FINAL 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 webform 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 31 October 2006, a total of 76 returns were received from Members (i.e. 45% 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 more than half of all Members who received the survey questionnaires submitted returns.

7. A total of 20 Developing Countries including Least Developed Countries (LDCs) (i.e. 22%) responded.

Survey Results and Findings

8. The top four severe weather hazards identified through the survey (Figure 2) are related to: a) Rain (64%), b. Hot and Dry weather (51%), c) High Winds (40%) and d) Cold Weather (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 (92%), b) High Winds, apart from those caused by Tropical Cyclones (89%) and c) Cold weather (83%). On the other hand, poor visibility (68%) 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 (56%), b) High Winds, apart from those caused by Tropical Cyclones (40%) and c) Poor visibility (39%).

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 (53%) and c) Poor Visibility (40%).

12. From Table 1, an average of 41% 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 and RA VI, 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 nor 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 “design of warning products”.

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 (41%), 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 (33%), b) Hot and Dry Weather (28%) and c) Tropical Cyclone (25%).

16. From suggestions on areas of improvement or support for development of PWS, a number of Developing Countries including LDCs (Appendix II) are calling for assistance in training and capacity building, hardware and software as well as communication with the public. On the other hand, the top suggestions from other Members (Appendix III) include improvements in forecast and warning products, in particular, applications of nowcasting making use of real-time observation data and enhanced cross-border exchange of warnings.

17. Although the survey result shows that less than 10% 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 Expert Team (ET/DPM) 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. It is proposed that the findings of the survey be communicated to Members for reference.

(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/territories.

(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	80	100	78	86	82	79	71
	warning to public	92	100	91	81	67	89	89	100
	warning with disaster management	85	90	91	86	83	83	85	92
	Warning with Exchange	31	35	0	33	17	21	24	38
	Warning with Advisory	69	65	45	71	33	34	50	67
	hazard without warning	38	20	0	22	14	18	21	29
	Hazard without warning but plan to	50	40	-	67	0	58	53	40
Cold Weather	**hazard with warning**	47	76	74	79	90	89	83	66
	warning to public	100	100	100	100	89	90	93	100
	warning with DM	100	77	100	95	100	88	88	100
	Warning with Exchange	0	33	6	68	0	41	37	58
	Warning with Advisory	75	44	41	68	67	31	39	37
	hazard without warning	53	24	26	21	10	11	17	34
	Hazard without warning but plan to	22	25	17	20	0	50	32	0
Rain	**hazard with warning**	59	66	62	73	78	80	73	72
	warning to public	96	95	100	91	93	84	89	96
	warning with DM	96	98	100	87	86	92	92	94
	Warning with Exchange	13	37	25	25	38	46	36	22
	Warning with Advisory	65	66	38	85	69	30	53	63
	hazard without warning	41	34	38	27	22	20	27	28
	Hazard without warning but plan to	94	10	0	55	13	13	31	50
Tropical Cyclones	**hazard with warning**	100	88	75	92	100	89	92	100
	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	47	33	65	67	50	56	55
	Warning with Advisory	60	93	33	91	100	38	82	86
	hazard without warning	0	12	25	8	0	11	8	0
	Hazard without warning but plan to	-	50	0	100	-	100	67	-
High Winds	**hazard with warning**	89	89	100	78	93	92	89	95
	warning to public	88	88	100	100	100	93	94	95
	warning with DM	75	69	100	100	85	93	89	86
	Warning with Exchange	13	19	38	50	54	47	41	33
	Warning with Advisory	38	75	25	67	62	27	45	62
	hazard without warning	11	11	0	22	7	8	11	5
	Hazard without warning but plan to	100	0	-	40	0	0	23	0
Low Visibility and Other Hazards	**hazard with warning**	67	59	78	63	67	74	68	56
	warning to public	92	100	100	100	100	85	92	93
	warning with DM	67	82	100	100	67	87	85	86
	Warning with Exchange	67	12	0	80	50	38	40	64
	Warning with Advisory	42	65	43	100	33	38	51	71
	hazard without warning	33	41	22	38	33	26	32	44
	Hazard without warning but plan to	67	8	0	67	0	57	40	27

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

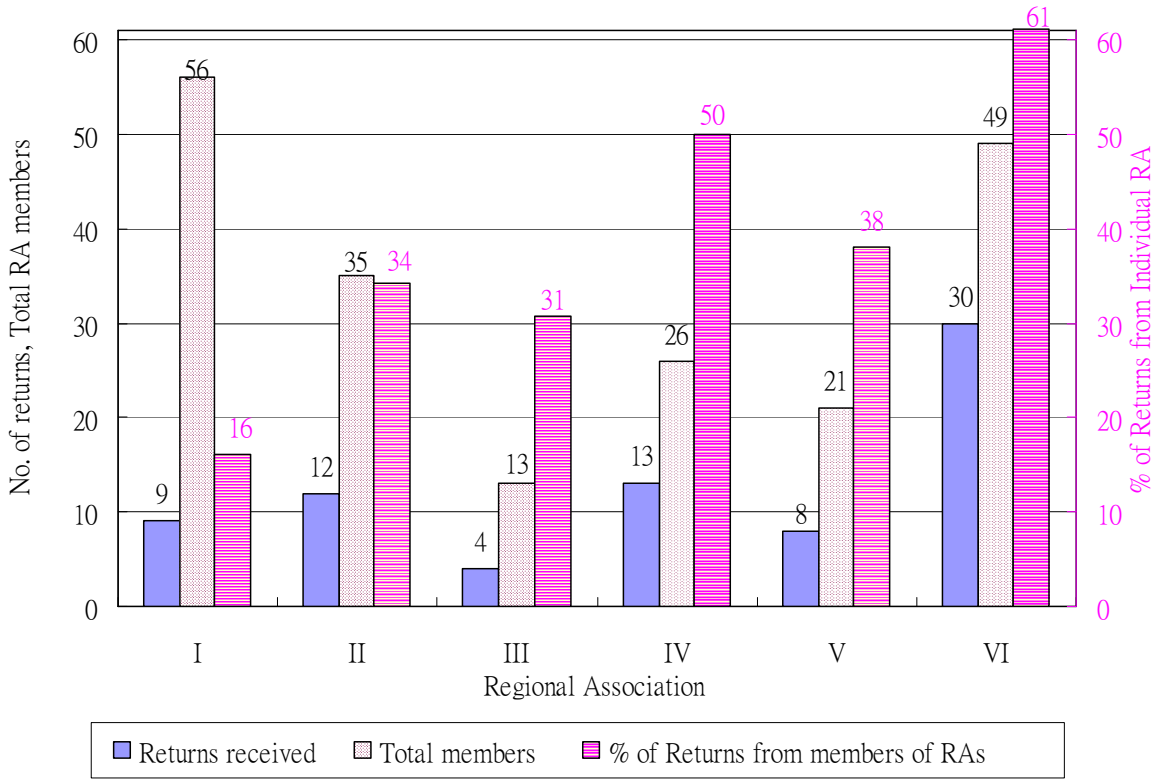
	Challenge type*	RA I	RA II	RA III	RA IV	RA V	RA VI	Global	Global	Developing Countries	
		No. of returns indicating "yes"							% #	No. of yes	%#
Hot and Dry Weather	1	14	10	9	18	2	28	81	27	22	28
	2	15	4	4	10	2	20	55	18	19	24
	3	10	6	5	5	4	13	43	14	15	19
	4	7	5	1	6	1	11	31	10	12	15
	5	12	6	6	11	6	21	62	20	20	25
Cold Weather	1	11	16	14	15	3	88	147	19	10	5
	2	11	6	12	10	0	65	104	14	11	6
	3	9	11	12	5	2	57	96	13	17	9
	4	5	11	0	1	0	16	33	4	15	8
	5	10	11	13	5	0	38	77	10	18	9
Rain	1	29	29	20	53	27	91	249	41	52	33
	2	27	10	12	25	6	39	119	20	39	24
	3	20	9	11	14	25	55	134	22	38	24
	4	22	12	3	7	13	25	82	14	33	21
	5	24	23	13	29	23	36	148	24	47	29
Tropical Cyclones	1	4	5	3	19	9	1	41	18	15	25
	2	4	2	0	7	0	1	14	6	7	12
	3	2	2	0	5	8	1	18	8	11	18
	4	3	2	1	4	1	1	12	5	5	8
	5	4	5	1	14	4	1	29	13	14	23
High Winds	1	8	6	8	12	8	22	64	21	14	18
	2	9	2	3	10	0	12	36	12	13	16
	3	4	2	4	5	7	12	34	11	8	10
	4	6	4	1	0	0	8	19	6	7	9
	5	6	4	4	8	6	13	41	14	10	13
Low Visibility and Other Hazards	1	13	12	9	10	7	17	68	18	13	13
	2	15	12	5	3	1	8	44	12	14	14
	3	12	3	5	5	4	10	39	10	12	12
	4	12	4	0	1	1	3	21	6	13	13
	5	11	7	7	5	5	4	39	10	12	12

* 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

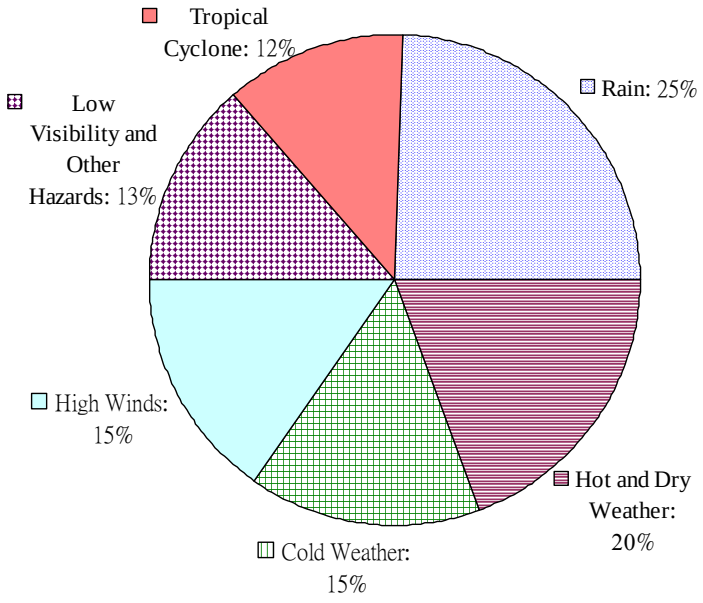
: As percentage of all returns

Figure 1. Statistics on survey returns from Regional Association Members (as on 20 September 2006)



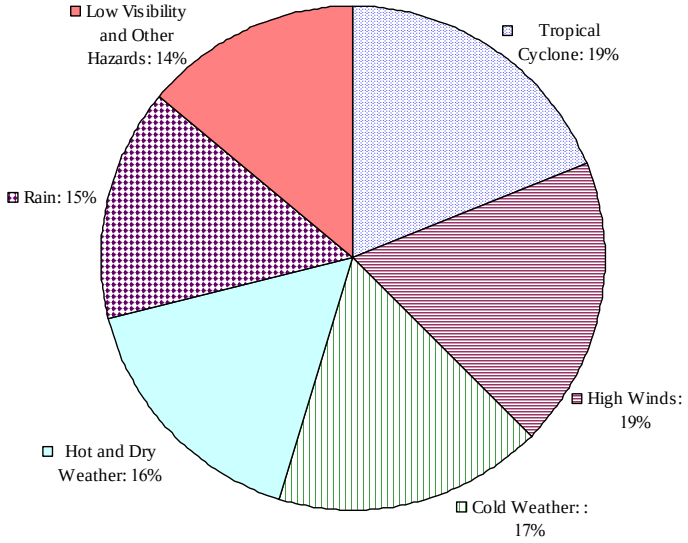
Note: Some countries are counted in more than one RA.

Figure 2. Percentage of returns indicating weather elements as hazards



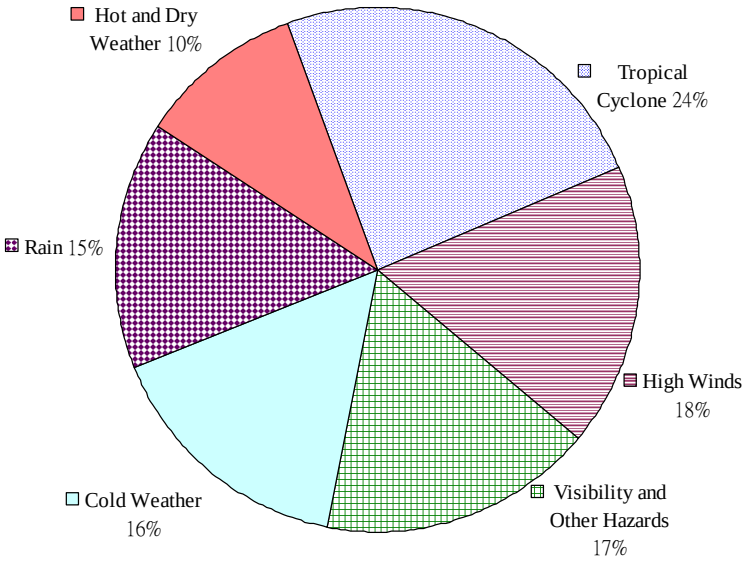
Hazard Weather Type	As percentage of all returns	As percentage of all hazard weather types
Rain	64	25
Hot and Dry Weather	51	20
Cold Weather	40	15
High Winds	40	15
Low Visibility and Other Hazards	35	13
Tropical Cyclones	32	12

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	92	19
High Winds	89	19
Cold Weather	83	17
Hot and Dry Weather	79	16
Rain	73	15
Low Visibility and Other Hazards	68	14

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



Hazard Weather Type	As percentage of all returns	As percentage of all hazard weather types
Tropical Cyclones	56	24
High Winds	40	18
Low Visibility and Other Hazards	39	17
Cold Weather	37	16
Rain	35	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 in real time.**			**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	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(ii) Drought	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(iii) Fire Danger (Wildfire)	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
Others (please specify)	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	

(* 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 in real time**			**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	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(ii) Heavy Snow	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(iii) Rapid snow melt	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(iv)Freezing rain	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(v) Frost	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(vi) icy Road	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(vii) Avalanche	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(viii) Extreme wind chill	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(ix) Extreme Low Temperature	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
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

(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 in real time: to public or media	to partners/ disaster management agencies	for cross border/ boundary exchange	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)
(i) Heavy Rain *with ☐ flood ☐ landslide ☐ mudflow ☐ thunderstorms ☐ tornado	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(ii) Flood	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(iii) Landslide or mudflow	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(iv) Thunderstorms *with ☐ gale ☐ hail ☐ lightning ☐ flood ☐ tornado	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(v) Hail	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(vi) Lightning	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(vii) Tornado	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
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

(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 in real time**			**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 ☐ high winds ☐ heavy rain ☐ flood ☐ landslide ☐ mudflow ☐ thunderstorms ☐ tornado ☐ storm surge	___	___	___	___	___	___	___	☐	☐	☐	☐	☐		
(ii) Storm Surge	___	___	___	___	___	___	___	☐	☐	☐	☐	☐		
Others (please specify)	___	___	___	___	___	___	___	☐	☐	☐	☐	☐		

(* 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 in real time.**			**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	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(ii) Smog	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(iii) Haze	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
(iv) Duststorm or Sandstorm	____	____	____	____	____	____	____	☐	☐	☐	☐	☐	
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

(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 ~

Appendix II

Areas for improvement suggested by Members of Developing Countries

A number of Members of Developing Countries, including LDCs, called for assistance in training and capacity building as well as the upgrading of their hardware and software for weather forecasting. There is also the need to improve communication with the public by enhancing the outreach programmes and presentation materials for the media. Cooperation with institutes and agencies on training and research to improve short-range weather forecasts and quantity precipitation prediction are highly desirable. These suggestions are summarized in Figure II-1.

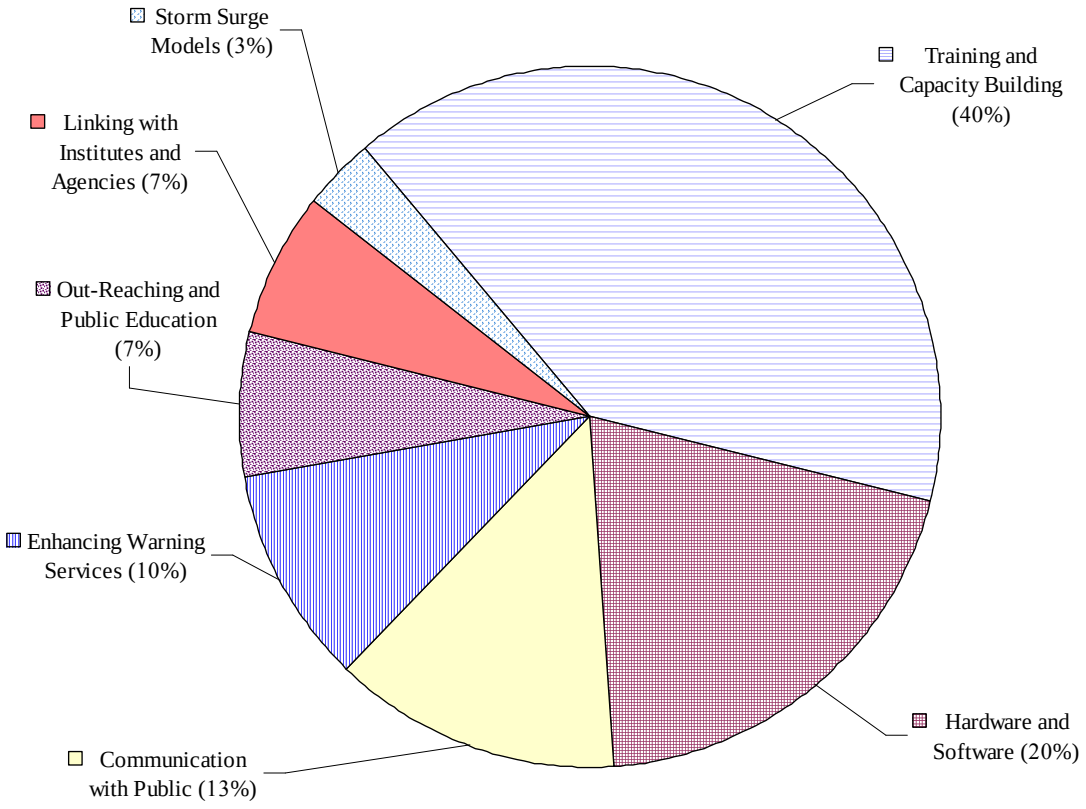


Figure II-1 Areas of improvement or support required for developing countries

Appendix III

Areas requiring enhancement and new development for other Members

The top suggestions for enhancement/development from Members other than those from developing countries include improvements in forecast and warning capacities, in particular, applications of nowcasting encompassing use of real-time radar, satellite as well as lightning data and enhanced cross-border exchange of warnings. Other desirable aspirations include upgrading existing hardware and software, publishing outreach materials, research, fighting threats for commercial competitors and preparation of event-specific forecast and warning products with a longer range. These suggestions are summarized in Figure III-1.

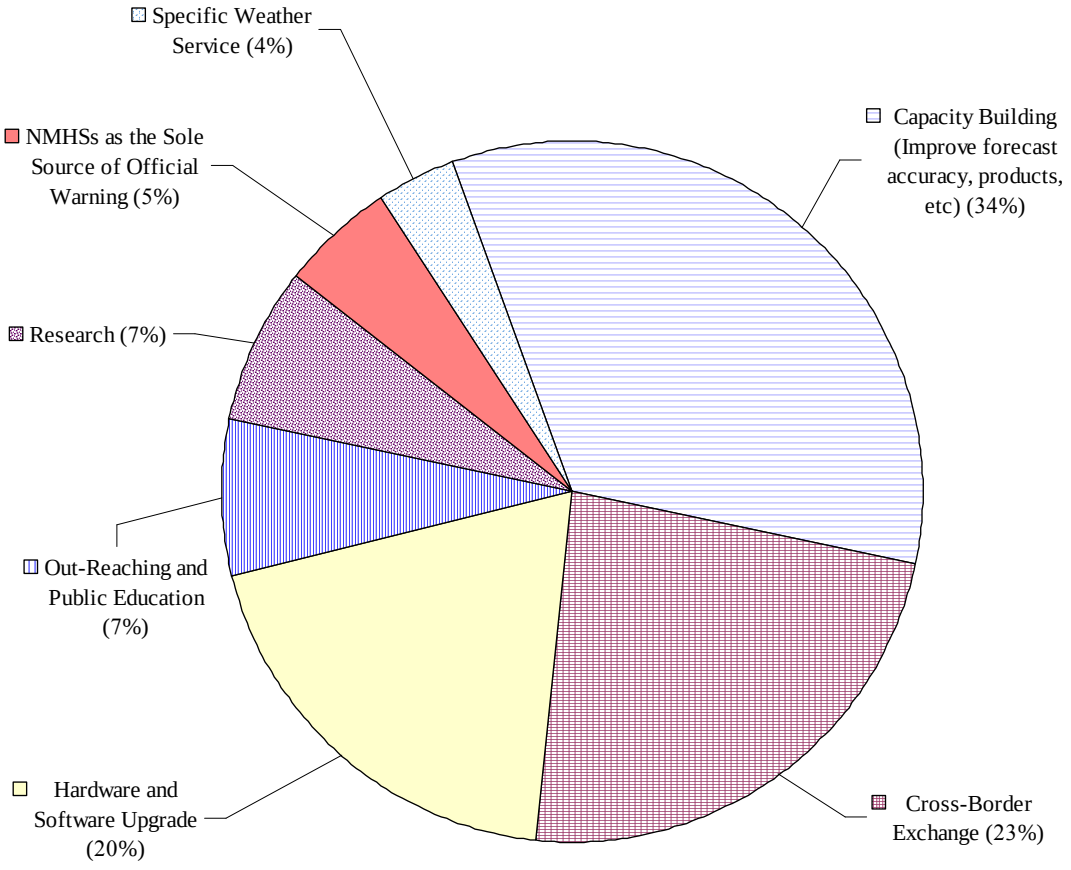


Figure III-1 Areas for enhancements or new developments for other Members