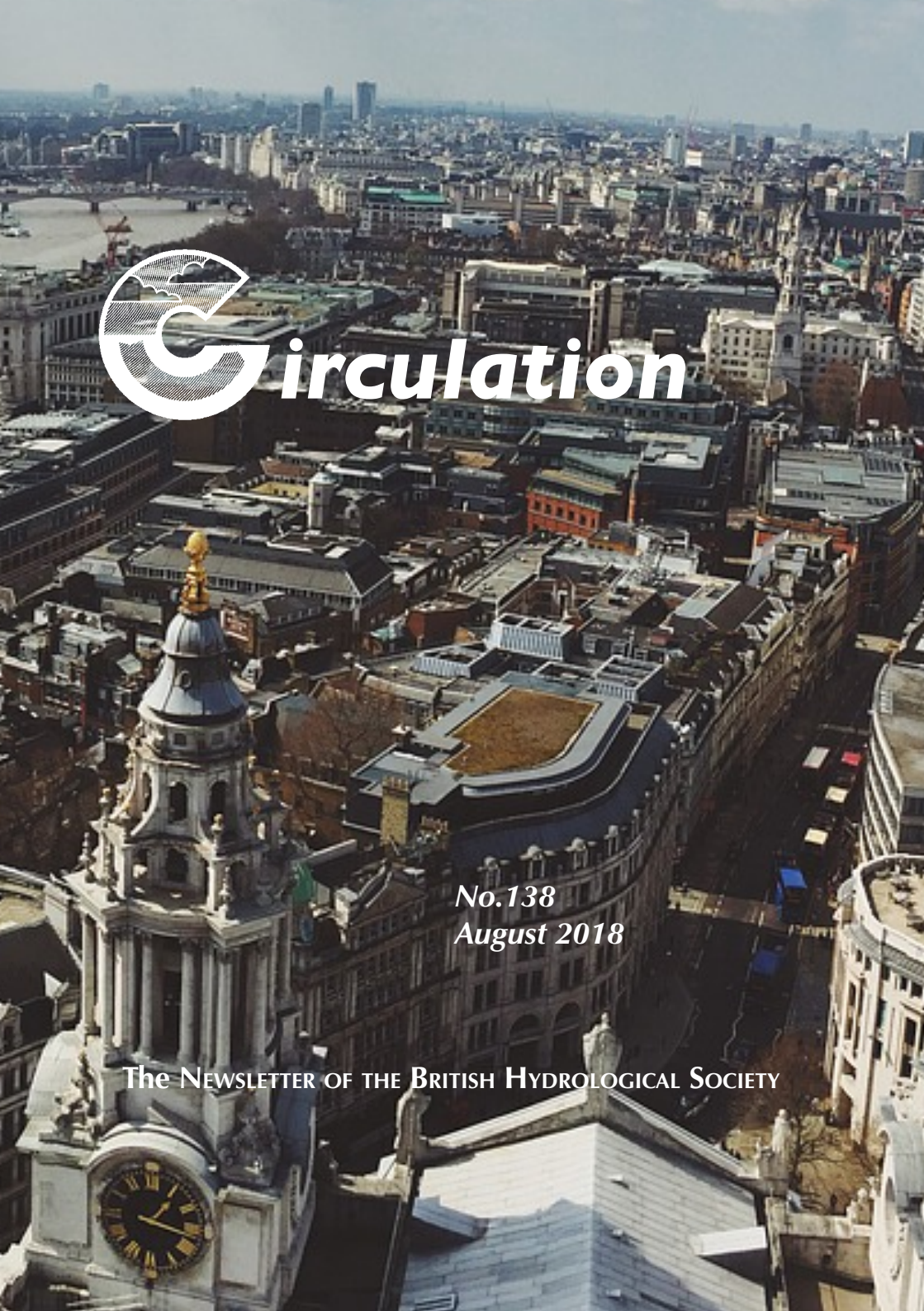


Circulation

No.138
August 2018

The Newsletter of the British Hydrological Society

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Copy deadline for Circulation No. 139 22nd October 2018

Only a few more days to register for BHS 2018.
Its easy – just follow the links on our web site at
http://www.hydrology.org.uk/BHS-2018.php

and while you're at it, how about entering our Photographic Competition which has the same closing date.

10th August 2018

Good photos are always useful and with our plans for giving our web site a new look will be much appreciated.

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President's Piece

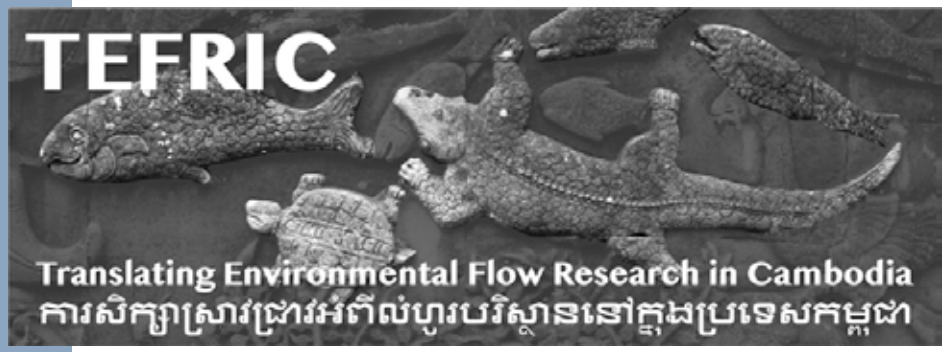
I am writing this in the midst of a long period of conditions reminiscent (to those of us of a certain age) of 1976. It hasn't been quite as hot this year as it was then (and there have been other hotter periods, notably 2003), but the week after week of apparently guaranteed hot sunny weather is very much as it was in that historic drought year. Here in Cambridge we are used to low rainfall, but having hardly more than a trace since May is definitely exceptional. Of course, by the time you read this we may be battling summer storms and floods …

Some things have certainly changed – back then there were no text messages from water companies urging us to be economical, just newspaper and TV adverts, amongst other things urging us to share a bath. Then came the appointment of Denis Howell, the country's first Sports Minister, as Minister for Drought (an interesting combination of government roles), and within days a deluge of biblical proportions that seemed to go on for most of the winter and a fair part of the following summer. I suspect that with the current standard of forecasting the change of weather would have been predicted with confidence before his appointment, but it certainly wasn't at the time. Very soon Denis Howell was the Minister for Floods! Somehow I suspect our Prime Minister (in the prevailing Brexit circumstances it feels safer not to refer to that person by name) will not be following James Callaghan's approach. Of course we are not in similar drought conditions as far as water resources are concerned because reservoirs and aquifers started the summer at good levels, but it can't do hydrologists any harm to have water resources and drought issues more prominently in the public eye. Climate projections for reductions in average summer rainfall have seemed at odds with actual conditions in recent years; one year doesn't make a trend, but perhaps this is what we have been led to expect.

Since the last issue of Circulation I have had the honour of representing the Society at the ICE President's Dinner, this year celebrating the 200th anniversary of the founding of the ICE. A very contrasting but equally enjoyable event the following evening was the dinner during the Peter Wolf Symposium. I was hugely impressed by the presentations made by some of our early career hydrologists, which you can read more about elsewhere in this issue. My thanks go to Adam Comerford and his team at the Canal & River Trust for organising and hosting the symposium this year.

Next it is the National Symposium at the University of Westminster for which we have an excellent programme. I am delighted that Professor Keith Beven accepted an invitation to give the opening address. Keith is the first hydrologist to be elected Fellow of the Royal Society for almost half a century, and it is a great honour for us to have him speaking at the Symposium. I look forward to that and the rest of the programme.

Peter Ede
President



First workshop on environmental flows in Cambodia

Julian R. Thompson[1] and Cedric L.R. Laizé[2]

[1]UCL Department of Geography
[2]Centre for Ecology and Hydrology

A river's hydrological conditions exert critical controls upon aquatic ecosystems with the variability, magnitude, frequency, duration, timing and rate of change of discharge being central to sustaining aquatic biodiversity and ecosystem integrity. In turn, a host of ecosystem services that support human populations are underpinned by healthy, functioning river systems. However, across the globe, rivers are changing as a result of water resource developments, including dams and other abstractions that modify natural flow patterns. In addition, climate change-related modifications to precipitation and evapotranspiration will inevitably induce changes in runoff and river flows although the projected nature of these changes varies by region and is often associated with considerable uncertainty.

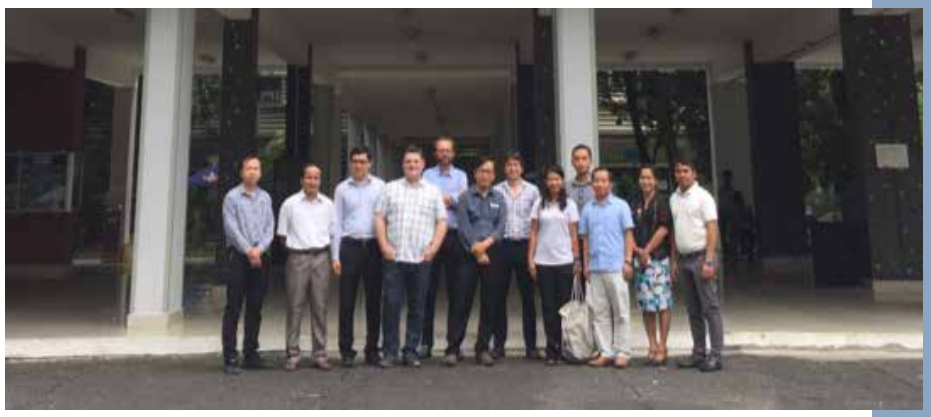
The science of "environmental flows" has developed in response to the requirement to establish river flow regimes than can sustain healthy, functioning aquatic ecosystems and, in turn, maintain economically, socially and ecologically important ecosystem services. A range of approaches has been developed to assess environmental flow requirements and to determine the potential impacts of hydrological change. In most cases, however, their application has been limited to more developed regions, in particular Europe, North America and Australia, and their use in developing region contexts is limited. Arguably it is in these regions, where the pace of development is rapid and often increasing and where large populations are heavily reliant on water-related ecosystem services, that the need to establish environmental flows is most critical.

Cambodia typifies this situation given the central role of the Mekong River and the Tonle Sap – the large lake which is both fed by and feeds the Mekong at different times of year – in the nation's economy. Rapid economic change and associated resource development, that includes dam construction and extensive land cover change, are likely to have major implications for the nation's river systems.

The TEFRIC project (Translation of Environmental Flow Research in Cambodia) aims to introduce environmental flow concepts to Cambodia and develop tools that will enable scientists and environmental practitioners to undertake environmental flow assessments. The project, which is funded by NERC's Innovation Follow-on Programme, is a collaboration between the UCL Department of Geography (Prof. Julian R. Thompson), CEH (Dr Cedric L.R. Laizé), the Institute of Technology of Cambodia (ITC) and the Tonle Sap Authority (TSA). It builds upon long-term collaboration between UCL and CEH in the field of hydroecology, a history of UCL-based hydrological research in SE Asia that includes Mekong-wide hydrological modelling and protected area management in the Mekong Delta, as well as established institutional links between the project partners. Most notably, Dr Sarann Ly who is coordinating ITC's contributions to the TEFRIC project, was taught by Dr Laizé when he was a lecturer at ITC between 1999 and 2001.

Central to TEFRIC is the development of a user-friendly version of the Ecological Risk due to Flow Alteration (ERFA) method. This environmental flow approach, which was developed by CEH (Laizé et al. 2014) and has been applied by UCL and CEH to assess the impacts and associated uncertainty of climate change through the Mekong River Basin (Thompson et al., 2014), enables a rapid assessment of the likely risk of change from historical / baseline conditions for a given future scenario using a traffic-light colour coding system. This is based on a series of metrics that characterise both high and low flow conditions. ERFA-TEFRIC has been programmed in R and includes a user interface developed in shiny that enables rapid modification to the parameters used in the environmental flow assessment. This is designed to enable their fine-tuning based on local expert knowledge of given river systems.

The first public release of ERFA-TEFRIC Ver. 1 took place during a workshop hosted by ITC on 18 July 2018. Participants included representatives from the Ministry of Water Resources and Meteorology, the Ministry of Environment, IUCN, Conservation International, Worldfish, the Royal University of Phnom Penh, Battambang University and the Royal University of Agriculture. A series of presentations introduced the concept



of environmental flows and the range of approaches that can be used in their assessment before ERFA-TEFRIC was demonstrated through a series of practical exercises. A review of the risk of ecological change projected by ERFA-TEFRIC for a wide range of scenarios provided through UCL's Mekong-wide hydrological modelling against participants' expert opinions was used to fine tune the environmental flow method's parameters as well as to identify potential new metrics for inclusion in subsequent releases.

On-going work is incorporating workshop outcomes into ERFA-TEFRIC Ver. 2 which will be launched at an event for scientists, water resource managers and decision makers in Cambodian and other Mekong riparian states in 2019. This final version of the software will also be freely available to the global hydroecological community.

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Laizé, C.L.R., Acreman, M., Schneider, C., Dunbar, M.J., Houghton-Carr, H.A., Flörke, M. and Hannah, D.M., 2014. Projected flow alteration and ecological risk for pan-European rivers. River Research and Applications, 30, 299– 314.

Thompson, J.R., Laizé, C.L.R., Green, A.J., Acreman, M.C. and Kingston, D.G., 2014. Climate change uncertainty in environmental flows for the Mekong River. Hydrological Sciences Journal, 59, 259–279.



This rubbish photo* (taken by the Editor) is to tempt you all to do better and send in your entries to our Photo competition.

*well at least its 'hydrological' ...

This year four BHS members went to EGU and, as always, were hugely motivated by the experience, as these reports indicate

EGU General Assembly

Vienna
April 2018

First, T. Singh from Birmingham writes: "The EGU meetings in April each year are one of the most attended hydrological conferences in the world, so provide the best opportunity for knowledge assimilation and networking. This year, thanks to BHS travel grant and HypoTRAIN (EU-funded project), I was able to present my work to the scientists from all over the world.

My main focus was on the session "Groundwater–Surface Water interactions: biogeochemical and ecological processes". I presented two posters: and also co-authored three other presentations with my colleagues from University of Birmingham and IGB Berlin on similar topics, ranging from field experiments to modelling.

The first poster "Differential Heat Propagation in Ripples, Dunes and Riffle-Pool Bedforms and its Impact on Hyporheic Exchange Flows" focused on the importance of temperature on physical, chemical and biological processes occurring in the hyporheic zones. Heat propagation and distribution within streambed is dependent on the induced pressure gradients along the sediment–water interface, which in turn are caused by interactions between channel flow and bed topography.

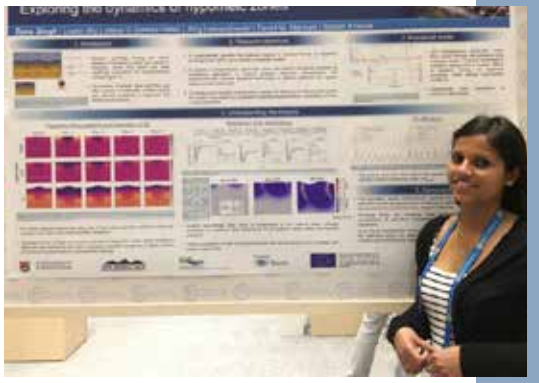
Hitherto, little attention has been paid to the interplay between different bedform geometries (such as ripples, dunes and alternating bars) and their impact on heat propagation and hyporheic zone behaviours. To understand these interactions, we constructed a numerical model that coupled Darcy flow with heat transport equations. The poster presented results that showed that the diurnal oscillations in surface water temperature propagate differently for different bedforms. Moreover, variations in dynamic viscosity generate significant changes in hyporheic flux. Understanding thermal patterns within the streambed with geomorphological controls facilitates deeper understanding of water chemistry and quality.

On the other hand the second poster "Exploring the dynamics of hyporheic zones" highlighted the consideration of dynamic discharge conditions on understanding hyporeheic zone characteristics. Stream stage fluctuations and streambed topography induce pressure gradients along the sediment-water interface and drive hyporheic exchange flow (HEF). With this in mind, it is understandable that changes in time-dependent hydrologic forcing can have significant effects on the hydrodynamic and transport characteristics of HZs.

In this study, we developed a two-dimensional, homogeneous flow and transport model with a time-varying pressure distribution at the sediment–water interface to explore the dynamic development of HZ characteristics in response to discharge fluctuations. Using this model, we explored a wide range of plausible scenarios for discharge and bed geometry (such as dunes, ripples, alternating bars). Our modelling results show that a single flood pulse alters the area and depth of the HZ, though quantitatively different when investigated using hydrological (streamlines/flow field) and geochemical (>90% of surface water in streambed) approaches of HZ.

We summarized the results of a comprehensive sensitivity analysis where the effects of hydraulic geometry (slope, amplitude of the streambed), flood characteristics (duration, skewness and magnitude of the flood wave) and biogeochemical timescales (time-scale for oxygen consumption) on the HZ's extent, mean age, and oxic/anoxic zonation are explored. Taking these multiple morphological characteristics into consideration, along with variable hydrological controls, has clear potential to facilitate process understanding and upscaling.

Finally, it was great to have feedback and comments on my work from experts in the field.



This proved my EGU trip to be successful and very useful. Apart from this, I also enjoyed the beautiful architecture of the city of Vienna. Overall, I found the EGU conference to be extremely beneficial. The talks and sessions I was able to attend, along with the opportunity to meet top scientists in my field, have provided me with numerous ideas that I plan to implement in my PhD study and have also given me ideas for my future career I am therefore very appreciative to have received the grant from the BHS, to enable me to attend the conference."

T. Singh
University of Birmingham

For Matthias Sprenger: "This year's EGU was my fourth time attending Europe's largest geoscience conference in Europe. With now over 15.000 scientists coming together for a week in April, the conference keeps on growing each year approaching the capacity of the conference venue, the Austria Center Vienna. However, it was once again very well organized and full of interesting sessions with excellent presentations and poster sessions that provided space for discussion.

I was fortunate enough to provide one of the 4,776 oral presentations as part of the very well attended session "Controls on water storage, mixing and release dynamics across multiple spatial and temporal scales: open challenges, new experimental approaches and modelling avenues" I presented my latest work on "Water ages in the critical zone of northern environments: Relation between storage and travel times of transpiration and recharge fluxes". As the northern environments undergo intense changes due to climate warming and land use regime shifts, there is a general need to better understand how such changes will affect the partitioning of water in the critical zone into runoff, transpiration and evaporation.

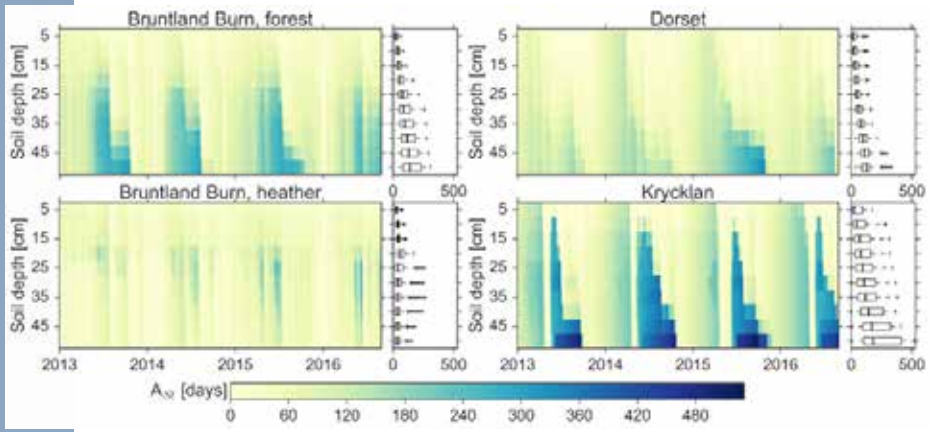


Fig. 1 Water age dynamics across the soil profile between 2013 and 2016 at forested and heather sites in Bruntland Burn, Scotland and forested sites at Dorset, Canada and Krycklan, Sweden. Color code represents simulated median water age (ASt) of the water in the soil on daily intervals at 5 cm depth intervals. The box plots summarize the water age variability at each considered depth. Figure taken from Sprenger et al. (2018, doi: 10.5194/hess-2018-144).

In the presented study, me and my co-workers, Doerthe Tetzlaff, Chris Soulsby, Hjalmar Laudon and Jim Buttle estimated the water ages of the soil water storage (Figure 1) and the groundwater recharge, evaporation and transpiration fluxes (Figure 2) at four sites across the northern latitudes (Bruntland Burn in Scotland (X 2), Dorset in Canada and Krycklan in Sweden). To this end, we used a soil physical model that was previously successfully tested at the study sites (Sprenger *et al.*, 2018, doi: 10.2136/VZJ2017.08.0149) and traced the water through the storage and fluxes of the critical zone. We found that the water ages are generally inversely related to the soil water storage volume: The higher the soil water storage, the younger the water in the recharge water, evaporation and transpiration fluxes. This finding is of general relevance as similar effects were found on the catchment scale for runoff. We could now show that this inverse storage effect is not limited to the runoff, but also applies to the evaporative water losses. The study is currently under public review in *Hydrology and Earth System Science Discussion* (doi: 10.5194/hess-2018-144). My presentation was highlighted by the session conveners as being of public interest and fitted very well into the session.

Other presentations dealt for example with "Catchment water storage increases with elevation" by **Maria Staudinger** and colleagues, "Groundwater storage as a major control of seasonal stream water quality dynamics during both base and storm flows" by **Ophelie Fovet** and colleagues, or "StorAge Selection functions in a catchment influenced by storage thresholds" by **Nicolas Rodriguez** and **Julian Klaus**.

Additionally to my oral presentation, I was happy to organize a session on "Stable isotopes to study water dynamics in the soil-plant-atmosphere continuum" together with **Josie Geris**, **Natalie Orlowski**, **Pilar Llorens** and **Christoph Hissler**. We had 21 abstract

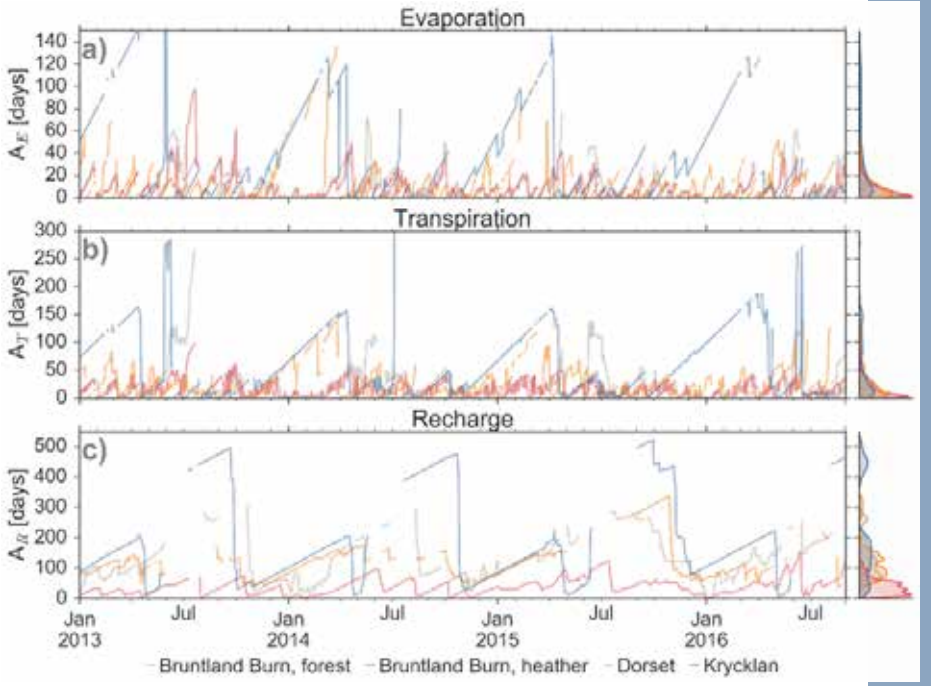


Fig. 2 Dynamics of the median water age in the evaporation (a), transpiration (b), and recharge (c) fluxes. The color code represents the four study sites. Figure taken from Sprenger et al. (2018, doi: 10.5194/hess-2018-144).

submissions for the session and got an oral and a poster slot on Friday morning and Friday afternoon, respectively. Despite the unfavorable timing of the session, the oral presentations were very well attended (*ca*. 100 scientists in the audience) and with intense discussions at the poster boards over the entire 90 minutes allocated.

The session opened with an invited contribution by Arthur Gessler on "Water and carbon dynamics in plants - what happens after a drought?". He provided a detailed introduction on how the water and carbon cycle are connected in the soil-plant interactions. He was followed by **Anam Amin**, a PhD student from the University of Padova, with "Interactions between soil and xylem water: an isotope-based global analysis". She has compiled a unique data set on stable isotope data of water and vegetation water and presented a first assessment of general relationships across the globe. **Adriá Barbeta** talked about "Ecohydrological study of a refugial *Fagus sylvatica* population using stable isotopes", where he showed ongoing research on the water uptake dynamics of F*agus sylvatica* and *Quercus robur* using stable isotope data.

Doerthe Tetzlaff presented "Advances in ecohydrological modelling at multiple scales using stable isotopes" conducted in her ERC funded VeWa project (Vegetation effects on water flow and mixing in high-latitude ecosystems). She showed the latest results obtained from spatial

distributed hydrological model ECH2O_iso, which is currently under review for *Hydrology and Earth System Science* (Kuppel et al., doi: 10.5194/gmd-2018-25).

Modelling results on the plot scale using Hydrus-1D were shown by **Asgar Kamen** whose talk showed results from his former PhD student on "Employing stable isotopes to determine the residence times of soil water and the temporal origin of water taken up by *Fagus sylvatica* and *Picea abies* in a temperate forest". The last talk of the session presented ongoing work to better understand "The role of matric potential, solid interfacial chemistry and wettability on isotopic fractionation of soil water" by **Marcel Gaj**. He showed his latest results from laboratory experiments that showed how soil wetness, contact angle of water and the surface of minerals all affect the equilibrium fractionation of stable isotopes. I got positive feedback from the attending scientists about the session and we aim to offer the session again next year. However, I am also organizing involved currently in a session proposal for the AGU Fall meeting 2018, where I will offer a similar session together with Natalie Orlowski, Todd Dawson and Stephen P Good ("Stable Isotopes in the Critical Zone: Methods, Applications and Process Interpretations", Session ID#: 45838).

Beside the generally overwhelming numbers of presentations, I took time to discuss with several scientists current developments and limitations on our understanding of water ages in the hydrological cycle. Finally, I also took the chance to attend for the first time the EGU Convener Party, which provided a pleasant end to a very busy week of conference in Vienna. Altogether, I learned a lot throughout the EGU General Assembly and am happy about the financial support provided by BHS to get such an inspirational experience as an early career scientist."

Matthias Sprenger
Northern Rivers Institute

The EGU this year started for Nicolai Brekenfeld "with several interesting sessions on water quality at the catchment scale, their states and trends as well as on sensor networks, hydrological connectivity and flow path characterisation using tracers and isotopes. However, it was not until Wednesday and Thursday when the sessions on groundwater – surface-water interactions (hyporheic exchange) started. Those sessions included the transport, storage and transformation of micropollutants and pathogens as well as other biogeochemical cycles and ecological processes. In one of those sessions (groundwater – surface-water interactions: biogeochemical and ecological processes), I had an oral and a poster presentation.

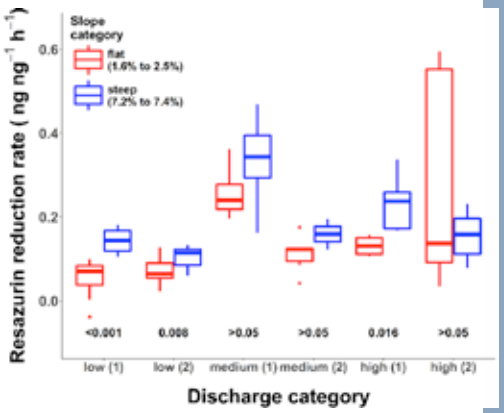
I presented results from my field work in an experimental catchment in Northern Sweden (Krycklan Catchment Study), where I – together with other colleagues – conducted flow manipulation and tracer experiments. Our aim was to analyse (a) how stream channel morphology (such as stream slope) influences the overall stream metabolism within stream reaches on a medium sized scale (10s to a few 100s of metres) and (b) how small scale (<1m) streambed topography (such as steps, pools and riffles) influences hyporheic exchange and biogeochemical cycling.

We found that steep stream reaches (>5%) have a higher residence time corrected metabolic activity (especially during low discharges) than reaches with a smaller slope (<2%) (see Fig. 1), which might be related to the turbulent and diverse flows in those steep reaches with near stagnant pool pockets and potentially high hyporheic exchange rates (on-going research).

On the small scale, we observed that small stream bed steps (length: <80cm, slope: 15% to 20%) have a high hyporheic exchange rate compared to other stream bedforms and a high microbial metabolic activity. Within those steps, the high dissolved organic carbon content in the hyporheic water (14±2mg C l^{-1}) in the upstream downwelling zone is decreased to 2±1mg C l^{-1} in the downstream upwelling area, whereas the dissolved inorganic carbon concentration (mainly dissolved CO_2) shows the exact opposite pattern.

After my talk, but also before and during the poster session, I had several very inspiring conversations with other scientists, discussing either my or their experiments.

Those talks were the most fruitful interactions for me during this year's EGU. I am therefore very glad to have received funding from the BHS to support this conference visit. Many thanks!"



Reduction of the metabolically sensitive 'smart' tracer Resazurin, corrected for the travel time within four stream reaches (steep: blue boxplots; flat: red boxplots), measured under three different discharge categories (low: ~2)/s; medium ~ 15 l/s; high: ~ 28 l/s). The p-values of the Wilcoxon rank sum test between the steep and flat reaches for each discharge category are given below the boxplots.

Nicolai Brekenfeld
University of Birmingham

"The number of people, events and topics discussed in the event make this conference a bit overwhelming for a first-time attendee." writes Jae-Young Lee. "However, a mobile application by the EGU 2018 was useful in planning my week by selecting personal programmes among a large number of presentations and workshops on offer.

My personal interest at the conference fell mainly in Hydrological Sciences. My presentation was included in "Water quality at the catchment scale: measuring and modelling of nutrients, sediment and eutrophication impacts" This session was well-organised with its purpose bringing together scientists working on experimental as well as on modelling studies to improve the prediction and management of water quality constituents (with a focus on nutrients, organic matter, algae or sediments) at the catchment scale. My research was looking at the effects of climate change and acidic deposition on long-

term surface water dissolved organic carbon (DOC) concentrations in upland catchments in Wales, UK. I focused on the methods and the preliminary findings on future trends of DOC concentrations in the upper Severn catchment, which was driven by two *weather@home* climate scenarios. I was very glad to be able to contribute in the session by sharing modelling studies at catchment scale that relate and quantify water quality changes under changing climates. The questions and comments received during and after the presentation were very helpful.

Apart from the valuable presentations held during the week, I was keen to attend some of the medal lectures given by award-winning scientists, with is always inspirational. For me, the most outstanding talk was given by **Yoshihide Wada** (IIASA, Austria), who won the 'Arne Richter Award for Outstanding Early Career Scientists'. His research focus has been on capturing the effects of the human footprint on the global hydrological cycle by establishing a novel method of separating human impacts (water use, reservoirs etc.) from natural climate variability through hydrological model simulations. During the talk, he shared a few challenges with respect to better representing the human-water interface in hydrological models, namely: (1) modelling human impacts on extreme weather events such as droughts and floods; (2) developing human impact indicators, in which more socially relevant indicators could connect water science; (3) groundwater modelling simulations; (4) incorporating regional water management such as water infrastructure and inter-basin water transfer; and (5) representation of rapid urbanisation. Not only that, he also emphasised that integrating human activities in hydrological models needs to consider the feedback from the other sectors including agriculture, energy, the economy, water quality and many others.

One of great things about the EGU is that it provides various short courses with some of courses being repeated every few years to attract attendees. I attended 'Using R in Hydrology', which was organised by **Louise Slater** (Loughborough University, soon to be University of Oxford, UK) with five other co-conveners and has been successfully running for the past few years. The short course has been on my list for a long time as it is aimed at researchers interested in hearing more about the software R as well as those who are advanced R programmers wanting to discuss recent developments. It was quite useful to me especially learning how to read and visualise large-scale gridded data (netCDF) with their examples being taken from British catchments, so it was very easy to follow.

I thoroughly enjoyed my first EGU and visit to Vienna. As this was my first large international conference, it was extremely valuable to have all the networking opportunities and to meet so many scientists within my field, as well as having surprise reunions from peers from my previous degrees. I am therefore sincerely grateful to the British Hydrological Society and the Environmental Change Institute at Oxford University for their financial support which enabled me to attend this conference."

Jae-Young Lee
Environmental Change Institute, Oxford



Peter Wolf Symposium 2018

Canal & River Trust, Fearns Wharf, Leeds
7–8 June 2018

This event is specifically aimed at early career hydrologists, to provide an opportunity for hydrologists at the start of their career to present to each other on their work in a friendly symposium environment. After a welcome from BHS President Peter Ede, **Steve Rose** (JBA) opened Session 1 with a keynote address on Natural Flood Risk Management. This focused on how NFRM forms an integral part of the flood risk management toolbox, illustrated with examples of how JBA have used NFRM to provide solutions on a catchment scale.

Josh Wells (Nottingham Trent University) started the presentations with a discussion on the implications for natural flood management when upscaling to the wider catchment. He presented his findings from the first part of a mosaic of flood risk management studies planned in Nottingham which used an interdisciplinary approach. **Stephen Turner** (Centre for Ecology and Hydrology) then introduced *Hydrological Outlook UK*, a collaborative publication between CEH, BGS, Met Office and the four UK measuring authorities, which aims to provide UK-wide seasonal forecasts of river flow and groundwater. This can be accessed via **http://www.hydoutuk.net.**

Sarah Warren (JBA) closed the session discussing how advanced statistical methods can be used to inform the national risk assessment in her presentation on 'Modelling a multivariate world', a data-driven approach that can capture the complex joint distributions and dependence observed in environmental data, rather than imposing false assumptions. This provides a practical and flexible approach that can be applied to combinations of a few variables, or scaled up to handle problems with hundreds of variables.

Session 2 focused more on the water environment. This started with a keynote from **Joseph Holden** (University of Leeds/Water@Leeds) who took us through the impact of land management and climate change on peatland hydrology (and carbon), and the importance of peatlands for future FRM. **Rebecca Smith** (Durham University) followed with her project on ground-surface water interactions.

She is using modelling to understand how ground and surface water interact with instream water quality, using the catchment of the Twizell Burn in NE England.

Nikos Mastrantonas (Centre for Ecology and Hydrology) then used a case study of the Kinu Basin, Japan, to demonstrate how evaluation and merging of 'Near Real-Time Satellite Precipitation Products' could be used, and the accuracies of this. He found that error varied per season, area, rainfall intensity/type and Satellite Precipitation Product, while bias-correction techniques had limitations for fine temporal scales and merging of products improved the results for all temporal and spatial scales.

The session ended with **Joseph Croft** (Imperial College) with his study evaluating the effectiveness of process- based dissolved organic carbon. The study uses an INCA-C model with a large number of parameters, something Joseph is hoping to reduce as he compares land uses over a greater spatial resolution. He also aims to categorise instream processes, particularly biodegradation and photodegradation and examine how land use affects the treatability of DOC.

Session 3 focused on topics surrounding social water and use of hydrology products. **Darren Leftley** (Canal & River Trust) started the session with a keynote on Commercial Water Development at the Trust. The Trust is diversifying its commercial income by using the natural potential of water for a range of services such as heating and cooling and hydropower. **Anna Robotham** (Environment Agency) then discussed mapping 'Flood Disadvantage' using the York 2015 flood event. This study looked for areas where social vulnerability and flood exposure coincide to form a Social Flood Risk Index (SFRI). This indicates the ability of a neighbourhood to recover after flooding. Thirdly, **Victoria Smith** (Durham University) took us through how analysis of the current state of water-resource management in the UK could be modelled as a social network, using agent-based modelling. This approach creates maps of social connections between collaborative working groups and partnership-working.

Rodolfo Nóbrega (University of Reading) then delivered a fun, light-hearted presentation about overcoming pitfalls when working in the tropics, based on his own experiences. He described the realities of rudimentary lab and field equipment, along with security and bureaucracy issues, and other important challenges to be aware of when identifying new research opportunities. **Liam Nicholson** (Mott MacDonald) finished the session with his presentation on estimating and improving confidence in QMED estimates within ungauged catchments using flood routing in the Worth catchment, a catchment with numerous reservoirs. To understand the influence each reservoir may have, QMED estimates were compared using flood routing and FEH catchment descriptors approaches. Study results suggest that where a catchment FARL value is <0.95, QMED estimates may significantly over-estimate flows when compared to a flood routing approach.

Before moving on to posters, **Adam Comerford** (Canal & River Trust) spoke on 'canal hydrology' and some of the quirkier sides to water management in a 200-year-old reservoir fed canal system.

An early-evening Poster Session was then held in the Adelphi Hotel Leeds where four posters were displayed:

- Quantifying the efficacy of floodplain storage as a Natural Flood Management (NFM) strategy through monitoring and model predictions on the Somerset Levels by: Tamsin Lockwood, Bristol University
- Flood Risk in Menstrie: Reviewing Future Management Options by Fiona Cuthill, RAB Consultants
- Storm Desmond: Tyne Valley Recovery by Rosie Hampson, JBA Analyst
- Parameterisation of the Dynamic TOPMODEL national-scale hydrological model using uncertain Multiscale Parameter Regionalisation by Rosanna Lane, University of Bristol

Prizes were awarded for best poster and presentations. Congratulations to Josh Wells (Best Presentation), Liam Nicholson (Runner up – Best Presentation) and Rosie Hampson (Best poster). The evening concluded with a World Oceans Day quiz and dinner at The Adelphi.

On day two, we were pleased to welcome **Alex Scott** and team from JBA Trust, who have created a suite of physical models to demonstrate the key principles of flood and coastal risk management. Delegates were split into small groups and able to see three models in action; the Augmented Reality (AR) Sandbox which is an interactive visualisation tool that shows how topography affects water moving through a catchment, a 'mini' flume to demonstrate the interaction of engineered structures with flow in a channel, and Physical Augmented Relief Model of Keswick. The sessions were informative and everybody had fun playing with the models, and seeing the technology in action.

Leeds City Council then showcased their flagship Leeds Flood alleviation scheme (in partnership with the Environment Agency), which officially opened in October 2017. After visiting Crown Point weir directly outside the office delegates boarded a boat and visited various features of the scheme, including Knostrop weir downstream, where they disembarked to look more closely. It is the first time moveable weirs have been used for flood risk reduction purposes in the UK. The weirs can be lowered to create more room for flood water, with the potential of reducing flood levels by up to 1 metre. Phase 2 of the Leeds Flood Alleviation Scheme will consider the entire River Aire catchment area, and will help to reduce flood risk in Leeds, including areas such as Kirkstall and Stourton, using NRM and engineering measures to help slow the flow. As well as a buffet lunch on the boat some of the delegates also enjoyed their first experience of going through a lock!

This concluded the symposium and many stayed on the boat as it took them towards Granary Wharf and the station.

In summary, the symposium was a great success, covering a range of topics within the hydrology discipline.



Sarah Edwards & Sarah Richards
Canal & River Trust

Regional meetings

One upon a time, there was always a BHS event being planned somewhere soon. For various reasons these are now fewer and further between even though our organisation encompasses five official Regional Groups, not all as active as each other.

This was a major concern at the last BHS Main Committee and accordingly, it was agreed that £500 per region should be set aside in the Society's budget, available to local organising committees to help defray some of the costs of room hire,refreshments, promotion and speakers' expenses.

We understand that local circumstances and personnel change but it is was felt important to take active steps to encourage more meetings, site visits and field trips since more formal presentation meetings invariably gravitate towards London because of ease of communications.

If you are in an area remote from one of our existing Regional Groups but would like to promote an event in your area please get in touch. The arrangement of the regional Groups is not set in stone.

Peter Ede

IASH Early Career Committee

IAHS is calling for applications from early career scientsists - defined as those up to 5 years after compleitng a PhD – to join this newly established Committee. More details are available on https://iahs/About-IAHS/Early-Career-Comiittee-.do

HURRY – Deadline 15 August 2018.

New members

Andrew Barnes.....Bath University
Sarah Dance .....Reading University
Benamin Filburn.....Environment Agency, Worcester
Cristopher Greensmith.....Ledbury
Alexander Hurley..... Birmingham
Jude Jeans.....Wallingford Hydrosolutions
Nohun Langevillier .....Industrial Science Centre, Lisburn

West Japan Floods

John Rodda has kindy passed on a note about these floods sent to him from **Kuni Takeuchi** in Japan which points up the contrast with our present situation and to show, as Terry Marsh always says, just how benign our climate is. Even our extremes pale by comparison *.

"The torrential rains in Japan lasted from 28 June to 8 July. Over 691.5mm/24hr and 1852.5mm/11days were recorded in Yanase, Kochi Prefecture and over 400mm/24hr and over 1000mm/11days in many other sites.

The total number of dead and missing people are respectively 127 and 12 as of today (18 July). The most seriously affected areas were Hiroshima, Okayama and Ehime and over two-thirds are people over 60 years old. Many were hit by sediment debris or washed away in rivers or ditches.

Over two million people in the area were ordered to evacuate and another two million in the area advised to consider evacuation, plus a further 1.8 million people i in Hiroshima prefecture. Over 4700 persons are still in evacuation centers on 18 July.

The victims and the volunteer helpers are now suffering from very high temperatures – over 35 degrees, over 39 degree C in some areas – that has been continuing since the end of the torrential rain."

*but we're not doing so badly – see page 17!
– *Ed.*

Events Calendar 2018

Date	Title	Venue	Type
13-15 August	30th Nordic Hydrological Conference	Bergen Norway	Conference
4-7 September	National Earth Observation Conference	Birmingham Univ	Conference
12-13 Sept	**BHS NATIONAL HYDROLOGY SYMPOSIUM**	**Westminster Univ**	
18-20 Sept	Advanced drought monitoring, prediction & management capabilities	Lancaster Univ	India-UK Water Centre
Nov TBA	Drought & Water Resource Planning	Warrington	BHS Regional
Dec TBA	Hydrology for infrastructure projects	Leeds	BHS Regional
19-23 November	National Flood Risk Management	Lancaster Univ	Short course
2019			
March (tbc)	UK Reservoir spllway flood hydrology	London	BHS National

UK Hydrological Bulletin: May – July 2018

With a weak Jet Stream tracking to the west and north of the UK throughout most of the late spring and early summer, high pressure dominated synoptic patterns, resulting in persistently dry and hot conditions over much of the country. Correspondingly, evaporative demands were exceptional, river flows generally declined steeply and the 2017/18 aquifer recharge season ended both early and abruptly. The arid landscape and soaring temperatures made comparisons with the extreme drought of 1976 inevitable. But whilst the latter was already well entrenched by the spring, the 2018 drought began with generally healthy reservoir stocks.

From late April,however, runoff rates generally declined steeply and increasingly arid conditions produced considerable agricultural stress and a much-heightened fire risk. In many impermeable catchments, previous minimum flows — for mid-summer — were eclipsed. Heavy local demands overstretched some water supply networks and a few small reservoirs (e.g. in Lancashire) ran dry. The lack of rain triggered a hosepipe ban in Northern Ireland and thence in north-west England. Generally however, stocks in most strategic reservoirs remained within the seasonal range entering July and groundwater levels were typical for the time of year. Late July saw many intense downpours with severe flash flooding, but with soil moisture deficits at near-record levels across much of country any early termination of the drought stress is very unlikely.

May was a notably warm and dry month with rainfall less than 60% of average across much of the northern half of the country. Rainfall totals were generally healthier to the south and above average in those areas where intense thunderstorms late in the month triggered a number of flood warnings and flash flood events. On the 27/28th a 24-hr rainfall total of 93.9mm was reported from Edgbaston, Birmingham — including 53.6 in an hour; higher accumulations may have been captured nearby. Flooding was locally severe with substantial transport disruption. Many London rivers were also in high spate. Generally however, May saw a steep decline in river flows, particularly in Northern Ireland and Scotland where estimated outflows at month-end were close to the lowest on record. This underlined the greater vulnerability of the largely impermeable northern and western catchments to rainfall deficiencies in the spring and early summer. Nonetheless, reservoir stocks — the north-west of England aside — remained well within the normal late spring range.

Although the passage of storm Hector on the 14th brought heavy rain to parts of western Scotland and Northern Ireland, June was a very warm and exceptionally dry month across most of the country (see Fig. 1). Especially arid conditions characterised parts of southern Britain — the Thames and Southern regions both registered only 3 mm of rainfall for the month and most of London reported <1 mm. England & Wales registered its driest June since 1925. Correspondingly, soil moisture deficits climbed steeply and, by month-end, closely matched the highest on record for late June, in a series from 1961 (see Fig. 2). Accordingly, irrigation demands increased while runoff rates declined markedly. For many rivers – including the South Tyne (Northumbria), Yscir (south Wales), Taw (Devon) and, in Scotland, the Spey (Fig. 3) end-of-month flows were at, or around, the minimum on record for the time of year. Consequently, reservoir stocks across most of the country declined substantially. Impacts were most severe in north-west England and a few small reservoirs (e.g in the southern Pennines) were effectively dry. Generally, however, stocks in major reservoirs across the UK remained within about 10% of the average for the time of year and groundwater levels were within the normal early summer range across most major aquifer outcrop areas.

With drought conditions extending across much of northern Europe, the UK drought — whilst easing in some northern areas — further intensified through July. Many parts of central and southern England registered an

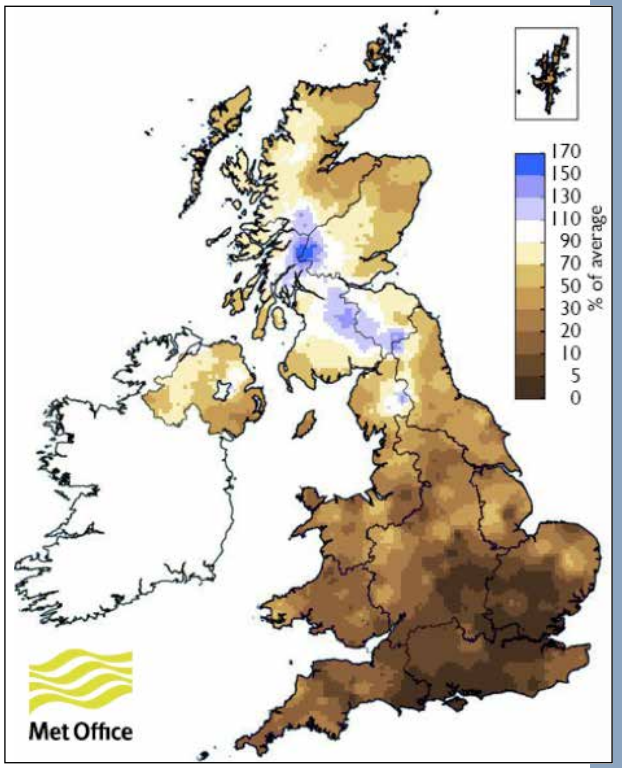


Fig 1 June 2018 rainfall as a percentage of the 1981–2010 average

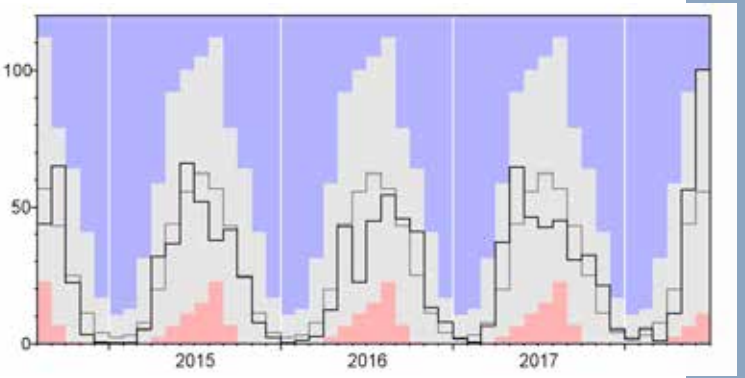


Fig. 2 End-of-month soil moisture deficits for the UK. The blue and pink envelopes define the long term maximum and minimum; the grey trace is the long term average. Data source: MORECS

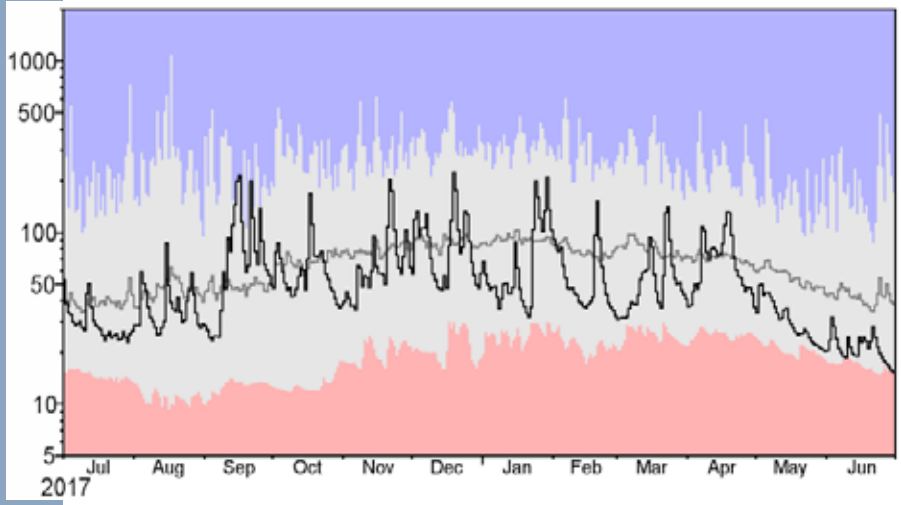


Fig 3 Daily flows in the River Spey at Boat o Brig (black trace), the blue and pink envelopes are the long term daily max. and min., the grey trace is the long-term daily average.

accumulated rainfall total of less than 5mm over 50 days. The landscape took on a exceptionally arid complexion and moorland fire risk remained at a high level. Stocks in many farm reservoirs were virtually exhausted and, with minimal grass growth, fodder supplies for livestock were dwindling.

The contraction in the stream network accelerated and a number of fish rescues were required, for example on the Teme (Warwickshire). Runoff rates in many permeable catchments held up well but previous minimum July flows were widely eclipsed in rivers with little baseflow support. On the 17th, a hosepipe ban (operating from July to august) was announced by United Utilities affecting 7 million customers in north-west England and a substantial length of the Leeds-Liverpool canal was scheduled for closure at the end of the month. Near month-end a decisive change in the track of the Jet stream heralded dramatic downpours in many areas – Belfast recorded 98.8 mm over 24 hours and localities in north Wales reported over 50 mm. The accompanying severe flash flooding caused widespread transport disruption. However, whilst short-term spates characterised many responsive rivers, the generally parched soil conditions imply that runoff rates are very likely to decline further through the late summer. Correspondingly, water resources stress will continue into the autumn in the absence of above average rainfall.

Terry Marsh
29/07/18

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

www.ceh.ac.uk/data/nrfa.nhmp

Obituary

Peter William Metcalfe (1971–2018)

Peter came to Lancaster in 2012 to study for a PhD with Keith Beven, Rob Lamb of the JBA Trust, and Barry Hankin of JBA Consulting, funded by the Centre for Global Eco-innovation. This was a huge step for him, as he had worked for 15 years as a computer programmer and consultant. His research was concerned with modelling catchment hydrology and water quality, and his first paper reported on the implementation of Dynamic Topmodel as an R library (Metcalfe *et al*., Environmental Modelling and Software, 2015). As an extension of this interest he got involved with the flood action group in the Brompton catchment in North Yorkshire. This led to a further paper on modelling potential flood mitigation strategies in the catchment (Metcalfe *et al*., 2017). Peter successfully defended his thesis on "Development of a modelling framework integrated catchment flood risk management" in December 2017. The thesis did not include much of the water quality work he had already done: that was still on a list of several aspects of the research that we would have developed further.

During 2016 Peter was employed part-time on small research project funded by the Rivers Trust Life-IP programme. Peter used his expertise with Dynamic Topmodel to evaluate the potential for nature-based flood mitigation in the headwaters of three catchments in Cumbria (Hankin et al., 2017). The approach developed in this study then helped to secure a major research project on "Natural Flood Management" funded by NERC. Peter began working on this project in January 2018 and was a key member of the research team. Beyond academia, Peter was a highly experienced climber and enjoyed politics, cycling and singing with the Lancaster University Choir.

Peter died in a climbing accident on 22nd April 2018 and is greatly missed by his research colleagues, friends and family.

Keith Beven and Nick Chappell

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BHS 2018

our 13th National Hydrology Symposium — being held in London for the first time