatial rainfall data
- Various studies in this project are carried out collaboratively with researchers in other Australian organisations (University of Western Australia, CSIRO Atmospheric Research, Queensland Centre for Climate Applications) and overseas (USA, New Zealand, South Africa, Canada, France)

End users and Stakeholders

Researchers involved in large-scale hydrological model and scaling studies, and practitioners requiring spatial and temporal storm characteristics for design purposes will use the space-time rainfall models. The improved surface hydrology models will be incorporated into the Bureau of Meteorology's numerical weather prediction schemes to give more accurate weather forecasts.

The main users of the seasonal rainfall and streamflow forecast models are agricultural and water agencies and consultants involved in the management of land and water resources. The short-term rainfall forecast models will be used by various agencies to improve flood forecasting.

Staff Involved

Project Leader	Dr Francis Chiew (The University of Melbourne)
Researchers	Research Fellow (Bureau of Meteorology Research Centre) Dr Alan Seed (Bureau of Meteorology) Dr Andrew Western (The University of Melbourne) Dr Beth Ebert (Bureau of Meteorology Research Centre) Dr Bryson Bates (CSIRO Land and Water) Dr Graham Mills (Bureau of Meteorology Research Centre) Prof. Tom McMahon (The University of Melbourne)

Participating Organisations

Bureau of Meteorology • CSIRO Land and Water • Department of Natural Resources, Qld • Department of Land and Water Conservation, NSW • Goulburn-Murray Water • The University of Melbourne

For Further Information: Dr. Francis Chiew Cooperative Research Centre for Catchment Hydrology
Department of Civil and Environmental Engineering, The University of Melbourne, Victoria, 3010
Tel: 03 8344 6641 • Fax: 03 8344 6215 • Email: f.chiew@civag.unimelb.edu.au

www.catchment.crc.org.au/climatevariability