NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 124 FEBRUARY 2004

A NOTE FROM THE DIRECTOR

Professor Rob Vertessy

Inside...

A MOST SATISFYING START TO 2004

Welcome to another year of *Catchword* and thanks for tuning into the work of the CRC for Catchment Hydrology. I'm writing this article in the foyer of the ICT Building at The University of Melbourne where our Centre is running the 2004 Catchment Modelling School (CMS). It's the opening day of our two-week offering of courses (February 9-20) and there is a tremendous buzz in the air. Over 300 people have registered for one or more of the 31 workshops being offered at the CMS. In all, more than 500 course places have been booked. Most of the workshop participants are from the consulting industry and various land and water management agencies. Here there is clear evidence of the Australian land and water industry expressing a demand for catchment modelling tools. There is even a contingent of seventeen scientists from the Korean Sustainable Water Resources Research Centre, one of our Research Affiliates.

Those in the foyer may not realise it, but a mountain of effort has preceded this workshop. At the foundation of the CMS have been our research teams who have developed the many catchment modelling software products on offer here. All of these teams have been toiling for years but they have worked particularly furiously these last few months to get the software up to scratch, and to complete user documentation and course notes. Some groups external to our CRC have had their shoulders to the wheel also, making this a genuine industry-wide effort. Layered on top of this has been a massive logistic effort, conducted in-house under the leadership of David Perry, our Communication and Adoption Program Leader. David's team has planned, marketed and coordinated the entire event, with distinction.

So, what's going on? Why is that we are getting more than 60 of our staff and colleagues from affiliated agencies to give up so many days, nights and weekends to present this set of workshops? The answer is that the CMS is one of our prime communication and adoption pathways to realise our mission: 'To deliver to resource managers the capability to assess the hydrologic impact of land-use and water-management decisions at whole-of-catchment scale'. Getting catchment modelling tools into the hands of those who need to use them is what we are all about.

The Catchment Modelling School is a necessary complement to our other big communication and adoption initiative: The Catchment Modelling Toolkit. This on-line repository of modelling software is now accessible on the web (see www.toolkit.net.au) and growing by the day. Most of the models presented at the CMS are now on the site or will soon be added. However, irrespective of the merit of these tools, they will be of limited benefit until there is a well-trained workforce capable of using them. That's why the Catchment Modelling School is so important.

On this first day of the CMS, five concurrent workshops are running, equipping participants with the skills to:

- design urban stormwater treatment trains (using MUSIC)
- determine environmental flow requirements in rivers (using RAP)
- detect trends in hydrologic time series data (using TREND)
- plan water allocations in large river systems (using IQQM)
- simulate river flow profiles (using HEC-RAS)

That's a great start and indicative of the variety and power of what is on offer throughout the duration of the CMS. I'm confident that the Catchment Modelling School will make a valuable contribution to skills development in the Australian land and water management industry. It is our expectation that this will become an annual event and stimulate on-going use and further development of the Catchment Modelling Toolkit.

Rob Vertessy
Tel: (02) 6246 5790
Email: rob.vertessy@csiro.au

COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY

NEW TECHNICAL REPORT

The Effect of Afforestation on Flow Duration Curves

By

Patrick Lane
Alice Best
Klaus Hickel
Lu Zhang

Technical Report 03/13

This report is part of a series that bridges the gap between the science of catchment water balances and the management of rivers for a range of outcomes by considering the impact of afforestation on flow distribution throughout the year.

Printed and bound copies of this report are available from the Centre Office for $27.50. Contact Virginia Verrelli on 03 9905 2704 or email crcch@eng.monash.edu.au

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PROGRAM 1

PREDICTING CATCHMENT BEHAVIOUR

Program Leader GEOFF PODGER

Developing a Decision Support Framework for the Mekong River Basin

Introduction

Apart from my duties with the CRC for Catchment Hydrology and Department of Infrastructure Planning and Natural Resources, I have also been involved in a large international consultancy to develop a Decision Support Framework (DSF) for the Mekong River Commission Secretariat (MRCS). The consultancy is led by Halcrow and includes a consortium of consultants from Australia and South East Asia. The project is funded by World Bank and commenced nearly two years ago and is currently nearing completion. I am talking about this project as there are many similarities to what the CRC for Catchment Hydrology is planning to achieve to fulfil its mission statement.

Mekong River Basin

The Mekong River basin starts in China in the Himalayas. It is a narrow long catchment that opens out as it reaches the border between China, Myanmar, Laos and Thailand. The river initially forms the border between Thailand and Laos. The river runs initially S.E. and takes a turn to the east around Vientiane, the capital of Laos. It then turns S.E. again towards Cambodia where it runs through the capital Phnom Penh. At Phnom Penh it heads in three directions, towards Ton Le Sap lake and bifurcates into two rivers that run towards the Vietnam border. In Vietnam the River brakes into a delta that covers a large proportion of southern Vietnam and finally flows into the South China Sea. See Figure 1.1.

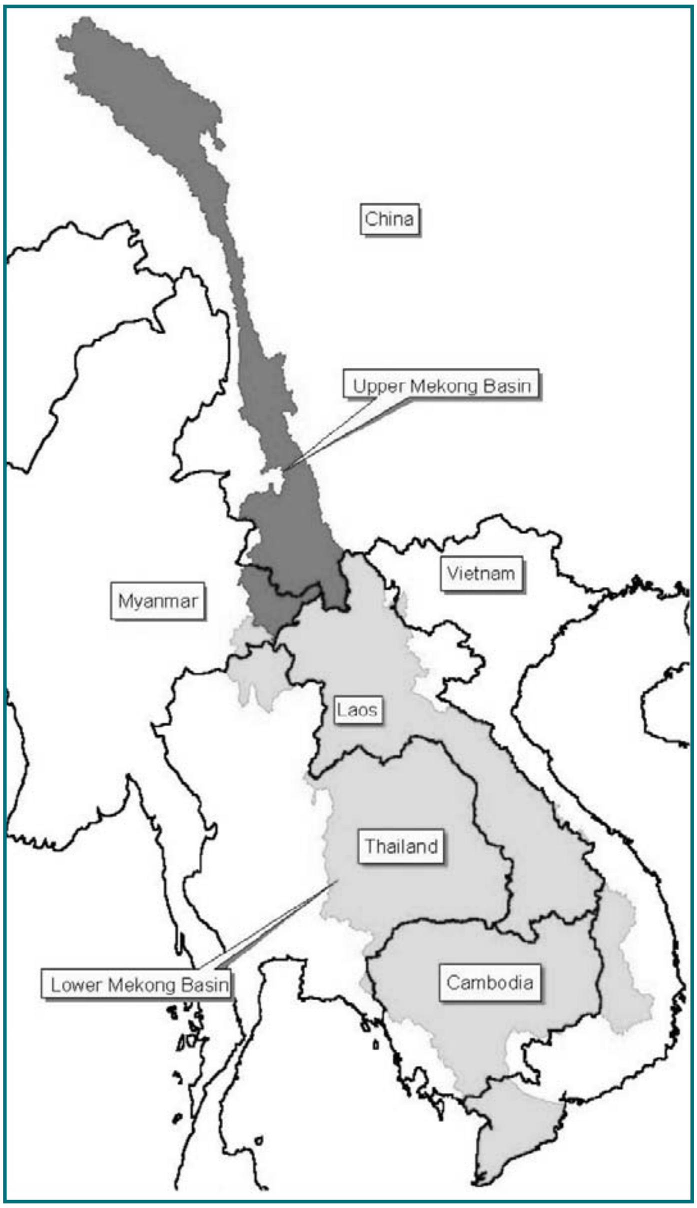

Figure 1.1 Mekong River Basin

Area being modelled

The area that is being modelled by the DSF is from the Chinese border to the South China Sea, which is the area within the jurisdiction of the MRCS. The climate is monsoonal with the wet season covering the period May to September. The average annual river flow is 460,000 GL, this is considerably more than any river in Australia. One of the major features of the system is Ton Le Sap lake that fills during the wet season and then maintains flows to the Delta during the dry season. The reversal of flow in the lake occurs around December each year, and is celebrated by the Cambodian water festival.

Purpose of decision support framework

The DSF is being developed to support decision making as part of the Basin Development Plan (BDP). Countries of the Lower Mekong Basin are cooperating to extract maximum benefit from the water resources of the Mekong with minimum adverse effects.

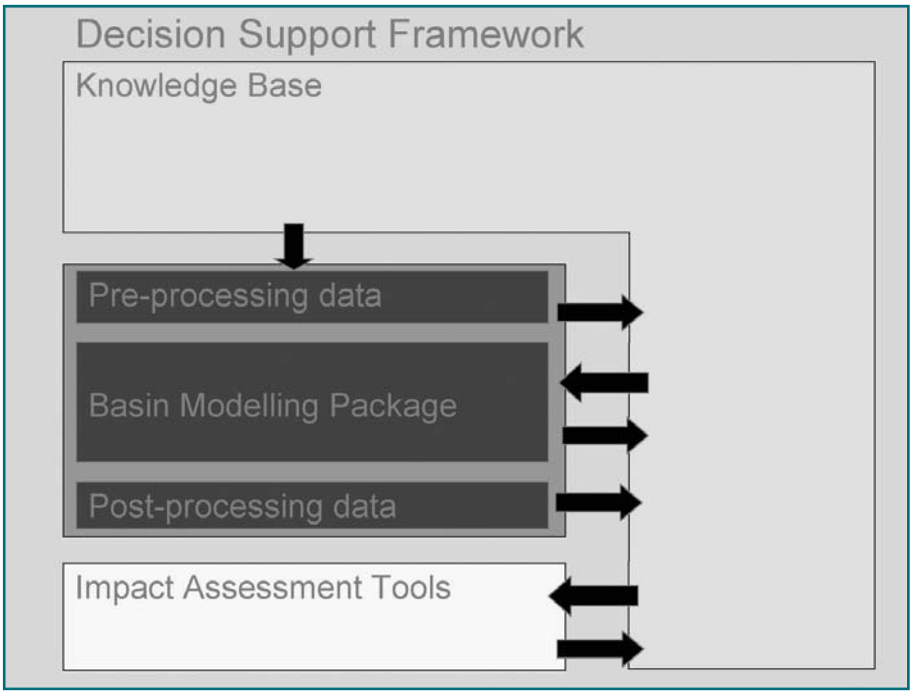

Figure 1.2 Structure of the Decision Support Framework

Decisions about regional development options concern balancing:

- resource use for development, with maintaining ecological balance,
- resource use in different sectors, and
- development needs of different countries,

Drivers of water use include both population and economic growth. Key sectors are the environment, fish production, hydropower production, irrigation development and navigation.

Building the decision support framework – design brief

The design brief for the DSF was to develop a basin modelling package to support decision making for basin planning and management, by assessing environmental and socio-economic impacts of development options, and helping formulate, test and monitor "Rules". It was also to provide a Knowledge Base, integrating existing databases with the Basin Modelling Package. A further aim was to promote sustainable modelling capability within the riparian countries

The design of the DSF, as shown in Figure 1.2, combines together a knowledge base, models and impact assessment tools. The knowledge base contains times-series flow and climate data, as well as spatial data including cadastral, land use, soils and flood inundation maps. The models include the catchment model Soil Water Assessment Tool (SWAT), the river basin planning model IQQM and the 1-d hydraulic model iSIS. The impact assessment tools were purpose built to investigate various flow metrics, spell analysis and flood inundation. The impact assessment tools were tied to various ecological indicators. The interface between all of these tools and the user interface is the purpose built DSF software.

SWAT model calibration & IQQM

The SWAT model was setup and calibrated for 112 catchments that cover the region between China and the Vietnamese border. IQQM was implemented as a river basin model from the Chinese border to Kratie in northern Cambodia. The IQQM comprises some 800 nodes that model irrigation, town water supply demand and hydropower generation. IQQM also determines irrigation demand for downstream of Kratie, including all of the Mekong Delta. The river downstream of Kratie was modelled using the iSIS hydraulic model that contains over 8000 nodes. The total area of irrigation modelled for the year 2000 is 2,093,800 ha in the dry season and 5,337,700 in the wet season.

The SWAT/IQQM models were calibrated and runs for a 16 year period from 1985 to 2000. The iSIS model is calibrated and runs for two one year periods that represent dry and wet climatic sequences.

The calibration criteria for this project are quite difficult to meet with poor rainfall, evaporation and flow data. For the SWAT/IQQM model volume matches of 5% were achieved on the tributaries and 1% on the main stream. Flow duration curves were matched with 2% on the mainstream and 10% on the tributaries. This is an exceptional result given the data that was available.

FOREST MANAGEMENT WORKSHOP, CANBERRA

23-25 March 2004

The CRC for Catchment Hydrology, along with the University of New South Wales, Forest Science Centre and New South Wales State Forests presents the Forest Management Workshop on 23-25 March 2004.

The aim of the meeting is to bring together scientists and forest managers to discuss recent developments in the understanding of forest catchment behaviour and management.

Presentations will be held on the 23 and 25 March 2004 and a field excursion will be organised for the 24 March 2004. The field excursion will visit the burnt forest area at the western side of Canberra and plantation forestry sites of NSW State Forests near Tumut.

The workshop is based around four key themes:

- Forest Hydrology
- Sediment Delivery and Water Quality
- Fire Management
- Sustainable Forestry

PLEASE NOTE:
The registration date has been extended to Friday 12 March 2004

For further information visit www.catchment.crc.org.au/news or see page 23 of this issue of Catchword.

Subsequent to completing the calibration of these models example scenarios were configured to show the models capability to model:

- climate change
- land use change
- irrigation development
- increased hydro power development in both China and the Lower Mekong Basin, and flood embankments.

Conclusion

Due to much hard work and effort by a lot of people the DSF is in the final review stages before final signoff. This is a unique, state of the art tool that will allow the MRCS to develop new rules and policies that will shape the direction of flow management with the basin. It will allow member countries to realise the impact of development on others.

The CRC for Catchment Hydrology can learn a lot from this project, as it embarks on its development of the whole of catchment model over the next year. There are a lot of synergies between this project and what we are trying to achieve and there is a lot that we can learn from this and other projects throughout the world. This knowledge in combination with what we already know is going to help us build a tool that will hopefully be adopted by resource managers throughout Australia.

Geoff Podger
Tel: (02) 9895 7480
Email: geoff.podger@dipnr.nsw.gov.au

NEW TECHNICAL REPORT

The Impact of Rainfall Seasonality on Mean Annual Water Balance in Catchments with Different Land Cover

By
Klaus Hickel
Lu Zhang

Technical Report 03/11

Our understanding of catchment hydrology is approaching the point where we can confidently predict the partitioning of rainfall and how it changes when we change the land use. This report describes some of the research that supports this important development. By enabling the consideration of seasonality, it enables more confidence in our prediction of how catchment hydrology changes when land use changes.

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PROGRAM 2

LAND-USE IMPACTS ON RIVERS

Program Leader
PETER WALLBRINK

Report by Peter Hairsine and Peter Wallbrink

Supporting the Revegetation of Australia

Background

Approximately 50 million hectares of woody vegetation has been cleared from the Australian continent since the first arrival of Europeans in the late 1700's. In recent decades there has been a major public debate about the continued practice of reducing woody vegetation on farmlands culminating in several states adopting new legislation and regulation to prevent or reduce land clearing.

Revegetation Programs

In parallel with this debate several major programs have been put in place by the Commonwealth and State governments as well as community groups to restore woody vegetation in Australia's landscapes. The Landcare movement, catchment groups and entities including Greening Australia have led to significant revegetation of land previously cleared as a part of agricultural development. Locally several thousands of hectares of vegetation have been restored in many catchments across the country due in part to the efforts of these organisations. Features of such revegetation programs are:

- They rely on small grants
- They frequently target key parts of the landscape including riparian zones
- They use, in part, voluntary resources
- They focus on revegetation with multiple species

Size of the task

If a small fraction of the original woody vegetation is to be restored then the task for these groups is massive and consequently very long term. The magnitude of the task can be further assessed by the recent statement from the MDBC that "an objective of establishing 1.5 million hectares of targeted woody vegetation by the year 2050" is appropriate.

Market-based approaches

In recent years there has been much interest in market-based solutions to accelerate the rate of revegetation in Australia. The Bushtender trials in Victoria and the Environmental Services Scheme in New South Wales are two examples of such mechanisms currently in operation. These schemes serve to accelerate the uptake of public funded revegetation activities while targeting the areas with public-good return. While these schemes may revolutionise the way publicly-funded, land management change is administered, the areas changed in the coming decades will be very small when compared with the goals necessary to achieve sustainability.

Plantation forestry

Plantation forestry is another path of establishing new woody vegetation in the landscape. In Australia major plantation growing programs began in Australia in the 1960s, and there are now more than 1.6 million hectares of plantations. Around 61% of these are softwood (pine), the remainder are hardwoods. The great majority of these plantations have been established in high rainfall (>800 mm mean annual rainfall) zones and consequently, they have not normally been in localities with major land and water degradation issues. In recent years, plantation managers are increasingly looking to lower rainfall zones for new forests. There is now a widespread recognition that forestry on farms will play a major role in revegetating rural landscapes. Farm forestry has the potential to become Australia's most sustainable primary industry, according to Greening Australia's CEO, Carl Binning.

The private forestry industry is in a major period of growth. The 'Plantations 2020 Vision' was initiated jointly by governments and the forestry industry in 1997. It aims to enhance regional wealth creation and international competitiveness by trebling the area of commercial tree crops by 2020 and is on track to achieving this goal. The challenge for catchment managers is to harness new plantations on sites where they result in multi-benefits for the economy and environment. (See the Commercial and Environmental Forestry website at http://www.ffp.csiro.au/cef/).

Challenges for revegetation

Australia's catchments are faced with enormous challenges many of which can be addressed through revegetation. On a national scale there a few universal features of strategies to address the issue of revegetation:

1. Land clearing and revegetation should be tackled in a combined approach.
2. New plantings must be well located to gain the best return from the effort expended.

NEW TECHNICAL REPORT

Changes in Flood Flows, Saturated Area and Salinity Associated with Forest Clearing for Agriculture

By
Richard Silberstein

Technical Report 03/1

This report presents results of an investigation into the connection between stream flow and the rise of watertables following clearing, and their fall after reafforestation. The main focus is to identify as well as possible the relationship between high flows and saturated area. While there remains work to be done to completely fulfil the aims of the project, a number of key results are reported.

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MDBC-CSIRO-CRC TECHNICAL REPORT SERIES

Impact of Increased Recharge on Groundwater Discharge: Development and Application of a Simplified Function using Catchment Parameters.

By

Mat Gilfedder
Chris Smitt
Warrick Dawes
Cuan Petheram
Mirko Stauffacher
Glen Walker

Technical Report 03/6

This report describes the development of a simple approach towards estimating the response of groundwater systems to changes in recharge that arise from changes in land-use. The emergent properties of a groundwater system are examined using scaling arguments, by combining the effect of aquifer properties into a single dimensionless groundwater system similarity parameter (G).

This report is available as an Adobe .pdf file only.

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3. New plantings must address multiple issues including salinity management, sediment and nutrient movement, carbon sequestration, and biodiversity considerations

4. New plantings must meet needs of a range of stakeholders – (public and private)

CRC support for revegetation

The CRC for Catchment Hydrology's projects provide technical support for several aspects of the future revegetation issue. Across the programs we provide a multi-issue spatial capability of assessing proposed planting and clearing scenarios on catchment behaviour. Our models and expertise enable the structuring of the environmental consequences of land use change. For example, in Program 2:

Project 2.20 (2B) provides a catchment wide understanding of the impact of revegetation upon the movement of sediment and nutrient from land surfaces, gullies and streambanks into streams and then through stream networks to reservoirs and the sea. This project thus provides some parts of the ability to relate on ground action to end of valley targets.

Project 2.21 (2C) has the expertise to predict the consequences of revegetation on stream salinity and the loads of salt carried by our rivers. This prediction includes the effect of differing climates, soils and groundwater systems and includes the lags from revegetation to the response in streams.

Project 2.22 (2D) specifically focuses on the role of riparian zones in protecting streams from the in flows of nutrients, with a focus on nitrogen. This project contributes especially to the spatial targeting of planting in this key part of landscapes.

Finally, project 2.23 (2E) enables assessment of the consequences of changing the type of vegetation on streamflow in our catchments. The increase of perennial woody vegetation will reduce streamflows. This project quantifies this effect by predicting changes of mean annual flow and the flow duration curves at a catchment's exit.

Should you have questions about these issues please contact the following people:

Peter Wallbrink - Tel: (02) 6246 5823,
Email: peter.wallbrink@csiro.au

Scott Wilkinson - Project 2B Tel: (02) 6246 5774,
Email: scott.wilkinson@csiro.au

Mark Littleboy - Project 2C Tel: (02) 6246 5787,
Email: mark.littleboy@csiro.au

Heather Hunter - Project 2D Tel: (07) 3896 9637,
Email: heather.hunter@nrm.qld.gov.au

Lu Zhang - Project 2E Tel: (02) 6246 5802,
Email: lu.zhang@csiro.au

Peter Hairsine
Tel: (02) 6246 5924
Email: peter.hairsine@csiro.au

Peter Wallbrink
Tel: (02) 6246 5823
Email: peter.wallbrink@csiro.au

PROGRAM 3

SUSTAINABLE WATER ALLOCATION

Program Leader
JOHN TISDELL

Using Water Pricing and On-farm Storages to Restore Environmental Flow Regimes

Water demands and natural flow regimes

The timing of extractive demand for water is often at odds with the natural flow regime in rivers. This problem is likely to be exacerbated by water trading. Modelled outcomes to trade suggest that water will move to its most profitable use. In doing so it will concentrate water use on specific crops at specific locations and watering times, thus moving the flow patterns of rivers further from natural flow regimes.

Economic options

There are a number of economic instrument options for restoring environmental flow regimes in river systems. Instruments currently under consideration include buy-back schemes, establishing environmental traders in the Murray Darling, and modifications to water tariff structures. While there has been much discussion on buy-back schemes and environmental traders in Australia, to date there has been limited discussion on the use of water pricing instruments.

Water pricing approaches

The notion underpinning the use of water pricing instruments is to establish a tariff structure for water extraction that would encourage farmers to change the timing of water orders more akin with that of the natural flow. As an example, in its simplest form such a tariff structure may impose higher prices for water in periods where extractive demand exceeds the natural flow regime and lower prices in periods when the demand for water is lower than the natural flow regime. Response to such a tariff structure, however, could be marginal unless the differential is significant enough to stimulate changes in cropping patterns and development of new practices. Given the significant lead-time necessary for major changes in cropping, this would be a long-term strategy.

On-farm storage issues

In catchments where on-farm storages are common, such pricing strategies could be effective in the short term without significant changes to cropping regimes. Through the tariff structure farmers could be encouraged to extract water out of sequence with their cropping requirement and store it on-farm. The tariff structures would need to be constructed such that the cost of water plus storage is less than the cost of direct extraction at times of crop need. In regions where there is significant capacity for on-farm storage of water in any case, a tariff-based policy may be need to be complemented by caps or timed storage extraction limits, simular to those used currently in the extraction of high flow water, in order to further spread the extraction of water and its use on farm.

In catchments where on-farm storage is possible, but not common, questions concerning possible subsidy schemes that may encourage construction of such storages may arise. Providing subsidies to farmers to encourage them to construct on-farm storages for this purpose may be controversial. It could be argued that subsiding on-farm storages is necessary to resolve this national problem. Others may argue that it adds private value to the landholders whose history of extraction caused the problem. Those who have already constructed storages and born the full cost may also feel such a scheme unjust. These issues would need to be played out in the political arena.

Work ahead

Designing elegant water tariff structures and developing on-farm storage policies in principle show great promise for resolving conflict between extractive and environmental demands in our rivers and streams. Over the next few months a number of such policy instruments will be evaluated in the experimental economics laboratory at Griffith University.

John Tisdell
Tel: (07) 3875 5291
Email: j.tisdell@griffith.edu.au

NEW TECHNICAL REPORT

Enhancement of the Water Market Reform Process: A Socioeconomic Analysis of Guidelines and Procedures for Trading in Mature Water Markets.

By
John Tisdell

Technical Report 03/10

This report summarises the main findings of a broad survey of the literature and current government policy on water reform, an extensive survey of irrigator and community attitudes to water reform across the three rural focus catchments of the CRC for Catchment Hydrology and the development and implementation of experimental methods to water management; its auctioning and self governance.

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MDBC-CSIRO-CRC TECHNICAL REPORT SERIES

Testing In-Class Variability of Groundwater Systems: Local Upland Systems.

By

Cuan Petheram
Chris Smitt
Glen Walker
Mat Gilfedder

Technical Report 03/8

This report assesses the extent information can be transferred between hydrogeologically similar catchments, by investigating in detail one set of similar catchments.

Assessment of Salinity Management Options for Kyeamba Creek, New South Wales: Data Analysis and Groundwater Modelling.

By

Richard Cresswell
Warrick Dawes
Greg Summerell
Geoff Beale
Narendra Tuteja
Glen Walker

Technical Report 03/9

This report describes a study of the hydrogeological factors influencing salinity in the Kyeamba catchment, located within the uplands of the Lachlan Fold Belt of south-eastern Australia.

These reports are available as Adobe .pdf files only.

Visit www.catchment.crc.org.au/publications and search under 'Land-use Impacts on Rivers'

PROGRAM 4 | Program Leader TIM FLETCHER

URBAN STORMWATER QUALITY

Report by Anne Rodriguez, Ana Deletic, Tim Fletcher

Calibration of MUSIC for Vegetated Swales

Summary

This project has focussed on verifying and improving MUSIC (Model for Urban Stormwater Improvement Conceptualisation) for modelling grass swales. To test MUSIC for a large number of different cases, the deterministic model of sediment behaviour in grass, named TRAVA, was used. TRAVA was initially verified for Australian conditions, using field data gathered on a swale in Brisbane. The model predicted outflows from the Brisbane swale to within 4% accuracy, and TSS removal to within 9% accuracy for medium flows. Subsequently, TRAVA was run for nine hypothetical sites, all with different soil and grass conditions. Results on TSS removal were produced for three flow rates at each site. The results from these runs were then used for calibration of a first-order kinetic decay model used in MUSIC (known as the k-C* model). It was found that the soil-type of the swale (especially soil permeability) had a negligible effect on k-C*. As grass surface depressions density and hydraulic roughness increased (causing more surface retention and less runoff), there was a decrease in k and an increase in C*. k and C* values both increased as a function of the flow rate. This study resulted in recommendations for the k-C* values for typical grass and soil conditions.

Introduction

The TRAVA model (Deletic, 2001) simulates two main processes – generation of runoff and sediment transport over grassed surfaces. It is a complex deterministic model that was developed for modelling sediment removal in non-submerged grass, and so far has been verified for a filter strip in Aberdeen. The inputs required are the intensity of rainfall and upstream flow into the swale, plus a range of physical parameters relating to soil, surface and sediment conditions. The output shows the overall reduction in water and sediment runoff. MUSIC (CRC for Catchment Hydrology, 2002) has a much broader scope, as it models the catchment as a whole, covering many different types of stormwater treatment measures. MUSIC simplifies all chemical, physical and biological processes into a single first-order kinetic decay equation given below

$$(C_{out} - C^*)/ (C_{in} - C^*) = e^{-k/q}$$

where C^* = background concentration (mg/L), C_{in} = input concentration (mg/L), C_{out} = output concentration (mg/L), k = (decay) rate constant (m/yr), and Q = hydraulic loading (m/a).

Due to a lack of empirical research conducted on swales, the current approach to approximating k and C* values is inexact. For a swale, the assumed values of k-C* are k = 15 000 m/yr and C* = 30 mg/L.

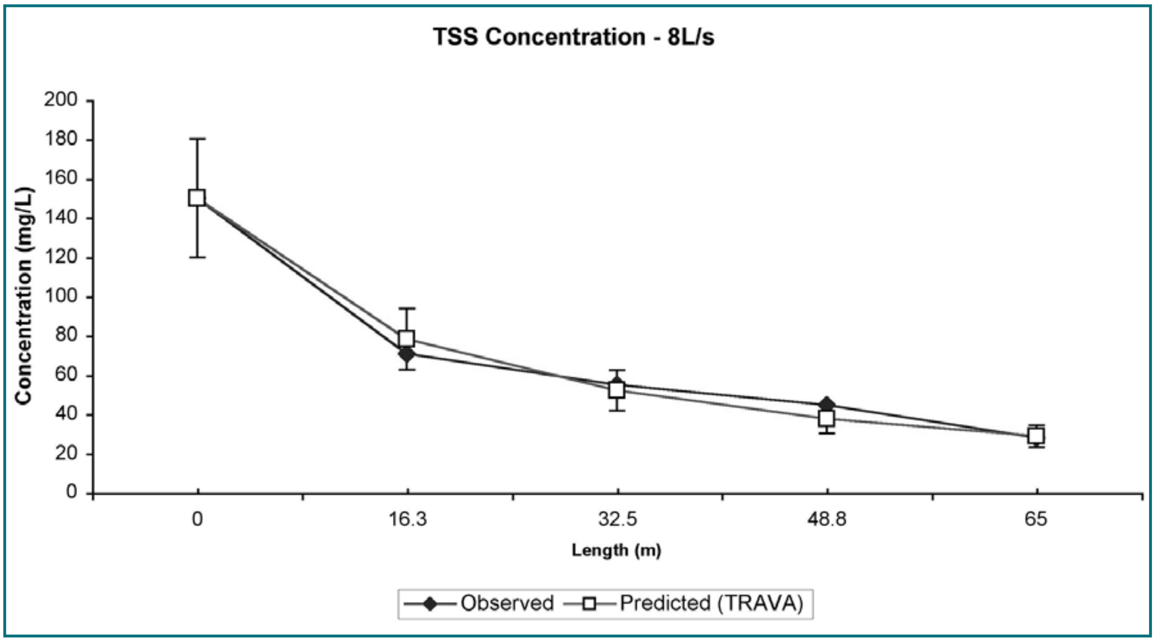

Figure 4.1: Concentration vs. Distance for 8 l/s

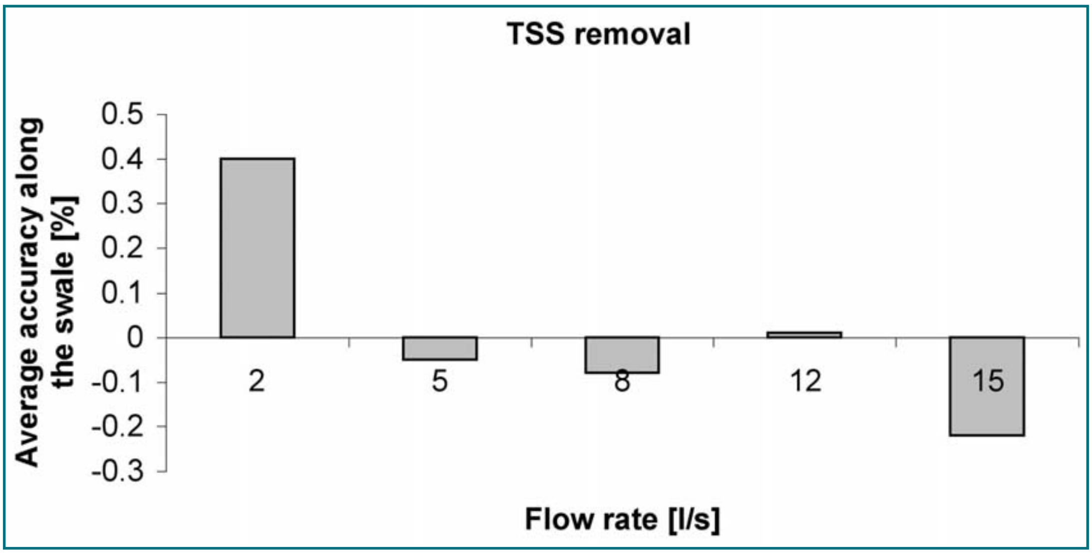

Figure 4.2: Accuracy of TRAVA for Predicting Brisbane Swale Data

Verification of TRAVA

The field data used in this project are based on experiments conducted by Brisbane City Council and the CRC for Catchment Hydrology in Brisbane. The experimental swale was 65m long, with a top width of 4m. Sampling points were located every 16.25 metres a long the swale. A constant-head tank provided steady flows ranging from 2 L/s to 15 L/s (Fletcher, 2001; Fletcher *et al.*, 2001). Due to the difficulty of measuring soil permeability, K, TRAVA had to be calibrated for K until the results on flow rate matched the measured data. The second part of the process involved calibrating TRAVA to match the measured concentration values. The main variable parameter affecting pollutant removal in TRAVA is the grass density, expressed as open flow width, B_0.

TRAVA was successfully calibrated for K = 5.5×10^{-7} m/s; the predicted outflows were within 4% of measured values. The accuracy for predicting TSS removal varied little for changing B0 values. It was finally found that B_0 = 0.80 yields the least average error over the five flow rates. For example the observed and modelled values for an experiment conducted with flow rate = 8 l/s is presented in Figure 4.1.

Figure 4.2 presents the accuracy of TRAVA for all experiments. It overestimated TSS concentration levels for 2 l/s. This was probably due to errors in measuring field data for a small amount of sediment. TRAVA also underestimated the concentration level of pollutants for a 15 l/s flow. This could be attributed to TRAVA assuming that the grass was not submerged, and therefore simulating more filtration than was actually the case (the 15 L/s flow rate actually had an average flow height of 9 centimetres, leaving grass in most of the flow path fully submerged).

The sample point at 16.25m is consistently the least accurate point, the result of inadequate mixing. The final sample point at 65m is the most accurate. For the final point, water was funnelled into a container, mixed and measured, allowing for an even distribution of sediment. For the points along the swale, a sample was taken directly from flowing water, making it difficult to obtain a sample of water with evenly dispersed sediment. This may explain why the sample taken at 65m is generally the most accurate.

MUSIC Calibration

The TRAVA model incorporates a number of variable parameters, relating to the soil, surface (grass) and sediment type. In this project only properties of the soil and surface were varied. Soil parameters are hydraulic conductivity (K), and water saturation content ($\_{r}$). An increase in these parameters causes more infiltration. Grass parameters are the surface retention, grass density and Manning's roughness coefficient. Surface retention (yd) is the average depth of depressions in the surface. Grass density (B_0) is the unblocked width of the grass cross section per unit width. Manning's coefficient (n) measures the roughness of the grass. As values of the grass surface parameters increase, the amount of runoff decreases, since more of the water will be retained.

TRAVA was run for 3 types of soils and 3 types of grass surfaces, with the parameters specified as in Table 4.1. In total, 9 different combinations of soil/grass were assigned to the 65-metres long swale (as the Brisbane swale). For each combination of parameters TRAVA was

NEW TECHNICAL REPORT

Non-Structural Stormwater Quality Best Management Practices - Guidelines for Monitoring and Evaluation

By

André Taylor
Tony Wong

Technical Report 03/14

This report presents a new evaluation framework and guidance for measuring the effects and life-cycle costs of non-structural BMPs. This framework defines seven different styles of evaluation to suit the needs and budgets of a variety of stakeholders involved with stormwater management.

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URBAN STORMWATER SOFTWARE

Model for Urban Stormwater Improvement Conceptualisation (MUSIC) version 2

MUSIC is a decision-support system. The software enables users to evaluate conceptual designs of stormwater management systems to ensure they are appropriate for their catchments. By simulating the performance of stormwater quality improvement measures, music determines if proposed systems can meet specified water quality objectives.

MUSIC Version 2 is available as a free evalution version download from the Catchment Modelling Toolkit website at www.toolkit.net.au/music

The MUSIC evaluation version allows you to trial the MUSIC software for 6 weeks. During that period you are able to purchase the MUSIC software for $330. Discounts apply if you a current MUSIC version 1 user.

For further information visit the MUSIC web site at www.toolkit.net.au/music

Please note: You must be a registered Catchment Modelling Toolkit member to download the MUSIC evaluation version.

Table 4.1: Parameter Combinations for K-C Calibration*

	Low	Medium	High
Soil	–$_s$ = 0.53	–$_s$ = 0.48	–$_s$ = 0.4
(Infiltration)	K = 10^{-8} m/s	K = 10^{-6}m/s	K = 10^{-4} m/s
Grass/Surface	n = 0.1	n = 0.35	n = 0.65
(Density/Smoothness)	y_d = 2.7	y_d = 3.5	y_d = 4.2
	B_0 = 0.9	B_0 = 0. 5	B_0 = 0.2

run for 3 flow rates- 5, 8 and 15 L/s. The flow rates and TSS concentrations were simulated at 16.25, 32.5, 48.75, and 65m.

MUSIC was calibrated using the TRAVA results, for all 27 runs. For example, in Figure 4.3 results are presented for the calibration of MUSIC against TRAVA results for medium soil parameters and medium grass parameters (Table 4.1).

The summary of the best fits for k-C* values for all 27 runs is presented in Table 4.2. The values of k-C* for low and medium soil parameters (low infiltration), are very similar. For high soil parameters, k-C* is lower. However, high values of soil parameters were very difficult to calibrate, as runoff was often completely infiltrated within two sample points. An increase in the grass parameter values meant more surface retention and therefore a lower rate of runoff. As grass parameters (surface retention) increased, the values for k decreased while the values for C* increased.

The model showed that the value for k increased with an increase in flow rate, despite theoretical arguments for k being constant. Some empirical studies have shown that the dependency of k-C* on the flow rate is an inherent characteristic of the first order kinetic equation.

From the results presented in Table 4.2, it could be recommended that, for majority of soils, k is between 5000-9000 m/year, while C* is between 3-15 mg/l.

Conclusion

TRAVA predicts infiltration in swales to within 4% accuracy, and pollutant removal to within 9% accuracy for common flow rates. Therefore, it was concluded that TRAVA could be used for the calibration of MUSIC for a number of practical cases. Nine different combinations of soil and grass types were chosen, and TRAVA was run for three flow rates at each of them.

MUSIC was successfully calibrated against the TRAVA results. It was found that the soil on which the swale is built has little effect on k-C*. However, k-C* is sensitive

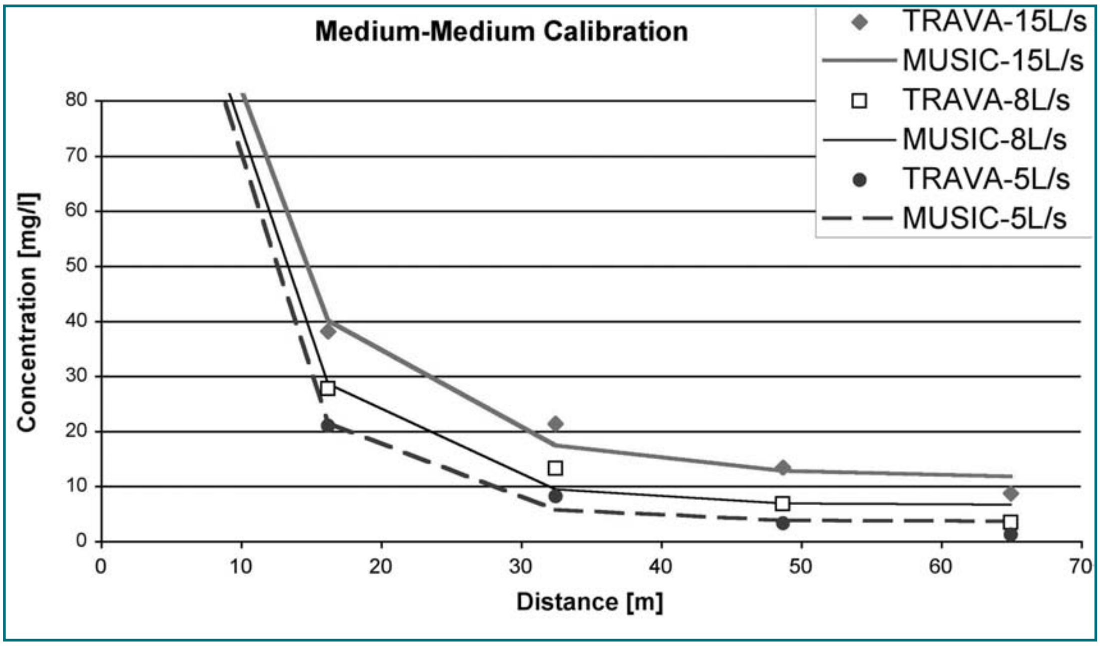

Figure 4. 3: Calibration of MUSIC using TRAVA results for the 'medium' soil and grass (Table 4.1)

to changes in grass parameter values and flow rates. As grass surface depressions density and hydraulic roughness increase (causing increased water retention and decreased runoff), there is a decrease in k and an increase in C*; k tends to increase as a function of the flow rate.

The derivation of this function could be the subject of future research. The main conclusion from this study is that for the majority of soils, k ranges between 5000-9000 m/year, while C* is between 3-15 mg/l. These results should be taken with some reservation, since MUSIC was calibrated using another model, but not on the bases of real data. Further work will be undertaken (using a second series of field experiments conducted in 2002), to refine and verify these findings.

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Ana Deletic
Tel: (03) 9905 2940
Email: ana.deletic@eng.monash.edu.au

Tim Fletcher
Tel: (03) 9905 2599
Email: tim.fletcher@eng.monash.edu.au

Table 4.2: Summary of k-C values for different soil/grass parameters, and flow rates*

Soil Characteristics		**LOW**		**MEDIUM**		**HIGH**	
Grass Retention	Flow [l/s]	k [m/yr]	C* [mg/l]	k [m/yr]	C* [mg/l]	k [m/yr]	C* [mg/l]
LOW	5	7000	1	6900	1	5000	0
	8	8800	2.5	8700	2.5	6600	0
	15	9700	6	9600	6	8800	9
	Average	**8500**	**3**	**8400**	**3**	**6800**	**3**
MEDIUM	5	5500	3	5500	3.5	3000	0
	8	7200	6	7200	6.5	3600	0
	15	8000	11	8000	11.5	6200	4
	Average	**6900**	**7**	**6900**	**7**	**4267**	**1**
HIGH	5	4100	10	4100	11.5	1300	0
	8	5400	14.5	5400	16	2800	0
	15	6100	21.5	6100	23	3600	0
	Average	**5200**	**15**	**5200**	**17**	**2567**	**0**

NEW TECHNICAL REPORT

Stochastic Generation of Climate Data

By
Ratnasingham Srikanthan
Senlin Zhou

Technical Report 03/12

This report describes stochastic climate data generation models for the generation of annual, monthly and daily climate data (rainfall, potential evapotranspiration, maximum temperature and other variables) that preserves the correlation between the different variables. The performance of the models are evaluated using climate data from ten sites located in various parts of Australia.

Printed and bound copies of this report are available from the Centre Office for $27.50. Contact Virginia Verrelli on 03 9905 2704 or email crcch@eng.monash.edu.au

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PROGRAM 5

CLIMATE VARIABILITY

Program Leader
FRANCIS CHIEW

Report by Andrew Frost and Sri Srikanthan

A Comparison of Subdaily Point Rainfall Models: DRIP vs NSRP

Introduction

Two models for stochastic generation of point rainfall data at subdaily timescales are currently being compared: the Disaggregated Rectangular Intensity Pulse (DRIP) model of Heneker *et al.* (2001) and the single site version of the Neyman-Scott Rectangular Pulse (NSRP) process model of Cowpertwait *et al.* (2002). These two models are quite different in their conceptualisation of the rainfall process, but have both previously shown good reproduction of statistics not used in calibration – particularly Intensity-Frequency-Duration curves – which are important in hydrological design. The two models have been calibrated to 10 major Australian cities/regional centres, sites where there is a relative abundance of pluviograph data for calibration (hence providing a best possible scenario in terms of data length for Australian conditions). The purpose of this study is to evaluate and compare the two models for use in the CRC for Catchment Hydrology's modelling toolkit.

The models are being evaluated on a monthly basis regarding their ability to reproduce certain 'standard' and extreme rainfall model statistics derived from the pluviograph record over a range of timescales (1, 6 and 24 hours) along with other daily, monthly and annual statistics derived from the longer daily rainfall series. Related statistics have been produced on a site-by-site basis allowing the user to determine if either model is applicable to a given project.

DRIP and NSRP model description

Within DRIP rainfall is conceptualised as a series of events – with associated random dryspell time, storm duration and storm intensity. As a result, DRIP is termed an event based model (see Figure 5.1).

Conversely, the NSRP model is an example of a cluster based model, with rainfall represented as clusters of rain cells associated with storms (see Figure 5.2). Each cell is considered as a pulse with a random duration and random intensity which is constant throughout the cell duration. Overlapping of cells is allowed both within the same storm and across different storms. The NSRP differs from DRIP in that events are not identified (as storms can overlap). The different conceptual bases (event vs. cluster) require differing calibration methods.

Calibration methods

DRIP relies on maximum likelihood for parameter estimation, calibrating distributions to the various event characteristics (storm duration/intensity, interstorm duration). If the calibrated distributions are a good match of those observed – the resulting simulated rainfall should match the various rainfall statistics observed.

NSRP on the other hand matches theoretical rainfall statistical characteristics of the model (eg. mean, standard deviation, skew, dry probability, autocorrelation, and probability of transition from a wet

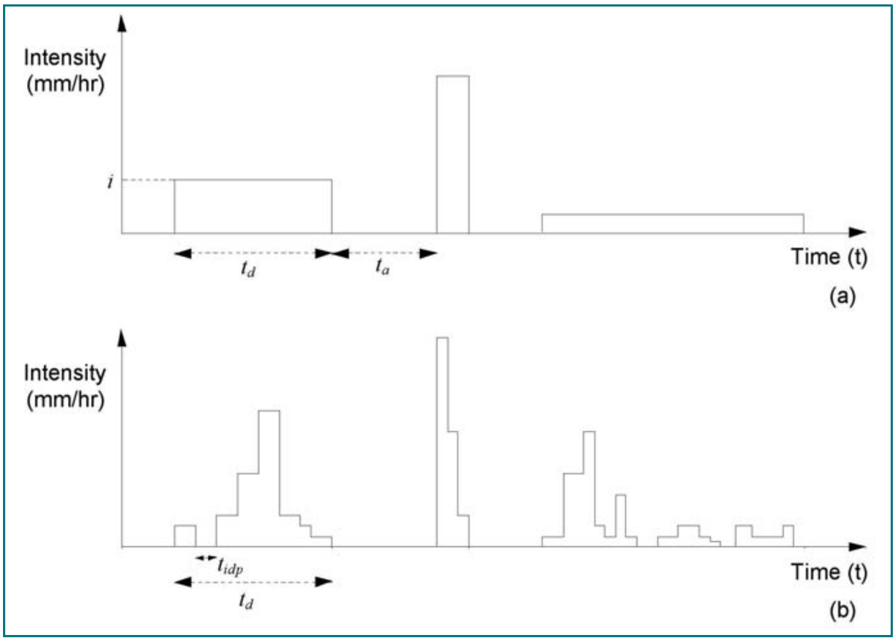

Figure 5.1. DRIP model of precipitation event series: (a) generation of a time series of rectangular rainfall pulses or events; and (b) a random shaped hyetograph produced by the disaggregation scheme. Figure from Heneker (2001).

state to dry state) over various timescales. The statistics and timescales used in calibration are user chosen (with a particular weighting applied to each statistic). If the calibrated statistics closely match those observed – the resulting simulated rainfall distribution should match that observed.

Current calibration issues

DRIP has been altered since the study of Heneker *et al.*, (2001), in an attempt to reduce user input in calibration, such that the model could be calibrated by a user with little experience (eg. a toolkit user). This change has, upon comparison with the results of Heneker (2002), apparently decreased the quality of statistics output – particularly IFD's. Further work is required on this calibration technique if the model is to be used with confidence in the CRC's toolkit.

A problem with the NSRP approach is that it is not clear what statistics or weightings should be used in calibration. Rather than single out a few calibration statistics for this study, all the above mentioned statistics were used (at timescales 1, 6 and 24hour). If sufficient weighting is not provided for a particular statistic, a poor fit might result (comparatively to other statistics).

Data

Pluviograph data from ten major cities and regional centres were chosen for this study – Adelaide, Alice Springs, Brisbane, Cairns, Darwin, Hobart, Melbourne, Perth, Sydney and Townsville. These sites were chosen due to the relatively long length of record available - at least 45 years of data (with the exception of Adelaide) - and also as the Heneker (2002) study used these sites thus allowing comparison. Other Bureau of Meteorology pluviograph sites (that have been digitised) throughout Australia have lengths typically in the range 15-25 years. Thus, this can be considered as being the best possible opportunity for identification of model parameters in Australian conditions.

Results so far

Many 'standard' rainfall model comparison statistics (Onof and Wheater, 1993, Cameron *et al.*, 2000) have been produced over a range of timescales for each of the ten sites. These statistics form the main basis of comparison. Other important extreme statistics were also produced (IFD curves) along with many other subdaily, daily, monthly and annual statistics. An example of some of the standard statistics produced for each of the models is provided in Figure 5.3.

DRIP performed well for the standard statistics, however it was prone to overestimation of IFD curves for short durations (apparently due to the new automated intensity-duration calibration method) as mentioned previously. Likewise some aggregation statistics (monthly/annual distributions) were poorly reproduced.

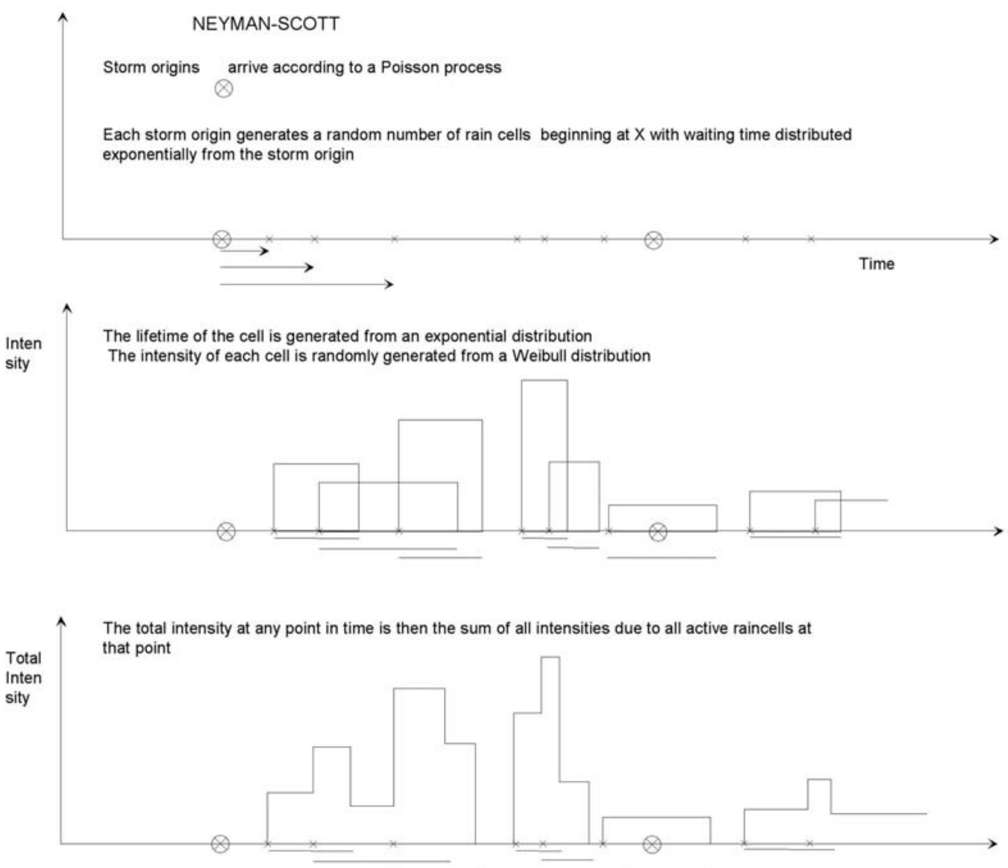

Figure 5.2. Schematic of the Neyman-Scott model (derived from Cowpertwait (1991)).

NEW TECHNICAL REPORT

Calibrations of the AWBM for Use on Ungauged Catchments

By

Walter Boughton
Francis Chiew

Technical Report 03/15

This report presents an approach for using the daily rainfall-runoff model, AWBM, to estimate runoff in ungauged catchments.

The report describes computer programs that can be used to optimise three key parameters in AWBM against runoff data from gauged catchments, and provides calibrated parameter values and catchment characteristics for 221 Australian catchments. The report then recommends an approach for using the calibrated parameter values in these and other catchments to guide the choice of AWBM parameter values for use in ungauged catchments.

Printed and bound copies of this report are available from the Centre Office for $27.50. Contact Virginia Verrelli on 03 9905 2704 or email crcch@eng.monash.edu.au

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Conversely the NSRP model, whilst reproducing the majority of standard statistics, IFD distributions and aggregation statistics well, it poorly reproduced the wetspell/dryspell duration means and standard deviations. Apparently there is not enough weighting on the fitted statistics related to the spell durations (transition probabilities, dry probabilities).

Conclusion

Based on the comparison of the two current models, deficiencies in both models have been identified. The NSRP model reproduces many statistics well (eg. IFD curves and annual rainfall), however it apparently performs poorly in regard to some wet and dry spell statistics. DRIP reproduces wet and dryspell characteristics well (as these are used in calibration), however it can perform poorly in terms of IFD.

Further work is underway on both models (in cooperation with model authors) to address these issues. It is not expected that one model will be able to be recommended over another, as both perform well for some statistics, whilst not for others. Rather, it is envisaged that both models be added to the toolkit, and a model is chosen for a particular study based on the statistics important to that study (IFD vs spell characteristics).

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Andrew Frost
Tel: (03) 9699 4001
Email: a.frost@bom.gov.au

Sri Srikanthan
Tel: (03) 9669 4513
Email: sri@bom.gov.au

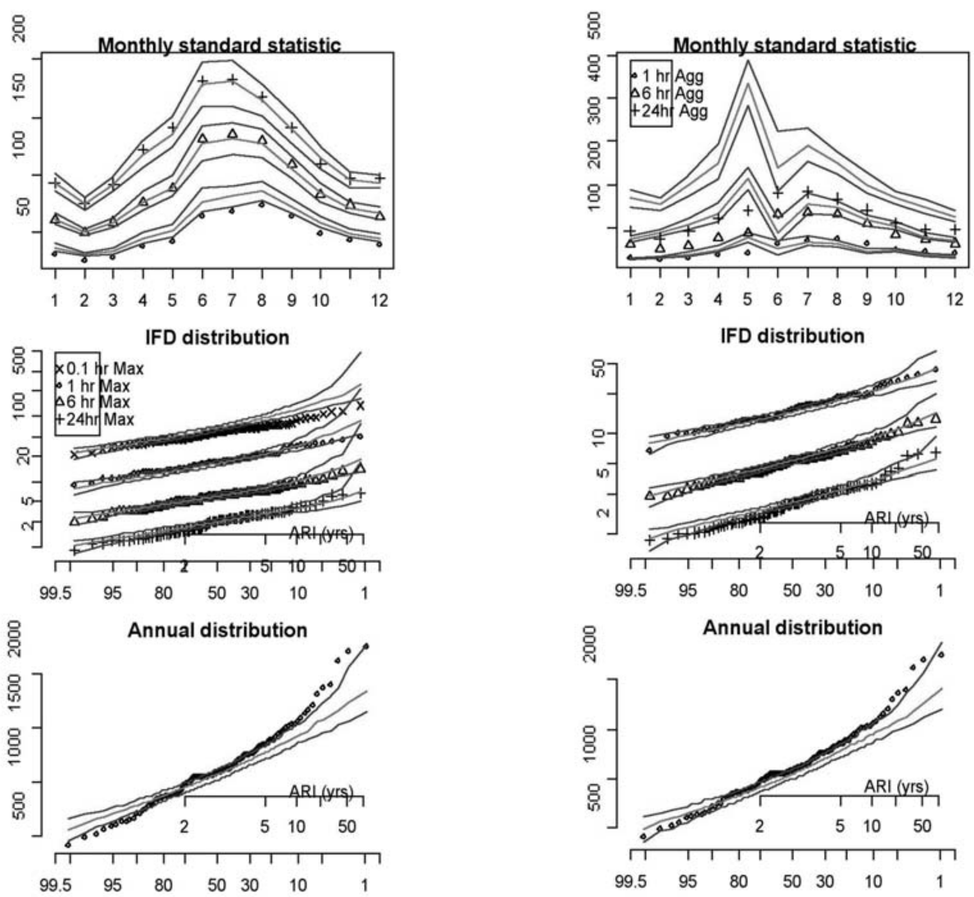

Figure 5.3. DRIP (left) vs NSRP (right) Brisbane monthly dryspell mean, IFD distribution and annual distribution.

NEW TECHNICAL REPORT

Stochastic Models for Generating Annual, Monthly and Daily Rainfall and Climate Data at a Site

By
Ratnasingham Srikanthan
Senlin Zhou

Technical Report 03/16

One of the goals of the Climate Variability Program in the Cooperative Research Centre (CRC) for Catchment Hydrology is to develop computer programs for generating stochastic data at time scales from less than one hour to one year and for point sites to large catchments.

The first phase of the program (2000-2002) has developed models to stochastically generate rainfall and climate data for a site at annual, monthly and daily time scales. Different models have been tested using data from across Australia, and the results have been reported in a series of CRC for Catchment Hydrology reports and research papers.

The purpose of this report is to provide guidance on the use of the stochastic modelling software.

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PROGRAM 6

RIVER RESTORATION

Program Leader
MIKE STEWARDSON

Report by Mike Stewardson and Elisa Howes

Is There a "Representative Reach"?

Data for environmental flow analyses

Environmental flow analyses often require knowledge of the hydraulic characteristics of river channels, which is typically derived from analysis of hydraulic survey data. These surveys usually consist of multiple channel cross-sections because these data can be easily converted for input to a one-dimensional hydraulic model. There is a need to balance survey costs and the adequacy of surveys for representing variability of the hydraulic environment in environmental flow study when choosing the quantity and spatial arrangement of these cross-section surveys along a river.

Choosing river reaches

The hydraulic assessments in environmental flow studies are generally at the scale of large segments of river, typically extending between major tributary junctions. For many of these investigations extensive mapping or sampling of long lengths of river is not cost effective. A common approach to sampling channel characteristics in these studies is to sample hydraulic conditions within one or more representative reaches. This "representative reach" approach requires two assumptions:

- The hydraulic characteristics of the reach are representative of the entire length of river being considered, and
- The surveyed cross-sections are an adequate sample of conditions along the representative reach.

'Representative reach' concept

To illustrate the representative reach concept, Figure 6.1 shows the three reaches used in an environmental flow study of the Broken River. The three reaches were located downstream of the three major points of regulation and each were about 1 km long. Reach 1 is a short distance downstream of a reservoir (Lake Nillahcootie), reach 2 is just downstream of a major diversion (Broken Weir) and reach 3 is downstream of another major diversion (Casey's Weir) and the release channel for a major off-stream storage (Lake Makoan). Each reach includes at least fifteen cross-sections spread over at least one meander wavelength. Cross-sections were evenly spaced with some additional cross-section required at riffle crests for one-dimensional hydraulic modelling.

Evidence from Victorian streams

We investigated the representative reach concept in three small Victorian streams and found evidence to support the use of this approach. Results suggested that a representative reach generally had similar mean

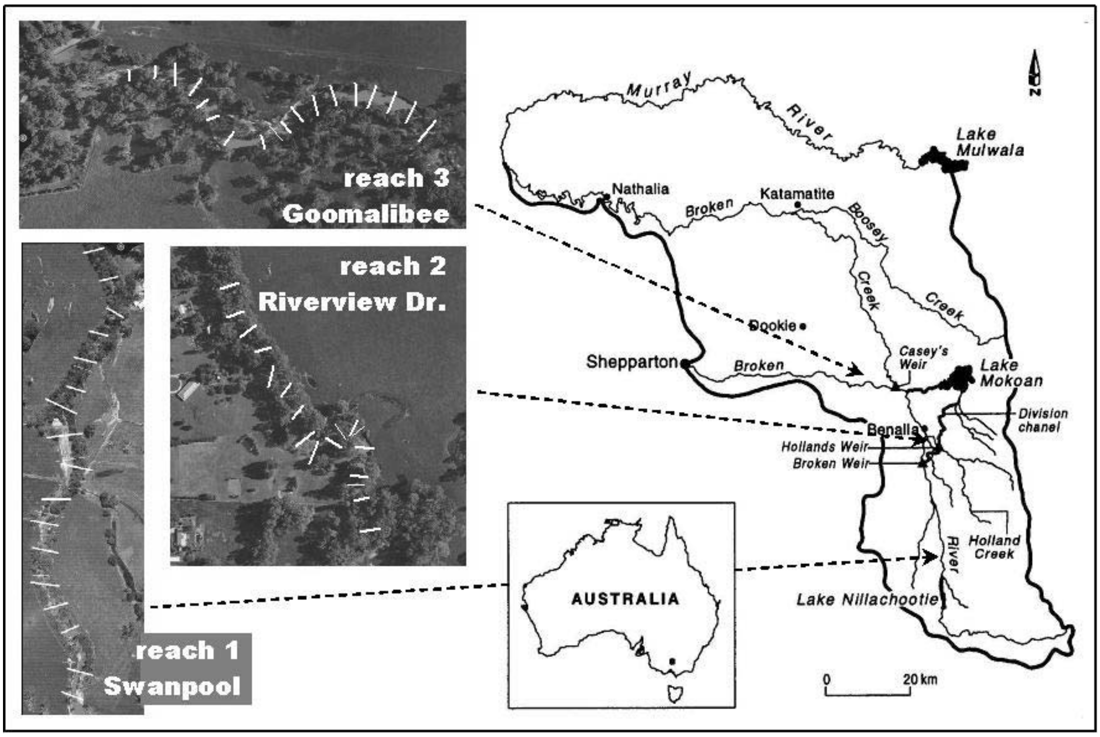

Figure 6.1. The representative reaches and cross-sections surveyed for an environmental flow study of the Broken River, south east Australia.

NEW TECHNICAL REPORT

Analysis and Management of Unseasonal Surplus Flows in the Barmah-Millewa Forest

By

Jo Chong

Technical Report 03/2

This report addresses a major threat to the Barmah-Millewa Forest forest; unseasonal flooding in the summer and autumn, when the forest would normally be dry. Based on analysis of pre-regulation conditions (1908-1929) and current conditions (1980 - 2000), forest flooding has increased from 15.5% of days to 36.5% of days between December and April.

In particular, small, localized floods, which inundate less than 10% of the forest, occur at least eight times more frequently now, than before regulation. Work by others has related these hydrologic changes to tree death and changes in floristic structure in wetlands.

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hydraulic characteristics to a longer length of river. However the representative reach only provided results representative of stream variability if the environmental conditions were visibly homogeneous along the longer river segment which it was supposed to represent.

In many streams there will be more variability in channel hydraulics over longer sections of river. A survey of 150 cross-sections along a 10 km stretch of the lower Loddon River in north-central Victoria illustrates this point. Figure 6.2a shows the cross-sectional Froude number at the 150 cross-sections. We chose to look at variation in Froude number because it is generally the most variable cross-sectional hydraulic parameters along a river reach. Also, high Froude number indicates riffle-type conditions and low Froude number indicates pool type conditions. We can divide the 10 km reach into ten 1 km sub-reaches each with 15 cross-sections. We see that the mean Froude numbers for each sub-reach are similar (Figure 6.2b) but the standard deviation of Froude number varies substantially between the sub-reaches (Figure 6.2c). These results show that a 1 km sub-reach may be adequate for evaluating mean conditions but is unlikely to provide an adequate sample of the range of hydraulic conditions along this river.

Summing-up

For each environmental flow study, the project team must decide on the number and length of representative reaches. Clearly more and longer survey reaches will provide a more representative sample of the river channel. Generally there is a survey cost associated with increasing the number of reaches as survey teams need time to access each site, carry out reconnaissance surveys and establish survey points.

In practice, we tend to limit the length of surveys so that they might be surveyed within one or two days but still include at least one complete meander wavelength.

The number of reaches is generally constrained by the project budget but at least one reach should be located downstream of each major point of regulations (i.e. reservoirs or diversions) as in the Broken River example. As a rough guide, 15 cross-sections will provide an adequate sample of conditions within representative reaches with fewer required in more uniform channels.

At this stage, there are no simple guidelines for choosing the location and number of representative reaches. Elisa Howes is undertaking further research in this area.

Mike Stewardson
Tel: (03) 8344 7733
Email: mjstew@unimelb.edu.au

Elisa Howes
Tel: (03) 8344 4291
Email: e.howes@pgrad.unimelb.edu.au

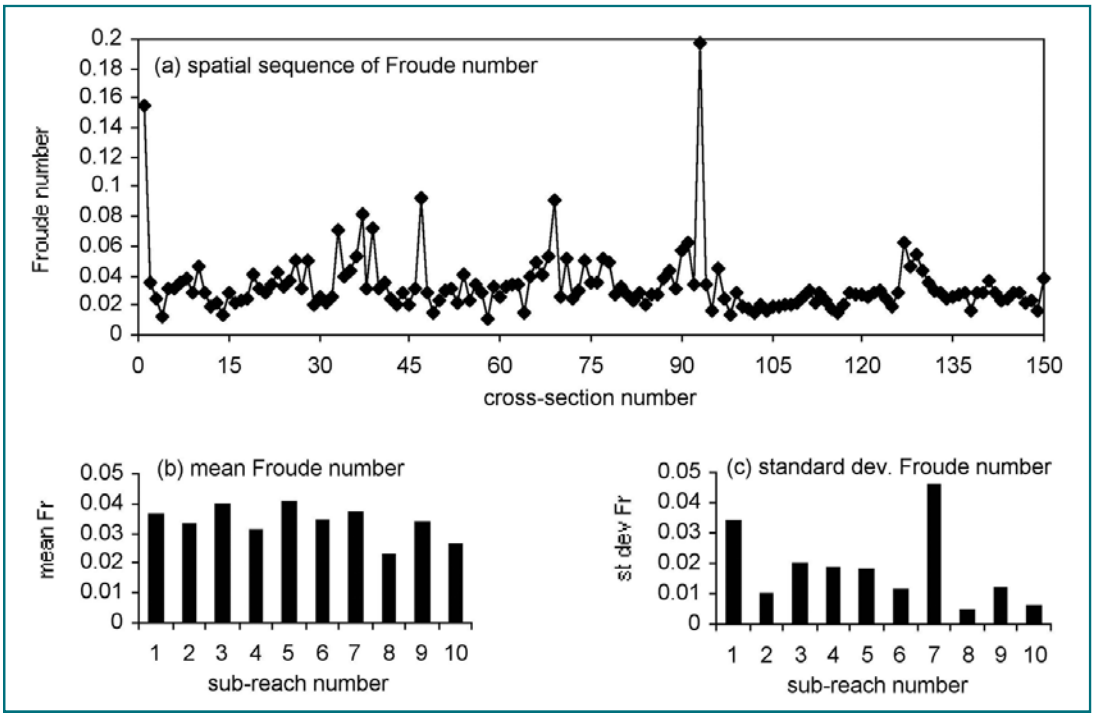

Figure 6.2(a) Cross-sectional Froude number at 150 evenly spaced cross-sections along a 10 km reach of the Lower Loddon River, north-central Victoria. Figure 6.2(b) and 6.2(c) show the mean and standard deviation of cross-sectional Froude number for ten discrete sub-reaches, each with 15 cross-sections (data provide by Elisa Howes, The University of Melbourne).

COMMUNICATION AND ADOPTION PROGRAM

Program Leader
DAVID PERRY

The Flow on Effect – February 2004

At a glance – a summary of this article

During 23-25 March 2004, interested *Catchword* readers will be able to participate in a Forest Management workshop in Canberra. The workshop will consist of two days of short presentations and a one day field trip. The registration deadline has been extended to Friday 12 March 2004. For further information please contact the Centre Office as soon as convenient on 03 9905 2704 or register by following the links at www.catchment.crc.org.au/news

No rest for the wicked?

Yes, the Catchment Modelling School is in full swing. Along with talking to participants and providing support to the workshop presenters, another *Catchword* article is due.

The scale of the Catchment Modelling School has possibly over-shadowed the excellent workshop scheduled for 23-25 March 2004 at CSIRO, Discovery Building, Black Mountain in Canberra. This forthcoming three day workshop - incorporating a one-day field trip - is a collaborative activity between the CRC for Catchment Hydrology, the University of New South Wales, the Forest Science Centre and New South Wales State Forests.

Forest Management Workshop objectives and scope

The aim of the three day event is to bring together scientists and forest managers to discuss recent developments in the understanding of forest catchment behaviour and management. This workshop follows on from the Erosion in Forests Workshop held in Bermagui, NSW (March 1997) and the Forest Management for Water Quality and Quantity workshop held in Warburton, Victoria, (May 1999). These workshops have proved to be a very successful forum for information sharing and discussing key issues of forest management.

Two of the three days, Tuesday 23 March and Thursday 25 March 2004, will be structured around a series of presentations by both research teams and field practitioners. For Wednesday 24 March, a field trip has been organised to take participants 'out of the classroom' and visit the burnt forest area at the western side of Canberra and plantation forestry sites of NSW State Forests near Tumut.

Forest Management Workshop topics

Four major key themes form the structure of the workshop, with a keynote presentation on each. The key themes are:

- Forest Hydrology
Keynote speaker: Prof Rob Vertessy, Director of the CRC for Catchment Hydrology

- Sediment Delivery and Water Quality
Keynote speaker: Prof Emmett O Loughlin, Hydrology Consultant, and Founding Director of the CRC for Catchment Hydrology

- Fire Management
Keynote speaker: Dr Jim Gould, Research Leader, Bushfire Behaviour and Management, CSIRO Forestry and Forest Products

- Sustainable Forestry
Keynote speaker: Prof Peter Kanowski, School of Resources, Environment and Society, Australian National University

Workshop registration and payment details

The full registration fee is $385 (or $435 including the workshop dinner on the Tuesday night) and students are invited to register for the workshop for only $100 (or $150 including dinner). The registration fee includes morning and afternoon tea, lunch, the field excursion and the workshop proceedings.

Registered participants to date

To date, over 50 participants have registered to attend. Organisations from New South Wales, the ACT, Victoria, South Australia and Tasmania are represented including: CRC for Landscape Environments and Mineral Exploration; CSIRO Forestry and Forest Products; Department of Agriculture, Forestry and Fisheries; Department of Environment and Conservation, NSW; Department of Sustainability and Environment, Victoria; State Forests of NSW; Melbourne Water; Forestry Tasmania; and private plantation managers

This diversity of interests and views will ensure that the workshop provides a fertile environment for active debate of issues associated with the four key themes

Accommodation and further information

Workshop participants are asked to book their own accommodation. The most convenient would be at University House: http://www.anu.edu.au/unihouse/ Other accommodation possibilities can be found at http://www.canberratourism.com.au

FOREST MANAGEMENT WORKSHOP, CANBERRA

23-25 March 2004

The CRC for Catchment Hydrology, along with the University of New South Wales, Forest Science Centre and New South Wales State Forests presents the Forest Management Workshop on 23-25 March 2004.

The aim of the meeting is to bring together scientists and forest managers to discuss recent developments in the understanding of forest catchment behaviour and management.

Presentations will be held on the 23 and 25 March 2004 and a field excursion will be organised for the 24 March 2004. The field excursion will visit the burnt forest area at the western side of Canberra and plantation forestry sites of NSW State Forests near Tumut.

The workshop is based around four key themes:

- Forest Hydrology
- Sediment Delivery and Water Quality
- Fire Management
- Sustainable Forestry

PLEASE NOTE:
The registration date has been extended to Friday 12 March 2004

For further information visit www.catchment.crc.org.au/news or see page 23 of this issue of *Catchword*.

www.toolkit.net.au

The Catchment Modelling Toolkit web site continues to expand. The Toolkit web site will be used to deliver the CRC for Catchment Hydrology's modelling software and supporting documentation over the next three years.

Members of the Toolkit web site can now download the River Analysis Package (RAP) and the Rainfall Runoff Library (RRL) by logging in and visiting:
www.toolkit.net.au/rap
www.toolkit.net.au/rrl

More software products will be available to download from the Toolkit site over the coming months, so keep an eye on www.toolkit.net.au

For further information visit www.toolkit.net.au

Comments and queries can be directed to
David Perry
tel: 03 9905 9600
email: david.perry@eng.monash.edu.au

Up-to-date information, including the final program, will be available in the Events and News sections of the CRC for Catchment Hydrology web site at www.catchment.crc.org.au/news

For further information, please contact Virginia Verrelli at the Centre Office on (03) 9905 2704.

Want to participate? – please act now
The registration deadline has been extended to Friday 12 March 2004. Unfortunately registrations cannot be accepted after this time, so if you are interested in attending the Forest management Workshop with colleagues from around Australia please download the Adobe Acrobat flyer and registration form from www.catchment.crc.org.au/news

We are looking forward to a rewarding and challenging three days

David Perry
Communication and Adoption Program
Tel: 03 9905 9600
email: david.perry@eng.monash.edu.au

POSTGRADUATES AND THEIR PROJECTS

Matt Francey

A part time PhD – how long will that take? I usually mumble some vague response to this question and then rave about the joys of part-time study and full time work.

My path to this point has certainly not been a straight line; after a dalliance at university in the late 1980's (and scraping through with a degree) I spent eight or so years travelling and working in the outdoor education/adventure field. The life of winters in Canada, summers rafting with a few trips to foreign climes in-between gradually wore me down. So in 1997 I found myself back at university part-time studying environmental engineering, which I must admit I had never heard of pre-enrolment. It seemed like a perfect way to connect my environmental interest from years in the outdoors with a long neglected technical inclination. A successful few years study and there I was, working happily away on stormwater quality at Melbourne Water, 5 days a week, 8am to 6pm. I'd hardly ever worn shoes to work let alone a tie.

The opportunity to do further study with Tim Fletcher's Urban Stormwater group presented itself in 2003 and I jumped at the prospect. What a great chance to be involved with both the research and the policy areas in the stormwater field. Melbourne Water was very supportive and allowed me to spend at least one day each week out at Monash.

The chosen topic builds strongly upon previous work done at the CRC for Catchment Hydrology into urban stormwater quality, particularly that by Hugh Duncan, Francis Chiew and Jai Vaze. If I were to describe the problem from a stormwater manager's point of view it would go something like this:

There are a variety of stormwater quality models that attempt to use physical processes to predict pollution loads. These models, by their very nature, are complex in both data requirements and calibration. There is also considerable doubt regarding their accuracy, therefore their uptake by stormwater managers has been very low.

On the other hand, models that use statistical methods to generate loads, such as the CRC's model MUSIC, are relatively easy to use and have achieved widespread acceptance. They do not however, attempt to describe the generation of pollutants at short time scales.

Preliminary work done by the CRC on catchments from Melbourne and Brisbane suggests that a marriage of the two approaches may be possible. The proposed method concentrates on rainfall intensity as the principle factor causing particle detachment from impervious surfaces. The questions this study aims to answer are:

- Can simple methods be used to satisfactorily predict event loads for a range of urban situations?
- Can we modify the method to give a representation of the pollutograph within an event?

A Victorian Stormwater Action Plan grant has enabled us to set up an extensive monitoring program of eight catchments in urban Melbourne. Short interval rainfall data as well as discrete TSS, TP and TN sampling will be obtained for approximately 50 storm events at each site. Justin Lewis and Peter Poelsma from Monash are managing the monitoring program and have patiently dealt with the unplanned roadwork, recalcitrant councils, illegal stormwater connections, 1/100-year floods and equipment delays that seem to plague this type of study. I am also fortunate to have Ana Deletic, Hugh Duncan and Tim Fletcher as joint supervisors; their varied experiences in this field ensure our weekly meetings are never boring, especially when held over coffee and cakes.

But anyway, the joys of part time study, and a new baby has complicated things at home, but all is well so far. The data from the catchments is starting to flow so the next year should bring some intriguing results.

Matt Francey
Tel: 03 9235 2221
Email: matt.francey@eng.monash.edu.au

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A complete list of all documents and products produced by the CRC since 1993 is available at our web site at www.catchment.crc.org.au/publications

Centre Office
CRC for Catchment Hydrology
Department of Civil Engineering
Building 60
Monash University Vic 3800
tel: 03 9905 2704
fax: 03 9905 5033
email: crcch@eng.monash.edu.au

CRC PROFILE

Our CRC Profile for February is:

David Rassam

The IRAQ Era

Well, I decided to include the magic word 'IRAQ' to the title, and who in his right mind would not read the article after seeing this word. Four thousand years of history seems to be making a difference, we are on the news every night! No more on this subject, I will talk about myself instead.

Having been surrounded by medical doctors all my life (father, two sisters, brother, and two brothers-in-law) I decided to study civil engineering. In my next life I would like to be a photographer and work for National Geographic (and do documentaries on Iraq, what! is the war going to take that long?). Seriously, photography is my hobby but the digital age has stuffed up everything. It's really a pity. You don't see those nice heavy cameras with long telephoto lenses in shops anymore, instead there are those weird-looking digital cameras where the only thing required is pressing a button and everybody happily thinks that he/she is a professional photographer the minute the images are downloaded through the USB port. As a result, my dear old Canon-F1, which weights over two kg when fitted to my favourite 135-mm F2 lens, is sitting in a cupboard somewhere in the house. My other hobby is listening to classical music; digital technology here has made a positive difference one should admit, but there's a small problem, I can only listen when I'm alone at home, and who would waste the opportunity of having a peaceful nap and listen to Mahler Symphony no. 3; clarification, I have a seven year old boy and a five year old girl who get along terribly well with each other.

Eight years after graduation, I decided to do a masters degree at Baghdad University. One of best friends had enrolled before me. He recommended that I join him and major in 'construction materials', so I did. What difference does it make anyway? I finished my studies and went straight on to do another six months of military service (instead of three years mind you just because I have a masters degree; this is like first class honours here qualifying straight for a PhD. If you are bright you get rewarded). But, don't get me wrong, this was in an engineering laboratory twenty minutes drive from home (compared to one and a half hours drive to my work); we chatted and played dominoes most of the day (something like a civil servants' life).

I'll skip the events of 1990-1991, you've seen it all on TV, but when you are there you get the real sound effects. After stereo digital TV it should get better, maybe in part three of the trilogy.

The 'Reset-Life' Button

I pressed that button on 4/9/1992. In the computer world this is like formatting your 'C' drive; you have a really clean start with absolutely nothing except the hardware. I arrived in Brisbane airport to get a warm welcome from the sniffer dog, no bombs, just a lousy peace of fruit that was accidentally left in one of my shopping bags in Bangkok. Anyway, the experience passed with a postcard from the 'dog' threatening that next time he would personally fine me $10,000.

Five months later, I got my first job at the University of Southern Queensland, which was a continuation of my career as an academic. There was a small problem though, I was working full-time for a half-time salary. Part of the deal was enrolling in a part-time PhD program. It didn't take me long to realise that things were not that great either money-wise or study-wise. Down to Brisbane I went, enrolled full-time at UQ and finished in under three and a half years. Nothing to do with construction materials, this time geomechnics.

Having done a bit of soil science and unsaturated flow modelling, I managed to impress the interview panel, which offered me my first real job at NR&M in Brisbane. The job title was 'Environmental Modeller' and had nothing to do with geomechanics. Three problems here, firstly, I hate the term 'Modeller' very much, secondly, it turns out that they thought I was some sort of a hydrology guru, and thirdly, the building where my office was located is called 'Agricultural Chemistry'! What am I doing with my life?

I exploited that misconception about hydrology and got involved with the CRC for Catchment Hydrology, working in projects, 2.5, 2D, 7E, and supposedly 1A but things abruptly changed. I got this email one day saying that there is a vacancy at CSIRO Land and Water in Brisbane, so I applied.

The CSIRO Era

Hydrological Modeller is my new job's title (note the term 'Modeller' that I still hate). I am 200 m from my old NR&M office, which was six times bigger than the space I occupy now. It's only been a month and a bit. If you keep in mind that I started on Christmas eve, I'm still waiting for a real desk, chair, and computer, and that my boss only arrived yesterday, you can hardly call it an era. I thought that by moving here I would avoid writing this article, but Virginia simply sent a reminder to my new CSIRO email, which seems to indicate that I'm still associated with the CRC. I can't escape my old roommate, Mark Littleboy as I will be working in Project 2C. Heather Hunter still wants me to continue with Project 2D, I will conclude by quoting an emailed message from Mark: "Sounds like you need to buy a tin of alphabet soup to work out all your projects".

David Rassam
Tel: (07) 3896 9342
Email: david.rassam@dnr.qld.gov.au

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For further information contact the Centre Office on 03 9905 2704 or email crcch@eng.monash.edu.au

WHERE ARE THEY NOW?

Report by Sara Lloyd

Over the last six month I have enjoyed having my evenings and weekends free, as well as settling into my dual job role with Melbourne Water and the Victorian Clearwater Program.

At Melbourne Water I am involved with the South East Catchment Strategy team working on various projects such as reviewing the cost effectiveness of wetlands owned and operated by Melbourne Water.

I have also begun work on an exciting project that aims to calculate the cost effectiveness of alternative Water Sensitive Urban Design (WSUD) applications (such as raintanks, bio-filtration systems and wetlands) for drainage scheme development. Changes in flow characteristics and water quality are examined in the context of life-cycle costs. Cost and downstream benefits are compared to those calculated for a conventionally developed drainage scheme with concrete pipes and a downstream wetland designed to meet best practice.

I also manage the Victorian WSUD capacity building program as part of the Municipal Association of Victoria's (MAV's) Clearwater Program (coordinated by the MAV and the Storm Industry Association, and supported by Melbourne Water). The aim of the Clearwater WSUD Program is to facilitate a greater understanding and ultimately adoption of integrated water management schemes across Victoria.

Last year I launched the first of a series of seminars, site visits, workshops and tailored training sessions, which target local government and industry professional (including consultants, water authorities, EPA, developers, etc.). A series of eight seminars and three field tours were conducted across Melbourne and regional areas. The seminar and tours set the context for a change in water cycle management practice and provided examples of WSUD applications currently in the ground and operating within Victoria.

This year, the program is developing a comprehensive education and training calendar, addressing many issues and misconceptions surrounding WSUD. The current focus is on developing workshops that adopt a hands-on approach whereby participants will apply training materials received at each session to worked examples based on case studies.

The program will culminate in regionally based 'Water Cycle Games' (similar to those already undertaken in NSW) which will allow participants to put into practice the learnings from the program as part of a collaborative team involving industry and local government stakeholders.

Sara Lloyd
Tel: (03) 9235 2112
Email: sara.lloyd@melbournewater.com.au

Forest Management Workshop

23 - 25 March 2004, Canberra

The CRC for Catchment Hydrology, along with University of New South Wales, Forest Science Centre and New South Wales State Forests, presents the Forest Management Workshop on 23-25 March 2004.

Workshop objectives and scope

The aim of the meeting is to bring together scientists and forest managers to discuss recent developments in the understanding of forest catchment behaviour and management. This workshop follows on the Erosion in Forests Workshop held in Bermagui, NSW (March 1997) and the Forest Management for Water Quality and Quantity workshop held in Warburton, Victoria, (May 1999).

These workshops have proved to be a very successful forum for discussing key issues of forest management. Presentations will be held on the 23 and 25 March 2004 and a field excursion will be organised for the 24 March 2004. The field excursion will visit the burnt forest area at the western side of Canberra and plantation forestry sites of NSW State Forests near Tumut.

Workshop topics

During the workshop four major key themes will be discussed, with a keynote presentation on each of the themes. The key themes are:

Forest Hydrology

Keynote speaker: Prof Rob Vertessy, Director of the CRC for Catchment Hydrology

Sediment Delivery and Water Quality

Keynote speaker: Prof Emmett O'Loughlin, Hydrology Consultant, and Founding Director of the CRC for Catchment Hydrology

Fire Management

Keynote speaker: Dr Jim Gould, Research Leader, Bushfire Behaviour and Management, CSIRO Forestry and Forest Products

Sustainable Forestry

Keynote speaker: Prof Peter Kanowski, School of Resources, Environment and Society, Australian National University

Registration and payment

The full registration fee is $385 (or $435 including the workshop dinner).

Students can register for the workshop for only $100 (or $150 including dinner) - a copy of your student I.D. card must be provided with registration.

The registration fee includes morning and afternoon tea, lunch, the field excursion and the workshop proceedings. The total number of people who can attend the excursion is limited so please register now to avoid disappointment.

To register please download the Workshop flyer from www.catchment.crc.org.au/news and complete the registration form. Fax or mail your registration to the CRC for Catchment Hydrology Centre Office by 12 March 2004

Workshop dinner

On 23 March a workshop dinner will be held at University House - ANU, Cnr Blamain Crescent and Liversidge Street, Acton. The dinner is optional and will cost an additional $50. Please indicate whether you would like to attend the dinner on your Registration form.

Accommodation

Workshop participants are asked to book a hotel room themselves. The most convenient location for the workshop is at University House: http://www.anu.edu.au/unihouse/ Other accommodation options can be found at http://www.canberratourism.com.au

For further information Please visit www.catchmnent.crc.org.au/news or contact Virginia Verrelli at the Centre Office on 03 9905 2704 or by email crcch@eng.monash.edu.au

COOPERATIVE RESEARCH CENTRE FOR

CATCHMENT HYDROLOGY

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If undelivered return to:

Department of Civil Engineering
Building 60
Monash University
Vic 3800

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POSTAGE PAID AUSTRALIA

CENTRE OFFICE:
CRC for Catchment Hydrology
Department of Civil Engineering
Building 60 Monash University,
Vic 3800
Telephone: +61 3 9905 2704
Facsimile: +61 3 9905 5033

crcch@eng.monash.edu.au

OUR MISSION

To deliver to resource managers the capability to assess the hydrologic impact of land-use and water-management decisions at whole-of-catchment scale.

OUR RESEARCH

To achieve our mission the CRC has six multi-disciplinary research programs:

- Predicting catchment behaviour
- Land-use impacts on rivers
- Sustainable water allocation
- Urban stormwater quality
- Climate variability
- River restoration

CRC AUSTRALIA

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 Infrastructure, Planning and Natural Resources
Department of Sustainability and Environment, Vic
Goulburn-Murray Water
Griffith University
Melbourne Water
Monash University
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Natural Resources, Mines and Energy, Qld
Southern Rural Water
The University of Melbourne
Wimmera Mallee Water

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