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Technical Report

Training courses and seminars in the JICA technical cooperation project

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Abstract: The JICA technical cooperation project has provided a wide range of training courses and seminars covering basic to applied topics to contribute to meteorological observation, forecasting, telecommunication, and disaster prevention. In this report, we describe the titles of training courses and seminars conducted during the project period and some summaries of them. The materials of these training and seminars can be used to organize knowledge for staff working in these fields.

Keywords: JICA; Training courses and seminars; Disaster risk reduction; International cooperation.

1. Introduction

In the Japan International Cooperation Agency (JICA) technical cooperation project [1], various training courses, seminars, on-the-job training (OJT), and technology transfer of products and software have been implemented to improve capacity. Among these, training courses and seminars have been the focus of efforts to improve the knowledge of many staff members. In this project, four outputs have been set. These are (1) maintenance and management of observation equipment, (2) radar data analysis technology, (3) utilization of observation data for forecasting, and (4) information dissemination technology. Various training programs were conducted for each of these outputs. For (1), (2), and (3), training in Japan was conducted in addition to training in Vietnam. For (1), the training was not limited to classroom lectures but also included OJT. The training was conducted not only by project members but also by dispatched Japan Meteorological Agency (JMA) officials.

This technical report has been prepared to provide an overview of the training and seminar activities in this project and to facilitate access to the materials for those who need

them. The training materials used for the training were prepared in PPT files in English and Vietnamese for the convenience of the participants. These materials are stored at the project office and will be available for future use as needed.

2. Training courses and seminars in 2018

Table 1. List of training courses and seminars in 2018.

Title of training course	Place	Date	Lecturer	Number of participants
Seminar on Utilization of Radar and Satellite data for disaster prevention in Japan	Hanoi	02 Aug 2018	Kenji Akaeda	40
Training course on extracting and displaying Japanese radar data	Hanoi	24 - 25 Sep 2018	Michihiko Tonouchi	14
Training course for the radars' software and data errors.	Hanoi	15 - 16 Oct 2018	Chiho Kimpara	
Seminar on Mesoscale Weather Prediction for Disaster Prevention (Section 2.1)	Hanoi	17 Oct 2018	Kazuo Saito	40
Training course on monitoring heavy rainfall and typhoon by using radar data, satellite data, ARG data and GPV data (Section 2.2)	Hanoi	17 - 19 Oct 2018	Kiichi Sasaki	24
Training course on basic knowledge of meteorological observation according to the guidance of WMO (Section 2.3)	Hanoi	06 - 09 Nov 2018	Koji Matsubara and Masao Mikami	24
Training course on controlling the quality of observation system, comparing the AWS data and Synop data	Hanoi	20 - 23 Nov 2018	Masao Mikami and Tsutomu Jomura	8
Training course on operation and maintenance of Phu Lien and Vinh radar	Phu Lien & Vinh	PL: 26 Nov - 05 Dec 2018 Vinh: 06 Dec - 14 Dec 2018	Masaru Wakabayashi	6
Seminar on Strategy to improve weather forecast information for disaster prevention	Hanoi	12 Dec 2018	Kazuo Saito	40

2.1. Seminar on utilization of radar and satellite data for disaster prevention in Japan

The first seminar in this project was held on 2 August 2018 to overview the JMA's effort to utilize radar and satellite data for disaster prevention. A combination of observation, analysis and forecasting is important to issue effective warnings related to heavy rainfall. Radar and satellite data are especially important to know the evolution of heavy rain-producing systems and to derive precise rainfall distribution. Radar is useful to catch the rainfall distribution, but some techniques are necessary to convert radar reflectivity data to accurate rainfall intensity. Quantitative precipitation estimation (QPE) products calculated from radar and rain gauges are useful to get precise rainfall distribution. QPE products produce some other products such as quantitative precipitation forecasting (QPF) or various indexes. These products contribute to the issuance of warnings.

2.2. Training course on monitoring heavy rainfall and typhoon by using radar data, satellite data, ARG data and GPV data

Introductory training courses on monitoring heavy rainfall and typhoon were conducted by output 3 (K. Sasaki of JMBSC) from 17 to 19 Oct 2018. First, a presentation and hands-on practice on typhoon monitoring with SATAID was given using Typhoons Mangkhut and Barijat of 2018 as actual examples. Second, a presentation and hands-on practice on heavy rainfall and typhoon monitoring with AWS, radar, and satellites using Typhoon Jebi as an example, which caused extensive damage to Japan in September 2018. Finally, hands-on practice on typhoon monitoring with NWP GPV data was given. A total of 24 staff from Aero-Meteorological Observatory (AMO) and National Center for Hydro-Meteorological Forecasting (NCHMF) participated in the training.

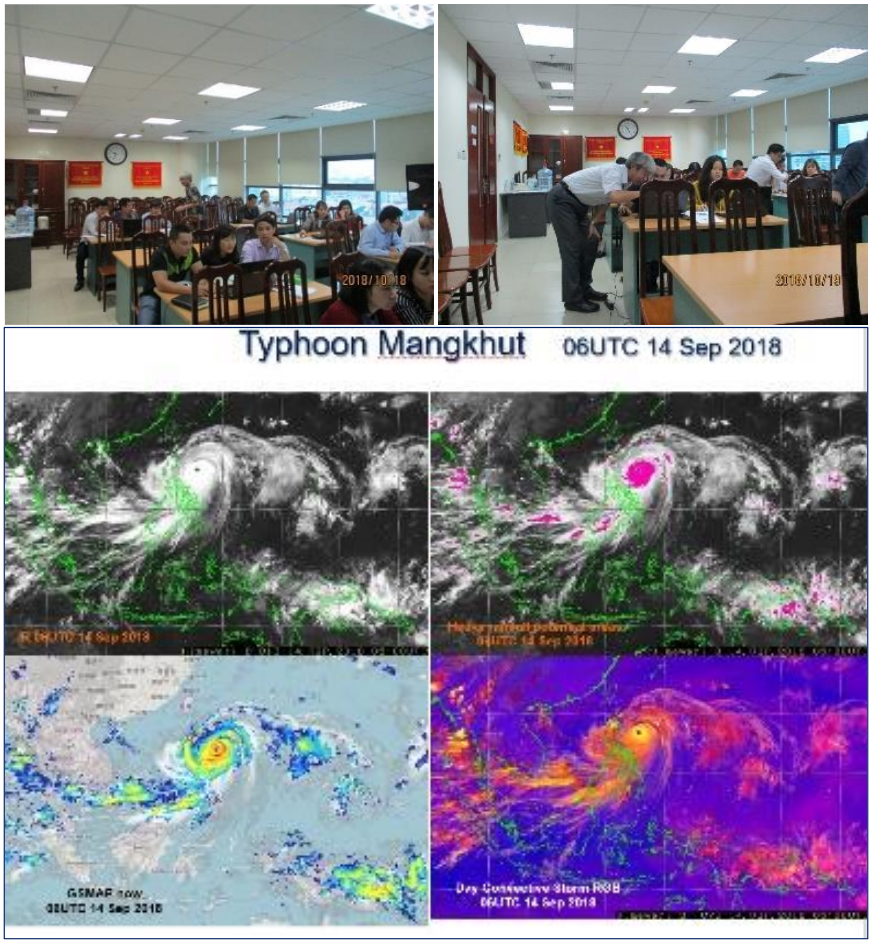

Figure 1. Training course on monitoring heavy rainfall and typhoon.

2.3. Training course on basic knowledge of meteorological observation according to the guidance of WMO

Introductory training courses on surface observation and its quality assurance were conducted by output 1 (M. Mikami and K. Matsubara of JMBSC) from 6 to 9 Nov. 2018. The accuracy of surface observation is highly dependent on the maintenance and calibration of surface instruments. Periodic maintenance and calibration are essential to keep the instruments in good condition. The observational environment is another factor to get good observational data. WMO showed several guidelines for the siting of observation and keeping its environment. Automatic quality control (AQC) is a useful method to detect anomaly data. We focus on the instruments or the environment of the observation site by utilizing the result of detection by AQC.

3. Training courses and seminars in 2019

Table 2. List of training courses and seminars in 2019.

Title of training course	Place	Date	Lecturer	Number of participants
Training course on the application of SATAID software in weather forecasting (Section 3.1)	Hanoi	18 - 22 Mar 2019	Shuji Nishimura and Marika Ono	31
Training course on Linux utilization	Phu Lien & Vinh & Hanoi	PL: 25-26 Mar 2019 Vinh: 28-29 Mar 2019 Hanoi: 01-02 Apr 2019	Chiho Kimpara	
Training on Operational Use of Kalman Filter Guidance for the Improvement of City forecasts & Outline of GSM KF guidance program "temp_guidance.bat"	Hanoi	25 & 28 Mar 2019	Kiichi Sasaki	
Training on Maintenance and Quality Control of Surface Meteorological Observation	Phu Lien & Vinh	Vinh: 28 Mar 2019 PL: 29 Mar 2019	Masao Mikami	20
Workshop on Integrating the hydro-meteorology system and orienting the development of improving forecast quality in Vietnam (Section 3.2)	Hanoi	10 Apr 2019	Kazuo Saito	40
Training course on Measurement of Meteorological Elements & Maintenance and Quality Control of Surface Meteorological Observation	Hanoi	16 - 17 Apr 2019	Masao Mikami	6
Training course for QC and QPE package of radar.	Japan	08 - 10 May 2019	JMA	2
OJT on radar maintenance at Phu Lien and Vinh radar sites	Phu Lien & Vinh	PL: 13 - 17 May 2019 Vinh: 20 - 24 May 2019	Tsutomu Jomura and Kenji Akaeda	
Training course on surface observation as part of output 1	Japan	24 Jun - 06 Jul 2019	JMA & JICA experts	6
Seminar on operational use of guidance for improvement of quantitative forecasts (Section 3.3)	Hanoi	25 Jul 2019	Kiichi Sasaki	22
Seminar on Heavy rainfall in Central Vietnam on 9th December 2018 and GSMaP data for precipitation nowcasting	Hanoi	20 Aug 2019	Kazuo Saito	25
Seminars: On the Northward Ageostrophic Winds Associated with a Tropical Cyclone Application of GSMaP data for precipitation nowcasting for the Heavy rainfall event in Central Vietnam on 9th December 2018	Hanoi	05 Sep 2019	Kazuo Saito	25

Title of training course	Place	Date	Lecturer	Number of participants
Seminar at Development Partners Conference on Hydro-Meteorological Services in Viet Nam	Hanoi	18 Sep 2019	Kenji Akaeda	50
Seminar on Disaster Management in Japan and effective usage of meteorological information	Hanoi	18 Oct 2019	Michihiko Tonouchi	25
Seminar on Natural Disaster prevention caused by heavy rainfall	Hanoi	23 Oct 2019	Kenji Akaeda, Yasutaka Makihara and Nguyen Vinh Thu	40
Seminar on quality control procedure of AWS data	Hanoi	25 Oct 2019	Tsutomu Jomura	40
Training course on evaluating the result of Japanese radar data with ARG data	Hanoi	04 - 06 Nov 2019	Chiho Kimpara	24
Seminar for improving rainfall observation accuracy and reliability for use in QPE/QPF application	Hanoi	07 Nov 2019	Masao Mikami	20
Training course on weather radar as part of output 2	Japan	10 - 23 Nov 2019	JMA & JICA experts	6
Training course on Development of Regional Quantitative Forecasts with Weather Guidance (Section 3.4)	Hanoi	02 Dec 2019	Kiichi Sasaki	

3.1. Training course on the application of SATAID software in weather forecasting

A satellite training course by JMA experts (S. Nishimura and M. Ono) was held from 18 to 22 March 2019 in the AMO conference room. 31 VNMHA staff members; 11 were from the Regional Hydro-met Centers, 6 were from NCHMF and 14 were from AMO participated in the Seminar. Lectures on the use of SATAID, the use of RGB images and on the basics of satellite image analysis and several event analyses were conducted.

Figure 2. Satellite training course by JMA experts.

3.2. Workshop on Integrating the hydro-meteorology system and orienting the development of improving forecast quality in Vietnam

On April 10, VNMHA hosted a special workshop on “Integration of Meteorology and Hydrology system and orientation for improving forecasting quality in Vietnam”. The workshop was held at conference room 210 of VNMHA and chaired by Mr. Le Cong Tanh, Vice Minister of MONRE. Most leaders of VNMHA including, Prof. Dr. Tran Hong Thai,

Administrator of VNMHA, Mr. Le Thanh Hai, Deputy Director General, and Assoc. Prof. Dr. Nguyen Van Thang, Director of the Viet Nam Institute of Meteorology, Hydrology and Climate Change(IMHEN), attended the workshop. As one of the two invited speakers, K. Saito gave a presentation on "Evaluation of heavy rainfall in Central Vietnam in 2018 and recommendations on the orientation for improving forecasting quality in Vietnam". Another speaker at the workshop was Dr. Marcel Marchand, an expert in flood risk and coastal management from Deltares (https://www.deltares.nl/en/), a hydrological research and consultancy firm based in the Netherlands. He gave a talk on 'Frame of integrated system for weather forecasting and early warning (Table 3).

Table 3. Agenda of workshop on integration of meteorology and hydrology system and orientation for improving forecasting quality in Vietnam.

Time	Content	Speaker
15h30-15h35	Introduction	
15h35-15h55	Frame of integrated system for weather forecasting and early warning	Marcel Machand
15h55-16h25	Evaluation of heavy rainfall in Central Vietnam in 2018 and recommendations on the orientation for improving forecasting quality in Vietnam	Kazuo Saito
16h25-16h50	Discussion	Tran Hong Thai - VNMHA Administrator
16h50-17h00	Remarks by MONRE leader	Le Cong Thanh - MONRE Vice Minister

Saito's presentation (Figure 3) was: 1) The heavy rainfall in Central Vietnam on December 9th; 2) Precipitation nowcasting; 3) Numerical Weather Prediction; and 4) Recommendations on the orientation for improving forecasting quality for short, middle, and long-range. Mr. Le Cong Thanh, Deputy Minister of MONRE, commented that Mr. Saito's presentation gave VNMHA very important points regarding its direction of future plans.

Figure 3. Example of presentation slides at the workshop.

3.3. Seminar on operational use of guidance for improvement of quantitative forecasts

A seminar on the operational use of guidance for the improvement of quantitative forecasts was held on 25 Jul 2019 at the AMO conference room with 22 participants. Output 3 (K. Sasaki of JMBSC) gave a presentation on temperature guidance with multiple linear regression method and Kalman filter method using JMA-GSM GPV data and ECMWF-IFS GPV data. Verification results of the temperature guidance with both models were also presented, as well as the results of city forecasts issued by NCHMF.

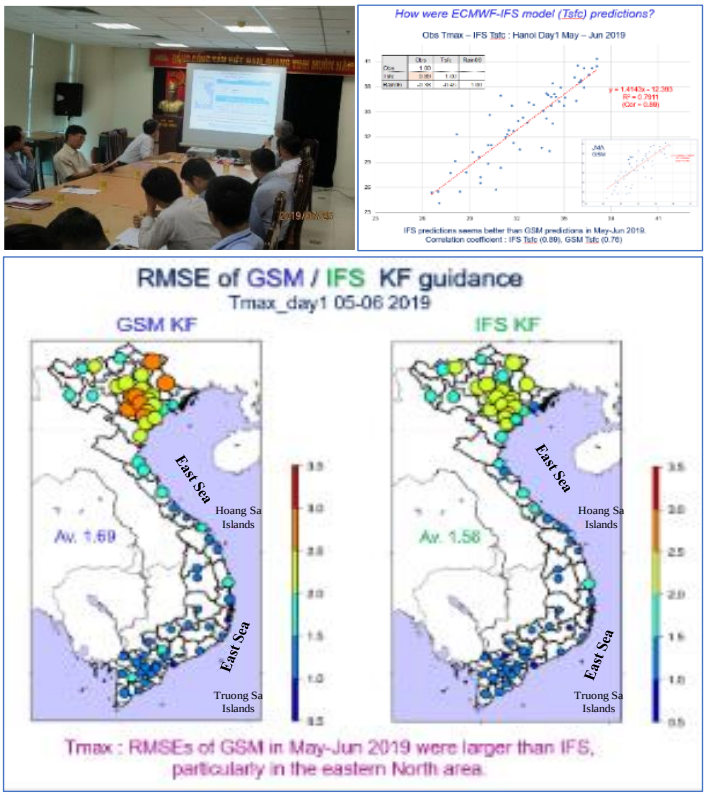

Figure 4. Seminar on operational use of guidance for improvement of quantitative forecasts.

3.4. Training on Development of Regional Quantitative Forecasts with Weather Guidance

Training on the development of regional quantitative forecasts with weather guidance was conducted at Vinh RFC on 2 Dec 2019 and at Phu Lien RFC on 5 Dec 2019. Output 3 (K. Sasaki of JMBSC) gave a presentation on the concept of MOS (multiple linear regression) guidance and Kalman filter temperature guidance. Hands-on practice on downloading GPV, visualization of GPV data with GrADS, and statistical analysis with Excel and R was also provided.

Figure 5. Training at Vinh RFC (left), and at PhuLien RFC (right).

4. Training courses and seminars in 2020 and 2021

Table 4. List of training courses and seminars in 2020 and 2021.

Title of training course	Place	Date	Lecturer	Number of participants
Training course on the basic principle of radar and radar data analysis guidance (Section 4.1)	Hanoi	02 - 06 Mar 2020	Yasutaka Makihara	40

Title of training course	Place	Date	Lecturer	Number of participants
Training course on application of numerical model products to support weather forecasting	Hanoi/Online	09 - 10 Mar 2020	JMA experts	42
Seminar at 9th Aero-Meteorology Conference	Hanoi	16 Dec 2020	Kenji Akaeda	30
Training course on operation of ARG system (Section 4.2)	Hanoi	22 Jul and 17 Aug 2021	Hiroyuki Ichijo	6
Advance training course on management of ARG system	Hanoi	18 Aug 2021	Hiroyuki Ichijo	2
OJT on maintenance with meteorological calibration equipment (Section 4.3)	Hanoi	21, 23 Dec 2021 and 5 Jan 2022	Ryohei Kobayashi	3 to 7
Seminar on Context of VNMHA's QPE and improvement & short-range precipitation forecast (Section 4.4)	Hanoi	27 Dec 2021	Chiho Kimpara and Kazuo Saito	19
Training course on setting clutter maps in JMA-QC Package	Hanoi	28 - 30 Dec 2021	Chiho Kimpara	5

4.1. Training course on the basic principle of radar and radar data analysis guidance

This 5-day training course covers a wide range of radar fundamentals as well as applied matters such as QPE calculations. Fundamentals include radar principles, characteristics of radar observation data, and quality control of anomalous and non-precipitation echoes. Applied topics include algorithms for calculating QPE using a combination of rain gauge and radar, characteristics of QPE products in Vietnam, and how to utilize QPE products. The training course also included an exercise to compare QPE products analyzed in Vietnam with rain gauge-only data and satellite data. The lecturer, Y.Makihara, who used to develop QPE products at the JMA, has a deep knowledge of QPE, and the training materials were well organized.

4.2. Training courses on operation and management of ARG system

Two training courses for operational staff and administrators toward full operation of the ARG system were held for 3 days from July to August 2021. The courses were comprised of technical lectures and practical instructions. The participants learned the comprehensive structure of the ARG system, functions of dataloggers and data collection servers, ARG data flow, and ARG maintenance issues.

Figure 6. ARG training courses: technical lecture (left), practical instruction (right).

4.3. OJT on maintenance with meteorological calibration equipment

The project provided equipment for meteorological calibration. This training provided handling the equipment and procedure to calibrate instruments at the calibration laboratory and at Ha Dong observatory. Since a thermal water chamber was installed at the calibration laboratory of the headquarters, the laboratory staff in charge of thermometers attended the training. Other equipment; digital barometers, digital Assmann psychrometers, and rain gauge checkers were introduced to technical staff at the laboratory and in the field.

Figure 7. Handling training for clibration equipment. (a) Training at the Headquarters; (b) Training at Ha Dong observatory.

4.4 Seminar: Context of VNMHA's QPE and improvement & Short range precipitation forecast

A seminar, Context of VNMHA's QPE and improvement & Short range precipitation forecast was held on 27 December 2021. In addition to JICA and VNMHA members, participants came from IMHEN, Hanoi University Science School (HUS), and a private meteorological company (Weather Plus). The first seminar on 27 December 2021 was conducted in a combination of online and onsite with a lecture from output 2 (C. Kimpara of JWA, online) and output 3 (K. Saito of JMBSC) (Figure 8).

Figure 8. The First Seminar is on 27 December 2021. (Left) AMO conference room, (Right) Screenshot of the online lecture.

5. Training courses and seminars in 2022 and 2023

Table 5. List of training courses and seminars in 2022 and 2023.

Title of training course	Place	Date	Lecturer	Number of participants
Seminar on short-range precipitation forecast (Part 2)	Hanoi	11 Jan 2022	Kazuo Saito	15
Seminar on Strengthening the development and innovation of	Hanoi	19 May 2022	Kenji Akaeda	40

Title of training course	Place	Date	Lecturer	Number of participants
heavy rainfall technology in disaster reduction				
Advanced training course on periodic maintenance AWS calibration tools at Phu Lien and Vinh	Phu Lien & Vinh	Vinh: 18 - 19 Oct 2022 PL: 25 - 27 Oct 2022	Ryohei Kobayashi	V:15 & P:12
Training course on QPE quality improvement and quantitative precipitation forecast (QPF) by using weather radar data and ARGs data (Section 5.1.1)	Hanoi	16-24 November 2022	Kenji Akaeda, Chiho Kimpara, Kazuo Saito, Bui Thi Khanh Hoa, Michihiko Tonouchi	40
Training course on short term weather forecast (Section 5.1.2)	Hanoi		Kazuo Saito, and Kiichi Sasaki	40
Training course on practicing the assessment of meteorological elements observed by AWS system	Hanoi	05 - 07 Dec 2022	Ryohei Kobayashi	8
Training course on inspection and quality control of AWS/ARG (Section 5.2)	Hanoi	13 - 15 Dec 2022	Hiroumi Shigeoka, Masaki Kuroiwa, and Hirokatsu Onoda	40
Training course on weather forecasting as part of output 3 (Section 5.3)	Japan	07 - 21 Feb 2023	Experts (JMA, JMBSC, Tohoku University)	6
Final seminar on activity summary of output 1 and output 4 (Section 5.4)	Hanoi	14 Apr 2023	Ryohei Kobayashi, Hiroyuki Ichijo, Nguyen Viet Huy, Kenji Akaeda, and Tsutomu Jomura	40

5.1. Training course on QPE and QPF, and short term weather forecast

From 16 to 24 November 2022, two comprehensive training courses, “Training course on QPE quality improvement and quantitative precipitation forecast (QPF) by using weather radar data and ARGs data” and “Training course on short term weather forecast” were held at VNMHA Headquarters in Hanoi. The first seminar was mainly held in the first week (16 to 18), but the lecture by M. Ttonouchi was held in the afternoon on 22 November (Table 6). The seminar was attended by 40 participants from VNMHA's Observation Division (AMO), NCHMF, and 9 regional forecast centers.

Table 6. Time tablet of training courses in Novemebr 2022.

Date	Items	Personal in charge
16 (Wed)	AM: 8:30 - 9:00: Registration	
	9:00 - 9:10: Opening time	AMO
	- Introduction of training course	Vice director - Tran
	- Opening speech of AMO leader	Xuan Tuan
	- Opening speech of Project Chief Advisor.	
	AM: From 9:10	
	- Lecture: Utilization of Radar data for Monitoring/Nowcasting Various Severe Phenomena	Kenji Akaeda
	PM: From 14:00	Chiho Kimpara
	- Lecture: Introduction of radar products and usage notes	(Online)
	AM: From 9:00	Chiho Kimpara
	- Lecture: Application of dual-polarization and future prospects	(Online)

Date	Items	Personal in charge
17 (Thu)	PM: From 14:00 - Lecture: Test of very short range forecast of precipitation in Vietnam	Kazuo Saito
18 (Fri)	AM: From 9:00 - Lecture: Some research results on the utilization of radar data in AMO	Bui Thi Khanh Hoa
21 (Mon)	AM: From 9:00 - Lecture: Mesoscale numerical weather prediction	Kazuo Saito
	PM: From 14:00 - Lecture: Mesoscale meteorology on local circulation and convection initiation	Kazuo Saito
22 (Tue)	AM: From 9:00 - Lecture: Mesoscale ensemble prediction	Kazuo Saito
	PM: From 14:00 - Lecture: Quality check of ARG and QPE	Michihiko Tonouchi
23 (Wed)	AM: From 9:00 - Lecture: Kalman filter T_{max}/T_{min} Temperature Guidance	Kiichi Sasaki
	PM: From 14:00 - Lecture: Precipitation Guidance (POP, regional mean/max 24h-rain)	Kiichi Sasaki
24 (Thu)	AM: From 9:00 - Exercise: Case study of heavy rainfall in Vietnam	Kiichi Sasaki

5.1.1. Training course on QPE and QPF

"Training course on QPE quality improvement and quantitative precipitation forecast (QPF) by using weather radar data and ARGs data" was held from 16 to 22 November 2022 (Table 5) at VNMHA. The lectures are K. Akaeda of JICA (am on Wednesday 16), C. Kimpara of JWA (online, pm on Wednesday 16 and am on Thursday 17), K. Saito of JMBSC (pm on Thursday 17), Hoa Bui of AMO, VNMHA (am on Friday 18), and M. Tonouchi of JMBSC (pm on Tuesday 22). Akaeda summarized the radar echo characteristics in Vietnam and explained some techniques to detect severe phenomena by radar. Kimpara explained the algorithm of QPE and the results of the evaluation of QPE. She also explained how to utilize dual-polarized data for precipitation observation. Tonouchi explained the result of the rain gauge evaluation and the effective utilization of rain gauge data for QPE calculation. Kazuo Saito introduced the development of a very short range forecast of precipitation system in Vietnam [2].

5.1.2. Training course on short term weather forecast

"Training course on short term weather forecast" was held from 21 to 24 November 2022 (Table 5) at VNMHA (Figure 9). The lectures are K. Saito of JMBSC (Monday 21 and pm on Thursday 22), and K. Sasaki of JMBSC (Wednesday 23 and am on Thursday 24). K. Saito gave lectures on mesoscale-numerical weather prediction on the morning of November 21, meteorology of local circulation and convective initiations in the afternoon, and mesoscale-ensemble forecasting on the morning of November 22. These lectures were prepared based on the materials at the forecasting technology training at the Meteorological College of Japan and the Japan Society of Certified Meteorological Forecasters, while original materials were added (Figure 10).

The training on temperature guidance by K. Sasaki included presentations on the development of MOS and Kalman filter guidance [3], verification results of GSM and IFS temperature guidance, statistical analysis using observation and GPV data sets, and simple hands-on training on MOS and Kalman filter temperature guidance calculations. On the last

day of this training course, comprehensive heavy rainfall case studies [4] were presented and practiced using surface observation data, radar QPE, satellite data, numerical prediction data, and precipitation guidance. The cases were the case of 24-hour rainfall exceeding 300 mm due to Typhoon NORU, which made landfall in central Vietnam from the night of September 27 to the early morning of September 28, 2022, and the case of 24-hour rainfall exceeding 500 mm due to Typhoon SONCA, which made landfall in central Vietnam on October 15, 2022.

Figure 9. Training course on short-term weather forecast.

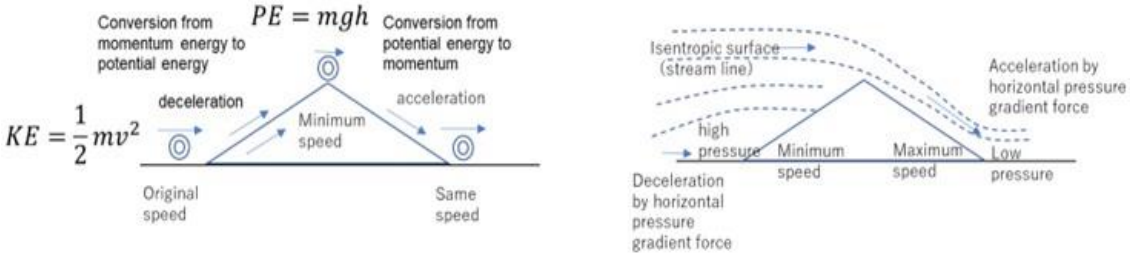

Figure 10. Difference between mass point past over a mountain (left) and downslope wind (right) in the lecture on mesoscale meteorology on local circulation and convection initiation.

5.2. Training course on inspection and quality control of AWS/ARG

This project invited two experts of calibration, maintenance, and data quality control from JMA to Hanoi for the training, besides, one quality control expert from JMA provided training remotely. This training provided organizing the traceability system as a foundation of the data quality and method of quality control in operation in JMA, especially rain gauge check. This seminar reached not only staff working in Hanoi but also from the whole country.

Figure 11. Data quality control training by JMA experts in Hanoi on 13-15 Dec 2022.

5.3. Training course on weather forecasting (output 3) in Japan

This training program was held from February 7 to 21, 2012, for trainees of VNMHA to acquire skills and knowledge related to precipitation nowcasting, short-time precipitation forecasting, numerical weather prediction and guidance, and use of meteorological observation data, through lectures and visits to Japanese meteorological agencies, research institutions, universities, and other institutions. Six VNMHA staff members and two project assistant staff members participated in the training according to the schedule shown in Table 7.

Table 7. Training details.

Date	Contents of Training	Location
7 (Tue)	Visiting Japan, Check-in JICA Tokyo	JICA Tokyo
8 (Wed)	Briefing on the training	JICA Tokyo
	Presentation "JMA technical meeting on forecasting (country report, sharing and discussing experiences on forecasting operations)"	JMA Headquarters
	Lecture "JMA Operations (general lecture on operations, discussion on meteorological operations)"	
9 (Thu)	Courtesy visit	JMA Headquarters
	Discussion "JMA forecast technical meeting (guidance, precipitation nowcasting, short-time precipitation forecast, satellite analysis)"	Weather Science Museum
	Observation tour "JMA Operation Room"	
	Site visit "Weather Science Museum"	
10 (Fri)	Lecture "Meteorological Disaster Prevention Information Released by JMA and Responses by Local Governments" (Figure 12)	JMBSC
	Observation tour "Life Safety Learning Center"	Life Safety Learning Center
12 (Sun)	Travel (Tokyo to Sendai)	
13 (Mon)	Observation tour "Sendai District Headquarters (District Meteorological Observatory Forecasting Service)"	Sendai District Meteorological Headquarters
	Visit the areas affected by the Great East Japan Earthquake and Tsunami and related facilities (Arahama Elementary School, Sendai City, Ishinomaki City Okawa Earthquake Lore Museum)	Arahama Elementary School Okawa Earthquake Lore Museum
14 (Tue)	Lecture "Numerical simulations of extreme weather phenomena with fine resolution" (Figure 13)	International Research Institute of Disaster Science, Tohoku University
	Travel (Sendai to Tokyo)	
15 (Wed)	Lecture "Operational Use of Numerical Weather Prediction" at JMA Forecasting Technical Meeting	JMA Headquarters
	Tour "Minato Science Museum (including Planetarium)"	Minato Science Museum
16 (Thu)	Transfer (Tokyo to Tsukuba)	Meteorological Research Institute
	Observation tour "Meteorological Research Institute (Phased Array Radar, Dual Polarized Radar, GPS, Wind Profiler, Lidar)"	
17 (Fri)	Observation tour "JMA Numerical Prediction Development Center, Aerological Observatory and Meteorological Instrument Testing Center (Spectrometer, Wind Tunnel)"	Numerical Prediction Development Center Aerological Observatory and Meteorological Instrument Testing Center
	Observation tour "Tsukuba Space Center"	Tsukuba Space Center
	Transfer (Tsukuba→Tokyo)	
20 (Mon)	Evaluation meeting Certificate Awarding	JICA Tokyo
21 (Tue)	Trainees return to Japan	

Figure 12. Lecture "Meteorological Disaster Prevention Information Released by JMA and Responses by Local Governments" at JMBSC.

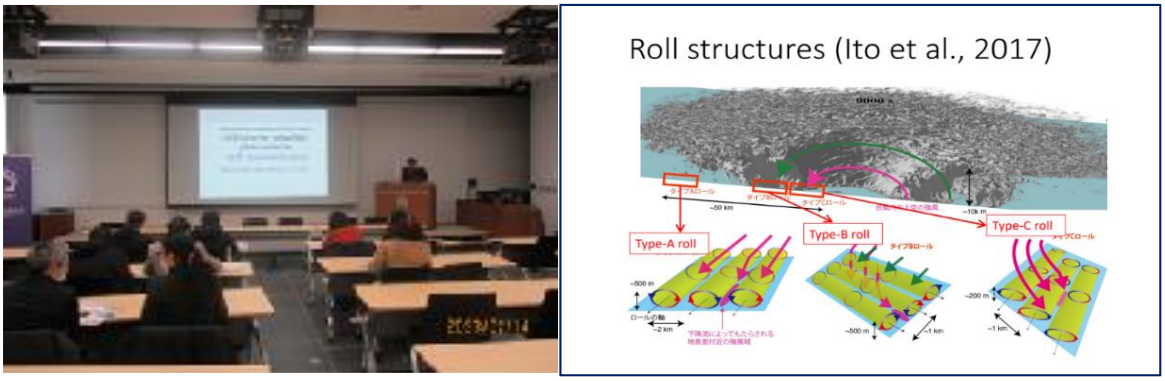

Figure 13. Lecture "Numerical simulations of extreme weather phenomena with fine resolution" at the International Research Institute of Disaster Science, Tohoku University.

At the evaluation meeting held on the last day of the training course, all six trainees gave presentations on what they learned from this training and how they will use the research results in the future. The participants gained a better understanding of the JMA's weather forecasting services, guidance, nowcasting, satellite analysis operations, numerical forecasting, and observation equipment. Participants also commented that the importance of early warning and impact-based forecasting (IBF), the JMA's use of disaster mitigation information, and its services for supporting regional disaster management were very helpful. Regarding the future application of the training outcomes, participants expressed their opinions on both short-term applications and long-term perspectives.

5.4. Final seminar on activity summary of output 1 and output 4

A series of seminars were planned to summarize the activities of each output. The first seminar for this purpose was held on 14 April 2023. This seminar summarized the activities of output 1 by R. Kobayashi, K. Akaeda and T. Jomura, and output 4 by H. Ichijo and N.V. Huy. Kobayashi recommended detailed plan for quality control of surface observation. He also introduced a quality monitoring system that can be easily accessed via Internet from every office. Akaeda and Jomura focused on how to improve the quality of radar observation. Their target is to improve scan strategies and improve some settings for PCAPPI calculation. Ichijo and Huy explained their activities to install a new ARG system and a new operational mobile web/app system. They also suggested their plan to improve information service.

6. Conclusion

During five-year period of this technical cooperation project, 29 training courses and 17 seminars have been conducted so far. As this project continues until the end of December 2023, a few more courses or seminars will be added. In these training courses and seminars,

we provided topics depending on each output as (1) surface observation methods, surface instrument maintenance and calibration, quality control, and radar maintenance, (2) radar observation basics, radar data quality control, radar data analysis methods, and QPE product algorithm and evaluation, (3) temperature and rainfall forecasting by using guidance methods, analyzing method for heavy rainfall cases, and QPF algorithm, (4) installation and maintenance of automatic rain gauge(ARG) system, data acquisition system for ARG and constructing mobile web/application information sharing systems.

We believe that these materials used in the training courses and seminars will be useful for future staff in charge of this field. If you would like to refer to these materials, please contact to the project office or the person involved in this technical project.

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References

1. Akaeda, K.; Tonouchi, M; Thu, N.V. Achievement of JICA Technical Cooperation Project in Period 2. *J. Hydro-Meteorol.* **2023**, *15*, 1–9.
2. Saito, K.; Hung, M.K.; Tien, D.D. Development of a prototype system of the very short-range forecast of precipitation in Vietnam. *J. Hydro-Meteorol.* **2023**, *15*, 59–79.
3. Sasaki, K.; Anh, V.T.; Hang, N.T.; Trang D.T. Development of maximum and minimum temperature guidance with Kalman filter for 63 cities in Vietnam up to 10 days ahead. *VN J. Hydrometeorol.* **2020**, *5*, 51–64. Doi: 10.36335/VNJHM.2020(5).51-64.
4. Sasaki, K.; Anh, V.T. Development of precipitation guidance for 36 regions in Vietnam up to 5 days ahead. *J. Hydro-Meteorol.* **2023**, *15*, 40–58.