

Flood and Coastal Erosion Risk Management R&D FCERM Research News

Issue 25



Research News is the biannual newsletter from the Joint Department for Environment, Food and Rural Affairs (Defra), Environment Agency, Natural Resources Wales and the Welsh Government Flood and Coastal Erosion Risk Management Research and Development Programme (FCERM). The programme conducts, manages and promotes flood and coastal erosion risk management research and development. The programme is organised by themes which are closely aligned to the policy and operational responsibilities of Defra, Environment Agency, Natural Resources Wales and the Welsh Government.

If you would like further information on the programme please visit our website:

<http://evidence.environment-agency.gov.uk/FCERM>

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This issue looks at how we're improving the quality of existing radar products using new dual polarisation technology and how we're working with natural processes and reducing flood risk.

There's also news about improving our asset inspection process, debris and blockage modelling and a focus on the new look Incident Management and Modelling theme.

Please pass this Research News on to anyone who has not received their own copy. Digital copies can be downloaded from our website or you can [subscribe](#) to receive future editions for free.



Andy Moores – Environment Agency



Stacy Sharman – Defra

Joint programme managers

Newsbites

FCERM-Net First Annual Assembly Event

FCERM-Net is a new network of academics, consultants and users of FCERM research. It is funded for three years by the Engineering and Physical Sciences Research Council (EPSRC). It aims to promote science, bring groups together and provide a catalyst for collaborative bids into Research Councils. The first Annual Assembly event held in June at Heriot Watt University was attended by over 100 people. Thought-provoking keynote presentations seeded a series of workshop discussions to exchange knowledge, find gaps and discuss the research questions needed to address FCERM issues.

FCERM-Net has an ongoing programme of webinars, has just launched its own website (www.FCERM.net) and its membership is growing. It is hoped that a series of funding bids will emerge, strengthened by the multidisciplinary dialogue both at the assembly event and through subsequent follow up.

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Articles

Improving the quality of existing weather radar products using new dual polarisation technology

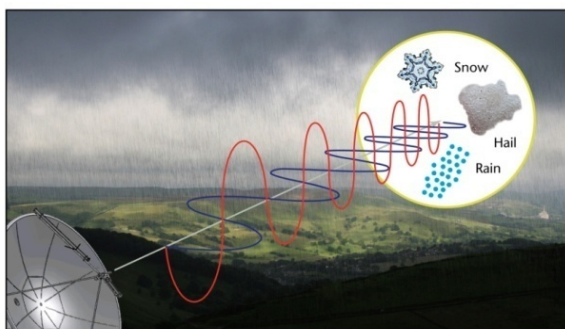
In partnership with the Environment Agency, Natural Resources Wales and the Flood Forecasting Centre, the Met Office is developing new data processing methods to improve the quality of weather radar products used to forecast intense flood events.

As part of this three-year project, which started in October 2013, information provided by dual polarisation radars will be used to develop new data processing algorithms. These will provide better information about the type of precipitation in the atmosphere, its intensity, size and location.

The new dual polarisation algorithms will increase the accuracy of forecasts. This will allow for more accurate and timely warnings, which will give emergency responders and the public better and earlier information.

What is dual polarisation?

Unlike conventional and Doppler radars, dual polarisation radars transmit and receive signals in both vertical and horizontal polarisations. Small differences between the two signals tell us about the shape of the target and its composition (ice or water).



Dual polarisation weather radars: electromagnetic signal shown in red (vertical polarisation) and in blue (horizontal polarisation)

The Met Office and the Environment Agency are rolling out the largest upgrade to the UK radar network in its 30 year history. By December 2013, dual polarisation technology covered most of southern England and Northern Ireland.

Focusing on the weather

Work package 1: Improved radar product accuracy through better identification and rejection of non-meteorological echoes

Weather radars can see more than just rain or snow. They see a wide variety of objects present in the sky (for example, birds, insects and planes) and on the ground or the sea (for example, vegetation, manmade structures, ships, lakes and oceans) as well as other signals like wireless network signals.

A major limitation in using radar products as input to hydrological and numerical weather prediction models is the presence of these non-meteorological data points as these can lead to severe errors in forecasts.

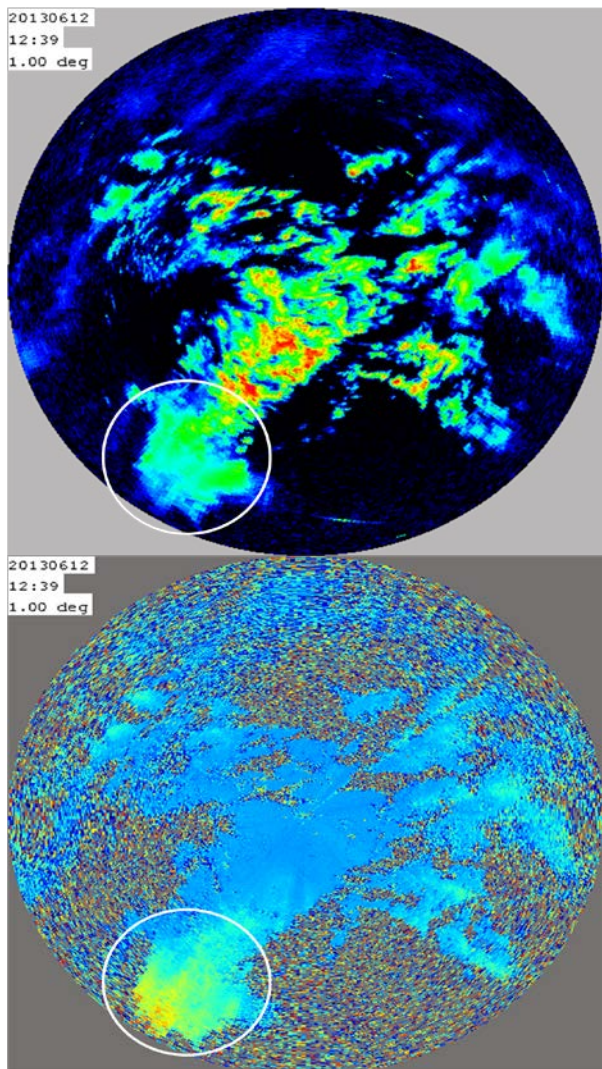
This work package will develop and implement an algorithm using the dual polarisation parameters and Doppler spectrum to better identify and reject pixels contaminated by non-meteorological objects, whilst retaining the signal originating from precipitation.

Seeing through the storm

Work package 2: Improved radar product accuracy through better calibration, monitoring and correction of radar reflectivity

Electromagnetic signals used by weather radars and telecommunications can be absorbed by liquid water in the atmosphere. This is known as attenuation.

Attenuation of the radar signal can cause major under-estimation of the actual rain rate behind an intense storm. This can lead to gross inaccuracy of the rain rate in forecasts. This may become more of an issue if the intensity of storm events increases under climate change.



Cheries radar (north-west London) showing an area affected by attenuation: (top panel) radar reflectivity (measure of reflected energy); and (bottom panel) differential phase shift (measure of delay in the echo caused by water in the atmosphere) – increase in phase shift indicates an area affected by attenuation. This information can be used to apply a correction.

This work package proposes to use dual polarisation information to remotely monitor the calibration error for each radar, as well as to better identify and correct attenuation of the radar signal.



This project is based on close collaboration research carried out with the University of Reading under the NERC funded project FRANC (Forecasting Rainfall through Assimilation of New observations of Convection).

More accurate rain rate products when it really matters

Work package 3: Improved radar product accuracy through adjustment of the Z/R relationship (where Z = Radar reflectivity factor and R = rainfall rate) during heavy rain and severe storm events

Dual polarisation information offers the opportunity for estimating rain rate based on the phase information (measure of delay in the echo caused by water in the atmosphere) rather than reflectivity (measure of reflected energy). This phase information is not affected by attenuation, such as reflectivity, and is therefore more reliable than reflectivity to retrieve rain rate above a certain threshold of precipitation intensity.

This work package proposes to develop a new hybrid rain rate estimation scheme which will make use of the phase or reflectivity information depending on the intensity of the precipitation.

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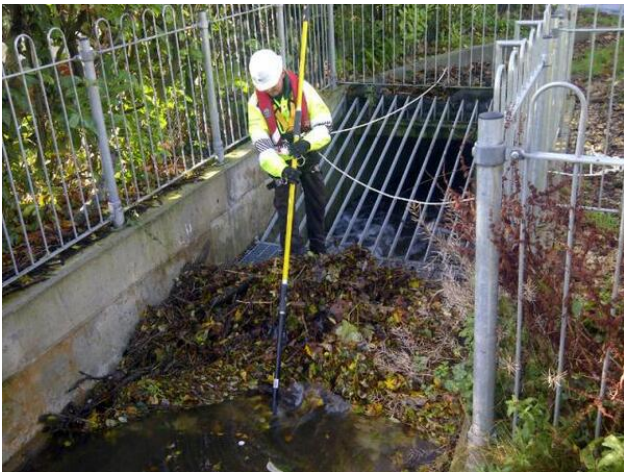
Debris and blockage modelling

Assessing flood risk from blockages

The Environment Agency and JBA are working to produce evidence-based guidance to help with assessing flood risk from blockages.

Our research staff are working with engineers and flood modelling staff to produce much needed guidance on how to assess flood risk from blockages. We will use the information to reduce the risk of flooding.

Blockages reduce flow capacity, potentially raising water levels and increasing the risk of flooding and structural failure. On the other hand, the presence of large woody debris can create diversity in flow regime and habitat, as well as water quality improvements.



Environment Agency staff removing a blockage

The first of three stages is now complete. Stage one included production of a summary of the available science, existing techniques and user requirements from across the flood risk management industry.

Our findings show an appetite for a consistent methodology that is compatible with readily available data and methods, as well as being scalable to the complexity of the problem.

We are now extending our initial research and constructing the basis of the guidance. We are also validating our findings and assumptions on real world data to add user confidence to our final document.

This guide will help to reduce flood risk through better knowledge of:

- where is at risk
- what is at risk
- which catchments and structures are most likely to cause problems
- other existing and ongoing work

We expect to publish the guide in autumn/winter 2014.



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Safer routes for urban flooding

Encouraging designing for exceedance

In recent years we have seen the devastating impact of flooding on communities. When rainfall exceeds the design capacity of the drainage system, flooding happens. Our drainage systems are struggling to cope now and the problem is likely to get worse with climate change. Flooding is often a complex interaction of different sources, pathways and receptors, across a number of different asset owners.

One of the main challenges and opportunities is how to better manage the results of heavy rainfall and surface water in our urban areas. To do this we can:

- invest heavily in below ground drainage systems making them bigger (beyond existing drainage design standards)
- allow water that escapes from drainage or cannot enter into systems in the first place, to find its own pathway and cause flooding and disruption
- manage the excess water that drainage cannot cope with on the surface within the existing environment by:
 - designing flood pathways
 - making often simple changes (for example changes to kerb heights)
 - creating multi-functional spaces that can be used for amenities and flood water

We call this 'designing for exceedance'.

The FCERM R&D Programme and Construction Industry Research and Information Association (CIRIA) have recently completed a project to encourage the uptake of designing for exceedance.

The project investigated why uptake of the concept has been slow since the publication in 2006 of 'C635 Designing for exceedance in urban drainage systems – good practice'. To help risk management authorities and others design for exceedance, the

project has collated a series of case studies to identify lessons learnt and success factors.



Important findings from the project include:

- the importance of interdisciplinary working within and between organisations
- recognising the value of multi-functional space which can be utilised for temporary flood storage
- involving communities in decision making
- recognising that designing for exceedance can be implemented on a variety of scales and costs

The outputs, especially the case studies, demonstrate how designing for exceedance can be successfully implemented at many scales and that perceived barriers to its use are routinely being overcome on the ground.

We expect the project findings to interest a wide variety of professions including:



- drainage, highway and transportation engineers
- urban designers
- landscape architects
- developers
- planners

Practitioners can use the outputs from this project to explain the concepts and to increase confidence in others to work together to design for exceedance. This will help both the Environment Agency in its strategic overview role and those whose properties are at flood risk from exceedance flows.

The project's findings were launched at an event held at the Institution of Chemical Engineers (ICE) in London on 30 April 2014. Around 100 people attended to learn more about the case studies and to enjoy a multidisciplinary panel debate.

The project materials can be downloaded from the Susdrains website:

www.susdrain.org/delivering-suds/drainage-exceedance/Encouraging-uptake/Background-outputs

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What is community resilience?

Rapid evidence assessment of community resilience

Defra commissioned Collingwood Environmental Planning (CEP) and partners¹ to carry out a rapid evidence assessment (REA) of community resilience so as to help to summarise what we know about community resilience and understand what it means.

The REA represents the first stage of the evaluation of Community Resilience Pathfinder projects, which are funded by Defra until March 2015. The 13 Pathfinder projects seek to improve flood resilience at the community level via financial, property level and community resilience measures.

Some of the most important findings are summarised below.

- Resilience should be considered as a dynamic process. It is inextricably linked to capacities, capabilities and processes that already exist on a day to day basis within a community.
- Creating resilience to flooding is an ongoing process of adaptation and learning from past events and preparing for future risks, rather than an outcome that is achieved once and never needs to be re-addressed.
- Community resilience is defined around the following five aspects: social, economic, institutional and infrastructure resilience, and community capital. The way resilience is framed and defined will lead to different actions and emphases.
- Building capacity for resilience to flooding requires both formal and informal structures and processes. Networks are of central importance in terms of both close ties and looser links between members of communities and more formal organisations.

The REA will inform how the evaluation is carried out and help to support Pathfinder projects by clarifying what resilience, and more importantly, what a change in resilience, looks like in practice.

The evaluation concludes in summer 2015.



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¹ The CEP consortium includes:

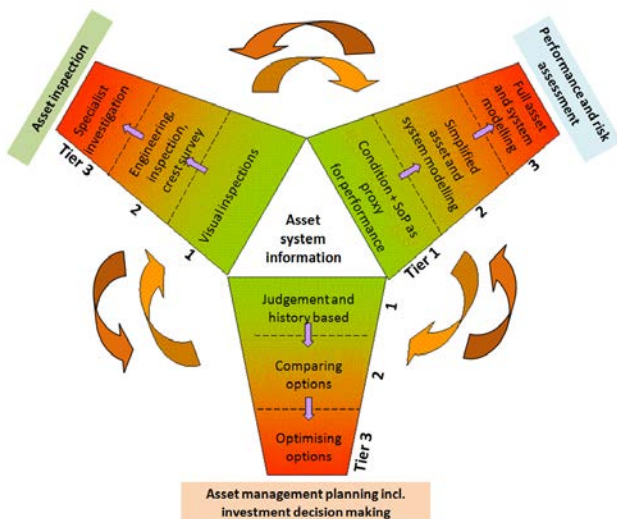
- Flood Hazard Research Centre at Middlesex University (Sue Tapsell, Professor Dennis Parker, Dr Simon McCarthy)
- University of Surrey (Dr Jane Fielding)
- Northumbria University (Dr Hugh Deeming)
- Centre for Evidence and Policy at King's College London (Alan Gomersall)
- nef consulting (Olivier Vardoulakis)
- CEP associates – Dr Elham Kashеfi, Dr Sue Weldon, Dr Tim Harries, Yvonne Rees, Ruth Johnston

Improving the asset inspection process

The asset inspection process is part of an overall cycle of risk and performance based asset management being developed by the Environment Agency under the Asset Performance Tools (APT) programme of research.

The new guidance ('Asset performance tools – asset inspection guidance', SC110008/R) was developed by Black & Veatch in association with John Chatterton Associates. It incorporates the findings of a review of current best practice and offers recommendations for improvement.

The tiered framework on which the recommended asset management cycle is based integrates key activities in the assessment cycle and directs the user to the appropriate level of activity according to assessed risk through a process of tiering.



Advancement up the three tiers is made in response to increasing levels of assessed risk. Research carried out during the development of the process shows that inspections can be targeted to need and interventions can be timed relative to the risk of expensive and often distressing asset failure, rather than dictated by routine alone. Inspections are driven by a considered balance of investment and flood risk, offering the greatest risk reduction at least cost.

Each flood risk management asset should have a target condition set for it taking into account risks and consequences. Application of the asset

inspection process can ensure efficient management of assets through proactive planning and application of a risk-based approach rather than relying on reacting to a failing asset, or one falling below its target condition.

The guidance recommends the triggers for moving from routine visual inspections (tier 1) to more advanced inspections at an intermediate (tier 2) or higher (tier 3) level.

It also describes the need to integrate 'asset inspection' (A) with assessments carried out into 'performance and risk' (B) and 'planning and investment decision making' (C). This needs an efficient flow of information between all inspections and assessments as intended by the APT programme. Parts 'B' and 'C' are expected to be the focus of new research starting this summer (SC140005).

The structure of the guidance document is in line with the grouping of asset types in the Environment Agency's Asset Information Management System (AIMS), that is:

- channel and culverts
- linear defences
- coastal defences
- beach structures
- structures and point assets

Further information can be found on:



- the relationship between condition and performance and why their monitoring is vital
- the risk-based approach to frequency of inspection
- how to inspect for engineering integrity
- different types of tier 2 and tier 3 inspections
- health, safety and environmental considerations

Consistent reporting and decision making is essential to establish relative priorities and confidence in the asset management process. It is

also important to be able to demonstrate how decisions have been made for auditing reasons.

Embedded in the guidance document is a prototype tool in the form of a Microsoft® Excel spreadsheet. This tool is intended to serve as a baseline model for developing a consistent interface between inspection activities and performance and risk activities. The basis of the tool is a standardised series of picklists designed to bring consistency and direction to actions following tier 1 inspections.

This new guidance will help the Environment Agency and other flood risk management authorities to improve the effectiveness of their inspection methods for flood and coastal risk management assets.

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Focus on: Working with Natural Processes

Reducing flood risk and improving the environment

We have recently completed projects that will help us to reduce flood risk by working with natural processes. This work is described below along with news of some ongoing research in this field.

Aquatic and riparian plant management guide

We have worked with a number of contractors and partners¹ to produce new guidance. This includes a decision support framework to help manage a range of plant species present in different types of watercourses.

The audience

The guide is primarily aimed at flood risk management operating authorities. However, it will also be of interest to land owners and community groups who wish to carry out watercourse maintenance work.

What does the guidance include?

- Technical guide – this provides detailed information on planning, undertaking and monitoring aquatic and riparian vegetation.
- Field guide – this helps identify plant species and collect the information needed to select an appropriate management technique.
- Decision-support spreadsheet tool – this helps select the most appropriate vegetation management technique(s) for the watercourse.

What does the guidance do?

The guidance helps plan all aspects of watercourse management. It covers a range of aquatic and riparian plant management techniques such as physical, chemical, environmental and biological control measures.

The information in the technical guide can be used alongside the spreadsheet tool to assess:

- the effectiveness of a management technique in relation to a specific species
- the impact of a management technique on watercourse type
- the technical feasibility of each management technique



Aquatic plants in a river

The spreadsheet tool lists the most appropriate management technique(s) and helps inform decisions. It is not a replacement for local knowledge. It is acceptable not to select the technique ranked number one in the list, given site specific conditions.

The field guide can be used on site, enabling you to collect information about the site and plant species in the form provided. Back at the office the information collected is entered into the spreadsheet tool to help inform management decisions.

Canadian Waterweed *Elodea canadensis* and Nuttall's Waterweed *Elodea nuttallii*

Canadian Waterweed *Elodea canadensis*
(c) JBA Consulting

Are non-native invasive species in the UK listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) and it is an offence to plant or cause their spread in the wild.

These species grow from stolons rooted in the sediments at the bottom of watercourses and have dark green translucent leaves in whorls of three (occasionally four).

Canadian Waterweed <i>Elodea canadensis</i>	Nuttall's Waterweed <i>Elodea nuttallii</i>
Broad leaves, widest at the middle	Narrower leaves, widest at the base
Leaf tip is blunt	Leaves taper to a pointed tip
Minute teeth on lower leaf margins	Minute teeth on all leaves
Leaves not strongly curved backwards or twisted	Leaves are curved backwards (i.e. recurved) or twisted

Extract from the field guide

How can I access the guidance?

The project reports and a short video explaining how to use the guides can be accessed from our [website](#).

Working with Natural Processes – development of a research framework

Working with natural processes to manage fluvial and coastal flood and coastal erosion risk involves protecting, restoring and emulating the natural function of catchments, rivers, floodplains and coasts' (Environment Agency 2012).

We have developed a Working with Natural Processes research and development framework with Black & Veatch and other partners². This framework identifies the research projects which need to be undertaken to help Flood Risk Management Authorities deliver flood risk management sustainably, improving the environment for people and wildlife.

This research framework has been developed in partnership with a range of organisations including many leading experts in the field.

What does the framework include?

It includes:

- **Inception Report** – summary of the evidence gaps and development of research priorities.
- **Science Report** – summary of the priority research projects.
- **Data and evidence register** – spreadsheet database of key research in this field.
- **List of projects** – summary of the key projects.

The project reports can be accessed from our [website](#).

What next?

We will use this framework to help prioritise projects for funding as part of the joint flood and coastal risk management research programme. It

will also be used to develop external funding bids and to facilitate partnership working.

We are working with colleagues in Scotland and Wales to establish a natural flood management network to help share knowledge and best practice across the UK.

The framework was launched at the [CIWEM Natural Flood Management conference](#) on 10 September 2014.

If you would like to find out more about these projects, become involved, or receive occasional updates, please contact me directly.

	<p>For further information contact Lydia Burgess-Gamble</p> <p>Lydia.burgess-gamble@environment-agency.gov.uk</p>
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¹ Aquatic plant guide contractors and partners:

- JBA in a consortium with the Centre for Ecology and Hydrology (CEH), Penny Anderson Associates.
- Natural England, Association of Drainage Authorities, Health and Safety Executive, Canal and Rivers Trust, Hampshire and Isle of Wight Wildlife Trust and North Level District Internal Drainage Board.

² WWNP R&D framework partners:

- Natural England, River Restoration Centre, British Society for Geomorphology, Forestry Commission, Natural Resources Wales, Bedford Internal Drainage Board, Natural Environment Research Council (NERC), Living With Environmental Change (LWEC) and Association of Drainage Authorities.

Focus on: Incident Management and Modelling (IMM)

The new look IMM theme

Around 5.5 million (or 1 in 6) homes in England are at risk of flooding. Of these, 2.5 million are at risk from rivers or the sea, with 500,000 at significant risk. We invest a lot of money and effort in flood prevention and management schemes, but we can never prevent all flooding.

Flood incident management and flood modelling are crucial in reducing the impacts and consequences of flooding.



Our Vision: *“Working together to help save lives and livelihoods and support communities and partners to prepare, respond and recover from flooding”*

The IMM R&D theme has a major role to play in equipping us with the necessary evidence, practical research and new capabilities to help the Environment Agency and the wider incident management community.

The theme covers a broad range of topics including:

- Data, methods and models for hazard, vulnerability, impact and wider risk assessments (including longer term)
- Observations and detection
- Hydro-meteorology
- Hydrological and hydraulic modelling and forecasting
- Warning and Informing
- Emergency planning and incident management
- Uncertainty and decision making

- Capitalising on technology and innovation

What are we aiming to achieve?

We aim to improve the way incident management and modelling practitioners, partners and communities prepare, respond and recover from flooding in good time; ultimately helping to save lives and livelihoods. This is achieved by working in partnership and conducting R&D that is practical and user-driven.

The IMM theme has six specific aims.

- Enable more proportionate and accurate 'impact-based' and probabilistic forecasts and warnings to support earlier, more tailored and more effective preparations and responses by the emergency response communities and those at risk
- Provide more accurate and user focused national and long term assessments of overall flood risk from multiple hazards/processes and joint or subsequent events and their impacts
- Work towards more integrated and seamless flood forecasting and modelling capabilities spanning from 'end-to-end' (cloud to coast)
- Exploit emerging opportunities from innovation, technology and 'big data' to deliver more user focused, effective and efficient forecasting and modelling services and risk assessments
- Deliver our research in a way that useable by and useful for the needs of different user groups supporting evidence based incident management, emergency planning and FCRM decision making more widely
- Improve the communication and use of science in incident management and our understanding of how people behave and respond during flood events

Working in partnership



We encourage partnership working with our other R&D themes and external partners to bring together teams from a range of disciplines to help prepare IMM activities for the future.

Key partners for our work are:

- FCRM practitioners in the Environment Agency, Flood Forecasting Centre and others risk management authorities (incl. Lead Local Flood Authorities)
- Professional partners and emergency responders
- Community groups, charities and ultimately the public using FCERM services
- Strategic and supply chain partners (Met Office, Water and Environment Management framework consultants and beyond)
- Government agencies and departments
- Leading researchers and industry experts in the field in the UK and internationally

How to get involved

We will work with our advisory group of leading experts in the field (IMM TAG), our own practitioners, the wider FRCM community and researchers to explore opportunities and gaps to be addressed by our programme or wider research initiatives.

	For further information contact Stefan Laeger (Theme Manager) stefan.laeger@environment-agency.gov.uk
	For further information contact Liz Anspoks (Theme Champion) Liz.Anspoks@environment-agency.gov.uk

Working in partnership

We work in partnership with universities, research institutes and centres of expertise to strengthen and support evidence needs. These partnerships usually sit outside of our programmes project listings and have proved to be an effective means of sharing timely evidence, expert analysis and skills.

Figure 1 shows the 25 partnerships that the Joint Flood and Coastal Erosion Risk Management R&D programme is currently undertaking. They equate to a lifetime cost of £31.1 million, with £450,000 directly funded from this programme.

Alongside the financial element, a considerable amount of time (in kind) is also invested in this work. For full details of the numerous organisations and institutions that are part of the work packages please see the websites listed later in this article.

The majority of the partnerships have arisen from work commissioned through one of the Research Councils or an EU framework (Figure 2). It is no coincidence that this research ties in with Defra/ Environment Agency strategic plans as we look to work increasingly closer with similar funding bodies.

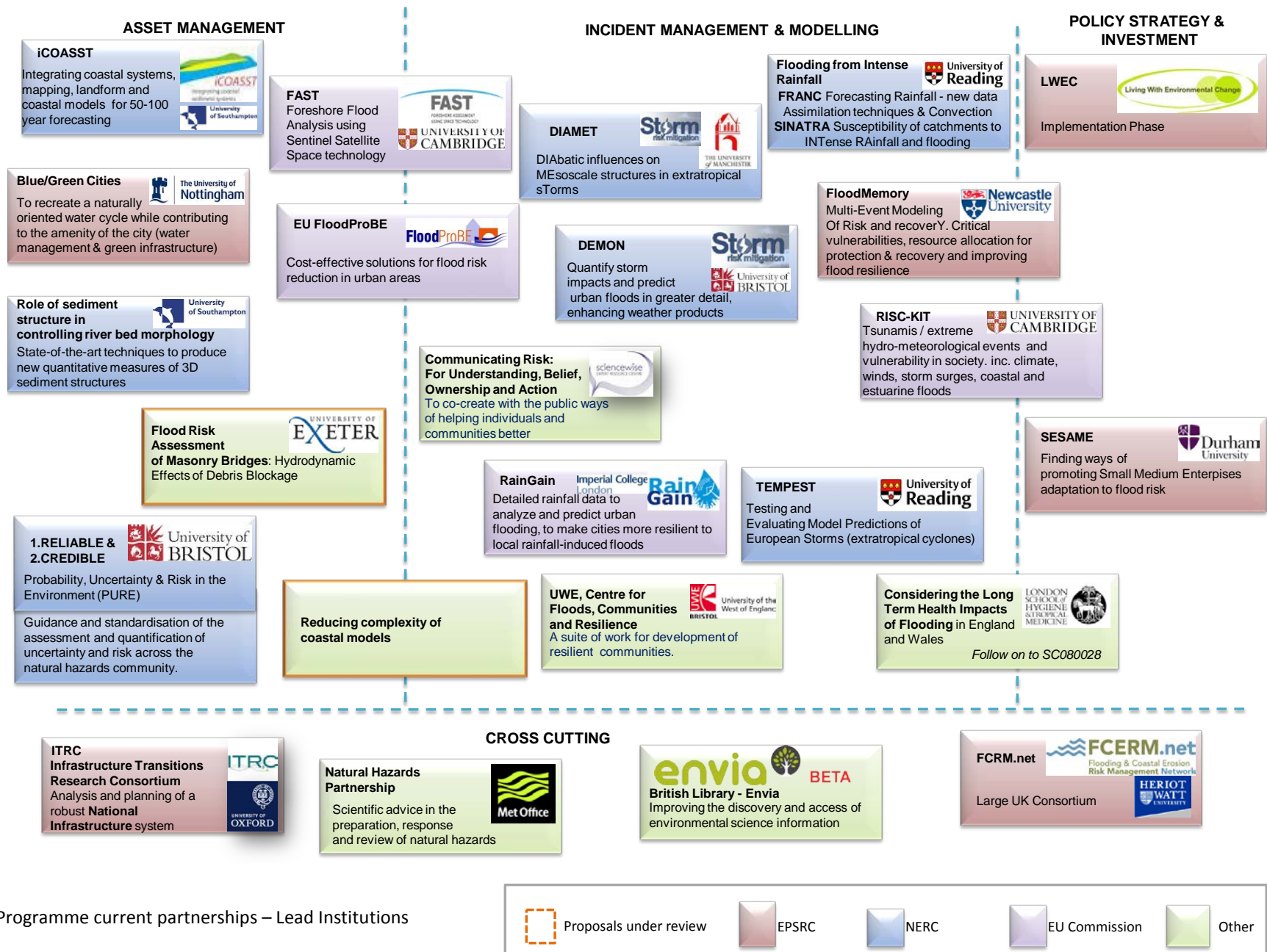


Figure 1: Joint Programme current partnerships – Lead Institutions

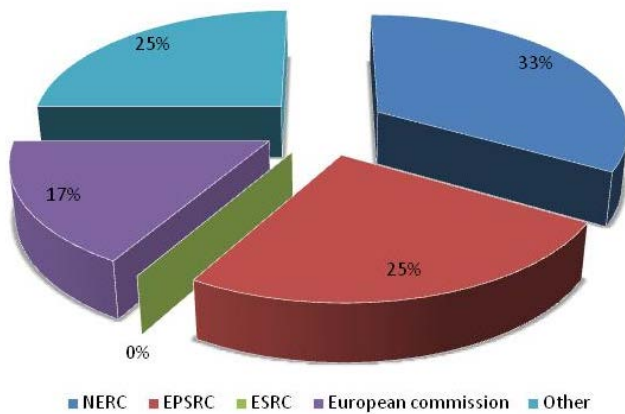


Figure 2: Split of partnership commissions

We are also heavily involved in workshops, consultations and discussion groups with many university centres and organisations such as CIRIA’s Research Council, the US Army Corps of Engineers, UK Water Industry Research (UKWIR), the Chartered Institution of Water and Environmental Management (CIWEM) and Institution of Chemical Engineers (ICE). This ensures a considered and coordinated approach, maximising benefits by bringing similar research together and attempting to prevent any overlaps. Importantly, we provide an overview role looking to ensure the flow of basic research into operational needs Figure 3 shows how our current partnerships align within this structure.



Figure 3: The four progressive stages of research

The Living With Environmental Change (LWEC) UK Flooding Strategy (www.lwec.org.uk/our-work/uk-first-flood-research-strategy) is one of the many strategic drivers that are also important to us. The strategy defines three flood and coastal erosion themes and we work hard to ensure these are supported by the objectives of our partnerships (Figure 4).

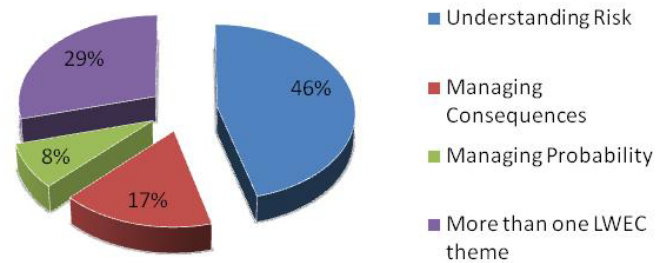


Figure 4: Partnership association to LWEC flooding strategy themes

Some of the more recent successes achieved as a result of partnerships programme include the setting up of the Flooding & Coastal Erosion Risk Management Network, FCERM.net. Its aim is to promote discussion across a consortium of UK experts from a large number of organisations and institutes to advance flood and coastal research. Phase 2 of the Flood Risk Management Consortium (FRMRC2) recently published research that formed the basis of the Defra/Environment Agency natural hazards framework. Production of the International Levee Handbook (ILH) involved discussions of best practice across nations and supported changes to the way in which embankments are managed.

One of the more challenging aspects of partnership working is assessing requests for support to this research programme. Below we provide the information we need to assess proposals.

Information needed with a request for support

- 1. What will the proposed project bring about and how will it help achieve priorities for (identifiable) end users?**
 - Clarity on who, how and what – especially the intended outcome and, importantly, the expected impact
- 2. Has the proposal been shaped to reflect requirements and with whom?**
 - Early engagement with stakeholders is key to ensure connection and consideration of wider requirements
- 3. What level of resource commitment is appropriate for the lifetime of the work and why?**
 - Often this includes thought about the time required after completion of the research to help support research transfer into practice
 - A justification of ‘why’ any support should be provided is very helpful
- 4. What type of support is appropriate (for example, data licensing, formal agreement, letter of support, part of governance)?**
 - An indication of preferred wider stakeholder engagement is preferable, including time estimates
- 5. What sort of engagement is expected in steering the research (for example, technical or strategic, weekly or monthly)?**
 - An understanding of what sort of difference any engagement can have on the project has become increasingly important as some research has been difficult to steer
- 6. How can we support uptake of the research?**
 - Clarity on whether the outputs are usable and how
 - An understanding of who needs to be involved is key
 - A transition plan is very useful
- 7. How successful could the research be?**
 - A good and clear understanding of the potential findings is important
 - Communication plans are very helpful
 - Outline any considerations for any further outputs to be exploited

We do need good time to properly assess proposals and cannot respond to last minute requests. We are planning to produce an assessment form which can be completed in part by the proposer and would welcome any comments on our information needs, as we develop this. .

For further information on these partnerships please refer to:

- Infrastructure Transitions Research Consortium www.itrc.org.uk
- Blue/Green Cities www.bluegreencities.ac.uk
- Finding ways of promoting SME adaptation to flood risk (SESAME) www.sesame.uk.com
- FloodMemory <http://gow.epsrc.ac.uk/NGBOViewGrant.aspx?GrantRef=EP/K013513/1>
- FCERM-net www.FCERM.net
- LWEC Implementation Phase www.lwec.org.uk
- Rain Gain www.raingain.eu
- EU FloodProBE <http://www.floodprobe.eu>
- (FAST) Foreshore Flood Analysis using Sentinel Satellite Space Technology www.geog.cam.ac.uk/research/projects/foreshoreassessment/
- RISC-KIT www.2020-horizon.com/Coasts-at-threat-in-Europe-tsunamis-and-climate-related-risks-i896.html
- Flooding from Intense Rainfall www.reading.ac.uk/geographyandenvironmentalscience/Research/ESS/ges-SINATRA.aspx
- Integrating Coastal Sediment Systems (iCoast) www.icoasst.net/
- DIAbatic influences on MESoscale structures in extratropical sTorms (DIAMET) www.bgs.ac.uk/stormrm/diamet.html
- Reliable www.nerc.ac.uk/research/programmes/pure/background.asp
- Testing and Evaluating Model Predictions of European Storms (TEMPEST) www.bgs.ac.uk/stormrm/tempest.html
- Credible www.nerc.ac.uk/research/programmes/pure/background.asp
- Developing enhanced impact models for integration with next generation NWP (DEMON) www.bgs.ac.uk/stormrm/demon.html
- Natural Hazards Partnership www.bgs.ac.uk/research/naturalHazardsPartnership.html#partners
- Communicating Risk: For Understanding, Belief, Ownership and Action www.sciencewise-erc.org.uk/cms/public-communication-and-engagement-on-risk/
- British Library Envia Project www.envia.bl.uk
- UWE - Centre for Floods, Communities and Resilience www1.uwe.ac.uk/et/research/cfcr



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Research outputs published in the last year

- **Aug 2014:** [Flood Risk Asset Inspection: Research to Improve Interventions](#) (SC110008)
- **Aug 2014:** [Working With Natural Processes Research Framework](#) (SC130004)
- **July 2014:** [Aquatic and Riparian Plant Management: controls for vegetation in watercourses](#) (SC120008)
- **May 2014:** [Framework and Tools for Local Flood Risk Assessment](#) (SC070059)
- **May 2014:** [Guidance for Beach Modelling Based on Desk-based Performance Analysis of Existing Schemes](#) (SC110004)
- **April 2014:** [Flood Risk Management Partnership Funding Evaluation](#) (FD2663)
- **March 2014:** [Flood Resilience Community Pathfinder Evaluation: Rapid Evidence Assessment](#) (FD2664)
- **Oct 2013:** Worked example – [Assessing Flood Risk in Pumped Catchments](#) (SC090006)
- **Oct 2013:** Revision - [Rainfall Runoff Management for Developments](#) (SC030219)
- **Sept 2013:** Webinar – [Updating the River Restoration Centre Manual of Restoration Techniques](#) (SC110027)
- **Sept 2013:** Webinar – [Updating the Water Framework Mitigation Measures Manual](#) (SC120019)
- **Aug 2013:** [Modelling with confidence - benchmarking the latest generation of 2D models](#) (SC120002)

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