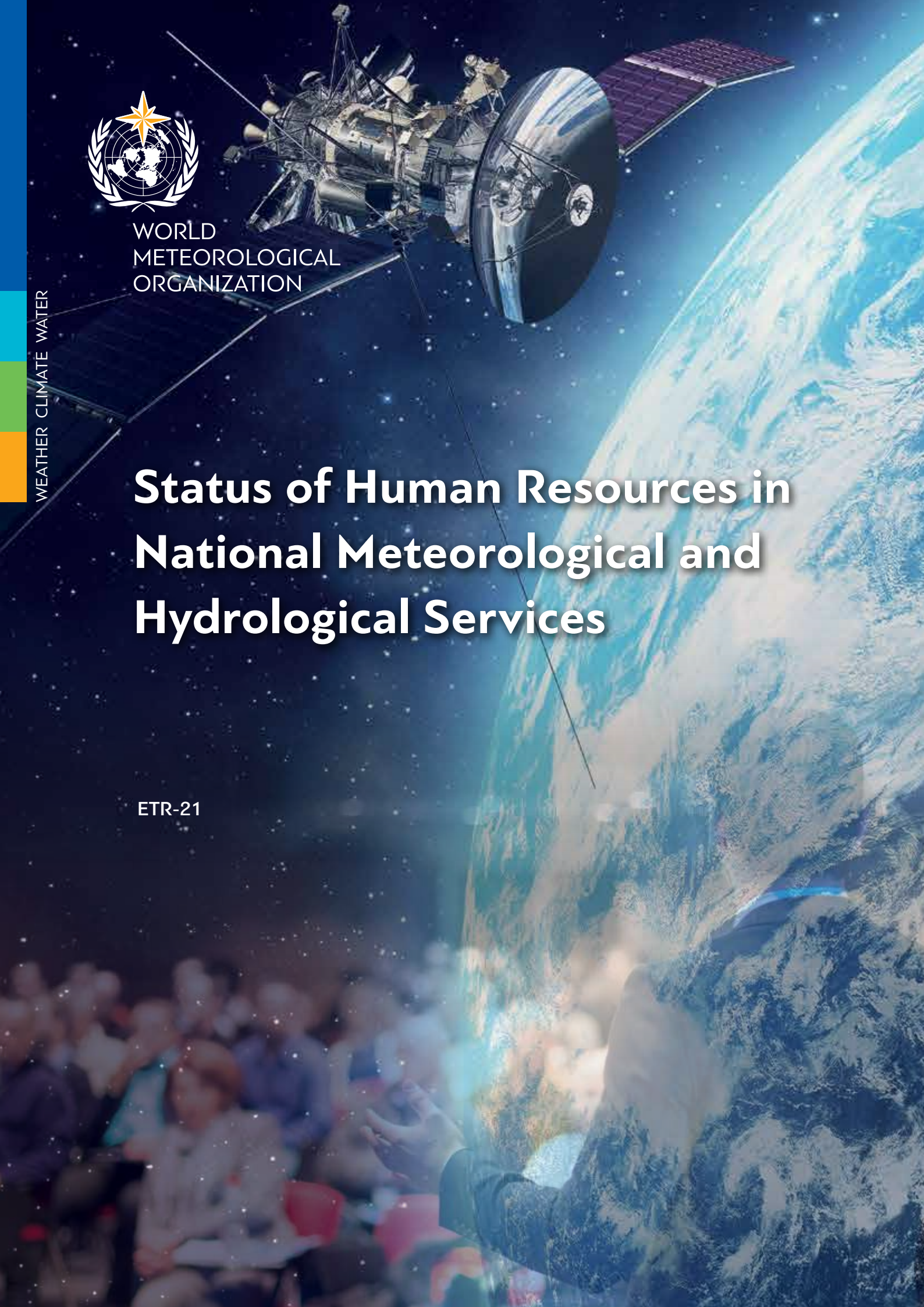

WORLD METEOROLOGICAL ORGANIZATION

WEATHER CLIMATE WATER

Status of Human Resources in National Meteorological and Hydrological Services

ETR-21

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WEATHER CLIMATE WATER

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2017

ETR-21

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Table of Contents

Foreword

In a world faced with rapid advances in information and technology, equipping staff with more skills is the best way for National Meteorological and Hydrological Services (NMHSs) to benefit from the advances in meteorology, hydrology and related geo-sciences so as to provide the highly needed quality service to address the social, economic, and environmental challenges related to climate variability and change. Recognizing the importance of education and training as an essential element for improving the provision of high quality service in support of decision-making, and the need to ensure that programme activities are based on facts and figures, WMO carries out a periodic survey of the status of human resource in NMHSs. Consequently, WMO conducted a survey during the period October 2016 to February 2017.

The survey whose results are presented in this report was conducted between October 2016 and February 2017 and had a high level of response across all the regions, making the findings representative of the situation and interest of most NMHSs. It has identified issues related to the ageing staff in NMHSs, training needs, and areas of priority for training, among others issues that needed follow-up to sustain and improve the capacities of NMHSs to enable WMO to effectively implement the decisions of WMO policy-making organs and contribute to the UN Sustainable Development Goals, the Sendai Framework for Disaster Risk Reduction 2015-2030, the Paris Agreement and other international agreements.

I wish to express my appreciation to those Members who responded to the survey. I invite all interested stakeholders to make use of the highly valuable information contained in this report and I also take this opportunity to reiterate my commitment to work with all in addressing issues related to human resource development in Member countries.

(Professor Petteri Taalas)
Secretary-General

1. Introduction

The World Meteorological Organization(WMO) conducted six world-wide surveys on Members' training requirements, opportunities and capabilities in the years 1985, 1989, 1994, 1998, 2002 and 2006. The results of the first five surveys were submitted to the Tenth (1987), Eleventh (1991), Twelfth (1995), Thirteenth (1999) and Fourteenth (2003) World Meteorological Congresses, respectively.

The current survey conducted from 2016 to 2017 focused on Human Resource Status of NMHSs, particularly as relates to staff situation by age bracket, gender, and professionals, together with training expectations in 2017, training priority areas, and status of the strategic plans of NMHSs.

The report is presented in three chapters. The first chapter provides an introduction and some major findings of the survey. The second chapter provides the details of the results of the survey and the third chapter provides conclusions.

The results of this survey provide insight into the state of human resources in the National meteorological and hydrological Services (NMHSs) of Members. In particular, the survey results provide information on training needs, expectations, and resources among Members, the WMO, and its training partners.

1.1 Survey Design and Administration

1.1.1 Survey Dissemination and Response Rates

The survey was available online in late 2016 and extended into early 2017. Responses were received between October 16, 2016, and February 21, 2017. 152 of 191 Members responded.

Table 1.1.1 shows the global and Regional response rates.

Table 1.1.1. Summary of responses to the Seventh WMO Survey 2016

Region	Nr of Members	Nr of Replies from Members	Percent
I	53	41	77%
II	34	25	74%
III	12	10	83%
IV	22	20	91%
V	21	17	81%
VI	49	39	80%
Total	**191**	**152**	80%

Figure 1.1.1a shows the response rates graphically.

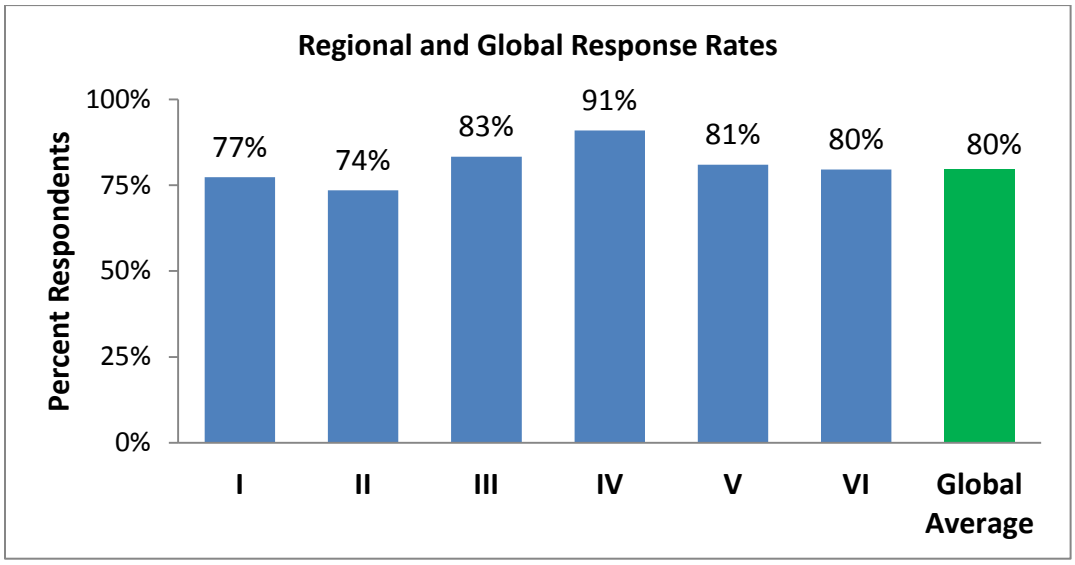


Figure 1.1.1a. Ratio of received responses to number of countries in 6 WMO Regional Associations

The global response rate is 80%. The WMO Regions are well represented in the survey results: each Region has a participation rate of at least 74%. RA-I and RA-II have response rates between 74-77%; RA-III, RA-V, and RA-VI have response rates between 80-83%; RA-IV has the highest response rate, at 91%.

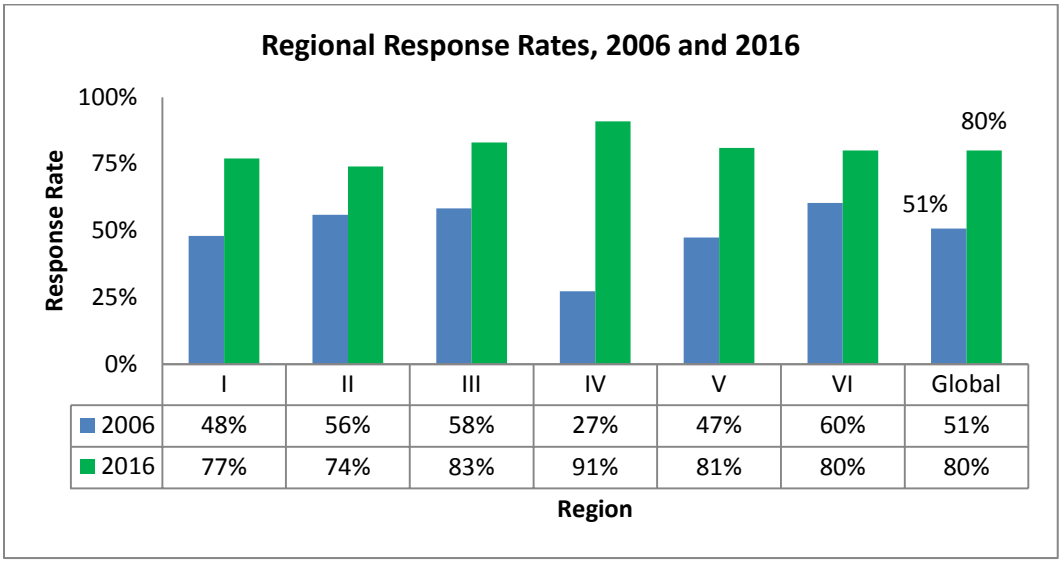
Map 1.1.1, on the following page, shows the survey respondents and non-respondents. Respondents are shaded green. Non-respondents are shaded white.

Map 1.1.1. Survey respondents and non-respondents

Map 1.1.1 shows that while the WMO Regions are well represented, there are geographic regions that figure prominently among the non-respondent group. The South Asian area is not well represented. The data set also does not include information from a significant portion of the Southern African area. Caution should be exercised when applying survey findings to these areas.

A list of Members that responded to the survey, by Region, is included in Appendix B.

The response rates for the current survey are higher than for the 2006 WMO Member Survey. Figure 1.1.1b, on the following page, compares the global and regional response rates for the 2006 (blue) and 2016 (green) surveys.



	I	II	III	IV	V	VI	Global
2006	48%	56%	58%	27%	47%	60%	51%
2016	77%	74%	83%	91%	81%	80%	80%

Figure 1.1.1b. Ratio of received responses to number of countries in 6 WMO Regional Associations, 2006 and 2016

The 2016 global response rate of 80% was up from 51% in 2006. This increase in response rate was shared among all Regions. The range of increase in response rates is 18 to 64 percentage points. RA-III saw the lowest increase in response rate (18 percentage points), from 56% to 74%; this increase in participation is still substantial. RA-IV saw the highest increase in response rates (64 percentage points), rising from the lowest response rate in 2006 (27%) to the highest response rate in 2016 (91%). The excellent response rate for the current survey may have been facilitated by the survey's brevity: the survey fits on a single page. Participation in future surveys may be facilitated by similar survey designs.

1.2 Major Findings

The major findings of the survey include:

- **Age:** In 67% of respondent Members, 51% or more of the NMHS workforce is 40 years of age or older. This is an issue especially for Members with early retirement options.
- **Expected retirement:** For some Regions and Members, human-resource losses due to retirement are expected to be dire.
  - Some Regions have average expected retirement rates of almost 30% of *all staff members.* Some Members are facing human resource losses higher than one in every two staff members in particular professional areas.

- On average, 27% of Members' Management staff is due to retire in the next five years. 17% of Members' Meteorologists are due to retire, and 19% of Meteorological Technicians. 20% of Members' Hydrologists and 18% of their Hydrological Technicians, on average, are due to retire soon.

Planning for succession, recruitment, and knowledge transfer to the next generation of NMHS staff members is relevant for all Regions and for many individual Members. Creating processes through which NMHS excellence can be maintained through this transition is of paramount importance.

- **Gender:** Only 14% of respondent Members have relative gender balance (41-60% female staff members) in their NMHS workforce. Almost one-quarter (23%) of survey respondents have 20% or fewer women in their NMHS workforce. Almost three-quarters (73%) of respondents have fewer female staff in their NMHSs than would represent gender balance.

- **Professional categories:** The largest group of NMHS workers worldwide are Meteorological Technicians (41,130 people). Next most numerous are Meteorologists (30,088 people). These two groups together represent about 50% of global NMHS staff.

  On average, 31% of Members' NMHS staff are Meteorological Technicians and 18% are Meteorologists. In almost one-third (32%) of the respondent Members, however, 20% or fewer staff members are Meteorological Technicians. In more than one-third (36%) of respondent Members, 10% or fewer staff members are Meteorologists. Depending on needs and conditions, these numbers may need to rise in order for NMHSs to be effective in achieving their core mission.

- **Capacity strengthening:** Serious need for capacity strengthening is a concern for most Members, and spans all professional areas. In particular, a majority of Members indicated a need for capacity development for Meteorological Technicians, Meteorologists, Climatologists, Management staff, and Researchers.

- **Numbers needing training:** Worldwide, more than 39,000 people need training in various professional areas. The most numerous group of people that need training are Meteorological Technicians (12,253 people). The next largest group are Meteorologists (9,835 people). Sizeable numbers of Researchers, Management staff, and Climatologists also need training.

- **Expected training in 2017:** 19,191 people anticipate training in 2017, supported by either government sources, project funds, the WMO, or other scholarships.

  - 53% of respondents anticipate that half of their 2017 trainees or fewer will receive support from government sources.

  - Many Members expect WMO funding to be a significant source for training support in 2017. Half of the survey respondents expect 11-50% of their 2017 trainees to be supported by WMO sources;

another 11% of the survey respondents are relying even more heavily on WMO funding.

- Substantial numbers of people will still need training in many Members' NMHSs, even if the education of the people anticipating training in 2017 comes to fruition. 74 Members (half of the respondents) will still have 25 or more people that need training; 24 Members will still have more than 100 people that need training.

When planning for allotments to fund training, it is important to recognize the variability among Members regarding expected funding sources, the numbers of people that need trained, and the potential impacts of shortfalls.

- **Training priority areas:** The following seven areas were indicated by 20 or more respondents as training priorities:

(a) Weather Forecasting and NWP
(b) Instruments and Observation
(c) Climates Services
(d) Agrometeorology
(e) Hydrology / Hydrometeorology
(f) Management and Administration
(g) Atmospheric Sciences and Research

These training priorities are consistent with other findings of the survey, which revealed substantial need for capacity strengthening for Meteorological Technicians, Meteorologists, Climatologists, Management staff, and Researchers.

- **Status of strategic plans:** 103 survey respondents reported that they have a strategic plan for their NMHS. They represent 54% of the global WMO Membership.

The following seven themes were consistently included in respondents' summaries of their strategic plans:

(a) Need for training and human resource development
(b) Need for development of instrumentation
(c) Communication and customer interactions
(d) Climate change, disasters, and adaptation
(e) International cooperation
(f) Service
(g) Commercialization

The seven themes are consistent with other findings of the survey, reflecting, in particular, the need for training and human resource development. The themes also reflect the complexity of the NMHSs' field of responsibility, as well as the challenges of providing funding for the accomplishment of their mission.

The survey form and basic calculations are presented in Appendix A and a list of Members that responded to the survey, by Region, is presented in Appendix B. The report was prepared with support from UCAR/COMET.

2. Results of the Survey

2.1 Staff Situation by Age

Major findings: In 67% of respondent Members, 51% or more of the NMHS workforce is 40 years of age or older. This is an issue especially for Members with early retirement options.

170,409 staff members work in NMHSs around the globe. Table 2.1a shows the number of NMHS workers in each Region, by each age bracket.

Table 2.1a. Numbers of NMHS workers by age bracket, by Region

Age Bracket	Regions						Global
	I	II	III	IV	V	VI	
< 20 years	40	207	4	1	91	1,256	1,599
20-30	1,778	15,094	472	612	2,402	6,220	26,578
30-40	3,157	20,600	1,066	1,527	2,521	14,745	43,616
40-50	3,527	21,475	964	1,781	1,780	16,901	46,428
> 50 years	3,187	18,858	1,712	3,281	2,390	22,760	52,188
Regional Totals	11,689	76,234	4,218	7,202	9,184	61,882	170,409

The age brackets offered by the survey were Less than 20 years, 20-30 years, 30-40 years, 40-50 years, and Over 50 years. While these definitions present some overlap in the age brackets, respondents sorted their staff into these categories without counting staff members twice. This is evident in the fact that national counts of staff by age category, gender, and professional area generally agree.

Table 2.1b shows the Regions' average percentages of staff members in each age bracket. These averages are calculated by averaging the Regional Members' national distributions.

Table 2.1b. Regional age distributions, calculated by averaging individual Member balances

Age bracket	Regional Averages						Global Average
	I	II	III	IV	V	VI	
< 20 years	0.8%	2%	0.4%	0.1%	5%	0.2%	1%
20-30	14%	19%	16%	21%	20%	10%	16%
30-40	30%	28%	25%	26%	24%	22%	26%
40-50	26%	27%	23%	24%	26%	28%	26%
> 50 years	29%	23%	36%	28%	25%	40%	31%
Regional Totals	100%	100%	100%	100%	100%	100%	100%

Figure 2.1 shows graphically the Regional and global average percentages of staff members in each age category.

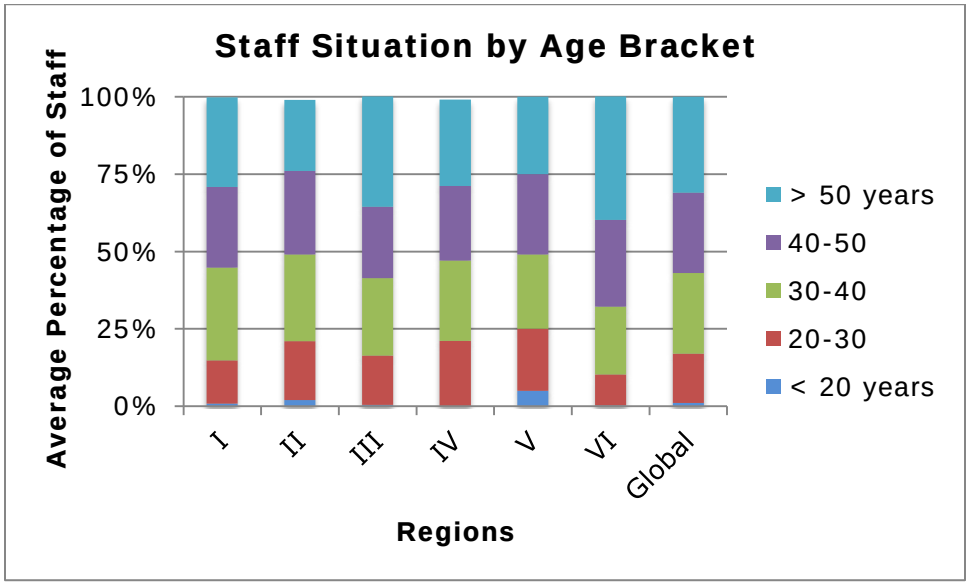


Figure 2.1. Staff situation by age bracket

The aqua-colored bars at the top of the stacks in Figure 2.1 represent the percentage of staff members that are over 50 years of age. The purple bars represent the percentage of staff members that are 40-50 years of age. Combining these two bars show that the Members of all six Regions average more than 50% of their NMHS staff that are 40 years of age or older. (See Table 2.1b for specific percentage values.)

RA-VI has the eldest NMHS workforce, with 68% of its staff members more than 40 years old.

The blue bars at the bottom of the stacks in Figure 2.1 represent the percentage of staff members that are under 20 years of age. The small size of these bars shows that only very small percentages of NMHS staff are in this youngest age group. RA-V has the highest percentage of youngest staff members among the Regions, followed by RA-II.

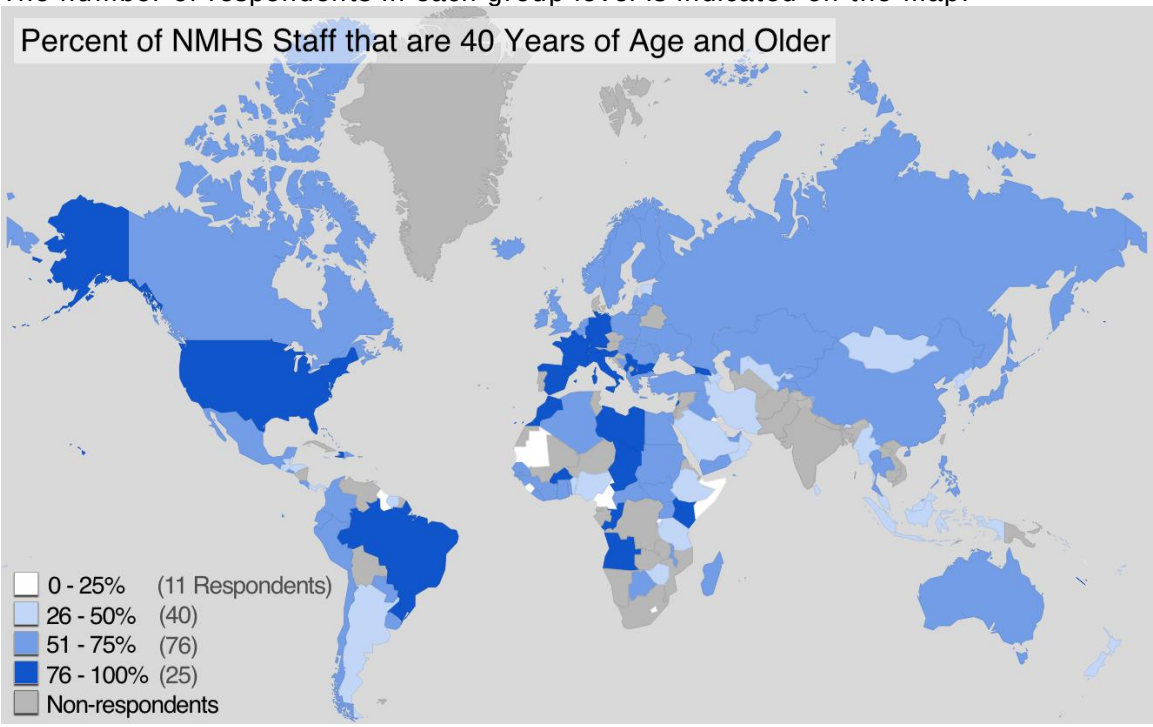
The fact that only 1% of the global NMHS workforce is less than 20 years of age (as shown in Table 2.1b) may reflect typical NMHS job-entry-level requirements around the world. According to the Sixth WMO Survey (2006),

In more than 70% of responding Members, the first degree and the postgraduate diploma/master's degree in meteorology are taken as the usual qualification for job-entry-level Meteorologists. Most often the duration required for the first and the postgraduate diploma/master's degree is of 4-5 years and 1-2 years, respectively. It also reveals that foundation training carried out in NMHSs takes mostly 1 year (p. 9.).

Map 2.1 shows Members' percentages of staff that are 40 years of age or older.

The percentages in Map 2.1 are grouped into four levels. Members in which 0-25% of staff are 40 years of age or older are shaded white. Members in which 26-50% of staff are in this category are shaded pale blue. Members with 51-75% of staff 40 years or older are shaded medium blue. Members with 76-100% of staff in this category are shaded dark blue. Members shaded grey did not respond to the survey.

The number of respondents in each group level is indicated on the map.



Map 2.1. Percent of NMHS staff that are 40 years of age and older

Map 2.1 shows that 11 Members (7% of respondents) have relatively young NMHS workforces, with fewer than 25% of staff members that are more than 40 years old. 40 Members (26% of respondents) have 26-50% of staff members that are more than 40 years old. 76 Members (50% of respondents) have 51-75% of staff members that are more than 40 years old. Finally, 25 Members (17% of respondents) have 76-100% of staff members that are more than 40 years old.

Combining the group levels of 51-75% and 76-100% of staff members that are more than 40 years old, reveals that in 67% of respondent States, 50% or more of the NMHS workforce is 40 years of age or older. The respondent States with significant percentages of older staff members in their NMHS workforces are distributed throughout the Regions.

Recruiting and supporting the next generation of staff members is critical for all Regions. Intensifying efforts to record knowledge and experience to share with new employees is prudent. These efforts are of particular relevance for Members in which more than 75% NMHS staff are more than 40 years of age.

2.2 Staff Situation by Gender

Major findings: Only 14% of respondent Members have relative gender balance (41-60% female staff members) in their NMHS workforce. Almost one-quarter (23%) of survey respondents have 20% or fewer women in their NMHS workforce. Almost three-quarters (73%) of respondents have fewer female staff in their NMHSs than would represent gender balance.

Table 2.2a shows the Regional and global numbers and percentages of NMHS staff by gender.

Table 2.2a. Regional NMHS numbers and percentages of men and women

Regions	Nr Women		Nr Men		Regional Totals
I	2,973	25%	8,704	75%	11,677
II	28,349	37%	47,773	63%	76,122
III	1,608	38%	2,611	62%	4,219
IV	2,378	33%	4,838	67%	7,216
V	5,090	55%	4,141	45%	9,231
VI	35,397	57%	26,458	43%	61,855
Total	**75,795**	**45%**	**94,525**	**55%**	**170,320**

Table 2.2a shows that 75,795 female staff comprise 45% of the global NMHS workforce, and 94,525 men comprise 55%. The Regions vary widely in the gender balances of their total NMHS workforces. RA-VI's NMHS workforce has the highest percentage of female staff members (57%), followed by RA-V (55%). RA-I has the lowest percentage of female staff members (25%). RA-II, RA-III, and RA-IV range in between, with 37%, 38%, and 33% female staff, respectively.

Table 2.2b shows five statistics regarding the Regional and global average percentages of female NMHS staff: Members' average percentages of female staff (the third row, "Average"); the maximum and minimum percentages of female staff among a Regions' Members (first and fifth rows, "Max" and "Min"); and the percentages that are one standard deviation above and below the mean (second and fourth rows, "Std Dev+" and Std Dev-").

Table 2.2b. Situation of female NMHS staff: Average, Max, Min, and Standard Deviation

Statistic	Regions						Global
	I	II	III	IV	V	VI	
Max	65%	77%	51%	83%	78%	76%	83%
Std Dev+	38%	53%	46%	54%	64%	60%	53%
Average	26%	32%	39%	36%	38%	42%	35%
Std Dev-	14%	11%	32%	18%	13%	24%	16%
Min	7%	0%	31%	9%	0%	2%	0%

Table 2.2b shows that respondents' average percentage of female NMHS staff is 35%. The maximum percentage of female NMHS staff among the global group of respondents is 83%, and the minimum percentage is 0%. About 68% of respondents' averages would fall between 16% and 53% female NMHS staff, if the distribution were approximately normal.

Table 2.2b also shows that RA-VI's Members have the highest average percentage of female NMHS staff (42%). RA-I's Members have the lowest average percentage of female NMHS staff (26%). (See the middle row in Table 2.2b, "Average")

All Regions except RA-III have at least one Member with fewer than 10% female NMHS staff (see the last row in Table 2.2b, "Min"). The minimum gender balance among RA-III's Members is 31% women.

A Member of RA-IV has the highest percentage of female staff among all respondents (83%). All Regions except RA-III have at least one Member with higher than 65% female NMHS staff (see the first row in Table 2.2b, "Max"). The maximum gender balance in RA-III is 51% women.

Figure 2.2 presents visually the Regional NMHS gender balance statistics listed in Table 2.2b.

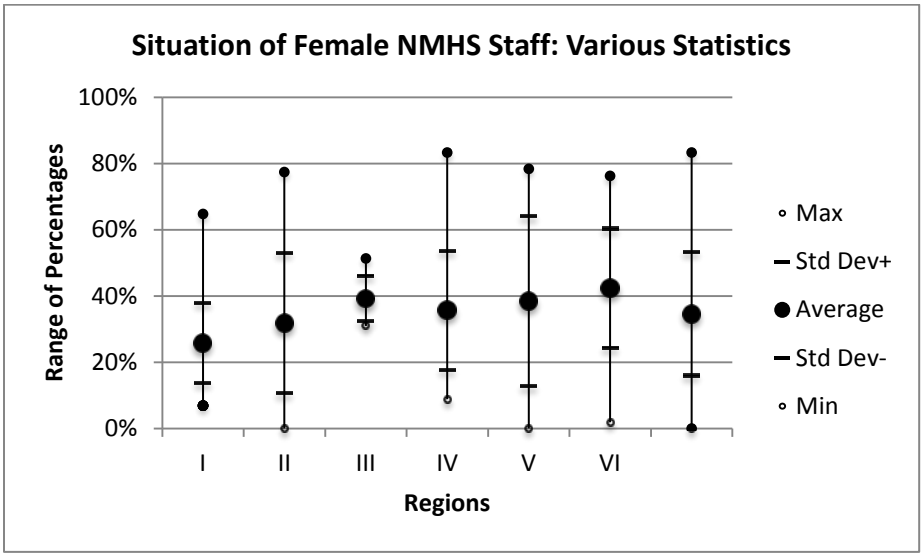


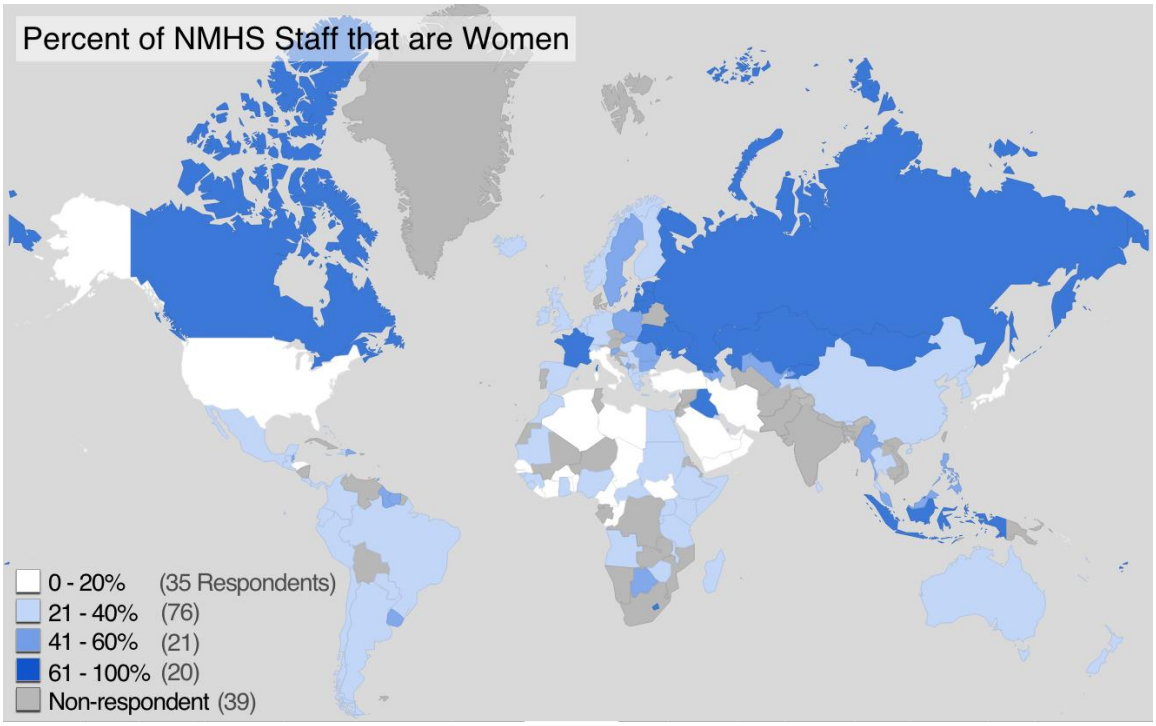
Figure 2.2. Situation of female NMHS staff: Various statistics

The heavy black circle near the middle of each Region's vertical line in Figure 2.2 is the Region's average percent of staff that are women. The small black circle at each end of the Regions' lines are the highest and lowest percentages of women among the Region's Members. The short lines that cross the Region's vertical lines represent the percentage that is one standard deviation above and below the mean.

Figure 2.2 shows again that most Regions have wide variability among their Members in terms of the percent of NMHS staff that are women. Some Members have no female staff members in their NMHS's at all; other Members have 70% or even 80% women among their staff members. RA-III's exception is again visible in Figure 2.2: all RA-III Members report between 31% and 51% female staff members.

Map 2.2 shows Members' percentages of female NMHS staff.

The percentages of female staff shown in Map 2.2 are grouped into four levels. Members in which 0-20% of staff are women are shaded white. Members with 21-40% female staff are shaded pale blue. Members with 41-60% of female staff are shaded medium blue. Members in which 61-100% of staff are women are shaded dark blue. Members shaded grey did not respond to the survey. The number of respondents in each group level is indicated on the map.



Map 2.2. Percent of NMHS staff that are women

Map 2.2 shows that few Members have relative gender balance in their NMHS workforce.

35 Members have 20% or fewer women in their NMHS workforce (shaded white in Map 2.2). This is almost one-fourth (23%) of survey respondents.

76 Members have 21-40% women in their NMHS workforce (shaded pale blue in Map 2.2). This is 50% of the respondent group.

The third group, which includes Members with relative gender balance in their NMHS workforces (41-60% women), contains only 21 Members. This is 14% of the survey respondents.

20 Members have a gender imbalance skewed toward women (61% women or greater). This is 13% of the survey respondents.

Thus, almost three-quarters (73%) of respondents have fewer female staff in their NMHSs than would represent gender balance. Only 14% of respondents have a relative gender balance among their NMHS staff (between 41-60% women). The remaining 13% of respondents' NMHS-staff gender balance is skewed toward women (61% women or greater).

Since 86% of respondents report gender imbalance among their NMHS staff members (skewed either toward men or toward women), promoting gender balance in NMHS workforces will require effort from nearly all Members. The goal of promoting gender balance will require special effort for Members whose workforces exhibit the more extreme gender imbalances.

2.3 Staff Situation by Professional Categories

2.3.1 Number of Staff in Each Category

Major Findings: The largest group of NMHS workers worldwide are Meteorological Technicians (41,130 people). Next most numerous are Meteorologists (30,088 people). These two groups together represent about 50% of global NMHS staff.

On average, 31% of Members' NMHS staff are Meteorological Technicians and 18% are Meteorologists. In almost one-third (32%) of the respondent Members, however, 20% or fewer staff members are Meteorological Technicians. In more than one-third (36%) of respondent Members, 10% or fewer staff members are Meteorologists. Depending on needs and conditions, these numbers may need to rise in order for NMHSs to be effective in achieving their core mission.

Table 2.3.1 shows the global and Regional numbers of NMHS staff that work in each of nine professional areas. The table is sorted by global totals (the right-most column in the table), from largest to smallest.

Table 2.3.1a. Numbers of NMHS staff working in the nine professional areas

Professional Areas	Regions						Global
	I	II	III	IV	V	VI	
Met Techs	4,731	21,894	1,136	1,264	1,906	10,199	41,130
Meteorologists	1,966	15,853	778	2,897	1,723	6,871	30,088
Researchers	452	10,794	272	289	234	3,245	15,286
Managers	575	8,441	321	446	886	3,347	14,016
Support Staff	3,619	3,210	759	618	884	4,340	13,430
Other	546	1,448	708	861	2,925	4,675	11,163
Climatologists	391	7,589	102	329	567	1,706	10,684
Hydro Techs	121	686	125	248	63	1,712	2,955
Hydrologists	88	685	91	303	68	1,257	2,492
Regional Totals	**12,489**	**70,600**	**4,292**	**7,255**	**9,256**	**37,352**	**141,244**

Table 2.3.1a shows that the largest group of NMHS workers worldwide are Meteorological Technicians (about 41,000 people in total). Next most numerous are Meteorologists (30,000 people). These two groups together represent about 50% of global NMHS staff.

In NMHSs around the globe, there are about 15,000 Researchers, 14,000 Management staff, 13,000 Support staff, 11,000 "Other" staff, and about 11,000 Climatologists.

Finally, there are about 3,000 Hydrological Technicians working for NMHSs globally, and 2,500 hydrologists. Note that relatively few respondents included hydrology staff in their NMHS staff counts. Only 43% of respondents counted Hydrologists among their NMHS staff, and 41% counted Hydrological Technicians.

Not all NMHS staff members around the globe could be classified into the nine professional areas. Of the 170,409 global NMHS staff, 29,076 (17%) could not be classified into the professional areas.

The size of Regional NMHS workforces varies from 4,292 in RA-III to 70,600 in RA II. RA-IV has 7,255 NMHS staff members, RA-V has 9,256, RA-I has 12,489, and RA-VI has 37,352. (See the last row in Table 2.3.1a.)

Table 2.3.1b shows Members' average percentages of staff members that work in each professional area. The averages are calculated only among the 141,244 staff members that could be classified into the nine professional areas. The table is sorted by global averages, from largest to smallest (the right-most column).

Table 2.3.1b. Regional professional area distributions, calculated by averaging Member distributions

Professional Areas	Regions						Global
	I	II	III	IV	V	VI	
Met Techs	33%	30%	31%	40%	43%	22%	32%
Meteorologists	16%	25%	13%	15%	17%	22%	19%
Support Staff	23%	15%	25%	10%	14%	16%	17%
Other	7%	6%	11%	7%	8%	12%	8%
Managers	8%	8%	8%	10%	9%	7%	8%
Climatologists	7%	5%	3%	12%	7%	5%	6%
Researchers	3%	4%	3%	1%	2%	8%	4%
Hydro Techs	2%	6%	4%	4%	1%	4%	3%
Hydrologists	2%	2%	3%	2%	0%	4%	2%

Table 2.3.1b shows that the global group of respondents average 50% meteorology staff in their NMHSs: on average, 31% of NMHS staff are Meteorological Technicians and 18% are Meteorologists. These two groups, Meteorological Technicians and Meteorologists, are the largest segments of the global NMHS workforce.

The global group of respondents average 17% Support staff, 8% Management staff, and 8% "Other" staff in their NMHSs. They average 6% Climatologists, 4% Researchers, 3% Hydrological Technicians, and 2% Hydrologists among their NMHS staff members. Again, note that relatively few respondents included hydrology staff among their NMHS staff counts.

Table 2.3.1b also shows that Regions vary in their distributions of staff members among the professional areas. For instance, on average, RA-V's Members average 43% Meteorological Technicians among their NMHS staff, while the Members in RA-VI average 22% Meteorological Technicians.

Figure 2.3.1a shows the average Regional and global staff distributions.

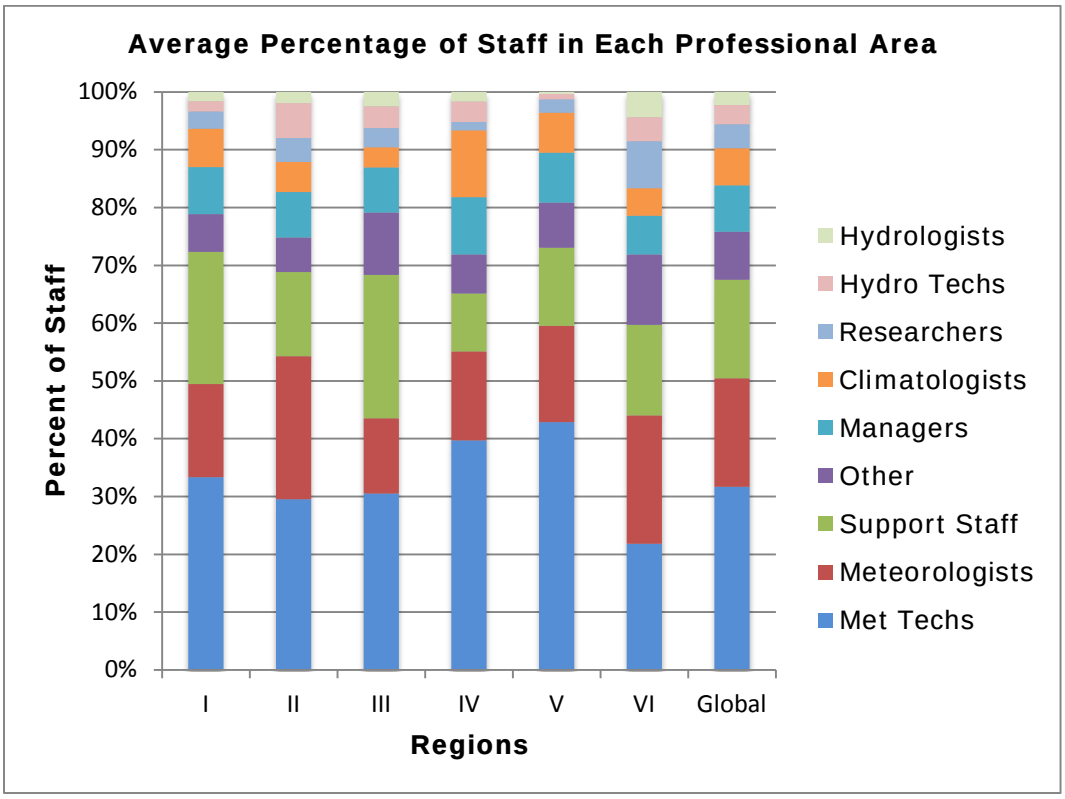


Figure 2.3.1a. Average percentage of staff in each professional area

Figure 2.3.1a shows that the Regions vary in the average percentages of their staff members that work in the various professional areas. For instance, Regional Members' average percentage of NMHS staff that are Meteorological Technicians varies from 22% among RA-VI's Members to 43% among RA-V's Members. (The blue bars at the bottom of the stacks in Figure 2.3.1 represent the average percentages of staff members that are Meteorological Technicians.)

The red bars (second up from the bottom of the stacks) represent the Regional Members' average percentage of staff members that are Meteorologists. The Regional Members' averages for this professional area vary from 10% among RA-IV's Members to 25% among RA-III's Members.

The pale green bars (third up from the bottom of the stacks) represent the Regional Members' average percentage of staff members that are Support staff. The Regional averages vary from 13% among RA-IV's Members to 25% among RA-III's Members.

Another category in which the Regional Members vary widely is the percentages of their staff members that are Climatologists (represented by the orange bar fourth from the top of the stacks). The averages vary from 3% among RA-III's Members to 12% among RA-IV's Members.

Finally, the Regional Members vary widely in the percentages of their staff members that are Researchers (represented by the blue bar third from the top of the stacks).

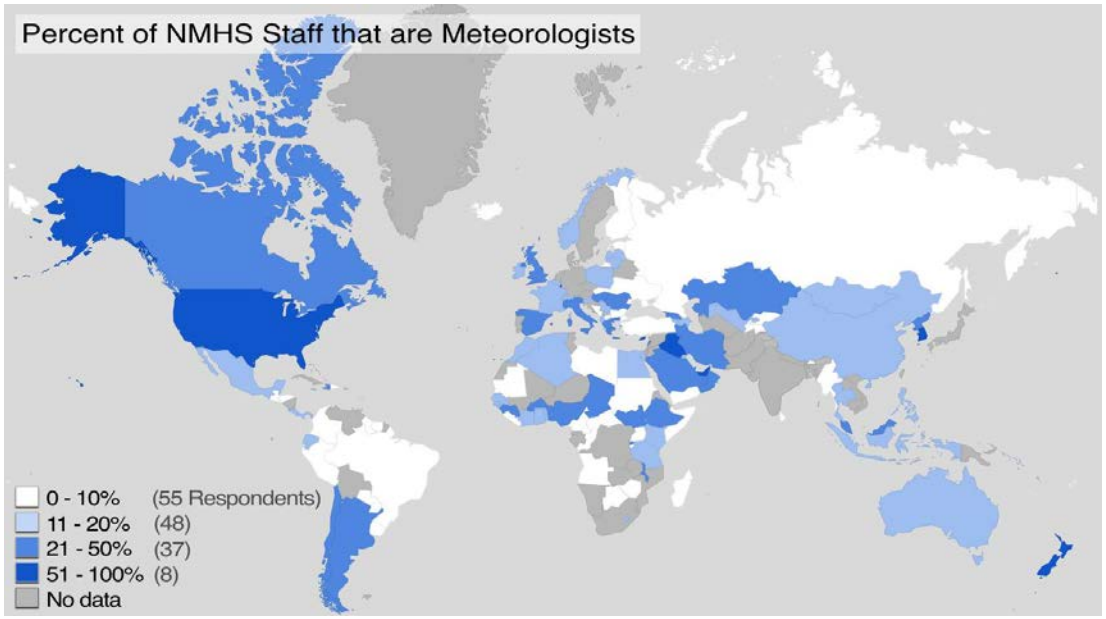
The averages vary from 1% among RA-IV's Members to 8% among RA-VI's Members.

Maps 2.3.1a and 2.3.1b, on the following pages, show Members' percentage of NMHS staff that are Meteorologists and Meteorological Technicians.

The percentages of staff members shown in Maps 2.3.1a and 2.3.1b are grouped into four levels.

- Members in which 0-10% of staff are Meteorologists (Map 2.3.1a) or Meteorological Technicians (Map 2.3.1b) are shaded white.
- Members in which 11-20% of staff work in these categories are shaded pale blue.
- Members with 21-50% of staff that work in these categories are shaded medium blue.
- Members in which 51-100% of staff work in these categories are shaded dark blue.
- Members shaded grey did not respond to the survey.

The number of respondents in each group level is indicated on the maps.



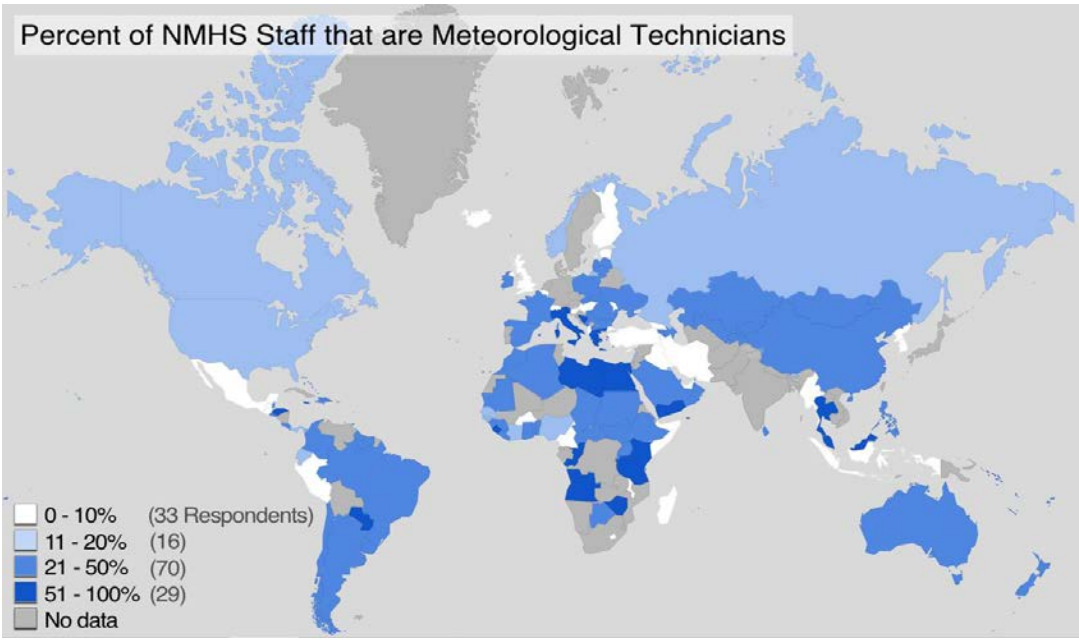
Map 2.3.1a. Percent of NMHS staff that are Meteorologists

Map 2.3.1a shows that in 55 Members' NMHSs, 10% or fewer of staff members are Meteorologists (shaded white in Map 2.3.1a). This is more than one-third (36%) of survey respondents.

In 48 Members' NMHSs, 11-20% of staff members are Meteorologists (shaded pale blue in Map 2.3.1a). This is almost one-third (32%) of the respondent group.

The third group, in which 21-50% of staff members are Meteorologists (shaded medium blue in Map 2.3.1a), contains 37 Members. This is one-quarter (25%) of the survey respondents.

In 8 Members' NMHSs, more than 50% of staff members are Meteorologists (shaded dark blue in Map 2.3.1a). This is 5% of the survey respondents.



Map 2.3.1b. Percent of NMHS staff that are Meteorological Technicians

Map 2.3.1b shows that in 33 Members' NMHSs, 10% or fewer of staff members are Meteorological Technicians (shaded white in Map 2.3.1b). In 16 Members' NMHSs, 11-20% of staff members are Meteorological Technicians (shaded pale blue in Map 2.3.1b). These two groups together are almost one-third (32%) of the respondent group.

The third group, in which 21-50% of staff members are Meteorological Technicians (shaded medium blue in Map 2.3.1b), contains 70 Members. This is almost one-half (46%) of the survey respondents.

In 29 Members' NMHSs, more than 50% of staff members are Meteorological Technicians (shaded dark blue in Map 2.3.1b). This is 19% of the survey respondents.

The variability in the percentages of staff members in each professional area suggests that it may be fruitful to investigate how the varying patterns of NMHS human resource distribution emerge from varying national conditions, whether certain patterns enable effective operation in specific conditions, and what human-resource patterns may serve as optimal targets for developmental plans.

Comparing Maps 2.3.1a and 2.3.1b reveals that some of the Members with fewer than 10% Meteorologists among their NMHS staff have much higher percentages of Meteorological Technicians. (See for example some Members of RA-I and RA-III.) These patterns of human resource distribution may also merit exploration—perhaps there are strategies of cooperation between Meteorologists and Meteorological Technicians that can increase NMHS's effectiveness in carrying out their responsibilities.

Tables 2.3.1c and 2.3.1d show five statistics regarding the Regional and global average percentages of NMHS staff that are Meteorologists (Table 2.3.1c) and Meteorological Technicians (Table 2.3.1d). These tables show the variability in Members' staffing patterns.

- Members' average percentages of staff in these two professional areas (the third rows, "Average");
- Maximum and minimum percentages of staff in these two professional areas among a Regions' Members (first and fifth rows, "Max" and "Min");
- and the percentages that are one standard deviation above and below the mean (second and fourth rows, "Std Dev+" and Std Dev-").

Table 2.3.1c. Situation of Meteorologists: Average, Max, Min, and Standard Deviation

	Regions						Global
	I	II	III	IV	V	VI	
Max	48%	68%	42%	53%	57%	77%	77%
Std Dev+	28%	45%	28%	27%	30%	39%	34%
Average	16%	25%	13%	15%	17%	22%	19%
Std Dev-	4%	4%	-1%	4%	3%	5%	3%
Min	0%	1%	0%	0%	0%	5%	0%

Table 2.3.1d. Situation of Meteorological Technicians: Average, Max, Min, and Standard Deviation

	Regions						Global
	I	II	III	IV	V	VI	
Max	66%	64%	51%	84%	75%	67%	84%
Std Dev+	52%	49%	45%	63%	64%	40%	52%
Average	33%	30%	31%	40%	43%	22%	32%
Std Dev-	14%	10%	16%	16%	22%	4%	11%
Min	2%	0%	0%	0%	8%	0%	0%

Table 2.3.1c shows that respondents' average percentage of NMHS staff that are Meteorologists is 19%. The maximum percentage of Meteorologists among NMHS staff in the global group of respondents is 77%, and the minimum percentage is 0%. About 68% of respondents' averages would fall between 34% and 3% NMHS staff that are Meteorologists, if the distribution were approximately normal.

Table 2.3.1d shows that respondents' average percentage of NMHS staff that are Meteorological Technicians is 32%. The maximum percentage of Meteorological Technicians among NMHS staff in the global group of respondents is 84%, and the minimum percentage is 0%. About 68% of respondents' averages would fall between 52% and 11% NMHS staff that are Meteorological Technicians, if the distribution were approximately normal.

Figures 2.3.1b and 2.3.1c present visually the statistics for Meteorologists and Meteorological Technicians shown in Tables 2.3.1c and 2.3.1c.

The heavy black circle near the middle of each Region's vertical line is the Region's average percent of staff that are Meteorologists or Meteorological Technicians. The small black circle at each end of the Regions' lines are the highest and lowest percentages of staff members In these categories among the Region's Members. The short lines that cross the Region's vertical lines represent the percentage that is one standard deviation above and below the mean.

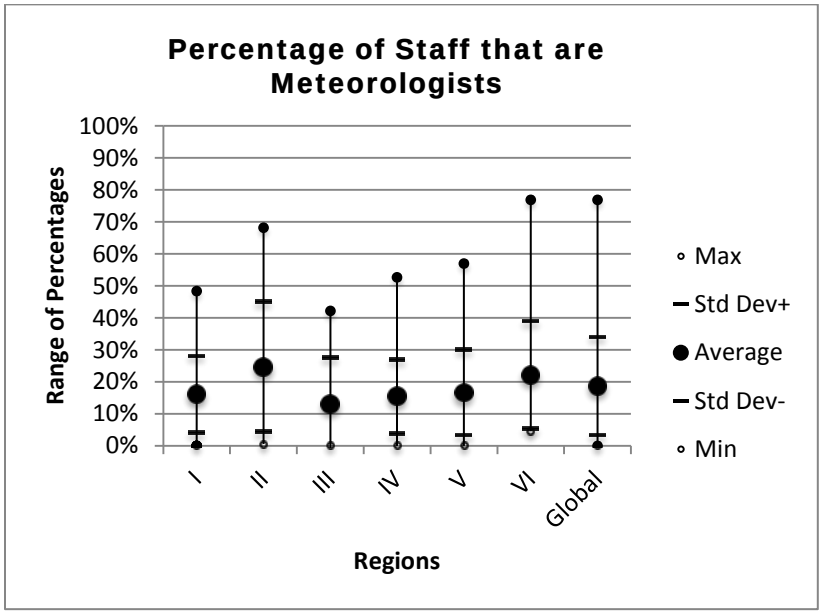


Figure 2.3.1b. Percent of staff that are Meteorologists

Figure 2.3.1b shows that while Regional Members' averages of the percentages of NMHS staff that are Meteorologists are similar (between 13-25%), the range of percentages among Regional Members is wide. RA-III's Members have the lowest average percentage of NMHS staff that are Meteorologists (13%), as well as the narrowest variation in percentages (from 0-42%).

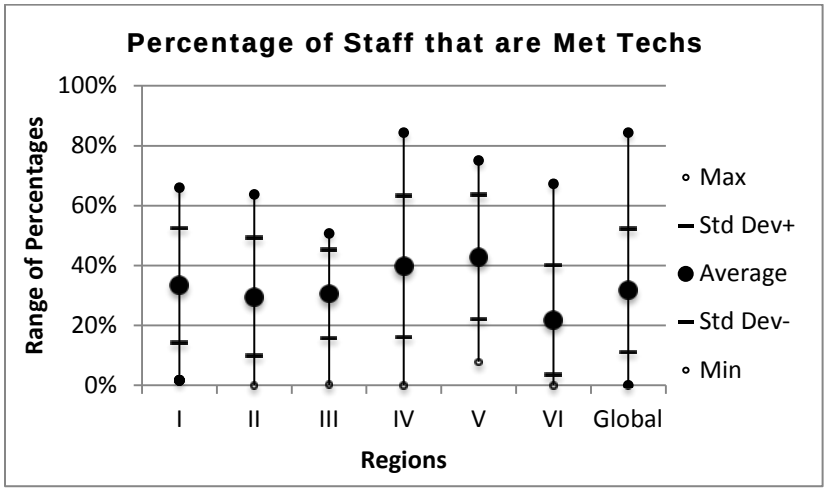


Figure 2.3.1c. Percent of staff that are Meteorologists

Figure 2.3.1c shows that Regional Members' averages of the percentages of NMHS staff that are Meteorological Technicians varies more widely than for Meteorologists (22% to 40%). RA-VI has the lowest average percentage of NMHS staff that are Meteorological Technicians (22%), while RA-V has the highest average percentage (43%). RA-III has the narrowest variation in percentages (from 0-51%).

As mentioned above, the variability in the percentages of staff members in the professional areas (Meteorologists, Meteorological Technicians, as well as the other categories) suggests that it may be fruitful to investigate how the varying patterns of NMHS human resource distribution emerge from varying national conditions, whether certain patterns enable effective operation in specific conditions, and what human-resource patterns may serve as optimal targets for developmental plans.

2.3.2 Areas that Need Capacity Strengthening

Major Findings: Serious need for capacity strengthening is a concern for most Members, and spans all professional areas. In particular, a majority of Members indicated need for capacity development for Meteorologists, Climatologists, and Meteorological Technicians.

Table 2.3.2a shows the number of respondents that indicated serious need for capacity strengthening in each professional area. Table 2.3.2b shows the percentages of respondents. The tables are sorted by the global number of respondents that indicated each area (the right-most column in the table), from highest to lowest.

Table 2.3.2a. Numbers of respondents with serious need for capacity strengthening in each area

Professional Area	Region						Global
	I	II	III	IV	V	VI	
Meteorologists	39	22	9	16	9	25	120
Climatologists	38	19	10	16	10	25	118
Met Techs	35	14	9	14	8	16	96
Researchers	24	13	7	5	6	18	73
Managers	27	8	4	10	4	8	61
Hydrologists	16	9	5	8	2	14	54
Hydro Techs	14	7	3	10	2	9	45
Support Staff	12	6	4	6	3	14	45
Other	10	3	1	7	4	7	32
Number of Respondents in Region	**41**	**25**	**10**	**20**	**17**	**39**	**152**

Table 2.3.2b. Percentages of respondents indicating need for capacity strengthening in each area

Professional Area	Region						Global
	I	II	III	IV	V	VI	
Meteorologists	95%	88%	90%	80%	53%	64%	79%
Climatologists	93%	76%	100%	80%	59%	64%	78%
Met Techs	85%	56%	90%	70%	47%	41%	63%
Researchers	59%	52%	70%	25%	35%	46%	48%
Managers	66%	32%	40%	50%	24%	21%	40%
Hydrologists	39%	36%	50%	40%	12%	36%	36%
Hydro Techs	34%	28%	30%	50%	12%	23%	30%
Support Staff	29%	24%	40%	30%	18%	36%	30%
Other	24%	12%	10%	35%	24%	18%	21%

Tables 2.3.2a and 2.3.2b show that *all* of the professional areas were indicated by at least 21% of respondents (32 of 152) as needing serious capacity strengthening in their NMHS.

79% (120 respondents) indicated that they need serious capacity strengthening for Meteorologists.

78% (118 respondents) indicated that they need serious capacity strengthening for Climatologists.

63% (96 respondents) indicated that they need serious capacity strengthening for Meteorological Technicians.

Thus, more than half of all the responding Members indicated that they need serious capacity strengthening for Meteorologists, Climatologists, and Meteorological Technicians.

48% (73 respondents) indicated that they need serious capacity strengthening for Researchers.

30%-40% of the respondents indicated that they need serious capacity strengthening for Management staff (61 respondents) and for Hydrologists (54 respondents).

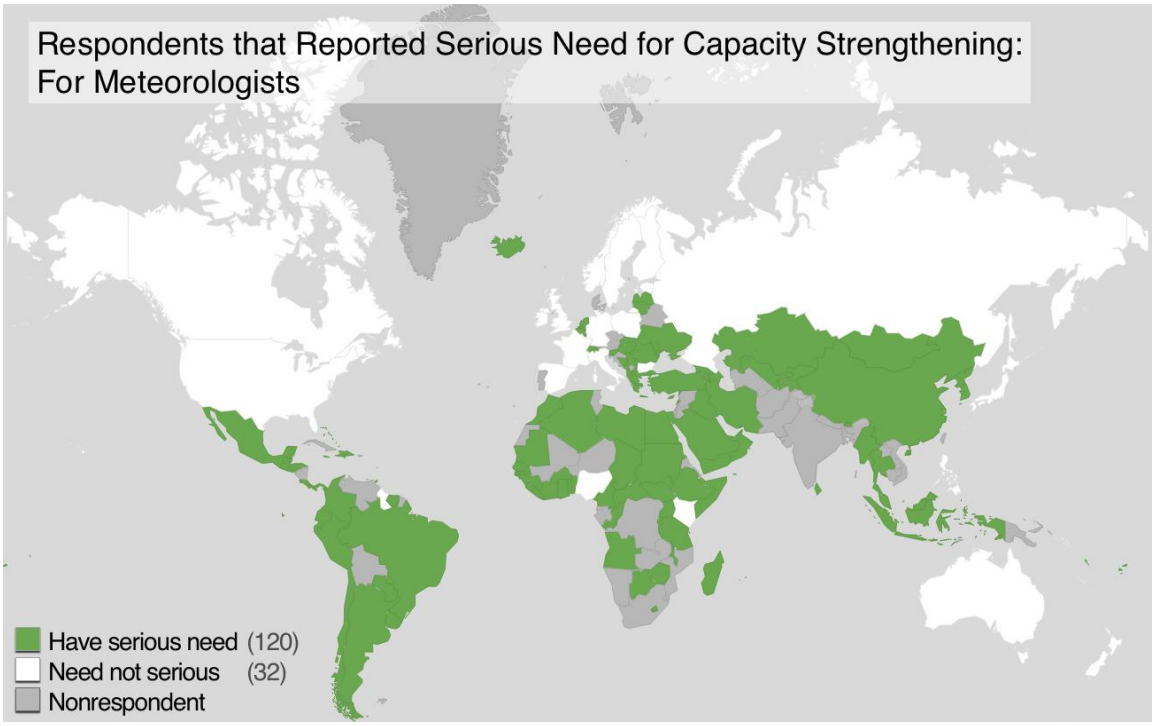
20%-29% of the respondents indicated that they need serious capacity strengthening for Hydrological Technicians (45 respondents), Support staff (45 respondents), and for “Other” staff (32 respondents).

Most of the suggestions for “other” capacities needed were for instruments and IT skills. There were several suggestions for communication and social skills.

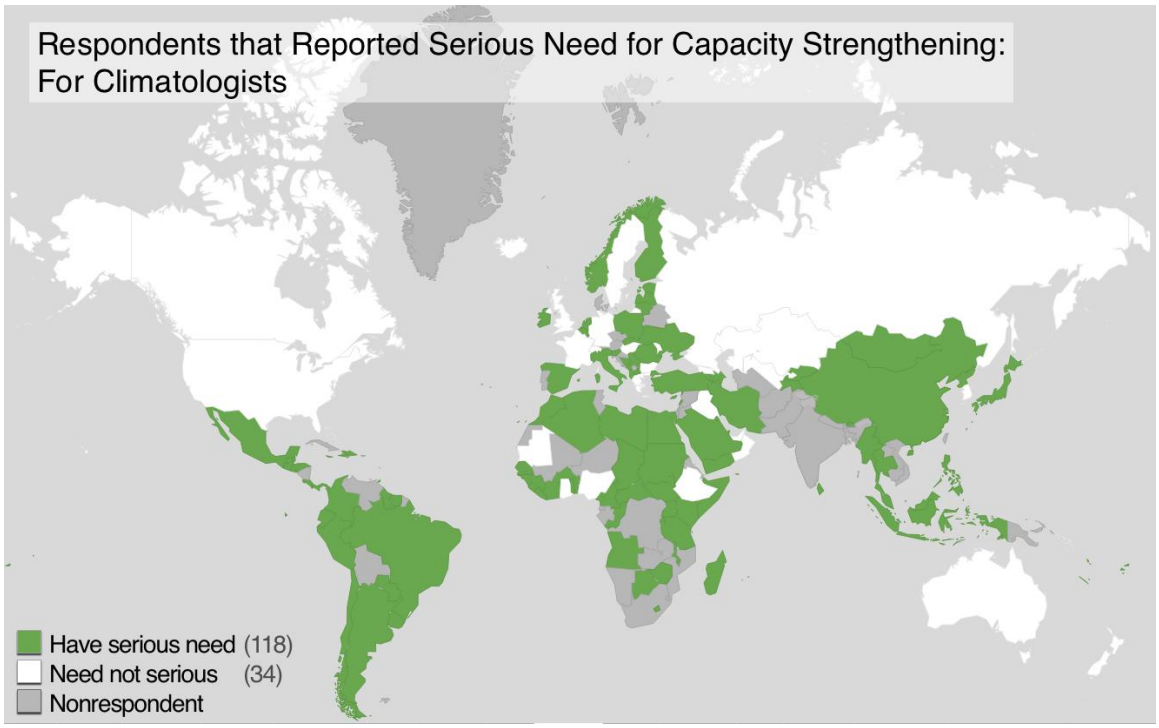
Maps 2.3.2a through 2.3.2d, on the following pages, show the Members that indicated serious need for capacity strengthening in the four most frequently indicated areas:

- Map 2.3.2a: Meteorologists (79% of respondents)
- Map 2.3.2b: Climatologists (78% of respondents)
- Map 2.3.2c: Meteorological Technicians (63% of respondents)
- Map 2.3.2d: Researchers (48% of respondents)

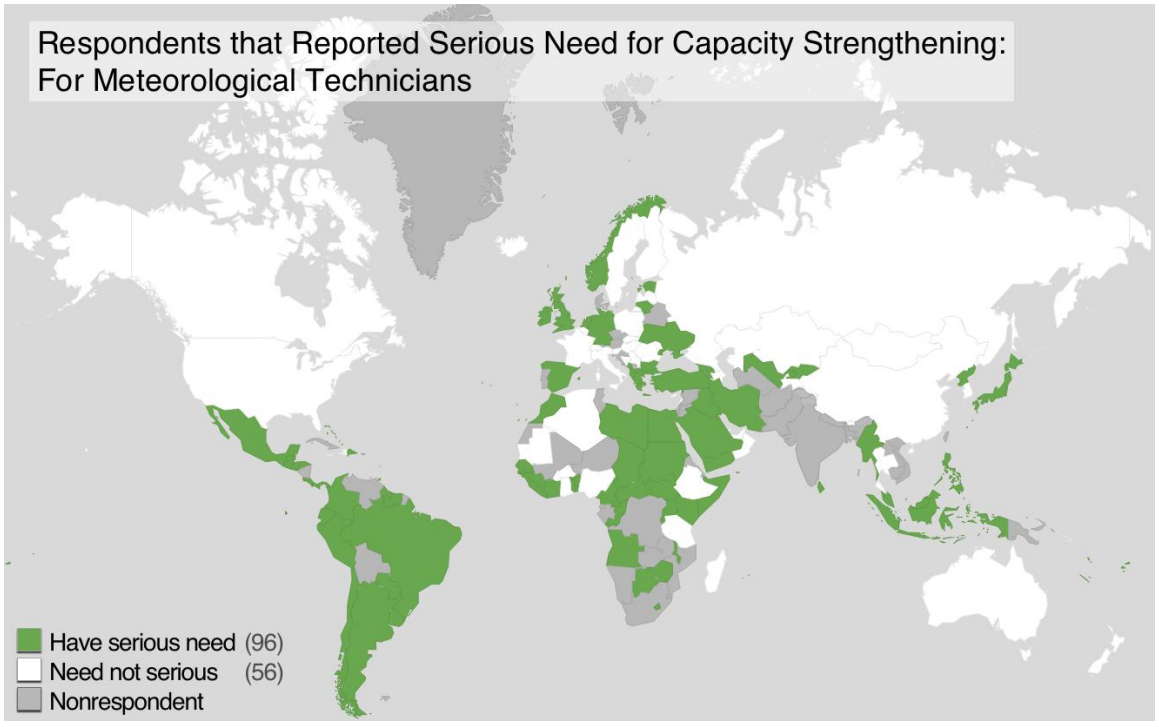
On each map, green shading shows Members that indicated they have serious need for capacity strengthening in that area. White shading shows Members that did not indicate that they have serious need in this area. Members that did not respond to the survey are shaded grey. The number of respondents in each group level is indicated on the maps.



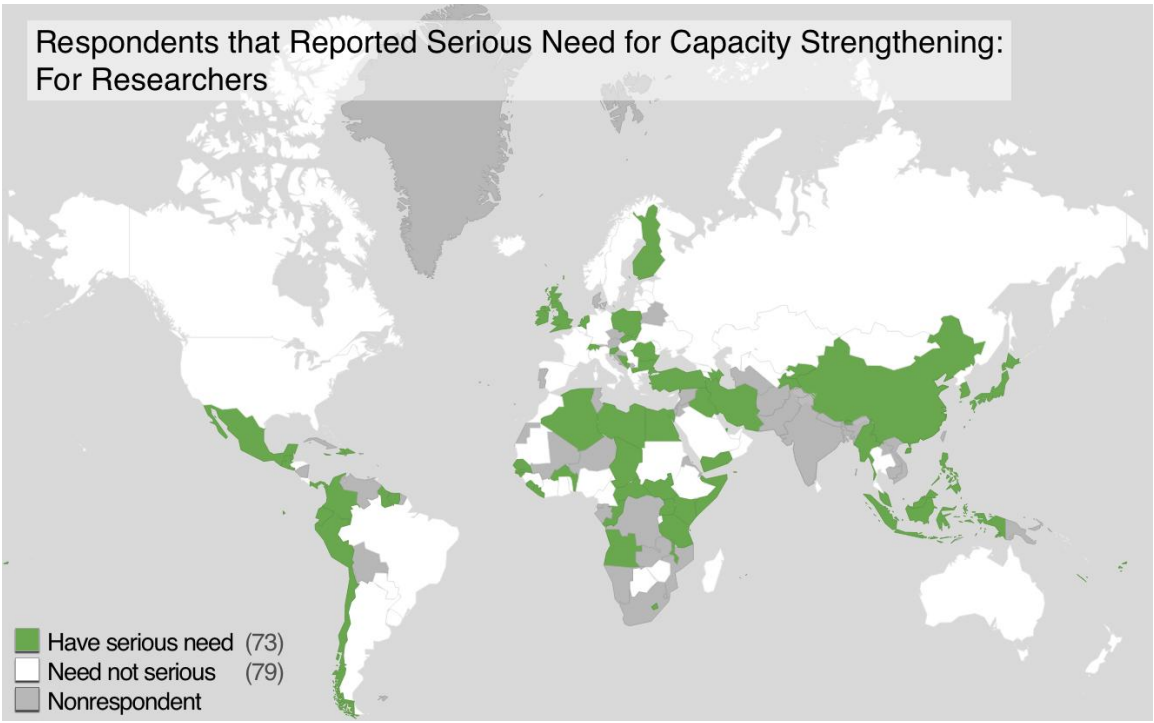
Map 2.3.2a. Respondents with need for capacity strengthening for Meteorologists



Map 2.3.2b. Respondents with need for capacity strengthening for Climatologists



Map 2.3.2c. Respondents with need for capacity strengthening for Met Technicians



Map 2.3.2d. Respondents with need for capacity strengthening for Researchers

Maps 2.3.2a and 2.3.2b show that the need for capacity strengthening for Meteorologists and Climatologists is widespread—almost 80% of respondents indicated that they have this need.
Map 2.3.2c shows that the 63% of respondents that indicated they have a serious need for capacity strengthening for Meteorological Technicians are spread among all Regions. Map 2.3.2d shows that this is also true for the 48% of respondents that indicated they have a serious need for capacity strengthening for Researchers: these needs are shared among all the Regions.

Respondents in RA-III expressed near unanimous need for capacity strengthening for Meteorologists, Climatologists, and Meteorological Technicians, as shown in Maps 2.3.2a, 2.3.2b, and 2.3.2c, as well as in Table 2.3.2b. This is also true for RA-I, although the percentages of respondents in RA-I are not quite as high as in RA-III.

Figures 2.3.2a through 2.3.2f, below and on the following pages, show the percentages of respondents that indicated serious need for capacity development in each area.

The percentage of respondents among the whole respondent group is shown in Figure 2.3.2a. The percentage of respondents in each Region is shown in Figures 2.3.2b through 2.3.2f.

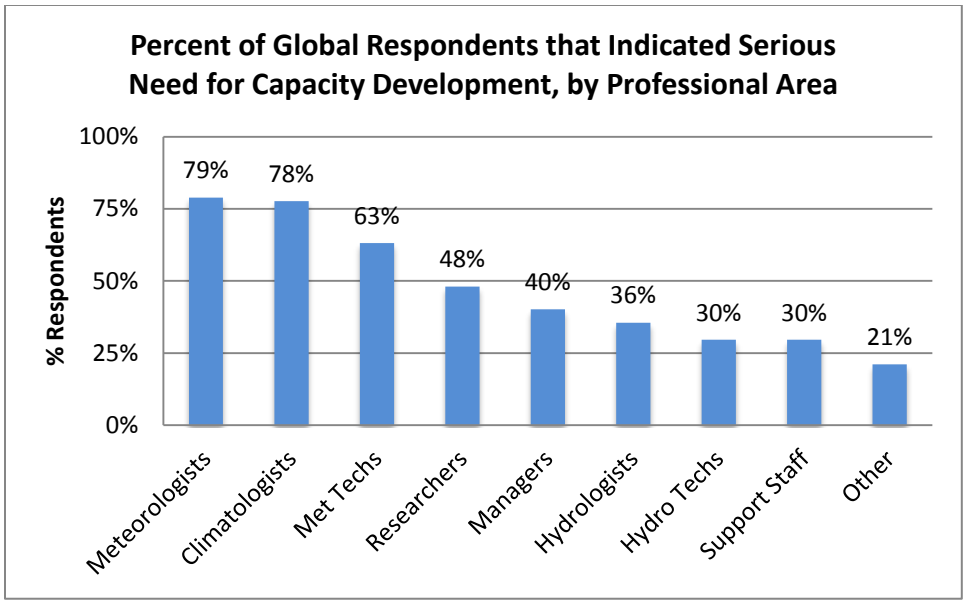


Figure 2.3.2a. Percent of global respondents that indicated serious need for capacity development, by professional area

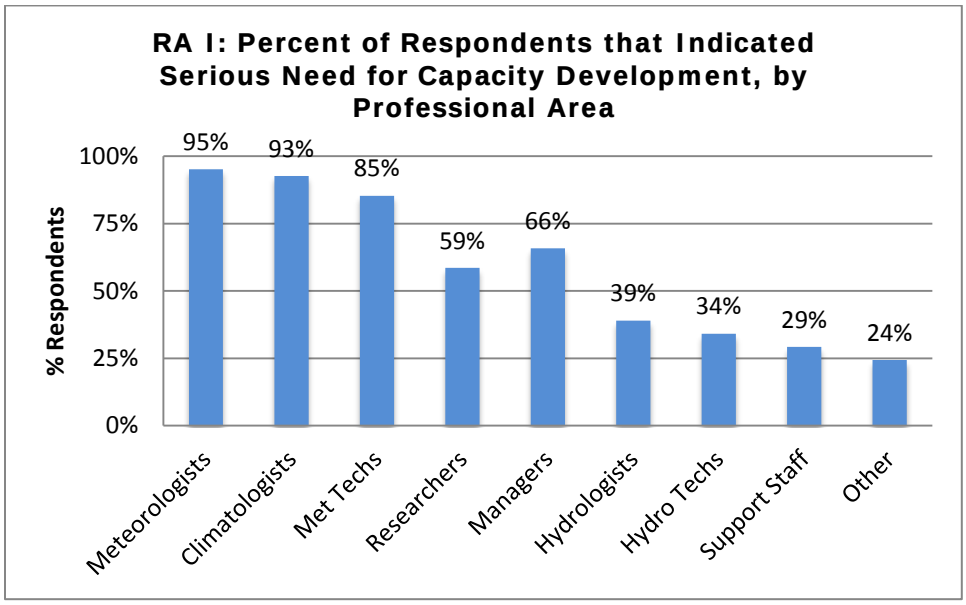


Figure 2.3.2b. Percent of RA-I respondents that indicated serious need for capacity development, by professional area

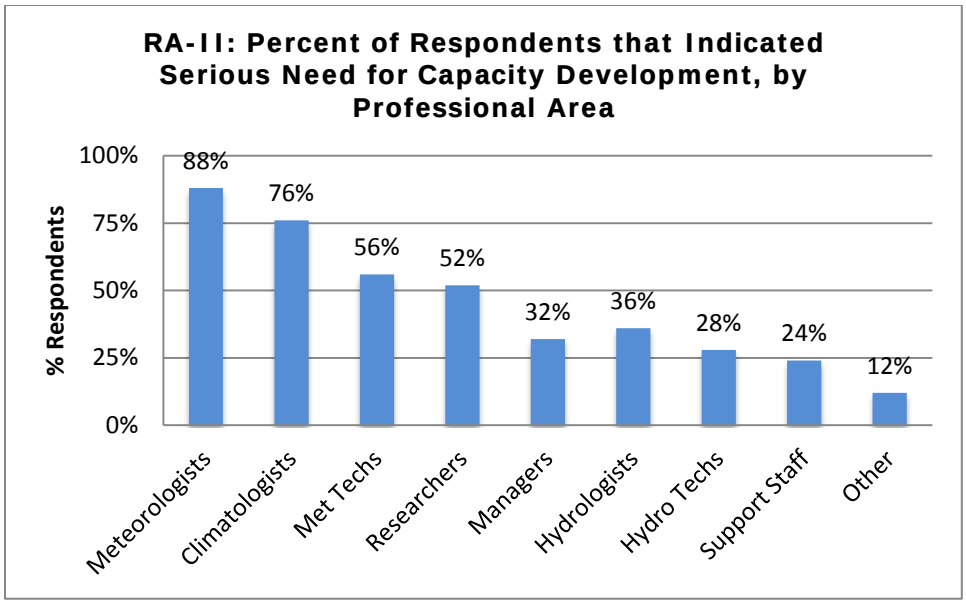


Figure 2.3.2c. Percent of RA-II respondents that indicated serious need for capacity development, by professional area

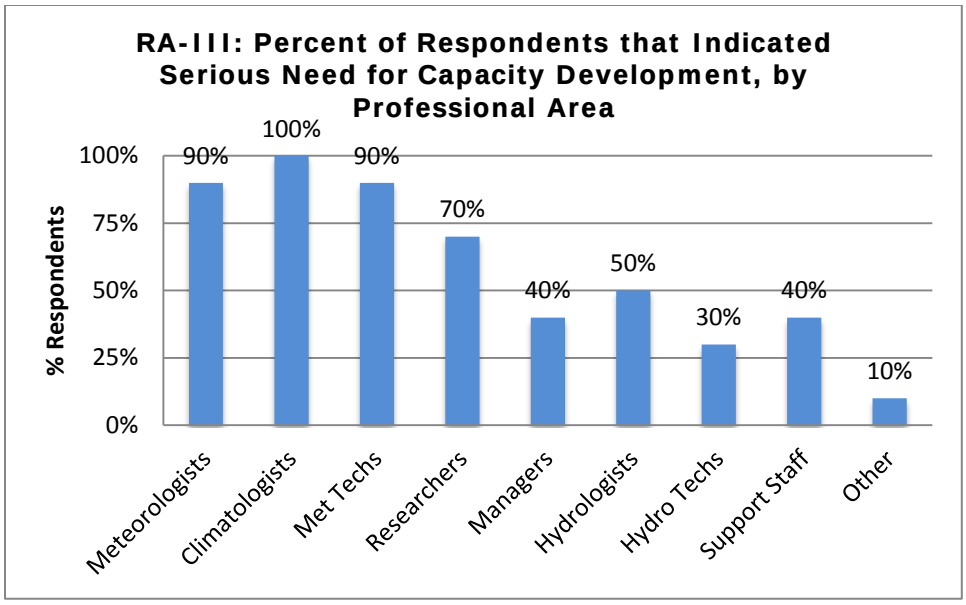


Figure 2.3.2d. Percent of RA-III respondents that indicated serious need for capacity development, by professional area

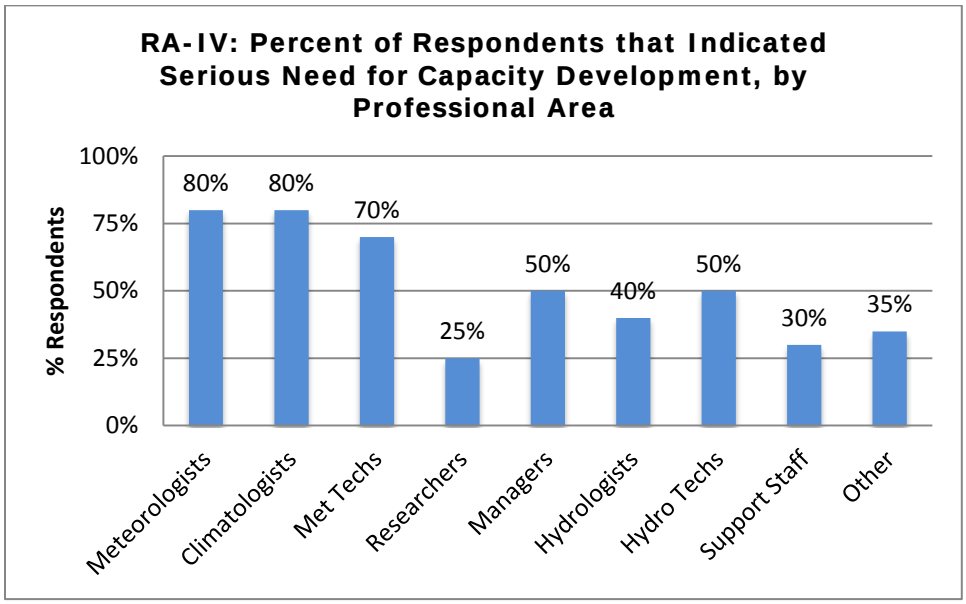


Figure 2.3.2e. Percent of RA-IV respondents that indicated serious need for capacity development, by professional area

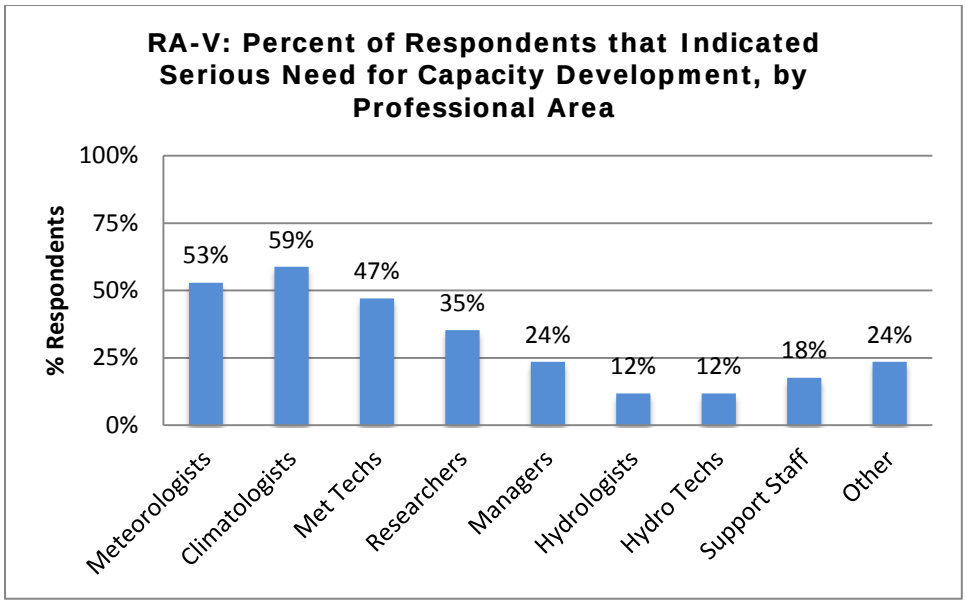


Figure 2.3.2f. Percent of RA-V respondents that indicated serious need for capacity development, by professional area

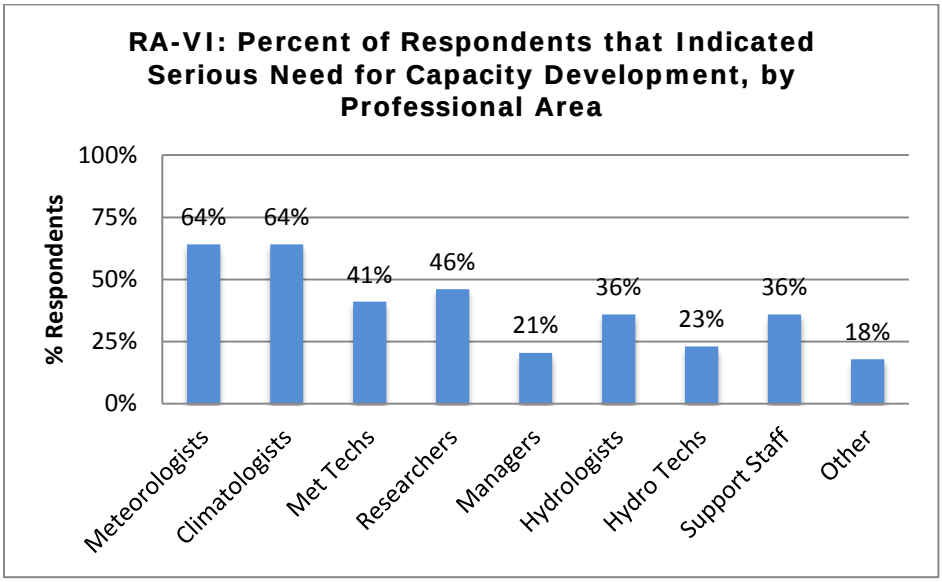


Figure 2.3.2g. Percent of RA-VI respondents that indicated serious need for capacity development, by professional area

2.3.3 Number of People that Need Training

Major Finding: Worldwide, more than 39,000 people need training in various professional areas. The most numerous group of people that need training are Meteorological Technicians (12,253 people). The next largest group are Meteorologists (9,835 people). Sizeable numbers of Researchers, Management staff, and Climatologists also need training.

Table 2.3.3 shows the numbers of people within each Region that need training in each of the professional areas. The table is sorted in order of the global total of staff members that need training in each category, from highest to lowest.

Table 2.3.3. Regional numbers of staff needing trained in each professional area

Professional Area	Regions						Global
	I	II	III	IV	V	VI	
Met Techs	2,119	6,922	506	960	236	1,510	12,253
Meteorologists	1,068	3,983	344	2,639	263	1,538	9,835
Researchers	199	3,187	247	302	54	475	4,464
Managers	281	2,189	39	525	66	578	3,678
Climatologists	351	2,190	62	163	98	331	3,195
Support Staff	545	503	150	530	61	1,252	3,041
Other	276	232	17	742	26	219	1,512
Hydrologists	86	140	50	307	26	115	724
Hydro Techs	84	187	9	240	21	62	603
Regional Totals	**5,009**	**19,533**	**1,424**	**6,408**	**851**	**6,080**	**39,305**

Table 2.3.3 shows that, worldwide, 39,305 people need training in various professional areas. The most numerous group of people needing training are Meteorological Technicians (12,253 people). The next largest group are Meteorologists (9,835 people), followed by Researchers (4,464 people).

3,678 Management staff need training worldwide, as do 3,195 Climatologists, 3,041 Support staff, and 1,512 “Other” staff. 724 Hydrologists need training, and 603 Hydrological Technicians. (Note again that these numbers of Hydrologists and Hydrological Technicians represent only those that are associated with NMHSs. The total numbers of hydrology staff that need training may be higher.)

Meteorological Technicians and Meteorologists

Maps 2.3.3a and 2.3.3b, on the following page, show numbers of Meteorological Technicians (Map 2.3.3a) and Meteorologists (2.3.3b) that need training in each respondent Members’ NMHS.

Maps 2.3.3a and 2.3.3b group the numbers of people that need training into four levels. Members in which 1-9 Meteorological Technicians or Meteorologists need training are shaded white. Members in which 10-20 people need training in these areas are shaded pale blue. Members with 21-99 people need training in these areas are shaded medium blue. Finally, Members in which 100 or more people need training in these areas are shaded dark blue. Members with no people that need training in these areas, who did not answer these questions on the survey, or who did not respond to the survey, are shaded grey.

The number of respondents in each group level is indicated on the maps.

Map 2.3.3a. Number of Meteorological Technicians that need training

Map 2.3.3a shows that the 12,253 Meteorological Technicians that need training are distributed among 120 Members (79% of respondents), which are scattered throughout the Regions.

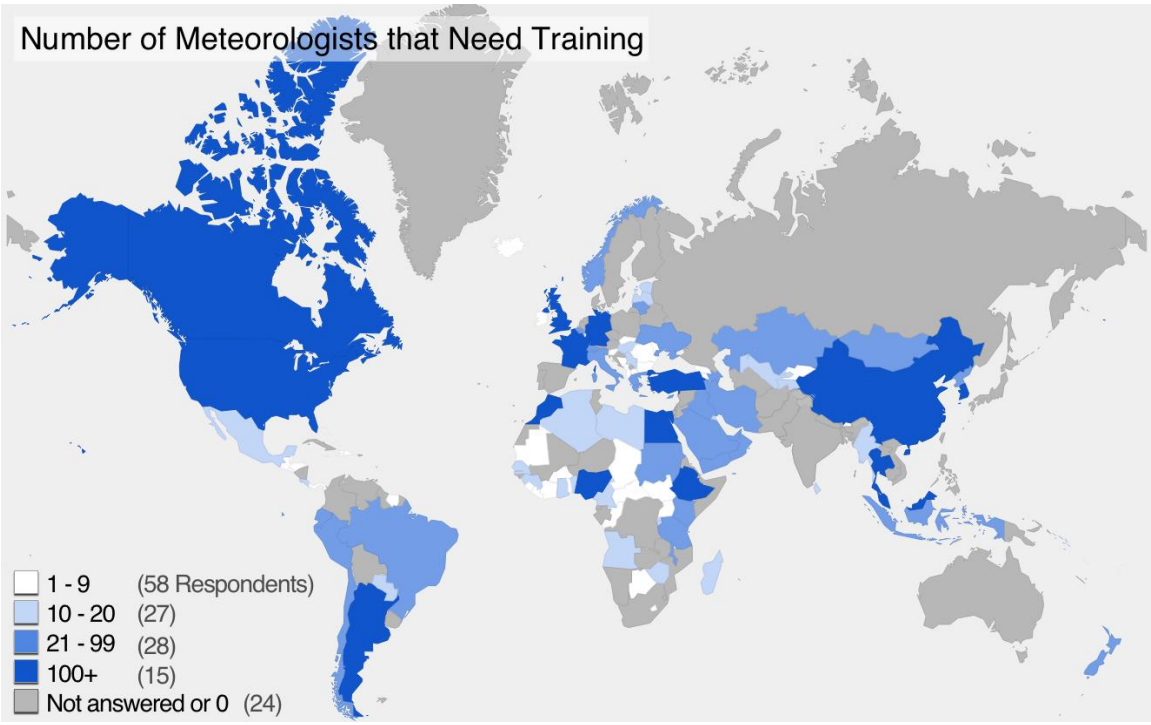
40 Members need to train 1-9 Meteorological Technicians (shaded white on Map 2.3.3a).

32 Members need to train 10-20 Meteorological Technicians (shaded pale blue).

25 Members need to train 21-99 Meteorological Technicians (shaded medium blue).

Finally, 23 Members need to train very large numbers of Meteorological Technicians—100 or more (shaded dark blue).

Regions are diverse in the numbers of Meteorological Technicians that each of their Members need to train.



Map 2.3.3b. Number of Meteorologists that need training

Map 2.3.3b shows that the 9,835 Meteorologists that need training are distributed among 128 Members (84% of respondents), which are also scattered throughout the Regions.

58 Members need to train 1-9 Meteorologists (shaded white on Map 2.3.3b).

27 Members need to train 10-20 Meteorologists (shaded pale blue).

28 Members need to train 21-99 Meteorologists (shaded medium blue).

Finally, 15 Members need to train very large numbers of Meteorologists—100 or more (shaded dark blue).

Regions are diverse in the numbers of Meteorologists that each of their Members need to train.

Maps 2.3.3a and 2.3.3b emphasize again that significant need for training in these professional areas is a situation shared by most respondent Members. About 80% of respondent Members need to train staff members as Meteorologists or Meteorological Technicians.

Researchers, Management Staff, and Climatologists

Maps 2.3.3c through 2.3.3e, on the following pages, show the numbers of Researchers, Management staff, and Climatologists that need training in each respondent State.

As was the case for the preceding Maps, Maps 2.3.3c through 2.3.3e group the numbers of people that need training into four levels. The number of people in each level is lower than for Maps 2.3.3a and 2.3.3b, however, since the numbers of Researchers, Management staff, and Climatologists that need training, while still substantial, are smaller than the numbers of Meteorological Technicians or Meteorologists that need training.

Members in which 1-3 people need training in Research, Management, or Climatology are shaded white. Members in which 4-9 people need training in these areas are shaded pale blue. Members with 10-29 people that need training in these areas are shaded medium blue. Finally, Members in which 30 or more people need training in these areas are shaded dark blue. Members with no people that need training in these areas, who did not answer these questions on the survey, or who did not respond to the survey, are shaded grey.

The number of respondents in each group level is indicated on each map.

Map 2.3.3c. Number of Researchers that need training

Map 2.3.3c shows that the 4,464 Researchers that need training are distributed among 87 Members (57% of respondents).

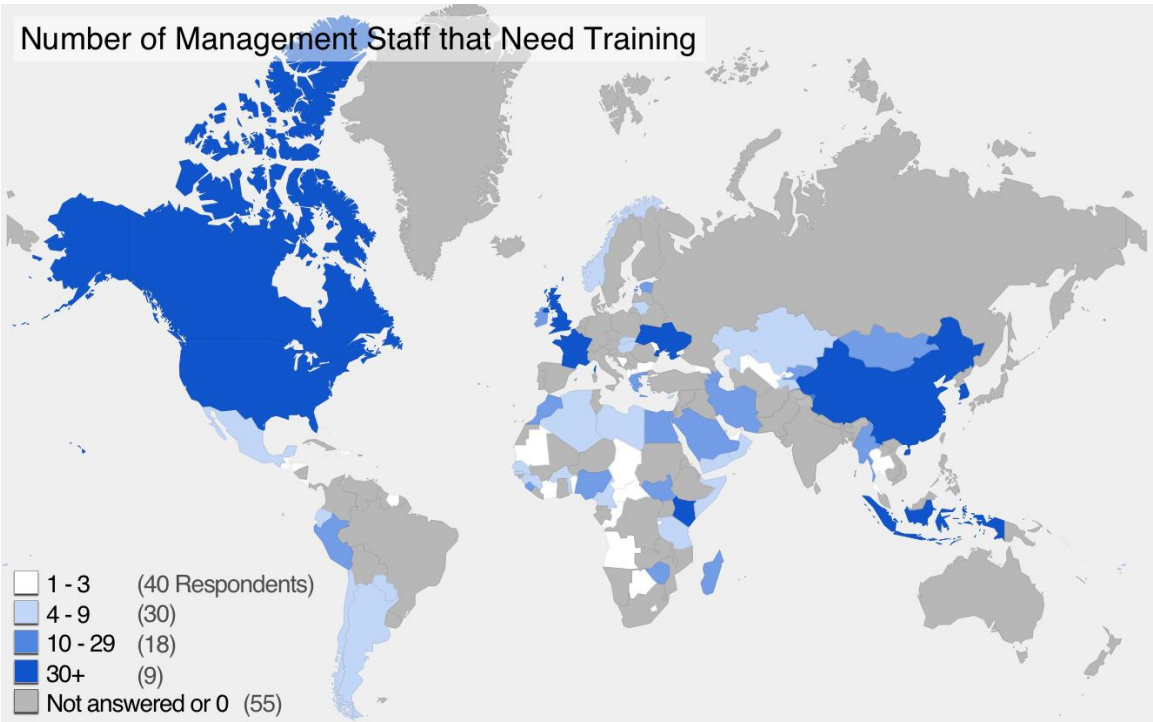
38 Members need to train 1-3 Researchers (shaded white on Map 2.3.3c).

23 Members need to train 4-9 Researchers (shaded pale blue).

17 Members need to train 10-29 Researchers (shaded medium blue).

Finally, 23 Members need to train large numbers of Researchers—30 or more (shaded dark blue).

The Members that need to train Researchers are scattered throughout the Regions. Regions are diverse in the numbers of Researchers that each of their Members need to train.



Map 2.3.3d. Number of Management staff that need training

Map 2.3.3d shows that the 3,678 Management staff that need training are distributed among 97 Members (64% of respondents).

40 Members need to train 1-3 Management staff (shaded white on Map 2.3.3d).

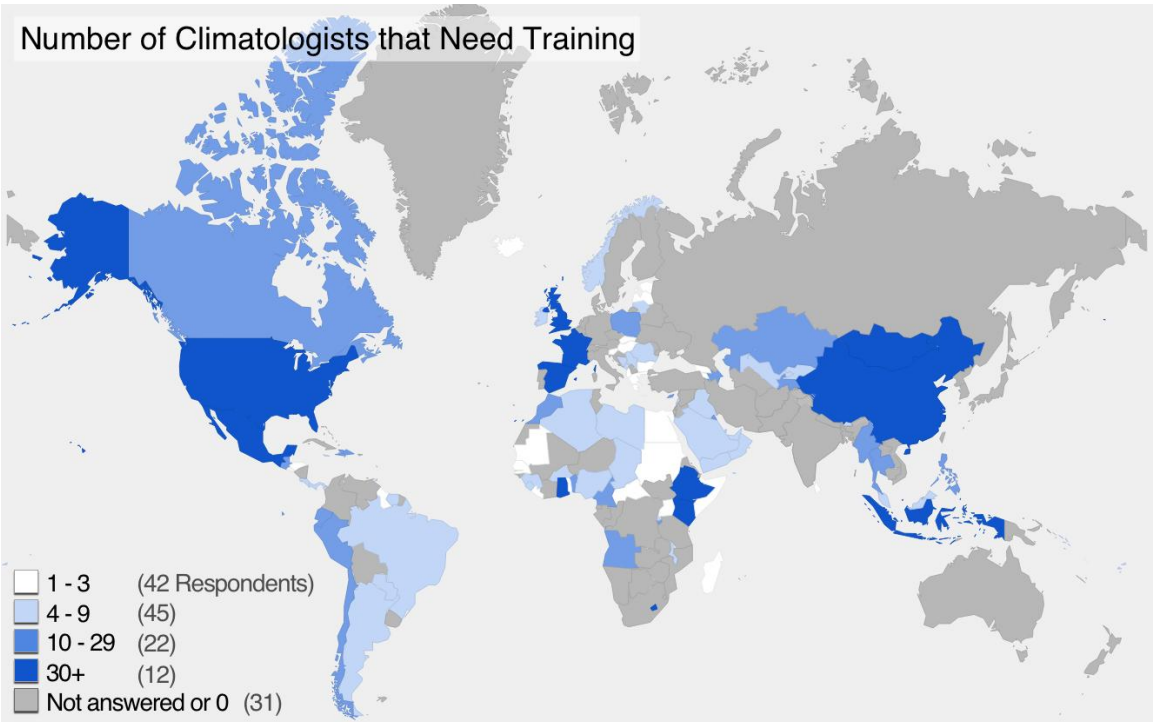
30 Members need to train 4-9 Management staff (shaded pale blue).

18 Members need to train 10-29 Management staff (shaded medium blue).

Finally, 9 Members need to train large numbers of Management staff—30 or more (shaded dark blue).

The Members that need to train Management staff are scattered throughout the Regions.

Regions are diverse in the numbers of Management staff that each of their Members need to train, except for RA-III, in which no Members need to train more than 30 Management staff.



Map 2.3.3e. Number of Climatologists that need training

Map 2.3.3e shows that the 3,195 Climatologists that need training are distributed among 121 Members (80% of respondents).

42 Members need to train 1-3 Climatologists (shaded white on Map 2.3.3e).

45 Members need to train 4-9 Climatologists (shaded pale blue).

22 Members need to train 10-29 Climatologists (shaded medium blue).

Finally, 12 Members need to train large numbers of Climatologists—30 or more (shaded dark blue).

The Members that need to train Climatologists are scattered throughout the Regions. Regions are diverse in the numbers of Climatologists that each of their Members need to train, except for RA-III, in which no Members need to train more than 30 Climatologists.

The need for training for Researchers, Management staff, and Climatologists is a situation also shared by most respondent Members. 57% of respondents need to train Researchers, 64% need to train Management staff, and 80% need to train Climatologists. The numbers of people that need trained in these areas are lower than the numbers of people that need training as Meteorologists and Meteorological Technicians that need training, but are still substantial.

2.3.4 Number of Staff Due to Retire

Major Findings: For some Regions and Members, human-resource losses due to retirement are expected to be dire.

Some Regions have average expected retirement rates of almost 30% of *all staff members.* Some Members are facing human resource losses higher than one in every two staff members in particular professional areas.

On average, 27% of Members' Management staff is due to retire in the next five years. 17% of Members' Meteorologists are due to retire, and 19% of Meteorological Technicians. 20% of Members' Hydrologists and 18% of their Hydrological Technicians, on average, are due to retire soon.

Planning for succession, recruitment, and knowledge transfer to the next generation of NMHS staff members is relevant for all Regions and for many individual Members. Creating processes through which NMHS excellence can be maintained through this transition is of paramount importance.

Table 2.3.4a shows the number of staff that are due to retire in the next five years, by Region and by professional area.

Table 2.3.4a. Total number of staff planning to retire in the next five years, by professional area

Professional Area	Regions						Global
	I	II	III	IV	V	VI	
Managers	125	490	70	237	263	262	1447
Meteorologists	211	757	124	701	213	593	2599
Met Techs	723	2536	398	418	403	919	5397
Hydrologists	18	31	11	84	17	74	235
Hydro Techs	21	48	24	44	11	184	332
Climatologists	83	896	5	26	64	84	1158
Researchers	19	834	2	70	48	208	1181
Support Staff	377	436	128	226	277	677	2121
Other	42	82	62	312	117	467	1082
Total Retiring	1,619	6,110	824	2,118	1,413	3,468	15,552
Total Staff	11,689	76,234	4,218	7,202	9,184	61,882	170,409
% Retiring	14%	8%	20%	29%	15%	6%	9%

Table 2.3.4a shows that 15,522 NMHS staff around the globe are due to retire within five years. This is 9% of the 170,409 global NMHS staff members.

The 15,552 staff members due to retire soon are distributed among the Regions. The overall percentage of Regional staff members due to retire varies widely, however, from a low of 6% in RA-VI to a high of 29% in RA-IV. The other Regions vary between these two extremes: RA-II expects 8% of its staff to retire soon; in RA-I and RA-V, the proportions are 14% and 15%, respectively; and in RA-III, the proportion is 20%.

Planning for succession, recruitment, and knowledge transfer to the next generation of NMHS staff members is relevant for all Regions. Exploration of the use of new technologies to support remaining staff members may also be a relevant strategy to enable NMHSs to continue to fulfill their responsibilities. For RA-III and RA-IV, with expected retirement rates of 20% and almost 30% of staff, the loss of retired staff members' knowledge and skill could cause dramatic impact on NMHS's abilities to fulfill their service responsibilities.

Table 2.3.4b shows Regional Members' average percentages of staff that are planning to retire soon, by professional area. These percentages are calculated only for respondents who currently employ staff members in each professional area.

Table 2.3.4b. Average percentage of staff planning to retire in the next five years, by professional area

Professional Area	Regions						Global
	I	II	III	IV	V	VI	
Managers	25%	24%	15%	44%	32%	22%	27%
Meteorologists	23%	11%	16%	23%	12%	13%	17%
Met Techs	27%	15%	20%	20%	20%	12%	19%
Hydrologists	36%	11%	25%	30%	22%	13%	20%
Hydro Techs	31%	8%	33%	13%	12%	16%	18%
Climatologists	17%	14%	3%	13%	14%	7%	12%
Researchers	10%	11%	4%	12%	12%	10%	10%
Support Staff	11%	10%	15%	18%	19%	11%	13%
Other	17%	5%	9%	15%	23%	14%	14%
Regional Percent	22%	12%	16%	21%	18%	13%	17%

Table 2.3.4b shows that there is less variation among the Regions when large and small NMHSs are weighted equally, as is the case when Members' national distributions are averaged. RA-II's Members have the lowest average retirement rate (12%), with RA-VI's Members close by (13%); RA-I's Members have the highest average retirement rate (22%), with RA-IV's Members very similar (21%). RA-III's Members' average expected retirement rate is 16%, and RA-V's Members' average is 18%.

Table 2.3.4b also shows that, on average, 27% of Members' Management staff is due to retire in the next five years. 17% of Members' Meteorologists are due to retire, and 19% of Meteorological Technicians. 20% of Members' Hydrologists and 18% of their Hydrological Technicians, on average, are due to retire soon. Global averages for the percentages of staff in other professional areas that are planning to retire soon are slightly lower.

Average expected retirement rates vary widely among the Regions' professional-area groups. For instance, Climatologists in RA-III have the lowest average expected retirement rate among all the Regional professional-area groups, at only 3%. Management staff in RA-IV have the highest average expected retirement rate among all the Regional professional-area groups, at 44%.

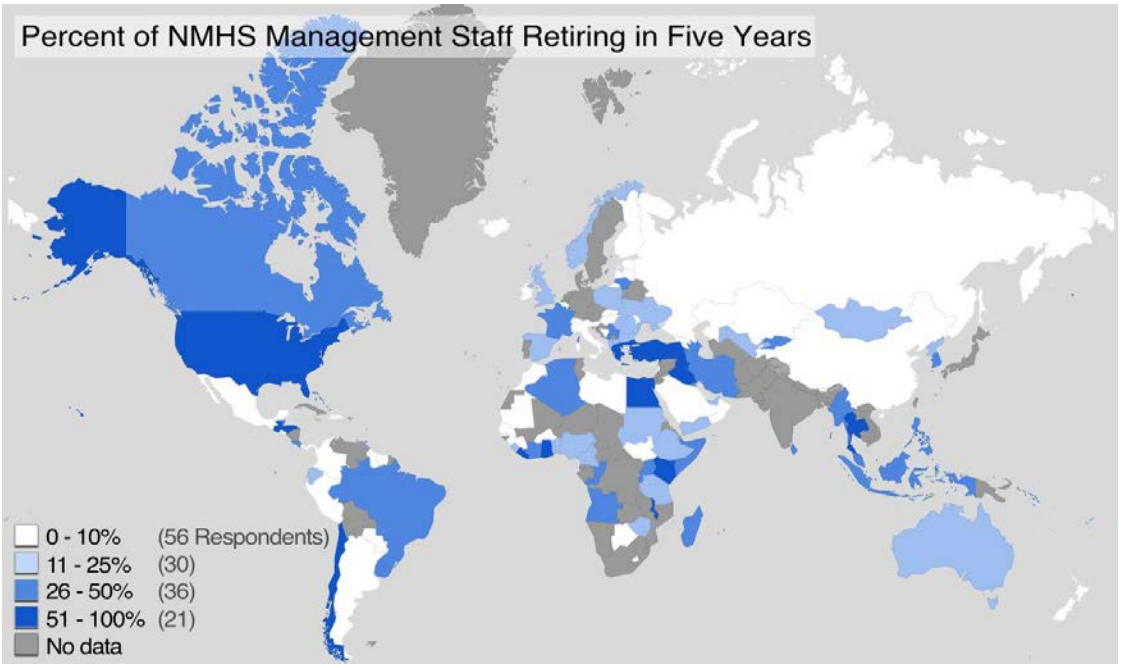
The data in Table 2.3.4b point again to potentially drastic loss of human resources in particular professional areas, sometimes in particular regions, sometimes worldwide. The loss in some cases is more than one in four of current staff members, and sometimes almost as high as one in every two current staff members.

Since the data in Table 2.3.4b are averages, this suggests that some Members may be facing lower potential losses of human resources than these numbers show, but that other Members may be facing *even higher* potential losses.

Maps 2.3.4a through 2.3.4c, on the following pages, show Members' percentages of Management staff, Meteorologists, and Meteorological Technicians that are due to retire in the next five years.

The percentages of staff members shown in Maps 2.3.4a through 2.3.4c are grouped into four levels. Members in which 0-10% of staff are retiring within five years are shaded white. Members in which 11-20% of staff are retiring soon are shaded pale blue. Members with 21-50% of staff planning to retire are shaded medium blue. Members in which 51-100% of staff are due to retire soon are shaded dark blue. Members shaded grey do not have staff retiring in that category, or did not respond to the survey.

The number of respondents in each group level is indicated on each map.



Map 2.3.4a. Percent of NMHS Management staff retiring in five years

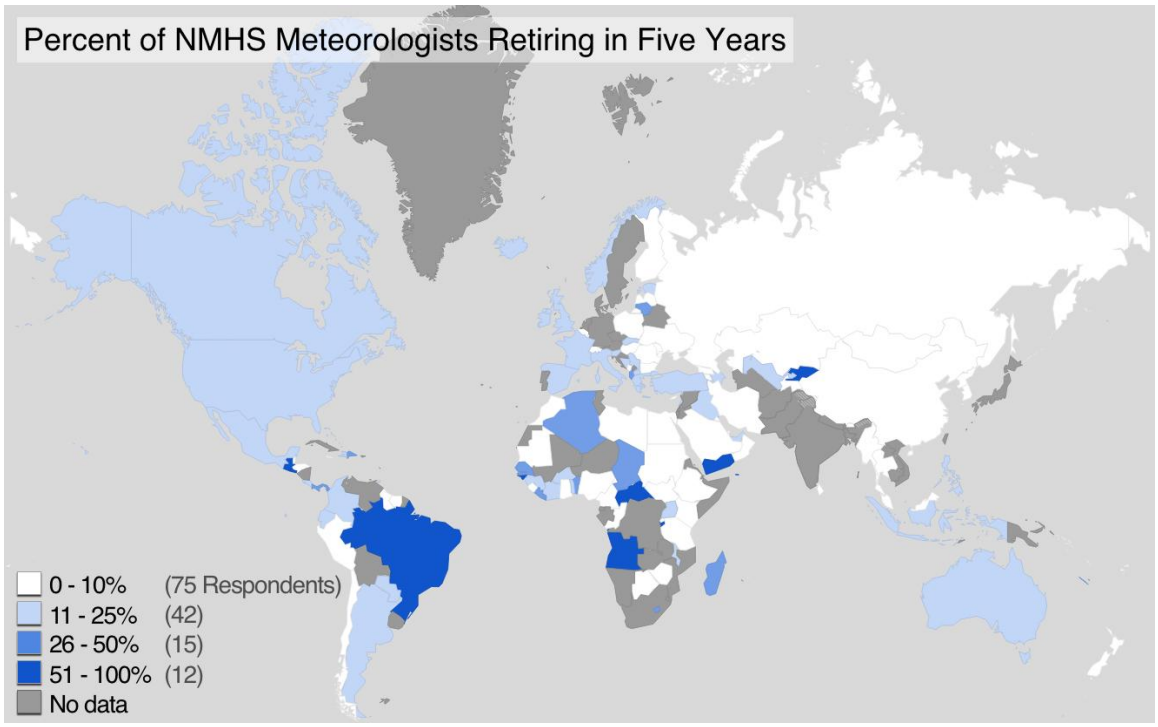
Map 2.3.4a shows that the 1,447 Management staff that are retiring are distributed among 143 Members.

56 Members (37% of respondents) have 0-10% of their Management staff planning to retire in the next five years (shaded white on Map 2.3.4a).

30 Members (20% of respondents) have 11-25% of their Management staff due to retire (shaded pale blue).

36 Members (24% of respondents) expect 26-50% of their Management staff to retire soon (shaded medium blue).

Finally, 21 Members (14% of respondents) foresee the imminent retirement of 50-100% of their Management staff (shaded dark blue).



Map 2.3.4b. Percent of NMHS Meteorologists retiring in five years

Map 2.3.4b shows that the 2,599 NMHS Meteorologists that are retiring are distributed among 144 Members.

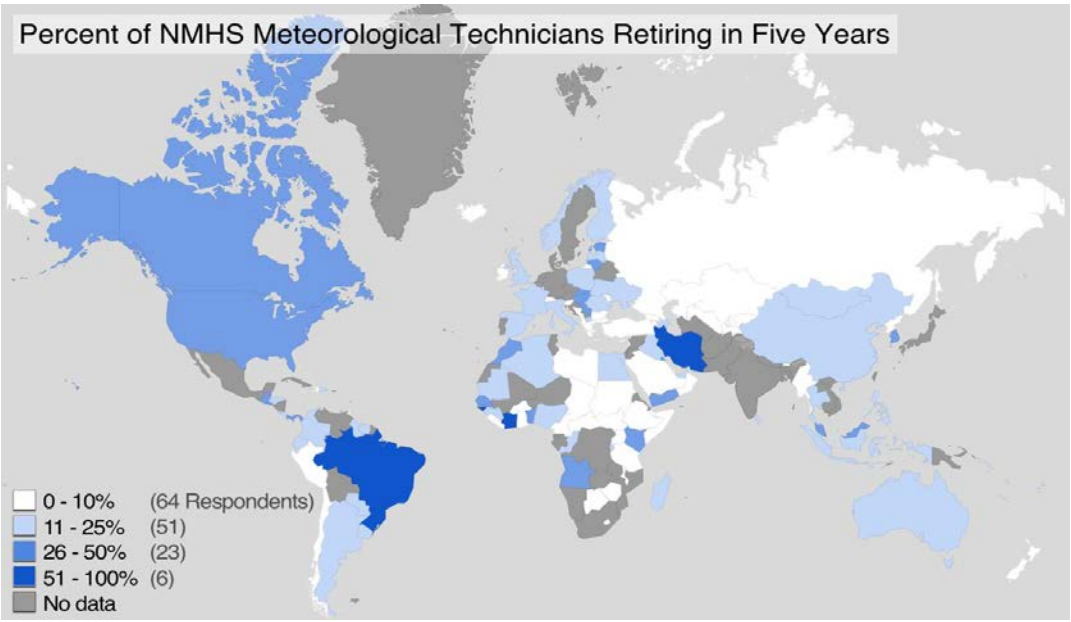
75 Members (49% of respondents) have 0-10% of their Meteorologists planning to retire in the next five years (shaded white on Map 2.3.4b).

42 Members (28% of respondents) have 11-25% of their Meteorologists due to retire (shaded pale blue).

15 Members (10% of respondents) expect 26-50% of their Meteorologists to retire soon (shaded medium blue).

Finally, 12 Members (8% of respondents) foresee the imminent retirement of 50-100% of their Meteorologists (shaded dark blue).

The Meteorologists expected to retire are distributed throughout the Regions, although Map 2.3.4b suggests that the Meteorologists in RA-II are younger than in other Regions: in most RA-II respondents, fewer than 10% of Meteorologists are expected to retire in the next five years. Table 2.3.4b shows that RA-II has the lowest average expected retirement rate for Meteorologists (11%), compared to the global average rate of 17%.



Map 2.3.4c. Percent of NMHS Meteorological Technicians retiring in five years

Map 2.3.4c shows that the 5,397 NMHS Meteorological Technicians that are retiring are distributed among 144 Members.

64 Members (42% of respondents) have 0-10% of their Meteorological Technicians planning to retire in the next five years (shaded white in Map 2.3.4c).

51 Members (34% of respondents) have 11-25% of their Meteorological Technicians due to retire (shaded pale blue).

23 Members (15% of respondents) expect 26-50% of their Meteorological Technicians to retire soon (shaded medium blue).

Finally, 6 Members (4% of respondents) foresee the imminent retirement of 50-100% of their Meteorological Technicians (shaded dark blue).

Maps 2.3.4a through 2.3.4c show that Members that expect substantial percentages of their Management staff, Meteorologists, and Meteorological Technicians to retire soon are distributed throughout the Regions. Furthermore, Regions are diverse in the percentages of staff members that each of their Members expect to retire soon in each of these professional areas.

As mentioned above, planning for succession, recruitment, and knowledge transfer to the next generation of NMHS staff members is relevant for all Regions and for many individual Members. Exploration of the use of new technologies to support remaining staff members may also be a relevant strategy to enable NMHSs to continue to fulfill their responsibilities. Creating processes through which NMHS excellence can be maintained through this transition is of paramount importance.

2.4 Training Expectations in 2017

Major Findings: 19,191 people anticipate training in 2017, supported by either government sources, project funds, the WMO, or other scholarships.

53% of respondents anticipate that half of their 2017 trainees or fewer will receive support from government sources.

Many Members expect WMO funding to be a significant source for training support in 2017. Half of the survey respondents expect 11-50% of their 2017 trainees to be supported by WMO sources; another 11% of the survey respondents are relying even more heavily on WMO funding.

Substantial numbers of people will still need training in many Members' NMHSs, even if the education of the people anticipating training in 2017 comes to fruition. 74 training; 24 Members will still have more than 100 people that need training.

When planning for allotments to fund training, it is important to recognize the variability among Members regarding expected funding sources, the numbers of people that need trained, and the potential impacts of shortfalls.

Table 2.4a shows the number of people anticipating training in 2017, grouped by Region and by the source of support they anticipate for that training. Table 2.4b, on the following page, shows the percentages of each Region's total number of 2017-trainees that are anticipating support from each funding source.

Table 2.4a. Regional numbers of staff anticipating training in 2017, by funding source

Funding Source	Region						Global
	I	II	III	IV	V	VI	
Government	1,966	4,047	458	4,603	898	4,100	16,072
Project Funds	401	606	194	28	45	147	1,421
WMO	518	264	135	87	62	96	1,162
Other Scholarships	216	129	59	16	30	86	536
Regional Totals	**3,101**	**5,046**	**846**	**4,734**	**1,035**	**4,429**	**19,191**

Table 2.4b. Percentage of 2017-trainees anticipating funding from each source

Funding Source	Region						Global
	I	II	III	IV	V	VI	
Government	63%	80%	54%	97%	87%	93%	84%
Project Funds	13%	12%	23%	1%	4%	3%	7%
WMO	17%	5%	16%	2%	6%	2%	6%
Other Scholarships	7%	3%	7%	0.30%	3%	2%	3%
Total	100%	100%	100%	100%	100%	100%	100%

Table 2.4a and 2.4b show that 19,191 people are anticipating training in 2017. 16,072 (84%) of these trainees anticipate government support. 1,421 (7%) anticipate support through project funding. 1,162 (6%) anticipate support through WMO funding. Finally, 536 (3%) anticipate support through other scholarships.

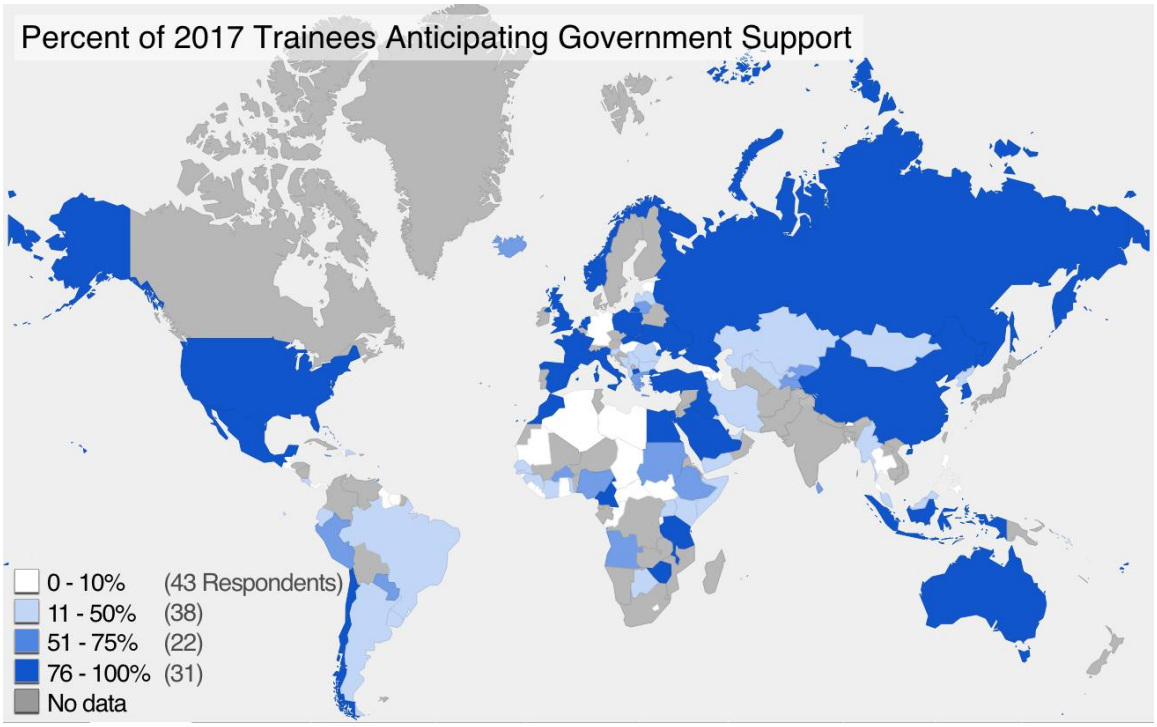
Maps 2.4a through 2.4c, on the following pages, show Members' percentages of 2017 trainees anticipating government support (Map 2.4a), project support (Map 2.4b), and WMO support (Map 2.4c).

The percentages of 2017 trainees shown in Maps 2.4a through 2.4c are grouped into four levels.

Map 2.4a (government support) and Map 2.4b (WMO support) are grouped into the same four levels. Members in which 0-10% of trainees anticipate support from these sources are shaded white. Members in which 11-50% of trainees anticipate support from these sources are shaded pale blue. Members with 51-75% of trainees anticipating support from these sources are shaded medium blue. Members in which 76-100% of trainees anticipate support from these sources are shaded dark blue. Members shaded grey do not have trainees anticipating support from these sources, did not answer this question, or did not respond to the survey.

Map 2.4c (project support) is grouped into a different set of four levels. Members in which 0% of trainees anticipate support from projects are shaded white. Members in which 1-25% of trainees anticipate support from projects are shaded pale blue. Members with 26-50% of trainees anticipating support from projects are shaded medium blue. Members in which 51-100% of trainees anticipate support from projects are shaded dark blue. Members shaded grey do not have trainees anticipating support from projects, did not answer this question, or did not respond to the survey.

The number of respondents in each group level is indicated on the maps.



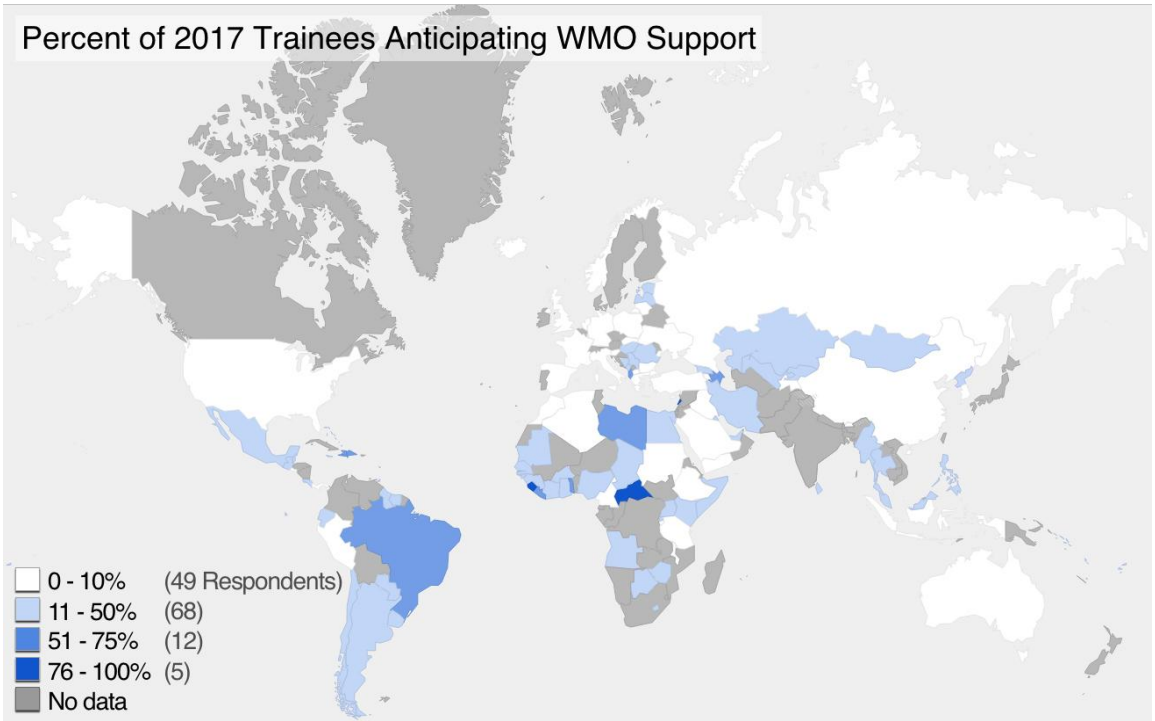
Map. 2.4a. Percent of 2017 trainees anticipating government support

Map 2.4a shows that about one quarter of respondents (43 Members, 28%) expect 0-10% of their 2017 trainees to be supported by government sources (shaded white on the map).

Another quarter of the respondents (38 Members, 25%) expect 11-50% of their trainees' support to originate from this source (shaded pale blue).

14% of respondents (22 Members) expect 51-75% of their 2017 trainees to be supported by government funding (shaded medium blue).

Finally, 20% of respondents (31 Members) expect 76-100% of their 2017 trainees to receive their support from government sources (shaded dark blue).



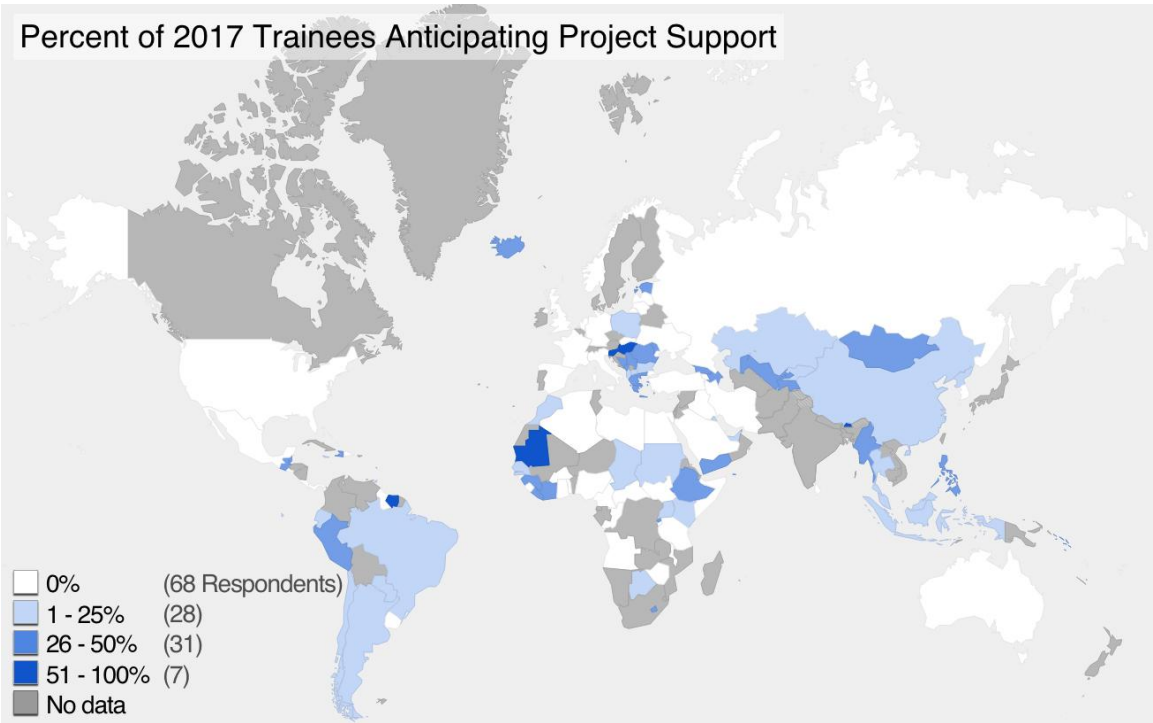
Map. 2.4b. Percent of 2017 trainees anticipating WMO support

Map 2.4b shows that one third of respondents (49 Members, 32%) expect 0-10% of their 2017 trainees to be supported by WMO funding (shaded white on the map).

Almost half of the respondents (68 Members, 45%) expect 11-50% of their trainees' support to originate from this source (shaded pale blue).

8% of respondents (12 Members) expect 51-75% of their 2017 trainees to be supported by the WMO (shaded medium blue).

Finally, only 3% of respondents (5 Members) expect 76-100% of their 2017 trainees to receive their support from WMO sources (shaded dark blue).



Map. 2.4c. Percent of 2017 trainees anticipating project support

Map 2.4c shows that in almost half of the respondents (68 Members, 45%) none of their 2017 trainees are receiving project support (shaded white on the map).

28 Members 18%) expect 1-25% of their trainees' support to originate from project funds (shaded pale blue).

20% of respondents (31 Members) expect 26-50% of their 2017 trainees to be supported by projects (shaded medium blue).

Finally, 5% of respondents (7 Members) expect 51-100% of their 2017 trainees to receive their support from project sources (shaded dark blue).

Map 2.4d, on the following page, shows each Members' number of people that need training beyond those anticipating training in 2017. This number was calculated by totaling each respondent's reported number of people that need training in each professional area, then subtracting the total number of people that anticipate training in 2017.

The numbers of people that need training beyond the 2017 trainees shown in Map 2.4d are grouped into four levels. Members in which the number of people anticipating training in 2017 are equal to or greater than the numbers needing training in general are shaded white. Members in which 1-24 people will still need training, even if the 2017 trainees' education comes to fruition, are shaded pale blue. Members in which 25-99 people remain needing training, beyond the 2017 trainees, are shaded medium blue. Members in which more than 100 people will yet need training are shaded dark blue. Members shaded grey did not respond to the survey.

The number of respondents in each group level is indicated on the map.

Map. 2.4d. Number of people that need training beyond the 2017 Trainees

Map 2.4d shows that substantial numbers of people still need training in many Members' NMHSs, even if the education of the people anticipating training in 2017 comes to fruition.

About one third of respondents (45 Members, 30%) are fortunate enough that their numbers of people anticipating training in 2017 are equal to or greater than the numbers of people reported to need training in the professional areas. (This group is shaded white on Map 2.4d.)

About one quarter of the respondents (33 Members, 22%) will have 1-24 people that still need training (shaded pale blue on the map).

One third of the respondents (50 Members, 33%) have 25-99 people that still need training (shaded medium blue).

24 Members (16%) have more than 100 people that still need training (shaded dark blue).

Map 2.4d shows that the Members that have more than 100 people still needing training, beyond their plans for 2017 training, are distributed amongst the Regions.

When planning for allotments to fund training, it is important to recognize the variability in expected funding sources among Members. A small shortfall from one source may still enable some Members to meet most of their training goals, while the same shortfall for another Member may seriously disrupt their planned progress.

Variability must also be acknowledged in the numbers of people that Members need to train. A few people that need training but do not receive it may not have a significant impact on a large NMHS, while the same number of people lacking training may be critical to a smaller NMHS.

Some of this variability in impact may depend on whether the people needing training are already qualified in their professional area and need to hone their skills; or whether the people that need training are just starting out and need trained from the ground up. The data from this survey can't shed light on this distinction.

2.5 Training Priority Areas

Major Finding: Seven training topics were indicated by 20 or more respondents as a training priority. First is Weather Forecasting and NWP, followed by Instruments and Observation, Climate Services, Agrometeorology, Hydrology/Hydrometeorology, Management and Administration, and Atmospheric Sciences and Research.

These training priorities are consistent with other findings of the survey, which revealed substantial need for capacity strengthening for Meteorological Technicians, Meteorologists, Climatologists, Management staff, and Researchers.

The survey invited respondents to list, in order of priority, four areas in which their NMHS group needs training. The priorities indicated by respondents were standardized into a list of 18 topic areas, as shown in the Table 2.5a.

Table 2.5a. Standardized List of Training Priorities

1	Aeronautical Meteorology	10	Hydrology/Hydrometeorology
2	Agrometeorology	11	Instrumentation and Observation
3	Atmospheric Modelling	12	IT Skills, Computing, Data Processing
4	Atmospheric Sciences and Research	13	Management and Admin Skills
5	BIP for Met Techs (MT)	14	Marine Met and Oceanography
6	BIP for Meteorologist (M)	15	Project Management
7	Climate Services	16	Public Education
8	Communication & Customer Interaction	17	Training of Trainers and Online Training
9	General Meteorology	18	Weather Forecasting and NWP

This report will refer to a respondent's selection of a topic as one of their top four priorities as a "vote." Not all survey respondents indicated a full set of four training priorities: 143 respondents (94%) indicated at least one training priority; 127 respondents (84%) indicated a full set of four training priorities. The group cast a total of 548 votes for training priorities.

Table 2.5b, on the following page, shows the number of votes each training topic received in the position of first, second, third, or fourth training priority. The fourth column of the table shows the total votes each topic received across all four priority ratings. The table is sorted by total number of votes.

Table 2.5b. Training priorities, and the number of respondents that selected each one as a priority

	Training Topics	1st Priority	2nd Priority	3rd Priority	4th Priority	Total
1	Weather Forecasting and NWP	83	22	16	10	131
2	Instrumentation and Observation	12	23	31	33	99
3	Climate Services	11	24	23	15	73
4	Agrometeorology	3	19	19	15	56
5	Hydrology/Hydrometeorology	7	14	12	10	43
6	Management and Admin Skills	1	3	3	15	22
7	Atmo Sciences and Research	1	6	6	7	20
8	Aeronautical Meteorology	7	5	4	3	19
9	IT Skills, Computing, Data	1	5	5	8	19
10	Comm. & Customer Interaction	4	4	6	3	17
11	BIP for Met Techs (MT)		8	3	4	15
12	BIP for Meteorologist (M)	9			2	11
13	General Meteorology	1	6			7
14	Atmospheric Modelling	3		2	1	6
15	Marine Met and Oceanography		2	2	2	6
16	Project Management			1	1	2
17	Public Education			1		1
18	Trainers / Online Training		1			1
	Total	**143**	**142**	**134**	**129**	**548**

Note: Cell shading indicates topics which few respondents selected as a priority. Dark grey = zero respondents; medium grey = one respondent; pale grey: two respondents.

Table 2.5b shows that the number of votes each training topic received ranged from a high of 131 to a low of 2. All 18 topics received at least 2 votes, but may have been ranked as different priorities. Seven topics had twenty or more respondents indicate them as a top-four training priority.

Figure 2.5a, on the next page, shows those seven training topics and the numbers of votes each received as a first, second, third, or fourth training priority. The blue segment of each bar represents the number of votes that topic received as a first priority. The red segments represent the number of votes as a second priority; the pale green segment represents number of votes as a third priority; and the purple segment represents number of votes as a fourth priority. The figure is sorted by total number of votes.

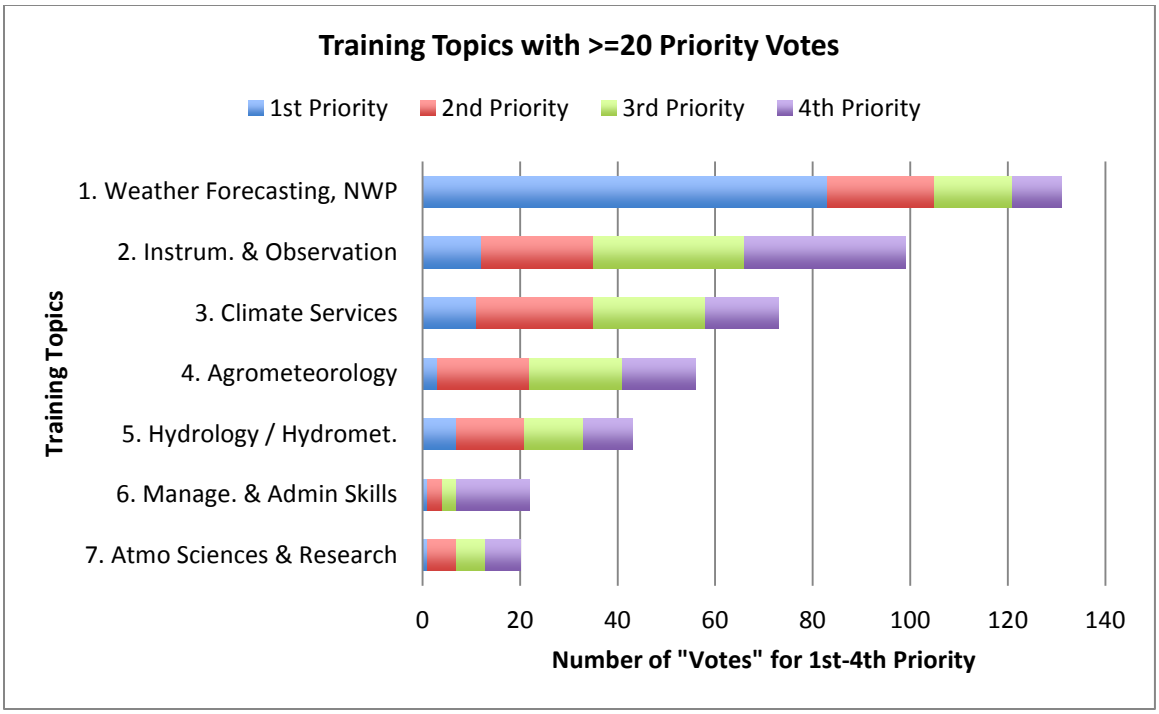


Figure 2.5a. The seven training priorities with more than 20 priority votes

Table 2.5b and Figure 2.5a show that Weather Forecasting and NWP is the training topic most frequently indicated as a top priority, both as the first priority and overall. It received 131 votes as a top-four training priority. This is almost one quarter of all votes cast (24%).

Instruments and Observation is the second most frequently selected training priority, receiving 99 votes —almost one-fifth of all votes cast (18%). This topic includes satellite-related priorities.

Climates Services is the third most frequently selected training priority. It received 73 votes (13% of all votes cast).

Agrometeorology is the fourth most frequently selected training priority (56 votes, 10% of all votes cast).

Hydrology / Hydrometeorology is the fifth training priority (43 votes, 8% of all votes cast).

The next-most frequently chosen topics are Management and Administration Skills (22 votes) Atmospheric Sciences and Research (20 votes). These each represent about 4% of all votes cast.

Table 2.5c shows the number of times respondents in each Region indicated each training topic as a top-four priority. In other words, it shows the number of votes each topic received as a top training priority in each Region, whether the vote was for first priority, second priority, etc. The table is sorted by the global priority order, from highest to lowest.

Table 2.5c. Number of votes each topic received as a top-four training priority in each Region

Priority Area	Global	I	II	III	IV	V	VI
Weather Forecasting and NWP	131	39	23	12	14	10	33
Instrumentation and Observation	99	30	17	6	17	12	17
Climate Services	73	19	14	7	12	8	13
Agrometeorology	56	25	9	6	8	2	6
Hydrology/Hydrometeorology	43	10	6	5	4	2	16
Management and Admin Skills	22	7	4		2	3	6
Atmospheric Sciences and Research	20	7	4		1	2	6
Aeronautical Meteorology	19	4	3	1	2	2	7
IT Skills, Computing, Data Processing	19	3	5		3	2	6
Comm. & Customer Interaction	17	1	3	1	7	1	4
BIP for Met Techs (MT)	15	7	2		3	3	
BIP for Meteorologist (M)	11	5	1		3	2	
General Meteorology	7	1	2	1		1	2
Atmospheric Modelling	6	1		1		1	3
Marine Met and Oceanography	6	2	1		1	1	1
Project Management	2						2
Public Education	1						1
Training Trainers and Online Training	1						1
Total Votes	**548**	**161**	**94**	**40**	**77**	**52**	**124**

Note: Cell shading indicates topics that few respondents selected as a priority. Dark grey = zero respondents; medium grey = one respondent; pale grey: two respondents.

Table 2.5d, on the following page, shows the percentage of each Region's respondents that indicated each topic as a top training priority, whether the vote was for first priority, second priority, etc. The table is sorted by the global priority order, from highest to lowest.

Percentages higher than 100% indicate that one or more respondents' training priorities, when standardized into the list of 18 topics, were standardized into the same general topic. In these cases, where one respondent's priorities included duplicates of the generalized topics, that topic receives more than one "vote" from one respondent.

Table 2.5d. Percentage of votes each topic received as a top-four training priority in each Region

Priority Area	Global	I	II	III	IV	V	VI
Weather Forecasting and NWP	86%	95%	92%	120%	70%	59%	85%
Instrumentation and Observation	65%	73%	68%	60%	85%	71%	44%
Climate Services	48%	46%	56%	70%	60%	47%	33%
Agrometeorology	37%	61%	36%	60%	40%	12%	15%
Hydrology/Hydrometeorology	28%	24%	24%	50%	20%	12%	41%
Management and Admin Skills	14%	17%	16%		10%	18%	15%
Atmospheric Sciences and Research	13%	17%	16%		5%	12%	15%
Aeronautical Meteorology	13%	10%	12%	10%	10%	12%	18%
IT Skills, Computing, Data Processing	13%	7%	20%		15%	12%	15%
Comm. & Customer Interaction	11%	2%	12%	10%	35%	6%	10%
BIP for Met Techs (MT)	10%	17%	8%		15%	18%	
BIP for Meteorologist (M)	7%	12%	4%		15%	12%	
General Meteorology	5%	2%	8%	10%		6%	5%
Atmospheric Modelling	4%	2%		10%		6%	8%
Marine Met and Oceanography	4%	5%	4%		5%	6%	3%
Project Management	1%						5%
Public Education	1%						3%
Training Trainers and Online Training	1%						3%

Note: Cell shading indicates topics that few respondents selected as a priority. Dark grey = zero respondents; medium grey = one respondent; pale grey: two respondents.

Table 2.5d shows that the ordering of training priorities is similar across the various Regions, with some exceptions. It also shows that for RA-I, RA-II, RA-II, and RA-VI, Weather Forecasting and NWP is overwhelmingly the most frequently indicated priority. For RA-IV and RA-V, Instrumentation and Observation was indicated as a training priority more frequently than Weather Forecasting and NWP.
Figures 2.5b through 2.5g, on the following pages, show the top seven training priorities for each Region.

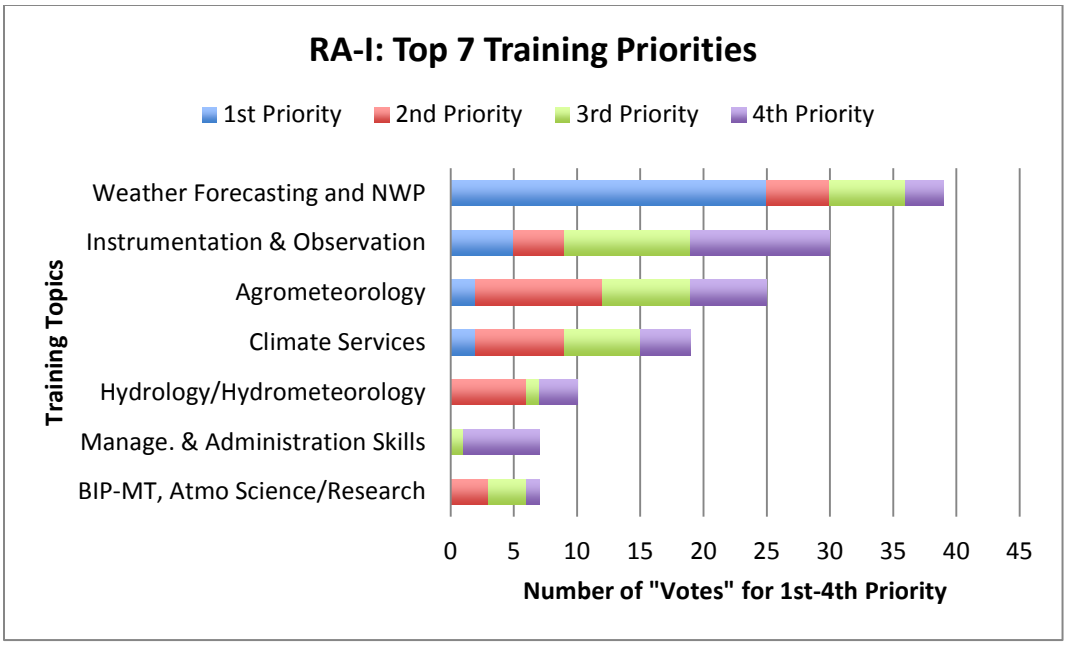


Figure 2.5b. RA-I: Top seven training priorities

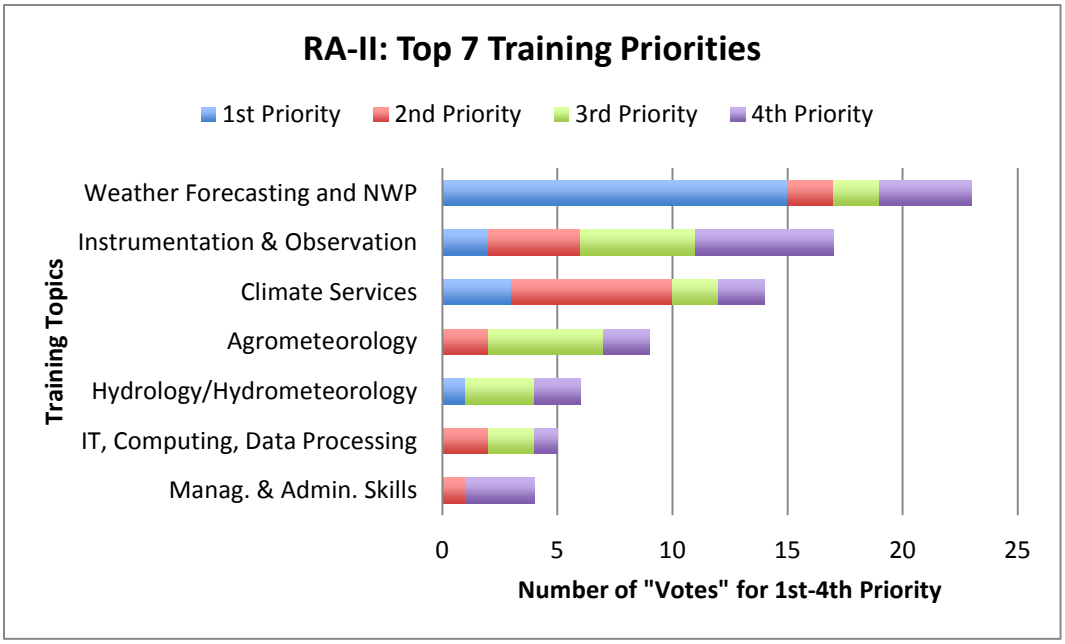


Figure 2.5c. RA-II: Top seven training priorities

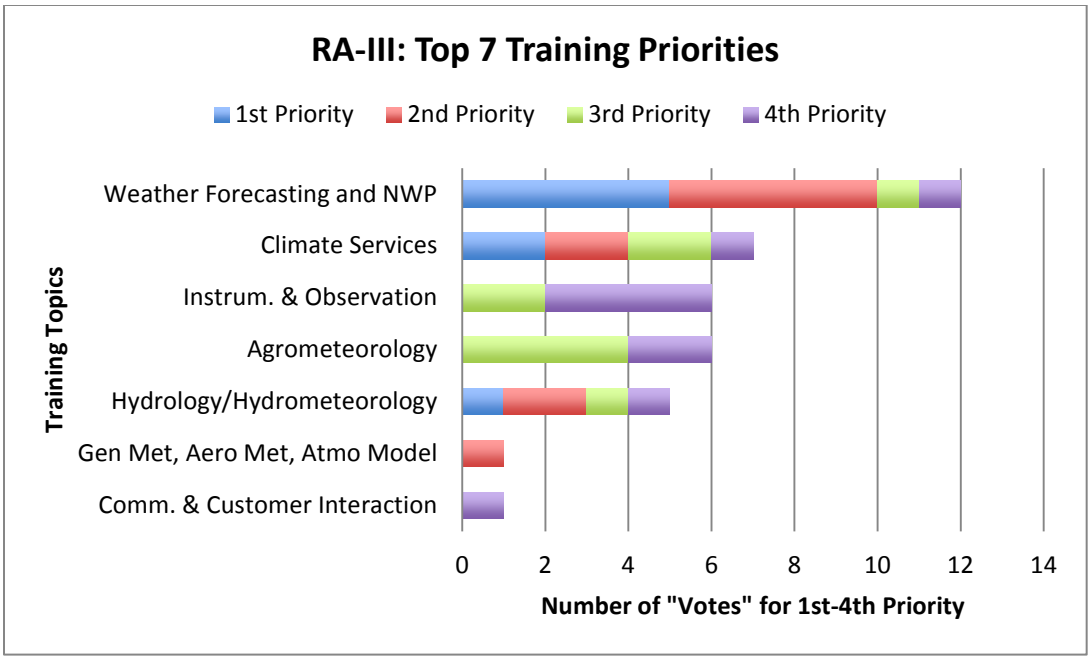


Figure 2.5d. RA-III: Top seven training priorities

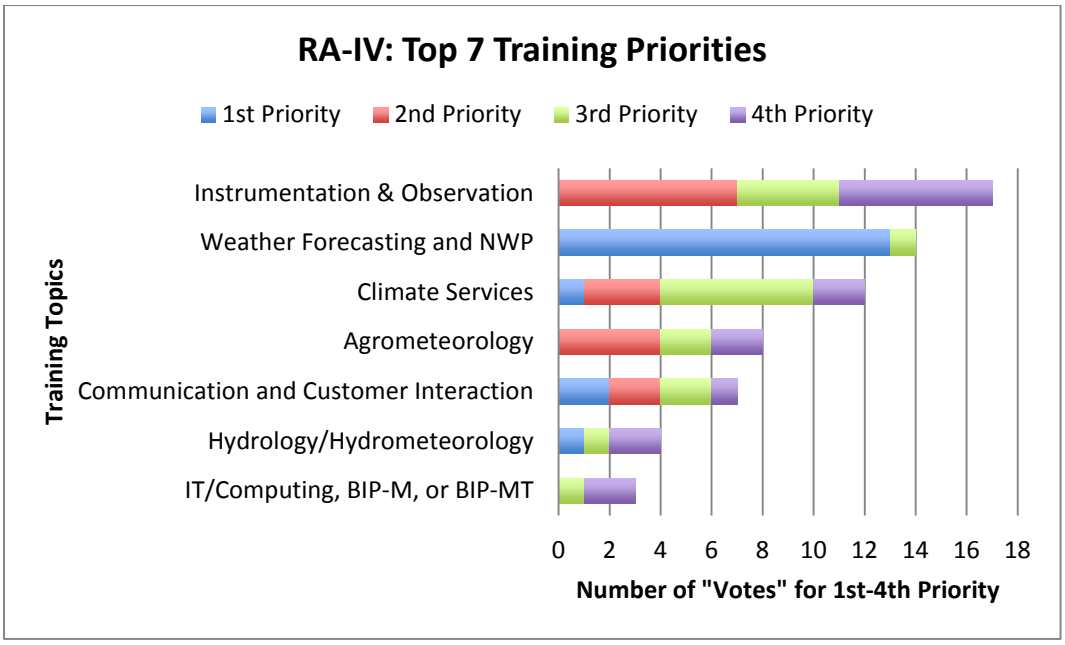


Figure 2.5e. RA-IV: Top seven training priorities

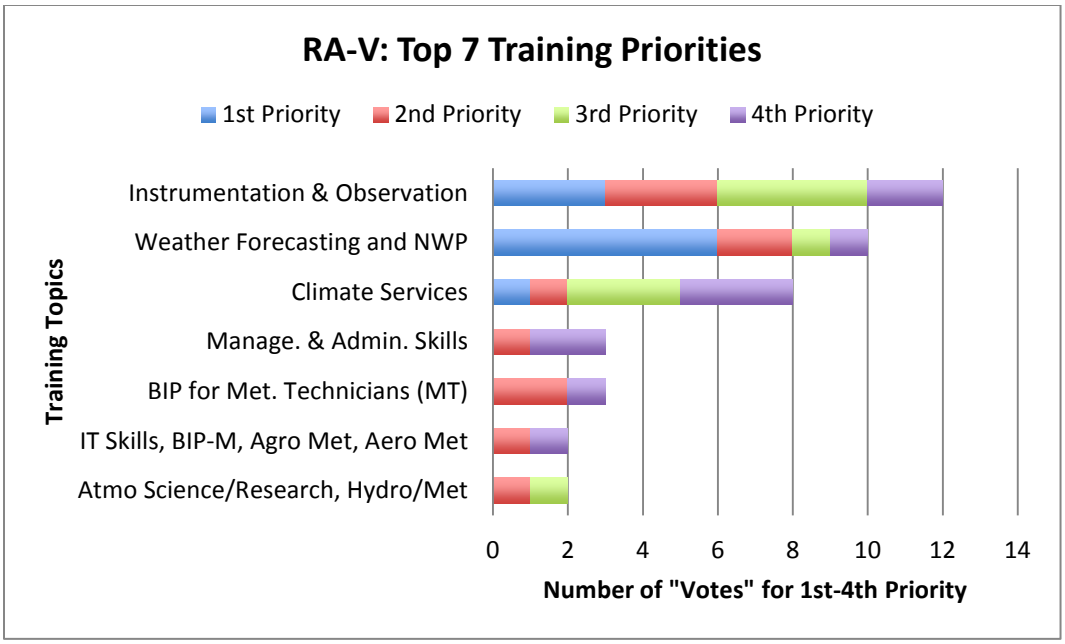


Figure 2.5f. RA-V: Top seven training priorities

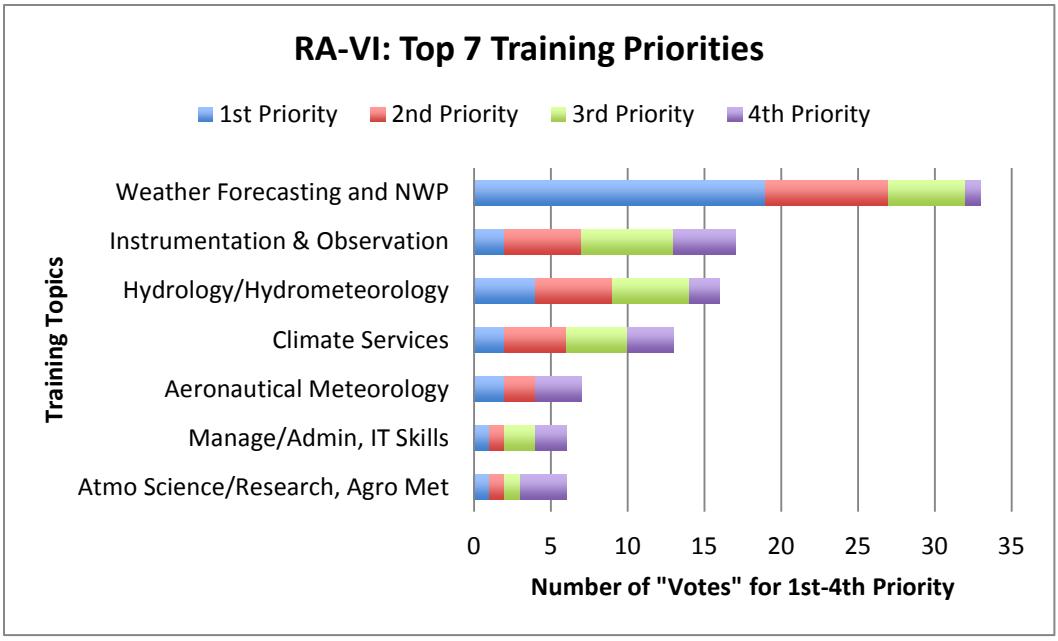


Figure 2.5g. RA-VI: Top seven training priorities

2.6 Status of NMHSs Strategic Plans

Major Findings: The 103 survey respondents that have an NMHS strategic plan represent 54% of the global WMO Membership.

The seven themes gleaned from respondents' strategic-plan summaries are consistent with other findings of the survey, reflecting in particular the need for training and human resource development. The themes also reflect the complexity of the NMHSs' field of responsibility, as well as the challenges of providing funding for the accomplishment of their mission.

Table 2.6a shows the number of Regional Members that reported having strategic plans for their NMHS, as well as the number of Members that reported not having a strategic plan, and the Members that did not respond to the survey. Table 2.6b shows these values as percentages of the total Regional Memberships.

Table 2.6a. Number of Members that have strategic plans

Region	Have	Not have	Not Submitted	Total
I	24	17	12	53
II	19	6	9	34
III	10	0	2	12
IV	12	8	2	22
V	12	5	4	21
VI	26	13	10	49
Total	**103**	**49**	**39**	**191**

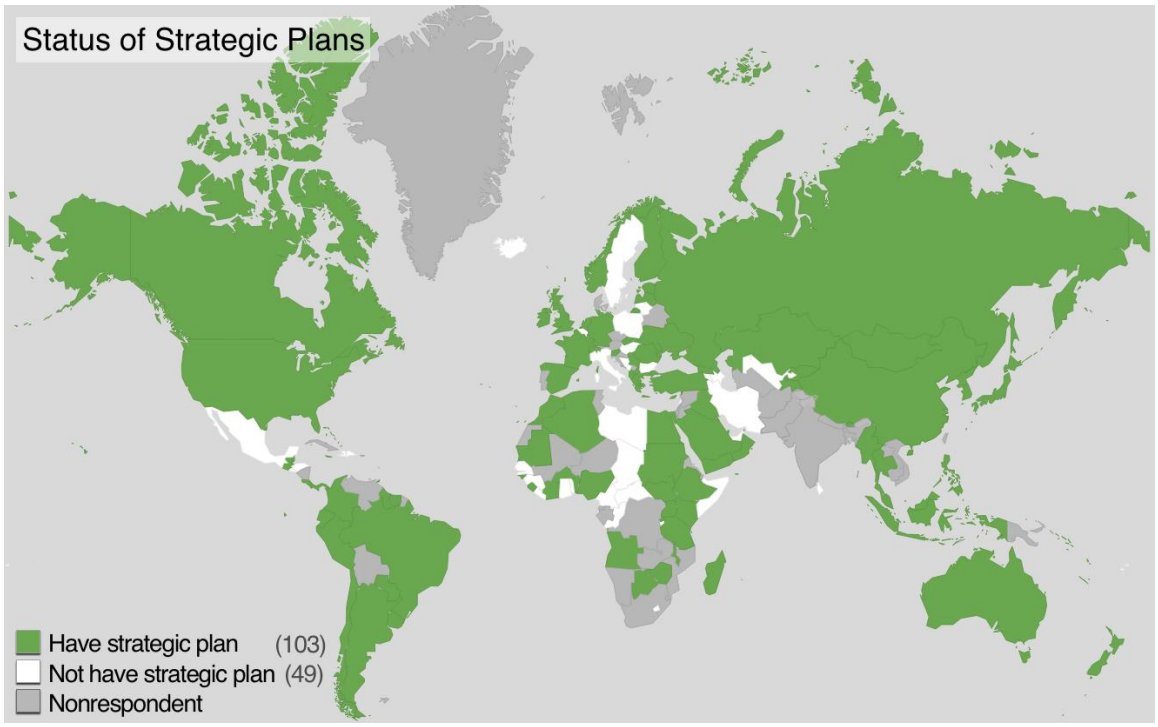
Table 2.6b. Percentages of Members that have strategic plans

Region	Have	Not have	Not Submitted	Total
I	45%	32%	23%	100%
II	56%	18%	26%	100%
III	83%	0%	17%	100%
IV	55%	36%	9%	100%
V	57%	24%	19%	100%
VI	53%	27%	20%	100%
Global	**54%**	**26%**	**20%**	**100%**

Table 2.6b shows that 103 survey respondents reported that they have a strategic plan for their NMHS. This group represents 54% of the global WMO Membership. 49 survey respondents reported that they do not have an NMHS strategic plan. This group represents 26% of the global WMO Membership. 20% of the global WMO Membership did not reply to the survey, so the status of their strategic plan is unknown.

RA-III has the highest percentage of Members that have NMHS strategic plans (83%). RA-I has the lowest percentage of Members that reported having a strategic plan (45%). Slightly more than half of the Members in the other Regions reported having strategic plans: 56% of RA-II Members, 55% of RA-IV Members, 57% of RA-V Members, and 53% of RA-VI Members.

Map 2.6 shows the Members that reported having strategic plans. Members with strategic plans are shaded green. Members that reported not having strategic plans are shaded white. Members that did not reply to the survey are shaded grey.



Map 2.6. Status of strategic plans

Map 2.6 shows that while the Members that do not have strategic plans are distributed among the Regions, all of the RA-III Members that responded to the survey reported having strategic plans.

Themes in the Strategic Plans

Of the 103 respondents that reported that they have an NMHS strategic plan, 102 included a description of their strategic plan. (102 is 67% of the full respondent group of 152, and 53% of the global WMO Membership.)

Seven themes were consistently included in respondents' summaries of their strategic plans:

1. Need for training and human resource development
2. Need for development of instrumentation
3. Communication and customer interactions
4. Climate change, disasters, and adaptation
5. International cooperation
6. Service
7. Commercialization

The following section will present quotes from Members' strategic plans that illustrate each theme.

1. Need for training and human resource development

Main challenges to [our National Meteorological Service] concern manpower. There is a significant lack of Meteorologists with the competencies defined in the WMO BIP-M, especially Meteorologists with forecasting skills, and Meteorologists with skills in the specialisms of climatology and climate change (currently one person), hydrology, agro-meteorology and marine meteorology (no current staff allocated to these areas). There is also limited knowledge and skill in developing cooperative working with a MHEWS, and in marketing weather, water and climate services. ~ RA I

The NMC (National Meteorological Center) and the NHC (National Hydrological Center) has a shortage of qualified staff. To solve this problem the NMC submitted a project for a one time course on Hydrology and Meteorology at Bsc Level (WMO Training document). This course will be covered by the Polytechnic College. ~ RA III

We have a training plan which we have to keep on adjusting because it depends heavily on the availability of funds which cannot be guaranteed at the time when needed. Core training also depends on CIMH's schedule, since this is the closest and cheapest Training Centre where we can get training. ~ RA IV

[We have a] high priority on learning and development, necessary to ensure a workforce with the knowledge and skills to perform not only current functions, but also to deliver on the priorities and plans of the future of the organization. ~ RA IV

The plan provides for capacity building in all sectors of activity both in the number of employees, mainly specialists, meteorologists, hydrologists, ecologists, seismologists and IT engineers, and in a technical sense. ~ RA VI

Basically everyone needs education and training every year. ~ RA VI

WMO workshops and training courses are very important and helpful for our specialists. ~ RA VI

2. Need for development of instrumentation

The lack of a fully functional Climate Data Management System is a problem - currently this is performed with a set of spreadsheets, but these do not provide the necessary metadata control and traceability. ~ RA I

Enhance observations networks, data communications and management… with a view to implement WIGOS at national level. ~ RA I

Increase and diversify the network of observations through the development of the National Network of the Meteorological Radars, incorporating equipment for monitoring: marine areas, electrical activity, volcanic ash, geophysics, solar radiation and the presence of aerosols in the atmosphere, applying standardization procedures according to recommendations issued by international organizations. ~ RA III

Needed most are telecommunications and computer, i.e. server capacities and applications for numerical weather prediction. ~ RA VI

Among the priorities we envisage upgrading of our technological systems, their re-equipment with modern technical means which includes in particular weather radars. ~ RA VI

3. Communication and customer interactions

Communication and Customer Interactions was ranked 10th among the 18 training topics; however, the theme appears frequently in respondents' summaries of their strategic plans.

It may be that compared to the training topics related to fundamental competencies for meteorology and agrometeorology, climate services, and hydrology, communication and customer interaction cannot be indicated as a training priority. But in the larger picture of NMHS activity in interaction with other organizations and the public, as represented and defined in Members' strategic plans, there is widespread agreement on and promotion of this perspective.

Strive to [create] clear, understandable and actionable warnings. ~ RA II

Offer high quality products and services, continuously improved, that meet the genuine needs of users. ~ RA III

There is a growing demand from the public for more up to date and localized weather information for safety and private. [Our National Meteorological Service] will further enhance its public communications role through the upgrade of our digital services and the delivery of more localized weather forecasts on a new website and app. ~ RA VI

Deliver world-class services that enable people and businesses to make better decisions about how the weather and climate affect them. ~ RA VI

Develop user-oriented forecasting and climate services. ~ RA VI

[Develop] High-quality research as a service – support for decision-making. ~ RA VI

4. Climate change, disasters, and adaptation

Time and climate data are becoming increasingly important in the activities of public authorities and economic actors… since the country's socio-economic development policies are heavily dependent on the vagaries of time, climate and water. ~ RA I

Natural hazards… coupled with significant levels of exposure and vulnerability are causing casualties having a substantial negative impact on the national economy. ~ RA VI

[We are] highly vulnerable to extreme weather events. … Changing weather patterns have already been observed over the last 15 years with increasing temperatures, decreasing precipitation, and more frequent extreme events like floods and droughts. ~ RA VI

Through the analysis of the measurements of various meteorological parameters… the usable agricultural land is highlighted and at the same time, the species that can thrive in crops and livestock and fisheries farming are identified. In addition, the mapping of wind and solar natural resources and the provided counseling in terms of renewable energy contributes to the promotion of green growth. ~ RA VI

5. International cooperation

Tighten global partnership for coexistence of the world. ~ RA II

Meteorology is intrinsically international in nature. ~ RA VI

The international dimension is closely linked to all of the cornerstones of our operations. ~ RA VI

6. Service

[The National Meteorological Service] is called upon to play an essential role in preserving the security of people and goods, increasing and improving the returns to the socio-economic activities of the people, of sustainable development… ~ RA I

[The National Meteorological Service] will continue to be the national authority which provides meteorological and climate-based products and services in order to protect life and property, contribute to the achievement of social, economic and physical well-being of the people… ~ RA IV

Ensuring the safety of [the people] through the provision of forecasts and warnings that are essential to support safety of life and property for the general public. The safety aspect imposes high standards of professional capability and delivery performance. ~ RA V

7. Commercialization

Privatization of the weather and climate services is well considered in the [National Meteorological Service] for future implementation, which is in line with the general national strategic plan put forth by the government. ~ RA II

The strategic plan of the [National Meteorological Service] includes the restructuring of the organization to increase efficiency and to re-position the entity to realize the generation of revenue through the development of weather and climate services. ~ RA IV

[We seek to promote our National Meteorological Service] brand as the preferred provider of weather and other related services and advocate for sustainable support in the country through the development of an effective pro-active alert system for government, DRRMC, Media (local and int'l) LGUs and households. ~ RA V

[We must] deliver an appropriate return to shareholders through commercial success in markets for weather-related services. ~ RA V.

3. Conclusions

The results of the Survey on Human Resource Status of NMHSs reveal that many Members are facing serious issues regarding their NMHS workforce. These issues span the range of indicators, from workforce aging and retirement to gender balance, from serious need for capacity development to widespread need for training.

Survey results show considerable diversity among the responding Members regarding the various indicators. Members within each Region are diverse in their status; Members that have similar status regarding various indicators are scattered among the Regions. Conveying the status of the NMHSs around the globe is a matter of describing the variation rather than central tendencies, and of looking at Members' statuses one by one.

The global survey response rate was 80%; at least 74% of the Members in each Region responded to the survey. Thus, the results are representative of the global Membership and the Membership of each Region. (See Map 1.2 or Appendix A.)

170,409 people work in NMHSs around the globe. The following sections will look briefly at the status of these staff members and the NMHSs that they serve.

Staff Situation by Age

The Members of all six Regions average more than 50% of their NMHS staff that are 40 years of age or older.

The Members of RA-VI have the eldest NMHS workforce, averaging 68% of staff members that are more than 40 years old. The Members of RA-V, with the lowest percentage of staff members that are more than 40 years old, still average 51% of staff members in this category. Only 1% of the global NMHS workforce is less than 20 years of age.

In 67% of respondent Members' NMHSs, 51% or more of the NMHS workforce is 40 years of age or older. The respondent States with significant percentages of older staff members in their NMHS workforces are distributed throughout the Regions. (See Map 2.1.)

Recruiting and supporting the next generation of staff members is critical for all Regions. Intensifying efforts to record knowledge and experience to share with new employees is prudent. These efforts are of particular relevance for Members in which more than 75% NMHS staff are more than 40 years of age and have early retirement.

Staff Situation by Gender

Few Members have relative gender balance in their NMHS workforce.

Almost one-fourth (23%) of survey respondents have 20% or fewer women in their NMHS workforce. Half of the respondent group have 21-40% women in their NMHS workforce. Thus, almost three-quarters (73%) of respondents have fewer female staff in their NMHSs than would represent gender balance. (See Map 2.2.)

Only 14% of respondents have relative gender balance (41-60% women) in their NMHS workforce. Another 13% of survey respondents have a gender imbalance skewed toward women (61% women or greater).

86% of respondents report gender imbalance among their NMHS staff members (skewed either toward men or toward women). Due to this high proportion of Members with gender imbalance in their NMHS workforce, promoting gender balance will require effort from nearly all Members. The goal of promoting gender balance will require special effort by Members whose workforces exhibit more extreme gender imbalance.

Staff Situation by Professional Categories

Number of Staff in Each Category

The largest group of NMHS workers worldwide are Meteorological Technicians (about 41,000 people in total). Next most numerous are Meteorologists (30,000 people). These two groups together represent about 50% of global NMHS staff.

About 15,000 Researchers, 14,000 Management staff, 13,000 Support staff, 11,000 “Other” staff, and 11,000 Climatologists also work in the NMHSs around the globe. About 3,000 Hydrological Technicians and 2,500 hydrologists were also counted in the survey results, although they are clustered in only 43% of respondent Members.

On average, 31% of Members’ NMHS staff are Meteorological Technicians and 18% are Meteorologists. In almost one-third (32%) of the respondent Members, however, 20% or fewer staff members are Meteorological Technicians. In more than one-third (36%) of respondent Members, 10% or fewer staff members are Meteorologists. Depending on needs and conditions, these numbers may need to rise in order for NMHSs to be effective in achieving their core mission.

Meteorologists

In more than one-third (36%) of respondent Members, 10% or fewer staff members are Meteorologists. In almost another one-third (32%) of respondent Members, 11-20% of staff members are Meteorologists. In one-quarter (25%) of respondent Members, 21-50% of staff members are Meteorologists. Finally, in 8 respondent Members’ NMHSs, more than 50% of staff members are Meteorologists. This is 5% of the survey respondents. (See Map 2.3.1a.)

Meteorological Technicians

In almost one-third (32%) of the respondent Members' NMHSs, 20% or fewer staff members are Meteorological Technicians. In almost one-half (46%) of the respondent Members' NMHSs, 21-50% of staff members are Meteorological Technicians. And in 19% of the respondent Members NMHSs', more than 50% of staff members are Meteorological Technicians. (See Map 2.3.1b.)

Some Members with fewer than 10% Meteorologists among their NMHS staff have much higher percentages of Meteorological Technicians. These patterns of human resource distribution may merit exploration: perhaps there are strategies of cooperation between Meteorologists and Meteorological Technicians that can increase NMHS's effectiveness in carrying out their responsibilities.

Overall variability

Regions and individual Members vary in the percentages of their NMHS staff that work in each professional area. It may be fruitful to investigate how the varying patterns of NMHS human resource distribution emerge from varying national conditions, whether certain patterns enable effective operation in specific conditions, and what human-resource patterns may serve as optimal targets for developmental plans.

Areas that Need Capacity Strengthening

All nine professional areas were indicated by at least 21% of respondents as needing serious capacity strengthening in their NMHS.

Almost 80% of respondent Members indicated that they need serious capacity strengthening for Meteorologists and Climatologists. 63% indicated that they need serious capacity strengthening for Meteorological Technicians. 48% indicated that they need serious capacity strengthening for Researchers.

The Members that indicated these needs for capacity strengthening are distributed throughout the Regions. (See Maps 2.3.2a through 2.3.2d.)

These results show substantial need for capacity strengthening. This need spans all nine professional areas and is a concern for most Members.

Respondents in RA-III expressed near unanimous need for capacity strengthening for Meteorologists, Climatologists, and Meteorological Technicians. This is also true for RA-I, although the percentages of respondents in RA-I are not quite as high as in RA-III.

Number of People that Need Training

39,305 people need training worldwide in various professional areas. The most numerous group of people that need training are Meteorological Technicians (12,253 people). The next largest group are Meteorologists (9,835 people).

The Meteorological Technicians that need training are distributed among 120 Members (79% of respondents), which are scattered throughout the Regions. The Meteorologists that need training are distributed among 128 Members (84% of respondents), which are also scattered throughout the Regions.

Sizeable numbers of Researchers, Management staff, and Climatologists also need training. 4,464 Researchers that need training are distributed among 87 Members (57% of respondents). 3,678 Management staff that need training are distributed among 97 Members (64% of respondents). 3,195 Climatologists that need training are distributed among 121 Members (80% of respondents).

The need for training for staff members in these professional areas is a situation shared by most respondent Members. Members vary widely, however, in the number of people in each professional area that need trained: some Members need to train one or two people in select professional areas; other Members need to train 30, 50, or even 100 or more people in several professional areas. Members needing to train these various numbers of people are scattered throughout the Regions. (See Maps 2.3.3a through 2.3.3e.)

Number of Staff Due to Retire

15,522 NMHS staff members around the globe are due to retire within five years—9% of the 170,409 people in the global NMHS workforce.

The overall percentage of Regional staff members due to retire varies widely, from a low of 6% in RA-VI to a high of 29% in RA-IV. The other Regions vary between these two extremes. For RA-III and RA-IV, with expected retirement percentages of 20% and almost 30% of *all staff members,* the loss of retired staff members' knowledge and skill could cause dramatic impact on NMHS's abilities to fulfill their service responsibilities.

On average, 27% of Members' Management staff is due to retire in the next five years. 17% of Members' Meteorologists are due to retire, and 19% of Meteorological Technicians. 20% of Members' Hydrologists and 18% of their Hydrological Technicians, on average, are due to retire soon.

Expected retirement rates vary widely among the Regions' professional-area groups. Some Members are facing human resource losses higher than one in every two staff members in particular professional areas. For instance, 21 Members expect to lose half or more of their Management staff to retirement in the next five years. 12 Members expect half or more of their Meteorologists to retire soon. 6 Members expect half or more of their Meteorological Technicians to retire in the next five years. (See Maps 2.3.4a through 2.3.4c.)

Planning for succession, recruitment, and knowledge transfer to the next generation of NMHS staff members is relevant for all Regions and for many individual Members. Exploration of the use of new technologies to support remaining staff members may also be a relevant strategy to enable NMHSs to continue to fulfill their responsibilities. Creating processes through which NMHS excellence can be maintained through this transition is of paramount importance.

Training Expectations in 2017

19,191 people anticipate training in 2017, supported by either government sources, project funds, the WMO, or other scholarships.

Government funding is anticipated to support 16,072 (84%) of the trainees worldwide. The extent to which Members anticipate government support for their 2017 trainees varies widely, however. 20% of respondents anticipate that most or all (76-100%) of their 2017 trainees' support will originate from government sources. More than half of the respondents (53%), however, anticipate that half of their 2017 trainees or fewer will receive support from government sources. In particular, more than one quarter of respondents (28%) expect fewer than 10% of their 2017 trainees to be supported by government sources. (See Map 2.4a.)

The variability in government funding for NMHS training points to the importance of other funding sources. For instance, 1,421 (7%) of the 2017 trainees worldwide anticipate support from projects. Slightly more than half of the respondents have 2017 trainees that anticipate project support. For a few Members (5%), project funds will support the majority of their 2017 trainees. (See Map 2.4b.)

1,162 (6%) of the worldwide 2017 trainees anticipate support from the WMO. WMO funding is a significant source for training support for many Members. Half of the survey respondents expect 11-50% of their 2017 trainees to be supported by WMO sources. 11% of the survey respondents are relying even more heavily on WMO funding, with more than half of their 2017 trainees anticipating support from this source. On the other hand, one third of survey respondents are relying less on WMO funding, with fewer than 10% of their 2017 trainees anticipating support from this source. (See Map 2.4c.)

Substantial numbers of people will still need training in many Members' NMHSs, even if the education of the people anticipating training in 2017 comes to fruition. 24 Members (16%) will have more than 100 people that still need training. One third of the respondents (50 Members, 33%) will have 25-99 people that still need training. About one quarter of the respondents (33 Members, 22%) will have 1-24 people that still need training. About one third of respondents (45 Members, 30%) are fortunate enough that their numbers of people anticipating training in 2017 are equal to or greater than the numbers of people reported to need training in the professional areas.

When planning for allotments to fund training, it is important to recognize the variability in expected funding sources among Members. A small shortfall from one source may still enable some Members to meet most of their training goals, while the same shortfall for another Member may seriously disrupt their planned progress.

Variability must also be acknowledged in the numbers of people that Members need to train. A few people that need training but do not receive it may not have a significant impact on a large NMHS, while the same number of people lacking training may be critical to a smaller NMHS.

Some of this variability in impact may depend on whether the people needing training are already qualified in their professional area and need to hone their skills; or whether the people that need training are just starting out and need trained from the ground up. Further investigations would be necessary to shed light on this distinction.

Training Priority Areas

Seven training topics were indicated by 20 or more respondents as a training priority:

1. Weather Forecasting and NWP
2. Instruments and Observation
3. Climates Services
4. Agrometeorology
5. Hydrology / Hydrometeorology
6. Management and Administration
7. Atmospheric Sciences and Research

Training priorities are similar across the Regions, with some exceptions. For RA-I, RA-II, RA-III, and RA-VI, Weather Forecasting and NWP was overwhelmingly the most frequently indicated priority. For RA-IV and RA-V, Instrumentation and Observation was the most frequently indicated priority.

These training priorities are consistent with other findings of the survey, which revealed substantial need for capacity strengthening for Meteorological Technicians, Meteorologists, Climatologists, Management staff, and Researchers.

Status of Strategic Plans

The 103 survey respondents that reported that they have a strategic plan for their NMHS represent 54% of the global WMO Membership.

RA-III has the highest Regional percentage of Members that have NMHS strategic plans (83%). RA-I has the lowest percentage of Members that reported having a strategic plan (45%). The survey respondents with strategic plans represent slightly more than half of the Members in the other Regions: 56% of RA-II Members, 55% of RA-IV Members, 57% of RA-V Members, and 53% of RA-VI Members.

While the Members that do not have strategic plans are distributed among the Regions, all of the RA-III Members that responded to the survey reported having strategic plans.

Seven themes were consistently included in respondents' summaries of their strategic plans:

1. Need for training and human resource development
2. Need for development of instrumentation
3. Communication and customer interactions
4. Climate change, disasters, and adaptation
5. International cooperation
6. Service
7. Commercialization

The seven themes are consistent with other findings of the survey.

In particular, the theme of "Need for training and human resource development" reflects the overall findings of the survey, that Members are facing serious human-resource issues concerning the need for capacity development in various professional areas, the need to address gender imbalances in their NMHS staffing, as well as the need to manage the transition as large percentages of staff members retire in the next five years.

The theme “Need for development of instrumentation” reflects the second most commonly indicated training priority, “Instruments and Observation,” and is compatible with the need to train Meteorological Technicians, the professional area in which the most people need trained.

The themes “Communication and customer interactions” and “Climate change, disasters, and adaptation” reflect the first and third most commonly indicated training priorities, “Weather Forecasting and NWP” and “Climate Services.” They also reflect the widespread need to train Climatologists.

The themes “International cooperation,” “Service,” and “Commercialization” reflect the complexity of the NMHSs’ field of responsibility, and the challenges of providing funding for the accomplishment of their mission.

Appendices

Appendix A: Survey Form and Basic Calculations

Survey on Human Resources Status of NMHSs

Name of Member/Country: _____

1. Give the number of NMHS staff in the following age categories	Less than 20 years	20-30 years	30-40 years	40-50 years	Over 50 years
	0	5	6	10	17
Total staff = 0+5+6+10+17 = 38	0/38 = 0.0%	5/38 = 13.0%	6/38 = 16.0%	10/38 = 26.0%	17/38 = 45.0%

2. What is the gender distribution of your staff (please give numbers)	Male	Female
	14	24
Total staff = 14+24 = 38	14/38 = 37.0%	24/38 = 63.0%

	3. Give the number of staff working in the following areas	4. Mark (x) against the areas you seriously need capacity strengthening	5. Give the number of people in these job categories in need of training	6. Give the number of staff who are due to retire in 5 years from now
Management	4 (4/38 = 10.5%)		1 (1/4 = 25.0%)	1 (1/4 = 25.0%)
Meteorologist (M)	5 (5/38 = 13.2%)	X (Frequency)	3 (3/5 = 60.0%)	2 (2/5 = 40.0%)
Meteorological Technician (MT)	2 (2/38 = 5.3%)	X (Frequency)	1 (1/2 = 50.0%)	0 (0/2 = 0.0%)
Hydrologist (H)	6 (6/38 = 15.8%)	X (Frequency)	3 (1/6 = 50.0%)	3 (3/6 = 50.0%)
Hydrological Technician (HT)	2 (2/38 = 5.3%)	X (Frequency)	1 (1/2 = 50.0%)	0 (0/2 = 0.0%)
Climatologist/ Climate Services	2 (2/38 = 5.3%)	X (Frequency)	1 (1/2 = 50.0%)	0 (0/2 = 0.0%)
Researchers	12 (12/38 = 31.6%)		0 (0/12 = 0.0%)	5 (5/12 = 41.7%)
Support Staff	5 (5/38 = 13.2%)		0 (0/5 = 0.0%)	1 (1/5 = 20.0%)
Other	0 (0/38 = 0.0%)		0 (0/0 = 0.0%)	0 (0/0 = 0.0%)

7. Indicate the number of experts expected to be trained in 2017 through the support of these various sources	Government	Project funds	WMO	Other scholarships
	1	1	5	0
Total staff to be trained in 2017 = 1+1+5+ = 7	1/7 = 14.3%	1/7 = 14.3%	5/7 = 71.4%	

8. List in order of priority the 4 areas where you need training	1st Priority	2nd Priority	3rd Priority	4th Priority
	Forecasting	Satellite observing	Hydrology	Instrumentation
We grouped these +400 free entries in 20 areas	(Frequency)	(Frequency)	(Frequency)	(Frequency)

9. Is there a strategic plan for your NMHS? (Please mark (x) Yes or No)	Yes	No
	X	
	(Frequency)	

Raw **Method** **Calculated**

Appendix B. List of Respondents

Table. Members that responded to the Seventh WMO Survey 2016

	Region I - Africa		
1	Algeria	22	Liberia
2	Angola	23	Libya
3	Benin	24	Madagascar
4	Botswana	25	Malawi
5	Burkina Faso	26	Mauritania
6	Burundi	27	Mauritius
7	Cabo Verde	28	Morocco
8	Cameroon	29	Nigeria
9	Central African Rep.	30	Rwanda
10	Chad	31	Sao Tome and Principe
11	Comoros	32	Senegal
12	Congo	33	Seychelles
13	Côte d'Ivoire	34	Sierra Leone
14	Egypt	35	Somalia
15	Ethiopia	36	South Sudan
16	Gambia	37	Sudan
17	Ghana	38	Togo
18	Guinea	39	Uganda,
19	Guinea-Bissau	40	United Rep. of Tanzania
20	Kenya	41	Zimbabwe
21	Lesotho		

	Region II - Asia		
1	Bahrain	14	Mongolia
2	Bhutan	15	Myanmar
3	China	16	Oman
4	Dem. People's Rep. of Korea	17	Qatar
5	Hong Kong, China	18	Republic of Korea
6	Iran, Islamic Republic of	19	Saudi Arabia
7	Iraq	20	Sri Lanka
8	Japan	21	Tajikistan
9	Kazakhstan	22	Thailand
10	Kuwait	23	United Arab Emirates
11	Kyrgyzstan	24	Uzbekistan
12	Macao, China	25	Yemen
13	Maldives		

Region III - South America			
1	Argentina	6	Guyana
2	Brazil	7	Paraguay
3	Chile	8	Peru
4	Colombia	9	Suriname
5	Ecuador	10	Uruguay

Region IV - North America, Central America, and the Caribbean			
1	Antigua and Barbuda	11	El Salvador
2	Bahamas	12	Guatemala
3	Barbados	13	Haiti
4	Belize	14	Honduras
5	British Caribbean Territories	15	Jamaica
6	Canada	16	Mexico
7	Costa Rica	17	Panama
8	Curaçao and Sint Maarten	18	Saint Lucia
9	Dominica	19	Trinidad and Tobago
10	Dominican Republic	20	United States of America

Region V - South-West Pacific			
1	Australia	10	New Zealand
2	Brunei Darussalam	11	Niue
3	Cook Islands	12	Philippines
4	Fiji	13	Samoa
5	French Polynesia	14	Singapore
6	Indonesia	15	Solomon Islands
7	Malaysia	16	Tonga
8	Micronesia, Federated States of	17	Vanuatu
9	New Caledonia		

Region VI - Europe			
1	Albania	21	Luxembourg
2	Armenia	22	Malta
3	Azerbaijan	23	Montenegro
4	Belgium	24	Netherlands
5	Bosnia and Herzegovina	25	Norway
6	Bulgaria	26	Poland
7	Cyprus	27	Republic of Moldova
8	Estonia	28	Romania
9	Finland	29	Russian Federation
10	France	30	Serbia
11	Georgia	31	Slovakia
12	Germany	32	Slovenia
13	Greece	33	Spain
14	Hungary	34	Sweden
15	Iceland	35	Switzerland
16	Ireland	36	The Republic of Macedonia
17	Italy	37	Turkey
18	Latvia	38	UK
19	Lebanon	39	Ukraine
20	Lithuania		

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