NEWSLETTER OF THE COOPERATIVE RESEARCH CENTRE FOR CATCHMENT HYDROLOGY

CATCHWORD

NO 77 OCTOBER 1999

A NOTE FROM THE DIRECTOR

Professor
Russell Mein

Inside...

The 'old' CRC for Catchment Hydrology – signing off

Our Annual Report for 1998/9 has been printed, and in the process of distribution (most readers of *Catchword* will be sent a copy). In the formal sense, it is the last official publication of the 'old' CRC. Some uncompleted work (including two core, and several postgraduate, projects) has now been officially transferred to the 'new' CRC.

We are deep into the development of a new research program, with new directions and focus; rather an exciting time in the CRC, and certainly a busy one. I am looking forward to telling you more about future plans, but in the meantime I would to reflect on the achievements of our 'Year 7'.

There have been many highlights from successful research and related activities. There is particular satisfaction from cooperative research that 'delivers' and meets the needs of the water industry. Here, the examples that spring to mind are:

- The CRC-FORGE project, which is now providing design data for extreme rainfalls (and hence flood estimation) for Queensland, NSW, Victoria, Tasmania, and South Australia
- The Tarago catchment study, which showed how simple land management practices could achieve an improvement in reservoir water quality at about one quarter the cost of conventional water treatment. The CRC and Melbourne Water won an Excellence in Technology in Technology Transfer Award for the degree of community involvement in the research, and their rapid implementation of the outcomes.

The Industry Report and Industry Seminar Series have been a particular success story for us. The Reports are each written for a particular target audience - those relevant for the implementation of the outcomes of the CRC's research in that field – and have proved very popular. Over 2000 of these have been sold! The Industry Seminars have also exceeded expectations. For instance, the 'Constructed Wetlands' Seminar (with CRC for Freshwater Ecology collaboration) attracted a sell-out crowd of 240 people in Melbourne; a survey of participants showed that 90% were from the users' sectors (local government, landscape planners, water authorities, and consultants), and 10% from research agencies. The success in Melbourne prompted a roadshow to Canberra, Sydney and Brisbane (with similar strong support); another, to Adelaide/Perth, is scheduled this month.

We've been praised for our postgraduate program, and the success achieved by involving CSIRO and industry (ie not only academics) in postgraduate projects. Two awards this year have been particularly pleasing for us. The Young Water Scientist of the Year (to Fiona Dyer), and the Professor K H Hunt Award (Santosh Aryal) for the best thesis in the Monash Faculty of Engineering. Equally pleasing has been the 100% take-up rate for students finding employment after completing their studies.

I want to mention the Second Stream Management Conference, held in Adelaide this year - a 'sell-out' event with over 400 registrants. The CRC was the organiser of the first such conference, and was heavily involved in this one as a co-sponsors, and manager of the technical program. The conference brought researchers, river managers, and community groups together; and featured presentations and discussion sessions involving them all. The success of the event was clear from the independent survey of participants' views.

We haven't neglected the importance of scientific exchange. A workshop on scaling issues – the applicability of research and measurements on small areas to much larger scales (and vice versa) – at the end of June brought 52 participants together. These included scientists from South Africa, New Zealand, and interstate. (The topic is particularly relevant for the 'new' CRC too).

These are some of the highlights from 1998/99 – our Year 7. When you read the Annual Report you'll find others, and see why we think it's been another good year. (If you don't receive a copy, and would like one, please call Virginia on 03 9905 2704).

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COOPERATIVE RESEARCH CENTRE FOR
CATCHMENT HYDROLOGY

MELBOURNE TECHNICAL SEMINAR

AFFORESTATION IMPACTS ON WATER YIELD

Speaker:
Dr Rob Vertessy
CSIRO Land and Water
Program Leader Predicting Catchment Behaviour

Thursday 25 November 1999

at Kimpton Theatre
Agriculture and Forestry Bld'g
Institute of Land and Food
The University of Melbourne
cnr. Tin Alley and Royal Parade, Parkville
(parking at University grounds for $2.00, Gate 1, Swanston Street)

Presented in conjunction with the Institute of Foresters, Australia

TIME:

5.30 pm start

COPIES OF VIDEOS, REPORTS AND WORKING DOCUMENTS ARE AVAILABLE FROM THE CENTRE OFFICE AT $20 PER COPY UNLESS OTHERWISE NOTED AND CAN BE ORDERED BY CONTACTING:

VIRGINIA VERRELLI ON
TEL (03) 9905 2704 or
FAX (03) 9905 5033
EMAIL virginia.verrelli@eng.monash.edu.au

PROGRAM 1
PREDICTING CATCHMENT BEHAVIOUR

Program Leader
ROB VERTESSY

Report by Rob Argent

A Catchment Modelling Toolkit (Project 1.1)

Following on from Program 1: Predicting Catchment Behaviour updates by Rob Vertessy and Rodger Grayson in recent editions of *Catchword*, the following article introduces Project 1.1.

Modellers' sins

Developing and using computer models in hydrology is at times a passion, a joy, a distraction, an annoyance, and even a downright pain. In model developers and users we find examples of all of the seven deadly sins, with developers' avaricious attempts to gain computing power, their gluttonous consumption of time, a lust for easy debugging and a better development environment, and their precious pride about the final results. In computer model users we see much sloth (read a manual? maybe later!), the envy of others with the latest version, and, of course, anger when the software doesn't perform.

Project goal

So, when developing a modelling toolkit for catchment hydrology we are dealing with some of the most powerful forces around (and I don't mean the 1 in 500 yr flood!). The goal of Project 1.1 is to provide a framework for the integration of existing models and newly developed ones (by Catchment Hydrology and others) into a toolkit for predicting catchment behaviour. We will provide a set of tools with which users can not only access and run existing models more easily, but also within which the technically inclined can develop their models without all of the input and output hassles that arise when starting from scratch.

Past approaches

Developing these tools is a daunting task – many of the CRC for Catchment Hydrology model developers reading this know that they can lump together a new monolithic model in FORTRAN (or even Delphi or C++) in half a day by cutting and pasting from existing models. The resulting models are often built to deal with specific research problems or locations, and, above all else, they work! This tradition has resulted in a legacy of monolithic models, many of which were developed when modern software engineering practice was in its infancy. These models have a high diversity of operational features (such as data formatting, time stepping, spatial structure, parameter input), despite often strong similarities in problem focus, data requirements and output interpretation. And, even worse, students pick up the bad habits of their supervisors and go on to create even more monolithic models.

New approach

So why a new approach? There are three reasons (at least!) – there are a few established models that CRC for Catchment Hydrology Parties would like to be able to use more easily; users and developers of emerging models would benefit from agreed procedures for review and documentation; and it would be nice to have a model development framework, tools and protocols in place so that developers can concentrate on the scientific task of algorithm development rather than the programming tasks of input and output management.

Project tasks ahead

Over the next few years, Project 1.1 will lead the establishment of protocols for evaluation, documentation, calibration and validation, and verification and peer review of models relevant to catchment hydrology. Experience has shown that our models, built by engineers and physical scientists, often work well but have limited abilities in fundamental software engineering areas such as flexibility, reuse, extensibility, and platform independence. Alternatively, models built by computer scientists and hard-core software designers don't meet the special needs of catchment hydrology. In the CRC for Catchment Hydrology we are in the fortunate position of being able to select and adopt those software engineering principles that aid our modelling, and ignore those that don't.

Pooling and incorporating models

In Project 1.1 we will pool a range of modelling approaches and models, adapt them where necessary, and develop methods for linking and sharing input and output across models. We will incorporate existing models as part of the toolkit testing and development procedure, thereby aiding the modelling approaches already in use by Catchment Hydrology Parties. This will act as both a feedback mechanism for how we are progressing, and also a way by which users can become familiar with the look and feel, and delivery mechanism, that will become part and parcel of CRC for Catchment Hydrology software.

Like all of the current CRC for Catchment Hydrology projects, Project 1.1 is in an infant state, with project agreements under negotiation, but look forward to further developments as we get into gear in 2000.

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PROGRAM 2

LAND-USE IMPACTS ON RIVERS

Program Leader

PETER HAIRSINE

Report by Carolyn Young and Peter Hairsine

Introducing the Murrumbidgee focus catchment

The Murrumbidgee catchment is a major sub-catchment of the Murray Darling Basin and covers an area of 73,400 sq km. The Murrumbidgee catchment is bounded on the east by the Great Dividing Range, and lies between the Lachlan Catchment to the north and the Murray Catchment to the south. Extending from the alpine areas and Southern Tablelands in the east to the Southwest Slopes and onto the Riverine Plains in the west, the catchment is highly variable in terms of physical characteristics. Due to this variability, the catchment area is often divided into three management areas - upper, mid and lower.

The Murrumbidgee River flows for 1,600 km and plays host to 14 major dams and 8 large weirs. The Snowy Mountains Hydro Electric Scheme assists with regulating water flow and supplying the 10,000kms of irrigation channels.

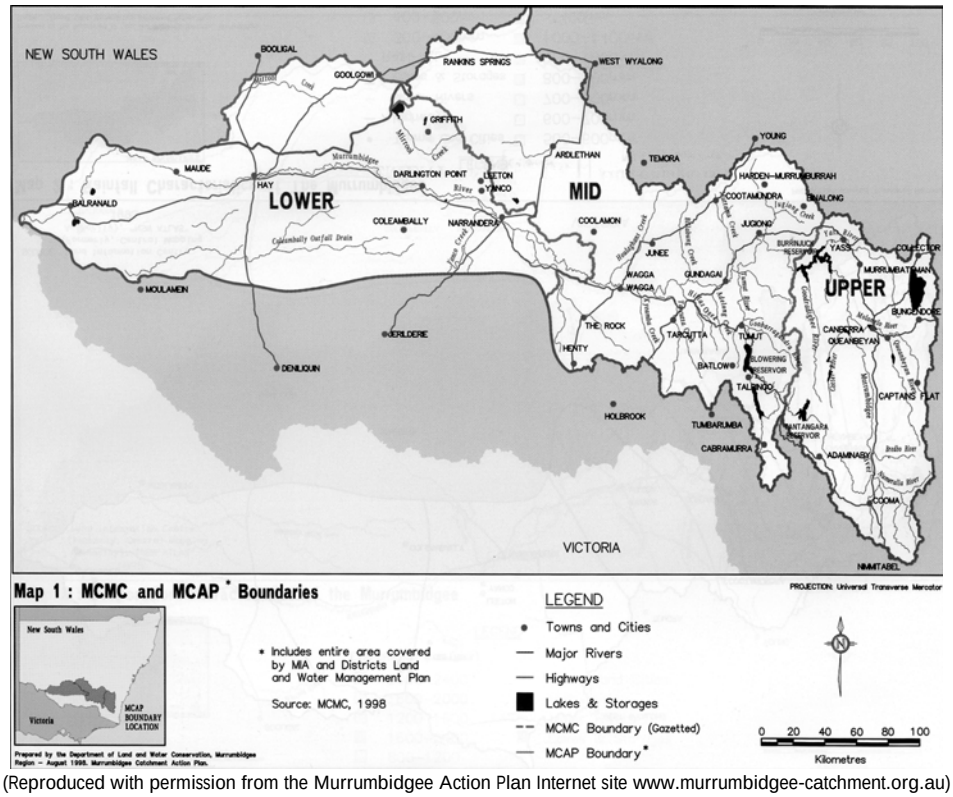
Land use varies from sheep and cattle grazing, conservation reserves and expansion of residential areas in upper catchment to irrigated agriculture, horticulture, dryland cropping and grazing, and forestry in the mid and lower areas of the catchment. The Murrumbidgee catchment is one of the most densely populated regions in rural Australia - over 520,000 people, including the ACT, with a growth rate of 1.5% pa.

The 'Murrumbidgee Action Plan' (MCMC 1998) has identified issues for the Murrumbidgee. Those high priority issues relating to the impact of land use on rivers are listed below:

- surface water quality management;
- remnant native vegetation management;
- dryland salinity and water logging;
- irrigation salinity and water logging;
- weed management;
- soil erosion;
- soil acidity;
- streambank erosion;
- riparian zone management;
- native vegetation decline;
- irrigation management;
- pest animal management; and
- wetland management.

Predicted land use changes in the Murrumbidgee catchment include:

1. Increase in softwood development;
2. Increase in vineyards (although this could slow down from current rates);



(Reproduced with permission from the Murrumbidgee Action Plan Internet site www.murrumbidgee-catchment.org.au)

NEW TECHNICAL REPORT

GUIDELINES FOR STABILISING STREAMBANKS WITH RIPARIAN VEGETATION

by

Bruce Abernethy and Ian Rutherfurd

Report 99/10

The Queensland Department of Natural Resources contracted the CRC for Catchment Hydrology to write technical guidelines to help specify the width and composition of vegetated riparian zones, for bank erosion control.

This report will guide and focus the practitioner's approach to planning riverbank stability works using vegetation.

The report is available from the Centre Office for $25.

Please contact Virginia Verrelli on tel: 03 9905 2704 or email: virginia.verrelli@eng.monash.edu.au

HOBART TECHNICAL SEMINAR

PROCESSES AND MANAGEMENT OF BANK EROSION IN HEADWATER STREAMS

SPEAKERS:
Dr Ian Prosser
Researcher, CSIRO CRC for Catchment Hydrology

Monday 8 November 1999
Start 11.15am
Tea/Coffee on arrival

at
CSIRO Marine Laboratories
Auditorium
Castray Esplanade
Hobart, Tasmania

For further information contact

David Bluhdorn on

tel: 03 6230 5960

3. The occurrence of dryland salinity in the upper-mid catchments and the resulting awareness of the problem (and access to funding) will probably lead to people changing their land use to prevent/reverse/control dryland salinity ie changing land use to native pasture, timber (including. carbon credits);
4. More hobby farms, especially around Canberra.

Project planning process

The CRC for Catchment Hydrology plans to test some of its research in the Murrumbidgee catchment. Projects are in an advanced state of planning and some should commence in the first half of 2000. Research issues considered will include: water yield changes resulting from land-use change, and sediment and nutrient movement through the Murrumbidgee's stream channel network (see September 1999 *Catchword* article "Fluxes and stores in river systems" by Jon Olley and Ian Prosser).

Murrumbidgee Catchment Coordinator for CRC for Catchment Hydrology

Carolyn Young is the Catchment Coordinator for the Murrumbidgee Focus Catchment. Carolyn is employed by the research arm of the NSW Department of Land and Water Conservation and 50% of her time will be devoted to the catchment coordinator role.

Carolyn has a degree in Natural Resources (Hons). Work experience includes trialling the Total Catchment Management (TCM) concept in the UK, coordinating the State-wide funding program 'Nutrient Control Works' and more recently, researching the feasibility of treating mine waste with constructed wetlands.

Current projects include the application of the newly released 'A Rehabilitation Manual for Australian Streams' in NSW.

References/further information

Murrumbidgee Catchment Management Committee (1998). Murrumbidgee Catchment Action Plan for Integrated Natural Resources Management. Murrumbidgee Catchment Management Committee.

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PROGRAM 3
SUSTAINABLE WATER ALLOCATION

Program Leader: John Tisdell

Report by John Tisdell

Socioeconomics: A new paradigm for the CRC

Catchment studies

Why do we fund the study of catchments? For many reasons - partially and importantly for knowledge and understanding, to restore flow regimes to natural states, but mainly to improve the condition and supply of water for people to use. Environmental and catchment problems are largely a result of human activity; thus, to manage a catchment requires the management of people. Economic activity, the activity of humans to improve their lot in life, has been blamed for the demise of our river systems.

Use of resources

Economics (as opposed to economic activity) is the study of how people use their limited resources to try to satisfy unlimited wants. In arid countries such as Australia, studying the use of our scarce water resources is vitally important. The driving force behind the extractive use of water in most catchments is the economic return from agricultural activity. Management of extractive water use requires an understanding of such motivating forces and the social implications and importance of water extraction for rural towns.

Socioeconomic aspects

In the new bid for funding, the CRC proposed to address the socioeconomic issues surrounding catchment hydrology. What does this actually mean? Socioeconomics is, as the name suggests, a fusion of sociology and economics. In practice, it means that economic analysis is conducted in concert with broader community issues. It is not a simple matter of ensuring that water is used where it produces maximum profit for the extractive user, for example. It is a matter of balancing the efficient use of water with the needs of rural communities, especially smaller communities dependent on irrigation activities for their survival.

Changes in status of water

The maturing of Australia's water economy and the resulting Council of Australian Governments (COAG) agreement has brought significant changes to the status of water. Water in many catchments is no longer an integral part of the land, and is at least, legislatively, a chattel which can be traded. Arguments for changing the status of

water are based on the notion that competitive markets will redistribute water in an equitable and efficient manner - provided there are no externalities to trade; there is a large number of buyers and seller who are well informed of the market's activities, and the rules of trade and the definition of rights are just. Furthermore there needs to be acceptance that extractive users wish to part with their water. For people to participate in a market there needs to be first an acceptance of the notion that water is now like a tractor or harvester which can be leased out or sold. Given community acceptance, consideration of the hydrological capacity to supply water to the new user, consideration of the environmental implications of changing the flow regime, and the community impact of shifting water and the associated community income, are integral factors within the hydrological, economic and sociological domain of mature water management.

CRC role

The CRC, with its depth of knowledge in the science of hydrological processes in catchments, is in the ideal position for integrating hydrological, economic and sociological processes operating within the biological and human environments of a catchment.

Within the sustainable water allocation program, Projects 3.1, 3.2 and 3.4 will in various ways address the socioeconomic issues within the focus catchments.

Project 3.1 will model the important linkages between the hydrological, climatic and economic processes operating in the focus catchments.

Project 3.2 will examine the acceptance of water as a tradable chattel, water market structures, (including conduct and performance), and develop trading rules.

Later, project 3.4 will explore the community implications of these new trading rules.

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NEW TECHNICAL REPORT

FOREST MANAGEMENT FOR WATER QUALITY AND QUANTITY PROCEEDINGS OF THE SECOND FOREST EROSION WORKSHOP - MAY 1999

by
J.Croke
P.Lane

Report 99/6

This report contains the Proceedings of the Second Erosion in Forests Workshop held in Warburton in May 1999. This volume of short papers and abstracts reflects the wide range of research approaches and tools currently used to measure and model the impacts of timber harvesting activities, including road construction and vegetation changes, on water quality and quantity.

Copies available for $20 from the Centre Office.

Please contact Virginia Verrelli on tel 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au.

SECOND EDITION OF INDUSTRY REPORT PUBLISHED

MANAGING URBAN STORMWATER USING CONSTRUCTED WETLANDS

by

Tony Wong
Peter Breen
Nicholas Somes
Sara Lloyd

Report 98/7

Over 900 copies of this successful Industry Report have been sold resulting in a Second Edition. This new edition includes a new section, Appendix A, which answers a number of common questions on the use of constructed wetlands in stormwater management.

Copies available from the Centre Office.

PROGRAM 4
URBAN STORMWATER QUALITY

Program Leader
TONY WONG

Report by Tony Wong

Constructed Wetlands in Urban Development – More answers to frequently asked questions

This is the final segment of the Frequently Asked Questions series on Constructed Wetlands presented over the last two months. The answers were prepared by Peter Breen (CRC Freshwater Ecology), Alf Lester (LFA Pty Ltd) and myself.

Question

Uncontrolled mosquitoes are a specific public health and amenity issue with regard to the use of constructed wetlands. How can good design reduce this risk?

Answer

Mosquitoes are a natural component of pond and wetland fauna. The construction of any water body (ponds or wetlands) will create some mosquito habitat. Mosquitoes however are usually not a dominant component of the fauna in freshwater systems and are controlled by natural processes such as predation.

Where mosquitoes become a dominant component of the fauna in freshwater systems (and are a public health risk) there are usually clear reasons:

- Water quality changes have impacted on predators
- The accumulation of plant litter or the growth of particular plant species has isolated areas of shallow marsh habitat from predators. In many systems this occurs as a result of reducing natural water level fluctuations.
- Increased areas of ponded or slow moving water, where natural predators (e.g. other insects, frogs and fish) cannot reach

A number of relatively simple design and operational features will limit mosquito populations and reduce public health risks

- Ensure predators such as other insects frogs and fish, have access to all parts of the water body.
- Ensure a proportion of the system is permanently inundated and acts as a refuge for predators
- Ensure the system experiences natural water level fluctuations. This interrupts the breeding cycle of some species and strands larvae on draw down
- When water fluctuations occur, ensure draw down is even so isolated pools are not separated from predators in the main body of water.
- Ensure the system receives a distinct wetting and drying cycle to help maintain desirable vegetation composition, breakdown plant litter and avoid excessive habitat partitioning by plant litter build-up
- Ensure human derived litter (eg. bottles, cans, cartons, etc.) does not accumulate in the system and act as an isolated breeding area
- Provide for artificial control over water level so seasonal adjustments can be made and active intervention undertaken
- Avoid directing low or trickle flows into overland flow paths. Where overflow paths are very flat or will be regularly engaged, provide sub-surface drainage
- During both construction and maintenance periods avoid the use of heavy machinery that create wheel ruts, isolated pockets and impede uniform drainage

Mosquito control is relevant to all components of the treatment train from gross pollutant trap (GPT) to the recreational lake.

Question

What are the management requirements of the vegetated zone? Do the emergent aquatic macrophytes need to be harvested?

Answer

The major long term management strategy for vegetation is to ensure that the different vegetation zones receive a hydrologic regime that will allow the target specie(s) for a particular zone to survive naturally and have a competitive advantage over potentially invasive species.

A major element of vegetation management is to ensure as natural a hydrologic regime as possible. Most natural hydrologic regimes are variable and result in water level fluctuations and wetting and drying cycles. The normal water level of a system has to be able to vary up, but particularly down, in a relatively seasonal way to ensure good vegetation cover and stability.

In constructed wetland systems the design of the outlet structure is critical to achieving variable hydrologic regimes that are well matched to the requirements of vegetation. Weir outlets tend to miminise water level variation, whereas perforated riser outlets and siphons maximise variation and allow some control of the hydrologic regime and the wetland vegetation.

Harvesting of emergent aquatic macrophytes in stormwater treatment systems is not required as a pollutant removal mechanism. The major role of vegetation in pollutant removal during event flows is its role in

enhancing sedimentation processes and providing surface area for the trapping and filtering of fine particles.

During low flows, vegetation provides a surface for the growth of biofilms which promotes pollutant uptake and transformation. This is an important stormwater treatment process, and consequently, the harvesting of vegetation could potentially decrease the treatment performance.

Over time, some large, deep-water species planting may develop a canopy that can contain a substantial amount of dead, standing plant material that can limit new growth, and result in a patchy vegetation

Because of the vital role of vegetation in stormwater treatment systems it is not advisable to harvest the whole system at one time. Should harvesting be required, the system should be progressively harvested to ensure uniform hydraulic resistance across the flow path and to encourage vegetation diversity.

Question

It is clear that the construction of some stormwater quality control devices and waterbodies within residential development will incur additional costs over and above what might be regarded as the standard order of costs for development. How can such additional costs be justified?

Answer

In part, the answer lies in sensitive urban design that adds value to the estate. The allocation of open space, drainage corridors and flow management, are now standard planning control and development conditions. There is already a clear requirement in many states to treat the quality of stormwater within the development site; often the use of constructed wetlands forms part of the Water Sensitive Urban Design strategy. The experience gathered from the design and development of a number of estates with significant water quality control devices, including waterbodies and wetlands, shows that these elements add to the character and help brand the estate.

Empirical data drawn from a number of projects indicates that the value of residential land, immediately adjacent to linear open space wetland/lakes, will sell at two to three times the average value received for residential lots within standard sectors of the estate. The increased value of lots adjacent to water elements also has a 'ripple effect'. Although land values progressively decline with distance from the open space/water elements, there is a substantial added value that accrues to the whole of the estate, rather than only to those lots that line the perimeter of linear open space/wetlands.

Data also indicates that where a strong image has been created, and there has been a high level of 'possession' by the incoming community, there is a higher rate of sale than might otherwise be achieved. This higher rate of sale effectively translates into further added value for the estate. A result of this is a faster return on investment, which can help off-set any extra costs of development.

Stormwater management using ponds and wetlands may not be suitable for all developments either because of size or topography. However, development conditions still need to be met and other Water Sensitive Urban Design techniques can normally be applied with little or no cost over conventional design.

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NEW TECHNICAL VIDEO

CATCHMENT WATER BALANCE A SIMPLE APPROACH

Presented by

Dr Lu Zhang
CRC for Catchment Hydrology
CSIRO Land and Water

CRC VIDEO 99/4

Results from over 240 catchments in many parts of the world, including Australia, show that for a given forest cover, there is a good relationship between long-term average evapotranspiration and rainfall.

This seminar describes the development of a simple two-parameter model that relates mean annual evapotranspiration to rainfall, potential evapotranspiration, and plant available water capacity.

NEW VIDEO

EROSION IN FORESTS
FIELD TOUR
WARBURTON, VICTORIA
MAY 1999

CRC VIDEO 99/3

This new CRC video presents the field tour in the Noojee State Forest undertaken as part of the recent 'Second Erosion in Forests Workshop'.

The video includes presentations by forest managers and researchers as well as questions from participants and group discussion.

Copies are available for $20 from the Centre Office.

Please contact Virginia Verrelli on tel 03 9905 2704 or email virginia.verrelli@eng.monash.edu.au

PROGRAM 5
CLIMATE VARIABILITY

Program Leader
TOM MCMAHON

Report by Alan Seed and Francis Chiew

Rainfall – space and time aspects

In one of the research areas in the Climate Variability Program, models will be developed to define the space and time characteristics of rainfall. The research will lead to methods for stochastically generating spatial rainfall data and design rainfall data. Methods for forecasting probabilistic short-term (several hours ahead), medium-term (up to a week ahead) and seasonal rainfall will also be included. Alan Seed from the Bureau of Meteorology will be responsible for most of this research, and he provides a background here of the research issues.

Managing variable rainfall and runoff

Australian rainfall is particularly capricious with droughts that can last over several years as well as periods of intense rainfall. In the semi-arid regions of Australia this variability in rainfall is amplified through the non-linear feedback processes (eg infiltration) in the hydrological cycle resulting in one of the most variable hydrological regimes in the world. Of course an accurate forecast of rainfall or runoff will not of itself prevent the crops from failing, water restrictions being applied, or the flood causing damage, but it could mitigate the effects of both drought and flood through improved management. Furthermore, the demands on the river systems are being reassessed to include the water required for the riverine environment and an adequate water quality - thereby increasing the need to manage the resource in an intelligent and optimal manner on a day to day basis. Quantitative measurement and forecasting of rainfall will therefore become an increasingly important component of operational water resource management.

Estimating resource supply and demand

The first and most basic step in any attempt to manage a resource is to determine both the supply and the demand. Informed attempts to manipulate the situation can only be made once the nature of the beast is understood more fully. The long-term availability of rainfall can be accurately determined through rain gauge networks, and very adequate maps of mean annual rainfall have been available throughout Australia for many decades. However, in the case of rainfall the devil is in the detail, or more accurately, in the variability in both space and time. This variability makes it difficult to measure rainfall accumulated over short periods and at high spatial resolution using point measurements only. Radar approaches can assist in managing this variability. The main attraction of radar measurements is their spatial and temporal sampling characteristics, although one has to tread warily through a slough of calibration issues and measurement artifacts.

CRC work to date

The CRC Project on "Spatial distribution of rainfall and storm movement" sought to address these problems by developing within Australia the methods to derive rainfall estimates from the weather radar measurements made routinely by the Bureau of Meteorology radar network. Calibration methods were developed and tested by Xudong Sun for his PhD using data from Darwin, with Sydney and Melbourne data having been used to develop calibration methods based on hourly and daily rain gauge data. An archive of significant rainfall events over the past four years for the three cities has been developed. These calibration methods will be used in a calibration sub-system which will enable real-time quantitative radar rainfall measurements to be made based on the Bureau radar network.

Errors

The error structure of rainfall measurements based on radar are quite different from those arising from rain gauge measurements. This difference, together with the impact of increased spatial resolution, implies that it is necessary to evaluate the impact of using radar data in hydrological models that have been developed and calibrated using gauge data. There is much work to be done therefore before radar rainfall measurements can be routinely used for hydrological applications.

Improving stochastic models

Radar measurements of rainfall are rich in temporal and spatial detail and therefore provide a natural source of information regarding the characteristic variability of rainfall in both space and time. This information is needed to improve the realism of stochastic models of space and time rainfall used to generate design storms and in water resource simulations.

There has been a rapid shift away from stochastic models of point rainfall to those based on scale invariance and turbulence. These models offer the hope of providing a parsimonious description of the spatial and temporal characteristics of rainfall over a wide range of scales.

A stochastic model of space and time rainfall has been developed and has been tested using the Darwin and Sydney radar data. The results, while still quite preliminary, are encouraging and the model is able to simulate both convective and widespread rainfall in both locations.

Next step – rainfields for design storms

The next step is to develop the model to the point where it is able to generate realistic rainfields for design storms within Australia. This will enable many equally plausible realisations of a design storm to be generated, thereby recognising the impact of spatial and temporal variability of rainfall on a design hydrograph.

A challenge ahead

Rainfall is highly variable over a wide range of spatial and temporal scales, and this impacts on the availability of water and the management of the river systems. A start has been made to quantify the variability at the small scale. Using the knowledge gained so far, the challenge now is to broaden our understanding of climate variability at the larger scale.

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PROGRAM 6
RIVER RESTORATION

Program Leader
IAN RUTHERFURD

Report by Nick Marsh

Predicting Scour at Snags

Our understanding of aquatic ecology is rapidly increasing, and so to is community awareness and involvement in the management and rehabilitation of our streams. Large woody debris (LWD) or snags have been recognised as a critical instream habitat element in lowland streams. The habitats provided by LWD include cover (i.e.shelter from predators).

Stream managers are not only maintaining existing levels of LWD but actively reintroducing it to streams. For the management or reintroduction of LWD, the formation of local scour holes can be a key criterion in maximising the habitat value of the snag. The prediction of scour hole formation like that shown in Figure 1 is the focus of Nick Marsh's PhD project.

Scour model criteria

There have been plenty of empirical formulae proposed for predicting a conservative scour depth at engineered structures such as bridge piers and groynes. This work has been useful in developing the LWD scour model. However, empirical models give limited insight into the scour processes involved and tend not to be easily generalised to dissimilar circumstances. The criteria for the LWD scour model is that it has to be simple to apply, applicable to a wide range of stream and LWD configurations, and provide quantifiable details that are suitable for stream management. The LWD scour model is based on a simple assumption that sediment will be scoured when the near bed flow conditions exceed those required for incipient motion of the bed sediment, and the scour hole will continue to grow until the near bed conditions fall below those for incipient motion.

The model development has required a solid approach to predicting incipient motion conditions, as well as a sound understanding of the flow conditions near alternative LWD configurations.

Incipient motion

Successfully predicting incipient motion conditions for sediment has frustrated researchers for most of this century. The biggest break through was the presentation of the well known Shields curve in 1936 and since that time researchers have concentrated on fine-tuning the semi-empirical curve.

INDUSTRY SEMINARS

MANAGING SEDIMENT SOURCES AND MOVEMENT IN FORESTS - THE FOREST INDUSTRY AND WATER QUALITY

SPEAKERS:
Dr Jacky Croke
Project Leader, CSIRO Land and Water
CRC for Catchment Hydrology

Dr Peter Wallbrink
Research Scientist, CSIRO Land and Water
CRC for Catchment Hydrology

Mr Peter Fogarty
Soil and Land Conservation Consulting (SLCC)

MELBOURNE
Monday 22 November 1999
Start 1.30pm for 2.00pm
Finish 4.30pm

BERMAGUI
Wednesday 24 November 1999
Start 9.30 for 10.00am
Finish 12.30pm

TAREE
Friday 26 November 1999
Start 9.30 for 10.00am
Finish 12.30pm

REGISTRATIONS CLOSE:

Tuesday 16 November 1999

Please see Industry Seminar Flyer with this issue of *Catchword*

STREAM CONFERENCE PROCEEDINGS

The Proceedings of the Second Australian Stream Management Conference held in Adelaide earlier this year are available through the CRC Centre Office for $95.

The two volumes (750+pp) consist of over 150 papers covering all aspects of stream management.

Please contact Virginia Verrelli on 03 9905 2704 to order your copy.

Figure 1: Scour hole formed under a River Red Gum log in the Edward River NSW. Under most flow conditions this log is submerged and the scour hole creates a great fish habitat

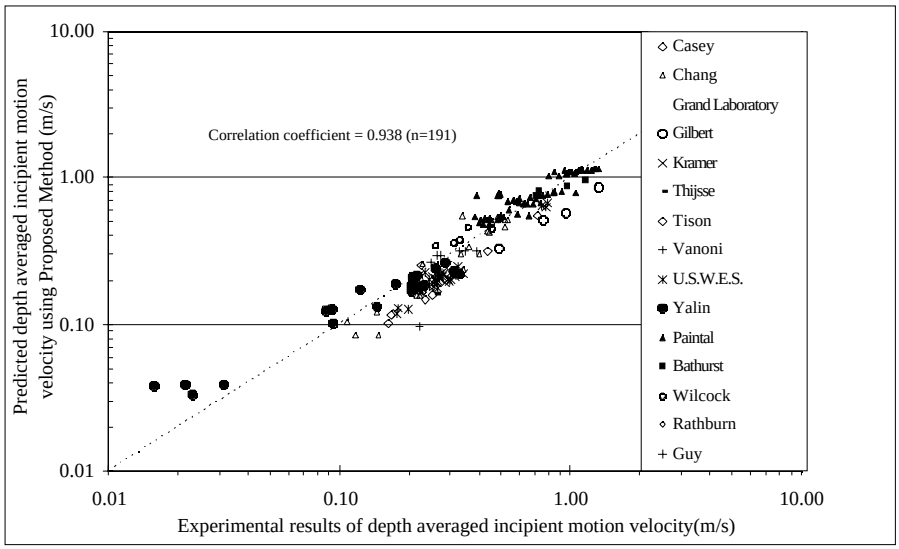

Figure 2 comparison of the proposed method of predicting incipient motion with results from experimental studies.

An alternative approach to that of Shields was presented by Yang (1973).It is also semi-empirical, but based on a critical velocity approach rather than Shields' critical shear stress approach. With the luxury of almost 100 years of mobile bed flume studies to fine-tune existing methods, Nick has been able to revisit the incipient motion question from a different perspective.

A new method

Nick has developed a new method of predicting incipient motion conditions based on the theoretical conditions for particle movement with the inclusion of lift and drag coefficients, and incorporating the effect of bed features such as a scour hole or bed forms. Figure 2 compares the theoretical incipient motion velocities (depth averaged) with those measured by experimentation. There are 191 data points presented here from 15 independent studies,

with sediment size ranging from 0.1mm to 22.5mm, and flow conditions with Reynolds numbers from 0.026 to 29435.

Local flow conditions around LWD

After determining the incipient motion conditions of the sediment, the other key element of the model is to predict the local flow conditions around alternative configurations of LWD. So far, Nick has been able to produce what appear to be reasonable approximations by considering the flow pattern at analogous traditional engineered structures. Single logs in the channel are modelled on flow conditions at submarine pipelines. For log jams at the side of the channel, flow patterns at a very rough groyne are considered, and for larger jams that confine the channel, flow patterns for channel constriction are used.

Results to date

So far the model is limited to theoretical calculations. The first real test will come by way of a series of validation runs in the flume at the University of Melbourne's hydraulics laboratory over the coming summer. Following the extensive flume work and likely fine-tuning of the LWD scour model, Nick will validate the model in the real world by looking at some LWD scour holes in a sand bed stream. By going through this involved process of refining and validating the model, we should end up with a simple and effective method of predicting LWD scour hole formation, and probably a little more insight into other related fluvial scour issues.

Nick Marsh
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EDUCATION & TRAINING PROGRAM

Program Leader
RODGER TOMLINSON

Report by Rodger Tomlinson

Introduction

The Education and Training Program will focus on developing the knowledge and skills base in land and water management across a range of audiences from high school students to corporate managers. The program will be offering a set of educational products in collaboration with other CRCs. The emphasis will be on the holistic or systems approach to catchment management. Key features of the program will be the inclusion of educational research projects in the area of action learning, and the integration of the planning and implementation of strategies with the Communication and Adoption Program.

PhD Program

Advertisements have recently been placed calling for research students interested in supplementary scholarships. The CRC Business Plan provides for 12 top-up scholarships during the life of the CRC, and up to 12 full scholarships. Students will be placed for periods with industry parties or community groups and will be expected to undertake specialist courses covering topics such as conflict resolution, project management, science/policy interface, science communication, environmental leadership, management of change and resource allocation. All of these topics are appropriate for enhancing the effectiveness of the students in the broader arena of integrated catchment management. Holistic PhD projects addressing the complex relationships between issues causing current problems will also be encouraged.

Postgraduate courses, short courses and seminars

An integrated group of courses will be developed utilising a range of flexible delivery techniques to provide a variety of training and educational opportunities. Web-based delivery, CD_ROMS, intensive short courses and interactive short courses will be used. Collaboration with other CRCs will see the development of subjects to be made available in existing Masters degrees dealing with the whole of system approach.

A key issue for the CRC is the adoption of the whole of catchment approach, particularly in the major land and water authorities. This will require the enhancement of training strategies and the involvement of research and

FLOOD WORKSHOP

CONTINUOUS SIMULATION SYSTEM FOR DESIGN FLOOD ESTIMATION

Main Presenter

Dr Walter Boughton

23-24 November 1999 at Monash University, Clayton

COST

$450
(non CRC party representative)
$400
(CRC party representative)

Registration form supplied with this *Catchword.*

Further details available from the Centre Office.

Please contact
Virginia Verrelli on
tel: 03 9905 2704 or email
virginia.verrelli@eng.monash.edu.au

ANNUAL REPORT

The CRC for Catchment Hydrology 1998/99 Annual Report is available.

Free copies can be obtained from the Centre Office.

stakeholders in the development of training modules to deliver the Centre's research outcomes. The Education and Training Program will work closely with the effective extension networks operated by several of the CRC's industry Parties.

Undergraduate Courses

The CRC can play a role in enhancing the effectiveness of graduates from many of our professional degree programs by encouraging a more integrated approach to natural resource issues. One way to achieve this is to develop guidelines for the introduction of a systems approach in subjects related to catchment management.

Community Education

The CRC has a role to play in changing community attitudes, and resource material will be developed for secondary school and community groups on catchment behaviour and management. Other short courses will be delivered to target audiences. One of the tasks proposed in this area is research into the development of frameworks for participatory involvement of the community in catchment issues. Outputs from this project will enhance the activities of the Communication and Adoption Program. This project will be carried jointly with the new CRC for Coastal Zone Estuary and Waterway Management. Indeed, a number of initiatives for joint development and delivery of education and training are being explored with both the Coastal CRC and the CRC for Freshwater Ecology.

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UPDATE EVAPOTRANSPIRATION MAPPING PROJECT

We regret to advise that the publication of the evaporation maps has been delayed, likely for some months. On the virtual eve of printing the maps, we discovered an error in the computer program used to generate them. This error occurred after our quality assurance processes, including a comparison with Morton's original program to ensure identical output results, and hence escaped earlier detection. We are glad that the problem was found prior to distribution, and are now investigating options to re-do the maps. I'd like to thank Dr Roger Jones and Dr Nick Austin for help with identification of the error.

To those who are waiting on the maps, the CRC apologises for this delay; you can be assured that we will do our best to expedite the revision.

(PROJECT LEADER: Q.J.Wang)

CRC PROFILE

Our profile for October is Lu Zhang.

Lu Zhang

I was born in Kashi, a small city in the far west of China. My earliest memory is of playing in a muddy river with a couple of kids. But it was a pity that I never learned how to swim. At the time, my father was working in a hydroelectric plant about 20 km from the city and there was no school there. This did not bother me and I stayed happily at home till I was eight. In 1968, my family moved to a power station closer to the city and I joined nine other kids in a local school starting from year three. The first lesson I learned was to take an afternoon nap and I was punished for not knowing that.

School in Kashi was very relaxed and we had a lot of time for playing, thanks to the Cultural Revolution. We spent most of school time in the countryside, at factories, and in the army - learning from peasants, workers, and soldiers. As a result, we missed out a lot on the subjects we were supposed to learn. In 1977 I finished my high school, and like thousands of other young graduates, I went to the countryside for "re-education". It was then I understood how important it is to have a proper education, and I began to study the subjects I missed in school. I had to be re-educated during the day (e.g. digging irrigation drains, building houses, etc) and educate myself during the night (e.g. learning physics, chemistry, etc). It took me two years to pick up all the subjects, thanks to my teacher who helped me voluntarily with my study. Initially I thought I would never even make university.

In 1979, I passed the national test for entering university and became a student in the Geography Department of Xinjiang University in Urumqi. That was the first time I heard the word "hydrology" in Chinese, and did not know what that meant exactly – I am not too sure about it even now! One of the interpretations offered to me was that it is the "art of water". I still like this interpretation. I cannot really say that the reason I chose hydrology as my major was because of my good memory of playing in muddy rivers as a child. The real reason was that I realised that if I studied hydrology I would have opportunity to visit the great rivers in China. In 1982, we went for a month-long field tour visiting several great rivers, including the Yangtze, to see what hydrologists were doing. This perhaps was the highlight of our university life.

After finishing university in 1983, I worked in the Geography Department for two years as a teaching assistant on groundwater hydrology. It was a coincidence that I went for an English test in 1985 organised by the Chinese IHP Committee and "accidentally passed the test", according the head of the department who did not want me to go for the test. The Head didn't actually like me, and kept my Certificate a secret for several weeks. From the IHP Committee I obtained a list of universities where I could study hydrology, and started to write letters to them. I remember it was in April 1986 that I received a letter from Professor Van der Beken of Vrije Univeristeit Brussel (VUB) and was very excited to learn that I had been accepted by the Inter-university Postgraduate Program in Hydrology. I managed to get my passport and visa organised and left Beijing on 27 August 1986. This was my very first flight and a long one – I was sick the whole time.

Life in Brussels was very different. For the first a couple of months, I felt lonely and home-sick and I was not sure that I wanted to continue my studies. However, this feeling disappeared shortly after the examinations started. As time went on, I started to enjoy my study. In 1988, I completed my Masters Thesis on evaporation, supervised by Professor R. Lemeur from the State University of Ghent. In the same year I was awarded a scholarship by the Belgian General Administration for Development Cooperation (ABOS), and started my PhD program. During my four years at VUB I worked with hydrologists and plant ecologists and learned how plants and water interact with each other. As part of my dissertation, I developed a model for estimating regional evapotranspiration using remote sensing data. I have to say that I really enjoyed the summer holidays in Europe visiting Bruges, Rubenshouse, Salzburg …

It was not an easy decision for Mei and I to come to Australia in 1993. When we landed in Sydney airport and managed to find the Climatic Impact Centre (CIC) at Macquarie University, I was greeted by a list of tasks from my boss with deadlines highlighted. Wait a minute, this does not sound like Australia! Well, I had to work long hours and spent all my spare time working in order to meet the deadlines. Anyway, I worked just over a year on the so-called PILPS project as a postdoctoral fellow. It was an interesting experience and I learned a lot about climate change and land surface schemes for general circulation models.

I joined CSIRO Division of Water Resources (now part of CSIRO Land and Water) in 1994 and the overall thrust of my research is towards achieving an understanding of the

Please note...

CRC publications and videos are listed in a separate document "CRC Publications"

The latest update has been included with this months *Catchword*

Additional copies of the October to December Publications List are available from the Centre Office.

processes underlying the hydrological cycle and interactions between the land surface, vegetation and the atmosphere. My research programs have encompassed modelling of regional scale water balance in relation to vegetation changes, soil-vegetation-atmosphere interactions, monitoring and assessing crop water use efficiency using remote sensing, and development and testing of physically-based models, particularly WAVES, and SCAM. My recent work has focussed on predicting whole-catchment water balances from annual rainfall and percent forest cover, and this work will continue in the new CRC in Peter Hairsine's Program.

In my spare time away from the long hours at work, I like gardening, playing table tennis, and listening to classical music, especially Beethoven.

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WHERE ARE THEY NOW?

Report by Santosh Aryal

After submitting my thesis in April 1998, I continued with the CRC for Catchment Hydrology preparing manuscripts for papers based on my PhD research. During this period, I went to the AGU Spring Conference -1998 in Boston. The trip was a fruitful experience. It gave me a feel for the enormity of size of the research community in hydrology and other geophysical disciplines in USA. Apart from other mainstream researchers, I found hundreds of students like me were vying for attention to their work from attendees who had a huge selection of research outcomes to digest in the form of poster papers and oral presentations. One of the impressions I came back with was that unless you are pre-published, it is pretty hard to get the attention of the participants in such crowds. Hence you don't get enough discussion and feedback on your article.

I started working in Sinclair Knight Merz (SKM) in Melbourne in June 1998. Having been a student for three and half years it was good to get back to the 'real world'. My work in SKM dealt mostly with dryland salinity problems in Victorian catchments. I enjoyed the opportunity to work and have a tiny part in concerted efforts that are being put into addressing the problems of salinity. While working with SKM I graduated and was awarded the Ken Hunt medal for excellence in research from the Faculty of Engieering at Monash University.

Recently, I have started as a postdoctoral fellow with the CSIRO Division of Land and Water in Perth, working in the Hydroclimatic Processes and Impacts group led by Bryson Bates. During my postdoc research, I envisage working mostly in the areas of scaling and regionalisational behaviour of catchments. This research involves the application of similarity theory that I developed in my PhD and requires a fair bit of data handling and interpretation. Currently I am performing terrain analyses of catchments from Victoria and New South Wales using digital data supplied by DNRE (Victoria), and the Land Information Centre (LIC) in NSW. The aim of this research is to come up with groupings of catchments in homogeneous regions based on the similarity of hydrological processes in catchments.

On the personal front, moving to Perth was a big change for us, more so for my wife Puja whose experience of living in Australian cities was limited to Melbourne. Now that we are settling-in and waiting for the arrival of our first baby in December, we feel we couldn't have chosen a better place to raise children.

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WORKSHOP ON
CONTINUOUS SIMULATION FOR DESIGN FLOOD ESTIMATION

Monash University
23-24 November 1999

Main presenter:
Dr Walter Boughton

This workshop is intended for people experienced in flood design who are interested in applying the latest developments in flood estimation methodologies. The continuous simulation approach developed by Dr Boughton in association with the CRC allows estimation of design floods from frequent events to floods of 1 in 2000 AEP.

Please see flyer with this *Catchword* or contact Virginia at the Centre Office on tel: 03 9905 2704 for more information.

WATER VICTORIA EMAIL (WAVE) LIST

The WaVE list (formerly known as VicWater) has been set up to facilitate the discussion of water related issues.

The list is free and can be used to advertise seminars, workshops, job vacancies, to solicit information on any range of water related topics or any other appropriate use. Posters should keep matters relevant to the state of Victoria, Australia. The list is closed, which means that only those on the list can post a message, but it is open for anyone to subscribe or unsubscribe as desired.

To subscribe, send subscribe to: wave-request@eng.monash.edu.au

To send a messages, send an email to:
wave@eng.monash.edu.au

The list is maintained by Peter Hill at Sinclair Knight Merz. Any queries should be directed to: phill@skm.com.au.

WaVE is supported by the Victorian Water Engineering Branch of the Institution of Engineers and the CRC for Catchment Hydrology.