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THE NEWSLETTER OF THE BRITISH HYDROLOGICAL SOCIETY

Circulation

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Please tell us what you think

BHS members' questionnaire

BHS is now 21 years old, and the main committee wants to take stock of progress made, and seek out new directions for development. An important aspect of this is consultation with the membership, and included with this mailing of *Circulation* is a short questionnaire that seeks your views on how the Society might develop. Please use it to help your committee know what our priorities should be. (Those few who responded the first time need not do so again.)

As well as gaining feedback on how well the society is doing at its 'core' activities (meetings, professional development, promoting careers in hydrology, etc.), we also seek your views on a range of possible strategic developments that might have significant implications for the Society as a whole. These include offers from publishers to help the Society develop its own Journal and proposals for alliances of UK scientific societies.

If you have Internet access, please submit your answers using the web-based form (see *www.hydrology.org.uk*).

We have tried to make the form as simple as possible to complete, but if you have more time to ponder on how you would like BHS to develop, we would welcome all your suggestions! Please email to *bhs@ice.org.uk* or send to the address on the form.

Steve Parsons, Paul Bates & Bruce Webb

New BHS website

The BHS website has been relaunched. The completely new design by Samui is more attractive and will be much easier to use and keep up-to-date. Please use the members' questionnaire (also on the site) to tell the committee what you like about it and what you would like to see added or improved. It will also eventually have a members only area. Please report any errors on the site to the Editor (jhgr@ceh.ac.uk).

See *www.hydrology.org.uk*

President's piece

Rather like the river levels and water supplies in parts of the UK, the news I have to convey in this my last piece as President of BHS is dwindling fast!

It has been a very great privilege to have served the Society as its President, and I will look back on the last couple of years with much pleasure. I have been extremely fortunate to have had a great deal of help and support from the other officers and members of the Main Committee, who have given very generously of their time, and also of their ideas for taking BHS forward. This has all been fitted into busy 'day jobs', as in the cases of **Sue White** and **Steve Parsons**, who retire from the Main Committee at the AGM: their contributions will be greatly missed.

Steve is retiring at the end of his second term as Honorary Treasurer and has spent a total of seven years on the Main Committee, and he is an exemplar of those members who are willing to give unstinting service and support to BHS over a prolonged period. In case there is any concern that the tradition (since 1997) of the Society's finances being overseen by employees of Mott Macdonald could now be broken, I am pleased to report that Steve will be succeeded by **Peter Ede**, who was the only member nominated to be Honorary Treasurer.

It is equally pleasing to learn that several people, from a range of hydrological backgrounds, are interested in serving on the Main Committee and that we have elections for the vacant Ordinary Members positions. Please use your votes.

Finally, I would like to take this opportunity to thank our two 'parent organisations' for their ongoing and very important support for the BHS during my period as President. This manifests itself in many different ways, but I would particularly like to highlight the activities of **John Griffin**, **Ian Littlewood** and **Frank Farquharson** from CEH Wallingford and **Tim Fuller** of the Institution of Civil Engineers, who continue to make major contributions to the work of the Society and its Main Committee.

Bruce Webb (B.W.Webb@Exeter.ac.uk)

Obituary: Professor Mike Hall

As reported by our President in the May *Circulation*, **Professor Mike Hall** passed away on 26 April after a long and courageous battle with illness.

Mike was the founding Honorary Secretary of the Society and served a three-year term in which he played a major role in laying the foundations for BHS and determining how it would be structured and administered. Much of its subsequent development into the premier society for hydrology in the UK can be attributed to Mike's very hard work in those early years.

After he retired from the Main Committee, Mike continued to support the Society very actively while pursuing an eminent and varied hydrological career in academia and consultancy, both in the UK and overseas. In recognition of Mike's outstanding contribution to the BHS, the Society decided to award him Honorary Membership, news that he was delighted to receive before his passing.

I first met Mike when I joined the Imperial College (IC) Hydrology Group in 1968 as a young, greenhorn, Assistant Lecturer. Mike took me under his wing then, and I was greatly impressed by his meticulous and structured approach to teaching and research. We collaborated closely during our IC years and particularly enjoyed exploring the mysteries of time series modelling and synthetic hydrology together.

Mike introduced me to the world of consultancy, and I was equally impressed by his capacity to mix academic rigour with a highly practical engineering approach. Occasionally, we fitted in all night sessions around the day-job at some computing bureau in Victoria (no PCs in those days!) to meet deadlines, pushing each other to keep going! With **Terence O'Donnell** and **Elizabeth Shaw** we formed a tightly-knit group, and I look back on those years as amongst the most enjoyable of my career — I believe that Mike viewed them in the same way.

Mike's fundamental laboratory catchment studies undertaken for his PhD at Imperial were to presage a lifelong involvement in the field of urban hydrology, where he made several important contributions. Notable amongst these were the design of flood control storage in urban areas, the impacts of urbanisation on the hydrological cycle (and unit hydrographs in particular), and his contribution to the development of the Wallingford Procedure through his membership of the NWC/DOE Working Party on the hydraulic design of storm sewers (1976-81). Mike's text on Urban Hydrology, published in 1984, was a major distillation of knowledge in the field, and is still a key reference today. He was highly effective at technology transfer, and over a period of years he ran a series of 16 mid-career training courses on Highway Drainage Design for PTRC Ltd.

In 1976, Mike left Imperial College to become head of the Hydrology/Hydrogeology Unit of Halcrow's water division. He led a team that included a number of former IC postgraduates to undertake hydrological and water resources studies across the world, frequently incorporating some new technical developments.

Mike continued to publish regularly in the engineering and international hydrological literature, and in 1986 he returned to the academic world to take up a Chair and the Headship of the Civil Engineering Department of Middlesex Polytechnic (now Middlesex University). Here he joined forces with **Brian Ellis** to draw water quantity and quality together in tackling a range of urban water management problems.

In 1992, Mike was appointed Professor of Hydrology at IHE Delft, and Head of the Hydrology Section of the Department of Hydraulic and Hydrological Engineering, where he had been a visiting lecturer since 1970. Mike was uniquely well equipped for the challenges of this post: he had a strong track record in postgraduate teaching and research, a wealth of experience of hydrological and water resources management problems in developing countries, and an in-depth understanding of postgraduate training needs. His international training, research and consulting activities took him to many already familiar stamping grounds across the developing world.

In the period 1992-96, he chaired the steering committee of NERC's Hydrological Radar Experiment (HYREX) special topic research programme, which brought him into regular contact with former UK academic colleagues.

In 1996, Mike was appointed Vice-Rector (Education) at IHE, and supervised the conversion of the institute's diploma courses into Masters programmes. He also played an important role in strengthening links between IHE and Dutch universities, notably the Vrije Universiteit Amsterdam, where he was appointed a Special Professor in 2000. While at IHE, Mike concentrated his research activities on the developing field of hydroinformatics, and over a period of some twelve years he authored/co-

authored a wide-ranging set of papers on the development and application of hydroinformatic tools and systems. Several of these papers were focused on the strengths and weaknesses of artificial neural networks, which Mike referred to as the 'Ultimate Black Box'. He became a member of the Advisory Board of the *Journal of Hydroinformatics*, and was a member of the organising committees for a series of international conferences on this subject.

However, Mike always found time to return to the UK to contribute papers to BHS national and international conferences: the last of these is included in the proceedings of the 2004 BHS International Conference, held at a familiar location, Imperial College. He retired from IHE in 2003 and was appointed Emeritus Professor.

Mike Hall leaves a rich heritage behind him, covering developments in teaching, research, consultancy, and the evolution of the British Hydrological Society. He will be very greatly missed by former colleagues, BHS members, the wider hydrological and engineering communities in the UK and overseas, and, above all, by his loving wife Shirley and son Antony.

Prof. Enda O'Connell
University of Newcastle upon Tyne

The future of British hydrology — an ongoing discussion

The article by **Florian Pappenberger** and **Hannah Cloke** (*Longing to be a swan, Circulation 85*) was an interesting and stimulating summary of many of the challenges facing hydrology. In order to move forward as a discipline, there is a need for an open discussion on the future of hydrology.

One key challenge that has been overlooked is the need to integrate academic, research-based hydrology and practical, applied hydrology. This is a subject that appears to have been ignored so far, but which could undermine the unity of the discipline.

Clearly both ground-breaking academic research and applied hydrology are necessary, but the two aspects should be mutually beneficial, with research providing better science for application, and applied hydrology giving direction and focus to research. Divorced from each other, both are weakened. There is not enough attention to integration of these two aspects of hydrology and they are diverging. Hydrologists facing the next 21 years need to address this.

In order to move towards integration, we need support. Research and applied hydrologists need to talk, and work more closely together. This issue needs to be discussed, acknowledged and supported at all levels within hydrology and from all facets of the subject in order to increase awareness and generate willingness to tackle the challenges.

With increasing awareness and support, the focus should shift towards mechanisms to accomplish integration, but these must be coupled with a widespread desire among hydrologists to pursue integration of their discipline.

By engaging in this important debate, and finding ways to resolve practical difficulties, we will achieve benefits for hydrology and provide exciting challenges for hydrologists.

The British Hydrological Society encompasses the full range of hydrology, and is well positioned to raise awareness, chair discussions and coordinate efforts to promote integration.

A few initial ideas are suggested here to try and encourage further thought within the Society:

- The BHS Committee should discuss the issue and promote integration;
- BHS meetings should address the application of academic research;
- Universities could liaise with applied hydrologists to ensure that BSc/MSc courses incorporate applied hydrology;
- Applied hydrologists (particularly in the Environment Agency and similar bodies) could actively engage with universities to influence the direction of research;
- Greater use could be made of work placements and exchange programmes;
- Applied hydrologists could seek greater input from academic hydrologists to tackle projects.

Tim Norton
Environment Agency

News from members

Hydro-Logic's new Exeter office

Hydro-Logic, the water monitoring and management technology specialists, have opened a new office near Exeter to cover the South West.

Nik Whalley has returned to the company to develop Hydro-Logic's consultancy services in the region. Nik is a Chartered Hydrologist with eight years of professional experience as a water and environmental consultant. He has a wide range of practical experience working alongside public and private sector clients and he is an active member of CIWEM and the British Hydrological Society.

For further information contact Nik at Hydro-Logic Ltd (Exeter Office), 3 Thorne Cottages, Cadhay Lane, Ottery St Mary, Devon, EX11 1QZ *(tel/fax 01404 813350, mobile 07717 204364, email nwhalley@hydro-logic.co.uk)* or visit the website at *www.hydro-logic.co.uk*.

Bob Sargent to lead CIWEM

Congratulations to **Bob Sargent** on becoming President elect of the Chartered Institution of Water and Environmental Management: he will become CIWEM's President in 2006. Bob is a hydrologist with 30 years experience since graduating from Lancaster University in 1974.

He worked for the Forth River Purification Board in Edinburgh as Chief Hydrologist, where he was instrumental in the development and promotion of SUDS in the UK. He moved to environmental policy on the formation of the Scottish Environment Protection Agency in 1996. He left in 2003 to establish a hydrology division with Marcus Hodges Environment, moving to Hyder Consulting when they acquired Marcus Hodges last year.

He is now Hydrology Technical Director with the Hyder Marcus Hodges division in Bristol. The current workload includes several highway projects, including the widening of the M25, as well as water resource work and a steady steam of flood risk assessments.

As well as his active involvement with CIWEM as a Council member and Chairman and Secretary of the Scottish branch committee, Bob was involved in the establishment of BHS and served on the Main Committee for several years in the 1980s, and was also active in the Scottish Hydrological Group.

IAHS Assembly

Freshwater: Sustainability within Uncertainty

Reports on the International Association of Hydrological Sciences VII[th] Scientific Assembly at Foz do Iguaçu, 3–9 April.

The VIIth Scientific Assembly in Brazil, entitled *Freshwater: Sustainability within Uncertainty*, was attended by over 400 delegates from around the world and included 7 Symposia and 8 Workshops over 5 days.

There was an excellent show of UK delegates at the meeting and a number of the Symposia were convened by BHS members: Des Walling (Sediment Budgets), Bruce Webb (Groundwater Resources – Sustainability Indicators), Louise Heathwaite (Dynamics and Biogeochemistry of River Corridors and Wetlands) and Kate Heal (PUB Workshop on Land Use and Water Quality Relations in Ungauged Basins).

The Sediment Budgets and Biogeochemistry Symposia had pre-published IAHS Red Books, but unfortunately they did not reach the delegates, but were impounded by the customs at Sao Paulo airport.

Bureau meetings

The first IAHS Bureau meeting on Sunday was attended by Louise Heathwaite (Vice President, IAHS), Bruce Webb (President, ICWQ) and Des Walling (IAHS Ltd) from the UK. It was chaired by the outgoing IAHS President, Kuniyoshi Takeuchi (Japan), who handed over to Arthur Askew (Australia) who is President for the next four years. The Bureau discussed IAHS finances, received reports from the IAHS Commissions and Working Groups, and approved a formal (wholly amicable) split between the International Association on Cryospheric Sciences (which will become part of IUGG at the 2007 Meeting) and the International Commission on Snow and Ice Hydrology (ICSIH), which remains an IAHS commission. They also agreed to support Elsevier's *Journal of River Basin Management*.

On the Saturday after the Assembly, Louise Heathwaite, Bruce Webb and Dragan Savic from the UK attended the second Bureau meeting. They discussed strategic planning for IAHS over the next few years, including the PUB initiative, which is moving into a new 'implementation' phase chaired by Professor Jeff McDonnell, the role of national representatives, and ways to encourage younger hydrologists to get more involved in IAHS (e.g. by convening Symposia or Workshops).

The UK is lucky to have an active hydrological community within BHS and a President who is also an IAHS commission chair. This link between the international association and national groups is not as well-defined in other countries. The Bureau also discussed the IUGG meeting to be held in Perugia in Italy in 2007. There will be a strong IAHS presence and an exciting programme of Symposia and Workshops that is being put together by a team led by Louise Heathwaite.

Symposium 4

The symposium on Dynamics and Biogeochemistry of River Corridors and Wetlands was convened by Louise Heathwaite (Lancaster Environment Centre, Lancaster University) along with Don Rosenberry (USGS), Masaki Hayashi (Department of Geology and Geophysics, University of Calgary, Alberta), Bruce Webb (Department of Geography, University of Exeter) and Dave Weaver (Agricultural Department, Western Australia). This symposium brought together a dynamic and exciting range of biogeochemical research that focused on diverse environments ranging from pristine wetlands to managed agro-ecosystems, and examined both natural and anthropogenically-driven processes. In spite of a few last-minute cancellations, the session ran well, with interesting presentations.

Several contributions focused on South America. Pedro Depetris (Universidad Nacional de Córdoba, Argentina), gave an insightful background to the Panará River and the surrounding area (which includes Foz do Iguaçu), and examined episodic changes in river chemistry following ENSO-driven floods that connected floodplain waters to the river network. Laura De Cabo (Museo Argentino de Ciencias Naturales, Argentina), looked at phosphorus and suspended sediment dynamics in the lower Panará River and Virginia Barros (Universidade da Regiao de Joinville, Brazil) was able to transform her poster presentation on environmental pollution issues in Babitonga Bay, Brazil, into an impressive talk at short notice.

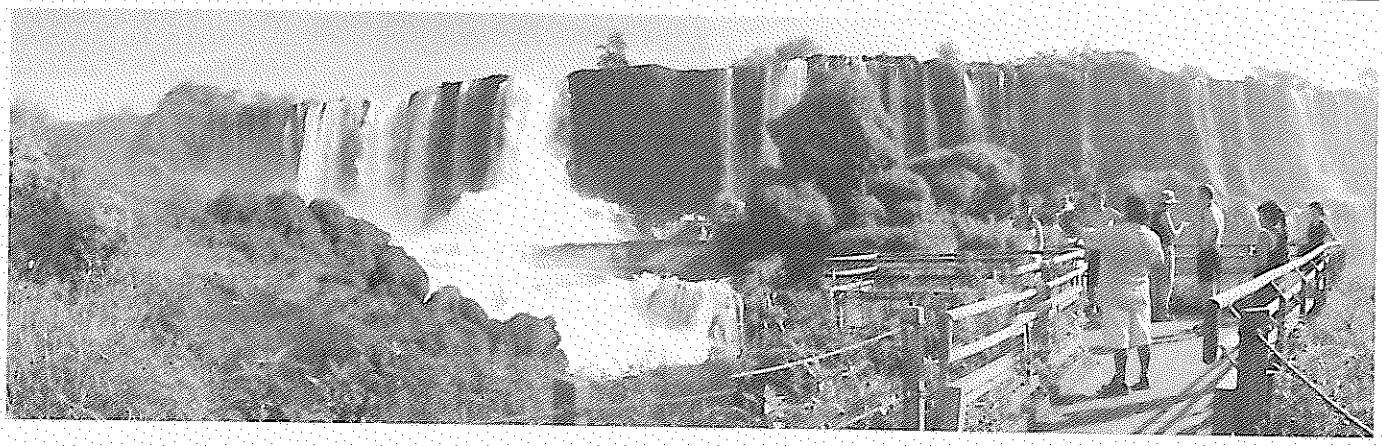
Links between floodplain lakes and the Amazon River were considered by Marie-Paule Bonnet (Laboratoire des Mécanismes et Transferts en Géologie, France) and Patricia Moreira-Turcq (IRD-Institut de Recherche pour le Developpement, Brazil), as part of a wider development programme funded by the IRD. Both speakers showed how floodplain lakes were a key source of redox solutes, such as arsenic, and organic carbon to the Amazon River, with major implications for seasonal changes in the biogeochemistry of this river.

The role of floodplains as a solute source, rather than a sink as is commonly thought, was also considered by Louise Heathwaite. Combined field and laboratory evidence showed how bioavailable phosphorous was released from floodplain sediments and subsequently transported into the river network during controlled flooding events. Managed flooding of the study area in the Norfolk Broads took place for bird conservation, but the additional flooding caused a water quality problem through phosphorous mobilisation and transport.

In contrast to these environments where floodplains and rivers waters were closely connected, Katarzyna Glinska-Lewczuk (University of Warmia and Mazury in Olsztyn, Poland) showed how artificially disconnected oxbow lakes suffered from reduced water quality and habitat degradation. She argued that oxbow lakes needed to be reconnected to the main river channel to improve these habitats.

The impact of long-term and short-term acidification was then discussed. David Dewalle (Penn State, USA) showed that long-term changes in nitrogen emissions in response to the US Clean Air Act has had no influence on stream nitrate concentrations in the Mid-Appalachians, since 63-96% of the nitrogen inputs were retained within the catchment. In contrast, Joanna Clark (Leeds University) showed how short-term acidification of peatland soil water, caused by sulphur redox reactions, temporarily reduced organic carbon concentrations by reducing their solubility. These integrated field and laboratory studies provided contrary evidence to other explanations of reduced water colour during droughts, which have included physical changes in the peat structure and low flows from peatlands in general.

Ecohydrological models for management of water quality were also considered. The role of spatial complexity in terms of understanding key locations for certain biogeochemical processes (e.g. denitrification) was a key theme for both Gunter Wriedt



(UFZ Environmental Research Centre Leipzig-Halle, Germany) and Valentine Krysanova (Potsdam Institute for Climate Impact Research, Germany) in studies of managed European catchments. Some speakers addressed the utility of models in less data-rich areas that also face key management issues. For instance, Adrian Gallardo (University of Tsukuba, Japan) presented work on denitrification processes within an agrarian system in Japan, and Adriano Da Paz (Universidade Federal do Rio Grande do Sul, Brazil) showed how modelling could be used to understand vegetation dynamics in the pristine Taim wetland in southern Brazil, where environmental protection legislation prevented site access.

Other speakers also considered the link between hydrology and ecology. Don Rosenberry (USGS) showed how extreme climate change from exceptionally dry to exceptionally wet years caused radical and rapid changes in wetland ecology in North Dakota. Cong Zhentao (Tsinghua University, Beijing, China) gave perhaps the most memorable talk of the symposium on a river restoration project in China. Construction of a dam on the Tarim River, China, in 1972 caused extreme degradation of a once lush riparian habitat by the cessation of downstream flow. The project showed how the dust bowl created by the dam had been restored to its former state by simply diverting water into the old river channel.

Perhaps the greatest strength of this symposium, and the IAHS Assembly in general, was the wide range of participants from a truly international, and very friendly, research community. This breadth of contributions, with the presentations covering such a dynamic mix of topics and research areas, is not seen at many other 'international' events. We are grateful to the BHS for the funds to help us attend this event, and are very much looking forward to the next Assembly in Perugia in 2007.

Louise Heathwaite (IAHS Vice-President)
Lancaster University
Joanna Clark, School of Geography
University of Leeds

International Symposium on Sediment Budgets

This very successful Symposium was organised by the International Commission on Continental Erosion (ICCE), and its success demonstrates both the strength of international interest in the field of erosion and sedimentation and the vitality of this commission, which is often viewed as somewhat peripheral to IAHS. Because of the large number of abstracts submitted, the Symposium programme extended over the full five days of the Assembly and resulted in two pre-published proceedings volumes (IAHS Publications No. 291 and No. 292) edited by Des Walling and Art Horowitz. These contained over 700 pages and more than 80 papers for oral presentation. It was unfortunate that unforeseen problems with the Brazilian customs prevented these volumes reaching the delegates until after the conference, since a key advantage of prepublication is the ability to refer to the papers being presented. The volumes were complemented by a CD, containing full versions of 26 of the poster papers and a further 23 poster paper abstracts, compiled by Fernando Campagnoli, Newton Carvalho and Geraldo Wilson. This was generously produced and distributed free of charge by the Brazilian Association for Engineering Geology and the Environment (ABGE) and the Brazilian Water Resources Association (ABRH). Most of the full papers on the CD were presented as posters during the Symposium.

For a few of the older participants, including myself, this was a very welcome opportunity to revisit both Brazil and the theme of Sediment Budgets, since ICCE had held a very successful Symposium on the same topic in Porto Alegre in December 1988. It was, however, particularly sad that Marc Bordas, who had played a major role in staging that Symposium, had passed away. Foz do Iguaçu was the final stop on the field excursion that followed the Porto Alegre Symposium nearly 17 years ago. A brief perusal of the substantial (590 page) red book produced for the 1988 Symposium (IAHS Publication No 174) provides a useful basis for assessing scientific progress in the field of catchment sediment budgets. Back in 1988, the study of sediment budgets was just beginning. Emphasis was still very much on monitoring and predicting sediment yields at the outlet of a catchment and there were few attempts to delve into the internal functioning of the catchment and to investigate sediment sources, transfers and sinks and thereby establish an overall sediment budget. The papers presented this year demonstrated our increasing awareness of the complexity of slope-channel transfer and the importance of floodplain and channel storage and our greatly improved understanding of these important aspects of sediment delivery.

The programme for this year's Symposium was logically structured to deal first with the main components of the sediment budget: Sediment Mobilization and Sediment Sources, Sediment Transport and Transfer, Sediment Storage, and finally Sediment Yield. It then progressed to Sediment Budgets *per se*, Modelling Sediment Budgets and their Components, Human Impacts on Sediment Budgets and Sediment Problems and Sediment Management Strategies.

As with other recent IAHS meetings, there is no direct link between Symposium convenors and Assembly organisers (who deal with registration and accommodation) and the problem of 'no-shows' introduced some uncertainty into the programme schedule. Fortunately, however, most of the presenting authors were there and there were very few gaps.

The Local Organisation Committee provided excellent support and coordinated pre-loading of Powerpoint presentations, which helped to provide a rapid and smooth transition between speakers. All presentations were of a high standard and all speakers made use of the digital projector: slides and transparencies appear to have been totally superseded. There were useful discussion periods after many of the sessions and at the end of the final day.

With more than 70 papers over the five days, it is difficult to report on

individual contributions, but brief details of the coverage will indicate the scope and content of the Symposium. It had a truly international flavour, with papers from North America, Australia, Europe, Africa, Asia and particularly South America, and authors from more than 30 countries. The two Brazilian co-convenors, Newton Carvalho and Edmilson Teixera, succeeded in encouraging plenty of Brazilians to participate. It was also interesting to note an increasing level of international collaboration in contributions.

In the sessions on *Sediment Mobilization and Sources*, the work of the Laboratory of Soil Erosion and Fluvial Processes at Moscow State University in documenting the sediment budgets of small slope catchments produced two particularly interesting and valuable papers. The important contribution of studies using novel techniques, including Cs-137 measurements and sediment fingerprinting or source tracing, was emphasised by several of the papers.

The inclusion of papers dealing with a wide range of environments served to emphasise the diverse erosional behaviour of different landscapes. In this case, an interesting paper from a Belgian team documented the unusual example of a catchment where a large proportion of the suspended load consisted of authigenic iron compounds originating as chemical precipitates, rather than particles eroded from the catchment surface or channel network.

A paper by a Japanese team reported on the severe erosion on the slopes of the Miyakejima volcano in Japan immediately after its eruption in July 2000, providing an estimate of the annual specific sediment yield of $1.1 \infty 10^6$ m^3 km^{-2} year^{-1}, which must be approaching the world record sediment yield!

The papers in the session on *Sediment Transport and Transfer* provided clear examples of the potential of new perspectives and new technology to provide an improved understanding of sediment behaviour. Work on the influence of wildfires on aggregate form and particle properties, behaviour and fate, reported by a joint UK-Australian-Canadian study, and work on sediment cascades in mountain catchments in the Alps of southern Germany, provide two examples of such developments.

Turning to *Sediment Storage*, the potential of new technology was again graphically demonstrated by two papers on the use of high-resolution field laser scanning for detailed mapping of surface topography, and by papers exploiting the potential of environmental radionuclides, more particularly Cs-137 and excess Pb-210, to document sediment accumulation rates and to investigate the important role of river floodplains in storing fine sediment.

The papers on *Sediment Yield* covered a wide range of topics but those describing results from the host country were of particular interest. Important new work on documenting the sediment load of the River Amazon at Obidos, at the outlet of the world's largest river basin, had been undertaken by a joint French-Brazilian group. Jorge Werneck Lima and his colleagues provided a valuable overview of the sediment loads of the major rivers basins of Brazil: their map was appropriately used to illustrate the covers of the proceedings volumes.

The papers in the sessions on *Sediment Budgets* covered both methodological aspects and the results of work on establishing budgets. Several emphasised the need to pay more attention to the organic component of the sediment budget, both in terms of carbon cycling and situations where the organic fraction represents a major or dominant component of the total sediment yield from a catchment. Others provided valuable insights into the sediment budgets associated with arctic and alpine drainage basins and the use of sediment budgets in developing erosion control and sediment management strategies.

The sessions on *Modelling Sediment Budgets and their Components* covered a wide range of modelling techniques and applications, including cellular landscape models, the application of the WEPP Model in a small Austrian catchment and the use of remote sensing information to improve the temporal resolution of the representation of vegetation cover density.

Studies dealing with *Human Impact on Sediment Budgets* provided several good examples of the sensitivity of sediment budgets to climate and land-use change and dam construction, drawn from different areas of the world. These papers were usefully complemented by those in the final sessions, which focused on *Sediment Problems and Sediment Management* and dealt mainly with countering reservoir sedimentation problems.

The Symposium provided clear evidence of considerable activity in the field of sediment budget investigations and of the importance of the sediment budget concept for erosion control and sediment management. Major progress has clearly been made since the last ICCE Symposium on this topic in 1988 and there can be little doubt that further advances will merit revisiting it again in the future.

I would like to express my gratitude to the BHS for providing financial support from the IAHS Exeter fund to assist me to attend this IAHS Scientific Assembly.

Des Walling
University of Exeter

PUB Symposium

Symposium 7, *"Prediction in Ungauged Basins: promises and progress"*, was held in parallel with the other six Symposia over the five days of the Assembly, with papers and discussion sessions relevant to the Prediction in Ungauged Basins (PUB) Decade (2003-2012). The overall convenor was **Prof. Murugesu Sivapalan**, University of Western Australia, Perth, Chair of the PUB Science Steering Group. There were seven technical sessions:

S7-1 Model improvements through detailed process studies
S7-2 Model evaluation and comparison: uncertainty analysis and diagnostics
S7-3 New data collection approaches and model development
S7-4 Complex systems and ecohydrology
S7-5 Nonlinearity, complexity, scaling and PUB
S7-6 New distributed modelling approaches and methods for testing models against observations
S7-7 Progress in PUB implementation (PUB WG)

Working with the various IAHS Commissions, the PUB Working Group sponsored four of the seven Conference Workshops, also held in parallel during the week:

W5 Model Parameter Estimation MOPEX-5
W6 Transferring Hydrological Data Across Spatial and Temporal Scales
W7 Land-use and Water Quality Relationships in Ungauged Basins
W8 Workshop on Isotope Tracers and Remote Sensing Techniques for Assessing Water Cycle

Attendance at this Symposium was high throughout the conference week, reflecting the level of interest in the PUB Decade and justly rewarding the general high quality of the papers and presentations. A noteworthy feature of Symposium 7 during its Technical Sessions and Workshops was the energy that PUB has created within the IAHS community: comments from the floor were lively, thought-provoking and constructive.

A specially designated open PUB discussion meeting on Wednesday 6 April, and a synthesis closing session on Friday 8 April (Chaired by the incoming Chair of the PUB Science Steering Group, **Prof. Jeff McDonnell**, Oregon State University, USA) were both very well attended. Many issues that have arisen during the early stages of PUB, or need to be addressed over the next two years leading up to the IUGG meeting in Perugia in 2007, were discussed.

Interested readers are encouraged to follow PUB progress in future IAHS Newsletters (BHS *Circulation* will inform its members of developments of particular relevance to the UK hydrological community).

Overall impressions

The Palace Rafain Hotel in Foz do Iguaçu offered good conference facilities and the conference was well attended. Both the quantity and quality of posters were high. The conference pack included a mini-CD and a publication outlining Brazilian water resources and their management.

An early highlight was the opening ceremony on Sunday 3 April, when the outgoing IAHS president **Kuniyoshi Takeuchi** handed over to **Arthur Askew**. The remaining evenings were taken up with the Assembly lecture given by **Prof. Carlos Tucci**, the IAHS General Assembly, meetings of the IAHS commissions and working groups, as well as by a great banquet, followed by swimming pool activities.

As always with parallel-session conferences, choosing where to be at any time was sometimes difficult. However, the excellent venue and organisation made it possible to 'pick and mix' to a degree that suited most people. A huge amount was fitted into the week but it worked (just) — there may be a case for a sixth day of conference being required allowing the Wednesday afternoon for excursions.

Most delegates found time within the busy schedule to visit the world-famous Itaipu dam and the magnificent Foz do Iguaçu falls (pictured on page. The red-book pre-published proceedings are IAHS Publications 291 to 296.

Corinna Abesser, BGS, Wallingford
Ian Littlewood, CEH, Wallingford

Symposia 5 and 6

I was able to attend The VIIth IAHS Scientific Assembly with the help of an award from the BHS's Exeter Fund, and I presented papers in two separate Symposia.

The Assembly provided a unique breadth of topics in hydrology, with Symposia on subjects from "Groundwater sustainability indicators" to "Contributions from glaciers and snow cover to runoff from mountains in different climates", and of course the ever-present "PUB" (Prediction in Ungauged Basins), as well as eight more specialised workshops.

My interests centre around the impacts of climate change and climate variability on hydrological variability, and so Symposium 6 "Regional hydrologic impacts of climatic variability and change with an emphasis on less developed countries", Symposium 5 "Contribution from glaciers and snow cover to runoff from mountains in different climates" and the PUB sessions (no pun intended!) were of most interest.

Climate change and variability was a central theme of many sessions. Many of the contributions concentrated on the Asian continent, presenting the results of both observations and modelling studies. Climate change (or variability) is having an impact on the sensitive Himalayan region. **Koji Fujita** reported that in Tibet many variables are sensitive to climate change. In particular, the precipitation/snow ratio may be expected to change, with winter temperature rises of up to 1°C reported over the Tibetan plateau.

Similar change has been seen in our own study in the Karakoram region of Pakistan, with winter temperatures rising consistently over the last 100 years but with an acceleration during the last 40 years. Summer temperatures in the Karakoram, and surrounding north-west India and south-west Tibet, are cooling. These effects, and those of precipitation, combine to have a significant impact on the hydrology of the region, highly dependent upon winter precipitation to provide summer snow melt and summer high temperatures to provide glacial melting.

The impact of climate change on glacial regimes was discussed at length. One of the more interesting papers was by **Gwyn Rees** (CEH Wallingford) who applied a rainfall-runoff model incorporating a glacier-melt model, using different local climate data for the Himalayan region but a hypothetical glacier model. He found that glaciers may be expected to retreat under climate change, but at different rates depending on the local climatology.

Even more severe impacts were reported for China. In separate presentations in Symposium 6, **Dawen Yung** and **Shenglian Guo** talked about the water resource crisis affecting China. In the north of the country there has been a stark reduction in summer rainfall over the last 120 years. Increasing air temperatures are thought to be caused by global warming. In an investigation by Dawen Yung into 50-year climate variability and links to water resources, discharges in the major rivers (e.g. the Yellow River with an area of 750 000 km^2, three times the size of the UK) appear to have reduced in the last 50 years. Annual average temperature has increased by 1.28°C in that period, with the greatest rise found in winter months. In contrast, average precipitation has reduced by 45.3 mm in 50 years. Increases in demand, coupled with these climatic trends, mean that the river flows dry much of the time. In fact during the 1990s there were 901 days when the Yellow River did not flow into the sea. With climate change, the Yellow River may never again flow into the sea.

This reminds us that climate change impacts are not only being felt in Europe and the United States, the regions most commonly researched, but also elsewhere in the world. Hydrology and water resources management will occupy a pivotal position in politics in future decades as the effects of climate change are fully realised, a position realised and expressed in the IAHS's own "Hydrology 2020" document.

Hayley Fowler
Newcastle University

EGU 2005

Vienna, Austria
24-29 April 2005

This year's General Assembly of the European Geosciences Union (EGU) saw a change of venue, good weather (i.e. not raining) and more than 10 000 papers by scientists from all over the world on an extremely broad range of geophysical topics. The following reports give three impressions of the conference, by Kate Heppel, Ahmad Moaven-Hashemi and Aidan Burton.

Kate Heppel's report

As I sat in the departure lounge of Heathrow Airport on 24th April I briefly wondered why I was surrounded by so many excited people, all brandishing cardboard and plastic tubes. Soon all became clear: many scientists were on the same flight as me, heading to the General Assembly of the European Geosciences Union (EGU), clutching their posters and presentations in eager anticipation of the week to come.

In fact the scientific programme did comprise a packed schedule of oral presentations, poster sessions, division/section meetings and medal lectures. There were many parallel sessions of interest in the Hydrological Sciences, Biogeosciences, and Soil System Sciences sections. As the conference was spread over the four floors of the Austria Center Vienna (ACV), this sometimes necessitated a

mad dash between sessions, hoping that all were running to time. So the refreshments offered at the late afternoon poster sessions seemed a particular bonus that encouraged a more relaxed discussion of research findings and an opportunity to meet the scientists responsible for interesting presentations from earlier in the schedule. It was always helpful when presenters plugged their posters during their talk, and indicated where they might be found during the poster sessions. Having attended the EGU for the first time this year, I would advocate submitting both an oral presentation and a poster to get the full benefit of both modes of research dissemination.

Session HS21 'Hillslope and catchment connectivity: dynamics, scale, evaluation and prediction' aimed to bring together researchers working on the broad subject area of landscape, hydrological and sedimentological connectivity from the hillslope to the catchment scale. The studies were wide-ranging, from investigations of methods for incorporating connectivity into modelling approaches to field evidence for sediment, hydrological and nutrient connectivity in a range of different environments. The first two presentations explored the evidence for coupling between hydrological and nutrient connectivity.

Philipp Schneider (University of Basel) focused on phosphorus losses in forested headwater catchments of the Black Forest; **Murugesu Sivapalan** (University of Western Australia) discussed nitrate transport and export from an agricultural catchment in Western Australia. Hydrological connectivity was generated by subsurface flow in each case. However, in the case of the phosphorus study the resulting lateral nutrient connectivity was considered to be low, whilst for the nitrate study the direct hydrological connection between upland and riparian zones during mid-winter was responsible for the downslope transport to the stream channel.

Eva Mueller (University of Potsdam) reported her research into different methods of incorporating the spatial variability of model input parameters into physically-based hydrological and nutrient transport models. This focused on a small semi-arid shrubland catchment in the Jordana Basin (New Mexico) and showed that higher the connectivity, in the sense of connected patterns of parameter values, led to better model performance.

Trevor Hoey (University of Glasgow) continued the emphasis on connectivity and mathematical modelling. His presentation assessed the importance of hillslope-alluvial and tributary-to-main-channel sediment transfer processes for the calculation of catchment-wide erosion rates using cosmogenic isotopes.

Tuesday morning began with the Hydrological Sciences session on 'Tracing the runoff generation process - integrated experimental investigations from plot to catchment scale', in which experimentalists were invited to present the results of process studies across the hillslope to catchment scale. Many of the studies used a combination of hydrological monitoring and hydrograph separation techniques to investigate the factors influencing the initiation and extent of subsurface flow processes. These factors included antecedent soil moisture (**Peter Chifflard**, University of Bochum), rainfall characteristics (**Birgit Zillgens**, GeoForschungs-Zentrum, Potsdam) and soil texture and structure (**Peter Kienzler**, ETH Zürich).

Stefan Uhlenbrook (UNESCO-IHE) stepped in at short notice to replace a missing author. He stressed that in addition to using chemical tracers to quantify the different components of a stream hydrograph, it is also important to understand the origins of these different components. For this, he advocated the use of geophysical techniques such as electrical resistivity tomography.

Special mention should also be made of session HS43, 'Use of isotopes in river basin studies'. During this session the convenor, **Tomas Vitvar** (International Atomic Energy Agency), made every effort to explain its purpose and to make the audience feel that they were part of a welcoming research community. The presentation by **Luc Rock** (University of Calgary, Canada) provided some useful pointers to the potential benefits and pitfalls of employing end member mixing using stable isotope techniques to elucidate the source and fate of nitrate and sulphate in river basins.

The Key Note presentation for the Henry Darcy Medal, awarded to **Tammo Steenhuis** (Cornell University, USA) was scheduled for Tuesday evening. The lecture was entitled 'Hunting for flow paths with Darcy' and in it Tammo outlined his outstanding research concerning preferential and bypass flow in structured soils and pollutant transport in rural catchments. It was particularly refreshing to listen to a talk given by a man who is clearly extremely modest about his achievements and very people-orientated in his supervision of students. His comments about the creation of Smurfs were particularly imaginative – seemingly a consequence of inexperienced students performing blue dye tracing experiments.

With its multitude of different programmes and sessions, the EGU proved an ideal opportunity to catch up with the latest developments in research. For instance, current interest in the transport of trace contaminants and microorganisms associated with colloidal material prompted me to attend session HS31 'Transport of colloids and microorganisms in the unsaturated zone - Laboratory and field evidence, assessment and modelling'. This proved to be an entertaining and coherent session that began with an informative overview of colloid mobilisation and retention mechanisms (**James Saiers**, Yale University). It continued with a series of talks based on laboratory experiments with flow chambers and column scale experiments (**Yan Jin**, University of Delaware; **Annette Dathe**, Cornell University; **Arturo Keller**, University of California). These presentations all concerned the relative importance of different mechanisms of colloid retention in the unsaturated zone at the air-water or air-water-soil interface. They were visually enhanced by videos of flow chamber experiments, and prompted some lively debate concerning appropriate experimental design and applicability of findings to field situations.

The session finished by scaling up to consider a field study of virus transport through the unsaturated zone of fissured limestone (**Raymond Flynn**, University of Neuchatel). The structure of the session was carefully thought out to maximise any opportunity for discussion and application of the findings of earlier talks to later presentations.

In all I found the General Assembly to be extremely worthwhile. It was a great opportunity to present my research to a wide and diverse audience from all over the world, and to meet other researchers. Vienna proved to be a delightful city in which to stage the event — plenty to see in the evenings, an excellent metro system, and hotels to suit a range of budgets. Last, but by no means least, I would really like to thank the BHS, whose travel grant enabled me to attend the meeting and experience the EGU for the first time.

Kate Heppell
Department of Geography
Queen Mary, University of London

Ahmad's surprise presentation

Thanks to the BHS travel grant awards, I submitted two posters to the EGU05 meeting, the first of which was presented orally. This was unexpected: there was a late cancellation at 09.15 on Monday and I was given the chance to present my poster about *"Modelling trends and interannual variability of rainfall in the West Bank"*. The main purpose of this study is to mimic the interannual variability of rainfall for the future climate. The occurrence of below-average rainfall is one of the important issues in this application. The analysis is carried out by means of a

Neyman-Scott stochastic model in order to generate a long time series of rainfall at multisites simultaneously. The approach takes into account the cross-correlation between the sites. In addition, the preservation of the annual rainfall skewness is one of the main issues in modelling the interannual variability. The model can reproduce the behaviour of the moving-average rainfall over a several year period. We used the HadRM3 output to study the future climate for three scenarios: control, high emissions and medium emissions. The approach is one where ensembles of annual rainfall series are generated, and then sampled to provide example inputs representing the likely range of hydrological characteristics. Pronounced fluctuations are found in annual rainfall for both historic and future climates, which can have a crucial impact on water supply and local agriculture.

The EGU assembly is one of the biggest in the field of geosciences and more than 7000 scientists attended it this year. The oral presentations were divided into 23 different sessions, of which I was mainly interested in three: Hydrological Sciences (HS), Natural Hazards (NH) and Climate, past, present, future (CL). I selected my favourite topics mainly from these sessions.

The Hydrological Sciences session on Monday morning (HS38) was very interesting and well attended. In spite of the early start, the room was full. The session started with **Alan Seed**, who addressed the problematic characteristics of rainfall for rainfall modellers, which embrace variability at time and space scales, anisotropy, motion within a rainfield that differs according to spatial scale, non-stationarity in space and time and non-homogeneity of spatial processes.

Application of a Bartlett-Lewis rainfall model with random parameters was presented by **Thomas Kjeldsen**. The rainfall model is linked with a four parameter probability distribution rainfall-runoff model (PDM) to reproduce the extreme value properties of the observed flow series. The rainfall model contained a formulation whereby storm duration and intensity are correlated and the parameterisation was selected from a set of near optimum calibrations by means of similarity to the observed rainfall extreme value rainfall properties.

Tom Over's presentation on the application of weather type modelling was about multivariate stochastic modelling of hourly hydroclimatic variables and its effect on wind erosion predictions. He explained a multivariate stochastic model to derive a relationship between hourly precipitation, air temperature, dew point, wind direction and solar radiation to predict wind erosion, tested for three sites in the Great Plains of the USA.

In "Spatial-temporal disaggregation of daily rainfall", **Segond** *et al.* adopted Generalised Linear Models (GLMs) to study the spatial variability of daily rainfall, including temporal non-stationarities in rainfall sequences (e.g. climate change) and spatial patterns (e.g. elevation and other location effects). They examined the possibility of generating hourly rainfall through a GLM combined with a single-site disaggregation model using Poisson cluster processes. The approach was evaluated in the Thames catchment, with 15 years of records from 21 rain-gauges covering an area of 1400 km^2.

Claire Goodess described the application of statistical and dynamical downscaling methods to construct scenarios of extremes. She described downscaling methods for reconstructing observed extremes for selected European regions and Europe for the future scenario. Issues included the changes in temperature and precipitation extremes, the consistency of the statistically-downscaled changes, consistency with dynamically downscaled changes, and consistency with the underlying GCM changes.

Hundecha and **Bardossy** have modelled extreme precipitation and temperature in Germany for the future scenario. They concluded that in the second half of the 20th century both the mean and the extremes of these variables have increased significantly at many locations in the western part of Germany. They used two different statistical downscaling methods to construct indices of daily extreme precipitation and temperature from circulation variables: the first method was a multiple regression between the seasonal indices of daily extremes and seasonal measures of large-scale circulation variables; they also used a multivariate autoregressive method. It was concluded that this technique is able to take account of the spatial correlation for multisites downscaling.

Klaus Wolter gave a talk about possible causes of the south-central European heat wave of 2003. To investigate the causes he and his co-workers used NCEP-NCAR reanalysis data. According to their research, the heat wave may not be fully explained by the trend. They concluded that strong late winter zonal flow over the North Atlantic as well as the mature phase of the 2002-03 El-Niño may have helped set the stage for a hot summer. After many dry summers, a good monsoon season over West Africa may have contributed the final straw to boost summer temperatures over Europe, along with unusually dry soils, in the wake of severely warm and dry spring. They suggested a heat-wave warning system should be established in Europe based on statistical methods.

Ahmad Moaven-Hashemi
University of Newcastle upon Tyne

Aidan Burton's selection

This year's European Geosciences Union General Assembly attracted over 10000 abstracts, more than 10% related to hydrological sciences. My focus at this conference followed a number of themes: rainfall models and their application, climate change, flood forecasting and hydroinformatics. I have reported a selection central to my interests, and those whose novelty or unusual nature caught my interest.

Alan Seed (Bureau of Meteorology Research Centre, Australia) warmed up a session on rainfall modelling and its applications with an overview and illustration of the characteristics of rainfall that cause headaches for rainfall modellers. These include variability at all time and space scales, properties that vary with direction, motion within a rainfield that differs according to the size of the feature, trends in rainfall properties that exist in both time and space and the overlaying of different discrete rainfall processes to produce what is observed as a single rainfall event.

Thomas Kjeldsen (CEH Wallingford) presented an application whereby a Bartlett-Lewis rainfall generator was linked with a rainfall-runoff model in a formulation designed to best represent extremes. The rainfall model was formulated so that storm duration and intensity were correlated. Calibration involved selecting the parameter set best able to reproduce the observed extreme value properties of the rainfall from a set of near optimum calibrations to other statistics of hourly rainfall. The rainfall-runoff model, a four parameter version of the linear Probability Distributed Model developed at the Institute of Hydrology, was calibrated to optimally reproduce extreme values of the observed discharge series.

Thomas Over (Eastern Illinois University, USA) described an application of a rainfall model to the newly-emerging field of weather modelling, presenting results for the American Great Plains. This region has a pronounced diurnal cycle, so the first step was to characterise this and to work with anomalies. Relationships were derived to predict anomalies in wind velocity, temperature and dewpoint from hourly rainfall occurrence and amount. These in turn were used to determine relationships predicting solar radiation. An hourly stochastic rainfall model was then used to drive a stochastic weather generator built on these relationships.

Two posters by **Tommaso Diomede** *et al.* (ARPA-SIM and University of Bologna, Italy) presented a scheme to use a meteorological database and searching scheme, based on similarity, to generate forecast ensembles of precipitation and subsequently of river discharge. The

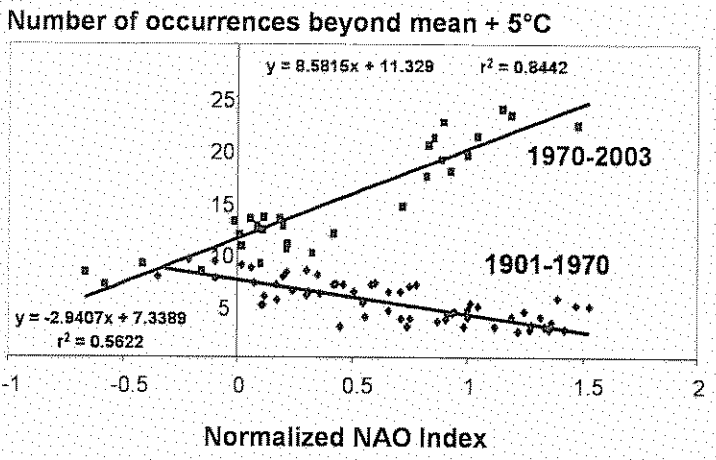
database consisted of 11 years of daily ECMWF analysis records of atmospheric variables over Western Europe and the Eastern Atlantic. Each analysis record was linked with the corresponding precipitation measurements recorded for the following 72 hours at 45 raingauges spread over the Reno river basin in Northern Italy.

Precipitation forecasting involved comparing observations of atmospheric variables to the analysis records in the database to identify the 50 most similar occasions in the past. The corresponding rainfall time series were extracted to provide a 50 member rainfall forecast ensemble. The quality of this ensemble was improved for lead times of greater than 24 hours by using Limited Area Model forecasts of atmospheric variables for lead time multiples of 24 hours in addition to initial observations.

The ensemble of forecast rainfall time series was input into a rainfall runoff model (TOPKAPI) of the Reno river basin to generate an ensemble of discharge forecasts. The forecasting scheme was found to be able to estimate forecast uncertainty well with the proviso that it may not be reliable for extreme events that may not be sufficiently well represented within the database.

Martin Beniston (University of Fribourg, Switzerland) reported a study of strong 'heat waves' in the winter season in Switzerland. Such heat waves may result in strong winter river discharges and disruptions in vegetative cycles, water resources and the skiing industry. He demonstrated that such events may be greater in magnitude than the summer heat waves that are more widely known. For example, the summer heat waves of 1976, 1998 and 2003 were all associated with winter heat waves. In 1967 and 1998 the summer anomaly was +10°C whilst the winter one was +15°C! The relationships between such events and the North Atlantic Oscillation were investigated, showing a step change from the 1970s onwards.

Klaus Wolter (University of Colorado, Boulder, USA) investigated possible causes of the European heat wave in the summer of 2003. This event was considered to have resulted in the deaths of 30000 people and economic losses in excess of $13 billion. He drew a link between the El Niño event of 2002-03 and an unusually active West African monsoon. Both of these are typically linked independently with hotter and drier summers in the Western Mediterranean region. Normally they are inversely related in magnitude and therefore counter each other. In this case the effects added, producing the extreme European summer. Such an insight suggests the possibility of a heat wave warning system for the region. Whilst the heat wave was considered to be exacerbated by climate change, a larger part of its magnitude was considered to be a random occurrence. This is particularly likely, given the highly localised (on a global scale) nature of the event.



Links between winter heat wave occurrence and the NAO (Beniston, M., 2005, Warm winter spells in the Swiss Alps: Strong heat waves in a cold season? Geophysical Research Letters, 32, L01812

Dimitri P. Solomatine (UNESCO, Delft, The Netherlands) gave a solicited presentation on the use of committee machines in hydrological modelling. Committee machines consist of several models, each being a specialist in some aspect of the system being modelled. For example, a rainfall-runoff committee-machine could consist of models specialising in: the rising limb, the peak flow, the recession and low flows. One type of committee machine, a tree, automatically classifies the input data to select the best model to use; the classifications being based on expert judgement augmented by machine learning techniques. A second type, an ensemble, uses all of the models simultaneously. The committee machine output is obtained following a careful combination of the outputs of the models. Such a combination may be as simple as an average, but could be considerably more sophisticated. Finally, a machine learning technique, boosting, was described, whereby situations found to be badly modelled by a certain data-driven model are used to generate a second specialised model. Those situations badly predicted by the second model are used to generate a third model, and so on. This collection of models also operates as a type of committee machine.

The broad nature of the EGU, covering topics as diverse as space sciences, the Sumatran tsunami and cryospheric (glaciers, ice and snow) sciences, leads to the frequent criticism that it lacks focus. Also the size of the conference is often criticised for making it difficult for the audience to interact with speakers. However, its broad nature allows those attending to observe seminars on fields outside of their primary expertise, thus alerting them to methodologies used in other disciplines that can be transplanted into their own fields. Further, the Hydrological Sciences section has taken a lead in developing poster sessions as a means to bring researchers together and to encourage discussion. Further details of these presentations and of past and future meetings may be obtained directly from the EGU website, *http://www.copernicus.org/EGU/EGU.html*. Finally, I would like to thank the BHS for supporting my attendance at what was for me a very successful conference.

Aidan Burton, University of Newcastle
aidan.burton@ncl.ac.uk

New members

A warm welcome to the following new members of the Society:

Stephen Blenkinsop	University of Newcastle upon Tyne
Victoria A Carr	Arup, Leeds
Kirsten E Chick	RPS Group, Bristol
Adam C S Clarke	Peter Brett Associates, Reading
Andrew Clay	RPS Group, Bristol
Russell S Long	Environment Agency, Bexhill on Sea
Ian T Joyner	Atkins Water, Epsom, Surrey
Michael Reade	Munich, Germany
Heather A M Rich	Peter Brett Associates, Reading

River Clyde Flood Management Strategy

Scottish Hydrological Group meeting
University of Glasgow
16 February 2005

The River Clyde Flood Management Strategy is an initiative of Glasgow City Council, part of the ongoing regeneration of the Clyde waterfront. Kenneth Barr, Project Manager and Technical Director at W.A. Fairhurst & Partners, presented an overview of the project to a packed audience. As Kenneth reflected in his introduction, this level of interest was no surprise, given the historical significance of the River Clyde in Glaswegian hearts.

The commission for this work was awarded in May 2003 to a joint venture of Halcrow Group Ltd and W.A. Fairhurst & Partners. The objective was to understand better the current and future flood risk (both tidal and fluvial) along the Clyde, identify and select the options for flood management at catchment scale, and develop a management strategy for Glasgow City Council.

The Clyde catchment extends over nearly 4000 km^2, including major tributaries such as the Avon, Kelvin, Cart and Leven. The catchment covers ten main local authorities, with small areas within a further five: in fact nearly half of Scottish councils are concerned with the catchment and therefore have a responsibility for flood management under the Scottish legislation. However, the areas at risk of flooding are mainly within South Lanarkshire, Glasgow City, Renfrewshire and West Dunbartonshire.

The River Clyde has been extensively engineered for navigation since the mid eighteenth century: from 1770 construction of groynes to narrow and deepen the channel; from 1824 steam dredging; from 1840 widening, deepening and straightening the channel; from 1850 to 1914 construction of quays and basins; from 1970 closure and infilling of a number of basins; from 1990 cessation of dredging between Glasgow Harbour and Broomielaw (city centre area). As a result, fluvial flood risk is much lower in Glasgow and downstream than in natural conditions, but tidal flood risk has increased.

Kenneth then reviewed the history of flooding and previous work carried out in the 1990s. He noted some discrepancies between previous studies identifying the number of properties at risk of flooding and others estimating damage costs.

The modelling approach was based on a catchment review, the development of a hydrological broad scale model, and detailed hydrodynamic modelling and flood mapping along a 56 km corridor. The team benefited from extensive new ground survey data (LiDAR) and detailed bathymetry of the river was surveyed by the team.

Joint probability of extreme river flows and high tide was also taken into account. More than 2000 properties at risk of flooding have been identified along the 56km corridor, fewer than previously predicted. Approximately two thirds of properties are at risk of tidal flooding, and one third at risk of fluvial flooding.

A wide variety of flood management options has been considered: catchment storage; tidal barrier in Glasgow or further downstream; combination of tidal barrier and catchment storage; direct defence.

One essential issue that became apparent during the project was the poor conditions of quay walls in many places. The environmental study also highlighted the international significance of the Clyde estuary for bird migration and other wildlife.

A preliminary comparison matrix of options was established, including parameters such as deliverability, environmental implication, fit with the City plan, engineering and operational risk, timescale and cost.

Everything pointed towards one preferred option — direct defence — which also offers the possibility of addressing the problem of poor quay wall conditions and flood risk at the same time.

The project is focusing on developing this preferred solution.

Discussion

Ken Picken (Atkins) asked what lifetime was considered for the management strategy and which climate change scenario was taken into account. The strategy looks at several decades and, for example, will inform future revision of the City plan. A range of climate change scenarios by 2050 to 2080 have been considered in line with information currently available from UKCIP.

Alvin Barber (City of Edinburgh Council) asked if the strategy covered other aspects such as surface water and sewer flooding. Kenneth explained that following the recent flooding of July 2002 in Glasgow's east end, these issues are being addressed by another project commissioned by Glasgow City Council in partnership with Scottish Water, but there is a dialogue between the teams.

Prof. Chris Salter (Edinburgh University) asked about the cost of direct defence, and how much it increases with climate change. There is no cost available, since there is no comprehensive scheme defined yet, but the team is confident that it is the cheapest option. Kenneth also noted that the length of areas at risk of flooding does not increase much with climate change.

Robin Wardlaw (Edinburgh University) asked for more details about the hydrological broad scale model. It was developed with Isis and is essentially a combination of FEH rainfall-runoff units, hydrographs taken from gauged sub-catchments and Muskingum-Cunge routing units. It was developed to identify boundary conditions for the detailed hydrodynamic model, assess the feasibility of upstream storage, and carry out outline sensitivity analyses to land-use change scenarios.

Paul Wilkinson (Carillion Building) asked about siltation and whether there were plans for further dredging. Kenneth confirmed that siltation had been taken into account, but there was no plan to address this issue by dredging as the impact of siltation is minimal on extreme (tidal) water levels.

Ronnie Falconer (Jacob Babtie) gave the word of thanks. He said that it was fitting on the day that the Kyoto agreement came into effect to be talking about climate change. The development of the River Clyde flood management strategy covers a broad range of complex issues and the result is a win win win situation: dealing with flood risk, dealing with regeneration, and making the Clyde the focal point in Glasgow once again.

Pascal Lardet
Halcrow

LOCAR meeting and site visit

BHS South East Section meeting
Centre for Ecology and Hydrology, Wallingford
followed by a visit to the Pang catchment
16th June 2005

The 2005 South East Section summer site visit was a successful event attended by about 15 people. The site visit was preceded by introductory talks by Roger Wyatt and Jon Finch.

NERC's lowland catchment thematic research programme (LOCAR) is an intensive interdisciplinary research programme to study key water resource issues in lowland Britain and to improve water and catchment management in permeable catchments on sandstone and chalklands. The study areas are the Tern in Shropshire, the Frome and Piddle in Dorset and the Pang and Lambourn in Berkshire.

Land-use changes, possibly drier summers and other environmental pressures increasingly affect water supplies from groundwater resources. Summer water shortages have led to headwaters drying out and prolonged winter rains have caused groundwater flooding. We have just had an exceptionally dry winter with very low groundwater levels.

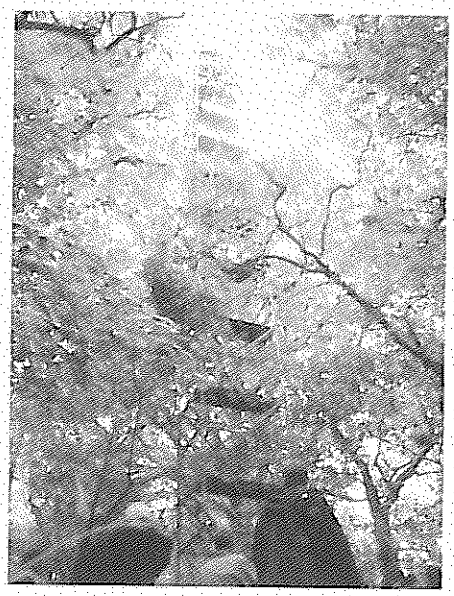
Roger Wyatt covered the basic background of LOCAR and then gave a resume of the instrumentation that has been installed for the project and the data it will provide. New instrumented sites have been set up within the study catchments to measure rainfall, evaporation, infiltration, groundwater levels and river flows so all the components of the water cycle can be measured automatically. Water samples are taken at regular intervals and during storms to monitor the movement of chemicals and sediments.

Jon Finch introduced the scientific rationale for the project and covered the groundwater balance for the Pang and Lambourn catchments, underlain mainly by the Chalk. He described the need to measure and understand the surface-groundwater interaction and the hydrological flux between groundwater, soil vegetation and the atmosphere.

The site visit in the afternoon included features of interest in the catchment such as a groundwater monitoring installation, a river water-quality monitoring site, a weather station and a woodland-canopy monitoring site.

Thanks to Roger, Jon and Amanda Lloyd for leading an enjoyable and informative visit and to members who contributed additional information.

Steve Tuck
Thames Water



Picture above: The woodland canopy monitoring tower at Grimsbury (photo by Yann Guidon, Environment Agency)

Hydrological Drought book

Hydrological drought — processes and estimation methods for streamflow and groundwater is a new textbook in the series *Development in water sciences*, edited by Lena M. Tallaksen and Henny A.J. van Lanen, published by Elsevier in November 2004 (175 Euro/$ hardback, 85 Euro/$ paperback).

It is a textbook for university students, practising hydrologists and researchers. Its aim is to provide a comprehensive review of processes and estimation methods for streamflow and groundwater drought. It includes a qualitative conceptual understanding of drought features and processes, a detailed presentation of estimation methods and tools, practical examples and key aspects of operational practice. Methods are demonstrated using sample data sets and tools on a CD.

Current water resources issues in the Eden catchment

BHS Pennines Section meeting and AGM
Newton Rigg College, Penrith
25th May 2005

Over 60 people attended the Pennines Section meeting in Penrith, sponsored by United Utilities (UU). The day kicked off with an Annual General Meeting to elect new committee members and to approve the proposed new constitution.

Six committee members were elected: **Christina McKay** (EA Wales), **Janet Makin** (United Utilities), **Joe Holden** (Leeds University), **Dave Collins** (Salford University), **Claire Walsh** (Newcastle University) & **James Lancaster** (Arup).

Dave Collins commented that the high attendance demonstrated the full re-establishment of the BHS Pennines Section. He also thanked the *ad hoc* committee members, including **Hilary Smithers** (SEPA), for their assistance in its revival.

'Aerial Eye Opener! Using aerial photography and GIS to target river habitat restoration in the Eden catchment' was the first presentation. **Lucy Dugdale** (Eden Rivers Trust) discussed how the Trust had used aerial photography and GIS to target river habitat restoration in the Eden catchment. They had built up a 3-D picture of the catchment by conducting a 750 km aerial survey.

Remote sensing and Landsat imagery was used to examine in-stream characteristics, such as depth, velocity and channel slope, and to determine the location and pathway of diffuse pollution (in the form of fine sediment or nutrients). These data were used to target and prioritise their restoration strategies (land management, buffer zones, hedgerows and wetlands) whilst maintaining a catchment wide picture. The project had enabled them to gain a better understanding of the catchment and how they could maximise the money available to achieve improvements.

Maggie Robinson (English Nature) gave the second presentation: *'Water Resource Requirements of Special Area of Conservation Habitats and Species'*. She spoke about the water resource requirements of SAC habitats and species. Designation of SACs has been driven by EU legislation: the 'Habitats Directive' 92/43/EEC and the resulting UK Habitats Regulations 2004.

Sites in the Eden catchment were an obvious choice for SAC designation, with their high diversity, abundance of protected species (e.g. Atlantic Salmon, Otter, Crayfish, Lamprey), varying geology and habitat types. Each designated species/habitat has different water resource requirements (quality and quantity). This was illustrated by the Lamprey, which has differing habitat requirements for each stage of its life cycle.

In assessing the water resource requirements, various flow considerations that need to be made, including fluvial processes and habitat variation, maintenance of adequate flows and a clear passage for migration of species. Despite all the work done on species requirements in the context of water quality, little has been done to link it to water quantity. English Nature's LIFE project aimed to pull together the information available; the Environment Agency were looking at species requirements through the CAMS process, using the RAM methodology.

'Water supply and protecting the River Eden' by **Richard Critchley** (United Utilities) explored current water supply issues in the Eden catchment. Water supply needs must be balanced with those of the environment and other water users to achieve sustainable water resource management. Stakeholder liaison was critical. Richard estimated that around a quarter of UU's 6.5 million customers receive water from the Eden catchment.

UU have made several improvements in the catchment to reduce the impacts of abstraction for public water supply as part of AMP3. They included voluntary prescribed flows on the River Gelt and installation of a fish pass and smolt screens at Heltondale. Voluntary increases in compensation flows have also been made from Wet Sleddale Reservoir. Richard concluded by stating UU's commitment to sustainable water resource management and further improvements in future.

'CHASM in the upper Eden: catchment response from the hillslope to the meso-scale' was next. **James Bathurst** (Newcastle University) talked about Catchment Hydrology And Sustainable Management (CHASM), a national programme involving instrumentation of four meso-scale (100 km^2) catchments, including the Eden. Studies focus on scaling theories and their application to practical management.

Dependency in hydrological response is being based on three scales using a common experimental design. The meso-scale contains two mini-scale basins (10 km^2), which in turn contains several micro-scale basins (1 km^2). The programme required a large amount of instrumentation, including raingauges, stream flow gauges and observation boreholes. Since the installation of the Eden instrumentation, three major floods have aided the assessment of flood peak translation and attenuation.

Examples from the February 2004 flood showed the catchment's response to the various storm processes, such as transmission of groundwater to the river. In the higher parts there was little storage effect in the groundwater, with piezometer levels reflecting the rainfall event; in the lower parts there seemed to be more storage and a slower response to rainfall. Flood peak discharges showed a high degree of correlation with catchment size, showing scale dependence. Estimates of scale dependency in sediment yield were also assessed.

James stressed the need to build on CHASM, which has now run to the end of its funding. There are possibilities for research on climate change, spatial rainfall distribution and land-use practice. In the near future there are proposals for models for risk analysis and the installation of mobile rainfall radar capabilities.

Asked whether there was any link with Lucy Dugdale's work, James replied that a Catchment Management Committee helped liaison with stakeholders and other researchers.

James said that although the instruments would remain in place now that CHASM was ending, their maintenance would require funding.

It was queried whether there had been artificial influences on the results. James said that the Eden catchment is predominantly rural, and the absence of any dams in the study area kept such influences to a minimum. The minor water abstractions and sewage inputs would have minimal impact.

Phil Merrin (UU) and **Keith Seymour** (EA) resumed after lunch, which included a regional speciality, sticky toffee pudding, with *'Understanding the surface water/groundwater interactions in the River Leith catchment'*. As part of the Habitats Directive Review of Consents, a collaborative project has been set up involving the two principal abstractors (UU and CenterParcs) and the EA to assess the impacts of groundwater abstraction on river flows and potentially on ecology.

Phil summarised the hydrogeology of the catchment and reviewed the principles of surface-groundwater interaction. The Penrith Sandstone aquifer provides a vital public water supply, but also baseflow support to the Eden and its tributaries. Previous modelling showed impacts of the two abstractors to represent between 2.1% and 51% of the drought flow. This study aimed to reduce this large uncertainty and to assess the significance under the Habitats Directive.

The pattern of flow loss and gain along the River Leith is complex, and it is difficult to analyse the results. Generally, losses occurred where the river flows over limestone, with flow accretion only seen downstream of Cliburn. During storm events, the peak river discharge and peak piezometer levels appeared to correspond, but the deeper observation boreholes tended to show a lag effect.

Connectivity between the river and the shallow aquifer has been shown. However, the deep aquifer responded mainly to barometric pressure, rather than rainfall events and high-river flows. In the subsequent groundwater modelling, riverbed conductivity was seen to be the most sensitive parameter.

The range of estimates for the impacts of abstraction was reduced, to between 8% and 37% of the lowest recorded flow. It could not be concluded that there was no adverse impact from abstraction. Further data will be required, along with a better understanding of the riverbed conductivity in controlling groundwater abstraction related losses in the river.

The final presentation was by **Brian Cox** (Atkins), who outlined a methodology produced for the EA to estimate hands-off flows (HoF) for SAC rivers based on ecological requirements. It aims to be a 'hands-on' approach to the determination of HoF, using actual data rather than modelling packages.

Habitat requirements for the designated species in the river are derived from a literature review and discussions with Agency staff. Water velocity and depth are often used as the critical habitat parameters, with the requirements of the most demanding species being used in the analysis. Several cross-sections are chosen

according to their ecological suitability. Riffle areas are often the habitat most sensitive to changes in flow, but there are also practical considerations such as gauging suitability. Flow gauging and measurement of the habitat parameters is carried out on at least three occasions over a range of low flows. Flow is then linked to derived habitat parameters (e.g. median depth) by linear regression.

Using the regression relationships, the sensitivity of habitat parameters to flow can be assessed and an acceptable flow range estimated. The concept of a range is crucial: should the habitat requirements be met at only one of the verticals or at 50% of the verticals? The optimal solution probably lies between these extremes. The HoF value at a cross-section is transposed to a suitable control site (e.g. an EA gauging station) using flow duration percentiles.

Work is continuing for other Cumbrian rivers for Stages 3 & 4 of the Habitats Directive. Confidence in the method is increasing, as is an appreciation of its limitations. The next key step was to assess the impact of hands-off flow estimates on water resources and catchments in a wider context.

Malcolm Newson (Newcastle University) suggested that flow types would give a better appreciation of the river system as a whole. Brian claimed that there was a strong correlation with the results using his method and that of the 'flow per bankfull metre width' flow type. **Jane Atkins** (EA) stressed that the method was designed to minimise the demands on time and money — a simple approach was needed to get things done.

Maggie Robinson made the point that flow variability is important, calling for compensation and hands-off flows to include high flow periods as well.

Site visits in the Eden catchment

Two groups boarded minibuses for the site visits. Despite being a bit blustery, the trip was a welcome part of the day that made the conference more than just a collection of presentations.

Sites in the River Leith catchment were visited, including the UU Cliburn borehole site and the new gauging station on the Leith installed for the ground/surface water interactions study.

Wet Sleddale reservoir lived up to its name, thanks to recent heavy rainfall, with the spilling reservoir attracting much visual interest. The new computerised system and actuator were seen, which control the voluntary releases of water to protect river flows. Finally, a trip to United Utilities largest reservoir, Haweswater, was accompanied by a brief talk on the operation of the system, the history of the site and a tour around the pumping station.

Mark Smith (United Utilities) & Catherine Treagus (Environment Agency)

Diary

14th–15th September 2005
BHS Postgraduate Symposium
Venue: University of Reading
Contact: Paul Franklin *(email p.a.franklin@reading.ac.uk)*

15th September 2005
BHS / Scottish Hydrological Group
"Hydromorphological aspects of the Water Framework Directive in the UK"
Venue: The Burrell Collection, Glasgow
Time: 10.00 for 10.30
Contact: Mike Cranston *(tel 01738 627989, fax 01738 630997, email michael.cranston@sepa.org.uk)*

21st September 2005
BHS national meeting (plus AGM)
"LOCAR (lowland catchment research)"
Venue: Institution of Civil Engineers, London (all day — AGM at 13.20)
Contact: Prof. Ian Douglas *(email ian.douglas@manchester.ac.uk)*

12th October 2005
Scottish Hydrological Group
"Continuous rainfall-runoff simulation; revitalisation of the FSR/FEH rainfall-runoff model" — Ann Calver and Lisa Stewart (CEH Wallingford)
Venue: Royal Society of Edinburgh
Time: 6.00 for 6.30 p.m.
Contact: Mike Cranston *(see above)*

19th October 2005
BHS South West Section meeting
"Risk-based environmental management"
Venue: University of Plymouth
Contact: Andrew Williams, University of Plymouth *(tel 01752 233053, email andrew.williams@plymouth.ac.uk)*

20th October 2005
BHS South East Section meeting
"Drought in the South East"
Venue: ICE London, Time: 18.45
Contact: Helen Procter *(tel 01372 754201, email helen.procter@atkinsglobal.com)*

9th November 2005
BHS national meeting + FloodRiskNet
"Recent advances in flood risk mapping"
Venue: University of Newcastle
Contact: Hamish Harvey *(email Hamish.Harvey@ncl.ac.uk)* or Tim Fuller

15th–17th November 2005
Institute of Fisheries Management
"Fisheries on the edge"
Venue: The Lowry, Salford Quays
Contact: Wendy Diedricks, APEM Ltd *(tel 0161 226 2922, fax 0161 226 0753)*

15th–17th November 2005
Irish National Hydrology Seminar
"Understanding and managing hydrological extremes"
Venue: Tullamore Court Hotel, Tullamore, Co. Offaly, Ireland
Contact: John Martin, OPW, Dublin *(tel 01 647 6742, email john.martin@opw.ie)*

23rd November 2005
Scottish Hydrological Group
"Postgraduate studies in hydrology and hydraulics"
Venue: Rankine Building, Glasgow University, Time: 6.00 for 6.30
Contact: Mike Cranston *(see above)*

24th November 2005
BHS South East Section meeting
"Tsunamis and the impact on water resources and water supply"
Venue: ICE London, Time: 18.45
Contact: Helen Procter *(see above)*

14th December 2005
BHS Midlands Section meeting
"Low flows & the hydro-illogical cycle"
Venue: University of Birmingham
Contact: David Hannah *(email d.m.hannah@bham.ac.uk)* Website: *www.drought.unl.edu/plan/cycle.htm*

UK Committee for the IAHS

The position of Chair of the UK Committee for the IAHS and UK National Representative rotates among the Commissions, roughly every four years, and **Bruce Webb** has handed over this role to **Ian Cluckie** of the University of Bristol, who is also the National Correspondent for the International Commission on Remote Sensing. Bruce will remain on the Committee as National Correspondent for the International Commission on Water Quality.

After many years of distinguished service, **Alan Gustard** has stepped down as National Correspondent for the International Commission on Surface Water. He is succeeded by **Gwyn Rees** (CEH).

HiFlows-UK: new website

The website *www.environment-agency.gov.uk/hiflowsuk* was launched on 1 August, and is now accessible to all. HiFlows-UK provides updated flood peak data for use with the methods in the Flood Estimation Handbook (FEH), and is a joint project between the three UK gauging authorities (the Environment Agency, SEPA and the Rivers Agency of Northern Ireland). See the flier enclosed with *Circulation*.

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