Survey on the Surface, Climate and Upper-air Observations and Quality Management in RA II (Asia)

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FOREWORD

This publication reports on the results of a survey on the surface, climate and upper-air observations and quality management in Regional Association II (Asia). The survey was conducted as one of the activities for the Pilot Project to Enhance the Availability and Quality Management Support for National Meteorological and Hydrological Services in Surface, Climate and Upper-air Observations, established during the 14th Session of Regional Association II (Asia), held in Tashkent, Uzbekistan in December 2008.

The questionnaire was distributed through the WMO Secretariat to thirty-five Members of RAII. Twenty-nine NMHSs, more than eighty percent of all the NMHSs in the Region provided responses to the questionnaire by the end of 2010. It included various questions as to how observations are made, how data are collected, quality-controlled and used, how calibration and maintenance of instruments is performed and how NMHS staff are trained.

The results of the survey were discussed at a JMA/WMO workshop on quality management in surface, climate and upper-air observations in RA II (Asia) in Tokyo in July 2010. This report provides an analysis of the results of the survey and in so doing provides some excellent insights into the key areas for priority attention to improve data quality in Regional Association II (Asia).

I wish to express my sincere gratitude and that of Commission for Instruments and Methods of Observation (CIMO) to the author of this report, Mr Yoshihisa Kimata. I am confident that many WMO Members will find the report informative and useful.

(Prof. B. Calpini)
President
Commission for Instruments and Methods of Observation

SUMMARY

This publication reports on the results of the survey on the surface, climate and upper-air observations and quality management in Regional Association II (Asia).

The survey was conducted as one of the activities for the Pilot Project (PP) to Enhance the Availability and Quality Management Support for National Meteorological and Hydrological Services in Surface, Climate and Upper-air Observations, established in the 14th session of Regional Association II (Asia), held in Tashkent, Uzbekistan in December 2008.

The questionnaire was distributed through the WMO Secretariat to thirty-five Members of RAII. Twenty-nine NMHSs, more than eighty percent of all the NMHSs in the Region provided responses to the questionnaire by the end of 2010. It included various questions as to how observations are made, how data are collected, quality-controlled and used, how calibration and maintenance of instruments are done, or how staff is trained at NMHSs.

The members of the PP got together at the "JMA/WMO Workshop on Quality Management in Surface, Climate and Upper-air Observations in RA II (Asia)", held in Tokyo, Japan, from 27 to 30 July 2010, assessed and discussed a part of the results of the survey along the other topics in the agenda. The major conclusions drawn from the limited number of responses of twenty-two NMHSs at that time were as followed:

- Problems with surface observations are due to the lack of appropriately calibrated instruments and maintenance support.
- Problems with observational reports are due to the insufficient data quality and missing and irregular reports.
- Improvement of QC methods are needed at different levels from maintenance and calibration of instruments to data availability.
- Several NMHSs don't have any operational systems for QC.
- Metadata are not updated with enough frequency.

The assessment was reflected in the recommendations adopted by the participants of the JMA/WMO Workshop and presented in the final report, whici is available from the WMO website: http://www.wmo.int/pages/prog/dra/rap/meetingsRAII.php

In this report of the survey, all the responses are examined and analyzed thoroughly. The results from some parts of the questionnaire that were not discussed in the workshop are also included in the report. Though the responses were added up by several NMHSs after the workshop, the final conclusions don't contradict what the PP had found out during the workshop.

All the data of the responses is available in an Excel file. If Members are interested in obtaining the file, they are kindly invited to contact the Coordinator of the PP:

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1 INTRODUCTION

1.1 Background

There has never been a greater need for better weather and climate services worldwide in terms of disaster mitigation and adaptation to climate change. As the fifteenth WMO Congress stated, the quality of products and services depends substantially on the quality of data. In order to meet the public needs, it is essential that national observing networks provide required observational data of required quality for international exchange through WMO GTS and WIS. In this context, Congress requested NMHSs to quality-control on on-site observations, ensure the traceability of measurements to recognized world standards and develop quality management systems (Cg- XV, Resolution 32). However, a number of NMHSs, especially those of the Least Developed Countries, have yet to acquire such capabilities.

The 14th session of RA II held in Tashkent, Uzbekistan in December 2008, adopted the Resolution 5 (XIV-RA II) establishing the Pilot Project to enhance the availability and quality management support for NMHSs in surface, climate and upper-air observations with the Terms of Reference:

- To identify the requirements of NMHSs of developing countries, in particular least developed countries in the Region,
- To assess the current status of the issues, and to facilitate communication between advanced centres and the recipient Members,
- To assist recipient Members in quality assurance of observational data from weather, climate and upper-air stations, including training,
- To monitor the progress of the project.

In accordance with the above TORs and the initial action plan of the PP, JMA, as the coordinator of the project, conducted a questionnaire survey and organized a workshop in 2010, in cooperation with the PP Coordinating Group members and the WMO Secretariat. The questionnaire was distributed in advance of the JMA/WMO workshop on quality management in surface, climate and upper-air observations in RA II (Asia), Tokyo, Japan, 27 to 30 July 2010. The responses from about 20 NMHSs had been collected within a month, analyzed and presented to the participants at the workshop. Until the end of the year, 29 WMO Members out of 35 in RA II provided the responses to the questionnaire.

1.2 Organization

The questionnaire was distributed to all WMO Members in RA II through WMO Secretariat in July 2010. A copy of the questionnaire is provided in Appendix A.

The factors possibly affect the quality of observational data exist at each stage of management for observations and data use. The questions in Section 1 concerning how observations are made, the data are quality-controlled, the sites and the instruments are maintained in operation, and the staff are trained are considered to be the main part of the questionnaire. In Section 2, it goes further to find out how Members utilize observational data exchanged via GTS and if they see some problems in its quality in perspective of the users. All these questions were asked to get the whole picture of quality management issues currently shared among NMHSs in the Region.

The questionnaire for the survey was organized into 3 sections.

- Surface and upper-air observations
- Observational data
- Comments or suggestions to the pilot project

Section 1 consists of eleven parts which each include several questions regarding each topic:

- Part I: Status of surface-base in-situ observations of basic networks
- Part II: Quality control of surface observational data
- Part III: Status of in-situ upper-air observations of basic networks
- Part IV: Quality control of upper-air observation data
- Part V: Maintenance and calibration of instruments for surface observations
- Part VI: Observation conducted by non-NMHS organization/institute
- Part VII: Training for observers
- Part VIII: Training course sponsored by WMO on the meteorological instruments
- Part IX: Status of observational stations
- Part X: Further improvement of the observational data quality
- Part XI: Observational data availability

Section 2 includes a few questions regarding observational data use. In Section 3, the respondents were asked to give comments and suggestions to the Pilot Project in free-response.

1.3 Responses

Twenty-nine NMHSs out of thirty-five Members in RA II provided the responses to the questionnaire. A list of NMHSs that replied to the questionnaire is provided in Appendix B.

2 SURVEY RESULTS

2.1 Summary of Section 1: Surface and upper-air observations

2.1.1 Summary of Part I: Status of surface-based in-situ observations of basic networks

Part I of Section 1 summarizes the current status and issues of surface observations network in different Members. Twenty-eight NMHSs responded to this part of the questionnaire. A typical station, such as one included in RBSN or RBCN was chosen as a representative of the network for answering the questions concerning the observed meteorological variables and the time and the frequency of observations and reporting. Comparing the results to the standard procedures described in the Manual on the Global Observing System (GOS Manual, WMO-No. 544), it can be said that most NMHSs make observations of necessary variables at appropriate time with enough frequency. However, as they only described the status of the representative stations in their observing networks, the results don’t necessarily apply to all the other stations in the networks. Observations are operated based on guidelines or manuals either developed by NMHSs on their own, WMO or instrument manufactures. It has been revealed that the most widely shared issue related to surface observations among the respondents is calibration of instruments.

2.1.1.1 Observed meteorological variables

All the 28 NMHSs make observations of air temperature, atmospheric pressure, humidity, wind and precipitation which are all indispensable to synoptic observation (Figure 1). Most of them measure the elements required at manned stations such as amount and type of cloud, visibility, and present or past weather. The figure also shows the high numbers for sunshine duration and solar radiation. Soil temperature and evaporation are fairly commonly measured, while measurements of snow depth are limited to the countries where snow falls in winter.

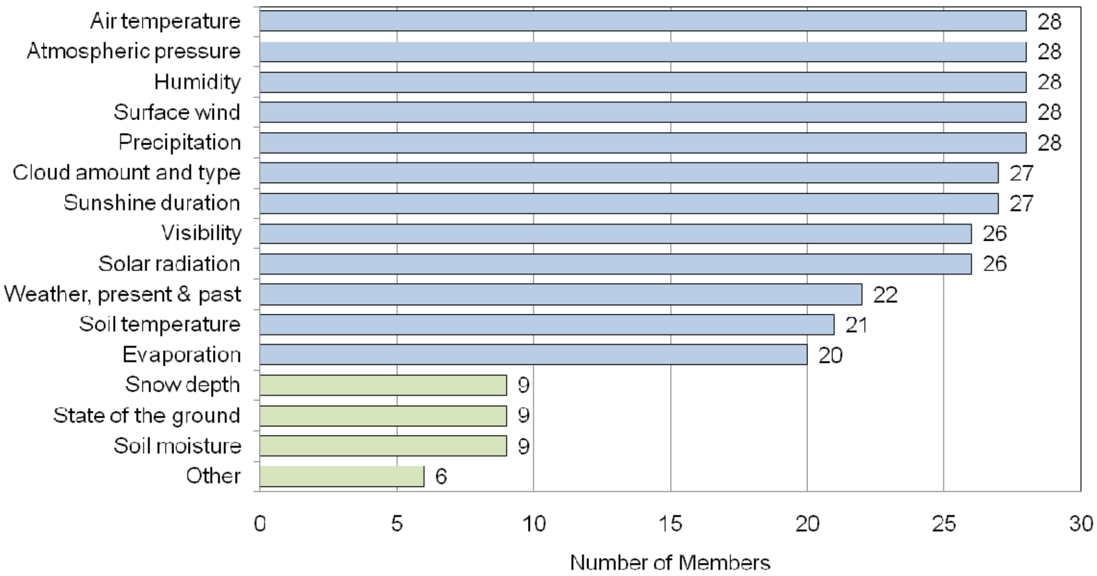

Figure 1 - Meteorological variables observed by NMHSs for surface observations

2.1.1.2 Time and frequency of observations and reporting

Figure 2 (a) to (d) show the time and frequency of observations and reporting for surface observations. Most Members make observations and send SYNOPs at 00, 03, 06, 09, 12, 15, 18 and 21 UTC, which are the main or the intermediate standard time for surface synoptic stations. A few NMHSs still fail to conduct observations or reporting even at the main standard time. Ten NMHSs make observation every one hour, 24 times a day. Four NMHSs make observation every half an hour since their stations are actually located at airports and send METARs.

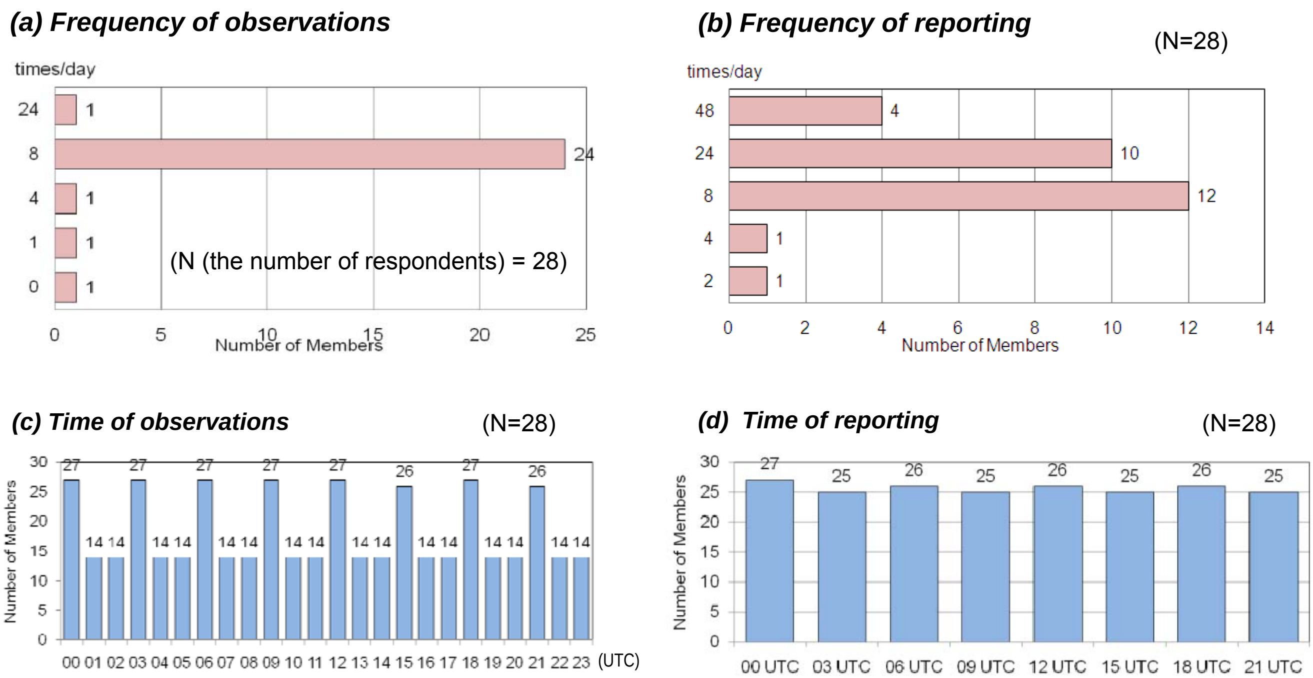

Figure 2 - Time and frequency of surface observations and reporting

2.1.1.3 Guidelines / manuals for observations

Sixteen Members develop their own guidelines or manuals on how to make observations and how to install observing stations. Most of the NMHSs that don't have any manuals on their own use the Guide to Meteorological Instruments and Methods of Observation (CIMO Guide, WMO No.-8), the GOS Manual or the Guide to the Global Observing System (GOS Guide, WMO-No. 488) (Figure 3). Six of them use manuals developed by manufactures.

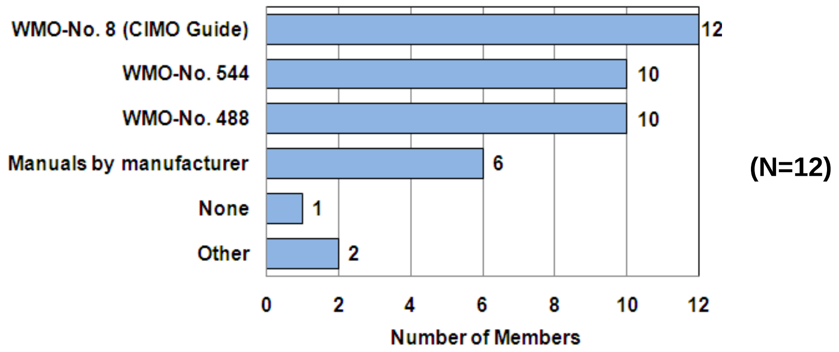

Figure 3 - Manuals for surface observations used by NMHSs (in case without own manuals)

2.1.1.4 Problems of observations

The respondents were asked what prevents them from performing observations of the required quality. According to Figure 4, lack of appropriately calibrated instruments traceable to international standards shows the highest number of all. Other common problems related to instruments are lack of maintenance support and deterioration of performance over time. Lack of appropriate technology of observations and communications, lack of observation skills, or lack of training or guidance also scores high. Other than these options prepared as multiple choices in the question, several NMHSs raise some issues in free-response (Table 1). Three Members commonly point out influence of environment, indicating that the urbanization of surrounding areas is affecting the observations in densely populated cities of the region.

Though the observations seem to have been quite well conducted as seen in the paragraph 3.1.1.1 to 3.1.1.3, all the problems noted in Figure 4 and Table 1 imply that the observational data acquired from such condition of observations are not immune to any errors

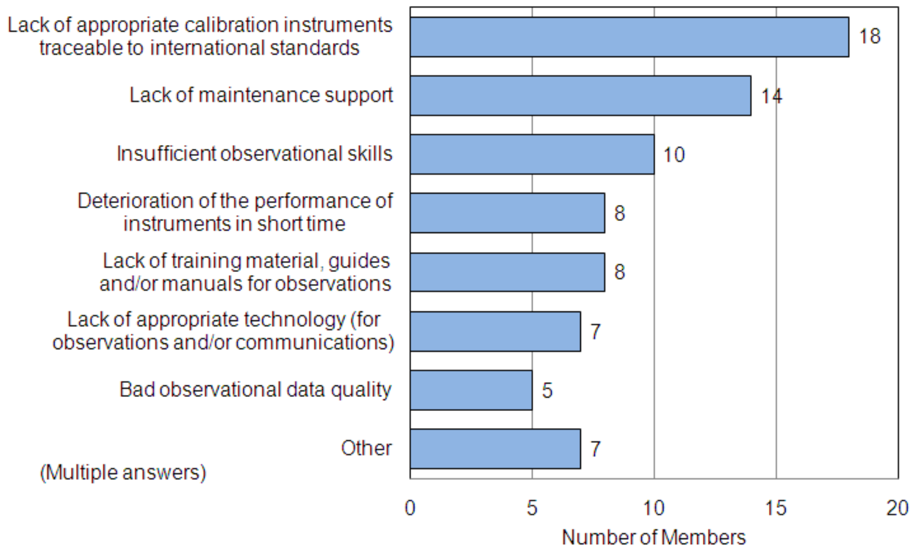

Figure 4 - Problems that prevents from performing required observations (multiple choices)

Table 1 - Problems that prevents from performing required observations (free-response)

Comment
• Financial constraints limit the number of observing stations.
• The problem of the continuity of observation and data regarding the environmental • change of observing stations due to urbanization, etc.
• 1) Lack of experiences in measurement and geopotential height encoding in SYNOP (4a3hhh), for stations of High Elevation > 800m • 2) There is no any Upper Air station
• It’s needed the manual in Kyrgyz language
• Lack of Meteorological Equipments
• Influences of observational environmental condition
• Influences of observational environmental condition
• No Major Problem at manned stations.

2.1.2 Summary of Part II: Quality control of surface observational data

Part II of Section 1 is intended to describe how quality control is conducted in observing systems at NMHSs and how the QC results are provided to data users.

According to the GOS Guide, observational data must be quality controlled at different levels of data pre-processing, processing and transfer in real time and non-real time, using various procedures. It is required for QC systems at NHMSs to have such multiple layers of checks for verification of observational data. Each NMHS described its QC practices in Table A, Appendix C.

The QC results should be available in a timely and accurate manner so that the local staff can fix errors and the users can determine fitness for use. The way how NMHSs communicate the QC results with observing staff or data users are also inquired.

It has been found that the state of calibration of instruments is most widely recognized as a main factor affecting observational data similar to the result from Part 1 for observation itself.

Twenty-eight NMHSs responded to this part of the questionnaire.

2.1.2.1 Quality control systems in operation

Twenty-three NMHSs responded that they had operational systems for quality control. Each NMHS describes what kinds of QC are conducted at various phases of their observing network system, for example, observing sites, data processing centres or communication centres (Table A, Appendix C). QC techniques are varied depending on NMHSs, however, some Automatic QC techniques such as coding format checks, gross error checks, consistency checks or special checks are commonly seen. Manual QC is widely used as well as AQC when checking observational data, interpreting AQC results, correcting error values or justifying the values at each phase.

2.1.2.2 QC results feedback

The respondents were asked how they communicated QC results to observing stations and users and what kinds of remedial actions were taken according to the results. The responses are shown in Table B, Appendix C.

Most NMHSs communicate the results to observers at observing sites so that they can verify or correct the values. The communication tools vary from e-mail, internet, intranet, wireless, VSAT, mobile, telephone or fax in real-time to ordinary mail or circular in non-real time. Several NMHSs try to prevent erroneous data from going to the public or add QC information to the original data on a real-time basis. Other remedies are calling for maintenance staff to inspect sites and check the performance of the instruments or training observers at stations to make it sure that the same error would not happen again.

2.1.2.3 Factors affecting the quality of observational data

Nineteen NMHSs respond that the state of calibration of instruments affects the quality of data significantly (Figure 5). Observer's skills, maintenance and environment are also major problems. Deterioration in performance of instruments in short time is relatively common. In addition to these, observer's errors in manually inputting data, lack of appropriate technology in observations and communications, or lack of procurement of spare instruments are listed in free-response.

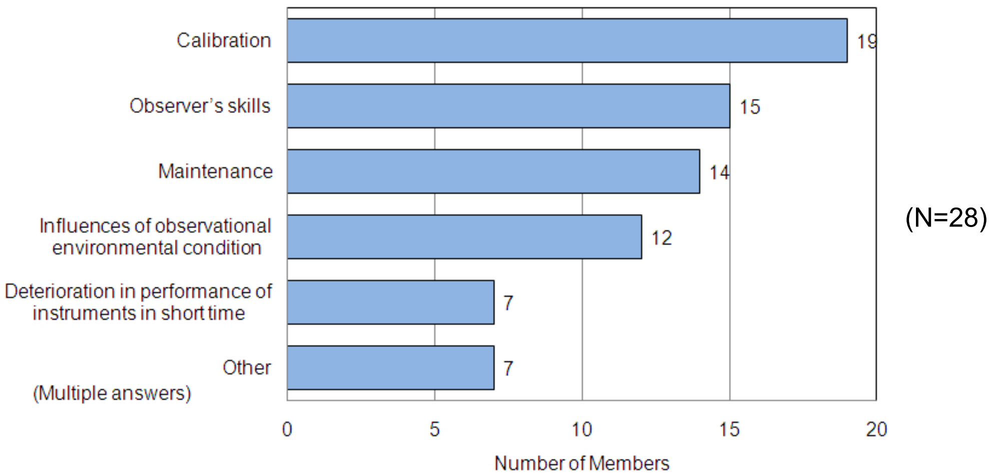

Figure 5 - Factors adversely affecting data quality

2.1.2.4 QC monitoring site

Japan Meteorological Agency lists and reports stations with data of suspected low-quality every month as the Monthly Global Monitoring Report on the website (http://qc.kishou.go.jp). The primary information on the quality is based on the difference between the observations and the corresponding first-guess fields of NWP (6-hour forecasts from the global model). On the other hand, RSMC Tokyo was designated as a lead centre for monitoring the quality of land surface observations (i.e. SYNOP) for Region II in March 1991. In accordance with the Manual on the Global Data Processing and Forecasting System (WMO No.-485), it publishes a Report on the Quality of Land Surface Observations in Region II (Asia) and sends them to the WMO Secretariat and Members in the Region every six months. The report is also posted at the same website as the Monthly Global Monitoring Report.

Seventeen NMHSs responded that they had used the Monthly Global Monitoring Report before. More than a third of the respondents didn't even know about the existence of the Web site.

2.1.3 Summary of Part III: Status of in-situ upper-air observations of basic networks

The questions in this part are similar to those in Part I for surface observations. Twenty-two NMHSs that have upper-air observation stations included in RBSN or RBCN responded to the questions about operational practices such as time, frequency of observations and reporting. Seven NMHSs don't have any such upper-air stations. Considering upper-air observations require NMHSs additional resources, it could be expected that the number of responses slightly cut back compared to that for surface observations. In addition, there was a question asking about remote sensing technologies in use at NMHSs. Other general issues regarding upper-air observations are also inquired.

2.1.3.1 Methods of upper-air observations

It has been revealed that GPS radiosonde is the most widely used method in upper-air observations among respondents (Figure 6). Fourteen NMHSs responded that they conduct GPS radiosonde observations. In some NMHSs, more than one method is used.

The respondents also provided information on ground-based remote sensing technologies they use to supplement conventional upper-air observations (Figure 7). Eight NMHSs use wind profilers. A few NMHSs use Microwave radiometer profilers or GPS receiver for integrate water vapour monitoring.

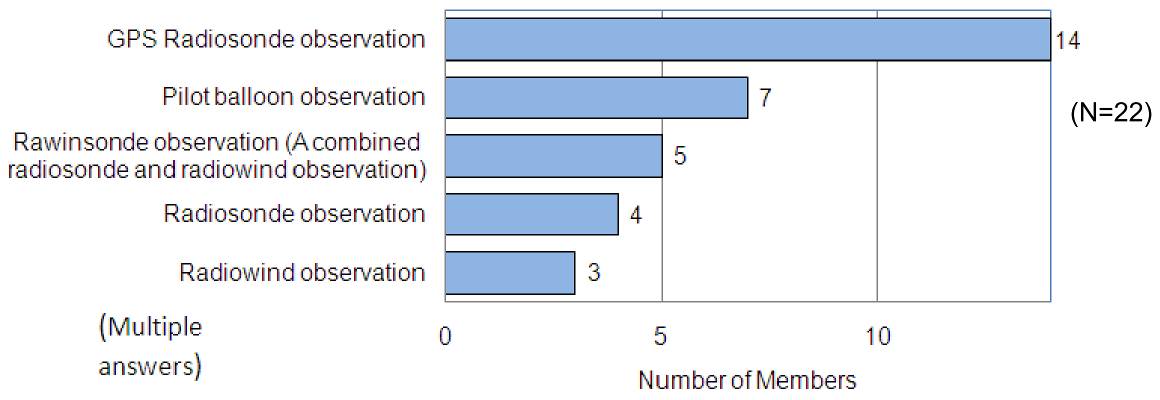

Figure 6 - Methods of upper-air observations for typical RBSN or RBCN stations

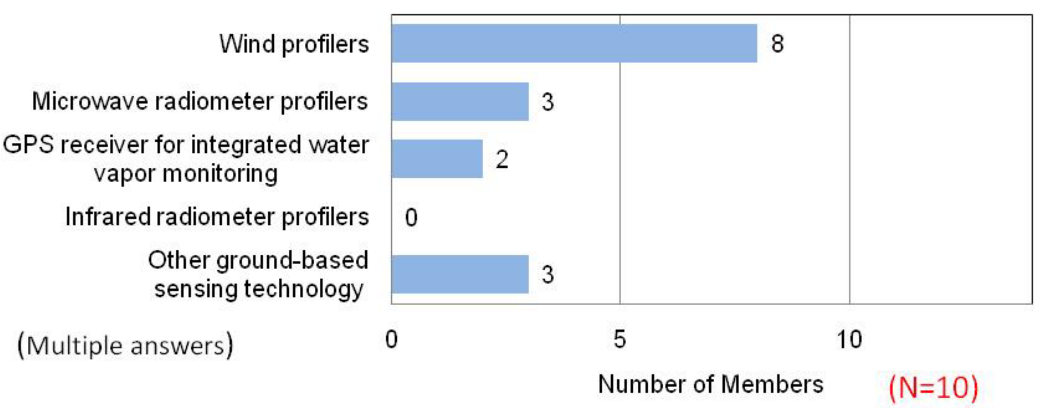

Figure 7 - Ground-based remote sensing technologies to supplement upper-air observations

2.1.3.2 Time and frequency of observations and reports

Figure 8 (a) to (d) show the time and frequency of observations and reporting for upper-air observations at typical upper-air synoptic stations.
Fourteen NMHSs make observations twice a day, while seven make once a day. Most of the observations are made at 00 UTC or 12 UTC. The same things can be said in the time and frequency of reporting, though the numbers are slightly lower than those of the observations.

According to the GOS Manual, observations shall be made and reported at least at 00 UTC and 12 UTC at a synoptic upper-air station. Only twelve NMHSs fulfil the requirement.

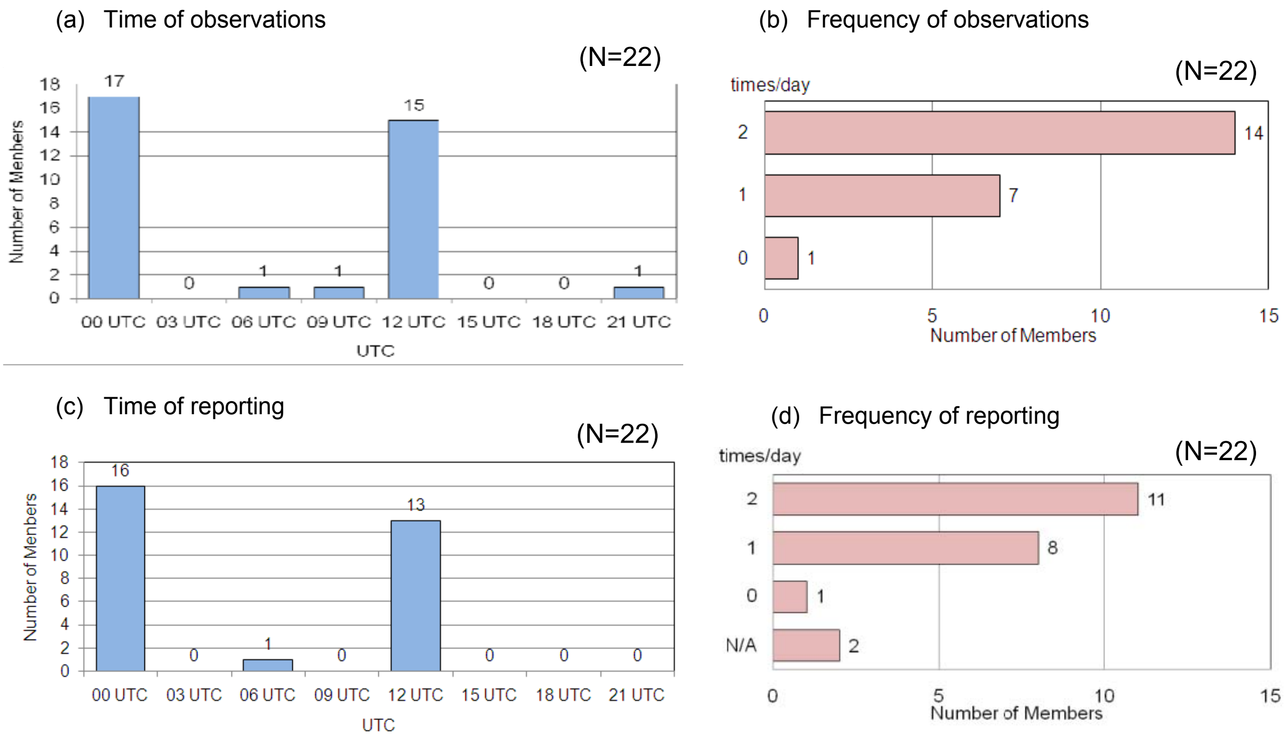

Figure 8 - Time and frequency of observations and reporting for upper-air observations

2.1.3.3 Guidelines or manuals for observations

Twelve NMHSs have their own guidelines or manuals. Ten NMHSs don't have their own, so most of them use the CIMO Guide, GOS Manual or GOS Guide (Figure 9). Manuals developed by manufacturers are used in six NMHSs.

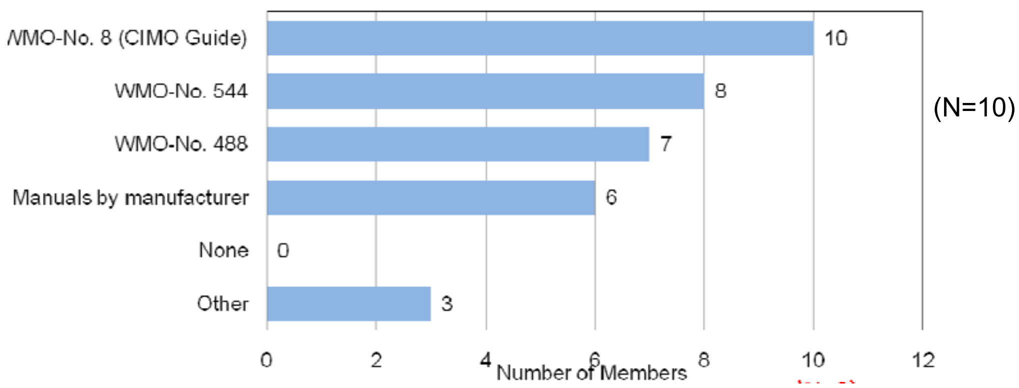

Figure 9 - Manuals for upper-air observations used by NMHSs (in case without own manuals)

2.1.3.4 Problems for observations

Lack of appropriate technology, maintenance support and calibration instruments are the most major problems among the choices prepared in the questionnaire (Figure 10). The problems associated with human capacity including lack of training and guidance materials, lack of observers' skills are also common. Several NMHSs pointed out other issues as free-response as seen in Table 2.

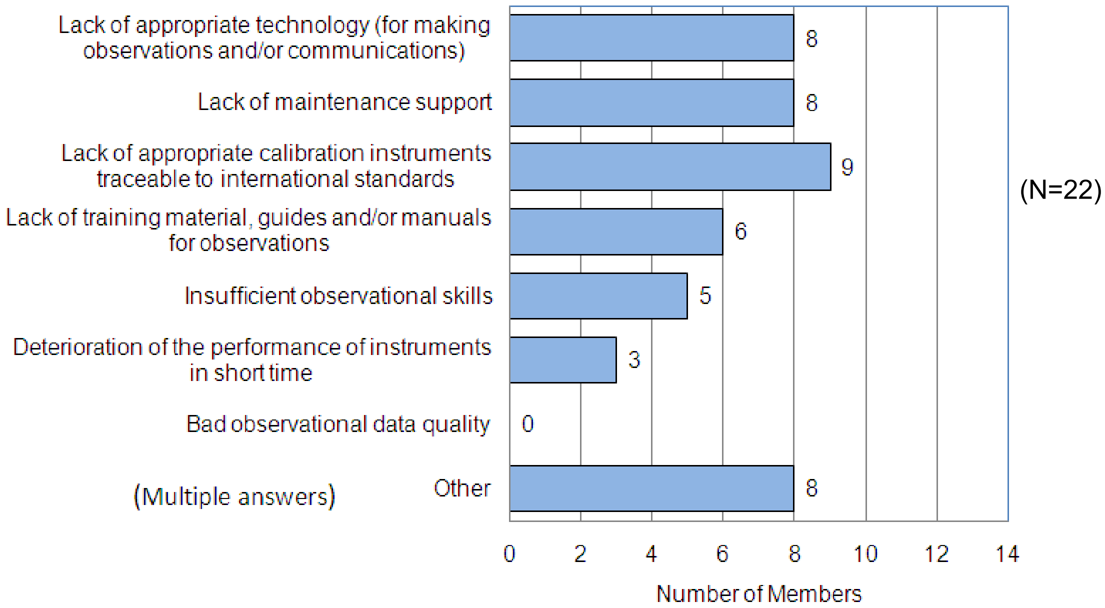

Figure 10 - Problems associated with upper-air observations (multiple-choice)

Table 2 - Problems associated with upper-air observations (free-response)

Comment
• No funding available for additional observations and observing stations.
• Now aerologic station does not spend aerologic supervision because of absence of an account material radio probes.
• Out-of-repair ground systems at some stations, unstable performance of some new ground systems, unstable reliability of radiosondes, staff recruitment and motivation, manual input of upper-air messages to teletypes on many stations, sometimes lack of chemicals and power supply, radio interference (esp. with cellular networks) issues, unfavourable meteorological conditions (strong surface winds)
• Lack of funds to purchase required numbers of radiosonde transmitters etc.
• No Major problem except high cost of operation
• Recently we had many radiosondes with faulty sensors. (Specially with faulty humidity sensors)
• Lack of Hydrogen Gas
• Calibration of instrument can not be completed in time.

2.1.4 Summary of Part IV: Quality control of upper-air observation data

This part of the questionnaire aims to describe how NMHSs conduct quality control on upper-air observations. Similar to Part II for surface observations, several questions concerning methods and practices of QC and the problems associated with data quality were asked.

2.1.4.1 Quality control systems in operation

Sixteen NMHSs responded that they had operational QC systems. Each of them describes their QC system as seen in Table C, Appendix C.
QCs are conducted automatically or manually either at observing stations, data-processing centres or archiving centres. It seems that AQC at data-processing centre has the greatest share of all the practices. A few NMHSs carry out systematic QCs at all the three levels.

2.1.4.2 QC results feedback

Table D, Appendix C shows how the same sixteen NMHSs as in the paragraph 3.1.4.1 communicate QC results with observing staff or data users in their networks. The descriptions are similar to those in Part II for surface observing networks.

2.1.4.3 Factors affecting the quality of observational data

The important factors affecting upper-air observational data quality were inquired. Observer's skills, calibration, deterioration in performance of observational instruments and observational environment condition were chosen by ten NMHSs in multiple-choices (Figure 11). Several NMHSs suggested other possible factors including technical problems related to sensors, ground systems or data processing systems, lack of manuals and guidelines, or staffing issues in free-response (Table 3).

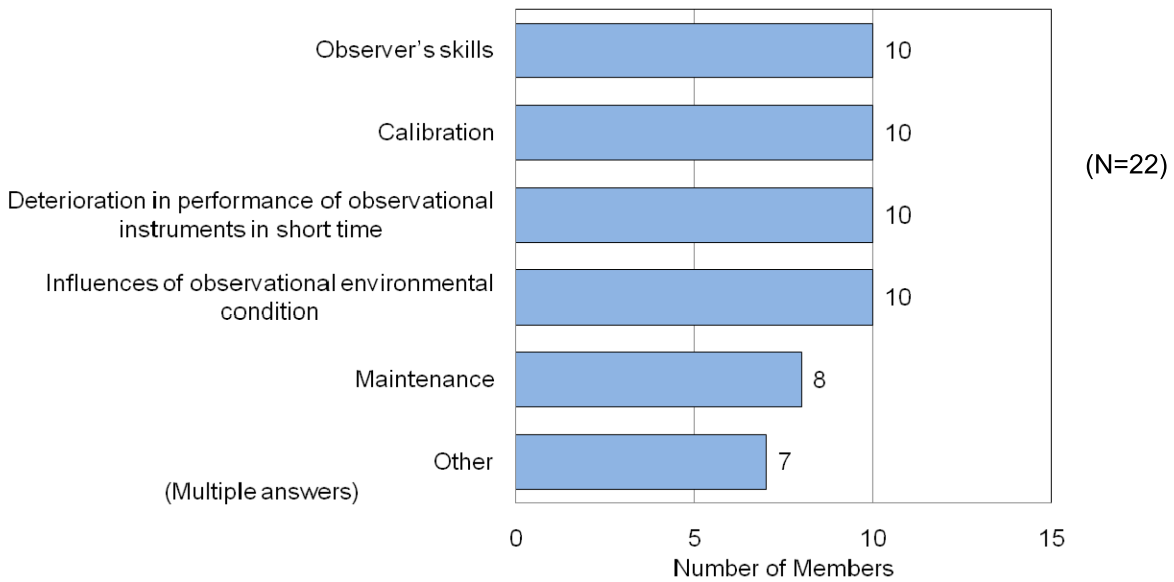

Figure 11 - Factors affecting quality of upper-air observational data (multiple-choice)

Table 3 - Factors affecting quality of upper-air observational data (free-response)

Comment
• Software of the radar is not working properly. ie. 15sec readings can't be taken. Wind is calculated using one minute data.
• Insufficient feedback between in-field performance experience and instrumentation procurement, out-of-repair ground systems at some stations, unstable performance of some new ground systems, unstable reliability of radiosondes, staff recruitment and motivation, insufficiently intelligent data-processing software, problems of aged personnel with modern PC software operating, manual input of upper-air messages to teletypes on many stations
• Lack of manuals and Guidelines
• Parameters and calculation formulas which are not disclosed by manufacturer
• Lack of appropriate technology (for making observations and/or communications)
• Obsolete sensors. Upper air network is being upgraded in technology to improve data quality.
• Radio Interference

2.1.5 Summary of Part V: Maintenance and calibration of instruments for surface observations

The CIMO Guide states that all synoptic land stations and principal climatological stations should be inspected no less than once every two years so that the quality of observations does not deteriorate significantly.

Part V is intended to see if NMHSs inspect their stations regularly and maintain instruments in good condition. In addition, it inquired if NMHSs could provide spare instruments in case of instrument failure. Twenty-eight NMHSs responded to this Part of the questionnaire.

2.1.5.1 Inspection and maintenance

Twenty-four out of twenty-eight NMHSs conduct inspections of observing stations and maintenance of the instruments regularly. The procedures and the frequency of the inspection and maintenance are described in Table E, Appendix C. Frequencies are different depending on what kinds of inspection and maintenance are carried out. For example, if it's only to examine the overall status of stations and instruments, local observers check or clean them every month or year at many NMHSs. When it comes to calibration of instruments, it seems to be done every few years or more on average.

2.1.5.2 Calibration of instruments

Nineteen NMHSs calibrate instruments at their own calibration laboratory. Most of them calibrate instruments regularly, or, when they are installed or repaired (Figure 12, Table 4). Some NMHSs that don't have a calibration laboratory seem to depend on neighbouring countries for equipment or solely on manufacture certifications.

It has been revealed that only twelve NMHSs, less than a half of all the respondents, are able to guarantee traceability of measurements to international standards.

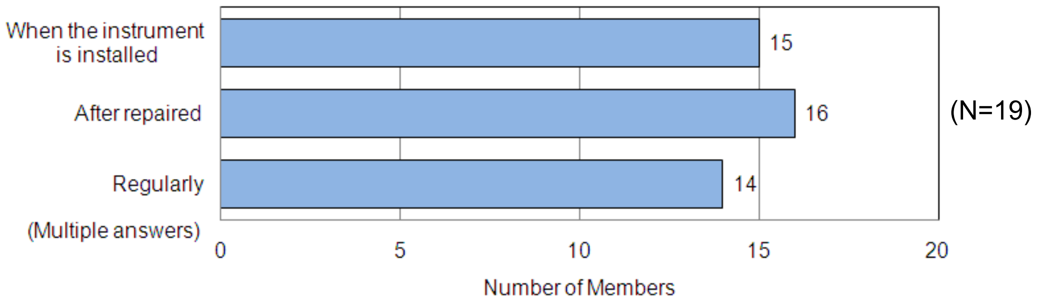

Figure 12 - Frequency of calibration of observational instruments

Table 4 - Frequency of regular inspections

Description
• For measurements of temperature, rainfall and atmospheric pressure, calibration checks are performed on an annual basis
• Please note that we have no specific laboratory for calibration. We depend mostly on manufacturer certificates and sometimes sent instruments abroad for calibration.
• Current meters are calibrated on the 2 years timetable basis.
• Barometer – Once in two years. • Thermometer – Once in two years. • Anemometer – None.
• 5 years (10 years only for electronic barometer)
• During the annual inspection and maintenance of the observational instruments.
• Once in year during inspection tours.
• Temperature, RH, precipitation and visibility sensors are calibrated annually. Wind sensors are replaced every two years(New wind sensor is calibrated by manufacturer)
• Humitemp probes replaced & re-calibrated 6 monthly
• Every 6 months or as specified in the manuals supplied by the manufacturer.

2.1.5.3 Procurement of spare instruments

Twenty-five NMHSs keep a basic set of spare instruments in case of any failure. Three NMHSs that don't prepare such instruments respond that it takes one week or more to repair and restart the observations in case of failure.

2.1.6 Summary of Part VI: Observation conducted by non-NMHS organization/ institute

Meteorological and climatological observations are conducted not only by NMHSs but also other governmental agencies, institutions or private companies for their own purposes. NMHSs may be able to effectively establish a more highly dense observing network by cooperating with them. Part VI aims to show whether NMHSs utilize the data obtained from such observations. Moreover, it is surveyed if NMHSs work as national authorities in setting regulations or giving guidance on meteorological observations made by any organizations in their countries. Such authorities may need to coordinate and direct different organizations towards the standardization in terms of observing performance in order to secure data quality.

The results show that more than one-third of the respondents use data from non-NMHSs. Only several NMHSs seem to act as regulating authority when it comes to giving permissions for starting observations or setting laws or regulations on the practices. Quite a few NMHSs give guidance and support to non-NMHSs on observations or staff training.

2.1.6.1 Utilization of observational data provided by non-NMHS organizations

Ten respondents use the observational data provided by the non-NMHS organizations or institutes in their own countries. The questions followed are asked only to these ten NMHSs.

2.1.6.2 Regulations regarding observational practices and instruments for non-NMHSs

Several NMHSs give permissions to or receive notifications from non-NMHS organizations or institutions when they start observations.

Seven have some regulations regarding observations practices. As Table 5 shows the details, a few NMHSs seem to set a law or a regulation for the practices, while others determine observing time and frequency, or give other directions for the corporative activities.

Six NMHSs also set some regulations for observational instruments used by the non-NMHS organizations/institutions as seen in Table 6.

Table 5 - Regulations regarding observations made by non-NMHSs organizations

Description
• Maintenance of Water Cadastre requires the jointed efforts come from different involved bodies. There is governmental directives that regulate such kind of cooperative activities.
• All of the meteorological observations in Korea must be conducted according to the meteorological observation standardization law.
• Observations should be done at specific times.
• Regulation/training of non-NMHS personal is conducted in coordination with NMHS.
• Article 6 of Meteorological Service Act
• Non- NMHS take only two observations at 03 and 12 UTC.
• Non- NMHS Organization only observe rainfall by NMHS regulators

Table 6 - Regulations regarding the use of observational instruments for non-NMHS

Description
• Korea has the meteorological observation standardization law regarding that.
• WMO Standard instruments must be used
• Regulation/training of non-NMHS personal is conducted in coordination with NMHS.
• Article 9 of Meteorological Service Act
• Non-NMHS uses ordinary Met. Instruments of non-recording type supplied by NMHS
• ordinary rain gauge
• Regulations of WMO given to non-NMHS organizations in establishing observatory.

2.1.6.3 Supports to non-NMHS organizations

Nine NMHSs provide supports to non-NMHS organizations/institutions to improve their observational data quality. The supports include providing training programs, giving guidance on the practices, calibration of instruments or financial support (Table 7).

Table 7 - Supports to non-NMHSs for improvement of data quality

Description
• Training programmes and coaching are provided to the non-NMHS organization/institution on the techniques of making weather observations.
• Historical data on weather and runoff measurements are widely used by ▪ the agricultural, design and engineering , water reservoirs work planners as corrective ▪ input to the weather management and water reservoirs exploiting models and decision ▪ making support systems. Also that data are useful while calculation of the water balance for irrigation system is doing. ▪ Data of meteorological observations are used as referenced data while energy-saving ▪ technologies are developing.
• KMA has provided observation training and technique.
• Some instruments are provided regular maintenance and training
• Article 10 of Meteorological Service Act: Guidance for procedure of observation
• They are supported financially
• Training and practical observation procedure
• Our organization has been working on instruments calibration of non-NMHS organization/institution.
• Giving guidance for quality management of non-NMHS organizations.

2.1.7 Summary of Part VII: Training for observers

2.1.7.1 Training course programme at NMHSs

Twenty-three NMHSs provide training courses for observers and maintenance personnel on surface observations, while fifteen NMHSs provide on upper-air observations (Figure 13). The timing of conduction of the trainings varies from quarterly to every five years (Figure 14, Table 8). Five NMHSs provide a training program every year. Fourteen NMHSs, almost half of the respondents, train their staff when new instruments are introduced. It seems that trainings are conducted irregularly upon necessity rather than regularly. The most widely-seen frequency of regular trainings is once a year both for surface and upper-air observations (Table 8, Table 9).

Training programmes are conducted in a way of lectures, practices, or combination of the two in most Members, while eight NMHSs provide trainings through E-learning (Figure 15).

Twenty-one NMHSs prepare materials for the courses on their own. WMO textbooks are also commonly used, while a few NMHSs rely on manuals written by instrument manufactures.

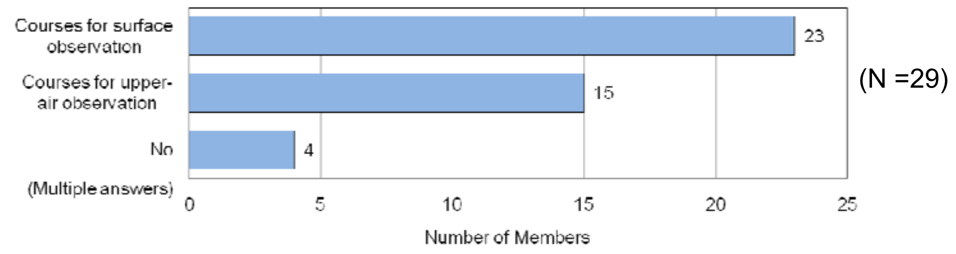

Figure 13 - Training courses conducted by NMHSs

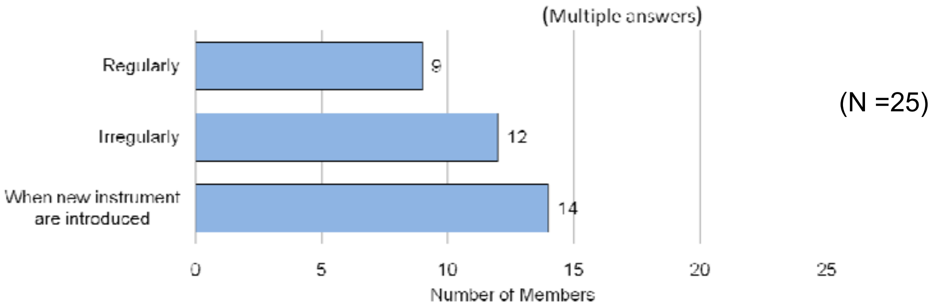

Figure 14 - Timing of the provision of training courses

Table 8 - Frequency of the provision of regular training on surface observations

Description (surface observations)
• Twice per year
• Once in a year
• Annually
• Quarterly
• Annual training at college and local district observatory
• WMO prescribed observer's course
• Once a year
• Every year the site observer are given a week long refresher course on observations and equipments
• One time per 5 year

Table 9 - Frequency of the provision of regular training on upper-air observations

Description (upper observations)
• Twice per year
• Once in a year
• Annually
• Annual training at college and local district observatory
• WMO prescribed observer's course
• Once a year

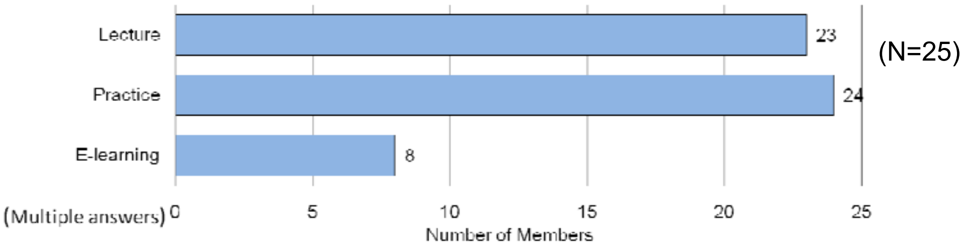

Figure 15 - Style of training courses

2.1.7.2 Problems for trainings

One of the most common problems among the respondents in staff training is shortage of trainers who can provide training (Figure 16). Lack of appropriate materials or equipment is also a problem. Other issues such as budget for travel expenses for participants of programs, lack of trainer's skills, insufficient technologies are raised as shown in Table 10.

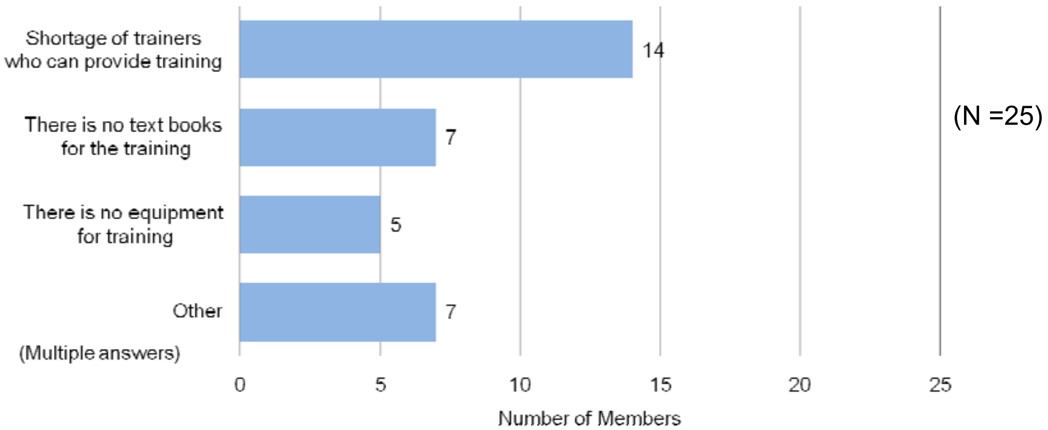

Figure 16 - Problems when carrying out staff training (multiple choices)

Table 10 - Problems when carrying out staff training (free-response)

Description
• Financial
• No Problem
• Lack of modern technology such as e-learning.
• Equipment for training are insufficient in terms of variety and up to date types
• Lack of funds for trainees travel and accommodation, web-conferencing is studied as a potential platform for e-learning
• Insufficient of the budget to conduct the training course.
• Trainer's training skills must be upgraded up to the latest technology.
• No significant problem
• None of the above
• No Proper Training Manuals & Text Books

2.1.8 Summary of Part VIII: Training course sponsored by WMO on the meteorological instruments

The WMO Regional Training Centres and other NMHSs offer some training programmes on meteorological instruments.

Only seven NMHSs have sent their staff to participate in training courses sponsored by WMO in the past five years. The courses they participated are described in Table 11. The trainees of the courses share what they have learned in the courses with other staff at the NMHSs through lectures, implementation of in-house training, or remake of the training materials for domestic use.

Table 11 - WMO training courses participated by NMHSs in the past five years

Description
• WMO International Workshop on "Radio spectrum use for meteorological needs: Monitoring and weather, climate and water prediction" (Geneva, Switzerland, September, 2009) • WMO Technical Conference on GISO (TECO-CISO)-14-th session of CGS (Dubrovnik, Croatia, March, 2009) • WMO Technical Conference on Meteorological and Environmental Instruments and Methods of Observation (Helsinki, Finland, November 2008) • Weather Radar Training Course (Antalia, Turkey, June 2007) • Training Course on Remote Sensing (Dekhradun, India, January-March 2007) • Training Course on Electronic Observation Systems (Alania, Turkey, June 2006) • 10-th Training Course on Remote Sensing and GIS (Dekhradun, India, October-June 2006)
• During the last five years, DMH staff who got the training on instruments at WMO's RTC in China as well as Training on RADAR held by Hong Kong Observatory and on Satellite held by other Center, they can improve their tasks in applying knowledge learnt from those trainings. All of trainees can carry out role and function of DMH, by self handling installation and maintenance of instruments.
• Number of courses on wx obs, met instruments and calibration at CAIRO regional training centre
• Israil,"Transmission of meteorological and agrometeorological conductions from convectional to automatic stations
• Training course on Automatic Weather Station Network, Hong Kong, China, From 26-30 November, 2007
• Our maintenance staff attend training course on AWS on Hong Kong and it was very helpful to increase them knowledge on AWS.
• Radar training course, in Istanbul, Turkey (2007)

2.1.9 Summary of Part IX: Status of observational stations

The surroundings of stations can significantly affect the data obtained at the sites. Several NMHSs have already expressed the concerns on the changes of environment around the stations as the answers for the questions asked in Part I or Part II. Because there are many high-densely populated cities in Asia, avoiding the effects of surrounding buildings, trees or any obstacles is a pressing matter. This part of the questionnaire is intended to show how the respondents handle the issue. It also surveyed whether metadata are appropriately recorded at NMHSs.

2.1.9.1 Monitoring the environment of stations

Twenty-five NMHSs monitor the changes of the environment of your observational stations. When changes are recognized, actions to remove the influence are taken. If there are environmental changes adversely affecting observations, most NMHSs responded that they remove the surrounding obstacles or, when it's difficult to remove the affects, move the station to the appropriate location (Figure 17). Eleven NMHSs responded that they just record the facts of the changes as metadata.

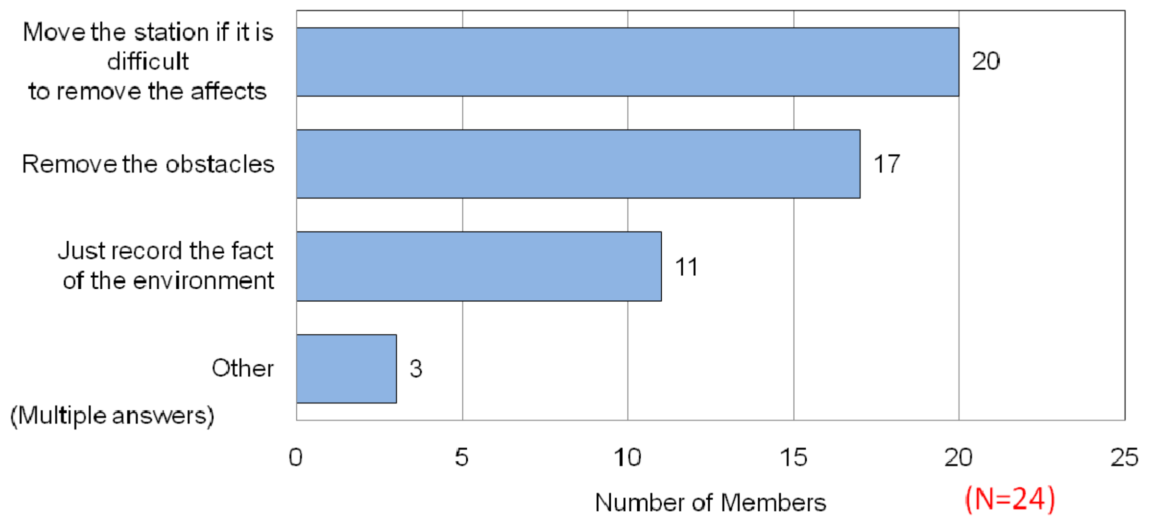

Figure 17 - Measures to avoid the affects of the environmental changes

2.1.9.2 Metadata records

Twenty-eight NMHSs responded that they keep basic metadata records of their observational stations. Among the metadata, the most widely recorded by the NMHSs is location (latitude, longitude and altitude) (Figure 18). Historical records of instruments and environmental conditions are also well recorded. Sixteen NMHSs replied they update the metadata annually, while five NMHSs don't update them within five years (Figure 19).

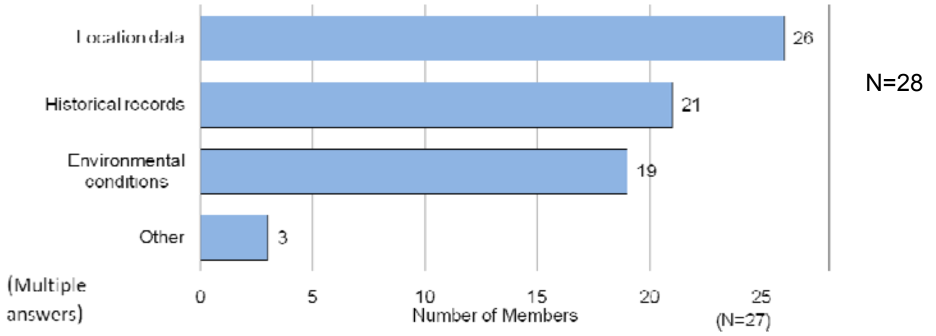

Figure 18 - Metadata recorded by NMHSs

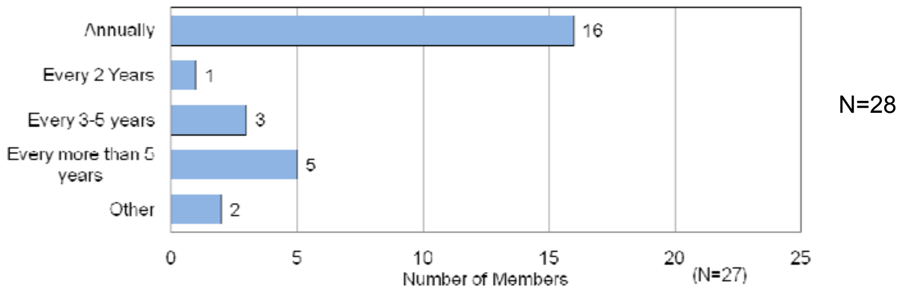

Figure 19 - Frequency of updating metadata

2.1.10 Summary of Part X: Further improvement of the observational data quality

Part X consists of only one question asking what challenge NMHSs would take on to improve the quality of observational data. The responses are shown in Figure 20 and Table 12.

Calibration and observer's skills are chosen by more than twenty NMHSs. Maintenance, instruments performance and procurement of instrument parts also score high (Figure 20). Some NMHSs find development in technologies of equipment, systems or QC are challenging in the improvement of data quality (Table 12).

Figure 20 - Challenges for the improvement of observational data quality (multiple choices)

Table 12 - Challenges for the improvement of observational data quality (free-response)

Description
• Budgetary issues
• Addressing the observational environment change due to urbanization, etc
• Further renovation of ground equipment, intercomparison of radiosondes and ground systems from various manufacturers, more intelligent software development (to decrease amount of the 1st and 2nd order QC errors), stronger feedback between in-field performance and procurements for upper-air consumables and equipment
• Technical development of QC
• Lack of appropriate technology (for making observations and/or communications).
• Upgrade the technology as per WMO requirement of data quality.
• We need observational equipments from WMO support
• The calibration unit is not totally functioning now. Actions are being taken to get it "Full Functioning".

2.1.11 Summary of Part XI: Observational data availability

Part XI inquires how well observational data from RBSN/RBCN stations are provided to international communities. The respondents were asked whether they report data from all their RBSN/RBCN stations, if not, the reason why. Nineteen NMHSs report from all the RBSN/RBCN stations in their countries. However, eight of them fail to report observational data at some of their stations due to observations and communication failure, or bad quality of data.

2.2 Summary of Section 2: Observational data

NMHSs are not only the provider but also the user of observational data in a way of producing various weather and climate products for domestic users. This part of the questionnaire is intended to describe the availability and utility of observational data exchanged via GTS for NMHSs in perspective of data users. Twenty-nine NMHSs responded this part of the questionnaire.

2.2.1 Observational reports used by NMHSs

As Figure 21 shows, SYNOP is most commonly used among the respondents. TEMP and CLIMAT are also used by many NMHSs, twenty-one and twenty-two respectively. CLIMAT TEMP was used by thirteen NMHSs. Besides these reports, several NMHSs use METAR and other aviation data.

The main purposes for using such observational reports are shown in Figure 22 and Table 13. Observational data is mostly used in real-time for weather forecast and monitoring. On the other hand, non-real time use is also common. Twenty-three NMHSs responded that they use observational data for climate monitoring and prediction. The data is also used for research and study.

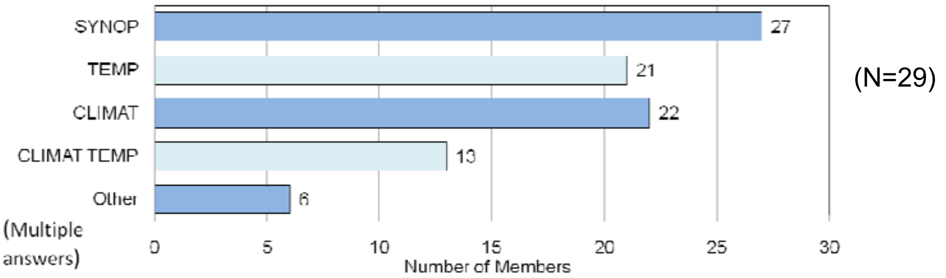

Figure 21 - Observational reports used by NMHSs

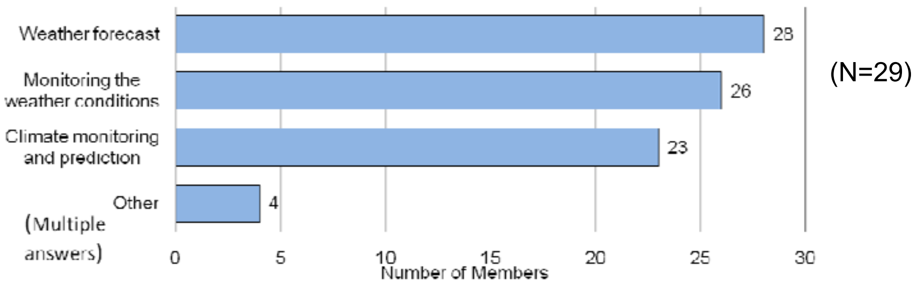

Figure 22 - Purposes of using observational reports (multiple choices)

Table 13 - Purposes of using observational reports (free-response)

Description
• Aviation weather forecasting
• To prepare reports, using in research and development, Judiciary and Insurance verification
• Research
• Research
• Researches, Study cases & training

2.2.2 Problems in using observational reports

Ten NMHSs, more than one-third of the respondents, have some problems in using observational reports. The most serious concern is the data quality (Figure 23, Table 14). Other concerns include missing of reports or communication failures. Some NMHSs try to solve the problems by conducting QC on the reports they get from GTS (Figure 24). They sometimes inform the organization responsible for the data of the error.

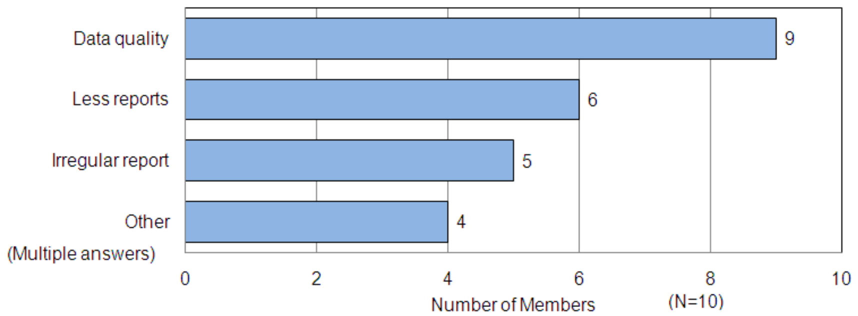

Figure 23 - Problems in using observational reports (multiple choices)

Table 14 - Problems in using observational reports (free-response)

Description
• Sometimes data quality
• Sometime data not received in time.
• GTS link frequently fault in our site
• We have never used the Observational Reports due lack of knowledge on it and its unavailability. Hence problems related to such reports are unknown

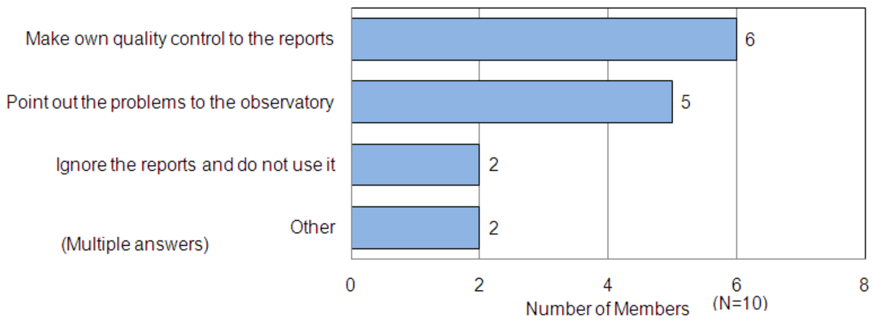

Figure 24 - User's efforts to improve the quality of observational reports

2.3 Summary of Section 3: Comments or suggestions to the Pilot Project

Comments and suggestions about how best to tackle the issues on data quality improvement in RA II within the framework of the PP were asked. Though the responses obtained from eleven Members are not referred here, they are very useful and informative and will help the Coordinator design the strategies for the PP.

CONCLUSIONS

Major problems with observations are lack of appropriately calibrated instruments traceable to international standards, maintenance support, or the knowledge and experience of the maintenance and calibration. Most NMHSs recognize the importance of maintenance and calibration of the sensors for the improvement of data quality. Therefore, full utilization of the services of RICs and establishment of calibration laboratories within each NMHS are included in the recommendations of the workshop.

Besides the issues on calibration and maintenance, observer's skills are recognized as one of the main challenges for the improvement of data quality. However, many Members face the shortage of trainers for staff training courses. It is recommended that the Coordinating Group of the PP explore the possibility of regional training opportunities for calibration, data quality management, monitoring of data and best practices in observations.

Frequent failures in telecommunications or other systems significantly reduce the data availability in the Region, thus damage the required performance of observing networks. In addition, some NMHSs do not have operational system for QC. Improvement of QC methods is needed at different levels from observing sites to communication or data archiving centres. Information sharing among Members in practices of observations and quality management is expected to be promoted by the PP.

Due to the urbanization, some NMHSs are having trouble finding the solution for changes of surroundings of stations. Updated metadata and maintenance of the environment conditions of stations are also needed to ensure data quality.

ACKNOWLEDGEMENTS

The coordinator of the PP would like to thank the Members who provided responses and Dr. Miroslav Ondras (WMO) for his input in developing the questionnaire.

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Appendix A: Questionnaire

WMO REGIONAL ASSOCIATION II (ASIA)

PILOT PROJECT TO ENHANCE THE AVAILABILITY AND QUALITY MANAGEMENT SUPPORT FOR NATIONAL METEOROLOGICAL AND HYDROLOGICAL SERVICES IN SURFACE, CLIMATE AND UPPER-AIR OBSERVATIONS

Questionnaire on the Surface, Climate and Upper-air Observations and Quality Management in RA II

Within the activities of the Pilot Project to Enhance the Availability and Quality Management Support for NMHSs in Surface, Climate and Upper-air Observations, established at the fourteenth session of Regional Association II (Asia), Tashkent, Uzbekistan, December 2008, the Coordinator (Japan) of the Pilot Project intends to conduct the survey to assess the current status of the implementation of weather, climate and upper-air observations, their provision and their quality management in RA II. RA II Members are therefore kindly invited to contribute to the survey. Results of the survey will be reported to a JMA/WMO Workshop on Quality Management in Surface, Climate and Upper-air Observations in RA II (Asia), to be held in Tokyo, Japan, 27-30 July 2010.

Name of Member:________________________

Person filling out this form:

Title: Mr ☐ Ms ☐ Dr ☐ Prof. ☐ (Please tick appropriate)
Name: _________________________________

Organization: ____

Address: ____

____

Telephone: _____________________________

Facsimile: ______________________________

Email: _________________________________

Date: _____________ _________________________________

(Signature of Permanent Representative)

SECTION 1: SURFACE AND UPPER-AIR OBSERVERS

Responsible section/Institute ___________________________

Part I: Status of surface-based *in-situ* observations of basic networks (e.g., Regional Basic Synoptic Network (RBSN) and/or Regional Basic Climatological Network (RBCN)) in your country

Please identify a typical RBSN/RBCN station for answering the following questions:

Index Number:________________ Station Name:_______________ ___________________________

Q 1-1 What are the observed meteorological variables?

□ Air temperature □ Atmospheric pressure □ Humidity
□ Surface wind □ Precipitation, amount & intensity □ Snow depth
□ Solar radiation □ Sunshine duration □ Visibility
□ Evaporation □ Soil temperature □ Soil moisture
□ Cloud amount and type □Weather, present & past □ Soil temperature
□ Other (please describe below): □ State of the ground

Q 1-2 What time and how often are observations conducted?

_____________ times per day:
□ 00 UTC □ 01 UTC □ 02 UTC □ 03 UTC □ 04 UTC □ 05 UTC
□ 06 UTC □ 07 UTC □ 08 UTC □ 09 UTC □ 10 UTC □ 11 UTC
□ 12 UTC □ 13 UTC □ 14 UTC □ 15 UTC □ 16 UTC □ 17 UTC
□ 18 UTC □ 19 UTC □ 20 UTC □ 21 UTC □ 22 UTC □ 23 UTC
□ More frequently (please specify)_______________________________

Q 1-3 What time and how often surface observations are reported to GTS (Global Telecommunication System)?

_____________ times per day:
□ 00 UTC □ 03 UTC □ 06 UTC □ 09 UTC
□ 12 UTC □ 15 UTC □ 18 UTC □ 21 UTC
□ More frequently (please specify)_______________________________

Q 1-4 Do you have your own guidelines and/or manuals (prepared by NMHS) on how to make observations and how to install observing station?
□ Yes □ No

(If your answer is "No", follow the next question, Q 1-4-1.)

Q1-4-1 Which kind of other guidelines and/or manuals are used by your NMHS? (Multiple answers are allowed)
□ WMO Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8 (CIMO Guide)
□ WMO Manual on the Global Observing System, WMO-No. 544
□ WMO Guide to the Global Observing System, WMO-No. 488
□ Manuals prepared by manufacturer
□ None
□ Other (please describe below):

Q 1-5 Are there any problems in your NMHS to perform the required observations? (Multiple answers allowed)

□ Lack of training material, guides and/or manuals for observations
□ Lack of appropriate technology (for making observations and/or communications)
□ Lack of maintenance support
□ Lack of appropriate calibration instruments traceable to international standards
□ Insufficient observational skills
□ Deterioration of the performance of instruments in short time
□ Bad observational data quality
□ Other (please describe below):

Part II: Quality control of surface observational data

Q 1-6 Do you have an operational system for the Quality Control (QC) of observational data?

□ Yes □ No

(If your answer is "Yes", follow the questions Q 1-6-1 and Q 1-6-2.)

Q 1-6-1 What kind of QC do you apply at different levels (at the observing station, in the data processing centre, communication centre (data archive/dissemination centre))? Please describe QC in detail.

Q 1-6-2 How do you communicate QC results to observing stations and users? Describe the remedial actions taken to address QC problems.

Q 1-7 What are the most important factors adversely affecting data quality in your NMHS? (Multiple answers allowed)

□ Observer’s skills
□ Maintenance
□ Calibration
□ Deterioration in performance of observational instruments in short time
□ Influences of observational environmental condition
□ Other (Please describe below):

Q 1-8 Have you ever used the JMA Global Data Monitoring Report on the webpage (http://qc.kishou.go.jp) for your data quality monitoring?

□ Yes □ No

(If your answer is "No", follow the next question, Q 1-8-1.)

Q 1-8-1 Why have you not used the JMA Global Data Monitoring Report

□ We did not know it is available
□ We do not know how to use
□ The content is not sufficient or appropriate (please describe below)

<u>Part III</u>: Status of *in-situ* <u>Upper-air observations</u> of basic networks (e.g., RBSN, or RBCN) in your country

Please identify a typical RBSN/RBCN station for answering the following questions:

Index Number:________________ Station Name:______________ ___________________________

Q 1-9 How are upper-air observations conducted?
□ Rawinsonde observation (A combined radiosonde and radiowind observation)
□ GPS Radiosonde observation (An observation of meteorological elements in the upper air, usually atmospheric pressure, temperature and humidity, GPS winds)
□ Radiosonde observation (An observation of meteorological elements in the upper air, usually atmospheric pressure, temperature and humidity)
□ Radiowind observation (An observation of upper winds by tracking of a free balloon by electronic means)
□ Pilot balloon observation (An observation of upper winds by optical tracking of a free balloon)
□ Other (please describe below):

____

Other ground-based remote sensing technology to supplement RBSN/RBCN upper-air network, such as:
□ Wind profilers
□ GPS receiver for integrated water vapor monitoring
□ Infrared radiometer profilers
□ Microwave radiometer profilers
□ Other (please describe below):

____

____
(If your answer is "Rawinsonde observation", “GPS Radiosonde observation” or “Radiosonde observation”, follow the questions: Q 1-10 to Q1-13.)

Q 1-10 What time and how often are observations conducted?

_____________ times per day:

□ 00 UTC	□ 03 UTC	□ 06 UTC	□ 09 UTC
□ 12 UTC	□ 15 UTC	□ 18 UTC	□ 21 UTC

Q 1-11 What time and how often are observations reported to GTS (Global Telecommunication System) in real-time?

_____________ times per day:

□ 00 UTC	□ 03 UTC	□ 06 UTC	□ 09 UTC
□ 12 UTC	□ 15 UTC	□ 18 UTC	□ 21 UTC

Q 1-12 Do you have your own guidelines and/or manuals (prepared by NMHS) on how to make observations and how to install observing station?
□ Yes □ No

(If your answer is "No", follow the next question, Q 1-12-1.)

Q 1-12-1 Which kind of other guidelines and/or manuals are used by your NMHS. (Multiple answers allowed)
□ WMO Guide to Meteorological Instruments and Methods of Observation, WMO-No. 8 (CIMO Guide)
□ WMO Manual on the Global Observing System, WMO-No. 544
□ WMO Guide to the Global Observing System, WMO-No. 488
□ Manuals prepared by manufacturer
□ None

□ Other (please describe specifically below):

Q 1-13 Are there any problems in your NMHS to perform the required observations? (Multiple answers allowed)
□ Lack of training material, guides and/or manuals for observations
□ Lack of appropriate technology (for making observations and/or communications)
□ Lack of maintenance support
□ Lack of appropriate calibration instruments traceable to international standards
□ Insufficient observational skills
□ Deterioration of the performance of instruments in short time
□ Bad observational data quality
□ Other (please describe below):

Part IV: Quality control of upper-air observation data

Q 1-14 Do you have an operational system for the Quality Control (QC) of observational data?
□ Yes □ No

(If your answer is "Yes", follow the questions Q 1-14-1 and Q 1-14-2.)
Q 1-14-1 What kind of QC do you apply at different levels (at the observing station, in the data processing centre, communication centre)? Please describe QC in detail.

Q 1-14-2 How do you communicate QC results to observing stations and users? Describe the remedial actions taken to address QC problems?

Q 1-15 What are the most important factors adversely affecting data quality in your NMHS? (Multiple answers allowed)
□ Observer's skills
□ Maintenance
□ Calibration
□ Deterioration in performance of observational instruments
□ Influences of observational environmental condition
□ Other (Please describe specifically below):

Q 1-16 Have you ever used the JMA Global Data Monitoring Report on the webpage (http://qc.kishou.go.jp) for your data quality monitoring?
□ Yes □ No

(If your answer is "No", follow the next question, Q 1-16-1)
Q 1-16-1 What are problems or the reasons you have not used the JMA Global Data Monitoring Report? Please describe below:

Part V: Maintenance and calibration of instruments for surface observations

Q 1-17 Does your NMHS conduct regular inspections of observing stations and maintenance of the instruments?

□ Yes □ No

(If your answer is "Yes", follow the next question, Q 1-17-1.)
Q 1-17-1 What kind of inspection and maintenance is done, and how frequent is it?

Q 1-18 Does your NMHS calibrate the observational instruments at your calibration laboratory?
□ Yes □ No

(If your answer is "Yes", follow the next question, Q 1-18-1.)
Q 1-18-1 When do you calibrate instruments? (Multiple answers allowed)
□ When the instrument is installed
□ After repaired
□ Regularly (specify period according to a variable):

Q 1-19 Does your calibration laboratory guarantee traceability of measurements to international standards, such as System International (SI)?
□ Yes □ No

Q 1-20 Do you keep a basic set of spare instruments to replace the failed ones?
□ Yes □ No

(If your answer is "No", follow the next question, Q 1-20-1.)
Q 1-20-1 How long does it normally take to repair and restart the observation in case of failure?
□ In a few days □ Over one week

<u>Part VI</u>: Observation conducted by non-NMHS organization/institute

Q 1-21 Does your NMHS use observational data provided by the non-NMHS organization/institute in your country?
□ Yes □ No

(If your answer is "Yes", follow the next questions: Q 1-22 to Q 1-25.)

Q 1-22 Are non-NMHS organizations/institutions mandated to conduct any notification to NMHS or to be authorized (permission) by NMHS to carry out meteorological observations?
□ notification to NMHS
□ permission by NMHS
□ No

Q 1-23 Are there any regulations regarding observation made by the non-NMHS organization/institution?

□ Yes
(Please describe specifically: ________________________________

____)
□ No

Q 1-24 Are there any regulations regarding the use of observational instruments for non-NMHS organization/institution?
□ Yes
(Please describe specifically:________________________________

____)
□ No

Q 1-25 Does your NMHS provide any supports to non-NMHS organization/institution to improve observational data quality?
□ Yes
(Please describe specifically:___________________________)
□ No

<u>Part VII</u>: Training for observers

Q 1-26 Do you have any training courses for observers and maintenance personnel? (Multiple answers allowed)
□ Courses for surface observation
□ Courses for upper-air observation
□ No

(If you have any courses, follow the next question, Q 1-25-1.)

Q 1-26-1 How often does your NMHS conduct the training?
□ Regularly □ Irregularly
□ When new instrument are introduced

(If your answer is "regularly", please describe specifically.)
□ Surface observations (______________________)
□ Upper-air observations (_____________________)

Q 1-27 What kinds of training do you conduct? (Multiple answers allowed)
□ Lecture □ Practice □ E-learning

Q 1-28 Do you prepare your own training text books?
□ Yes □ No

(If your answer is "No", follow the next question.)
Which text books do you use?
□ WMO training text books
□ Other (Please describe specifically:_________________)

Q 1-29 Do you have the following problems when carrying out the training for your staff in your NMHS? (Multiple answers allowed)
□ Shortage of trainers who can provide training
□ There is no text books for the training
□ There is no equipment for training
□ Other (Please describe specifically: ____

____)

<u>Part VIII</u>: Training course sponsored by WMO on the meteorological instruments

Q 1-30 Have your staff members participated in training courses on the meteorological instruments sponsored by WMO during last five years?
□ Yes □ No

(If your answer is "Yes", follow the questions: Q 1-30-1 and Q 1-30-2.)

Q 1-30-1 Please describe effective training courses they took in the past:

____

____

____

____

Q 1-30-2 Do the trainees who have taken the training course share training results with other staff members?
□ Yes □ No

(If your answer is "Yes", follow the next question, Q 1-30-2-1)
Q 1-30-2-1 How do they share training results with other staff members?
□ Implementation of in-house training
□ Making training materials available for domestic use
□ Other (Please describe specifically below.):

(If your answer is "No", follow the next question, Q 1-30-2-2.)
Q 1-30-2-2 Why did they not share training results with other staff members? Please describe below specifically.

<u>Part IX</u>: Status of observational stations

Q 1-31 Do you monitor the changes of the environment of your observational stations?
□ Yes □ No

(If your answer is "Yes", follow the next question, Q 1-31-1.)
Q 1-31-1 If there are the environmental changes affecting adversely your observational stations, what do you do? (Multiple answers allowed)
□ Remove the obstacles
□ Move the station to the appropriate location if it is difficult to remove the affects
□ Just record the fact of the environment
□ Other (Please describe specifically.):

____

____

Q 1-32 Do you have basic metadata records about the measurement instruments, observational environment, location (latitude, longitude, altitude), and so on?
□ Yes □ No

(If your answer is "Yes", follow the questions Q 1-32-1 and Q 1-32-2.)

Q 1-32-1 What kind of metadata record do you have? (Multiple answers allowed)
□ Historical records of the measuring instruments
□ Environmental condition of observational station
□ Location of the station (latitude, longitude, altitude)
□ Other (Please describe specifically below.):

____

____

Q 1-32-2 How often do you update the metadata records?
□ Annually
□ Every 2 Years
□ Every 3-5 years
□ Every more than 5 years

<u>Part X</u>: Further improvement of the observational data quality

Q 1-33 What are the challenges to improve further the quality of observational data in your NMHS?
□ Observer's skills
□ Maintenance
□ Calibration
□ Instrument performance
□ Procurement of parts
□ Other (Please describe specifically below.)

<u>Part XI</u>: Observational data availability

Q 1-34 Do you report the observational data from RBSN/RBCN stations internationally?
□ All RBSN/RBCN stations
□ Most RBSN/RBCN stations
□ Few RBSN/RBCN stations

Q 1-35 If you do not provide data from all RBSN/RBCN stations, why?
□ Observations not taken
□ Observational data not collected at headquarters
□ International telecommunication not working
□ Other(Please describe specifically below.)

____

SECTION 2: OBSERVATIONAL DATA

Responsible section/Institute ___________________________

Q 2-1 What kind of observational reports in Region II (Asia) do you use? (Multiple answers allowed)
□ SYNOP report
□ TEMP report
□ CLIMAT report
□ CLIMAT TEMP Report
□ Other (Please describe specifically: ____
_____________)

Q 2-2 What are the aims to use above reports? (Multiple answers allowed)
□ Monitoring the weather conditions
□ Weather forecast
□ Climate monitoring and prediction
□ Other (Please describe specifically :____________________)

Q 2-3 Do you have any problems to use the observational reports?
□ Yes □ No

(If your answer is "Yes", follow the next questions: Q 2-3-1 to Q 2-3-3.)
Q 2-3-1 What are the problems? (Multiple answers allowed)
□ Data quality
□ Less frequent reports
□ Irregular reporting
□ Other (Please describe specifically below.):

Q 2-3-2 Do problems above happen frequently?
□ Yes □ No

Q 2-3-3 Do you make any efforts to solve the problems?
□ Yes □ No

(If your answer is "Yes", follow the next question, Q 2-3-3-1)
Q 2-3-3-1 What kind of efforts do you make?
□ Point out the problems to the observatory
□ Make own quality control to the reports
□ Ignore the reports and do not use it
□ Other (Please describe specifically:_______________)
Please write down problems concerning observational data, if any.

SECTION 3 COMMENTS OR SUGGESTIONS TO THE PILOT PROJECT

Responsible section/Institute ___________________________

Q 3-1 If you have any comments or suggestions to the Pilot Project on the observational data quality improvement in RA II, please describe below specifically.

*Please send the completed questionnaire to Coordinator of the Coordination Group at the following address not later than **9 July 2010**:*

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Appendix B: List of NMHSs replying to the survey

NMHSs	Reply to the questionnaire
Afghanistan	No
Bahrain	Yes
Bangladesh	Yes
Bhutan	Yes
Cambodia	Yes
China	Yes
Hong Kong	Yes
India	Yes
Iran	Yes
Iraq	Yes
Japan	Yes
Kazakhstan	Yes
Kuwait	Yes
Kyrgyzstan	Yes
Lao	Yes
Macao	Yes
Maldives	Yes
Mongolia	Yes
Myanmar	Yes
Nepal	Yes
North Korea	No
Oman	Yes
Pakistan	Yes
Qatar	Yes
Russia	Yes
Saudi Arabia	No
South Korea	Yes
Sri Lanka	Yes
Tajikistan	No
Thailand	Yes
Turkmenistan	No
United Arab Emirates	Yes
Uzbekistan	Yes
Viet Nam	Yes
Yemen	No

Appendix C: Tables

Table A - Quality Controls conducted in operation of surface observing networks **What kind of QC do you apply at different levels?**
□At the observation stations, field units are installed with electronic boards integrated with low-pass filters to remove signal noise. AWS data are transmitted back to the Hong Kong Observatory Headquarters which is the data processing centre. An Integrated Meteorological Data Quality Assurance System (INDAS) has been installed to carry out QC of the AWS data. QC procedures including range test, trend test and consistency test are performed on the AWS data. QC procedures including range check, spatial check and consistency check are applied in the data archive centre.
□It's done manually. A supervisor responsible for Quality Control before its being transmitted on to the GTS, QC is also performed to figure out the odd ones (comparing the data with the climate normal) while data processing.
□In situ level (before data transmitting to Communication Centre) : Observer's preliminary data control doing per experience and logical considerations. Communication centre level (before bulletin is formed and transmitted to GTS) : The data pre-processing of data received to check the compliance data coded with coding rules per WMO's telegrams coding requirements. Synoptic Operational Service level (within 1 hour after bulletin has been formed and transmitted to GTS) : Synoptic operational shift staff collates data after mapping and makes any amendments if need per its experience, logical current considerations and via immediate feedback to observational network. Any reliable amendments are sent to GTS as delayed compliments to bulletin sent earlier. Data processing centre level: Comprehensive data control and analysis doing before meteorological data monthly books publishing and archiving.
□Step 1 : Real-time AQC (On-site) Step 2 : Real-time AQC (Data processing centre) Step 3 : Real-time MQC (On-site) Step 4 : Non real-time MQC (Data processing centre)
□Plotting and analyzing Stage - comparing with other data at closer stations Monthly Summary – Check with self recording charts Computerizing Stage – I Quality control is done by CLICOM/CLIMSOFT systems II Using data distribution maps
□At the observation station, we use specifically designed software to encode data corresponding to WMO format. At the data processing centre, we also perform data packing to messages by specifically designed software. At the communication center, data archiving and dissemination are controlled efficiently by Automatic Message Switching System. The QCs of all levels are well performed mostly by machines which have their own error checking and reporting. There is less chance for making mistake in the routines.
□Check for logical and statistical errors at data processing centre,
□Cldb qc based on WMO standard qc
□QC – "Persona - MIS" for 2 levels
□QC at different levels is performed manually which include rechecking of the observational data at the station as well as National Communication Centre. If there found error(s) at any level, then it is rectified immediately. Further, the data is also checked during archiving at Climate Data Processing Centre.
□Not at observing station, but at AWS stations the Q/C performed. Extensive Q/C performed at processing center.

Table A - Quality Controls conducted in operation of surface observing networks What kind of QC do you apply at different levels?
□Real time QC (comparison with limit value and etc) at the observing station and in the data processing center. Non-real time QC (comparison with observational data around the station and etc) in the data processing center.
□1. At the observing station, the Officer-in-Charge checks all the observations and rectifies the mistakes. 2. At the data processing centre, the concerned personnel checks all the data sheets and then the corrected data are entered in the computer system by using computer keyboards. The computerized data are rechecked again and final corrections are done. After these processes the data are finally archived in the departmental data base. 3. At the communication center, the corrected data are disseminated to all the concerned users.
□• Manual QC at manned synoptic station by comparing with long term normal(Averages) at observer's intelligence. QC algorithms for AWS is under development • Synop message is checked for proper WMO format at communication centres before forwarding to users. Any message found erratic is flagged for manual correction. • Suitable software of 10 day moving averages is run for checking errors in meteorological parameters. Doubtful values are flagged for manual correction.
□Meteorologists and technicians check first observation data in local meteorological center. Climate section in the Institute of the Hydrology and Meteorology make last control of observation data along specific instruction and transfer checked data to center of data base.
□The main QC in observing station is: 1. the check in the format off, 2. the check in climatic extreme of elements. 3. The check in station extreme of elements, 4.the check inconsistency of elements. The same content of QC is included in provincial meteorological date department and national date department.
□1.Periodic maintenance and calibration at observation station. 2.Manual data checking assisted with home-made computer program.
□Manual data quality control - data Checker, QC results modify and justification between station and communication center
□In communication center we check the heading of the messages and at the observing station and data processing center we control the limited check, consistency check in time and the relation between the meteorological parameters for 2 times and with 2 quality control programs. After QC we archived the data.
□At time of Observation : check report versus data and back-up instruments Post observation : check by Forecast Office Supervisor immediately after issue Post observation : check by "next shift" Observer Post observation : Monthly KPIs
□We Use HYDATA software system for data archiving. Accordingly the data screening is done for QC.
□QC data processing canter by software
□Every observation is being checked with the previous one, and also before entering in communication system(at observation station). Manual checking ob abnormal values are done with actual observational values. Enter QC by "crisis" data base server.

Table B - Communications of QC results in surface observing networks **How do you communicate QC results to observing stations and users?**
□Email alerts will be sent to maintenance staff, front-line operators and other users when the QC results show suspicious or erroneous AWS data. If necessary, the operators will stop releasing the suspicious or erroneous AWS data to the public and the maintenance staff will carry out maintenance visits to rectify faulty equipment.
□QC results are communicated to observing station in the form of circulars. Additional training is provided if required.
□All stations of Uz NHMS included into communication center contour are communicated via radio batch communication system facilities. Stations got fault with observations are notified on data shortcomings within day and also are provided with guideline on things are to be watched over.
□If QC problems happen, data processing center notifies observing stations of QC results by phone, short message service (SMS), and email immediately. Then observing stations check on the reason of the problem and make a process to solve it, like a calling to the maintenance company. At the same time, the error data won't be published to users.
□Corrections will be informed through telephone immediately, for further Checking
□We notify the QC results through our organization intranet. All observing stations and users easily access to these results. This intranet is also available for users to address and discuss the QC problems.
□Ask the regional office for station inspection, instrument check and refresher training to the observer.
□Correct online
□QS results are sending by e-mail to every regional centre.
□QC results are communicated using the available means of communication like telephone, SSB set, VSAT, Fax, email. The error(s) found during archiving at Climate Data Processing Centre is/are generally communicated in written form.
□All data are in climate database. All data has an assistant Q/C value and users can choose data based on Q/C value.
□To add QC results to data sets, and to communicate with JMA users by intranet. Technical development.
□The corrections made in the data processing center are communicated to the observing stations and concerned users by letters and other communicative means. In the case of the observing stations, all the necessary departmental steps are taken so that the past mistakes are not repeated again.
□• Communication through official letters • Remedial actions: Training of observers, Inspection and checking the performance of instruments
□We use mobile, internet, VSAT to communicate results of control and take advice about observation technology for local meteorological center and observation stations.
□The QC result of national data department are firstly communicated to the provincial data department and it communicates the results to the observe stations. If there is error in the observing data, the observer in station need to check the original observation, find the reason for the error data.
□Report the problem with the head of weather forecast and monitoring center.
□Telephone, Single side Band (SSB)

Table B - Communications of QC results in surface observing networks **How do you communicate QC results to observing stations and users?**
▫If there is any errors in data after observing stations, it must be corrected there (if related to operator) but if there is any errors in data at data processing center (IRIMO center) it doesn't reported to stations, it is corrected by QC programs at his center.
▫Individual Observers advised of errors by email. Monthly Performance Review published on intranet.
▫After QC, if data are found to be faulty, then the instruments at the site are calibrated and verified simultaneously. The proper QC data are provided to the Users.
▫We instruct the observing stations to take appropriate steps.

Table C - QC practices in operation of upper-air observing networks What kind of QC do you apply at different levels?
□Range check and consistency check are applied at the data archive centre
□In-built software QC system
□Step 1 : Real-time AQC (Data processing centre) Step 2 : Non real-time MQC (Data processing centre)
□Recheck the observation and make summary at the observing stations. Compare with regional data and NWP outputs at the analyzing stage
□Upper-air QC is a multi-tier system of near real-time observation error checks and medium- and long-range performance monitoring: At upper-air stations: - operational quality control during flight until message reporting - next-day re-check - cross-check by station engineer-aerolog At Regional administrations – spot-check of observations raw and processed data, connecting upper-air stations and lead centre (verification of rejected data) At Hydrometeorological centre of Russia (WMC “Moscow”) – operational upper-air data QC within regular data assimilation cycles At Russian Research Institute for Hydrometeorological Information – World Data Center (RIHMI-WDC) in Obninsk – QC of archived upper-air data At Central aerological observatory – monthly and long-term upper-air data performance monitoring based on products from Hydrometeorological centre of Russia, providing feedback to upper-air stations and requesting remedial actions
□QC at different levels is performed manually which include rechecking of the observational data at the station as well as National Communication Centre. If there found error(s) at any level, then it is rectified immediately. Further, the data is also checked during archiving at Climate Data Processing Centre.
□All operate data insert into the climate database automatically checked performed on some aspects of the data.
□At the observing station, comparison with last observing data. In the JMA/HQ, comparison with observing data around station
□1. At the observing station, the Officer-in-Charge checks all the observations and rectifies the mistakes. 2. At the data processing centre, the concerned personnel checks all the data sheets and then the corrected data are entered in the computer system by using computer keyboards. The computerized data are rechecked again and final corrections are done. After these processes the data are finally archived in the departmental data base. 3. At the communication center, the corrected data are disseminated to all the concerned users.
□• Manual QC at observing station by comparing with long period normal(Averages) at observer’s intelligence. • TEMP message is checked for proper WMO format at communication centres before forwarding to users. Any message found erratic is flagged for manual correction. • Hydrostatic quality checks performed at data processing centres.
□Meteorologists and technicians check first observation data in local meteorological center. Climate section in the Institute of the Hydrology and Meteorology make last control of observation data along specific instruction and transfer checked data to center of data base.
□Complete format check, including the format for GTS headings and TEMP reports according to WMO publications of Manual on GTS and Manual on codes, at communication centre.
□We try to apply QC in all three levels. But most of QC is applied in the data processing center.

Table C - QC practices in operation of upper-air observing networks **What kind of QC do you apply at different levels?**
□At observing
□Before upper air observatory, we check the ground observation and enter in the system before the release of radiosonde instruments. The system itself will maintain the quality of observation.

Table D - Communications of QC results in upper-air observing networks **How do you communicate QC results to observing stations and users?**
□Station owner will be informed when data fails to pass the QC procedures
□QC is done in the station itself
□It does the same as the Q 1-6-2's response
□Observing stations will be informed through telephone or VSAT phone.
□Feedback: monthly reports of rejected data and suspect stations /own statistics according to WMO No.485/, monthly, quarterly and yearly web reports at http://cao-ntcr.mipt.ru/monitor (English version available at http://cao-ntcr.mipt.ru/monitor/monitorrese.htm), yearly review, yearly best stations national contest Remedial actions: maintenance requests, site inspections, requests to radiosondes, ground equipment and software manufacturers, guidelines and consultations
□QC results are communicated using the available means of communication like telephone, SSB set, VSAT, Fax, email. The error(s) found during archiving at Climate Data Processing Centre is/are generally communicated in written form.
□By the forecasters
□To Add QC results to data sets, and to communicate with JMA users by intranet
□The corrections made in the data processing center are communicated to the observing stations and concerned users by letters and other communicative means. In the case of the observing stations, all the necessary departmental steps are taken so that the past mistakes are not repeated again.
□• Communication through official letters • Remedial actions: Training of observers, Inspection and checking the performance of instruments
□We use mobile, internet, VSAT to communicate results of control and take advice about observation technology for local meteorological center and observation stations
□N/A (No Answer)
□If there is any errors in data after observing stations, it must be corrected there (if related to operator) but if there is any errors in data at data processing center (IRIMO center) it doesn't reported to stations, it is corrected by QC programs at his center.
□Yes
□By instructing the observing stations for taking appropriate steps.

Table E - Inspection and maintenance practices conducted by NMHSs **Description**
□Preventive maintenance is carried out generally on a monthly basis for the automatic weather stations. General inspection on equipment conditions, cleaning, tidying of site environment are performed during preventive maintenance. Corrective maintenance is conducted when there is operational failure.
□Inspection is done by observers on daily basis; any errors detected are reported to the technical support section for action.
□Station barometer pattern-matching: □ Monthly for aviation meteorological service needs □ Every 2-3 years for meteorological stations Bulb thermometer calibration doing per Guidance on meteorological observations (for meteorological observational stations): □ During winter time. Current meters calibration- every 2 years.
□KMA has made a contract with private companies for the maintenance of observation equipment. They check up the equipment twice a year, but if the problem happens, they should examine and solve it immediately. KMA headquarter has also conducted regular inspections for observation.
□Daily inspection is done by observers. Monthly Maintenance done by instrument section.
□1). Annual visit (inspection) of instruments' status, check-up of normal functionality. 2). On-site maintenance, changing failed instrument. 3). Take the instruments that not possible to carry out maintenance on site, to Headquarters for further maintenance. 4). Update the inventory lists
□General inspection of physical status of instrument, Maintenance: Replace defective parts Frequency: As and when problem is reported or during inspection visit
□On site inspection and maintenance is done on monthly basis and when needed.
□Preventive Maintenance and on spot calibration check twice a year.
□Actually, it is done when the equipment is error or missing data and equipment is broken from any stations
□Metodical inspection 1 time per 3 years
□Usually inspection of instrument(s) is carried out once in a year or when so needed in case of urgency due to some fault in the equipment(s)
□1) Yearly calibration of surface instruments (temp, R.H.) 2) AWS sensors calibration every 3 and 6 months 3) 2 week inspection for AWS stations
□In manned stations, checking and inspecting the condition of observational field and instruments are executed daily. Maintenance of cleaning and checking sensors is executed monthly or with longer interval.
□The inspection and maintenance of the observational instruments is done annually.
□• Preventive maintenance and general cleaning / lubrication - every quarter • Comparison with portable standards - once a year
□Local engineers make inspection and maintenance of observational instruments at local meteorological center, but guarantee measurements only at calibration laboratory. Deadline of guaranty is deferent in ever measurement, such as one year of barometer.

Table E - Inspection and maintenance practices conducted by NMHSs Description
□Inspection and maintenance are mainly cleaning and checking instrument of observing, and do it hourly.
□Monthly site inspection and instruments checking
□One/ three year or two/ five year
□Daily maintenance completed on data checks, monthly checks on battery/power & system data logging, 3 monthly checks on wind vane & anemometer (bearings replaced annually) 6 monthly RVR offset & calibration checks.
□As there are lots of stations across the country, hence the inspection and maintenance are done on the priority basis. Every year the annual maintenance of stations are done.
□Monthly or as and when required.