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**WORKSHOP ON RADAR DATA EXCHANGE**

ITEM: 3.1

EXETER, UK, 24-26 APRIL 2013

Original: ENGLISH

## **CURRENT STATUS OF WEATHER RADAR DATA EXCHANGE**

Regional Report on the current status of weather radar operated in RA V and its data exchange

*(Submitted by Riris Adriyanto, Indonesia)*

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### **SUMMARY AND PURPOSE OF DOCUMENT**

To report the present status on the weather radar network and data exchange in Region V

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### **ACTION PROPOSED**

Participants of the workshop are invited to note the information contained in the document.

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## CURRENT STATUS OF WEATHER RADAR OPERATED IN RA V AND ITS DATA EXCHANGE (EXETER, UK, 24-26 APRIL 2013)

### 1. Introduction

RA V region members are 22 countries in South-east Asia and South-west Pacific. Most of RA V member countries are (tropical) maritime type, vulnerable to climate variability and limited in resources. There are several significant weather systems, which are very important to be monitored in the region, such as Monsoon, Tropical Cyclone/Typhoon, Tropical Storms and Transboundary haze pollution from forest-fires. These phenomena bring socio-economic impacts for the countries in South-east Asia and South-west Pacific

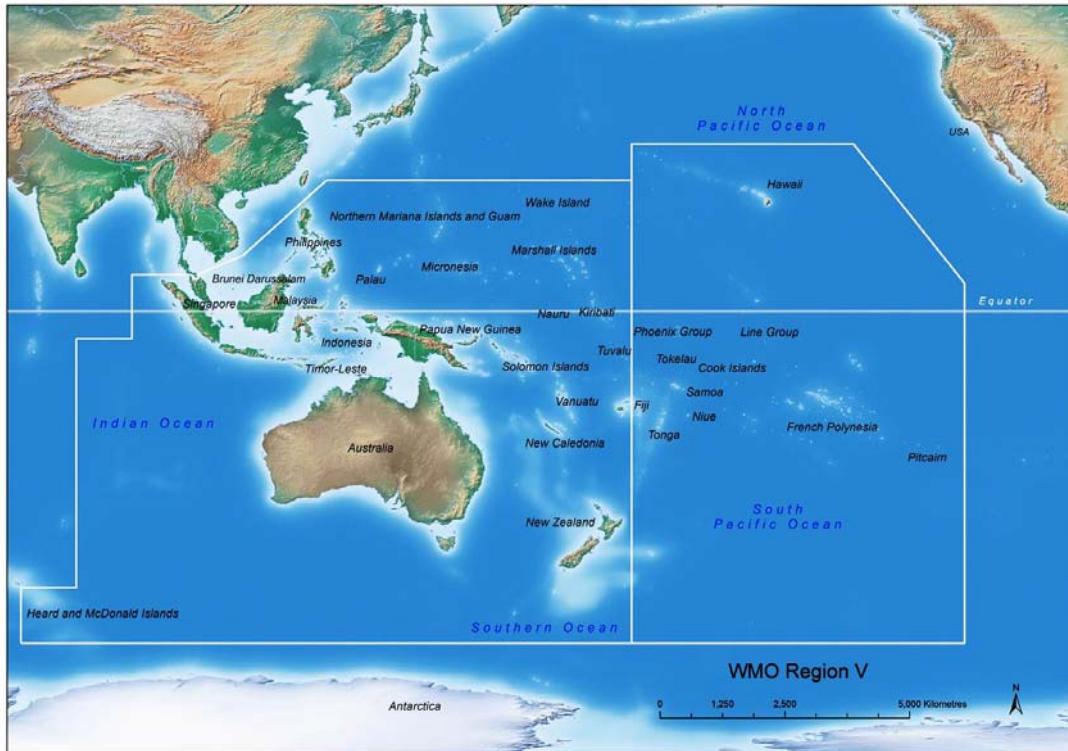


Figure 1. Geographical extent of WMO Regional Association V

Content of this report is based on gathered information from the web, inputs and contributions obtained from some national radar focal points in the Region and member of RA V Working Group on Infrastructure (WG-INFR) from : Indonesia, Malaysia, New Zealand and Australia. Efforts have been made to assemble more comprehensive information, but due to the limited time, not all countries responded or gave inputs. It was found that from 22 Member countries of RA V, less than half of the members have been operating weather radar systems, among others are : Australia, Brunei Darussalam, Indonesia, Malaysia, New Zealand, Philippines, Singapore and Fiji. There is no information on the current status of weather radar operated by other members.

### 2. Weather Radar Operated by RA V Member Countries

#### Indonesia

The history of Indonesian weather radar systems was began in early 1990s with conventional radar network established in major provincial weather service offices. Since 2006 conventional / non-Doppler radar system was gradually upgraded into modern Doppler radar system which is becoming one of key components for Meteorological Early Warning System of the country.

As of April 2013 there are 27 weather radars operated across the country by its National Meteorological Services (Indonesia Agency for Meteorology Climatology and Geophysics / BMKG).

All of those radars are C-Band Doppler with single polarization and supplied by 4-different foreign radar manufacturers : Gematronik / Selex SI (Germany), EEC and Baron Systems (USA), and Vaisala Oyj (Finland). According to the masterplan of BMKG's radar network for ten years period (2006 – 2016), total number of weather radar of Indonesia will be 51 Doppler weather radars to cover most of provinces cities.

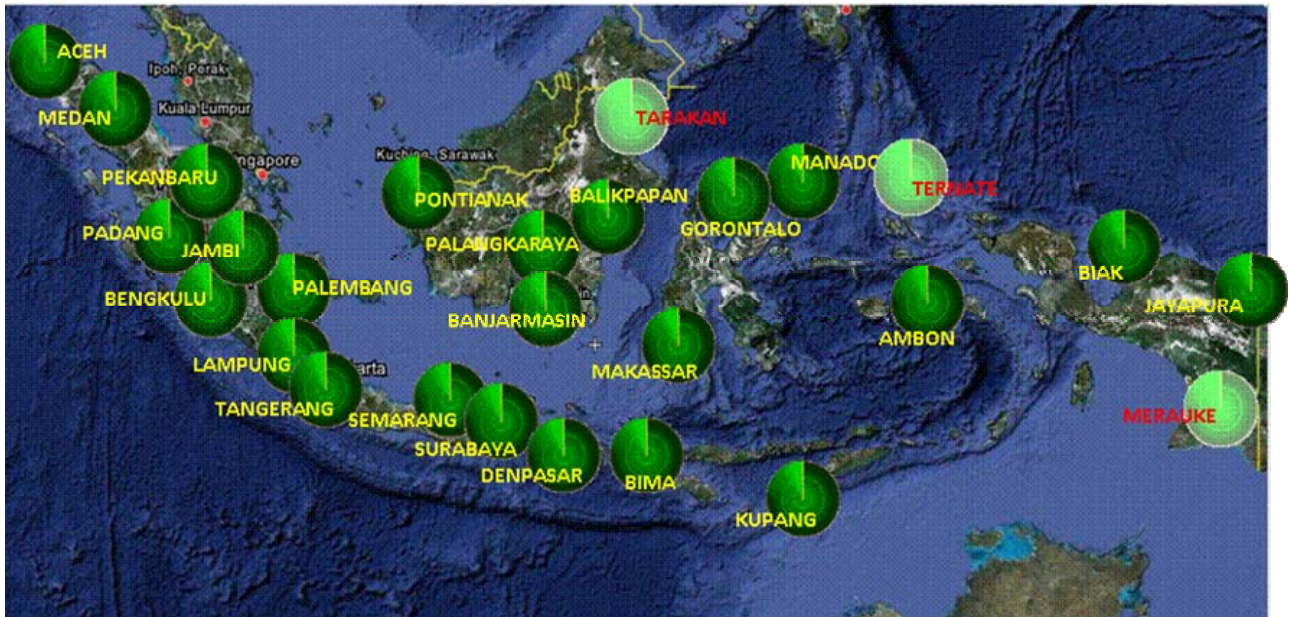


Figure 2. Indonesia C-Band Doppler weather radar network (as of April 2013)

The table below is Indonesia's list of weather radars operated by BMKG.

| No | Radar Name   | Transmitter       | Polarization               | Band     |
|----|--------------|-------------------|----------------------------|----------|
|    |              | (TX) Type         |                            |          |
| 1  | Ambon        |                   |                            |          |
| 2  | Balikpapan   | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 3  | Banda Aceh   | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 4  | Banjarmasin  | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 5  | Bengkulu     | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 6  | Biak         | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 7  | Bima         | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 8  | Denpasar     | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 9  | Gorontalo    | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 10 | Jambi        | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 11 | Kupang       | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 12 | Lampung      | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 13 | Makasar      | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 14 | Manado       | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 15 | Medan        | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 16 | Merauke      | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 17 | Padang       | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 18 | Palangkaraya | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 19 | Palembang    | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 20 | Pekanbaru    | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 21 | Pontianak    | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 22 | Semarang     | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 23 | Sentani      | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 24 | Surabaya     | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 25 | Tangerang    | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 26 | Tarakan      | Coaxial Magnetron | Single / Linear Horizontal | C - Band |
| 27 | Ternate      | Coaxial Magnetron | Single / Linear Horizontal | C - Band |

Amongst the 27 radars operated in the country, there are 14 radar sites have been connected via MPLS data communications to the radar mosaic system at the BMKG's head office so called Hydrometeorological Decision Support System (HDSS). This system was developed by Weather Decision Technologies Inc. (WDT), a US company based in Norman, Oklahoma. The HDSS system is able to generate some products used for weather forecasting and warnings, i.e. : all Indonesian radar reflectivity mosaic, QPE and radar based forecast based on MAPLE algorithm (developed by McGill University Canada). As of end of 2013 additional 10 radar sites will be able to connect to the HDSS server to send their realtime raw data products.

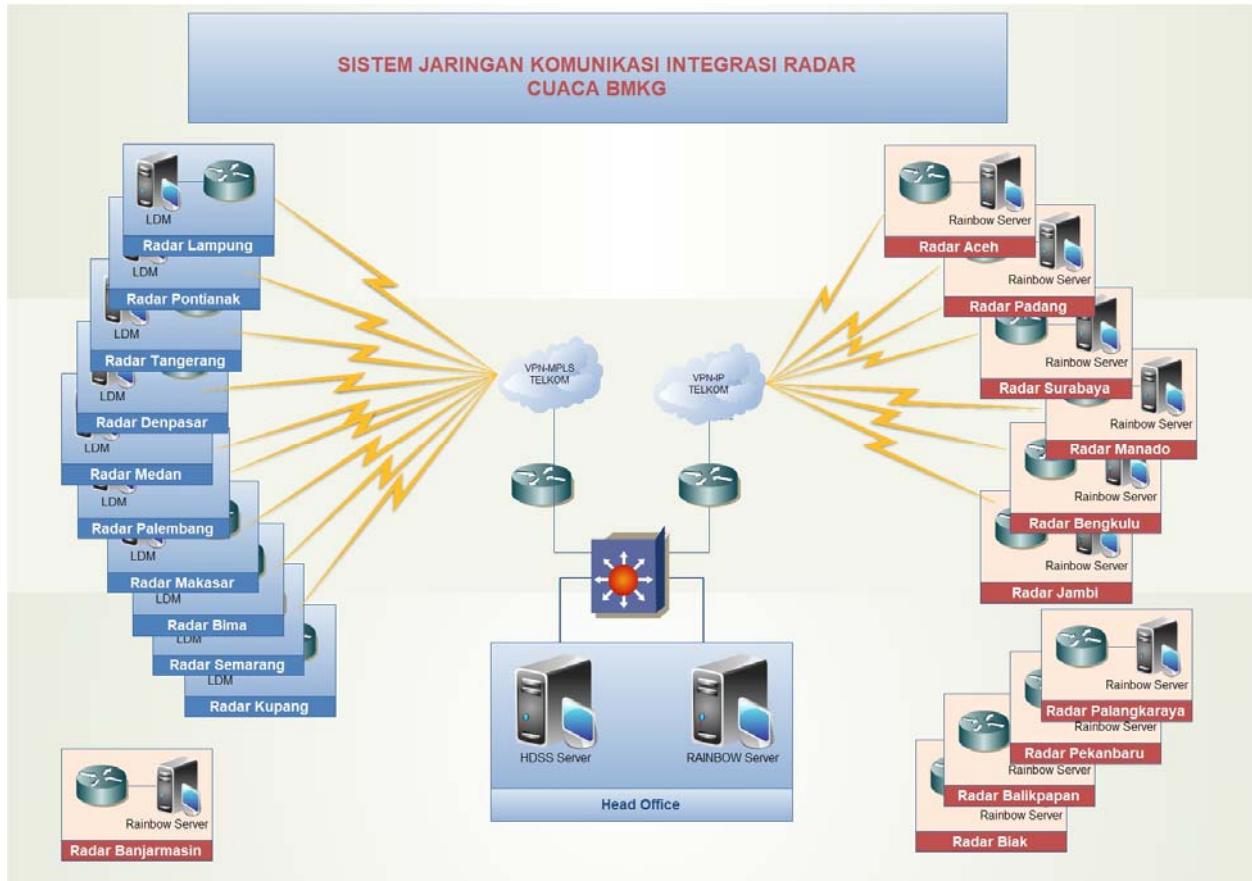


Figure 3. Centralized radar data communication to HDSS system

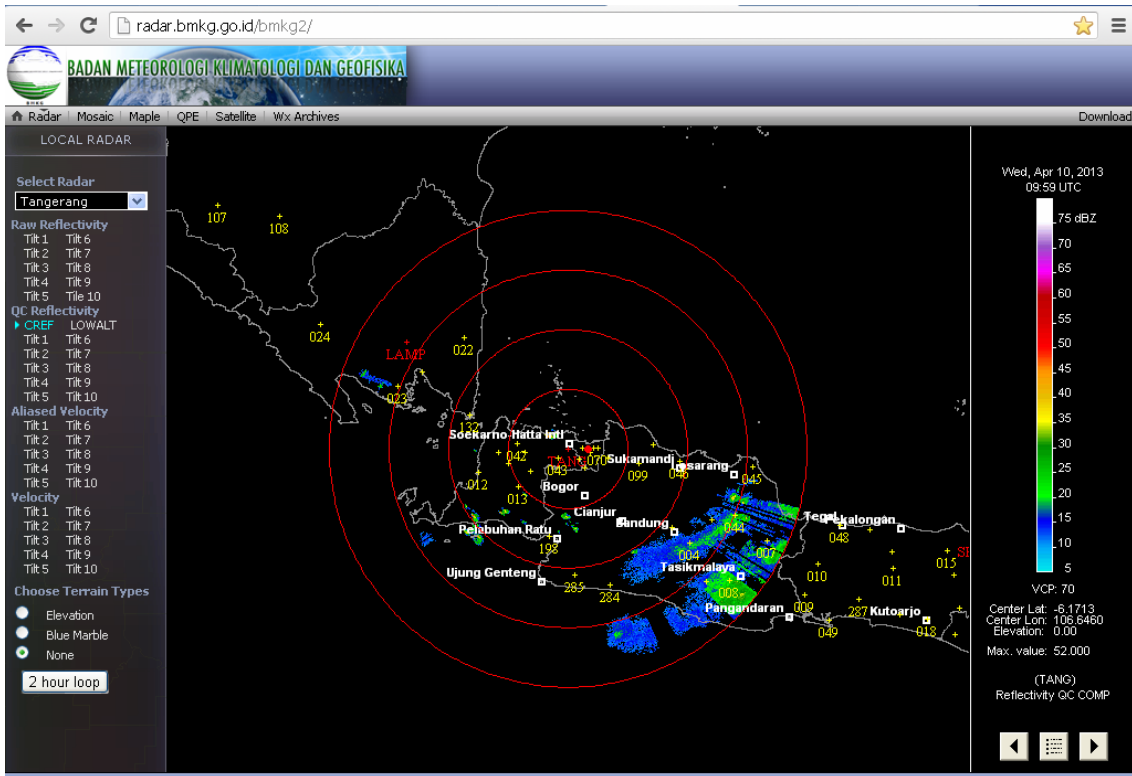
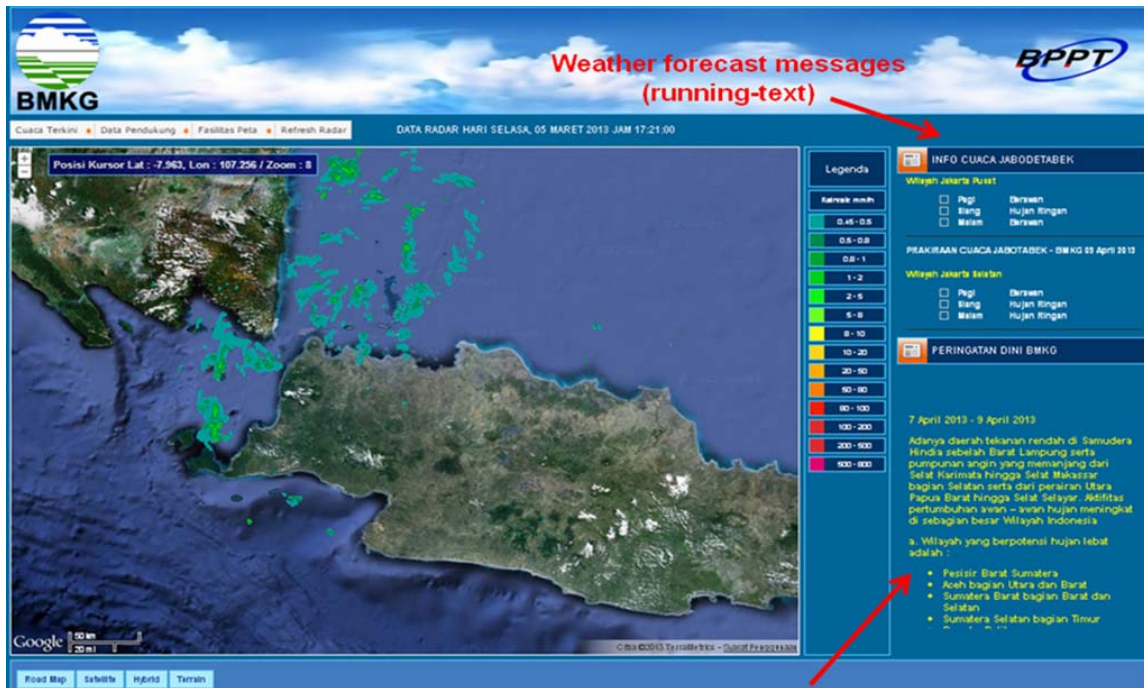


Figure 4. Web interface of Indonesia integrated radar product (HDSS system)

Regarding weather radar data exchange practices, Indonesia has no bilateral agreements yet for radar data exchange with its neighboring countries in the region. So far at national level, there is only an initial efforts to exchange radar data to research institution (i.e. National Agency for Research and Application of Technology / BPPT). Data in NetCDF format for low level reflectivity has been used by the two agencies (BMKG and BPPT) to be published as rainfall radar information to the general public via specific internet website (see figure below).



<http://202.46.1.53/bmkg/>

Early warning messages (running-text)

Figure 5. Interactive web-based weather radar products for general public (initial collaborative efforts BMKG-BPPT)

## Malaysia

Malaysia has operated 12 Doppler weather radars throughout the Malaysian Peninsular and northern Borneo (Sabah and Sarawak region), consists of S-band radars (8 sites) and C-band radars (4 sites). Malaysia Meteorological Department (MMD) is the only agency operates weather radars in Malaysia.

Radar product is available via website (radar imageries) and its stakeholders normally will get advice from MMD to apply the data or from out sources. All of the radars are using the same radar signal processing and softwares, therefore no significant problems to integrate radar images. MMD uses same radar software (IRIS) and same RCP for the whole radars system.

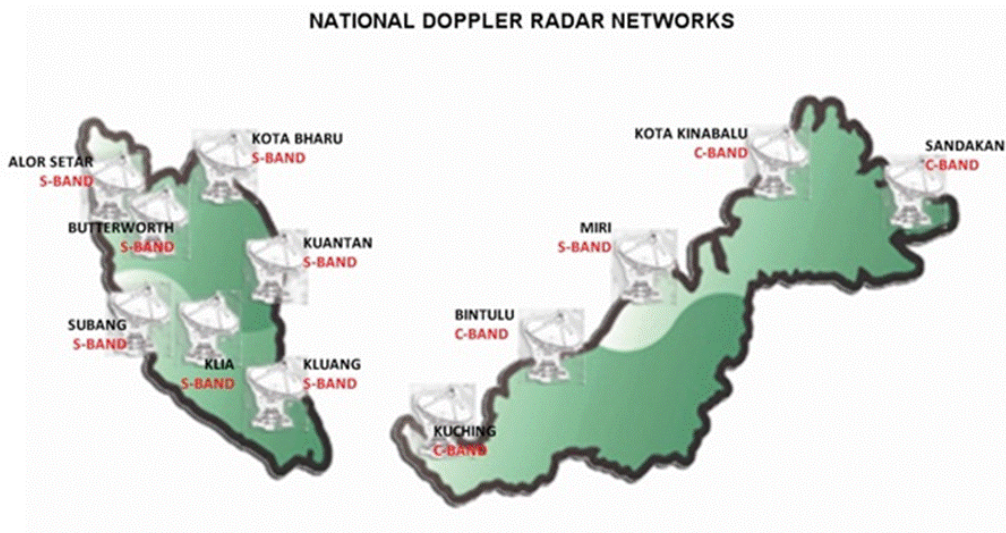


Figure 6. Malaysia weather radar network (as of 2012)  
(image courtesy of : Kamiluddin IBRAHIM / Malaysian Met. Department)

## New Zealand

New Zealand operates 8 C-band Doppler weather radar systems located in Hokitika, Invercargill, Mahia, Mamuku, New Plymouth, Outlook Hill, Rakaia, and Tamahunga are being used for weather monitoring in New Zealand. Those radars cover almost all NZ region except some blank areas over mountainous regions (see figure below).

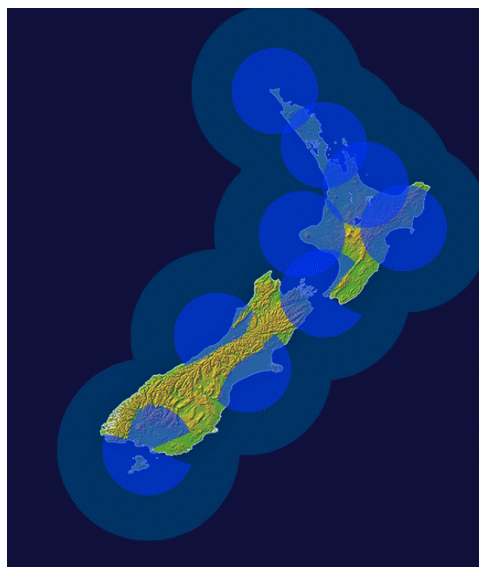


Figure 7. New Zealand's weather radar coverage (as of 2012)  
(source : <http://blog.metservice.com/2010/10/weather-radars/>)

New Zealand has bilateral agreement with Australia for weather radar data exchange both raw data and products.

## Australia

Australia's weather radar network, operated by the Bureau of Meteorology (BoM), consists of 58 radars and covers most coastal and some inland regions of the continent. The network design features radars located in highly populated areas and along the coastlines, particularly the northern coastline where tropical cyclones threaten during the wet season (austral summer). Some radars are also used part-time for wind-finding (Susan J. Rennie, 2012).



[http://www.bom.gov.au/australia/radar/about/radar\\_coverage\\_national.shtml](http://www.bom.gov.au/australia/radar/about/radar_coverage_national.shtml)

Figure 8. Australia weather radar network

BoM plans for the future to assimilate radial winds from precipitation radar, and optionally from clear air echo, into high resolution versions of BoM NWP model (ACCESS) with city domains. The objective of this assimilation is to improve the forecast of severe weather with lead times of 3 to 12 hours (Susan J. Rennie, 2012).

## Other RA V Members

The following table shows weather radar status of other 18 countries of RA V (information gathered from some web resources)

| No. | Country                        | Number of weather radar | Remark   |
|-----|--------------------------------|-------------------------|--|
| 1   | Brunei Darussalam              | 1                       | Site : Bandar Seri Begawan   |
| 2   | Cook Islands                   | No information          |  |
| 3   | Fiji                           | 3                       | Sites : Nadi, Nausori, Labasa<br><a href="http://www.met.gov.fj/radar.php">http://www.met.gov.fj/radar.php</a> |
| 4   | French Polynesia               | No information          |  |
| 5   | Federated States of Micronesia | No information          |  |
| 6   | Kiribati                       | No information          |  |
| 7   | New Caledonia                  | No information          |  |

|    |                               |                |  |
|----|-------------------------------|----------------|--|
| 8  | Niue                          | No information |  |
| 9  | Papua New Guinea              | No information |  |
| 10 | Philippines                   | 6              | Sites : Baguio, Subic, Tagaytay, Cebu, Hinatuan, Tampak<br><a href="http://noah.dost.gov.ph/">http://noah.dost.gov.ph/</a>                                     |
| 11 | Samoa                         | No information |  |
| 12 | Singapore                     | 1              | <a href="http://app2.nea.gov.sg/rain_animation.aspx">http://app2.nea.gov.sg/rain_animation.aspx</a>  |
| 13 | Solomon Islands               | No information |  |
| 14 | Tonga                         | No information |  |
| 15 | Timor Leste                   | No information |  |
| 16 | United States (Hawaii region) | 4              | WSR-88D (Sites : Kauai, Molokai, Kohala, South Point)<br><a href="http://www.prh.noaa.gov/hnl/pages/radar.php">http://www.prh.noaa.gov/hnl/pages/radar.php</a> |
| 17 | United Kingdom                | No information |  |
| 18 | Vanuatu                       | No information |  |

### 3. Weather radar data exchange practices by Members of RA V

RA V region consists of majority of South-west Pacific and some Southeast Asia countries are separated by ocean, therefore only few of them have land border between their neighboring nations. In addition many of the country members do not have weather radars installed in their region. Therefore those nations are most likely assuming that radar data exchange with other countries is not a priority program.

There are few countries of the Region that have bilateral/multi-lateral agreement of radar data exchange . They are : New Zealand-Australia, and Malaysia-Singapore.

- New Zealand – Australia
  - New Zealand Meteorological Service has bilateral agreements with the Australian Bureau of Meteorology to obtain radar images (graphics) and also a commercial arrangement for raw radar data.
  - Weather radar data elements which are exchanged : Both raw and processed data
- Malaysia – Singapore
  - Currently Malaysia and Singapore have initiated bilateral cooperation in sharing radar data
  - Radar data in BUFR format is exchanged and the results of the two parties can decode the data. The two images with different system can also be integrated.

### 4. Recently emerged Radar data exchange practices

#### ASEAN countries :

ASEAN (Association of South-East Asia Nations) membership consists of some of nations in RA II and RA V region. Currently there are no collaborative initiatives collectively involved all ASEAN members for weather radar data exchange. With exception of Malaysia and Singapore that have initiate bilateral arrangements in this particular area. However, cooperation is being pursued towards the ASEAN SCMG (Sub-Committee on Meteorology and Geophysics) to get agreement among members.

SCMG encourages Members to collectively initiate regional weather data exchange among ASEAN countries since last 2 SCMG meeting in Brunei (2011) and Cambodia (2012). But



unfortunately this agenda is still on pending status and no clear follow up actions yet have been formulated by those subsequent SCMG meetings.

## **5. Summary**

- Out of 22 country members there are only 4 countries of RA V that have implemented bilateral radar data exchange, namely : Australia, New Zealand, Malaysia, and Singapore
- BUFR is the most common data format being used in the radar data exchange by some countries
- In general, due to the region of RA V has a number of island nations separated by a considerable amount of ocean, therefore those countries do not have a strong need for other country's radar data.
- ASEAN is seeking possibilities to facilitate weather radar data exchange among its Members within regional cooperation framework.