

“The Importance of Meteorological Forecasts as Early Warning Systems”

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This Conference paper draws heavily on two publications:

1. “*Preventing and Mitigating the Impact of Natural Disasters*”
(Australian) Bureau of Meteorology 2006
2. “*Guidelines on Integrating Severe Weather Warnings into Disaster Risk Management*”
World Meteorological Organisation 2005

In keeping with the Conference theme, the focus is placed on *coastal* natural disasters so threats posed by droughts, bushfires, heatwaves and the like are not specifically addressed. Note also that this paper should be seen to complement the Conference presentation by providing some of the relevant background and theoretical considerations.

NATURAL HAZARDS

Almost all the natural hazards which affect Australia are directly or indirectly of meteorological, hydrological or oceanographic origin. That is, while some other parts of the world are especially prone to volcanoes and earthquakes, resulting from processes within solid earth, it is mainly through the interaction of the atmosphere, oceans, rivers and land surface that the fury of nature is unleashed, from time to time, on the Australian community.

Meteorological, hydrological and oceanographic hazards that loom largest on the Australian coastal scene are:

- **Tropical Cyclones** – probably the most dangerous natural hazard to affect the Australian region. As well as the extreme winds that circulate around the cyclone ‘eye’, they usually give rise to other natural hazards such as floods, storm surges and mountainous seas.
- **Floods** – there are two main kinds of floods – short-lived flash floods and river floods which may last from days to months as flood waters move down stream to the ocean or to inland lakes such as Lake Eyre.
- **Tsunamis** – these consist of fast-moving ocean waves propagated outwards from the site of undersea earthquakes or landslides on the continental shelf. As they move into the shallow water surrounding coasts and islands, they become higher and steeper and may surge inland with devastating force.
- **Severe Thunderstorms** – often accompany larger scale changes in atmospheric conditions (eg the passage of cold fronts) but may also result from local processes (eg intense summer afternoon heating) within a relatively homogeneous air mass. Severe storms may involve tornadoes, hail, squall lines, lightning, thunder and torrential rains.

WARNING SYSTEMS

One of the most effective ways of mitigating the impact of natural disasters is through the provision of state-of-the-art warning services which enable communities to prepare for the approaching cyclone, storm, flood or other natural hazard and to take those measures necessary to avert the loss of life and minimise the damage caused to property and the environment.

The provision of warning services is the highest priority of national weather services. In Australia, the Bureau of Meteorology provides comprehensive warning services for the full range of meteorological, hydrological and oceanographic hazards and works closely with the mass media and emergency management organisations to ensure the maximum effectiveness of the warning services in triggering government and community action to reduce the social and economic costs of disasters.

Tropical Cyclones: Steady population growth in Australia's northern coastal areas - especially Queensland - has greatly increased Australia's vulnerability to tropical cyclones. These immense storms sustained by the heat of the tropical ocean typically occur between December and April. On average six tropical cyclones cross the coast each year. Often 1000 km wide, but moving at only 10-20 km/h, they can bring winds of 200 km/h and more. Rotating clockwise, their steady winds from the one direction can send potentially damaging storm surges against the coast. Tropical cyclones are called hurricanes in the Atlantic, and typhoons in the Asian region. While forecasters locate them relatively easily with improved satellites and radar, their often erratic movement makes it difficult to predict landfall with a high level of accuracy more than 12-24 hours ahead. Storm surges generated by cyclones can be a great hazard. Computer models have become far more sophisticated and, together with improved satellite technologies, have contributed to the average error in the 24-hour prediction of cyclone tracks being halved over the past 20 years.

Floods: The Bureau of Meteorology has a major role in the national flood warning system, in partnership with water and emergency management agencies, and local government. Following the record Hunter Valley floods of 1955, the Bureau was instructed to set up a specialised hydrometeorological service, including flood forecasting capabilities. Flood forecasting has improved steadily in recent decades with new satellite monitoring systems, greatly increased electronic data collection and upgraded computer modelling and data presentation. Today's national coverage includes more than 70 catchments monitored in real-time by 2000 water level gauges and 2000 rainfall gauges. The Bureau provides quantitative warnings for 314 locations in 126 river basins. Around 1200 warnings are issued each year.

Tsunamis: The catastrophic Asian tsunami of Boxing Day 2004 prompted new regional warning systems for these destructive long-wavelength ocean waves triggered by major ocean disturbances such as earthquakes and volcanic eruptions. In May 2005 the Bureau of Meteorology received funding support for the establishment of an Australian Tsunami Warning System in partnership with Geoscience Australia and Emergency Management Australia. It will coordinate with international tsunami warning systems in the Pacific and Indian Oceans. The Bureau's role includes sea level tsunami detection, communications, tsunami wave modelling, and provision and dissemination of tsunami warnings.

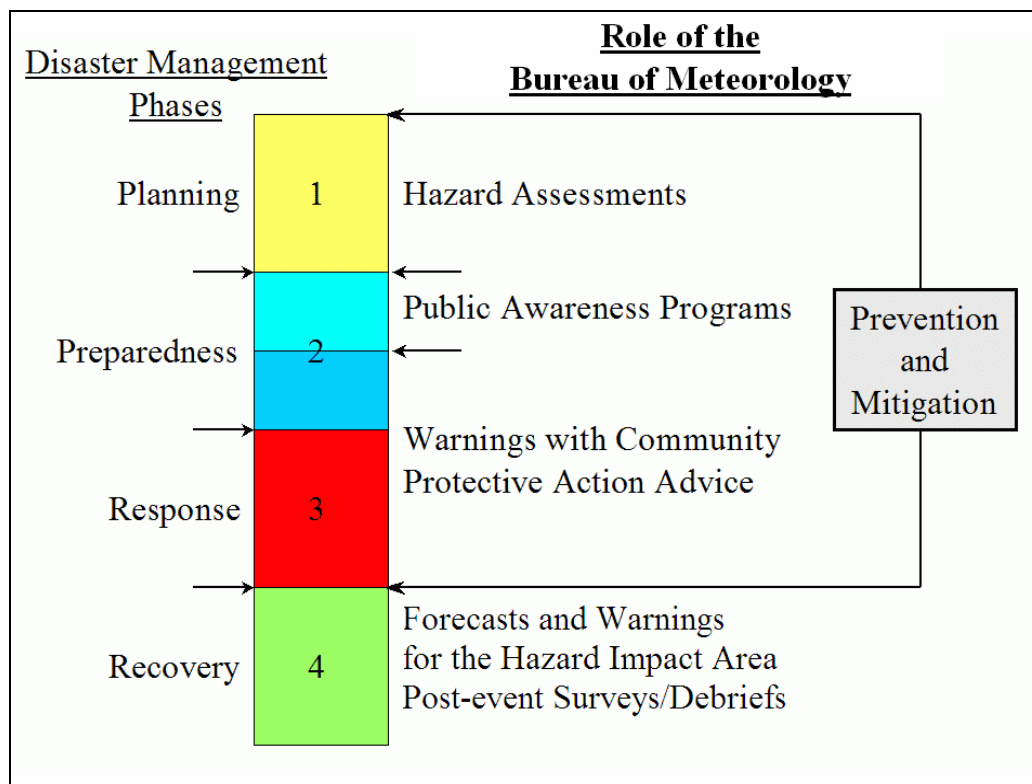
EFFECTIVE EARLY WARNINGS

Natural disasters can lead to extensive property damage, disruptions to social activities and loss of life. During 2006, natural disasters worldwide contributed to 21342 deaths and caused about \$Aus25B damage. Severe Tropical Cyclone LARRY (Innisfail March 2006) caused upwards of \$Aus500M damage - but fortunately no lives were lost. While the figures have been high, it should be pointed out that they would have been even higher without pre-disaster efforts, particularly early warning systems, which contribute significantly to an effective risk management strategy.

The primary objective of a warning system is to empower individuals and communities to respond appropriately to a threat in order to reduce the risk of death, injury, property loss and damage. Warnings need to get the message across and stimulate those at risk to take action. Effective inclusion of the severe weather warning system in a risk management plan relies on national weather services such as the Bureau of Meteorology appreciating the needs of a multi-cultural, economically stratified and often mobile community, and the community understanding the hazard, its vulnerability and the most suited protective action to take.

Greater focus towards disaster mitigation also means:

- further increasing the emphasis on extending the lead time of warnings;
- improving the accuracy of warnings at varying lead times;
- satisfying greater demand for probabilistic forecasts;
- better communication and dissemination of warnings;
- using new technologies to alert the public;
- better targeting of the warning services to relevant and specific users (right information to right people at right time at the right place); and
- ensuring warning messages are understood and appropriate response action taken.



STAKEHOLDER INVOLVEMENT

Stakeholders need to be consulted as partners in the design and refinement of severe weather warning systems, and on the larger scale, the risk management plan.

Stakeholders include the public, other government departments, emergency management agencies, local authorities, non-government organizations, the media, social scientists, national and regional infrastructure authorities, academia, etc. In the Australian context, the indigenous community represents a significant stakeholder.

Involving stakeholders in developing and enhancing the end-to-end severe weather warning system has many benefits, such as:

- improved presentation, structure, and wording of the warnings themselves;
- more effective communication of the risks and actions to take in response to severe weather;
- better understanding of how, and how often, stakeholders want to receive warnings; and
- increased sense of ownership, and therefore, credibility in the warning system.

WARNING PRESENTATION

Effective warnings are short, concise, understandable, and actionable, answering the questions of "what?", "where?", "when?", "why?", and "how to respond?". The use of plain language in simple, short sentences or phrases enhances the user's understanding of the warning. In addition, the most important information in the warning should be presented first, followed by supporting information. Effective warnings should also include detailed information about the threat with recognizable or localized geographical references.

Warnings should be presented in several different formats – text, graphics, colour-coded categories, audio – and should include specific actions for people to take to respond to the event. The various formats also make it easier for people with disabilities to receive and act on the warnings. All formats, however, must present the information accurately and consistently.

WARNING COMMUNICATION

Dissemination is delivery of the warning messages; but communication is accomplished only after the information is received and understood. So the foundation of warning communication builds on the format and wording of the warnings, dissemination methods, education and preparedness of stakeholders, and their understanding of the risks they face. Communication is also significantly enhanced when consistent warning information is received.

Severe weather warnings should be communicated using a variety of formats (text, graphics, voice) and disseminated via as wide a range of media as is available (press, radio and television, e-mail, cell phone, Internet, etc.). Media broadcasts from the warning centre and/or radio and television interviews with one or more authoritative figures can be effective in triggering response from people.

Effective communication about risks and warnings requires knowledge about the recipients. In most countries including Australia, the public is very diverse, with different backgrounds, experiences, perceptions, circumstances and priorities. Any attempts to communicate with the public must reflect this diversity.

WARNING RESPONSE

Public education and awareness, stakeholder involvement, warning presentation, and warning communication all contribute to an appropriate response to the warning.

The warning message by itself does not stimulate an immediate response from individuals. Individuals receiving the warning will first assess their own personal sense of risk. The additional information required before they take action depends on the content and clarity of the initial warning and the credibility of the issuing organization. The potential for individuals to respond appropriately is dramatically increased if they are provided with information to assist them in defining their personal risk and highlighting what life- or property-saving actions to take.

Successful warning programs strive to ensure that every person or agency at risk:

- receives the warning;
- understands the information presented;
- believes the information;
- personalizes the risk;
- makes correct decisions; and
- responds in a timely manner.

An individual's perception of risk is enhanced if:

- warning messages before and during a particular event are issued and updated frequently;
- warnings are delivered by multiple credible sources;
- warning messages are consistent;
- the basis for the warning is clear; and
- suggested response actions are included.

Preparedness prior to a hazardous event is critical to an effective response to the warning. Individuals, families, schools, businesses, communities and public facilities should have an advance plan in place, so they know what to do and where to go when a warning is received. The Bureau of Meteorology and its risk management partners have a key role to play in assisting their constituents to prepare an action plan.