Circulation

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Chartered Hydrologist: blocked by Government policy

The Main Committee has been beavering away at investigating the feasibility of the Society applying to the Privy Council for its very own Royal Charter. If successful, this would have enabled professional hydrologists who hold appropriate qualifications and who have achieved a standard level of competency, training and experience, to be awarded the title 'Chartered Hydrologist', or CHydrol.

Regrettably, we have to report that the Main Committee's study has indicated that it would almost certainly be impossible for BHS to attain this Royal Charter in its own right. After many meetings with Institutions such as ICE, CIWEM, the Society for the Environment and most recently the Science Council, it has emerged that we would be unable to meet the stringent requirements of the Privy Council on a number of counts. It has also become clear that it is Government policy not to allow a proliferation of chartered designations, but instead to force all professionals working in these fields to accept the three main umbrella

professional titles of: CEng, Chartered Engineer; CEnv, Chartered Environmentalist; and CSci, Chartered Scientist.

Although this is disappointing, it is not entirely surprising and we are not dispirited or discouraged by this development! Our discussions with the various institutions have actually helped us focus on the main issues and also helped to forge closer ties with the key players. But we have also been able to bring to the attention of each party we have met, the importance that our members attach to the need to improve opportunities and training programmes for professional development for hydrologists.

Our survey last year clearly indicated that although there is a strong demand, too few hydrologists actually achieve, or are being encouraged to work towards, chartered status. There are also indications that key employers are reviewing their attitudes towards this important issue, mainly because it is now being recognised by many, particularly in the public sector, that their policies and structures for professional development for hydrologists have been completely inadequate in the past, and that there needs to be a concerted effort on all sides to address this problem.

This presents the Society with a great opportunity to work with the institutions and key employers to change the *status quo* and to move this long-standing issue forward with a much greater sense of urgency. Our next objective is to reach agreement with all the parties, so that more formalised training programmes can be set up to ensure that candidates aiming for any of the three chartered professional routes will have clear and unambiguous sets of hydrological experiences and competences to achieve. Members will still be free to chose which route suits their own experience and aspirations, and whether they should work towards chartership through corporate membership of either ICE, CIWEM, IWO (Institution of Water Officers) and possibly one or two others. But for more and more of our members we do want to make the features of each of these routes more obvious, with the end goal of Chartered status being seen as more attainable and the career benefits more transparent.

There are still several important issues to resolve, such as formal support from all the key employers, academic 'vetting' of appropriate MSc courses and agreement on the definition of competencies for what could become three slightly different groups of professionals within BHS – Engineering Hydrologists with CEng, Scientific Hydrologists with CSci and Environmental Hydrologists with CEnv.

Progress has been made, and we really do feel that we are well on the way to raising the profile of the professional hydrologist not only within the main Institutions, but also in the eyes of the key employers. We hope to report on further progress at the AGM on 19th September at Birmingham University.

Rod Hawnt and Celia Kirby

Its Exeter!

Yes, the BHS National Hydrology Symposium for 2008 will be held in Exeter University. Appropriately, for our tenth such event, we shall be returning to Exeter where — as more senior members will remember — the idea for a hydrological society was discussed and subsequently launched 25 years ago.

It was also the venue for our first international conference, held in 1998. Ten years on, and the facilities are even better, with a new hall of residence close to the conference facilities in the Peter Chalk centre.

The theme is "**Sustainable Hydrology in the 21st Century**" and the meeting will run from 15–17 Sepember 2008. Calls for abstracts will be made in early September — check the web address: http://www.events.ex.ac.uk/bhs2008/index.php/bhs/ for further details.

President's piece

My two years is nearly up. Just when you start to get to grips with the job, it's time to hand on the baton to the next in line – on 19th September Frank Farquharson takes over as your new President.

I will leave my end-of-term report for the AGM, to be reproduced in the next issue of this newsletter. But I can report that the last two years has seen the effects of climate change on extreme weather variability come to the fore as a major issue, not only for hydrologists, but also for the media and the general public. The Year of the Drought (in SE England) in 2006, has been followed immediately by the Year of the Floods. Flash floods have suddenly become more like buses.… you don't see one for years and then all of sudden 2 or 3 arrive one after the other, with two major events in less than a month hitting (for the most part) different parts of the country. Except the poor town of Tenbury Wells in Worcestershire, where the River Teme burst its banks at least three times during the two events. In Bromyard, where my own office is, a few properties were also inundated during both events, with some elderly residents of a caravan park (sited far too close to the banks of the River Frome) being rescued by the Fire Brigade and cars being submerged on a causeway less than 100 metres from my office.

Even the wedding of the daughter of a long-standing BHS member and old friend and colleague, Alec Willis, who lives in my own village, was affected. Just days before 'the big day' there was still over a foot of water in the Church! Luckily, flash floods recede nearly as quickly as they rise and after the enormous clean-up efforts of villagers, family and friends the wedding went ahead as planned on a beautiful sunny day. It had to happen to a hydrologist!

Was this a message from The Big Weather Controller upstairs? Have I underestimated my own talents for long-term weather forecasting? Maybe there is a potential business opportunity for producing hydrological crystal-balls!

"What on earth is he on about?" I hear you say. Well, in my last piece, written at the end of April, I wrote: "Another summer flash-flood of Boscastle proportions, especially if an urban environment in the south east is affected, will only serve to confirm the media's proposition that the next 'sauna-age' (as opposed to 'ice-age') is upon us already!" Oh dear, oh dear — I should have kept my mouth shut! Sorry, Alec!

These events are, of course, described as 'unique' or 'unprecedented' in living memory, probably because media memories are so short, and the spatial distribution of events is totally ignored. There is certainly an opportunity here for BHS to advertise to the media the existence of the Chronology of British Hydrological Events; visit www.dundee.ac.uk/geography/cbhe. For the hydrologist it's not difficult to ascertain that if you get an extended duration summer-profile intense rainstorm of greater than 100 mm falling onto saturated catchments, with high CWIs or low SMD, then rapid runoff is inevitable. But low SMD in late June and July **IS** 'exceptionally rare'! Only once before (in Easter 1998) have I witnessed so many instances of direct surface runoff coming straight off fields and onto the roads or into people's property. On this occasion many of those affected in our part of Herefordshire live nowhere near a watercourse, until new ones suddenly appeared running through their gardens or down their drives and into their homes!

So what is the cause? A shift in the position of the Jet Stream and/or *El Nino* are being cited as possible reasons for the high rainfall during June and July that preceded each of these events. Undoubtedly climate-change is happening and for the first time firm scientific evidence emerged (coincidentally in the week after the July floods) linking an increased frequency of storm events with global warming. *The Independent* and other newspapers ran articles about the latest findings from the Hadley Centre Research team which claim that 'human fingerprints' were all over the most probable causes of more frequent extreme storm events, because this is exactly what is predicted by their climate models. Whether it's droughts or floods, or the vast amount of extra work being generated by the requirements of the Water Framework Directive, this is all good news for the professional hydrologist in the UK. The lead article in this issue explains why BHS will be unable to achieve

the Holy Grail of Chartered Hydrologist, but this drive for better recognition as key professionals has also confirmed that there is a strong demand and need for more formalised professional development training programmes for hydrologists. Not just from our members who are frustrated by poor career structures and a lack of opportunity to progress without changing jobs, but also from many employers, particularly in the public sector.

That is why the time can never be better, when hydrologists are in greater demand than ever, for BHS to work more closely with Institutions, universities and employers to produce a nationally-accepted professional development framework for hydrologists; similar to that which has been in place for engineers for decades. That is the next challenge in our campaign.

Rod Hawnt
President

Ecohydraulics

6th International Symposium Christchurch, New Zealand 18-23 February 2007

This Symposium is held every two years, each time on a different continent. After Madrid in September 2004, Christchurch was chosen to host this week-long event, during which researchers from all around the world discussed subjects related to hydrology, aquatic ecology and the emerging disciplines of hydroecology and ecohydraulics. More than 300 delegates attended the conference, which was divided into 4 sessions per day, following a keynote lecture in the morning.

My particular interests are fish habitat use in rivers and streams in relation to habitat availability, flow regime and other environmental parameters. I was first to present on "Aquatic habitat characterization, flow variability and habitat use by brown trout (*Salmo trutta*) and bullhead (*Cottus gobio*)". Riverine physical habitats and habitat utilization by fish have often been studied independently such that flow variability and its influence on habitat use are not well understood. Varying flows modify habitat composition and connectivity within a stream. My study examines the utilization by brown trout and bullhead of habitats that vary with flow in terms of size and type, persistence or duration, and frequency of change from one state to another, by comparing groundwater-dominated sites (stable regime) with runoff-dominated (flashy regime) upland, riffle-pool streams. Habitat surveys carried out at two-month intervals on the River Tern, Shropshire (groundwater-dominated) and on the Dowles Brook, Worcestershire (surface runoff-influenced) showed differences in habitat composition and diversity between the two streams. The temporal variability in mesohabitat composition was also shown to differ between the two flow regime types. Direct underwater observations showed differences in habitat use between the two species, as expected, but also between the two flow regimes, which led to a new hypothesis as to which processes (biological or physical) most influence fish habitat use.

Kristin Eastman (Stuttgart University, Germany) followed with a very interesting talk about the effects of embeddedness on the spawning habitat of fish, describing a methodology to assess and characterize it in a quantitative way in the field, from negligible to high. This new methodology was implemented in two case studies on the suitability of salmon and grayling spawning habitat in gravel bed rivers and showed the importance of including embeddedness when modelling spawning habitats.

Jian-Ping Suen (National Chung Hung University, Taiwan) presented "Determining the necessary flow regime for operation of existing reservoirs", a novel regime-based approach that uses hydrological indicators to achieve the characteristics of a desirable downstream ecological flow regime.

The ecological flow regime approach is more focused on reducing the impacts of the existing reservoir by providing the necessary amount and variability of water for a

Travel grants

Travel grants are awarded from the Society's general funds to help BHS members whose travel expenses to attend scientific meetings are not met by an employer. Applicants should have been members of the Society for at least six months. The amount will depend on the nature and location of the meeting and the case put forward.

Priority is given to members under 35 or retired from employment, who are presenting papers and who have not previously received support from BHS. Successful applicants will be expected to write a short report for *Circulation*. Travel grant applications should be made to the Hon Treasurer at least two months before the conference or meeting.

The Exeter Fund, administered by the Society, offers grants to British hydrologists to take part in IAHS / IUGG events.
To apply, use the form at *www.hydrology.org.uk/about_awards.htm* or contact **Peter Ede**, Mott MacDonald Group, Demeter House, Station Road, Cambridge, CB1 2RS *(tel 01223 463690, email peter.ede @mottmac.com).*

river to support its downstream ecosystems. In this project, a post-dam ecological flow regime is proposed for the operation of existing reservoirs. This regime has two major concerns. First, the ecological flow regime considers the characteristics of flow data from nearby locations with less human modification. Second, the serial discontinuity concept is applied for modification of the reference flow. These steps allow the ecological flow regime to be established for the downstream area of the existing reservoir. We remained in Taiwan for the next talk as **Hsiao-Wen Wang** presented "Assessment of environmental conditions of Bei-Gang River in Taiwan". Along the Bei-Gang River, a pool-and-weir type fish passage at the Da-Chi Dam, established in 1997, was destroyed in a big flood. Using one-dimensional modelling, as well as the Index of Biotic Integrity and habitat suitability curves for key fish species in the river, the situation was assessed in this river to establish maintenance base flows. Following the results obtained, a replacement fish passage was built. This showed a very clear example of how current research on habitat availability, flow regime and fish can find applications in water engineering.

Another session also of major interest to me was "Habitat suitability and fish". **Ian Jowett** (National Institute of Water and Atmospheric Research, Hamilton, New Zealand), **John Hayes** (Cawthron Institute, New Zealand), **Michel Dedual** (Taupo Fishery Area, Department of Conservation, New Zealand) and **William Miller** (Miller Ecological Consultants, Colorado, USA*)* each presented different tools to assess and represent habitat use by salmonids as well as habitat suitability. Ian Jowett focused on GAMs (General Addictive Models), which are non-parametric smooth functions that predict the relationship between abundance (or probability of occurrence) and flow. Their major advantage is that they take into account the correlation that exists between habitat variables such as depth and velocity. John Hayes advocated general fish habitat use curves as opposed to river specific ones which are too sensitive to the habitat conditions in one river. He also stated that habitat use curves are more realistic than habitat suitability curves (this is a big debate at the moment!). Michel Dedual argued that when studying fish habitat use, one should take into account the relationship between flow and food production in a stream. William Miller showed that bivariate habitat use curves are a better, more accurate representation of what happens in streams. Mapping of the spatial distribution of habitats using bivariate parameters (depth × velocity) was recommended.

This symposium was a very inspiring experience. The very interesting talks, combined with the good atmosphere, provided me with a lot of opportunities to meet people working on similar subjects and to come out with a lot of ideas for my PhD. It gave me confidence and enthusiasm to pursue a career in academia.

Marie-Pierre Gosselin
School of Geography, University of Birmingham

Uncertainty in Environmental Modelling

International Workshop, Uppsala, Sweden, March 2007

As part of the activities associated with **Keith Beven's** (Lancaster University) 2006/07 visit to Uppsala University, courtesy of the King of Sweden, an international workshop was hosted by the Uppsala Water Centre to explore a favourite topic of Keith's on 'Uncertainty in Environmental Modelling'.

The workshop began with presentations on methods for undertaking uncertainty analysis, and then progressed through considerations of uncertainty in data and model conditioning, to a focus on the final day on communication of uncertainty within a decision-making context.

After the workshop was opened by the main organiser, **Sven Halldin** (Uppsala University), **Keith** gave a keynote talk on the GLUE controversy, a subject that has produced several recent communications in the *Journal of Hydrology*. This was followed by several interesting presentations including discussion of the value of multi-objective optimisation by **Henrik Madsen**, the utility of wavelet analysis for assessing model performance by **Bettina Shaeffli** and comparison of models using Bayesian methods by **Marcel van Oijen** (CEH). There seemed to be a general consensus that there was no shortage of methods available for undertaking uncertainty analysis, but it was important to remember that most often whilst only one component of uncertainty (e.g. parameter uncertainty) was directly accounted for within the analysis, other types of error (such as model structural error) were likely to influence the results.

The breadth and variety of presentations on the second day highlighted the many and varied potential sources of uncertainty in environmental modelling and served to underline the importance of quantifying this uncertainty. **Andras Bardossy** presented an assessment of the influence of uncertainty in spatially varying rainfall estimates on modelled stream flows. Studies involving water quality data and modelling by **Katri Rankinen**, **Francesc Gallart** and **Karl Wahlin** highlighted the additional uncertainties that come into play when water quality is considered in addition to quantity. **Jim Freer** (Lancaster University) also highlighted many of these issues, but also considered how we might move forward to potentially reduce uncertainties in the future, by developing an uncertain learning framework to inform the design of monitoring and field data collection and to refine model structures.

On the final day the implications of modelling uncertainties were considered by a series of presentations that discussed communication of uncertainty to policy-makers and model end-users. **Jeroen van der Sluijs** highlighted the fact that decisions often need to be made before conclusive scientific evidence is available and that the potential impacts of incorrect decisions can be very large. **Jen Christian Refsgaard** and **Sarah Dunn** (Macaulay Institute) both referred to decision support tools that have been developed through recent European projects to provide a framework for communication between modellers and end-users, to ensure that appropriate models are selected and that the results, including uncertainty analysis, are correctly interpreted. **Georgia Destouni** demonstrated how uncertainty in model predictions could influence policy decisions by integrating the risk within a cost-effectiveness framework for pollution abatement.

The practical implications of uncertainty highlighted by this final session led to a good healthy debate to conclude three very interesting and informative days, from which it was clear that the issue of uncertainty in environmental modelling is likely to steer many aspects of future model development and application.

Sarah Dunn
Macaulay Institute

Progress with the BHS/NHF *Hydrology Research* journal

If you missed news of it in previous issues of *Circulation*, the new journal *Hydrology Research* will start in 2008, published by IWA Publications. It will supersede *Nordic Hydrology*, the well-known journal of the Nordic Association for Hydrology (NHF) since 1970, and aims to increase the number of issues per year from four (*NH*) to six (*HR*).

BHS and NHF have joined forces for *HR*, each appointing an Editor. Dan Rosbjerg (Denmark) is the current Editor of *NH* and will continue as Editor (NHF) of *HR*. Ian Littlewood is Editor (BHS) of *HR*. Fortuitously, both Editors attended the XXIV IUGG General Assembly and were able to discuss progress towards *HR*. (At IUGG, Dan was elected a Vice President of the International Association of Hydrological Sciences, IAHS; *HR* will surely benefit from this link.)

Nordic Hydrology is an international journal (*HR* will continue and strengthen this aspect) but it is not surprising that a recent analysis by IWAP shows that a large majority of the top ten cited *NH* papers, from 2003 to 2007 (so far), were concerned with aspects of the hydrology of Nordic countries and arctic/glacial/alpine regions, and that most of the authors of those papers were from Nordic countries. Continuation of this strong input from Nordic and cold-region hydrologists to the new *HR* is expected; *HR* will be largely 'business as usual' for the NHF with Dan continuing in his editorial role. However, *HR* is an important and exciting new venture for BHS.

Hydrology Research will be the official journal of BHS and NHF. British hydrologists (particularly BHS members) are encouraged to support *their* journal by submitting papers and helping to review manuscripts. Manuscripts for possible publication in *HR* can be submitted now via the IWAP online submission scheme accessible from the *NH* website (https://www.editorialmanager.com/hydrology/. Offers already received from BHS Members to help with reviewing manuscripts have been greatly appreciated but more are needed. If you receive an email from the IWAP Editorial Manager asking you to review a manuscript please respond positively if you can. If you do not hear from that route but consider yourself to be a potential reviewer (this is vitally important 'hydrological community' work and can be rewarding at a personal level) please contact the Editor (BHS) with your details.

The success of *HR* for BHS depends to a large extent on enthusiastic support from BHS Members. Please consider *HR* as a publication route for your work, and encourage others to do the same. *HR* needs your manuscripts now. The Editors are currently putting together an *HR* Editorial Board that will appear in the next issue of *Circulation*.

Ian Littlewood
Editor (BHS), *Hydrology Research*
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News from members

CONSULATIONS

As many of you know, BHS is often asked for input to government consultations. As a professional society, we welcome this and we thank all those who responded recently to two DEFRA exercises. You may also be interested that we were asked recently to comment on the efficacy of the UK Research Councils but declined to do so because of the difficulties of speaking on behalf of so many of our members who are either R.C. employees or in receipt of research funding.

CONGRATULATIONS

to **Prof James CURRAN** of SEPA, who has been made an MBE for services to the environment and to sustainable development in Scotland

Also to **Nigel Arnell** who takes up his appointment as Director of the Walker Institute for Climate System Research, Department of Meteorology, University of Reading, as from 1st August 2007.

EGU General Assembly

Vienna, Austria
15th – 20th April 2007

The format of these conferences is like AGU meetings, with many sessions consisting of short presentation slots. The conference acts as both an academic forum and social gathering for geoscientists from all over Europe, with discussion taking place both within and outside the formal academic programme. Vienna is a great setting for a conference, especially as the congress centre is located on the banks of the Danube, and within easy reach of the centre of the city. This year, the weather was especially beautiful, and the sun shone all week. However, as the week is always packed with sessions and events, time for sightseeing was limited! BHS funded the four of us to attend. Tobias was one of seven UK hydrologists who travelled to the conference by train, a 24-hour journey via London, Brussels and Cologne, to raise awareness of the environmental impact of academic travel — of which more later... but as the train was a little lacking in comfort, most chose to travel more conventionally by air. Clare and colleagues from Sheffield University found flying to Bratislava and cruising down the Danube a particularly enjoyable way to arrive in Vienna.



The conference was well organised, and pre-registration meant that even registration was generally hassle-free. The only place where queuing was really necessary was for the two computers in the rehearsal rooms — which presented an opportunity to meet some interesting people. The conference was a mixing pot for all sorts of people with a wide variety of academic interests, and the week was inspiring. However, the sheer number of sessions could be overwhelming — especially if you had not been before. Between us, we attended a large number of different talks and the following notes present some of the talks and events which we found most memorable, organised loosely under topic headings.

New techniques

One technique with potential for developing understanding of both small and large scale runoff and sediment transport processes is the development of environmental tracers. **Pryce *et al.*** presented work on developing tracers for phosphorus and sediment using rare earth oxides (REOs) and fluorescent microspheres. The talk described the potential that these two novel methods provide, not only in terms of the identification of sources of sediment and phosphorus, but also regarding connectivity and pathways, and reported the results of initial experiments which showed encouraging results of the binding capabilities of REOs to soil particles as well as improvements in cost-effective analytical extractions. **Michaelides *et al.*** also compared the application of REOs and ^{134}Cs as soil tracers for quantifying sediment connectivity across the hillslope–floodplain interface and spatial patterns of soil erosion and deposition.

Grimm *et al.* focused on digital soil organic carbon mapping, using environmental layers of soil classes, parent material, forest history, and various topographic attributes, and a random forest modelling approach, which is a new entity of ensemble regression tree approaches. This new method is insensitive to overfitting and irrelevant features, considered an advantage over standard methods.

Another technique of advanced data acquisition is the Generalized-Nearest-Neighbor (GNN) technique for the improved classification of remote sensing data, presented by **Schulz *et al.*** Instead of the commonly used distance measures to classify remotely-sensed image pixels, they proposed a non-linear transformation of the original mapping space to separate clouds of pixels of the same class. This is considered to be more accurate than standard K-Nearest-Neighbour techniques, to allow improved exploration of the uncertainties of classifications, and was able to identify critical areas of data limitation. **Tetzlaff & Wendland** showed how aerial photographs can be used to identify the locations of field drains. These represent an important pathway for diffuse nutrient and pesticide inputs to surface waters in agricultural areas although spatially-differentiated data are generally not available for models. The presentation showed that artificial drainage installations can be identified using differences in soil moisture, soil density and height of vegetation.

The issue of scale was a recurrent theme within the sessions. **Javaux *et al***. compared different approaches for modelling root water uptake, arguing that different effective processes dominate at different scales which therefore require different models. The underlying model assumptions were reported to have large effects on the prediction of root water uptake. **Govers *et al*.** touched on the importance of scale in erosion process research, noting that data are scale-dependent and that processes are not well understood across a range of scales. However, while many experimental studies focus on data from plot scale experiments, **Krueger *et al***. demonstrated that we still do not fully understand the processes which operate at this scale. In the context of sediment and phosphorus transfer, the knowledge gaps appear to be the links between hydrology and sediment dynamics. In an attempt to explore some of these issues, multi-scale experiments were described which used novel monitoring methods, for example, **Deasy *et al.*** described how it is possible to monitor runoff and nutrient fluxes at the sub-catchment scale without a plot structure. The transfer of data across scales was also briefly considered, with **Brazier *et al***. showing that nutrient data are scale dependent, and that empirical relationships could be used to upscale understanding of nutrient behaviour in degraded semi-arid environments.

Connectivity

The concept of 'connectivity' transcended various sessions and was the main focus of talks in at least six different sessions. It is widely acknowledged that the connectivity of landscape components affects fluxes of water and sediment and, consequently, nutrients and biological functioning within catchments. Fundamentally, the more connected a landscape is, the faster and more efficiently water and sediment will move through the system. Connectivity, however, is affected both by the morphological and surface characteristics and external factors (such as the spatial patterns of rainfall intensities and durations) of a catchment. Also, depending on the environment, different factors have varying degrees of control on hydrological connectivity. Therefore, there many factors across varying time and space scales that may control connectivity. The increasing appeal of this concept for understanding these fluxes is partly due to the range of scales and environments at which it can be applied and partly due to the approaches that can be taken to describe it — statistical, geostatistical, mathematical, empirical.

Several talks focused on the effect of vegetation structure and pattern on runoff connectivity on hillslopes. **Hearman *et al.*** tested the effects of different vegetation patterns (such as bands, labyrinth, patches and randomly-distributed vegetation) on runoff connectivity through an indirect effect on infiltration rates, using percolation theory. They found that a threshold percentage of vegetation cover existed, above which more rainfall was needed to generate and connect runoff on the hillslope. **Sandercock and Hooke** also discussed the role of vegetation in reducing sediment connectivity in ephemeral channels. Through its effect on increasing channel roughness, vegetation in different locations may prevent sediment movement and decrease the connectivity of sediment transfers within ephemeral channels of SE Spain. **Lane *et al.*** examined the effect of topographic structure on catchment hydrological

connectivity using a topographic-derived Network Index to represent the duration and frequency of hydrological connectivity at different points on their catchment grid. Their results implied that hydrologic connectivity may be controlled by a relatively small number of topographically-defined critical locations within a catchment.

Lesschen and Cammeraat posed hydrological connectivity as a concept for upscaling runoff and erosion in semi-arid areas, considering the critical controls at three scales. At the plot scale, vegetation is the main control on hydrological connectivity; at the hillslope scale, slope gradient, shape and substrate are the principal controls; while at the catchment scale, geomorphological boundaries are critical. By using this concept of connectivity it is possible to identify 'sinks' at different scales which dis-connect water and sediment movement in catchments.

Zehe and Blöschl gave a paper on a new theoretical framework for measuring connectivity of flow paths, in which they discussed connectivity of flows as a manifestation of Fermat's principle – the idea that the system follows pathways that minimise the time it takes for excess water to leave the system. **Croke *et al.*** investigated two forms of connectivity on sediment delivery from the Fitzroy River catchment, Queensland, Australia to the Great Barrier Reef Marine Park, the effects of hillslope-channel coupling and the presence of 'bottlenecks' on sediment movement and patterns within the catchment. **Chifflard and Zepp** investigated the influence of connectivity between hillslopes and floodplains on channel flow in a small instrumented German catchment. They demonstrated the effect of the flat floodplain element on delaying runoff entering the channel and the presence of groundwater-related thresholds for runoff connectivity across the hillslope-floodplain-channel interface. The effect of riparian wetlands in hillslope-channel connectivity was also considered by **Soulsby *et al.*** where thresholds in hyporheic exchanges were identified as being important for hillslope-channel hydrological connectivity, with important implications for hyporheic ecosystems. **Tetzlaff *et al.*** discussed the implications of catchment hydrological connectivity on the connectivity of aquatic habitats and the migration of adult Atlantic salmon into the Girnock catchment, Scotland, for spawning. In an overview paper, **Kirkby and Bracken** presented a conceptual model for the different mechanisms of hydrological connectivity in semi-arid and humid environments.

Risk Management

An interesting session for anyone involved in the disaster management aspects of hydrology, was session NH12, which considered interoperability and data access requirements for disaster reduction and emergency management. **Caballero *et al.***, opened with a discussion of ORCHESTRA, a Unified Open Architecture for Risk Management Applications. This was the first of three presentations on the implementation of a particular data infrastructure used for disaster management, using pilot projects focusing on one or two hazards in a particular locality. An implicit assumption in all three presentations was that the hazards had been adequately identified and prioritised, or that this would occur during the piloting phase.

Löwe *et al.* discussed a tsunami warning system, produced by Germany as part of a bilateral aid package for Indonesia (German/ Indonesian tsunami Early Warning System – GITEWS). This paper focused on the use of the 'Sensor Web Enablement' (SWE) approach, to communicate between newly installed ocean monitoring instruments and an operations room. **Fabbri & Nagy-Rothengass**, summarised previous work done in this field and outlined opportunities for future funding under Framework Seven. Among many of the presenters, the benefits of Service Orientated Architecture (SOA) were assumed without question. Nagy-Rothengass was the only speaker to suggest that there are limits to SOA, describing them as "necessary but not sufficient", listing data licences, standard compliance and network connectivity as some of the potential problems not solved by the application of SOAs. Amongst a number of interesting observations was that funding agencies tend to only fund pilot studies, and there is reluctance on behalf of the research funding bodies to fund projects to completion. This tends to mean that many projects never get further than the pilot stage as alternative funding

is not available for the later stages of the project. Practitioners therefore need to encourage funding bodies to fund projects though to an operational status.

Additional Highlights

Aside from the academic sessions, two highlights of the week took place on the Tuesday evening. The first was a debate on *'The carbon footprint of academic travelling*'. Background to the debate had been provided earlier by **Krause *et al.*** on the sustainability of different ways of travelling to the EGU General Assembly. The talk had presented an approximation of the carbon footprint of the EGU General Assembly based on the travel behaviour of a sample of this year's attendees, and explored possibilities for cutting down on carbon emissions, comparing different travel options in terms of their immediate economic cost, CO_2 emission, security, efficient use of time and comfort. **Wouter Buytaert** and **Tobias Krueger**, from Lancaster University's Department of Environmental Science, former EGU president **John Ludden** (also BGS president), **Martin Juckes** from the British Atmospheric Data Centre and BBC science reporter **Jonathan Amos** debated whether the carbon footprint of the EGU is bigger than necessary. The responsibility of geo-scientists to consider their environmental impact carefully was accentuated, and the uncertainties in carbon emission data and the need for a detailed carbon budget of the EGU General Assembly were discussed. It was argued that the conference attracted a large number of splinter and business meetings and was therefore more effective than separate smaller conferences. Several ideas were put forward for reducing the conference's carbon footprint, including alternative locations, more use of communication technologies, low carbon emission travel funds from the conference organising body — potentially in negotiation with train companies — and carbon emission offset schemes. The reduction in size of this year's conference abstract book by more than half was presented as a positive example for saving resources. The topic attracted a large and interested audience and generated positive feedback: it remains to be seen whether the EGU will take on board some of the suggestions to improve the sustainability of its General Assembly.



Gary Bilotta (IGER North Wyke)and Richard Brazier (Exeter) taking time out from the sessions and enjoying the sun.



Peter Strauss (Federal Agency for Water Management, Institute for Land and Water Management Research, Petzenkirchen, Austria), John Quinton, Tobias Krueger and Owen Pryce (Department of Env. Sci., Lancaster on their way back down the Danube to Vienna after visiting Peter's research centre at Petzenkirchen.

The second was a networking dinner organised by **Artemi Cerdà**, to provide a relaxed atmosphere in which social and academic networks could be expanded. The event was held in a typical Viennese

Weinkeller, and was attended by around fifty conference attendees with an interest in soil and erosion processes.

Overall, EGU 2007 was a thought-provoking and worthwhile event, and is a conference worth travelling to, especially if the environmental impact of conference attendance is carefully considered!

Clare Deasy, Sheffield & Lancaster Universities
Tobi Krueger, Lancaster University
Katerina Michaelides, University of Bristol
Andy Smith, Newcastle University

Water management and conservation: recent developments in hydro-ecology

BHS National Meeting (with BES)
ICE, London, 18th April 2007

This conference was organised jointly by BHS and the British Ecological Society and sponsored by the Environment Agency, Natural England and the Countryside Council for Wales. The three agencies have been working closely together to develop an understanding and practical ways to assess the interactions between water and ecology. This work was driven by the need to assess the impact of existing abstraction licences and water management on water and wetland habitats. The conference was divided into three sessions: (1) Water Flows in Wetlands, (2) Hydroecology in Rivers and (3) Wet Dunes and Wet Grassland.

Ian Barker, head of Water Resources in the Environment Agency, opened the meeting. Ian gave a customer's perspective, highlighting the pressures on water resources and the need for robust information to support risk-based decision-making. Ian's comments were supported and added to by **James Marsden** from Natural England who chaired the first session.

Bryan Wheeler from Sheffield University gave two presentations on wetland water supply mechanisms (WETMECs). The first covered the concepts behind the classification of wetlands using water supply mechanisms. The classification set out 20 different WETMECs developed using data from around 200 sites. The second presentation demonstrated the practical applications of the theory in setting objectives for wetlands, understanding threats and identifying appropriate management solutions.

The first session finished with a presentation by **Nadia Barsoum** of work by Forest Research. This developed the water supply mechanism approach, discussed in the previous presentations, to Wet Woodland habitats and in particular to residual alluvial forests within the UK. This covered identification of appropriate objectives and management regimes for these types of habitats and also identification of where the current gaps in understanding lie.

The second session, chaired by Ian Barker, began with **Kevin Exley** presenting a summary of work done by the Environment Agency on the River Itchen. The approach used an understanding of the relationship between invertebrates and flow to set summer low flow thresholds. For the Itchen, the flow in the previous summer influences the invertebrate community in the following spring.

Presentations of work on rivers continued with **Mike Dunbar** from CEH looking at LIFE scores (lotic invertebrate index for flow evaluation) and how they can be influenced by habitat modification. Long-term invertebrate datasets were examined alongside River Habitat Survey habitat modification scores and it was found that modified habitats tend to have lower LIFE scores but have a steeper gradient of response to changes in flow.

This was followed by **Mike Acreman** from CEH presenting the results of a collaborative project





A conceptual model of dune-slack hydrology was presented which demonstrated the sequential development of slacks within a system. They set out further research that would be needed to establish restoration and management requirements.

The presentations sparked much useful discussion which will be accommodated in future development of hydro-ecological project work.

Alastair Burn from Natural England closed the conference by reiterating some of the challenges for the future, in particular providing tools that enable risk-based decision-making and understanding the consequences of those decisions.

Katie Fawcett and Kath Charles
Environment Agency

developing a tool kit enabling the rapid assessment of river characteristics as a guide to the likely impact of flow changes on available physical habitat.

The final session, chaired by **Alistair Burn** from Natural England, picked up on themes from the first session. The first presentation was by **David Gowing** of the Open University. He discussed the importance of understanding the hydrology of wet grassland sites, as there was a clear link between plant communities and soil hydrology. He set out work that had investigated what degree of variability in unusual years could be tolerated and what would lead to a change in vegetative community.

The final presentation on wet dune slacks was by **Tony Davy** of the University of East Anglia with **Ab Grootjens** of Groningen University.

Editorial

Well, what do you think of it? Better? Please give us some feedback, including your views on whether we should give only short summaries of event write-ups and then publish the full accounts on the web. This would be in the cause of saving paper, you understand, absolutely not to deny our dutiful rapporteurs the chance to give full rein to their literary skills. See page 18 for one example of how we might do things in future.

While on the subject of web communications, will members please note that since the majority have email access, we shall forewarn you this way for future Society voting, even though you may wish to return your ballot papers by snail mail.

Celia Kirby

How can we trust models?

BHS National Meeting hosted by the South East Section
Centre for Ecology and Hydrology, Wallingford
5th June 2007

Computer modelling plays a key role in modern-day water management. However, modellers are confronted with a wide range of choices, complex problems and often limited theoretical understanding and system data. These challenges often reduce confidence in the modelling process and ultimately in the results. The aim of this meeting was to increase awareness of the approaches adopted across key domains and institutions to support good modelling practice and this may encourage the development and adoption of standardised procedures. The meeting was well attended with more than 50 delegates (mostly practitioners).

Mervyn Bramley (Wessex Regional Flood Defence Committee) provided an excellent introduction to the day with an assessment of the problems faced by today's hydrological modellers in building trust into models to increase their applicability and post-development use. He highlighted the wide range of models that are available and emphasised the importance of the modeller having a clear under-standing of his/her requirements. He considered whether there are some basic procedures and checks that could be followed to avoid some of the common modelling problems. He suggested we should concentrate efforts on "How can we be sure we are getting the best out of the model?" rather than "Is this a good model?". He concluded by saying that the procedures and frameworks being presented later in the meeting may help ensure that we get the best out of our models for the money, effort and data invested in them.

Jon Bartlett (Black & Veatch Ltd.) gave an enlightening and incredibly matter-of-fact run through the practicalities of creating suitably validated models with his presentation entitled, "Does my flood look big in this? Practical validation of river models". Jon encouraged delegates to use all the tools available to them, from formal database management and survey validation techniques (including GIS) to good old common sense and visual checking of data. A comprehensive list of common traps was revealed, including allowing communication between hydrologist and modeller to deteriorate, and relying on undefined floodplain flow paths in 1-D model codes. Practical modelling was encouraged by adding an element of truth to models, allowing human adjustment, together with judgement, on the basis that the hydrologist is better than a model 90% of the time. During the discussion that followed the importance of checking rating curves, inspecting visual data and the role of the expert modeller in assessing if a model is behaving properly were stressed.

Paul Hulme (Environment Agency) provided a groundwater modelling perspective with his presentation on "Groundwater modelling — how do you model something you can't see?". He reported that a survey of existing groundwater models revealed that only 5 out of 32 had been used since their development, the main reason being a lack of confidence in their representation of the actual groundwater systems. This demonstrated the need to have an iterative process for improving conceptual understanding, and for groundwater models this may account for about 50% of the total effort. The use of models was put into perspective with a conclusion that models are often not initiated to give the right absolute answers, but to provide enough tested and structured information to engage with other disciplines. The discussion focused on the importance of model validation and on how we can encapsulate the expertise used to develop the model.

Robert Lamb (Jeremy Benn Associates) presented "Good modelling practice in flood mapping and forecasting" concentrating on applying protocols for minimum

standards in hydrological modelling, including effective project management. Robert showed an example of comparing a scaled inflows methodology with fully distributed rainfall-runoff techniques, to demonstrate that the model should be driven by the project objectives and outputs required. During the discussion the importance of floodplain roughness in predicting flood depths was stressed. Furthermore, it was flagged that this can only be defined subjectively at present.

Neil Murdoch (Environment Agency) gave the last presentation of the morning session, entitled "Water quality modelling in a regulatory context". He described how modelling techniques have responded to the need to calculate permits and to have a strong statistical orientation, reflecting the requirements of EU Directives. He suggested that as point sources are now much better controlled, the focus is shifting to diffuse sources. We do not know the effectiveness of the spot sampling regime to characterise such sources and their impacts. The discussion that followed focused on how we can build greater trust in probabilistic models. There is a clear need for more data to produce stronger quantiles and regressions.

The afternoon session was chaired by **John Rodda** (Hydro-GIS Ltd) with the main emphasis placed on frameworks currently available to support the modelling process, therefore complementing the morning session very well.

David Ramsbottom (HR Wallingford) gave the first presentation 'Modelling and Decision Support Framework (MDSF) for Catchment Flood Management Planning'. The MDSF calculates the impacts of flooding using outputs from flood models and provides a structured framework to support decision-making. The system

New members

Ulrika Aberg.....University of Leeds
Helen Adams.....Environment Agency, Tonbridge
James Addicott.....Environment Agency, Winchester
Jacqueline Helen Arthur.....JBA Consulting, Skipton
Melissa Bance.....Environment Agency,Ipswich
Dan Boswell.....Environment Agency, Knutsford
Michaela Bray.....University of Bristol
Richard William Dunn.....British Waterways, Swansea
Rolf Farrell.....Environment Agency, Leeds
Jason Dean Fairbairn.....Environment Agency, Lincoln
Colin Fenn.....Independent Consultant, Goring on Thames
Mark Cyril Franklin.....Environment Agency, Warrington
Andrew Bruce Frost.....The Concrete Centre, Camberley
Andy Gilbert.....Hyder Consulting, Cardiff
Alison Jayne Goddard.....Yorkshire Water, Bradford
Sarah Goode.....Environment Agency, Reading
Robin Green.....Hydro-Logic Ltd, Bromyard
Robin Guy.....Mouchel Parkman, Bradford
Michael John Hammond.....Atkins Water, Swansea
Alexia Haysom.....Environment Agency, York
Stuart Hyslop.....Environment Agency, Reading
Barbara Hohenwarter.....Halcrow, Waltham Cross
Paul Hulme.....Environment Agency, Peterborough
Janmaizatulriah Jani.....University of Sheffield
Victoria Jayne King.....Capita Symonds, Portishead
Evangelia Kordomenidi.....University of Birmingham
Joanne Leverick.....Environment Agency, Reading
Stefon Laeger.....Environment Agency, Winchester
Attila Lazar.....Reading University
Edwin James Lomas.....NJL Consultants, Ironbridge
Matthew Kennedy.....University of Birmingham
Dr Sally Mackenzie.....Halcrow, Swindon
Paul Michael Marchant.....Environment Agency, Lincoln
William Matthew Mayes.....IRES Newcastle University
Eleanor Isabel McOuat..Mountain Environments Ltd, Callander
Will Minchin.....Entec UK, London
Mary Catherine Ockenden.....Lancaster University
Jon Pavey.....Mott MacDonald, Cambridge
Abigail Ruth Pryce.....Entec UK Ltd, London
Ilias Pechlivanidis.....Imperial College London
Katherine Pygott.....Halcrow, Handforth
Renji Remesen.....Bristol University
Jeanne-Phillipe Renauld.....Bristol University
Zdenka Rosolova.....JBA Consulting, Skipton
Elizabeth Scott.....Essex & Suffolk Water, Chelmsford
Jessy Simmance.....Environment Agency, Hatfield
Michael Streetly.....ER International, Shrewsbury
Nicola Sugg.....SLR Consulting, Bradford on Avon
SonBad Trinh.....University of East Anglia
John-Paul Wale.....Sinclair Knight Merz, London
Catherine Wilson.....Halcrow, Handforth

was developed initially in 2002 to provide support for Catchment Flood Management Plans (CFMPs) but has wider applications, such as Shoreline Management Plans, and various strategy and feasibility studies. David outlined the nature of CFMPs and how the MDSF contributes to the process. The framework enables the collection and management of the data required, helps to identify present and future flood risk areas and allows for the appraisal of various options. It also provides a consistent approach to facilitating the production of these catchment flood management plans and provides guidance on land use and climate change scenarios.

Typical outputs of the MDSF are flood extent maps and flood depths (GIS-based data management), an assessment of flood damages and various social impacts. An assessment can be made of flood risk under existing conditions and with estimated future scenarios and with proposed flood management policies in place.

David demonstrated the calculation of flood extent and depth and how flood damage can be derived from this. A typical output from the MDSF are depth-damage curves, where water depth is plotted against economic damage. An estimation of average annual damages can be calculated from this and following on from this, a calculation of the social impacts (social flood vulnerability index). David concluded his presentation by reminding everyone about the dangers involved in not undertaking a thorough QA of the large datasets involved. Errors can be caused as a result of incorrect interpretation of the data.

A short discussion followed regarding the sharing of best practice and the need for more effective communication between the various parties involved in the modelling process. Enquiries were made as to further versions of the MDSF software. A second version is currently being developed and should be available by spring 2009. Updates include a more thorough treatment of flood defences and enhancement to the overall approach to flood management but the newer version will not account for the benefits given through flood warning.

The final presentation of the day was given by **Gareth Old** and **John Packman** (CEH). The presentation detailed the 'Updated HarmoniQuA Modelling Support Tool'. Harmonising quality assurance in model based catchment and river basin management (HarmoniQuA) was completed at the end of 2005. The project developed a software-based Modelling Support Tool (MoST) and an associated Knowledge Base (KB) to contribute towards enhancing the credibility of catchment and river basin modelling. The project was run over four years (2002–2005) and involved 12 partner organisations from ten countries. Great emphasis was placed on consultation and the review of literature and best practice. Gareth summarised the key points of the modelling support tool and how the system aims to provide a user-friendly guidance and quality assurance framework. The HarmoniQuA framework enables the user to record all stages of the modelling and therefore provides an audit trail to check previous decisions. Guidance is given for the next phases of the modelling to promote best-practice. HarmoniQuA provides harmonised support for modelling across seven domains (groundwater, precipitation-runoff, hydrodynamics, flood-forecasting, water quality, biota and socio-economics).

John gave a live demonstration of the system and detailed the main phases of the system. The KB, which consists of a flowchart of the modelling process and associated guidance, is central to MoST. The main steps of the flowchart include

- Model study plan
- Data and conceptualisation
- Model set-up
- Calibration and validation
- Simulation and evaluation.

Each step includes a broad assessment of the general soundness of the approach or results obtained and a report/discussion between the client and modeller. John also took the audience through the three main components within MoST: (1) Guiding; (2) Recording; and (3) Reporting. The system is comprehensive but also flexible so that it can be tailored to specific types and complexities of modelling jobs.

Key points raised in the discussion included the value of systems such as HarmoniQuA as a reference tool and whether they really do assure quality. It was stressed that the use of MoST does not ensure a model is properly used: it provides a structure to support good modelling practice

and allows all parties to preserve a record of what they have done so that models can be reviewed and updated.

There was an interesting discussion on the nature of modelling and how we can trust models. Attendees were keen to discuss how we assess the confidence in models and what is the correct definition of 'trust'. It was concluded that the technical community should show how we can get the best value out of the modelling process and existing best practice and how we can build upon this. The aim is to use models in a beneficial way to facilitate and support the decision-making process. The benefit of international collaboration in developing a wide-ranging approach to quality assurance was recognised. This is likely to be particularly relevant to trans-national river studies (*cf* WFD requirements). Presentations throughout the day demonstrated that many modelling problems are common to several domains so quality assurance procedures may be developed most effectively in a collaborative way. The final points raised included a discussion of the re-use of existing models and how far this can be taken.

The conference served to increase the awareness of the various procedures that are being adopted across many domains and institutions to support good modelling practice.

Helen Proctor, Atkins Ltd
David Mould, Gareth Old and John Packman
Centre for Ecology and Hydrology, Wallingford

[Readers please note that extended abstracts from this meeting will be available on the BHS web site shortly –Ed.]

Sue Walker awarded Honorary Membership

On behalf of the Main Committee of the Society I am pleased to announce that the Society has awarded Honorary Membership to former President, Dr. Sue Walker.

The award of Honorary Membership is made for life in recognition of the contribution of distinguished individuals to the practice of hydrological science or engineering, or to reward the outstanding contribution of a BHS member to the work of the Society.

Sue joined North West Water Authority in 1980 as a hydrologist. She was primarily involved in the planning and operation of water supply systems but also worked on hydrological aspects of sewerage and sewage treatment systems. She became Hydrological Systems Manager on privatisation in 1989 before moving across to the National Rivers Authority in 1991 as NW Regional Water Resources Manager. She then became Regional Water Manager in the Environment Agency where her remit extended to Flood Defence, Fisheries and water-based recreation and conservation.

Sue is one of the few members of BHS to be awarded an Honour from the Queen — the OBE awarded in the 1998 New Years' Honours list for 'Services to Water Management', recognising her leadership in the management of the 1995/6 drought.

Sue left the EA in 1999 when her family decided to move to Braemar in Scotland. She was then appointed a part-time Professor in the Dept. of Geography and Environment at the University of Aberdeen, whilst also starting her own consultancy practice. Since moving to Scotland, Sue has continued to develop her professional career in new areas of public service, while at the same time raising a young family. Since 1999 she has held a number of public sector appointments in Scotland — as a Board Member of North of Scotland Water Authority and Scottish National Heritage, and currently with SEPA, the Deer Commission for Scotland and the Cairngorms National Park Authority. She is also a Member of Waterwatch Scotland (which represents views of Scottish Water customers), the Fisheries (Electricity) Committee (which advises Ministers and the industry on the impact of hydro development and operations on fisheries) and on the Scottish Executive Scientific Advisory Panel. The latter complements her earlier roles on the Terrestrial and Freshwater Science and Technology Board of NERC and the Built Environment College of EPSRC.

Sue is a widow following the sudden death of her husband in November 2004. She has two children — Catriona (now 12) and Alistair (10).

Sue Walker was a longstanding elected member of the BHS Main Committee and Pennines Hydrological Society representative, before being elected Honorary Treasurer and then President Elect and President from 1993–1995.

Congratulations to Sue on this award which, as the above profile testifies, is thoroughly deserved.

Rod Hawnt, President

Flood forecasting

BHS South West Section, joint meeting with CIWEM
University of Bristol, 20 June 2007

This meeting was the second joint meeting between BHS and CIWEM South-West divisions and also a well-attended, lively meeting with an impressive set of speakers. Over 70 people attended and a registration list (of 60 of these) indicated 18 had both CIWEM & BHS memberships, another 17 had CIWEM membership only and another 7 BHS membership only.

The meeting started with a provocative and entertaining introduction by **Dawei Han** (University of Bristol) in which he asked why meteorology seemed to be making great strides forward while hydrology was lagging behind, referencing a recent paper in Science ('River-Level Forecasting Shows No Detectable Progress in 2 Decades', Richard A. Kerr , Science, 15 June 2007, **316** (5831) 1555, DOI: 10.1126/science.316.5831.1555a).

Brian Golding (Met Office) presented the latest developments in flood forecasting meteorology, particularly on rainfall predictions. Improvements have been made but there is scope for much more – the 1km resolution NWP (Numerical Weather Prediction) model, scheduled to become operational in 2009, is believed to be the answer to a number of difficulties in short-range precipitation forecasts, especially at thunderstorm scale. He also highlighted how UK rainfall extreme statistics are well below those of other parts of the world and whether climate change could push our extreme statistics towards those found elsewhere in the world.

Colin Clark (independent) made an interesting presentation on his findings in the Brue catchment in Somerset, challenging, in his inimitable way, some of the established methods of rainfall-runoff modelling, rainfall data from radar and the value of tools such as MORECS and MOSES for determining catchment wetness. His finding showed that the use of lysimeters and local raingauge data gave best results.

Yipping Chen (Atkins) gave a detailed presentation on river modelling for flood forecasting purposes — how this is done currently and the role models play in the flood forecasting and warning process within the Environment Agency. He also compared different rainfall-runoff model performance — PDM *vs* PRTF.

Oliver Pollard (Environment Agency) talked about the Agency's National Flood Forecasting System (NFFS): its history, purpose and the improvements it has made to flood forecasting, especially confidence in the forecasts. The NFFS, he argued, has been a valuable and necessary project that has led to national consistency, robustness and increased confidence in warnings.

Nik Whalley (Hydro-Logic) presented some local scale flood forecasting / warning work in Scotland, showing how trash screen blockage during flood events could be monitored remotely by telemetry and other real-time information of problems such as highway inundation could be issued through warning signs.

Each presentation was followed by an interesting question & answer session which referred to, *inter alia,* MOSES usage in real-time flood forecasting, radar data quality, forecasting and warning for future 'Boscastles'.

All presentations are mounted on the BHS South West website so that they can be downloaded and viewed by a wider hydrological community. The web site is: https://www.bris.ac.uk/civilengineering/research/waterresources/bhs.

Murray Dale
Halcrow Group Ltd

Drought Reflection Day

BHS SE Section, visit to Bewl Reservoir, 4th July 2007

This event provided the ideal opportunity for a reflection of the recent drought events between 2004 and 2006, the development of the situation and implications for the supply of water.

Jonathan Simpson from Mid Kent Water led a party of approximately 20 people around the treatment works at Bewl, describing the processing which takes place on site; from the raw water which is abstracted from the reservoir to the treated drinking water which enters supply. The tour enabled the attendees to learn more about the various stages of treatment first-hand and how this related to the supply and demand during recent droughts.

Andy Willo (Environment Agency) then discussed the issues which arose from the recent drought situation, in terms of the environmental challenges, working with the water companies and the public. The key environmental challenges included responding to the drought incidents such as algal blooms and fish distress. Fish rescues and oxygenation were typical responses to areas with fish distress. Impacts were also observed in breeding bird populations and macroinvertebrates. Drought tends to exacerbate existing problems such as water quality and it is quite often hard to distinguish any impacts resulting solely from the drought. Andy described the monitoring and mitigation required as part of the series of drought permits and drought orders which were granted and the commitment needed for monitoring during the life of the permits.

Many lessons were learnt from working with the water companies, including effective communication and planning. Shared resources and bulk supply adjustments were critical in the recent drought. It was also necessary to plan for the 'What-If' drought i.e. the 3rd dry winter. Working with the public was also critical in terms of raising awareness via various advertising campaigns and again the need for effective communication was highlighted.

The second presentation was given by **Meyrick Gough** from Southern Water, looking at the issues from a water company perspective. Meyrick used Weir Wood as a case study and detailed the actions undertaken by Southern Water during the drought. These included bulk transfer adjustments, reduction in production from the reservoir, various media campaigns, hosepipe restrictions and tripartite meetings between Southern Water, South East Water and the Environment Agency. A drought order was also sought and granted to reduce the compensation release from the reservoir.

One of the key actions to take place was the Weir Wood enhanced transfer scheme. This enabled an increased flexibility with the transfer between Hardham, Buchan Hill Reservoir, Turners Hill Reservoir and Weir Wood. The use of this enhanced transfer scheme, coupled with the reduced output from the works at Weir Wood, enabled the reservoir to be refilled in 2006 following the critical dry periods.

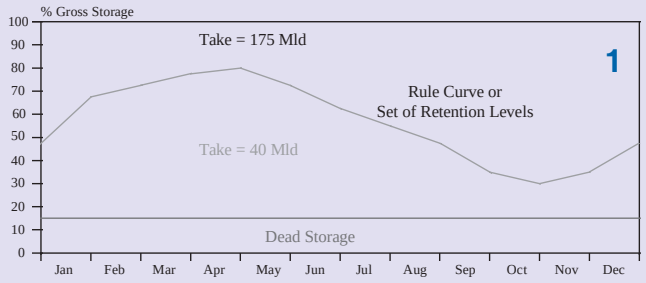
Discussion of drought reservoir yield comparisons concluded that we needed to go back to stochastic system modelling. This is necessary as different water companies are using different lengths of record to assess reservoir yields. As a result, it is becoming impossible to compare different schemes.

Helen Proctor
Atkins Ltd



Reservoir operation: the case for water value based policies

Conventional reservoir operation is typically based on defining the maximum amount of water to be abstracted as a function of storage content and time of year. In simple cases, this needs the specification of 'above' and 'below' curve quantities and the derivation of the storage contents below which the lower rate should be adopted if a prescribed level of supply reliability is to be maintained over a given inflow sequence (Fig. 1).



Conventional reservoir operating policy

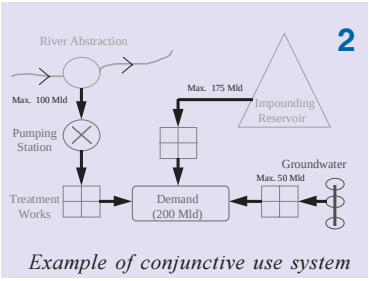
For isolated direct supply reservoirs the 'above curve' rate may be limited by a maximum aqueduct capacity and the 'below curve' rate is often set equal to the so-called 'firm yield'. Deriving the associated 'critical storage volumes' or 'retention levels' is relatively straightforward using some form of critical period analysis, and such control rules are efficient in terms of minimising spill and maximising total average abstractions.

However, few reservoirs now operate in isolation and, once they form part of an integrated or 'conjunctive use' supply system, the optimum 'below curve' rate is no longer obvious. For example, when a reservoir is operated in conjunction with a costlier source, it makes economic sense to set the 'below curve' abstraction rate to the difference between the demand and the maximum output of the alternative source. This is because a lesser 'below curve' value means that the critical storage volumes can be set lower than for the 'firm yield' situation, with a consequent reduction in spill and increase in total reservoir take.

Other examples of conjunctive use involve the combined operation of two or more reservoirs where potential benefits, in terms of increased 'yield' and/or reduced operating costs, can arise from exploiting spatial and temporal variations in their respective inflow sequences and differences in the degrees of regulation afforded. To realise such benefits, individual reservoir operating policies need to be replaced or augmented by 'balancing rules' to maintain reservoirs at preferred states of relative fullness. While essentially heuristic, such rules can be effective in achieving the desirable situations when reservoirs spill and empty coincidentally.

Multiple regime operating policies

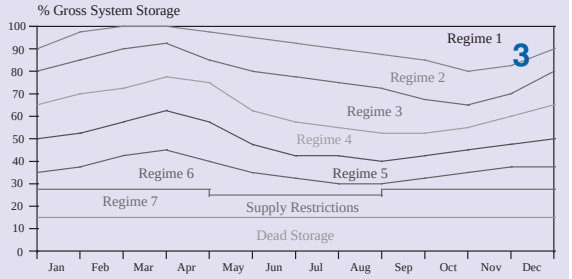
As systems become more complex in terms of the number of reservoirs, alternative water sources, and operational constraints in the form of aqueduct, treatment works and pumping station capacities, the application of operating policies based on individual reservoir rule curves becomes increasingly difficult to justify in terms of operating cost minimisation, supply security maximisation and even deployable output determination (Fig. 2).



Example of conjunctive use system

For such systems, 'multiple regime operating policies' (Fig. 3) can define target abstraction rates from different sources as a function of the quantity of water held in storage at a particular time of year. It can be noted that such rates represent 'target values', since availability at any particular time may be reduced by time and flow dependent licences, maintenance schedules and other operational constraints. Additional regimes can be incorporated for specifying the imposition of demand management measures, while individual reservoir operating rules may still be necessary to protect local compensation requirements or supplies.

Determining the storage volumes below which a particular regime should be adopted does, however, present a significant optimisation problem, since they are not independent variables and it is not feasible to apply critical period methods. Integrated simulation and stochastic Dynamic Programming (DP) methods can be used to optimise such volumes, and demonstrate the scope for significant potential savings in operating costs when compared with more conventional policies. However, the limitations of 'rule based' simulation methods, where abstractions are made according to a defined order of preference, become increasingly apparent as more complex systems are modelled, and the optimum resource/demand allocation in each time step less obvious.



Multiple regime operating policy for conjunctive use system

Water value based operating policies

Compared with individual reservoir and multiple regime rules, water value based policies can provide a more intuitive indication of when other sources of water or power generation within the system should be operated i.e. when the cost of doing so is less than that associated with releasing water from storage. However, within the allocation procedure, all associated 'downstream' costs need to be taken into account, and with hydroelectric plants relative generation efficiencies must be considered. Water values can also provide the logical basis for balancing releases from, and making transfers between, reservoirs.

Water value based reservoir operating policies are increasingly used to optimise hydro-thermal power system operation, with the application of mathematical programming techniques prompted by increased private sector investment. Since decisions on the levels at which generating plants should operate can have major financial implications for owners, it is vital that such decisions are transparent and based on clearly defined economic and technical criteria. Heuristic rules for individual reservoir operation or balancing are open to challenge, with power system regulators insisting that operational decisions be based on rigorous mathematical procedures.

Linear programming based simulation and time steps

Advantages of using linear programming to optimize the resource/demand allocation within each time-step when simulating the operation of water resource, water supply or power supply systems, include:

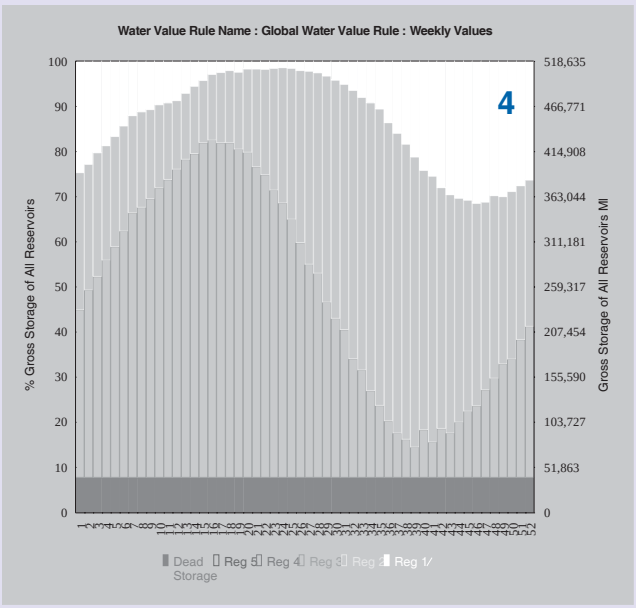
- the Objective Function to be minimised can contain unit costs associated with the operation of treatment plant, pumping stations, river abstractions, aqueducts, transmission lines, hydro, thermal and wind power generation plant, as well as supply shortfall penalties and benefits;
- the optimal solution to a properly formulated problem is guaranteed;
- operational limits such as those represented by maximum and minimum outputs, time and flow dependent licences etc., can be formulated as '>=', '<=' and '=' constraints;
- solutions can provide the 'marginal costs' for supplying extra units of water or power at demand

centres and intermediate distribution system nodes, and thus form the basis for tariff setting, 'spot market' and inter-basin transfer pricing, and 'indicative' planning.

Disadvantages are that:

- the Objective Function and all constraints must be linear;
- solution times increase with both the number of objective function variables and the number of constraints.

Until recently, solving an LP problem for each time step of a water or power supply system simulation over long inflow sequences would have been computationally unrealistic. However, with modern computing power we can exploit the appreciable benefits of such formulations, and the effects of any linear approximations can be considerably reduced by using daily rather than weekly or even monthly time steps. Modelling a major water supply and power system will typically produce an LP matrix of some 500 columns (objective function variables) × 500 rows (constraints), a problem which the latest computers can solve in less than half a second. For simple systems solution times can be less than 0.01 of a second per time step.



Optimised 3-regime water value based weekly operating policy

Comparisons of conventional, multiple regime and water value based operating policies

Acceptance of new techniques for operating policy optimisation is always hindered by the impossibility of guaranteeing the magnitude of potential benefits that might accrue from application to a particular system, since the scope for optimisation depends on the demands and supply reliability criteria imposed and the ultimate supply capability or 'yield' of the system. The 'optimisation space' may be further reduced by capacity and licence constraints.

A recently developed computer program, AQUARIUS, combines LP-based daily, weekly or monthly time-step simulation with stochastic DP for weekly or monthly policy optimisation. It enables the modelling and optimisation of individual reservoir rules, as well as multiple-regime and water value based system operating policies, and can therefore be used to compare each approach. As part of the development process, AQUARIUS models have been built for a number of major water resource, water and power supply systems, and results indicate the potential for substantial improvements in operational efficiency using water value based operating policies. A major factor is the efficiency with which reservoirs with disparate characteristics are kept in balance during both draw-down and refill cycles. An optimised weekly time-step water value policy for one of these systems is shown in Fig. 4, it being noted that within the simulation water values can be interpolated between individual curve values.

Increasing recognition of the true value and scarcity of water, the prospect of increasing flow variability as a result of climate change, and political and regulatory concerns are likely to increase the pressure on system operators to ensure and demonstrate that water resources under their control are used as efficiently and equitably as possible. This seems bound to result in demands for the increased application of robust mathematical optimisation techniques in place of more conventional 'heuristic' methods.

Comprehensive comparisons need to be made with existing methods of operation, although this process can be facilitated using generalised software incorporating 'user friendly' interactive techniques for model building and data entry. Further details of Program AQUARIUS can be found at www.pwsc.co.uk.

Tim Wyatt
Power & Water Systems Consultants



Oh what a lovely summer….

It began for some of us, I guess, with just looking out the window and moaning but for many, it's been a hard-working few weeks. Rod, in his President's Piece on page 3 puts a nice perspective on this interesting summer and reminds us (hopefully) of why we became hydrologists in the first place. I took the liberty of asking a few BHS members for their experiences and **Richard Maxted**, Hydrology team leader, EA's North-East Region, has kindly given his impressions:

Forecasting duty officer role. During the June event most of the region's hydrologists were involved as either forecasters or as Flood Warning duty officers. Not much "day job" hydrology got done as staff were either on duty (8-hour shifts including through the night), catching up on lost sleep or getting some pre-duty R&R, or doing stuff at work that related to the floods. We helped out providing some hydrological context for the rainfall and the flows, trying to ensure our monitoring teams got a good set of peak gaugings (they did !), and helping out with wrack surveys and the like.

Perhaps one of the most important roles at this stage is to resist the temptation to jump to conclusions or give premature return periods. There is enormous pressure from the media on senior incident staff to explain and justify — they need a firm line and some help.

Post event. We have been asked to write up the hydrology of the event in conjunction with our forecasting team colleagues. This will set up the situation beforehand, the meteorology of the event and the flood response. It'll be part of the wider incident report. It is at this stage that we start the return period analysis. Some of the numbers for the rainfall already look shockingly large, which immediately makes one cautious. The sheer scale of the event means everything needs care and the special skills of a hydrologist — checking for simple hydrological common sense.

For some of the team of nine in this region this is our second big event — five of us were here in 2000, and it didn't feel as difficult an event because it wasn't as widespread. For those of the team for whom this is biggest event so far in their careers its been quite an eye-opener……

[Note: Thingss continued to deteriorate after Richard sent in this piece. *Circulation* went to press just after the Thames appeared to peak at the end of July: it remains to be seen just how big an entry 2007 will make in the hydrological records. *Ed.*]

Meetings

CONSTRUCTED WETLANDS
University of Edinburgh
5–6th December 2007

There is growing interest in the use of constructed wetlands to treat contaminated runoff from farm-yards and associated buildings and tracks, driven by sustainability issues in relation to subsequent land application: even lightly contaminated drainage can be a significant source of faecal pathogens and other pollutants in sensitive catchments. The importance of constructed wetlands in the restoration of water quality in such catchments is a key focus of this meeting. Several treatment options are considered: reedbeds, stabilisation ponds, retention ponds, and combinations of drainage features.

The event is run by IEMA, with support from SEPA and in association with the Constructed Wetlands Association. Further details: events@iema.net

FLOOD RISK MANAGEMENT RESEARCH IN TO PRACTICE
Keble College, Oxford
30 September – 2 October 2008

FLOODrisk 2008 will explore research advances in flood risk analysis and innovations in flood risk management practice. The conference will consider all aspects of flood risk and will cover all the causes of floods, their impacts on people, property and the environment, and portfolios of risk management measures. Dedicated conference website http://www.floodrisk2008.net.

FLOOD RECOVERY INNOVATION AND RESPONSE
ICE, London
2–3 July 2008

Full conference information is available at:
http://www.wessex.ac.uk/friar2008cfp.html

Diary

5th September 2007
BHS/SHG meeting
"Characterisation of Abstraction pressures on Groundwater"
Venue: Rankine Building, Glasgow University
Time: 6 for 6.30 p.m.
Contact: Manuela Toth (tel: 0141 352 7881)

18-19th September 2007
"Water Summit"
ICE Conference
Venue: Olympia, Kensington, London
Contact: *Tel:* 0845 056 8069

19th September 2007
BHS National Meeting
"Hydroecology: putting theory into practice"
Organised by BHS Midlands section
Venue: Birnmingham University
Contact: David Hannah (tel: 0121 414 6925)

19th September 2007
BHS Annual General Meeting
1.00 p.m.
Venue: Birmingham University
(see previous entry)

26th September 2007
BHS South-West Section, joint with CIWEM
"Urban water management"
Venue: Exeter University
14.00 p.m.
Contact: Soon-Thiam Khu (tel: 01392 663627)

10th October 2007
BHS-SHG meeting
"Modelling climate change and rivers flows"
Venue: Royal Society of Edinburgh: 6.00 for 6.30 p.m.
Contact: Manuela Toth (tel: 0141 352 7881)

3rd October 2007
BHS South-East section
"Effluent re-use"
Venue: ICE London
6.00 p.m.
Contact: Helen Proctor (01372 754201)

17th October 2007
BHS National Meeting
"Understanding processes for basin scale management"
Venue: ICE London
Contact: Sarah Dunn (01224 498200)

25th October 2007
ICE 6th National Conference in Wales
"Learning to Live With Flooding in Wales"
Venue: County Hall, Atlantic Wharf, Cardiff Bay
Contact: Tim Fuller, ICE (tel: 0207 665 2234)

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