UNISDR Science and Technology Conference
on the implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030

Launching UNISDR Science and Technology Partnership and the Science and Technology Road Map to 2030

To promote and support the availability and application of science and technology to decision-making in Disaster Risk Reduction

27-29 January 2016
Geneva International Conference Centre

Short concept note: Work Stream 2, Working Group 1

Early Warning and Hazard Monitoring

1) Overview

The steady growth of disaster risk, increased human and assets exposure and lessons learned from past disasters, points to the need to further strengthen disaster preparedness and response including through multi-hazard early warning systems. The Sendai Framework for Disaster Risk Reduction 2015-2030 has consequently defined one of its seven global targets to "*Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030*" (UNISDR 2015a).

Significant investment is required to ensure that capacities are in place for people-centred, multisectoral and multi-hazard early warning systems linked with emergency communications mechanisms, social technologies and hazard-monitoring telecommunications systems. The development of these systems must be science-based, tailored through a participatory process and responsive to the needs of users, including social and cultural aspects, considering gender and age specific requirements. As much as possible, the resulting applications should deliver early warning information products through the use of simple, low-cost equipment and facilities and should be delivered across as many dissemination and broadcasting channels as possible.

In this context, monitoring represents the process of collecting scientific information about potential perils and warning describes the manner in which this information is assimilated into a process that results in a message that is disseminated to appropriate stakeholders and contains a call to action. Warning information needs to consider all potential disasters across environmental, technological, biological and natural hazard domains. It should include where possible information beyond the characterizations of hazards to include likelihood and impact, in line with modern risk assessment methodologies. Hazard monitoring should include not only real-time data acquisition on hazard events as they develop or occur, but also the assimilation of fundamental studies of natural, environmental, technological and health issues that underlie the hazards themselves (e.g., studies of diseases as well as of active earthquake faults). Warning information needs to be appropriate to the timescale of the potential disaster, which can range from only minutes for a tsunami, to hours or days for extreme weather, and months to years for droughts or pandemics (Foresight 2012).

Participants in this Working Group are invited to discuss how to improve methods, tools, data and communication systems related to Early Warning and Hazard Monitoring and in particular how to align the research agenda with the needs of modern disaster risk reduction. This will help to shape the S&T Road Map and the role and work plan of the Scientific and Technical Partnership to support the implementation of the Sendai Framework.

2) Stock Taking

The development of warning systems has traditionally focussed on natural hazards where there is a relatively high degree of certainty of a rapid or sudden-onset event that may endanger lives and property. Warning systems have also traditionally been developed in parallel with response mechanisms and scenarios for emergency response organisations. Thus, much as disaster management has historically focussed on disaster preparedness and response, so too have warning systems. With enhanced technology for real-time data collection and capability for modelling and dissemination of information, warning systems are becoming increasingly sophisticated and complex. They are able to incorporate greater scientific rigour, provide more accurate and detailed information, and disseminate more broadly to the population. In turn, advances in computer simulation and modelling have made it possible to include information about the underlying hazards, as well as about the exposure and vulnerability of populations so that warning information can truly inform response.

Environmental, technological, biological and natural hazards operate on many different time scales. Thus, warning systems must be adaptable to these needs. Climate change operates on the scale of decades; whereas a drought may unfold over years and a pandemic over months. Monitoring and warning systems need to consider this continuum in time for developing and disseminating information to the public so that appropriate and timely action can be taken.

Critical to the success of any warning system is communication. Following the 2004 Indian Ocean Tsunami, which killed about 230,000 people, Indian Ocean countries developed a number of warning systems coordinated through the UNESCO Intergovernmental Oceanographic Commission (UNESCO 2015). This system of warning centres incorporates the latest in advanced detection, analysis and communication technology, and has issued warnings for a number of potentially damaging events; but, it has fallen short 'in the last mile' (Witze 2014), resulting in the failure of communities to respond appropriately to the danger at hand. This issue is being addressed through the concept of people-centred early warning systems, which comprises four elements: risk knowledge; monitoring and warning service; dissemination and communication; and response capabilities (UNISDR 2009). Developing successful communication systems requires extensive preparation, including an understanding of how to enable and ensure that communities can and will respond effectively (Yulianto et al 2011).

The wide ranging need for and applications of hazard monitoring and early warning systems as led to the development of a number of programs and systems to provide information and warnings about pending and future disasters. Some have been facilitated by advances in remote sensing technology which has resulted in enormous improvements in space-based satellite systems for observing and disseminating information for early warnings across environmental, technological and natural hazards. Others are leveraging advances in computer technology, such as by implementing internet portals to assist in assimilating and disseminating information from global to local level to researchers, policy makers and the public alike. Examples of global systems that enable sharing of early warning and hazard monitoring information include:

- The World Meteorological Organization Information System (WIS) is the single coordinated global infrastructure responsible for managing the free exchange of weather, climate and water information around the globe. WIS provides an integrated approach to meet the requirements for routine collection and automated dissemination of hazard monitoring data and products, as well as data discovery, access and retrieval services for all weather, climate, water and related data, including warnings, produced by WMO's 191 Member countries (WMO).
- The Global Framework for Climate Services (GFCS) is a joint program of the World Meteorological Organisation (WMO) and the World Health Organisation (WHO) which was established to "enhance resilience in social, economic and environmental systems" by improving climate information and weather systems in selected regions of the world.
- Established in 2005, The Group on Earth Observations (GEO) is dedicated to the application of earth observation information to a wide range of humanitarian needs. GEO is creating a Global Earth Observation System of Systems (GEOSS) that will link Earth observation resources world-wide including for hazard monitoring and early warning applications (GEOSS n.d.).
- The United Nations Platform for Space-based information for Disaster Management and EmergencyResponse (UN-SPIDER) was established in 2006 to provide information for humanitarian aid and emergency response, with a particular focus on assisting developing countries to gain access to satellite data for emergency preparedness and response needs (UN 2015).
- The International Health Regulations (IHR) (2005) which is a legally binding agreement adopted by 196 countries. Through the IHR, WHO keeps countries informed about public health risks, and works with partners to help countries build capacity to detect, report and respond to public health events (WHO 2008).
- The World Animal Health Information System, (WAHIS) which is an internet-based early warning system that processes data on animal diseases in real-time and disseminates information to the international community whenever an important epidemiological event occurs in a Member Country (WAHIS n.d.).
- The FAO Global Information and Early Warning System (GIEWS), which was established in the wake of the world food crisis of the early 1970s, provides information on food production and food security. GIEWS a worldwide network which includes 115 governments, 61 Non-Governmental Organizations (NGOs) and numerous trade, research and media organizations
- UNESCO's Intergovernmental Oceanographic Commission Tsunami Programme (UNESCO n.d.), which facilitates the global coordination of regional tsunami warning systems and information.

Examples of emerging multi-hazard early warning systems at regional and national levels include:

- The European Flood Alert System (EFAS) and the European Forest Fire Information System (EFFIS). It provides daily meteorological fire danger maps and forecasts (including maps of burnt areas and damage assessment) up to six days before. It is a real-time alert system developed by the European Commission for the Participating States of the EU Civil Protection Mechanism.

- The Global Disaster Alerts and Coordination System (GDACS), developed by the Joint Research Centre of the European Commission and used jointly by the EU and UN. It is a fully automatic 24/7 alert system which gathers data about natural events (earthquakes, tsunamis, tropical storms, floods and volcanoes).
- The Natural Hazards Partnership Daily Hazard Assessment (NHP n.d.). It is an 'at a glance' overview of potential natural hazards and health implications that could affect the UK over the next 24 hours, 5 and 30 days. It provides an all hazards summary to help increase UK's ability to respond to, and be prepared for multi-hazard events. The document contains links to more detailed information about each of the highlighted hazards, helping users to gain more value from existing services and thereby speeding up decision making and response.

The capacities of implementing early warning systems in different countries and regions remain highly varied, with in Least Developed Countries (LDC) and Small Island Developing States (SIDS), particularly susceptible to weaknesses in their ability to issue critical warnings. Over 80% of the LDCs have only a basic early warning system. In 15 countries, no such system even exists. In the island states, only four or five out of 40 having an effective system.

3) The way forward

The way forward for enhanced early warning and hazard monitoring requires methods be defined and communicated that increase the efficiency and effectiveness of early warning systems and multi-hazard monitoring networks, as well as promotes their use for risk management and ensure that these networks are themselves highly resilient.

In line with the Sendai Framework's scientific recommendations and addressing the challenges of measurement in producing efficient and effective warning and hazard monitoring products and services, issues suggested for discussion during the relevant conference sessions include the following:

- Discuss and identify main gaps and challenges in the development and maintenance of early warning systems and real-time multi-hazard monitoring and data collection.
- Identify where advances in technology and science, such as through hazard and risk modelling, warning systems can be improved to deliver more accurate information on the possible impact of natural, environmental and technological hazards.
- Identify the needs for observing networks and information systems for fundamental hazard monitoring and hazard assessment, such disease monitoring for health warnings and active earthquake faults and volcanoes for geophysical hazards, warnings and risk assessments.
- Identify needs for improved communication of warning information, including understanding and education for warning recipients, to ensure effective community response.
- Identify mechanisms for and opportunities to improve early warnings and hazard monitoring in less-developed regions and countries where resources are limited.

- Develop hazard monitoring and data collection systems for ecosystems and their possible sequential effects at the relevant social and spatial scale, from local to national, regional and global scale.
- Promote enhanced collection, availability and dissemination of datasets fundamental to assessing the effectiveness of early warning systems and real-time hazard monitoring. Information should include disaggregated census data, household surveys, sectoral data and systematic post-disaster analysis of early warming system failures or shortfalls and the subsequent socio-economic impacts on communities.

These discussions will help to inform the S&T Road Map to support the implementation of the Sendai Framework. Relevant areas of the Road Map (UNISDR 2015b) are shown below.

Priority for Action 1: Understanding Disaster Risk		
Expected Outcomes	**Key Actions**	**Review Progress and Needs**
1.1 Assess and update the current state of data, scientific and indigenous knowledge and technical availability on disaster risks reduction and fill the gaps with new knowledge.	• Establish datasets of, update periodically and disseminate risk information, including on exposure and vulnerability, to build awareness and knowledge of disaster risk • Enhance access to environmentally sound technology, local knowledge and inclusive innovation • Promote community engagement in risk data collection.	• Guidelines for national and regional, multi-hazard, risk assessments and mapping. • Guidance for reporting disaster risk knowledge through people centred communication channels. • National, multi-hazard, risk profiles updated regularly • Periodic regional reports on disaster risks drawing on national risk assessments • Global Network for sharing disaster data and statistics. • Improved and accessible data and integrated metrics on exposure and vulnerability from local to global scale
1.2 Synthesize, produce and disseminate scientific evidence in a timely and accessible manner that responds to the knowledge needs from policy-makers and	• Promote real-time and near real-time access to reliable DRM data and use information and communications technology; • Ensure the synthesis and use of traditional, indigenous and local	• National and regional knowledge centres for disaster risk management. • Good practises on use of indigenous and local knowledge • Case studies on DRR through science and traditional, indigenous and

practitioners;	knowledge and practices in DRR • Engage scientific focus on disaster risk factors and scenarios, including emerging disaster risks; • Develop methods, models and tools for national risk assessments.	local knowledge and practises • National open-data platforms for DRR in alignment with the SDGs and other global agreements
1.3 Ensure that scientific data and information can support and be used in monitoring and reviewing progress towards disaster risk reduction and resilience building.	• Develop and monitor a set of core indices and indicators to measure progress • Promote the development of quality standards, such as certifications particularly at national and regional levels.	• Standards and best practises for multihazard early warning systems for DRR • National peer reviews to follow-up, assess and report on progress on implementation of Sendai Framework
Priority For Action 2: Strengthening Disaster Risk Governance to Manage Disaster Risk		
Expected outcomes	**Key Actions**	**Review Progress and Needs**
2.1 Ensure a stronger involvement of science in policy- and decision-making at all levels	• Promote the mainstreaming of disaster risk assessments and mapping into land-use planning and other policy development and implementation, and rural development planning and management	• National and regional Communities of Users and Practitioners
Priority For Action 3: Investing in Disaster Risk Reduction for Resilience		
Expected outcomes	**Key Actions**	**Review Progress and Needs**
3.1 Provide scientific evidence to enable decision-making of policy options for investment and development planning	• Promote cooperation between academic, scientific and research entities and networks and the private sector to develop new products and services to help reduce disaster risk • Develop risk modelling tools	• Guidance on disaster risk and impact assessments

	and databases so that risk models may be used to assist in monitoring progress in DRR.	
Priority for Action 4: Enhancing Disaster Preparedness For Effective Response, and to "Build Back Better" In Recovery, Rehabilitation and Reconstruction		
Expected outcomes	**Key Actions**	**Review Progress and Needs**
4.1 Identify and respond to the scientific needs of policy- and decision-makers at all levels to strengthen preparedness and resilience	• Develop, maintain and innovate technology for people-centred, low cost early warning systems and emergency communication mechanisms.	• Periodic national and regional reporting on early warning systems and emergency communication mechanisms; in place and planned
4.2 Build capacity to ensure that all sectors and countries understand, have access to, and can use scientific information for better informed decision-making	• Establish / strengthen existing training and education mechanisms and peer learning • Develop the workforce capacity in all sectors in understanding disaster risk • Enhance knowledge and technology transfer and promote the use of global technology pools to share know-how, innovation and research	• National and regional help desks for technical advice on risk assessment and risk management capability • National and regional training and capacity building programmes in DRR

Participants are invited to discuss how to strengthen these proposals further, and define specific next steps for immediate actions in this regard. Participants are also invited to discuss what specific initiatives and partnerships that need to be put in place to take this forward? Discussion at this work session should also address how existing networks and initiatives can be linked together to achieve this and what are the top 3 priority areas of investment needed in this area?

A few proposals are made below for consideration during the discussions to advance the application and further development of methodologies and to form consensus on commitments to improve the multi hazards early warning systems, their normative guidance, their technology and innovation use, and the accuracy of their information.

1. Improved early warning multi-hazards systems

a. Improved multi-hazard early warning systems and hazard monitoring that
    i. Cover the wide scope of the Sendai Framework, encompassing the risk of small and large-scale, frequent and infrequent, sudden and slow-onset disasters, caused by natural or environmental, technological and biological hazards.
    ii. Backed by appropriate institutional reform, capacity building and infrastructure modernization necessary for the system to function.
    iii. Cover the five main components of early warning systems: Risk Knowledge, Monitoring and Warning Services, Dissemination and Communication, Response Capability and Cross-Cutting Issues and Gaps.
b. Development, maintenance and access to fundamental information on underlying hazards which form the basis for improved warnings (and risk assessment).
c. The development of innovative technology and communication systems that provide people centred, low-cost early warning systems and emergency communication mechanisms. This will increase availability, understanding and accessibility of these systems.

2. Development of Guidelines and Standards

a. The development of quality standards and operational guides on standard operating procedures that link early warning systems and hazard monitoring processes to the response agencies and to those vulnerable to a particular hazard and that encourages transboundary information sharing.
b. Ensure preparedness and contingency plans are consistently reviewed, updated and linked to warning systems.

3. Improved accuracy and communication

a. Application of science and technology, including remote sensing and geographic information systems (GIS) applications and the application of risk and impact models to improve the accuracy, timeliness and efficacy of warning information.
b. Application of innovative Information Communication Technology so early warning messages are tailored to reach policy makers and the public in appropriate, easy to understand formats.

References

EU Civil Protection Mechanism.http://ec.europa.eu/echo/what/civil-protection/monitoring-tools_en

Foresight Reducing Risks of Future Disasters: Priorities for Decision Makers (2012) Final Project Report. The Government Office for Science, London.

GEOSS. 2015. *Group on Earth Observations*. [ONLINE] Available at:http://www.earthobservations.org/geoss.php. [Accessed 06 November 15].

Natural Hazards Partnership (NHP n.d.). Daily Hazard Assessment. http://www.metoffice.gov.uk/nhp/daily-hazard-assessment

UN. 2015. UN-Spider. [ONLINE] Available at: http://www.un-spider.org/about/what-is-un-spider. [Accessed 06 November 15].

UNESCO. 2015. UNESCO Intergovernmental Oceanographic Commission Tsunami Programme. [ONLINE] Available at: http://www.ioc-tsunami.org/. [Accessed 06 November 15].

UNISDR. 2015a. Sendai framework for disaster risk reduction 2015–2030. In: UN world conference on disaster risk reduction, 2015 March 14–18, Sendai, Japan. Geneva: United Nations Office for Disaster Risk Reduction; 2015. Available at http://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf

UNISDRb. 2015. The science and technology Road Map for the UNISDR science & technology partnership supporting the implementation of Sendai Framework for DRR 2015-2030. Available at http://www.preventionweb.net/files/45270_unisdrscienceandtechnologyroadmap.pdf

UNISDR. 2006. Developing early warning systems – A Checklist.

WHO. 2008. International Health Regulations (2005). 2nd ed. Switzerland: WHO.

Witze, Alexandra. Tsunami alerts fail to bridge the ‘last mile, Nature News, 10 December 2014. Available at ’http://www.nature.com/news/tsunami-alerts-fail-to-bridge-the-last-mile-1.16516 (cited 5 November 2015).

The World Animal Health Information System (WAHIS n.d.). OIE. http://www.oie.int/animal-health-in-the-world/the-world-animal-health-information-system/the-oie-data-system/

Yulianto E, Rafliana I, Aditya V, Febriawati L (2011): Impact of Pre-Disaster Public Awareness Activities on Public Readiness: A Case Study on Mentawai 25 October 2010 Tsunami, Nat. Hazards Earth Syst. Sci., 11, 1–17, 2011 www.nat-hazards-earth-syst-sci.net/11/1/2011/ doi:10.5194/nhess-11-1-2011

Annex: Key statements in the Sendai Framework for Disaster Risk Reduction

The following text from the Sendai Framework is relevant to this working group on warnings and hazard monitoring:

14. Against this background, and in order to reduce disaster risk, there is a need to address existing challenges and prepare for future ones by focusing on monitoring, assessing and understanding disaster risk and sharing such information and on how it is created; strengthening disaster risk governance and coordination across relevant institutions and sectors and the full and meaningful participation of relevant stakeholders at appropriate levels; investing in the economic, social, health, cultural and educational resilience of persons, communities and countries and the environment, as well as through technology and research; and enhancing multi-hazard early warning systems, preparedness, response, recovery, rehabilitation and reconstruction. To complement national action and capacity, there is a need to enhance international cooperation between developed and developing countries and between States and international organizations.

18. To support the assessment of global progress in achieving the outcome and goal of the present Framework, seven global targets have been agreed. These targets will be measured at the global level and will be complemented by work to develop appropriate indicators. National targets and indicators will contribute to the achievement of the outcome and goal of the present Framework. The seven global targets are:
…

(g) Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030.

25. To achieve this, it is important:

(a) To enhance the development and dissemination of science-based methodologies and tools to record and share disaster losses and relevant disaggregated data and statistics, as well as to strengthen disaster risk modelling, assessment, mapping, monitoring and multihazard early warning systems;

(b) To promote the conduct of comprehensive surveys on multi-hazard disaster risks and the development of regional disaster risk assessments and maps, including climate change scenarios;

(c) To promote and enhance, through international cooperation, including technology transfer, access to and the sharing and use of non-sensitive data and information, as appropriate, communications and geospatial and space-based technologies and related services; maintain and strengthen in situ and remotely-sensed earth and climate observations; and strengthen the utilization of media, including social media, traditional media, big data and mobile phone networks, to support national measures for successful disaster risk communication, as appropriate and in accordance with national laws;

33. To achieve this, it is important:

…

(b) To invest in, develop, maintain and strengthen people-centred multi-hazard, multisectoral forecasting and early warning systems, disaster risk and emergency communications mechanisms, social technologies and hazard-monitoring telecommunications systems; develop such systems through a participatory process; tailor them to the needs of users, including social and cultural requirements, in particular gender; promote the application of simple and low-cost early warning equipment and facilities; and broaden release channels for natural disaster early warning information;

34 To achieve this, it is important:

...

(b) To promote the further development and dissemination of instruments, such as standards, codes, operational guides and other guidance instruments, to support coordinated action in disaster preparedness and response and facilitate information sharing on lessons learned and best practices for policy practice and post-disaster reconstruction programmes;

(c) To promote the further development of and investment in effective, nationally compatible, regional multi-hazard early warning mechanisms, where relevant, in line with the Global Framework for Climate Services, and facilitate the sharing and exchange of information across all countries;

36

(iv) Older persons have years of knowledge, skills and wisdom, which are invaluable assets to reduce disaster risk, and they should be included in the design of policies, plans and mechanisms, including for early warning;

(v) Indigenous peoples, through their experience and traditional knowledge, provide an important contribution to the development and implementation of plans and mechanisms, including for early warning;

36 (d) Media to take an active and inclusive role at the local, national, regional and global levels in contributing to the raising of public awareness and understanding and disseminate accurate and non-sensitive disaster risk, hazard and disaster information, including on small-scale disasters, in a simple, transparent, easy-to-understand and accessible manner, in close cooperation with national authorities; adopt specific disaster risk reduction communications policies; support, as appropriate, early warning systems and life-saving protective measures; and stimulate a culture of prevention and strong community involvement in sustained public education campaigns and public consultations at all levels of society, in accordance with national practices.