Circulation

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Who knows what this is?

See story inside....

Belated Birthday Greetings

WITH THE BHS APPROACHING its 30th Anniversary this year, belated 50th birthday greetings to the Hydrological Research Unit (HRU) which was formed 21 years earlier on 1 April 1962 at the Hydraulics Research Station, Wallingford. Brought about by deliberations in the Committee on Hydrological Research of the Department of Scientific and Industrial Research, the Unit was given the task of answering the question "Do trees use more water than grass?". From the experiments conducted at Stocks Reservoir, Frank Law (Senior) had found that his small plantation of coniferous trees reduced the volume of water available for runoff compared to short vegetation. This result was highly controversial since at this time large areas of upland Britain were being afforested, but the adequacy of future water resources was being questioned. His findings were challenged because of the small size of the plantation, and uncertainty about the mechanisms providing the extra energy needed for evaporation. The Unit was established to provide an answer to these problems at the basin scale.

Initially the Unit had a staff of five headed by Eamon Nash, but with the resignation of Eamon to return to Ireland, Jim McCulloch, who had experience with research catchments in East Africa, became Head in May 1964. On 1 April 1965, following the reorganization of government science by the Wilson Government, the Natural Environment Research Council was established with HRU as one of its component bodies. Three years later the Unit became the Institute of Hydrology (IH) while more recently after more than 30years IH was subsumed into the Centre for Ecology and Hydrology.

It is worth noting that in the early 1960s when HRU was set up very few scientists and engineers called themselves hydrologists. There were hydrogeologists working in the Geological Survey and hydrology had been practised in the then colonies for many years. Consulting engineers were involved in hydrology and there were post-graduate hydrology courses at Imperial College and several other universities. However the HRU provided a focus for hydrology in a manner that no other body was able to do. At the present time hydrology is well established in the UK, in universities, consulting engineers, in government and its agencies and in other bodies.

When the British Hydrological Society was formed in 1983 nearly 20% of its initial 280 membership came from the Institute of Hydrology. Now the Society has 1000 or so members and there are several hundred British members of the International Association of Hydrological Sciences. The UK has made and continues to make substantial contributions to UNESCO's International Hydrological Programme and to WMO's Commission for Hydrology. . What will the next 50 years bring?

Mark Robinson, John Rodda, John Sutcliffe

For those interested, the background to the establishment of the HRU and the Institute of Hydrology is described more fully in: Robinson, M., Rodda, J.C., Sutcliffe, J.V. 2013. Long-term environmental monitoring in the UK: Origins and achievements of the Plynlimon catchment study. *Trans Institute of British Geographers.* In Press.

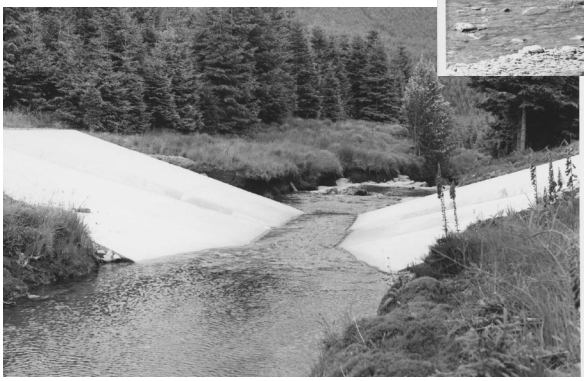


Front cover:Experimental flume for use in the Plynlimon catchments under test at Hydraulics Research Station.

Left: The original HRU building in the grounds of the Hydraulics Research Station, Howbery Park.

Cefn Brwyn weit on the R. Wye





Flat-V flume on the R. Severn

President's Piece

Have you noticed how popular Hydrologists have become recently? There's been a steady stream of jobs advertised for hydrologists over the last few months, as well as numbers of research opportunities waiting for young hydrologists to develop their knowledge and expertise. With the recent droughts, floods, water resource and climate change issues the demand may be expected, but what of the supply? In the consultancy world, where many job adverts are now coming from, many hydrologists were shed during staff cuts and mergers as a result of the financial crisis after 2007. Now workload is picking up it is no surprise that those victims of re-organisation and "right-sizing" have not waited around but gone onto to other things - who would want to work in an industry where you get laid off every few years?

But that is only part of the problem. As well as more mature hydrologists leaving the industry there is only a limited number of new recruits coming into it. Why? Well, you can only really study hydrology once you are a graduate, and that means having acquired your first big debt. Then you need to get another one studying for a hydrologically-based MSc. With no NERC grants available these days, for reasons that are not particularly clear, it's no wonder that many have second thoughts. The profession is gradually being starved of new recruits as a result.

Whist it is nice to be in demand, the country needs a better way to ensure it has the hydrologists it needs. BHS is trying to help by offering grants to MSc students. We are grateful to employers - well, the employer - who have (has) contributed to this scheme but at present this is only a limited stop-gap. We need a re-think on training and employment of hydrologists. Meanwhile, if any of you consultants who are desperately trying to recruit hydrologists want to help BHS support more new ones, give us a call.



President

New BHS Secretary

WE ARE DELIGHTED TO WELCOME **Harry Dixon** of CEH onto the Committee as our new Secretary. Harry is a hydrologist at the CEH where much of his current work surrounds the management and development of the UK National River Flow Archive (NRFA). His research interests focus on hydrometry and hydrometric data management. He is a current member of a British Standards Institution (BSI) Hydrometry Committee. Since 2009 Harry has help run the UK focal point for the International Hydrological Programme of UNESCO and Hydrology and Water Resources Programme of WMO. Harry has been a BHS member since 2003 and before moving to CEH he gained a PhD from the University of Birmingham investigating streamflow changes across Wales and the English Midlands. Although originally from the Pennines, Harry seems to be gradually migrating south and currently lives in Oxford.



New Members

Stephen Addy.....The James Hutton Institute, Aberdeen
Joshua Henry Arnott.....Atkins, Witney, Oxon
Omotayo Ayeni.....South Croydon
Joe Compton.....Lancaster University, Keighley
Andrew Cunliffe.....Exeter University
David Dufton.....Leeds University, Brighouse, W.York
Robert Fulton.....Atkins, Peterborough
Michael Grocott.....University of Birmingham
Matthew Hill.....Loughborough University
Michelle Hinfey.....Environment Agency, Bodmin
Dana Jacob.....Dundee University
Faye Louise Jackson.....Telford
Golnaz Jahanshahi.....Newcastle University
Amy Lennard.....Liverpool University
Kate Mathers.....Loughborough University, Leicester
Kathryn Emma Maye.....The Canal & River Trust, Warwick
Victoria Susan Milner.....University College Worcester
Katie Muchan.....CEH Wallingford
Valentina Noacco.....Bristol University
Daniel Leigh Stansfield.....Halcrow Group Ltd, London
Atish N Vadher.....Loughborough University
Jonathan Werritty.....Scottish Environment Protection Agency, Edinburgh
Gavin Williams.....Birmingham University
Clifford Wills.....Environment Agency, Bodmin
Amy Woodget.....University College Worcester

Climate averages: new data resource from the Met Office

Thanks to **Andrew Black** who spotted this news release about the latest 30-year climate averages :

http://www.metoffice.gov.uk/news/releases/archive/2012/1981-2010-averages

Andrew says clicking on the last link in the text and then through to UK mapped averages allows visual comparison of maps for the three standard periods available.

Aquator™ User Group Meeting Autumn 2012

THE SIXTH *AQUATOR*™ USER Group Meeting was held on 12th October 2012 at Worcester College, University of Oxford. Jointly promoted by Oxford Scientific Software and Hydro-Logic, the event was attended by 30 delegates drawn from water companies, regulators, consultants and academia.

The meeting provided an opportunity for users to be updated with the latest developments in the software. This was complemented by user presentations of a range of *Aquator* case studies. These included the modelling of the Bilbao/Vitoria system in Spain (presented by **David Ocio Moreno** from Sener in Spain) through which the results from the *Aquator* model had helped to avert significant regional tensions. The subject of climate change was addressed in other case studies and in particular, the attendant uncertainty in water resource forecasts.

The keynote address was delivered by **Chris Lambert** (Water Policy and Strategy Manager, Thames Water Utilities Ltd) who gave an illuminating illustrated talk on the management of the recent drought from the perspective of Thames Water.

The User Group meeting was preceded on 11th October by a Workshop that included sessions dealing with advanced use of *Aquator*, the use of VBA and Genetic Algorithms.

The User Group meetings provide an opportunity for users to meet and discuss their experiences of working with *Aquator*. For further information on the User Group, and *Aquator* in general, contact **Paul Roberts** at proberts@hydro-logic.co.uk or Tel: 01189 331325.



We plan to run a series in ***Circulation*** *on the specialist hydrological research and teaching groups that have been set up in recent years. Many thanks to* ***David Butler*** *and his group at Exeter for starting the ball rolling.*

Centre for Water Systems, University of Exeter

Harrison Building, North Park Road, Exeter EX4 4QF

Phone: +44 (0)1392-723732, Fax: +44 (0)1392-727965, E-mail: cws@exeter.ac.uk

THE CENTRE FOR WATER SYSTEMS (CWS) at the University of Exeter was founded in 1998 with two permanent members of staff and is now are an internationally recognised centre of excellence in water engineering research with 9 academic staff, over 30 researchers and funding from UK and EU sources running at over £1M per year. In EPSRC's most recent review of their research portfolio, CWS was highlighted as one of just four leading centres of water engineering research in the UK. The particular strength of the Centre is in cross-disciplinary research into hydroinformatics and urban water management, and Centre staff have been key players in the initiation and development of these topics. Our core expertise includes data mining, decision support, hydraulics, urban hydrology, numerical modelling, optimisation, simulation and systems thinking. The Centre is part of the multi-disciplinary College of Engineering, Mathematics and Physicals Sciences (CEMPS), one of six Colleges making up the University of Exeter.

We have significant interaction with other relevant research centres in the College: Climate Systems; Energy and the Environment; Renewable Energy; Systems, Dynamics & Control and are particularly well placed physically and in relationship terms with the Met Office.



The Centre is led jointly by Professors Savić and Butler. Dragan is Professor of Hydroinformatics and very well known in the field of hydroinformatics, focusing on decision support methodologies for water and wastewater system management. He was awarded an EPSRC Advanced Research Fellowship (2001-2005), and held for the Centre two consecutive Platform Grants and many other EPSRC and EU grants (in Frameworks 5, 6 and 7). Prof. Savić has co-authored four books, four edited volumes and published over 120 research and professional papers in refereed journals. He is an inaugural IWA fellow and currently serves as the Editor-in-Chief for the Journal of Hydroinformatics.

David is Professor of Water Engineering and has an international reputation in urban water management. He was formerly professor of water engineering at Imperial College London. He has had unbroken EPSRC funding for nearly 20 years, including a current established career fellowship, two consecutive platform grants and several research consortia. He has

also received European Union and industrial funding for his work. Prof. Butler has co-authored five books (including a core textbook), eight edited volumes, 12 published reports and has over 120 research papers in refereed journals. He is also an inaugural IWA fellow, a REF2014 panel member and currently serves as the Co-editor-in-Chief of the Urban Water Journal.

The Centre is fortunate to have a large and talented academic staff, several of whom are leaders in their respective fields:

- Professor Zoran Kapelan – urban water infrastructure, decision support systems, risk & uncertainty, real-time management of water systems.
- Professor Slobodan Djordjević – simulation tool development, urban flooding, sewer network performance.
- Associate Professor Fayyaz A. Memon – water reuse, water efficiency, SUDS, life cycle assessment.
- Dr Gavin Tabor – computational fluid dynamics, turbulence simulation, biofluid mechanics, urban hydrology applications.
- Dr Raziyeh Farmani – urban water systems, water resources management, asset management.
- Dr Guangtao Fu – flood control and risk management, climate change impacts and adaptation, optimal design under uncertainty.
- Dr Diego Gomez – water resources management, protection and restoration, modelling of environmental systems.

In addition to our active research portfolio, we offer an MSc in Water Management. It draws on the experience and research capability of staff together with external lecturers from leading companies and government agencies, with the aim of delivery of a theoretically sound, yet practically relevant course. It provides knowledge and key skills in the broad area of urban water management including the essential aspects of clean water supply (supply, treatment and distribution) and waste water disposal (sewerage, treatment and flooding), providing an understanding of how these systems work and tools for simulating their performance. Topical issues covered on the course include: water losses and leakage, water efficiency, climate change mitigation and adaptation, sustainability, asset management, whole-life costing, urban flooding, integrated modelling, risk and uncertainty. Full or part time attendance is possible.

We organise many dissemination events and of most relevance to BHS readers is the forthcoming International Conference on Flood Resilience – Experiences in Asia and Europe, to be held at the University of Exeter, 5–7th September 2013.

The aim of this event is to gather professionals to present and discuss the latest research advances and practices in the development and implementation of resilience measures and flood management plans.



More details can be found at: **www.icfr2013.org**

The Centre has an up-to-date website (www.exeter.ac.uk/cws), where you can find more details of the MSc, research staff, current projects, publications, resources, news and vacancies. We publish a regular biannual newsletter that can be sent to you on request.

Recent publications

Chen, A.S., Evans, B., Djordjević, S. and Savić, D.A. 2012. Multi-layered coarse grid modelling in 2D urban flood simulations. *J. Hydrol.,* **470–471**, 1–11.

Korteling, B. Dessai, S. and Kapelan, Z. 2012. Using info-gap decision theory for water resources planning under severe uncertainty. *Water Resour. Manage.*, DOI 10.1007/s11269-012-0164-4.

Astaraie-Imani, M., Kapelan, Z., Fu, G. and Butler, D. 2012. Assessing the combined effects of urbanisation and climate change on the river water quality in an integrated urban wastewater system in the UK. *J. Environ. Manage.*, **112**, 1–9.

Economou, T., Kapelan, Z. and Bailey, T. 2012. On the prediction of underground water pipe failures: Zeroinflation and pipe specific effects. J. Hydroinform., **14**, 872–883.

Fu, G. and Butler, D. 2012. Frequency analysis of river water quality using integrated urban wastewater models. *Water Sci. Technol.*, **65**, 2112–2117.
Quevauviller, P., Barceló, D., Beniston, M., Djordjevic, S., Harding, R.J., Iglesias, A., Ludwig, R., Navarra, A., Ortega, A.N., Mark, O., Roson, R., Sempere, D., Stoffel, M., van Lanen, H.A.J. and Werner, M. 2012. Integration of research advances in modelling and monitoring in support of WFD river basin management planning in the context of climate change. *Sci. Tot. Environ.*, **440**, 167–177.
Farmani, R., Henriksen, H.J., Savić, D. and Butler, D. 2012. An evolutionary Bayesian belief network methodology for participatory decision making under uncertainty: an application to groundwater management. *Integr. Environ. Assess Manage*., **8**, 456–461.
Giustolisi, O., Laucelli, D., Berardi, L. and Savić, D.A. 2012. Computationally efficient modeling method for large water network analysis. *J. Hydrau. Eng*., **138**, 313–326.
Sušnik, J., Vamvakeridou-Lyroudia, L.S., Savić, D.A. and Kapelan, Z. 2012. Integrated System Dynamics Modelling for water scarcity assessment: case study of the Kairouan region. *Sci. Tot. Environ.*, **440**, 290–306.
Hutton, C.J., Kapelan, Z., Vamvakeridou-Lyroudia, L.S. and Savić, D.A. 2012. Dealing with uncertainty in water distribution systems models: a framework for real-time modelling and data assimilation. *ASCE J. Wat. Res, Plann. Manage.*, DOI10.1061/(ASCE)WR.1943–5452.0000325.

An interesting new slant on global climate models

IT COULD BE THAT CURRENT GCMs are tending to simulate an excessive number of droughts in current and future scenarios.

This observation is made in a recent paper in *Nature** based on a joint study by scientists in the UK, Holland, Austria and France, led by **Chris Taylor** at CEH Wallingford. The finding hinged on examining imagery from weather satellites which track the development of storm clouds across the globe and the somewhat surprising revelation that rainclouds tend to brew up in places where it has not rained in the previous few days: the conventional thinking is that there is a positive feedback loop whereby reduced evaporation from dry soils decreases rainfall, leading to even drier conditions.



The new satellite evidence that afternoon storms develop preferentially over dry soil is clearest across semi-arid regions of Africa and Australia, but is also apparent in parts of Europe, North America and Asia, The study went on to analyse global weather and climate models and found the opposite behaviour,leading to a concern that existing models might be wrong in triggering rain over wetter soils.

Both heat and moisture are critical ingredients for the build-up of rain clouds; moisture provides the fuel for the rain, but heat can provide the ignition. On sunny days the land heating the air creates thermals which reach several kilometres up into the atmosphere. If the soil is dry, the thermals are stronger and thus more favourable for the rapid growth and import of cumulo-nimbus storm clouds enhancing the likelihood of rain.

*Taylor, C.M., de Jeu, R.A.M., Guichard, F., Harris, P.P. and Dorigo, W.A. 2012. Afternoon rain more likely over drier soils. *Nature* **489**, 423–426.
DOI 10.1038/nature11377.

WMO Hydrology:

An update from the 14th Session of the WMO Commission for Hydrology (CHy-14)

Geneva, 6th – 14th November 2012

REPRESENTATIVES FROM 51 COUNTRIES met for the 14th Session of the World Meteorological Organization's Commission for Hydrology (CHy) in early November 2012. The Commission shapes the water related activities of the WMO and provides guidance regarding the implementation of the Organization's Hydrology and Water Resources Programme. During the Session the Commission reviewed the progress of activities completed over the 2008–2012 period and agreed a future programme of work for the next four years. The UK delegation was led by **Ann Calver** (Vatnaskil LWRC) in her last role as Hydrological Adviser to the UK Permanent Representative to WMO before handing the responsibility to **Alan Jenkins** (Centre for Ecology & Hydrology). In addition to Ann and Alan, support was provided by **Harry Dixon** (CEH), **Cathy Moore** (Met Office) and **Charlie Pilling** (Flood Forecasting Centre).

The Commission devoted considerable attention to potential hydrological contributions to WMO's new Global Framework for Climate Services (GFCS). Designed to further the development and incorporation of science-based climate information and prediction into planning, policy and practice, the GFCS is a major new initiative covering all of WMO's areas of activity. The Framework aims to enable producers, researchers and users to join forces to improve the quality and volume of climate services worldwide, particularly for developing countries. Following debate, the Commission highlighted the crucial role of water-related climate services and, over the next four years, aims to foster active participation of the hydrological community in implementing the GFCS. Advances in areas such as seasonal streamflow forecasting and the understanding of hydrological responses to climatic variability were recognised as key to decision-making in water management around the globe and, as such, important topics for further international collaboration.

The Commission also discussed progress and future plans in relation to the Quality Management Framework for Hydrology and the possible adoption of WaterML 2.0 as a joint WMO/ISO standard for the transfer of hydrological data worldwide. A recent independent review of the World Hydrological Cycle Observing System (WHYCOS) and other capacity-building initiatives in hydrology and water resources were amongst other issues considered.

A number of interesting scientific lectures were presented during the Commission's meeting exploring topics such as Soil Moisture Measurements from Space and the Current State of the Art in Hydrological Data Exchange Formats and Protocols. Full presentations and the provisional meeting report can be viewed at: http://chy-14.wmo.int.

The future programme of work agreed by the Commission included initiatives across five Theme Areas and seven cross-cutting issues (see Box). An ambitious programme of activities was agreed for each Theme Area and the Commission's new Advisory Working Group will now prioritise these and guide their implementation over the coming four years.

The UK has a long history of providing important contributions to WMO hydrology (see *Circulation* No. 102). After eight years serving as a member of the Advisory Working

CHy-14 Theme Areas:

1 Quality Management Framework – Hydrology
2 Data Operations and Management
3 Water Resources Assessment
4 Hydrological Forecasting and Prediction
5 Water, Climate and Risk Management

Group, **Ann Calver** stepped down from this role in November 2012. In recognition of her outstanding contribution to the Commission's work Ann was presented with a Certificate by the outgoing President, **Julius Wellens Mensah** (Ghana).

The Commission also noted the imminent publication of a report on *Guidelines for Hydrological Data Rescue* (jointly authored by **Matthew Fry**, CEH) along with other recent UK contributions including a review of issues surrounding *Climate and Meteorological Information Requirements for Water Management* (authored by **James Dent**). The future programme of work agreed by the Commission's presents many opportunities for UK hydrologists to contribute to the work of WMO and those interested are encouraged to look at the plans which can be found at: http://www.wmo.int/pages/prog/hwrp/chy.

UK individuals interested in contributing to WMO hydrology are encouraged to consider joining one of the Open Panels of CHy Experts (OPACHE). For more information about how to join a Panel, or other matters regarding UK contributions to the WMO Commission for Hydrology, please contact me.

Harry Dixon
UK Committee for National and International Hydrology
Centre for Ecology & Hydrology
harr@ceh.ac.uk

Implementing the new FEH rainfall depth-duration-frequency model for reservoir flood safety assessment

BDS Evening Meeting 19 November 2012

THIS MEETING OF THE BRITISH DAM SOCIETy, held at ICE and streamed live on the internet, was intended to update the reservoir engineering community on the current status of the new Flood Estimation Handbook (FEH) rainfall depth-duration-frequency (DDF) model which has been developed at CEH with collaboration from the Met Office and the Universities of Sheffield and Leeds.

Lisa Stewart and **Dave Morris** from CEH were the main presenters, followed by **Colin Clark** from the Charldon Hill Research Station who gave a personal view of the estimation of extreme rainfall in reservoired catchments. About 45 people attended the meeting and another 84 were able to follow the presentations and discussions on-line. **Martin Airey**, BDS Chairman, chaired the meeting and **Peter Mason**, Chairman of the Reservoir Safety Advisory Group, introduced the background to the subject and its relevance to dam engineers.

The assessment of flood risk is a vital element in the safe design, maintenance and operation of large reservoirs. In the UK, the standard approach is to use statistical estimates of rainfall frequency in combination with an event-based rainfall-runoff model to derive a design inflow hydrograph, which is then routed through the reservoir. Lisa started the presentation by describing the development of the new rainfall DDF model, which has been designed to replace the DDF model published as part of the FEH procedures in 1999. The first stage of this work was commissioned by Defra following concern expressed within the reservoir profession about the extent to which the FEH rainfall estimates of long return period were found to deviate from those obtained from the earlier design standard published in the Flood Studies Report (FSR) in 1975. In many cases, the FEH rainfall estimates were found

to exceed those of the FSR, and even to exceed estimates of probable maximum precipitation.

Lisa introduced the background to the problem and described the steps taken in developing the new DDF model, including the abstraction of annual and seasonal maximum rainfall depths and the compilation of data about 63 extreme storms recorded in the UK from 1886 to 2006. The project has been divided into three phases, the first of which was completed in 2010. Over the last 15 months, funding from CEH has been used to refine the model and to generalise the results across the UK.

Dave Morris presented details of the tests carried out to validate the model results and to compare them with the FSR and FEH procedures. The tests have focused on over 70 sites chosen for their long raingauge records and proximity to reservoirs, also with the aim of giving a good coverage of the UK.

Lisa then showed a number of examples of the application of the new model, including a study of reservoir flood safety at Nant-y-Moch Reservoir in mid-Wales. Plans are currently being developed to replace the current FEH rainfall model implementation on the FEH CD-ROM with a new web tool. This will allow easy access to the results of the new model to a wide range of users. Finally, Lisa pointed out that, although the impetus to revise the FEH DDF model came originally from users requiring estimates of extreme floods, the new model will replace the existing FEH model for the full range of return periods from 2 to over 10 000 years.

Colin Clark then introduced his presentation by saying how glad he was that the estimates in the Defra report had been increased since last year (the Final Draft is dated 2009). There were some storm data that had not been included in the report such as from the Louth and the Martinstown storms, where measurements of 355, 342, and 305 mm had been recorded which would cover an area in excess of 30 km^2.

Most of the dams in SW England are located on catchments less than this area, making the estimation of small scale storm very important. Three examples of such storms were shown: Louth, Boscastle, and Martinstown. Depth area analysis showed that the storm depth at an area of 20 km^2 and below was considerably higher than FSR PMP. Colin then showed a table from previously published work which compared the return period of the storm (after accounting for the soil moisture deficit) and the resulting flood. The Defra (2009) report showed big differences is the rarity of storm and flood, while the about to be published New Guide to Flood Estimation shows a much greater concordance. In Colin's view, the results of the latest revision of the Defra report are better, especially for the Boscastle event, but there are still major discrepancies. From a brief analysis of the raingauge network, the differences between the two methods are lowest where the network is more dense. This is because during a storm it is the higher rainfall near the centre of the storm that will be recorded. For SW England, the home of many big storms, and where the raingauge density is about one fifth of that in parts of SE England, the differences between the two methods are greater.

Discussion

A lively discussion followed the presentations. **Jeremy Wright** from the Heath and Hampstead Society asked about the value of local rainfall records. Lisa Stewart replied that the current formulation of the model did not allow for individual raingauge records to be analysed, although they were obviously of great value to the model development. Dave Morris pointed out that a large number of daily raingauge records for the last 100 years or so existed in manuscript form but that it would cost a great deal to digitise them. **David MacDonald** (formerly of Black & Veatch) expressed his concern that the new estimates from the revised FEH rainfall model could be too low as a result of the reliance on the sample of rainfall events used. He reiterated the view that further digitisation of historic rainfall records would be beneficial.

Other questions related to the relative lack of raingauges in the south west, whether very recent extreme events had been included in the analysis and whether the new model took account of climate change. Lisa and Dave answered that future updates to the model were planned so that newly available rainfall records could be incorporated into the analysis from time to time. Radar data, however, were currently unsuitable for the type of quantitative analysis that underpinned the model. Data from very recent events had not been included in

the analysis because it takes time to apply quality control procedures, and the likely effects of climate change on the model outputs was a subject for future research.

Finally, it was pointed out that a review of methods for design hydrograph construction for studies of reservoir flood risk was needed.

Lisa Stewart & Colin Clark

A video link to the meeting is available via the BDS website (www.britishdams.org).

[Note: *reports of this meeting were received from both Colin Clark and Lisa Stewart to whom we are extremely grateful. The subsequent merging was done by me and any contradictions are therefore my responsibility. –Ed.*]

Uncertainty in climate change research: an integrated approach

American National Center for Atmospheric Research (NCAR) workshop, Boulder (Colorado) 6–17 August 2012

THIS VERY INTERESTING WORKSHOP was organized by **Linda Mearns** (NCAR IMAGe), **Chris Forest** (Penn State University) and **Hayley Fowler** (Newcastle University). Presentations covered a wide variety of issues related to climate change, with speakers and participants selected from different backgrounds: climate modelling, impact modelling (e.g. hydrology), uncertainty quantification, decision making under uncertainty and multi-integrated.

Throughout the talks, and also when working in groups, it became evident to me that communication with people from different research areas can be very challenging: not only is the background knowledge different but so also are the aims, motivations and methodologies dissimilar. This is an extremely important point for hydrologists working in climate change who need to use climate models' output (which could have been designed for process understanding, and were normally not designed to produce inputs to hydrological models) and the need to communicate their findings to decision-makers in order for the appropriate mitigation measures to be implemented. It was evident in this workshop that communication (especially communication of uncertainties) between different research areas working with climate change needs to be improved.

The focus of this workshop was also decision-making under uncertainty. Projections of climate change have, and probably will always have, a large uncertainty attached to them but this cannot be allowed to lead to inaction. Adaptation measures to deal with future impacts need to be planned and implemented, so the need for robust adaptation measures (instead of an optimal adaptation measure for a particular future scenario) was stressed as a possible way of dealing with uncertainty.

The talks from this workshop are available online at **www2.image.ucar.edu/workshops/uncertainty-climate-change-research-archive**. For hydrologists, Dr Forest's talk about "Climate/Earth System projections and their uncertainties – an overview" is a good introduction to climate models and might be a good starting point to explore all the other excellent talks presented in the workshop.

Selma Guerreiro
School of Civil Engineering & Geosciences, Newcastle University

EcoSummit 2012: Ecological Sustainability: Restoring the Planet's Ecosystem Services

Columbus, Ohio, USA
30 September – 4 October 2012

THIS 4TH ECOSUMMIT HAD 1600 delegates from 75 countries with over 65 symposia and 21 forums and workshops on practical issues related to improving our environment. Considering the number of symposia, spread of disciplines and environments covered, it was impossible to attend all symposia and give an overview of the entire conference. Therefore, I will report on matters discussed at the symposia I attended.

I was most interested in symposia discussing ecosystem service science and, in particular, water quality methods and case studies that address multiple ecosystem service delivery in agricultural landscapes, as discussed below. These topics fit well with my NERC-funded PhD project, which is seeking to understand trade-offs and underlying mechanisms between different agricultural management practices and multiple ecosystem service provisioning, on the newly established North Wyke Farm Platform, Rothamsted Research, UK.

Methods in ecosystem service science: These symposia discussed the challenges of moving ecosystem service science into practice. Despite rapid development in ecosystem service research, there are still gaps and challenges of putting the ecosystem services framework into practice: how can we re-shape the research that is required rather than repackaging what we are already doing? Several challenges were highlighted.

First, the framework and its definitions are still ambiguous and vary across disciplines **(Brooker** *et al.*). Second, mapping and quantification of ecosystem service provisioning is still lagging behind (**de Groot**, **Costanza**), partly, because single ecosystem services are studied rather than trade-offs between multiple services. Third, despite decision making being the focus of the ecosystem services framework, there is a lack of cooperation and communication between decision makers/policy makers, the general public and scientists, which limits the communication of research already conducted as well as the identification of important knowledge gaps (**Brooker** *et al.*). And forth, there is a need to bridge the gap between studies valuing ecosystem services and actually turning this "value" into monetary value (*d***e Groot**, **Braat**, **Costanza**, **Farley**).

Water quality: There was a range of water quality-related presentations, using various approaches and working at different scales and in various environments, up to combining water quality with other ecosystem services. Several talks assessed water quality as a single ecosystem service in relation to management of climatic conditions at different scales. For example, **Mitsch** showed the positive impacts of the recent summer drought in the Mississippi-Ohio-Missouri river basin on reducing the area of the hypoxia zone in the Gulf of Mexico. **Chaubey** *et al*. modelled water quality and quantity impacts of switching from food crops to bioenergy crops (switchgrass and *Miscanthus*).

Kirstensen reported on the state of European waters in the light of the Water Framework Directive. The capacity of individual ecosystems to provide several ecosystem services was discussed, such as assessing water quality and greenhouse gas sequestration in wetlands, from individual constructed/natural wetlands to large scale wetlands (**Mitsch**).

Ecosystem service provisioning in agricultural landscapes: Here, most talks focused on soil processes and functions as the underlying

'engine' of ecosystem service provisioning in agricultural landscapes. For example, **Hedlund** suggested soil carbon content be used as an indicator for good soil quality, because high soil carbon content indicates high soil biodiversity, high food web complexity, high soil nutrient content and good soil structure, all with subsequent effects on runoff, erosion and yields. **Lal** and **Levin** described sustainable soil management and therefore sustainable food production with economic analogies such as "soils are like financial accounts, you cannot take out more than you put in" and saw agriculture in the context of global nutrient flows: from rural landscapes into cities as nutrient sinks without closing the loop of returning nutrients back into rural landscapes.

A number of presentations dealt with valuing agro-ecosystem services (**Farley**, **Hemerik**, **Bradley**). Several talks attempted to value multiple agro-ecosystem services. The question "how do we combine the different scales of agro-ecosystem service provisioning into a single framework?" was often raised. For example, **Lindborg** *et al*. highlighted the additive effect of farm-scale and landscape-scape effects on biodiversity, in contrast to other ecosystem services, such as water quality, where individual fields may be considered as individual units. Additionally, **Brown** gave an overview of new arising geopolitics of food scarcity.

The Ecosummit also provided the opportunity to meet and socialise with colleagues informally, particularly at the conference banquet and the mid-week field trips. I attended a trip visiting Malabar Farm, home of a Pulitzer-prize winning author Louis Bromfield, who was a pioneer in sustainable agricultural practice during 1932–1942 and Ohio State University's Agricultural Research and Development Centre to learn about current research topics. Particularly interesting was the visit to the project studying the long-term effects of soil tillage on maize production. The field trip ended with a traditional Amish dinner and great opportunities to chat with people with the same research interests.

Overall, the 4th Ecosummit was a fantastic conference to attend. I would recommend any young scientists involved in ecosystem services research to attend the next Ecosummit in 2016, and I thank the BHS very much for providing funding to help my attendance on this occasion.

Sabine Peukert
University of Exeter/Rothamsted Research

Second European Flood Risk Management Conference

Rotterdam, The Netherlands 20–22 November 2012

FLOODrisk 2012 WAS A SUCCESSFUL event where I was able to share my research findings with a range of scientists, practitioners and policy makers from across the world. The event provided an excellent opportunity to think and discuss together, to explore research advances in flood risk analysis and management practice.

The conference included all aspects of flood risk and covered the causes of floods, their impacts on people, property and the environment. Thus, the event was very relevant and useful for my work at JHI: not only extending knowledge of what others are doing in terms of flood risk management but also helping to inspire innovative research ideas of my own. Attending such a conference provides a good chance to intermingle and socialise with colleagues from other institutions working in the similar fields.

The excursion trip at the end of the conference was a phenomenal experience for me where I gained knowledge about wonderful projects aimed at protecting people and land from coastal storms and surges by means of sophisticated sea defence systems. Under a national scale

project called 'Delta' project, there are many tidal barriers and sea defence walls built to protect the land from extreme tidal conditions.

I will try my best to apply the knowledge I gained from this event in my work.

Sohan Ghimire
The James Hutton Institute, Aberdeen



One of the movable barrier constructed as part of Deltawork in the Netherlands to protect low-lying settlement areas several metres below sea level in the time of heavy storms and extreme tidal surge conditions.

AGU Fall Meeting

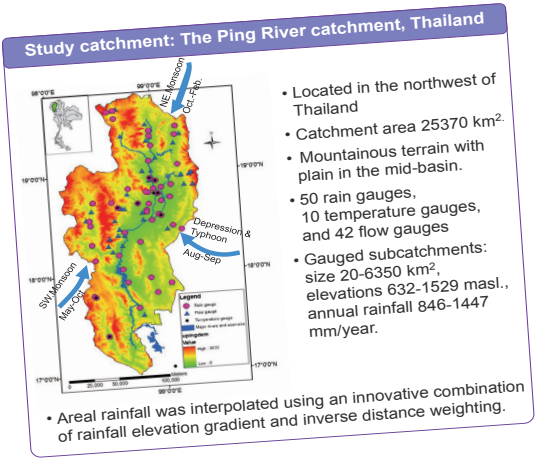
San Francisco, California
3–7 December 2012

THE AMERICAN GEOPHYSICAL UNION'S annual Fall Meeting is one of the world's biggest conferences covering extensive area of geophysical sciences and has attracted about 23,000 attendees. This year, new interdisciplinary sessions were identified into three SWIRL themes: (1) Characterizing Uncertainty, (2) Dust and Aerosols, and (3) Subduction. This was to offer interdisciplinary learning opportunity and new collaboration. A mobile phone application was launched for the first time to allow planning on the go and live updates.

The sessions, which I personally found particularly interesting, were (1) Uncertainty quantification and parameter estimation: impacts on risk and decision making; (2) Hydrological modelling under non-stationarity, and bridging the scale gap between watershed studies; and (3)Regional classification frameworks. Here are examples of presentations that reflect my research interests:

Barbara Minsker (University of Illinois Urbana-Champaign) was invited to present how uncertainty can be reduced using human knowledge. Expert judgement was included into a model performance assessment framework along with traditional quantitative objectives and this approach was found to provide more reasonable solutions for decision-makers. **Luciano Raso** (Delft University of Technology) developed a framework for decision-making under uncertainty which can be reduced when more information is available but at the expense of acquisition of new observations. The framework was used to identify what and how much to observe. The net value (gross value of the information carried by that observation deducted by the cost of obtaining it) of an observation was calculated and the observation showing the highest expected net value was selected as optimal.

Keith Beven (Lancaster University; Uppsala University) was invited to present "Non-stationary model residuals: information, disinformation and measures of information". In his talk, he explained the difficulty in determining simple representation of the non-stationary error characteristics and the challenge of exploring measures of information which help identify informative change and detect non-stationarity in the system. **Barry Croke** (Australian National University) showed two methods of deriving a unit hydrograph from streamflow data to identify non-stationarity in the catchment response. The unit hydrograph was derived from (1) direct estimation from streamflow data and (2) deriving a unit hydrograph model backwards in a constrained deconvolution of observed streamflow. A variable partitioning between quick and slow flow components from these methods



Extract from Supattra's poster

was caused by the amount of effective rainfall and rainfall intensity. A modification to the model structure to account for rainfall amount and intensity is needed to allow the analysis of non-stationarity.

In the session "Bridging the scale gap between watershed studies and regional classification frameworks", **Thorsten Wagener**'s (University of Bristol; Pennsylvania State University) invited talk highlighted the important of catchment classification as a learning framework for generalising the understanding of hydrological processes and for understanding the potential impacts of environmental change. By applying a joint bottom-up and top-down modelling to more than 300 US catchments with over 40 years of data, he found that different modelling strategies provided different insights. The search for common catchment classification is ongoing work.

Apart from the oral presentations, the AGU conference provided an exception range and quality of poster presentations. Some of the posters that captured my interest were "Trading space for time in Bayesian framework" (**Bulygina** *et al.*), "Establishing a connection between hydrologic model parameters and physical catchment signatures for improved hierarchical Bayesian modelling in ungauged catchments" (**Marshall** *et al.*) and "The effect of weighting on the NARCCAP ensemble mean" (**Bukovsky** *et al.*). My own poster, "Conditioning rainfall-runoff model parameters to reduce prediction uncertainty in ungauged basins", was presented in Session (1) in which I discussed my work and gained useful comments from visitors. Some of the conference posters have been published as e-posters [http://fallmeeting.agu.org/2012/eposters/].

In addition to scientific forums, the AGU 2012 also provided an opportunity for networking and socialising. The conference atmosphere was relaxed, friendly, and enjoyable. Overall the AGU Fall Meeting 2012 was valuable learning experience for me and has much to recommend it and I am very grateful to the British Hydrological Society for providing me a BHS Travel Grant.

Supattra Visessri
Department of Civil and Environmental Engineering
Imperial College London

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 downloaded from *www.hydrology.org.uk* or contact **Nigel Goody**, SEPA, 7, Whitefriars Crescent, Perth PH2 0OPA *(tel 01738 448806, email: nigel.goody@sepa.org.uk)*.

Numerical morphological modelling of braided rivers

IN 2012 I SPENT TWO-MONTHS visiting the National Institute for Water and Atmospheric Research (NIWA), Christchurch, New Zealand. The objective of my visit was to collaborate with NIWA's Sediment Processes Research group to develop Delft3d morphodynamic models of the Rees River, New Zealand. This report provides an overview of why numerical modelling of braided rivers is relevant (and interesting!) and provides a summary of my initial results, which will form part of my doctoral thesis.

Extensive braided river systems are found in many of the world's young mountain regions, where sediment is being actively eroded and conveyed downstream. The natural dynamics of piedmont braided rivers are, however, increasingly impacted by headwater impoundments, land-use change, sand and gravel extraction, and hard defences associated with flood risk management. These impacts change the natural supply, and spatial distribution, of water and sediment to braided rivers. Tools are needed to simulate the evolution of three-dimensional river morphology to support river management decisions that are concerned with limiting ecosystem degradation and mitigating sedimentological hazards.

To date there has been a dearth of suitable tools for simulating braided river behaviour at temporal and spatial scales of practical relevance to river management. The challenges of understanding and predicting braided river morphodynamics over time and space scales relevant to environmental management are now, however, being addressed by two key developments. First, revolutions in geomatics technologies enable the acquisition of repeat topographic surveys to monitor natural braided morphodynamics at a temporal

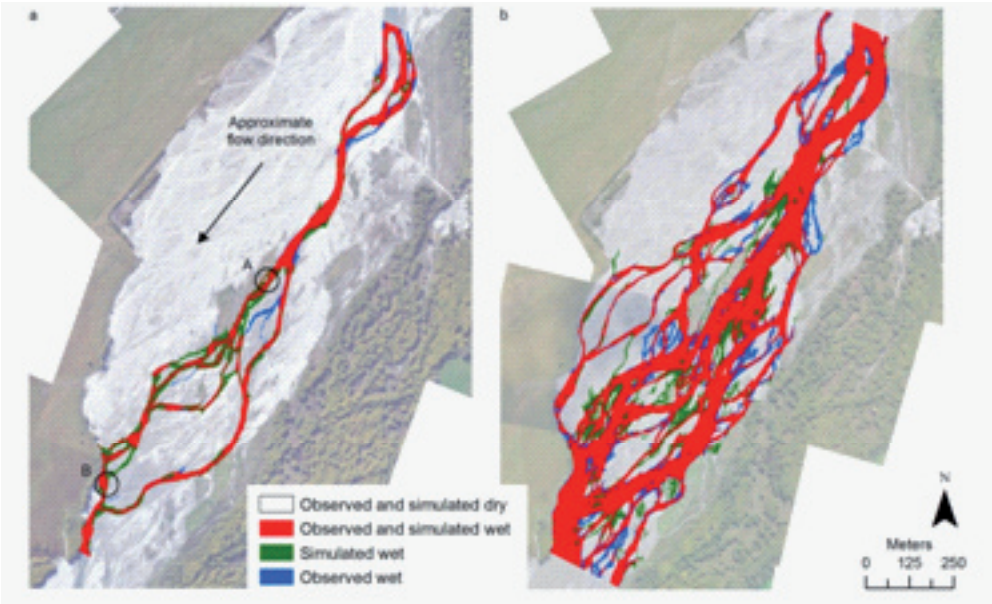


Fig 1 *Observed and predicted inundation extents for reach scale (a) low and (b) high flows.*

frequency commensurate with natural forcing by flood events. Second, advances in numerical modelling techniques offer opportunities to simulate braided river morphodynamics using highly resolved numerical approaches.

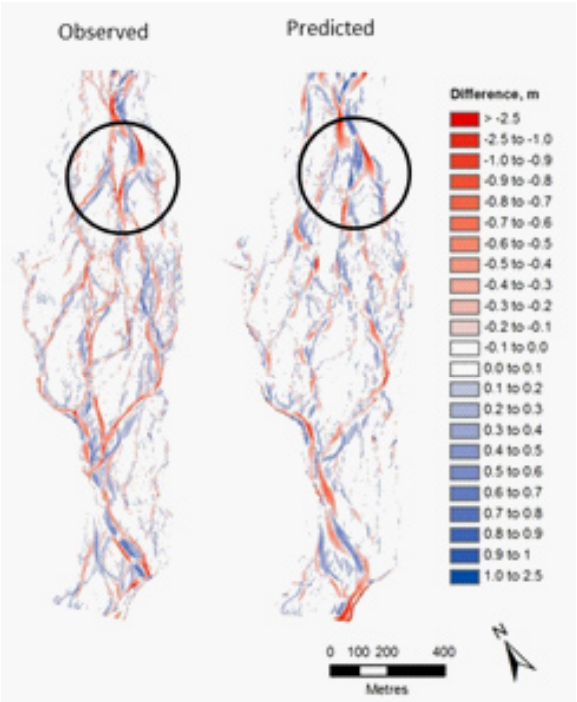
In 2009 I was involved in a field campaign that monitored the evolution of a 2.5 km long reach of the braided Rees River, South Island, New Zealand, through a sequence of high-flow events. We used a combination of terrestrial laser scanning and optical-empirical bathymetric mapping to produce high-resolution Digital Elevation Models (DEMs) of the braidplain following each high-flow event1. We then used the technique of DEM Differencing2 to map patterns of erosion and deposition. These DEMS, and associated maps of channel change, provide a set of boundary conditions for developing and validating numerical morphodynamic models.

During my visit to NIWA I focused upon using the open source Delft3d modelling system to simulate flow, bedload transport and morphological change, using the Rees River dataset. The first few weeks of my visit focused upon learning how to use the modelling software, and then calibrating and validating hydraulic models of braided river flow. Figure 1 (previous page) shows a comparison between observed and predicted inundation extents for one parameter set. Given the complexity of braidplain flow routing, through multiple influences, the performance of the hydraulic simulation was considered to be acceptable.

The final two-thirds of my visit focused upon applying new bedload transport and bank erosion modules, which had been developed by the Sediment Processes group, to simulate the morphodynamics of the Rees River. I focused upon simulating a single high-flow event and undertaking wide-ranging parameter sensitivity tests. Figure 2 shows an observed map of erosion and deposition for this event, and compares it to predicted patterns of erosion and deposition.

The performance of the model is remarkable. However, the validation of morphodynamic simulations of braided river dynamics is not straightforward. My current research is on developing techniques to compare observed and predicted braidplain topographies.

Following my visit to NIWA I travelled to Dunedin to give a presentation to the Natural Hazards Management team at Otago Regional Council. I then returned to the Rees River to complete some further sedimentological fieldwork. Finally, before returning to the UK, I gave a seminar at Auckland University. I recently presented the results from this research at the Delft3d Users' Conference in Delft, The Netherlands. My visit to New Zealand was partially funded by the BHS; I am extremely grateful for their support.



Richard David Williams
Institute for Geography and Earth Sciences, Aberystwyth University
rvw@aber.ac.uk

Fig 2 *Observed and predicted morphological change during a single high-flow event.*

UK Hydrological Bulletin: November 2012 – January 2013

Note: this edition of the Bulletin has been extended to include an overview of the remarkable hydrological conditions experienced in 2012.

ACROSS MOST OF THE UK, late 2012 and early 2013 weather patterns were very cyclonic with exceptional rainfall totals in many areas. Water resources remained notably healthy but flooding was common and widespread and many runoff records were eclipsed; a remarkable contrast with the arid conditions experienced early in 2012.

Through much of early November high pressure dominated synoptic patterns, a rare circumstance in the context of the previous seven months, but on the 19th the passage of a very vigorous frontal system heralded an exceptionally unsettled interlude. Rainfall totals over 8–10 days were greater than the monthly average in many parts of England & Wales, with accumulated totals exceeding 180 mm in Snowdonia and Dartmoor. Flash flooding incidents were common (e.g. in western Scotland) and landslips disrupted a number of important transport links (e.g. the A83). This very wet episode ensured that November rainfall totals were markedly above average in a broad swath from Northumbria through the Midlands to south Devon (a recurring feature of rainfall patterns since the spring). By contrast, much of northeast Scotland was relatively dry and Northern Ireland reported its 2nd driest November in the last 20 years.

With catchments close to saturation, river flows responded rapidly to the November deluges — floodplain inundations were both frequent and extensive across much of the country. Notable flood events were common (e.g. on the 19th at Dunblane and Aberfoyle in Scotland and the 27th when two modern estates were inundated at St. Asaph and Ruthin in north Wales). Flood warnings extended across much of the UK and very extensive areas of agricultural land were under water. With most major rivers in high spate, runoff from England & Wales was outstanding during the fourth week – exceeding the previous maximum in a series from 1961 – see Figure 1.

Correspondingly, reservoir stocks were exceptionally healthy for the late autumn although water quality issues did limit the replenishment to a number of lowland pumped-storage reservoirs (e.g. Grafham).

After declining through the early autumn, groundwater levels generally rose steeply through November and at month-end new seasonal maximum levels were registered in some northern index wells and across substantial parts of the southern Chalk outcrop. Such exceptional levels, reflected in heavy outflows from many high-level springs, before the onset of the winter implied a considerably enhanced risk of localised groundwater flooding in vulnerable areas (e.g. south Dorset, Hants and Berkshire) which is likely to extend through much of the recharge season.

After a damp start to December, the weather across much of Britain was cool and relatively dry until



River Thames at Sonning 25/12/12

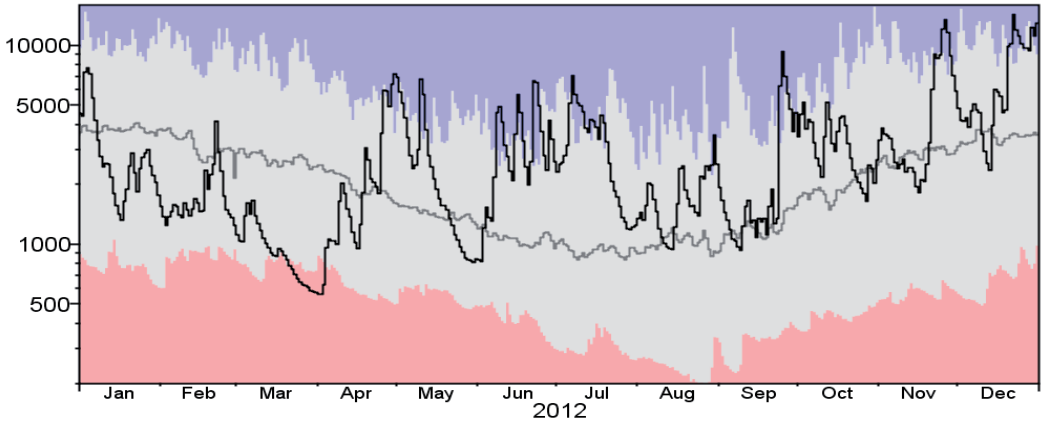


Fig 1 *2012 daily outflows from England & Wales with daily max., min., and mean (based on the 1961–2011 record)*

the 14th when many areas recorded rainfall totals of 20–30 mm heralding a further remarkably wet episode which lasted into early January. Cumulative rainfall totals for the five days beginning on the 20th were particularly impressive: Stoneyford in north east Scotland reported a three-day total of 169 mm and many areas exceeded the December average in this timeframe. With catchments again saturated, the runoff response was truly exceptional. Flood warnings extended across much of the UK; the Environment Agency reported 570 properties flooded over the latter half of the month. Particular severe flooding was experienced in some areas (e.g. at Braunton in Devon and Stonehaven, Aberdeenshire) and incidents of pluvial, fluvial and groundwater flooding were widely reported. The associated extensive transport disruption was locally aggravated by landslips — on the 26th the British Geological Survey issued a rare Landslide and Rockfall warning for the South West.

By year-end, the Somerset Levels had been flooded for over a month and, generally, floodplain inundations were of a remarkable spatial extent (see photo). This directly reflects the truly exceptional runoff: based on provisional data, estimated outflows over the 20–31st December from England & Wales were the highest for any 12-day sequence in a series from 1961, with the singular exception of late October–early November 2000.

Estimated outflows from England &Wales in mid-March 1947 (when snowmelt made a major contribution to the most extensive flooding in the century) suggest the late December 2012 runoff was exceeded by a substantial margin but other examples in the historical record must be very rare. Unsurprisingly, given the outstanding rainfall since the early spring, both surface and groundwater resources were exceptionally healthy entering 2013.

With most catchments extremely vulnerable to further rainfall, it was fortunate that high pressure during much of early January held further Atlantic frontal systems at bay, allowing runoff rates to decline from their outstanding late-2012 levels. Temperatures declined sharply in mid-month heralding a notably cold interlude with substantial snowfall extending across most of the country — particularly around the 18–19th when snow accumulations exceeded 30 mm in many upland areas (e.g. in the Brecon Beacons and the Cairngorms). With the arctic conditions continuing, thousands of schools closed during the third week and transport disruption was both extensive and persistent. On the 25/26th, a westerly airflow introduced much milder conditions — with substantial precipitation as it abutted against a cold continental airmass. Flooding was reported in south Wales and, as the warm front progressed east, a general thaw was initiated. By the 27/28th, a combination of factors — significant rainfall, snowmelt, exceptional groundwater outflows, and spring tides — resulted in flood warnings once more extending across much of the country and a further sequence of exceptional daily outflows from Great Britain.

2012 – A remarkable year

THE UK CLIMATE IS INHERENTLY variable and that variability achieved an extreme expression in 2012. By the early spring runoff and groundwater levels were seasonally very depressed across much of the country, the agricultural and environmental impacts of the prolonged rainfall deficiency were severe and the water resources outlook was fragile in large parts of central, eastern and southern England. A decisive change in synoptic patterns then heralded the wettest April-December on record for England & Wales. The focus of hydrological concern switched rapidly from drought stress to flood risk — a very rare occurrence during the late spring and summer — and many rainfall and runoff records were eclipsed as the exceptionally wet conditions continued to the end of the year.

An exceptionally mild March, the driest for the UK since 1953, intensified drought conditions which had developed across much of England & Wales over successive dry winters — triggering the introduction of widespread hosepipe bans in early April. This coincided with a decisive change in synoptic patterns as the Jet Stream adopted a more southerly track. April was the wettest on record for England &Wales[1] and June also eclipsed the previous highest rainfall for the month. The drought conditions were effectively terminated by July but the very wet conditions continued into the early winter. November and December taken together were the second wettest since 1929, contributing to a remarkable nine-month rainfall accumulation (since March) that, provisionally, is the highest for any nine-month sequence in the historical England &Wales series which begins in 1766.

The development and decay of soil moisture deficits throughout 2012 exhibited extraordinary departures from the seasonal average until late in the year. End-of-March deficits were the highest in the MORECS[2] series (from 1961) for the UK but, contrary to the normal pattern, April witnessed a dramatic decline in deficits. The sustained rainfall ensured that average soil moisture deficiencies for the English Lowlands over the summer half-year were the lowest on record; contrasting markedly with 2011 when soils were the driest in the April-September timeframe (Figure 2). The sodden soils impacted severely on agriculture, restricting access to land and reducing crop yields (historically, a replication of the soil conditions experienced over the first nine months of 2012 would have implied widespread famine). The virtual absence of significant soil moisture deficits also allowed rivers, and aquifers, to respond to the record rainfall in a manner more typical of a normal winter.

During the first three months of 2012 runoff rates were seasonally very depressed and, by late March, outflows from England &Wales had fallen below the corresponding flows during the extreme drought of 1976 (see Figure 1). The meagre runoff rates were accompanied by a major contraction in the stream network and a substantial, albeit temporary, loss of aquatic habitat. Given normal late spring and summer rainfall, increasing evaporation rates would have ensured that flow recessions were sustained into and through the summer.

In 2012, runoff rates increased dramatically during April and previous maximum daily outflows from England &Wales were regularly exceeded throughout the summer half-year. Outflows for June–August were similar to those recorded in 2007 but for the summer half-year, 2012 established a new maximum by a wide margin. There have been other rapid terminations of severe drought conditions — most notably in1976 — but there is no modern parallel to a recovery of such a magnitude being sustained through the late spring and summer. River flows briefly returned to within the normal flow range during early September but thereafter floodplain inundations were again common and sustained.

[1]Except where otherwise stated rainfall records are based on the National Climate Information Centre (Met Office) rainfall series which began in 1910.

[2]MORECS: Met Office Rainfall and Evaporation Calculation System

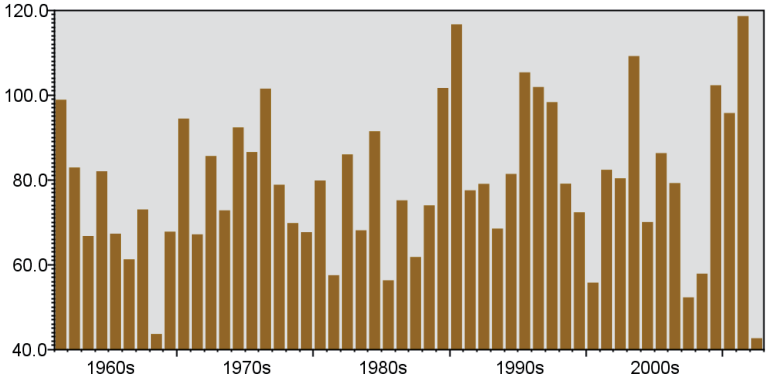


Fig 2 *Average MORECS soil moisture deficits for April-September for the English Lowlands*

The Environment Agency estimates that approximately 7000 properties were flooded in 2012 (a total that would have very much greater in the absence of flood alleviation measures). Fluvial, pluvial, groundwater and tidal flooding all contributed to this total but, whilst some extreme flows were recorded (e.g. on the Rheidol in central Wales in June), the sustained high runoff at the regional and national scales was very exceptional. An index of the singularity of the 2012 runoff patterns is provided by the number of days, 48, on which new maximum daily outflows from England &Wales were established (in a 52-year series). No other year approaches within 20 of this total.

After very meagre recharge through successive winters, groundwater levels were seasonally depressed through the early months of 2012. By March, index wells registering new monthly minima were widespread across southern Britain and estimated overall storage in the Chalk was lower than at the same time in 1976. The transformation in groundwater resources throughout 2012 paralleled that for river flows but was more complex. Aquifer characteristics (particular their storage properties), together with local rainfall patterns and the depth to the depressed water-tables considerably influenced the responsiveness of individual aquifer units. In a few areas, including a number of Permo-Triassic sandstones outcrops in the Midlands, groundwater levels remained seasonally depressed at year end. Generally though, groundwater levels were characterised by remarkable recoveries through the summer followed by further notable increases late in the year. At the Chilgrove House well in the Chalk of the South Downs, which has one of the longest groundwater level records in the world, average levels through the summer of 2012 (see Figure 3) have only been closely approached once (in 1879) in a 177-year series. By year-end, overall storage in the Chalk was close to the highest on record, high levels springs were flowing very strongly and a widespread risk of groundwater flooding continues into 2013.

2012 may be viewed as the culmination of a notably volatile decade with severe droughts (2003, 2004–06, 2010–12) and damaging flood episodes (e.g. in 2004, 2007, 2008, 2009). But volatility is a

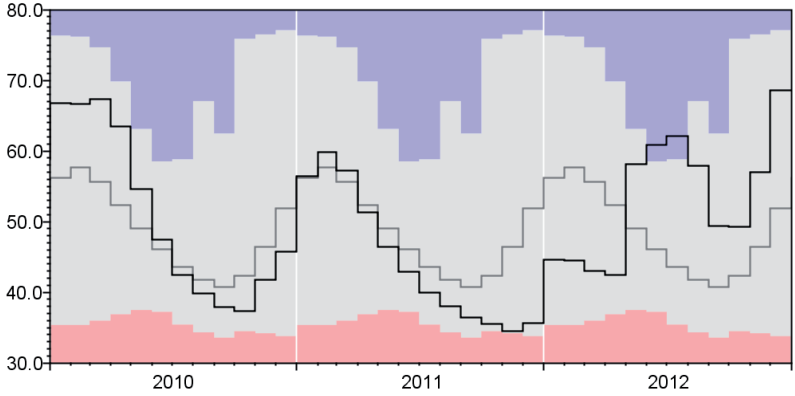


Fig 3 *Monthly groundwater levels for Chilgrove together with the min. and max. and mean levels (based on the 1836-2011 record)*

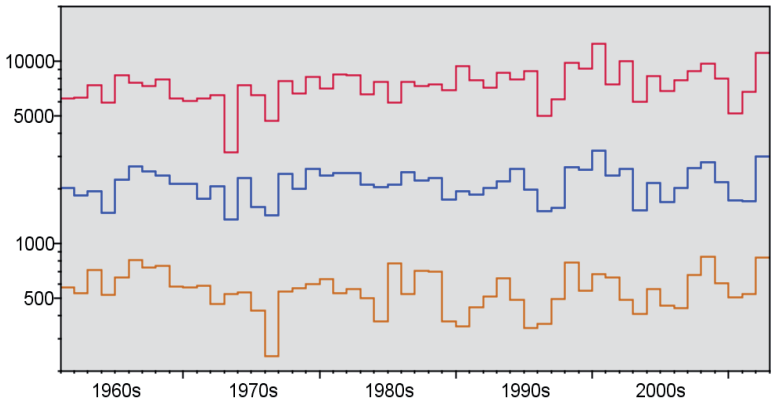


Fig 4 *Annual mean, Q95 and Q2 outflows from England & Wales 1961-2012*

defining feature of the UK climate and flood and drought/flood-rich periods may be identified throughout the instrumented record. The recent past assumes a greater significance given the likelihood that global warming is impacting on runoff and recharge patterns across the UK; the pace and magnitude of any enduring change will have major implications for future water management. It is important to note therefore that, as yet, few compelling long term trends in outflows from England & Wales have been clearly identified (see Figure 4).

Note: Many of details given in this report are provisional and subject to change when fully validated data become available.

Terry Marsh
Centre for Ecology & Hydrology
tm@ceh.ac.uk
28/1/13

For more details of the National Hydrological Monitoring Programme please visit:

National Hydrological Monitoring Programme: http://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.

Editorial

As promised, the photos from last year's Photo Competition are now up on the web site, currently under 'News' while we decide upon an appropriate home.

Two other points to note about the web site:

(1) We have had to remind those placing job adverts on the LinkedIn site that these should go to their proper home on the web so as to reach a wider audience and also to contribute (in a small way) to the Society's coffers.

(2) We are exploring the possibility of a mobile App for the site, likely to be limited in the first instance to Events and Jobs.

Celia Kirby

Hydrology Research: an International journal

READERS ARE REMINDED THAT from 2008 BHS has been a Partner in *Hydrology Research* – with the Nordic Association for Hydrology (NHF) and IWA Publishing. It's good to see that recent Issues have included an increasing number of papers from UK-based hydrologists — see below.

Subscribers can download papers from the journal's website – see **Browse Archive** (back to 1970), **Current Issue**, **Uncorrected Proofs** and **Online Preview**. Online Preview papers are waiting to be moved to the Current Issue. Uncorrected Proofs are published online quickly after manuscript acceptance. All papers in the four categories have a doi and are citable (give the doi and, for Uncorrected Proofs, state "in press").

HR publishes papers by authors from around the world, so readers are strongly recommended to sign up for the free HR Contents Alert service and use the journal's website to stay up to date. There is also an RSS feed available for HR.

The range of research hydrology covered by the journal is good. It is pleasing to see recent British hydrology (the real thing) making it into HR (e.g. "A hydrological assessment of the November 2009 floods in Cumbria, UK" (**44**, 180–197). With 2012 having been a remarkable year in the UK, hydrologically-speaking, it is hoped more manuscripts of this type will be submitted soon.

Ian Littlewood
Editor Hydrology Research: an International Journal

Recent papers in HR by UK-based Authors/Co-authors

Volume 43 Number 3, 2012

The Thames flood series: a lack of trend in flood magnitude and a decline in maximum levels
Terry Marsh and Catherine L. Harvey..... 203–214
doi:10.2166/nh.2012.054

Volume 43 Number 5, 2012 (BHS2010, Newcastle, Special Issue)

Editorial: Professor Dan Rosbjerg stands down as Editor (NHF) Hydrology Research
Ian G. Littlewood and Chong-Yu Xu..... 547–547
doi:10.2166/nh.2012.000

Role of hydrology in managing consequences of a changing global environment
Claire Walsh, Hayley Fowler, Chris Kilsby and Andrew Black..... 548–550
doi:10.2166/nh.2012.101

Modelling and reconstruction of the River Kennet palaeohydrology and hydrogeology: Silbury Hill and Avebury in 4,400 BP
P. G. Whitehead and W. M. Edmunds..... 551–559
doi:10.2166/nh.2012.137

The role of groundwater characteristics in catchment recovery from nitrate pollution
S. M. Dunn, W. G. Darling, C. Birkel and J. R. Bacon..... 560–575
| doi:10.2166/nh.2012.020

Reconciling observed and modelled phytoplankton dynamics in a major lowland UK river, the Thames
Attila N. Lázár, A. J. Wade, P. G. Whitehead, C. Neal and M. Loewenthal..... 576–588
doi:10.2166/nh.2012.029

Crisp discharge forecasts and grey uncertainty bands using data-driven models
S. Alvisi, E. Creaco and M. Franchini..... 589–602
doi:10.2166/nh.2012.121

Self-organising map rainfall-runoff multivariate modelling for runoff reconstruction in inadequately gauged basins
Adebayo J. Adeloye and Rabee Rustum..... 603–617
doi:10.2166/nh.2012.017

An appraisal of the performance of data-infilling methods for application to daily mean river flow records in the UK
Catherine L. Harvey, Harry Dixon and Jamie Hannaford..... 618–636
doi:10.2166/nh.2012.110

Prediction intervals for rainfall–runoff models: raw error method and split-sample validation
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doi:10.2166/nh.2012.157

BHS Committee business

The BHS Main committee meets quarterly, in the ICE's headquarters in Great George Street, London SW1. There is always routine business to deal with but these occasions are when various initiatives are put forward and discussed, with the fine objective of enhancing the value of the Society for members.

Among the items discussed at the last meeting were links with the new Earth Science Forum and also how best to improve links with other organisations with strong hydrological interests and commitments, such as Local Government departments. If members have ideas for more such links, do please let us know.

The end of PUB

PUB — Predictions in Ungauged Basins — was IAHS's major research initiative during the 2003–2012 decade, and came to a close at the IAHS Delft conference in October 2012. This initiative led to significant international and regional initiatives to further the science of hydrology.

The end of the PUB decade does not mean the end of the need for robust methods of estimation to represent hydrological processes in ungauged basins; the quest for improvements to estimation procedures must continue, but a great deal has been achieved. Two books giving overviews of runoff prediction in ungauged basins will be published in 2013. PUB will be succeeded by a new initiative, **Panta Rhei** – Change in Hydrology and Society, a new term to get to know. This initiative will be formally launched at the next IAHS Assembly, i.e. at Gothenburg in July 2013

Diary

28 February 2013
Environmental virtual observatories: managing catchments with wellies, sensors and smartphones
BHS South East Section meeting
Time: 18.30
Location: ICE, London
Contact: Jo Wakefield (Tel: 07803 258578)

13 March 2013
Managing flood risk – culvert screen blockage
BHS Pennines Regional evening meeting.
Contact: Rob Burton (01433 631483; rburton@hydrologic.co.uk)

25–26 March 2013
Peter Wolf Early Career Hydrologist's Event 2013
Location: Imperial College London
Contact: Mike Simpson (Tel: 07712 189629)

7–12 April 2013
EGU General Assembly
Vienna, Austria

10 April 2013
Urban Aquatic Ecosystems
Joint BHS/RGS Biogeography Research Group meeting
Centre for Hydrological and Ecosystem Science, Loughborough University.
Contact: Paul Wood (p.j.wood@lboro.ac.uk)

15 April 2013
Changing Extremes in Hydrology
One-day conference, Exeter College, Oxford
On-line registration: http://hydro-giss.co.uk/registration_form.html

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■ Membership enquiries: Tim Fuller, BHS Secretary, Institution of Civil Engineers, 1-7 Great George Street, London SW1P 3AA. Tel: 0207 665 2234 Email: bhs@ice.org.uk

■ Editor: Celia Kirby Tel: 01544 230053
Email celia.kirby@btinternet.com

■ Web pages: **http://www.hydrology.org.uk/**

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17 April 2013
Ecohydrology
BHS National Meeting
Location: University of Birmingham, B15 2TT
Contact: David Hannah (Tel: 0121 414 6925)

22–26 July 2012
Knowledge for the Future
IAHS Assembly, Gothenburg, Sweden
http://iahs-iapso-iaspei2013.com/

11th International Precipitation Conference
30 June – 3 July 2013
Congress Centre De Reehorst, Ede-Wageningen, The Netherlands
Contact and registration:
http://www.wageningenur.nl/en/show/11th-International-Precipitation-Conference.htm
info.ipc11@wur.nl

Wessex Institute of Technology

Water and Society2013
4–6 Sept 2013
New forest UK

Call for Papers: Submit an abstract online at:
http://www.wessex.ac.uk/watersoc2013

The nature of water ● Water as a human right ● Water as the source of life ● Water in a changing climate ● Future water demands and adaptation strategies ● Water resources contamination ● Water resources management ● Irrigation and desertification ● Water, sanitation and health ● Transnational water rights ● Legislation and controls ● Lessons to be learnt ● Water and disaster management

Stop press!

Next BHS National Symposium — in 2014 — is to be held at Bristol University

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