Dissemination of and response to community-based warnings

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Abstract

The purpose of the lecture is to give information on dissemination of and response to warnings of natural hazards and to indicate current problems and directions for future developments.

In Japan, seventy-one meteorological observatories of the Japan Meteorological Agency (JMA) issue severe weather, storm surge, high waves and flood warnings, and five principal observatories as well as the Headquarters issue tsunami warnings when serious disasters are expected. Each meteorological observatory disseminates warnings to organs related to disaster prevention, such as its corresponding prefectural government(s) and police and the news media, using multi-destination facsimile, on-line systems, etc. Each municipality receives the information from its prefectural government through a disaster-preventive radio communication system. Some prefectural governments operate the Local Authorities Satellite Communication Network for the information transmission. Watching meteorological, terrestrial and hydrological conditions with vigilance, municipalities alert the residents to prepare for possible disaster through various media such as a disaster-preventive radio system, sound trucks and sirens. Mass media also plays an important role in disseminating disaster prevention/mitigation information to the public, although the municipalities have the formal responsibility for the information dissemination.

Warnings of tropical cyclones issued by the Bangladesh Meteorological Department are dissemianted not only by various governmental authorities and the media - radio, television and press, but also by the Bangladesh Red Crescent Society. In a system well suited to local circumstances, the warnings are transmitted through a network of district and sub-district control offices. The Society's 20,000 volunteers alert people at the 'grass-root' level through megaphones and house-to-house contact.

To overcome the limitations of the conventional communication system, a dependable scheme for dissemination of tropical cyclone warnings, the DWS (Disaster Warning System) has been installed in India. Under the DWS, warnings are transmitted by satellite, the Indian National Satellite, to all those stations, of the network of about 100 ground receiving stations, which are in the threatened areas.

Heavy rain warnings are issued in Japan when precipitation amounts are likely to reach danger levels, which are pre-determined for each area (191 areas). However, disasters often occur locally and the relationships between precipitation amounts and disasters are complex. Thus, to avoid missing events, warnings are apt to be issued so frequently that residents who have not previously suffered from damage tend to slight warnings. In this context, for effective use of severe weather warnings, it is important for public confidence in the information to grow through improvement of weather forecast accuracy. With regard to tsunami warnings, it is essential to reduce the relay time of the information flow between observatories and the public in order to disseminate warnings as promptly as possible. For prompt transmission, satellite communication systems should be expanded in the near future.

From studies on the April 1991 tropical cyclone in Bangladesh, investigators have concluded that one of the several factors contributing to the high death toll was the failure of some people to respond to the warnings due to their belief that they were false alarms. While a degree of over-warning is unavoidable, every effort must be made to increase the accuracy of cyclone track and intensity forecasts and hence warnings and to strengthen public awareness and education campaigns.

INTRODUCTION

Disaster preparedness information such as warnings plays an essential role to prevent and mitigate natural disasters.

Hurricane Gilbert of September 1988 was the biggest hurricane in the past 30 years to hit Jamaica (WMO, 1989). Despite the fact that its strong wind lasted longer than that of Hurricane Charlie in 1951 and the population had increased substantially during the intervening years, Gilbert claimed 45 lives, while Hurricane Charlie killed no less than 151 Jamaicans. The National Meteorological Service of Jamaica identified the factors which contributed to the lower death toll. The factors included increased usage of imageries from meteorological satellites and weather radars, regular contact with the Regional Hurricane Centre operated by the US Weather Bureau in Miami, close liaison between the Office of Disaster Preparedness in Jamaica and the Meteorological Service, etc. Such improvements led to warnings addressed to specific groups at risk with longer lead time. Jamaica's experience illustrates the contribution of warnings to natural disaster mitigation.

This presentation summarizes the current state of the information provision for natural disaster prevention, taking examples in Japan and other countries, and makes several recommendations for the future improvements in disaster preparedness information.

PRESENT STATUS OF WARNINGS FLOW

Warnings in Japan

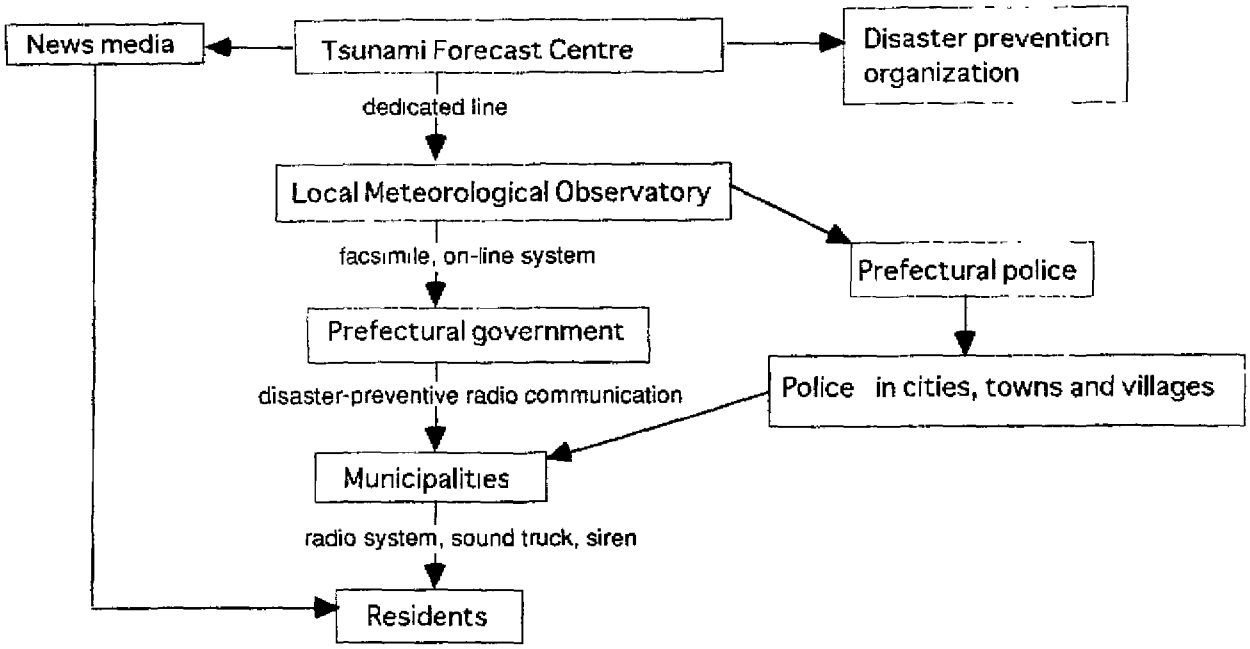
In Japan, the Japan Meteorological Agency (JMA) issues warnings for severe weather, storm surge, high waves, flood and tsunami in accordance with the Meteorological Service Law. (Flood warnings on 80 designated rivers are issued after consultation with the Ministry of Construction which is in charge of river management). Figure 1 shows the outline of the information flow. Seventy-one meteorological observatories of JMA issue warnings for severe weather, storm surge, high waves and flood, and the Tsunami Forecast Centres in five principal observatories and in the Headquarters issue tsunami warnings when serious disasters are expected. Each meteorological observatory disseminates warnings to organs related to disaster prevention, such as its corresponding prefectural government(s) and police and the news media, using multi-destination facsimile, on-line systems, etc. The general public is provided with the warnings mainly through news media such as television and radio. Each municipality receives the information from its prefectural government through a disaster-preventive radio communication system. Some prefectural governments operate the Local Authorities Satellite Communication Network for the information transmission to the municipalities. Watching meteorological, terrestrial and hydrological conditions with vigilance, municipalities alert the residents to take counter-measures against possible disaster through various media such as a disaster-preventive radio system, sound trucks and sirens.

Warnings in Bangladesh

In Bangladesh, the Bangladesh Meteorological Department is entrusted with the responsibility of issuing tropical cyclone warnings and their dissemiantion (Chowdhury, et al., 1993). The warnings are

transmitted to the Cyclone Preparedness Programme (CPP) of the Bangladesh Red Crescent Society (BRCS) as well as various governmental authorities and media such as radio, television and press. The cyclone storm warning signals issued by the Meteorological Department are addressed mainly to ships and ports. BRCS has over 20,000 village volunteers in the coastal areas. In a system well suited to local circumstances, CPP transmits the warnings to village volunteers through a network of district and sub-district control offices. The volunteers alert people at 'grass-root' level through megaphones and house-to-house contact to prepare for the cyclone and to eventually evacuate. According to a case study on Tropical Cyclone 02B that struck coastal areas of Bangladesh at the end of April 1991, 60% of the inhabitants of the area heard a warning from three major channels for dissemination of the warnings: megaphones by BRCS (19.4%), radio (37.3%) and inter-personal communication (43.3%). The high percentage of the inter-personal communication and megaphones indicates the effectiveness of the CPP community-based warning dissemination system.

TSUNAMI WARNING



OTHER WARNINGS

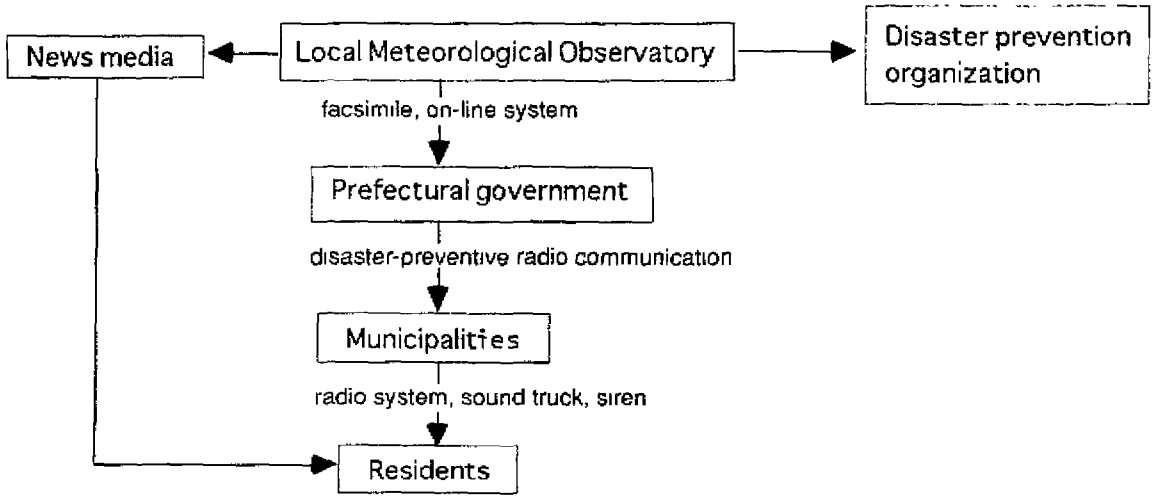


Figure 1 - Flow of warnings issued by the Japan Meteorological Agency

RAPID DISSEMINATION OF INFORMATION

The warning flow described in the preceding section usually works satisfactorily. However, when the time available before the public has to take action is very short, it may not. This section discusses an issue of the rapidity of the information dissemination with examples of tsunami warnings in Japan.

Tsunami from the south-west of Hokkaido Earthquake

A major earthquake with a magnitude of 7.8 on the Richter scale took place south-west of Hokkaido at midnight on 12 July 1993 (see Figure 2). A few minutes later, the small island of Okushiri was devastated by massive tsunamis with a maximum height of more than 20 m. Okushiri recorded 231 deaths which were mainly due to the tsunamis. The Tsunami Forecast Centre of the Sapporo District Meteorological Observatory of JMA issued a tsunami warning five minutes after the occurrence of the earthquake. However, some municipalities received the warning from the Centre through the formal administrative route more than thirty minutes after the earthquake occurrence.

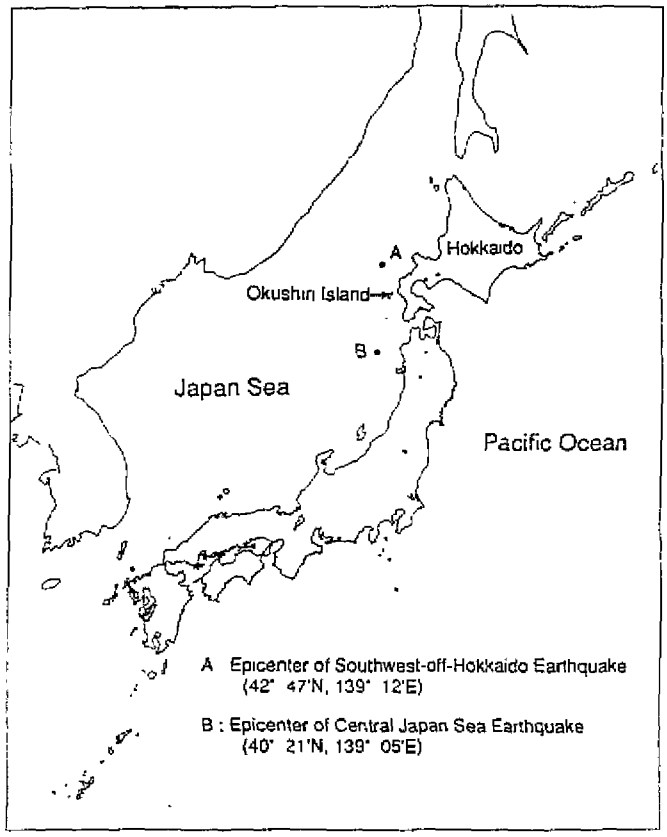


Figure 2 - Epicenters of Southwest-off-Hokkaido Earthquake and Central Japan Sea Earthquake

The warnings issued by JMA pass through a few relay points before they reach inhabitants. In some cases, the relay points number no less than four: the Local Meteorological Observatory, the prefectural government, the branch office of the prefectural government, and the muncipality. The addition of relay points, even if automated, would increase the risk of telecommunication problems.

The warnings are not always automatically relayed. A person in charge at a relay point may receive the warnings by facsimile, and then transmit them to the next relay point by facsimile or by a radio communication system. Such manual operations hamper rapid dissemination of warnings. Moreover, persons in charge in prefectural and municipal offices are not always on standby. In other words, warnings may not be relayed during the night and at holiday periods, and consequently it may take a long time before the warnings reach the general public.

Satellite-based dissemination of warnings

For the purpose of shortening the time to detect an earthquake which may cause tsunamis, JMA deployed 150 new seismographs (each seismograph is installed at intervals of about every 50 km) throughout the country in March 1994 (see Figure 3). The Tsunami Forecasting Centres automatically receive seismic wave data from the 150 seismographs and detect the magnitude and location of an earthquake using only P-wave data. Previously, S-wave data were also needed for the detection. Owing to the increase in the number of seismographs and utilization of P-wave data which arrive earlier than S-wave data, tsunami warnings can be issued within a few minutes after occurrence of an earthquake.

Moreover, it is essential to reduce the relay time of information flow between observatories, which issue the warnings, and the public in order to disseminate warnings as promptly as possible. In this regard, JMA has developed a "Satellite-based Emergency Information Multi-destination Dissemination System" and its receiving equipment are being deployed in prefectural and municipal offices, news media, etc. throughout the country (see Figure 3). Through this satellite-based communication system, prefectural government and municipalities can directly receive warnings immediately after the issuance. If loud speakers in cities and towns are connected with the receiving equipment and both the network system and the communication system work well, residents can become aware of the warnings only a few minutes after the occurrence of an earthquake. In comparison with the previous situation, rapid dissemination of warnings by these systems is very effective to alert people to evacuate. In addition, through this satellite-based communication system, warnings can be disseminated to the municipalities even when landlines are damaged by the earthquake. In fact, when the above-mentioned earthquake of 12 July 1993 occured, the JMA's dedicated line which connects the Tsunami Forecast Centre and the Local Meteorological Observatories was damaged and hence other ways such as telephone and VHF radio were used. As a consequence, it took a long time to transmit the warnings.

In India, the Cyclone Warning Centres established by the India Meteorological Department issue cyclone alerts and warnings (India Meteorological Department, 1988). The usual modes of communications of the warnings by telegram is not reliable especially during cyclone situations. To overcome the limitations of the conventional communication systems, a dependable scheme for dissemination of warnings, the Disaster Warning System (DWS) has been installed. Under the DWS, the warnings are transmitted to the Indian National Satellite which, in turn, broadcasts it for instantaneous reception by about 100 ground receiving stations which are located in cyclone prone areas. This enables warning messages to reach receivers located in an area which is likely to be affected by adverse weather even when communication by telegrams is not functioning.

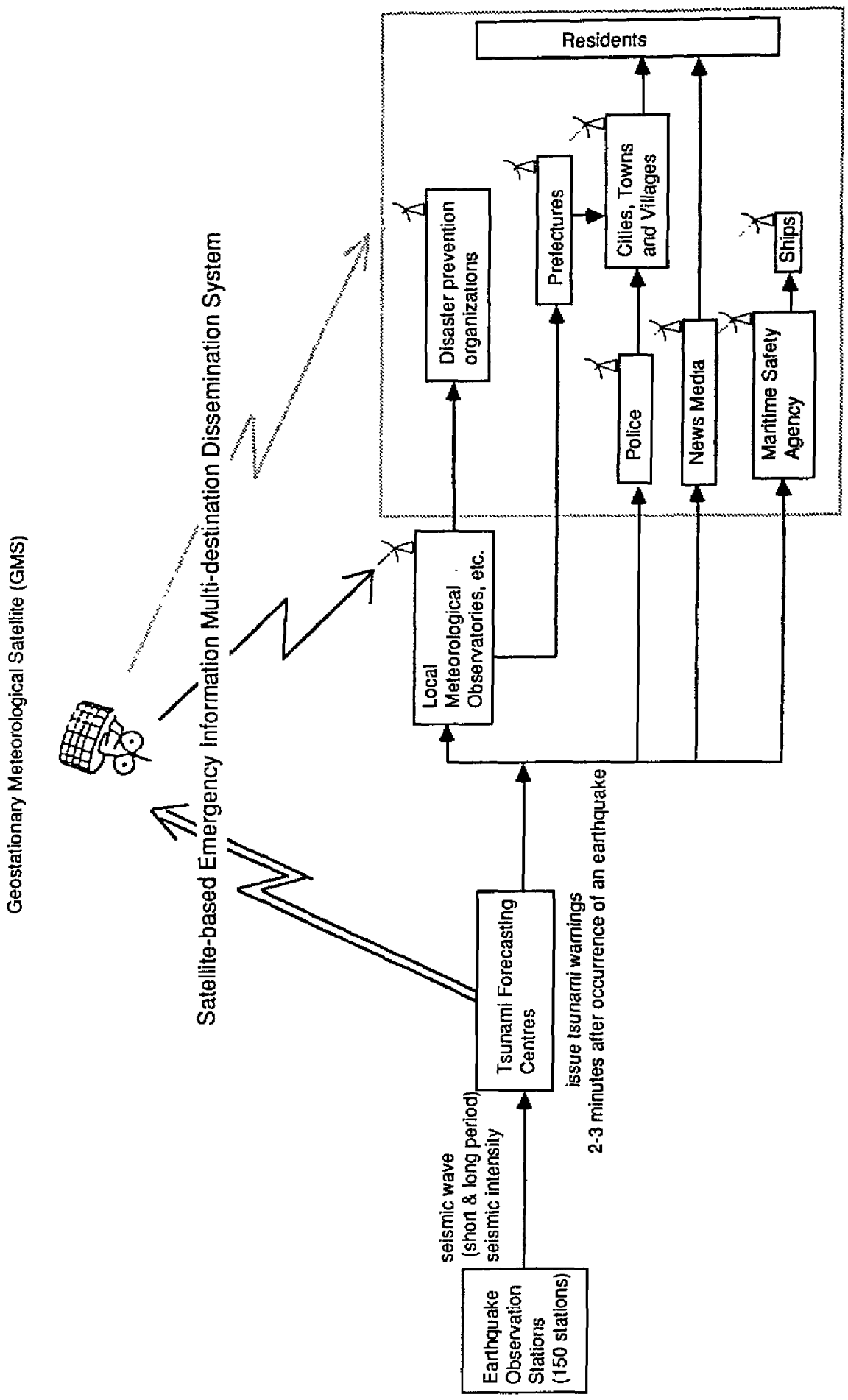


Figure 3 - JMA's new system for tsunami forecasting and emergency information dissemination

DEPENDABLE AND PLAIN WARNINGS

Recent advancement in science and technology has improved warnings for natural disasters. However, to use these warnings effectively in disaster prevention activities, the warnings have to express and provide information in such a way that the recipients can understand correctly and respond appropriately to the view of the authorities such as JMA about meteorological conditions.

This section focuses on the subject of expression of the warnings and the follow-up action by the municipalities.

Neglect of warnings and the importance of monitoring the actual condition

On 29 and 30 April 1991, a huge cyclone hit the coastal areas of Bangladesh after an interval of about 20 years without cyclones of such severity and magnitude. The Bangladesh Meteorological Department made an appropriate forecast and issued warnings, which were disseminated to inhabitants in the areas concerned. A study (Chowdhury et al., 1993) concluded that a lot of inhabitants, including BRCS volunteers who are in charge of transmitting the warnings within communities, did not fully believe the warning and they neglected to prepare for the oncoming cyclone. It was found that some people began to evacuate only upon the arrival of the cyclone and, in consequence, many ended up as victims. Why did so many people neglect the warning? One of the main reasons proposed was previous false alarms: although warning of 'great danger' was issued every other year in the 1980s, the coastal areas were not damaged so seriously; since people felt deceived by previous warnings, they were inclined to think that the warning would be false again and to discount the potential seriousness.

People's response to Typhoon Mireille which made landfall on Japan in September 1991 illustrates the same problem. Mireille was one of the biggest typhoons to hit Japan in the last twenty years and claimed 62 lives there. According to a damage survey by the Japanese Group for the Study of Natural Disaster Science, most victims were killed outdoors when the typhoon was passing through, while accuracy of the typhoon forecasts and warnings was satisfactory. The Group pointed out that neglect of the warnings aggravated the loss of lives and properties. The Urban Safety Research Institute conducted a questionnaire survey of people in a damaged city. 87.7% of the people who answered the questions had known of the issuance of the warnings for the storm. However, only 27.4% expected that a violent storm would be coming, while 60.3% did not pay heed to the warnings at all.

In Japan, heavy rain warnings are issued when precipitation amounts are likely to reach danger levels which are set up in each region (191 regions throughout the country) on the basis of experimental relationships between disasters and the rainfall amounts. These regions are much wider than disaster-stricken areas. In other words, even when the warning is issued appropriately from the view point of the meteorological observatories, a lot of residents tend to consider it a false alarm because they are wholly safe. In addition, warnings are apt to be issued frequently so as to avoid missing events. The heavy rain warning is issued five times per region on average. For these reasons, residents who have not suffered damage might be inclined to make light of warnings.

Since the present warnings are addressed to too large a region from the viewpoint of inhabitants, people wish to receive warnings focused on further sub-divided small areas and with detailed information about time. However, in reality, possible forecast accuracy with the present technique is far from their

expectations. It is very difficult to meet the requirements. Therefore, small-scale meteorological and hydrological situations should be monitored to supplement the prognostic warnings.

In Japan, municipalities which have responsibilities of issuing evacuation orders assemble anti-disaster organizations such as fire and flood preparedness brigades in response to warnings issued by JMA. Municipalities give an evacuation order judging from the warnings and the actual condition such as observed precipitation amount. About 100,000 areas throughout the country are designated as disaster-prone zones where natural disasters such as a landslide are expected to happen. Only about 1% of the disaster-prone zones are equipped with automatic telemetered rain gauges and are continuously monitored. If telemetered rain gauges with which municipalities monitor the actual condition are installed in all the disaster-prone zones, decision-makers can give an appropriate evacuation order as the need arises on the basis of the actual condition.

Time	:	12.20
Title	:	Yamaguchi Prefecture Heavy rain and flood warnings, thunderstorm advisory
Headline	:	In Yamaguchi pref., from now to tomorrow morning, severe rain, more than 50 mm/hour, 150 mm in total
Text	:	A baiu (seasonal) front is still active and stationary over Tsushima strait. In some regions in Yamaguchi pref., from now to tomorrow morning, it will rain severely. The rainfall amount will be more than 50 mm/hour and 150 mm in total. Be fully alert. Serious natural disasters such as landslides, flood and inundation are expected. Also be alert to gust and thunderstorm.

Example 1 - Contents of Warning

Contents of warnings

Even when a meteorological service realises that a huge tropical cyclone is coming, the general public may not realise the potential hazards of the tropical cyclone if the meteorological service only issues a simple warning such as big, danger, great danger, etc., without any other special information. In this context, clear and detailed information is useful for enhancing people's caution. For example, in early September 1993 when typhoon Yancy (9313) was approaching, JMA asked the news media to use the expression "one of the biggest typhoons in the past 50 years" to indicate the seriousness of the situation. Owing to this rare action of JMA, many people were further alerted to the typhoon and were saved in spite of the cruelty of the typhoon.

Moreover, before September 1983, warnings issued by JMA consisted of the title and a long text which explained the present meteorological condition, forecast, bases of the warning issuance, etc.

The text was so long, with material which meteorologists use for explaining the meteorological conditions on television, etc., and normally only the title of the warning was announced, without the long explanation. JMA began to add to every warning a headline, which is a short phrase describing the situation or potential hazards briefly and clearly, to the long explanation text whenever a warning is issued (see Example 1). This short phrase can easily be announced on television and radio, etc., and is expected to be used on the television, that is, words superimposed on the screen without interruption of the regular programme, thus bringing this useful and meaningful information promptly and forcefully to the attention of the general public

EDUCATION AND PUBLIC AWARENESS

When the major earthquake hit Okushiri Island in July 1993, a lot of coastal residents began to go up to higher places immediately after they felt a tremor of the earth. Their quick response to the earthquake was based on experiences on the occasion of the Central Japan Sea Earthquake with a magnitude of 7.7 on the Richter scale on 26 May 1983 (see Figure 2). The death toll from the earthquake was 104 people and 100 out of them were killed by tsunamis. Before this earthquake, the coastal area of the Japan Sea had few experiences of tsunamis and few people thought that the area would be attacked by massive tsunamis, while tsunamis have repeatedly hit the coast of the Pacific Ocean in Japan. A party of elementary school children and a teacher who were having a picnic on the coast did not start evacuating until tsunamis were seen and 13 children were killed. Considering the facts that they felt a big tremor of the earth, that the tsunami reached the coast about ten minutes after the occurrence of the earthquake, and that the height of the tsunami (3.7 m) was lower than the height of the tide embarkment (4 m) of which a stair-shaped side wall could be easily climbed, they could have been saved if they had known how dreadful a tsunami is and had begun evacuation to a safe place. The tragedy made people realise the great importance of education on the subject.

For the purpose of public education, the International Co-ordination Group for the Tsunami Warning System (ITSU) of the Intergovernmental Oceanographic Commission (IOC) is developing several kinds of earthquake and tsunami textbooks according to ages. Production of educational materials such as booklets, textbooks, slide-shows, and video tapes are cheap in comparison with establishment of information networks and shelters. The booklets should be prepared not only in English but also in many local languages which are spoken in disaster vulnerable areas. International organizations would be ideally suited to take the lead in the preparation and translation of these types of educational materials.

CONCLUSIONS

In order to make warnings which are issued to prevent disasters more useful and effective, the following is suggested.

(a) Rapid and secure dissemination of information in an emergency

Warnings, especially tsunami warnings, should be disseminated rapidly. Automatic relay between telecommunication systems and satellite-based systems to transmit emergency information simultaneously would each be helpful for rapid and secure dissemination of information. By use of satellites, the general public can receive warnings even when landlines in between are damaged.

(b) **Importance of monitoring the actual meteorological condition**

It is in disaster-prone zones, amongst others, that evacuation is important for preventing human damage. With the present meteorological knowledge and technology, it is impractical to issue detailed prognostic flash flood and micro-meteorological scale warnings addressed to each sub-divided local disaster-prone zone.

To complement this, decision-makers should alert residents to go to safer places or issue an evacuation order as the need arises by monitoring the actual condition with telemetered rain gauges, weather radars, etc.

(c) **Content of warnings**

Organs which issue warnings should make an effort to make the contents of warnings easily understood and used for the news media, communities and the general public. The headlines of the warnings by JMA would be one example. Moreover, when severe weather is expected to hit for the first time in the last few decades, this information should be announced to the public so that they do not discount the seriousness.

(d) **Education and Public Awareness**

People who have experienced serious disasters in person in the past understand the horror of natural disasters and make themselves fully alert. Education is very important so that inexperienced people can also be ready to deal with possible emergencies. International organizations should play a vital role in organizing the activities regarding preparation and translation of the materials for public education and awareness

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