INDONESIA AGENCY FOR METEOROLOGY CLIMATOLOGY AND GEOPHYSICS

Country Report

Operation of Indonesian Weather Radar: Current Status and Future Plan

BMKG's Participants

Henrikus Jatining Wahyu Argo

Forecaster

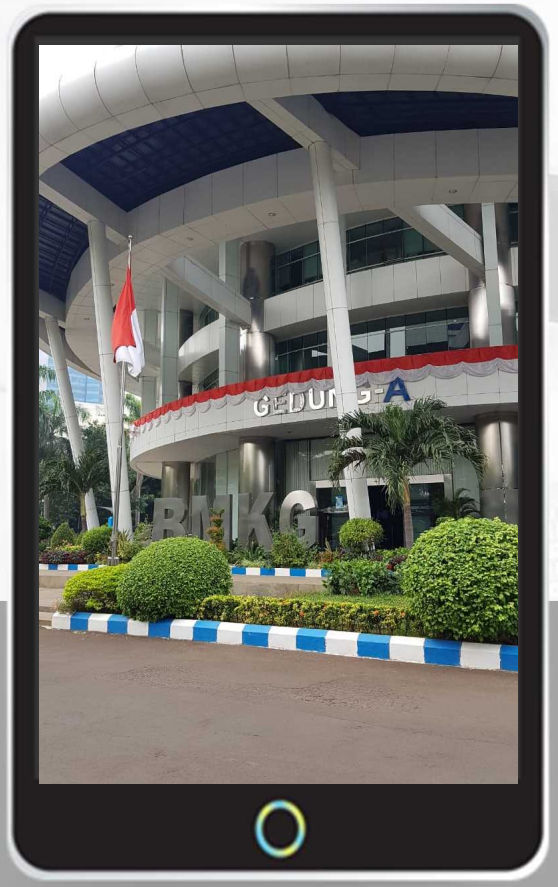
Sub Divion for Radar Imagery Processing

Idris Susanto

Forecaster

Sub Divion for Radar Imagery Processing

OUTLINE



01 **Indonesia’s Overview**

02 **Current Status and Issues of Radar Network**

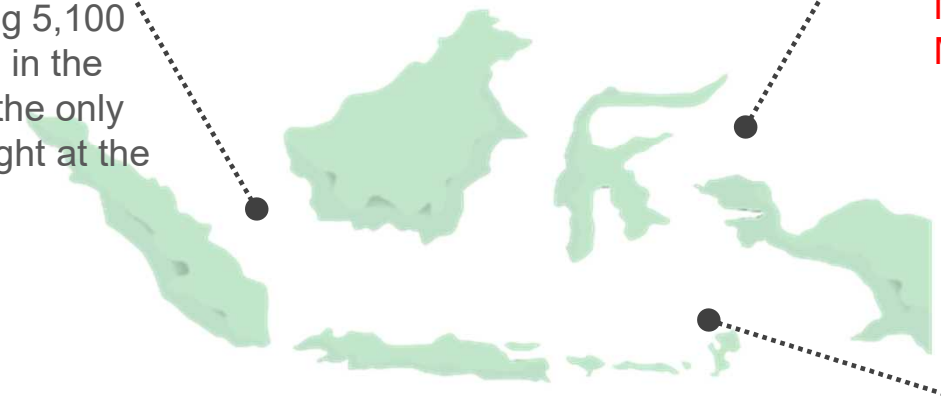
03 **Future Plan**

Indonesia Overview

A

Regional

The Republic of Indonesia is the world's largest archipelagic country with 17,508 islands stretching 5,100 kilometer from West to East, in the equator. It is also known as the only world's maritime continent right at the equator.



B

Weather

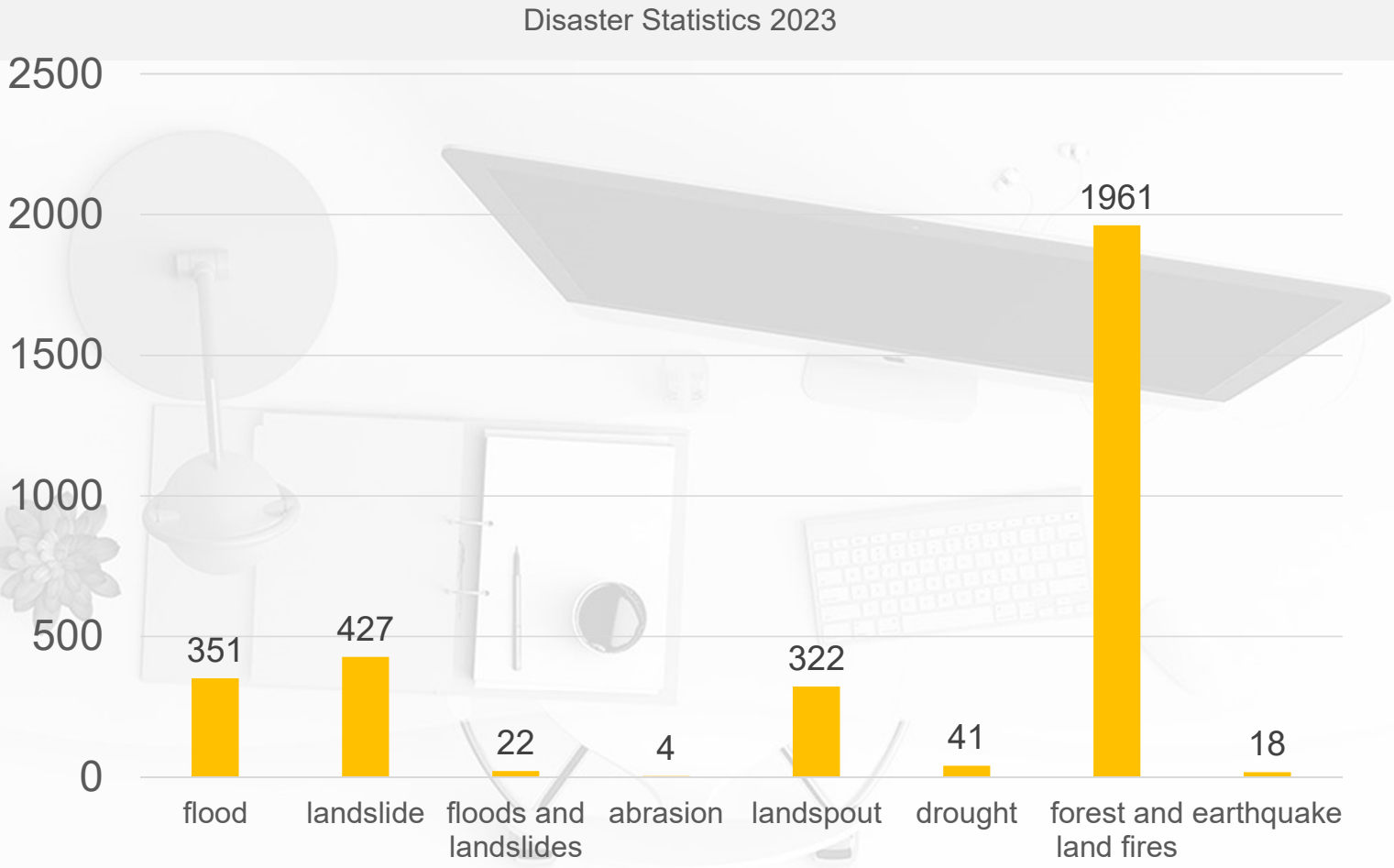
Unique climate conditions – CONTRIBUTORS : El Nino, La Nina, the Australian Monsoon and the Asian Monsoon and Indian Ocean Dipole Mode

C

Climate Characteristic

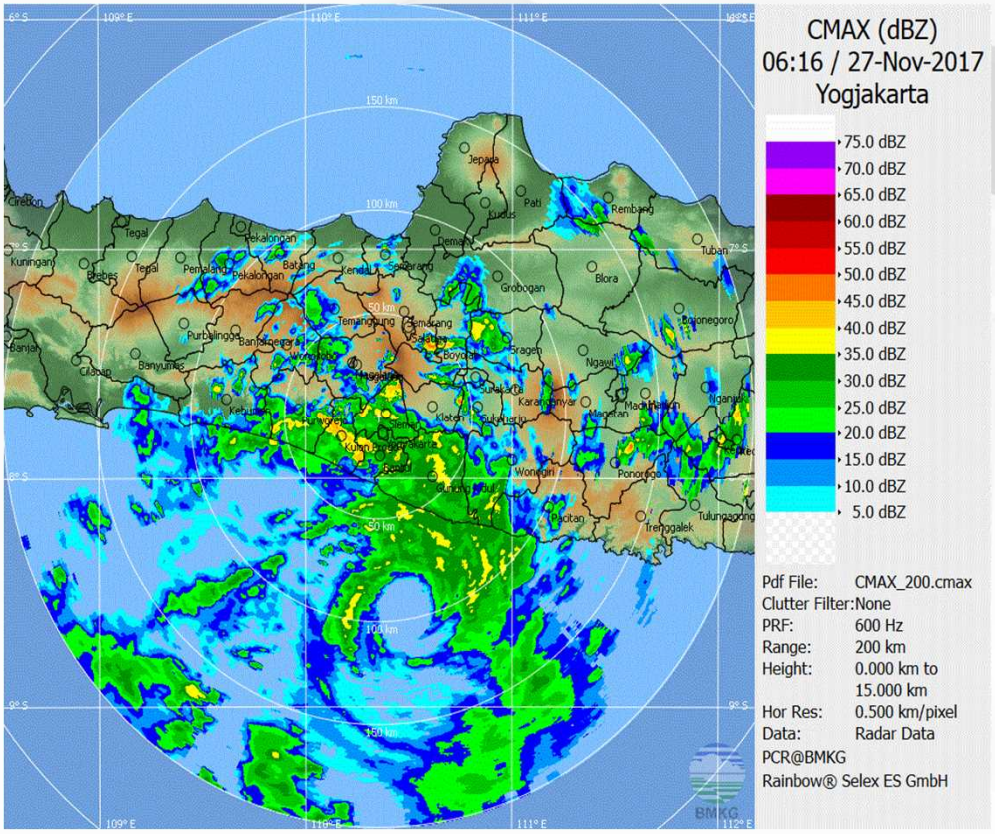
The archipelago of Indonesia belongs to the Austral - Asiatic tropical zone. This led Indonesia consist of two seasons (wet and dry seasons), as climate characteristic in Indonesia.

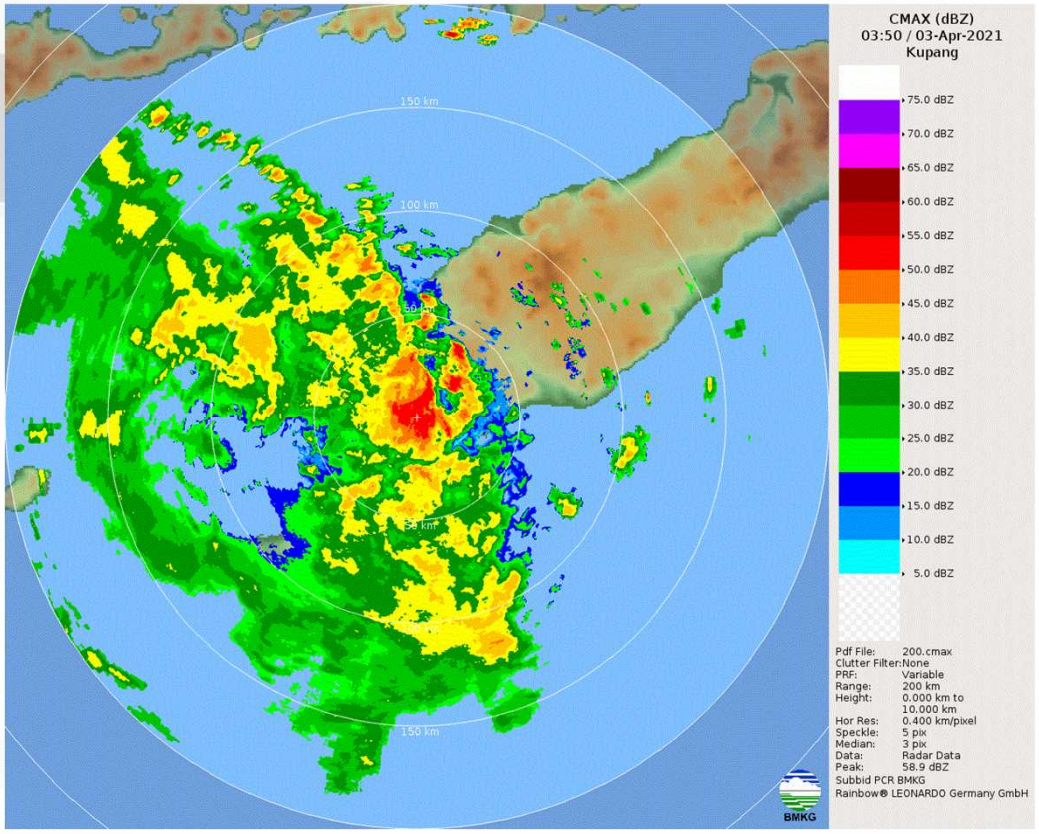
Disaster


Disaster Statistics 2023
2500
2000
1500
1000
500
0
351
427
22
4
322
41
1961
18
flood
landslide
floods and landslides
abrasion
landspout
drought
forest and land fires
earthquake

Disaster

Tropical Cyclone (Cempaka & Seroja)

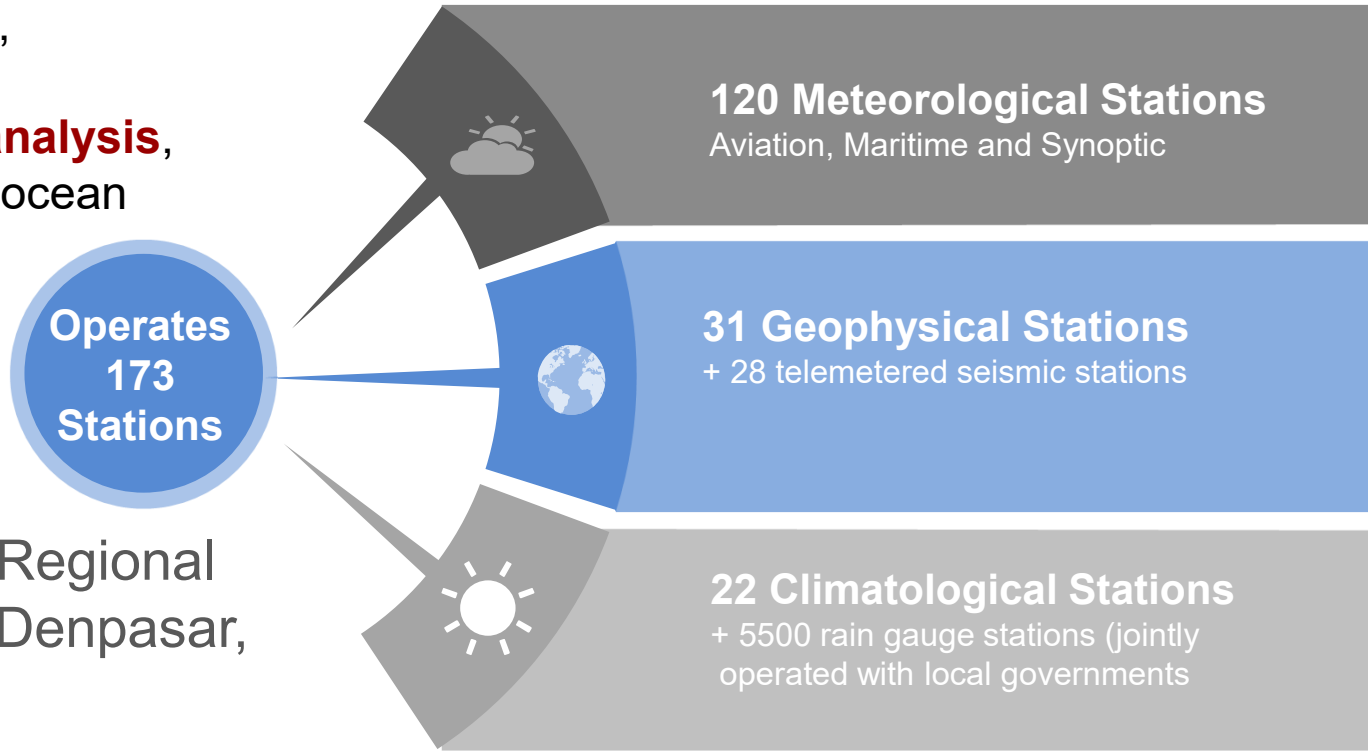




BMKG Observation Review

Part of Responsibilities:

implementation of meteorological, climatologically and geophysical **observation**, **data processing-analysis**, and **information services** in the ocean and in the atmosphere.



BMKG is composed of 5 Regional Offices (Medan, Ciputat, Denpasar, Makasar, and Jayapura)

Current Radar Observation

Total 42 + 4 Radar :

37 C band (33 Single & 4 Dual Polarization)

5 X-Band Radar

(1 Single Polarization &

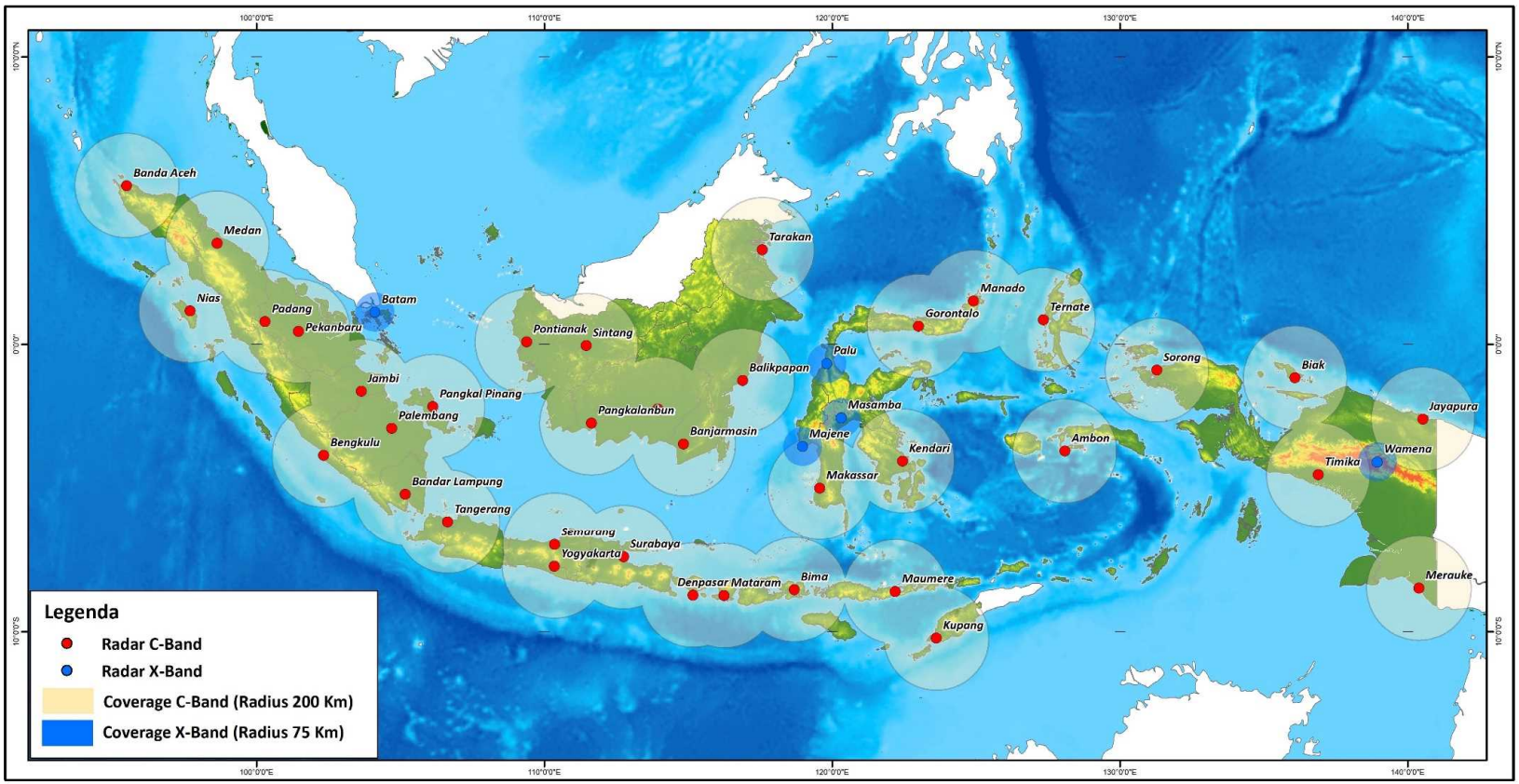
4 Dual Polarization)

3 X Band TDWR (1 Integrated)

1 C Band Dual Polarization(IAF - integrated)

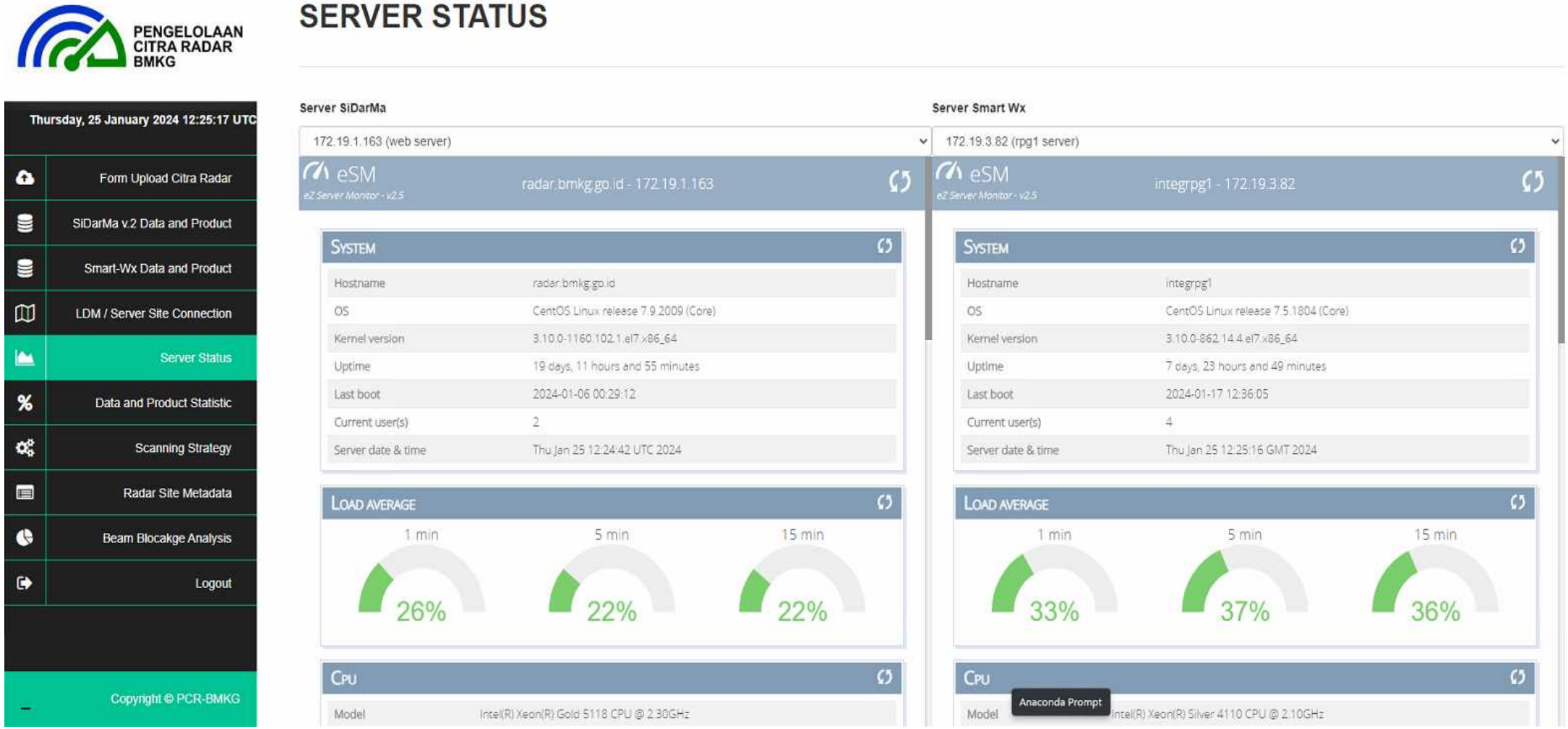
44 Radar Site Connected to BMKG's HQ

(Weather Radar Integration)



Current Radar Observation

WEATHER RADAR MONITORING SYSTEM



Issue Related to Frequency Coordination

BMKG has establish cooperation with Ministry of Communication (Since 2018)

Allocation of frequency between 5600-5650 MHz (C-Band)

Instrument related to the radio frequency in range of 5600-5650 MHz are prohibited (since 2021)

Issue Related to Radar Observation

- Partial Blocking (Artificial and natural)
- Communication over radar site and HQ
- Electricity

Radar Maintenance

Radar System regularly maintained 3 times a year

collecting information about current status of radar system (hardware and supporting facilities) and little troubleshooting

(around the first quarter of the year)

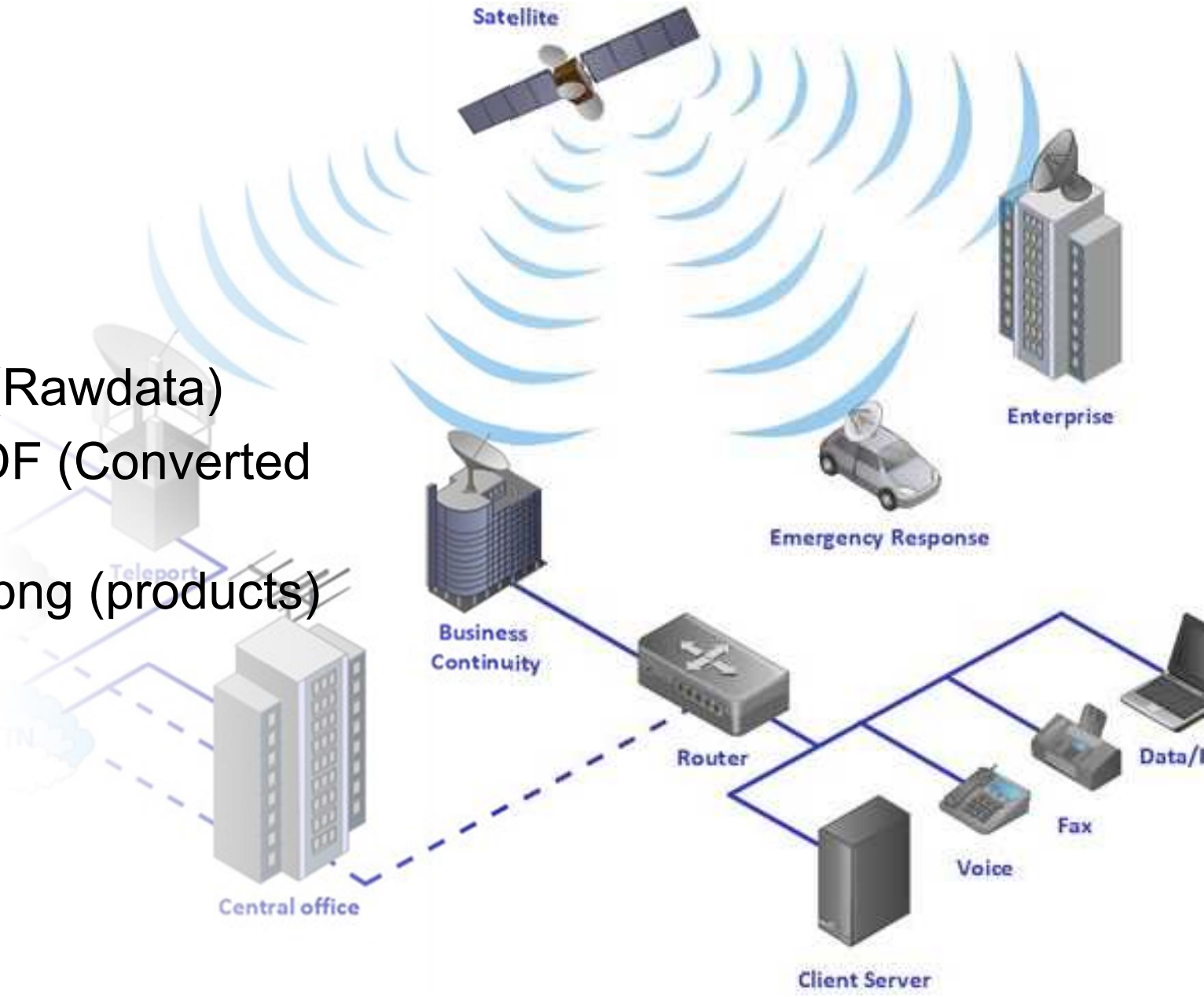
with expert radar from the manufacture to maintain and calibrate radar system, replace part if needed, troubleshooting

(around the middle of the year)

make sure everything goes well with troubleshooting, replacing part **if needed**

Data transmission Status

- Volumetric Data (Rawdata)
- HDF5 and NetCDF (Converted rawdata)
- Geotif, hdf5 and png (products)



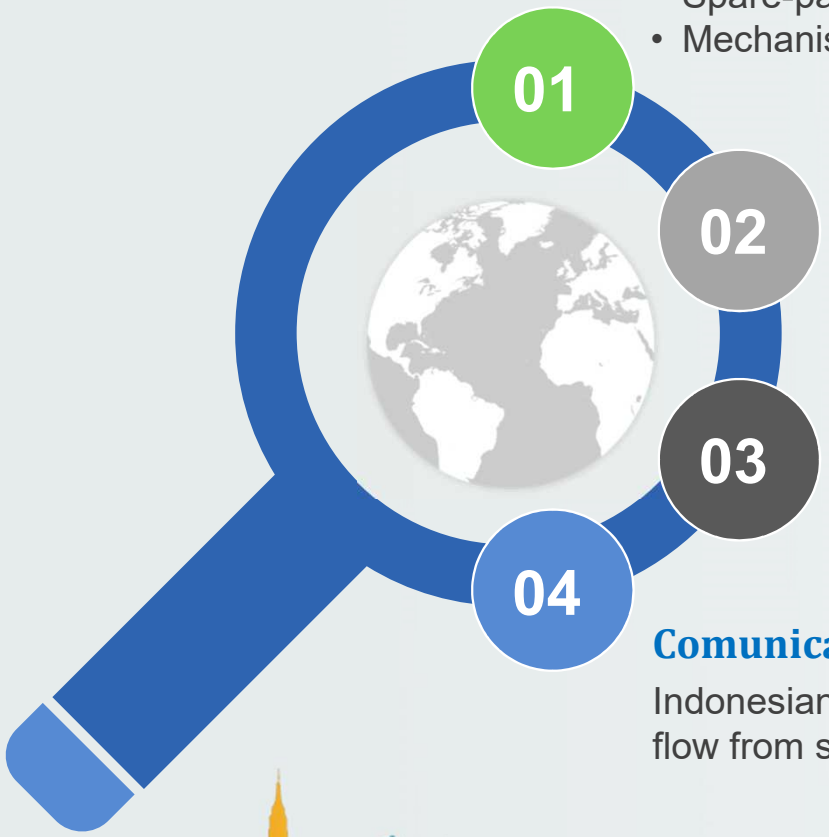
Staffing of Radar Operation

1. Planners for radar observation
2. Coordinators for installing radar system
3. Budgetary management
4. Management team of operational radar system and data
5. National dissemination of radar data

Radar of Other Organization

- Indonesia Research Agency (mobile)
- Indonesia Airforce (fixed and mobile)
- Ministry of Public Works (Integrated to BMKG)

Limitation and Challenge



Maintenance

- Spare-parts availability
- Mechanism and maintenance schedule

Radar and Supporting System

- Interference (on progress)

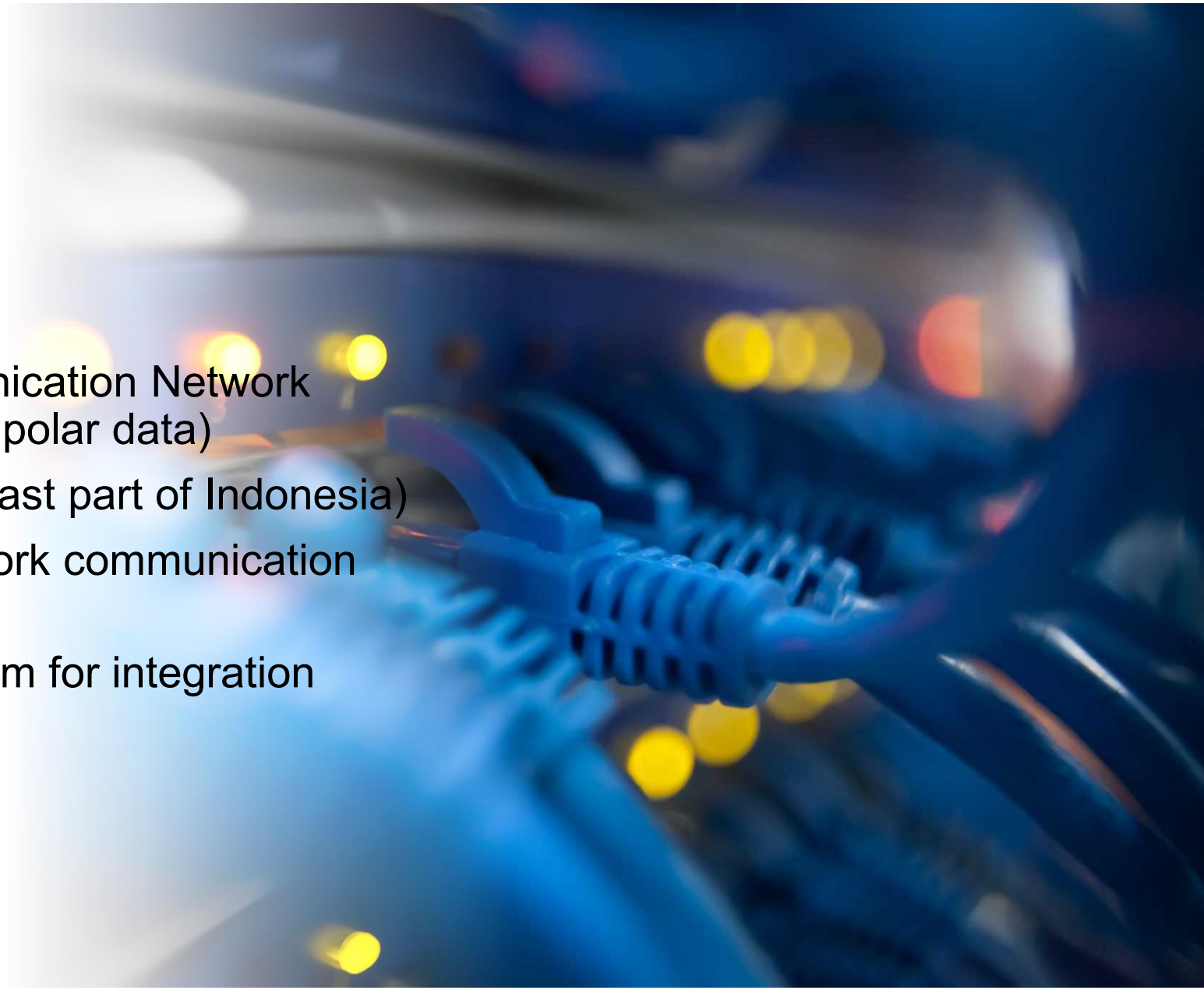
Human resource

- Number and level of well-trained radar technicians and operator for radar maintenance and radar data analysis
- Radar data processing and analysis
- Radar IT system development

Comunication System

Indonesian consist of many Island, it make specific problem in data flow from site to the HQ, especially for dual-pol radar data.

Challenges



- Stability of Communication Network (Especially for dual polar data)
- Electricity supply (east part of Indonesia)
- No redundant network communication (site-HQ)
- No redundant system for integration system

Future Plan

Radar Coverage

Improve our radar Coverage by installed more radar (expect 75 radar sites till 2024)

Radar Data Quality

Implementing pre-processing & post processing in **every each site**, so data coming into the integration system produce good product

Human resource

Improve our Operator and Technician capability by workshop and training

Interference

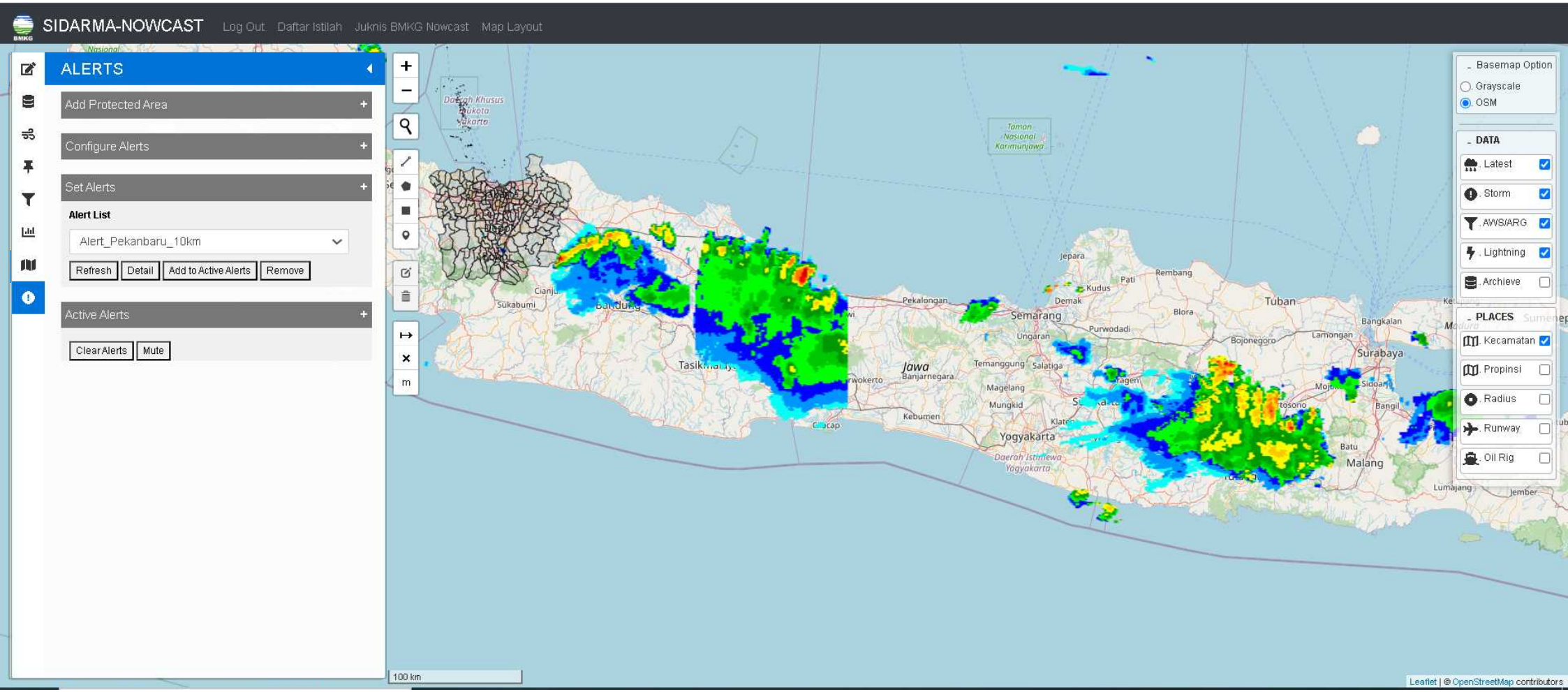
Improve our cooperation with Indonesian Ministry of Communication and Information to get allocated frequency to protect weather radar frequencies (On Progress)

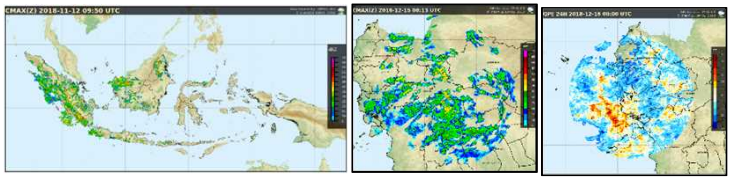
Centralized Monitoring of Radar Operational Monitoring

Facilitate the monitoring and troubleshooting, so that we have the history data of our system and support to the local technician for solving the problem. Ensuring weather radar data stability and minimized the down time

What we have done…..

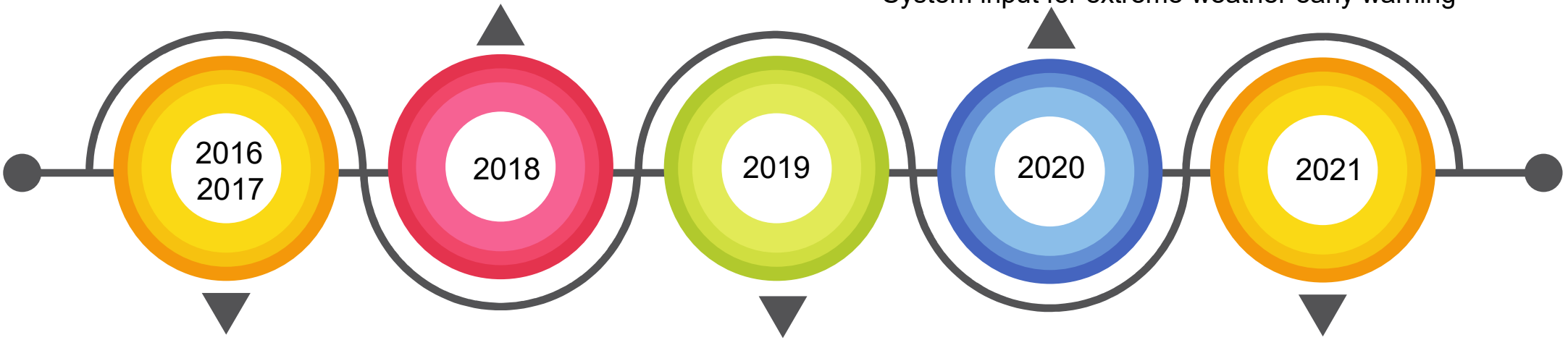
In-House Radar Data Integration System (Sidarma)



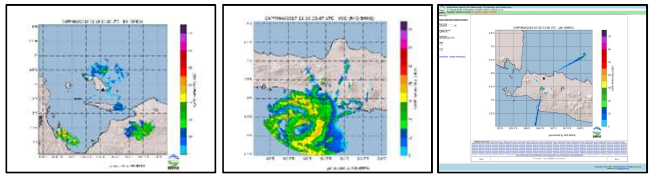


- Mosaic radar imagery
- QPE
- Radio frequency interference filtering

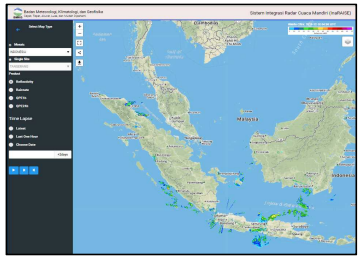
- Nowcasting algorithm implementation (TITAN, STEPS)
- SIDARMA-NOWCAST
  System input for extreme weather early warning



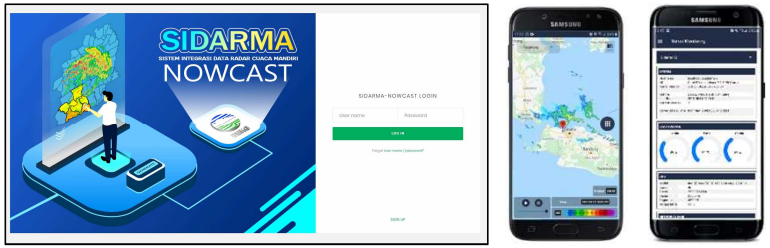
- System development initiation
- Based on open-source library (python)
- Web-based static map



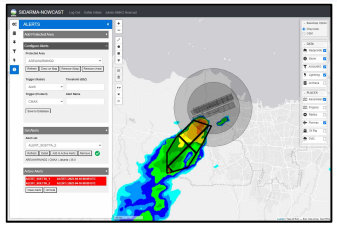
Web-GIS dissemination system updates



- SIDARMA-NOWCAST feature update
- Add HWIND, SSA, CAPPI Products
- Development of SIDARMA MOBILE apps

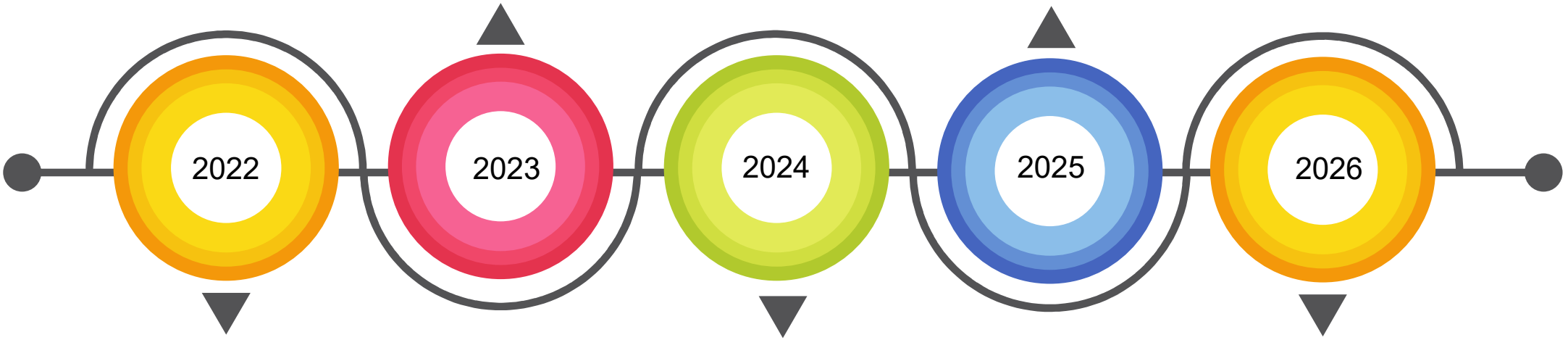


BBacking up existing integration systems

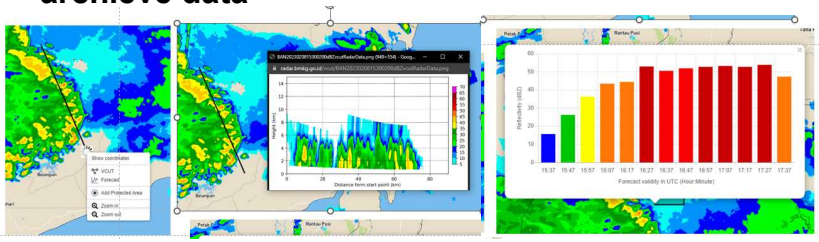


SIDARMA-NOWCAST feature update:
- Automatic alert on protected area
- Integrate AWS/ARG and LD observation network
- Radar data verification tool

- Redundant System phase 2



- SIDARMA API Service
- SIDARMA-NOWCAST feature update: **vertical cross-section, data extraction, point/area forecast, load archieve data**

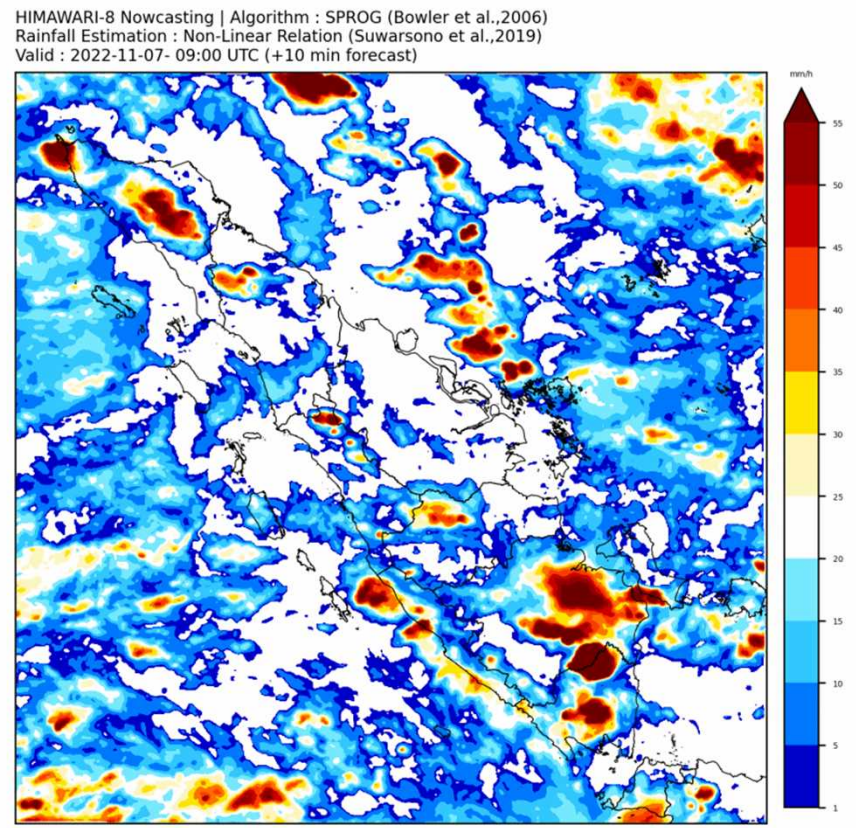


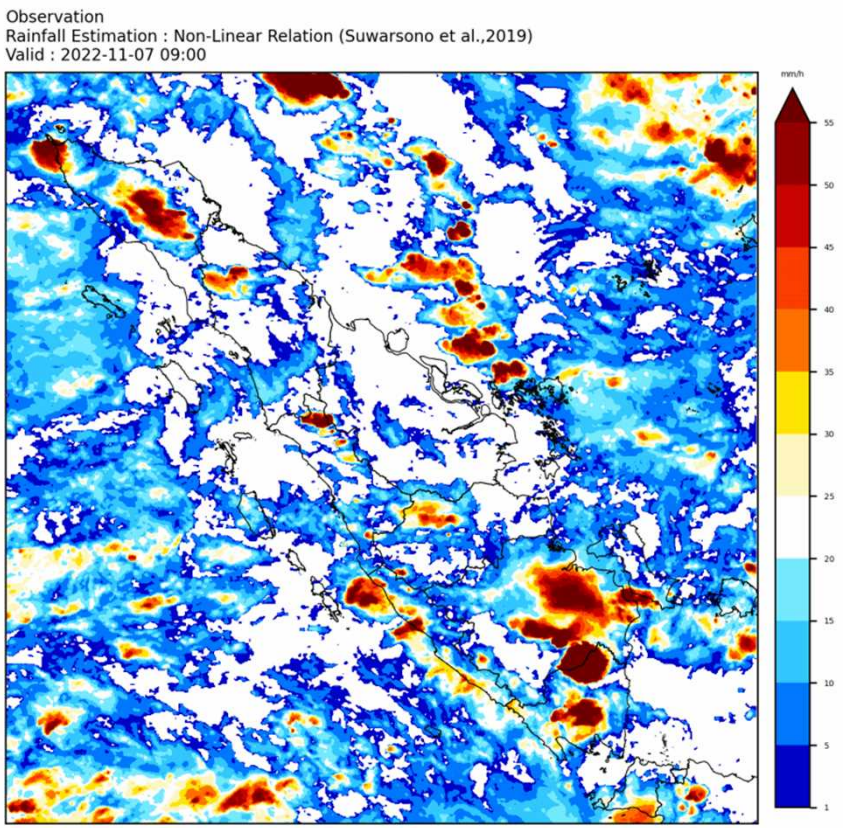
- Development of SIDARMA MOBILE apps for Ios
- Development Redundant System (Backing up existing integration systems)

?

Satellite nowcasting

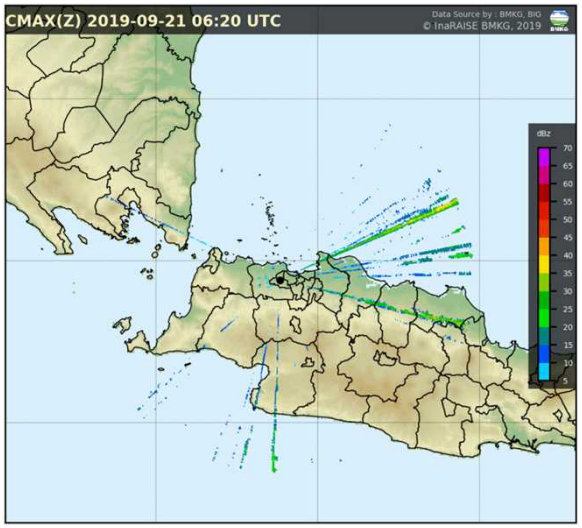
- Algoritma nowcasting satelit



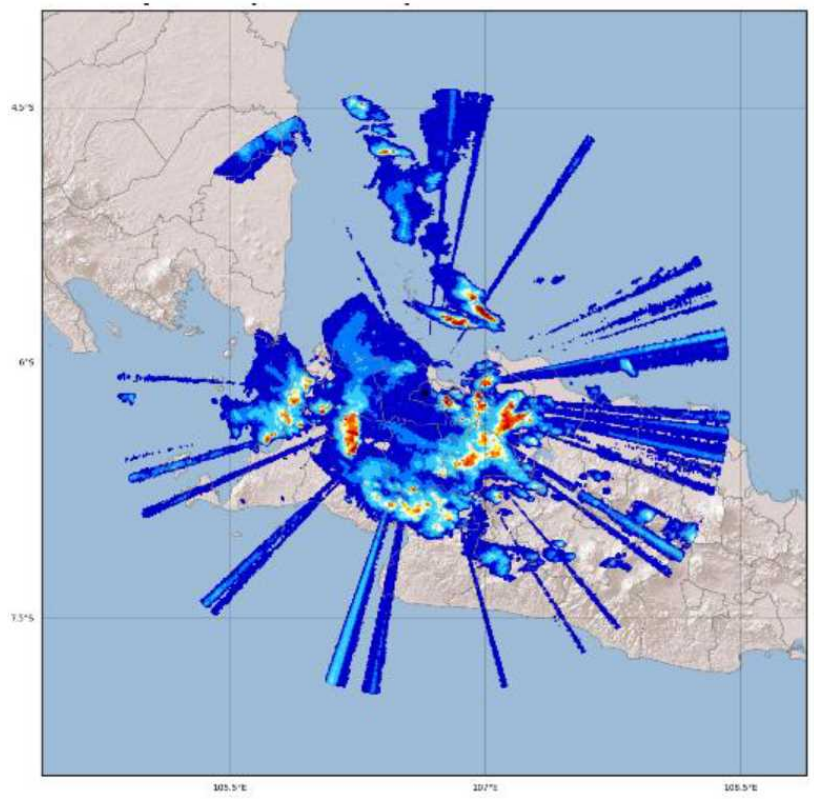


Weather Radar Data Quality Control

Radar interference form another emitter



Will affect to QPE (Quantitative Precipitation Estimation) which is one of the input data for J-FEWS



Activities performed :

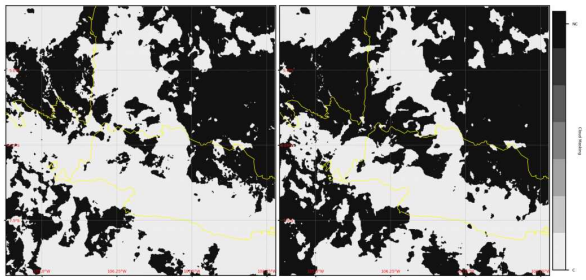
- Collaborating to Ministry of Communication to protect weather radar operating frequency
- Doing post-processing filter to remove interference spikes.

Post-processing correction

3 method already tried :

- ***Himawari-8 cloud mask***
- Doppler-velocity filter
- Beam-filling filter

Figure 1. Cloud Mask generated from Himawari-8

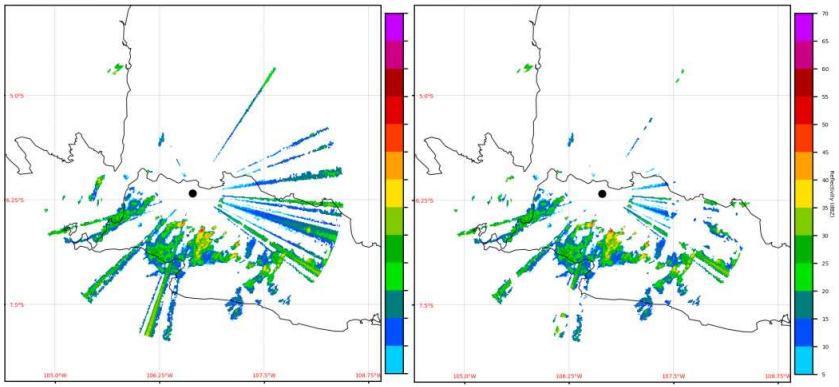


Cloud Mask 1 (IR+I3+VIS)

Cloud Mask 2 (IR+VIS)

Remarks for Himawari-8 cloud mask : not efective too remove interference spikes

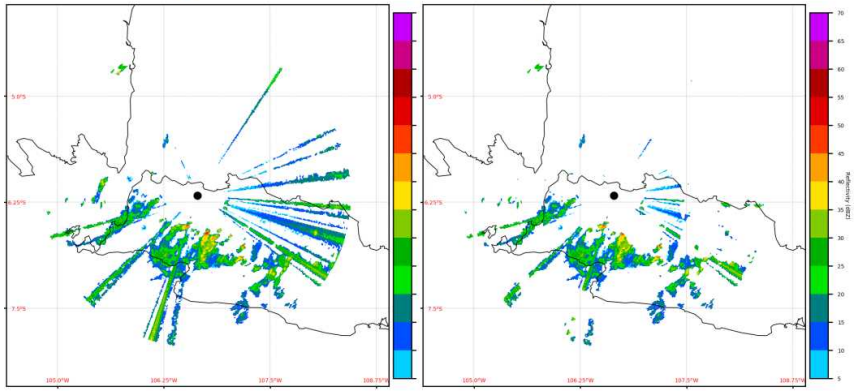
Figure 2a. Satellite Filter Applied



Uncorrected Image

Corrected Image using Cloud Mask 1

Figure 2b. Satellite Filter Applied II



Uncorrected Image

Corrected Image using Cloud Mask 2

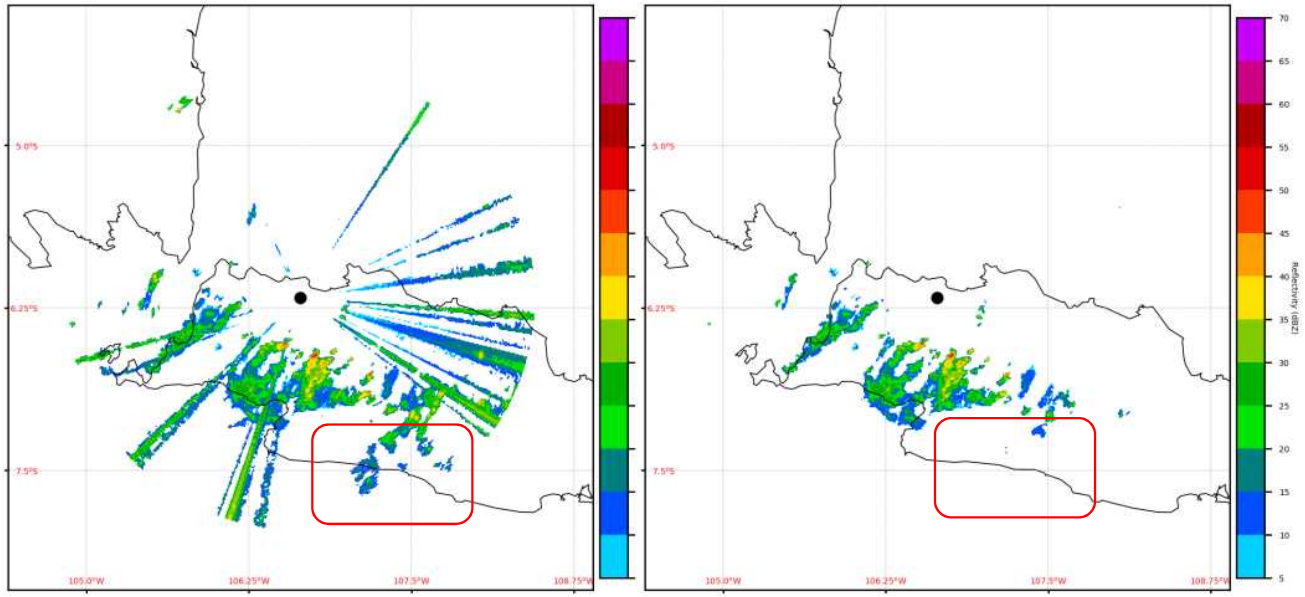
Post-processing correction

3 method already tried :

- Himawari-8 cloud mask
- ***Doppler-velocity filter***
- Beam-filling filter

Remarks for Doppler-velocty filter : efective to remove interference spikes, but there are some precipitation removed

Figure 3. Doppler Velocity Filter Applied



Uncorrected Image

Corrected Image (Doppler-velocity filter)

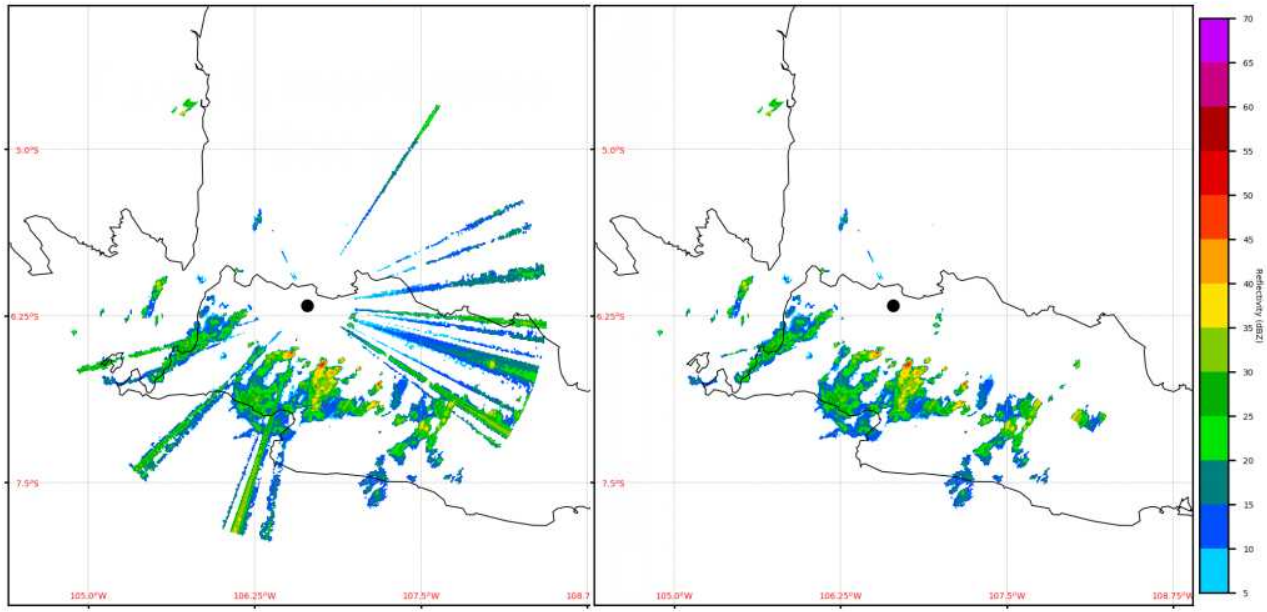
Post-processing correction

3 method already tried :

- Himawari-8 cloud mask
- Doppler-velocity filter
- ***Beam-filling filter***

Remarks for Beam-filling filter : efective to remove interference spikes, ther is no precipitation removed

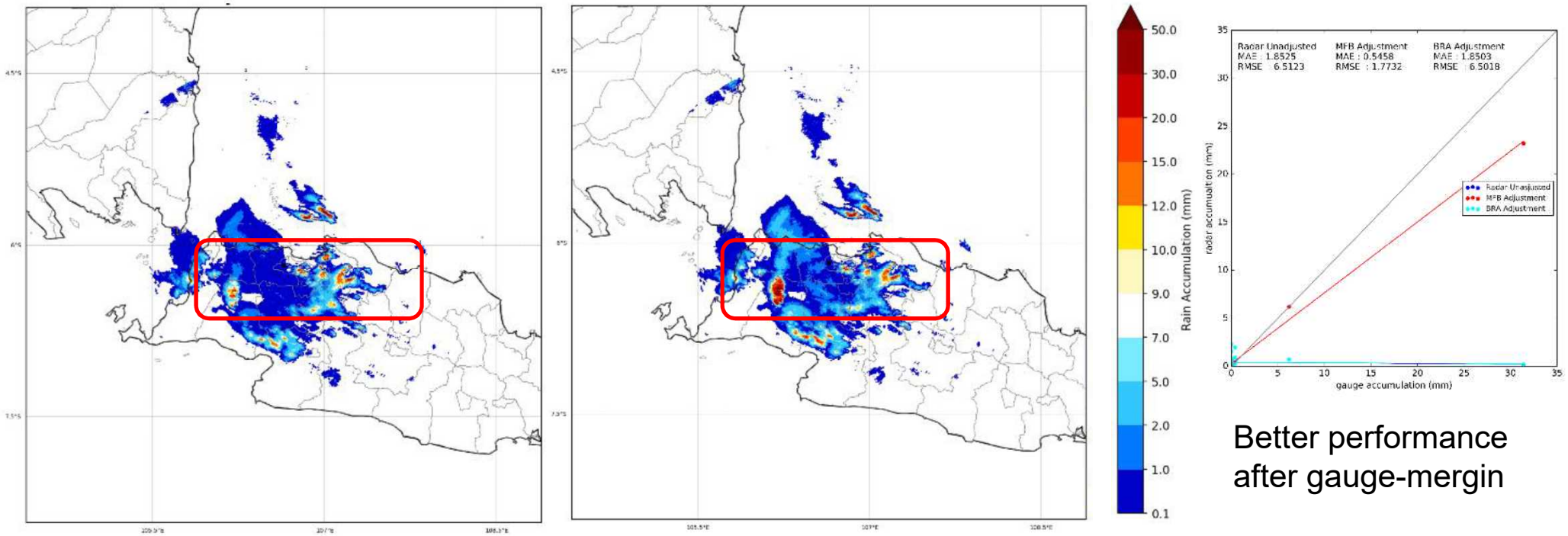
Figure 4. Beam fill filter



Uncorrected Image

50% Beam filled with data

Radar-Gauge merging



Better performance after gauge-mergin

Radar - gauge merging is important to improve QPE accuracy.

Thank You