



WORLD METEOROLOGICAL ORGANIZATION  
ASSOCIATION OF SOUTHEAST ASIAN NATIONS

TRAINING WORKSHOP ON WEATHER RADAR QUALITY CONTROL  
AND RADAR DATA EXCHANGE

BANGKOK, THAILAND, 29 JANUARY–2 FEBRUARY 2024



FINAL REPORT

## EXECUTIVE SUMMARY

The World Meteorological Organization (WMO)/the Association of Southeast Asian Nations (ASEAN) Training Workshop on Weather Radar Data Quality Control and Radar Data Exchange was hosted by the Thai Meteorological Department (TMD) from 29 January to 2 February 2024 in Bangkok, Thailand, with full support from the Japan Meteorological Agency (JMA). This was a joint initiative under the Regional WMO Integrated Global Observing System (WIGOS) project titled Capacity Building in Radar Techniques in Southeast Asia adopted by the Regional Association II (Asia) at its Seventeenth Session (Online, September, 2021) and the ASEAN project on weather radar endorsed at the Forty-fourth Meeting of the ASEAN Sub-Committee on Meteorology and Geophysics (SCMG) (Bohol, Philippines, October 2023), which share common goals for the region. The activity was in line with the direction of the United Nations' Early Warnings for All initiative (launched in 2022), which aims to protect everyone on Earth from natural hazard by early warnings.

The workshop was attended in person by radar experts from National Meteorological and Hydrological Services (NMHSs) in nine ASEAN Member States (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Thailand and Viet Nam) and Bangladesh. Representatives of JMA and the WMO Regional Office for Asia and the South-West Pacific, a member of the WMO Joint Expert Team on Operational Weather Radars (JET-OWR), radar experts from JMA and the Japan International Cooperation Agency (JICA), and independent radar experts from Japan, Spain and Switzerland were also in attendance either in person or online.

The major objectives of the workshop were to develop Southeast Asian countries' capacity for weather radar operation, maintenance, quality control and data exchange via the sharing of basic expertise in related areas, including dual-polarization radar, quality control techniques, calibration and recent developments in radar data exchange (such as data formats and the status of the Southeast Asian radar network).

A number of presentations and hands-on sessions were given, and practical matters were discussed. The final stage involved a general recap and a commitment from attendees to develop national and regional capabilities in the field of weather radar.

## GENERAL SUMMARY

The World Meteorological Organization (WMO)/the Association of Southeast Asian Nations (ASEAN) Training Workshop on Weather Radar Data Quality Control and Radar Data Exchange was held from 29 January to 2 February 2024 in Bangkok, Thailand. The program of the workshop and the list of participants are given in Annexes.

### 1. Organization of the Workshop

#### 1.1. Welcome Remarks

The workshop was opened at 8:45 AM on Monday, 29 January 2024 at the Century Park Hotel in Bangkok, Thailand with welcome remarks from representatives of the Thai Meteorological Department (TMD), the Japan Meteorological Agency (JMA) and the WMO Regional Office Secretariat for Asia and the South-west Pacific (RAP).

Dr. Wattana Kanbua, Director of Meteorological Development Division of TMD and the Chair of the Local Organizing Committee (LOC), welcomed all participants and reported the background of the workshop. He noted that this workshop is one of activities of the WMO Regional Association (RA) II and RA V joint Regional WMO Integrated Global Observing System (WIGOS) project “Capacity building in radar techniques in the Southeast Asia” coordinated by the JMA. He thanked the support from JMA, WMO and the ASEAN Sub-Committee on Meteorology and Geophysics (SCMG) members to make the training workshop happened where WMO and JMA kindly support around 10 radar experts to transfer technical knowledge in various topics under the training workshop which is being attended by about 27 on-site participants and approximately 80 participants attending online mode. Finally, he thanked WMO and JMA for kind cooperation and keeping close working with TMD in making all arrangements concerned for the training workshop.

Mr. MINEMATSU Hiroaki, Senior Scientific Officer of Office of International Affairs of JMA celebrated that this year marks the tenth anniversary of the first ASEAN workshop hosted by TMD with support of JMA and congratulated this timely and meaningful workshop, mentioning that over the past decade, technical advances, including spread of dual-polarization weather radar and emergence of operational solid-state weather radar, have highlighted the potential of weather radar.

Mr. Yongqing Chen, Technical Coordinator (Infrastructure) of the WMO RAP, welcomed all the participants. He noted that the weather radar is one of the useful tools for monitoring extreme events and disasters which are posing significant challenges to

WIGOS, and the weather radar network will be one promising candidate component of the Regional Basic Observing Network (RBON) which WMO is developing in each region in response to the United Nations Early Warnings for All initiative. He further noted that the workshop will help relevant National Meteorological and Hydrological Services (NMHSs) improve their radar observation and application capabilities, thereby better monitoring frequent extreme events, and contributing to the reduction and prevention of meteorological disasters.

## 1.2. Opening Address

Ms. Kornrawee Sitthichivapak, Director-General of TMD warmly welcomed all the participants to the workshop. She outlined that weather radars are very significant and effective tools to assist NMHSs to monitor rainfall and support accurate nowcasting. She expressed sincere appreciation to WMO and JMA in providing technical and financial support again to organize this 2024 which aims to enhance the utilization of weather radars and address the challenges on weather radar data quality and standardization. She expected the workshop could help member countries increase the effectiveness of weather forecasting and Disaster Risk Reduction (DRR) not only to improve their capacity on weather radar operation but this will also enhance cooperation among ASEAN members in WMO RA II and RA V to maintaining national weather radar network and sharing data for application in support to the effectiveness of severe weather forecasting and early warning in each country and would also serve to the implementation of our global initiative “Early Warning for All”.

## 2. Keynote Speeches

### 2.1. WMO Activities on Operational Weather Radar

Mr. YAMAUCHI Hiroshi, Vice-chair of the Joint Expert Team on Operational Weather Radar (JET-OWR) of WMO introduced the team’s activities which address issues on weather radar such as the spread of dual-polarization radar, increased interference from other radio sources and wind turbines, and increased demand for data exchange. He mainly explained about the development of radar guidance materials (Guide to Operational Weather Radar Best Practices) which covers from the introduction of weather radar to its use in qualitative precipitation estimation (QPE) as well as the WMO radar database (WRD) and radar data format for data exchange (FM301). He provided a detailed introduction to the Volume VI of BPG on radar data processing, which is particularly relevant to the content of the radar training workshop. He also

mentioned expectation that the new radar format and guidance materials will encourage the development and use of open source radar analysis tools.

The current version of the BPG is available through the following link: <https://community.wmo.int/en/activity-areas/weather-radar-observations/best-practices-guidance>

## 2.2. Radar Network in Southeast Asia

Mr. HAGIYA Satoshi, representative of the Regional WIGOS project of RA II, “Capacity Building in Radar Techniques in Southeast Asia”, explained and significance and importance of the project which aims to enhance capability of each country through sharing knowledge and developing regional radar network, and introduced workshops and technical meetings has been held as part of capacity building activities of the project. As for radar data exchange, he presented recent progress including new participation and the creation of a sample regional composite map consisting of participating countries’ domestic composite. He mentioned that this project has contributed DRR capabilities in each country and the region, and it’s in line with the United Nations’ Early Warnings for All initiative.

## 3. Workshop Sessions

### 3.1. County Reports

Radar experts of participating ASEAN Member States and Bangladesh gave presentations on their current status of weather radars including specification of radar systems, maintenance, quality control, data processing, products, technical problems and future plans. Each presentation was followed by discussion and participants shared their experiences and knowledge.

### 3.2. Basics of Weather Radar

Mr. AKAEDA Kenji, former radar meteorologist of JMA and former advisor for the Japan International Cooperation Agency (JICA) technical cooperation project for Viet Nam, first presented a list of items related to radar technology and explained the utilization of dual-polarization data and open software as matters of particular emphasis in this workshop. Next, the fundamentals of radar, including various parameters of radar, the radar equation, effective beam height, methods for determining precipitation distribution from radar reflectivity, error sources affecting the weather radar observation, and quality control of radar data, were explained.

### 3.3. Basics of Dual-Polarization Weather Radar 1 —Introduction—

Dr. NAGUMO Nobuhiro, Senior Scientific Officer, Office of Research and Development of JMA, gave a presentation on the basic of dual-polarization radar system and dual-polarization variables. He explained the difference of radar system between single and dual polarization radar, then introduced microphysical definition of each variable. He emphasized the importance of daily monitoring in order to obtain a perspective on quality control and new development. In the discussion with Dr. Ishihara and Dr. Jordi, they discussed the details of the mechanical configuration of a dual-polarimetric device that precisely balances two orthogonal polarizations.

### 3.4. Basics of Dual-Polarization Weather Radar 2 —Quality Control—

Dr. Nagumo gave a presentation on the quality control technique of dual-polarization radar and introduced the wind turbine-related issue on dual-polarization radar. He provided the useful algorithm examples of clutter discrimination. In terms of a wind turbine-related issue, he showed the possibility of mitigation of the related echoes partially, further emphasized to obey to WMO guideline for installing of wind farm. He discussed with Dr. Ishihara about details of the algorithm of hydrometeor classification including anomalous propagation derived from wind turbine.

### 3.5. Practical Study of Weather Radar 1 —Operation & Maintenance—

Mr. SAWADA Morihiro, Assistant Scientific Officer, Observation Division of JMA, explained the operation and maintenance of JMA's nationwide weather radars. He emphasized that radars are unmanned and remotely monitored and operated, and that the JMA's Radar Observation and Processing System (ROPS) and the lines used for monitoring, operation, and data communication have their own backups. He discussed with the participants about the failure and replacement frequency of SSPA (Solid-State Power Amplifiers) units, and he explained that there have been no serious failures incurred over the past three years. Some participants were very interested in this session, and he shared the frequency of inspection reports in case of failure and specific measures to protect from lightning strikes.

### 3.6. Practical Study of Weather Radar 2 —Calibration—

Mr. Sawada explained the calibration of radar. He emphasized the importance of real-time monitoring of polarization variables and calibration of them to maintain high

observation accuracy from the viewpoint of precipitation intensity estimation and classification of precipitation type. Also, he explained that super-hydrophobic coating suppressed the bias of polarization variables caused by water runoff from the radome. He discussed with the participant about the necessity to monitor  $\rho_{hv}$ . Also, he explained to the participants about the updating frequency of observation data used in the monitoring tool data.

### 3.7. Radar Applications 1 —Dual-Polarization Radar Application—

Mr. SAKAI Takahiro, Assistant Engineer, Office of Research and Development of JMA, he described rainfall rate estimation and hydrometeor classification using dual-polarization radar variables. For the rainfall rate estimation, he explained the JMA conventional QPE and rainfall rate estimation using  $K_{DP}$ . The rainfall rate estimation method using R- $K_{DP}$  was shown to be more accurate for rain gauges than the conventional precipitation estimation method using the Z-R relationship. He also explained an overview of the  $K_{DP}$  calculation method under development.

For the HC (hydrometeor classification), he explained the developing JMA HC algorithm. After that, he demonstrated the results of the verification of several severe storm cases. And he showed that the JMA HC algorithm can detect the location of hail and graupel areas, without estimations. He discussed with the participants about methods of detecting hail in single polarization radar.

### 3.8. Radar Applications 2 —Doppler Velocity—

Mr. Akaeda described the principles of Doppler radar observations and the phenomenon of Doppler velocity folding, as well as the methods used to unfold this folding phenomenon. In order to utilize Doppler velocity data for operational purposes, VAD methods to derive vertical wind distribution and low-level wind-shear detection methods at airports, as well as mesocyclone detection techniques related to tornado detection were presented.

### 3.9. Radar Applications 3 —Open Meteorological Radar Software Constellation—

Dr. Jordi FIGUERAS, former radar expert of MeteoSwiss and Dr. Daniel WOLFENBERGER, MeteoSwiss radar expert, provided a hands-on training on open-source radar data processing software. The training had 3 parts. The first part provided an overview of radar data processing and presented some useful software packages. The second part focused on the MeteoSwiss Py-ART, a Python-based library for radar data

processing and visualization. It consisted in a brief presentation of the software package followed by a series of exercises. The third part focused on Pyrad, a Python-based data processing framework. Again there was a brief presentation of the software package followed by a demonstration of its capabilities with practical exercises. The presented examples covered many aspects of radar meteorology, ranging from simple plotting and gridding, to clutter filtering and attenuation estimation, up to QPE and multi-Doppler processing.

All course material can be accessed through the following link: <https://github.com/openradar/asean2024-pyrad-course>

### 3.10. Radar-Related Topics 1 —A Case Study of Hail Detection in Thunderstorms—

Dr. ISHIHARA Masahito, Meteorology Senior Advisor of JICA showed hail detection techniques using weather radar data. Questionnaire were firstly given to the 10-country participants, asking hail damage and hail information in their countries; there are moderate hail damage in the five countries. Using the radar data provided from JMA, a case study of a hail thunderstorm generated on 24 May 2018 was presented. Legacy methods of hail detection using single-polarization data (maximum reflectivity and vertically integrated liquid water density VILD) showed the possibility of hail falling on the ground. Meanwhile dual-polarization data (differential reflectivity, correlation coefficient and specific differential phase) clearly indicated the evolution process of hail: creation of a hail core aloft and its touch-down to the ground during the period for 20 minutes.

### 3.11. Radar-Related Topics 2 —Hail Analysis in Northern Thailand Using Dual-Polarimetric Radar—

Dr.Nattapon Mahavik, Naresuan University in Thailand, presented his research that investigated the occurrence of thunderstorm squalls combined with the formation of hailstorms in the Chiang Khong district of Chiang Rai province, northern Thailand, utilizing ground-based radar data from TMD on April 23, 2020. This day witnessed a severe thunderstorm event where strong winds and hailstorms caused damage to approximately 500 houses. By utilizing principles of cloud droplet classification, the situation during the event was understood using dual-polarimetric variable data in conjunction with upper air weather layer simulation data using ERA5 data. This study led to the idea of applying data from TMD, which is one of the first works to disseminate research knowledge at the international level addressing issues in Thailand. This aims to



generate knowledge for practical use in disaster warning for the public, along with disclosing the source code produced from the research using open-source radar library [https://github.com/nattaponm/hail\\_dualPol\\_Chiangkhong](https://github.com/nattaponm/hail_dualPol_Chiangkhong). The research suggests the need to establish a knowledge base for applying radar data for nowcasting severe weather conditions. Additionally, there are proposals to increase the frequency of sweeps and the number of elevation angles, along with investing in radiosonde measurements in areas prone to atmospheric disasters. This would enhance the efficiency of nowcasting severe weather conditions. The research paper can be accessed via the following link: <https://ph01.tci-thaijo.org/index.php/aer/article/view/254200>

### 3.12. Radar Data Exchange and Format

Mr. Fatah Masthawe, Director of Hydrometeorological Sub-division of TMD, discussed the current formats of radar data, which include various types such as NEXRAD Level II (WSR-88D), CFRADIAL (CF-Radial), ODIM (Opera Data Information Model), HDF5 (Hierarchical Data Format version 5), UF (Universal Format). Meanwhile, WMO also has its formats for storage, such as GRIB, with files in these formats typically smaller, especially NetCDF. Currently, radar data exchange utilizes this format. However, according to the new agreement by WMO, radar data must be in the WMO-CF RADIAL format, presenting a new challenge in regional data exchange.

### 3.13. Regional Radar Network and Radar Data Exchange

Mr. Hagiya reviewed the continued efforts of the Southeast Asia radar network project, which was mentioned in the keynote speech on the Day 1 and presented challenges in weather radar observation in Southeast Asian countries that have been identified through this project, such as lack of knowledge on radar operation and maintenance (including calibration of dual polarization radars) and human resources, frequency interference and non-precipitation echoes, lack of spare parts and so on. Mr. Hagiya also mentioned that technical meetings and workshops are useful for capacity building of participating countries and the benefits of regional radar data exchange, aiming for achieving DRR not only in each country but also the across Southeast Asia.

### 3.14. Summarization of the Training Workshop

Mr. Akaeda began by summarizing each of the training courses in the workshop and asked for supplementary comments from the lecturers on the use of dual-polarization data and open software, both of which were emphasized in this workshop. He then asked

each participant what they thought of this workshop, how satisfied they were with it, and what they would expect for future workshops. Many participants were satisfied with this workshop and also expressed interest in the open software, which was a new initiative in this course. Participants who are newly in charge of radar operations expressed their desire for the workshop to continue to include basic radar matters, while other participants expressed an expectation for a lecture on the utilization of radar data through detailed case studies.

#### 3.15. Technical Tour

Participants visited TMD's Samut Songkhram Weather Station in Samut Songkhram Province, and observed C-band weather radar facility, a local Radio Broadcast tower and meteorological fields on 31 January 2024 and visited the sightseeing tourist places nearby.

#### 4. Closure of the Workshop

Ms. Kornrawee Sitthichivapak, Director-General of TMD provided a closing remark and presented certificates to all the participants. The workshop was closed at 12 PM Friday, 2 February 2024 with a great success.

**WORKSHOP PROGRAM**  
(Bangkok, Thailand, 29 January–2 February 2024)

Day 1            Monday, 29 January 2024

Time	Item	Speaker
8:45–10:00	Opening Ceremony Welcome Remarks - Representative of TMD - Representative of JMA - Representative of WMO RAP Opening Address - Director-General of TMD Group Photo	Dr. Wattana Kanbua Mr. MINEMATSU Hiroaki Mr. Yongqing Chen  Ms. Kornrawee Sittichivapak
10:00–11:30	Keynote Presentation 1 WMO Activities on Operational Weather Radar - World trends on weather radar observations - JET-OWR's activities - Guide to Operational Weather Radar Best Practices - Introduction to Weather Radar Data Processing	WMO expert Mr. YAMAUCHI Hiroshi (Online)
11:30–12:30	Keynote Presentation 2 Radar Network in Southeast Asia - Background and current situation - Future outlook	JMA expert Mr. HAGIYA Satoshi
12:30–13:30	Lunch	
13:30–16:30	Country Report	Experts of ASEAN Member States and Bangladesh
16:30–17:00	Basics of Weather Radar - Introduction of the workshop	Radar expert Mr. AKAEDA Kenji
18:00–21:00	Welcome Reception	

Day 2            Tuesday, 30 January 2024

Time	Item	Speaker
8:30–12:30	Basics of Weather Radar (cont.)	Radar expert

	<ul style="list-style-type: none"> <li>- Weather radar history</li> <li>- Weather radar basics</li> <li>- Maintenance</li> <li>- Noise-causing events</li> <li>- QPE basics</li> </ul>	Mr. AKAEDA Kenji
12:30–13:30	Lunch	
13:30–14:15	Basics of Dual-Polarization Weather Radar 1 Introduction <ul style="list-style-type: none"> <li>- Dual-polarization radar system</li> <li>- Dual-polarization variables</li> </ul> Importance of monitoring	JMA expert Dr. NAGUMO Nobuhiro
14:15–15:00	Basics of Dual-Polarization Weather Radar 2 Quality Control <ul style="list-style-type: none"> <li>- Control of non-precipitation echoes</li> <li>- Flowchart of non-precipitation echo removal</li> </ul> Measures against wind turbines	JMA expert Dr. NAGUMO Nobuhiro
15:00–15:30	Coffee Break	
15:30–17:00	Practical Study of Weather Radar 1 Operation & Maintenance <ul style="list-style-type: none"> <li>- JMA's Radar Observation and Processing System (ROPS)</li> <li>- Dual-polarization radar with solid-state power amplifiers</li> <li>- Structure of operation</li> <li>- Remote monitoring by ROPS</li> <li>- Trouble shooting</li> <li>- Maintenance</li> </ul>	JMA expert Mr. SAWADA Morihiro

Day 3            Wednesday, 31 January 2024

Time	Item	Speaker
8:30–17:00	Technical Tour Visit radar site & discussion	

Day 4            Thursday, 1 February 2024

Time	Item	Speaker
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8:30–9:20	Practical Study of Weather Radar 2 Calibration - Calibration of Z - Monitoring and calibration of $Z_{DR}$ and $\Phi_{DP}$ - Effectiveness of super-hydrophobic radome coating	JMA expert Mr. SAWADA Morihiro
9:20–10:30	Radar Applications 1 Dual-polarization radar application - Rainfall rate estimation - Hydrometeor Classification	JMA expert Mr. SAKAI Takahiro
10:30–10:45	Coffee Break	
10:45–11:15	Radar-Related Topics 1 A case study of hail detection in thunderstorms	JICA expert Dr. ISHIHARA Masahito
11:15–12:30	Radar Applications 2 Doppler Velocity - Utilization of Doppler velocity - Interpretation of velocity aliasing (folding) and radial velocity - Mechanism of velocity aliasing (folding) correction process - Low level wind shear detection	Radar expert Mr. AKAEDA Kenji
12:30–13:30	Lunch	
13:30–17:00	Radar Applications 3 - Open meteorological radar software constellation - The MeteoSwiss Py-ART - Pyrad architecture and principles	Radar expert Dr. Jordi FIGUERAS MeteoSwiss radar expert Dr. Daniel Wolfensberger (Online)

Day 5      Friday, 2 February 2024

Time	Item	Speaker
8:30–9:30	Radar-Related topics 2 - Hail analysis in northern Thailand using dual-polarimetric radar	Radar researcher of Naresuan University, Thailand Dr.Nattapon Mahavik
9:30–10:00	Radar data exchange and format - Radar data exchange	TMD expert Mr. Fatah Masthawe

	- ASEAN radar network	
10:00–10:30	Regional Radar Network and Radar Data Exchange	JMA expert Mr. HAGIYA Satoshi
10:30–11:30	Summarization of the Training Workshop	Radar expert Mr. AKAEDA Kenji
11:30–12:00	Closing ceremony - Certificate presentation - Group photo	

## List of participants

**Participants**Bangladesh / Bangladesh Meteorological Department (BMD)

Mr. Md. Aftab Uddin

Meteorologist

Mr. Md. Omar Faruk

Assistant Communication Engineer,

Brunei Darussalam / Brunei Darussalam Meteorological Department (BDMD)

Mr. Mohammad Affindi Bin Haji Sabli

Meteorological Officer

Cambodia / Department of Meteorology (DoM)

Mr. Monichoth Soim

Deputy Director Department of Meteorology

Mr. Thaily Oy

Vice Chief of Weather Observation Office

Malaysia / Malaysian Meteorological Department (MMD)

Dr. Fauziana Binti Ahmad

Meteorologist

Radar and Satellite Division

Mr. Rachel Aswin Bin Jominis

Meteorologist

Sarawak Regional Office

Lao PDR / Department of Meteorology and Hydrology (DMH)

Ms. Souphaphone Phonesamai

Weather Forecaster

Mr. Anouluck Rathsavong

Officer technician of Maintenance Radar

Myanmar / Department of Meteorology and Hydrology (DMH)

Ms. Chaw Su Hlaing

Meteorological Officer  
Meteorological Division

Ms. Ohmar Thein

Executive Engineer  
Engineering Division

The Philippines / Philippine Atmospheric, Geophysical and Astronomical Services  
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Mr. John Mark Dolendo

Weather Specialist II

Mr. Mark Geoffray Gales

Regional Forecaster

Indonesia / Meteorological, Climatological, and Geophysical Agency (BMKG)

Mr. Henrikus Jatining Wahyu Argo

Weather Radar Forecaster  
Sub Division for Radar Imagery Processing

Mr. Idris Susanto

Weather Radar Forecaster  
Sub Division for Radar Imagery Processing

Viet Nam / Viet Nam Meteorological and Hydrological Administration (VNMHA)

Mr. Tran Anh Tuan

Chief, Pha Din Weather Radar Station

Mr. Do Trung Truc

Officer, Hydro-Meteorological Network Management Department

Thailand / Thai Meteorological Department (TMD)

Mr. Fatah Masthawe

Director of Hydrometeorological Sub-division

Ms. Natkamon Khemngoen

Meteorological Officer  
Meteorological Observations Division

Mr. Virachart Promta

Director of Weather Radar Sub-division



Meteorological Observations Division

Mr. Peeranat Longsombun

Meteorologist

Numerical Weather Prediction Sub-division, Weather Forecast Division

Mr. Jaral Yiemwech

Meteorologist

Analysis Radar and Satellite Sub-division, Weather Forecast Division

Thailand

Mr. Tanasak Tanajinda

Electrical Engineer Professional Level

Drainage and Sewerage Department

Mr. Parinya Intaracharoen

Conduct Research

Department of Royal Rainmaking and Agricultural Aviation

Mr. Sarawut Arthayakun

Scientist

Department of Royal Rainmaking and Agricultural Aviation

Dr. Nattapon Mahavik

Lecturer and Researcher

Naresuan University

**Expert**

Japan / Japan Meteorological Agency (JMA)

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Mr. SAKAI Takahiro

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International Strategy Officer for Meteorological Observations  
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Third Laboratory, Department of Typhoon and Severe Weather Research  
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Japan

Dr. ISHIHARA Masahito

Meteorology Senior Advisor  
Japan International Cooperation Agency (JICA)

Mr. AKAEDA Kenji

Former radar meteorologist of JMA and former advisor for JICA technical  
cooperation project for Viet Nam

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Dr. Jordi Figueras

Former radar expert of MeteoSwiss and Senior Surveillance System Engineer

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Dr. Daniel Wolfensberger (Online)

MeteoSwiss radar expert

World Meteorological Organization (WMO)

Mr. Yongqing Chen

Technical Coordinator (Infrastructure)  
Regional Office for Asia and the South-West Pacific, Member Services and  
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**Local Organizing Committee**

Thailand / Thai Meteorological Department (TMD)

Dr. Hathaichanok Ngerndee

Senior Foreign Relations Officer  
International Affairs Sub-division

Ms. Chayaphon Chaloesaen

Foreign Relations Officer  
International Affairs Sub-division

Mr. Nithi Thanawongwat

Meteorologist  
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Ms. Premwadee Traitangwong

Meteorologist  
Central Weather Forecast Sub-division, Weather Forecast Division

Mr. Kitti Chancholyut

Public Relations Officer  
Public Relations Sub-division

## The Number of Radars

Frequency	Polarization	Transmitter	Baron	EEC	ELDES	Gematronik/Selex	JRC	Mitsubishi	Toshiba	Vaisala	
S-band	Single-pol	Magnetron				1 (KHM)				2 (MYS)	
		Klystron									
		Solid-state						3 (MYA)			
	Dual-pol	Magnetron		1 (THA)		3 (MYS) 1 (MYS)*					
		Klystron				1 (BRN) 6 (MYS)					
		Solid-state									
C-band	Single-pol	Magnetron	3 (IDN)	16 (IDN)		13 (IDN)				4 (MYS) 1 (IDN)	
		Klystron					6 (JPN)	1 (JPN)	1 (JPN)		
		Solid-state									
	Dual-pol	Magnetron		19 (THA)		4 (IDN) 6 (THA)					1 (IDN)
		Klystron									
		Solid-state						13 (JPN)	4 (JPN)	4 (JPN)	
X-band	Single-pol	Magnetron		1 (IDN)							
		Klystron									
		Solid-state									
	Dual-pol	Magnetron				3 (MYS)					
		Klystron									
		Solid-state		4 (IDN)	1 (IDN)						

<Country code>

BGD: Bangladesh, BRN: Brunei Darussalam, KHM: Cambodia, MYS: Malaysia, LAO: Lao PDF, MMR: Myanmar, PHL: The Philippines, IDN: Indonesia, VNM: Viet Nam, THA: Thailand, JPN: Japan

\*: Antenna and signal processor are produced by Gematronik and product processing is done by IRIS software.