WORLD METEOROLOGICAL ORGANIZATION

JOINT RA II/RA V WORKSHOP ON WIGOS FOR DISASTER RISK REDUCTION

Jakarta, Indonesia, 12-14 October 2015

FINAL REPORT

DISCLAIMER

Regulation 42

Recommendations of working groups shall have no status within the Organization until they have been approved by the responsible constituent body. In the case of joint working groups the recommendations must be concurred with by the presidents of the constituent bodies concerned before being submitted to the designated constituent body.

Regulation 43

In the case of a recommendation made by a working group between sessions of the responsible constituent body, either in a session of a working group or by correspondence, the president of the body may, as an exceptional measure, approve the recommendation on behalf of the constituent body when the matter is, in his opinion, urgent, and does not appear to imply new obligations for Members. He may then submit this recommendation for adoption by the Executive Council or to the President of the Organization for action in accordance with Regulation 9(5).

© World Meteorological Organization, 2016

The right of publication in print, electronic and any other form and in any language is reserved by WMO. Short extracts from WMO publications may be reproduced without authorization provided that the complete source is clearly indicated. Editorial correspondence and requests to publish, reproduce or translate this publication (articles) in part or in whole should be addressed to:

Chairperson, Publications Board
World Meteorological Organization (WMO)
7 bis, avenue de la Paix
P.O. Box No. 2300
CH-1211 Geneva 2, Switzerland

Tel.: +41 (0)22 730 84 03
Fax: +41 (0)22 730 80 40
E-mail: Publications@wmo.int

NOTE:

The designations employed in WMO publications and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of WMO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Opinions expressed in WMO publications are those of the authors and do not necessarily reflect those of WMO. The mention of specific companies or products does not imply that they are endorsed or recommended by WMO in preference to others of a similar nature which are not mentioned or advertised.

This document (or report) is not an official publication of WMO and has not been subjected to its standard editorial procedures. The views expressed herein do not necessarily have the endorsement of the Organization.

CONTENTS

AGENDA

1. OPENING SESSION
2. SESSION A - COUNTRY REPORTS
3. SESSION B - INVITED SPEAKERS
4. SESSION C - REVIEW, DISCUSSION AND REFINEMENT OF COMMON PROJECTS
5. SESSION D - CONCLUSIONS AND RECOMMENDATIONS
6. OTHER RECOMMENDATIONS AND CLOSURE

EXECUTIVE SUMMARY

The Joint RA II/RA V Workshop on WIGOS for Disaster Risk Reduction (DRR) was held in Jakarta, Indonesia, at the kind invitation of the government of Indonesia, from 12 to 14 October 2015, at the Headquarters of the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG).

The Workshop was aimed at enhancing the exchange of observations across the Southeast Asia region and to improve the availability and quality of those observations in particular that have significant applications in DRR related activities, e.g. in early warning systems for severe weather events. The Workshop was building on two draft plans for WIGOS projects, one related to radar data and another one related to satellite data, which had been developed during a preparatory meeting held from 21-23 April 2015 at Jakarta, Indonesia.

The Workshop took note of the current and planned observing networks and related activities from the national reports delivered by representatives from 14 participating WMO Member countries, 8 from RA II and 6 from RA V. The Workshop discussed the following specific topics delivered by 8 invited speakers: weather forecasting and warnings, radar observations, lightning detection systems, satellite observations and GSM (Global System for Mobile communications) attenuation by rain, plus a special talk on the WMO Observing System Capabilities Analysis and Review tool (OSCAR). Finally, the Workshop reviewed and further developed the draft common projects for weather radars data and for satellites data.

The major outcome of the Workshop is contained in the "Jakarta declaration", which proposes to develop two projects across regions II and V under the WIGOS umbrella, and to establish a joint coordination group for each project. The Management Groups of WMO RA II and RA V are requested to review, approve and support these projects. The declaration also recommends that the WMO Secretary General be requested to support the projects with technical assistance within available resources, and that satellite operators provide the necessary support via CGMS (Coordination Group for Meteorological Satellites).

GENERAL SUMMARY

1. OPENING SESSION

The opening session of the Joint RA II/RA V Workshop on WIGOS for Disaster Risk Reduction (DRR) was held at the Headquarters of BMKG in Jakarta, Indonesia, on Monday 12 October 2015.

1.1. Opening remarks

Dr Andi Eka Sakya, the Director-General of the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG), Permanent Representative of Indonesia with the WMO and President of WMO Regional Association V, opened the session at 09:30 local time, Monday 12 October 2015. Dr Sakya welcomed the honorable guests from the government of Indonesia, Prof. Iskandar Zulkarnain, Head of National Science Institute, Mr Afif, Deputy Chairman of the National Aerospace Institute, Dr Ismail, from the Ministry of Communication and Information, Mr Samsul Bahri, from the Agency for the Assessment and Application of Technology. He also welcomed the WMO representatives, as well as the national delegates from the WMO RA II and RA V Member countries. He noted that WIGOS is a global facilitating framework and mentioned that this Workshop would seek to stimulate better availability of observations for DRR and that the Workshop would look for preliminary plans of common projects to sustain DRR needs, for a better use of both radars and satellites data. Dr Sakya noted that the implementation of WIGOS at national level would require involvement of all relevant stakeholders, as well as of the relevant WMO regional networks. He mentioned that the Second Session of the ICG-WIGOS Task Team on the Plan for the WIGOS Pre-operational Phase (TT-PWPP-2) had identified what Members will need to achieve in their national implementations as a minimum in order to become WIGOS ready by the end of the financial period 2016-19. Dr Sakya emphasized that this is a crucial moment to discus and improve collaboration amongst countries from both Regional Associations II and V and shared his enthusiasm and optimism regarding the implementation of WIGOS in Indonesia. Dr Sakya expressed his sincere appreciations to WMO and to all participants who had been working to make this Workshop successful, and also expressed his wishes for a productive discussion. Finally, he formally declared the Workshop open, and wished all participants a pleasant stay in Jakarta.

1.2. Introductory remarks

On behalf of the WMO Secretary General, Dr Michel Jarraud and on behalf of the Director of the WMO Observing and Information Systems Department, Dr Wenjian Zhang, Dr Lars Peter Riishojgaard, WIGOS Project Manager, WMO Secretariat, thanked Dr Sakya and Indonesia for hosting the meeting at BMKG in Jakarta. He welcomed the participants to the Workshop and thanked the BMKG for the exceptional arrangements. Dr Riishojgaard mentioned that WIGOS would remain a WMO strategic priority area, and that over the course of the next financial period, WIGOS would gradually transition from being a project to becoming a more permanent WMO infrastructure element. He also mentioned the leading role needed to be played by NMHSs (National Meteorological and Hydrological Services) in the national implementation of WIGOS. He noted with satisfaction a broad cross-regional representation of WMO Members from RA II and RA V participating at the Workshop and underlined the importance of supporting DRR services with good observing systems. Finally, Dr Riishojgaard mentioned the need to review the Regional WIGOS Implementation Plans (R-WIPs) as a follow-up of the conclusions from this Workshop.

1.3. Organizational matters

Mr Luis Nunes, WIGOS Scientific Officer, WMO Secretariat, delivered a short presentation recalling the objectives of the Workshop and listed the expected outcomes as stated in the concept note for the meeting: Improvement of data sharing and data integration across the southeast Asia region; improved performance of the observing systems (availability, geographic coverage, timeliness and quality); issues/challenges and solutions identified for the effective interoperability of Member's observing systems to enable real-time exchange of meteorological data and products; integration of non-NMHSs data sources for weather related emergency activities in the region; In his presentation, Mr Nunes guided the participants through the Programme of the Workshop, day by day and session by session.

Mrs Neng Alia from BMKG informed the participants about the working hours of the Workshop and provided some information regarding the local arrangements.

1.4. The Pre-operational Phase of WIGOS

Dr Susan Barrell, Chair of ICG-WIGOS and vice-president of CBS, delivered a presentation on the Pre-operational Phase of WIGOS. Dr Barrell recalled the concept of WIGOS as a global framework encompassing the observing components of all WMO programmes and co-sponsored programmes and mentioned the essential role of regional associations and NMHSs to bring WIGOS to become fully operational by 2020. She recalled the overall vision for WIGOS and the 10 key activity areas laid out in the WIGOS Framework Implementation Plan (WIP), as well as the role of the WIGOS framework in the coordination of national activities, particularly in providing standards and recommended procedures for the operations and maintenance of the observing systems and for the integration of observations from other (non-NMHS) agencies

Dr Barrell described the next phase of the WIGOS development, namely the Pre-operational Phase, which includes the following five priority areas: National WIGOS implementation, Regional WIGOS Centres, the WIGOS Information Resource, the WIGOS Data Quality Monitoring System, and WIGOS Regulatory and Guidance Material. The goal is for all Members to be "WIGOS Ready" by the Eighteenth World Meteorological Congress (Cg-18) in 2019, which means, as a minimum, for each Member: to have implemented the WIGOS Metadata Standard, the WIGOS Station Identifiers, the OSCAR (Observing System Capabilities Analysis and Review) tool and the WIGOS Data Quality Monitoring System. By that time Members should be supported in their activities by Regional WIGOS Centres and should also have started integrating partner systems.

1.5. Overview of outcomes from the Preparatory meeting for the Workshop (Jakarta, 21-23 April)

Mr Mulyono Prabowo, Director of the Centre for Public Weather services of BMKG, delivered a presentation on the outcomes of the Preparatory meeting for the Workshop, held in Jakarta, Indonesia, from 21-23 April 2015. He mentioned that he main goals of that meeting had been reviewing the existing WIGOS projects in RA II and RA V and drafting preliminary plans for joint projects that could enhance the quality and availability of observations to support warnings and forecasts in the South East Asia region. He mentioned that the existing WIGOS related projects in RA II and RA V had been reviewed by the participants representing the following WMO Member countries: China, Australia, Republic of Korea, Japan and Indonesia.

Mr Prabowo briefly described the output from the two breakout groups of the preparatory meeting, each of which had drafted a project plan. One plan addressed the issue of radar data with the following overall goals: Improving data quality from the existing radar networks, expanding and integrating national radar networks and exchanging internationally the radar data. The other draft project plan, for satellite data, had the overall goals of all Members in the target region to be able to receive and use geostationary satellite data at their full spatial, spectral and temporal resolution subsets for their national region of interest, including generation of key products, and to develop a mechanism for countries in the target region to request and receive event-driven rapid-scan geostationary satellite data.

Finally, Mr Prabowo mentioned that the preparatory meeting had prepared the draft programme of the present Workshop, and had agreed on the overall concept and organizational details, such as dates, venue and participants.

2. SESSION A - COUNTRY REPORTS

The representatives from each of the following 14 Member countries delivered a presentation reporting on the status and plans of their national observing networks and activities. The bulleted lists below contain the major remarks and/or a summary of the observing system in each of the following Member countries:

Bangladesh - represented by Mr Shaikh Shahjahan Alam:

- Recommendation for Future Development:
  - Establishment of Automatic Weather Station (AWS) over Bangladesh;

- Establishment of buoy-based AWS to collect sea and river data in Bangladesh;
- Human Resources Development to meet the future requirements of
    - Establishment of the WMO Information System (WIS);
    - Other Advanced Processes and Technology of early warning;
    - Establishment of Numerical Weather prediction (NWP);
    - Establishment of Weather Studio;
    - Establishment of Direct to Home (DTH) System;
- Upgrade of 35 conventional observatories to automatic systems with telemetry;

o Summary: 10 pilot-balloon stations, 3 RS Stations, 5 radar Stations.

Hong Kong, China - represented by Mr Hok Yin Lam:

- Summary:
    - 1 Upper air station, 3 Wind profilers, 4 Buoys, 1 lightning detection network, 5 radar stations, 2 Satellite receiving stations;
    - In agreement with other stakeholders: 4 AWSs and numerous rain gauges (owned by other government departments);
- Plans for the observing networks - Keep up the existing observing network:
    - Implement new instruments if opportunities arise;
    - Partnership with nearby meteorological authorities for better coverage and data sharing;
    - Remove/replace instruments containing mercury;
    - Observe the WIGOS metadata standard;
- Increased collaboration with more stakeholders on meteorological data sharing.

Japan - represented by Mr Yoshiro Tanaka:

- 16 Radiosonde Stations, 33 Wind Profilers, 29 C-band Doppler radars (including 9 airport radars) plus 26 radars of MLIT (Ministry of Land, Infrastructure, Transport and Tourism);
- PWV derived from GEONET (GPS network) assimilated in JMA Meso-scale NWP Model since 2009;
- Plans for future observation - satellites:
    - Development of weather monitoring techniques by fully utilizing highly advanced function of new generation satellites;
    - Automatic detection of rapidly developing Cb clouds using high frequency/high resolution/multi band satellite observations;
    - Improved depiction of detailed wind field e.g. for typhoon forecasting through tracking of cloud/water vapor;
- Plans for future observation - radars:
    - From 2015: solid state (dual pol) radars installed at airports;
    - In 5 years: next generation weather radar to be installed;
    - Afterward: feasibility study for operational Phased Array;
- Summary:
    - Good meteorological observations are critical to good meteorological services;
    - Meteorological observing systems have been developed in the past and will be developed in the future (never ending);
    - Achieving good quality observations is necessary to meet user requirements which tend to increase over time;
    - Since NMHSs in general do not have sufficient resources (human and financial), collaborations with non-NMHS entities will be important.

Lao PDR - represented by Mr Vanhdy Douangmala:

- Plans for future observation:
    - Improvement of Hydro-Meteorological network, upgrade to: 51 AWS and 26 Hydromet stations;
- Summary: No upper-air stations, 1 radar station and 3 Satellites receiving station;

- MoU with other stakeholders: Department of Civil Aviation and Air Traffic Management.

Myanmar - represented by Ms Moe Thu Khaing:

- Summary:
  - 1 Radiosonde station, 1 Satellite receiving station (Donated by JICA), 3 radar Stations (one station nearly completed in Kyauphyu, 2 more to come);
- Conclusion:
  - Effort to improve the cyclonic storm detection and warning system;
  - Upgrading of telecommunication system, since telecommunication capabilities are essential and act as a backbone for all meteorological and hydrological activities.

Republic of Korea - represented by Dr Dohyeong Kim

- Plans for the observing network:
  - Geo-KOMPSAT-2(COMS Follow-on) program(2018):
    - GK-2A : Next Generation Meteorological Imager and SWx monitoring;
    - GK-2B : Ocean Color and Atmospheric trace gas monitoring;
  - 10 S-band dual-polarization Doppler radars by 2019;
- Summary:
  - Upper Air Observation: 5 radiosonde stations, 13 wind profilers, 10 radiometers;
  - Radar Stations: 10 Operational, 1 Testbed, 1 Aviation, 1 Research;
  - Marine Platforms: 65 buoys, 18 long wave monitoring, 6 wave radars, 19 AWS;
- MoUs in Operation with 4 organizations for radars and with 28 agencies for AWS.

Thailand - represented by Dr Wattana Kanbua

- Plans for the observing network:
  - to install AWS in some areas in order to surveillance extreme event and is also used to analyze and warning;
  - established 2 meteorological stations in central part and 3 officials sedentary work in order to interact with the administration of the provinces;
- Summary:
  - 11 Upper air stations (5 R/S, 6 pilot-balloon), 3 Marine and 22 radar stations;
  - Good weather forecasts come from good observations;
  - Good observations depend on good and frequent maintenance;
  - Training in weather observations is essential.

Vietnam - represented by Mr Nguyen Vinh Thu

- Future plans - satellites:
  - Setting up new HRPT system: NOAA, FengYun1-3, Metop, Aqua/Terra MODIS, etc;
  - Operation of HimawariCast system;
  - Decoding Himawari Standard Data;
  - Receiving COMS data;
  - Creating secondary products;
- Future plans - radars and others:
  - 2 radars supported by Japan (2016), 2 in 2017, 3 in 2017-2018;
  - Lightning detection - 18 sensors covering Vietnam and the vicinity (2017) ;
  - Observations: 200 Synoptic (2018), 370 AWS (2018), 3000 Raingauge (2017);
- Summary:
  - 6 Upper air stations, 18 Marine stations, 8 radar stations, 3 Satellite systems;
  - MoU and projects with Japan, Finland, Italy, Rep. Korea, Norway to upgrade to: 200 synoptic, 370 AWS, 12 PILOT, 8 upper air, 3000 rain-gauge, 30 marine, 13 weather radar, 1 satellite receiving, 200 CLIM, 18 lightning sensors.

Australia - represented by Dr Susan Barrell

- Summary:
  - Key infrastructure and network improvements sought:
    - Satellite receivers - Upgrading reception systems for polar orbiting satellites at Melbourne, Darwin, Davis and Casey;
    - 40 radiosonde stations;
    - 61 weather radars - radar infrastructure aged and mixed technology, in need of investment and modernization; plans to progressively upgrade;
    - Upper air network inefficient - good station distribution, but reduced sonde schedule;
    - Lightning services tender underway;
  - Partnering to extend reach and fill gaps:
    - AWS network expansion with third parties;
    - Tiered network approach;
    - Developing a sustained marine observing system;
  - Focus on delivering integrated observing services:
    - Ensure that users are able to use and extract value;
  - Observing System Strategy - National WIGOS Plan.

Brunei Darussalam - represented by Mr Hassanul Kamal Haji Adam

- Plans to expand surface observation at least 30 AWS throughout the nation;
- Summary:
  - Satellite receiving stations: Geostationary (MTSAT) and polar orbiting (METOP-A, Terra, Suomi, Aqua, NOAA); Data processing: METEOR;
  - 1 upper air station, 1 radar station.

Indonesia - represented by Mr Riris Adriyanto

- To address the critical gaps, BMKG 5-year plan:
  - To add new 25 weather radars (S, C or X band);
  - To install LLWAS (Low-Level Wind-Shear Alert System) at 5 major airports;
  - Deployment of new 87 AWOSs at small airports nationwide;
  - Deploy 40 HF coastal radars;
  - To add 3000 manual OBS rain gauges for voluntary rainfall observations;
  - 700 new Automatic Rain gauges to be deployed;
  - Explore possibility to use remote sensing data to cover weather observations in remote area: satellite and radars;
  - In response to WIGOS implementation, promote and collaborate with more stakeholders regarding meteorological data sharing; expand collaboration on observations outside of traditional partners, i.e.: oceanographic agencies, universities, private companies;
- Summary:
  - Current status of National observing system:
    - 21 upper air stations, 13 marine stations, 36 radar sites, 61 lightning detection sensors;
  - Cooperative observations with other stakeholders at present covering:
    - 58 agromet stations, 15 VOS, 2 marine AWS platform (offshore), 186 AWS stations, 104 ARG stations and > 4000 manual OBS rain gauges.

Malaysia - represented by Mr Hamray Muhammad Yazit

- Plans for the observing network;
  - Upgrade the antenna system – brushless motors & dual polarization radars;
  - Increase the numbers of radar stations;
  - To install 6 X-band radars – wind shear alert system at airports;
  - To install 5 new S-Band and 3 new X-band weather radars;

        - To develop QPE and QPF - Improve on the quality of data and products for operational purposes;
        - Automation of rainfall stations;
    - Summary:
        - 401 Agro meteorological/climate stations/Aeronautical;
        - 10 Upper air stations;
        - WRVR system at 17 airports;
        - 8 Lightning Detection Stations;
        - One PLWS at KLIA;
        - 12 radar stations (10 for weather, 2 for aviation);
        - Satellite Receiving System (6);
    - MoU on meteorological data sharing with other stakeholders.

Philippines - represented by Mr Vicente Palcon, Jr.

- Plans for the observing networks:
    - Additional installation of 4 doppler radars and 2 mobile weather radars;
    - Installation of more AWS, ARG and particularly WLS for 13 Major River Basins;
    - Installation of locally fabricated Met. Buoys and Installation of HF radar and Wave Glider;
    - Installation of HimawariCast and COMS;
    - Installation of Lightning Detectors;
    - Development and Implementation of Field Maintenance and Calibration Procedures for Basic and other Instruments;
    - VSAT Interconnectivity and Redundant Communication System (All Weather Communication System) ;
    - to launch micro-satellite by 2016 and 2017 in collaboration with University of the Philippines and with the Hokkaido University and Tohoku University of Japan (this program is also supported by the JAXA);
- Summary:
    - 8 upper air stations, 13 radar stations, 1 wind profiler;
    - Collaborate with more stakeholders on meteorological data sharing.

Singapore - represented by Mr Lesley Choo

- Plans for the observing networks:
    - 31 rainfall stations to be added by end 2015 (ongoing);
    - 18 rainfall stations to be taken over and added to the MSS network in 2016 (planned);
    - New C-band dual polarization radar to be installed in 2Q 2016 (on-going);
    - Wind and Aerosol LIDARs to be installed in 4Q 2015 (on-going);
    - Satellite Reception System to process data from the Himawari/NPP satellites (end 2015);
    - Airport Runway Automatic Weather Observing Systems and Low Level Wind Shear Alert Systems to be replaced and taken over by MSS in 2016-2018 (planned/on-going);
- Summary:
    - 1 upper air station, 1 radar station, Lightning Detection Network (4 sensors), 1 wind profiler, Satellite Reception Systems.

Special Session on OSCAR

At the end of day one, Mr Nunes delivered an introductory presentation on the OSCAR tool, with a focus on OSCAR/Surface. He mentioned the main features of OSCAR database and briefly described the three components of OSCAR: OSCAR/Requirements, OSCAR/Space and OSCAR/Surface. Next, he provided a more detailed introduction to the recently developed OSCAR/Surface, a system developed in collaboration between WMO and MeteoSwiss (most of the resources provided by the latter), as an online repository of metadata for all surface-based observational assets under WIGOS - WMO and co-sponsored observing systems - which will

replace, among other things, WMO Pub.9, Volume A.

Mr Nunes also mentioned the current status of development of OSCAR/Surface, including the migration of metadata from different sources, as well as the transition plan from Vol.A into OSCAR. He guided the participants through the main webpages of OSCAR/Surface and mentioned the development of a machine-to-machine interface, as well as the authentication levels and process. Finally, he recalled what Members are requested to do to comply with the Technical Regulations in relation to WIGOS metadata, and he also briefed the participants on planned future developments of OSCAR, such as the "gap analysis module", the development of which is still in a planning phase.

3. SESSION B - INVITED SPEAKERS

3.1. Mr Agie Wandala Putra, from the Public Weather Services Division of BMKG delivered a presentation about "Weather forecasts and warning activities in BMKG, Indonesia".

Mr Putra informed the participants that the most frequently occurring natural disasters in Indonesia are floods, followed by landslides and droughts. BMKG is developing a project for the improvement of forecasts through digital processing. Mr Putra described the early warning system of BMKG and its products for heavy rainfall/thunderstorm, strong wind, flood, forest fire, rough sea and air pollution. The BMKG forecasting centre runs daily briefings with its regional centres and for their operation they integrate the observations from various sources, weather radars, satellites (e.g. Himawari-8) and lightning systems.

3.2. Mr Takanori Sakanashi, a radar observing systems expert, from the Office of observation systems operation of the Japan Meteorological Agency (JMA), delivered a presentation on "Technical Development Activity on Weather Radar Observation".

Mr Sakanashi mentioned the capacity building activities for radar techniques in the Southeast Asia region, through the WIGOS RA II project III-2 (Observing systems integration for supporting disaster risk reduction - Capacity Building in Radar Techniques in the Southeast Asia) involving the Sub-Committee on Meteorology and Geophysics (SCMG) of the Association of Southeast Asian Nations (ASEAN), as well as through the project of the Meteorological Working Group of the WMO/ESCAP (Economic and Social Committee for Asia and Pacific) Typhoon Committee, for weather radar composite maps.

Mr Sakanashi noted that trainings were successfully held as a good first step for radar integration. He explained the results of cooperation with Thailand as improvement of data quality, e.g. noise reduction, calibration with rain-gauges and quality control (QC), allowing producing maps of radar composite and QPE (Quantitative Precipitation Estimation). The cooperation with Malaysia succeeded in converting radar data format from IRIS to GRIB2 and in creating the elevation angle composite table.

Mr Sakanashi described the JMA technology for producing composite maps, which would allow for trans-boundary radar composite maps. He explained that radar composite images overlaid on satellite imagery would be useful for weather monitoring by forecasters. Mr Sakanashi emphasized that JMA’s technology is based on GRIB2 format. If radar data is exchanged internationally, regional radar composite maps for the ASEAN region could be developed under WIGOS framework. He concluded stating that JMA is willing to expand its collaboration on the development of quality controlled radar products in Southeast Asia within the WIGOS framework.

3.3. Mr Hok Yin Lam, Lightning Detection Systems Expert, from the Hong Kong Observatory, Hong Kong, China, delivered a presentation on "Lightning Detection Systems".

Mr Lam briefly explained the basics of lightning and of lightning location and detection methods. Then he described the main features of Lightning Detection Systems (LDS) and networks, mentioning the detection efficiency and location accuracy.

Mr Lam underlined the Hong Kong experience of integrating LDS sensors from different Meteorological Bureaus to produce real-time maps of lightning activity in the region to support weather monitoring and the issuing of weather alerts. He mentioned the benefits of LDS data to protect lives and properties under thunderstorm conditions, e.g. in/nearby airports, through timely improved issues of forecasts and warnings. Finally, Mr Lam mentioned the prerequisites of running

a successful LDS, such as good siting, coverage planning, infrastructure, basic knowledge, personnel and expertise, routine monitoring of the system performance and site maintenance and evaluation. He also commented while Southeast Asia has good LDS coverage, data is not currently shared amongst countries.

3.4. Mr Alan Seed, Weather Radar Expert, from the Australian Bureau of Meteorology (BoM) delivered a presentation on "Regional radar rainfall estimation for Disaster Risk Reduction".

Mr Seed mentioned the current status and the upgrade process of the Australian Radar Network, with three to four radars being installed and/or replaced every year. He described the network architecture and the system generating and distributing weather radar based products, such as QC, QPE, for which coverage depends on the distance from radar, and QPF (Quantitative Precipitation Forecasting). Mr Seed described the steps of the QC applied to various products from volume scans, to surface radar reflectivity, as well as to instant rain rate, rainfall accumulations and forecasts plus the probability of rain >50mm, where the QC chain depends on the type of radar. For real-time rain gauge adjustment a *Kalman* filter technique is used. Mr Seed mentioned the products verification procedures, e.g. through monthly statistics of spatial errors of the gauge comparison.

Mr Seed noted the advantages and disadvantages of the various data formats for exchange of radar information and presented his views on a possible Regional Radar Data Centre: minimum standard for radar hardware and maintenance, data communication links, software installed at the NMHS to reformat and transmit the data, and data licensing arrangement and multi-national agreement to fund and operate a Data Processing Centre. Finally, he mentioned the OPERA programme (operational radar composite products) under Eumetnet (a grouping of 31 European National Meteorological Services) as an example and listed the advantages of establishing a Regional Radar Data Centre as being: large domain radar mosaic in support of longer range nowcasting, better rainfall estimates for trans-national river basins and regional scale floods, improved radar data quality control and products, improved support for national radar operations and cost savings for participating NMHS.

3.5. Dr Dohyeong Kim, Satellite Expert, from the Korea Meteorological Agency (KMA), Republic of Korea, delivered a presentation on "Satellite Observations and Applications of KMA".

Dr Kim presented the current status of the COMS satellite, including its program, its ground segment and its data service; He mentioned the COMS products and described the COMS data quality monitoring, the precipitation estimation and the severe/convective weather detection for nowcasting and short-range forecasting applications of COMS data, as well as for supporting NWP and other applications such as fog, dust and volcanic ash monitoring, but especially for tropical cyclone analysis.

Dr Kim also provided an overview of the plan for the Geo-KOMPSAT-2A and Geo-KOMPSAT-2B satellites, their timelines (launch of GK-2A in 2018) and for the future Korean LEO (Low Earth Orbit) satellites, the first of which is planned to be launched in 2022. He finally outlined the improved performance of future Geo-KOMPSAT satellites compared against the COMS satellite, as having four times more spatial and temporal resolution, also three times more channels and products.

3.6. Mr Yukihiro Kumagai, Satellite Expert, from Satellite Program Division of the Japan Meteorological Agency, Japan, delivered a presentation on "Satellite observations (Himawari-8)".

Mr Kumagai noted the recent start of operations of the new satellite Himawari-8 at 02:00 UTC on 7 July 2015 replacing MTSAT-2 satellite and mentioned that Himawari-8/9 will observe East Asia and the Western Pacific region for a period of 15 years (Himawari-9 will be launched in 2016 as a backup satellite). He outlined the improved performance of Himawari satellites against the MTSAT satellite, having six times more temporal resolution, also three times as many bands, as well as a new rapid-scan function for targeted areas (e.g. typhoons, volcanoes) of 1000 km x 1000 km every 2.5 minutes.

Mr Kumagai explained the procedures for real-time data access, via Himawari-Cast and Himawari-Cloud and their specifications and encouraged MTSAT users to transition from MTSAT direct dissemination to those new services before MTSAT direct dissemination terminates on 4 December 2015.

Mr Kumagai also announced the Sixth AOMSUC (Asia-Oceania Meteorological Satellites Users Conference) in Tokyo, November 2015. In the plenary session JMA plans to discuss the needs and requirements of Himawari-8 data including 2.5-minute rapid scan data, and JMA will conduct training events on the new generation of geostationary meteorological satellites during the conference.

3.7. Dr Xiaojing Wu, Satellite Expert, from the National Satellite Meteorological Centre of the China Meteorological Administration (CMA), China, delivered a presentation on the "Chinese Meteorological Satellites and Products".

Dr Wu mentioned the current status and future programs of the FengYun Meteorological Satellites, both polar and geostationary systems, including their lifetime and locations/orbits. He underlined the fact that FY-2F is a standby satellite (at 114 deg E) for regional rapid-scan tasks. He described the main instruments and channels of each satellite program and presented the future plans for CMA satellites. In particular, Dr Wu explained the transition to the new generation of Chinese geostationary satellites, FY-4, the new instruments onboard and the improved performance against FY-2 satellites, e.g. the number of channels (three times more), the observation efficiency and the spatial and temporal resolution (both doubled).

Dr Wu described the features of the Chinese LEO satellites FY-3, such as the payload of the new satellites to be launched in comparison with the current ones. He presented the plans for a rainfall mission satellite to be launched in 2020 as well as the CMA initiatives for user preparedness for the new generation satellites.

Dr Wu also described the available operational products from the FY-2 satellites, and mentioned some of the main applications such as weather monitoring and NWP. Finally, he mentioned the satellite data dissemination systems, as well as the CMA's international cooperation activities regarding satellite observations.

3.8. Dr Lars Peter Riishojgaard, from WMO Secretariat, delivered a presentation on "Measuring rainfall using cell phone links", on behalf of Dr Aart Overeem, invited expert in GSM (Global System for Mobile communications) attenuation by rain, from the Royal Meteorological Institute of Netherlands, who was unable to attend the Workshop.

Dr Riishojgaard explained the basic principle of estimating rainfall from the attenuation of electromagnetic signals transmitted from the antenna of one telephone tower to another, i.e. a (microwave) "link", as well as some of the challenges involved, e.g. signal losses during dry weather, melting precipitation, and variations due to the antenna itself becoming wet. He showed an example of applying the method in the Netherlands, mentioning the high geographic density of cell towers, and therefore a large number of "links", in the country and showed the results in comparison with data from weather radars and rain-gauges. The statistics of verification of a 2.5-year period data against gauge-adjusted radar rainfall revealed that quality of daily rainfall maps from 2000 links is comparable to those based on 30 rain gauges, but much less hourly extremes are captured by 30 rain gauges compared to 2000 links.

Finally, Dr Riishojgaard, listed the conclusions: cellular communication network were not originally designed to measure rainfall but rainfall maps from "links" often correspond quite well to radar-based maps; In summer the quality is comparable to maps from automatic rain gauges (for densities about 1 gauge per 1000 km^2), which is promising for, e.g., Indonesia; There is potential for improving flood early warning, validation of satellite QPE, merging with satellite or weather radar data; Application to long time series for other networks and climates is necessary.

4. SESSION C – REVIEW, DISCUSSION AND REFINEMENT OF COMMON PROJECTS

Session C was split in two parts, one dedicated to review and discuss the draft project on radar data, co-chaired by Mr Y. Tanaka from JMA, and another one dedicated to review and discuss the draft project on satellite data, co-chaired by Dr D. Kim, from KMA.

The session was held in several sub-sessions, partly in plenary, partly in break-out groups. During plenary, Mr Tanaka provided a simple but very convincing demonstration on the possible integration of radar data from Indonesia, Japan and Malaysia, together with satellite data, using JMA procedures and software, which is possible as long as radar data is quality controlled and

made available/exchanged. On the satellite side, Dr Kim guided participants through the current draft of the satellites data project.

Two breakout groups were organized for more in-depth discussions, one dedicated to the project on radar data, chaired by Mr Tanaka, and the other one dedicated to the project on satellite data, chaired by Dr Kim. The membership of the radar breakout group was the following: Yoshiro Tanaka, Mulyono Prabowo, Alan Seed, Hok Yin Lam, Takanori Sakanashi, Lesley Choo, Hamray Muhammad Yazit, Vanhdy Douangmala and Luis Nunes. The membership of the satellite breakout group was the following: Dohyeong Kim, Susan Barrel, Yukihiro Kumagai, Xiaojing Wu, Riris Adriyanto, Hassanul Kamal Haji Adam, Shaikh Shahjahan Alam, Moe Thu Khaing, Wattana Kanbua, Vicente Palcon Jr., Nguyen Vinh Thu, Wong Shwei Lin and Lars Peter Riishojgaard.

5. SESSION D – CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions related to satellite data project

The main results of the discussions related to the satellite data project, both during presentations and from breakout-groups are summarized as follows:

- The excellent satellite coverage in the Southeast Asia region, with three WMO Members, China, Japan and Republic of Korea, operating geostationary platforms with partly overlapping fields of view was recognized;
- This very good geostationary coverage provides an opportunity to further improve the services provided to the citizens of the Southeast Asia region in case of dangerous and severe weather events; this needs to be carefully planned in a coordinated fashion rather than triggered as actions once the dangerous weather is occurring;
- The meteorological satellite operators over the region were commended for the already ongoing activities, but nonetheless important gaps were identified in the capabilities of many of the participating Members;
- It was therefore decided to develop an inventory of national capabilities in terms of (i) data access, (ii) data processing capabilities, and (iii) trained staff in using and interpreting satellite data and products;
- It was furthermore decided to document existing regional requirements for products relevant for DRR (e.g. convective systems, tropical cyclones, and volcanic ash);
- It was decided to perform a gap analysis to develop a consolidated view of where the most important gaps lie in terms of requirements that cannot be met with existing capabilities and to draft a plan for how to address the gaps;
- Finally, it was decided to draft a protocol for NMHS requests to satellite operators for event-driven rapid scans of their national area of interest, with the aim of discussing this with the meteorological satellite operators at AOMSUC and CGMS Sessions.

The satellite data project, previously drafted during the preparatory meeting (21-23 April 2015, Jakarta, Indonesia) was reviewed and updated; the final version approved by this Workshop is included in Appendix III-A.

5.2. Conclusions related to radar data project

The main results of discussions related to the radar data project, both during presentations and from breakout-groups are summarized as follows:

- The exchange of lightning data amongst WMO Members in the Southeast Asia region should be promoted, e.g., through bilateral agreements, to enable the generation of (sub-) regional maps in real/near-real time. The LDS networks should be used as complimentary systems in relation to radar networks; The global lightning detection network can be used to help monitor the weather in remote oceanic areas, where no radar networks are available;
- Improvement of data quality is the most important and challenging issue regarding the existing radars of WMO Members in the Southeast Asia region;
- International exchange of radar data at regional level, to produce composite maps for the Southeast Asia region is a key point to be addressed by the RA II/RA V project(s). The project should start with simple steps to ensure the calibration of radars, data quality control and so on. The need to use the same set of processing algorithms for the long-term was

mentioned;
- Resources and benefits for RA II and RA V Members, would be optimized if radar data from Members were collected in a "Regional Radar Data Centre" to produce sub-regional gridded maps in near real-time, e.g. QPE;
- Most of the Members representatives present in the break-out group expressed willingness to share radar data; some of their countries are already doing it. Japan and Australia also expressed interest in sharing radar technology knowledge;
- It was recognized that due to the region of geographic coverage often extending into neighboring countries, most Members countries would benefit from radar data sharing;
- The observing needs and gaps in the region should be considered in the development of the radar data project;
- An updated inventory of the actual capabilities (radars, but also LDS) in Southeast Asia Member countries is needed;
- The continued and enhanced capacity development activities, including training on radar techniques, were strongly supported.

The radar data project, previously drafted during the preparatory meeting (21-23 April 2015, Jakarta, Indonesia) was reviewed and updated; the final version approved by this Workshop is included in Appendix III-B.

6. OTHER RECOMMENDATIONS AND CLOSURE

6.1. The Jakarta declaration

The participants in the Workshop agreed to summarize and publish the major outcome of the Workshop as a "Jakarta Declaration", which is synthesized below - the complete document, including the proposed terms of reference for the coordination teams of each project are included in Appendix IV:

Taking into account the unique meteorological and geophysical nature of the Asia/Oceania region, the list of WMO Member countries to be involved in the joint RA II and RA V projects for radar and for satellite data was extended to include also Cambodia, Macao China, Papua New Guinea and Timor-Leste, in addition to the list of Members participating at the Workshop: Australia, Bangladesh, Brunei Darussalam, China, Hong Kong China, Japan, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Republic of Korea, Singapore, Thailand, Vietnam.

The participants in the Joint RA II/RA V Workshop on WIGOS for Disaster Risk Reduction (DRR) proposed, to initiate two cross-regional projects to be developed under the WIGOS umbrella:

a) A "Joint RA II/RA V WIGOS Satellite Data Project", as specified in Appendix III-A, aimed at (i) strengthening the capabilities of all Members to use geostationary satellite images and derived products in support of DRR, and (ii) developing a protocol for the NMHSs in the project countries to request event-driven rapid-scan imagery for their respective national areas of interest;

b) A "Joint RA II/RA V WIGOS Radar Data Project", as specified in Appendix III-B 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);

The participants further proposed, to establish a close coordination between the satellite project and the ongoing "RA II WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training", and with the RA V Task Team on Satellite Utilization, as well as to develop the radar project based on the existing RA II and RA V WIGOS Projects via a proposed joint Coordination Group. For this, the Management Groups of WMO Regions II and V are requested to review and approve these two projects, and to support their further development once approved.

It was also recommended that the WMO Secretary General be requested to support this project with technical assistance within available resources, and to recommend to CGMS that the satellite operators provide the necessary support to it.

Finally, the satellite operators of China, Japan and the Republic of Korea were encouraged to make digital data at the full resolution available to all Members involved in the "Satellite data project" and to support the project in any way they can. All Members participating in "Radar data project" are encouraged to freely share their radar data products with other project Members,

according to the project plan.

6.2. Closure of the Workshop

At the closure of the Workshop, Dr Riishojgaard thanked the BMKG for hosting the Workshop in their premises and for providing excellent conditions for participants.

Mr M. Prabowo also thanked the participants for traveling to Jakarta to attend the Workshop and wished safe travels back home, and then he closed the Workshop at 3 PM, 14 October 2015.

Appendix I

LIST OF PARTICIPANTS

Dr Andi Eka Sakya	Director-General of the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) Jakarta, Indonesia Tel.: + 62-21-424779 Fax: + 62-21-4248116 Email: andi.eka.sakya@bmkg.go.id
Mr R. Mulyono Rahadi Prabowo	Director of Centre for Public Weather services of the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) Jakarta, Indonesia Tel.: + 62-21-6544701 Fax: + 62-21-6544701 Email: mulyono.prabowo@bmkg.go.id
Mr Edward Trihadi	Director of centre for Communication network of the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) Jakarta, Indonesia Tel.: + 62-21-4246321 (ext. 1701) Fax: + 62-21-4241169 Email: edward.trihadi@bmkg.go.id
Mr Damianus Tri Heryanto	Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) Jakarta, Indonesia Tel.: + 62-21-6540158 Fax: + 62-21-6540158 Email: damianus.heryanto@bmkg.go.id
Mr Riris Adriyanto	Head of Division for Remote Sensing Imagery Management of the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) Jakarta, Indonesia Tel.: + 62-21-4246321 (ext. 4210) Fax: + 62-21-6546314 Email: riris.adriyanto@gmail.com
Mr Hasanudin	Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) Jakarta, Indonesia Tel.: + 62-21-4246321 (ext. 3310) Fax: + 62-21-4260266 Email: hasanudin@bmkg.go.id
Mr Kanton Lumban Toruan	Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) Jakarta, Indonesia Tel.: + 62-21-4246321 (ext. 1619) Fax: + 62-21-6540158 Email: kanton.lumban@bmkg.go.id
Mr Hanif Andi Nugraha	Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) Jakarta, Indonesia Tel.: + 62-21-4246321 (ext. 1700) Fax: + 62-21-4241169 Email: hanif.andi@bmkg.go.id

Mr Ana Oktavia Setiowati	Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) Jakarta, Indonesia Tel.: + 62-21-4246321 (ext. 4414) Fax: + 62-21-6546314 Email: ana.setiowati@bmkg.go.id
Mr Agie Wandala Putra	Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) Jakarta, Indonesia Tel.: + 62-21-6546314 Fax: + 62-21-6546314 Email: agie.wandala@bmkg.go.id
Dr Xiaojing Wu	China Meteorological Administration Beijing, China Tel.: + Fax: + Email: wuxj8@cma.gov.cn
Dr Susan Barrell	Bureau of Meteorology 700 Collins Street, G.P.O. Box 1289K, Melbourne, VIC 3001, Australia Tel.: +61 (3) 9669 4444 Fax: +61 (3) 9669 4168 Email: S.Barrell@bom.gov.au
Mr Alan Seed	Bureau of Meteorology 700 Collins Street, G.P.O. Box 1289K MELBOURNE, VIC 3001 Australia Tel.: + Fax: + Email: a.seed@bom.gov.au
Mr Yoshiro Tanaka	Japan Meteorological Agency 1-3-4, Otemachi, Chiyoda-ku TOKYO 100-8122, Japan Tel.: +81 3 3211 4966 Fax: +81 3 3211 2032 E-mail: yoshiro.tanaka@met.kishou.go.jp
Mr Takanori Sakanashi	Japan Meteorological Agency 1-3-4, Otemachi, Chiyoda-ku TOKYO 100-8122, Japan Tel.: + Fax: +81 3 3211 2032 E-mail: takanori-sakanasi@met.kishou.go.jp
Mr Yukihiro Kumagai	Japan Meteorological Agency 1-3-4, Otemachi, Chiyoda-ku TOKYO 100-8122, Japan Tel.: + Fax: +81 3 3211 2032 E-mail: kumagai_y@met.kishou.go.jp
Dr Dohyeong Kim	Korea Meteorological Administration 636-10 National Meteorological Satellite Centre Gwanghyewon, Jincheon Chungbuk, 365-831, Republic of Korea Tel: +82-70-7850-5705 Fax: +82-43-717-0210 E-mail: dkim@kma.go.kr
Mr Shaikh Shahjahan Alam	Meteorological Department Dhaka, Bangladesh E-mail: sj_alam99@yahoo.com

Mr Hassanul Kamal Haji Adam	Meteorological Department Brunei Darussalam E-mail: hassanul.adam@met.gov.bn
Mr Vanhdy Douangmala	The Department of Meteorology and Hydrology (DMH), Vientiane Lao PDR E-mail: vanhdy_dml@yahoo.com
Mr Hok Yin Lam	Hong Kong Observatory Hong Kong, China E-mail: dlam@hko.gov.hk
Mr Hamray Muhammad Yazit	Malaysian Meteorological Department Kuala Lumpur, Malaysia E-mail: hamray@met.gov.my
Ms Moe Thu Khaing	Department of Meteorology and Hydrology Myanmar E-mail: moethukhaing.dmh@gmail.com
Mr Vicente Palcon	Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) Manila, Philippines E-mail: vppalconjr@yahoo.com
Mr Lesley Choo	National Environment Agency Meteorological Services Division Singapore E-mail: Lesley_Choo@nea.gov.sg
Mr Wong Shwei Lin	National Environment Agency Meteorological Services Division Singapore E-mail: wong_shwei_lin@nea.gov.sg
Dr Wattana Kanbua	Thai Meteorological Department Bangkok, Thailand E-mail: watt_kan@hotmail.com
Mr Nguyen Vinh Thu	National Hydro-Meteorological Service Vietnam E-mail: nvthu@nchmf.gov.vn

WMO SECRETARIAT	7 bis, avenue de la Paix CH-1211 Geneva 2 Switzerland
Dr Lars Peter Riishojgaard	WIGOS Project Manager Tel.: +41 22 730 8193 Fax: +41-22 730 80 21 Email: lriishojgaard@wmo.int
Mr Luis Nunes	WIGOS Project Office Tel: +41-22 730 81 38 Fax: +41-22 730 80 21 Email: lfnunes@wmo.int

PROGRAMME - RA II/V Workshop on WIGOS for DRR, 12-14 October, Jakarta, Indonesia
***Final** (updated)*

Monday AM, 12 October 2015

TIMING	SPEAKER	SESSION / PRESENTATION TITLE
09:00-09:10	Director-General of BMKG, or a representative (TBC)	**Opening remarks**
09:10-09:20	Lars Peter Riishojgaard, WMO representative of SG, WIGOS Project Manager	**Introductory remarks**
09:20-09:30	Local organizer representative (TBC) and Luis Nunes, WIGOS Scientific Officer	**Organization matters**
09:30-09:50	Sue Barrell, Chair of ICG-WIGOS	**The Pre-operational Phase of WIGOS**
09:50-10:10	Mulyono Prabowo, representative of BMKG	**Overview of outcomes from the Preparatory meeting for the Workshop** (Jakarta, 21-23 April)
10:10-10:30	… Coffee-Break …	
Session A – Country Reports		
10:30-10:50	Shaikh Shahjahan Alam	• National Report from Bangladesh
10:50-11:10	Hok Yin Lam	• National Report from Hong Kong, China
11:10-11:30	Yoshiro Tanaka	• National Report from Japan
11:30-11:50	Vanhdy Douangmala	• National Report from Lao PDR
11:50-12:10	Moe Thu Khaing	• National Report from Myanmar
12:10-13:30	… Lunch-Break …	

PROGRAMME - RA II/V Workshop on WIGOS for DRR, 12-14 October, Jakarta, Indonesia
***Final** (updated)*

Monday PM, 12 October 2015

TIMING	SPEAKER	SESSION / PRESENTATION TITLE
Session A – Country Reports (Cont.)		
13:30-13:50	Dohyeong Kim	• National Report from Republic of Korea
13:50-14:10	Wattana Kanbua	• National Report from Thailand
14:10-14:30	Nguyen Vinh Thu	• National Report from Vietnam
14:30-14:50	Sue Barrell	• National Report from Australia
14:50-15:10	Hassanul Kamal Haji Adam	• National Report from Brunei Darussalam
15:10-15:30	… Coffee-Break …	
15:30-15:50	Riris Adriyanto	• National Report from Indonesia
15:50-16:10	Hamray Muhammad Yazit	• National Report from Malaysia
16:10-16:30	Vicente Palcon, Jr.	• National Report from Philippines
16:30-16:50	Lesley Choo	• National Report from Singapore
16:50-17:10	Special Session on OSCAR - Presentation by the WMO Secretariat	
17:10-17:30	RESERVED	

PROGRAMME - RA II/V Workshop on WIGOS for DRR, 12-14 October, Jakarta, Indonesia
***Final** (updated)*

Tuesday AM, 13 October 2015

TIMING	SPEAKER	SESSION / PRESENTATION TITLE
Session B – Invited Speakers		
09:00-09:25	Agie Wandala Putra, Public Meteorological Services Division - BMKG	**Weather forecasts & warning activities in BMKG**
09:25-09:50	Takanori Sakanashi, Radar observing Systems Expert, Japan Meteorological Agency, Japan	**Technical Development Activity on Weather Radar Observation**
09:50-10:15	Hok Yin Lam, Lightning Detection Systems Expert, Hong Kong Observatory, Hong Kong, China	**Lightning Detection Systems**
10:15-10:35	… Coffee-Break …	
10:35-11:00	Alan Seed, Weather Radar Expert, Australia Bureau of Meteorology	**Weather Radar observations**
11:00-11:25	Dohyeong Kim, Satellite Expert, Korea Meteorological Agency, Republic of Korea	**Satellite observations**
11:25-11:50	Yukihiro Kumagai, Satellite Expert, Japan Meteorological Agency, Japan	**Satellite observations (Himawari-8)**
11:50-12:15	Xiaojing Wu Satellite Expert, China Meteorological Administration, China	**Satellite observations**
12:15-12:40	Presentation TBC – if time allows *(Aart Overeem, invited expert in GSM attenuation by rain, from the Royal Meteorological Institute of Netherlands, will not be present)*	**GSM attenuation by rain (TBC)**
12:40-13:40	… Lunch-Break …	

PROGRAMME - RA II/V Workshop on WIGOS for DRR, 12-14 October, Jakarta, Indonesia
***Final** (updated)*

Tuesday PM, 13 October 2015

TIMING	CHAIR	SESSION / PRESENTATION TITLE
Session C – Review, Discussion and Refinement of Common Projects		
13:40-14:25	Yoshiro Tanaka, Surface observing Systems Expert, Japan Meteorological Agency	• **C1 – Draft project on Radar Data** Review and discussion in plenary
14:25-15:10	Dohyeong Kim (TBC), Satellite Expert, Korea Meteorological Agency, Republic of Korea	• **C2 – Draft project on Satellite Data** Review and discussion in plenary
15:10-15:30	… Coffee-Break …	
15:30-17:00	Yoshiro Tanaka, Surface observing Systems Expert, Japan Meteorological Agency	• **C1 – Draft project on Radar Data** Discussion in breakout group
	Dohyeong Kim (TBC), Satellite Expert, Korea Meteorological Agency, Republic of Korea	• **C2 – Draft project on Satellite Data** Discussion in breakout group
17:00-17:30	RESERVED	

PROGRAMME - RA II/V Workshop on WIGOS for DRR, 12-14 October, Jakarta, Indonesia
***Final** (updated)*

Wednesday AM, 14 October 2015

TIMING	CHAIR	SESSION / PRESENTATION TITLE
Session C – Review, Discussion and Refinement of Common Projects (Cont.)		
09:00-09:30	Yoshiro Tanaka, Surface observing Systems Expert, Japan Meteorological Agency	• **C1 – Draft project on Radar Data** Review of preliminary outcomes from the breakout groups – plenary
09:30-10:00	Dohyeong Kim, Satellite Expert, Korea Meteorological Agency, Republic of Korea	• **C2 – Draft project on Satellite Data** Review of preliminary outcomes from the breakout groups – plenary
10:00-10:20	… Coffee-Break …	
10:20-12:30	Yoshiro Tanaka, Surface observing Systems Expert, Japan Meteorological Agency	• **C1 – Draft project on Radar Data** Resume discussion in breakout group
	Dohyeong Kim, Satellite Expert, Korea Meteorological Agency, Republic of Korea	• **C2 – Draft project on Satellite Data** Resume discussion in breakout group
12:20-13:30	… Lunch-Break …	

PROGRAMME - RA II/V Workshop on WIGOS for DRR, 12-14 October, Jakarta, Indonesia
***Final** (updated)*

Wednesday PM, 14 October 2015

TIMING	CHAIR	SESSION / PRESENTATION TITLE
Session D – Conclusions and Recommendations		
13:30-14:15	Yoshiro Tanaka, Surface observing Systems Expert, Japan Meteorological Agency	• **D1 – Conclusions for the project on Radar Data**
14:15-15:00	Dohyeong Kim, Satellite Expert, Korea Meteorological Agency, Republic of Korea	• **D2 – Conclusions for the project on Satellite Data**
15:00-15:20	… Coffee-Break …	
15:20-16:00	**Other Recommendations and Closure**	

Appendix III-A
Project plan for satellite data

Joint RA-II/RA-V WIGOS Project on Satellite Data

Overall goal of project

- All Members in the target region to receive and be able to interpret and use geostationary satellite data as full spatial, spectral and temporal resolution subsets for their national region of interest, including the ability to generate key products
- To develop a protocol for countries in target area to request and receive and ingest event-driven rapid-scan geostationary satellite data in support of Disaster Risk Reduction

1

Joint RA-II/RA-V WIGOS Project on Satellite Data

- Purpose of project
  - To improve the utilization of geostationary satellite data by NMHSs in support of services, particularly for Disaster Risk Reduction
- Deliverables
  1) Inventory of national capabilities in terms of (i) data access (CMA, JMA, KMA), (ii) data processing capabilities, and (iii) trained staff in using and interpreting satellite data and products
  2) Documented requirements for products relevant for DRR (e.g. convective systems, tropical cyclones, and volcanic ash)
  3) Adequate capacity in all Members to meet requirements listed under 2)
  4) Protocol for NMHS requests to satellite operators for event-driven rapid scan data covering national areas of interest for DRR

2

Joint RA-II/RA-V WIGOS Project on Satellite Data

Partners
- Data providers
  - CMA, JMA, KMA
- Data users
  - Australia, Bangladesh, Brunei-Darussalam, Cambodia, East Timor, Hong Kong China, Indonesia, Lao PDR, Malaysia, Myanmar, Papua New Guinea, Philippines, Singapore, Thailand, Vietnam
  - Coordination group from RA-II / RA-V
    - ✓ Co-Coordinators for "RA II WIGOS project to Develop Support for NMHSs in Satellite Data, Products and Training"
    - ✓ Chair of RA-V Task Team on Satellite Utilization

3

Joint RA-II/RA-V WIGOS Project on Satellite Data

- Implementation steps, including capacity development
  1) Develop inventories of national capabilities
  2) Develop consolidated requirements for DRR relevant products
  3) Gap analysis
  4) Draft Rapid Scan Protocol
  5) Capacity Development Plan
- Timeline
  - Draft project plan : Nov 2015 (during/after AOMSUC-6)
  - Discussion by RA-V and RA-II Management Groups (Oct/Nov 2015)
  - Presentation to CM-13, Jan 2016
  - Presentation CGMS-44, discussions with CMA, JMA, KMA: June 2016
- Funding requirements (will be established during steps 1-3)
  - Facilitate target countries for reception system including HW and SW
  - Training

4

Appendix III-B
Project plan for radar data

Improving Radar Data for DRR in RA-II/RA-V (East/South East Asian Region)

Overall goals:

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

1

Issues to be discussed

- Specific source of requirements for global observation
  - ✓ OSCAR
- Level of products?
- Data formats
  - ✓ Are common formats supported across system vendors?
- Possible role for WMO
  - ✓ Joint formats
  - ✓ Support for procurement processes (guidance material)
  - ✓ Rain gauge-based calibration
- Hardware maintenance

2

Specific source of requirements

The requirements from the nowcasting application area for global observations should contribute to the design of radar networks in support of DRR activities in the Region.

- ✓ OSCAR

3

Level of products?

1. Develop quality controlled radar data in each Member
2. Create national radar composite grid data in each Member
3. Exchange national radar composite grid data in real time

4

Data formats

- ✓ Are common formats supported across system vendors? (specify one common format for exchanging data process)
- ➢ For exchanging processable data, conversion from the original data format provided by different manufactures is necessary following WMO standardized data format

5

Possible role for WMO

- ✓ Joint formats:
  WMO existing guidelines as reference materials for the project
- ✓ Support for technical specification regarding the purchase, installation, operation, calibration and maintenance of equipment (further development of guidance material, e.g. the JMA guidance to be published as IOM report)
- ✓ Quantitative precipitation estimation:
  WMO to encourage Members to generate/develop QPE following the existing methods being used and evolving.

6

Appendix III-B
Project plan for radar data

Hardware Maintenance

- Has to be considered as a basic and fundamental requirement for all radar systems (the WMO standard practices and procedures should be referred)
- The calibration of radar systems has to be ensured. WMO recommends that radar systems should be calibrated regularly.

7

Possible RA-II/RA-V WIGOS Radar Project

- Contents of project plan:
  - Purpose of project:
    - Metrics of success
  - Deliverables
  - Partners
  - Implementation steps, including capacity development
  - Timeline
  - Funding requirements (if any)

8

Purpose of project

- Improvement of data quality of existing radars;
  - Metrics of success:
    1) Number of weather radars performing radar system maintenance and calibration according to the recommendation (WMO No. 8).
    2) Number of weather radars using quality control procedures on the base reflectivity (dBz)
    3) Number of weather radars to be used as national radar composite

    Surveys should be made at the beginning/end of the project.

9

Purpose of project

- Development and expansion of national radar network;
  - Metrics of success :
    1) Number of Members who established national radar composite
    2) Number of new weather radars that actually expand geographic coverage, including border areas

10

Purpose of project

- International exchange of radar data in near real time
  - Metrics of success:
    1) Number of Members internationally exchanging radar data in near real time

11

Deliverables

- Reports of analysis of the surveys results
- Demonstration project of real time data exchange (regional mosaic)
- Capacity development activities between Members of both Regions
- The reports of the outcomes of the cooperative activities concerning the project among Members

12

Appendix III-B
Project plan for radar data

Partners

Partners:
- RA II EG-WIGOS theme leaders for surface-based remote sensing for DRR; Leaders of Project III-2 (Malaysia and Thailand);
- RA V WG-INFR and TT-WIGOS
- ASEAN Sub-Committee on Meteorology and Geophysics (SCMG)
- ESCAP/WMO Typhoon Committee

Supporting partners:
- CBS ET-SBO
- CIMO ET on Operational Remote Sensing
- RA II EG-WIS and its counterpart of RA V

13

Implementation steps

- Establishment of the Coordinating Group;
- Prepare and circulate the surveys (regarding all the metrics).
- Analyze and publish the survey results;
- Identify and prioritize the actions according to the result of the surveys considering capacity development aspects of Members, to cope with the needs of national radar networks in terms of improving radar coverage, performances and data quality;
- The Coordinating Group will draft an implementation plan for the exchange of radar grid data considering possible sub-regional data centers and procedures.
- The Coordinating Group will also promote exchange of radar grid data between Members.

14

Timeline

Activities	Timeline (months)											
	3	6	9	12	15	18	21	24	27	30	33	36
Establishment of the Coordinating Group	■											
Prepare and circulate the surveys (regarding all the metrics). Analyze and publish the survey results		■	■									
Identify and prioritize the actions according to the result of the surveys				■								
Cope with the needs of national radar networks in terms of improving radar coverage, performances and data quality					■	■	■	■	■	■	■	■
The Coordinating Group will draft an implementation plan for the exchange of radar grid data considering possible sub-regional data centers and procedures.				■	■	■						
The Coordinating Group will also promote exchange of radar grid data between Members.				■	■	■	■	■	■	■	■	■

15

Funding requirements (if any)

- Coordination Group face-to-face meeting once a year
- For the implementation of the project by running the activities, including workshops, technical work, …

16

Appendix IV

Jakarta Declaration

adopted by the

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

Noting,

The unique meteorological and geophysical nature of the Asia/Oceania region defined by the following WMO Region II and V Members: Australia, Bangladesh, Brunei, Cambodia, East Timor, Hong Kong China, Indonesia, Lao PDR, Malaysia, Myanmar, Papua New Guinea, Philippines, Singapore, Thailand, Vietnam, which is characterized by frequent high-impact phenomena such as tropical cyclones, severe convective weather and volcanic eruptions,

The need to protect lives and property in this densely populated region, and the central role played by the National Meteorological and Hydrological Services in Disaster Risk Reduction,

Noting further,

The excellent coverage of this region with satellite imagery obtained from geostationary platforms operated by three WMO Members, namely China, Japan and the Republic of Korea,

The existing “RA II WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training” led by two Co-Coordinators representing Japan and the Republic of Korea, respectively,

The recent developments to improve radar coverage in many of the participating Members,

The existing "RA II WIGOS Project for Observing systems integration for supporting Disaster Risk Reduction - Capacity Building in Radar Techniques in the Southeast Asia",

The need to improve the quality of radar data and to further improve the coverage and availability of weather radar data in the region;

Recognizing,

The sovereign authority of satellite operators to determine the observational priorities of their space-based assets based on national priority needs and other concerns,

The participants in the Joint RA-II/RA-V Workshop on WIGOS for Disaster Risk Reduction

Propose,

*T*o 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) A “Joint RA-II/RA-V WIGOS Satellite Data Project” aimed at (i) strengthening the capabilities of all Members to use geostationary satellite images and derived products in support of Disaster Risk Reduction as specified in the Annex to this declaration, and (ii) developing a protocol for the NMHSs in the project countries to request event-driven rapid-scan imagery for their respective national areas of interest,

b) 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);

Further propose,

To establish a close coordination between project a) and the ongoing “RA II WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training”, and with the RA-V Task Team on Satellite Utilization,

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;

Recommend,

That the WMO Secretary General be requested to support this project with technical assistance within available resources, and to recommend to CGMS that the satellite operators provide the necessary support to it;

Encourage,

The satellite operators of China, Japan and the Republic of Korea to make digital data at the full resolution available to all Members involved in the “Satellite data project” and to support project a) in any way they can,

All Members participating in project b) to freely share their radar data products with other project Members, according to the project plan.

Annex I: Terms of Reference for the Coordination Group for the "Joint RA-II/RA-V WIGOS Satellite Data Project" :

The Coordination Group shall be composed of

(i) the Co-coordinators of the existing "RA II WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training",
(ii) the Chair of the RA-V Task Team on Satellite Utilization,

The task of the Coordination Group shall be:

(a) To identify the requirements of NMHSs of WMO Members participating in the "Joint RA-II/RA-V WIGOS Satellite Data Project" regarding satellite imagery, data and products in support of their weather services, including forecasts and warnings;

(b) To develop an inventory of the capabilities of the NMHSs listed under (a), in particular those from developing Members, in the areas of (i) satellite data reception, (ii) satellite data processing, (iii) satellite data interpretation and utilization;

(c) To provide a gap analysis in which the capabilities under (b) are matched against the requirements under (a); To develop an action plan to close the gap identified under (c);

(d) To devise a protocol under which individual Members can request event-driven rapid-scan satellite data covering their national area of interest for Disaster Risk Reduction;

(e) To report progress on this project to the RA-II and RA-V Management Groups

Annex II: Terms of Reference for the Coordination Group for the "Joint RA-II/RA-V WIGOS Radar Data Project" :

The Project Coordination Group should be composed of:

(i) The Coordinators of the RA-II Radar Project (R-WIP-II Project III.2)

(ii) One or two members from Region V appointed by RA-V-MG, who are responsible for the radar tasks (R-WIP-V, Task 4.3.2)

Its tasks should be:

(a) to devise ways to strengthen the radar capabilities of the project Members, according to the plan proposed by the "Joint RA-II/RA-V Workshop on WIGOS for Disaster Risk Reduction" held in Jakarta, Oct 12-14, 2015 (see Final Workshop Report);

(b) to develop a detailed plan, including resource requirements, for a radar data project involving the project Members;

(c) to seek support from Members participating in this project in terms of financial and human resources;

(d) to promote the adjustment/update of the Regional WIPs according to the plans for this project, taking into account the five priorities of the WIGOS Pre-operational Phase;