

WORLD METEOROLOGICAL ORGANIZATION

EXPERT TEAM ON PUBLIC WEATHER SERVICES IN SUPPORT OF DISASTER PREVENTION AND MITIGATION (ET/DPM)

Beijing, China

12-16 June 2006



FINAL REPORT



EXECUTIVE SUMMARY

A meeting of the Expert Team on Public Weather Services in Support of Disaster Prevention and Mitigation (ET/DPM) was held in Beijing, China from 12-16 June 2006. The meeting was chaired by Dr M.C. Wong (Hong Kong, China). Under its terms of reference, the ET/DPM had to work on several areas namely: assistance to developing countries in disaster mitigation in the framework of PWS; further development of the SWIC Web site; role of PWS in early warning process; cross-border exchange and exchange over the Internet; and application of nowcasting to warnings.

The key conclusions from the work of the Expert Team are summarised below.

- (i) The Expert Team (Team) reviewed the initiatives of the past Team, formerly the Expert Team on Warnings and Forecasts Exchange, Understanding and Use, and noted with satisfaction the progress made since the last meeting held in Paris in 2004.
- (ii) The Team conducted a survey in January 2006 jointly with the Expert Team on Service and Product Improvement (ET/SPI) of WMO Members to assess the gaps and needs of NMHSs on severe weather warning services. After analysing the initial returns from 74 Members as of 3 June 2006, the Team prepared an interim report and proposed the following recommendations:
 - (a) The survey provided useful insights as well as “quantitative” information on severe weather hazards and warnings. A reminder should be sent to those Members who have not yet responded. The Team will contact Members, especially developing countries who have not yet responded to encourage them to do so. If successful, the status and needs of developing countries will be better represented.
 - (b) Using the contact information provided on each completed survey, it is proposed that an inventory of warning systems operated by Members be developed.
 - (c) Based on the survey results identifying rain as the hazard of most concern and some 40% of the responses cited “forecasting accuracy” as the primary challenge, the Team recommended enhancing the predictability of rain (as defined in this survey) as the most effective area to focus on to reduce the vulnerability of Member countries.
 - (d) To improve on the warnings of short-term severe weather phenomena, especially rainstorms, nowcasting as a decision-support tool, is called for. Workshops and capacity building on nowcasting should be considered; and
 - (e) The success of a warning is to change people’s behaviour, and education is the key issue. Workshops and capacity building on reaching out to decision-makers as well as the public to help them understand the meaning of warnings and enhance their ability to translate these into action should be considered.
- (iii) The Team addressed the scope of disaster prevention and mitigation and agreed that it extended beyond the Planning phase to also include relevant NMHS actions and responsibilities during the Preparedness and Response phases of Disaster Management. It was agreed that developing countries should be provided with examples of successful initiatives of NMHSs to improve disaster prevention and mitigation together with examples of measures taken by NMHSs to rectify identified deficiencies. NMSs are therefore to be canvassed to provide suitable examples to be

made available initially through special links on the WMO PWS web page and later published.

- (iv) The Team reviewed the progress achieved in the SWIC website in the past couple of years, noting in particular, the addition of a recap function to loop tropical cyclone positions in the past 7 days and the new webpage on “thunderstorms”. It also noted the production of the video on regional and global tropical cyclone tracks animation produced by stitching together 3-hourly web pages of SWIC from the archive of 2005 events and provided suggestions to improve on the presentation of the video.
- (v) In view of the possibility of displaying gales on the SWIC webpage in a certain location without a corresponding warning, the Team recommended that the proposed “Gales” page be launched in the WWIS website instead. Noting that there was no agreed universal criteria for “Extreme Temperatures”, let alone for warnings, the Team recommended that the proposed page on “Extreme Temperatures” also be launched in the WWIS website instead.
- (vi) On the development of multiple-languages versions of the SWIC, the Team recommended the SWIC host to explore the technical feasibility of automatic translation of the warning messages into different languages as well as study the associated resource implications before proposing on the way forward.
- (vii) The Team recommended that a link be established between the SWIC and European Multiservice Meteorological Awareness (EMMA) web pages after the latter becomes operational. As a longer-term aim, the Team endorsed the desirability of expanding SWIC to include additional official warnings other than those specific to severe weather.
- (viii) The Team supported the publication of a user guide on WWIS and SWIC for distribution to public and media as proposed by the ET/SPI. The Team also supported in principle the eventual merging of the WWIS and SWIC websites with one URL as proposed by the ET/SPI but pointed out that implementation of multiple-language versions of the SWIC would be a great challenge.
- (ix) To define and clarify the role of NMHSs in the early warning process and develop reference material, the Team made separate recommendations for NMHSs in developed and developing countries including LDCs. For developed countries, PWS issues include improving accuracy for forecasts and warnings for out to seasonal timescales and use of probability information in forecasts and warnings. The Team considered that developed countries should act as advisors for NMHSs in developing countries including LDCs. Enhancing and expanding relationships with partners and stakeholders should be a priority.
- (x) The Team recognized the importance of promoting Members’ awareness on the availability of public weather forecasts and warnings on the Internet as well as enhance the visibility of public weather services. Various actions have been taken to ensure ease-of-use of weather information on the Internet and the usefulness of information available. The Team also noted requests from commercial entities to acquire the XML databases of WWIS and SWIC and agreed in principle the provision of these databases as one way to enhance the visibility and image of NMHSs. However, the question of charges to be imposed in the provision of these databases could not be resolved at the Team level and the Team recommended that this issue of charging should be brought to the notice of the WMO Secretariat.

- (xi) The Team considered recent publications on the topic of nowcasting with the most significant being a paper on advances in nowcasting presented at the 2005 CBS Technical Conference on Public Weather Services. The paper includes a table of major operational nowcasting systems as reported in the WMO WWRP Nowcasting Working Group. Discussion then focussed on the nowcasting timescale, the weather elements most frequently associated with nowcasting, the observational platforms necessary for an effective nowcasting service, and various initiatives that can automate and streamline the product preparation and dissemination aspects of the nowcasting process.
- (xii) The Team reviewed developments following the publication of PWS 9 “Guidelines for Cross-border exchange of Warnings” giving particular attention to SWIC and the EMMA programme. Liaison between advanced international systems for the exchange of warnings is recommended.
- (xiii) The Team recommended to provide the final joint report of the PWS Survey on Severe Weather Services conducted earlier in 2006 to CBS OPAGs and Technical Commissions to serve as a resource for their activities/deliverables.
- (xiv) The Team will collaborate with the WMO WWRP Nowcasting Working Group in conducting a nowcasting workshop in Sydney, Australia in October 2006.

1. INTRODUCTION

1.1 The China Meteorological Administration (CMA) kindly agreed to host a meeting of the Expert Team on PWS in Support of DPM (ET/DPM) in Beijing from 12 to 16 June 2006. The meeting was chaired by Dr M.C. Wong (Hong Kong, China). Ms Haleh Kootval (Chief, Public Weather Services Division, WMO Secretariat) welcomed the participants on behalf of the Secretary-General and briefed them on the recent meetings of the Open Programme Area Group (OPAG) on PWS including those of the Implementation Coordination Team (ICT) and the Expert Teams on Services and Products Improvement (ET/SPI) and the Expert Team on Communication Aspects of PWS (ET/COM), which would have direct bearing on the work of the ET/DPM. She also highlighted the objectives and expected outcome of the meeting of the Expert Team. She drew attention to the Team's Terms of Reference (TOR) as approved by the CBS as follows:

- (a) **Monitor and report on the progress of earlier initiatives of ET-DPM and make recommendations as appropriate to OPAG/PWS;**
- (b) **Monitor and report on aspects of disaster prevention and mitigation that relate to support of major WMO cross cutting activities such as Disaster Prevention and Mitigation, the WMO Space Programme and THORPEX;**
- (c) **Identify ways to assist developing countries in their efforts to improve disaster prevention and mitigation in the context of their national PWS programme;**
- (d) **Continue to provide guidelines on the development of Severe Weather Information Centre (SWIC) for improved international availability and access to NMHSs' official severe weather information via the Internet;**
- (e) **Define and clarify the role of PWS in early warning process and develop appropriate reference material based on current practices on early warning highlighting communication and technology aspects. Create general guidelines from reference materials for use by NMHSs;**
- (f) **Promote awareness of, and provide guidance to, Members on the exchange of public weather forecasts and warnings on the Internet;**
- (g) **Keep under review the development of cross-border exchange of warnings with reference to the published WMO guidelines;**
- (h) **Develop reference material on the application of nowcasting to the provision of public warnings associated with mesoscale weather phenomena;**
- (i) **Report and advise on collaborative activities with other CBS OPAGs and Technical Commissions.**

1.2 The list of participants is given in Annex I. The programme of the meeting is contained in Annex II

1.3 The meeting began its work with considering each TOR. Each team member discussed its TORs and prepared a separate report on the details of its work for inclusion in the final report of the meeting.

2. BACKGROUND

2.1 The meeting was informed by Ms Kootval that the Thirteenth Session of the Commission for Basic Systems (CBS) (St Petersburg, February 2005) had approved the Terms of Reference of the Open Programme Area Group (OPAG) on PWS, which had been proposed by the Implementation Coordination Team on PWS. The work of the PWS Programme continues to be coordinated through three expert teams and an implementation and coordination team. These are the Expert Team on Services and Products Improvement (ET/SPI); the Expert Team on the Communication Aspects of PWS (ET/COM); the Expert Team on PWS in Support of Disaster Prevention and Mitigation (ET/DPM); and the Implementation/Coordination (IC) Team on PWS. The terms of reference of all the teams had been modified by CBS-XIII to reflect the areas of work still outstanding or those which needed emphasis in each team. The subsequent changes in the membership of each team were based on the areas of expertise required accordingly.

2.2. The results of work under the various TORs of the Expert Team are summarized below.

3. ET/DPM WORK PROGRAMME

3.1 TOR (a): Monitor and report on the progress of earlier initiatives of ET-DPM and make recommendations as appropriate to OPAG/PWS;

3.1.1 The Chair of ET/DPM (Chair) provided the Expert Team (Team) with a review of the initiatives of the past Team, formerly the Expert Team on Warnings and Forecasts Exchange, Understanding and Use, and reported on their progress since the last meeting held in Paris in 2004. The status of implementation of the follow-up actions of the Paris meeting is shown in Annex III. The Team was satisfied with the progress made.

3.1.2 The Team noted that upon approval by the CBS XIII, the World Weather Information System (WWIS) and Severe Weather Information Center (SWIC) became operational components of the Public Weather Services Programme (PWS) on 23 March 2005. The Team also noted the enhancements made to the WWIS (English version) and SWIC websites including the creation of sub-domain names with ".int" extensions, with a view to promoting these two websites as authoritative sources of global official information on weather and warning, (b) implementation of a web-based city forecast data submission form with a Spanish data entry interface as well as an Arabic web form, (c) provision of links to the official tourism boards websites of some Members to promote the site to the global travelers, (d) making available the pamphlets for WWIS and SWIC for download on the respective websites and (e) addition of new pages in SWIC on observations of "Heavy Rain/Snow" and occurrences of thunderstorms as decoded from synoptic observations.

3.1.3 The Team has published the "*Guidelines on Integrating Severe Weather Warnings into Disaster Risk Management*" (PWS-13)

3.2 TOR (b): Monitor and report on aspects of disaster prevention and mitigation that relate to support of major WMO cross cutting activities such as Disaster Prevention and Mitigation, the WMO Space Programme and THORPEX

3.2.1 The Chair briefed the Team on the Hyogo Framework for Action adopted by 168 Governments in January 2005 which would serve as guidance for states, organizations and other actors at all levels in designing their approach to disaster risk reduction. He highlighted that enhancing early warnings was one of the five priority areas in the Hyogo Framework for Action.

3.2.2 The Team continued to pursue and support WMO cross-cutting activities and initiatives. The Team has developed and conducted a survey in collaboration with the Expert Team on Service and Product Improvement (ET/SPI) on WMO Members with the following objectives:

- (a) To compile information on severe weather warning systems operated by Members with a view to publishing a handy reference on such system;
- (b) To assess the vulnerability of various Members to weather-related disasters with a view to developing workshops to address the gaps and weaknesses identified, and
- (c) To assess the PWS needs of National Meteorological and Hydrological Services with a focus on identifying opportunities to improve products and services, in particular, on severe weather warning services

3.2.3 The survey was issued in January 2006. The survey questionnaire was prepared in four languages namely, English, French, Spanish and Russian. A copy of the English version of the questionnaire is shown in the Appendix to Annex V. An electronic version of the questionnaire and a webform were also available on the WWIS website for downloading and submission of return respectively by Members. A total of 170 questionnaires were successfully sent out. After analysing the initial returns from 74 Members, the Team prepared an interim report on the survey and proposed the following recommendations:

- (a) The survey provided useful insights as well as “quantitative” information on severe weather hazards and warnings. A reminder should be sent to those Members who have not yet responded. The Team will contact Members, especially developing countries who have not yet responded to encourage them to do so. If successful, the status and needs of developing countries will be better represented.
- (b) Using the contact information provided on each completed survey, it is proposed that an inventory of EWSs operated by Members be developed.
- (c) Based on the survey results identifying rain as the hazard of most concern hazard and some 40% of the responses cited “forecasting accuracy” as the primary challenge, the Team recommended enhancing the predictability of rain (as defined in this survey) as the most effective area to focus on to reduce the vulnerability of Member countries.
- (d) To improve on the warning of short-term severe weather phenomena, especially rainstorms, nowcasting as a decision-support tool, is called for. Workshops and capacity building on nowcasting should be considered.
- (e) The success of a warning is to change people’s behaviour and education is the key issue. Workshops and capacity building on reaching out to decision-makers as well as the public to help them understand the mean of warnings and enhance their ability to translate these into action should be considered.

Details on the Team’s observations and findings can be found in the report which is also shown in Annex IV.

3.3 TOR (c): Identify ways to assist developing countries in their efforts to improve disaster prevention and mitigation in the context of their national PWS programme

3.3.1 The Team first addressed the scope of disaster prevention and mitigation and agreed that it extended beyond the Planning phase to also include relevant NMHS actions and responsibilities during the Preparedness and Response phases of Disaster Management. In partnership with emergency services authorities, prevention and mitigation by NMHSs during the 3 phases are broadly defined as being (refer to Figure 1 below):

- (a) Undertaking hazard assessments utilising severe weather databases during the Planning phase;
- (b) Conducting public awareness programs explaining the hazard risk during the Preparedness phase; and
- (c) Operationally including community protective action advice in warnings during the Response phase.

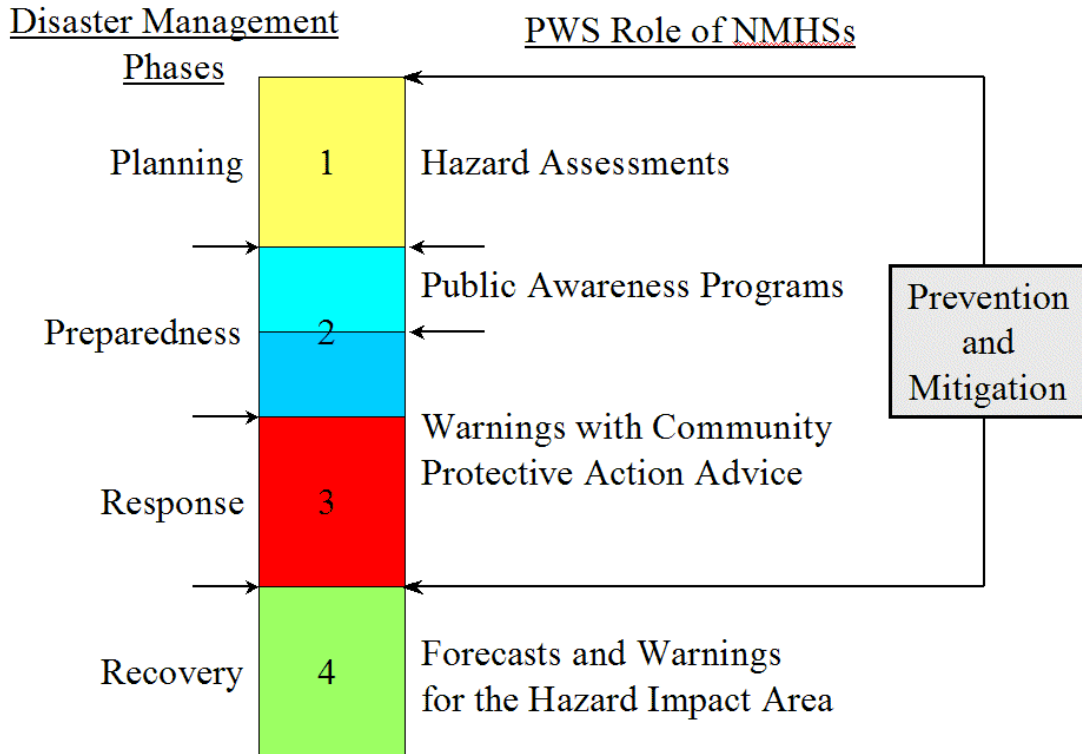


Fig. 1 Schematic showing links between the 4 disaster management phases and the PWS role of NMHSs

3.3.2 The Team then proceeded to discuss the merits of preparing a set of guidelines to assist developing countries in their efforts to improve disaster prevention and mitigation in the context of their national PWS programs. It was agreed that a better approach would be to provide developing countries with examples of successful initiatives of NMHSs to improve disaster prevention and mitigation together with examples of measures taken by NMHSs to rectify identified deficiencies. Besides regular warnings of hazardous weather, intra-seasonal and seasonal predictions were considered to be within scope. NMHSs are therefore to be canvassed to provide suitable examples to be made available initially through special links on the WMO PWS website and later published. Particular efforts will be made to solicit such examples from developing countries.

3.4 TOR (d): Continue to provide guidelines on the development of Severe Weather Information Centre (SWIC) for improved international availability and access to NMHSs' official severe weather information via the Internet

- 3.4.1 In order to ensure that the future work on the SWIC was in alignment with the original objectives of the setting up of the website, the Team discussed and reaffirm the main functions of the website:
- (a) To serve as a one-stop portal for official warnings issued by NMHSs,
 - (b) To enhance public awareness of potential hazards, and
 - (c) To raise the profiles of NMHSs issuing the warnings.
- 3.4.2 The Team reviewed the progress made in the past couple of years. It noted, in particular, the addition of a recap function named "past position of tropical cyclone" to loop tropical cyclone (TC) positions in the past 7 days and the new webpage on "thunderstorms". It also noted the production of the video on regional and global TC tracks animation produced by stitching together 3-hourly web pages of SWIC from the archive of 2005 events. The Team also provided suggestions to improve on the presentation of the video which the Chair would forward to the SWIC operator.
- 3.4.3 The Team discussed the proposed development of the "Gales" web page to be launched in SWIC based on SYNOP reports. It reviewed and accepted the proposed quality checking scheme for gale data in the SYNOP reports, with the filtering off of about 20% of suspect data including some 5% which may be correct. Observations which fail the quality control checking will not be displayed. The Team also recommended that an explanation of this quality control checking be added to the web page.
- 3.4.4 A discussion took place on which threshold could be adopted for "severe high winds" (more significant than "Gales"). National criteria adopted for warning were considered but the Team noted there was no agreed universal standard for ground locations. The Team considered also the risk of displaying gales in a certain location without a corresponding warning could cause confusion which might eventually lead to the user discrediting the website. The Team recommended that the "Gales" page be launched in the WWIS website instead. The Chair agreed to forward this recommendation to the Chair of ET/SPI for consideration.
- 3.4.5 The Team discussed the proposed launch of an "Extreme Temperature" page on SWIC and noted there was no agreed universal criteria for on "Extreme Temperature", let alone for warnings. The Team recommended that such a page be launched in the WWIS website instead. The Chair agreed to forward this recommendation to the Chair of ET/SPI for consideration.
- 3.4.6 The Team agreed that it would be of utmost importance as SWIC expands to maintain its credibility by only posting official warnings and relevant observations made available by WMO members. Linking to other internationally available warnings (e.g. volcanic or tsunami) will also be considered.
- 3.4.7 The Team also discussed the proposal on multiple-languages versions of the SWIC and noted the challenges facing their implementation, in particular, translation of warning messages into different languages. The Team recommended that the operators of SWIC should explore the technical feasibility of automatic translation of the warning messages into different languages as well as study the associated resource implications before deciding on the way forward.

- 3.4.8 The Team recommended that linkage be established between the SWIC and European Multiservice Meteorological Awareness (EMMA) after the latter became operational. (See also discussions in TOR (g) below.) As a longer-term aim, the Team endorsed the desirability of expanding SWIC to include additional official warnings other than those specific to severe weather.
- 3.4.9 The Team supported the publication of a user guide on WWIS and SWIC to be distributed to the general public and media and provided suggestions to improve on the draft guide prepared by Mr. S T Lai of the ET/SPI. The Team also supported the gradual merging of the WWIS and SWIC websites as proposed by the ET/SPI but pointed out that implementation of multiple -language versions of the SWIC would be a great challenge.

3.5 TOR (e): Define and clarify the role of PWS in early warning process and develop appropriate reference material based on current practices on early warning highlighting communication and technology aspects. Create general guidelines from reference materials for use by NMHSs

- 3.5.1 The role of PWS in developed countries was addressed separately from that in developing countries and LDC's.

Developed countries

- 3.5.1.1 Huge investment has taken place in computer power and satellite programmes with the aim of developing very high resolution models capable of accurate forecasting of severe weather on a local scale. It is worth noting here that a substantial percentage of returns from developed countries in a recent PWS survey identified forecast accuracy for heavy rain and thunderstorms as being a challenge. Improved skill at longer timescales is also being sought using ensemble techniques.
- 3.5.1.2 The Team considered the importance of NMHSs working together with partners and stakeholders, particularly in relation to warnings and DPM. Effective partnerships should allow the user to design the warnings jointly with the NMHS, with regard to structure and content. The NMHS role suggested is one where partners can 'pull' information from the meteorological provider (e.g. NMHS) to make informed decisions. It is important that all involved should have a complete understanding of the end-to-end process and the roles and responsibilities of each member of the partnership. Training and liaison visits are highly recommended.
- 3.5.1.3 The increased use of probabilistic output is encouraged for NMHSs purposes, especially for services developed with, and for, partners and stakeholders. For seasonal forecasts, the use of probabilities is integral to the process and NMHS has an important role in establishing optimum methods for informing the public. For shorter range forecasts, ensemble systems are continually being developed and product bases expanded (e.g. the UK Met Office has extended the scope of its ensemble system to 15 days). Useful information such as a consensus forecast can be extracted from both single model and multi-model ensembles to be used in decision making processes.
- 3.5.1.4 The Team noted that much work is still needed in order that full understanding of probability products is achieved amongst all disaster managers and other stakeholders, including the public. It recommended that probabilistic information be gradually phased into forecasts and warnings based on user's level of acceptance. The ET/COM will be developing guidelines on communicating probabilities.

- 3.5.1.5 The Team noted that some forecasters might be reticent to use the probability approach if they are not properly equipped and trained. The Team considered that this is a cross-cutting issue and recommended that this be brought to the attention of OPAG DPFS.

Developing countries including Least Developed Countries (LDCs)

- 3.5.1.6 The Team considered that developed countries should assist NMHSs in developing countries including LDCs. There are already projects in place to address some of the data requirements in support of DPM (e.g. Severe Weather Demonstration Project). It suggested that representatives from NMHSs of developed countries be paired to NMHSs of developing countries as advisors on how to develop partnerships with disaster managers and other stakeholders. An individual or team from a developed country's NMHS could visit a developing country's NMHS for 1-2 weeks and attend with their local NMHS representatives previously arranged meetings with safety/security partners, the media, health officials, etc. to initiate or strengthen partnerships. After the visit, the advisor(s) would maintain on-going communication and support to their NMHS colleagues in the developing country. The Chair will undertake to convey this proposal to the Secretariat for consideration by the WMO cross-cutting Programme for LDCs.
- 3.5.2 As a longer term goal, an aspect which should be explored further is an extension of the scope of SWIC to include early warning systems on seasonal timescales. The Team agreed to document examples of where the application of seasonal forecasting in the context of disaster mitigation has led to a successful outcome for reference by Members.

3.6 TOR (f): Promote awareness of, and provide guidance to, Members on the exchange of public weather forecasts and warnings on the Internet

- 3.6.1 The SWIC and WWIS web pages are primary portals for the exchange of public weather forecasts and warnings on the Internet. The ET/DPM oversees the SWIC page and ET/SPI oversees the WWIS page. Therefore most of the Team discussion focused on SWIC.
- 3.6.2 To promote ease-of-use and understanding of public weather forecasts and warnings, icons and graphics should be used as far as possible at the first entry level. Usage of icons and graphics will transcend language barriers and promote a wider usage of the public weather forecasts and warnings on the Internet. Detailed text of the forecasts and warnings can be included at the second level for users who wish to obtain more details. In view of the fact that Internet access in developing countries and LDCs in particular, is limited and slow, it is recommended that streamlined products with simple icons and graphics should be utilised.
- 3.6.3 Although severe weather warnings are displayed on SWIC when available, there is no consistency on the level and differentiation of warnings such as advisories, alerts, watches and warnings. The Team recommended to include this issue in the SWIC planned survey as to whether or not there is a necessity to better define the various levels of warnings.
- 3.6.4 The XML databases of WWIS and SWIC are provided free-of-charge to Members. However, recently there have been requests from commercial companies to acquire these databases. The Team agreed that in principle, the provision of these XML databases, even to commercial companies, will promote the visibility of public weather services. These companies are required to acknowledge WMO and the contributing countries in the usage of such products. However, the question of charges to be imposed in the provision of these databases could not be resolved at the Team level and the Team

recommended that this issue of charging should be brought to the notice of the WMO Secretariat.

- 3.6.5 The Team reviewed the draft user's guide to WWIS and SWIC provided by the ET/SPI. The Team made several suggestions including segmenting the guide into one section on SWIC and the other on WWIS, adding a glossary of terms, an annex on quality control of gales and additional screen captures. The Chair will pass these suggestions to ET/SPI.
- 3.6.6 The Team supported in principle the eventual merging of the WWIS and SWIC websites with one URL as proposed by the ET/SPI. The Team also pointed out that implementation of multiple-language versions of the SWIC would be a great challenge.
- 3.6.7 The Team discussed the inclusion of additional useful information such as radar images, for display on the Internet, in addition to public weather forecast and warnings. However, radar images are neither essential nor additional according to Resolution 40, so some countries have classified them as commercial products and as such will not be available for free display nor exchange. Some countries do display radar images on their respective home pages. Since WWIS and SWIC provide hyperlinks to the home pages of participating Members, users who need these products will be able to access these radar images directly from Member countries' home pages, if available.

3.7 TOR (g): Keep under review the development of cross-border exchange of warnings with reference to the published WMO guidelines

- 3.7.1 A tentative review was made of developments following the publication in 2003 of PWS 9 "Guidelines on the Cross-Border Exchange of warnings". Some significant initiatives have been in progress, especially SWIC and EMMA. SWIC is commented in other parts of this report.
- 3.7.2 Mention was also made of the development of a Tsunami alert system, especially in the Indian Ocean, and the contribution of WMO to it, which underscores how important, useful and effective is such a system as the GTS for quick exchange of warnings at the global scale.
- 3.7.3 The EMMA programme which was already mentioned in the cited Guidelines, has been launched in 2000 under the aegis of EUMETNET, an European consortium of European NMHS. It aims at the construction of a service available on the Internet, using graphical information (similar to the French "Vigilance" system), which will offer access to detailed information from the existing national warning services, risk qualification and behaviour information. A first Phase was completed in 2004, and recently a short and final second Phase was launched, to be concluded by the end of 2006. It is expected that the system would be operational by then, with archiving support and having been reviewed by experts in disaster management authorities. The Team commented on issues concerning accessing graphical information at different levels of geographical detail, partnerships between NMHS and disaster managers, multilingualism with automatic translations, shared funding and other aspects.
- 3.7.4 The Team noted and welcomed the achievements and also appreciated the difficulties related to EMMA. It confirmed the adequacy of the Publication PWS-9 concerning the global approach to cross-border exchange. The Team emphasised precautions that must be taken when building such an international scheme aiming at the cross-border exchange of warnings. The experience of EMMA illustrates the needs for political will, good planning, effective leadership and prudent allocation of resources.
- 3.7.5 The Team was of the view that very productive convergences could be pursued between the collective systems for exchange of warnings, namely the RSMC and TCWC

procedures, SWIC and EMMA. The possibility for directly linking from SWIC to EMMA should be explored.

- 3.7.6 Liaison between focal points of these systems should be encouraged by WMO, aimed at ensuring compatibility, adoption of some common technical standards and methodology, that ultimately could permit user-friendly navigation among the various systems.

3.8 TOR (h): Develop reference material on the application of nowcasting to the provision of public warnings associated with mesoscale weather phenomena;

- 3.8.1 The Team considered recent publications on the topic of nowcasting with the most significant being a paper by Edwin S. T. Lai from the Hong Kong Observatory which was presented at the CBS Technical Conference on Public Weather Services in St Petersburg, Russian Federation (February 2005). The paper entitled "Advances in Nowcasting" includes a table of major operational nowcasting systems as reported in the WMO WWRP Nowcasting Working Group. However it was further noted that there is a wealth of literature on this topic, including many valuable references.

- 3.8.2 The nowcasting timescale is most commonly defined to be in the 0-3 hour range commencing with the observation time, although some sources extend the definition out to 6 hours. The weather elements most frequently associated with nowcasting include rainfall (flash flooding, landslides), thunderstorms (tornadoes, hail), fog, low cloud and poor visibility. While disaster managers, transport authorities and hydrologists are amongst the primary beneficiaries of an effective nowcasting service, the wider community also greatly benefits.

- 3.8.3 The observational platforms necessary for an effective nowcasting service were identified by the Team as being a combination of weather radars (conventional and Doppler), imagery from the new generation of weather satellites, high-density mesonets (predominantly AWS), lightning detector networks and profilers (otherwise radiosondes). Access to high-resolution mesomodel output is also very desirable. To further assist the nowcast process where warning preparation and dissemination times are critical, priority must be given to automating product preparation, providing a range of decision support tools, developing graphical products of the forecast weather elements, and providing for efficient channels of communication. All warnings should include (a) a description of the hazard, (b) the likely impact and (c) advice on the most appropriate community response.

- 3.8.4 The PWS Program has recently surveyed NMHSs to obtain information on the natural hazard warning systems operating in their countries, combined with an assessment of the vulnerability of developing countries to natural disasters and their need for assistance in that regard. The results of the survey will provide input to a planned nowcasting workshop in Sydney, Australia in October this year and a proposed workshop later on to address the urgent need to reduce vulnerability to natural hazards. The Expert Team will collaborate with the WMO WWRP Nowcasting Working Group in conducting the Sydney workshop and in other initiatives under this TOR. Measures may be taken to expand on the nowcasting information tabled in the CBS Technical Conference paper mentioned in 3.8.1.

3.9 TOR (i): Report and advise on collaborative activities with other CBS OPAGs and Technical Commissions.

- 3.9.1 As discussed under TOR (b), the Team has recently conducted the PWS Survey on severe weather warning services in collaboration with ET/SPI. The final joint survey report will be provided to CBS OPAGs and Technical Commissions to serve as a resource for their activities/deliverables. In addition, a questionnaire on collaboration between PWS

Programme and other CBS OPAGs has been distributed to the chairs of those OPAGs to identify areas of interest.

- 3.9.2 As discussed under TOR (h), the Team will collaborate with the WMO WWRP Nowcasting Working Group in conducting a nowcasting workshop in Sydney, Australia in October 2006.

4. DELIVERABLES AND FUTURE FOLLOW-UP

Based on the discussions of the TORs and associated deliverables, the Team agreed to undertake the following activities to implement the deliverables:

Deliverable 1: *Regional roving seminars on natural disaster management in the context of the PWS programme...TORs (a, c, e, i)*

Regional roving seminars require a large investment of resources. A lower cost alternative to these seminars would be to develop a presentation with the help of communication professionals summarizing the "Guidelines on integrating severe weather warnings into disaster risk management" (PWS- 13) updated with additional examples of applications of the documented procedures from developing countries. Results from the recently completed PWS Survey on Severe Weather Warning Services could also be incorporated. This presentation and the associated speaker notes could be part of a resource kit which would also include PWS- 9 "Guidelines for Cross-border exchange of Warnings". The resource kit could be posted on PWS website and distributed to NMHSs on CD or DVD.

The resource kit would serve a dual purpose: a) inform decision makers on what their nation's NMHS provides as regards forecasts, warnings and other meteorological information and b) how to integrate weather information into decision-making processes. This kit could serve as a first step in bringing together the NMHSs with stakeholders and decision-makers to begin building new or strengthening existing partnerships. The kit also offers opportunities to promote and highlight the work of the ET/DPM and PWS to Member countries.

The Team agreed on the following work schedule:

- (a) The **Chair** will prepare by **end of September 2006** a short draft proposal for the development of the presentation and resource kit. The proposal will consider the intended audience, language requirements, scope, timeline etc. The draft proposal will be forwarded to the ET/COM and submitted to the **Secretariat** for the identification of suitable resources by **end of 2006**.
- (b) Chief, PWS will liaise with Chair of ET/COM.

Deliverable 2: *Resource kits (booklets, CDs, etc) for the public, esp. for school children, on DPM, preferably, using cartoon figures to help them understand the threats of natural hazards and protective actions to be taken...TOR (b,c)*

The Team recommended that the feasibility of developing such resource kits should be explored jointly with the Expert Group on Public Education and Outreach.

The Team agreed on the following work schedule:

- (a) Chief, PWS will contact Chair of Expert Group and inform Team of the outcome by end of October, 2006.

- (b) Chief, PWS will also investigate how the well-received illustrated WMO publication on Climate Change was developed and use that publication as a model by end of December 2006.

Deliverable 3: *Publish "Guidelines on Integrating Severe Weather Warnings into Disaster Risk Management...TOR (a,c,e)*

The Guideline was published as PWS-13.

Deliverable 4: *PWS survey on severe weather warning services in various countries...TOR (c,g,h,i)*

This survey was developed and conducted jointly with ET/SPI in January 2006. The initial returns of 74 were analysed by ET/DPM which would continue to take lead in the analysis of results. The Team recommended to encourage, through reminders and personal contacts, those Members who had not yet responded, especially, the Developing Countries and those in RA I, to return the survey questionnaires. Upon completion of the final analysis, the findings and recommendations would be posted onto the PWS website for Members' reference and serving as a resource for other deliverables from ET/DPM, ET/SPI and perhaps others. (Refer to the recommendations outlined in the draft report on initial findings and observations on the survey in Annex IV.)

The Team agreed on the following work schedule:

- (a) **Chair** will develop a "standard" reminder highlighting the value of the survey and provide by **20 June 2006** a list of those Members who have not yet responded to Team by 20 June 2006.
- (b) **Chief, PWS** will contact representatives of respective Members attending EC and inform Team of outcome by end of June 2006.
- (c) Team to encourage relevant Members to submit returns through reminders and personal contacts (Target cut-off date for returns will be 31 August 2006.)
- (d) **Chair** will analyse returns and draft final report together with Team for submission to Secretariat by **end of October, 2006**.

Deliverable 5: *Enhanced SWIC Website to include multi-hazard warning pages, multiple language versions and more participation by Members. The ultimate objective is to develop the SWIC into a multi-hazard information and resource centre...TOR (d,g)*

The Team reaffirmed the desirability of the SWIC to include multi-hazard warnings and recommended that linkage be established between the SWIC and European Multiservice Meteorological Awareness (EMMA) after the latter became operational. Initial contacts with the developers of EMMA on the possibility of establishing such a linkage have been positive.

The Team recognized the challenges in implementing multiple language versions and recommended to explore the technical feasibility of automatic translation of the warning messages into different languages as well as study the associated resource implications.

The Team agreed on the following work schedule:

- (a) **Chief, PWS** will contact the General Manager of **EUMETNET** and **Mr Michael Walsh** of Met Eirean, a member of the Working Group on Cooperation of

European Forecasters by **end of July 2006** on the establishment of links with EMMA.

- (b) **Chair** to identify SWIC focal point to liaise with EMMA developers/operators by **end of July 2006**.
- (c) **Chair** to monitor progress and inform Team by.

Deliverable 6: *Workshop on advances in nowcasting and applications in early warnings of meteorological and hydrological hazards, involving system developers, forecasters as well as disaster management experts...TOR (c,h,i)*

A workshop on nowcasting is scheduled for October 2006 and will bring together meteorological experts and representatives of some disaster management agencies.

Deliverable 7: *Survey to assess the vulnerability of developing countries, including LDCs, to natural disasters and their needs, followed by a workshop to identify and address the areas where vulnerabilities can be reduced in the context of national PWS programmes...TOR (c,h,i).*

This survey activity has been folded into deliverable 4. (Refer to **deliverable 4** for information on the survey.) Based on the survey results for developing countries, a workshop organisation plan will be developed accordingly.

Deliverables 8 and 9: *Publication of success stories showing how disaster prevention and preparedness, in particular, effective warning systems, reduce vulnerability and Prepare examples of best practice in early warning systems...TOR (b,c,e)*

The Team will compile examples of best practice and collect relevant cases of stories on successful application of effective warnings systems to disaster risk reduction, in particular, in developing countries. These will be published on the PWS website for reference by WMO Members initially. After a sufficient number of cases have been accumulated, the relevant webpages will be made available to the public.

The Team agreed on the following work schedule:

- (a) **Chief, PWS** to explore whether the WMO Secretariat could contact Members for examples and case studies by **end of August 2006**.
- (b) **Chair** will then prepare by **end of September 2006** a common format for submission of cases/examples and prepare a draft letter for use by Secretariat to send to Members possibly before end of 2006. The letter will need to spell out explicitly that the submitted text may be edited before publication to ensure consistency of format without changing the content.
- (c) The above process may be repeated periodically seeking inputs from Members using the common format, to ensure the accumulation of a reasonably large number of cases.

Deliverable 10: *An international conference on PWS in support of DPM to provide a forum for professionals of various disciplines (meteorologists, media and communications experts, social scientists, engineers, etc.) to discuss early warning systems in support of DPM, effective warning dissemination and disaster communication. The will also serve to facilitate building up of a coherent disaster reduction "community"...TOR (c,f)*

Developing and fostering understanding and partnership with key stakeholders is highly important in disaster risk management. Organizing a PWS conference in support of DPM would ensure a mutual understanding of the roles and responsibilities of each of professional in the end-to-end process. In view of recent conferences of similar nature, the Team agreed to keep this item on the list of its future deliverables and in the meantime explore the possibility of a joint conference with other Programmes/Bodies engaged in similar activities (e.g. a Joint Conference with the Typhoon Committee.)

5. VISIT TO CHINA METEOROLOGICAL ADMINISTRATION (CMA)

5.1 On 14 June 2006, the Team paid a visit to the National Satellite Meteorological Center, National Meteorological Information Center, HUAFENG Group of Meteorological Audio & Video Information, and National Meteorological Center. It was briefed on the achievements of CMA in weather observations, telecommunications, computation abilities, public weather services, natural disaster prevention and mitigations, environmental forecasting, agro-meteorological and ecological meteorological services. The Team was shown the advanced equipment and modern facilities in CMA to support the above activities including a 21 TFLOPS supercomputer, 2 types of operational satellites, more than 100 Doppler radars and a 24-hours weather channel. The Team expressed strong appreciation to CMA for the very informative tour.

6. CLOSING

6.1 The key conclusions arising from the meeting of the ET/DPM are given in the Executive Summary of this report. The Team accomplished its task of addressing the assigned TORs and associated deliverables.

6.2 The Team expressed appreciation to the China Meteorological Administration for the excellent arrangements made and the warm hospitality provided.

6.3 The meeting of the ET/DPM closed at 1300 on Friday 16 June 2006.

List of Annexes to the Final Report of the
Expert Team on Public Weather Services in Support of
Disaster Prevention and Mitigation (ET/DPM)

Beijing, China, 12 – 16 June 2006

- | | |
|-----------|---|
| Annex I | List of Meeting Participants |
| Annex II | Meeting Programme |
| Annex III | Status of Follow-up Actions of Paris meeting (2004) |
| Annex IV | Interim Report on PWS Survey on Severe Weather Warning Services |

**PARTICIPANTS AT THE MEETING OF THE CBS OPAG/PWS
EXPERT TEAM IN SUPPORT OF DISASTER PREVENTION AND MITIGATION (ET/DPM)**

(Beijing, China, 12-16 June 2006)

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**EXPERT TEAM IN SUPPORT OF DISASTER PREVENTION AND MITIGATION (ET/DPM)
(Beijing, China, 12-16 June 2006)**

PROGRAMME

	Monday, 12 June	Tuesday, 13 June	Wednesday, 14 June	Thursday, 15 June	Friday, 16 June
AM 0900	1. Opening 2. Background Information and Objectives (Secretariat) 3. Emerging and new issues impacting on the future direction of the work of ET (ET Chair and Secretariat)	TOR (c): Discussion of key issues led by Jim Davidson/Baogui Bi (inputs from all) TOR (d): Discussion of key issues led by ET Chair (inputs from all)	TOR (g): Discussion of key issues led by Charles Dupuy TOR (h): Discussion of key issues led by Jim Davidson	6. Conclusions, deliverables and follow-up actions	8. Preparation of report of the Expert Team
1200					
	<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>	<i>Lunch</i>
PM 1330	4. ET/DPM work programme TORs (a,b,i): Report by: ET Chair and discussion of key issues	TOR (e): Discussion of key issues led by Chris Alex, Nick Graham TOR (f): Discussion of key issues led by Hwang Yung Fong	5. Discussion of the deliverables of the ET	7. Visit to CMA	9. Adoption of the report 10. Closure
1700					

FOLLOW-UP ON ACTION ITEMS IN FINAL REPORT OF ET/WFEU, 31 MAY – 4 JUNE 2004

No	ET/WFEU Final Report: Action Items	Status /Remark
1.	TOR(a) 4.1.5 Develop further pages on thunderstorms, gales and extreme temperatures. Contact participating Members on relative priority.	Page on thunderstorms launched. Gales page ready for launch.
2.	4.1.6 Collect views from users through a survey sheet to be posted on the site	Form ready for comment.
3.	4.1.6 Establish links between SWIC and EMMA web site.	To establish link when EMMA goes public later this year.
4.	TOR(b) 4.2.6 Development of standardized XML format for submission of weather forecasts ; display of weather observations.	City forecasts available for download in XML since early 2004. "Cloudiness and rain" web page on official observation now operational
5.	4.2.7 Submission of information through Web form in other languages.	Web forms with Spanish, Arabic and French inputs respectively now available.
6.	4.2.5 The ET suggested that the WWIS/SWIC pamphlet be made downloadable.	WWIS/SWIC pamphlet now available for download in web sites.
7.	TOR(c) 4.3.4 Write to the World Tourism Organization to enquire about the availability of a data base of tourism agencies to be contacted as part of promoting the web sites; Contact major airline companies to encourage them to link to WWIS.	Letters sent to WTO. Some Member's pages include links to respective tourism agencies.
8.	4.3.5 Draft promotional material on the WWIS which will be distributed through the Regional Rapporteurs.	Slogans now available for download.

No	ET/WFEU Final Report: Action Items	Status /Remark
9.	4.3.6 Continue to work towards increasing the likelihood that the most prominent web search engines will present links to WWIS and SWIC near the top of their search listings.	Crucial keywords added to WWIS and SWIC front pages to facilitate easy searching.
10.	4.3.7 Develop questionnaire to be posted on WWIS to get feedback from users. ET/WAFU members will comment and review the questions.	Draft questionnaire ready for comment.
11.	4.3.8 Develop a XML schema for the exchange of public weather forecasts over the Internet The WWIS constituency will be involved in developing this general XML schema.	XML schema now available.

INTERIM REPORT ON PWS SURVEY ON SEVERE WEATHER WARNING SERVICES

Introduction

1. The meeting of the Public Weather Service (PWS) Core Implementation Coordination Team (ICT), held in Dublin from 17 to 21 October 2005, decided that, as one of the deliverables, the Expert Team on Disaster Prevention and Mitigation (ET/DPM) would conduct a survey in collaboration with the Expert Team on Service and Product Improvement (ET/SPI) on WMO Members with the following objectives:

- (a) To compile information on severe weather warning systems operated by Members with a view to publishing a handy reference on such system;
- (b) To assess the vulnerability of various Members to weather-related disasters with a view to developing workshops to address the gaps and weaknesses identified, and
- (c) To assess the PWS needs of National Meteorological and Hydrological Services with a focus on identifying opportunities to improve products and services, in particular, on severe weather warning services

Distribution of questionnaires

2. The questionnaire was prepared in four languages namely, English, French, Spanish and Russian. A copy of the English version of the questionnaire is shown in Appendix I.

3. In January 2006, Mr. Gerald Fleming, Chairman of OPAG on PWS successfully distributed a total of 170 questionnaires to WMO Members by email and/or fax. An electronic version of the questionnaire and a web form were also available on the World Weather Information Service (WWIS) website for downloading and submission of return respectively by Members.

Number of returns

4. The number of replies received for this survey is very encouraging. They come from Members of all Regional Associations and with a wide geographical distribution.

5. As of 3 June 2006, a total of 74 returns were received from Members (i.e. 44% of 170 surveys successfully sent out). Figure 1 gives a detailed breakdown of the returns.

6. The most enthusiastic response came from Regional Association (RA) IV and VI where nearly half of all Members who received the survey questionnaires submitted returns.

7. Out of a total of some 90 Developing Countries including Least Developed Countries, only 20 (i.e. 22% of 90) responded.

Survey Results and Findings

8. The top three severe weather hazards identified through the survey (Figure 2) are related to: a). Rain (64%), b). Hot and Dry weather (51%) and c). High Winds, apart from those caused by Tropical Cyclones (40%).

9. Figure 3 shows that a high percentage of those Members who have responded (hereafter called Members) already have alerts/warnings in place for: a). Tropical Cyclone (91%), b). High Winds, apart from those caused by Tropical Cyclones (89%) and c). Cold weather (83%). On the other hand, poor visibility (67%) is the element with least available alerts/warnings in place.

10. Figure 4 indicates that cross-border exchange of severe weather warnings are most well established (in terms of availability) for: a). Tropical Cyclones (58%), b). High Winds, apart from those caused by Tropical Cyclones (42%) and c). Low visibility (40%).

11. The top three severe weather elements where Members indicated plans for introducing warnings (Table 1) are: a). Tropical Cyclone (67%), b). Hot and Dry (52%) and c) Poor Visibility (38%).

12. From Table 1, an average of 40% of the Members who do not operate certain hazardous weather warnings indicated that they have plans to introduce such service.

13. Tropical Cyclone (TC) is the element of highest concern to Members, almost all Members have warnings for the hazard and provide warnings to public as well as disaster managers (Table 1). In RA IV, all Members that did not have TC warnings in place indicated plans to provide such warnings. It would be of interest to note that 25% of returns from RA III indicated TC would be a hazard but there were no warnings or plans to introduce warnings.

14. Table 2 shows that the main challenges/obstacles in the provision of alerts/warnings are “forecast accuracy”, followed by “public understanding of warnings” and “warning communication/dissemination”.

15. The top three weather elements where “forecast accuracy” is considered a challenge/obstacle in the provision of alerts/warnings (Table 2) are: a) Rain (40%), b) Hot and Dry Weather (27%) and c) High winds, apart from those caused by Tropical Cyclones (21%). For Developing Countries, including LDCs, they are a) Rain (38%), b). Hot and Dry Weather (33%) and c) Tropical Cyclone (30%).

16. From suggestions on areas of improvement or support for development of PWS, a number of Developing Countries (Appendix II) are calling for assistance in capacity building, hardware and software, improving forecast accuracy and public education. On the other hand, the top suggestion from Developed Countries (Appendix III) is for improvements in forecast and warning products, in particular, applications of nowcasting.

17. Although the survey result shows that less than 15% of the returns indicated “Constraints in coordinating with disaster management agencies being a challenge/obstacle”, it is recommended that this be interpreted with caution. This could merely reflect the mindset of some responders that coordination with disaster managers would be outside the ambit of the NMHS. The Team expressed the view that it is important to change such mindset and encourage enhanced communication with stakeholders.

Recommendations

18. Based on the above, the Expert Team (ET/DPM) proposed the following recommendations:

- (a) The survey provided useful insights as well as “quantitative” information on severe weather hazards and warnings. A reminder should be sent to those Members who have not yet responded. The Team will contact Members, especially developing countries who have not yet responded to encourage them to do so. If successful, the status and needs of developing countries will be better represented.

- (b) Using the contact information provided on each completed survey, it is proposed that an inventory of warning systems operated by Members be developed.
- (c) Based on the survey results identifying rain as the hazard of most concern and some 40% of the responses cited “forecasting accuracy” as the primary challenge, the Team recommended enhancing the predictability of rain (as defined in this survey) as the most effective area to focus on to reduce the vulnerability of Members’ countries.
- (d) To improve on the warning of short-term severe weather phenomena, especially rainstorms, nowcasting as a decision-support tool, is called for. Workshops and capacity building on nowcasting should be considered; and.
- (e) The success of a warning is to change people’s behaviour, and education is the key issue. Workshops and capacity building on reaching out to decision-makers as well as the public to help them understand the meaning of warnings and enhance their ability to translate these into action should be considered.

Table 1: Statistics on Hazards Perceived and Warnings Provided by Members
(in percentage of all returns received)

		RA I	RA II	RA III	RA IV	RA V	RA VI	Global	Developing Countries
Hot and Dry Weather	hazard with warning	62	77	100	78	86	83	80	76
	warning to public	92	100	91	81	67	89	88	93
	warning with disaster management	85	88	91	86	83	83	85	86
	Warning with Exchange	31	41	0	33	17	19	24	38
	Warning with Advisory	69	59	46	71	33	33	48	72
	hazard without warning	38	23	0	22	14	18	21	24
	hazard without warning but plan to	50	40	-	67	0	55	52	44
Cold Weather	hazard with warning	47	76	74	79	90	89	83	68
	warning to public	100	100	100	100	89	91	94	100
	warning with DM	100	72	100	95	100	87	88	100
	Warning with Exchange	0	41	6	68	0	40	37	52
	Warning with Advisory	75	38	41	68	67	30	37	48
	hazard without warning	53	24	26	21	10	11	18	32
	hazard without warning but plan to	22	10	17	20	0	50	29	10
Rain	hazard with warning	59	64	62	73	78	79	72	68
	warning to public	96	97	100	91	93	83	89	91
	warning with DM	96	97	100	87	86	92	92	88
	Warning with Exchange	13	43	25	25	38	44	36	21
	Warning with Advisory	65	60	38	85	69	28	51	66
	hazard without warning	41	36	39	27	22	21	28	32
	hazard without warning but plan to	94	5	0	55	13	13	31	53
Tropical Cyclones	hazard with warning	100	87	75	92	100	89	91	96
	warning to public	100	100	100	100	100	88	98	100
	warning with DM	100	100	100	100	100	100	100	100
	Warning with Exchange	40	54	33	65	67	50	58	57
	Warning with Advisory	60	92	33	91	100	38	81	87
	hazard without warning	0	13	25	8	0	11	9	4
	hazard without warning but plan to	-	50	0	100	-	100	67	100
High Winds	hazard with warning	89	87	100	78	93	92	89	84
	warning to public	88	85	100	100	100	93	94	95
	warning with DM	75	62	100	100	85	93	89	86
	Warning with Exchange	13	23	38	50	54	47	42	43
	Warning with Advisory	38	69	25	67	62	27	44	57
	hazard without warning	11	13	0	22	7	8	11	16
	hazard without warning but plan to	100	0	-	40	0	0	23	25
Low Visibility and Other Hazards	hazard with warning	67	56	78	63	67	73	67	46
	warning to public	92	100	100	100	100	84	92	92
	warning with DM	67	79	100	100	67	87	84	85
	Warning with Exchange	67	14	0	80	50	35	40	62
	Warning with Advisory	42	57	43	100	33	35	48	69
	hazard without warning	33	44	22	38	33	28	33	54
	hazard without warning but plan to	67	0	0	67	0	57	38	33

Table 2: Summary of challenges/obstacles in the provision of alerts/warnings

Challenge type*	RA I	RA II	RA III	RA IV	RA V	RA VI	Global	Global	Developing Countries		
	No. of returns indicating "yes"							% #	No. of yes	%#	
Hot and Dry Weather	1	14	8	9	18	2	28	79	27	25	33
	2	15	4	4	10	2	19	54	18	21	28
	3	10	6	5	5	4	13	43	15	16	21
	4	7	4	1	6	1	11	30	10	12	16
	5	12	6	6	11	6	20	61	21	21	28
Cold Weather	1	11	7	14	15	3	85	135	18	13	7
	2	11	3	12	10	0	59	95	13	14	7
	3	9	11	12	5	2	57	96	13	18	10
	4	5	10	0	1	0	16	32	4	15	8
	5	10	11	13	5	0	34	73	10	21	11
Rain	1	29	22	20	53	27	87	238	40	58	38
	2	27	9	12	25	6	36	115	19	45	30
	3	20	9	11	14	25	51	130	22	40	26
	4	22	11	3	7	13	22	78	13	33	22
	5	24	19	13	29	23	32	140	24	48	32
Tropical Cyclones	1	4	3	3	19	9	1	39	18	17	30
	2	4	1	0	7	0	1	13	6	7	12
	3	2	1	0	5	8	1	17	8	11	19
	4	3	1	1	4	1	1	11	5	5	9
	5	4	4	1	14	4	1	28	13	14	25
High Winds	1	8	3	8	12	8	22	61	21	14	18
	2	9	2	3	10	0	12	36	12	15	20
	3	4	1	4	5	7	12	33	11	8	11
	4	6	2	1	0	0	8	17	6	7	9
	5	6	4	4	8	6	13	41	14	10	13
Low Visibility and Other Hazards	1	13	8	9	10	7	16	63	17	14	15
	2	15	9	5	3	1	6	39	11	16	17
	3	12	2	5	5	4	10	38	10	13	14
	4	12	3	0	1	1	3	20	5	13	14
	5	11	5	7	5	5	3	36	10	13	14

* Notation:

1. Forecast accuracy
2. Design of warning products
3. Warning communication and dissemination
4. Constraints in coordinating with disaster management agencies
5. Public understanding of warnings

: As percentage of all returns

Figure 1. Statistics on survey returns from Regional Association Members (as on 3 June 2006)

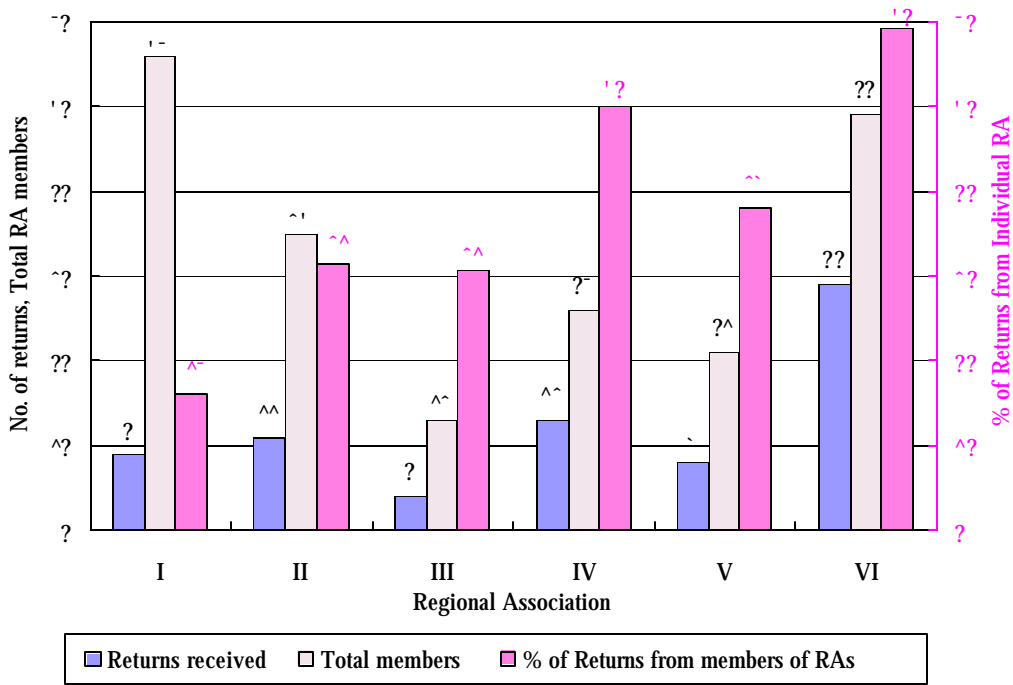
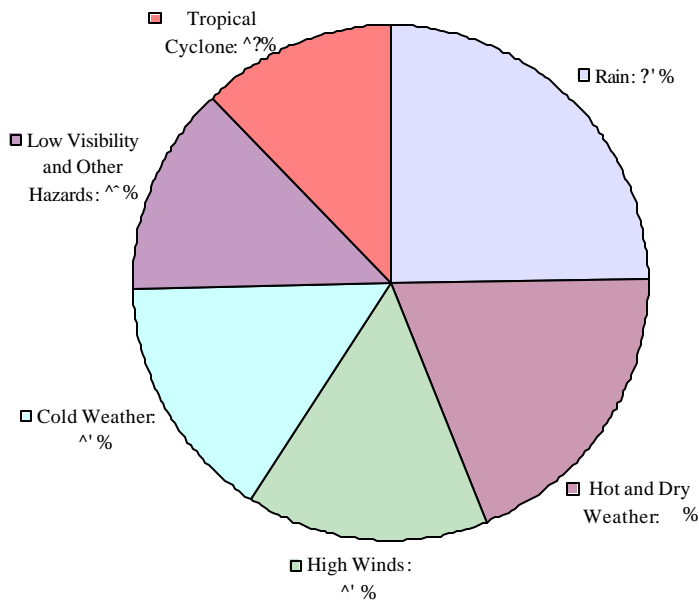
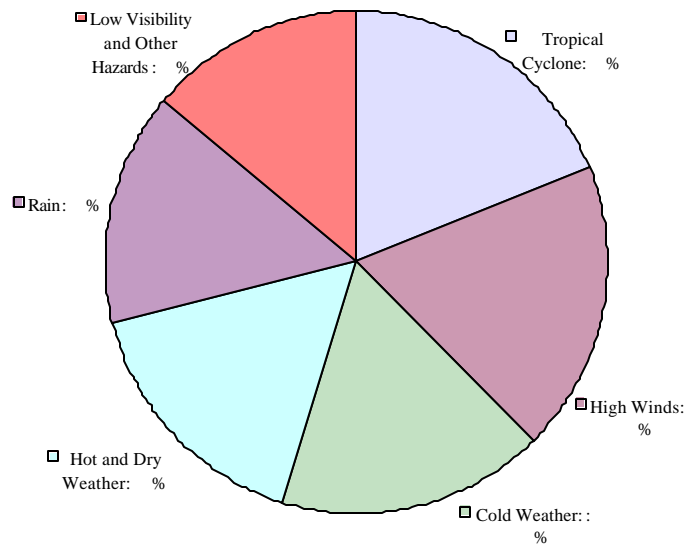


Figure 2. Percentage of returns indicating weather elements as hazards



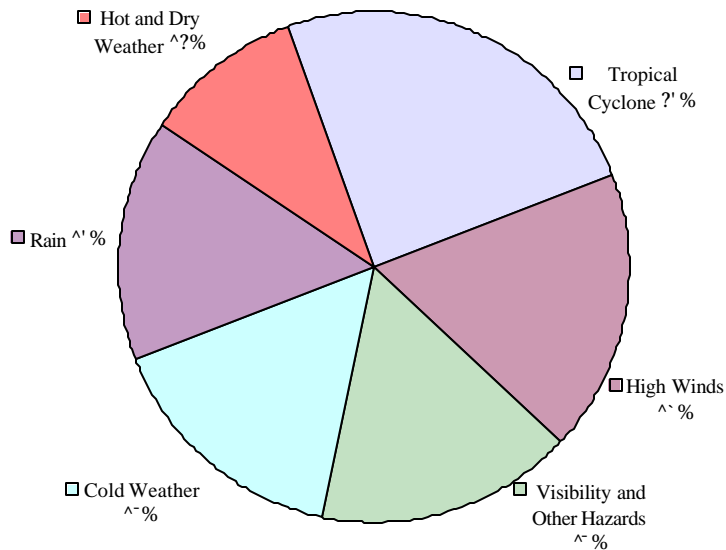
Hazard Weather Type	As percentage of all returns	As percentage of all hazard weather types
Rain	64	25
Hot and Dry Weather	51	20
High Winds	40	15
Cold Weather	39	15
Low Visibility and Other Hazards	35	13
Tropical Cyclones	32	12

Figure 3. Percentage of alerts / warnings available for weather hazards



Hazard Weather Type	As percentage of all returns	As percentage of all hazard weather types
Tropical Cyclones	91	19
High Winds	89	19
Cold Weather	83	17
Hot and Dry Weather	79	16
Rain	72	15
Low Visibility and Other Hazards	67	14

Figure 4: Percentage of alerts / warnings available for cross-border exchange



Hazard Weather Type	As percentage of all returns	As percentage of all hazard weather types
Tropical Cyclones	58	25
High Winds	42	18
Low Visibility and Other Hazards	40	16
Cold Weather	37	16
Rain	36	15
Hot and Dry Weather	24	10

WORLD METEOROLOGICAL ORGANIZATION
CBS OPAG SURVEY ON PUBLIC WEATHER SERVICES (PWS)

Please return questionnaire to : Mr. Gerald Fleming (OPAG Chair)

(e-mail : gfleming@eircom.net; Fax : (353 1) 283 9684 ; Mail: 30 Parkview Wexford, Ireland)

In replying, Members are welcome to make use of the questionnaire form online at <http://www.worldweather.org/pws/nhw-questionnaire.html> with the following User Name : OPAGPWS and Password : wsc7q5eh

The objectives of this survey are :

- (a) To compile information on the severe weather warning systems operated by Members with a view to publishing a handy reference on such systems,
- (b) To assess the vulnerability of various Members to weather-related disasters with a view to developing workshops to address the gaps and weaknesses identified, and
- (c) To assess the PWS needs of National Meteorological and Hydrological Services with a focus on identifying opportunities to improve products and services, in particular, on severe weather warning services.

This questionnaire is mainly concerned with:

- (a) Your scope of severe weather warning services,
- (b) Identification of opportunities/needs in your PWS in the provision of severe weather warnings and other services/products , and
- (c) Support and resources required for development and improvement of your PWS in relation to the operation of severe weather warnings.

Part I Member's Information

Member:

Region: Regional Association *

Website URL: (if available):

Part II Please complete the following tables:

(a) Severe Weather Warning Services associated with Hot and Dry Weather

Please select 'Y' for 'yes', 'N' for 'no' and blank for 'not applicable'													
Weather Element	Is this element a hazard in your country/territory?	Is alert/warning on this element available in your country/territory?	If you provide alerts/warnings on this element, are they available <u>in real time</u>			If you provide alerts/warnings, do you issue advisory/guidance on response action?	If you do not currently provide alerts/warnings on this element, do you plan to introduce one in your PWS?	What are the challenges or obstacles in the provision of alerts/warnings on this element? (Please see Footnote # and select using a "√" for as many items as appropriate. Leave blank if not applicable.)					
			to public or media	to partners/disaster management agencies	for cross border/boundary exchange			1	2	3	4	5	Others (Please specify)
(i) Extreme High Temperature	—	—	—	—	—	—	—	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(ii) Drought	—	—	—	—	—	—	—	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(iii) Fire Danger (Wildfire)	—	—	—	—	—	—	—	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Others (please specify)	—	—	—	—	—	—	—	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

(* Select as appropriate)

Footnote (for answers to last column): 1 = Forecast accuracy; 2 = Design of warning products; 3=Warning communication and dissemination; 4=Constraints in coordinating with disaster management agencies; 5 =Public understanding of warnings

(b) Severe Weather Warning Services associated with Cold Weather

Please select 'Y' for 'yes', 'N' for 'no' and blank for 'not applicable'													
Weather Element	Is this element a hazard in your country/territory?	Is alert/warning on this element available in your country/territory?	If you provide alerts/warnings on this element, are they available <u>in real time</u>			If you provide alerts/warnings, do you issue advisory/guidance on response action?	If you do not currently provide alerts/warnings on this element, do you plan to introduce one in your PWS?	What are the challenges or obstacles in the provision of alerts/warnings on this element? (Please select using a "✓" for as many items as appropriate. Leave blank if not applicable.)					
			to public or media	to partners/disaster management agencies	for cross border/boundary exchange			1	2	3	4	5	Others (Please specify)
(i) Blizzard or Drifting Snow	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(ii) Heavy Snow	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(iii) Rapid snow melt	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(iv) Freezing rain	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(v) Frost	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(vi) icy Road	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(vii) Avalanche	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(viii) Extreme wind chill	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(ix) Extreme Low Temperature	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Others (please specify)	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Footnote (for answers to last column): 1 = Forecast accuracy; 2 = Design of warning products; 3 = Warning communication and dissemination; 4 = Constraints in coordinating with disaster management agencies; 5 = Public understanding of warnings

(c) Severe Weather Warning Services associated with Rain

Weather Element (* Select as appropriate)	Please select 'Y' for 'yes', 'N' for 'no' and blank for 'not applicable'						What are the challenges or obstacles in the provision of alerts/warnings on this element? (Please select using a "✓" for as many items as appropriate. Leave blank if not applicable.)						
	Is this element a hazard in your country/territory?	Is alert/warning on this element available in your country/territory?	If you provide alerts/warnings on this element, are they available <u>in real time</u>			If you provide alerts/warnings, do you issue advisory/guidance on response action?	If you do not currently provide alerts/warnings on this element, do you plan to introduce one in your PWS?	1	2	3	4	5	Others (Please specify)
			to public or media	to partners/disaster management agencies	for cross border/boundary exchange								
(i) Heavy Rain *with <input type="checkbox"/> flood <input type="checkbox"/> landslide <input type="checkbox"/> mudflow <input type="checkbox"/> thunderstorms <input type="checkbox"/> tornado	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
(ii) Flood	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
(iii) Landslide or mudflow	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
(iv) Thunderstorms *with <input type="checkbox"/> gale <input type="checkbox"/> hail <input type="checkbox"/> lightning <input type="checkbox"/> flood <input type="checkbox"/> tornado	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
(v) Hail	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
(vi) Lightning	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
(vii) Tornado	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Others (please specify)	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

Footnote (for answers to last column): 1 = Forecast accuracy; 2 = Design of warning products; 3 = Warning communication and dissemination; 4 = Constraints in coordinating with disaster management agencies; 5 = Public understanding of warnings

(d) Severe Weather Warning Services associated with Tropical Cyclones

Please select 'Y' for 'yes', 'N' for 'no' and blank for 'not applicable'														
Weather Element	Is this element a hazard in your country/territory?	Is alert/warning on this element available in your country/territory?	If you provide alerts/warnings on this element, are they available <u>in real time</u>			If you provide alerts/warnings, do you issue advisory/guidance on response action?	If you do not currently provide alerts/warnings on this element, do you plan to introduce one in your PWS?	What are the challenges or obstacles in the provision of alerts/warnings on this element? (Please select using a "✓" for as many items as appropriate. Leave blank if not applicable.)						
			to public or media	to partners/disaster management agencies	for cross border/boundary exchange			1	2	3	4	5	Others (Please specify)	
(i) Tropical Cyclone *with <input type="checkbox"/> high winds <input type="checkbox"/> heavy rain <input type="checkbox"/> flood <input type="checkbox"/> landslide <input type="checkbox"/> mudflow <input type="checkbox"/> thunderstorms <input type="checkbox"/> tornado <input type="checkbox"/> storm surge	—	—	—	—	—	—	—	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
(ii) Storm Surge	—	—	—	—	—	—	—	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Others (please specify)	—	—	—	—	—	—	—	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

(* Select as appropriate)

Footnote (for answers to last column): 1 = Forecast accuracy; 2 = Design of warning products; 3 = Warning communication and dissemination; 4 = Constraints in coordinating with disaster management agencies; 5 = Public understanding of warnings

(e) Severe Weather Warning Services associated with High Winds other than Tropical Cyclone, Rainstorm or Snowstorm

Please select 'Y' for 'yes', 'N' for 'no' and blank for 'not applicable'															
Weather Element	Is this element a hazard in your country/territory?	Is alert/warning on this element available in your country/territory?	If you provide alerts/warnings on this element, are they available <u>in real time</u>			If you provide alerts/warnings, do you issue advisory/guidance on response action?	If you do not currently provide alerts/warnings on this element, do you plan to introduce one in your PWS?	What are the challenges or obstacles in the provision of alerts/warnings on this element? (Please select using a "✓" for as many items as appropriate. Leave blank if not applicable.)							
			to public or media	to partners/ disaster management agencies	for cross border/ boundary exchange			1	2	3	4	5	Others (Please specify)		
(i) Monsoon Winds	___	___	___	___	___	___	___	___	___	___	___	___	___	___	
(ii) Winds in Coastal Waters	___	___	___	___	___	___	___	___	___	___	___	___	___	___	
(iii) High Winds	___	___	___	___	___	___	___	___	___	___	___	___	___	___	
Others (please specify)	___	___	___	___	___	___	___	___	___	___	___	___	___	___	

Footnote (for answers to last column): 1 = Forecast accuracy; 2 = Design of warning products; 3=Warning communication and dissemination; 4=Constraints in coordinating with disaster management agencies; 5 =Public understanding of warnings

(f) Severe Weather Warning Services associated with Low Visibility and Other Hazards

Please select 'Y' for 'yes', 'N' for 'no' and blank for 'not applicable'													
Weather Element	Is this element a hazard in your country/territory?	Is alert/warning on this element available in your country/territory?	If you provide alerts/warnings on this element, are they available <u>in real time</u>			If you provide alerts/warnings, do you issue advisory/guidance on response action?	If you do not currently provide alerts/warnings on this element, do you plan to introduce one in your PWS?	What are the challenges or obstacles in the provision of alerts/warnings on this element? (Please see Footnote # and select using a "✓" for as many items as appropriate. Leave blank if not applicable.)					
			to public or media	to partners/disaster management agencies	for cross border/boundary exchange			1	2	3	4	5	Others (Please specify)
(i) Dense Fog	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(ii) Smog	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(iii) Haze	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
(iv) Duststorm or Sandstorm	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Others (please specify)	___	___	___	___	___	___	___	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Footnote (for answers to last column): 1 = Forecast accuracy; 2 = Design of warning products; 3=Warning communication and dissemination; 4=Constraints in coordinating with disaster management agencies; 5 =Public understanding of warnings

(g) Areas of improvement or support you would like to obtain for development of your PWS in relation to warning services as well as other new products and services (please specify)

Part III Please provide a contact for further information or update details of your PWS Focal Point:

Last name: * [Dr.](#)

First name:

Telephone: **Fax:**

E-mail:

(* Select as appropriate)

[Reset](#) [Submit](#) [Print](#)

~ Thank you ~

Requests from LDCs and LLDCs and SIDSs

(In descending priority as indicated by the number of returns making such requests)

1. Capacity Building (Forecast accuracy, products, preparation and presentation of media material.)
2. Hardware and software
3. Communication with public
4. Training and research
5. Public education
6. Enhancing warning services
7. Linking with institutes and agencies
8. Storm Surge Models

Remarks from Developed Countries

(In descending priority as indicated by the number of returns making the remark)

1. Improve forecast and warning products and dissemination, in particular, application of nowcasting
2. Join up approach with other agencies and countries
3. Provide more accurate forecasts and warnings
4. Publish outreach materials
5. Upgrade existing hardware and software
6. Presentation of weather info to public and media
7. Training
8. Prepare event-specific forecast products,
9. Develop real-time data capability
10. Fight threats for commercial competitors
11. Publish outreach materials
12. Fight threats from commercial competitors
13. Prepare event-specific warning products
14. Nowcasting; Use of advanced radar (including Doppler capability) to provide better nowcasts
15. Establish National Radar Network, Update of the National Lightning Network, Nowcast, Modelling, Satellite Monitoring
16. Use of more graphical forecasts
17. Develop alerts for heat stress
18. Longer-range severe weather forecasts – at least of possibilities
19. Introduction of measures of uncertainty
20. Design of warning products
21. Make available warning system on web
22. Development of standard operational procedure
23. Cross border exchange
24. Develop real-time data capability