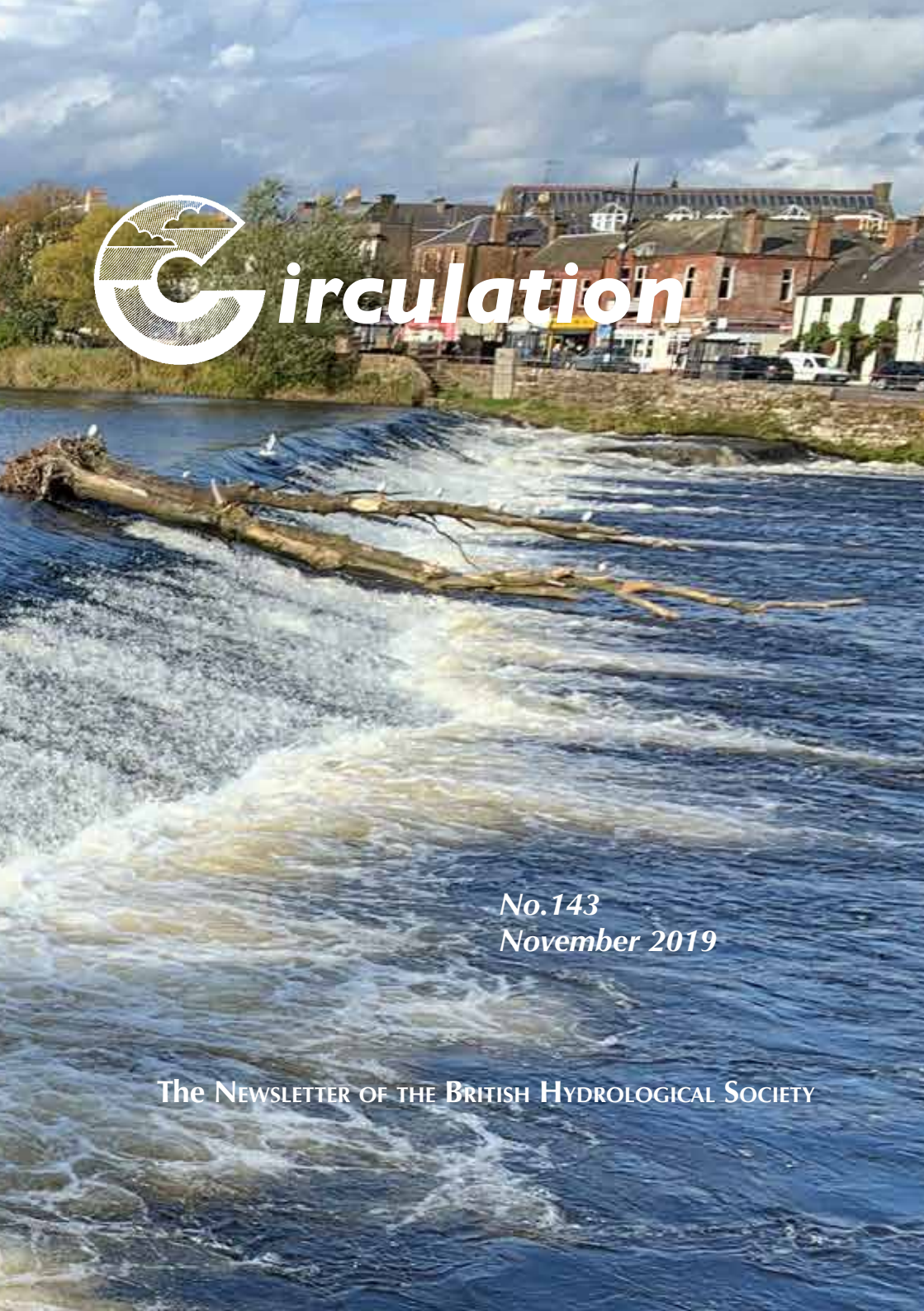


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The Newsletter of the British Hydrological Society

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We hope the move to a mid-month distribution has not inconvenienced readers.

Just Terry's luck that despite the extra time, getting data right up to the end of the previous quarter has been a struggle. He also asks that we note the maximum temperature at Wallingford given in the last issue should have read 36.5°C

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President's Perspective

First, I should like to pay tribute to Peter Ede for his inspired leadership of BHS over the past two years; I am personally very thankful that he continues to be an executive member of the committee as 'BHS Past President'.

Your country needs you

The country needs its hydrologists like never before! Consider the last few months: we have seen flooding in Reeth (30 July), Ottery St Mary (9 Sept), more widely across England on 24 Sept, Laxey (1 Oct) and 100 flood rescues in England and Wales at the end of October, all affecting many people. Internationally over 200 people died and about a million were displaced by flooding in India this summer. Then in October, hundreds of thousands of people were affected by flood events in South Sudan, Ghana, Niger, Ethiopia and Kenya (http://floodlist.com).

While we hydrologists need to play our part in slowing future climate changes, too many people are already at frequent risk of flooding. To lessen these risks, greater investment is needed now in both engineering solutions and nature-based 'natural flood management' (NFM). The importance of the British hydrological community acting locally and internationally has never been greater.

Risk mitigation

In the UK, several engineering schemes are underway or planned, for example in Godalming (Surrey) and Keswick (Cumbria), while the Environment Agency and other regulators are piloting nature-based solutions on farmland. If NFM measures can be shown to be cumulatively as effective as engineering schemes, then there is an strong argument for redirecting existing farm support (currently in excess of £1 billion per year) to funding NFM. Mechanisms for achieving this could be through the proposed 'Environmental Land Management System' (ELMS; https://deframedia.blog.gov.uk/2019/09/25/the-future-of-farming/) if we leave the EU, or by transforming the payments within the Common Agricultural Policy (https://www.farminguk.com/news/farmers-in-payment-by-results-pilot-deliver-green-goals_54102.html) if we were to remain. Whichever path we follow we do need to engage fully with our farming community who have considerable hydrological expertise and experience of the land they manage.

Two major reports highlight urgent need for action

On 8 October 2019, Ofwat published a new long-term strategy to 'Improve Life through Water'. They forecast that population and climate change will mean that the UK water supply system would need an additional 4 billion litres of water per day for failure resilience by 2050. They propose achieving this through equal investment in building new infrastructure, leakage reductions and demand management. This is a challenging objective for water companies that will demand considerable

innovation by their hydrologists (https://www.newcivilengineer.com/the-future-of/future-of-water/future-water-squaring-investment-circle-16-10-2019/).

Four days earlier on 4 October, the National Biodiversity Network, a consortium of environmental organisations, published an equally significant report: 'State of Nature 2019'. This showed that UK wildlife is in a much worse state than it was in their reference year of 1970, which they attribute, in part, to deteriorating soil and water quality. Quantifying and mitigating harmful levels of soil and water quality for our wildlife demands technical input from UK hydrologists.

We urgently need concerted action to mitigate the soil and water quality impacts of some of our food production systems and to introduce other nature-friendly interventions, while maintaining the critical rural economy. ELMS again offers potential environmental solutions to this issue, if the researcher community (including hydrologists) can show that interventions can deliver measureable benefits at landscape scales - so demonstrating that investment of public money is effective. Fortunately, this accords with the new strategy of the UKRI Natural Environment Research Council (NERC). Alongside a commitment to doubling of investment in grants, they will be expecting awarded grants to deliver measureable environmental improvements in addition to world-leading science.

How you can help

Hydrologists have a huge role to play in all these challenges and I encourage you to get involved. Please share your expertise by contributing to BHS regional and national meetings over the coming months, and by sharing your activities and opportunities via the BHS mailing list (bhs-hydrology@jiscmail.ac.uk) and social media (https://twitter.com/britishhydrosoc).

A very tangible way of promoting your ideas for exciting new developments in hydrology would be to contribute suggestions, preferably before the end of November, for sessions at BHS2020 (via http://www.hydrology.org.uk/assets/BHS2020_session_proposal_form.docx).

BHS wants to give greater national exposure to individuals engaging in hydrological consultancy work, and to companies delivering hydrological technologies or solutions. Consequently, from 1 January 2020, BHS will offer free space on a revised website (http://www.hydrology.org.uk/register_consultants.php) to individual BHS members or hydrologically relevant companies to promote their skills and services; details will be available shortly.

Nick Chappell
President
October 2019

37th Annual General Meeting
1st October 2019
Institution of Civil Engineers

The Society's AGM was held during the BHS National meeting 'Flood Forecasting: Developments inScienc and Application' The President, Peter Ede, thanked the 63 delegates and BHS members who attended the meeting.

Report of the 36th AGM
The report of 36th AGM held on the 12th September 2018 was published in *Circulation* 139 (pages 6–8). This report was approved.

President's Report
The previous AGM took place during the National Symposium held at the University of Westminster. The symposium was a very successful "sell-out" event, including two busy days of presentations and a Symposium Dinner. There were also fulsome tributes to our previous President, Professor Geoff Petts, who died a month before the Symposium for which he had done the initial planning. A number of BHS members, including myself and one past President, attended Geoff's memorial service held in London last October. There have been a number of successful National and regional meetings (see the Hon Secretary's report), but unfortunately the Peter Wolf Symposium that had been planned for early September had to be deferred. Plans are well in hand for this event in 2020, as well as for our next National Symposium at the University of Lancaster.

I am delighted to announce that we have recently received a substantial bequest from the estate of Dr Janet Wolf, widow of our former President Professor Peter Wolf. The committee will be considering how best to use this very generous donation.

The Society retains its 'special' relationship with its founding partners the Centre for Ecology and Hydrology (CEH) and the Institution of Civil Engineers (ICE). BHS is now a 'Specialist Knowledge Society' of the ICE. During the year we have been well-supported by ICE in relation to technical meetings held at the ICE, confirming their stated willingness to help the societies to develop the "knowledge" aspects of their work. CEH continues to support us in relation to the production of Circulation. We note that CEH will be changing its legal status later this year to become an independent research institute, and will be slightly changing its name to the UK Centre for Ecology and Hydrology, but we understand that they will still be supporting BHS.

I should like to thank all members of the committee for their support during my two years as President, and other BHS members who have offered helpful contributions or support during that time. It is gratifying to know that people have read published material in circulation or have taken note of what one said at a meeting.

I particularly like to thank Ian Littlewood who is stepping down after two years as Honorary Treasurer. He has made a significant contribution to our Society procedures during his

term, as well as a previous period on the committee and serving as the first BHS Editor of our journal Hydrology Research. A good example of how the Society benefits from the willingness of members to put themselves forward and contribute to our activities.

As stated on the BHS website, the President's Prize is awarded in recognition of a formative paper or report for work which has advanced the science of hydrology significantly. This is the first Prize since 2015 and I am delighted that this year to be able to award the Prize to Professor Hannah Cloke (who presented as part of the BHS Flood Forecasting conference) for her leadership of the NERC Flooding from Intense Rainfall programme which has certainly has been a major contribution to the field of hydrological forecasting science. You may be aware that earlier this summer she was honoured by Her Majesty in her Birthday Honours list and we certainly cannot compete with that! However, I am very pleased that as a hydrological community we are able to recognise Hannah's contribution in this way.

Finally, I am delighted that Nick Chappell is now taking on the role of President, and I wish him well.

Peter Ede

Honorary Secretary's Report

I took on the role in the past 12 months, taking over from Ian Pattison, and have really enjoyed being part of the Committee and would like to thank other members for their support. We've had some very interesting meetings in the past year including 'Celebrating hydrometry' which was very well attended. Nick Chappell convened a meeting on 'Natural Flood Management' at Lancaster University and of course the Symposium on Advances in Hydrology, and – given some of the events over the summer – a topical meeting on 'Reservoir Flood Studies'.

A big thanks to Lucy Barker and Michael Pollock who are actively communicating BHS news through our Twitter account @britishhydrosoc and we're also continuing to communicate to our members through the Society's newsletter *Circulation*.

Looking to the year ahead we have an emerging programme and some exciting meetings being planned. These include 'supporting development through hydrology', looking at some international hydrological research, a meeting on 'natural processes and change including eco-hydrology' and a final meeting on 'making decisions with imperfect data'. Details to be circulated in due course.

I'm pleased to confirm that the 2020 Peter Wolf Young Hydrologist Symposium will be taking place at the University of Strathclyde on the 17th and 18th June. The meeting will include a two-day programme of presentations, interaction with industry and knowledge sharing. Also, and as reported in the last issue of *Circulation*, BHS2020 will be taking place at Lancaster University. There is currently a call for session proposals with a deadline of 22nd November.

Finally, there have been a couple of changes and new members to the Committee. Thanks to everyone for putting their name forward as we had a great deal of interest. We now welcome: **Scott McGrane** (University of Strathclyde) who will be taking over from Ian Littlewood as the Honorary Treasurer; **Mike Vaughan** (National Flood Hydrology Team, Environment Agency) and **Elizabeth Lewis** (Computational Hydrology, Newcastle

University) as Ordinary Members. (see pages 20–21)

Michael Cranston

Honorary Treasurer's Report

As outgoing Treasurer I would like to thank Janet Homer at ICE for her input and guidance concerning technical aspects of BHS accounts over the past two years. My thanks also to the Committee for helping to make my time as Treasurer so interesting.

A draft financial statement was distributed , with final accounts for FY 2018/19 to be included the Trustees' Report for the year, which will be inspected externally and then formally agreed. The Society remains in good financial health overall. There are two main components of the Total Funds managed by BHS.

The Accumulated Fund, at £68,130 according to the draft statement, was £2,026 down on one year previously but at the time of the AGM a late payment to BHS of £4,000, due in 2018/19, was being pursued. Notable factors affecting the AF in 2018/19 include the following: (i) the BHS2018 Symposium yielded only a relatively modest surplus and (ii) lower income, relative to the previous FY, from Job Advertisements placed on the website and from subscriptions to the Register of Consultants. There was greater expenditure than in the previous FY on improvements to and maintenance of the BHS website. Looking forward to FY 2019/20, BHS has learned of a substantial



legacy it will be receiving (see President's Report).

In recognition of the restricted purpose of the Exeter Fund, the selection of grant awardees is now undertaken largely by the UK Committee for IAHS but is still managed within the BHS portfolio. For many years now, EF grants have not been awarded as evenly through time as they might have been. IAHS/IUGG Assemblies being biennial means there are no applications every other year so perhaps a more pro-active approach to inviting applications should be adopted and more EF grants could be awarded but mindful of preserving the fund's spending power.

Grants to assist attendance at other conferences outside the UK are provided from the AF, and are now referred to formally as BHS Conference Grants. The terms and conditions of Conference and EF grants are described in new documents for each scheme, downloadable from the website.

There are currently two non-BHS donors to the MSc Studentship Scheme (awards to successful applicants). Previously, one donor had transferred money to BHS in advance of the awards being decided. This had caused confusion and complexity in the accounts, e.g. carry-over between years when, for a given year, more money had been transferred by the donor to BHS than their one-third share of the actual spend. The model has

been revised so that, by default, transfers to BHS from donors are made in arrears. Possible scaling-up of the MSc Studentship Scheme, to include more donors, leading to more awards, has been raised at Committee. The payment in arrears model should facilitate any scaling-up.

My previous Treasurer's Report, for FY 2017/18 (*Circulation*, Nov 2018, 139, p8), flagged the start of recent discussions about whether, given we now live in a digital age, the hardcopy version of our newsletter should be stopped. The "President's Piece" in Circulation, 136, February 2018, included a brief overview of the issue in general terms. A paper I put to Committee in April 2018 highlighted that the cost of our newsletter (about £12,000/yr) amounted to about 44% of Members' subscriptions (33% when an external donation of £3,000/yr towards the cost of newsletter editorial work is factored in). Whether this 44%/33% is too high for a newsletter (I think it is) is a point for consideration but not the main one addressed in my 2018 paper, or here.

The "Postage" and "Printing, stationery and photocopying" expenditure items in the financial statement presented at the AGM, and in the accounts to be included in the annual Trustees' Report, do not cover the relevant breakdown costs of the hardcopy version of our newsletter. An analysis of actual expenditure on these aspects is required. My 2018 paper to Committee reported that 72% of the total cost of *Circulation* was for its printing, stationery, addresses on envelopes and postage (UK and overseas). So, hardcopy *Circulation* is costing about £8,640/yr (based on data from 2017 and 2018).

For many years now, concurrent with distribution of each quarterly hardcopy newsletter, a PDF version has been made downloadable from our website. So, *Circulation* is free of charge worldwide to anyone connected to the web, which is good because BHS does not wish to restrict access to its newsletter to Members only.

BHS could proactively distribute the PDF of each issue to Members (UK and overseas) at no cost, e.g. as an email attachment. A very large majority of Members (almost all) now use email. Common sense would suggest that, given the digital age we enjoy, any BHS expenditure on printing and distributing a glossy hardcopy newsletter is unnecessary. Furthermore, the approximately £8,640 saved every year, if we were to go 'digital only' for our newsletter (matching a similar action for many other societies' newsletters, etc, over the past decade or so), could be spent on things more central to our charitable aims and objectives. Affection for our hardcopy newsletter is well-deserved and understandable but we need to move on. I have always been, and will continue to be, a strong supporter of our excellent newsletter. Long live *Circulation*! But let's go modern and drop the hardcopy. It's an unnecessary, expensive luxury for a small society like BHS (distribution of a digital version is free and recipients can print it locally if they wish). Hardcopy uses trees, etc. Let's use the money that will be saved on other BHS things.

My best wishes to Dr Scott McGrane as he succeeds me as BHS Treasurer.

Ian Littlewood
Hon Treasurer

The President's Prize

The Society's President's Prize is awarded biennially in recognition of a formative paper or report or work which has advanced hydrology significantly.



"This is the first President's Prize since 2015," said Peter Ede when making the presentation at the AGM, "as the one due in 2017 having been missed as a result of Geoff Petts' illness. "I am delighted to award the prize to Professor Hannah Cloke for her leadership of the NERC Flooding from Intense Rainfall ß which has been a major contribution to the field of hydrological forecasting science."

Letter to the Editor

DWR consult
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11 October 2019

Dear Editor

Thomas Kjeldsen's paper on the FEH statistical method

I refer to Kjeldsen's recent paper on important aspects of the FEH statistical method. It is good that such things appear in the BHS Newsletter where they can catch the eye of practitioners. I led the research team that produced the original FEH and accompanying software in 1999.

Choice of distribution for flood growth estimation

When judged from L-moment ratio diagrams alone, the Generalised Extreme Value (GEV) does indeed provide almost as appropriate a distribution as the Generalised Logistic (GL or GLO) for general use in describing UK annual maximum floods. The L-moment ratio diagrams on p137 of FEH Volume 3 demonstrated this for both rural and urban catchments.

There were two reasons why the FEH team chose to recommend the GL rather than the GEV. It was timely to remind hydrologists that annual maximum floods are not drawn from any particular statistical distribution. If the GEV distribution had been recommended as in the 1975 Flood Studies Report, UK users might have begun to consider the choice unquestionable. It was important to perturb the *status quo* in part because it was evident that the all-digital FEH would entice many users to adopt shortcuts and defaults, rather than exploiting the new datasets, methods and software in an enquiring approach to flood frequency estimation.

The second reason why we favoured the GL over the GEV is that — when applied to UK river flood data — the GL less often leads to a flood frequency distribution that is 'bounded above'. Except in

cases where floodplain or lake storage is exceedingly influential in moderating extreme flows, it is reckless to impose a statistical model for the flood growth curve that generates estimates of rare and very rare flood events that are little higher than floods already gauged.

The surprise for me has been the extent to which experienced researchers and consultants submit to the regulatory demand for 'all sites' outputs. Agencies and insurers value continuity, consistency and completeness in flood risk mapping above all else. Lip service is paid to the importance of incorporating local and historical flood data. Crucial steps such as "Reviewing the pooling-group" (Section 6.3 of FEH Volume 3) are skated over: a gauged record is more likely to be omitted simply because its L-moment ratios are disparate rather than through the proper criterion that its catchment is hydrologically dissimilar to the subject catchment. To do anything too specialist, selective or site-specific is viewed with suspicion.

Kjeldsen has done important research in many aspects of flood risk estimation: including the interpretation of historical flood data. It is therefore bizarre that he illustrates a preference for the KAP3 distribution using flood data for the Avon at Bathford. With historical flood data beneath Bath Spa railway station a few kilometres downstream showing appreciably higher floods, the flood frequency curves from the KAP3 and GEV distributions are simply unacceptable at this site. Perhaps Kjeldsen is wearing different hats for different occasions. But flood risk estimation is so important that the acquisition and incorporation of all relevant data should ever be the mantra.

Kjeldsen determines the superior performance of KAP3 (in comparison to GEV or GL) based on L-moment ratios for pooled flood data. Pooling is necessary to avoid undue extrapolation from gauged flood data at a single site. But pooling systems are manufactured items. It is more secure to base a UK-wide distributional choice on the L-moment ratios of the flood peak data directly, rather than as moderated by a pooling scheme. While it is correct for long-record stations to gain greater weight than short-record stations, how can one justify prioritisation of a station that happens to appear in lots of UK pooling groups?

Yours sincerely
Dr Duncan W Reed



John Vernon Sutcliffe

August 1925 – September 2019

Dr John Sutcliffe was born into an Anglo-Irish family London in where his father was a Church of Ireland clergyman. John was mortified that he had not been born in Ireland and always thought of himself as a proud Irishman, particularly where international rugby was concerned. His father's work took John to Shanghai as a young boy and he was later educated at Cheam and Marlborough College. In 1943 he volunteered to join the Enniskillen Fusiliers and served part of his time in India and Pakistan, and later admitted he was quite grateful when the Japanese surrendered so that he and his men did not have to go and fight them in Burma.



John started a mathematics degree course at Jesus College Cambridge but although doing well in his Part I exams had become 'bored' with maths and switched to a geography and surveying course from which he graduated with an MA in 1950. This change of course led to a job as a surveyor on the Jonglei Investigation team as team leader mapping the upper reaches of the Sudd, a major swamp area on the Nile in Sudan between 1950 and 1954, often having to lead his team wading chest deep though papyrus to obtain suitable transects. He was ahead of his time in the 1950s, using the ecology of the Nile to distinguish between seasonal and permanently flooded areas of the Sudd to support hydrological understanding of the area, Later he and Yvonne Parks theoretically demonstrated that local grazing could be supported or wiped out according to different canal withdrawal regimes, whilst still fulfilling the canal's objectives of reducing evaporative losses in the Sudd and increasing downstream water availability, He returned to Cambridge and gained a PhD in 1957 following further analysis of the impact of the annual flooding in the Nile on the Sudd and on its ecology.

He subsequently joined Sir Alexander Gibb & Partners (SAGP) as a hydrologist working on water resource and flood problems for projects in Iran, Kenya, New Zealand, Nigeria and Pakistan, Although SAGP were essentially a civil engineering consultancy they had a forward

looking approach to how the relatively young science of hydrology might be useful to them and in 1960 sent John to an IAHS Symposium in Helsinki to present two papers on his work with SAGP.

During this symposium John met Eamonn Nash, a leading figure in UK hydrology at that time, and subsequently John was seconded by SAGP to act as Technical Secretary to a Committee of the Department of Scientific and Industrial Research (DSIR) which was considering future hydrological research needs of the UK,

Committee recommendations led to the formation of the Hydrological Research Unit (HRU) in 1962 as an offshoot of the Hydraulics Research Station (HRS, now HR Wallingford) with Eamonn Nash as Director. HRU initially had a very small staff of just eight including John Rodda, who was responsible for catchment research work at HRS and John Sutcliffe who had practical experience of hydrological surveys and the research needs of the engineering community gained from his time at SAGP. In 1964

Nash returned to Ireland to take up a position at the University of Galway and was replaced as Head of the HRU by Jim McCulloch. In 1965 government reorganisation resulted in transfer of the HRU to the newly formed Natural Environment Research Council (NERC) which, because of the growing importance of hydrological research, became in 1968 the Institute of Hydrology (IH). Hydrological research developed rapidly in the following decades as the number of staff at IH rose to around 150 by the mid 1970s, maintaining both studies in hydrological processes and under John's leadership, hydrological applications.

In 1970 John co-authored a seminal paper on river flow forecasting models with Eamonn Nash where they proposed the Nash-Sutcliffe goodness of fit coefficient that is even today one of the most widely referenced efficiency tests used by modellers (Nash, J.E. and Sutcliffe, J.V., 1970, 'River flow forecasting through conceptual models part I – A discussion of principles', J. Hydrol., **10**(3), 282–290).

A major impetus for the latter flowed from a meeting held at the Institution of Civil Engineers (ICE) back in 1959 to consider flood problems in the UK, particularly those affecting reservoirs. Following this, and a further meeting in 1965, ICE Council set up the Paton committee, on which John served as DSIR representative, to seek views and set out specific recommendations for how current flood estimation methods could be improved. The outcome of this process was the UK Flood Studies, funded by NERC, and undertaken by a team of 15 hydrologists plus temporary support staff at IH with John as its head. Through John's efforts the study included not only data from the UK but also from the Republic of Ireland as he believed that the island of Ireland must be treated as a hydrological entity. The resulting 5-volume Flood Studies Report (FSR) was published in 1975 and became the standard approach to flood estimation in the UK for over 25 years. However, fuelled by the availability of longer rainfall and streamflow records the FSR was superseded in 1999 by an update led by IH, the Flood Estimation Handbook (FEH). Although not directly involved in this update, John's comments and advice were sought from time to time and greatly appreciated by the FEH team.

Following publication of the FSR John encouraged the formation at IH of a group primarily concerned with the providing hydrological consulting services to consulting engineering firms

and to bodies such as the World Bank and regional development banks, This enabled the research work done on rainfall-runoff modelling, statistical analysis and, later, the methodologies derived in the Floods Team to be applied to major water resources and flood design schemes around the world. Building upon such consultancy, John encouraged IH colleagues to develop statistical flood estimation techniques using data from over 70 countries, leading to prediction methods being published in a series of papers.

Though John retired from IH in 1985 he continued his involvement in several studies of Lake Victoria long afterwards and his knowledge and experience of the Nile basin contributed to the value of various consulting reports, During his career John published two books. The first arose from his passion for the Nile – the definitive and well received, 'The Hydrology of the Nile' (Sutcliffe and Parks 1999). The second in 2004, 'A Question of Balance', reviewed many of the consultancy problems he had worked on during his career. This second book was John's gentle encouragement to hydrologists to understand the basic concepts of water balance of an area/project before relying on more complex models for hydrological answers, This was at a time when a stochastic component to modelling was almost de rigueur, John could usually spot a hydrological project taking a wrong turn by jotting a few numbers on the back of an envelope. He also authored and co-authored over 80 papers, and I was lucky enough to be co-author for 12 of those, which fact contributed in no small measure to my promotion prospects at IH/CEH.

The collaboration between John and Julia Shaw, on ancient water resources in India, explored whether an understanding of water resources by Buddhist monks underpinned the development and spread of Buddhism. The linking of anthropology with hydrology to investigate development of tanks (reservoirs) in India and Sri Lanka again illustrates John's lifelong capacity to think about his subject in unconventional ways.

And, in a nice circular conclusion to his academic career, his final paper published only last year (Sutcliffe, J.V. and Brown, E.L, 2018, 'Water losses from the Sudd', Hydrol. Sci. J., **63** (4), 527–541) revisited the relationship between Nile flows and vegetation distribution in the Sudd and the potential impacts upon any future proposals for the Jonglei Canal project.

There is no question that all of us who had the privilege of working with John appreciate the part that he played in the development of our professional careers, It was always a pleasure to work with him where his 'light touch' leadership allowed junior colleagues to follow their initiative whilst still keeping an eye on matters. He took an active interest in all the projects being undertaken at any time and would happily contribute to discussions whenever his experience was needed. His wry sense of humour and mischievous approach to 'authority' initially took some getting used to, although his deep understanding of 'how hydrology really worked' was a lesson to all he worked with and was very greatly appreciated.

For those interested in more information, Keith Beven filmed a very informative lengthy interview with John in the summer of 2018 as part of his History of Hydrology series. This can be viewed on YouTube: https://www.youtube.com/watch?v=BR4POrYj2iY

Frank Farquharson

Congratulations to the winners of our 2019 Student Prize

First place goes to **Molly Sim** of Sheffield University for her dissertation "An assessment of the impact of maize yields and climatic variables on the water footprint of maize in Iowa, 1958–2016.".

The two runners-up are:
Xanthe Polaine , Newcastle University for "Use of game theory to assess future water security challenges associated with climate change in transboundary basins: A Tigris–Euphrates study", and **Jack Rogers**, Oxford University, for "An investigation into the influence of climate change on the extreme precipitation event that occurred over central Europe in August 2002."

Molly's Abstract

Maize is the most important food and feed crop in the world, accounting for 20% of global calorie intake. The United States is the country that produces the largest proportion of maize globally, with the state of Iowa having the highest maizeyields nationally. The agricultural industry is dependent on both the Earth's climate and its freshwater resources – with maize accounting for 10% of global water footprint (WF) -therefore research into the relationship between maize productivity, water consumption and climatic parameters is essential for achieving maximum agricultural output. This study reports changes in the WF of maize in Iowa from 1958 to 2016, and how this is affected by the yield and different climatic variables, and these relationships were investigated by carrying out Pearson's product moment correlations and bivariate and multivariate linearregressions. The aim of this study wasto investigate the relationship between the WF of maize in Iowa and climatic parameters and crop yield, so that agricultural policy makers are able to identify changes needed in maize cultivation industry in order to maintain food, bioenergy, and economic security within Iowa, whilst minimising water consumption, under future climatic conditions. This study focused primarily on the blue water footprint (WFblue) of maize, as understanding the variables that affect WFblue is key in order to reduce water consumption. When considering the impact of climatic parameters and maize yield on the WFs,the yield was identified as the most important factor, and from the regression analysis it was determined that WFbluehad a significant positive relationship with maximum temperature and crop evapotranspiration and a significant negative relationship with yield, humidity and effective precipitation.

Flood Forecasting: Developments in Science and Application



The 2008 Pitt Review was one of the widest ranging policy reviews ever carried out in the UK and resulted in the establishment of the Flood Forecasting Centre, with forecasting products now being issued to a range of stakeholders. Agencies responsible for flood forecasting have advanced real-time modelling applications to support the growing need for early warning services which has in turn seen a significant improvement in flood resilience.

This BHS meeting brought together scientists, practitioners and policy makers involved in flood forecasting across the UK and Ireland. The opening and keynote presentation was provided by Professor **Hannah Cloke** (University of Reading) who was later awarded the Presidents prize for her contribution to hydrology (see page 9). Her talk on 'improving flood preparedness with early warning systems' covered aspects of the recently completed NERC Flooding from Intense Rainfall (FFIR) program focusing on improving the science of prediction of flash flooding. One of the key successes of FFIR as explained by Hannah has been in the co-production of flood forecasts across multiple disciplines but also referenced the challenge facing the community:

"I feel confident saying the universal biggest challenge facing everyone involved in forecasting flooding from intense rainfall is communicating the uncertainties around the location and timing of flood events." (**Linda Speight**, FFIR Researcher)

Hannah's talk ended with some excellent examples of forecast-based financing across the humanitarian sector and the key message that ensemble forecasts do lead to better decision making, a message echoed by subsequent speakers.

Charlie Pilling and **Rob Cowling** (Flood Forecasting Centre) explained how flood forecasting as a science had significantly progressed since the 2007 floods and recommendations made in the Pitt report. They reflected on some useful learning during this time, including: the need for professional training and experience to underpin service delivery; focussing on what decision makers need; operating consistently across weather, flood forecasting and warning community for clarity; and providing a blend of local and

national information is important for customers.

Leonore Boelee (HR Wallingford) provided an overview of the methods for handling uncertainty in flood forecasting and why this is important, summarising that "uncertainty can improve your forecast". **Jan Verkade** (Deltares) provided a global perspective on developments in operational flood forecasting systems, continuing the theme of improving methods for uncertainty estimation. Jan also presented on growing areas for forecasting science particularly on forecast verification, impact forecasting and making better operational decisions using forecasts, particularly in the field of hydroelectric reservoir optimisation.

Session 2 was an opportunity to showcase emerging flood forecasting capabilities across the UK and Ireland. **Matt Roberts** (Met Éireann) presented on the early stages of the new national flood forecasting and warning service in Ireland where a range of modelling approaches (URBS, WRF-Hydro, HYPE and WFLOW) have been selected for pilot in several catchments to determine a future national forecasting strategy.

Gemma Toher (Manx Utilities) covered the steps being taken to review the feasibility of flood warning on the Isle of Man – particularly topical as significant flooding was taking place across the island on the day of the meeting! **Pascal Lardet** (SEPA) presented on the efforts in Scotland to further develop their capabilities. Through their developing flood strategies key areas of development will include making the best use of ensemble forecasts, better visualisation and communication of forecasts and potentially towards more targeted services.

Samantha Mitchell (NRW) covered the growth of flood forecasting in Wales and celebrating NRW being the first organisation to migrate their operational platform (FEWS) across to hosting on the cloud. Sam highlighted that for forecasters in Wales their focus is on improving rainfall estimates, stating "the challenge is not building well calibrated models – the challenge is whether to trust the rainfall forecasts." Finally, **Paul Wass** (JBA Consulting) presented on the efforts to consolidate, standardise and simplify England's flood forecasting system with a move from multiple platforms and models to a single system and modelling approach, no small task given the scale of the operations across the Environment Agency.

Ongoing challenges remain for the flood forecasting community, including recent developments on how to handle and communicate forecast uncertainty, with a growing application of probabilistic forecasting. This was the focus of Session 3 which was opened by **Steven Cole** (CEH) who presented on 'forecasting everywhere' with recent developments in national scale flood and impact forecasting. Steve outlined several case studies of where distributed hydrological models (Grid-to-Grid) are now operational providing fluvial forecasts everywhere and being further utilised to support hazard impact modelling of surface water flooding.

As covered by several presentations, there is an increased desire to move to providing impact-based forecasting, a topic covered in detail by **Faye Burrows** (Environment Agency). User research was highlighted by Faye stating that they were well received by the public and are more useful than observed data and that flooding thresholds and impact descriptions were most useful to help



users better understand impact.

Paul Smith (waternumbers) talked about filling a void with cost effective flood forecasting systems for community based early warning systems. The approach, which is taking local community monitoring and alerting and linking these to pan-European precipitation forecasts, is currently being trialled as part of a Horizon 2020 program, ANYWHERE.

The session was closed by **Neil Ryan** (Environment Agency) who attempted to set the scene for improving future flood forecasting capabilities. He noted that one of the key developments of the new Incident Management Forecasting System going live in 2020 will be the ability to share the same forecasts from the national scale (Flood Forecasting Centre) to the local, through end to end forecasting. The desire being to provide more time for forecast interpretation and communication, rather than forecast production.

Michael Cranston
BHS Honorary Secretary

BHS Consultants Register

This section on our web site was set up as a fee-paying service for firms (and individual BHS members practising as freelance consultants) to make themselves known to the wider membership. The original aim was to demonstrate the range and breadth of hydrological services.

Nowadays, internet search facilties available to all makes this rather superflouous, certainly for the international consultancy firms. However, the drop-down menu of individual consultants is widely appreciated and we shall continue to support this facility. From now on, applications to feature in the Register will be free to members and a call for updated CVs/Expertise offered will be circulated in the New Year for a 2020 re-launch.

BHS2020

8–10 September 2020
Lancaster University, UK

To remind you...

There is still time (just!) to submit ideas for Sessions on any topic of relevance to part of the BHS community, whether studying or working within consultancies, government, research organisations, water companies or academia, As well as the various formats of oral presentations and posters, session formats may be demonstrations, debates, interactive multi-media etc.

Use the simple MS-Word form available from the BHS website:http://www.hydrology.org.uk/news/php by Fri 22 Nov 2019.

Also, if you have ideas for social activities that you would like to see at BHS2020 please also use the final section of this form
Any questions: ask the local organisers
Nick Chappell or Keith Beven via bhs2020@lancaster.ac.uk.



Advance Notice

We shall run another BHS Photographic competition next year, with prize-winning entries on display at BHS 2020 + award of prizes.
Full details and rules for entry will be displayed on the web site in due course, with a closing date in August 2020. We are telling you now so that you don't miss the chance to get some amazing shots in the coming months if or when hydrologically interesting opportunities arise.

New members to the Main Committee

Elizabeth Lewis



"I am a lecturer in computational hydrology at Newcastle University where I collaborate with international met services to create new rainfall datasets, improve rainfall data quality and collate data from unusual sources. I also work with national-scale physically-based hydrological models to look at the impact of climate change on hydrological extremes. I am very pleased to be joining the BHS committee to represent early career members and promote equality and diversity in hydrology. I think that the BHS is a fantastic organisation and my aim is to promote the work of BHS members through a programme of public engagement events. I also want to work with universities and schools to encourage the next generation of hydrologists. Thank you very much for voting for me!"

New members

Ian Campbell.....Argyll & Bute Council
Craig Mercer.....Arcadis Consulting Ltd, St Mellons
Virgine Keller.....Centre for Ecology & Hydrology
Garret MacFarlane.....Oban
Felicity Monger.....Leeds
Matthew Blakemoore.....Canal & River Trust
Fulvio Lopane.....University of Newcastle
Giulia Giani.....University of Bristol
Afrah Daham.....University of Bristol

Mike Vaughan



" I began my hydrological career in 1991 when I joined the National Rivers Authority as a hydrometric field officer, initially working in the Midlands before moving to Devon a couple of years later. In 1995, I undertook an MSc in Engineering Hydrology at Newcastleand and then moved to the Southern Region of the Environment Agency as a hydrologist and I've remained with the Environment Agency in Worthing ever since.

The new millennium brought my first taste of operational forecasting for a major flood event: the Autumn 2000 floods, which saw repeated flooding and records broken across the region. Meanwhile, the 'day job' continued with supporting the development and operation of the Environment Agency's National Flood Forecasting System, further expansion of the hydrometric network, the installation of a new weather radar, as well as local flood forecasting model development projects for various catchments.

Organisational restructuring in 2012 brought a move into a 'design' flood hydrology role, initially in the South-East, and since 2014 in the newly-formed National Flood Hydrology Team. In parallel with this, I also undertook a part-time PhD in flood forecasting applications of rainfall-runoff modelling at Imperial College which I completed earlier this year.

The real-time forecasting and 'design' hydrology strands have now been brought together in the 'Flood Hydrology Road Map' project that I'm currently leading. This project is establishing and prioritising the development needs, both operational and research, that are required for applied flood hydrology to meet the societal challenges of the next 25 years.

I'm looking forward to working with the committee, both established and new members, in helping the BHS to continue the breadth of its work promoting the development, application and dissemination of hydrological knowledge, and supporting the development and diversity of future hydrologists who will be entrusted with providing hydrological expertise for the benefit of all

Travel grant report

IUGG General Assembly
Montréal, Canada
8-18th July 2019



The 27th IUGG Conference was a large interdisciplinary conference which included sessions organised by a total of eight Associations. I attended the first week which included both IAHS (hydrological) and IACS (cryospheric) sessions, which was an excellent combination given my interests across hydrology and glaciology.

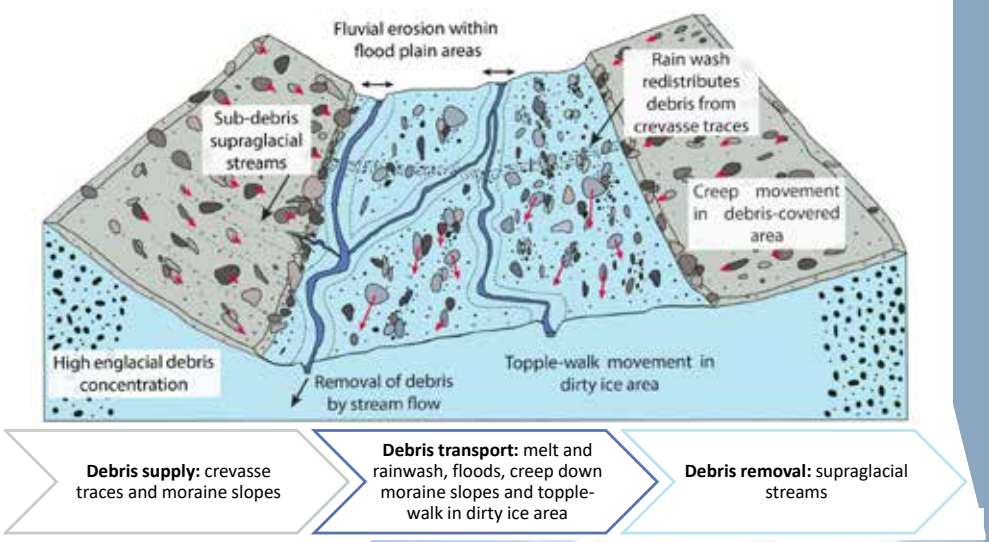
I presented an invited talk within the Debris-covered Glaciers session titled 'Pulling Apart the Peak of the Østrem Curve: Understanding Ablation and Debris Dynamics in Dirty Ice Areas'. In this work we corrected DEMs created from drone imagery to provide a map of spatially-continuous ablation across an area of partially debris-covered (dirty) ice on Miage Glacier, Italy. Previous work to understand sub-debris ablation assumes a complete debris cover, even though field evidence suggests that thin debris is rarely continuous.

By combining drone data with ground truth measurements of the ice surface characteristics we were able to reveal why ablation varies with changes in percentage debris cover. We also mapped the changes in the debris cover and tracked the movement of individual clasts between drone images to reveal the processes of debris movement.

Within the same session, **Katie Miles** (Aberystwyth University, UK) discussed the surface and subsurface hydrology of Khumbu Glacier. Her dye traces revealed that flow routing was slow and inefficient through the linked pond system, but that faster flow was evident in the subglacial systems traced from the upper ablation zone.

The second meeting of the IACS Debris-covered Glacier Working Group also took place at the conference. I am currently participating in the melt model inter-comparison experiment, so it was very useful to discuss the modelling with the other participants (for more information see: https://cryosphericsciences.org/activities/wgdebris/). Within this meeting I initiated a call for glacier runoff records in order to better understand the spatial and temporal changes in glacier runoff. If any BHS members have data they would be willing to share then please get in touch (catriona.fyffe@northumbria.ac.uk).

There were many excellent presentations, including the union lecture by **Veena Srinivasan** who discussed India's Water Crisis. Veena highlighted that politics, socioeconomic drivers and the physical feedbacks caused by human actions are often not accounted for within models but had resulted in important impacts on Indian water resources. She emphasised that it was important





to quantify the links between human actions and physical impacts, collect more good quality data, and pay attention to the political economy.

The benefits of quality catchment data were emphasised by **John Pomeroy** (University of Saskatchewan, Canada) in his presentation on the Marmot Creek catchment (in the session on 'Declining Glaciers and Snow Cover and their Impacts on Downstream Hydrology'). He showed that compensation processes dampened the effect of the meteorological changes on runoff, with increasing runoff at higher elevations compensated for by greater evapotranspiration at lower elevations.

Lauren Somers (McGill University, Canada) also presented her modelling of the Shullcas Watershed in Peru. She highlighted that although groundwater was an important contribution to streamflow, its contribution would decrease in the future due to increasing ET and a decreasing glacier contribution.

Overall, I found the conference to be incredibly valuable and I very much appreciate the generous contribution of the British Hydrological Society towards my attendance.

Catriona Fyffe
Northumbria University

UK Hydrological Bulletin: August – October 2019

The August-October period was exceptionally wet at a national scale, registering the third highest rainfall in this timeframe since 1954 and overall runoff from Great Britain provisionally ranks third in a series from 1961. Correspondingly, the frequency of both fluvial and flash flooding events was seasonally very notable. However, regional contrasts in runoff patterns were also important — floodplain inundations, particularly in a broad zone from south-west to north-east England contrasting with a residual drought threat in parts of the English Lowlands. Exceptional late-October rainfall substantially reduced soil moisture deficits and triggered a notable rise in groundwater levels and flows in many spring-fed streams across much of the country. The persistence of cyclonic weather patterns since the late summer ensured seasonally very healthy reservoir stocks (in most regions) and the October runoff from England & Wales was the highest, for the month, since 1967. With many catchments near to saturation, severe and protracted flooding — particularly in rivers draining from the south Pennines — continued well into November.

August

August was the third wettest for the UK since 1992 adding to a cluster in the early 21st century. However, the normal north-west to south-east rainfall gradient across the country was greatly accentuated; much of Scotland recorded around twice the average monthly rainfall whilst parts of eastern and southern England fell appreciably below. Entering August, and following extreme rainfall in late-July, flood warnings were widespread and overspilling at Toddbrook reservoir in the southern Pennines triggered the evacuation of Palley Bridge. The flood threat became more extensive during the second week when Spadeadam (Cumbria) recorded a three-day rainfall total of 133 mm; in north Wales Capel Curig also recorded >100mm. A dry interlude then heralded further flooding around month-end and August runoff in a number of northern rivers (including the Ness, Tyne and Eden) eclipsed previous maxima. Importantly, however, groundwater levels remained depressed across parts of the Chalk outcrop. In Suffolk, levels in the Dial Farm borehole were the 2nd lowest for August in 51-year series (Fig. 1) and continuing depressed flows characterised many spring-fed streams, for instance in parts of the Chilterns and South Downs.

UK Summer (June–August) rainfall totals for the 21st century thus far have exhibited enhanced variability but, currently, no compelling long-term trend in summer rainfall is evident; this is also true of overall outflows (in a series from 1961).

September

September was another wet month – 30% above average for the UK as a whole but with a protracted dry and warm spell over the first three weeks across parts of the English Lowlands. As a consequence of the notably high temperatures, and an associated rapid increase in soil moisture deficits, modest drought stress became evident. The landscape took on an arid complexion and, in East Anglia, flows in the Little Ouse fell below those registered

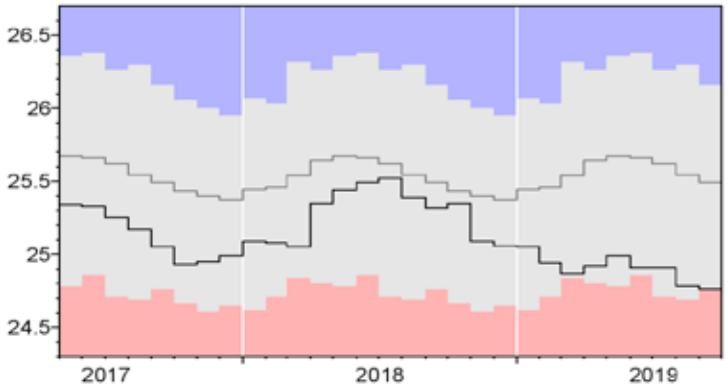


Fig 1 Monthly mean groundwater levels for the Dial Farm borehole (Chalk). The blue and pink envelopes are the period of record monthly maximum, ad minimum; the grey trace is the long term average.

during the extreme drought of 1976. Isolated examples of fish-stranding (e.g. in spring-fed streams in the Chilterns) were evidence of local ecological stress. Fortunately, a major synoptic change on the 21st heralded the return of exceptionally wet conditions and, in most regions, a rapid decline in soil moisture deficits. Overall outflows from England & Wales climbed steeply and, in the fourth week, briefly exceeded the previous daily maxima (for the time of year) in a series from 1961 (Fig. 2). Correspondingly, whilst the immediate hydrological concern again focussed on flood risk, the seasonally exceptional runoff ensured that reservoir stocks were substantially above average across much of the UK. Exceptions included several large reservoirs in southern England where groundwater levels also remained depressed in a few index wells and boreholes in the Chalk aquifer.

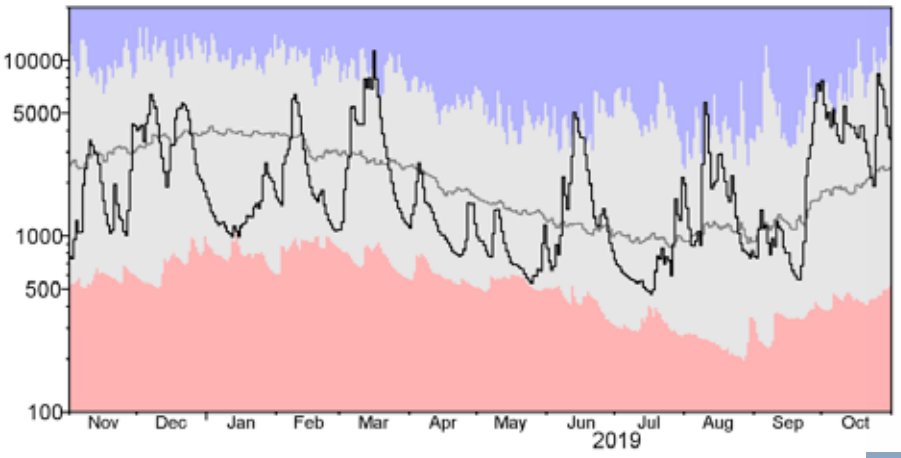


Fig 2 Daily outflows from England and Wales (m^3s^{-1}). The blue and pink envelopes are the period of record daily maximum and minimum; the grey trace is the long-term average.

October

With an Atlantic airflow still dominant, October was another very wet month, contributing to the third wettest June–October for the UK in a series from 1910. But regional variations in the October rainfall were notable. Parts of eastern and southern Scotland registered below average but, most significantly, large areas north and south of the Humber were particularly wet. With near-saturated catchments across many parts of England & Wales flood risk remained high. On the 1st, more than 50 Flood Warnings and >150 Alerts were in operation and thunderstorms triggered flash flooding with associated transport disruption. In the Isle of Man, the village of Laxey was isolated as the Laxey river overflowed and a landslip blocked the main road to Douglas.

After a calm interlude, cyclonic conditions returned in the second week. Achnagart in northern Scotland recorded 142.2 mm of rain over three days (9–11th) and, with most rivers in spate, Flood Warnings were again common across England & Wales. Flood risk escalated further during the final week when 48-hr rainfall accumulations of >50 mm were relatively common. In the Brecon Beacons, Libanus registered 70 mm and surface runoff was evident in a number of areas. By the 27th, FloodWarnings across England & Wales approached 150 with around 200 Alerts. The associated exceptional runoff heralded extreme flooding in rivers draining the south Pennines (the Don in particular) in early November. In contrast, and notwithstanding healthy replenishment to the unsaturated zone across much of the Chalk aquifer, late October groundwater levels continued to decline in a few of the slowest-responding index wells and boreholes.

Terry Marsh
15/11/19



...a hydrological phenomenom in Herefordshire [26.10.19]

Stop press!

Early Career Women in Water Conference 2020

This conference will take place at Cranfield University on 17th March 2020 and will bring together young professionals and researchers in the water science and engineering sectors to debate key issues in knowledge and innovation, and ways forward for successful careers of women in water.

If you want to contribute with a presentation or a poster. download the form from ECWW@cranfield.ac.uk before the deadline on 10th January 2019. All accepted abstracts will be published in a Conference Proceedings Book available with open access on Cranfield University's institutional repository, CERES.

Events Calendar 2020

Date	*Title*	*Venue*	*Type*
17 March	Early Career Women in Water	Cranfield Univ.	Conference
19–20 April	Weather Radar & Hydrology	Nanjing, China	Conference
17–18 June	Peter Wolf Symposium	Stratheclyde Univ	Symposium
09-10 Sept	BHS NATIONAL HYDROLOGY SYMPOSIUM	Lancaster Univ	BHS National Symposium



Photo: River Nith at Dumfries