NERC PURE Associates: Harnessing Science for Improved Risk Assessment

Aim of the call: NERC is keen to enhance the impact of its investments by facilitating the take up of NERC science and expertise related to risks from natural hazards. The purpose of this call was to invite a broad range of applicants from the NERC community, to enable new partnerships and collaborations with business, policy-makers and NGOs and encourage researchers to work on short (3-6 month) user-focussed projects.

The focus of the call was for projects:

a. To produce robust risk assessments based upon single or multiple natural hazards that integrate measures or models of exposure and vulnerability; this will enable decision-makers to take action to manage risk
b. To develop tools to support decision-making under environmental uncertainty.

Funded awards (October 2013)

Application title	University	Associate	User organisation	Cost
Expanding the use of meteorological forecasts for health protection through improved visualisation of skill and uncertainty	University of Reading	Dr G Masato	Public Health England	19,091
Probabilistic forecasting for managing weather risk and uncertainty in energy applications at extended (monthly) range	University of Reading	Mr K J Lynch	Centrica plc	19,590
Early warning and risk assessment of shellfish toxicity	Scottish Association for Marine Science	Dr C Whyte	Seafood Shetland	22,377
Risk visualisation and quantification for enhanced disaster risk reduction	University College London	Mr R J Wall	Catholic Agency for Overseas Development	24,937
Satellite-based rainfall estimates in Weather based Index Insurance (SatWin)	University of Reading	Mr R Maidment	MicroEnsure	25,784
Enhancing Calculation and Communication of UK Wild Fire Danger Forecasts in Support of UK Fire & Rescue Service Wildfire Response, Landowner Prescribed Burn Planning and UK Land Access Management	King's College London	Mr M DeJong	Met Office	25,057.37
Tools and guidance for covariate analysis of flood and wave threshold exceedances: moving from research to application	Lancaster University	Mr R Towe	JBA Trust Ltd	22,904
A model for standardised pest and disease risk assessment of UK forests for carbon buffer and	University of Edinburgh	Miss S A Davies	Forestry Commission	21,254

insurance purposes				
Embedding future projections of climate and extreme hydro-meteorological events into strategic risk management and decision making	University of East Anglia	Dr J T Price	Maplecroft	27,571
Emergency events and vulnerable people: Harnessing science to practice	Durham University	Dr J Wistow	Public Health England	21,334
Operational probabilistic flood forecasting model or the Karnali River Basin, Nepal - Collaboration between Lancaster University and Practical Action Consulting	Lancaster University	Dr P J Smith	Practical Action Consulting	25,915
Flood Awareness Through Engagement (FATE)	Heriot-Watt University	Mr S Owusu	Scottish Government	15,685
Developing a risk assessment approach for forest fire at the rural-urban interface: potential of the wildfire threat analysis framework	University of Manchester	Dr A Kazmierczak, Mr J Aylen, Ms J M McMorow	Forestry Commission	33,175
Visualisation of climate model output and uncertainties for the DECC 2050 Global Calculator	London School of Economics	Dr E L Thompson	Department of Energy and Climate Change (DECC)	26,452
Improving the safety of RNLI operations through better use of probabilistic weather information	London School of Economics	Mr E W Wheatcroft	Royal National Lifeboat Institute (RNLI)	28,022
Incorporation of parameter uncertainty into estimates of distributions of future hurricane damages	University College London	Mr X M Liang	RMS	22,616
An NGO Administered Near Real Time Aftershock Forecasting Tool for Humanitarian Risk Assessment and Emergency Planning	University of Ulster	Ms Kiera Quinn, Dr Abigail Jimenez Lloret	Concern Worldwide	29,360.50
Statistical model to predict the risk of clogging of Torness station water intake by marine species	University of Oxford	Mr A W S D van Lennep	EDF Energy	23,122
"Volcanomics". Trialling analysis of eruptive scenarios via economic and probabilistic approaches on Tristan da Cunha and its application to decision support	University of East Anglia	B Andrews A Hicks	FCOOTD	23,260 18,904
			Total	**£476,410.87**

Project Summaries

Expanding and improving environmental heat and cold-stress forecasts.

Giacomo Masato and Andrew Charlton-Perez (University of Reading), Virginia Murray (Public Health England)

This project aims to enable Public Health England (PHE) to make more accurate and focused alerts to the public and to other government departments for heat waves and cold snaps, by making better use of the more detailed information available in the Met Office forecasts. The NERC PURE Associate will begin by working with PHE to understand the temperature ranges that need alerts and the spatial and temporal scales over which accurate alerts would be valuable. Then the skill level for this purpose of different forecasts from the Met Office models will be calculated, and finally visualisation tools will be developed and presented to PHE along with recommendations for their use in alerts.

Probabilistic forecasting for managing weather risk and uncertainty in energy applications at extended (monthly) range.

Kieran Lynch and David Brayshaw (University of Reading), Matt Dodwell (Centrica)

The aim of this project is to develop a tool that will enable long-range probabilistic weather forecasts of wind-power output to be communicated to Centrica's Energy trading team. This team needs robust and accurate long term wind power forecasts, and an assessment of their uncertainty, to optimise their asset positions and inform their trading decisions. Long range wind power forecasts also inform off-shore physical maintenance and scheduling decisions.

Mr. KJ Lynch, who is part of the team at Reading will lead the development of the aforementioned tool. Underpinning this tool is science that forms the core of Mr. Lynch's PhD studies on being able to more accurately quantify the uncertainty in long rage wind power forecasts (up to 3 weeks in advance).

Early warning and risk assessment of shellfish toxicity.

Cullum Whyte and Keith Davidson (SAMS), Ruth Henderson (Seafood Shetland)

The EU FP7 project Asimuth has proved the concept of using alert bulletins to alert the aquaculture industry to harmful algal bloom (HAB) generated risk. Bulletins synthesise data streams generated by HAB and associated shellfish biotoxin monitoring. This project will build on that proof of concept to allow these prototype bulletins to be developed to a level suitable for weekly distribution to the aquaculture industry in the largest rope grown mussel harvesting region in the UK, the Shetland Isles. The work will analyse historical records of HABs and shellfish toxin levels in

Shetland, to better understand how these relate to current environmental conditions. It will also develop improved data-assimilation methods. Real-time risk presentation methods will be developed and demonstrated to the Shetland shellfish industry, with the aim of leading to a service whose running costs could be funded by the industry.

Risk visualisation and quantification for enhanced disaster risk reduction.
Richard Wall and Stephen Edwards (UCL), Kate Crowley (CAFOD) and Michael Spranger (AON Benfield).

The disaster management cycle includes mitigation, prevention, preparedness, response and recovery. Development agencies have long term, proactive goals that address underlying risk factors. Humanitarian agencies target short term disaster response. Disaster Risk Reduction (DRR) aims to reduce risk throughout the disaster cycle and so is key to bridging the agency gap.
Absence of rigorous scientific hazard assessment is a recognised weakness in DRR strategies, which could be addressed through private sector solutions. This project will pilot a risk visualisation, quantification and modelling tool called ImpactOnDemand in the context of Cambodia in order to build on existing community level work in that country, so assisting with effective organisational humanitarian decision making.

Satellite-based rainfall estimates in Weather based Index Insurance (SatWin).
Ross Maidment and Emily Black (University of Reading), Ulrich Hess (MicroEnsure)

Weather based index insurance (WBII) is accessible to millions of farmers in Africa. It pays out if a weather-based index is breached, rather on a proven loss. However, WBII is limited to areas with reliable rain gauges and the insured variable (rainfall) is just a proxy for agricultural/financial loss.
To address these limitations, the project will use a new 4-km resolution satellite-based rainfall dataset to carry out hazard risk assessments for excessively high and low rainfall anomalies in Africa and so identify robust insurance indices. These assessments will be embodied in a decision support tool for risk managers. The project will focus upon Zambia, but its use will later be extended to other data sets and regions.

Enhancing calculation and communication of UK wild fire danger forecasts in support of UK fire & rescue service wildfire response, landowner prescribed burn planning and UK land access management.
Mark Dejong and Martin Wooster (KCL), Karl Kitchen (Met Office)

Under certain meteorological conditions, wildfire becomes a significant risk across many areas of the

UK. Multiple ignition sources can lead to extreme stresses on many UK Fire and Rescue Services (FRS). With fire management events, payback from optimal deployment of resources is greatly magnified when one considers that we may be preventing a small fire from getting out of control and becoming a major event. This project will combine a research level understanding of the spatial controls on 'fire danger' and fire behaviour, a probabilistic approach to classifying risk and an understanding of the propagation of uncertainty to build significant enhancements in the current Fire Severity Index information and 5-day forecasts produced by the Met Office. This will allow the Met Office to provide new services to new clients, namely UK Fire and Rescue Services, UK landowners in relation to prescribed burns and the relevant authorities controlling public land access.

Tools and guidance for covariate analysis of flood and wave threshold exceedances: moving from research to application.

Jon Towe and Jonathan Tawn (University of Lancaster), Rob Lamb (JBA Trust)

The project will address a problem of improving the precision and scientific robustness of probability estimates for extreme floods and water levels, specifically for river flooding and offshore sea level/wave extremes. The project team will develop a tool that will encourage transfer of advanced statistical techniques to wider industry applications in flood risk and offshore engineering. The tool will enable risk analysis in trialing and experimenting with advanced statistical methodology for the analysis of threshold exceedance data.

A model for standardised pest and disease risk assessment of UK forests for carbon buffer and insurance purposes.

Susan Davies and Genevieve Patenaude (University of Edinburgh), Pat Snowdon (Forestry Commission)

Pests and diseases are one of the largest causes of forest loss and damage. The Forestry Commission needs a scientific way of assessing these risks, for compliance with the Woodland Carbon Code (WCC). This project will develop a risk model for the WCC portfolio, through assessing the risks from the main pests and diseases threatening key species within this portfolio (likely to be those that constitute over 2%). The utility of this will be tested using WCC projects as case studies. The project will also utilise insurance expertise from a related NERC sponsored project - the Forest Finance Risk Network. Since insurers face similar issues with regard to assessing the risk to UK forests, it is hoped that the model may subsequently find wider application in this sector.

Embedding future projections of climate and extreme hydro-meteorological events into strategic risk management and decision making.

Jeff Price and Stephen Dorling (UEA), James Allan (Maplecroft)

The project aims to help businesses, humanitarian organisations and NGOs improve their strategic and operational risk assessments in relation to the potential impacts of climate change upon natural hazards. In particular, the project will develop metrics to communicate uncertainty in projections of climate and extreme hydro-meteorological events.

Models will be developed for characterising and quantifying uncertainty at a global level and will be directed towards agricultural production and businesses. Methods for processing and visualising relevant datasets will be established to support innovative tools for decision making.

Extreme events and vulnerable people: Harnessing science to practice.

Jonathan Wistow and Sarah Curtis (University of Durham), Virginia Murray (Public Health England)

This project involves collaboration between the Extreme Events and Health Protection team in Public Health England (PHE) and Researchers at Durham University. The aim is to enhance dissemination of PHE guidance relating to extreme weather events, such as heatwave, cold weather or flooding, to local authorities, health and social care organisations, careworkers and community representatives, in neighbourhoods and communities at local level. Anticipatory plans based on this guidance can lead to more complete preparedness, emergency response and recovery from such events. The project will use experience from previous research to elaborate a new toolkit designed to assist in the communication of guidance and public health messages across local communities of practice and the public. The research will explore how PHE guidance is locally interpreted and whether there are barriers to embedding the guidance in local practice.

Operation probabilistic flood forecasting model of the Karnali River Basin in Nepal.

Paul Smith and Keith Bevan (Lancaster), Sarah Brown (Practical Action Consulting)

The aim of this project is to develop and deploy a probabilistic forecasting system of the river levels at the Karnali River Basin in Nepal, which is prone to flood related disasters. This work will complement Practical Action Consulting/Practical Action's wider work on building national, sub-national and community resilience through improving early warning, disaster preparedness and disaster risk reduction.

Using historical data collected from the Karnali basin, the team at Lancaster Environment Centre lead by Dr. Smith will develop a suitable probabilistic forecasting model of the river levels. This

model will form a part of a wider system to provide suitable visual summaries of the probabilistic forecast information required by both expert and non-expert users.

Flood Awareness Through Engagement (FATE).

Seth Owusu and Grant Wright (Heriot-Watt University), Debi Garft (Scottish Government)

Flood risk awareness raising and education is an essential part of the Scottish Government's approach to sustainable flood risk management. This project seeks to build on existing work by communicating scientifically robust information about flood risk and uncertainty to the general public in a novel and accessible manner. This will be achieved using a physical interactive tool, which will be trialled at the Glasgow Science Centre with the aim of increasing public awareness of the issues surrounding flood risk and empowering people to take actions to manage their flood risk.

Developing a risk assessment approach for forest fire at the rural-urban interface: potential of the wildfire threat analysis framework.

Aleksandra Kazmierczak, Jonathan Aylen, Julia McMorow (University of Manchester), Rob Gazzard (Forestry Commission)

This project aims to develop a framework to assess, understand and manage wildfire threats and impacts in forests and at the forest-urban interface, and to start to translate this knowledge into a spatial modelling tool. It builds on the combined expertise of the project partners from the University of Manchester, Forest Research and Forestry Commission England to combine two widely used conceptual models: Wildfire Threat Analysis (WTA) and the Crichton risk triangle.
The two frameworks show strong synergies and, when combined, would present forest managers with a powerful tool for assessing fire impact. It can be used by forest managers and other stakeholders for strategic decision making. The project will refine the proposed framework, scope the appropriateness of the various GIS data layers, investigate the availability of data and sources of uncertainty, and communicate the key uncertainties to stakeholders.

Visualisation of climate model output and uncertainties for the DECC 2050 Global Calculator.

Erica Thompson and Leonard Smith (CATS, LSE), David Mackay (DECC)

The UK Department of Energy and Climate Change (DECC) is tasked with ensuring affordable, reliable energy supply to the UK within binding carbon targets. The DECC 2050 Calculator is a user-friendly online tool that provides a number of levers for possible mitigation actions (e.g. more or less nuclear, travel by road, etc). It provides a visualisation of energy use and resulting carbon emissions allowing people to see the impacts that result from different pathways.
The proposed Global DECC calculator extends the idea of a country specific calculator to the world, and to the extent possible will include climate impacts. This project will prototype a tool to visualise

the output and uncertainties in possible climate trajectories, reflecting the strengths of the basic science while admitting the ambiguity in the detailed outcomes. The aim is to visualise our foresight today, making clear the time and length scales over which various simulations are robust and actionable. Available online with a transparent discussion of its strengths and weaknesses, it is hoped that the visualiser will raise awareness with the general public, promote engagement with the challenges we face, and feed into evidence-based policy and decision-making by governments, the private sector, citizens, and others.

Improving the safety of RNLI operations through better use of probabilistic weather information.

Ed Wheatcroft and Leonard Smith (CATS, LSE), Cath Reynolds (RNLI)

RNLI is the charity that saves lives at sea. Every year, volunteer lifeboat crew are called out around 8,000 times. Difficult operational decisions about what a lifeboat is capable of in rough seas sometimes have to be made. This project aims to provide a risk visualisation tool to help inform these operational decisions by combining academic work around weather risk analysis with RNLI knowledge and data about incident rates. The project should also determine time-scales on which existing weather forecast products might better inform RNLI activities.

Incorporation of parameter uncertainty into estimates of distributions of future hurricane damages.

Ken Liang and Richard Chandler (UCL), Steve Jewson (RMS London)

This project is motivated by the need to better represent epistemic uncertainty in hurricane damage modelling. It will develop and publish methods for the incorporation of parameter uncertainty into three key components of the RMS hurricane model, and then examine the impact of that uncertainty upon the estimated distribution of financial losses. The three components are: long-term event rates, the relationship between interannual fluctuations of hurricane numbers and sea surface temperature, and the method of conversion of hurricane numbers to landfalling counts. The project will also address the issue of statistical model selection according to the availability of data and the level of understanding of process mechanisms.

A near real time aftershock forecasting tool for humanitarian risk assessment and emergency planning.

Kiera Quinn, Abigail Jimenez Lloret, John McCloskey, Max Hope, Sandy Steacy, Paul Dunlop (University of Ulster), Dominic Crowley (Concern Worldwide)

Concern Worldwide is an international humanitarian organisation that works with communities in the poorest countries of the world, including those facing significant earthquake risks. We cannot

predict earthquakes but we are increasingly able to give accurate near real-time forecasts of the intensity and spatial distribution of aftershocks. This project will develop a set of software tools to make near real-time assessment of aftershock hazard in near real time during the emergency response phase and explore its potential to inform humanitarian emergency planning and response activities. Concern Worldwide is working with the University of Ulster Geophysics Research Group to develop this prototype aftershock forecasting tool and potentially integrate it into existing disaster risk reduction systems and training programmes. In addition to developing the tool, conducting detailed testing, and developing guidelines and protocols for its application, the project will deliver a support programme to build humanitarian capacity in tool use.

Statistical model to predict the risk of clogging of Torness station water intake by marine species.
Alexis Van Lennep and Patrick McSharry (University of Reading), Arnaud Lenes (EDF Energy)
Torness power station has been operational for 25 years and has records over that time of the history of partial blocking of the seawater intake by jellyfish or seaweed. This project will correlate those records with the records of weather conditions and other relevant environmental parameters over the period, to develop a statistical model. This can then be used in future with weather forecasts and other environmental forecast information to provide 24--48 hour warnings of such clogging.

"Volcanomics". Trialling analysis of eruptive scenarios via economic and probabilistic approaches on Tristan da Cunha and its application to decision support.

Barnaby Andrews, Anna Hicks, Jenni Barclay and Ian Bateman (UEA), Laura Benyohai (Tristan da Cunha disaster advisor)
Tristan da Cuhna is a remote active volcano in the South Atlantic Ocean. The project aims to assist in the development of the most effective way to improve planning and preparedness for a volcanic emergency, in order to take timely and cost-effective decisions. The project will condust a self-contained pilot study and the approaches developed will have a wider and generic applicability to volcanic risk management and decision- and policy-making.