



Radar Network in Southeast Asia

5 February 2018

Koichiro Kakihara

Administration Division, Observation Department
Japan Meteorological Agency

Leader of the RA II and RA V joint regional
WIGOS project “Capacity building in radar
techniques in the Southeast Asia”



Contents

- I. Introduction
- II. Experimental exchange of radar composite data
- III. Three frameworks underpinning regional radar network in Southeast Asia
- IV. Purpose of the training workshop
- V. Conclusion

I. Introduction

- ◆ Challenges and long-term prospective in Southeast Asia
- ◆ Benefits of regional radar network in Southeast Asia

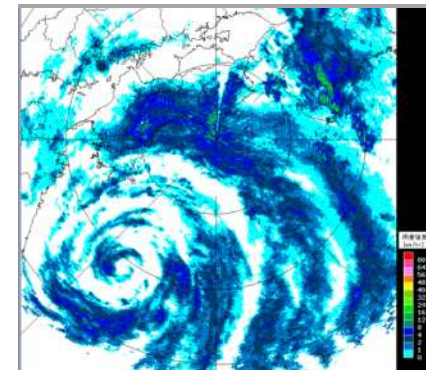
Challenges and long-term prospective in Southeast Asia

- Disaster Risk Reduction (DRR) is a common challenges in the Southeast Asia.
- Especially, natural disasters caused by heavy rain (e.g. floods and landslides) highly impact on society in the region.



Challenges and long-term prospective in Southeast Asia

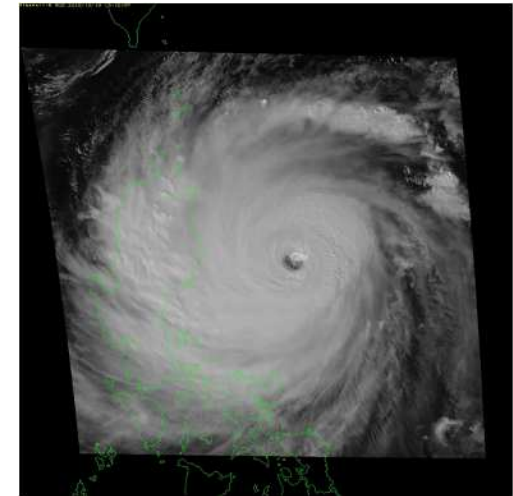
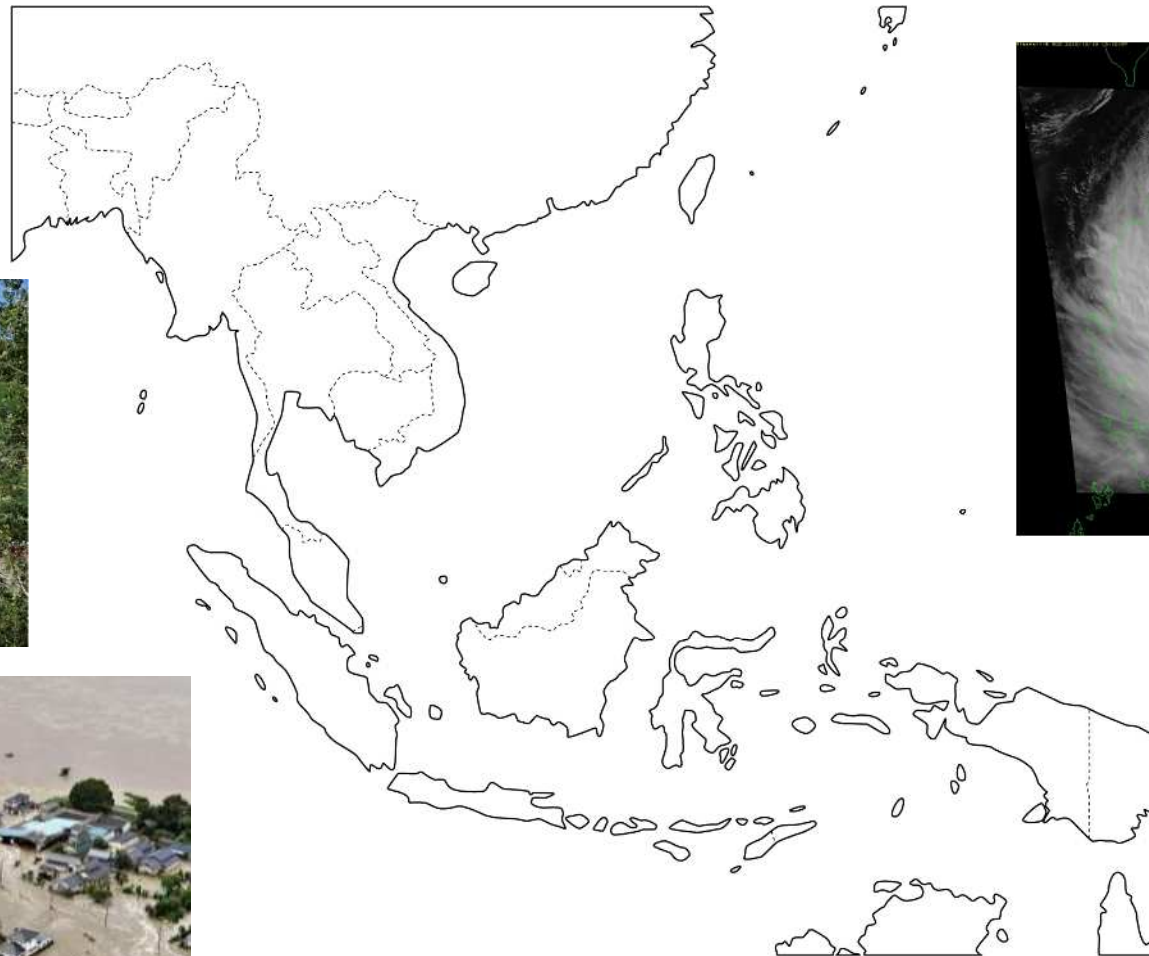
- To mitigate risks by these disasters, it is necessary to monitor real time rainfall situation widely and accurately by radar observation, in addition to surface observation and satellite observation, and to predict impacts of the disaster in advance.

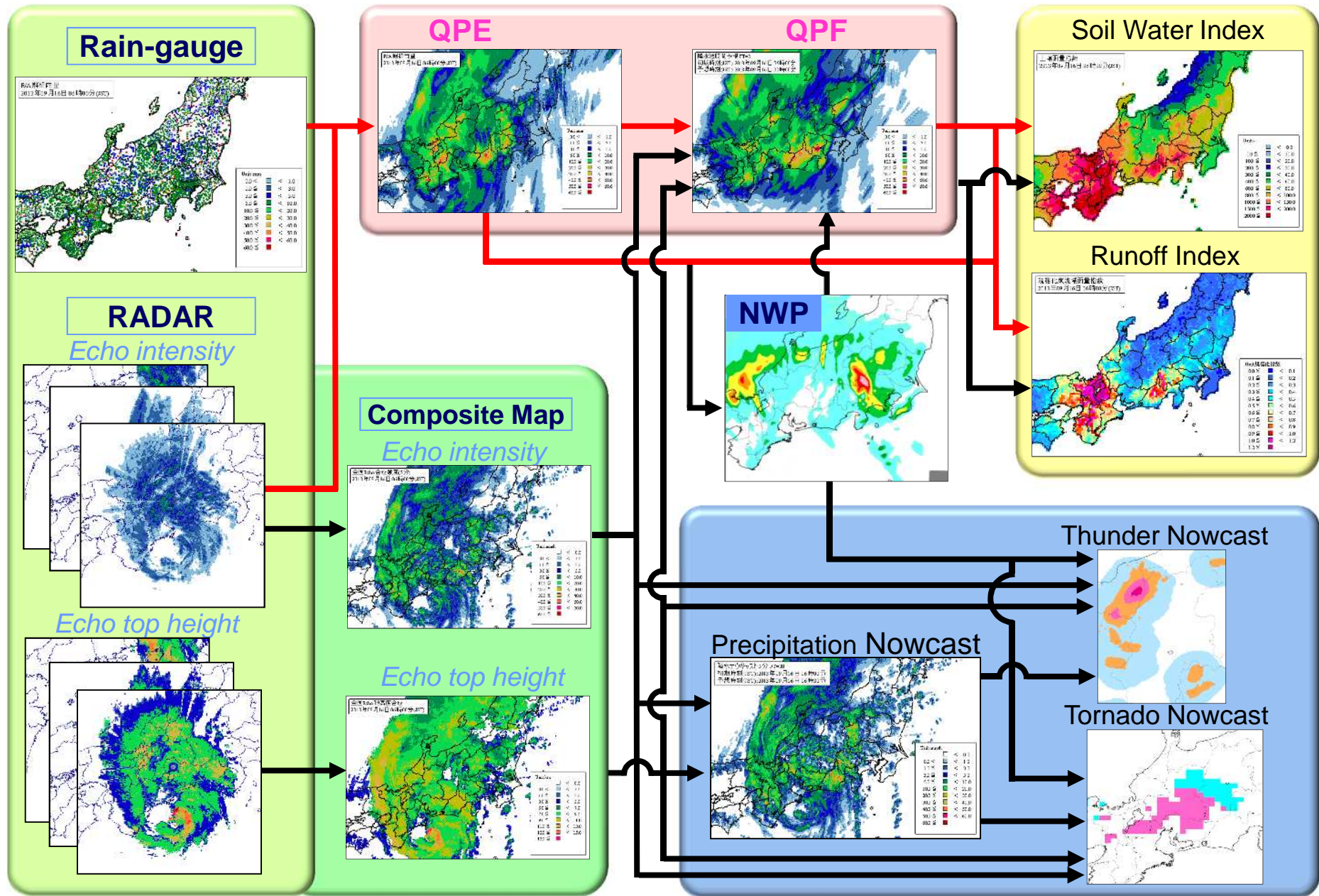


Challenges and long-term prospective in Southeast Asia

- In this region, knowledge and techniques on radar utilization are now developing, and many challenges still remain for application of radar observation data to DRR.
- Especially, to increase number of radar experts and develop domestic radar network are urgent challenges for many countries in this region in utilizing radar observation data to DRR.

Benefits of regional radar network in Southeast Asia







Benefits of regional radar network in Southeast Asia

- Sharing knowledge of radar observation and operation, through development of radar network, directly connects to capacity building in radar observation techniques (e.g. data processing, data management and data application) in each country.



Benefits of regional radar network in Southeast Asia

- Capacity in monitoring and forecasting of severe weather using radar observation data will enhance monitoring cross-border rainfall and severe weather.
- Furthermore, by working with hydrological institutions in each country, the capacity leads to;
 - Enhancement of management of major international rivers; and,
 - Efficient early warning to support National DRR.



II. Status and future plan of radar data exchange in Southeast Asia

- ◆ Experimental exchange of radar composite data
- ◆ Future challenge

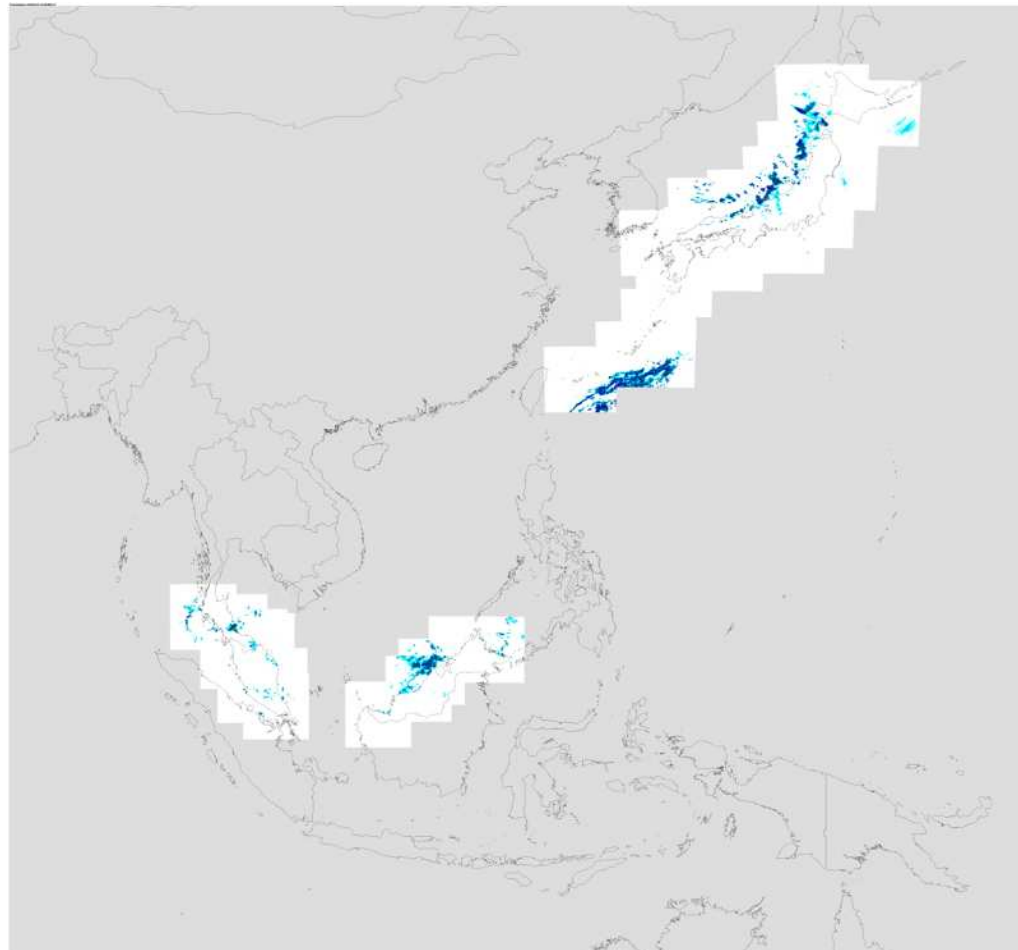


Experimental exchange of radar composite data

- Experimental exchange of radar composite data among TMD, MMD and JMA started on 10 November 2016.
- Radar composite imagery using radar composite data through experimental data exchange among TMD, MMD and JMA has been shared with Typhoon Committee Members from 25 October 2017.

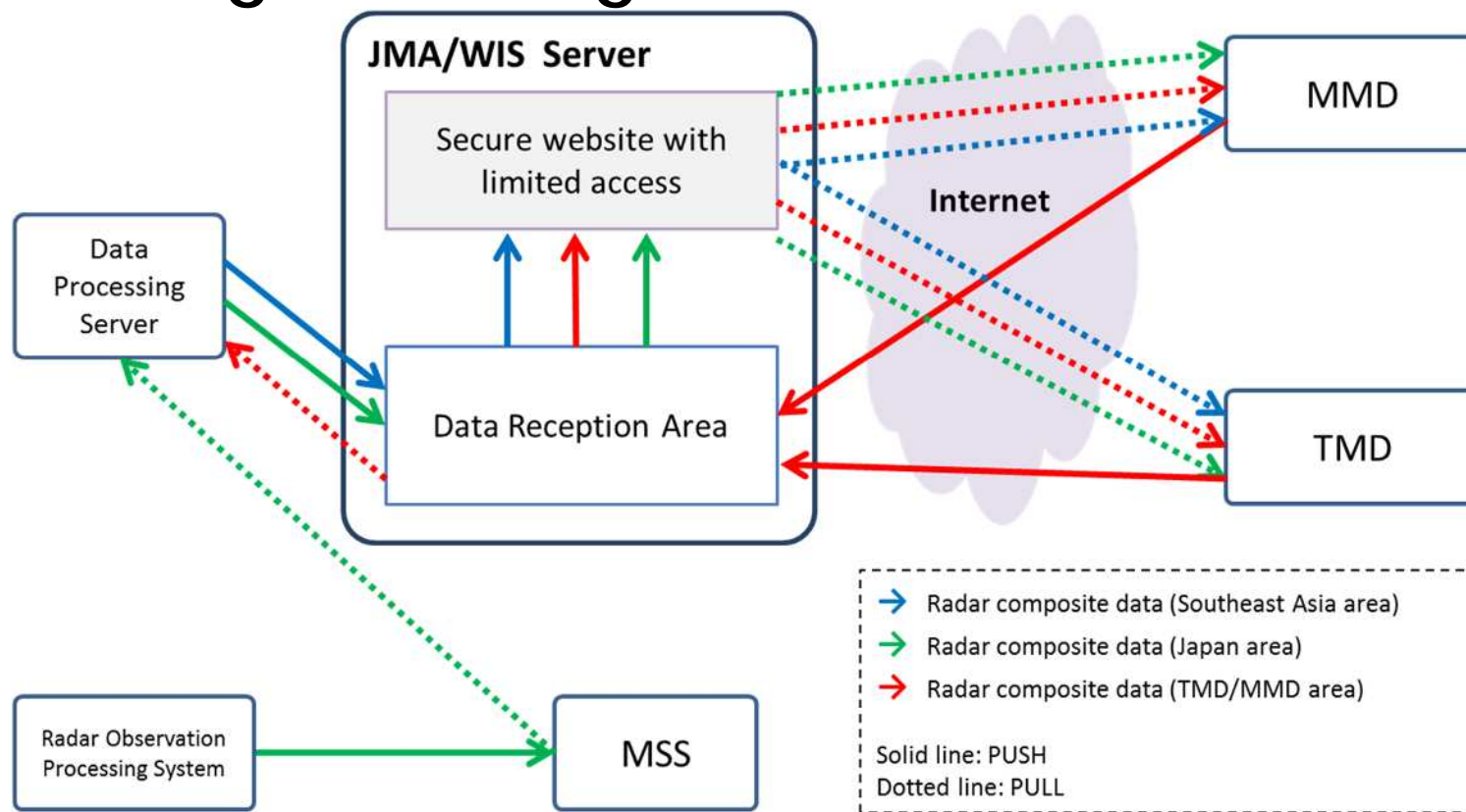
Radar composite imagery

22:00 UTC 22/01/2018



<https://tynwp-web.kishou.go.jp/Analysis/Radar/index.html> (Required ID and password)

Network for Radar Composite Data Exchange among TMD, MMD and JMA



Data	File name
Composite data in SE	Z__C_RJTD_yyyyMMddhhmmss_RDR_SEAGPV_Gll0p01deg_Pri60lv_Aper60min_ANAL_grib2.bin
Composite data in JMA	Z__C_RJTD_yyyyMMddhhmmss_RDR_JPNGPV_Ggis1km_Pri60lv_Aper5min_ANAL_grib2.bin
Composite data in MMD	Z__C_WMKK_yyyyMMddhhmmss_RDR_MMDGPV_Gll0p01deg_Pri60lv_Aper10min_ANAL_grib2.bin
Composite data in TMD	Z__C_VTBB_yyyyMMddhhmmss_RDR_TMDGPV_Gll0p01deg_Pri60lv_Aper15min_ANAL_grib2.bin

Definitions of types of radar data

- Type 0
The information is in the form of voltages inside, and passed among, the electronic components of the instrument hardware. Special recording equipment is required to measure and record such data. International exchange of such information is not considered relevant.
- Type 1
Such data are also known as “time series” and in-phase and quadrature “I/Q” data that are processed and produced by the instrument’s signal processor. These are commonly digitized, and it is becoming easier to record such data. A standardized representation may be considered useful, although international exchange may not be relevant for the foreseeable future.

Definitions of types of radar data

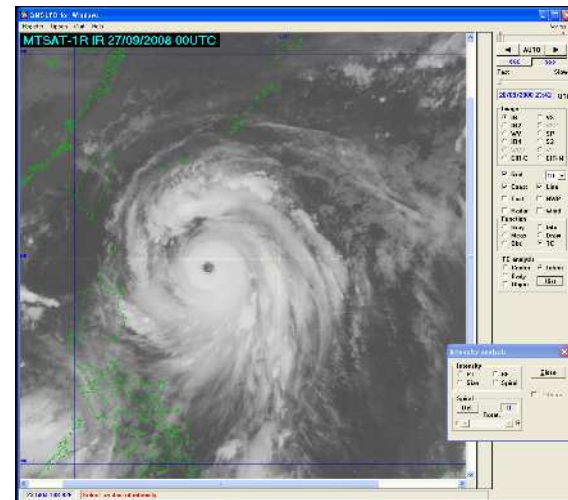
- Type 2
The information has been processed from Type 1 and are organised in native polar coordinates by rays, bins, and quantities. Such data are highly relevant for international exchange, and they are the subject of the information model presented in this document.
- Type 3
The information has been processed from Type 2 data to derive higher-order products from a single site, or data that have been consolidated from several sites into a single product. Such products may be one-dimensional vertical profiles, transformed to Cartesian space, vectors, or other representation.

Why GRIB2 data?

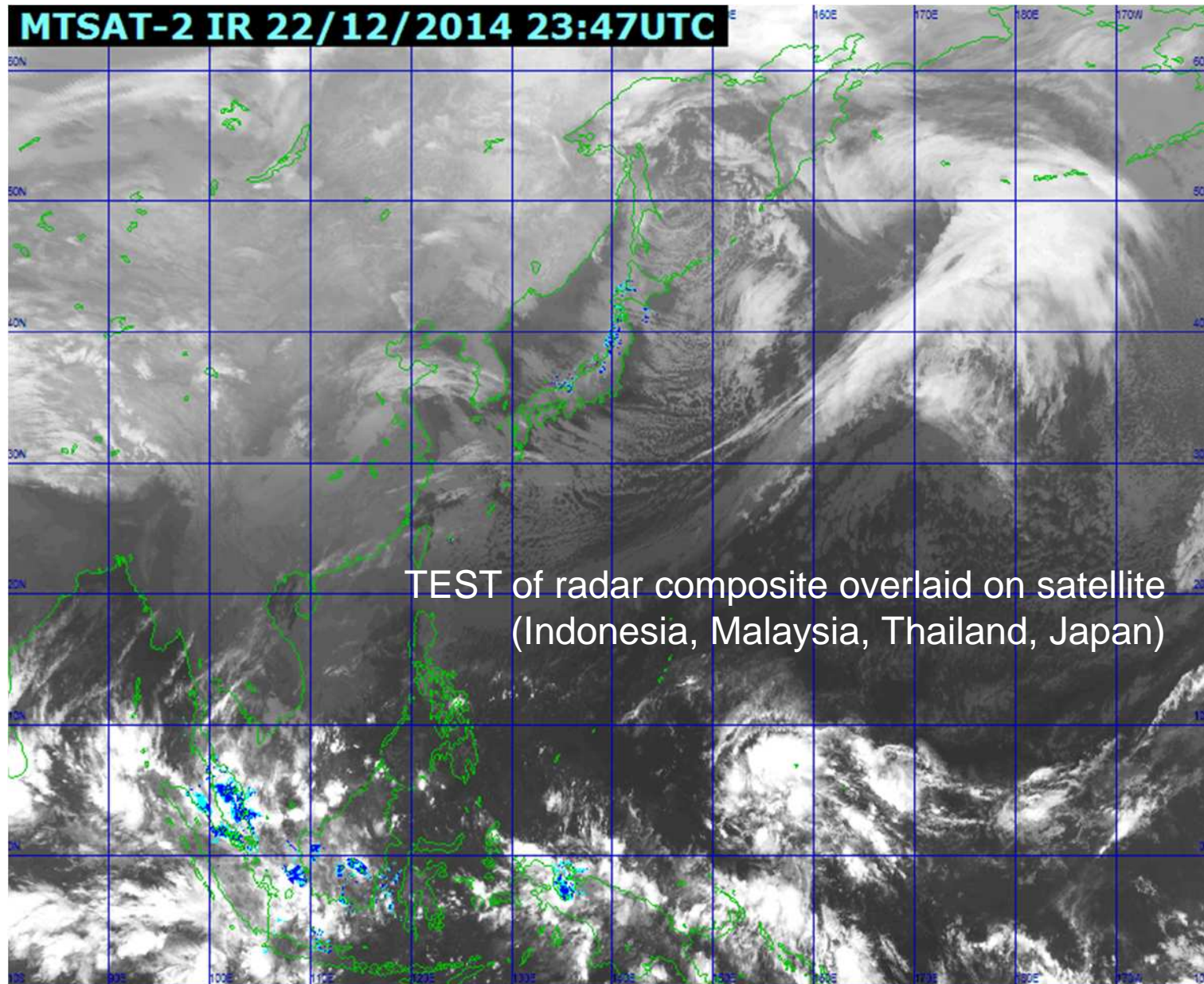
- The purpose of this project is simply to create a regional radar composite image through international data exchange of national composite radar data.
- The regional composite image will be used by forecasters in each country for their operational services, in particular, disaster risk reduction related activities.

Why GRIB2 data?

- GRIB2 data can be easily used by SATAID, satellite analysis software operationally used by many NMHSs in SE Asia.
- It is important to "start" data exchange and create regional composite.

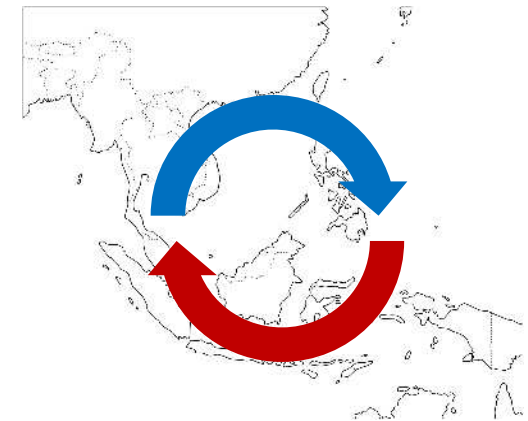


Radar Composite on Satellite



Future challenge

- International exchange of Type 2 data (such as in CfRadial2 format) has been discussed by WMO/Inter-Programme Expert Team on Operational Weather Radars (IPET-OWR).
- Radar data exchange in Type 2 data in this region will be a future challenge.



III. Three frameworks underpinning regional radar network in Southeast Asia

◆ WMO (WIGOS)



◆ ASEAN



◆ ESCAP/WMO Typhoon Committee

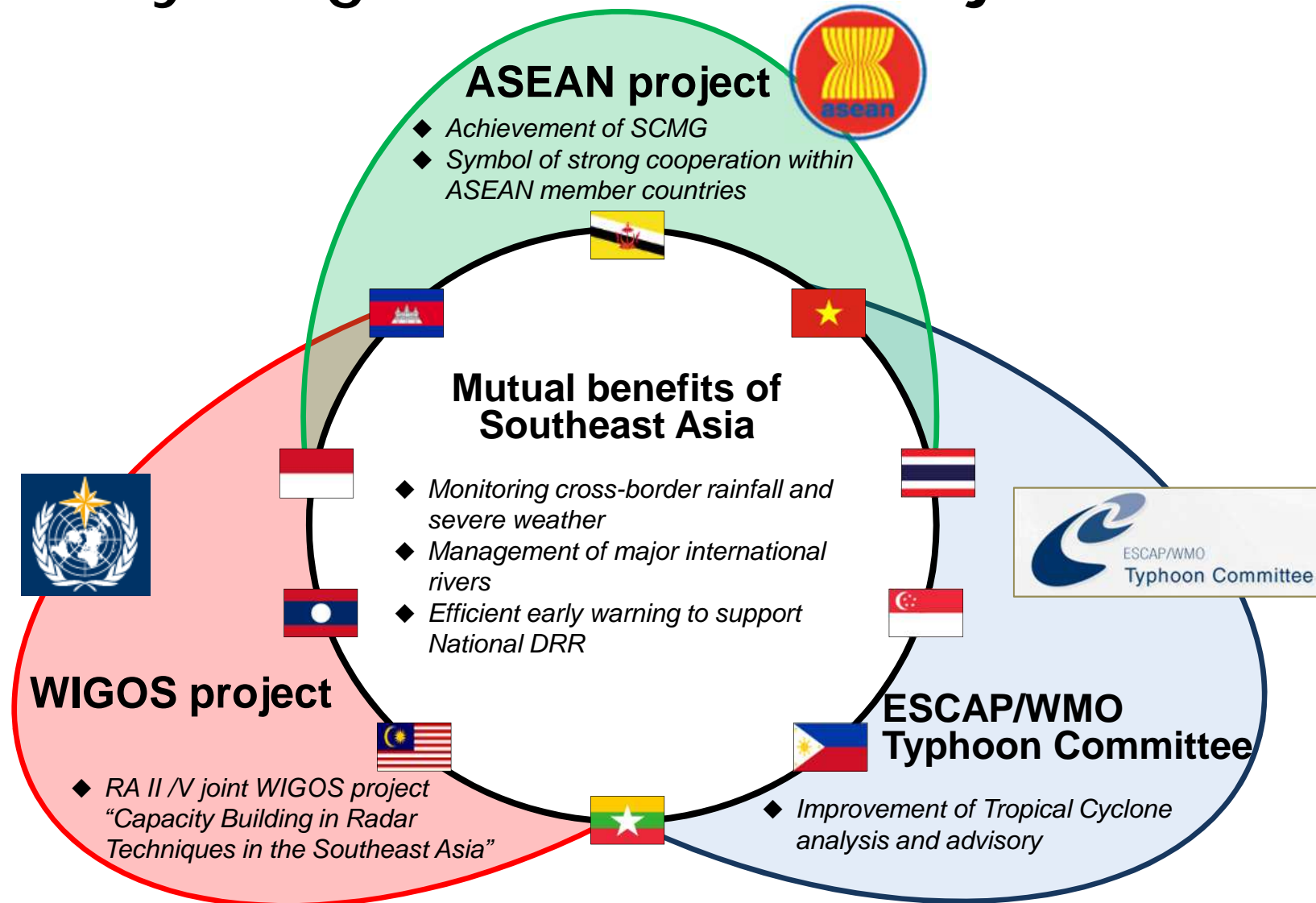




ASEAN and WMO Regions



Synergies of Radar Projects



RA II/V joint Regional WIGOS project on weather radars

- RAII-15 (Doha, Qatar, Dec 2012) approved the RA II/V joint regional WIGOS project, Capacity Building in Radar Techniques in the Southeast Asia.

RA II-15/Doc. 4.4(1), APPROVED, p. 28

ANNEX II RA II WIGOS IMPLEMENTATION PROJECTS

List of RA II WIGOS Projects

No.	Project title	Key regional players
I	Monitor and review the Implementation of EGOS- IP in RA II	China; Hong Kong, China
II	Standard and best practise Portal, including technical documents with necessary details in English from all RA II Members	Republic of Korea
III.1	Observing systems integration for supporting disaster risk reduction - Integration of Surface-based Remote Sensing Data in the East Asia	China, Japan, Republic of Korea
III.2	Observing systems integration for supporting disaster risk reduction - Capacity Building in Radar Techniques in the Southeast Asia	ASEAN (Thailand, Malaysia)
IV	Enhance the Availability and Quality Management Support for NMHSs in Surface, Climate and Upper-air Observations	Japan
V	Developing a Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) in Asia Node	China, Japan, Republic of Korea
VI	Develop Support for NMHSs in Satellite Data, Products and Training	Japan, Republic of Korea



Joint RA II/RA V Workshop on WIGOS

(Jakarta, Indonesia, 12-14 October 2015)



Jakarta Declaration

Participants in the Joint RA-II/RA-V Workshop on WIGOS for Disaster Risk Reduction (BMKG, Jakarta, 12-14 October 2015)

➤ Propose,

- *To initiate two regional projects to be developed under the WIGOS umbrella, involving the following Members: Australia, Bangladesh, Brunei, Cambodia, China, East Timor, Hong Kong China, Indonesia, Japan, Lao PDR, Malaysia, Myanmar, Papua New Guinea, Philippines, Republic of Korea, Singapore, Thailand, Vietnam:*
- **A “Joint RA-II/RA-V WIGOS Radar Data Project” aiming at**
 - (i) improvement of data quality of existing radars,**
 - (ii) development and expansion of national radar networks,**
 - (iii) near real time international exchange of radar data, and**
 - (iv) development of «sub-regional» radar data centre(s);**

Jakarta Declaration

Participants in the Joint RA-II/RA-V Workshop on WIGOS for Disaster Risk Reduction (BMKG, Jakarta, 12-14 October 2015)

- Further propose,
 - *To develop project b) based on the existing RA-II and RA-V WIGOS Projects via a proposed joint Coordination Group;*
- Request,
 - *The Management Groups of WMO Regions II and V to review and approve these two projects, and to support their further development once approved;*
- Encourage,
 - *All Members participating in project b) **to freely share their radar data products with other project Members**, according to the project plan.*

RAII/V Regional WIGOS Project

- RAII-16 (Abu Dhabi, UAE, Feb 2017) approved the regional WIGOS project, Capacity Building in Radar Techniques in the Southeast Asia.
- RAII MG-12 (Geneva, May 2017) approved EG-WIGOS members including leader of the radar project.

ANNEX II

RA II WIGOS IMPLEMENTATION PROJECTS

No.	Project title	Project Coordinator(s)
I	Monitor and Review the Implementation of EGOS-IP in RA II	China; Hong Kong, China
II	The web-interface for sharing status of standardization and experience and monitoring synoptic observations in RA II	Republic of Korea
III	Capacity Building in Radar Techniques in the Southeast Asia	Japan, Thailand, Malaysia, and Indonesia (RA V)
IV	Enhance the Availability and Quality Management Support for NMHSs in Surface, Climate and Hydrological Observations	Japan, China



Coordination Group

Country	Name
JAPAN (COORDINATOR)	Mr. Koichiro Kakihara
THAILAND (CO-COORDINATOR)	Mr. Boonlert Archevarahuprok
MALAYSIA (CO-COORDINATOR)	Mr. A. Kamiluddin Ibrahim
INDONESIA (CO-COORDINATOR)	Mr. Riris Adriyanto
BANGLADESH	Mr. Mohammad Sazzad Hossain
CAMBODIA	Ms. Phalla Peou
LAO PDR	Mr. Vanhdy Douangmala
MYANMAR	Mr. HlaTun
PHILIPPINES	Mr. Maximo F. Peralta
SINGAPORE	Mr. Mah King Kheong
VIET NAM	Mr. Nguyen Vinh Thu

Aims of the Regional WIGOS project

This project aims to develop effective early warning systems building on radar data in Southeast Asia, through following activities:

1. Improvement of data quality of existing radars;
2. Development and expansion of national radar networks; and
3. Near real-time international exchange of radar data, as a results of the above activities.
4. Development of «sub-regional» radar data centre(s).

Benefits of the regional WIGOS project

- Sharing knowledge of radar observation and cooperative development of radar network in Southeast Asia lead to capacity building in radar observation and rainfall disaster risk reduction in this region.
- By working with hydrological institutions in each country, the capacity leads to;
 - Enhancement of management of major international rivers; and,
 - Efficient early warning to support National DRR.

ASEAN Radar Workshop (2014)



- Proposed jointly by Malaysia and Thailand
- Hosted by TMD
- All ASEAN Members were invited
- led by Japanese experts from JMA, radar manufacture and University

(Bangkok, Feb - Mar 2014)

- The good first step toward ASEAN radar composite !





ASEAN Radar Workshop (2014)



Active discussion by **BMKG, MMD, TMD, JMA** made the workshop very successful !!





ASEAN SCMG Project

	ASEAN Cooperation Project Proposal BRIEF FORMAT – FOR PROJECTS UNDER USD 100,000
Project Classification Code:	
Project Title: Training Workshop on Weather Radar Data Quality and Standardization	
Project Description: <p>Advances in severe weather nowcasting, data assimilation, weather and climate model validation, satellite rainfall verification, and hydrological applications have led to new and enhanced requirements for high quality country and regional weather radar datasets and weather radar precipitation products. Recent advances in weather radar technology, signal and data processing have brought the field to the brink of operational readiness for the quantitative use of these products. In the past, radars were perceived to address only local and qualitative applications, such as for severe weather diagnosis and warning. This view is rapidly changing as scientific needs for assimilation of weather radar data in Numerical Weather Prediction models and diagnostic and trend analysis for climate applications require harmonized weather radar data and quality information. This has been made possible by high speed telecommunication networks that allow vast amounts of data to be transferred and by storage technology that permit data archiving in a central location.</p> <p>While the progress in the radar QPE has been impressive, it is also recent and there are many differing approaches and solutions. It is therefore necessary to harmonize, consolidate, validate, verify, identify the best algorithms and under what conditions to specify the quality of the products. Non-precipitating weather radar echoes (due to insects and Bragg scattering) can reveal valuable Doppler wind fields for NWP and for the identification of low level convergence boundaries for nowcasting convective initiation.</p> <p>In the latter situation, reflectivity fields are also useful. Dual-polarization radar is an emerging operational technology that provides considerable data quality information. It is able to identify ground clutter, distinguish biological targets, rain-snow boundaries and the presence of hail. Therefore, a data quality framework that can distinguish or classifies the radar targets is needed.</p> <p>The operational use of weather radar data essentially relies on an efficient data QC. Weather Radar Operations & Maintenance and QC processing is a common problem for all NMHS' and a collaborative and sharing approach of the techniques and results will have mutual benefits. Processing differences include techniques or algorithms to mitigate filtering or ground clutter at the signal and data processing stages, to determine the appropriate vertical profile of reflectivity, to identify attenuation and partial blockage effects</p>	

ASEAN Sub-Committee on Meteorology and Geophysics (SCMG) at its 39th session (Manila, the Philippines, May 2017) endorsed the project of this training workshop.

ESCAP/WMO Typhoon Committee Activity

- “Development of regional radar network” has been endorsed by ESCAP/WMO Typhoon Committee as one of the Annual Operating Plans (AOPs) since 2011.
- In line with the AOP, JMA has provided technical cooperation for TMD, and technical meetings between TMD and JMA has been held annually.

ESCAP/WMO Typhoon Committee Activities

- **2011 JMA→TMD**

Expert mission (Bangkok, 7-9 Sep)

- **2012 JMA←TMD**

Attachment Training for TMD experts on radar composite techniques (Tokyo, 19-22 Nov)

- **2013 JMA←TMD**

Technical Meeting on radar composite map for TMD and JMA experts (Tokyo, 25-28 Nov)

- **2014 JMA←TMD**

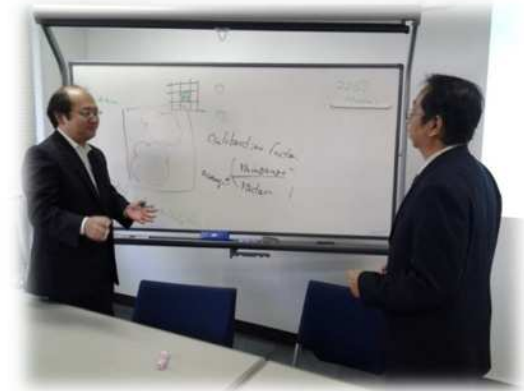
Technical Meeting on radar composite map for TMD and JMA experts (Tokyo, 25-28 Nov)

- **2015 JMA→TMD**

Technical Meeting on radar composite map for TMD and JMA experts (Bangkok, 30 Nov - 4 Dec)

- **2016 JMA←TMD**

Technical Meeting on Radar QC and QPE for TMD, MMD and JMA experts (Tokyo, 12 Dec - 15 Dec)



ESCAP/WMO Typhoon Committee Activity

- Experimental exchange of radar composite data among TMD, MMD and JMA started on 10 November 2016.
- Radar composite imagery using radar composite data through experimental data exchange among TMD, MMD and JMA has been shared with Typhoon Committee Members from 25 October 2017.

ESCAP/WMO Typhoon Committee Activity

- Technical meeting on radar QC and QPE between TMD, MMD and JMA was held from 12 to 15 December 2017 at JMA headquarters (Tokyo, Japan).
- In addition to the discussion on radar QC and QPE techniques, the meeting exchanged views on future plans of the project activities, including expansion of the regional radar network.



Technical Meeting on Radar QC and QPE (Tokyo, Japan, 12 – 15 December 2017)



IV. Purpose of the training workshop

	ASEAN Cooperation Project Proposal BRIEF FORMAT – FOR PROJECTS UNDER USD 100,000
Project Classification Code:	
Project Title: Training Workshop on Weather Radar Data Quality and Standardization	
Project Description: <p>Advances in severe weather nowcasting, data assimilation, weather and climate model validation, satellite rainfall verification, and hydrological applications have led to new and enhanced requirements for high quality country and regional weather radar datasets and weather radar precipitation products. Recent advances in weather radar technology, signal and data processing have brought the field to the brink of operational readiness for the quantitative use of these products. In the past, radars were perceived to address only local and qualitative applications, such as for severe weather diagnosis and warning. This view is rapidly changing as scientific needs for assimilation of weather radar data in Numerical Weather Prediction models and diagnostic and trend analysis for climate applications require harmonized weather radar data and quality information. This has been made possible by high speed telecommunication networks that allow vast amounts of data to be transferred and by storage technology that permit data archiving in a central location.</p> <p>While the progress in the radar QPE has been impressive, it is also recent and there are many differing approaches and solutions. It is therefore necessary to harmonize, consolidate, validate, verify, identify the best algorithms and under what conditions to specify the quality of the products. Non-precipitating weather radar echoes (due to insects and Bragg scattering) can reveal valuable Doppler wind fields for NWP and for the identification of low level convergence boundaries for nowcasting convective initiation.</p> <p>In the latter situation, reflectivity fields are also useful. Dual-polarization radar is an emerging operational technology that provides considerable data quality information. It is able to identify ground clutter, distinguish biological targets, rain-snow boundaries and the presence of hail. Therefore, a data quality framework that can distinguish or classifies the radar targets is needed.</p> <p>The operational use of weather radar data essentially relies on an efficient data QC. Weather Radar Operations & Maintenance and QC processing is a common problem for all NMHS' and a collaborative and sharing approach of the techniques and results will have mutual benefits. Processing differences include techniques or algorithms to mitigate filtering or ground clutter at the signal and data processing stages, to determine the appropriate vertical profile of reflectivity, to identify attenuation and partial blockage effects</p>	

Background

ASEAN SCMG

- *To developed ASEAN framework on weather radar QC and data exchange*
- *To developed ASEAN weather radar exchange format*
- *Characterize and assess errors involved in radar quality control algorithms and to Provide guidance on standardization on weather radar operations & maintenance and QC algorithms to ASEAN members*
- *To develop plans for a proof-of-concept on the viability of data exchange*

WMO WIGOS

This project aims to develop effective early warning systems building on radar data in Southeast Asia.

- *Improvement of data quality of existing radars*
- *Development and expansion of national radar networks*
- *Near real-time international exchange of radar data*
- *Development of «sub-regional» radar data centre(s)*

Typhoon Committee

- *To request JMA to update QC techniques applied to TMD and MMD radar network, to introduce the calibration process for QPE into operation of TMD radar and,*
- *To request JMA, TMD and MMD to continue experimental test of radar data sharing among the three participating Members, and to share the experiences of the test with the RA II WIGOS radar project in southeast Asia*

Background

ASEAN members (10)

Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam

WMO WIGOS project (12)

ASEAN + (Bangladesh, Japan)

Typhoon Committee members (14)

ASEAN - (Brunei, Indonesia, Myanmar)

+ (China, North Korea, South Korea, Hong Kong, Japan, Macao, US)

Purpose of the Workshop

- Aims of each country in the region are;

(in the short term)

- 1) Capacity building in radar observation techniques;
- 2) Composite of national radar data;

(in the mid-long term)

- 3) Development of radar network in Southeast Asia;
- 4) Disaster Risk Reduction caused by heavy rain.

Purpose of the Workshop

- Through multilateral framework (e.g. Typhoon Committee) and bilateral cooperation, TMD, MMD and JMA have promoted technical cooperation, which has made a good progress to exchange radar composite data among three countries as a result.
- Now, it is the stage that knowledge gained through the above activities will be shared with countries in this region and be expanded. This workshop is the first step!

Purpose of the Workshop

- From the aspect of capacity building in techniques, in this workshop, as a sequel from previous training workshop, lectures and hands-on training will be provided focused on following objects:
 - 1) Quality Management in radar observation;
 - 2) Orientation of Quantitative Precipitation Estimation (QPE) using radar data;
 - 3) Composite of multiple radar data in each country.

Purpose of the Workshop

- From the aspect of development of regional radar network in Southeast Asia,
 - 1) Precedent examples by Thailand, Malaysia and Japan will be shared with the participants;
 - Outcomes and future challenges (e.g. technical issue, data policy)
 - 2) Problems and future challenges in radar observation and usage in each country will be shared among participants , as the first step toward development of regional radar network in Southeast Asia.

V. Conclusion

- Improvement of quality management of weather radars and development of national radar network makes radar observation data effectively be utilized in DRR in each country.
- Development of radar network among multiple countries and international exchange of radar data help each NMHS predict impacts of the disaster (caused by flood of international rivers and tropical cyclones) in advance.
- Assimilation of radar data to NWP will contribute to improve precipitation forecast.

Conclusion

- Activities on capacity building in radar techniques and development of regional radar network has been conducted under the frameworks of WMO/WIGOS, ASEAN and ESCAP/WMO Typhoon Committee.
- This workshop is a good chance to facilitate capacity building in radar techniques and development of regional radar network in each country in this region.



Thank you.

