PREDICTING CATCHMENT BEHAVIOUR

COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY

Project 1.2
Scaling Procedures to Support Process-Based Modelling at Large Scales

Project Objectives

A major difficulty in trying to develop large-scale hydrological models for forecasting precipitation, run-off and water yield is our current inability to integrate the effects of small-scale variability, both in space and time, into such models. This project aims to develop efficient algorithms, which can represent such effects.

Expected Outcomes

The outcomes will be significant improvements in the confidence land and water managers can have in simulations of large-scale hydrological response. The algorithms developed in this project will better represent spatial and temporal variability that is important but presently ignored in catchment modelling. The methods developed will pave the way for realistic large-scale hydrology and contaminant movement models that can be used by management without the over-simplification used in existing approaches. Our work will also assist in improving the numerical weather prediction models that are capable of high spatial resolution (in the order of km).

Target problems

A fundamental problem with advanced large-scale models is the difficulty in transferring algorithms that represent small-scale processes to a larger scale. This difficulty results from two inter-related sources: small-scale spatial and temporal variability, and the limited length and time scales associated with what are generally non-linear processes, particularly runoff and associated processes. These can affect fluxes (interactions) across model element boundaries, either directly or indirectly, but they cannot be explicitly represented in models if they are occurring within one element or timestep.

Research Plan

There are two potential solutions to this difficulty. One is to increase the spatial and temporal resolution of the model until everything is represented explicitly. This is not viable due to the potentially enormous computational demands as well as the lack of high resolution information.

The alternative is to develop algorithms to represent such variability which are efficient but compatible with the large scale models. This is the only tractable option for truly large scale and long term modelling.

The challenge therefore is to develop flux predictions that integrate the small-scale effects in the most appropriate way, based on an understanding of dominant processes.

While the approaches developed will be generic, we will work in the first instance with CRC for Catchment Hydrology Project 5.1 (Modelling and forecasting hydroclimate variables in space and time) and Project 2.3 (Prediction of water yield from large multi-use catchments) to develop methods applicable to those modelling problems. As the methods develop, they will be extended for broader application

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

- Review international literature related to the effects of scale on processes; the characteristics of spatial and temporal variability in process controls; and algorithms for parameterising the sub-element and sub-timestep variability of these process controls
- Undertake analysis of existing spatial data sets to establish the basic forms of functions for parameterising the sub-element, and sub-timestep variability for application to modelling in Projects 5.1 and 2.3
- Develop methods for determining the parameters for the most appropriate sub-element and sub-timestep representations from relatively easily obtainable data
- Develop guidelines for application of the functions that represent sub-element and sub-timestep variability to assist modellers in deciding when such representations are necessary – i.e. guidance as to when such variability will be an important influence on hydrological response and when it can be ignored without loss of accuracy

Linkages

Project 1.2 is formulated around close linkages with CRC for Catchment Hydrology Projects 5.1, 2.3(and ultimately 1.1) and will be providing methods that are essential for model development in those Projects. In doing so, we will develop general approaches that will be suitable for other modelling within and outside the CRC.

End users and stakeholders

In the first instance, the users of the methods developed in this project will be modellers working in Projects 5.1 and 2.3, but as the methods are developed further, we expect that most of the large scale modelling within the CRC will be able to utilise the outcomes.

Staff Involved

Project Leader	A/Prof. Rodger Grayson (The University of Melbourne)
Researchers	Dr. Andrew Western (The University of Melbourne) Dr. Senlin Zhou (The University of Melbourne) Dr. Lu Zhang (CSIRO Land and Water) Dr. Graham Mills (Bureau of Meteorology) Dr. Alan Seed (Bureau of Meteorology) Mr David Wilson (The University of Melbourne) Dr. Ross Woods (National Institute for Water and Atmospheric Research, New Zealand) A/Prof. Günter Blöschl (Technical University of Vienna)

Participating Organisations

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

For Further Information: A/Prof. Rodger Grayson Cooperative Research Centre for Catchment Hydrology
Department of Civil and Environmental Engineering, The University of Melbourne, Victoria 3010
Tel: 03 8344 6641 • Mob: 0417 054 660 • Fax: 03 8344 6215 • Email: R.Grayson@civag.unimelb.edu.au

www.catchment.crc.org.au/catchmentprediction