Government
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Science

The Use of Science in Humanitarian Emergencies and Disasters

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Government Office for Science

Foreword

By Professor Sir John Beddington, the Government Chief Scientific Adviser.

We live in an uncertain world, and the impacts from natural hazards are growing as population density increases. Climate change is a major cause of the increase in the level of hazard, though we are yet to fully understand the severity and character of the changes. What is clear is that we must do more to prepare and predict for hazardous events. Making the best use of science and technology to support the decisions that governments, organisations and individuals make will help to reduce the scale of humanitarian emergencies.

This recognition that we needed to make better use of science led Andrew Mitchell, the Secretary of State for International Development, to request that I examine the area. In response to his request, I have commissioned two pieces of work. Both will improve our use of science in predicting and preparing for disasters. This is the first of those reports, it identifies specific actions that the Government can take now which will improve the way it plans and responds to international humanitarian disasters.

In publishing this report, I am particularly grateful to the expert panel who oversaw much of the work and to my team here in the Government Office for Science. I look forward to seeing the outputs from its recommendations and I have committed to work with colleagues from across Government, the academic community and those in the private sector to take the actions forward. I believe the recommendations that are made here can make a real difference to the way the UK prepares for and predicts humanitarian emergencies.

Professor Sir John Beddington

Executive Summary

Lord Ashdown published his Humanitarian Emergency Response Review in March 2011, and the Government responded in June of that year. The Government response made two key science policy commitments: to improve the use of science in predicting and preparing for disasters, and to work with others to find new ways of acting quickly in "slow onset" disasters to stop them becoming major emergencies.

Andrew Mitchell, the Secretary of State for International Development, asked Sir John Beddington, the Government Chief Scientific Adviser (GCSA) to improve the Government's use of science in both predicting and preparing for disasters, drawing on the Chief Scientific Advisers' network across government. In addressing this request, the GCSA commissioned two pieces of work. The first is this report, and the second is a Foresight report looking ahead 20-30 years to examine the future causes and impacts of disasters.

This report is primarily focused on government, and changes to the way government plans and prepares for international humanitarian emergencies.

There are three main recommendations which can be implemented relatively quickly to make a real difference to improve the way that government currently uses science advice. Two new expert groups are proposed. The first will provide systematic advice to Ministers on emerging international risks and the uncertainties in assessing those risks. The second will meet when an international emergency occurs and will provide a prognosis for the "reasonable worst case", based on scientific advice.

A further recommendation proposes the establishment of a list of experts who can provide advice on specific hazards when an emergency occurs.

The remaining recommendations look further forward and reflect additional evidence gathered during the preparation of the report. Specifically, the fourth recommendation proposes enhancements to existing cross cutting research coordination mechanisms in order to provide better engagement between disciplines, and between UK science researchers and users. The fifth recommendation is to develop the evidence base for action in response to early warnings from risk assessments. The final recommendation is to consider the possible benefits in a greater partnership between the public and private sectors to improve the developing, sharing and using of data to prepare for and predict humanitarian disasters.

These recommendations will provide stimulus and support to the excellent work already undertaken in collaboration between Government and the humanitarian disasters community. Taken together, they should make significant further improvements to the way science advice is used by the community.

Summary of recommendations

Key Recommendations

Recommendation 1: The Government Chief Scientific Adviser should establish a risk expert group to provide advice to Ministers on emerging international risks. Initially, the group should meet quarterly, and provide regular reports as risks emerge.

Recommendation 2: The risk expert group should, under the direction of the Cabinet Office, ensure there is a list of experts available who can be approached to provide advice on specific hazards and their impacts.

Recommendation 3: The GCSA, working with relevant CSAs, should establish procedures for a Humanitarian Emergency Expert Group (HEEG) to be convened during an emergency. The group would immediately provide a prognosis of the "reasonable worst case", based on science advice, following a major rapid onset emergency. This would inform response options.

Additional Recommendations

Recommendation 4: DFID, UK research councils and other UK funders of science should further strengthen and improve cross disciplinary working. This may be through a cross governmental organisation. Together they should establish a more effective approach towards engagement between researchers and research users, both in the UK and internationally.

Recommendation 5: The emerging findings of the GO Science Foresight Project should be used to inform the work DFID is currently undertaking on disaster resilience. It will also inform DFID's ongoing work in developing the evidence base for action in response to early warnings from risk assessments (including previous international responses) and slow onset disasters.

Recommendation 6: The Government Chief Scientific Adviser will use the output of the GO Science Foresight Project to further consider the benefits in the public and private sectors developing, sharing and using data to prepare for and predict humanitarian disasters.

Contents

Chapter 1: Background and introduction

1. In March 2011, Lord Ashdown presented his Humanitarian Emergency Response Review to the Government[1]. In his report he provided a comprehensive assessment of the UK and the international community's current response to humanitarian emergencies. Lord Ashdown found that the Department for International Development (DFID) is well respected and well regarded. However, the review also concluded that, in light of the potential future need, there would have to be a step change in the way DFID responded and how science is used in that response.

2. The Ashdown report identified areas where change was needed, and made a series of recommendations for action. A continuing theme throughout the report was a need to make better use of science in predicting and preparing for humanitarian emergencies. The Government's response to Lord Ashdown's report was published in June 2011[2], together with a framework for the UK's humanitarian policy. The Government's response made policy commitments in science in two areas:

    1. Improve the use of science in both predicting and preparing for disasters, drawing on the Chief Scientific Advisors' network across government. Ensure scientific data on disaster risks is used to inform and prioritise country and regional level work on resilience.

    2. Work with others to find new ways of acting quickly in "slow onset" disasters to stop them becoming major emergencies.

3. Following the Government response, Andrew Mitchell, Secretary of State at DFID, wrote to Sir John Beddington, the Government's Chief Scientific Adviser (GCSA) asking him to lead the UK Government's action in this area.

4. In addressing this task, the GCSA commissioned two pieces of work. The first is this report which provides recommendations to Government. The second is a Foresight project looking ahead 20-30 years to examine the future impact of disasters, informed by the best current research across the natural sciences, health, social sciences and economics. It will also look at what effect emerging science and technology may have on managing those impacts, particularly in politically or economically fragile states.

Methodology

5. This report was prepared under the leadership of the Government Chief Scientific Adviser, Sir John Beddington, and a group of independent experts. It draws on desk based research, interviews or written responses with 5 individuals and representatives of 25 organisations. Annex 2 has more detail on the methodology.

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[1] Humanitarian Emergency Response Review, Chaired by Lord Ashdown. See: http://www.dfid.gov.uk/Documents/publications1/HERR.pdf

[2] See: http://www.dfid.gov.uk/what-we-do/key-issues/humanitarian-disasters-and-emergencies/how-we-respond/humanitarian-emergency-response-review/

Scope and purpose

6. This report has constrained its scope to disaster risks and uncertainties arising from natural hazards such as earthquakes, tsunamis, storms, heat waves and wildfires, floods and drought, as well as biological rapid onset disasters such as epidemics or pandemics of human, animal or plant diseases. It considers only issues that are likely to impact primarily on life or livelihoods in low income countries. It considers how scientific evidence, and the technologies used to obtain that evidence are used to support prediction and preparation for emergencies. It does not consider how specific technologies are used in responding to such emergencies.

   The report considers:

   - what processes are currently in place for providing advice and how effective they are;
   - how well advice is used at present and therefore what is currently achieved;
   - what policy and operational gaps there are nationally and internationally;
   - what is missing from current advice to meet the policy and operational needs;
   - how better use can be made of current advice and whether new mechanisms and links are needed in a UK or international context;
   - whether there is a need for a formal advisory arrangement such as a Scientific Advisory Group;
   - what formal arrangements, similar to those adopted to provide UK emergency advice would improve the UK Government's operational response to international emergencies; and
   - what explicit links exist into UK non-government agency activities.

Definitions

7. This report uses the classification of natural hazards set out in Table 1. In deriving the classification a number of definitions of natural hazard for example, the Hyogo Framework for Action, [3] have been taken into account.

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[3] http://www.unisdr.org/files/1037_hyogoframeworkforactionenglish.pdf

Natural Hazard	Example
Flood	River flood, coastal flooding (including storm surge), flash floods.
Storms	Tropical storms or major local storms including strong winds.
Earthquake	Earth tremors.
Tsunami	Arising as a consequence of an earthquake, or a landslide.
Volcano	Lava and ash flows, ash in the atmosphere and erupted gases (such as SO_2).
Landslides	Collapses and mudflows.
Extreme temperatures	Extreme temperatures can include hot or cold extremes, and also the consequences. For example, wildfire, or mortality.
Drought	Agricultural (famine) and hydrological (water availability), dust storms, wildfires.
Health epidemics and pandemics	Viral, bacterial or parasitic infections.
Animal diseases and pests /plant diseases and pests	Fungal infections and insect infestation.

Table 1: Natural hazards considered in this report.

8. Risk is the combination of hazard and occurrence[4]. The hazards considered in this report are those that are predominantly natural and have an impact on society. Some hazards will have components which arise out of human actions. The impacts of hazards and their distribution will also be strongly shaped by social, economic and political factors.

9. Outcomes arising from armed conflict have not explicitly been considered. However, the interactions of a disaster with a conflict can be a significant complicating factor, and some of the evidence in this report comes from areas of the world where impacts from natural hazards combine with those from conflict.

10. A humanitarian emergency response is required when the impact on affected communities[5] overwhelms the local capacity to manage. Emergency response can be required for a rapid onset emergency such as an earthquake, or equally for a slow

[4] For example, see the National Risk Register: http://webarchive.nationalarchives.gov.uk/+/http://www.cabinetoffice.gov.uk/media/348986/nationalriskregister-2010.pdf

[5] Reducing Disaster Risk through Science. ISDR 2009

onset emergency such as a drought. Figure 1 shows the "prevent, prepare, respond" cycle[6].

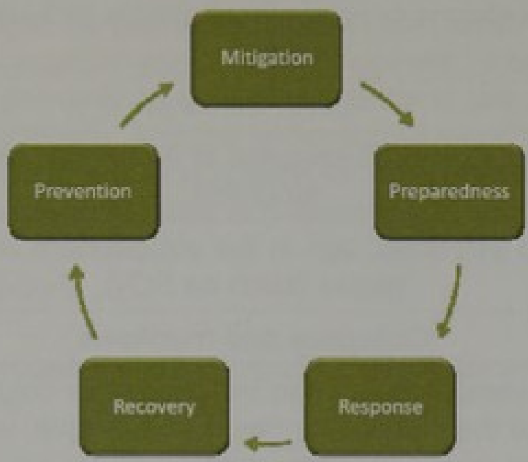

Figure 1: The prevent, prepare, respond cycle.

[6] Health Protection Agency. Disaster Risk Management for Health. Overview. http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1296686244041

Chapter 2: Setting the scene

11. The role of science in predicting and preparing for an emergency is complex. Emergencies themselves typically involve many interacting factors, generating a range of risks and uncertainties. A large amount of information is available from a wide variety of sources, from those on the ground contributing valuable single points of data to international organisations gathering and processing millions of inputs. An overview of how scientific advice for emergencies is currently organised and the range and complexity of the assessments of risk and uncertainty is set out here.

International landscape for disaster risk reduction

12. Examples of major institutions with a role in disaster risk management are listed in Annex 3. A number of these organisations are primarily science providers, for example: universities and research councils (including component institutes). Others are major users of science, such as RedR, and Engineers Without Borders, Non Governmental Organisations (NGOs) and international agencies such as the World Bank (including their Global Facility for Disaster Reduction and Recovery)[7], UN International Strategy on Disaster Reduction, the World Health Organisation, the World Meteorological Organisation (WMO) and the European Commission Humanitarian Aid and Civil Protection Office (ECHO).

13. The UN International Strategy for Disaster Reduction (UNISDR) is the focal point in the UN system for the coordination of advocacy for disaster reduction. Since 2009 it has produced the biannual Global Assessment Report on Disaster Risk Reduction. The ISDR Secretariat has a desk dedicated to scientific and technical issues based on cross sectoral and interdisciplinary cooperation involving the scientific community, national and local governments, NGOs, the private sector, as well as the organisations and agencies of the UN system[8].

14. The International Council for Science (ICSU) has established the Integrated Research for Disaster Risk initiative (IRDR) which is also co-sponsored by ISDR. The UK is represented in both these scientific fora. The Global Science Forum of the OECD is involved in a number of risk modelling initiatives[9].

15. Within the EU, the Monitoring and Information Centre (MIC) is part of the community mechanism for civil protection and one of its roles is to provide daily alerts of disasters[10] across the world (including human-made disasters). It has close

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[7] The Global Facility for Disaster Reduction and Recovery (GFDRR) is a partnership of 39 countries and 8 international organizations committed to helping developing countries reduce their vulnerability to natural hazards and adapt to climate change. See: http://www.gfdrr.org/gfdrr/

[8] Establishment of an Advisory Scientific and Technical group for the ISDR. Inter-agency Task Force on Disaster Reduction, third meeting, Geneva, 3-4 May 2001.

[9] For example, see http://www.gripweb.org/gripweb/sites/default/files/monthly_newsletter/GRIP_Monthly_Highlight_Nov%202011%20-%2030.11.pdf

[10] http://ec.europa.eu/echo/civil_protection/civil/prote/mic.htm

interaction with the UN Office for the Coordination of Humanitarian Affairs (OCHA), ECHO, and the Red Cross when these are present on the ground.

16. Discussions at G8, G20, UN system institutions, regional inter governmental organisations such as APEC[11] and the EU indicate that disaster risk reduction is becoming part of the mainstream economic and political agenda. For example the G20 has recognised the value of disaster risk reduction tools to better prevent disasters, protect populations and assets, and manage their economic impacts[12].

UK landscape

17. DFID has the lead UK Governmental interest in responding to humanitarian emergencies that affect populations in low-income countries. It contributes core funding to the UN and ECHO and is also the largest funder of the UN Central Emergency Response Fund (CERF).

18. Humanitarian emergencies are also of interest to a range of other UK Government Departments (see Annex 3 for details). For example, an event can directly impact the UK or its citizens abroad such as the Fukushima nuclear emergency. A major humanitarian emergency can also provide a shock to the world economy, or to key UK interests which have a major impact here in the UK. Box 2.1 provides an example.

> A major influenza pandemic originating overseas would have a significant impact on the UK; notably pandemic flu is currently the top risk in the UK's own national risk register[13].
>
> In recognition of the importance of improving human health worldwide, both from a humanitarian perspective and for the UK's own security, the Foreign and Commonwealth Office (FCO), DFID and the Department for Health (DH) have developed an outcomes framework on global health[14]. The DH has also agreed a UK institutional strategy with the World Health Organisation (WHO)[15].

Box 2.1 An example of a cross Government issue.

19. The Office of the Government Chief Scientific Advisor has previously had an interest in this area. In 2005, the GCSA was asked by the Prime Minister to convene a group of experts following the East Indian Ocean tsunami. In its report "The Role of Science in Physical Natural Hazard Assessment"[16] the lead recommendation was to establish

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[11] Asia Pacific Economic Cooperation: http://www.apec.org/

[12] http://g20.org/en/news-room/press-releases/235-communique-meeting-of-finance-ministers-and-central-bank-governors

[13] http://www.cabinetoffice.gov.uk/resource-library/national-risk-register

[14] Health is Global: An outcomes framework for global health 2011-2015. http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_125671.pdf

[15] http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/documents/digitalasset/dh_095295.pdf

[16] The Role of Science in Physical Natural Hazard Assessment. Report to the UK Government by the Natural Hazard

an International Science Panel for Natural Hazard Assessment. A panel with that name has since been established by the ISDR.

20. There are also many UK based NGOs who have a key international role in humanitarian emergencies and are major users of science advice, and a number of these NGOs have contributed evidence for this report (see Annex 2 for a full list).

The private sector

21. The private sector uses and critically interprets scientific data for a variety of reasons. As an example, the energy sector makes predictions on demand and also on sourcing based on UK Met Office weather forecasts of wind and other conditions that influence demand.[17] Wind speed is critical for wind turbines; a probabilistic estimate will therefore be made as to whether energy can be sourced from turbines or whether alternative sources need to be developed.

22. The insurance sector also uses scientific data. The type of information that it sources is innovative. Insurance underwriting and reinsurance decisions can be made based on modelled estimations of risk. In addition to traditional insurance approaches, new data and analytics have supported initiatives such as the Caribbean Catastrophe Risk Insurance Facility enabling governments and others to employ parametric, index based insurance to provide simplified mechanisms to receive swift and significant payments following defined disasters[18]. Box 2.2 notes the resilience of the insurance market.

> The year 2011 brought the highest ever level of natural catastrophe losses to the worldwide insurance market at approximately $110 billion. In spite of this the industry has operated without dislocation and this resilience has been due, in large measure, to improvements in the use of science and risk modelling over recent years. This is supported by a regulatory framework whose aim is to ensure that insurance companies can remain solvent for the occurrence of a 1:200 year risk event.

Box 2.2 Insuring against natural hazards.

Working Group. June 2005. http://www.bis.gov.uk/files/file8511.pdf
[17] www.eci.ox.ac.uk/publications/downloads/sinden05-dtiwindreport.pdf
[18] http://www.ccrif.org/

Global risk assessments

23. In preparing this report, it became clear that there are a wide range of risk assessments publicly available, from the global to the regional level and covering a substantial range of natural hazards. Annex 1 considers how risk assessment tools and early warning systems are currently being used to help anticipate an emergency, both for slow and rapid onset disasters. Box 2.3 provides examples of how a risk assessment can be used.

> Risk assessments can be used to:
>
> - anticipate potential emergencies;
> - enable risk management options to be considered;
> - inform the direction of investment in science research;
> - identify countries or regions where increasing the resilience to a hazard is needed;
> - support departmental policy where the shock from a regional emergency could have major implications.

Box 2.3 Examples of how a risk assessment can be used.

24. As can be seen in Annex 1 there are many risk assessment tools available to policy makers. Hazards such as earthquakes, tsunamis and floods are physical events which can be measured, and can sometimes be probabilistically modelled to provide assessments of potential likelihoods and impacts on regions. However, quantifying vulnerability to a risk often requires a degree of expert judgement[19]. Policy makers need to ensure that the methodologies underpinning each risk assessment are suitable for their own policy needs and the characteristics of the risk in question. For example, risks will often be assessed in relative rather than absolute terms, meaning that different risk assessments may not be directly comparable.

25. There may also be ambiguities where different groups in society interpret and evaluate evidence differently. In these circumstances there will be multiple perspectives, including those from different disciplines, which must be made explicit.

26. The private sector is undertaking a considerable amount of work in this area. For example, the insurance industry also has a strong interest and expertise in assessing disaster risk. The tools and methods used by that sector could usefully be considered.

27. Risk assessment of natural hazards has often been performed at a national or regional level. The impact of an earthquake or catastrophic flooding may occur in a single country or a localised region of that country. However, it may have broader transnational impacts or dependencies. The assessment of such large scale, trans-national events may not be well captured or identified by a national approach.

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[19] For example, see the GO-Science Blackett review on high impact low probability risk for more discussion on this area: http://www.bis.gov.uk/go-science/science-in-government/global-issues/civil-contingencies

28. Consequently, risk assessments need to consider the likelihood and impact of any particular risk over a range of scales, from global to local, depending on the risk and impact. Whilst a particular risk may be relatively likely within a region (for example, flooding) it may nevertheless be relatively unlikely at a particular locality[20].

[20] Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters.

Chapter 3: Summary of findings

29. Information on how well science advice is used within the humanitarian community was gathered from interviews, written responses and desk research. This chapter summarises the findings, which lead to the six recommendations.

30. There are many good examples of science advice being used successfully in preparing for an emergency and of the good work and commitment of the scientific community. For example, researchers from the Humanitarian Futures Programme at Kings College London reported that some areas of UK science, including meterological and climate science, are widely held in high regard, but nevertheless took the view that the best use is not made of it. The focus in this chapter is on overcoming barriers to further strengthening the use of that science.

What processes are currently in place for providing advice and how effective are they?

31. For any emergency, the more specific the warning can be in terms of timing, location, and intensity, the more effectively the response can be targeted to the impact. However, even where the science is not yet good enough to give a specific warning of time and place, scientific assessments can still be used for a programme of disaster risk reduction. For example, the likely impacts of a major earthquake in the Nepal region are sufficiently well understood to inform current disaster risk reduction work[21].

Current risk and hazard mapping

32. As discussed in chapter two, many risk asssesments are currently available. To be effective, the methodology used in any assessment must be based on a good understanding of what the risk assessment will be used to do. Additionally, it should be known if all of the risks have been included, and an explicit view on what has been excluded. Based on evidence collected for this report, two maps have been created in figures 2 and 3 to demonstrate the wide range of information that is available and how an assessment could be displayed pictorially.

33. Figure 2 shows the main natural hazards by continent or country where scientific advice could be needed to support risk planning. For example, the blue circles in figure 2 show areas that have a high risk of flooding. The information on specific hazards in figure 2 was obtained using the World Bank and Columbia University's *Hotspots* global risk assessment maps, and also using the *Global Risk Data Platform* (created & hosted by UNEP/GRID-Geneva, supported by UNESCO).

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[21] http://www.recoveryplatform.org/resources/projects_by_irp_partner_organizations/160/earthquake_risk_reduction_and_recovery_preparedness__programme_for_nepal

34. Figure 3 highlights some of the risk tools and approaches which were identified through desk research, either through reports or internet searches, and could be used in preparing a detailed risk assessment. Some risk assessment tools focus on specific areas of the world, whereas others have global coverage.

35. These two figures demonstrate the type of assessments that can inform UK policy makers on the priority of relative risks in key countries. They are very general and illustrate a range of possible hazards and approaches at the global scale that would, for any issue, be complemented by finer-grained analysis and sources of information, including regional and local risk and hazard-mapping. Figure 3 illustrates a few amongst many possible systems and approaches for assessing risk and uncertainties.

36. A number of international bodies involved in humanitarian disasters are highlighted in chapter two (and Annex 2).

How well advice is used at present and therefore what is currently achieved.

37. The nature of the science advice sought, and its use, varied amongst the stakeholders interviewed. For example, Care International said that they used science evidence from recognised, corroborated and peer reviewed sources such as the IPCC, and key academic and government institutions. They also had an extensive emergency planning system. Many stakeholders emphasised the use of information from field officers monitoring hazards to create an "alert level" for an area using a number of information sources, including from local sources and partner organisations. World Vision identified the use of Famine Early Warning Systems Network (FEWS NET)[22] to provide triggers for early action. The use of multiple sources of information can be important in situations of uncertainty.

38. The World Food Programme highlighted the value of access to and use of meteorological and climate information in its work. For example, in the Darfur region of Sudan they made careful assessment of precipitation forecasts to alert them to the risk of flooding. The specific concern of the WFP was the potential for even localised flooding to disrupt delivery routes for food aid. Identification of the flooding risk allowed the WFP to stockpile food in the relevant areas and avoid potential localised food crises in the event of transport disruption.

39. Increasingly, technology enables better use of data from a variety of sources, including from citizens and affected populations. To be most effective, this requires expert interpretation, analysis and dialogue with users. For example, the use of the Open Source Mapping project to provide detailed maps of Haiti following the disaster in January 2010 made extensive use of cell phone information, Geographic Information Systems, and satellite imagery[23]. Position data from Subscriber Identity Module (SIM) cards were used to estimate the magnitude and trends of population movements following the Haiti 2010 earthquake and cholera outbreak[24]. ECHO

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[22] See: http://www.fews.net/Pages/default.aspx

[23] For example, see http://opensource.com/life/10/1/openstreetmap-haiti

[24] Improved Response to Disasters and Outbreaks by Tracking Population Movements with Mobile Phone Network Data:

reported the use of cell phone data to track the location of individuals; this was extremely useful in tracking population movement during a slow-onset disaster.

40. The Schistosomiasis Control Initiative (SCI) provided a clear example of the value that delivery organisations place on the use of data when planning their interventions. In its work in disease prevention across 11 African countries, varying levels of pre-existing data on exposure population groupings were available. In cases where an insufficient level of data was available to effectively plan evidence based programmes of activity, the SCI would design studies and commission local technicians to carry out necessary survey work to guide their decision making before proceeding.

What policy and operational gaps are there nationally and internationally?

41. There are high expectations about the precision and potential use of scientific research.[25] This can often translate into an expectation that scientific advice will provide a definitive answer. As such, an answer is rarely possible. There is a danger that organisations will "wait and see" until additional scientific evidence becomes available to provide more certainty. However, in many areas such as weather and climate forecasting, probabilistic forecasting is essential which means that policy makers will always have to take a decision based on uncertain information.

42. The early warning systems in East Africa noted elsewhere in this report, and the recent Oxfam and Save the Children report[26], identified potential reasons for the failure to translate early warning into early action at the start of the recent East Africa famine. Alongside lack of national political action, their report highlighted the perceived need for media coverage of the situation to stimulate donors, and the unwillingness of decision makers to act when there is uncertainty.

43. Climate science and seasonal weather forecasting has been at the forefront of communicating the inherent uncertainty in science (including modelling) much more effectively. Several respondents, said that greater confidence is required in climate change predictions, and more regional forecasts are required, rather than the global predictions that are presently available. This is a particularly pertinent issue for countries such as Bangladesh. However, to provide a high resolution regional forecast, it is necessary to have a high resolution global forecast underpinning it. The Regional Integrated Hazard Early Warning System provides one such approach, with predictions of seasonal rainfall and its variability for the Asia Pacific region[27].

44. Where different sources of advice lead to conclusions which provide a range of uncertainty that does not overlap, the validity of the sources should be re-examined. Users of science advice must be absolutely clear what the implications of the uncertainties are for their policy or operational decisions and that there may be multiple perspectives, including the local population, which affect how this advice will

A Post-Earthquake Geospatial Study in Haiti. Bengstsson et al. Plos Medicine August 2011 | Volume 8 | Issue 8 |

[25] Understanding the economic and financial impacts of natural disasters. World Bank 2004

[26] A dangerous delay: The cost of late response to early warnings in 2011 drought in the horn of Africa. http://policy-practice.oxfam.org.uk/publications/search/?q=*;q1=Publications;sort=publication_date;x1=page_type

[27] E.g, see http://www.rimes.int/sc/

be used. When appropriately used, commonly available technology such as the mobile phone can be beneficial in communicating warnings derived from science advice to a wide audience. Many examples of this sort of technology were cited; one example being the provision of early warning via mobile phones in Bangladesh when major flooding was predicted[28].

What is missing from current advice to meet the policy and operational needs?

45. The need for confidence in probabilistic models was emphasised by some stakeholders who noted that major funders will only commit funding once a disaster has already happened, or when there is significant public profile for a disaster. If significant funding from donors is provided earlier, resilience work could be increased beforehand (for example, by expanding health programmes in areas of high risk and running more nutrition programmes or strengthening health systems).

46. Stakeholders told us that there was a "language" barrier between NGOs and academia, and that the translation of science to policy was more of an issue than the availability of science *per se*. Effective translation depends on a deeper understanding of what science can offer (the science push) and what is needed (the science pull). A representative from the United Nations Development Programme (UNDP) reported that institutions needed to be focussed on the longer term (both in science and policy) and need to work more closely together. The UNDP said that there was a need to move to engaging the large user community.

47. However, significant science advice may not always be used by policy makers as they do not understand the full capability or implications of it. This need for a better two way dialogue to understand the evidence is a widespread issue when science advice is provided to policy makers. For example, the review by Dame Deirdre Hine looking at the UK Government's response to the outbreak of pandemic influenza in 2009 recommended that much more work needed to be done to communicate the uncertainty in science advice to Ministers[29]. There are many initiatives to try to improve dialogue between science providers and users, and also with the public more widely.

48. Another cause of the gap can be the drivers for research, for example the need for academics to publish in peer reviewed journals. A stakeholder told us that Research institution needs, and not the needs of people, can sometimes drive the S&T research and impose a burden. This means that the funded research is not always what local people require. The longer term timescales of "blue skies" research does not always link in well with the shorter funding timescales (often one year) of funders, although this issue is recognised and improvements are occurring.

49. Stakeholders said it was important to be able to quantitatively demonstrate the benefit of using science. A number of stakeholders suggested that there should be more evaluation of science advice. One of the outcomes of the Millennium Villages project

[28] For example, see http://www.irinnews.org/report.aspx?ReportId=93914

[29] The 2009 Influenza pandemic. An independent review of the UK response to the 2009 influenza pandemic. Dame Deidre Hine.

will be better quality data to enable better cost/benefit information to demonstrate where science advice and practice is working[30].

50. Merlin said that, often, only "gold standard" evidence was considered acceptable, for example randomised control studies, and there needed to be a greater acceptance that less peer reviewed evidence could be valuable. Stephen Edwards from the Aon Benfield UCL Hazard Centre said it would be both beneficial and strategically important to get more scientists and engineers working more closely with the NGOs and to capture the evidence of the benefits of proper participatory collaboration. For example, knowledge exchange internships could be used, which would allow the different sectors to gain a deeper understanding of the challenges and opportunities involved in collaboration.

51. Discussions with stakeholders highlighted the extent of the information available, particularly in weather and climate modelling. However, it is clear that there are issues surrounding the way that policy makers take decisions based on the evidence available. Whilst policy makers may understand that science advice will have uncertainties, using this uncertainty appropriately to take a decision may cause confusion. Better dialogue between scientists and policy makers could improve this.

How better use can be made of current advice and whether new mechanisms and links are needed in a UK or international context.

52. Short term weather forecasts are increasingly based on "ensemble modelling"[31] and climate predictions on longer timescales are always probabilistic. As discussed above, forecast information is presented to policy makers in this way. If decision makers are to make effective decisions, it will be important that they understand how to take effective decisions based on the relative likelihood of different outcomes and inherent uncertainties.

53. As more science advice is increasingly presented in probabilistic terms, this will require effective two-way communication between scientists and decision makers. It also requires a continuous approach to updating the advice as more information becomes available and the level of uncertainty diminishes. Where uncertainties persist, it requires alternative possible scenarios to be spelt out clearly.

54. In the longer term, this probabilistic approach will lead to much better decision making, but in the short term decision making will be improved by much better dialogue between science providers, policy makers and the public. For example, box 3.1 is an example used by the UK Met Office of presenting forecast information in a new form.

55. Another way to present the outputs of more probabilistic modelling is through a narrative approach, which allows the data to be presented in a way that allows

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[30] www.milleniumvillages.org

[31] In ensemble modelling, multiple numerical predictions are conducted using slightly different initial conditions that are all plausible given the past and current set of observations, or measurements.

scenarios to be based around the analysis. However, it is not just for scientists to drive this approach, policy makers need to be closely involved.

> In its National Severe Weather Warning Service, the Met Office has adopted a "traffic light" system in order to communicate to members of the public the potential impact of a weather related event on the UK. This takes account of not only the severity of the weather event but also its local impact, depending on exposure and vulnerability. The advice is a four-colour system which indicates varying levels of risk of impacts and a comment on actions to take at each level:
>
> - GREEN — "No severe hazard expected"
> - YELLOW — "Be aware"
> - AMBER — "Be prepared"
> - RED — "Take action"
>
> Each traffic light assessment includes several scenarios, for example, an "Amber" assessment includes both "high impact, low likelihood" and "medium impact, high likelihood".

Box 3.1: Communicating complex science.

56. The UK Space Agency reported that there was a huge amount of remote sensing data potentially available but many organisations were unaware of this. The International Charter on the use of space assets provides an opportunity for access to satellite data from Charter members. "Activation" of the charter needs to be undertaken from an authorised user, but the data can then be requested by organisations such as NGOs. The US Agency for International Development activated the Charter during the Pakistan floods in 2010, and in the aftermath of hurricane Katrina, imagery was provided by the Nigerian satellite, Nigeria-sat 1.

57. Better coordination between organisations is needed on data, standards, models and related platforms. This coordination must link to the appropriate organisations and stakeholders at an international level. For example, the United Nations Platform for Space based Information for Disaster Management and Emergency Response (UN-SPIDER) was established in 2006 to ensure that all countries and international and regional organisations have access to and develop the capacity to use all types of space-based information to support the full disaster management cycle.[32]

58. One way in which data can be coordinated is a model similar to the UK Natural Hazards Partnership or Energy Research Partnership (see chapter four, box 4.1).

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[32] See http://www.oosa.unvienna.org/oosa/unspider/index.html

Is there a need for a formal advisory arrangement such as a Scientific Advisory Group?

59. When a major national emergency occurs in the UK, the Government forms a "Cabinet Office Briefing Room" committee (COBR) to coordinate a cross-departmental response. If science advice is needed to inform this response, a Scientific Advice Group for Emergencies (SAGE) is called. As an example, during the Fukushima emergency, COBR considered the implications for UK nationals living in Japan, and SAGE was asked to provide scientific advice on their safety. It may be useful to consider how this type of science providing mechanism can work in humanitarian emergencies where a COBR has not been called.

60. Formal arrangements to improve the UK Government's operational response to an international emergency are recommended in the next chapter.

What explicit links exist into non UK Government agency activities?

61. A risk based approach takes into account the probabilistic nature of the science. For example, World Vision highlighted the use of the Famine Early Warning Systems Network (FEWS NET) in famine prediction, and said that this system can be used to provide triggers for famine, and allowed organisations to be more flexible in their funding response. However, the governance requirements for some NGOs mean that it is not possible to hold on to substantial amounts of donor money in anticipation of an emergency and the UN Central Emergency Relief Fund (CERF) was seen as very useful as it provides cash rapidly in an emerging disaster.

62. There is often a gap between what the science practitioners are doing (or proposing) and what is needed to provide a response at a local level. This is a two way issue, and both groups need to do more to establish a common set of "user requirements". The Global Network for Disaster Reduction spoke of the need to take note and gather evidence from locally derived information. They noted that over 50 years, deforestation has occurred along the Indus river basin, together with the establishment of embankments and roads. It was clear locally that this would impact water run off. When heavy rain fell in 2011, high water velocity combined with high levels of sediment and led to inevitable flooding. Over 20 million people were in danger. These lessons need to be learned to prevent similar emergencies arising in other locations.

63. Many examples of current work to increase dialogue were found. The Humanitarian Futures programme at Kings College London (KCL) includes promotion of a dialogue between scientists and policy makers. A range of forums have been tried and developed in that programme to strengthen this dialogue. Futures groups, have brought together scientists and policy makers to discuss the drivers of future crises as well as emerging scientific learning and technologies which could help address these drivers. Technology policy fairs had been useful where the science practitioners could describe their work, and policy makers could describe their needs.

64. In some instances, these proved considerably more effective than employing tailored scenario development exercises. The most effective dialogue tool employed by the programme to date have been exchanges between scientists and humanitarian development policy makers, and the partners and communities with whom they work.

65. Better communication between science providers with local and indigenous knowledge can be important. In some circumstances local knowledge (often based on experience of coping with past disasters) can offer a valuable complement to "formal" science. Local and community knowledge can reveal social and cultural logic about dealing with a hazard and responses to them need to be understood to develop socially acceptable responses that genuinely work "on the ground".

66. An additional mechanism by which science advice can better meet the needs of the local population is to ensure that the right people have access to the right information. For example, some stakeholders thought that those most affected by weather related natural disasters often don't have access to scientific information, or the information may not be in the local language. Some stakeholders thought that it would be very useful to have a "one stop shop", independent of any single NGO which would ensure relevant and tailored advice to help prevent duplication of effort.

67. The Department for Business Innovation and Skills (BIS) and the UK research councils fund a wide range of activities to increase the three-way dialogue between science providers, policy makers and the wider public. For example, the Natural Environment Research Council (NERC), in partnership with Sciencewise Expert Resource Centre is carrying out a public dialogue to explore the views of the public in relation to geoengineering[33].

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[33] http://www.sciencewise-erc.org.uk/cms/geoengineering

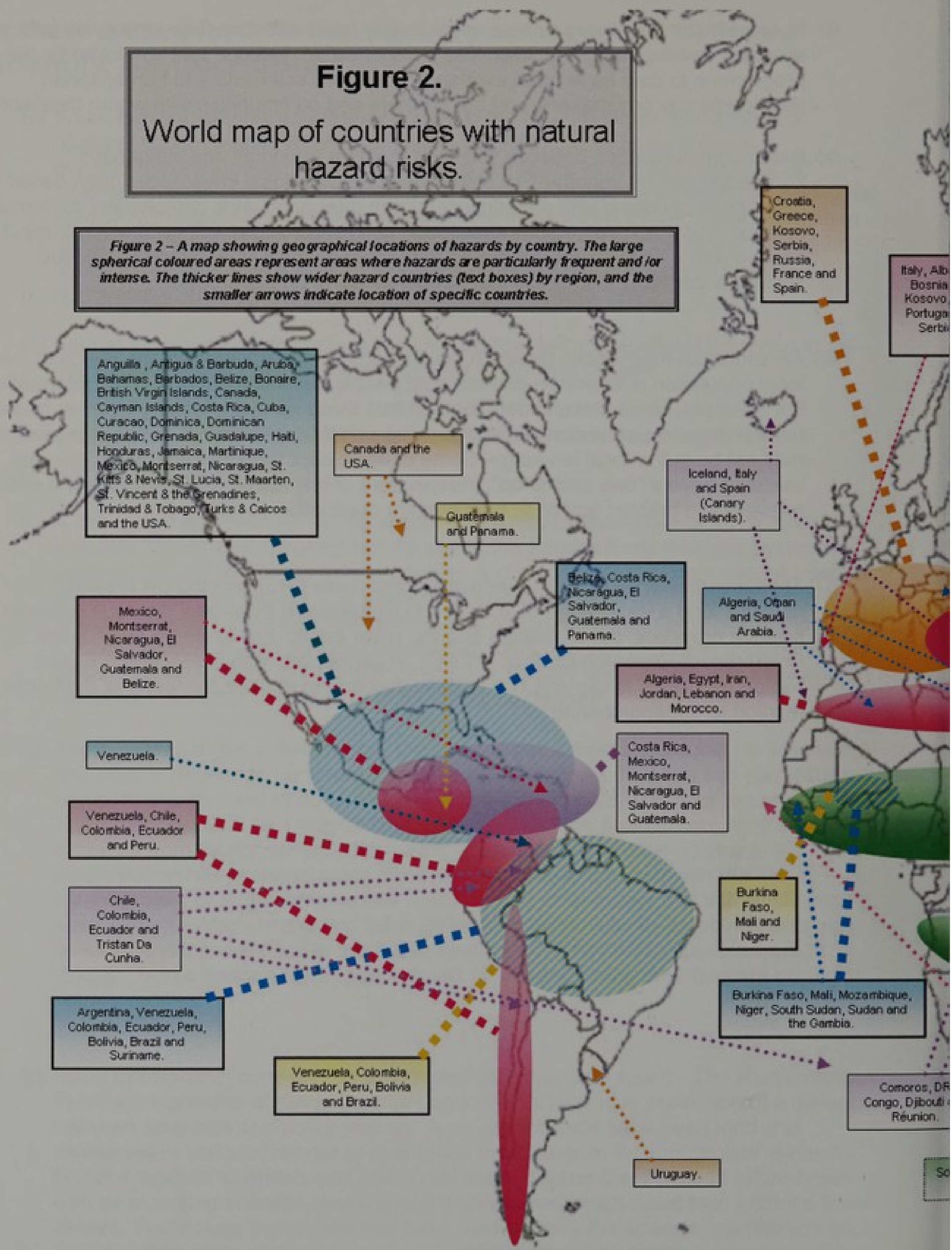


Figure 2.

World map of countries with natural hazard risks.

Figure 2 – A map showing geographical locations of hazards by country. The large spherical coloured areas represent areas where hazards are particularly frequent and /or intense. The thicker lines show wider hazard countries (text boxes) by region, and the smaller arrows indicate location of specific countries.

38.

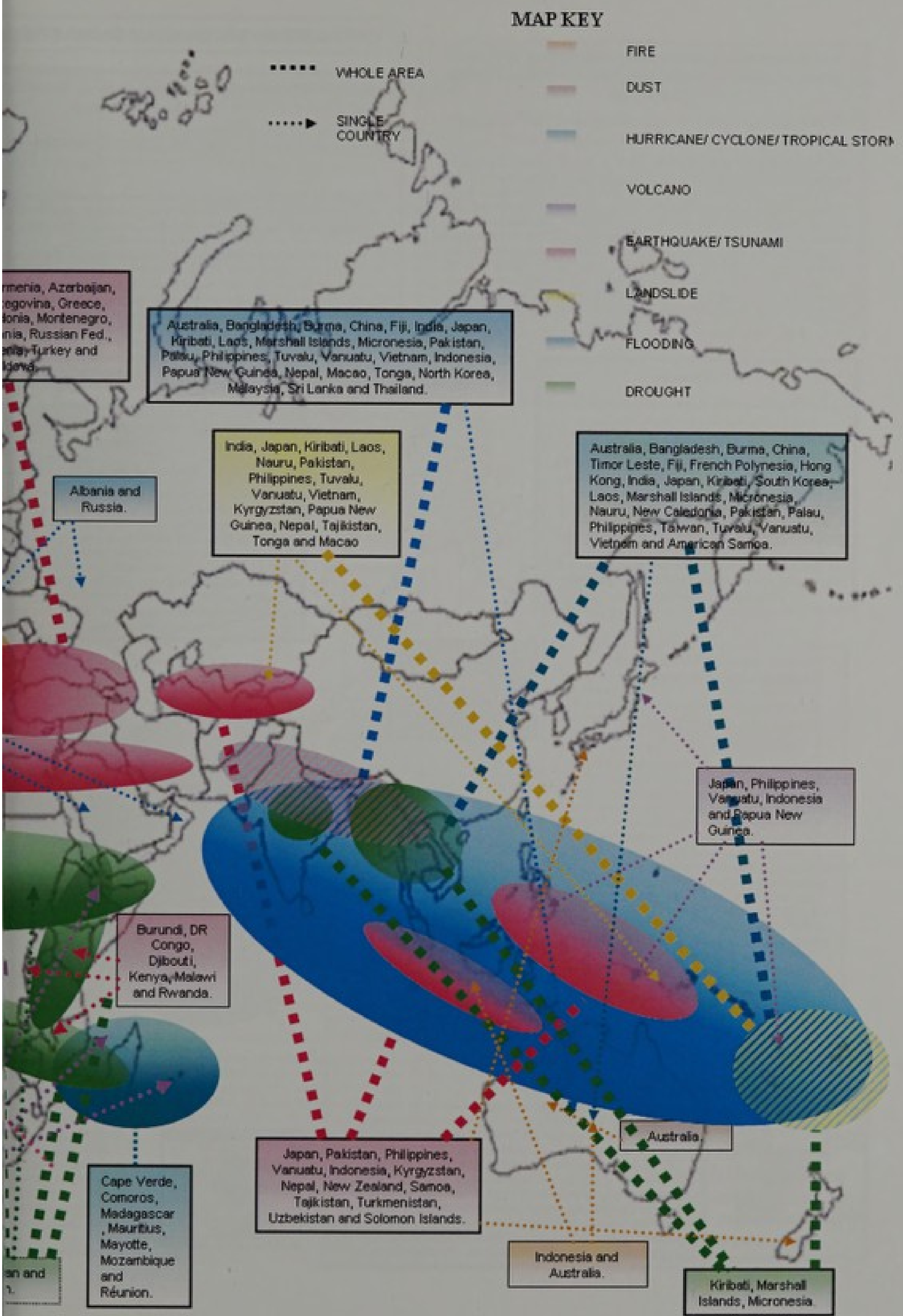

MAP KEY
WHOLE AREA
SINGLE COUNTRY
FIRE
DUST
HURRICANE/ CYCLONE/ TROPICAL STORM
VOLCANO
EARTHQUAKE/ TSUNAMI
LANDSLIDE
FLOODING
DROUGHT
Australia, Bangladesh, Burma, China, Fiji, India, Japan, Kiribati, Laos, Marshall Islands, Micronesia, Pakistan, Palau, Philippines, Tuvalu, Vanuatu, Vietnam, Indonesia, Papua New Guinea, Nepal, Macao, Tonga, North Korea, Malaysia, Sri Lanka and Thailand.
India, Japan, Kiribati, Laos, Nauru, Pakistan, Philippines, Tuvalu, Vanuatu, Vietnam, Kyrgyzstan, Papua New Guinea, Nepal, Tajikistan, Tonga and Macao
Australia, Bangladesh, Burma, China, Timor Leste, Fiji, French Polynesia, Hong Kong, India, Japan, Kiribati, South Korea, Laos, Marshall Islands, Micronesia, Nauru, New Caledonia, Pakistan, Palau, Philippines, Taiwan, Tuvalu, Vanuatu, Vietnam and American Samoa.
Albania and Russia.
Japan, Philippines, Vanuatu, Indonesia and Papua New Guinea.
Burundi, DR Congo, Djibouti, Kenya, Malawi and Rwanda.
Australia
Japan, Pakistan, Philippines, Vanuatu, Indonesia, Kyrgyzstan, Nepal, New Zealand, Samoa, Tajikistan, Turkmenistan, Uzbekistan and Solomon Islands.
Cape Verde, Comoros, Madagascar, Mauritius, Mayotte, Mozambique and Réunion.
Indonesia and Australia.
Kiribati, Marshall Islands, Micronesia.

FIGURE 3 – World map of Global & Reg

TAOS Real Time Impact Forecasting System (RTFS) for CCRIF (Caribbean Catastrophe Risk Insurance Facility) Countries

Produced by Kinetic Analysis Corp. for CCRIF's second generation loss model.

This product enables all members of CCRIF to access real-time estimates of estimated hazard levels/impacts on populations and infrastructure for tropical cyclone events, providing information to both disaster managers and finance/economy officials. Also, it provides special products for Haiti, for example, information to help manage refugee camps, aid operation centres, and transportation hubs by producing site specific projected wind speeds and coastal flooding levels. The hazard values provided represent maximum expected hazard intensity at each location or grid cell across the analysis area for any storm, which can be converted into projected effects on populations and infrastructure. Also has the ability to give location specific details of storm trajectories and modelled risks can be used as alerts by emergency managers.

GLEWS (Global Early Warning System for Major Ar
Including Zoonoses)

Collaboration between FAO, OIE (World Organisation fo
and WHO (World Health Organisation).

This joint risk assessment aims to provide preventive and predictive
assess risks or understand trends in disease evolution. GLEWS regu
updates risk factors, analysing data on the influencing factors on th
persistence of disease.
The risk assessment is initially be performed in specific regions for
diseases, such as CCHF, RVF, H5N1 HPAI, Rabies and Brucello
framework, risk analysis and mapping methodologies will be develo
using reliable available data on outbreaks, including monitoring activ
countries. Information is jointly gathered by FAO, OIE and WHO. T
eventually confirmed by the national authorities and combined wit
including land use, trade, livestock population, animal movement, etc
map. These early warning outputs are made available to internatio
decision makers charged with disease monitoring and c

HEWSweb

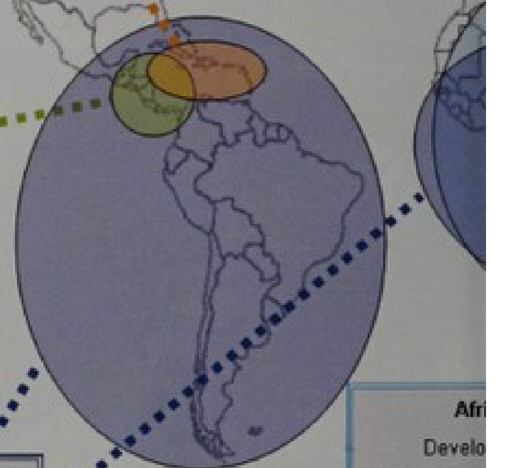
The Inter Agency Standing Committee (IASC) Humanitarian Early Warning System

This interagency platform for early warnings of natural hazards includes monitoring of earthquakes, floods, heavy/torrential rain, storms/cyclones, volcano updates, and locusts, all covered in a simplistic way. It has been developed by the WFP (World Food Programme) for the IASC. This system relies on early warning information from a number of UN agencies, as well as non-UN bodies such as the US Geological Survey and the Food and Agriculture Organisation (FAO) Locust Watch programme.

GFDRR – Global Facility for Disaster
Recovery

Managed by the World Ban

This facility conducts risk assessments in over 40 co
guidelines for risk assessment methodologies an
development and distribution of spatial risk dataset
platforms to be used as risk analysis and communic
disaster managers and decision makers (Global Ris
Each country has its own specific programme, tailor
data it already has among other factors. GFDRR u
already collated by affected country's government
modelling techniques to produce risk assessments
strategies, adapted to individual country's



Central America Flash Flood Guidance system (CAFFG)

Developed by the Hydrological Research Centre, USAID and other foreign agencies.

This flash flood guidance and early warning system allows decision makers within the fields of meteorological and hydrologic services to forecast the risk of flash flooding for all seven Central American countries (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama). It is a diagnostic tool that allows investigation into weather (e.g. heavy rain) and terrestrial (e.g. saturated ground) related factors that can initiate flash floods. With the information provided by this tool, decision makers can then make a rapid evaluation of the potential for a flash flood in any given area.

Afri
Develo

This is a soft
quantify and m
security risk
drought, but inc
is planned. It co
monitoring and
assessment a
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rainy season ev
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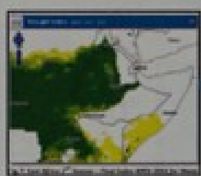
agriculture. I
number of peop
affected, or rec

FEWSNET (Famine Early Warning System Network)

USAID

This early warning system maps global famine to different criterion, such as market food prices, rainfall and crop failures, using both satellite and terrestrial data. It provides monthly food security updates for 25 countries in West Africa, East Africa, Southern Africa, Central America, South America and the Caribbean. The output maps show varying indicators of famine, including satellite imagery of vegetation coverage, rainfalls averages, water requirement satisfaction, and the path of the ITCZ. Also provides near- and medium-term forecasts for famine and other weather hazards. The Central American early warning system is Mesoamerica Famine Early Warning System.



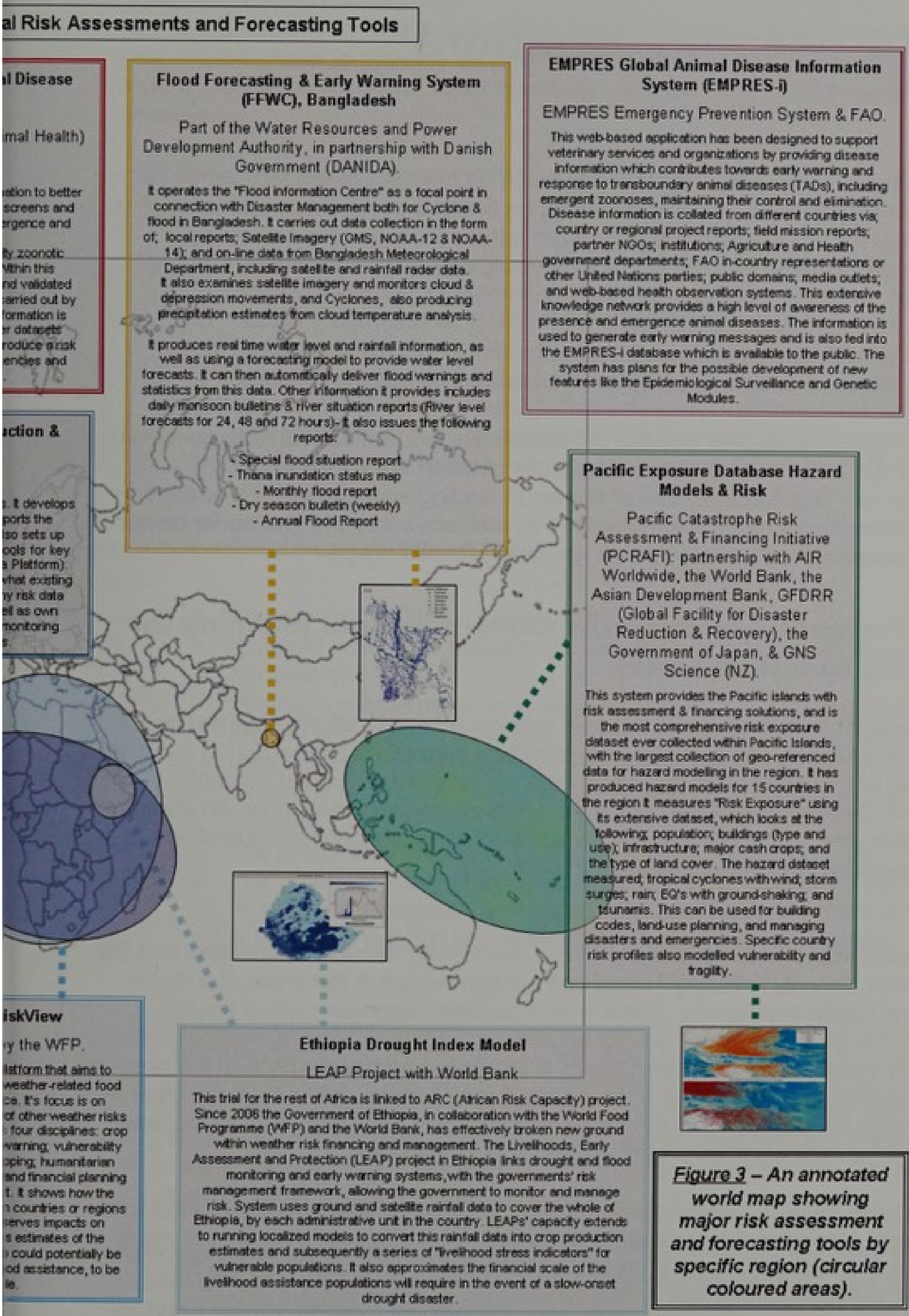


***Figure 3** – An annotated world map showing major risk assessment and forecasting tools by specific region (circular coloured areas).*

Chapter 4: Recommendations

68. The recommendations in this report are focused on changes in practice within UK Government departments. As well as taking on board these recommendations, it is important that the UK continues to learn from international good practice and incorporates this into its own emergency planning and response structure where appropriate.

69. Based on the evidence summarised in chapter three, there are three key recommendations with an additional three supporting recommendations.

70. Together, they aim to ensure that the UK's response to international emergencies is science-led. The main recommendations (1-3) focus on areas where the UK Government can ensure better use of the world-leading science which is already available. Subsequent recommendations (4-6) address some of the broader issues raised by stakeholders during evidence gathering for this report.

Better use of science advice across Government in planning for and responding to emergencies

71. The UK Government's framework in using science advice to inform planning and preparing for national emergencies, and providing immediate advice during such an event is well established. The approach uses the Government Chief Scientific Advisor, and Departmental Chief Scientific Advisors and their networks. An important aspect of this advice is to ensure that the existing science advice is understood in terms of modelling and communicating the risk.

72. International mechanisms such as the WHO, the Health Security Committee and the Global Health Security Advisory Group can provide advice in the onset of a major international health emergency. There is no equivalent approach within the UK Government to provide science advice on other emerging or existing international risks. Nor is there any current mechanism to provide immediate advice at the onset of a major international emergency when a COBR is not called. It has become clear that an appropriate early warning system is needed for the UK Government to respond effectively to humanitarian emergencies which arise overseas.

73. There is a wide range of good advice which can inform internationally focussed risk assessments. However, it is unrealistic to expect policy makers to be able to easily integrate all the relevant advice (some of which may be contradictory) and to understand the provenance and quality of the data sources, without expert interpretation.

74. To meet these needs, three key recommendations are made.

Recommendation 1: The Government Chief Scientific Adviser should establish a risk expert group to provide advice to Ministers on emerging international risks. Initially, the group should meet quarterly, and provide regular reports as risks emerge.

75. This group should take a strategic view of global natural hazards. Its outcomes would be:

- Capturing emerging global risks to provide a global assessment considering key natural hazard risks against departmental priority countries. This assessment could be captured as a global risk map (building on that which has been created for this report).
- Advice to all interested Government Departments about changes to the risk assessments of major natural hazards in their priority countries and about interpretation of early warnings so that they can plan accordingly.
- Improvements in establishing trigger points for early action in slow onset emergencies.

Membership and ways of working

- The group should be chaired by the GCSA.
- It should include all relevant CSAs, other experts should be co-opted as necessary.
- Initially, it should meet on a quarterly basis, with standing agenda items to identify and discuss emerging risks and monitor existing risks. It should also take the lead in implementing recommendations two and three.
- Quarterly reports will be provided to Ministers through the National Security Council.
- The group may form sub-groups as specific issues emerge.
- The group will need to be supported by a Secretariat who will manage the emerging risk register, and gather and coordinate information to the group, so it is proposed that the key relevant departments will contribute.

76. It is also recommended that preparation is put in place for dealing with humanitarian emergencies when they occur. To that end, preparations should be made to draw together experts at short notice. To facilitate this, a list of key experts, with contact numbers, should be drawn up so that Departments can access the relevant expert advice quickly and should include a wide range of natural and social science, and user expertise. The rapid identification of appropriate experts and advice should be tested before a crisis occurs.

Recommendation 2: The risk expert group should, under the direction of the Cabinet Office, ensure there is a list of experts available who can be approached to provide advice on specific hazards and their impacts.

Recommendation 3: The GCSA, working with relevant CSAs, should establish procedures for a Humanitarian Emergency Expert Group (HEEG) to be convened during an emergency. The group would immediately provide a prognosis of the "reasonable worst case", based on science advice, following a major rapid onset emergency. This would inform response options.

77. The HEEG would be formed on an ad-hoc basis when needed, following a rapid onset emergency and as requested by a Government Department. It should mobilise a network of appropriate experts (including CSAs) to provide a rapid prognosis of the "reasonable worst case" to guide the immediate operational response. The GCSA would chair, with a Departmental co-Chair(s) as appropriate. Support would be provided from the relevant Department(s).

78. The Humanitarian Emergency Expert Group should establish the available scientific evidence, and provide advice to relevant Departments on questions such as:

- What are the immediate impacts?
- Who will be affected, where and how?
- Will the impacts change?
- What are the secondary hazards?

79. The list of experts set out in recommendation two should be drawn upon for this Group.

Better engagement between disciplines and between users and providers of science

80. The new structures proposed above focus on better ways in which science advice can be given to policy makers within Government. However, the links between those providing the science advice and those using it to make decisions could also be further strengthened.

81. There is uncertainty around all science advice, while many emergencies involve complex interactions which generate inherent uncertainties. It is therefore very important that policy makers, when making their decisions, understand the character, strengths and limitations of that advice. Amongst other priorities, the creation of a register of global risks would help in this dialogue as it would provide greater clarity on the areas where advice is needed.

82. Science providers, meanwhile, need to provide advice in the format that is most useful to policy makers and appropriate to the character of the hazard involved. Overall, better dialogue should also mean that research itself is better informed by an understanding of the wider impacts and policy implications.

83. Cross-disciplinary working in key areas should also be further promoted, including perspectives from local knowledge and users. The Research Councils UK (RCUK)

cross-council initiatives (for example, the Global Uncertainties programme[34]) are good examples of work to bring together researchers and the research from different natural and social scientific disciplines to increase collaboration under a broad theme.

Recommendation 4: DFID, UK Research Councils and other UK funders of science should further strengthen and improve cross disciplinary working. This may be through a cross governmental organisation. Together they should establish a more effective approach towards engagement between researchers and research users, both in the UK and internationally.

84. A cross governmental organisation such as UKCDS or Living with Environmental Change (LWEC)[35] may be the most appropriate mechanism to improve engagement between researchers and research users.

85. The UK Collaborative on Development Sciences (UKCDS) is an existing collaboration of UK Government Departments and research funders who work together to maximise the impact of UK research on international development. A UKCDS Disasters sub-group with membership from a wider range of relevant stakeholders, including international experts and those from policy and NGOs, has met since 2009 to exchange information on funding priorities and to discuss a more coordinated approach to disasters and humanitarian research. The group engages with academic and research organisations on an ad-hoc basis. This group for example, could be used to discuss a more strategic approach to UK and international funding collaboration to address the key risks identified by the expert risk group.

86. The cross government group could build upon the existing areas where the UK is world-leading and deliver a great deal of value to countries who are trying to improve their national resilience and to strengthen national capabilities to manage emergencies at a local level. The Integrated Research on Disaster Risk (IRDR) has requested that the UK establish a national science committee as part of its work to establish global regional centres of excellence. This recommendation also responds to that request.

Early warning into early action

87. The question of why there is often a failure to act on early warnings raises complex issues. For example, an Oxfam/Save the Children report identified a number of potential reasons for the failure to translate early warning into early action at the start of the recent East Africa famine. These are not related to the quality of the science advice informing the early warning system[36]. Some stakeholders reported that there was a perceived fear of being seen to be "wrong" when an emergency is anticipated but does not materialise ("false positives"). Quantitative evidence has not been found regarding how frequently these or their counterpart ("false negatives") occur.

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[34] http://www.globaluncertainties.org.uk/
[35] Living with Climate Changes: see http://www.lwec.org.uk/about
[36] A Dangerous Delay: The cost of late response to early warnings in the 2011 drought in the Horn of Africa. http://policy-practice.oxfam.org.uk/publications/a-dangerous-delay-the-cost-of-late-response-to-early-warnings-in-the-2011-droug-203389

Recommendation 5: The emerging findings of the GO Science Foresight Project should be used to inform the work DFID is currently undertaking on disaster resilience. It will also inform DFID's ongoing work in developing the evidence base for action in response to early warnings from risk assessments (including previous international responses) and slow onset disasters.

Better ways of public and private working

88. Relevant data is created and used in both the public and private sectors[37]. Whilst outside of the original scope of the terms of reference, it is important to consider better ways of public and private working.

89. Much science advice is presented probabilistically, as are risk assessments. Many policy makers are uncomfortable with this approach as the advice cannot provide "certainty" that the proposed decision is "correct". This lack of certainty can lead to inertia. Use of data in the commercial sector indicates that taking a view on the balance of probabilities is entirely possible. Public and private sectors can learn much from each other.

90. Further, there is a view that humanitarian disasters are, in financial terms, paid for by populations one way or another. This might be through taxation or through insurance, or hybrids. All of those with an interest in averting these catastrophic losses, for whatever reason, have a basis for sharing and improving the available data and using it to mitigate risks.

Recommendation 6: The Government Chief Scientific Adviser will use the output of the GO Science Foresight Project to further consider the benefits in the public and private sectors developing, sharing and using data to prepare for and predict humanitarian disasters.

91. This would be a good opportunity to identify specific ideas for long-term collaborative and multi-sector efforts to better anticipate, and, or manage extreme events.

92. This link between public and private sector in using data to global benefit is an issue which will be explored in the GO Science Foresight Project on "Improving future disaster anticipation and resilience" due for publication in the autumn.

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[37] http://www.weforum.org/reports/global-risks-2012-seventh-edition

Research Coordination. There are a number of models for cross-cutting research mechanisms. Examples of two are described below:

The Energy Research Partnership: a model for a government/NGO partnership

This is a Government/NGO advisory partnership. It is co-chaired by the CSA for the Department of Energy and Climate Change and the CEO of the National Grid. This partnership brings together key stakeholders and funders of energy research, development, demonstration and deployment in Government, industry and academia and other interested bodies, to identify and work together towards shared goals. This partnership has been designed to give strategic direction to UK energy innovation, seeking to influence the development of new technologies and enabling timely, focussed investments to be made.

An advice group which is not solely Government focussed could provide a "neutral" space for involvement of NGOs. It would also make the best science advice available to policy makers in NGOs as well as Government policy makers.

The Natural Hazards Partnership

The Natural Hazards Partnership (NHP) delivers a cross Government approach to improve the coherence and quality of hazard management, and the planning, preparation, warning and response to natural hazards in the UK.

Its vision is to provide information, research and analysis on natural hazards for the development of more effective policies, communications and services for civil contingencies, Governments and the responder community across the UK.

Through the consortium of public bodies that form the NHP, principally Government Departments & agencies, trading funds and public sector research establishments, its aim is to establish a forum for the exchange of knowledge, ideas, expertise, intelligence and best practice in relation to natural hazards. It also provides a common and consistent source of advice to Government and emergency responders for civil contingencies and disaster response and an environment for the development of new supporting products and services. For example, it issues a daily natural hazards "watching brief" for the UK (see Annex 4) and has been developing a Hazard Impact Model capability.

Whilst the focus is on natural hazards that disrupt the normal activities of UK communities or damage the UK's environmental services, the NHP could potentially provide the international community with a model for cross government hazard management based on a platform of world-class environmental sciences.

Box 4.1 Existing models of partnership working.

Chapter 5: Conclusions

93. In preparing this report it has become clear that there is both a wide breadth of science already available in this area, and a large number of reports published which consider humanitarian disasters. This has emphasised the need to take action. It is not acceptable that some parts of global society have had data which clearly indicate an oncoming humanitarian disaster and yet inertia appears to get in the way of that risk being communicated or the warning being acted upon.

94. Whilst there is no one approach that will solve all problems, the recommendations made here when implemented will be a step forward. This report has created six recommendations where immediate changes can be made to help and support the use and uptake of science. The GO Science Foresight report to be issued in the Autumn of 2012 will address some of the broader systemic issues where changes can be made over a longer time scale.

95. This report is focused on the way the UK Government can make better use of science and knowledge in preparing for and predicting humanitarian emergencies and disasters. Over time, this new UK approach could have a wider influence and impact on international organisations and offer opportunities for the UK.

96. In a number of areas of science, the UK has world leading scientists and institutions and experience with multidisciplinary approaches. There are a number of world leading, international humanitarian and development agencies who are based in the UK and can benefit from increased dialogue with scientists. It is also important that UK good practice on the effective use of science should influence the wider international community to increase the effectiveness of current science. Likewise, it is important the UK continues to learn from international good practice.

97. Recommendations made in this report can be implemented relatively quickly, and will make an important change in the effectiveness in which the UK Government uses science advice when it predicts and prepares for humanitarian emergencies.

98. The first progress report on these recommendations will be made in November 2012.

Annexes to the report

Annex 1 discusses the use of risk assessments and early warning systems and contrasts warning systems for rapid and slow onset disasters.

Annex 2 presents the methodology used to prepare this report and the organisations and individuals who gave evidence.

Annex 3 provides a summary of some of the main organisations operating in the natural disasters field (by geographical region), and also summarises the interest of UK Government Departments and Agencies in this area.

Annex 4 is an example of the daily assessment of key natural hazards which are potentially of concern to UK emergency planners (for example, flooding or volcanic activity in Iceland which could impact UK airspace) provided by the Natural Hazards Partnership.

Annex 1: Global risk assessments and early warning systems

This discusses how risk assessments can be used to inform policy makers, and provides examples of several early warning systems for both rapid and slow onset emergencies.

Risk assessments and the impact of an emergency

1. It is clear that risk assessment as a tool needs to be used with care and a good understanding of the methodologies and underpinning data used in constructing a risk analysis.

2. One such factor to consider is the impact of rapid onset emergencies which may be different to those of slow onset emergencies. Many risk analyses use mortality data or economic loss to assess the impact of a natural disaster. This means that risk assessments may underestimate other factors such as the massive social disruption which often occurs during slow impact emergencies like drought.

3. Analysis from the Internal Displacement Monitoring Centre shows that over 42 million people globally were displaced by disasters triggered by sudden-onset natural hazards in 2010, whilst 17 million people were displaced by such disasters in 2009, and 36 million in 2008[38]. Yet there are not comparable figures for those forced to move by slow-onset disasters. Even if there were, these combined figures would still neglect a key group of people highlighted by the recent Foresight report on Migration and Global Environmental Change – those who are trapped in circumstances where they are unable to move away from the dangers prevailing in heightened vulnerability[39].

4. Whilst some of the contributions to risk assessments, most notably weather and climate predictions are providing ever more reliable forecasts, overall the production of many risk assessments can be further complicated by the sheer complexity and increasing unpredictability of events. This caution on complexity is further supported by the Intergovernmental Panel on Climate Change report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX). [40]

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[38] Yonetani, M. 2010. Displacement due to natural hazard-induced disasters: Global estimates for 2009 and 2010. Geneva: Internal Displacement Monitoring Centre and Norwegian Refugee Council.

[39] Foresight: Migration and Global Environmental Change Final Project Report (Government Office for Science, 2011); available at http://www.bis.gov.uk/foresight/our-work/projects/published-projects/global-migration/reports-publications

[40] IPCC, 2012: Summary for Policymakers. In: Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 1-19. http://ipcc-wg2.gov/SREX/images/uploads/SREX-SPM_FINAL.pdf

Using risk assessments

5. Figure 4 shows the geographical location of natural hazard events in 2010 as an example of the wide range of occurrence of these events. For example, Mosquera-Machado and Dilley compared global disaster risk assessment results for two global disaster risk analyses which provide country rankings for risk: the Columbia University Hotspots project, and the Disaster Risk Index[41] (DRI). The authors produced comparable indexes of country rankings, derived from both the DRI and Hotspots.

6. The rankings produced using each tool contained 25 countries. The numbers of countries common to both lists for an individual hazard ranged from 7 to 16 out of the 25 countries in each list. When multiple hazards were considered to produce a ranked list of 25 countries, only 6 countries appeared in both lists.

How the UK prepares and responds to a national emergency

7. Within the UK, science advice has a key role in both the prediction and preparation for any emergencies in the UK, and also for responding during an emergency:

   - The **planning and preparation** for emergencies includes a National Risk Assessment. The "public facing" version is the National Risk Register which is designed to increase awareness of the kinds of risks the UK faces, and to encourage individuals and organisations to think about their own preparedness. The register also includes details of what the Government and emergency services are doing to prepare for emergencies. Figure 5 gives an example of the risks considered in the National Risk Register.

   - When a major national emergency occurs in the UK, the Government forms a "Cabinet Office Briefing Room" committee (COBR) may be formed to coordinate a cross-departmental response. If science advice is needed to inform this response, a Scientific Advice Group for Emergencies (SAGE) is called. As an example, during the Fukushima emergency, COBR considered the implications for UK nationals living in Japan, and SAGE was asked to provide scientific advice on their safety. It may be useful to consider how this type of science providing mechanism can work in humanitarian emergencies where a COBR has not been called.

[41] A comparison of selected global disaster risk assessment results. Mosquera-Machado and Dilley, Nat Hazards 48: 439-456, 2009.

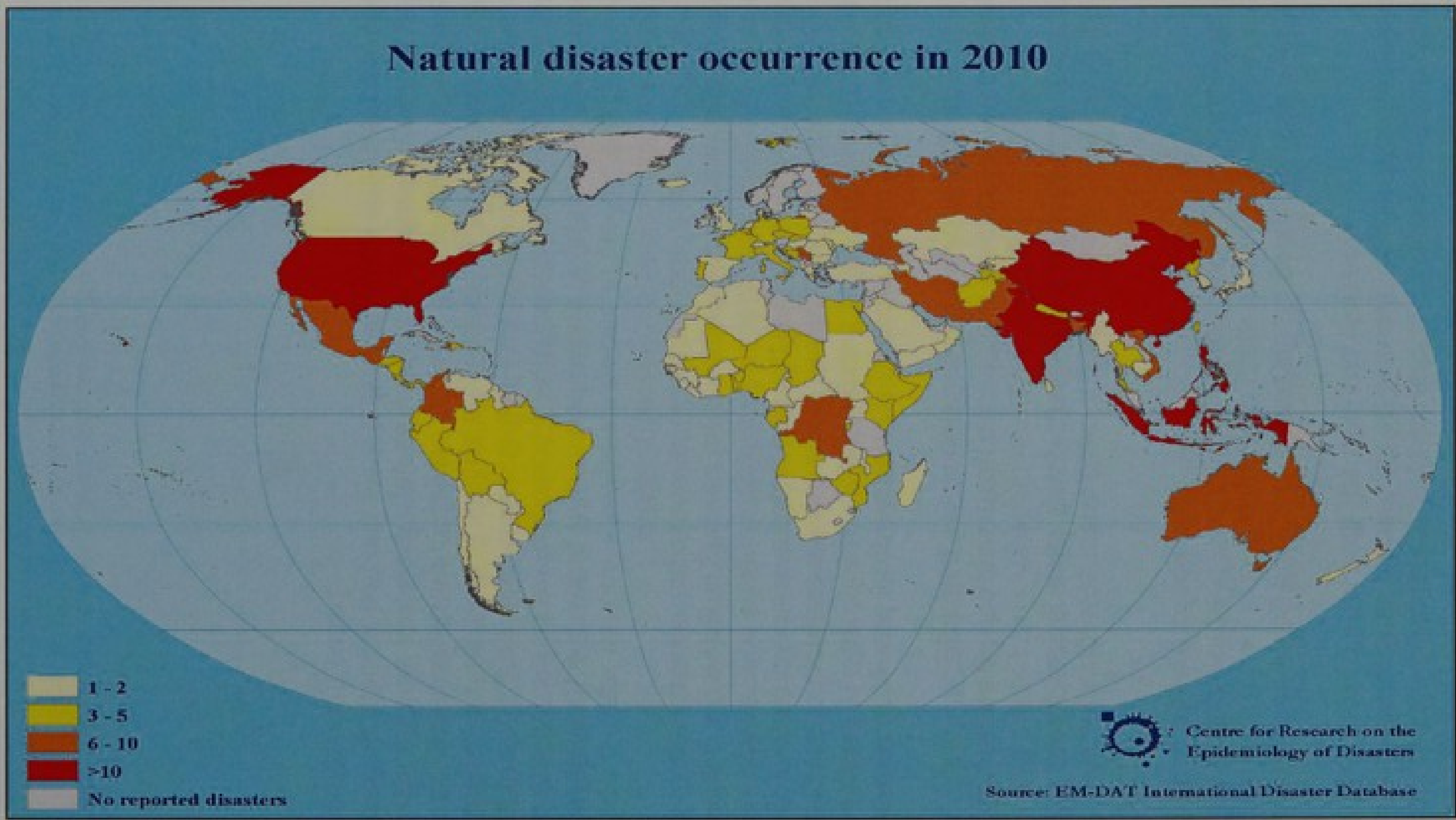

Figure 4: Natural disaster occurrence in 2010. Source: EM-DAT: The OFDA/CRED International Disaster Database – www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.

This figure is presented as illustrations of the types of mechanisms, hazards, and bodies that are currently available.

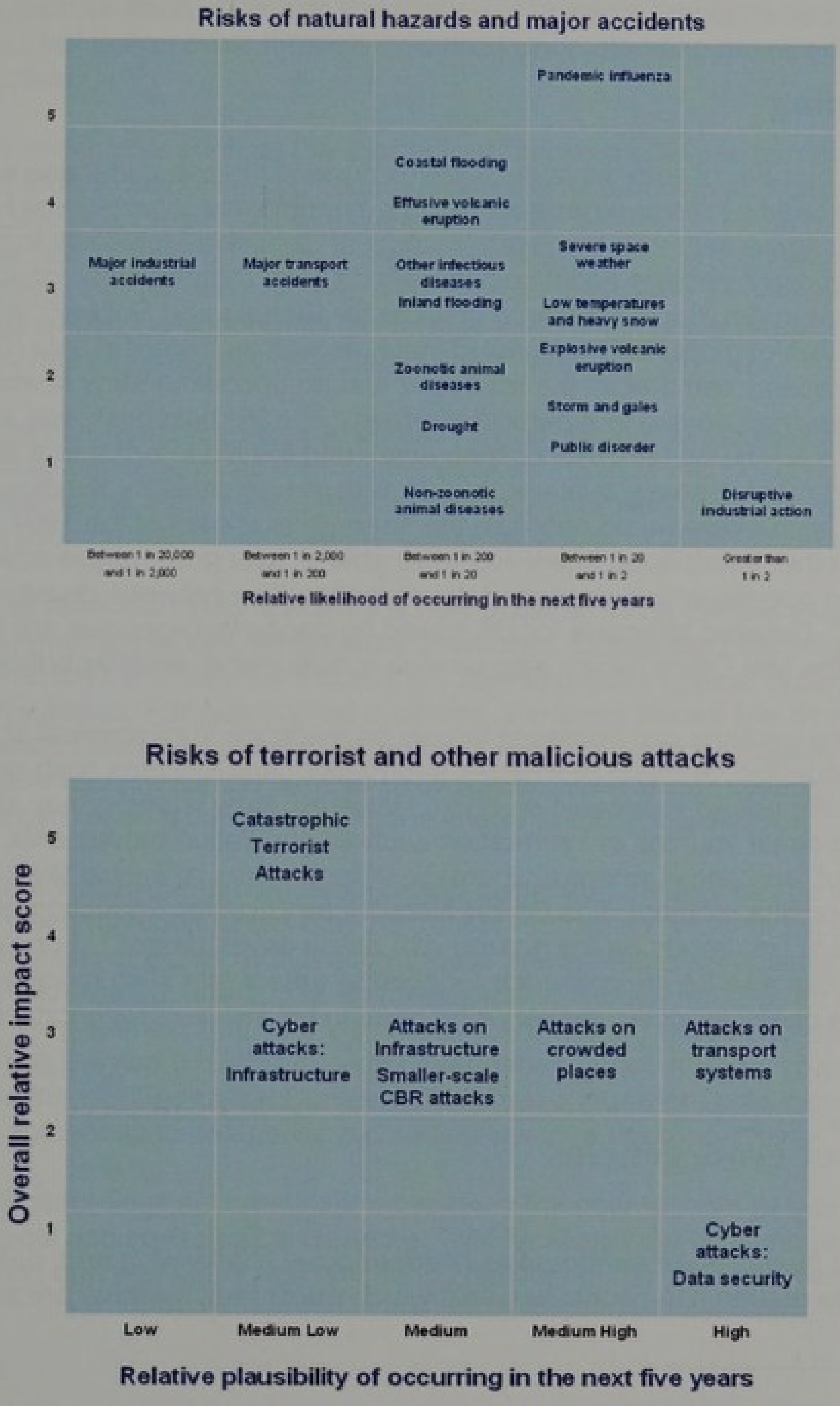

Figure 5: Risks of terrorist threats and natural hazards facing the UK. Taken from the National Risk Register 2012

Early warning

8. There are a number of early warning systems currently in use and these early warning systems are used by many organisations. For example, the International Red Cross has a formal agreement with the Earth Institute at Columbia University to provide monthly seasonal forecasts and also a weekly disaster management information system[42]. The International Research Institute for Climate and Society[43] (IRI) includes current analysis of global and regional climate, as well as historical data. Current seasonal forecasts can predict the likelihood that an upcoming rainy season will be wetter or drier than normal in a particular region. The IRI help desk was asked by the Red Cross to advise on the 2009 El Nino event and the IRI forecast that the East Africa region would receive above average rainfall, with the potential for flooding, although the 2009 El Nino event would not have the strength or impact of the 1997 event. Based on this and other information, the IFRC were able to take pre-emptive actions (including an appeal) which shortened the response time between disaster and relief operations[44]. Detailed forecasts for UK based humanitarian agencies are produced on request by the Met Office, which also provide a daily global weather bulletin.

9. Early warning systems can be based largely on evidence from physical science, including modelling, analysis of weather information, and systems such as monitoring seismic activity before a volcanic eruption. However, early warning may also come from other indirect sources of information such as population movements, or monitoring of food prices where an increase in food prices at a local level may be the first indication of a problem. The Global Network for Disaster Reduction has been clear on the need to link trends on the ground with policy development[45]. For example, rising food prices can also be the precursor for political unrest and such monitoring systems may also be useful for policy makers who need to be aware of forthcoming political shocks.

Rapid onset emergencies

10. Forecasting the timing of earthquakes is enormously challenging and, despite considerable research in countries within which major fault systems are active, is

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[42] See: http://www.earth.columbia.edu/articles/view/2009
[43] For example, see http://portal.iri.columbia.edu/portal/server.pt
[44] A better climate for disaster risk management. International Research Institute for Climate and Society First published 2011. See:
http://portal.iri.columbia.edu/portal/server.pt/gateway/PTARGS_0_5643_7757_0_0_18/CSP3_Final.pdf
[45] Summary Report: Views from the Frontline Local reports of progress on implementing the Hyogo Framework for Action.May 2011
http://plan-international.org/files/global/publications/emergencies/Global-Network-Disaster-Reduction2011summary_report.pdf

unlikely to improve soon. Accurate forecasting of volcanic eruptions also remains problematic, but is improving through increased understanding of volcanic processes in the last decade.

11. Risk assessment tools such as the Global Earthquake model use current science advice and tools to calculate and communicate the hazard, risk and also the impacts on society and economy.[46] These assessments can be used to focus mitigation efforts to lower the risk. In addition, there are early warning tools for secondary hazards following an earthquake for example, a tsunami alert system can give local and national authorities the opportunity to mobilise and implement emergency plans where the tsunami has originated some distance out to sea.

12. Bringing together agencies with complementary remits in a formal partnership can deliver substantial benefits. In the UK, the establishment of the Flood Forecasting Centre following the 2007 floods, has dramatically improved the early warning of dangerous flooding events such as the Cumbrian floods of 2009[47].

13. Prediction of seasonal cyclone activity is now possible using climate models, partly based on knowledge of sea temperature anomalies. Designated warning centres using observational data and weather models are able to predict tropical cyclones up to several days ahead. For non tropical cyclones, alerts are issued five days ahead and warnings issued with lead times of 24 hours or more[48]. Weather models, coupled with ocean models can predict the number of cyclones over a whole season. These predictions can made a couple of seasons ahead of the actual season.

14. In the case of volcanic eruption, atmospheric dispersion models can be used to determine where noxious gases may be transported which could be harmful to human health. A number of global monitoring facilities are available to consider volcanic hazards. Following the eruption of Eyjafajllajokull in Iceland in 2010, an extensive network of early warning monitors was put in place. More widely the Humanitarian Early Warning Service (HEWS) provides information about volcanic eruptions and ash levels[49] and the US Geological Survey established a four-step, colour coded alert system for volcanoes to categorise increasing levels of volcanic activity.[50]

15. The Word Meteorological Organisation oversees the international network of National Meteorological and Hydrological Services. This facilitates the free and open exchange of information and enables a rapid response network in the case of emergencies.

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[46] http://www.globalquakemodel.org/summary

[47] The Flood Forecasting Centre is a partnership between the Environment Agency and the Met Office, see http://www.ffc-environment-agency.metoffice.gov.uk/

[48] See: http://www.hpa.org.uk/webc/HPAwebFile/HPAweb_C/1296686255398

[49] http://www.hewsweb.org/volcanoes/

[50] http://volcanoes.usgs.gov/activity/alertsystem/index.php

Slow onset emergencies

16. Risk assessments and the resultant warning systems for slow onset emergencies appear to be in common use. A number of examples are given here:

- The WHO Global Outbreak Alert and Response Network (GOARN) tracks emerging infectious diseases from around the world and can provide a real time alert system to national and international authorities and is a technical collaboration of existing institutions and networks. The GOARN forms part of the WHO Global Alert and Response system which aims to provide an international system for response to a disease outbreak[51]. Surveillance systems to identify emerging disease outbreaks focus on indicator based and event based surveillance. Indicator based surveillance involves the routine collection of pre-defined diseases using case definitions. Event based surveillance uses the rapid collection of ad hoc information about acute public health events and can use both official and unofficial sources such as the media.

- The Regional Climate Outlook Forums are the mechanisms through which consensus seasonal forecasts are generated on a regional basis around the world. By bringing together countries having common climatological characteristics, the forums ensure consistency in the access to and interpretation of climate information.

- The Department for International Development (DFID) has a Climate Science Research Partnership with the UK Met Office. A new African Climate Science Research Partnership (CSRP) between the DFID and the Met Office Hadley Centre (MOHC) is working, in consultation with African stakeholders, to advance scientific understanding and bring new science into use[52]. It also includes a structured programme in capacity building and training which is essential for delivering in-country resilience and preparedness.

17. A number of reports have stated that the recent famine in East Africa was predicted in advance but insufficient action was taken to pre-empt the disaster[53] and, as noted in the body of the report, a recent report by Oxfam and Save the Children has considered why the early warnings provided by the Famine Early Warning Systems Network (FEWS NET) was not acted upon earlier.[54] Ververs evaluated a number of early warning regional systems in East Africa in 2010 and 2011[55,56]. Five early warning

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[51] http://www.who.int/csr/en/

[52] http://www.metoffice.gov.uk/hadobs/csrp/

[53] We thought trouble was coming, Funk, C Nature 476, 7 (2011) | doi:10.1038/476007a

[54] A dangerous delay. The cost of late response to early warnings in the 2011 drought in the horn of Africa. Oxfam and Save the Children joint briefing note, January 2012.

[55] The East African Food Crisis: Did Regional Early Warning Systems Function? M-T Ververs, J. Nutr. 2012 jn.111.150342

systems were examined (including FEWS NET), two of them were considered to have provided an early warning (FEWS NET and Food and Nutrition Security Working Group alerts[57]) but three other systems did not.

18. There are a wide range of early warning systems to identify potential water quality issues, or land degradation. These can include analytical sampling techniques, such as the Global Environmental modelling water programme,[58] and the Food Contamination Monitoring and Assessment Programme (GEMS/Food) monitors trends and levels of contaminants in food.[59] Such monitoring is very important for long term understanding of issues such as nutrition, but can also identify potential slow onset disasters including food or chemical contamination.

19. Remote sensing from space can provide good information when trying to asses land degradation to identify potential vulnerabilities, and generate scenarios which can inform risk assessments[60]. The HEWS web (humanitarian early warning service) is an inter-agency partnership project aimed at establishing a common platform for humanitarian early warnings and forecasts for a range of natural hazards and can provide information on a range of hazards including animal pests such as locusts and aims to provide a global "one-stop shop" for early warning information for multiple natural hazards.[61]

The "last mile"

20. It is important to be clear that an "early warning" is not the sole requirement for effective early action. In reality there is also a need to understand the warning so action can be taken. For an early warning system to be effective, it needs to reach the target audience in time to enable an appropriate response which can reduce the impact of the natural hazard event. This "last mile" may be delivered through the use of technology such as mobile phones or other satellite communication or with megaphones and hand sirens to provide early warning.[62] However, this "last mile" is a key part of early warning, and requires effective two-way dialogue to be useful.

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[56] See also: http://www.acaps.org/img/documents/early-warning-and-information-systems-in-east-africa-acaps---early-warning-and-information-systems-in-east-africa.pdf

[57] For example, see http://www.disasterriskreduction.net/fileadmin/user_upload/drought/docs/FSNWG%20UpdateJuly2011%20110722Version13.pdf

[58] For example, see http://www.gemswater.org/

[59] For example, see http://www.who.int/foodsafety/chem/gems/en/index.html

[60] Early Warning Systems: A Review, Quansah et al. *Journal of Terrestrial Observation Volume 2, Issue 2 Spring 2010*

[61] For example, see http://www.hewsweb.org/about/

[62] ICT for disaster risk reduction: an overview of trends, practices and lessons. United Nations Asian and Pacific Training Centre for Information and Communication Technology for Development (UN-APCICT), 2010.

Annex 2: Methodology, and stakeholders consulted

1. This report is based on desk based research, interviews with representatives of 28 and 2 written responses. The work was overseen by a Senior Advisory Board of Departmental Chief Scientific Advisers (CSAs), and a panel of 6 independent experts. Further advice was provided by senior officials from 10 Government Departments or Agencies (including the Met Office and the British Geological Survey).

Review timing

2. The majority of the interviews for this review were conducted in November and December 2011. A number of additional interviews were conducted in January and early February 2012.

Methodology

3. This report was prepared under the leadership of the Government Chief Scientific Adviser (GCSA), Sir John Beddington and a group of experts. This report has been written by GO Science. It has been reviewed and agreed by the expert panel below who met a number of times during the project to discuss the findings as they emerged. The panel has also contributed to the preparation of this report.

4. In addition to that support, thanks are due to Virginia Murray of the Health Protection Agency for her particular help in the preparation of this report.

Independent expert panel

5. A small group of independent experts were appointed by Sir John Beddington. This expert group gave specific evidence to support the development of the report. They also provided a review function during the preparation and presentation of emerging findings and final report. The expert group consisted of:

    - Rowan Douglas (CEO, Global Analytics, Willis Re and Chairman, Willis Research Network);
    - Professor Andy Hall (London School of Hygiene and Tropical Medicine);

- Professor Melissa Leach (ESRC STEPS Centre, Institute of Development Studies, University of Sussex);
- Professor Tim Palmer (University of Oxford);
- Professor John Rees (British Geological Survey); and
- Dr John Twigg (University College London).

Senior Advisory Board (SAB)

6. A Senior Advisory Board of CSAs was established to advise on the strategic direction of the project, and to agree the main recommendations. It was chaired by the GCSA with CSAs from relevant Government Departments, Agencies and Devolved Administrations:

    - British Geological Survey;
    - Department for Energy and Climate Change;
    - Department for International Development;
    - Department for Health;
    - Foreign and Commonwealth Office;
    - Home Office;
    - Environment Agency (for the Department for the Environment, Food and Rural Affairs);
    - Ministry of Defence;
    - Met Office; and
    - Welsh Government.

Government Officials Project Advisory Group (PAG)

7. The Project Advisory Group (PAG) comprised officials from the key Government Departments who have an interest in the project's aims and ultimately its conclusions.

    - Department for Energy and Climate Change (DECC);
    - Department for international Development (DFID);
    - Environment Agency (for the Department for the Environment, Food and Rural Affairs);
    - Foreign and Commonwealth Office (FCO);
    - Department for Health;
    - Ministry of Defence;
    - Met Office;
    - UK Space Agency; and
    - Health Protection Agency

- British Geological Survey

8. Discussions with selected officials from the Departments forming the PAG also contributed to the formulation of the recommendations.

Evidence gathering and analysis of evidence

9. The agreed scope for this work was a short project. Consequently, most written evidence was obtained from existing reports with additional written evidence from the independent expert panel and questionnaires sent to a number of non government stakeholders.

10. Additional evidence was obtained from non government stakeholders who were interviewed via a semi-structured questionnaire, either in person or by telephone. Selected PAG members were also interviewed.

11. The evidence was assessed to identify the key common themes where there were barriers to a more effective use of the existing science.

Individuals interviewed

- Leszek Borysiewicz (Vice-Chancellor of Cambridge University)
- Brian Collins (University College London)
- Ian Diamond (University of Aberdeen)
- Stephen Edwards (Aon Benfield UCL Hazard Centre)
- David Harper (Department of Health Chief Scientist)

Stakeholders interviewed

- ActionAid
- British Red Cross
- CAFOD
- Care International
- Defence Science and Technology Laboratory (DSTL)
- ECHO
- Global Network of Civil Society Organisations for Disaster Reduction
- Imperial College London
- International Committee of the Red Cross
- International Federation of the Red Cross and Red Crescent Societies
- Kings College London
- Merlin
- OCHA
- Oxfam
- Plan UK
- Save the Children
- UCL Institute for Risk and Disaster Reduction

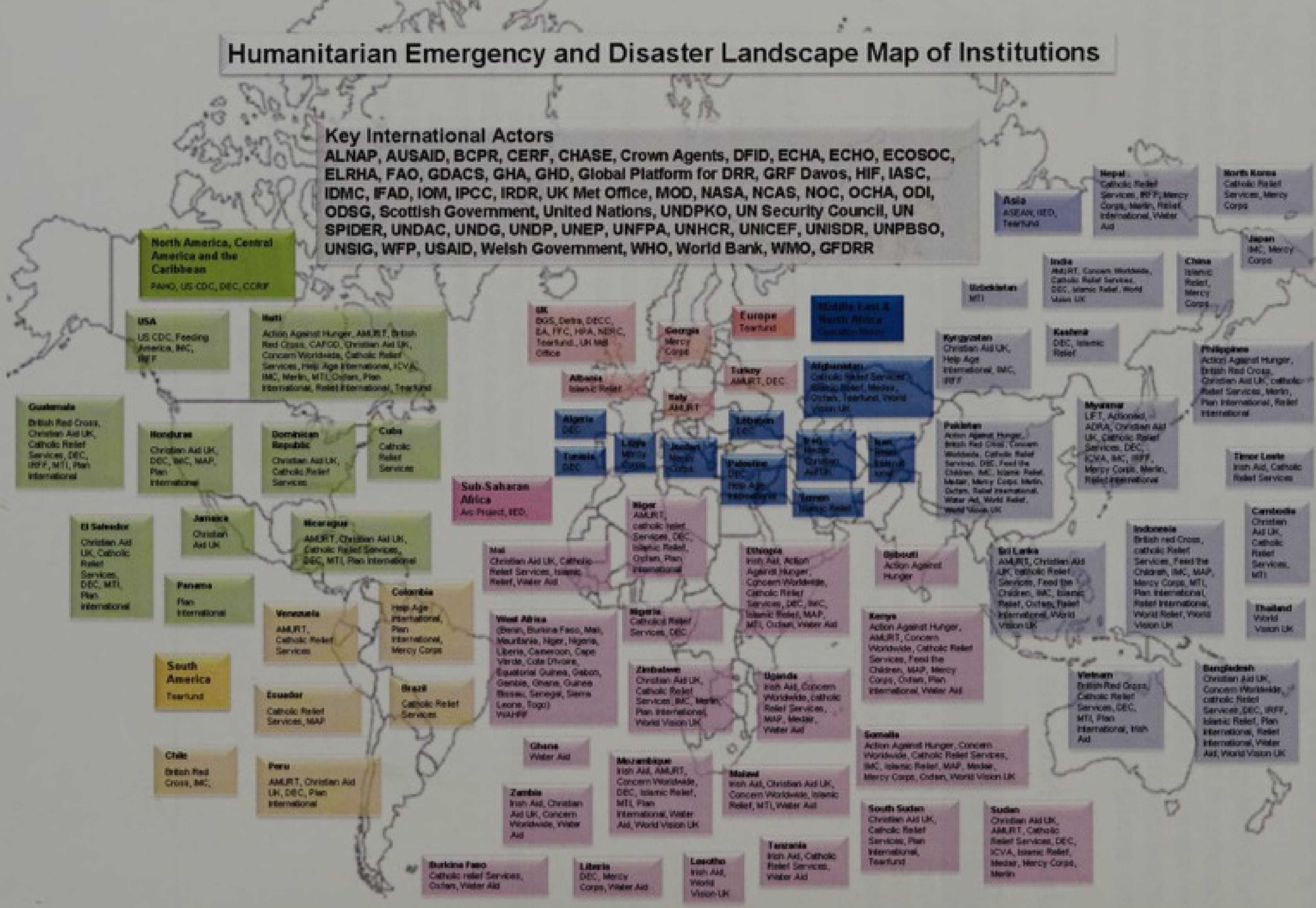
- UNDP
- UNHCR
- UNICEF
- UNITAR
- UNOOSA
- UN WFP
- World Vision International
- World Vision UK

Annex 3: Summary of organisations operating in the natural disasters field

The following table provides details of some of the major organisations and initiatives operating in the natural disasters field. It also includes a summary of the role of some of the major UK departments and agencies that have a policy or operational role in the natural disasters field. Figure 5 displays the key organisations by geographical region (this should be printed in A3).

United Nations

What?	*Role in humanitarian response?*
Hyogo Framework for Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters.	The World Conference on Disaster Reduction 18 to 22 January 2005 in Kobe, Hyogo, Japan, led to 168 countries adopting the present Framework for Action. A key international framework for the use of science in emergencies. It is a ten year plan to safeguard countries against natural hazards and directly influences the actions countries take to strengthen disaster management. An internationally acceptable framework for disaster risk reduction. Advocacy by UNISDR.
Millennium Development Goals	A set of guiding aims endorsed by 189 members states in September 2000 to mark the beginning of a new century. Broadly the commitments were to improve a range of key indicators by 2015. Many of the organisations listed use these goals as guiding aims for the work they do. Of crucial relevance to the subject matter of the SHED report are the goals to "Ensure Environmental Stability" and "Combat HIV/Aids, Malaria and other diseases".


Humanitarian Emergency and Disaster Landscape Map of Institutions
Key International Actors
ALNAP, AUSAID, BCPR, CERF, CHASE, Crown Agents, DFID, ECHA, ECHO, ECOSOC, ELRHA, FAO, GDACS, GHA, GHD, Global Platform for DRR, GRF Davos, HIF, IASC, IDMC, IFAD, IOM, IPCC, IRDR, UK Met Office, MOD, NASA, NCAS, NOC, OCHA, ODI, ODSG, Scottish Government, United Nations, UNDPKO, UN Security Council, UN SPIDER, UNDAC, UNDG, UNDP, UNEP, UNFPA, UNHCR, UNICEF, UNISDR, UNPBSO, UNSIG, WFP, USAID, Welsh Government, WHO, World Bank, WMO, GFDRR
North America, Central America and the Caribbean
PAHO, US CDC, DEC, CCRIF
South America
Tearfund
Sub-Saharan Africa
Arc Project, IED,
Europe
Tearfund
Asia
ASEAN, IED, Tearfund

International organisations

Who?	*Role?*
CERF (Central Emergency Response Fund)	International humanitarian response mechanism – rapid financial response to assist victims of emergencies. DFID is the largest funder of CERF.
ECHO (European Commission Humanitarian Aid & Civil Protection)	A user of science – provides funding on a "needs" basis. Receives funding from DFID and is also a member of United Nations Disaster Assessment and Coordination (UNDAC)[63], and works closely with the EU Monitoring and Information Centre.
European Union MIC (Monitoring & Information Centre)	EU community mechanism for civil protection, providing daily early warning alerts on natural disasters. Has close interaction with OCHA, ECHO, and the Red Cross.
GARDRR (Global Assessment Report on Disaster Risk Reduction)	Produced by UNISDR. This assessment considers regional and national platforms and encourages development of risk reduction activities at the national and local level. The regional platforms are multi-stakeholder forums that reflect the commitment of governments to improve coordination and implementation of disaster risk reduction activities whilst linking to international and national efforts. The national platforms reflect the commitment of each government to implement national and local disaster risk reduction activities whilst linking up to international

[63] See: http://www.unocha.org/what-we-do/coordination-tools/undac/overview

	efforts.
ICSU (International Council for Science)/ IRDR (Integrated Research for Disaster Risk) Initiative	Co-established the Integrated Research on Disaster Risk initiative[64]. Promotes research and technology within the field of disaster response. Supports a number of countries committees to coordinate researchers in national countries across regions.
OCHA (Office for the Coordination of Humanitarian Affairs)	Works closely with EUMIC and IASC (clusters). Manages CERF for rapid disaster response. Also a member of UNDAC, often responsible for mobilising UNDAC personnel to affected areas.
IASC (Inter-Agency Standing Committee)	This is a communications forum for UN and non-UN humanitarian agencies. It acts in a co-ordination role for policy development and decision making across a broad range of key partners.
UNDAC (The United Nations Disaster Assessment and Coordination)	This is part of the international emergency response system for sudden-onset emergencies. It is designed to help the United Nations and governments of disaster-affected countries during the first phase of a sudden-onset emergency. UNDAC also assists in the coordination of incoming international relief at national level and/or at the site of the emergency.
World Bank	Major user of science in emergencies. Member of the Inter Agency Standing Committee[65] clusters to provide rapid accurate response in emergencies. Member agency of the Interagency Panel on Climate Change (IPCC) who use science to help plan for/reduce the disaster risks associated with

[64] See: http://www.irdrinternational.org/

[65] The Inter Agency Standing Committee is the primary mechanism for inter agency coordination of humanitarian assistance. See http://humanitarianinfo.org/iasc/

	Climate Change. Also co-produced "Hotspots" work, modelling natural hazard locations globally, alongside Columbia University.
World Health Organisation / Health Action in Crisis	WHO/HAC works closely with Member States, international partners and local institutions to help communities prepare for, respond to, and recover from emergencies, disasters and crises.
World Meteorological Organisation (WMO)	WMO has a major programme in Disaster Risk Reduction.

Non governmental organisations

Who?	*Role in humanitarian response?*
Engineers Without Borders	International organisation which provides links between country groups to facilitate the use of science during emergencies.
Global Network of Civil Society Organisations for Disaster Reduction	A Global Network of Civil Society Organisations committed to working together to improve disaster risk reduction policy and practice at every decision-making level.
National Red Cross and Red Crescent Societies	Embody the work and principles of the International Red Cross and Red Crescent Movement. National Societies act as auxiliaries to the public authorities of their own countries in the humanitarian field and provide a range of services including disaster relief, health and social programmes.
Red Cross (International Federation of Red Cross and Red Crescent Societies)	The International Federation coordinates and directs international assistance to victims of natural and technological disasters, to refugees and in health emergencies. It combines its relief activities with development work to strengthen the capacities of National Societies and

	through them the capacity of individual people. The International Federation acts as the official representative of its member societies in the international field.
RedR	Provider of science specialists for emergencies/disasters. Maintains a register of people for operational agencies to use in the event of an emergency.

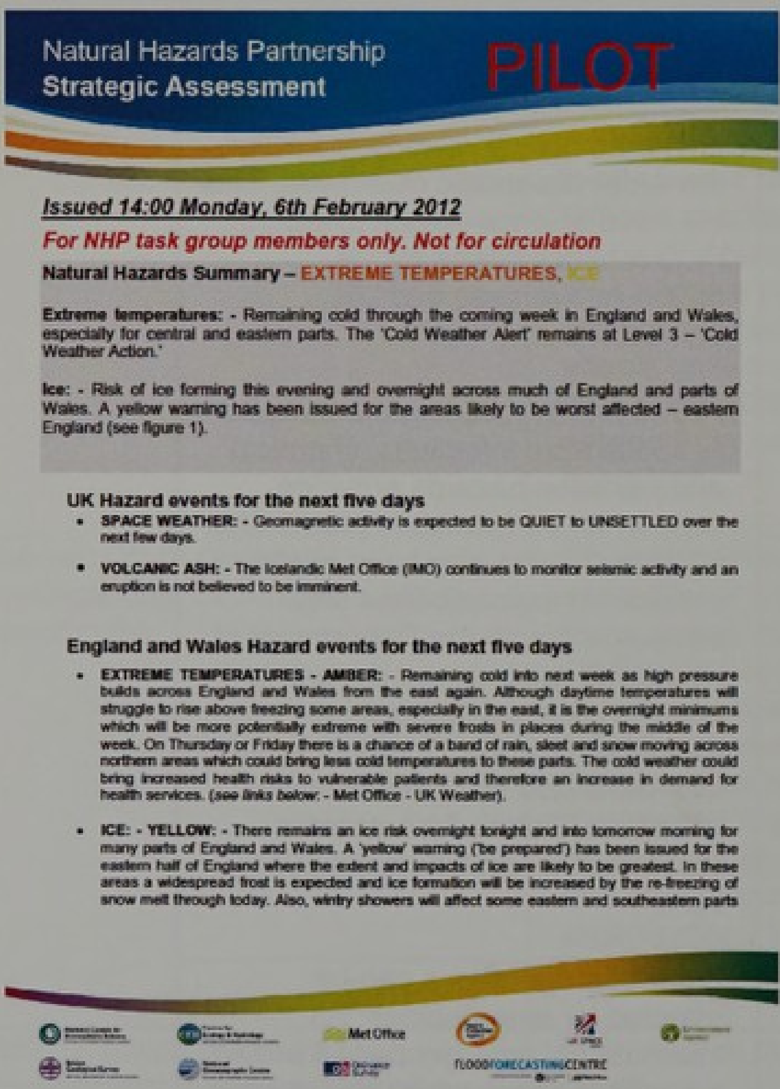
UK Government Departments and Agencies

Who?	*Examples of interest*
BIS (Department for Business, Innovation & Skills)	The Department for Business, Innovation and Skills and the Foreign & Commonwealth Office jointly fund a network of Science Officers overseas (Science and Innovation Network). A strategic shock from a humanitarian emergency can also have significant effects on the global economy and a better understanding of potential shocks from natural hazards is important.
Cabinet Office (and civil contingencies Secretariat specifically)	UK representative in many EU and international organisations with a focus on risk reduction. The Civil Contingencies Secretariat have overall responsibility for the National Risk Assessment (NRA) and the National Risk Register (NRR) which is designed to increase awareness of the kinds of risks the UK faces, and encourage individuals and organisations to think about their own preparedness.
DEFRA (Department for the Environment, Farming & Rural Affairs)	International plant and animal health.
DFID (Department for International	The 2002 International Development Act provides the legal basis for

Development)	DFID's response to humanitarian emergencies. It gives the Secretary of State for International Development powers to provide humanitarian assistance, with the sole purpose to "alleviate the effects of a natural or man-made disaster or other emergency" outside the UK. Common to all of these is the principle that humanitarian action will be based on need, and need alone.
DH (Department of Health)	International health issues. Works closely with WHO and OIE (the World Organisation for Animal Health) to predict, prepare and track disease.
FCO (Foreign & Commonwealth Office)	The provision of appropriate UK science advice to foreign governments can also form part of the wider diplomatic objectives. This will need science advice to support FCO responsibilities for UK nationals overseas and UK embassies.
HPA (Health Protection Agency)	HPA's role in reducing the dangers to health from infections, chemical and radiation hazards provides support to, and works in partnership with others who also have health protection responsibilities and advises, through the Department of Health, all government departments and devolved administrations throughout the UK. It supports with DH, DFID and FCO the initiative "Health is Global: An outcomes framework for global health 2011-2015".
MOD (Ministry of Defence)	Overseas operations can be affected by emergencies. An international emergency can provide a strategic shock which can change the political and social dynamics of a region.

Annex 4: Natural Hazards Partnership. Daily assessment of key natural hazards of concern to UK emergency planners

The Natural Hazards Partnership has been established to provide information, research and analysis on natural hazards for the development of more effective policies, communications and services for Government and the emergency responder community. One of their roles is to provide scientific and technical advice to the Cabinet Office on matters relating to natural hazard risks for the National Risk Assessment (NRA). Below is an example of the daily strategic assessment of hazards provided to members of the partnership.



Natural Hazards Partnership
Strategic Assessment
PILOT

Issued 14:00 Monday, 6th February 2012

For NHP task group members only. Not for circulation

Natural Hazards Summary – EXTREME TEMPERATURES, ICE

Extreme temperatures: - Remaining cold through the coming week in England and Wales, especially for central and eastern parts. The 'Cold Weather Alert' remains at Level 3 – 'Cold Weather Action.'

Ice: - Risk of ice forming this evening and overnight across much of England and parts of Wales. A yellow warning has been issued for the areas likely to be worst affected – eastern England (see figure 1).

UK Hazard events for the next five days

- **SPACE WEATHER:** - Geomagnetic activity is expected to be QUIET to UNSETTLED over the next few days.
- **VOLCANIC ASH:** - The Icelandic Met Office (IMO) continues to monitor seismic activity and an eruption is not believed to be imminent.

England and Wales Hazard events for the next five days

- **EXTREME TEMPERATURES - AMBER:** - Remaining cold into next week as high pressure builds across England and Wales from the east again. Although daytime temperatures will struggle to rise above freezing some areas, especially in the east, it is the overnight minimums which will be more potentially extreme with severe frosts in places during the middle of the week. On Thursday or Friday there is a chance of a band of rain, sleet and snow moving across northern areas which could bring less cold temperatures to these parts. The cold weather could bring increased health risks to vulnerable patients and therefore an increase in demand for health services. (*see links below*: - Met Office - UK Weather).
- **ICE:** - **YELLOW:** - There remains an ice risk overnight tonight and into tomorrow morning for many parts of England and Wales. A 'yellow' warning ('be prepared') has been issued for the eastern half of England where the extent and impacts of ice are likely to be greatest. In these areas a widespread frost is expected and ice formation will be increased by the re-freezing of snow melt though today. Also, wintry showers will affect some eastern and southeastern parts

Met Office
FLOODFORECASTINGCENTRE

Natural Hazards Partnership
Strategic Assessment PILOT

this evening and for a time overnight, further enhancing the ice risk in these areas. This could lead to further disruption to travel. (*see links below*: - Met Office - UK Weather).

- **DROUGHT**: - (Updated 27th January 2012) Lincolnshire, Cambridgeshire, parts of Bedfordshire and Northamptonshire, and west Norfolk remain in official drought. Some rivers have responded to recent rainfall but recovery is slow. (*See links below*: - Met Office - UK Weather, EA - Drought and The Centre for Ecology & Hydrology (CEH) - NRFA Monthly Hydrological Summary Archive).

General outlook for the next 30 days:

After a cold week for many areas this week a northwest/southeast split is expected to dominate through the middle part of the month. This seeing central, eastern and southern parts remaining cold but mostly settled. Whereas northern and western areas are likely to be less cold and more unsettled. There is a chance of these unsettled conditions spreading southeastwards at times which brings a snow risk down to lower levels. Towards the latter part of the month there appears to be an increasing likelihood of less cold conditions spreading to all parts as winds tend to come form a westerly direction. This would mean it would be milder than of late with temperatures closer to normal for all parts. A north/south split may also develop with southern areas often dry and settled and northern areas generally more unsettled with rain and snow at times, but mainly over hills.

For more specific information please follow the links below:

- **British Geological Survey (BGS)**
  http://www.bgs.ac.uk/home.html
- **Department of Health (DH)**
  http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_126666
- **Environment Agency - Drought**
  http://www.environment-agency.gov.uk/homeandleisure/drought/default.aspx
- **Environment Agency - Floods**
  http://www.environment-agency.gov.uk/homeandleisure/floods/3days/125305.aspx
- **Health Protection Agency- Extreme Events and Health Protection**
  http://www.hpa.org.uk/Topics/EmergencyResponse/ExtremeWeatherEventsAndNaturalDisasters/
- **Met Office - UK Weather**
  http://www.metoffice.gov.uk/public/beta/weather/warnings/
- **Met Office - UV / Pollen**
  http://www.metoffice.gov.uk/public/beta/weather/forecast/

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