Fourteenth National Hydrology Symposium

Book of Abstracts

Lancaster University 12-13 September 2022
Lake District 14 September 2022

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Lancaster University

British Hydrological Society

Key to page numbers for abstracts

Notes:

- First authors are the presenters
- Where authors have formally agreed for their email address to be public – this is shown
- Two poster presenters have provided links to short oral summaries – see p41 and 48

Oral Presentations

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Session 2: Community response to flooding (Chair: Ann Kretzschmar) 10:25-11:15 Mon 12 Sep

Session 3: Innovative approaches for testing and understanding NFM & nature-based solutions (Chairs: Kate Heal, Leo Peskett, Josie Geris & Megan Klaar) 1 of 2, 11:30-12:30 Mon 12 Sep

Session 4: Impact of flooding on critical infrastructure & the built (urban) environment (Chairs: Maria Pregnolato & Lindsay Beevers) 11:30-12:30 Mon 12 Sep

Session 5: Estimation of extreme floods in a changing environment (Chair: Thomas Kjeldsen) 1:15-3:15 Mon 12 Sep

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Session 8: Ecohydrology & water quality (Chairs: Clare Rowland, Sarah Halliday & Sayali Pawar; including Water Futures: surface water quality challenges in a changing climate; Ecohydrology and biogeochemistry open session; Use of UK Land Cover Map data for hydrological applications) 3:40-5:30 Mon 11 Sep

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Session 12: Trees, forestry and NFM and Co-producing a monitoring framework for evaluation of Nature-based Solutions for Flood Management (Chair: Tom Nisbet and Paul Lunt) 10:50-11:50 Tues 13 Sep

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Session 13: Future of the UK flood warning service – how best to expand & standardise approaches (Chair: Vicky Shackle) 1:15-2:25 Tues 13 Sep

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Session 1 Data science in hydrology (Chair: Matt Fry) 10:25-11:15 Mon 12 Sep Theme 1: Future hydrology

ID: 71

Felipe Fileni

Newcastle University

Quality control methods for the 15min flow and levels datasets in the UK

In the UK, significant efforts have been made to quality control the high-resolution rainfall datasets available nationally. Flow datasets, another key component of hydrological modelling, have not received the same treatment. These datasets are generally controlled at their source, by the local responsible for hydrometry. What is proposed herein is a universal approach, with a series of quality control tests, that could be applied at the National scale, aiming to improve the quality of the data that is fed to hydrological models.

ID: 112

Thomas Kjeldsen

University of Bath

On the use of NRFA peaks-over-threshold data for design flood modelling

This study presents an initial investigation into the use of the NRFA Peaks-over-Threshold (POT) database for design flood estimation in the United Kingdom. Two new POT datasets are created from a quality controlled version of the original NRFA dataset; the POT3 and POT1 datasets, characterised by on average three and one exceedance above the threshold. Using these new datasets, the distributional assumptions underpinning the statistical POT models are assessed, showing that peak flow data are predominantly over-dispersed (tendency for temporal clustering), while the magnitude of the exceedances can mostly be considered to follow a general pareto distribution. Links between the POT model and the equivalent annual maximum distributions are considered. Finally, preliminary result are reported on the potential link between the POT data and large-scale climatic drivers, including regional rainfall and the NAO index. The implications of non-stationarity in the POT data are discussed in terms of design flood estimation.

ID: 132

Georgios Sarailidis (1), Thorsten Wagener (2), Francesca Pianosi (3)

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Integrating Scientific Knowledge into Machine Learning using Interactive Decision Trees

Decision Trees (DT) are widely used in the geosciences to automatically extract patterns from large datasets. But their application is hindered by data limitations and potentially physically unrealistic results. We develop interactive DT (iDT), an opensource python toolbox, that put the human in the loop and integrate the power of experts' scientific knowledge with the power of the algorithms to automatically learn patterns from large datasets. We demonstrate with 3 case studies how experts incorporate their knowledge in the DT development achieving higher interpretability.

ID: 158

Tess O'Hara

Newcastle University

Bringing the Crowd to the Cloud - WOW!

Crowd sourced rain observations from citizen scientists in Great Britain are shared from private automated weather stations to the Met Office Weather Observations Website (WOW). This research presents the results of WOW data consolidation, cleaning and quality control demonstrating that almost 2,500 private weather stations generated data of comparable quality to Official monitoring networks. The crowd sourced weather stations fill gaps in the monitoring network and provide an opportunity for radar validation. An example will be presented of the benefit of including WOW data in post event hydrological modelling.

Session 2 Community response to flooding (Chairs: Ann Kretzschmar and Ewan Larcombe) 10:25-11:15 Mon 12 Sep Theme 3: Natural flood management & partnership working

ID: 5

Ewan Larcombe

National Flood Prevention Party

The problems with maintenance of land drainage within a complex, urbanised environment at risk of flooding - and associated legislative shortcomings

This area is designated flood plain and we have been flooded three times this century. The transition from agricultural to urbanised status has made it increasingly difficult to ensure that the ancient network of land drainage infrastructure is maintained in a 'fit for purpose' condition. Furthermore legislation has failed to keep up with the times.

ID: 12

Dr Rhian Thomas

University of Glasgow

Climate extremes: risk perceptions, mitigation drivers, public health impacts and experience

A major knowledge gap in terms of how climate change affects mental health has been highlighted and a lack of evidence base, particularly for Scotland. Research presented discusses findings from a growing contribution of research on social impacts of flood/drought hazards using qualitative questionnaires and interviews. The main themes addressed are physical and mental health impacts of floods/droughts; perceptions of risk and association with past experience and the importance of indirect experience; the role community support can play; drivers of risk mitigation; flood warning experiences; and misunderstandings/mis-communications of where responsibility lies for flood protection measures.

ID: 66

Ewan Larcombe

Parish Council

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The problem of maintaining flow and quality of ordinary watercourses within an urbanised environment.

Steady but remorseless development on Lower Thames flood plain throughout the 1900's converted land from agricultural to densely urbanised and populated. Existing ancient land drainage infrastructure was and still is ignored. Today - after three flood events this century - the ordinary watercourses are restricted or totally blocked and the water quality (if there is any) is deteriorating. This presentation highlights the practical issues and difficulties associated with ensuring that land drainage infrastructure is fit for purpose and also meets current environmental aims.

ID: 142

Sevilay Topcu

Cukurova University (Emeritus Professor)

A Comparative Study on Community Risk Perceptions and Infrastructural Measures for Floods

The success of participatory flood risk management in local communities depends on the appropriate problem and action perspective of flood risks. Socio-economic conditions and culture of the societies affect the ability of communities to prevent disasters. Both Turkey (Black Sea region) and the Netherlands (Limburg region) have been experiencing riverine flash floods for a long time, however the factors affecting the degree of risk acceptance and vulnerability as well as degree of participation of local residents in disaster prevention activities are different between flood sites. Hence we compare community risk perceptions and infrastructural measures between the two countries.

Session 3 Innovative approaches for testing and understanding NFM & nature-based solutions (Chairs: Kate Heal, Leo Peskett, Josie Geris & Megan Klaar) 11:30-12:30 Mon 12 Sep Theme 3: Natural flood management & partnership working

ID: 6

Elizabeth Follett (1), Barry Hankin (2)

Hydro-environmental Reseach Centre, School of Engineering, Cardiff University (1), Lancaster Environment Centre (2) follette1@cardiff.ac.uk

Investigation of varying channel and barrier physical properties on outflow from series of barriers using a sparse input 1D model

Targeted design and placement of leaky barriers and accurate representation in hydraulic models is needed to design and assess effectiveness of natural flood management projects. Varying barrier spacing, water surface profile change, lower gap vertical width, overflow to local floodplain, channel slope, and best-fit equivalent channel resistance were assessed by representing a series of barriers in a sparse input 1D network model. Backwater rise upstream of barriers depends on loss of momentum within the barrier. Best-fit resistance approached an analytical maximum for closely spaced barriers.

ID: 43

Angus Middleton

Viridian Logic Ltd

Low cost optimisation and comparison of NFM options at landscape scale

HydroloGIS specifies all NbS options across drainage basins and ranks the degree of flood and diffuse pollution services they will deliver, assigning normalised values to each pixel. These can be converted into quantified

flood/pollution reductions offered by any combination of NbS across the entire region, when compared to full flood or nutrient modelling/monitoring for only small areas in the region. This gives major cost reductions, improves planning and optimises outcomes.

ID: 47

Keith Beven

Lancaster University

The importance of retention times in Natural Flood Management interventions

Natural Flood Management is an increasingly popular policy option for flood mitigation in the UK. It involves a variety of different types of in-stream and off-line storage elements. These are often implemented on the basis of convenience in the choice of both sites and materials. Past work (e.g. Metcalfe et al. HESS 2018) has suggested that if storage elements fill too quickly the effect on downstream hydrograph peaks during events that flood properties will be small. Equally, if storage elements fill and then drain too slowly, their effectiveness during multi-peaked extreme events will be much reduced. This paper describes some analyses of retention times of in-stream structures of different types that can be used to make natural flood management more effective.

ID: 79

Stephanie Bond (1), Mike J Kirkby (2), Jean Johnston (3), Alistair Crowle (4), Joseph Holden (5)

University of Leeds (1), University of Leeds (2), Natural England (3), Natural England (4), University of Leeds (5)

A hillslope flume for measuring surface roughness

Different land covers are known to 'slow the flow' to different extents as the result of surface roughness, controlling overland flow velocity downslope. Roughness is also a common parameter used in hydrological modelling to describe the extent of resistance to overland flow. However, roughness data exists for very few temperate climate land covers. This presentation will introduce a portable flume for measuring hillslope overland flow velocity, used as a proxy for roughness, and demonstrate the importance of roughness in NFM using a case study from Swindale, Cumbria.

ID: 85

Marianne Piggott

Mott MacDonald

The Natural Flood Management Manual: A framework to use hydrology to deliver effective NFM

The new CIRIA NFM manual provides a start-to-finish route map to deliver NFM. It focuses on the 'where?' and 'how? to protect, restore and mimic nature. Understanding hydrological processes is critical to delivering effective NFM on the ground but analysis should be proportionate and adaptive at each stage to balance investment with the scale and complexity of the catchment. Our presentation will introduce the NFM manual with a focus on how hydrology can understand, plan, design and monitor measures by offering an innovative modelling decision framework customised to the needs of each stage.

Session 4 Impact of flooding on critical infrastructure & the built (urban) environment (Chairs Maria Pregnolato & Lindsay Beevers) 11:30-12:30 Mon 12 Sep Theme 2: Floods & droughts theme

ID: 82 (1) Maria Pregnolato, (2) Lindsay Beevers, (3) Ioana Popescu, (4) Yuexiao Liu, (5) Nigel Wright

(1) Dept. of Civil Engineering, University of Bristol, Bristol, BS8 1TR, UK, (2) Institute of Infrastructure and Environment, University of Edinburgh, Edinburgh, EH9 3JG, (3) IHE Delft Institute for Water Education, PO Box 3015, 2601 DA Delft, the Netherlands, (4) Dept. of Civil Engineering, University of Bristol, Bristol, BS8 1TR, UK, (5) School of Civil Engineering, University of Leeds, Leeds, LS2 9JT

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Identifying flood and droughts hotspots under global change: a worldwide review

Hydrological hazards ('hydro-hazards') are defined as extreme events associated with the occurrence, movement and distribution of water, specifically resulting in floods and droughts. As a result of global climate change these hazards are expected to change in the future, with areas of the globe becoming 'hotspots' for the intensification of these extremes. This paper is the first global review of the research on future floods and droughts. We highlight the geographical areas where increasing hazards are anticipated, and those areas where no significant research has been published.

ID: 95 Sarah Johnson (1), Robert Wilby (2), Dapeng Yu (3), Tom Matthews (4)

Loughborough University (1,2,3), King's College London (4)

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Global analysis of emergency service provision to vulnerable populations during floods of various magnitude under climate change

In a world of increasing global flood hazards, vulnerable populations are disproportionately affected by flooding, account for most flood casualties, and often rely on emergency services due to flood-induced injuries, exacerbated medical conditions, and requiring evacuative assistance. However, emergency service demand often exceeds the potential capacity whilst flooded roads and short emergency response timeframes decrease accessibility, service area, and population coverage; but how does this compare across the globe and what will the future hold? To answer this question, a global analytical framework has been created to determine the spatial, temporal, and demographic variability of emergency service provision during floods. The framework includes an accessibility analysis to identify emergency service accessibility to vulnerable populations based on restrictions of flood barriers and response-time frameworks, a vulnerability analysis to compare the environmental injustice of emergency service provision between key demographic groups, and a hotspot analysis to identify the extent and distribution of the most at-risk and vulnerable locations and people. The highlighted geographical and temporal differences in emergency service provision globally and between regions, in addition to the framework itself, can be used by national and international organisations to inform strategic planning of emergency response operations and major investments in infrastructure, services, and facilities to maximise the benefit to the disproportionately affected vulnerable populations. This includes the production of more detailed flood hazard and evacuation maps that highlight vulnerability hotspots, the prioritisation of vulnerable population groups in emergency response plans to minimise geographic and population disparities of flood injuries and fatalities, and the allocation of emergency service hubs in regions of high vulnerability but low emergency response provision.

ID: 117

Dr Hazel Long (1), Jodi Old (2), Dr Fiona McLay (3), Elaine Fotheringham (4)"

Scottish Environment Protection Agency (1)

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Translating new climate projections into guidance for land use planning in Scotland.

New UKCP18-based projections on how climate change will affect UK rainfall extremes and flood flows have been published (Chan et al. 2021 & Kay et al. 2021) but are too complex for use by non-climate specialists. We describe how the projections have been simplified to update SEPA's Climate Change Allowances for Flood Risk Assessment in Land Use Planning. This provides a case study of the process by which science informs real world adaptation decisions and illustrates the policy and implementation considerations which need to be considered alongside science in the development of guidance.

ID: 141

Sevilay Topcu

Cukuova University (Emeritus Professor)

Flash Floods and Their Effects on Critical Infrastructure and Urban Areas in Turkey

Floods are the second most destructive type of natural disaster in Turkey after earthquakes. While climatic-meteorological and geological-geomorphologic factors are important aspects of floods, unwise land use such as deforestration and more importantly occupation of flood plains by residential buildings as well as critical infrastructures such as roads and airports increases the severity of the disaster, fatality and financial damages of the hazard. This study assesses the causes and effects of recent flood events in relation to the critical infrastructure and urban areas in Turkey.

ID: 144

Giuseppe T Aronica

University of Messina , Italy

Prioritization of Infrastructures' Criticality: A Multi-criteria Decision Analysis vs. Using Vulnerability Curves

Classification of civil infrastructures could be important for giving priority to the most critical ones in regard to allocating funds in the flood hazard mitigation and recovery processes. In the current study, a methodology has been proposed based on synthetic vulnerability curves, which emphasizes functional vulnerability to floods with an eye to structural/non-structural damages. On the other hand, a kind of Multi-Criteria Decision Making (MCDM) method has been proposed to prioritize the critical infrastructures with respect to the sustainability indicators. The proposed methods have been tested in two flood-prone areas, i.e. the city of Sarajevo, Bosnia crossed by the river Zujevina and the city of Berat, Albania, crossed by the river Osum. A comparison of the two methods represents that both methods introduced the "roads" as the most critical infrastructure among all in Berat. In the case of Sarajevo, "roads" are proved to be the least vulnerable of all given critical infrastructures by the two methods. For both methods, the final values of criticality for the different critical infrastructures are very close to each other, and thus, not a big difference can be emphasized among their level of vulnerability to floods.

Session 5 Estimation of extreme floods in a changing environment (Chair: Thomas Kjeldsen) 1:15-3:15 Mon 12 Sep Theme 2: Floods & droughts

ID: 1

David Cameron

JBA Consulting

Evaluation of the FEH Rainfall Runoff and ReFH2 methods for a gauged catchment in north east Scotland

Both ReFH2 and FEH Rainfall Runoff (RR) remain regulatory accepted methods for flood estimates in Scotland. However, FEH RR often appears to be the regulator's choice, perhaps because it often provides a conservative flood estimate. This is particularly the case in north east Scotland. This is an unusual situation given the common use of ReFH2 elsewhere in the UK and also the historic nature of FEH RR. The purpose of this contribution is twofold: 1/ Evaluate the rainfall-runoff element of the ReFH2 and FEHRR approaches by running them with observed rainfall and comparing the outputs with gauged data for a gauged extreme event (August 2014, on the Black Burn at Pluscarden Abbery gauging station), 2/ Evaluate the design flood element of the two approaches by undertaking flood frequency analysis and sense checking the resulting estimates of the frequency of the August 2014 event. Rainfall frequency will also be considered in explaining differences between ReFH2 and FEHRR. This includes FEH99, FEH13, FEH22 (if available) and output from a stochastic rainfall model. Conclusions and recommendations from this comparison will then be made.

ID: 9

Sam Watkiss (1), David Archer (2), Brian Ervine (3)

Leeds University recent graduate (1), Water Resource Systems Engineering Group, School of Engineering, Newcastle University, NE1 7RU, UK and JBA Trust, 1 Broughton Park, Skipton, North Yorks., England, BD23 3FD (2), Leeds University, School of Geography (3)

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The characteristics of 'Walls of water' floods on Pennine catchments and their transmission downstream

Visible flood waves, described as walls of water (WoW) have been identified on rivers in northern England rising in the Pennines from both historical and recent gauged data. Recent data are based on digital level and flow records at 15 minute intervals. The focus of this paper is on the characteristics of gauged WoW events on the Rivers Wear and Tees and their comparison to 'normal' floods. Rapid 15 minute rise in these events of over 1.30 metres is compared with the maximum rate of rise in annual maximum peak floods of 0.34 metres, illustrated by comparing flood hydrographs. WoW flood peaks occurred within an hour of the most rapid rate of rise and in the case of 7 June 1983 recession followed immediately at Stanhope on the River Wear and Middleton on the river Tees. The propagation of the flood wave downstream is illustrated. The 15 minute increase in discharge is compared in relation to the peak flow for WoW and normal floods at different gauged locations down the catchments again showing striking differences. Estimated Time to Peak (Tp), used for design flood estimates of the hydrograph, for these events is very much lower than estimated from the recommended FEH equation with upstream catchments showing underestimates of 75%.

ID: 24

Duncan Faulkner (1), Sarah Warren (2), Sean Longfield (3), Jonathan Tawn (4)

JBA Consulting (1,2), Environment Agency (3), Lancaster University (4)

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Non-stationary flood frequency with physical covariates: bridging the gap between theory & practice

There are nearly 4000 research papers on non-stationary flood frequency analysis. Yet in many countries these techniques are not yet used in flood management. One reason may be that research tend to focus on model fitting rather than extracting the sort of results needed by designers and decision makers. We present a method that overcomes the difficulty of extracting useful results from non-stationary models that include physical covariates for which the value in any future year is unknown. This is now available for use by practitioners planning flood alleviation schemes in England.

ID: 37

Anthony Hammond

JBA

A region of influence approach to estimating flood frequencies for climate change scenarios

For practical purposes the current guidance for attributing fluvial climate change allowances in England is based on percentage changes to the 50-year return period attributed to geographical regions. This proof-of-concept study introduces an approach that would enable the practitioner to derive allowances for the full distribution of extremes (as opposed to single return periods) and is based on catchment characteristics. A region of influence approach, adopted by the Flood Estimation Handbook (FEH), is applied to estimate changes to QMED and LCV (Hosking and Wallis 2007) as opposed to extreme flows. The approach is, therefore, distribution neutral and can be applied to any catchment for which an FEH analysis has been undertaken. Results for an example scenario (RCP8.5 2080s) are compared to a geographically regional method and an example is provided for a single catchment estimating extremes with the FEH method and adjusting them for the RCP8.5 2080s scenario.

ID: 63

Zijie Wang

Loughborough University

Temporal scaling properties of extreme rainfall and intensity-duration-frequency curves in the UK

Temporal scaling techniques are used to estimate sub-daily rainfall intensities from more widely available daily series. This study investigates spatial and temporal variations in the scaling properties of UK rainfall, stratified by homogeneous rainfall regions, geographical factors, seasons, and air masses. Such scaling relationships can be used to generate extreme rainfall estimates for ungauged sites, for specified durations, and return periods. These tools will eventually be used to evaluate pluvial flood risk in urban areas under present and future climate scenarios.

ID: 69

Adam Griffin

UKCEH

How do you model or generate 1000 1000-year events?

For risk quantification, a typical approach is to compile a large set of possible extreme events. To look into possible future risk, you need a large set of possible future events. However, typical hydrological model runs (and even observed records) only give one once-in-100-years event in 100 model years. My work looks to use statistical methods to apply UKCP18 data, Grid-to-Grid outputs, and the eFLAG dataset to generate a large set of widespread flood (and drought) events which better describe the variability of possible extreme events.

ID: 76

Catherine Sefton

UK Centre for Ecology & Hydrology

Recent hydrological extremes in the UK: the 2018/2019 drought and 2019/2020 floods

In recent years, the UK has witnessed hydrological events at both extremes, with intense drought and remarkable flood events that had significant impacts on society. Summer 2018 brought heatwave and drought, with the joint highest UK temperatures on record and a protracted dry spell that extended into 2019. By contrast, the summer and autumn of 2019, and the winter that followed, were exceptionally wet across much

of the country and saw a succession of damaging floods. We appraise the duration, magnitude, extent and impacts of both events and place them in historical context.

ID: 81

Gemma Coxon (1), Leanne Archer (2), Laura Devitt (3), Elizabeth Kendon (4), Jeff Neal (5), Paul Bates (6), Andy Smith (7)

Geographical Sciences, University of Bristol (1, 2, 3, 4, 5, 6), Met Office (4), Fathom (7)

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Using UKCP Local for Pluvial and Fluvial Flood Hazard Estimation Under Climate Change

Current estimates of future UK flood risk are unreliable as they are based on coarse resolution climate models, which are unable to capture short-duration rainfall extremes responsible for flooding. In this study, we use the UKCP Local climate projections (2.2km, hourly precipitation) to drive flood models for one pluvial (Bristol) and two fluvial (Dyfi and Thet) case studies. We find that using the full UKCP Local space-time varying precipitation fields can lead to radically different estimates of future flood risks to those contained in current guidance based on simplified uplift methods.

91

Gianni Vesuviano

UK Centre for Ecology & Hydrology

The FEH22 rainfall depth-duration-frequency model

We recalibrate the FEH13 DDF model to a large rainfall maxima dataset, developed for the Hydro-JULES programme, that includes record-breaking and other large events not included in the model available on the FEH Web Service. Sub-daily gauges in particular are increased from ~1000 to ~1700. We compare frequency estimates for some severe historical events. We also compare design rainfall depths generally across the UK and discuss differences in their spatial patterns. The recalibrated model will be made available via the FEH Web Service in late 2022.

ID: 111

Simon Moulds

University of Oxford

Skillful decadal flood prediction using a mode-matching approach

We use a statistical-dynamical approach to evaluate the ability of decadal hindcasts to skilfully predict UK boreal winter flooding at decadal timescales. Using a large ensemble we show that predictions of the 95th percentile of boreal winter streamflow are skilful when averaged over lead times of 2-9 years from the initialization date. Reducing the ensemble size by selecting members which adequately represent the North Atlantic Oscillation significantly improves the predictive skill. Our findings show the potential of decadal predictions to inform flood risk management at long lead times.

Session 6 International hydrology (including From hillslopes & wetlands to mega rivers: advances in tropical hydrology and Use of UK-based knowledge overseas e.g., flood forecasting (Chairs: Evangelia

Kordomenidi and Rory Walsh) 1:15-3:15 Mon 12 Sep Theme 5: International hydrology

ID: 3

Mike Law

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Pragmatic hydrology in data-poor environments for Pacific islands infrastructure projects

Having worked for nineteen years for the Environment Agency and private consultancy in Yorkshire, Mike has spent the last thirteen years working as a hydrologist for a large infrastructure firm in New Zealand. His presentation provides examples of developing robust hydrological inputs to a range of water resource and transport projects in the Pacific islands and remoter parts of New Zealand and Australia, where time frames can be short, expectations high, budgets small, and with limited data.

ID: 14

Fazir Khan

Alpha Engineering & Design (2002) Ltd

A novel framework for the application of this NOAA hydrological data with for use in the Caribbean.

There continues to be a high degree of uncertainty with hydrological modeling for flood prediction in the Caribbean due to the challenge faced by engineers and hydrologists in selecting applicable rainfall data for input into abstract deterministic models, as it relates to the quality and quantity of rainfall data available for territories across the region. Rainfall data has multiple gaps; the number of years of continuous data is too small for extrapolation; most catchments are ungauged, and in many cases, 24-hr is the highest temporal resolution available. In 2008, the National Oceanic and Atmospheric Administration (NOAA) published a Precipitation-Frequency Atlas for Puerto Rico and the USVI which contains precipitation frequency estimates based on hourly data collected over an extended period and very rigorous statistical analyses of annual maximum and partial duration series. This paper reviews the quality and quantity of rainfall data in the region and compares it to the NOAA-derived estimates, assessing spatial variation, temporal distribution, statistical applicability, and climate change. ADD how we did it and what we found. A novel framework is proposed for the application of this NOAA data with territory-specific qualifications, taking into account historical meteorological events of estimated magnitude and their known development paths for various islands. The principle motivation of this paper is to improve the accuracy of flood forecasting in the Caribbean by bridging the most prominent gap in hydrological modelling as it relates to input precipitation data

ID: 49

Daryl Hughes (1), Ryan Pereira (2), Geoff Parkin (3), Isabella Bovollo (4), Steve Birkinshaw (5), Angela Franklin (6), Garvin Cummings (7).

Lyell Centre (1), Lyell Centre (2), Newcastle University (3), Durham University (4), Newcastle University (5), Guyana Water Incorporated (6), HydroMet, Ministry of Agriculture, Guyana (7).

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Improving hydrological predictions in the data-sparse Essequibo River basin, northern Amazonia

Tropical water and carbon cycles are a crucial, yet poorly constrained, component of Earth's climate system. Hydrological predictions in the tropics are undermined by sparse records of (highly variable) rainfall. We therefore built a SHETRAN hydrological model of the 155,000 km^2 Essequibo River basin to improve our understanding of hydrological flows in northern Amazonia. Our model will inform adaptive management to future climatic and land use changes. Furthermore, it will underpin simulations of organic matter fluxes to the ocean, to improve global climate projections.

ID: 67

Eva Kordomenidi

JBA Consulting

Multi-objective optimisation for reservoir management -A case study in tropical South East Asia

Most real-world problems engineering optimization problems are multi-objective by nature. Objectives often conflicting. Multi-objective reservoirs are often used to serve multiple demands for domestic, industrial, irrigation, environment, hydropower production, and flood control. Determining how to best meet these multiple needs is a complex problem because of the nonlinear storage-inflow relationship, conflicting objectives, dynamic properties, and nonlinear constraints. The answer is set of solutions that define the best trade-off between competing objective. This case study describes the analysis undertaken for a multi-use reservoir in a tropical monsoon driven region in South East Asia. The analysis involves the following: 1/ Review of historical reservoir release operating rules and actual practice, 2/ Dam operation objectives: Four conflicting objectives are evident: (i) dam safety, (ii) downstream flood damage, (iii) meeting irrigation demand, (iv) hydropower production, 3/ Quantifying objectives: Metrics is calculated for each objective quantified as expected annual values over a long-term (20+ year) hydrological simulation of the reservoir's behaviour, 4/ Simulating the historical reservoir release operating rule, and quantifying historical performance on the three metrics, as a baseline, 5/ Developing reservoir rule curves, 6/ Searching the solution space to find the Pareto (non-dominated solution) surface, 7/ Consider possible areas for further improving reservoir operating performance, eg by gauging water-levels or upstream rainfall with runoff modelling.

ID: 115

Paul Wass

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Real time reservoir control on the River Lee using a forecasting system

Work will soon begin on a €150m flood alleviation scheme in Cork: Ireland's second city. Flood storage is needed to achieve the required standard. Storage will be created in two hydropower reservoirs on the River Lee, just upstream. Drawdown is triggered by the innovative forecasting system described in this paper. Four days prior to the event, reservoirs are lowered from a level optimum for hydropower generation to one that can manage the flood event. This is the first system in Ireland to attempt real time, 'rule-based', reservoir drawdown for flood alleviation.

ID: 131

Linda Speight

University of Oxford

Using global flood forecasts to support international humanitarian operations for tropical cyclones

Over the past three years we have been producing forecast bulletins for tropical cyclones. We will share our journey of learning how to make the best use of global forecasts to support humanitarian decision making including: 1/ Incorporating emerging scientific knowledge, 2/ Sharing transparent and accessible information, 3/ Adapting to the potential discrepancy of the scale of global models and the focus of decision makers, 4/ Building links to local organisations, 5/ Improving capacity for forecast based decision making, 6/ The need for user relevant metrics to assess the skill and value of global models

ID: 150

Tom Beskeen

Mott MacDonald

The Black Drin basin: A panoply of hydrological modelling challenges in the Balkans

The proposed development of the Skavica hydropower project in Albania requires detailed rainfall-runoff modelling of the transboundary Black Drin basin to inform baseline and future climate change energy assessments. This presentation considers the technical and practical solutions implemented to address the complex challenges of this basin including karstic flow contributions, outflow control of Lake Ohrid (Europe's deepest lake), the influence of existing hydropower plants on river flows, mountainous terrain influencing meteorological patterns and snow accumulation/melting.

ID: 166

Eva Kordomenidi

JBA Consulting

Multi-objective optimisation for reservoir management -an industry perspective

Multi-objective reservoirs are often used to serve multiple demands for domestic, industrial, irrigation, environment, hydropower production, and flood control. Determining how to best meet these multiple needs is a complex problem because of the nonlinear storage-inflow relationship, conflicting objectives and nonlinear constraints. The answer is set of solutions that define the best trade-off between competing objectives. This case study discusses a methodology developed to determine alternative operational regimes for a dam in South East Asia which is used for irrigation and hydropower purposes.

ID: 184

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Hydrological implications of changes in rainstorm size-frequency in Sabah (Malaysian Borneo)

Evaluating hydrological consequences of predicted climatic change in the tropics is a complex challenge, not only because of uncertainties about societal, land-use and vegetational responses and feedbacks, but also because different hydrological variables are influenced by different rainfall variables – that IPCC climatic models often lack. This paper explores impacts of changes in rainstorm size-frequency 1910-2020 (and future) in Sabah, Malaysian Borneo, on different hydrological variables, with a particular focus on annual interception and river flow using a simple Excel-based model.

Session 7 Future hydrometry & hydrological monitoring (Chair: Nick Everard) 3:40-5:30 Mon 12 Sep Theme 1: Future hydrology

ID: 38

Robert L. Wilby (1), Matthew F. Johnson (2)

Loughborough University (1), University of Nottingham (2)

How hard can it really be to sustain a national water temperature indicator?

Water temperature (Tw) is a determinant of river chemistry and ecosystem function that reflects air temperature, volume of flow, and hydrological pathways, making it a good indicator of climate change. Here, we recount efforts to develop a Tw indicator to track climate change signals within English rivers. Our search for sentinel sites was based on ~1 million Tw values from an Environment Agency archive spanning 2000-2018. Results were presented in the Climate Change Committee 2021 Report to Parliament, but monitoring site closures are threatening the sustainability of this simple indicator.

ID: 58

Richard Dallison (1), Sopan Patil (2)

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Future water availability for run-of-river hydropower in the UK and Ireland under climate change

The EXP-HYDRO model has been used to assess the impact of worst-case (RCP8.5) UKCP18 future climate change scenarios on streamflow in 585 UK and Irish catchments, to 2080. Within those catchments, 531 run-of-river hydropower abstractions have been identified. Mann-Kendall trend analysis has been used to quantify the impact of streamflow changes on abstraction characteristics, such as, number of days abstraction is possible and maximum abstraction is reached, and annual total abstraction. Nation-specific general abstraction licence variations have also been accounted for, allowing comparison.

ID: 77

Nick Everard(1), Mark Randall(2), Guy Schumann(3), Harry Dixon(4)

UK Centre for Ecology & Hydrology(1), Queensland Government(2), RSS Hydro(3), UK Centre for Ecology & Hydrology(4)

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What if we could measure streamflow from space...?

Streamflow is a critical hydrological parameter, but also one of the most difficult to measure. Traditionally, people are needed on site, along with expensive and sometimes complex equipment. But what if we could measure streamflow anywhere on the planet, with nobody on site? Or even in the same country? This presentation introduces the ESA sponsored and UKCEH led FluViSat project, which explores the potential of ultra hi-res satellite imagery for direct observations of surface velocity and hence determinations of streamflow.

ID: 97

Matt Fry

UK Centre for Ecology and Hydrology

A hydrological data commons for research

The proposed Flood and Drought Research Infrastructure will provide a digital research infrastructure for hydrology alongside new measurements from FDRI catchments. This digital infrastructure will address a number of areas where access to data is a limiting factor for research. FDRI will develop a hydrological data commons to deliver a wider range of high resolution UK hydrological monitoring data than has previously been accessible, coupled to cloud-based platforms for simple access and analysis of this data. The research community will be consulted on priority data for inclusion.

ID: 103

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Environment Agency (1), UK Centre for Ecology & Hydrology (2)

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Exploring the current and future user requirements for water quantity data

As part of the Natural Capital and Ecosystem Assessment (NCEA) programme, the Environment Agency and UKCEH sought the views of hydrometric data users on their current and future water quantity data requirements, in the context of the NCEA programme and a changing climate. The exercise has enabled the collection of a breadth and depth of information that can support follow-on activities to help meet data users' needs and inform the development of future hydrometric networks that are fit for purpose. In this talk we will present some key findings and resulting ideas for further work.

ID: 130

Dr Gareth Old

UK Centre for Ecology and hydrology

Floods and droughts research infrastructure (FDRI): enabling the hydrological research community

Observatory science has transformed understanding and driven innovation in hydrology. There is an urgent need for renewed investment in UK hydrological research infrastructure to provide the evidence to underpin our resilience to flood and drought events. Community requirements, identified through a UKRI-NERC funded scoping study, were used to inform a successful application for funding. Once implemented, FDRI will provide a digitally enabled UK-wide network of observatories (with fixed and mobile instruments), facilitating innovation and integrating the scientific community.

ID: 135

David Fadipe

Scottish Environment Protection Agency

Developing new pluvial flood maps for Scotland

Surface water flooding was identified as the largest flood risk facing Scotland in the 2018 National Flood Risk Assessment affecting approximately 210,000 homes & businesses. This is predicted to increase due to climate change. To enable communities to understand the hazard & develop resilience to flooding, requires the evidence base to be regularly updated for informed decision making & adaption planning. SEPA have partnered with JBA Consulting to develop new pluvial flood maps to account for the science & data changes that have occurred since current surface water flood maps were published in 2013. This session will cover the development process for the new maps including key methodology changes.

ID: 149

Dr Annie Ockelford

Environment Agency

Get HIP! - the EA's Flood Hydrology Improvements Programme (FHIP)

The UK flood hydrology roadmap sets out a vision for flood hydrology in the UK for the next 25 years. The six-year EA Flood Hydrology Improvements Programme (FHIP) aims to implement and deliver some of the actions of the roadmap. Here we will give details of the projects FHIP is currently delivering across the ways of working, data and methods strands which will serve to improve operational approaches and raise the profile and standards in flood hydrology. We will highlight the opportunities for the community to engage with the FHIP.

ID: 155

Dr Jonathan G Evans

UKCEH

COSMOS-UK: The National Soil Moisture Observation Network – Available Data and Applications

COSMOS-UK continuously measures soil moisture and meteorological variables across the UK, at 48 long-term locations, from 2013 ongoing. Research grade datasets are publicly available, focusing on large area (0.1 km2) soil moisture measurements using Cosmic Ray Neutron Sensors (CRNS), as well as point soil moisture measurements at various soil depths. Evapotranspiration is estimated as the residual of the land surface energy balance. The suite of data is an invaluable resource in testing and calibrating hydrological and land surface models, and example applications are shown.

ID: 181

Harley Dixey

Newcastle University

Investigating the effectiveness of image enhancement for improving tracer detection in LSPTV

Image enhancement techniques are often used in image velocimetry analysis to improve tracer detection. However, a lack of evidence exists as to the level of improvement these methods provide in Large-Scale Particle Tracking Velocimetry (LSPTV). Here we show that applying image enhancement techniques in KLT-IV increases tracer detection and, in selected cases, improves the accuracy of discharge estimates. Yet, careful selection of procedures is required to avoid introducing unwanted noise. These findings offer empirical guidance for selecting appropriate image enhancement techniques for LSPTV.

Session 8 Ecohydrology & water quality (Chairs: Clare Rowland, Sarah Halliday & Sayali Pawar; including Water Futures: surface water quality challenges in a changing climate; Ecohydrology and biogeochemistry open session; Use of UK Land Cover Map data for hydrological applications) 3:40-5:30 Mon 11 Sep Theme 4: Ecohydrology & water quality

ID: 2

Nadeem W. Shah

Forest Research

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The effects of land use, and particularly forestry, on aquatic carbon transport

There is considerable interest and debate on the amount, sources and pathways of carbon transport from terrestrial environments to surface waters and oceans, and how aquatic fluxes (DOC/DIC/POC) are affected by land-use including forestry. Here, we consider the sources and origin of DOC to surface waters, present data from studies investigating the effects of forestry on DOC transport and finish by introducing new research utilising in-situ monitoring and lab analysis to improve our understanding of the effects of land use on aquatic carbon transport.

ID: 29

Rosie Hampson

JBA Consulting

Hydrology for intertidal habitat restoration

Estuarine habitats are subject to pressures from coastal squeeze and industrialisation. In the Tees Estuary, for example, around 90% of saltmarsh has been lost since the 1860s. Visions to restore intertidal habitat must consider impact on both tidal and fluvial flood risk. This presentation will focus on the application of hydrology to hydraulic modelling as a tool for understanding such complex environmental problems and its role in estuary planning. Drivers for restoring intertidal habitat and potential barriers to implementation will be considered. Case studies from varied catchments will be presented; some rural and others very urbanised, some where flow direction is uncertain.

ID: 31

Tamsin Lockwood

University of Bristol / Natural England

The role and impact of Community Flood Groups for effective NFM management and maintenance

Strong collaboration and catchment-wide stakeholder interaction is widely associated as essential for NFM success. However, there is a lack of evidence to understand the requirements and impact of the management and maintenance conducted as a result of these relations. Here, the role and impact of a Community Flood Group for managing and maintaining an online water storage pond site in the Parrett catchment, SW-England was considered. An assessment of management tasks was made according to a series of success criteria to determine the applicability and feasibility of different tasks for sustaining pond function.

ID: 34

Dr James Miller

UKCEH

FEH and land cover map – improving and exploring new methods for estimating floods

The Flood Estimation Handbook relies on LCM products to derive catchment descriptors used in flood estimation methods for ungauged catchments. Both FARL and URBEXT have been updated using more recent LCM products. Methods and results of these updates at both local and national scale will be presented – alongside key differences to current descriptors. Initial results of recalibrating QMED will be covered. We also explore options for new catchment descriptors using new LCM data and other mapping products, including updates for FARL and the application of landscape metrics used in ecology.

ID: 44

Clare Rowland (1), Dan Morton (2), Chris Marston (3), Nye O'Neil (4)

UKCEH (1)

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An introduction to the UK Land Cover Map

In this presentation we provide a brief introduction to the UK Land Cover Maps for prospective users. The UK Land Cover Maps (LCM) are one of the UK's most widely used environmental data sets. The presentation covers a range of topics, including the land cover and land cover change data sets, data access, methods for using the data sets and plans for the future. The talk also briefly describes the methods underpinning LCM production and their impact on the data sets, as well as the ongoing development of methods for land cover change mapping.

ID: 57

Shaini Naha (1), Miriam Glendell (1) and Alena Bartosova (2)

(1)The James Hutton Institute, Aberdeen, Scotland, (2) Swedish Meteorological and Hydrological Institute, Sweden

Modelling climate change impacts on water quality at catchment scale using HYPE

Climate change is likely to increase the frequency of floods and droughts and impact river water quality. This is a growing concern globally including in 'water rich' countries like Scotland. Moreover, the latest future UKCP18 climate projections suggest a future trend towards warmer, wetter winters, and hotter, drier summers in Scotland. However, these future changes are likely to be varying spatially across the country. Thus, understanding these hydrologic and water quality impacts on a regional scale has crucial role in the management of water resources. In this study, we focus on a subcatchment in Tarland (70 km2) located in northeast Scotland, where water quality is of concern, primarily due to inputs of sediments and nutrients from agriculture. We employ a semi-distributed, continuous, process based HYdrological Predictions for the Environment (HYPE) model, in conjunction with the latest bias corrected data from the UKCP18 Regional (12km) climate ensembles, to predict historical and future, streamflow and water quality variables (nitrogen, phosphorus, suspended sediment). Our methodological approach also involves using an ensemble of calibrated HYPE models, representing the overall model uncertainty due to parameter value choices instead of using a single realization model to predict the responses. Specifically, we aim to predict the changes in both annual and seasonal, flows and water quality variables, and provide with a set of results on the likely future behaviour of Tarland subcatchment. Future projections of hydrologic and water quality variables, along with the associated model parameter uncertainties shall help with better hydrologic impact assessment and developing adaption strategies. Keywords: Climate change, UKCP18, HYPE, uncertainty

ID: 90

Karolina Krupska (1), Hannah Cloke (2), Linda Speight (3), Steve Robinson (4), Adam Gilbert (5)

University of Reading/Environment Agency (1) University of Reading (2) University of Oxford (3) University of Reading (4) Environment Agency (5)

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Forecasting of bathing waters quality in England – improving the present by looking ahead.

I would like to present a review on how we forecast bathing water quality in England and discuss challenges that need to be addressed before optimal framework in England can be realised. Rationale: Due to climate change, short duration rainfall resulting from rapidly developing convective systems is projected to be more frequent in the future, especially in the summer months, which form the core of bathing season. Such intense summer storms may lead to significant increases of faecal indicator organisms (FIOs) in bathing waters

representing major risks to human health. Water infrastructure has already been struggling to keep pace with changes to rainfall and a growing population causing an increase in water firms releasing unpermitted sewage discharges into rivers and watercourses. In addition, the Covid-19 pandemic has led to an increase in domestic holidays causing periodic overcrowding of British beaches and further strain on the sewage network. Although there have been advances in bathing water forecasting, the current approaches are unlikely to provide robust tools to support safe use of bathing waters in a changing climate with increased storminess and an already overstretched sewage infrastructure, and there is urgent need to review how we forecast bathing quality in England and around the world. Furthermore, after Brexit (31st January 2020) the UK's government agenda moved towards a nation resilient to climate change; healthy air, land and water; green growth and a sustainable future. Brexit has been seen as an opportunity to mitigate worsening impacts of climate emergency (HM Government, 2022). This creates a chance to make improvements in existing approaches applied for forecasting of bathing waters in the UK. In this review we discuss shortcomings in current UK's operational practice (focusing on England) and address the challenges ahead. Firstly, we discuss current scientific understanding of factors influencing bathing water quality and its complexity. Next, we explain the drivers behind the need for new bathing waters forecasting approaches in a changing climate. We review the current methods for bathing water forecasting, and highlight some weaknesses. We question, does operational practice reflect current understanding of the science and take the advantages of available forecasts. Finally, we discuss challenges that need to be addressed before optimal framework for bathing water forecasting in England can be realised.

ID: 98

Ben C Howard

University of Birmingham

Restoring the liver of the river: instream wood as a nature-based solution to nutrient pollution

The hyporheic zone (HZ) can function like the liver of the river by attenuating nutrients from mixing groundwater and surface water. We investigated the potential of (re)introducing instream wood to increase the capacity of the HZ to perform this filtering function, using microcosm and field experiments to study biogeochemical and hydrological mechanisms. Introducing wood increased microbial metabolic activity and transient storage, leading to increased nitrate removal and production of green-house gases. Introducing wood to streams could prove an effective restoration technique.

ID: 110

Muyeol Jung

Durham University, The Department of Geography

The impact of the construction of eight barrages on water quality and diatom assemblages in the Nakdong River, South Korea

The Nakdong River in South Korea has eight barrages constructed between 2010 and 2012 as part of the Four Major Rivers Restoration Project (FMRRP) implemented by the South Korean Government to enhance water quality and ecosystems in the river as well as to secure water resources throughout the year. Since its completion in 2012 April, the barrages have regulated the river flow. This study aims to investigate spatio-temporal changes in water quality and diatom assemblages in the Nakdong River and its tributaries from 2009 to 2018 in relation to the construction of the barrages. The statistical examination of the ten years of water quality data in the Nakdong catchment shows that the construction of the barrages has turned the main river into a reservoir-like water body and made an impact on water quality such as a sharp drop in Suspended Solids, a synchronised change in water temperature in the main river, increases in water temperature, chlorophyll-a concentration, and pH level, and an increase in COD (chemical oxygen demand). The result of clustering

analysis and indicator species on the ten years of diatom assemblages presents the dominance of diatom taxa which are easily found in the downstream of the main river into the up-, and midstream of the main river. These combined results indicate that the construction has significantly affected water quality and diatom assemblages in the Nakdong river by turning the river into having a homogeneous ecological environment with highly polluted water and the dominance of pollution tolerant diatom species which were only confined to the downstream before the construction. This study demonstrates the impact of the huge engineering work in the river in ten years of the timescale from a longitudinal perspective as the prime example.

ID: 177

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Cranfield University

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An overdue revisiting of sewage fungus: Hydrological, water quality and microbial controls on growth

Sewage fungus (SF) remains a persistent issue in UK rivers (over 6000 Environment Agency investigations were recorded from 2000-2020). With public and regulatory attention on river water quality, there is a pressing need to revisit our understanding of SF and controls on its growth. Two years of fieldwork was conducted on the River Crane (London) to determine how water quality and hydrology affect SF outbreaks. Genetic sequencing on riverbed biofilms has identified shifts in the microbial community from organic pollution (airport de-icers), offering a potential biosentinel for investigations.

Session 9 Next generation of land-surface and hydrological modelling (Chair: Simon Dadson) 09:00-10:20 Tue 13 Sep Theme 1: Future hydrology

ID: 187

Simon Dadson (1,2,3), Eleanor Blyth (1), Douglas Clark (1), Andrew Hughes (4), Jamie Hannaford (1), Bryan Lawrence (5), and Jan Polcher (6)

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Hydro-JULES: Next Generation Land-surface and Hydrological Predictions

The changing water cycle is central to humanity's imperative to mitigate and adapt to the impacts of environmental change in the 21st century. Outcomes from COP26 and the Paris Accord challenge scientists to improve our understanding of the water cycle's role in the Earth system, to quantify the risks and impacts of anthropogenic warming and environmental change on hydrological extremes, and to provide more precise estimates of hydro-meteorological hazards and the availability of water resources worldwide. In the United Kingdom, the National Flood Resilience Review and the Climate Change Committee's Independent Assessment of UK Climate Risk have stressed the importance of accurate assessments of current and future flood risk, and stimulated innovation to provide better predictions of floods across all time-scales. Moreover, the transition to Net Zero challenges the research and academic community to provide resilience of key demands robust, defensible, physically-consistent projections to support long-lived investment decisions economic and infrastructure assets to current and future water resources availability and extremes. The principal objective

of the Hydro-JULES programme is to create a three-dimensional model of the terrestrial water cycle for the research and academic community to study the impacts of future climate and land cover change on the water cycle. This model is designed to run as a standalone collection of components, each with well-defined modular interfaces, but also to be coupled with the Joint UK-Land Environment Simulator (JULES) which is the land-surface scheme at the heart of the Met Office Unified Modelling suite of tools, and which is therefore linked to the atmospheric and oceanic models and used as part of the UK's weather and climate prediction capability. The presentation will explore the scientific drivers for integrated land surface and hydrological modelling and outline the main elements of the structure of the work programme. We discuss the development of interfaces between components of the terrestrial water cycle to support integrated modelling of the water cycle and associated Earth system feedbacks, and describe recent developments including: (i) open-access community datasets for hydrological modelling available via EIDC; (ii) soil moisture data assimilation protocols to use in situ COSMOS data with state-of-the-art satellite Earth observations from NASA SMAP and ESA SMOS, ASCAT, and Sentinel sensors to improve soil moisture estimates over Great Britain; and (iii) a national groundwater model with geologically-derived supporting datasets"

ID: 17

Piotr Morawiecki (1) Philippe Trinh (2)

University of Bath (1)

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A mathematical framework for the unification of rainfall-runoff models

There are numerous models used to predict river flow, ranging from physically-based to data-based (conceptual and statistical). However, these models are often developed independently of one another. In our work, we show that theoretical foundations of physical models can be used to better understand the limits of applicability of other approaches. We develop simple benchmark scenarios and derive analytical scaling laws to describe the river flow. Comparisons across different models allows us to better understand theoretical limits of applicability of other approaches.

ID: 48

Keith Beven

Lancaster University

When might a model be considered as fit-for-purpose (or not)?

We would like to use models that are fit for a particular purpose in making predictions. Traditionally, models have been calibrated against historical data and then some sample of those calibrated models used in prediction. There has been very little consideration of epistemic uncertainties and how they might affect the way we assess models as hypotheses about how catchment systems work. We suggest that a more Popperian approach is required to assess when models should be considered as NOT fit for purpose. We consider this issue for the case of flood hydrograph simulation using Dynamic Topmodel, making use of a strategy of limits of acceptability for model simulations set prior to making model runs.

ID: 64

Michael Eastman (1) Katie Facer-Childs (2) Elizabeth Cooper (3) Jamie Hannaford (4)

UK Centre for Ecology & Hydrology (1; 2; 3; 4), Irish Climate and Research Units, Maynooth

University (4)

Assimilating observed flows to improve rainfall-runoff simulation

Producing accurate streamflow forecasts is dependent on estimating the current state of the system correctly. This presentation explores the potential for streamflow data assimilation (DA) to improve initial condition estimates for GR4J - a catchment water balance model used operationally in the UK Hydrological Outlook - and thus improve the quality of seasonal forecasts. We test various DA algorithms and modelling setups across a large and diverse range of catchments across the UK, and explore which methods work most effectively, and where and when they improve initial condition estimates.

ID: 102

John R. Wallbank (1), David Dufton (2), Ryan R. Neely III (2), Lindsay Bennett (2), Steven J. Cole (1) and Robert J. Moore (1)

UK Centre for Ecology & Hydrology (1), National Centre for Atmospheric Science (2)

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X-band radar precipitation estimates assessed using a hydrological model for mountainous catchments

Quantitative Precipitation Estimates - obtained from observation campaigns using the National Centre for Atmospheric Science's mobile X-band dual-polarisation Doppler weather radar (NXPol) in mountainous areas of Northern Scotland and Cumbria - are assessed with reference to observed river flows using Grid-to-Grid (G2G), a distributed hydrological model. The effectiveness of different steps in the X-band radar processing chain are examined, and the precipitation estimates compared to those from raingauges and the C-band radar network.

ID: 134

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National-Scale Physically-Based Hydrological Modelling with UKCP18 Climate Projections

A national-scale, physically-based, hydrological model (SHETRAN) has been developed to investigate hydrological impacts of the UKCP18 scenarios. The model has been developed in uncalibrated and auto-calibrated forms and enables us to directly link climate change projections, hydrological impacts, and mitigation strategies. Simulations are also coupled with cross-discipline models (e.g., UDM) via the DAFNI Facility. Initial results for Great Britain show decreased flows, with the south and east greatest affected, while instances of high flows (Q5) increase along the west coast.

ID: 148

Rhiannon Bryan

JBA Consulting

Grand Union Canal Strategic Resource Option Modelling

Water companies in England and Wales are currently investigating a wide range of potential ways to address the long-term challenge of providing resilient, sustainable sources of potable water in the face of the challenges of climate change, population growth and the need to reduce unsustainable abstractions. One of these Strategic Resource Options (SROs) under consideration is to use the Grand Union Canal to transfer treated effluent from Birmingham to the Affinity Water central supply area which forms a ring around the west and north of London. The project is being developed collaboratively by Affinity Water, Severn Trent Water and the Canal and River Trust. JBA Consulting have been commissioned to undertake hydrological,

hydraulic and water quality modelling of the transfer, along with hydrometric and topographic surveys of the canal and connected watercourses. The canal is a complex level driven system and depending upon the route selected, there are up to three summits over which water will need to be lifted, around 100 locks to be by-passed by pumping or by-weirs and channels, and inter-connections with sensitive rivers. For this project, a comprehensive modelling approach was designed and executed to model: water movement through the canal, hydraulic control aspects and water quality impacts on the canal and connected water courses of the entire canal system involved in the SRO. The sources of flow into the canal have been updated using hydrological (rainfall-runoff) models and input into water resource modelling software Aquator XV, which includes a specific canal pound and lock component developed for the purposes of simulating canal movement. We have used Aquator models initially developed by the Canal & River Trust as a starting point and worked to combine them into a single model to represent the whole scheme route. This represents inflows from gravity and pumped feeders into the canal network, as well as water losses and movement due to lock operations, leakage, and evaporation. The purpose of this model is to represent the canal with the inclusion of the Minworth effluent, the canal feeders, and the reservoir system, as well as the demands and exports from the system and to assess if, where and when the introduction of the SRO could lead to imbalances to the demands of the system. Canals have several hydraulic controls and levels at pounds trigger decision making. This cannot be simulated through the water resource modelling and a hydraulic model is developed Flows from the Aquator model form the flow boundaries into the hydraulic model, built in Flood Modeller Pro (FMP), which we are using to test the impacts of the transfer on water levels, the velocity at constrictions and overflows into rivers. The transfer flow will come from Severn Trent Water's Minworth wastewater treatment works, one of the UKs largest. The FMP Water Quality module is being used to test the impacts of the transfer on water quality along the lengths of the transfer route, helping to identify treatment permit levels that prevent deterioration and where possible improve water quality in the canal. This information can be fed back into the design of the additional treatment processes which will be required at Minworth to support a discharge into the canal. The models are being verified using an extensive hydrometric survey, also delivered by JBA, as well as historic flow and level data recorded by the Canal and Rivers Trust. Water quality monitoring is also being used to verify the water quality modelling.

Session 10 Risk estimation for droughts, including extreme droughts (Chairs: Jamie Hannaford, Rob Wilby & Geoff Darch) 09:00-10:20 Tues 13 Sep Theme 2: Floods & droughts

ID: 4

Mike Law

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Climate Change Adjustment of Long Time Series Rainfall

With greater recognition of the pressures on water resources and the value of wetlands, we need to understand how climate change will affect long rainfall and flows over longer periods, as we have been doing with flood event-base flood hydrology for many years. This presentation focuses on a simple and tool developed in New Zealand to generate climate adjusted rainfall time-series for use in water resource investigations and continuous simulation modelling. The tool does not require access to climate models and simulation, and so can be used by practitioners with limited time and resources

ID: 20

Amulya Chevuturi (1); Maliko Tanguy (1); Cecilia Svensson (1); Jamie Hannaford (1,2)

(1) UK Centre for Ecology & Hydrology (UKCEH), Maclean Building, Benson Lane, Wallingford, Oxfordshire, UK, (2) Irish Climate Analysis and Research UnitS (ICARUS), Maynooth University, Maynooth, Ireland

amuche@ceh.ac.uk

Drivers of extreme UK droughts

Our study aims at understanding drivers of extreme UK droughts and subsequently identifying its forecast predictors, which is essential for improving early warning systems and ascertaining water resource availability. We investigate the driving processes leading to northwest and southeast UK droughts by evaluating relationships between UK standardized precipitation index and global-scale climate variables (e.g., sea surface temperature) over a long study period of 1862—2015. Building upon our results, we will attempt to identify the teleconnection pathways between different oceanic regions and UK droughts to determine drought predictors, which could be applied to predictive models.

ID: 28

Adam Griffin

UKCEH

Generating widespread drought event sets for present and future using empirical copulas

One approach to risk analysis through CAT modelling is a scenario approach which uses a large event set to estimate risk. Often hydrological model runs are too limited in number to fully explore possible extreme drought events. Using the eFLaG dataset to identify a small set of widespread drought events and a novel empirical copula approach to statistically explore the rest of the possibility space, we can generate a much larger dataset of extreme, widespread drought events to observe changes in drought characteristics into the future.

ID: 40

Ali Rudd, Alison Kay, Rosie Lane, Vicky Bell (1)

UKCEH (1)

Hydrological drought characteristics at different levels of warming

Presentation of research into how hydrological drought characteristics might change in the future using the latest UKCP18 Climate Projections. The study was funded as part of the eFLaG project and provides information on the impacts of climate change at different levels of global warming which is being requested by policymakers and climate risk communicators. Such information is essential for adaptation planning as assessments move away from climate scenarios based on assumptions about future emissions of greenhouse gases.

ID: 53

Maliko Tanguy (1), Amulya Chevuturi (1), Ben P Marchant (2), Simon Parry (1), Jonathan D Mackay (2,3), Jamie Hannaford (1,4)

(1) UK Centre for Ecology and Hydrology, Wallingford, Oxfordshire, OX10 8BB, UK, (2) British Geological Survey, Keyworth, Nottingham, NG12 5GG, UK, (3) School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, B15 2TT, UK, (4) Irish Climate Analysis and Research UnitS (ICARUS), Maynooth University, Ireland

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How will climate change affect spatial coherence of droughts?

How climate change will affect spatial coherence of droughts is a key question that water managers must answer. Here, we use the new eFLaG future simulations of streamflows and groundwater levels for the UK to analyse the projected change in drought spatial coherence using joint probabilities of occurrence. Some key findings are: an increase in coherence in summer everywhere in the country; in winter, however, it will only increase in the South-East; and, in most regions, the coherence between groundwater and streamflow droughts will increase, one exception being the South-East in summer.

ID: 59

Ellie Willmott (1); Claire Tunaley (2)

Scottish Environment Protection Agency (SEPA) (1), Scottish Environment Protection Agency (SEPA) (2)

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Drought risk assessment tool – DRAT – hydrological data use in regulatory decision making

SEPA reports on water scarcity levels throughout the summer months to help inform water users of potential risks to supply. When the water scarcity level is significant SEPA can stop operators from abstracting. In 2018 the definition of significant water scarcity level was determined through obtaining ecological evidence. This approach was resource intensive and difficult to implement. In 2019 a hydrological trigger level of 30 days below Q95 was introduced via DRAT. This paper looks at the difference this has made to regulatory decision making between water scarcity events in 2018 and 2021.

ID: 68

Tom Beskeen

Mott MacDonald

Development of a rainfall-runoff model based drought forecasting tool applied in the Anglian region

This presentation outlines recent work with Anglian Water to implement a drought forecasting tool and dashboard that links GR6J rainfall-runoff models with near real-time HadUK observational data, 3-month meteorological forecasts and probabilistic scenarios. This work provides a hydrological risk-based approach to forecasting in order to provide benefits for drought planning and improve lead time for decision makers. Forecast performance has also been evaluated. An on-the-fly ability to adjust model states to reflect recent observed data has been tested using an Ensemble Kalman Filter (EnKF).

Session 11 How valuable is hydrology in flood warning systems? (Chair: Linda Speight) 10:50-11:50 Tues 13 Sep Theme 2: Floods & droughts

ID: 109

Charlie Pilling

Flood Forecasting Centre (Met Office)

Surface Water Flooding: Identifying and warning for extreme events now and in the future

Defra estimate that currently 3.2 million properties are at risk from surface water flooding in England alone. There is emerging evidence that the risk from surface water flooding is increasing, both the hazard (intense short period rainfall as our climate changes), and the exposure and vulnerability. Taking the flash flooding in London during summer 2021, we consider what improvements could be made to identify and warn for extreme events now and in the future.

ID: 114

Rob Millington (1), Paul Wass (2)

Canal & River Trust (1), JBA Consulting (2)

Rob.Millington@canalrivertrust.org.uk

Forecasting to support reservoir infrastructure repair and development

Reservoir civil engineering works are expensive and expose infrastructure to new risks. The Canal and & River Trust has worked with JBA to implement local, specific forecasting systems that provide real time simulations and alerts to operator's mobile devices. A system has been operational at Toddbrook Reservoir since March 2020 and forecasts at two further locations are being added to support ongoing reservoir engineering works. We describe how these systems have been rapidly developed, deployed and operated. We explore how they support operational management of the reservoirs and risk management in areas including water resources, reservoir safety and construction during maintenance or repair.

ID: 115

Paul Wass

JBA Consulting

paul.wass@jbaconsulting.com

Real time reservoir control on the River Lee using a forecasting system

Work will soon begin on a €150m flood alleviation scheme in Cork: Ireland's second city. Flood storage is needed to achieve the required standard. Storage will be created in two hydropower reservoirs on the River Lee, just upstream. Drawdown is triggered by the innovative forecasting system described in this paper. Four days prior to the event, reservoirs are lowered from a level optimum for hydropower generation to one that can manage the flood event. This is the first system in Ireland to attempt real time, 'rule-based', reservoir drawdown for flood alleviation.

ID: 137

Dr. Helen Griffith

University of Reading

The role of land surface in enhancing or suppressing Atmospheric River driven floods

Atmospheric Rivers (ARs) are intense regions of moisture flux in the lower regions of the atmosphere which when aligned with winter storms, can result in heavy or persistent rainfall (e.g., Storm Desmond in 2015, Ciara and Dennis in 2020 and Christoph in 2021). Previous work has suggested that the orientation of the landfalling AR relative to local catchment topography is an important factor in understanding the most impactful ARs (Griffith et al., 2020). In this work, we have analysed the influence of ARs upon the strongest (POT3) floods of the last 30-years along the western coastline of the UK (a total of 81 catchments), attempting to understand how the land-surface and/or catchment processes can either intensify or dampen the effects of an overhead AR. The results we hope will further the potential of ARs in modern day flood-forecasting.

Session 12 Trees, forestry and NFM and Co-producing a monitoring framework for evaluation of Nature-based Solutions for Flood Management (Chairs: Tom Nisbet and Paul Lunt) 10:50-11:50 Tues 13 Sep Theme 3: Natural flood management & partnership working

ID: 13

Dr Paul Lunt (1)

University of Plymouth (1)

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Benefits of partnership working to co-produce a county flood management monitoring strategy

The presentation will show case the benefits of a local Universities led partnership approach to monitor flood resilience interventions. Monitoring builds on partnerships with flood risk management authorities and community organisations in co-producing a shared monitoring framework. The framework includes research-led monitoring, contributing to national-level understanding and cost appropriate monitoring designed to engage local communities. Benefits of the partnership include access to specialist equipment and staff, quality insurance of data and student engagement with real word solutions.

30

Sarah Collins (1), Anne Verhoef (2), Majdi Mansour (1), David Macdonald (1)

(1) British Geological Survey, (2) University of Reading

Modelling the impact of land use change on floods and drought in a large, permeable catchment

It is thought tree planting and practices such as cover cropping increase soil water storage and infiltration through improved soil structure, potentially reducing flooding. We simulate what effect these land use and management changes have in the Upper Thames, which is characterised by permeable geology and arable farming. The land surface was modelled with the detailed, field-scale hydrological model SWAP, and baseflow with a semi-distributed groundwater model. We found that land use and management measures have limited potential for reducing flooding in permeable catchments.

ID: 140

Nisbet, T. (1); Broadmeadow, S. (2); Valatin, G. (3); Blyth, E. (4); Robinson, E. (5); Fitch, A. (6) and Jones, L. (7)

Forest Research (1), (2), (3); UK Centre for Ecology and Hydrology (4), (5), (6) and (7).

tom.nisbet@forestresearch.gov.uk

An evaluation of the flood regulation service of GB woodlands

We present a valuation of the flood regulation service of existing woodland to inform natural capital accounts. The JULES model was used to estimate the additional volume of flood water lost by storm day wet-canopy evaporation or stored belowground due to drier soils. Calculation of the woodland flood benefit was based on the replacement cost of constructing a flood storage reservoir. The natural capital value of the flood regulation service of GB woodland was estimated over 100 years at £24.5 billion (£7,790/ha) compared to bare soil and £11.6 billion (£3,676/ha) compared to managed grass.

ID: 143

Steve Birkinshaw

Newcastle University

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The effect of forest on river flows over a 55-year growth cycle in the Coalburn catchment

The Coalburn catchment (1.5 km2) in Kielder Forest is Britain's longest running forest hydrology research catchment, so provides a valuable NFM case study for effect of forests on reducing flood flows. Originally grassland, it was instrumented in 1967 and planted with Sitka spruce in 1972. The conifer trees are now mature and logging of 30% of the catchment has occurred with the rest planned over the next 10 years. The effect of the forest on annual streamflows and peak discharge flows over this entire 55-year growth cycle will be shown.

ID: 162

Thomas Myerscough

Wyre Rivers Trust

Wyre Catchment NFM - the development of the UK's first green investment NFM project

Since 2020 The Rivers Trust, Triodos Bank and the Wyre Rivers Trust have been collaborating with a range of partners to develop the the Wyre Catchment NFM project. A project that will see the delivery of 70Ha of NFM interventions and 39Ha of woodland creation in the Upper Wyre and Calder catchments, helping to alleviate flooding in Churchtown, which sits on the banks of the River Wyre near Garstang. The project will be funded by private investment, which is repaid by beneficiaries of the ecosystem services produced by the project. Land managers, farmers and land owners will be paid to host and maintain the interventions, initially for 9 years, with the potential for further extensions.

Session 13 Session 13: Future of the UK flood warning service – how best to expand & standardise approaches (Chair: Vicky Shackle) 1:15-2:25 Tues 13 Sep Theme 2: Floods & droughts

ID: 16

Neil Ryan

Environment Agency

Developing the future flood forecasting and warning service in England

Following on from the introduction of the new Incident Management Forecasting System, we are about to now undertake a large and ambitious programme of work to exploit the capabilities of the new system. This will include large-scale flood forecast model improvement and expansion and steps to improve model input data quality. We will also be developing and implementing new forecasting approaches and communication methods. The future forecasting service we will be developing, along with the new warning messaging system under development open opportunities for improvements and new says of communicating and warning of flooding as well as greatly improved real time data sharing.

35

Rob Lamb (1), Sean Longfield (2), Sue Manson (3), Hannah Cloke (4), Charlie Pilling (5), Nick Reynard (6), Owain Sheppard (7), Anita Asadullah (8), Mike Vaughan (9), Hayley Fowler (10), Keith Beven (11), Eoghan Daly (12), Richard Gosling (13)

JBA Trust and Lancaster University (1), Environment Agency (2), Environment Agency (3), Reading University (4), Flood Forecasting Centre (5), UKCEH (6), Natural Resources Wales (7), Environment Agency (8), Environment Agency (9), Newcastle University (10), Lancaster University (11), DfI Rivers (12), Scottish Environment Protection Agency (13)

The UK Flood Hydrology Roadmap: a 25-year plan of action.

A “roadmap” for UK flood hydrology over the next 25 years was published in March 2022 after a 47-month co-creation process involving more than 270 people and 50 organisations from different sectors and technical disciplines. It is a costed, long-term plan covering all facets of flood hydrology in the UK. We will explain the roadmap’s development, highlight key actions, and discuss funding and expected outcomes. We will place the roadmap in the context of wider initiatives in hydrological research and flood risk management innovation.

ID: 55

Jo Cullen, Helen Harfoot (1)

Environment Agency (1)

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The EA Flood Hydrology Improvements Programme’s pathway to reducing uncertainty in flood hydrology

Accurate hydrology is key to making sound flood risk decisions and yet the associated uncertainties can be high and are often overlooked. This has been evidenced through a literature review and 6 case studies in our recent project ‘The relative importance of hydrological uncertainties in the flood modelling chain’. The Flood Hydrology Improvements Programme will now focus on reducing uncertainty in our data and ensuring the next generation of flood estimation and forecasting models will deliver the outputs we need to facilitate effective communication with decision makers.

ID: 62

Paul Smith

Waternumbers Limited

Build your own flood forecasting system

With near-real-time data from national agencies and the ability of citizen scientists to collect their own observations, people have unprecedented opportunities to observe the evolution of flood hazards. But what if they want to forecast such events into the near future? The national flood forecasting system offers a centralised approach; but can this be democratised? This presentation demonstrates a framework using data-based mechanistic (DBM) modelling with open data and libre software which allows people to generate their own adaptive local forecasts for areas at risk in near-real-time. It is shown how this can be extended to a national system.

ID: 174 and 185

Lucile Verrot

SEPA

Evaluating operational flood forecasts and alerting systems: methods, challenges and opportunities

Flood forecasts are developed based on long-term hydrometeorological data. Once used operationally, evaluating the performance of the forecasts and the performance of the dissemination system poses great challenges. In fact, evidence of flooding and non-flooding is mostly based on public reports: it is geographically sparse, not systematic, and usually subjective and qualitative. We present the methodology currently in place at SEPA to evaluate the forecasts and the flood warning dissemination. Based on case-studies, we also explore its limitations and the possible ways to improve and standardize the process. Oral presentation

Session 14 Rainfall–streamflow modelling at ungauged sites for assisting with UK dam spillway flood safety assessments (Chair: Ian Littlewood) 1:15-2:25 Tues 13 Sep Theme 2: Floods & droughts

ID: 70

Ian Littlewood

IGL Environment

Unit Hydrographs and UK reservoir spillway flood hydrology

Based on parts of BHS Occasional Paper No. 15 “Unit Hydrographs and United Kingdom hydrology 1990-2020: IHACRES rainfall–streamflow modelling” the presentation examines aspects of current standard UH practice for estimating design flood hydrographs to assist with UK dam safety inspections.

ID: 101

Haxton, T. (1), Vesuviano, G. (2), Pucknell, S.(3) and Kjeldsen, T.R.(4)

WHS (1) (3), UKCEH (2), University of Bath (4)

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Exploring the estimation of the PMF using ReFH2

The current reservoir safety guidance recommends the use of the FSR/FEH rainfall-runoff model to estimate PMF (probable maximum flood) peak flows. This study utilises the assumptions made within the current PMF procedure and applies these within the ReFH2 rainfall-runoff model; the recommended model for estimating standard design events. Peak flows from the methodology are compared with those from the FSR/FEH model for 400+ catchments. The study highlights the potential for ReFH2 to be used as the single rainfall-runoff model for all return periods, up to and including probable maximum flood.

ID: 8

Dr Nick Mandeville

Water Resource Associates LLP

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Reversing the traditional sequence of the two main modules in quickflow rainfall-runoff models

The new gross hydrograph concept is the theoretical outflow hydrograph produced by a selected catchment, assuming a runoff percentage ROP of 100%. A possible pattern for the observed recessions is given as the product of the ROP value for the particular storm in which they occur, and the corresponding gross hydrograph ordinates. To reproduce these features of the observed recession curves, it is preferable to reverse the traditional sequence of the two main modules used in quickflow rainfall-runoff models, with the shape transformation module preceding the volume reduction one.

ID: 165

Amy Green

Newcastle University

PYRAMID: Platform for dYnamic, hyper-resolution, near-real time flood Risk AssessMent Integrating repurposed and novel Data sources

Traditional, new and hidden data sources are incorporated into cutting-edge hydrological and hydrodynamic physically-based models. Accessible, meaningful and timely dynamic flood information is provided, allowing for better flood preparation at a local level, better informing decision making. With stakeholder collaboration, a web-platform demonstrator is presented, for the city of Newcastle upon Tyne and the wider catchment, with near-real time updates, providing interactive visualisations and dynamic flood risk maps.

ID: 152

Andrew Black

University of Dundee

Rain gauge under-catch and catchment water balance in the mountainous hydrometric wilderness

Total precipitation in parts of the UK remains subject to considerable uncertainty, not least due to the effects of snowfall. A comparison of long-period mean annual runoff and official long-term SAAR fields leads to P-Q (precipitation minus runoff) values ranging from less than zero to more than 600 mm per annum for apparently similar mountainous catchments in Scotland. In this study, 7 years of TBR and monthly-read rainfall data from the Feshie catchment are used along with SEPA river flows and CHESS Penman PE data to examine the disparities between catchment inputs and outputs.

ID: 26

Duncan Faulkner (1), Kay Shelton (2), Jude Jeans (3), Tracey Haxton (4), Murray Dale (5), Thomas Kjeldsen (6), Sean Longfield (7), Tim Hunt (8), Clare Waller (9)

JBA Consulting (1,2,5), Wallingford HydroSolutions (3,4), University of Bath (6), Environment Agency (7,8,9)

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Options for improving probable maximum flood estimates for UK reservoir safety

The probable maximum precipitation and flood (PMP and PMF) are used for assessing reservoir safety under the Reservoirs Act (1975) for “Category A” reservoirs. Most aspects of their methods and data have not been updated since 1975. The Defra/EA R&D project “Improving PMP and PMF estimation for UK reservoir safety” Phase 1 study has assessed options for new methods based on latest research and data. The recommended options form a family of modules allowing for future enhancement and better alignment with UK flood frequency estimation methods.

Session 15 Innovative approaches for testing and understanding NFM & nature-based solutions (Chairs: Kate Heal, Leo Peskett, Josie Geris & Megan Klaar) 4:00-5:30 Tues 13 Sep Theme 3: Natural flood management & partnership working

ID: 87

Nick A Chappell, David Mindham, Gareth McShane (1), David Kennedy (2), Doug Coyle (3), Trevor Page, Keith Beven, Paul Smith, Ann Kretzschmar, Barry Hankin, John Quinton, Phil Haygarth, Rob Lamb (1)

Lancaster Environment Centre, Lancaster University, Lancaster LA1 4YQ (1), Environment Agency, Penrith, CA11 9BP (2) Cumbria County Council, Carlisle, CA6 4SJ (3)

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Cumbrian NFM effectiveness monitoring network

A network of standardised flumes and associated raingauges and live telemetry has been established in the Cumbrian mountains (with UKRI-NERC and Environment Agency funding). These flumes typically gauge up to 1 km2 stream catchments and have been installed to help evaluate the effectiveness of Natural Flood Management (NFM) features for reducing major flood peaks on these streams. Many of these micro-basins incorporate continuous monitoring of NFM features, and some are immediately above Communities@Risk. Within this presentation, we will highlight some of the learning about: (1) differences in natural flood behaviour at micro-basin scales (and so need for accurate distributed monitoring), (2) how observed feature time-series are linked directly to rainfall-streamflow data, and (3) how different NFM features behave during floods to inform design.

ID: 113

Chris Skinner (1), Josh Wolstenholme (2)

Environment Agency (1), Energy and Environment Institute, University of Hull (2)

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Modelling the efficacy of leaky dams using a Landscape Evolution Model

Most natural flood management numerical modelling is hydrological and focuses on flood risk without accounting for the evolving geomorphology of 'fixed' features such as leaky dams. The long-term effectiveness of NFM interventions requires an understanding of the nested hydrogeomorphological processes at work within catchments, particularly those related to bed scour, sediment transport and deposition, as well as the feedbacks following implementation of leaky dams. Using the NFM toolbox developed for CAESAR-Lisflood, different storm scenarios on a series of leaky are assessed.

ID: 118

Tim Howson

University of Manchester

The evolution of stone and timber dams, as part of peatland restoration, in eroded gully systems

500 small stone and timber dams were randomly sampled 8-9 years after installation in eroded blanket peat gully systems. Vegetation cover and abundance, sediment accumulation, and available water storage capacity were measured. On average, 92% and 93% of gully floors and 84% and 95% of gully walls were fully vegetated, while sediment depths were 21.1 and 20.3 cm, representing 42% and 43% infill, for stone and timber dams, respectively. 62% of dams had > 50% of static storage remaining, and only 2% had failed. Therefore, runoff attenuation functions were maintained for almost a decade.

ID: 125

Emma Shuttleworth (1), Martin Evans (2), Tim Allott (3), Martin Kay (4), Adam Johnston (5), Donald Edokpa (6), Tim Howson (7), Joe Rees (8), Joe Holden (9), Dave Milledge (10), Salim Goudarzi (11), Tom Spencer (12), Michael Pilkington (13)

The University of Manchester (1-8, 12), University of Leeds (9), Newcastle University (10, 11), Moors for the Future Partnership (12, 13)

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A ten-year trajectory of hydrological recovery in a restored blanket peatland: implications for NFM

Damaged peatlands lose their hydrological integrity, depressing water tables & exacerbating downstream flooding. Restoration can raise water tables & slow the flow of water. Recently, the focus of restoration has

shifted from stabilising eroding surfaces to reintroducing Sphagnum moss. We report the results of long-term post-restoration monitoring on the Kinder Plateau, UK. Peak flow & lag time show immediate step changes after revegetation due to increased surface roughness. Sphagnum planting provides further benefits. We also show that rewetting is not at odds with flow attenuation.

ID: 126

Tim Allott

University of Manchester

Peatland gully blocking and natural flood management: a micro-catchment study

Gully blocking is increasingly used as a restoration approach in degraded blanket peatlands. As part of the NERC PROTECT-NFM project we report on a before-after-control-intervention (BACI) experiment of different gully blocking interventions: impermeable peat dams, permeable cobble dams, and 'NFM optimised' peat dams with a restricted diameter bypass pipe. We present data on post -blocking hydrological and stormflow changes and discuss the implications for gully blocking as a natural flood management technique.

ID: 128

Salim Goudarzi

Newcastle University

Natural Flood Management through Peatland Restoration: Scenario Modelling in the Glossop catchment

Studies show that NFM interventions can have an impact at small (1 ha) scale but doubts remain about whether they remain effective at societally relevant scales. We couple numerical modelling and experimental data to simulate NFM impacts for 600 properties at risk of flooding in the 40 km2 Glossop catchment. Existing interventions (~5% of catchment area) have little impact (1-2%). Extreme but possible future interventions (30% of area) could reduce peak discharge by 10-20% for annual return period. Their effect is reduced with storm size but persists even for a 500 year storm.

ID: 129

Wouter Buytaert

Imperial College London

Innovation in hydrology: from low cost sensor prototypes to FDRI

Hydrology is still a very data scarce science, as both the density and quality of hydrological observations lag behind those of many other disciplines. This stresses the need to explore new technologies for hydrological sensing. Here, we present a case study of developing low-cost sensors for community-based flood early warning in remote mountain environments. We then discuss the challenges of upscaling such technologies from the laboratory to the field scale, and the potential of the upcoming Floods and Droughts Research Infrastructure (FDRI) to remove some of the major bottlenecks.es and in current national climate change adaptation policies.

ID: 146

Dr. Imogen Barnsley (1), Prof. David Sear (2), Prof. Justin Sheffield (3), Dr. Julian Leyland (4), Tim Sykes (5)

University of Southampton, Environment Agency & JBA Consulting (1), University of Southampton (2), University of Southampton (3), University of Southampton (4), Environment Agency (5).

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Testing the application of Natural Flood Management in a groundwater-dominated catchment and its resilience to future climate changes using the SHETRAN model.

The SHETRAN model was used to represent surface and sub-surface flood processes in a highly permeable chalk catchment. Natural Flood Management (NFM) scenarios were compared against a non-NFM baseline scenario to quantify the effect of NFM application using observed rainfall data and future projected rainfall under UKCP18 climate change scenarios. Results indicate that NFM has a limited flood reduction effect in this groundwater-dominated catchment due to the dominant flood mechanisms. Climate change rainfall scenarios led to conditions that overwhelmed the moderate flood reductions observed.

Session 16 Risk estimation for droughts, including extreme droughts (Chairs: Jamie Hannaford, Rob Wilby & Geoff Darch) 4:00-5:30 Tues 13 Sep Theme 2: Floods & droughts

ID: 72

Steven Wade

Atkins

Regional Climate Data Tools: Using stochastic data and UKCP18 to understand drought risks

This presentation will provide an overview of drought risks in England and Wales and how the regional water resources groups have made use of our stochastic weather generator and bias-corrected UKCP18 Regional Climate Models (RCM). The multi-site stochastic generator provides a significant step forward for drought risk assessment and climate modelling corrects significant bias in the Met Office RCM. We will discuss the rapid development of both tools and reflect on the lessons learned implementing these tools for hydrological modelling and regional water resources planning.

ID: 78

Simon Parry

UKCEH

The future of UK drought: Contrasting fortunes projected for low river flows and groundwater levels

This study capitalises on a newly-produced multi-model ensemble of future river flows and groundwater levels for the UK spanning 1981-2080 derived from the UKCP18 climate projections. Low river flows are projected to decrease in the majority of UK catchments and across all hydrological models. This is consistent with projections of low groundwater levels at boreholes in some aquifers, but a substantial number of boreholes show negligible change or moderate increases in low groundwater levels, suggesting future increases in streamflow drought may not necessarily follow for groundwater.

ID: 83

Wilson Chan (1), Ted Shepherd (2), Nigel Arnell (3), Geoff Darch (4), Katie Facer-Childs (5)

University of Reading (1), University of Reading (2), University of Reading (3), Anglian Water (4), UK Centre for Ecology and Hydrology (5)

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Current and future extreme UK droughts

Understanding extreme droughts is challenging given the short observational record, their multivariate nature and large internal climate variability. We use the EC-Earth time slice initialised large ensemble to drive GR6J hydrological models at UK catchments to quantify the chance of an unprecedented drought and understand the characteristics of extreme droughts in a future climate. Bottom-up" physical climate storylines are further used to understand how extreme droughts may develop given specific conditions (e.g. Dry spring-summers) and to stress test hydrological systems.

ID: 86

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UNSEEN approaches to generating extreme droughts for resilience planning

Water companies in England are now required to assess their resilience to 1 in 500 year droughts as part of their water resource management plans for the next 25 years. Quantifying such rare droughts is complicated by the length of available data and the changing climate. So far, stochastic weather generator methods have been the preferred approach. In this study, we show how the 'UNSEEN approach' can also be used to characterise extreme meteorological droughts that have yet to be observed across NW Europe but are, nonetheless, physically plausible now, and in the near future.

ID: 92

Lucy J Barker (1) Katie Facer-Childs (2) Kevin Collins (3) Jamie Hannaford (4)

UK Centre for Ecology & Hydrology (1) UK Centre for Ecology & Hydrology (2) Kevin Collins (3) UK Centre for Ecology & Hydrology, Irish Climate Analysis and Research UnitS (ICARUS), Maynooth University (4)

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Making sense of drought risk: current and future approaches to communications in England and Wales

Droughts have costly socio-economic and environmental impacts, even in the stereotypically wet UK. Societal expectations pose a challenge to communicating drought risk, in addition to issues around drought definition and management, and the (often) large spatial and long timescales of droughts. Between 2020-2021, UKCEH and the Open University RADAR (Reviewing Approaches for communicating Drought status And Risk) project worked with the providers and users of drought risk communications to review existing practices and recommend more effective current and future drought risk communication.

ID: 107

Robert J. Moore (1), Steven C. Wells (2), John R. Wallbank (3), Steven J. Cole (4)

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Recent developments of the PDM rainfall-runoff model for flood and drought management

The PDM rainfall-runoff model provides a toolkit of model functions to flexibly represent a range of catchment flow behaviours. Recent PDM developments are highlighted and challenges discussed. System advances include a modern user-interface supporting interactive model-building, and a semi-automated environment - for model structure-selection and calibration - enabling fast application to hundreds of catchments. Model extensions aim to improve the representation of catchments with mixed hydrological-response zones (e.g. urban and rural), or with inter-catchment water exchanges.

ID: 120

Gordon Aitken

Heriot-Watt University

Partitioning Model Uncertainty in Multi-model Ensemble River Flow Climate Change Projections

Droughts pose an increasing environmental and economic risk in the UK. The UKCP18 derived eFLaG dataset provides state-of-the-art river flow projections across the UK. A QE-ANOVA approach has been used to partition contributing sources of uncertainty for two flow quantiles (Q5 & Q95), at near and far future time scales, for each of the 200 UK eFLaG catchments. Results suggest a larger hydrological model uncertainty associated with low flows and greater regional climate model uncertainty for high flows and total uncertainty increasing from near to far future.

ID: 179

Sayali Kunal Pawar

University of Dundee

What does the future hold? Using Standardised Precipitation and Evapotranspiration Index (SPEI) to project drought in Scotland.

UN Sustainable Development Goal (SDG) 6.1 aims to achieve universal and equitable access to safe and affordable drinking water for all by 2030. However, even in a developed nation such as Scotland, climate change, and the water systems resilience to it, is putting achieving this goal at risk. Despite being abundantly blessed in terms of water resources, Scotland is facing an accelerated increase in the frequency of extreme weather events. The UK Climate Projections 2018 indicate that Scotland's climate will become warmer, with drier summers, and increased occurrence of drought events. Recent water scarcity events prove the surge and are evidence for the projected weather patterns. Unlike drought indicators which are parameters describing meteorological, hydrological, or agricultural drought conditions, like precipitation amounts, streamflow levels, and soil moisture information, drought indices derive value based on statistical calculations. One such meteorological drought index is the Standardised Precipitation and Evapotranspiration Index (SPEI) which is similar to the Standardised Precipitation Index (SPI). Unlike SPI, SPEI incorporates changes in evapotranspiration as it includes both precipitation and temperature as input data for calculation. Hence, SPEI makes a good choice for projecting future changes in a warming world and allows us to see the impact of climate change in inducing drought. Regional-scale analysis of SPEI across 36 sites using a 50 km grid generated drought scenarios for the longer term 2041-2080 using all 12 model members the UKCP18 dataset using 1981-2020 as the baseline period. These UKCP 18 projections were bias-corrected and downscaled to a 1km grid across Scotland before we acquired the data for analysis, thus enabling the calculation of SPEI at a finer scale. SPEI was then calculated at a 6-month timestep across the 36 sites in Scotland. The number of extreme drought months was computed for the baseline and the future periods. The drought month was defined as any month which has SPEI ≤ -2. After calculating the extreme drought months for baseline and future periods, the metrics from 1981-2020 were subtracted from the future period for each model member to demonstrate the amount of change in the number of drought months from the baseline period. Results were calculated separately for the individual member and not averaged to avoid incorporating uncertainty associated with projections. The majority of the sites across the spatial extent showed projected increases in the number of drought months for the future period for each of the model members. Sites in the southwest and western Scottish islands showed a greater increase compared to other sites where extreme drought months were observed with little or no change. Results highlighted the need for better preparedness for water scarcity situations which are going to be exacerbated by climate change.

Posters

Poster-board: 1 ID: 7

Dr Nick Mandeville

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Link to short oral summary of poster: https://vimeo.com/737963332/aefe673050

Patterns between different seasons' recession curves held on the UK National River Flow Archive

When plotted together on a log (flow) scale versus time, summer recession curves often bear an uncanny resemblance to winter, and other seasons', recession curves from the same catchment, but with a vertical displacement to a lower level on the plot. Symposium attendees are free to choose one of their favoured (quick-flow dominated) catchments, from the UK Benchmark Network shortlist of 146 near-natural catchments (UKBN_Station_List_vUKBN2.0_1). They will then be able to discuss this recession curve characteristic with the author, using plots downloaded from the NRFA databank.

Poster-board: 2 ID: 11

Ryan Jennings

JBA Consulting

Monitoring and modelling of leaky barriers on the River Bourne - Landwise NFM

Ryan Jennings (JBA consulting) and on behalf of Gabrielle Powell, a PhD researcher from the university of reading. We would like to talk about a pilot natural flood management (NFM) project partnered with Englefield Estate and Pang Valley Flood Forum in Berkshire. This is a collaborative project where knowledge is being co-produced. Through modelling and level monitoring we are evaluating the efficiency of leaky barriers for NFM. Our talk would cover the themes of 'land use and restoring nature' and 'working in partnership'. The key message we'd like the audience to take away is that the effectiveness of leaky barriers can be quantified in an effort to advance the evidence base for NFM. The project is part of the Landwise NFM programme. "

Poster-board: 3 ID: 15

Helen Hooker (1), Sarah L. Dance (1,2,3), David C. Mason (4), John Bevington (5), Kay Shelton (5)

(1) Department of Meteorology, University of Reading, (2) Department of Mathematics and Statistics, University of Reading, (3) National Centre for Earth Observation (NCEO), Reading, (4) Department of Geography and Environmental Science, University of Reading, (5) Jeremy Benn Associates Limited (JBA Consulting)

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Spatial scale evaluation of forecast flood inundation maps

Evaluating the accuracy of forecast flood maps is essential for model development and improving future flood predictions. Conventional binary verification measures typically provide a domain-averaged score of forecast skill. This score is dependent on the magnitude of the flood and the spatial scale of the flood map. A new, scale-selective approach is presented to evaluate the entire flood extent and the flood edge location of forecast flood maps against remotely observed flood extents. The methods are applied to a flood event in February 2020 of the River Wye and the River Lugg.

Poster-board: 4 ID: 18

Katie Muchan

Environment Agency

Updating the interim national guidance on non-stationary fluvial flood estimation for NRFA v10

In 2020, DEFRA published new tools and techniques to detect and take account of non-stationarity in flood frequency estimation (FCERM R&D project FRS18087). The study included analysis of eligible gauging stations from the NRFA v7 dataset. Conclusions were drawn about the extent and location of non-stationary flow timeseries. We present an update using 3 years extra data (NRFA v10). This includes the major floods in February 2020. Our analysis gives an updated national overview of the extent and location of non-stationary flow timeseries and shows the importance of using up-to-date flow data.

Poster-board: 6 ID: 21

Cyril Effiong, (1) David Hannah, (2) Fraser Sugden

School of Geography and Environmental Science, University of Birmingham, United Kingdom, (1) School of Geography and Environmental Science, University of Birmingham, United Kingdom, (2) School of Geography and Environmental Science, University of Birmingham, United Kingdom

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River Based Livelihood In a Changing Environment: A Case Study of the Niger River In Nigeria.

Climate change has direct and indirect impact on livelihoods of local community and this can have serious impact on the behaviour of local farmers and fishers. The changing climatic factor like temperature can affect how some crops thrive hitherto affect the behaviour of local communities especially those who depend on natural resource for livelihood. More so, adverse climate change affects the economic outcome of farmers and fishers, especially during flooding or drought; and this varies for different regions of the world. This research seeks to develop a methodology that spans both physical and human geography to examine how changing climatic factors affect the livelihoods of local communities on floodplains. A 30years secondary data on hydrology parameters will be sourced and simulated to examine the trend and pattern of flooding the study area. Furthermore, through a primary data will be collected to examine the coping strategies and vulnerability of farmers and fishers during extreme weather event. The project among other things will reveal how climate change contributes to the livelihood risk of farmers and fishers and their coping strategies put in place to limit vulnerability.

Poster-board: 7 ID: 22

Duncan Faulkner JBA Consulting

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Screening tool for dam safety in countries without established flood estimation procedures

Flood studies to assess dam safety can be expensive and complex, especially in parts of the world without established procedures for flood estimation. This poster presents a screening tool which assesses the capacity of a dam spillway using approximate hydrological and hydraulic methods. It automates the process of identifying a critical storm duration, accounting for the reservoir lag effect. Inputs can be either a catchment rainfall and loss rate or a peak inflow. Some easily-derived information on the catchment and reservoir is also needed.

Poster-board: 8 ID: 23

Duncan Faulkner

JBA Consulting

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Whatever happened to April showers?

April 2022 saw water butts being emptied across the land as gardeners kept their newly sown or planted seedlings supplied with moisture. It was the latest in a series of unusually dry Aprils across not just the UK but a large area of Europe. There is a significant downward trend in April rainfall at sites in the east and north of England and Northern Ireland. We explore reasons for this, links with larger-scale phenomena and implications for water resources, agriculture and gardeners.

Poster-board: 9 ID: 25

Duncan Faulkner (1), Clare Waller (2),

JBA Consulting (1), Environment Agency (2)

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The challenges of flood frequency estimation in groundwater-dominated catchments

Fluvial flood estimation in groundwater-dominated catchments is particularly challenging. Floods can arise from various combinations of processes including flash flooding, baseflow-dominated flooding and karst flooding. Runoff processes and even catchment areas can change dramatically between events. Annual maximum flows can be zero some years and occasionally enormous. FEH methods can struggle to represent these unusual features. A recent EA-commissioned review has identified a number of potential improvements and recommendations for flood estimation in groundwater-dominated catchments.

Poster-board: 10 ID: 27

James Molloy (1), Clare Waller (2), Kirstie Murphy (3)

JBA Consulting (1), Environment Agency (2), JBA Consulting (3)

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Sensitivity of Probable Maximum Flood to snowmelt method at Environment Agency reservoirs

The Probable Maximum Flood (PMF) is used for assessing reservoir safety under the Reservoirs Act (1975) for "Category A" reservoirs. The winter PMF estimate includes an allowance for snowmelt rates. Different methods are available to estimate the snowmelt rate. This project assessed the sensitivity of PMF estimates at Environment Agency reservoirs to snowmelt method. The results may help inform the wider reservoir community of practice about the potential impacts of snowmelt methodology on reservoir safety and provides evidence to support future improvements in snowmelt data and methods.

Poster-board: 11 ID: 32

Tamsin Lockwood

University of Bristol/ Natural England

Subsoiling as an agricultural management method for Natural Flood Management

Subsoiling is commonly used in agriculture to reduce local compaction issues. However, it's impact for flood risk is associated with high uncertainty. Here the impact of subsoiling for NFM was examined at five study sites in the Tone and Parrett catchments, comparing control with trial field sections. Through sampling and testing, physical and hydraulic soil datasets were produced to characterise these impacts according to soil organic

carbon, bulk density, and infiltration. Plot-scale infiltration, overland flow and sediment yield data were produced from a series of rainfall simulations.

Poster-board: 12 ID: 33

Sarah Collins

British Geological Survey

Can hydrochemical tracers better constrain the models we use to predict change with NFM?

Constraining hydrological model parameters with flow alone is notoriously difficult and we often end up with many hundreds (or even thousands) of acceptable models. We integrate a tracer model into Dynamic TOPMODEL and simulate the movement of stable isotopes through the Shiplaw catchment, a tributary of the Eddleston Water. We also compare the modelled contribution to streamflow from sub-surface and surface flow with estimated groundwater fraction from alkalinity data. The inclusion of the hydrochemistry data in model calibration results in more sensitive parameters and fewer acceptable models.

Poster-board: 13 ID: 36

Anthony Hammond

JBA

Conceptual rainfall runoff modelling to assess the impact of natural flood management solutions.

NFM has been implemented in the Shipston-on-Stour catchment. I calibrated hourly rainfall runoff models on each hydrological year of concurrently available precipitation and flow. I then ran each of these models with the full timeseries of rainfall and evapotranspiration and extracted the associated annual maximum series. I found the median annual maximum to be significantly lower (statistically) in the model calibrated on data since the NFM measures. This impact on the index flood was then applied to the standard FEH flood frequency

Poster-board: 14 ID: 39

Ali Rudd, Alison Kay, Matt Brown (3)

UKCEH (1)

How does rainfall temporal resolution affect estimates of future flood peak changes?

Estimates of how flood peaks may change in future are required for adaptation planning and the availability of a new hourly rainfall dataset provides an opportunity to test the robustness of our method for providing flood peak change estimates. We will present on whether hydrological models have been underestimating future flood changes due to climate change because of the temporal resolution of rainfall inputs used analysis methods to account for the NFM.

Poster-board: 15 41

David Pritchard

Newcastle University

A New Open Spatiotemporal Weather Generator

Stochastic weather generators have an important role to play in the management of hydrological extremes. Here we present a new Python package designed to improve the accessibility, usability and performance of a well-established weather generator. The package is based on an open-source spatiotemporal Neyman-Scott rainfall model and regression models for non-rainfall climate variables. It has been designed to simplify and speed up weather generator applications in UK catchments in both baseline and future climates.

Poster-board: 16 ID: 42

Clare Waller

Environment Agency

Machine learning potential in operational flood forecasting

The Environment Agency operates the production of fluvial flood forecasts and the issue of fluvial flood warnings for England. The local forecasting service uses local models relying on the Probability Distributed Model and FloodModellerPro set up over individual catchments. This research project explored the potential of machine learning long-short term memory (LTSM) models to complement the operational local models for flood forecasting. Overall, LTSMs captured flood peaks, timing and volume as well as the operational local models at the daily scale.

Poster-board: 17 ID: 50

Rosie Lane (1), Emma Robinson (2), Alison Kay (3), Matt Brown (4), Vicky Bell (5), Eleanor Blyth (6)

UK Centre for Ecology & Hydrology

Development of new PE datasets for the UK.

We discuss our latest developments related to potential evaporation data for the UK. First, we introduce Hydro-PE. This dataset provides historical and future gridded PE, developed using HadUK-Grid observational data and UKCP18 climate projections. Secondly, we discuss development of a PE dataset for real land-cover (as opposed to the commonly used short-grass PE) and the impact this could have for hydrological model simulations.

Poster-board: 18 ID: 51

Rosie Lane (1), Alison Kay (2)

UK Centre for Ecology & Hydrology

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Climate change impact on hydrological extremes across Great Britain

We modelled climate change impact on the magnitude and timing of extreme flows across GB. To model flow changes, we used an ensemble of climate projections from UKCP18 and the grid-to-grid national hydrological model. This contribution discusses the projected changes in 10-year return period low flows, high flows and combined hydrological-extremes by 2050-2080.

Poster-board: 19 ID: 52

Emily Trill (1), James Blake (2), Joanna Clark (3), John Robotham (4), Peter Scarlett (5), Ponnambalam Rameshwaran (6), Gareth Old (7)

UKCEH (1,2,4,5,6,7), University of Reading (3)

LANDWISE: evaluating the potential for land use and land management NFM

LANDWISE examines the NFM potential of land use and management in lowland catchments. We focussed on five soil types on two geologies; across agricultural land, grassland and woodland. We compared conventional and innovative farming systems and gathered empirical evidence of variation within and between fields. We show that near-surface soil properties and management is important for deeper soil water storage. We show that land use, management and organic matter content are significant in affecting soil properties and increasing NFM potential.

Poster-board: 20 ID: 54

Xiaobin Qiu(1), Hayley J. Fowler(2), David Pritchard(3)

School of Engineering, Newcastle University(1)

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Quality control of the gridded blended gauge-radar-satellite hourly precipitation dataset (UKGrsHP)

Gridded precipitation datasets are widely used in flood risk research and quality control is extremely important prior to their application. However, current approaches to quality control are limited or unable to resolve complicated quality issues (such as radar beam blockage, ground clutter effects, etc.). Here, we use the Maximum Difference Method (based on Tobler's first law of geography and variogram theory) and the Robust Score Method (based on robust statistics) to identify artefacts in an hourly blended precipitation dataset (UKGrsHP) for the UK. These methods make use of the spatial relation between local and neighboring pixels to identify and remove erroneous pixels. Preliminary results indicate that, in seven selected hourly rainfall data time steps, they can capture more than 75% of artefacts (rainfall > 150mm) caused by errors in radar or satellite.

Poster-board: 21 ID: 60

Shaini Naha(1), Kit Macleod(1), Zisis Gagkas(1) and Miriam Glendell(1)

(1)The James Hutton Institute, Aberdeen, Scotland, UK

Understanding the vulnerabilities of Scotland's water resources to drought

Water scarcity and droughts are an increasingly frequent phenomenon, even at assumed water-rich latitudes, including Scotland, which will likely lead to a broad range of adverse impacts on water resources and water quality. This presentation is about recent started project, funded by the Scottish Government's Strategic Research Program 2022-2027, that aims to advance the understanding of droughts and future vulnerabilities of Scotland's freshwater resources for relevant sectors/receptors. Currently, we are reviewing existing modelling approaches, datasets, and national and catchment level studies of changes in flow paths, groundwater storage and freshwater vulnerabilities to ascertain what information is available on when and where water scarcity and drought may occur in Scotland. We are working with water management and policy stakeholders to assess what methods are available for water scarcity and drought prediction, building on existing datasets, models, extreme scenarios and their likelihood of occurrence, thresholds and meteorological, soil, and hydrological drought indices. We will employ open-source hydrological models for specific catchment scale sector-based case-studies. The case studies will ensure transferability/scalability of our modelling approach from local to national scales that would help us in building a free and open-source integrated drought risk modelling approach for meteorological, soil moisture, and hydrological drought at national scale. Stakeholder engagement with regulators (SEPA, Scottish Water, NatureScot) and industry (agriculture, freshwater fisheries, whisky) will play an important role in developing this integrated modelling approach. Finally, we will develop a trans-disciplinary, probabilistic Decision Support Tool based on Bayesian Belief Networks, to model the complex drivers of drought including the cascading and multi-sectoral effects, enabling more efficient decision-making at catchment and local scales. This work will address several research questions including; what are the specific impacts of droughts; what are the vulnerabilities that may apply to Scotland; how we can mitigate and adapt to water scarcity; how we can reduce water abstraction, specifically reduce water use in agriculture. Keywords: Drought, freshwater vulnerabilities, hydrological modelling, climatic projections, Bayesian Belief Networks, water scarcity"

Poster-board: 22 ID: 65

Marta Ponti

University of Strathclyde

A framework to assess the impact of flooding on the release of microplastics from waste management facilities

The impact of flood on waste management facilities can induce the release of micro pollutants to freshwater systems with concerning impacts on the marine environment, agricultural ecosystems, and human health. Almost 30% of the total waste managed in the UK in 2019 was characterised by Microplastic Releasers (MPRs): plastic waste, synthetic textile, rubber waste, and mix/undifferentiated materials that are able to or contain items that can deteriorate and fragment into micro components. In recent years, the management of solid waste and its contribution to flood-driven microplastic pollution has been limited with a focus on plastic waste mismanagement specifically, and the assessment of the risk is long overdue. We present a new methodology combining publicly available data on waste with pluvial and fluvial flood extent maps. The methodology was applied to the UK where the impact of pluvial flood on waste management facilities shows a 3-fold increment between 20 and 50-year return period in waste at risk of releasing microplastics during inundation resulting in almost 5 million tonnes per day. The methodology was applied to the UK where the impact of pluvial flood on waste management facilities shows a 3-fold increment between 20 and 50-year return period resulting in almost 5 million tonnes of waste per day at risk of releasing microplastics during inundation. We conclude that further studies at the local scale are necessary to establish site-specific mitigation measures and containment systems able to decrease the flood-induced microplastic mobilisation from waste management facilities.

Poster-board: 23 ID: 73

Susana Almeida (1), Neil Upton (2), Steven Wade (1), Sam Leader (1), Rob Tothill (1)

Atkins (1), United Utilities (2)

Projected future flows for the North-West of England

This study presents hydrological projections for the North West of England, based on the latest UK Climate Projections (UKCP18). The assessment of the impact of these projections on flow is performed by using climate factors representing the changes to the climate for the 2070s, and applying them to perturb the historical climate data for the 1981-2000 baseline reference period. The hydrological models were used to simulate flow in the future period with the perturbed historical data for 24 United Utilities catchments, using existing Catchmod and GR6J models.

Poster-board: 24 ID: 74

Lauren Petch

Atkins

Stochastic weather generation for water resources and drought modelling

To ensure a resilient supply, water companies must test their systems against a range of weather events. Stochastically generated datasets allow companies to model a variety of scenarios above and beyond the historic record as well as estimate comparative risk probabilities. This study presents the stochastic weather generation model used to generate regional rainfall and PET data for water companies in England and Wales. The model uses historical teleconnection and weather data to produce hundreds of spatially coherent stochastic scenarios.

Poster-board: 25 ID: 75

Samantha Leader

Atkins

Regional Climate Data Tools in Industry: comparisons between UKCP18 and stochastic droughts

Water companies in England and Wales incorporate climate change into their long term plans to ensure that they are resilient to severe droughts under baseline and future climate scenarios. Water companies use the Regional Climate Data Tools products for their long term planning: (i) A stochastic weather generator for drought risk assessment and (ii) future climate change scenarios based on Met Office UKCP18 products. This study presents comparative analysis between products, providing insights into the strengths and weaknesses for national, regional and Water Resource Zone scale planning.

Poster-board: 26 ID: 84

Mason Durant (1), Chris Counsell (2), Fai Fung (3), Rob Wilby (4)

HR Wallingford (1), HR Wallingford (2), Met Office / University of Bristol (3), Loughborough University (4)

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Peer reviewed publications overlook novel thinking: the role of grey literature in systematic review

Previous systematic reviews have tended to neglect what happens to methods when they are applied in practice, focussing instead on easier to obtain academic literature. This makes understanding how methods are implemented in practice impossible and misses the opportunity to improve understanding of practitioner context. This poster outlines a review methodology that includes grey literature, applied to water resource planning in the UK, aiming to understand how climate change information is implemented within water resource assessments for long term planning.

Poster-board: 27 ID: 88

Gerbren Haaksma (1) Dr Namrata Bhattacharya Mis (2) Dr Servel Miller (3)

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Link to short oral summary of poster: https://youtu.be/v2H0b_zFckI

SMART Monitoring for evidence based NFM in Slaithwaite-Kirklees

The Metropolitan Borough of Kirklees is a beautiful, hilly area of West Yorkshire. Many of its towns and villages are located in valleys and are at risk of flooding as the rivers and tributaries fill up with runoff rainwater from the surrounding hills. Kirklees Council is looking to install natural flood barriers to manage the flow of water before it runs into the valleys. Andel together with Probado, Chester University, Leeds Coppice Workers and Kirklees Council have developed a pilot project to monitor rainfall, water levels and soil moisture to determine the impact of NFM interventions.

Poster-board: 28 ID: 89

David Mindham

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Quantification of runoff response in NFM micro-basins - using time constants to compare runoff responses in both time and space

A simple method for estimating the time constant of individual rainfall-runoff events is used to investigate the range of behaviours for several gauged micro-basins, with the aim to inform on the appropriateness and effectiveness of Natural Flood Management (NFM) features. It is shown that each micro-basin has a wide

range of responses, characterised by differing time constants, and that all the micro-basins have different distributions of time constants, even the basins with perceived similarities. This indicates the need for stream monitoring prior to any NFM feature installation. In addition, a threshold antecedent condition has been observed and objectively identified, which denotes when runoff response begins to stabilise. This then allows for better comparison across micro-basins, linking physical characteristics of the basins to the stabilised responses.

Poster-board: 29 ID: 93

John Robotham (1); Emily Trill (2); James Bishop (3); Gareth Old (4); Ponnambalam Rameshwaran (5); David Sear (6)

UK Centre for Ecology & Hydrology (1-5); University of Southampton (6)

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Monitoring NFM in the Evenlode Catchment: Evidence on the delivery of multiple benefits

The Littlestock Brook NFM pilot scheme in the Evenlode Catchment was established in 2017/2018 as a catchment-based approach to alleviate flood risk to the downstream community whilst also delivering benefits for water quality. Hydrological monitoring at multiple scales has allowed us to investigate the efficacy of offline storage features and pond interventions for both flood attenuation and diffuse pollution mitigation. We present findings on the cumulative effect of these interventions to reduce downstream flood peaks and to intercept and store fine sediment and nutrients.

Poster-board: 30 ID: 94

I-Hsien Porter

JBA Consulting

Hydrological Priorities and Network Appraisal

The EA's Flood Hydrology Improvements Programme (FHIP) will drive improvements in data, tools and understanding to better manage future flood risk. This project will prioritise hydrological processes associated with flood risk, now and in the future, to enable targeted investment. It will evaluate where understanding can be improved due to (1) gaps in hydrological processes knowledge (methods appraisal) or (2) lack of data to quantify them (network appraisal). As the project commences, this poster will outline the aims of the study, our proposed approach, and how it will contribute to the FHIP.

Poster-board: 31 ID: 96

Alannah Killeen

UK Centre for Ecology & Hydrology (UKCEH)

National River Flow Archive (NRFA) and National Hydrological Monitoring Programme (NHMP): Recent Developments

The National River Flow Archive (NRFA) and the National Hydrological Monitoring Programme (NHMP) have had several recent updates, improving data availability and ensuring users have access to high quality data. Version 11 of the Peak Flow Dataset will be released in early September to the NRFA website, allowing users to input updated peak flow data into flood risk estimation software. The NHMP aids interpretation of the hydrological status and a new feature of the Hydrological Summary is the inclusion of COSMOS-UK, providing new state of the art field scale soil moisture data. The poster will summarise these developments and others, appraising the benefits they provide to the NRFA and NHMP resources."

Poster-board: 32 ID: 99

Eleanor Pearson

JBA Consulting

Innovative nested modelling of Natural Flood Management and large traditional storage in the Ouse

The York Flood and Coastal Resilience Innovation Programme (FCRIP) seeks to use a novel nested modelling approach to investigate flood risk across three different scales. The flood forecasting model for York will be used to identify opportunities for large traditional storage. A broadscale catchment hybrid Dynamic TOPMODEL–JFlow model of the Swale, Ure, Nidd and Ouse will enable physical process representation of both hillslope hydrology and fluvial hydraulics. A micro-catchment hybrid Dynamic TOPMODEL–JFlow model will assess small community flood risk at the highest resolution.

Poster-board: 33 ID: 100

Eleanor Pearson

JBA Consulting

Model-led design of Natural Flood Management measures increases their efficacy

The NERC LANDWISE NFM research project has highlighted the potential for increased NFM benefit within the small watersheds upstream of populations at risk. A range of runoff management features have been tested on the small clay based catchment above the vulnerable villages of Swallowfield and Riseley through community-led and model-led design approaches to reduce surface water flood risk, as experienced in the July 2007 flood event. This model-led design scenario increased peak flow reductions in some places to greater than 10%.

Poster-board: 34 ID: 104

Ryan Jennings

JBA Consulting

Quantifying Runoff Attenuation Feature (RAF) performance through detailed drone DEM survey.

The Paddock Farm RAF has been constructed by excavating a grassland field to provide surface water runoff storage for local properties at risk. 1m EA LiDAR data was available (pre-RAF construction) to help quantify the RAF flood attenuation benefit through hydraulic modelling. A high resolution topographic DEM drone survey was undertaken at a range of resolutions to less than 20mm across the site which could be directly added to the hydraulic model. This, combined with a site visit examination, showed that the RAF could reduce the peak flow by up to 80% for the 200-year return period event.

Poster-board: 35 ID: 105

Eugene Magee (1) Michael Eastman (2) Matt Fry (3) Doran Khamis (4) Gordon Blair (5)

UK Centre for Ecology & Hydrology (1) (2) (3) (4) (5)

Defining functional river reaches through spatially constrained clustering

Despite being a fundamental element of hydrology, no single definition of river reach is agreed upon. The Environment Agency's River Habitat Survey subdivides networks into 500m lengths of river channel, whereas the UKCEH Digital River Network divides catchments according to confluences. This research demonstrates the potential of a spatially constrained clustering algorithm for defining river reaches according to their function, with a case study exploring its application to water quality data.

Poster-board: 36 ID: 106

Jessica Webb

Mott MacDonald

Assessing the use of ponds to deliver multiple benefits in a medium-sized, lowland catchment

The lowland Alconbury Brook catchment has an extensive history of flooding. The Environment Agency has launched the NFM Pilot Project to assess the efficacy of NFM in the catchment. The Project has currently installed sediment traps, trees and ponds. The study employed bespoke mapping and modelling to determine optimum locations of ponds to deliver multiple benefits. Results showed that siting ponds along the Mile Brook and Alconbury Brook tributaries could deliver flood risk reduction, water quality benefits and increased engagement with landowners to promote nature recovery in the catchment.

Poster-board: 37 ID: 119

Joshua Little

Cardiff University

Development and validation of a method quantifying engineered logjams using a common physical metric

Engineered logjams in headwater streams are commonly used to improve flood defense and aid in climate change adaptation, but quantifying the flow through the logjams remains difficult. This paper gives best practices for measuring discharge in small streams using the current meter and float methods. Cross-sections of time average longitudinal velocity in flume experiments were compared to current meter and float method observations to determine the suitability of each method. Field observations of discharge and water depth are obtained in order to quantify jams using a common physical metric.

Poster-board: 38 ID: 122

Gemma Coxon (1), John Bloomfield (2), Wouter Buytaert (3), Nick Everard (4), Matt Fry (4), Gareth Old (4), Gwyn Rees (4), Thorsten Wagener (5)

Geographical Sciences, University of Bristol (1), British Geological Survey (2), Imperial College London (3), UK Centre for Ecology & Hydrology (4), University of Potsdam (5)

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Lessons learned from catchment observatory and network design in the UK, Europe and North-America

The number of catchment observatories is growing but there is little guidance on synthesising data and insights across catchment observatories to produce process based understanding. We collate information from 85 catchment observatories and conduct 21 questionnaires to review the strengths, weaknesses and lessons learned from catchment observatories and networks. We recommend that catchment observatory networks are community-led, flexible and extensible, with co-ordinated digital infrastructure to enable transferability of new insights and understanding.

Poster-board: 39 ID: 123

Geoff Darch (1), Nele Reyniers (2), Nans Addor (3), Timothy Osborn (4)

Anglian Water Ltd. (1), Climatic Research Unit, University of East Anglia (2), Fathom (3), Climatic Research Unit, University of East Anglia (4)

Model evaluation approaches for constraining uncertainty in projected drought changes.

Projections of future drought risk typically involve a cascade of modelling, postprocessing and analysis decisions, each of which introduce uncertainty. Using regional climate model projections for GB and a modular framework for hydrological modelling, we investigate the contribution of some of these decisions to the total uncertainty in the resulting projections of changes in different drought characteristics. In addition, we test and compare the potential of model performance- and robustness-based approaches to constrain this uncertainty.

Poster-board: 40 ID: 124

Donna Wilson (1), Katie Muchan (2), Clare Waller (3), Tracey Ashworth (4), Sarah Marseglia (5) Bethan Flynn (6), Environment Agency (1-6)

FloodHydrology@environment-agency.gov.uk

Flood event analysis for the Mersey, Severn and Derbyshire Derwent catchments (February 2022)

The Environment Agency undertakes flood event analysis to support communications and post-event reviews. In February 2022 there was a succession of three storms – Dudley, Eunice and Franklin which brought persistent rainfall to large parts of the UK, resulting in high ranking flood levels being recorded in the Mersey, Severn and Derbyshire Derwent catchments. This reporting summarises these events and considers the cause of high levels such as rainfall extremity, antecedent conditions, reservoir levels, co-incident timing of peaks and non-stationarity.

Poster-board: 41 ID: 127

Jessica Webb

Mott MacDonald

Assessing the use of ponds to deliver multiple benefits in a medium-sized, lowland catchment

The lowland Alconbury Brook catchment has an extensive history of flooding. The Environment Agency has installed sediment traps, trees and ponds as part of a NFM pilot study. This poster demonstrates the targeted use of a simplified runoff attenuation routing model to identify target sub-catchments for ponds to deliver multiple benefits flood risk and water quality. Results showed that siting ponds in the mid and upper sub-catchments could deliver flood risk reduction, water quality benefits and increased engagement with landowners to promote nature recovery in the catchment.

Poster-board: 42 ID: 133

Georgios Sarailidis '(1)', Francesca Pianosi '(2)', Thorsten Wagener '(3)', Rob Lamb '(4)', Kirsty Styles '(5)', Stephen Hutchings '(6)'

Water and Environmental Engineering, Department of Civil Engineering, University of Bristol, Bristol, United Kingdom '(1)', '(2)' Institute of Environmental Science and Geography, University of Potsdam, Potsdam, Germany '(3)' JBA Trust, UK '(4)' JBA Risk Management, UK '(5)', '(6)' Lancaster Environment Centre, Lancaster University, UK '(4)'

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Linking the relative importance of input uncertainties of a flood risk model with basin characteristics.

Flood risk models contain numerous uncertainties, and past (catchment-scale) studies yield conflicting results as to which are the dominant ones. In this project, we investigate dominant uncertainties at a larger scale, namely, the Rhine River basin which shows great physical and socio-economic variability. Our goal is to identify spatial patterns of dominant input uncertainties and link them to local characteristics, e.g. physical, socio-economic. Hence, we use JBA's flood risk model which is capable of simulating risk across such a large region.

Poster-board: 43 ID: 136

Joshua Little

Cardiff University

Development and validation of a method quantifying engineered logjams using a common physical metric

Engineered logjams in headwater streams are commonly used to improve flood defense and aid in climate change adaptation, but quantifying the flow through the logjams remains difficult. This paper gives best practices for measuring discharge in small streams using the current meter and float methods. Cross-sections of time average longitudinal velocity in flume experiments were compared to current meter and float method observations to determine the suitability of each method. Field observations of discharge and water depth are obtained in order to quantify jams using a common physical metric.

Poster-board: 44 ID: 138

Dr. Helen Griffith

University of Reading

Building Storylines of Future Catchment Hydrology

A storyline is defined as a physically self-consistent unfolding of past events or of plausible possible futures (Shepherd et al. 2017). It has advantages in effective risk communication and adaption, as it moves the emphasis away from probability across to plausibility (Butler et al. 2020; Simpson et al. 2021). Working as part of the EvoFlood (quantifying the Evolution of Flood hazard and risk across a changing world) project, this work presents a novel methodology for estimating future floods based on not only climatic drivers, but the wider impacts of dams, river regulation and changing land-use. Grounded in historical events, future storylines are developed according to 'best', 'most-likely' and 'worst' case future scenarios, within the context of nine globally important catchments: Amazon, Brahmaputra, Mississippi, Congo, Nile, Rhine, Volga, Mekong and Yangtze.

Poster-board: 45 ID: 139

Josh Thompson

Loughborough University

Climate gentrification: Valuing perceived risks in property prices

There is growing evidence that physical climate hazards, such as floods and wildfires, affect property prices. This is leading to a process of climate gentrification (CG) where there is greater demand for properties possessing climate resilient traits. I will present a new working definition of CG that captures links between physical climate hazards, perceptions of risk and resilience, and capital flows in property markets. I will present key drivers of CG and an empirical case study of property data for a flood prone UK city to show how climate gentrification suppresses house price growth.

Poster-board: 46 ID: 145

Stephen Addy (1), Mark E. Wilkinson (2)

The James Hutton Institute (1) (2)

stephen.addy@hutton.ac.uk

Assessing the geomorphic and peak flow lag time responses to leaky barriers in an upland stream. A three-year case study

Over three years, a short reach of the Elm Sike (catchment area 0.33 km2), a steep headwater tributary of the Bowmont Water in the Scottish Borders, containing sixteen leaky wooden barriers (LWBs) was monitored. Annual topographical surveys were conducted to assess geomorphic changes and continuous 5-minute water levels were recorded over an upstream control and downstream response reach to assess changes in peak flow lag times. Initial findings suggest the sediment capture and flood peak delay effectiveness of the structures was limited. Recommendations on future design are made.

Poster-board: 47 ID: 147

Jae hun Shin

Cranfield University, School of Water, Energy and Environment

Climatic Influences on Spatio-Temporal Variation of Suspended Sediment Dynamics in Rivers

Climate change is impacting precipitation and temperature regimes, but more research is needed on its impacts on suspended sediment concentration (SSC) dynamics in rivers. In this project, SSC records from 120 sites in the contiguous US were analysed, by season and annually, using geographically weighted regression (GWR) based on 7 indicators. Analysing the spatially different GWR coefficients, the key findings are the identification of spatial patterns in SSC indicators that align with climate patterns e.g., ecoregions and variable importance of catchment characteristics across the continent.

Poster-board: 48 ID: 151

Elizabeth Follett (1), Valentine Muhawenimana (2), Ian Maddock (3), Catherine Wilson (4)

Hydro-environmental Research Centre, School of Engineering, Cardiff University (1, 2, 4), School of Science and the Environment, University of Worcester (3)

Instream dynamics of leaky barriers used in natural flood management

Hydrological, hydraulic and high resolution bed morphology data were examined along a 5.36 km reach of Wilde Brook, Shropshire, UK to assess leaky barrier instream dynamics. Leaky barriers caused backwater rise and localised overbank flows depending on storm magnitude, barrier and channel properties. Magnitude of barrier-generated backwater rise was observed to both increase and decrease following storms, linked to barrier accretion and depletion. Net volume hydrographs showed that barriers successfully created a rapid rising limb filling behind barriers and slower falling limb water release.

Poster-board: 49 ID: 153

Andrew Black

University of Dundee

Baseflow and hydrograph comparisons in a data-sparse mountainous rewilding catchment

Rewilding projects are being undertaken across the UK at a range of scales, but rarely at such a large scale as in the 230 km2 Feshie catchment in Scotland. The landowner is working towards restoring ecological potential, but the restoration of a largely absent forest cover offers potential to change annual water loss and runoff response. This paper presents the results of 1 year of monitoring of two contrasting headwater 30 km2 catchments each above 500 m OD, comparing median empirical hydrographs with tracer results and predictions from BFIHOST. Implications for flood risk are reviewed.

Poster-board: 50 ID: 154

Michael Tso

UK Centre for Ecology & Hydrology

Comparison and integration of UK soil moisture data products

The status of soil moisture across a national scale is of interest to a wide range of environmental science applications. For instance, it controls the amount of carbon that can be sequestered in soils and thus affects a country's ability to meet Net Zero targets. In the UK, national scale soil moisture monitoring is provided by the COSMOS-UK network, which has also been used to calibrate statistical models to yield UK-wide gridded soil moisture. Additionally, soil moisture is also returned as by-products in river flow and land surface models. Finally, gridded UK soil moisture information are also provided by global satellite products (e.g. SMAP and ASCAT) and global models. In this study, we compare and evaluate the soil moisture response of different products, such as their drydown behaviour, soil water deficit estimates, and representative depths. Critically, we seek to understand the factors influencing the similarities and differences between these products (e.g. driving data and soil properties) and suitability of each product in various applications. We then explore potential ways to integrate soil moisture data from various products to provide more robust and holistic estimates of UK soil moisture status. This work contributes towards the ongoing efforts to improve the readiness to provide UK soil moisture information to the scientific community.

Poster-board: 51 ID: 156

Tracey Ashworth

Environment Agency

Salvaging historic hydrometric data – digitisation strategies

Many UK hydrometric records are not fully digitised and only accessible in a limited way. But much of this data could usefully contribute to hydrological research and calculations. This project considered how the Environment Agency's non-digital data can best be digitised and brought into wider use, reviewing previous digitisation projects and considering novel methods such as crowdsourcing. The window of opportunity to address digitisation is increasingly limited as paper record quality declines and operational experience of older non-digital recording systems is lost.

Poster-board: 52 ID: 157

Qiuyu Zhu

University of Leeds, Water@Leeds

gyqzh@leeds.ac.uk

Assessing the impacts of Natural Flood Management at a larger catchment scale Natural

Flood Management (NFM) is a sustainable and resilience flood risk mitigation strategy. Within the strategy, different types of NFM interventions and features are multiply implemented at a catchment-scale. There is a lack of scientific evidence to determine the effectiveness of single or combination of several types of NFM interventions at a larger catchment scale (>100 km2). This project coupled the SD-TOPMODEL and Flood Modeller Pro to simulate NFM impacts in the River Aire Catchment. This coupled hydrological-hydraulic model is used to understand the interaction of interventions and compare their impacts at different catchment scales.

Poster-board: 53 ID: 159

Vivian Camacho Suarez

Previsico Limited

Reducing uncertainty in heavy rainfall forecasts used to support flood modelling warning systems

As precipitation intensity is expected to increase and weather patterns become more 'uncertain', the associated flood damage costs in the UK could rise by 40% by 2050s. In the UK, surface water flood risk is updated daily and provided at the county-level. These coarse temporal and spatial resolutions mean that the spatiotemporal dynamics of the fast-developing convective storms may not be captured. Therefore, by increasing the temporal and spatial resolutions and the frequency of update of precipitation data, accurate flood predictions (Flood nowcasting) are obtained. The Flood nowcasting predictions are key to provide real time surface water flood risk information such as flood warnings to support emergency responders, insurance companies and council officials. This study presents a case study within the city of London to illustrate how the London Fire Brigade utilize the Flood nowcasting information in their flood response. Accurately, estimating and communicating flooding prediction uncertainties is key so adequate decision making and strategic planning can be made (e.g. closing flooded roads; pumping road sections; dispatching sandbags; positioning emergency vehicles).

Poster-board: 54 ID: 160

Clarissa Rizzo (1), Tracey Haxton (2), Jude Jeans (3)

Wallingford HydroSolutions (1), Wallingford HydroSolutions (2), Wallingford HydroSolutions (3)

Advances in flow estimations at ungauged sites – Qube, an online modelling system

Qube is an online water resource modelling system developed by WHS in partnership with the EA for use by regulators, water companies and the wider hydrological community. Qube estimates natural and influenced flow statistics and time series in the UK and Ireland maximising the use of local data. Recent developments in the hydrological models include: improved estimation of the natural flow duration curve, estimation of daily flow timeseries, the introduction of more complex artificial influence representation, and the development of near and far future estimates of the natural FDC.

Poster-board: 55 ID: 161

Daniel Hamilton (1), Tracey Haxton (2)

Wallingford HydroSolutions (1,2)

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A rapid method for estimating the critical duration event in ReFH.

Within the FEH ReFH design event model the duration of the event affects the design peak flow and hydrograph. The 'recommended duration' is currently based on the unit hydrograph time to peak (Tp) and average annual rainfall (SAAR). We have tested the perception that the 'critical duration', that which produces the maximum peak flow, can be notably higher. We have also developed an equation to allow rapid estimation of the critical duration, which could be incorporated as part of the ReFH method in the future.

Poster-board: 56 ID: 163

Phil Wadley (1), Nick Chappell (1)

Lancaster Environment Centre (1)

phillip.wadley@lancashire.gov.uk

Upstream Downstream - Quantifying the Effectiveness of Leaky Dams to Reduce Flood Risk

This MSc project focused on field measurements, with numerous leaky dams installed in Whinlatter Forest, Cumbria, surveyed using a total station, and various methods tested in extrapolating an elevation model for each dam, with the errors associated with each model and their impact on the derived volumes calculated.

The models were then combined with time-series level data for each dam to derive volume time-series (m3/sec), which is directly comparable to the downstream discharge measured by a flume, allowing for the actual reduction in discharge peaks to be quantified.

Poster-board: 57 ID: 169

Alejandro DUSSAILLANT (UKCEH)

UK Centre of Ecology & Hydrology

Flash Floods and Debris Flows Monitoring using Low-Cost System with In-Situ Image Velocimetry Processing

We will present a low cost system that acquires laser altimetry and camera image data that is processed in-situ to obtain velocity (and flow) that are telemetered via cellular network and/or iridium satellite. The low implementation cost allows to monitor many hazardous sites covering a larger area, and in locations with unreliable networks. The image velocimetry method includes a brightness filter and normalized cross correlation. To eliminate outliers a flow direction filter is used. We will present both laboratory and field test results under a variety of conditions.

Poster-board: 58 ID: 170

Richard Maxey

SEPA

The Scottish Flood Forecast, a new three day flooding outlook for the public

The Scottish Flood Forecast is a new product that has been developed by the Scottish Flood Forecasting Service (SFFS) partnership between SEPA and the Met Office. It is a public version of the daily Flood Guidance Statement (FGS) that has been issued by SFFS to Category 1 and 2 responders since 2011. It is currently in its beta phase, and available to be viewed by the public, on SEPA's website at www.sepa.org.uk/scottishfloodforecast. It is put together by the SEPA duty forecaster each day, on a new platform that also produces the daily FGS. The risk status is based on the same matrix as the FGS, with days 1 to 3 being reported, and language has been carefully chosen to ensure that the messages can be understood by the general public in order for them to take appropriate action.

Poster-board: 59 ID: 171

Alexandra Seawell

Newcastle University

How do flashy catchments respond to changes in rainfall profile shape?

I would like to submit my poster summarising my first year of PhD work. Climate change could alter the frequency of occurrence of different rainfall profile shapes which in turn could affect flooding. I have begun analysing the effect on flood hydrographs in flash-flood susceptible catchments from whether input rainfall profiles are front-loaded, symmetrical or back-loaded shapes. Preliminary results suggest this can affect peak flow which could have consequences for design standards.

Poster-board: 60 ID: 172

Emma Bennett

UK Centre for Ecology & Hydrology (UKCEH)

COSMOS-UK: Evolution of the National Soil Moisture Observation Network

Soil moisture is a key component of the natural environment and important for hydrometeorology and ecology, determining greenhouse gas emissions and assessing the risk of floods and droughts. COSMOS-UK is a national network measuring soil moisture and meteorological variables to provide near real-time data for analysis and use in modelling studies, flood forecasting and validation of remote sensing products. This poster outlines the background and evolution of the network, which is further described in an associated presentation, with data available to explore on the UK-SCAPE ex

Poster-board: 61 ID: 173

Dr Elias Nkiaka

University of Sheffield

How useful are gridded water resources reanalysis for assessing water security in ungauged basins?

Achieving water security in ungauged basins is critically hindered by a lack of in situ river discharge data to assess past, current and future evolution of water resources. To overcome this challenge, there has been a shift toward the use of freely available satellite and reanalysis data products. However, due to inherent bias and uncertainty, these secondary sources require careful evaluation to ascertain their performance before being applied in ungauged basins. The objectives of this study were to evaluate river discharge and evapotranspiration estimates from eight gridded water resources reanalysis (WRR) across eight river basins located in Central-West Africa. Results highlight strengths and weaknesses of the different WRR in simulating discharge dynamics and ET across the basins. Our results further revealed that the performance of the models in simulating river discharge is strongly influenced by model structure, input data and spatial resolution. Considering all the evaluation criteria Noah, Lisflood, AWRAL, and Terra are among the best performing WRR products. Considering the plethora of products available, it is imperative to evaluate their performance in representative gauged basins to identify products that can be applied in each region. Results from this study suggest that gridded WRR products are a useful source of data for assessing water security in ungauged basins. hibition stand.

Poster-board: 62 ID: 175

Edward Fleming

Environment Agency

Sedimentation of the Great Ouse Tidal River and implications for flood risk management

What was once England's largest wetland, the Fens now account for half of the most productive agricultural land in the country and are home to various communities and businesses alike. However, a third of the Fens is currently below sea level, and climate change poses significant challenges for future flood risk management. A crucial flood risk asset is the great Ouse Tidal River, a heavily human-influenced section of the River Great Ouse between Denver Sluice and The Wash. It lies at the crucial junction between the marine-dominated processes of the wash and fluvial-dominated processes of the Great Ouse. Bed levels along this stretch are subject to considerable changes. This is evidenced by a series of tidal bars which are visible a low tide. Their impact on flood risk is poorly understood. Traditionally, widespread dredging was undertaken of the channel. However, this was largely for navigation purposes and the degree of dredging needed to make a meaningful impact on bed levels would be unviable. Instead, natural processes such as those operating during high flow events may be utilised to remove sediment build-up and may negate the need for more intensive, traditional intervention such as dredging. The aim of this study is to characterise the bedforms, document their evolution and determine the state of the sediment flux. This will be conducted through the analysis of high resolution, multibeam bathymetric data, lidar and photogrammetry. The results reveal a complex system of tidal bars, which rapidly evolve in response to high flow events. Working with natural processes are key to the future management plan of the river, but the extent to which human intervention is needed is not known. The

outcomes of the study will help determine whether the effect of these nature-based solutions are sufficient to maintain the cross-sectional area of the Tidal River or whether more intensive, traditional intervention, such as dredging will be required.

Poster-board: 63 ID: 176

Siavash Fasihi

Birmingham City University

A Conceptual Causality Framework for flooding and drought risk

The climate-change-induced and anthropogenic stressors on water resources could cause the current water-related hazards to communities. This paper evaluates the risk of flooding and drought by assessing the impact of these events in different subfields through an unbiased systematic approach. The main objective of this paper is to create a conceptual framework that captures the causes of flooding and drought events, including disaster risk reduction measures of flooding and drought and various elements of the existing water resources management systems.

Poster-board: 64 ID: 178

Adam Threlfall Hartley

Queen Mary University of London

Modelling catchment scale hydrological effects of landscape rewilding.

Rewilding is an approach to conservation that focuses on landscape-scale restoration of natural processes. Assessment of rewilding has mostly focused on biodiversity with impacts on flooding largely assumed. Research suggests that NFM is good for mitigating small floods and maintaining baseflow but is less effective for larger events. This study investigates whether rewilding, a more hands-off approach, can be used to mitigate flooding at larger spatial scales and across different types of event, using literature, field and modelling-based research.

Poster-board: 65 ID: 180

Dr. Ann Kretzschmar

Galgate Flood Action Group

Community response to the November 2017 flood in Galgate, Lancashire

The village of Galgate, south of Lancaster, grew up around the river Conder. It has a long history of flooding in the village often from the Conder. Whitley Beck meets the Conder in the centre of the village. It has a flashy response and drains a long section of the M6 which can result in flooding especially when intense rain falls on saturated ground as it did in 2004 and 2017. In November 2017, the community responded to a major flood event by forming a Flood Action Group. This poster will outline what happened, how the community responded and developments since 2017.

Poster-board: 66 182

Naveed Bhatti

SSE Renewables

Managing water levels for protected species - a case study with Common scoter

Common scoter (Melanitta nigra) is a very rare breeding duck in the UK. There is a small population in north Scotland that is protected under the West Inverness-shire Lochs Special Protection Area (SPA). A number of

the important SPA breeding lochs are also impounded for the production of hydro-electricity. Managing the water levels at the correct height is vital for their breeding success, but also introduces challenges. Working together with key partners, the aim is to maintain and boost the population, and help protect it from local extinction.

Poster-board: 67 ID: 183

Gemma Harvey

Queen Mary University of London

The hydrological highs and lows of landscape rewilding

Rewilding is a radical conservation approach that involves restoring wildness to anthropogenically altered landscapes. Resulting changes to hydrological processes have the potential to influence flood attenuation and low flow stresses but this is largely unexplored. Our project considers the role landscape rewilding can play in modifying the water cycle and mitigating the impacts of hydrological extremes. Through systematic review and meta-analysis we evaluate the evidence for rewilding impacts on high and low flows to inform future research and rewilding practice.

Poster-board: 68 ID: 186

Emily Fowler

British Hydrological Society

BHS Equality, Diversity and Inclusion

Poster-board: 69 ID: 108

Chris Skinner

British Hydrological Society

BHS Governance 1 of 2

Poster-board: 70 ID: 168

Chris Skinner

British Hydrological Society

BHS Governance 2 of 2

Computer demonstrations

Table 1 Robinson LT (LT 16) ID: 10

Dr. Ann Kretzschmar

Environment Agency

Hydrometric data at the touch of a button – Environment Agency Open data

The Environment Agency collects accurate and up-to-date hydrometric data from over 5,000 measuring sites across England. The Open Data project gathers this data into one of the world's largest open access hydrological datasets. Both current and historic data will be available via a user interface and API, providing easier data access for research as well as enabling informed decisions for water management. Come and visit us to test out the service, we are always looking for feedback to inform future improvements.

Table 2 Robinson LT (LT 16) ID: 45

Roberto Villalobos

University of Costa Rica & Newcastle University

UK design storms are flawed and need updating.

The Summer and Winter design hyetographs derived in the 1975 Flood Studies Report (FSR) are a cornerstone of UK flood estimation. We use the hyetographs of 72,000 storms, obtained from a large sub-hourly resolution rain gauge dataset for Great Britain, to demonstrate that the FSR profiles are a flawed representation of large numbers of flood-generating storms. The FSR profiles underestimate the peak intensity of short-duration storms. Manual and automatic clustering methods are then used to explore the hyetograph dataset and generate a set of more representative hyetographs for GB.

Table 3 Robinson LT (LT 16) ID: 46

Roberto Villalobos

University of Costa Rica & Newcastle University

Creating a large rainstorm dataset for annual maximum events in Great Britain

Multiple advances in rainfall measurement and quality control have enabled the creation of a very large rain gauge dataset with sub-hourly temporal resolution at Newcastle University. This dataset, with coverage over Great Britain, has been used to identify over 72,000 independent rainstorms that contain annual maximum (AM) rainfall values for a series of sub-hourly to daily time periods. This novel dataset reveals significant overlaps between AM values of different durations and provides new insights into rainfall extremes in GB and their properties.

Table 4 Robinson LT (LT 16) ID: 56

Steve Turner

UK Centre for Ecology & Hydrology

The Hydrological Outlooks and eFLaG Portals

Two new portals to showcase data from two projects - the operational UK Hydrological Outlook and eFLaG - the new future flows. I will use my own laptop, and bring a poster to highlight what the portals show (two A3 posters, one for each portal?)

Table 5 Robinson LT (LT 16) ID: 61

Lucy Barker

UK Centre for Ecology & Hydrology

Dynamic high-resolution hydrological status monitoring in real-time: The UK Water Resources Portal

The UK Water Resources Portal provides integrated, near-real time and dynamic access to UK hydrological status monitoring data. Co-developed with a range of stakeholders over the last eight years, the Portal currently provides access to rivers flow (including live data for England and Scotland), rainfall, groundwater level and real-time COSMOS-UK soil moisture data. Commonly used drought indices are also available for rainfall, river flows and groundwater levels, and different plotting styles allow users to compare current conditions to those of the past, including flood and drought events.

Table 6 Robinson LT (LT 16) ID: 80

Demonstrations on large screen in tiered LT 17 (next door) on Tues 13 Sep 2022 at the following times: 10.20 - 10.50; 10:50 - 11:20; 11.20 - 11.50

Catherine Sefton

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UK Centre for Ecology & Hydrology

Natural Capital and Ecosystem Assessment (NCEA) Hydrological Network Appraisal Demonstrator

A Demonstrator version of a new web-tool that is in development is available to view at BHS2022, and feedback welcomed. The tool allows filtering and visualisation of an extensive suite of metadata describing the Environment Agency's flow gauging network. I will bring my own laptop, and printed Use Cases to illustrate the application of the Demonstrator to address the objectives of the NCEA Water Quantity Sentinel Networks project, which was funded by Defra and delivered by UKCEH on behalf of the Environment Agency.

Table 7 Robinson LT (LT 16) ID: 116

Gemma Nash

UK Centre for Ecology & Hydrology

Freshwater Data Explorer (FWDE) – standardizing citizen science and long-term monitoring data

There is an increasing amount of freshwater citizen science data becoming available and a growing need for this to be accessible and understandable. Data from networks such as FreshWater Watch, Riverfly, SmartRivers, and Bloomin' Algae has potential to complement regulatory monitoring to increase our understanding of the health of rivers and lakes and support actions. The Freshwater Data Explorer allows regulators and citizen scientists to view and understand the availability of monitoring data from multiple sources, its temporal and spatial distribution, and its potential usability.

Table 8 Robinson LT (LT 16) ID: 121

LCM team

UKCEH

Land Cover Map discussion

A guided discussion session to enable users of the UK Land Cover Map (LCM) to discuss their experience of using the land cover map and to raise issues with the LCM team. The session will also provide an opportunity for users to provide feedback, and suggestions, on developments that could aid their work and improve the usability of the LCM data sets.

British Hydrological Society

NAC 19/08/2022