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Conference report

Building global resilience to natural hazards: Translating science into action

Monday 28 – Wednesday 30 January 2013 | WP1197

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Emerging themes

- There is a need for better links between scientists, whose ever improving skills and analysis can help predict and forecast the nature, scale and anticipated impact of natural hazards, with those policy makers, planners, NGOs, affected communities and others who need that information communicated effectively to help them prevent disasters and reduce their impact in the short and longer term.
- A number of UK reports over the last two years as well as a number of international documents all state the need for greater scientific input to avert disasters from having such a major impact. These reports include the Foresight Report Reducing Risks of Future Disasters: Priorities for Decision makers' (published November 2012)[1]; The Use of Science Advice in Humanitarian Emergencies and Disasters (the SHED Report of June 2012)[2] and the Humanitarian Emergency Response Report (HERR, March 2011)[3].
- Major advances in predictive and multi-disciplinary science, allied to communication technologies are providing unprecedented opportunities for disaster risk reduction and tackling humanitarian emergencies. More could be done without a lot more new science.
- The importance of both physical sciences and social sciences working together to contextualise natural science messages so that an understanding of how local communities work and organise themselves, such as the way messages filter down through societies, power relations and gender biases, is crucial for the science and forecasting to embed into local community networks.
- The multifaceted nature of disasters which are seldom the result of a single hazard, requires the need to move away from mono-disciplinarity to an inter-disciplinary view, but the incentive structures of the different communities present significant barriers to this. Multi-disciplinarity is not rewarded within the academic field where peer review from colleagues, a research infrastructure that favours mono-disciplinary excellence plus entrenched views on research justifying itself as an exclusively intellectual pursuit can dominate.
- Scientists should not to be afraid of communicating uncertainty, especially to local communities who are used to dealing with uncertainty on an almost daily basis. More emphasis should be given to the probability of an event occurring rather than focus on uncertainty. The reliability of the probability is what will play a significant role in influencing whether people respond to a forecast or early warning and this takes time to establish. Better understanding by scientists about what information the 'local mayor' might need in order to prevent or prepare for a forthcoming disaster for example is recommended.
- The role of IT, mobile technology and social networking has enhanced communication channels both downstream and upstream. Forecasts can be

distributed by SMS to farmers, fishermen and communities. Real time information can be provided by affected communities as a disaster evolves via mobile phone (crowdsourcing) for an over view which could inform how resources are deployed. Care needs to be taken not to rely on the latter, as in the case of many earthquakes and tsunamis, the mobile infrastructure is often compromised.

- An awareness of the role that communication and language play when communicating complex scientific messages across sectors and communities is critical. The science is not useful unless these messages are communicated in a manner, and delivered by trusted agents, that ensure the messages are understood and accepted.
- There is insufficient bottom up, demand driven research currently. More needs to be done to engage with those that require the information to make better decisions that might affect their livelihoods in an impending disaster. The issue of adaptive capacity of communities as well as knowing the right questions to ask and knowing what information is required is a difficult landscape to chart. It is therefore vital that scientists engage more with what is required rather than what they want to do their research on.
- Regional institutions and infrastructures can play an important role in facilitating exchange of experiences and knowledge, and have the convening power to free up information across borders which can be pooled in centralised databases, build capacity and foster partnerships.

Introduction

1. Disasters, caused by a combination of natural hazards, extreme weather events and poor social conditions have increased exponentially over the last Century. The first 10 years of the 21st Century have incurred a loss of life and property higher than the whole of the 20th Century and the humanitarian and science communities are on tenterhooks awaiting the inevitable 'one million deaths' event. Climatic changes, and the increasing incidence of unprecedented extreme weather, allied to rapidly changing demographics of population growth and location are creating increased risks. So what can be done to postpone such an outcome of an event, or even prevent a hazard from causing such devastating loss?
2. Adaptive capacity is the core to resilience; if the capacity to respond at a local level is poor then the whole system fails. In order to enhance this adaptive capacity a number of systems and knowledge need to be in place at all levels. The critical interdependence of the components of a disaster mean that people are required to step 'outside their boxes' which is not always easy to do, particularly within the scientific/academic community and government. Institutional frameworks and incentives often hinder a multifaceted approach; combine this with different levels of capacity and modalities across nations and the seeds are already sown for a fractured approach and response.
3. Disaster Risk Reduction (DRR) is gaining greater traction within the humanitarian community. Many of the activities that build communities' ability to cope with shocks have, however, been at the core of development research for the past 50 years. Given the fact that for every $1 dollar invested in DRR nets a $40.85 benefit over a 10 year period (World Bank), more prominence needs to be given to this aspect of humanitarian action and an elision of the two communities – development and humanitarian - should be fostered more pro-actively, with the existing research mined for its relevance to disaster risk reduction. Greater linkage is also needed between DRR and climate change adaptation for tomorrow's hazards is needed.
4. The role of science in the humanitarian effort has gained increasing prominence with the rise of relatively new disciplines such as plate tectonics, advances in medical

science and a recognition that the application of scientific knowledge is different to the production of scientific knowledge. However, despite this recognition there is still a fracture between the various stakeholders in this process.

5. There is certainly a need for better science, however, there is a vast repository of science knowledge that is not being put to use effectively and where 'good enough' science will have as much of a beneficial impact as chasing the holy grail of perfect science. Waiting for the holy grail could mean a loss of many lives and it is charting a course between satisfying criteria of rigour versus what will be good enough to 'do the job' that presents much of the problem for humanitarian practice.

Integrated, holistic and multi-disciplinary approaches

Multi-disciplinary

6. The science that contributes to an understanding of hazards and their effects is but one part of the whole. There are many other contributing elements that play a role in alleviating the impact of a disaster that bring in a wide range of stakeholders. For example, earthquake resistant buildings require the input of planners, architects as well as an understanding of how people actually live their lives and manage their livelihoods. This requires an integrated, inter-disciplinary approach that is in conflict with how science producers are incentivised within the academic world. Mono-disciplinarity is still accorded far higher esteem and rewarded more than multi-disciplinarity, thus the breaking down of silos is left to those scientists working on best endeavour. More needs to be done, therefore, to formalise a recognised multi-disciplinary framework within which actors can contribute rather than the ad hoc initiatives which currently exist.

7. This need for integration is not just expressed within academic circles. The role of regionally integrated networks such as the Association of South East Asian Nations (ASEAN) are regarded as important in being able to collate information across borders because the impacts of many hazards rarely confine themselves neatly within national boundaries[4].

Incentive and drivers

8. Incentives shape the way people work and operate. They are the drivers of career progression, esteem amongst peers and the framework within which each sector defines success. With the number of actors revolving around a disaster, these differing incentives do not align and this can hinder the efforts of the collective to move forward in a disaster. Academics are subject to rigorous peer review, are defined by their publication track record and how many times their work is cited in other publications. Humanitarians are subject to harsh scrutiny by the media, their funding public and increasingly the governments that fund them.

9. The timeframes within which both sets of actors work differ enormously. Academic research rarely gets to publication within the year of the research being completed, because of the peer review process, and yet humanitarians need access to the latest evidence immediately. Academics are reluctant to express opinions until their research has been verified by their due processes.

10. The media are driven by the commercial imperative to attract as large a circulation of readers as possible. The temptation for many is therefore to be light on fact and heavy on headline, with often misleading and irresponsible messages coming out as a result.

Interpreting science and translating it into action

11. The physical sciences required to predict and forecast hazards cannot benefit communities at risk unless those forecasts and predictions are translated into a form or language that the recipient communities can understand. In order to provide relevant

messages, the way in which communities live and work has a bearing on how they will receive, act upon and inform their decision making. This involves the social and behavioural sciences and those programmes that combined a mix of physical scientists, social scientists and local agents were agreed as being successful in bringing about lasting change in this area. The example of longer term ensemble flood forecasting in Bangladesh combined a team of scientists, communicators, IT specialists and those with local knowledge to produce an easily understood forecasting communication tool so that farmers are able to make decisions on whether to harvest earlier before the predicted flood or plant later once the flood had subsided.

Regional Integrated Multi-hazard Early Warning Systems for Africa and Asia (RIMES) Flood Forecasting

The RIMES flood forecast provides information about the onset of flood, duration, and dates of flood recession. The forecast offers sufficient lead time to interpret and translate information, particularly for farmers, through established communication channels such as a short message service (SMS) bulletins and flood pillars. Evaluation of this project's impact among target households reveals that an average of 18,637 Bangladeshi Taka has been saved per household due to the increased lead time to implement flood mitigation strategies.

RIMES places particular importance on making its forecasts user friendly at all levels. It also works to build capacity at all levels by working through national and local level institutions in each member states by:

- Strengthening warning provider – user interface through multi-stakeholder early warning forums;
- Building capacity of users in translating warning information into impact outlooks and response options, and their application in making decisions to reduce disaster risks;
- Improving communication of disaster risks;
- Enhancing community responses to warning information;
- Providing user feedback to warning information providers for improving warning products and systems.

www.rimes.int

Weather forecasting

12. The science behind weather and climate forecasting is increasing rapidly from weekly forecasts to monthly and seasonal forecasts, and longer term climatic change. Enhanced risk models can help longer term forecasts, and a key aim is to ensure that the meteorological forecasting becomes seamless (from the short-range to longer term forecasting). Predictions about the El Nino are improving for example. The use of models by the UK Met Office can now show to as local as 1.5km. Bespoke forecasting models by the Met Office, such as that to forecast the direction and severity of Typhoon Bopha in the Philippines (December 2012), or help fisherman in Lake Victoria are examples of where the forecasting by the scientists now needs to be part of a multi-disciplinary approach to interpret the forecast into action to reduce risks.

Predicting earthquakes and volcanoes

13. There are 1.5 million earthquakes around the world every year of which 150 are magnitude 6 or above, and 1 or 2 per year are magnitude 8. Chile, for instance, has a magnitude 8 earthquake every 10 years or so. Whilst plate tectonics has been known for 40 years, earthquake science is still in its relative infancy compared to the maturity of weather forecasting. Predicting volcanic activity of those volcanos at biggest risk has

improved, but it is still difficult to predict how long a volcano will be active or when the climax will be. Even if the threat is known to scientists what do local communities know, for example the Haiti earthquake in 2010; or does Jamaica know that it could be next in line?

Developments in the science

14. Significant advances continue to be made in climate and physical science that can improve forecasts and better assess probabilities in the short and longer term. There is also much greater linkage of different sciences, such as meteorology and hydrology. The case of assessing flood risks in China was cited as one example of many; also the development of storm models in Brays Bayou, Houston by Rice University using weather radar (rainfall measurements), physics based distributed hydrologic modelling (to provide detailed predictions of flow at critical times of a storm) and IT to transmit real-time alerts to those at risk. New technologies and use of modelling, mapping, data from radar, satellites and imagery are all contributing to improving scientific forecasting. The key is for different scientific disciplines to work together and to learn from one another.

Social science and community memory

15. Low frequency, high impact disasters present a problem as there is little in the way of community memory on what the impact might be. Historical records are a useful tool that can be used in schools to teach children and their families what happened. For example, the last earthquake in Bangladesh was in 1897; if an earthquake were to hit Bangladesh now, there will be no awareness of its impact or how to respond. Aceh, pre-2004, was virtually unaware of tsunamis, the last major one having struck in the 1400s and before that prior to 900AD. These events therefore lose even generational memory and no local knowledge is building up. ASEAN countries, however, are now working on a historical disaster database.
16. The flipside of the history coin is that the past should not be used to define the future. Future scenarios will be much worse as populations are increasingly drawn to urban centres, high rise buildings proliferate and marginalised communities are pushed out to flood plains, areas prone to landslides and lacking sufficient voice to challenge a poor building regulatory environment, notwithstanding the impact of climate change as extreme weather events increase.

Disaster risk reduction and the humanitarian/development nexus

17. Disaster Risk Reduction and development activities, when viewed at the local community level do not differ to the extent that donors and actors in the West/North have constructed. Talk of a humanitarian or development focus has led to a fracture of those communities in the North working on these issues. The donor community has also not helped in this regard, with budget lines that run under specified allocations for humanitarian or development activities. This has to change and with the current focus on resilience, an ideal opportunity presents itself around which the two communities can coalesce and learn from each other.

Compartmentalisation and fragmentation

18. The complexity of a disaster requires a range of skills, interpretations and experience when considering the response. No one event causes a disaster. Whilst a specific hazard such as an earthquake will hit a specific area it is the fact that people are living there that is the disaster ("Mother Nature did not bring these 20,000 individuals to this place" Voltaire). This is more often than not magnified by the fact that poorer sections of a population live on marginalised land (prone to landslips) and are less able to police aspects such as building regulations.
19. All these aspects, therefore, need to inform the response to disasters. The complexity of forecasting, plus the inherent risks of communicating probability, uncertainty and risk

itself require many different sciences and skills. Because of the incentive structures within the scientific research communities, there is still too much being done from a single perspective. The landscape is improving with the recognition of inter-, trans- and multi-disciplinarity for such applied situations found within the humanitarian and development sectors, but the research infrastructure has a long way to go before it truly breaks down the mono-disciplinary silos.

20. There needs to be a greater focus on human behaviour. Human beings are not rational – even when possessed of the facts and it is frequently the case that scientists are viewed with some suspicion. The case of a scientist working in Indonesia using a tsunami measuring device demonstrates that in Irian Jaya, where there were no tsunamis, the local communities welcomed him because they felt his 'box' prevented the tsunamis, however in Sumatra, where there are frequent tsunamis, he was not welcome because those communities thought his 'box' caused the tsunamis.

Communication

21. Communication comes in many forms; from communicating complex scientific messages to specific at risk communities, managing the media to deliver responsible messages and the use of IT/Social Networking for gathering data on emerging crises and responses through crowdsourcing.

22. Language plays a large role in communication and examples were given where materials produced in French were largely ignored by the most at risk communities, who subsequently requested the materials be translated into their local language. Had more time been spent on consultation with the local community in this case, both time and resources would have been saved.

23. Even with those speaking the same national language, the different languages of individual sectors can cause misunderstandings. Partners may be talking about the same end result or activity, but in using different acronyms, methodologies and words, confusion arises and an unnecessary barrier is created. The role of facilitation and mediation under these circumstances can be useful to tease out the underlying messages to reach a common understanding.

24. Another important constituent in the communication process is the 'messenger'. The role of trust is crucial. Those undertaking the communication have to be trusted for their messages to be understood. Emphasis was given to the 'Local Mayor Test'; what was it that the local Mayor needs to know in order to inform his/her citizens. Consideration also needs to be given to the fact that local politics can impact on scientific translation. An understanding of how local politics work, social constructs and power relations is therefore a critical part of the communications process. An example was given of Chief Kariuki in Kenya who is using Twitter to keep in touch with his district of North Nakuru – the local population can tell him what they want and he responds. He now has a following of over 16,000 people who value his work and opinions. He has therefore become a trusted messenger and champion of public good. In a disaster, his community would act on his advice[5].

25. The role of communication is seen as both an opportunity and a constraint to furthering the impact of science in building resilience and enhancing response. On the one hand, communication intermediaries can create misunderstandings by either oversimplifying messages or not fully communicating them correctly for the relevant audiences. On the other hand, it is acknowledged that many scientists have a unique way of communicating their research that is not necessarily easily understood by those outside that particular branch of science. A recognition of each parties' capabilities with regards to communication therefore needs to be acknowledged, and expectations managed in terms of what each party can achieve alone. In an ideal situation, when scientists are involved all the way through a programme, the results are much better as all parties gain a greater understanding of each other's capacity, style and ability both to send out and receive communication of scientific messages.

Applying science to flood mitigation in Houston

Houston plays host to the largest medical facility in the world. It is also subject to frequent storms where up to 30 inches of rain can fall in 24 hours (Tropical Storm Allison 2001). Although there were mitigation / defence structures in place in the form of storm gates, they took 5 hours to close, by which time the basement and all infrastructure housed within, such as electrics, computers, air conditioning etc had been flooded. Several issues needed to be addressed following this disaster, among which were:

- The need for rebuild guidelines to take account of the fact that the basement and first floor of the hospital could be flooded;
- How to use the second floor and above to maintain circulation throughout the building and keeping the maintenance systems well above the flood level;
- How to take responsibility on the decision to close down a hospital? Prior to 2001 all the institutions were in competition, so there was no incentive to assist each other. Post 2001, this changed and a protocol was signed by all parties;
- How to deal with false alarms and the potential loss of credibility if nothing happens? This was also dealt with in the protocol which outlines measures that have to be followed. By signing the protocol all parties bought into this thereby negating any kind of conflict.

Uncertainty, risk and probability

26. The insurance industry has done a lot of work on mapping risk. Up to now much of this has remained in the private sector but increasingly there is a recognition that this information can serve more of a global public good, such an example being the development of a global earthquake model by OECD countries, insurance and reinsurance companies.

Multi-hazard risk assessment for disaster reduction in China

A consortium of institutes and government agencies have developed an integrated hazard map for China, mapping 13 different types of disasters, disaggregated so that local planners can plan for disasters relevant to their area. The aim between 2011 and 2015 is to achieve disaster losses for China of less than 1.5 per cent of GDP. China is able to do this as such a large country it can set a ‘stable goal’. To work with percentage GDP target losses would not be possible for smaller countries.

The methodology uses a combination of reporting at all levels and quality control using software. Where there is a lack of capacity to report below county level, training materials have been developed. The assessments are conducted every 5 years and also based on historical trends. There is not a need for longer term future trends as the assessments happen within the relatively short time frame of 5 years.

27. One of the major problems to be overcome is how to deal with credibility when nothing actually happens for many years. The more often this happens, the less likely any warning messages are going to be trusted. The reliability of the probability when it comes to forecasting any disaster, whether it be rapid onset or slow onset is critical. In Bangladesh, RIMES has honed an early flood warning system for farmers but a major part of its success is that the programme has also built the capacity of the local communities to understand what the forecasts actually mean to the farmers[6]. The

Early Warning System (EWS) that is used is highly visual, which works for communities with poor literacy or areas where a number of different local languages/dialects are spoken, and the farmers have been trained to interpret this system. It is based more on a 'When, How Long and When Receding' model, rather than volume of water or percentage change of it happening, as the farmers do not want to know this. This capacity building, however, is not a quick process – RIMES started its work in 2000 and it is now reaping rewards. RIMES produces the forecasts and it is up to the farmers to decide when to harvest or plant, as they now have the capacity to do so. Being able to produce longer term forecasts has had significant benefits to the farmers as it gives them time to implement their strategies for early harvesting or late planting, rather than only having the option of a damage limitation response.

28. The development and humanitarian communities need to be more live to the fact that local communities are well able to deal with risk and uncertainty, in fact, they are better equipped than most 'developed' communities, as they deal with these things on a daily basis. Developed countries have to a large extent been cushioned from risk and uncertainty due to sophisticated insurance schemes, social security policies and funds combined with a better regulatory frameworks that are enforced. The very removal of risk and uncertainty from the daily lives of the developed world have left them more risk averse in the presentation of risk to others.

Bottom up, demand driven science

29. The case of RIMES' work demonstrates well the need to ask those most affected by a disaster what exactly it is they want to know, and how it should be presented to them. Too often, information is presented in a format that is neither understood nor relevant for those who require the information most.

30. There is also a need to engage with vulnerable communities much earlier in the hazard cycle in order to identify the kinds of science that will have an impact. This is not to say that science, as an intellectual pursuit is no longer relevant – indeed it is as blue skies thinking inform the reality of future generations – however, there does need to be much more in the way of consultation with those on the ground such as first responders and the vulnerable communities themselves. The example of how the modelling of Padang City in Indonesia is being developed at community level could be replicated. This had been driven by the commitment of individuals who formed an NGO after their involvement in the response to the 2004 Tsunami.

31. The issue of local capacity was emphasised. If local communities do not have the capacity to ask the relevant questions that will lead to a better understanding of the impending crisis the scientists are less able to help in this regard. However, it is often the case that the local communities are well aware of the situation and are baffled as to why scientists have had to spend so long arriving at the same conclusion.

32. For scientists to work with local communities, who often use a different language, work in very different ways and in remote areas, requires a great deal more in resources – not just finance. Time, effort and patience to work in partnership across these very different modus operandi, personalities, power structures and priorities takes a great deal of time. A longer term approach is therefore required which is often in conflict with the standard research and project funding cycle timeframes of between three to five years.

Conclusions: priority areas and recommendations

33. There is a clear current window of opportunity to engage with the number of high level discussions going on particularly around the post 2015 landscape and Hygo+10. A number of groups are calling for Disaster Risk Reduction to be included in the post 2015 infrastructure and the evidence exists to demonstrate the validity of this call.

34. Three clear strands of recommendations emerged:

Mapping – gap analyses, working across constituencies, communities and disciplines to identify what is being done, what needs to be done and where the most impact is likely to be.

- Pooling of scientific resources and information – regional organisations such as ASEAN have already started work on this, others should follow. In order to do this, many barriers need to be overcome – national, disciplinary, constituency, community. There is also a need to make use of what already exists in all disciplines and communities involved and of relevance to the humanitarian effort. Greater links between climate change adaptation and DRR work are also needed.
- Generate a true 'Geography of Risk' which overlays where the poor and vulnerable are and will be in relation to where the hazards might present themselves. This has not been done and will require the coming together of both the hazard scientists and the development community.
- Generate a proactive diagnosis of gaps within the various disciplines, pooling these Gap Analyses to see if they are being addressed elsewhere. This would provide a more coherent overview of what is actually required and where.
- Work with regional organisations such as ASEAN to produce coherent, nuanced databases of risk, hazard threats, vulnerable areas and populations.

Communication and Access to information

- Engage with the media in a more meaningful way to ensure that they understand the complexity of disasters, even if they have an imperative to simplify. A code of conduct for the media to report responsibly could be one option.
- Whilst the evidence underlying messages can remain the same, the presentation and emphasis of aspects of this evidence needs to be tailored / nuanced to suit local contexts and audiences. Resources need to be allocated accordingly as well as the political will to do so. The presentation of evidence to convince local government to act will be different to that which will convince local communities.
- Work more with the Open Source movement to make information more accessible and build 'smarter' resources
- Learn from the Health Sector's 'Going the Last Mile' in terms of getting information to those that need it most rather than just focussing on policy makers or those easier to access and inform.
- More resources need to be committed to capacity building not only within local communities to enable them to understand the science but also within scientific communities to enable them to translate their messages in ways that are useful and can be understood.

Institutional and incentivisational change

- There is a need for 'Process Re-engineering'; finding different ways of working with people – communities, partners, policy and decision makers. In the UK the example of Natural Hazard Partnership brings together expertise from across the UK's leading public sector agencies with the aim of drawing upon scientific advice in the preparation, response and review of natural hazards, ensuring more coordinated and coherent advice for the government and resilience community . Work has included creating a hazard impact model of the UK and identifying different types of flood and drought, providing daily information about natural hazards, the likelihood and impact, using a probabilistic approach and communicating through SMS and social media[7].
- 'Process re-engineering' might also mean working towards changing historical and entrenched institutional structures related to research and funding. In the UK, the Higher Education Funding Council for England (HEFCE) have initiated the introduction of Impact outside academia as a criteria for the next Research

Excellence Framework in 2014 which will change the way academics demonstrate the relevance of their research. More such institutional changes need to be in place.

- There needs to be a robust regulatory framework that can transfer risk to the private sector within the next four to eight years. This is already underway but needs to be done more quickly as public sector reserves are not sufficient to cope with the future demand as a result of increased and more severe hazard disasters.
- Curricula need to be adapted in vulnerable areas so that children grow up with knowledge of disaster impact and how to respond in the first instance. More emphasis on scientific and historical teaching in schools and higher education will also help the adaptive capacity of communities as more children grow up to become better educated adults.
- Greater recognition must be given to multi- and inter-disciplinary courses at the Higher Education level. This will encourage more people to take these types of courses and will lead to a greater understanding of not just the science but also how to apply the science for the myriad of communities vulnerable to risk.

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[1] http://www.bis.gov.uk/assets/foresight/docs/reducing-risk-management/12-1289-reducing-risks-of-future-disasters-report.pdf

[2] http://www.bis.gov.uk/go-science/science-in-government/global-issues/civil-contingencies/shed-report-2012

[3] http://www.dfid.gov.uk/Documents/publications1/HERR.pdf

[4] http://www.asean.org/communities/asean-socio-cultural-community/category/asean-ministerial-meeting-on-disaster-management-ammdm

[5] https://twitter.com/Chiefkariuki

[6] http://www.rimes.int/

[7] https://www.gov.uk/government/policies/improving-the-uks-ability-to-absorb-respond-to-and-recover-from-emergencies; http://www.bgs.ac.uk/research/naturalHazardsPartnership.html