Session 1.4 Review of the results of the questionnaire on Quality Management of Surface Meteorological Observations in RA II

S. Kigawa, K. Makiyama and T. Hayashi Japan Meteorological Agency 19 March 2018

Thank you

for joining this workshop

Communication with you in the last two months

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And many e-mail messages

Draft report

Questionnaire on Quality Management for Surface Meteorological Observations in Regional Association II (Asia)

RA II WIGOS Project to Enhance the Availability and Quality of Management Suppor for NMHSs in Surface, Climate and Upper-air Observations

March 2018

SUMMARY

This is the report on the results of Questionnaire on Quality Management for Surface Meteorological Observations in Regional Association II (Asia).

The questionnaire survey was conducted as one of the activities of the Regional WIGOS project in RA II, "Enhance the Availability and Quality Management Support for NMHSs in Surface, Climate and Upper-air Observations", and 20 NMHSs in RAII Members responded to the questionnaire.

The following are highlighted as the important topics of the analysis:

- Automatic precipitation/hydrological stations are operated by only one thirds of NMHSs which responded to the questionnaire.
- In two thirds of NMHSs, the number of manned precipitation/hydrological stations exceeds that of automatic ones.
- Precipitation/hydrological stations are mainly operated as manned ones and those observation data are not reported automatically to NMHSs' headquarters.
- In addition, precipitation/hydrological stations are operated with difficulties in a quality check of the observation data and an environmental check of the stations.
- A percentage of NMHSs which utilize observation data of the precipitation/hydrological stations for application effective in Disaster Risk. Reduction, such as advisories/warnings and nowcasting, is generally lower than that of NMHSs utilizing observation data of weather stations.

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NMHSs recognized "lack of skilled staff" rather than "lack of knowledge."
 Many NMHSs carry out "data correction" as a follow-up action of erroneous data, while "user notification" is hardly adopted.

It was recognized that many observation stations faced difficulties in both quality check of observation data and environmental check of stations, although a precipitation observation is one of key components for DRR.

Giving that DRR is one of the highest priority, multi-scale challenges should be discussed by Member countries how to solve the issues above. Based on the other aspects of the survey, it is also expected to discuss on follow-up actions of erroneous data and a capacity building by the best combination between telecommunicated and face-to-face learnings.

As a conclusion of this report, it was proposed that the member countries would plan a workshop to know practical issues and discuss how to improve in it.

2

2 tables and 32 graphs



Why do we assemble here?

JMA / WMO Workshop on Quality Management of Surface Observations - RA II WIGOS project Tokyo, Japan 19-23 March 2018

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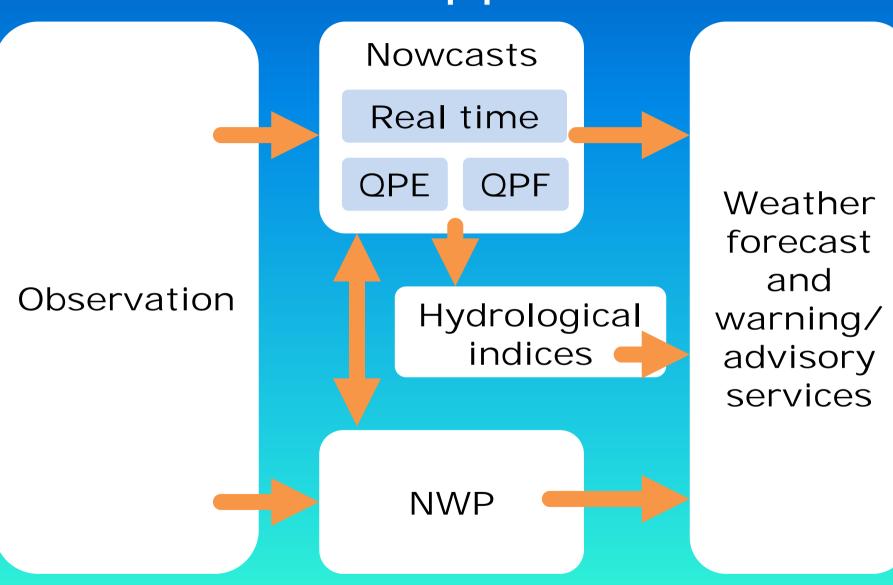
Recent disasters



Country report previews

6

JMA's approach



JMA's posters on Day 4

RADAR/RAINGAUGE-ANALYZED PRECIPITATION

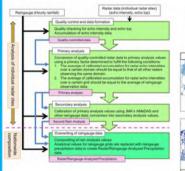
Outline

The Radar/Raingauge-Analyzed Precipitation product (referred to here as RA/R) provides estimation data on precipitation in areas licking raingauges based on radar observation of rainfall linensity. Radar rainfall calibration using precipitation data from raingauges increases the quantitative accuracy of RA/Information, giving Edver superiority over radar and raingauge data alone

R/A data generation is based on observation results from JMA and MLIT and on information from raingauges operated by JMA, MLIT and local governments. The process involves the following:

- . Quality control Data conversion
- Primary analysis of rainfall
- condary analysis of rainfall
- Nationwide composition generation Raingauge data overwriting





Raingauge guality control

Raingauge data provided from outside JMA are quality-controlled upon arrival. Data from raingauges with quality flags and those for which reported positional conversion and values in the constant table differ are not used. Data from gauges showing excessive cumulative hourly precipitation are also eliminated.

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Primary analysis

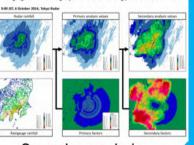
Primary analysis is conducted to adjust spatial distributions of hourly radar rainfall data to AMeDAS-based hourly rainfall observation data. AMeDAS is an acronym of rainee oudervation coas, versions is an automyth of Automatod Metaorological Data Acquisition System – the name given to JMA's AWS (Automatic Weather Station) network in Japan. The network has approximately 1,300 raingauges at intervals of around 17 km. Adjustment is conducted by multiplying rader-observed rainfall values with a primary factor for each radar.



Raingauge data overwriting

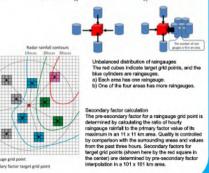
Pre-secondary factor interpolation for secondary factor estimation may cause underestimation at raingauge grid points. To prevent non-detection of heavy rain, hourly raingauge rainfail data are overwritten for such grid points. Data in the surrounding eight grid points are also overwritten with interpolated values if their original values are lower than hourly raingauge rainfall.

Light rain from stratus clouds sometimes evades radar detection even if it is caught by raingauges. When hourly raingauge rainfall ranges from 0.5 to 4 mm and secondary analysis values around the gauge are lower than this, the hourly raingauge rainfall for the grid point and its surrounding points is also overwritten



Secondary analysis The objective of secondary analysis is to exam

ine small-scale precipita distribution using raingauge data provided by JMA, MLIT and local governments. b)



VERY-SHORT-RANGE FORECASTS OF PRECIPITATION

Outline

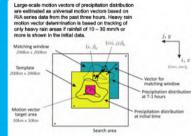
Very-short-range (precasts of precipitation (referred to here as "VSRF") are issued at 10 minute intervals to predict one-hour precipitation amounts for the next six hours. Extrapolation from an initial value is the most accurate method for

precipitation prediction with a head time of up to a few hours. This approach involves prediction of precipitation distribution based on initial intensity and velocity. As the fundamental characteristic of extrapolation is linear, the accuracy of extrapolation-based prediction decreases with head time and deteriorates markedly beyond the lifecycle of a recipitation phenomenon. The accuracy of numerical weather prediction NWP) also decreases with time, but the deterioration is gradual and lower than that of the extrapolation method in the first few hours. Based on these characteristics, appropriate combination of extrapolation and NWP provides optimal performance in precipitation prediction with a head time of up to several hours.

Initial values

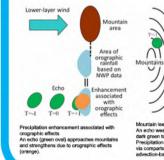
The initial values of precipitation distribution prediction are calculated from the nationwide composition of radar echo intensity and the primary and secondary factors ned in R/A ner

Motion vectors



Orographic effects

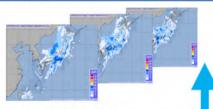
Calculation of landform-induced effects in VSRF involves enhancement in consideration of orographic rainfall, dissipation and mountain overlapping. Orographic rainfall information contained in initial data is estimated using NWP



Mountain lee-side reduction An echo weakens with time (from rk green to light green) Precipitation reduction is estimated via comparison of T = 0 with aduaction-based from T = -1

Echo

motion



Overall Prediction

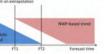
Prediction of precipitation intensity distribution is based on extrapolation of the nationwide composition of precipitation intensity at the initial time with related

Heavy-rain-area motion vectors are merged with universal motion vectors. Multitime-interval motion vectors are used for prediction at the corresponding forecast time. Thus, while prediction at earlier forecast times is generated using motion vectors determined at shorter time intervals, prediction at later forecast times is based on motion vectors with longer time intervals.

Trend prediction

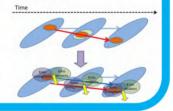
Precipitation intensity trends are estimated and predicted using the latest data on echo motion and NWP rainfall forecasts. In the extrapolation method, the drift of precipitation intensity is predicted without intensity change except for crographic effects. This approach provides accurate prediction up to a few hours for large-scale (i.e., long-lasting) meteorological disturbances. However, for small-scale disturbances, trend prediction is needed to improve prediction accuracy.

For VSRF, a method of trend prediction (i.e., variations in precipitation intensity with time) is adopted. This approach is based on trend estimation at the initial time and the trend calculated from NWP data. As illustrated below, the relative weights for this estimation are changes with forecast time. The analytic trend is highly weighed in the first hour, and its weight decreases w



The analytic trend is also useful when complex echo motions are observed. Top: A precipitation system (blue) moves eastward and a heavy-rain area (red) in the system moves southeastward.

The extrapolation method involves the use of motion vectors created by combining universal motion vectors with heavy-rain area motion vectors. If there is a difference in motion between the precipitation system and the heavy rain core, prediction may be insufficient due to the mismatching of motion vectors against this system and core. Trend extrapolation solves this problem. Bottom: Analytic trend information improves prediction accuracy for complex echo motion.



 \bigcirc \mathbf{i}

JMA's posters on Day 4

HIGH-RESOLUTION PRECIPITATION NOWCASTS

Outline

Since summer 2004, the Japan Meleonological Agency (JMA) has issued Precipitation Nouceas (referred to have as conventional Precipitation Nouceasts, or CPMU) providing information on horizontal probabilition data (the number is a precipitation and the second second

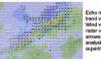
Data used in HPRNs

HRPN analysis algorithm inputs are observation data including two distinct radar networks, surface, inter-agency rain gauge, radioeonde, wind profiler (GPS (Global Positioning System) based precipitable water and Liphtning Detection Network System (LIDEN) information. Data on typhoon locations and maximum wind speeds are also used



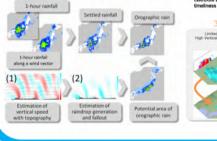
Motion detection

A multi-scale motion detection technique is adopted for HRPNs, as with CPNs, to determine motion on various temporal and spatial scales for the establishment of echo motion vectors. Scales range in time from 5 minutes to 1 hour, and on a horizontal scale from cumulonimbus cloud size to nearly 100 km.



Echo motion vectors (gray arrows) and trend vectors (while) Wind vectors calculated from Doppler radar velocity data are shown as black arrows. The background of the figure is analysis precipitation intensity distribution superimposed onto the map.

Orographic rain estimation



Quick and easy access HRPMs are intanded to support self-protection against sudden heavy rah. JMA's related web pages are designed to give users an overview of the shudon with the minimum and citicat to evable prompt.

of the exhaution with the minimum number of clicks to enable prompt evacuation for antidy. These resources are optimized for mobile-device and PC viewing.



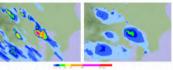
IMA's HRPN web resources

Mobile (left) and PC (right) resources are provided to support self-protection. Several options are given for superimposition of information on areas where heavy rein, lightning and hazardous winds are expected. Rainfell amounts from rain gauge observation can also be displayed.

Error band-width estimation

Nowcasting prediction improvement has brought new challenges in the provision of information on prediction quality to user, the quality of prediction between a wellbearved eche already present at the initial time and a cumufantimus developing during the forecast time may offler significantly. From another vesporit, prediction quality is affected by the integrity of initial values (i.e., analysis data), incorrect data caused by radio wave interference can make rain appear heavier than 1 actually is, and pensistent non-precipitation actions caused

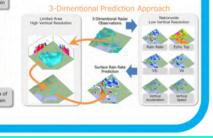
(ue, analysis data), incorrect data caused by radio wave interference can make the appear heavier than it actually is, and persistent non-precipitation echoes caused by structures such as windrallis may be erroneously interpreted as orographic rain. Accordingly, prediction quality is indirectly linked to radar observation quality.



Hourly forecast rainfall P (left) and error band-width ϵ (right) at 1600 JST on July 23 2013

3D Prediction

HRPNs adopt an approach using a high-resolution prediction by spatial three dimensions regarding notable heavy main regions selected. Predictions outside the selected regions are generated by a longer time step and reduced vertical calculations using sevenal two-dimensional information converted from the three-dimensional distribution of rain. This exables to distribute a high-resolution and high-guality prediction with securing its imminess an onvocating products.



SOIL WATER INDEX, RUNOFF INDEX, AND SURFACE WATER INDEX

5. First tank

Outline

When hazardous weather conditions are expected, JUA issues a weaky of information including Emergency Manings, Warnings, Anhonces and Baldelm so that appropriate the source of the safety of information is efficient possible includes. Such as the issues of execution reduction (DRR) architects and whice so valentary evacuation. Emergency Warnings, Warnings, Aolisories and Landhilde Ach Information em issues in consultations and one source Round Index values. Surface Water Index information can be used for Emergency Warnings, Warnings, and Advisories for heavy rain. These three indices are calculated using a tank model.

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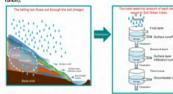
more than 50 years ago by the National Research Center for Disaster Prevention (NRCDP) to predict river water levels based on rainfail observation. The original version of the model calculates rainfail amounts flowing into rivers with a temporal delay (Okaté, 2000).

Three-lank cascade model The tank model used by JMA is the one proposed by Jehnhars and Kobstake (1979). The right figure shows a threelank cascade model. The first, second and third tanks correspond to surface runoft, surface layer infiltration runoff and groundwater outflow, respectively.

Soil Water Index

The Sol Water Index provides estimations on average amounts of water stored in sol of certain areas, helping to darify the risk of landslide-related indicatins caused by heavy rain. JAR uses induce values as oritisent for the issuance of Emergency Warnings, Warnings Advisories for heavy rain and Landslide Alex Information.

Raimster prestates the ground surface and flows into heres or into the ground. As the amount of water stored in soil hercease, the risk of and sixpe collapse rises. Figure below shows a tank model simulating how ranwater flows on through soil. Each tank has a side outlet representing outflow to the surround soil and a bottom outlet representing outflow to surface size, and and the second tank corresponds to infitization nund at the surface size, and that of the first enic corresponds to nund as groundwater. third tanks is output from the side into corresponds to nund as groundwater there in this is output from the bottom outlet of the upper tank (infitration nonf).



Addeling of rainfall accumulation in soil and runoff

Runoff Index

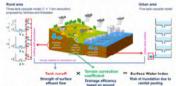
The Runoff Index represents the probability and potential magnitude of reinfailrelated floading. In identiate the amount of rain value contained in rivers, Spooffaaly, values express the amount of water at a certain point in a river with S-km square resolution. Calculation is based on animulation in which propriation flows; ninto the river (runoff process) and flows downstream (flow process) with reference to information on the river channel, basis and land use.

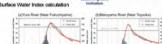
JNA uses the Runoff Index for issuance of Flood Warnings and Advisories. The right figure outlines the concept of the index, which is calculated for all rivers in Japan that have a length of 15 km or more and are registered in National Land Numerical



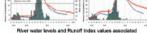
Surface Water Index outline

Surface Water Index values indicate the risk of Inited Inundation caused by reinfall. Such isanchiston occurs when rainfall excends the capacity of events. Tradicide diches and other drainage facilities, and is othen seen in two-hing areas regardless of proximity for knew. Accordingly, surface effluent flow is considered to give a photal role in initiand inundation. Topographical grademts are also importent factors; in areas with steep landform gradents, aniwater flow rangidy downstream and is less likely to accumulate. Based on this concept, the Surface Water Indom was designed for estimation of nuor famoutis using a tank mode with Indom-induced correction.

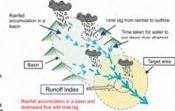












Conceptual chart of The Runoff Index

Questionnaire survey

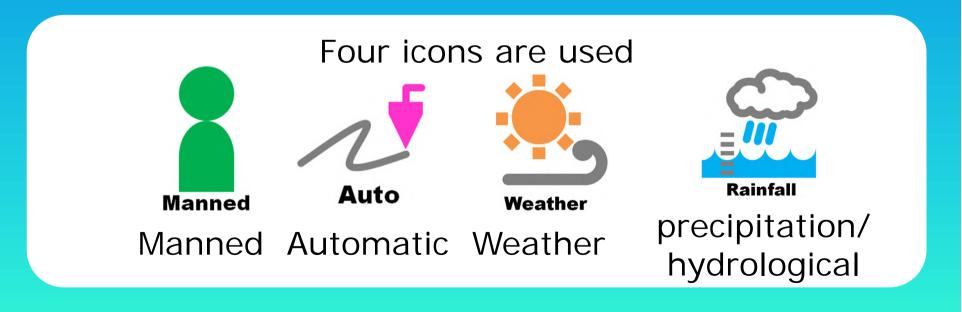
The questionnaire survey on Quality Management for Surface Meteorological Observations in RA II was conducted in 2016.

Twenty NMHSs in RA II Members responded to the questionnaire.

JMA analyzed the responses and prepared the draft report of the survey results.

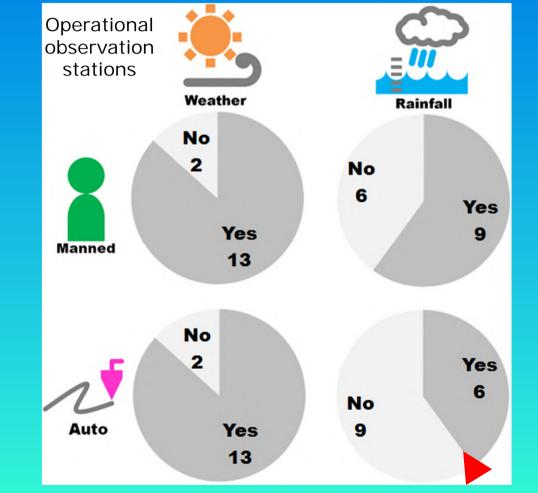
Survey analysis

Four groups: manned weather stations, manned precipitation/hydrological stations, automatic weather stations and automatic precipitation/hydrological stations are used



Major findings (1/4)

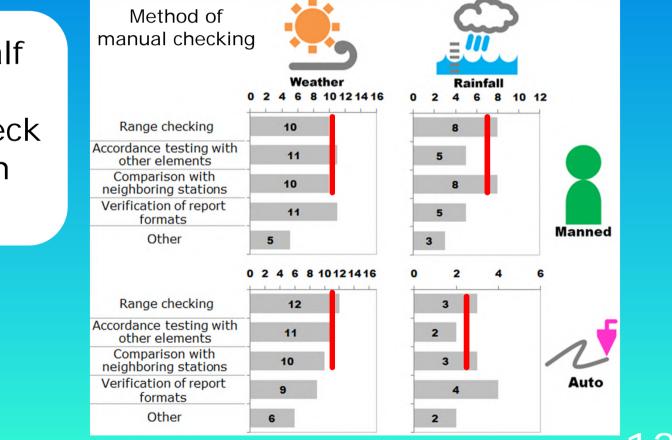
Automatic precipitation/hydrological stations are operated by only one third of NMHSs.



Major findings (2/4)

Precipitation/hydrological stations are operated with difficulties in a quality check of the observation data and an environmental check of the stations.

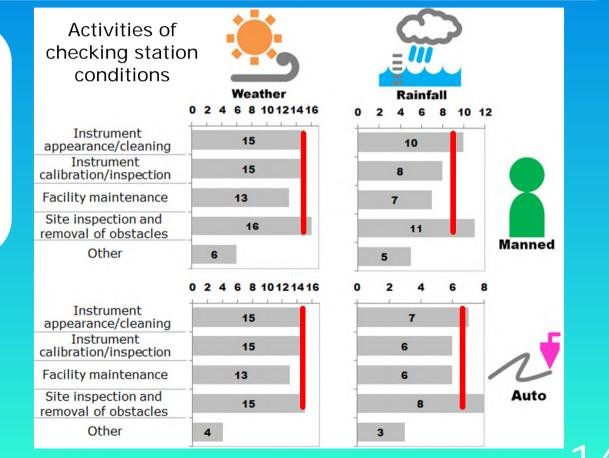
Only one half of NMHSs manually check observation data. Range check Accordance testi other eleme Comparison v neighboring sta Verification of r formats



Major findings (2/4 cont.)

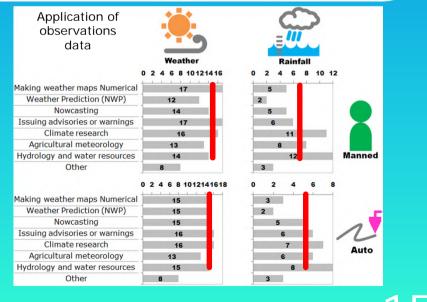
Precipitation/hydrological stations are operated with difficulties in a quality check of the observation data and an environmental check of the stations.

Lower activities are conducted for checking station conditions.



Major findings (3/4)

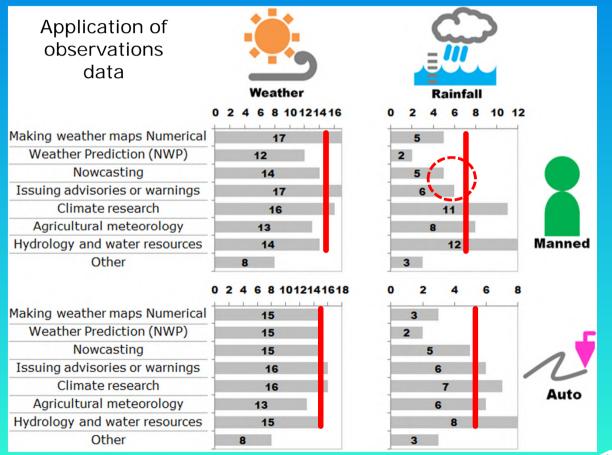
A percentage of NMHSs which utilize observation data of the precipitation/hydrological stations for application effective in Disaster Risk Reduction, such as advisories/warnings and nowcasting, is generally lower than that of NMHSs utilizing observation data of weather stations.



6

Major findings (3/4)

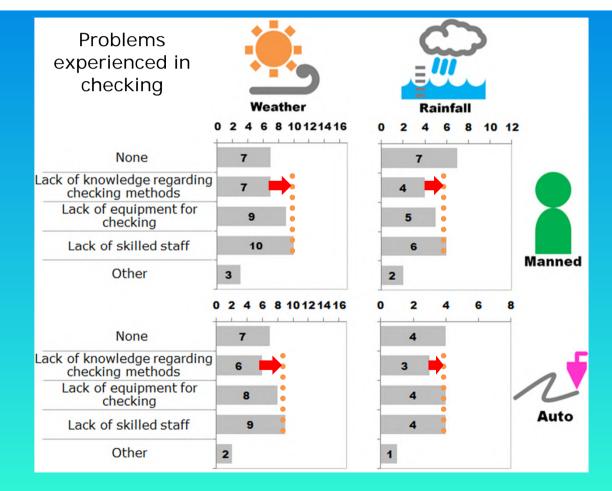
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6

Major findings (4/4)

NMHSs recognized "lack of skilled staff" rather than "lack of knowledge."



Survey results

Many NMHSs which responded to the questionnaire operate services in rainy regions.

Although a precipitation observation is one of key components for DRR, it was recognized that many observation stations faced difficulties in both the quality check of observation data and the environment check of the stations.

It was also found that there was room for improvement in applications of observation data such as nowcasting or issuing advisories/warnings.

Discussions

Given that DRR is one of the highest priorities, multi-scale challenges should be discussed by Member countries to solve issues.

We are focusing on the precipitation observation in this workshop.

Although we focus on rain...

One-week Forecasts: Tokyo			Get mor informa on this area					•
Prefecture Tokyo			-	▼ Print				
Probability (of warning	<u>s</u>				» N	lotes	
Updated a	t 11:00 J	ST, 18 Marcl	h 2018					
Da	te	19 Mon	20 Tue	21 Wed	22 Thu	23 Fri	24 Sat	25 Sun
Tok Daily F	orecast	@/ 今	<u>ې</u> اچ	<u>ې</u> اچ	<u>ې</u> ا	@ا€	،	ا∰
Probability of precipitation		10/20/40/60	80	90	60	20	20	20
Reliability		1	1	А	С	А	А	В
Tokyo	High (°C)	18	10 (8 - 12)	8 (6 - 10)	18 (14 - 22)	17 (15 - 18)	18 (16 - 19)	20 (18 - 23)
	Low (°C)	9	6 (4 - 7)	3 (2 - 5)	7 (4 - 9)	6 (4 - 8)	5 (4 - 7)	7 (5 - 9)

What?

What do we learn and discuss?





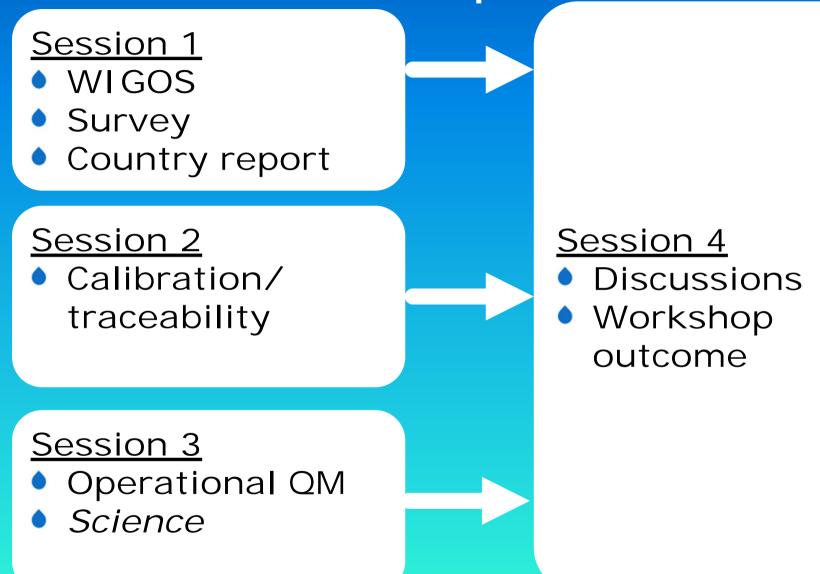
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Science!

We need science

Workshop outline

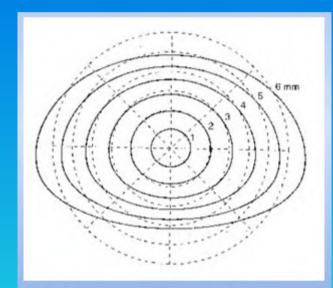


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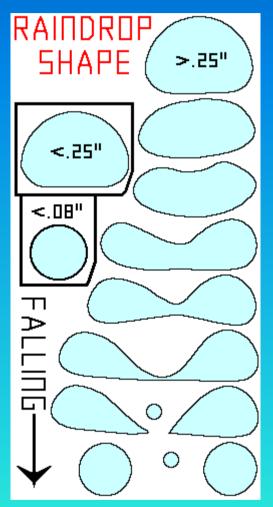
Huge raindrop

Unnatural?

Raindrop shape and size



Equilibrium drop shapes for drop diameters of 1-6mm.

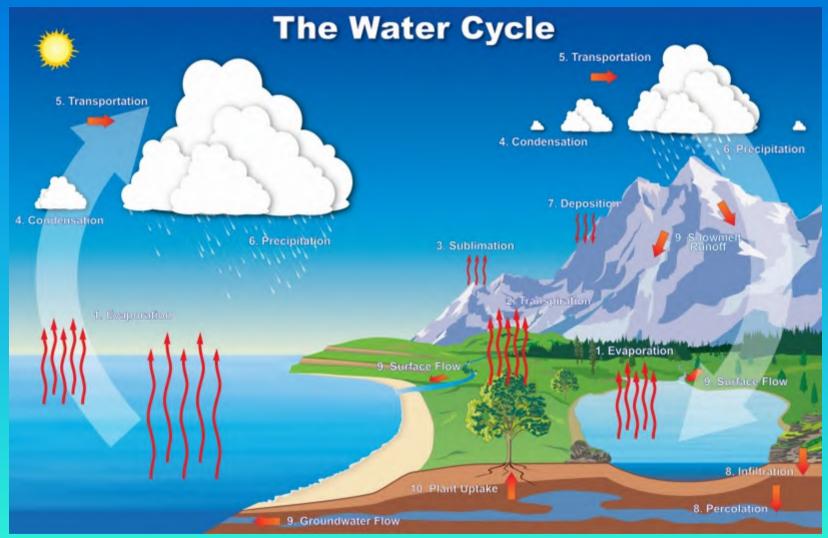


https://pmm.nasa.gov/education/articles/shape-of-a-raindrop

Motivation and inspiration



Motivation and inspiration



http://www.noaa.gov/resource-collections/water-cycle

Findings and discussions

Automatic precipitation/hydrological stations are operated by only one third of NMHSs.

Precipitation/hydrological stations are operated with difficulties in a quality check of the observation data and an environmental check of the stations.

A percentage of utilization of precipitation/hydrological observation data for Disaster Risk Reduction applications is generally.

NMHSs recognized "lack of skilled staff" rather than "lack of knowledge." (A) Visions of surface observation networks

(B) Short-term orlong-term goals ofthe quality ofobservation data

(C) Improvement of on-site quality management

(D) Approach to training skilled staffs

How?

How do we discuss?

Organization

(A) Visions of surface observation networks

(B) Short-term orlong-term goals ofthe quality ofobservation data

(C) Improvement of on-site quality management Ms. Al Hameli, Ms. Al Mandoos Ms. Do, Mr. Faisal, Mr. Le Xuan

Dr. Cui, Mr. Douangmala Mr. Phapany, Mr. Promsut Mr. Sungkhawanna Mr. Thala Bandaralage Mr. Wimalasuriya

Mr. Abdul Karrem, Dr. Ahmad Mr. Hak, Mr. Lwin, Ms. Nan Mr. Toe Aung

(D) Approach to training skilled staffs

Ms. Baten, Mr. Chowdhury Mr. Gayyoom, Mr. Lyhon

JMA / WMO Workshop on Quality Management of Surface Observations - RA II WIGOS project Tokyo, Japan 19-23 March 2018

Supported by speakers

Key words

(A) Visions of surface observation networks

(B) Short-term orlong-term goals ofthe quality ofobservation data

design, DRR, integrated, international/interagency, observation/analysis, regional climate

DRR, field work, international collaboration, quality information, services/products, study

(C) Improvement of on-site quality management

calibration, environment, instrument, integration, spatiotemporal scale, system

(D) Approach to training skilled staffs

cooperation, face-to-face, post-workshop newsletters, practical demonstration, telecommunicated, training materials

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Related stories

(A) Visions of surface observation networks

(B) Short-term orlong-term goals ofthe quality ofobservation data

(C) Improvement of on-site quality management Rain and snow (25 Jan) Quality of design and service (31 Jan)

Quality of design and service (31 Jan) Qualitative or quantitative (6 Jan)

Qualitative or quantitative (6 Jan) Quality management for WIGOS era (19 Feb)

(D) Approach to training skilled staffs

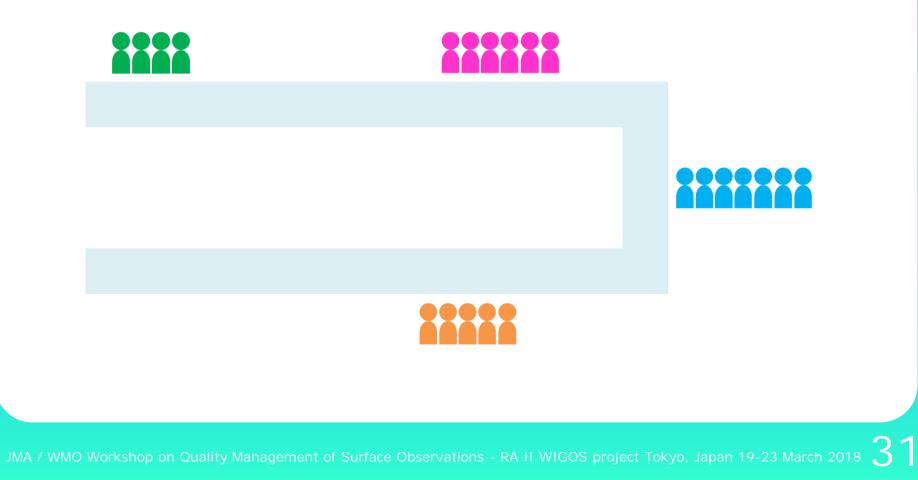
Training for improving skill (14 Feb) Workshop (19 Feb)

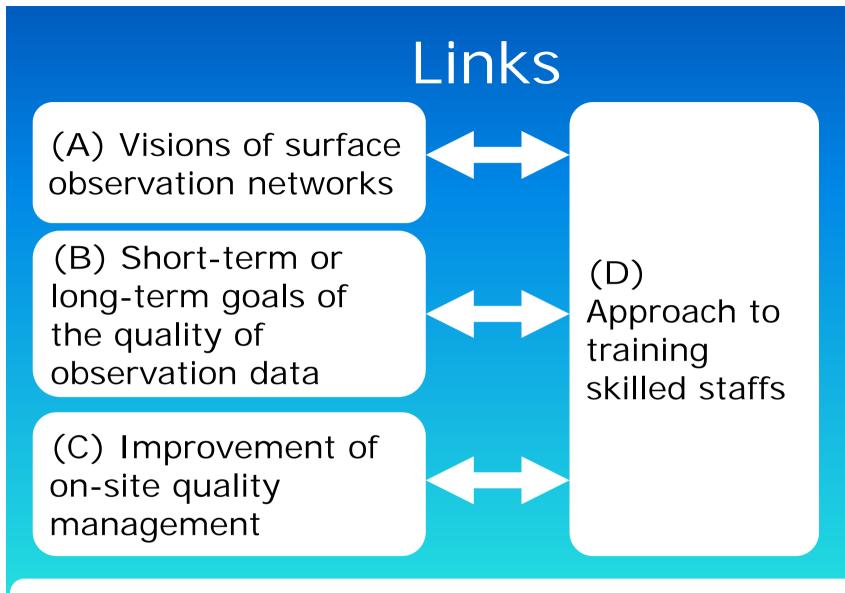
Schedule

[Session 4.1 Discussion on future activities/actions for improvement of quality management of observation data in RA II
0900-0910	Discussion guidance
0910-1030	 Group discussions Discuss a group's topic with referring other sessions' lectures, key words and related stories (newsletter dated 19 Feb.). Write presentation slides on a summary of group discussions using a template below.
1030-1100	Break
1100-1130	Presentations on group discussion results
1130-1230	General discussion on proposal for action plan

Configuration

Session 4.1 Discussion on future activities/actions for improvement of quality management of observation data in RA II <u>0910-1030 Group discussions</u>





Because ultimately only skilled staffs would realize (A), (B) and (C). Therefore, discussions on (A), (B) and (C) should be linked to (D).

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(D) Approach to training skilled staffs

It is noted that many NMHSs recognized "lack of skilled staff" rather than "lack of knowledge" according to the survey.

> Sharing knowledge and information is becoming easy through technological innovations of telecommunication.

We live in our highly-telecommunicated age and the telecommunicated approaches must provide many people opportunity to learn.

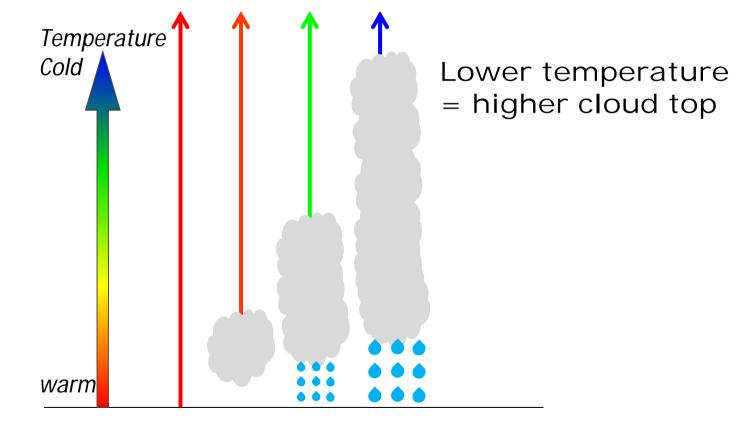
Face-to-face meetings still have a significant role such as learning, training, and finding common goals.

A face-to-face meeting works to unite the people concerned.

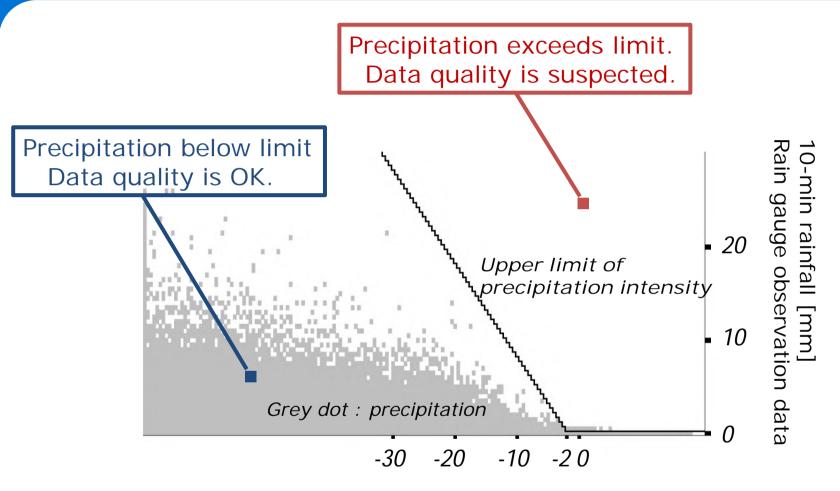
Visions – integration (1/3)

Satellite Infrared imagery

In the troposphere, temperature decreases with height. You can estimate cloud top height using infrared brightness temperature.



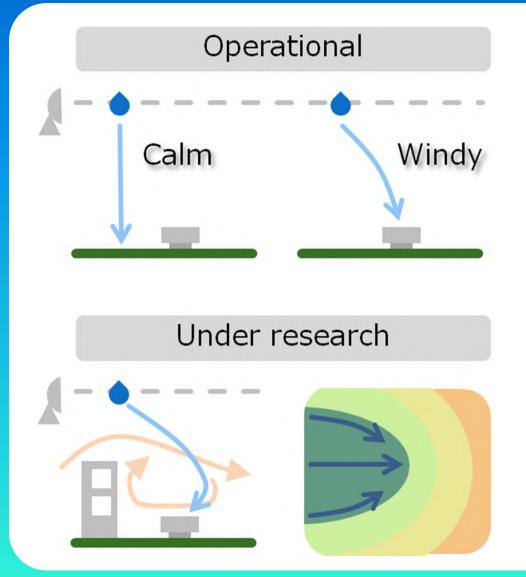
Visions – integration (2/3)



Infrared brightness temperature - surface temperature [K]

35

Visions – integration (3/3)



The current HRPN operational algorithm is designed to correct windinduced horizontal drift that occurs when raindrops fall based on the wind speed of several layers.

The nature of complex raindrop tracks associated with air flow (left) and the orographic concentration of raindrops are currently being researched.

Summary

The questionnaire survey on Quality Management for Surface Meteorological Observations in RA II was conducted in 2016.

Twenty NMHSs in RA II Members responded to the questionnaire.

JMA analyzed the responses and prepared the draft report of the survey results.

It was recognized that many observation stations faced difficulties in both the quality check of observation data and the environment check of the stations.

Improvement in DRR applications of observation data is needed

WE WILL DISCUSS

Discussions

(A) Visions of surface observation networks

the quality of observation data

(C) Improvement of on-site quality management

(D) Approach to training skilled staffs

(B) Short-term or

long-term goals of

Between atmosphere and people



Thank you

