SUMMARY REPORT

Technical meeting on a regional weather radar network for Southeast Asia

(Online, 11 to 12 November 2021)

A technical meeting on a regional weather radar network for Southeast Asia was held online by the Japan Meteorological Agency (JMA) from 11 to 12 November 2021. This was a part of activities in the Annual Operating Plan (AOP) 2021 – item 3 "Development of regional radar network" of the Working Group on Meteorology (WGM) of the ESCAP/WMO Typhoon Committee (TC), which was endorsed by the Fifty-third Session of TC held online hosted by JMA from 23 to 25 February 2021, and was attended by representatives from National Meteorological and Hydrological Services (NMHSs) in Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam. The session was intended to support sharing of Members' technical developments and discussion of the regional radar network covering Southeast Asia, and took place in collaboration with the World Meteorological Organization's (WMO) Regional WMO Integrated Global Observing System (WIGOS) project of the WMO Regional Association (RA) II and V on the regional weather radar network called "Capacity Building in Radar Techniques in Southeast Asia." Last year's instance of this annual meeting was canceled due to the COVID-19 pandemic.

Attendees reviewed the project achievements and highlighted their current situations along with challenges in weather radar with others. The discussions underlined the significance of data exchange within the regional radar network and engagement in technical collaboration. The end of the meeting featured a discussion on the direction of the project and yielded an agreement to proceed with data-exchange support for NMHSs.

Mr MINEMATSU Hiroaki from JMA served as a moderator. The meeting programs is provided as Appendix I. The list of attendees is provided as Appendix II.

1. Opening (11 November)

1.1. The meeting was opened by Mr OBAYASHI Masanori, Director-General of the Atmosphere and Ocean Department of JMA. He praised this project marked 10th anniversary this year since it was registered with the Typhoon

Committee in 2011 and emphasized the importance of promoting effective use of weather radar in Southeast Asia and improving the region's disaster prevention capacity.

2. Progress of the project and purpose of the meeting (11 November)

2.1. Mr MINEMATSU Hiroaki from JMA gave an introductory presentation on this technical meeting and reviewed the progress of the project since its initiation in 2011. He confirmed it's important to proceed with this initiative by utilizing three underpinning frameworks; WMO/WIGOS, ASEAN and ESCAP/WMO Typhoon Committee. In addition, he referred to the current situation of the experimental domestic weather radar data exchanges and explained the purpose of this meeting.

3. Operation of dual-pol weather radar (12 November)

3.1. Mr YAMABE Daiki from JMA introduced about the usage of dual-pol radar. Among the technologies of using dual polarization data, he focused on quality control methods and explained the improvements from conventional methods adapted to single-pol radar. In addition, He explained that dual-pol radar requires careful calibration in order to observe accurate dual polarization data and the JMA's calibration method was also introduced.

4. QPE and HCA applied with Dual-Polarization Radar Data (12 November)

4.1. Dr NAGUMO Nobuhiro from JMA introduced about the usage of dual-pol radar. Among the technologies of using dual polarization data, he focused on Quantitative Precipitation Estimation (QPE) and Hydrometer Classification Algorithm (HCA). He presented the improvements from conventional method, new schematic algorithms and their estimation results.

5. Country reports and discussion (11 to 12 November)

5.1. Mr Gumilang DERANADYAN from the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) explained the sub division for weather radar imagery management developed an inhouse weather radar integration system known as SIDARMA in 2019. Because

interference has been found in most C-Band radars, BMKG has developed the velocity filter and the beam filling techniques, and introduced them to the system. In addition, currently, BMKG uses two forecast algorithm based on weather radar for weather forecast; TITAN Storm and STEP. Because those algorithm haven't been running for a long time, there is no evaluation yet. BMKG considers that pre-processing and post-processing are very important to enhance the radar data quality, and the scanning strategy and configuration of its parameter/variable should be considered before correcting radar product.

5.2. Ms Marcella JAMES J. from the Malaysian Meteorological Department (MMD) presented about MMD's existing and upcoming weather radar network which followed by the updates on MMD's radar technical progress, radar products application, radar composite method and utilization of dual polarization data. She also presented on MMD's challenges and ways forward especially in its direction towards expanding its dual polarization radar network which mainly on QC, QPE and QPF development and improvements.

5.3. Mr John Grender C. ALMARIO from the Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA) said that their AGENCY is currently innovating their services specially with the Radar to provide a better network of Remote sensing Equipment. He said that PAGASA is currently engaged with projects in relative to QC/QPE and QPF in partnership with another MET agency from other countries like JMA from JAPAN and local University. PAGASA is looking forward to acquire technical skill for their Radar Personnel and also looking for a solution with their capacity to acquire a spare part for maintenance despite the policy from local auditing agency which limits spare parts purchase.

5.4. Mr Mah KING KHEONG from the Meteorological Service Singapore (MSS) presented an overview of the weather radar network in Singapore. His presentation briefly described the radar's data quality controls and operational products, and that the radar precipitation product was generated using a dual polarization surface rain intensity algorithm provided in the

"Rainbow" radar software. He has also brought up the problem with two-way wet radome losses and the effects on the dual polarization radar data quality and queried on possible mitigation methods.

5.5. Mr Peeranat LONGSOMBUN from the Thai Meteorological Department (TMD) introduced that TMD has already adopted the java library which is developed by JMA with the lowest elevation angle (at least 4 elevation angles) lowest level intensity (EIL), and TMD had also developed the two python scripted. The first is beamblockage command forgiven information about elevation height charts, beamblockage in any azimuth and elevation angle, additional, generated composite angle table for using on the radar composite processed with lowest elevation angle. The second command is ufconvert to process the weather radar network and Radar/Rainguage-Analysis. In addition, he explained TMD had recommendation that the development of regional radar network is very helpful for the National Meteorological Services (NWS) to provide more and effective information in spatial and temporal for server weather in a specific area.

5.6. Ms Hoa BUI THI KHANH from the Viet Nam Meteorological and Hydrological Administration (VNMHA) presented about the performance of the applying QPE technology transferred by JMA in 2019-2021 for several heavy rainfall events in Vietnam and introduced about the development of lightning warning techniques, hail and radar quality control using dual polarized radar data.

6. Summary of country reports (12 November)

6.1. Mr YAMAMOTO Kentaro from JMA summarized the country reports. He said the reports mainly shared outline of the progress of QC/QPE/QPE development, the usage of dual-polarization radar and the challenges faced by each country with participants.

7. Discussion on Regional Radar Network and its Expansion in Southeast Asia (12 November)

7.1. Mr KUROIWA Masaki from JMA reviewed the progresses of the regional

radar network in Southeast Asia. As the introduction to a discussion, he clarified the benefit of the radar network and required rules among participants and introduced the outline of "Guidelines for the Participation in Experimental Regional Radar Composite Data Exchanges in Southeast Asia" drafted by BMKG, MMD, TMD and JMA, which can assure the benefit.

7.2. Participants discussed the importance and effectiveness of the regional radar network to develop Disaster Risk Reduction (DRR) capacity of NMHSs and then agreed it was necessary to share concrete procedures for joining the network with project participants. During the discussion, Mr Gumilang DERANADYAN from BMKG, Mr John Grender C. ALMARIO from PAGASA and Ms Hoa BUI THI KHANH from VNMHA showed their will to proceed with necessary arrangements with JMA.

8. Activities over the next year (12 November)

8.1. Mr MINEMATSU Hiroaki from JMA explained the draft of AOP 2022 submitted to the ESCAP/WMO TC's WGM. The AOP is shown as follows;

a. To further refine quality control techniques applied to the participants' radar networks, including dual pol. Radars, to improve their quality of radar composite
b. To implement and refine MMD and TMD's QPE calibration using rain-gauge with technical assistance of JMA
c. To support applicants to join the experimental radar data exchange in the near future, and to share the progress with the RA II/V WIGOS radar project in Southeast Asia
d. To compose a user's guide among JMA, MMD and TMD.
e. Submission of progress reports by participants. Upon the receipt of the reports, holding follow-up technical meeting(s) to identify a way forward

8.2. Attendees agreed that;

a. JMA will share the current Guidelines for experimental domestic radar data exchanges and explain concrete procedures for joining the network after the meeting

b. NMHSs being positive about the data-exchange will proceed with arrangements to join the exchange with JMA.

9. Closure (12 November)

9.1. Mr. MINEMATSU Hiroaki from JMA made closing remarks.

Appendix I

PROGRAM

Technical meeting on a regional weather radar network for Southeast Asia
(Online, 11 to 12 November 2021)

Thursday, 11 November 2021

Time (UTC)	Title
06:00-06:15	Opening (Welcome remarks, Orientation)
06:15-06:35	Progress of the project and purpose of the meeting
06:35-06:55	Operation of dual-pol weather radar
06:55-07:20	Country reports and discussion (Indonesia)
07:20-07:45	Country reports and discussion (Malaysia)
07:45-08:00	Break
08:00-08:25	Country reports and discussion (The Philippines)
08:25-08:50	Country reports and discussion (Singapore)

Friday, 12 November 2021

Time (UTC)	Title
06:00-06:10	Orientation
06:10-06:40	QPE and HCA applied with Dual-Polarization Radar Data
06:40-07:05	Country reports and discussion (Thailand)
07:05-07:30	Country reports and discussion (Viet Nam)
07:30-07:45	Break
07:45-08:00	Summary of the country reports
08:00-08:25	Discussion on Regional Radar Network and its Expansion in Southeast Asia
08:25-08:40	Activities over the next year
08:40-08:50	Closure

Appendix II

LIST OF ATTENDEES

Technical meeting on a regional weather radar network for Southeast Asia

(Online, 11 to 12 November 2021)

Indonesia / BMKG

Dr ENDARWIN	Coordinator Remote Sensing Management Division
Mr Gumilang DERANADYAN	Weather Radar Analysist and Forecaster Subdivision for Weather Radar Imagery Management

Malaysia / MMD

Mr Maqrun Fadzli MOHD FAHMI	Director Radar & Satellite Meteorology Division
Ms Marcella JAMES J.	Meteorological Officer Radar & Satellite Meteorology Division

The Philippines / PAGASA

Mr John Grender C. ALMARIO	Weather Specialist I Meteorological Equipment, Telecom. & Technical Services Section Engineering & Technical Services Division

Singapore / MSS

Mr Mah KING KHEONG	Principal Meteorologist Weather Services Division ASMC Services, Forecast Application Development Department
Mr Zheng KAIYUAN *(Absence)*	Executive Meteorologist Weather Services Division ASMC Services, Forecast Application Development Department

Thailand / TMD

Ms Patchara PETVIROJCHAI	Director Research and Technical Cooperation Sub-division
Mr Peeranat LONGSOMBUN	Meteorologist Numerical Weather Prediction Sub-division

Viet Nam / VNMHA

Ms Hoa Bui THI KHANH	Forecaster Meteorological Radar Division Aero-Meteorological Observatory
Mr Vinh NGUYEN QUANG	Engineer Meteorological Radar Division Aero-Meteorological Observatory

Japan / JMA

Mr MINEMATSU Hiroaki	International Strategy Officer for Meteorological Observations Observation Division Atmosphere and Ocean Department
Mr KAWASAKI Teruo	Scientific Officer Observation Division Atmosphere and Ocean Department
Mr TANAKA Hideaki	Assistant Scientific Officer Observation Division Atmosphere and Ocean Department
Mr YAMAUCHI Hiroshi	Senior Coordinator for Observation Planning Observation Division Atmosphere and Ocean Department
Mr YAMABE Daiki	Assistant Scientific Officer Observation Division Atmosphere and Ocean Department
Mr OKAGAKI Akira	Senior Coordinator for International Cooperation Office of International Affairs Planning Division Administration Department
Mr KOIDE Naohisa	Senior Scientific Officer Office of International Affairs Planning Division Administration Department
Mr KUROIWA Masaki	Scientific Officer Office of International Affairs Planning Division Administration Department
Mr YASUI Kazuki	Scientific Officer Office of International Affairs Planning Division Administration Department

Mr OMORI Shiro	Dupty Head Office of Meteorological Analysis and Application Development Administration Division Atmosphere and Ocean Department
Mr YAMAMOTO Kentaro	Senior Scientific Officer Office of Meteorological Analysis and Application Development Administration Division Atmosphere and Ocean Department
Dr NAGUMO Nobuhiro	Senior Scientific Officer Office of Meteorological Analysis and Application Development Administration Division Atmosphere and Ocean Department
Ms INOUE Hanako	Senior Scientific Officer Office of Meteorological Analysis and Application Development Administration Division Atmosphere and Ocean Department
Mr NAKAYAMA Ryuichiro	Senior Scientific Officer Office of Meteorological Analysis and Application Development Administration Division Atmosphere and Ocean Department
Mr KASAHARA Shingo	Senior Coordinator for Typhoon Disaster Mitigation RSMC Tokyo - Tokyo Typhoon Center
Mr MOCHIZUKI Yasushi	Scientific Officer RSMC Tokyo - Tokyo Typhoon Center