Benefits, challenges and issues of multi-hazard approach to observing networks

Dr Susan L. Barrell
CBS Coordinator for Disaster Prevention and Mitigation

Introduction

Mitigating the impacts of natural disasters through the detection, tracking and advance warning of severe weather, climate, hydrological and oceanographic events is the most essential contribution that weather and climate information makes to the safety of life and property. The long-term monitoring of these events provides a baseline for assessing changes in their characteristics, frequency etc as well as vital information for research, which forms the basis of improved prediction and preparedness actions.

The most fundamental and essential contribution that observing systems make to the overall effectiveness of early warning systems is through the maintenance of sustained and robust basic observing systems that provide ongoing weather watch and climate monitoring functions and through the free and unrestricted international exchange of the data they deliver. For many countries, their capacity to operate effective disaster preparedness, prevention and mitigation programs owes much to the development of the globally cooperative system of the WMO World Weather Watch.

Benefits of multi-hazard approach

The adoption of a multi-hazard approach to early warning systems has been widely embraced. A multi-hazard approach to observing systems may be seen as a natural extension of this concept, but in many respects, that is what well-sustained and supported basic observing systems already provide through their essential underpinning of all types of warning systems. In fact, the safety of life and property is the driver and core function of basic observing systems.

In order to meet the strict requirements of early warning for a variety of hazard events, very hazard-specific networks that match the time and space scale requirements of the hazard phenomena must supplement the basic systems.

The multi-hazard approach presents some opportunities for more coordinated development and inter-operation of observing systems at national and international levels, as well as more effective utilisation of resources. In particular, it could facilitate, *inter alia*, data integration and assimilation, interoperability (including adoption of common data protocols) and system-level operational support and maintenance synergies.

Issues and Challenges

If the observing system requirements of individual hazards can be well specified, a multi-hazard systems approach that is underpinned by robust and sustained basic observing systems, overlaid by hazard-specific components, and developed and operated within an interoperability framework can offer synergies and efficiencies. Key points to note are:

- A sound understanding of the data requirements and key decision processes associated with each type of hazardous event (eg tropical cyclone, tsunami, flood etc) is critical to the design of basic observing systems that provide the ongoing watch function – the configuration and operation of the basic observing system needs to reflect the core data requirements for detecting and initiating a preliminary response to any emerging hazardous weather (or climate) situation and to respond with key environmental information in the event of non-meteorological and/or human-induced hazards (eg oil spills, nuclear disasters, volcanos). It is essential that the signatures of all relevant hazardous events can be detected at the earliest opportunity and appropriate alerts raised, although much of this practical effort falls on the associated data processing and analysis functions.
- Once a hazardous event is detected, the role of the hazard-specific observing system become critical. Depending on the nature of the hazard, a variety of system-based responses can be initiated, such as triggering particular observations types, enhanced spatial/temporal coverage, etc. Critical to effective use of the basic and hazard-specific observations is a good understanding of the processes to be followed, identification of response actions common to multiple hazards and/or unique to specific hazards, specification of and adherence to relevant standards (observations and practices), ongoing coordination, reporting and communications requirements etc.
- End-to-end system redundancy is an important design consideration for the sustained operation of both the basic observing systems that support hazard detection and monitoring and the hazard-specific systems. This is important at both the observing system level (such as redundant sensors on automatic weather stations and an appropriate mix of space-based and surfaced based systems to characterise the event from different perspectives) and the supporting system level (such as redundant communications options via land line and satellite).

- Reporting and availability of observations, appropriate both to the ongoing monitoring function and the response process when a hazardous event is detected, should be appropriate to the nature of the event (such as the timeframe, extent, severity). Critical to national, regional and global response capabilities is the existence of robust and sustained global data communications, dissemination and access systems (via the WMO Global Telecommunication System and the WMO Information System, WIS) and data processing and forecasting systems (via Global Data Processing and Forecasting System (GDPFS) that provide meteorologists and other users with the tools to assimilate and utilise available data in the development of appropriate warning and response products, and to deliver these products;
- As well as facilitating the 'integration' of observations across different hazards, the multi-hazard approach could deliver more effective overall results if it assists the coordinated availability to decision makers of data across different disciplines and disaster impact areas, such as weather or climate data with disease vectors and seismic information;
- The concept of the interoperability framework and the 'system of systems' approach embraced by GEOSS is an appropriate model, with the emphasis on coordination, collaboration and inter-operation rather than system integration per se. Attempting to integrate into a single overarching system creates the risk of losing ownership of and commitment to the component systems while compromising on all requirements and meeting none;
- The WMO World Weather Watch and National Meteorological and Hydrological Services are already, in effect, applying a multi-hazard approach through the operation of their basic observing systems, and a key outcome of the current enhanced focus on this approach should be to strengthen these basic observing systems while also considering the incremental benefits of supplementing them with more targeted hazard-specific components.

Conclusion

Observing systems are a key component of the overall end-to-end early warning system, with the most important contribution being delivered through the sustained operation of basic national and global observing systems providing ongoing weather watch and climate monitoring functions, supported by robust communications and data processing systems. For a multi-hazard approach to deliver significant benefits, the requirements of individual hazards must well-understood, specified and represented in well-supported and sustained basic observing systems and supplemented by very hazard-specific observing systems. A key challenge is delivering these benefits without falling into a 'one-size-fits-all' trap.