Observation network and data collection and processing systems

TRILOK SINGH
INDIA METEORLOGICAL DEPARTMENT
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Observation Network

Provide a summary of your observation network:

1. **Synoptic stations**
   - ❖ Total number of stations are 340 and same number shared in GTS, 3 hourly
   - ❖ BUFR and ASCII Format

   - Buoy Data – 12 Nos. (BUFR and ASCII Format)

2. **Automatic Weather Stations**
   - ❖ Total number of stations – 716
   - ❖ GPRS and data in CSV and ASCII Format

3. **Radio-sounding network**
   - ❖ Total number of stations - 56
   - ❖ 56 stations data shared on GTS and 12 Hours frequency i.e. (00 and 12 UTC)
   - ❖ Data formats used (ASCII, BUFR)

Data Collection and Processing Systems

1. **Data Collection**:

   Satellite, GPRS, Manual

2. **Data Aggregation**:

   Automatic Switching System

3. **International Data Sharing**:

   RTH New Delhi and GISC

4. **IT Infrastructure**:

   Software - AMSS

   Server - 5 (RTH and WIS)

   Internet Bandwidth – 1 GBPS

   RMDCN – 6 MBPS

WIS 2.0 Training Workshop, Guangzhou, China, 15 September 2025

National observation networks: Station types, data loggers, data formats, and IT Infrastructure

Report by: Mingjiao GONG
GISC Beijing
National Meteorological Information Centre (NMIC)
China Meteorological Administration (CMA)

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Observation Network

- **Synoptic stations (total number, number of stations shared in GTS, and frequency)**

  We have 372 Synoptic stations, which are shared in GTS.

  Frequency： 224 stations update every 3 hours, other stations exchange 8 times a day.

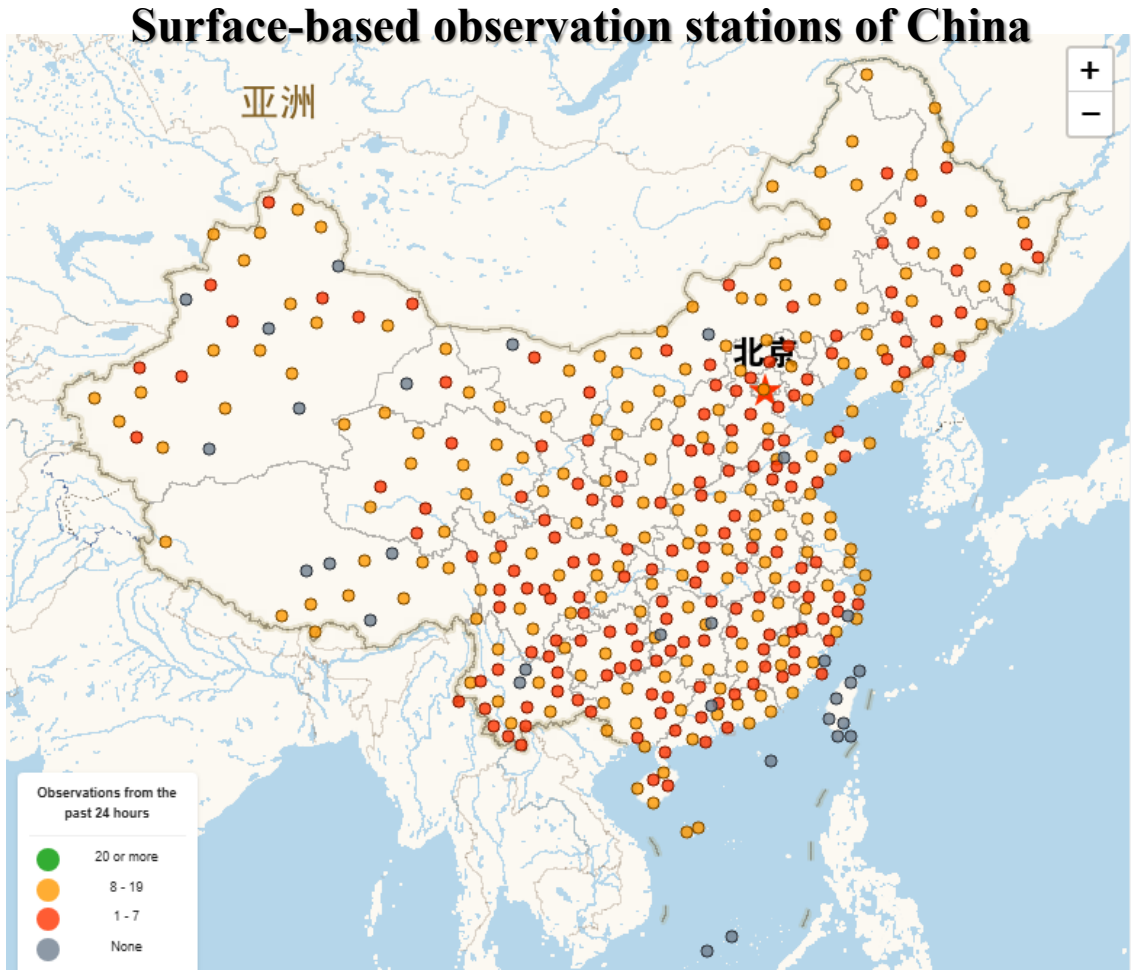
- **Automatic Weather Stations (number and brand, shared or not shared in GTS/WIS)**

  We have 372 Automatic Weather Stations which are shared in GTS/WIS2

  The main brands are Huayunshengda (Beijing) and Aerospace New Sky Technology.

- **Radio sounding network (number, shared or not shared in GTS)**

  We have 88 upper-air stations which are shared in GTS.



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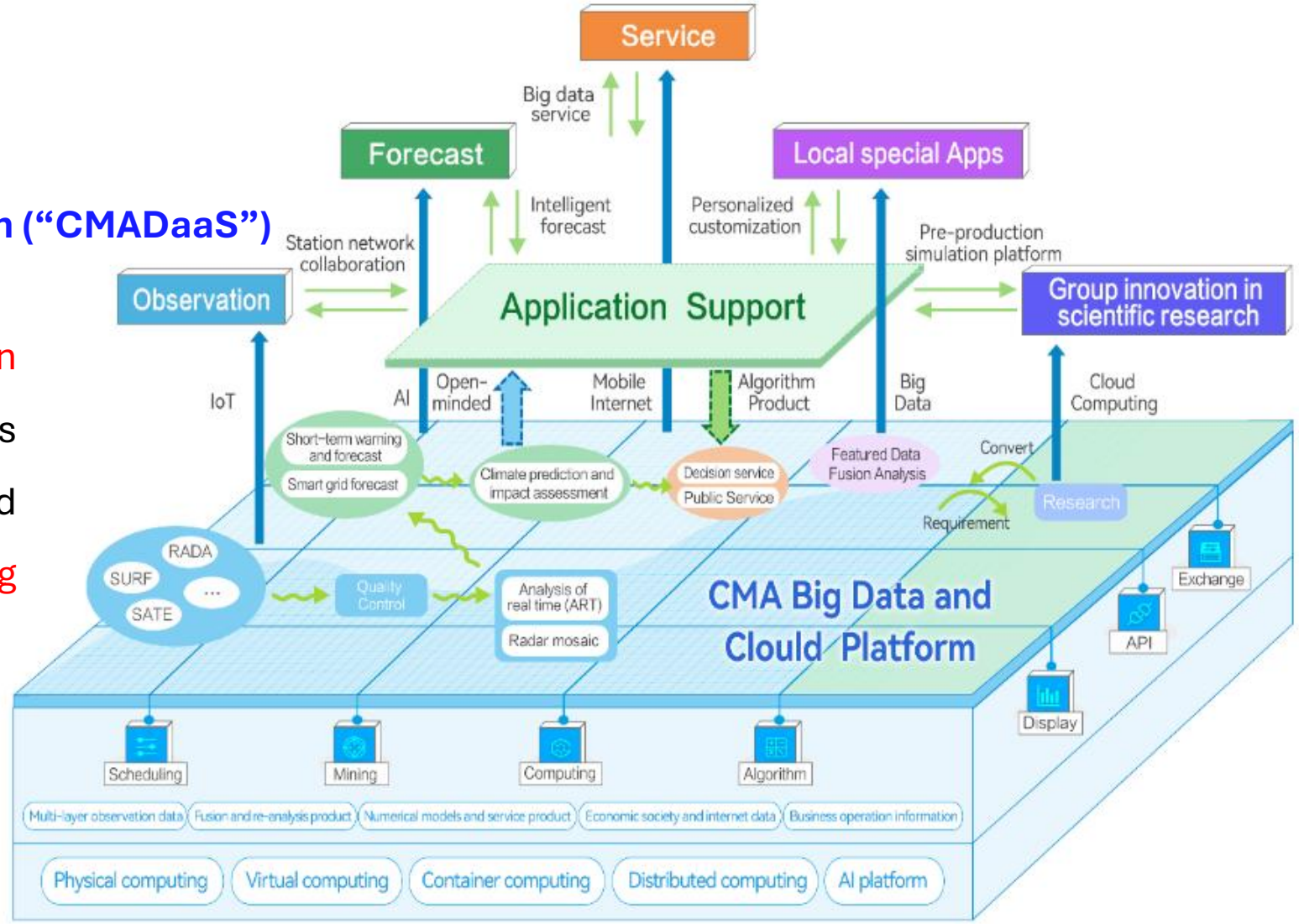
The use of data in China

In China, we use **SYNOP, TEMP, AMDAR, satellite data, etc.** to support weather forecast and climate prediction.

CMA Big Data and Cloud Service Platform ("CMADaaS")

The "CLOUD + TERMINAL" is the foundation of the new meteorological business technology system, providing unified platform services of "data, computing power and algorithm".



CMA Big Data and Cloud Service Platform Architecture Diagram

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IT and Telecommunication Infrastructure

- **Servers (number)**
  Total 30 (GTS servers:5 + GISC servers:4 + WIS 2.0 servers:21)
- **Automatic Switching System (brand)**
  In-house software
- **Connectivity used to collect data from AWSs**
  Terrestrial broadband network, mobile networks (4G/5G), satellite communication system.
- **Principal RTH, GISC**
  RTH Beijing and GISC Beijing

RTH Beijing Area of Responsibility

- China
- Democratic People's Republic of Korea
- Vietnam

GISC Beijing Area of Responsibility

NCs (7):

- China
- Hong Kong, China
- Macao, China
- Democratic People's Republic of Korea
- Mongolia
- Nepal
- Pakistan

DCPCs (6):

- WWIS (Hong Kong, China)
- WMC (CMA)
- RSMC (CMA)
- BCC/NCC (CMA)
- NSMC (CMA)
- RTH (CMA)

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IT and Telecommunication Infrastructure

CMA assumes the responsibility of RTH in Region II of WMO.

- **Telecom (Internet bandwidth, RMDCN,...)**

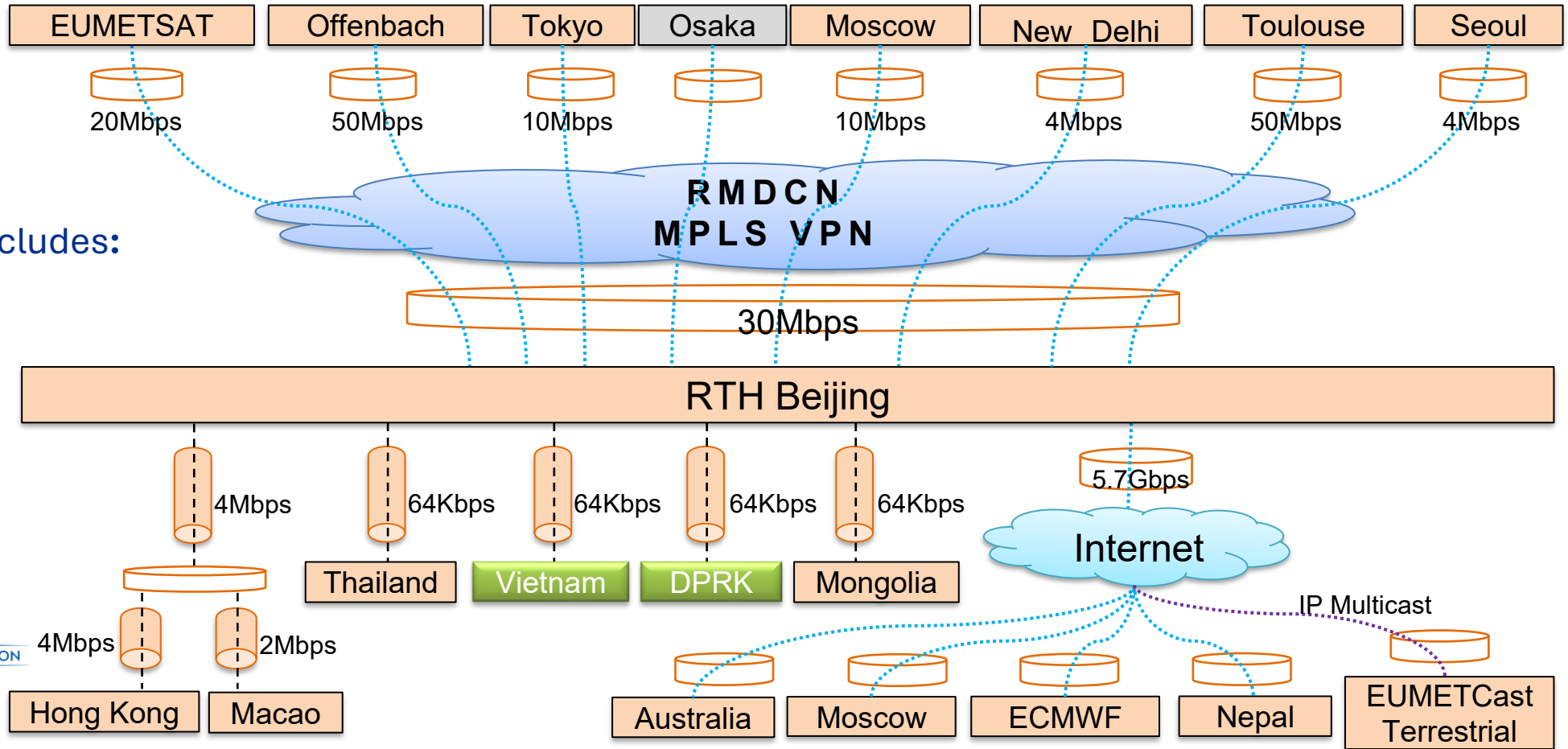
  Internet bandwidth: 5.7Gbps.

  RMDCN bandwidth: 30Mbps.

  Delicate line: Connecting with Thailand, Vietnam and other six members, bandwidth from 64Kbps to 4Mbps.

GTS data exchange includes:

- surface
- upper-air
- ocean/ship/buoy
- satellite
- NWP products
- ...



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Thank you
Merci
Gracias
شكرا
谢谢

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Observation network and data collection and processing systems in Lao PDR

Bounteum SISOUPHANTHAVONG
Department of Meteorology and Hydrology
Ministry of Agriculture and Environment
Lao PDR

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Observation Network

Provide a summary of your observation network:

1. Synoptic stations

- number of stations: 22
- number shared in GTS: 22, frequency: 5 stations/every 3 hours; 17 stations (00, 03, 06, 09 and 12 UTC)
- Which format: SYNOP

2. Automatic Weather Stations (AWS)

- Total number of stations: 117
- Number of stations shared on GTS and update frequency: None
- Data logger types and data formats (OTT, HyDro Spider,

3. Radio-sounding network

- Total number of stations: 0, **under Donation Project (Wind Profiler)**
- Number of stations shared on GTS and update frequency
- Data formats used (ASCII, BUFR, or other to specify)

Data Collection and Processing Systems

1. Data Collection:

- The Department of Meteorology and Hydrology (DMH) of Lao PDR currently operates a centralized, web-based system **" MNEO"** to manage all meteorological and hydrological data workflows.
- This platform supports the collection, aggregation, storage, and dissemination of observational data from national and international sources.
- Data is collected from a diverse range of observation networks, including
  - Automatic Weather Stations (AWS) provided through various programs and partners (WB-MIWRM, DRM, ADB, FAO, WMO, China, Korea, Japan, Thailand, MRC). These stations collect real-time meteorological and hydrological data.
  - Other Observational sources :
    - ➢ Lightning detection system (TOA)
    - ➢ Satellite observations from GK2A, FengYun, and Himawari
- Data is transmitted using multiple protocols:
  - ➢ GSM, FTP, HTTP REST API, and Socket connections.
- Collected data includes both meteorological and hydrological parameters, gathered in formats such as BUFR, CSV, and ASCII.
- All incoming data is routed directly into the MNEO system, where it is continuously monitored and processed.

2. Data Aggregation:

- The MNEO platform delivers automated aggregation and processing of observational data, with the process centrally managed by its core component — the Automatic Meteorological Switching System (AMSS). Deployed within the NEO Kubernetes cluster, AMSS is responsible for coordinating the flow of incoming data streams from diverse observation networks. This architecture ensures reliable, continuous data workflows suitable for both internal operations and external dissemination.
- Core Capabilities:
  - ❖ Real-time data compilation from various sources
  - ❖ Reliable messaging between processing services using RabbitMQ
  - ❖ Microservices dedicated to data ingestion, decoding, threshold monitoring, and export preparation
  - ❖ Aggregated data is stored across PostgreSQL and NoSQL database systems

3. International Data Sharing:

Lao PDR currently operates an active link to the WMO Global Telecommunication System (GTS) via RTH Bangkok, Thailand.

4. IT Infrastructure:

- DMH uses the MNEO system, is a Web Application created and provided by Campbell Scientific which is interacting with backend composed of several services. It uses different databases which are split between a SQL and No-SQL Databases.

- MNEO allows accessing a large range of weather data (meteorological observations, forecasts and products), via a user-friendly web browser UI. In order to display real-time and weather forecast data, MNEO manages an Automatic Message Switching System

- It is deployed in a Kubernetes cluster using physical servers and virtual machines, managed with vSphere. It uses Fast Storage (NVMe SSD) for daily operations and NAS Storage (NLSAS-12Gbps) for backups, both connected via NFS protocol. The network is divided into VLANs for cluster, storage, and management traffic, with redundancy provided by two core switches in STACK mode. The system is monitored and managed using tools like K8s Dashboard, Portainer, and Harbor, with Kubernetes ensuring high availability and scalability for the application. Security is maintained through a firewall protecting all network communication.

- Users with appropriate credentials can access MNEO UI through secured Login web page; once logged in, users can customize their working space following personal needs.
- MNEO offers two access modes:
  - Internal: Used by forecasting, climatology, and hydrology teams via dedicated DMH workstations.
  - External: Accessible through a public web portal (https://neo.dmh-monre.gov.la) to support public users.
- This integrated system ensures MNEO is a reliable, high-performance platform for managing and sharing environmental and meteorological information.

wmo.int

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Observation network and data collection and processing systems

Ahmed Zalif
Maldives Meteorological Service
Maldives

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Observation Network

Provide a summary of your observation network:

1. **Synoptic stations**
   - number of stations, number shared in GTS, frequency: **5 stations and all are shared in GTS, 1 more synoptic station will be established soon**
   - Which format (SYNOP or BUFR): **SYNOP**

2. **Automatic Weather Stations**
   - Total number of stations: **42 Stations but only 31 stations are in operation currently**
   - Number of stations shared on GTS and update frequency: **None**
   - Data logger types and data formats: **Campbell Scientific CR800, CAE MHASTER, CAE Compact Plus. CSV format**

3. **Radio-sounding network**
   - Total number of stations: **1, now out of service, working on upgrade under SOFF project**
   - Number of stations shared on GTS and update frequency: **Once at 12:00**
   - Data formats used (ASCII, BUFR, or other to specify): **TEMP**

Data Collection and Processing Systems

Please provide an overview of your current data collection and processing systems, including:

1. **Data Collection**: How is data gathered from your observation network?

Synoptic Stations data are collected manually, and AWS data are sent through mobile network

2. Data Aggregation: What methods or systems are used to compile and organize the collected data?

All data are collected and displayed with charts in CAE Datalife system.

3. International Data Sharing: How is your data currently published on the GTS?

We have dedicated circuits to RTH Delhi and RTH Melbourne

4. IT Infrastructure: What hardware, software, and platforms used for these tasks?

Dell HPC server, Lenovo x3500 M5, MESSIR software, Datalife software, AHMS, vSphere, Windows, Linux

Observation network and data collection and processing systems

Nguyen Viet Huy
Viet Nam Meteorological and Hydrological Administration
(Hydro-Meteorological Information and Data Center)

Viet Nam

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Observation Network

Summary of the observation network:

1. **Synoptic stations**
   - number of stations: 213
   - number shared in GTS: 33 (frequency: 3h)
   - Which format (SYNOP or BUFR): Both

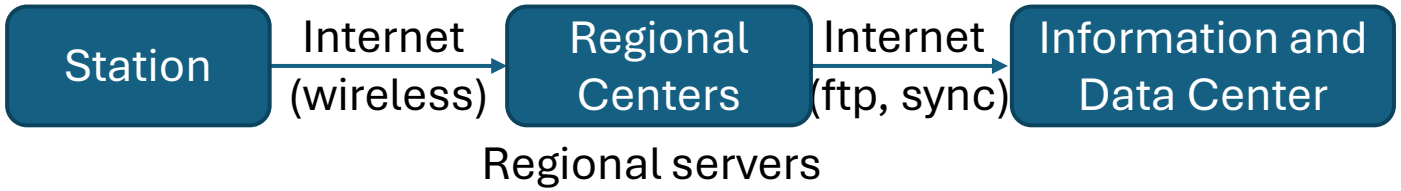
2. **Automatic Weather Stations**
   - Total number of stations: ~4500 (-4000 rain gauge, -200 meteo station, ~300 hydro station)
   - Number of stations shared on GTS: 0
   - Data logger types and data formats: from some providers (Campbell, CaE, OTT ....) with specified format (binary, csv, xml ...)

3. **Radio-sounding network**
   - Total number of stations: 6
   - Number of stations shared on GTS : 6 (frequency: 12h)
   - Data formats used (ASCII, BUFR, or other to specify): ASCII

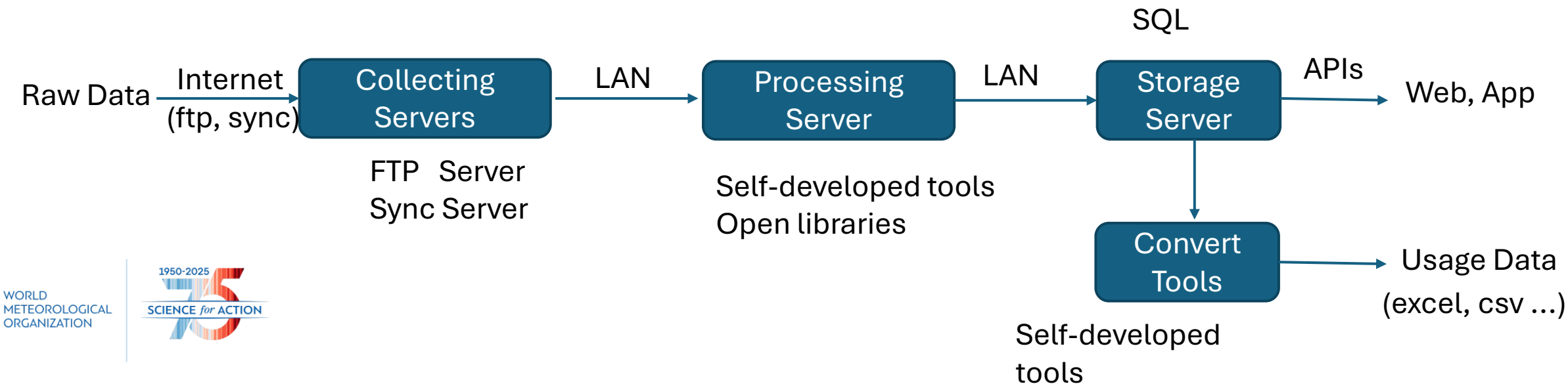
Data Collection and Processing Systems

Overview of the current data collection and processing systems:

Data Collection: How is data gathered from the observation network?



Data Aggregation: What methods or systems are used to compile and organize the collected data?



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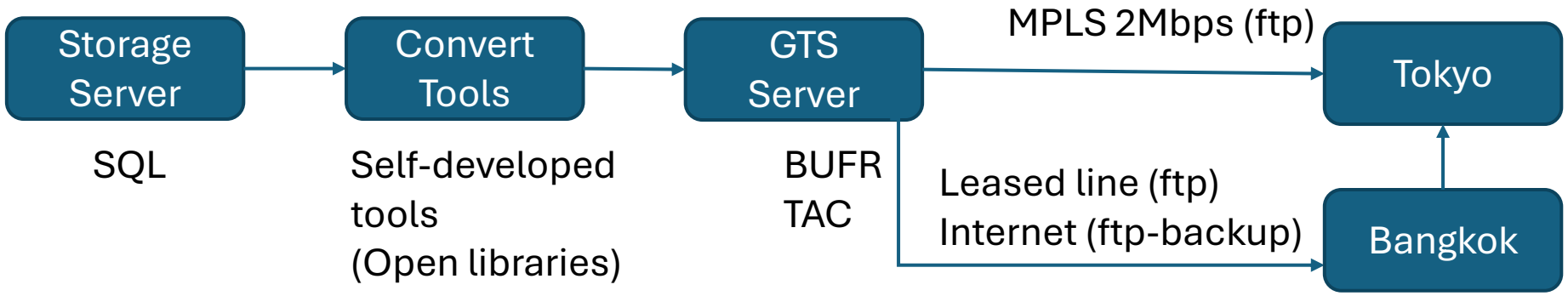
Data Collection and Processing Systems (cont.)

Overview of the current data collection and processing systems:

International Data Sharing: How is the data currently published on the GTS?



IT Infrastructure: What hardware, software, and platforms used for these tasks?

- Hardware: IBM and Dell servers, quite old and overload
- Software: SQL Server (data storage) , Self-developed Software Tools (C# and Python, with open-source libraries)
- Platforms: Servers (Windows and Ubuntu); Automatic stations (3G/4G transmission platforms by Vietnamese providers), Leased lines (managed by VNPT)

Observation network and data collection and processing systems

W.P Kelum Priyadharsena
Department of Meteorology
Sri Lanka

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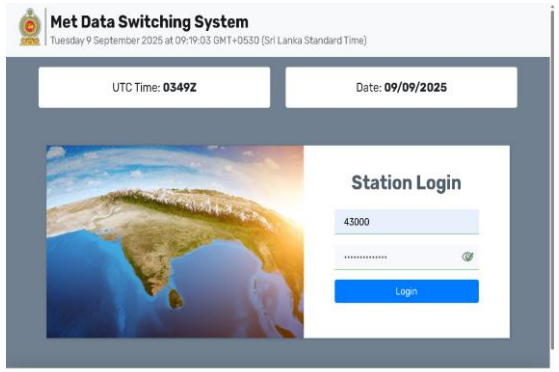
Observation Network

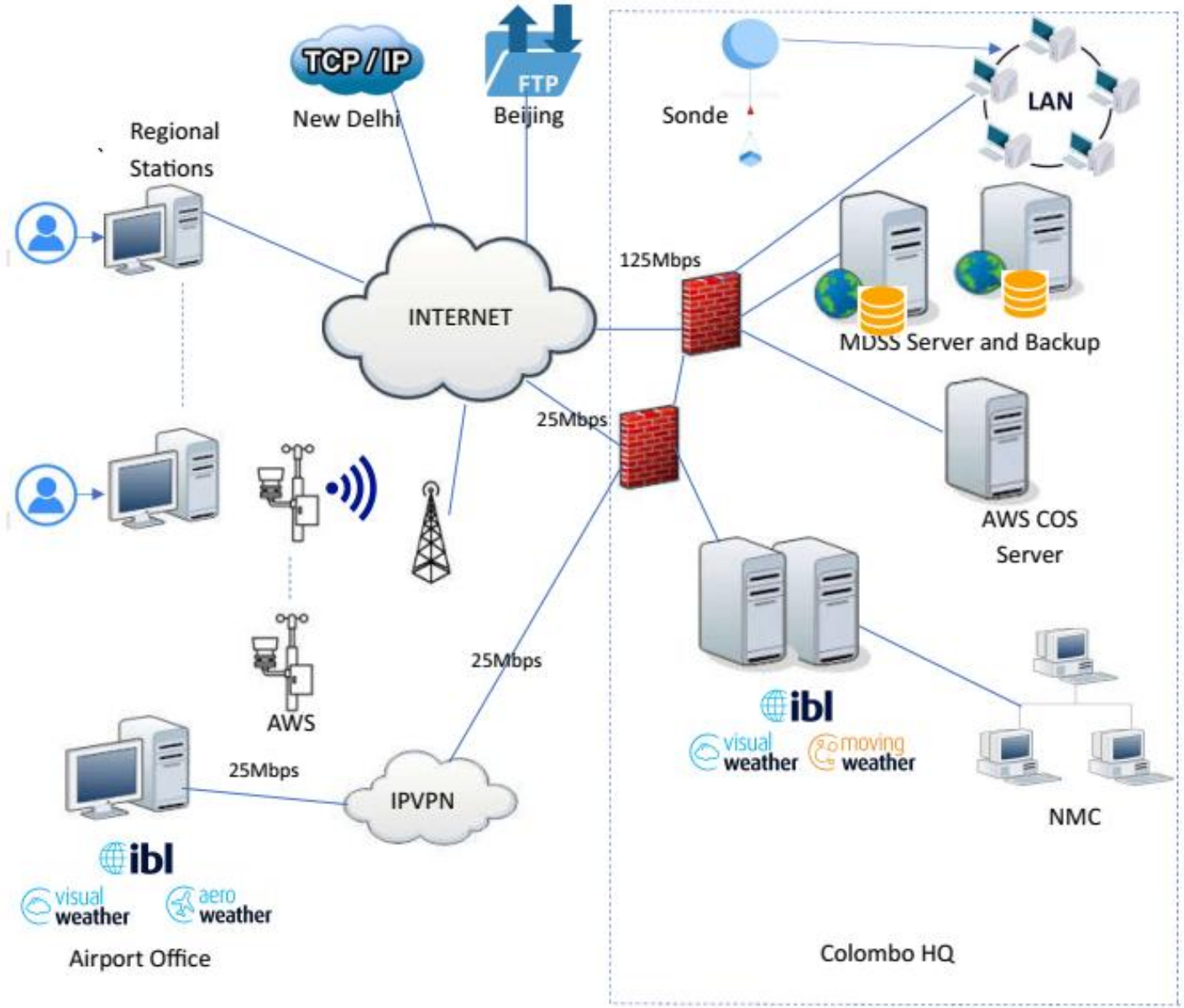



Summary of observation network:

1. **Synoptic stations**
   - Total stations: 24
   - Shared on GTS: 8 (hourly), 16 (3-hourly)
   - Format: BUFR
2. **Automatic Weather Stations**
   - Total stations: 35
   - Transmitting to Colombo HQ: 15
   - Shared on GTS: 8 (hourly)
   - Data logger type: Meisei (Japan) – obsolete, to be upgraded
   - Data format: CSV/SQL
3. **Radio-sounding network**
   - System: Meisei Japan IMS-100
   - RadiosondeTotal stations: 1 (Colombo), expanding to 2 (with Trincomalee under modernization project)
   - Shared on GTS (updates in BUFR format)

Data Collection and Processing Systems





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Observation network and data collection and processing systems

PA PA SWE
Department of Meteorology and Hydrology
MYANMAR

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Observation Network

Provide a summary of your observation network:

1. **Synoptic stations**
   - number of stations(**82**), number shared in GTS(**51**), frequency (00,03,06,09,12,15) (**6** times)
   - Which format (SYNOP or BUFR) **SYNOP**

2. **Automatic Weather Stations**
   - Total number of stations (**158**)
   - Number of stations shared on GTS (**51**) and update frequency (**6** times)
   - Data logger types and data formats **Campbell Scientific , CSV format**

3. **Radio-sounding network**
   - Total number of stations (**2**)
   - Number of stations shared on GTS and update frequency **(Nill) But now it is not issued due to the GPS interference**
   - Data formats used (ASCII, BUFR, or other to specify) **ASCII**

Data Collection and Processing Systems

Please provide an overview of your current data collection and processing systems, including:

1. **Data Collection**: How is data gathered from your observation network?

manual observer and AWS data logger

2. Data Aggregation: What methods or systems are used to compile and organize the collected data?

The head office receives the observation data from the remote station by using the phone and the duty staff enter the collected data on PC manually and go to transmission automatically with message switching system. Although we have an observation station numbered over 100, we can share only 51 stations' data with GTS. (detailed next slide)

3. International Data Sharing: How is your data currently published on the GTS?

The data are shared via GTS THAILAND, INDIA and JAPAN

4. IT Infrastructure: What hardware, software, and platforms used for these tasks?

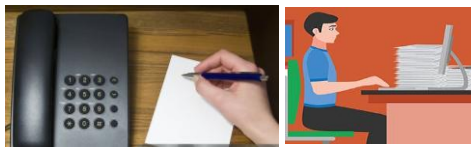
Hardware	**Dell Precision Tower 3620**
Software	**MSS (Message Switching System)**
Platforms	**Windows 10 pro**

2. Data Aggregation: What methods or systems are used to compile and organize the collected data?

Data Collection & entry manually

Manual observation
24 stations

phone



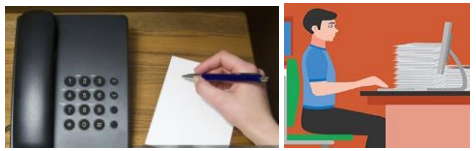
Upper Myanmar

upper Myanmar office Mandalay

internet

Manual observations
27 stations

phone

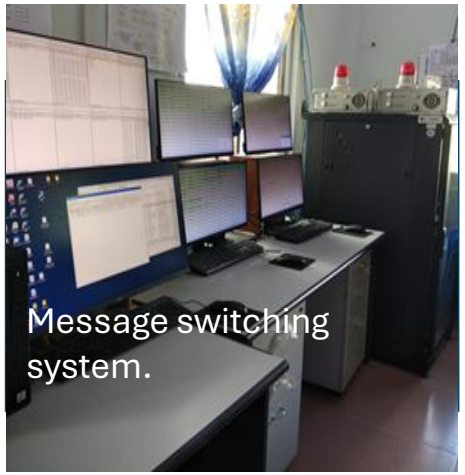


Lower Myanmar

Lower Myanmar office Yangon

internet

Data transmission system



51 stations

GTS

Head office(Nay Pyi Taw)

X

158 stations

AWS stations (JICA,) → Storage server(JICA) → webpage(JICA)

AWS stations (Korea) → Storage server(Korea) → webpage(Korea)

AWS stations (IRM) → Storage server(IRM) → webpage(IRM)

(Local use)

X Data integration

Observation network and data collection and processing systems

BATBOLD ALTANGEREL

NATIONAL AGENCY METEOROLOGY AND ENVIRONMENTAL MONITORING

MONGOLIA

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Observation Network

1. **Synoptic stations**
   - A total of 138 are synoptic stations, 63 stations data shared in GTS, every 3 hours
   - Data format: SYNOP in local country, BUFR in Beijing

2. **Automatic Weather Stations**
   - 200 AWS
   - Not shared on GTS
   - Datalogger types: CR1000, QML and data formats are ASCII /CSV/

3. **Radio-sounding network**
   - 4 Upper air stations
   - 4 upper air stations data shared on GTS and every 12 hours
   - Data format: ASCII in local country , BUFR in GTS

Data Collection and Processing Systems

1. **Data Collection**:
   - Synoptic station's data is collected every 3 hours in MET.COM.Center via a web page using the Internet.
   - AWS data is collected every 1 minute using a GSM/3G/4G cellular network from AWS datalogger.
2. **Data Aggregation**: All weather data is collected in a SQL database, from where other operations are performed using the application program.
3. **International Data Sharing**: Weather data is shared with the GTS using SMTP and POP3 to be transmitted to the Beijing center.
4. **IT Infrastructure**:
   1. Hardware: modem in AWS for data transferring, rack and tower server PC
   2. Sofware: Windows server 2019, Linux, MS SQL, MySQL, Visual studio….
   3. Platform: Hydro and Meteo Data Transferring System /developed by NAMEM/

Observation network and data collection and processing systems

Muhammad Kashif Memon
Pakistan Meteorological Department

Pakistan

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Observation Network

Provide a summary of your observation network:

1. **Synoptic stations**
   - Number of stations → **114**, number shared on GTS → **46**, frequency → **every 3 hours**
   - Format (SYNOP and BUFR)

2. **Automatic Weather Stations**
   - Total number of Flood Automatic Weather Stations → 48
   - Total number of Hybrid Automatic Weather Stations → 45
   - Number of stations shared on GTS → **not yet shared on GTS**
   - Data logger types and data formats → Web based → JSON

3. **Radio-sounding network**
   - Total number of stations → **4**
   - Number of stations shared on GTS → **NIL**
   - Data formats used (**ASCII Only**)

Data Collection and Processing Systems

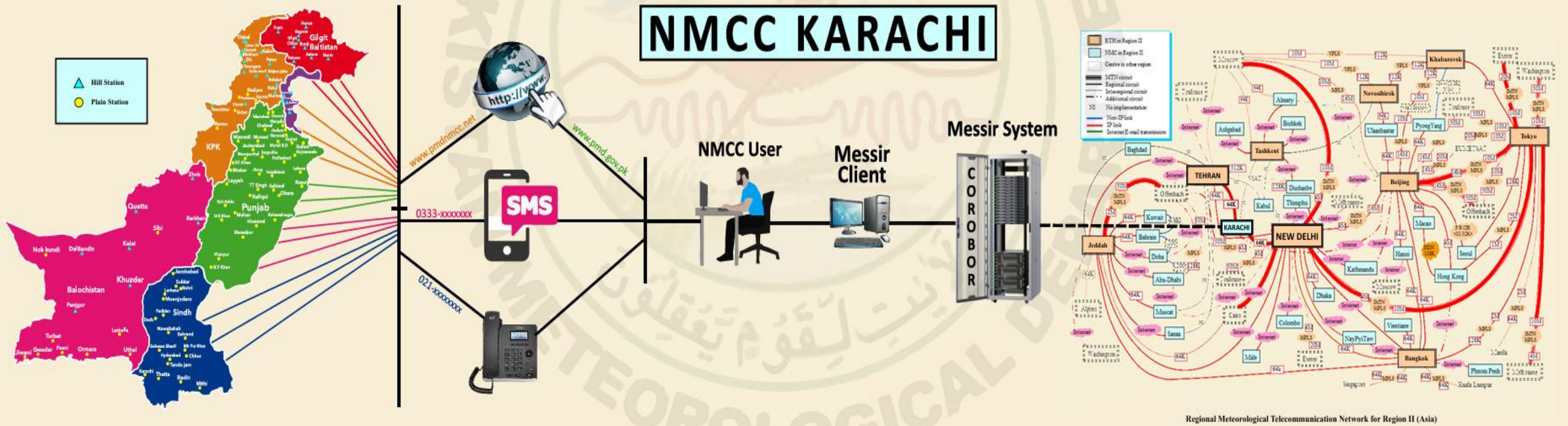
Overview of current data collection and processing systems, including:

1. **Data Collection**: Data is collected from Observatories through SMS and uploaded to website.
2. **Data Aggregation**: There is Java based software created to valid and generate data in WMO standard format with GTS Headers and transmitted to Message Switching System and WIS 2.0
3. **International Data Sharing**: The data from our Message Switching System is transmitted to New Delhi and Tehran, New Delhi transmits our data to GTS.
4. **IT Infrastructure**: What hardware, software, and platforms used for these tasks?

   Java and Python Based software, MESSIR Comm (MSS), Moving Weather, WIS2.0, Site to Site VPN and CISCO Routers.

NATIONAL METEOROLOGICAL COMMUNICATION CENTER

National Meteorological Communication Center is an important unit of Pakistan Meteorological Department (PMD) where the collection of Met data and its rebroadcast both on National and International take place. Timely transmission / provision of meteorological data to used for forecasting purpose.



Regional Meteorological Telecommunication Network for Region II (Asia)

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Observation network and data collection and processing systems

KHOEUN Sokhom

Department of Meteorology / Ministry of Water Resources and Meteorology

Kingdom of Cambodia

Observation Network

1. Synoptic Stations:

- Total 35 synoptic stations, 35 stations share in GTS, 13 frequency due to unstable existing
- List of data format: Synoptic, Upper-Air, Warning, Aviation, Chart, Climate, Forecast, NWP(CSV), BUFR(CSV) Surface, BFR(CSV) Upper-Air, BUFR(CSV) Climate, BUFR(CSV) Forecast, BFR(CSV) Ocean, Radar, Tide.

2. Automatic Weather Stations:

- There are 86 AWS (KMA_Existing 27 AWS, UNDP_Existing 24 and ADB_Existing 35 AWS)
  - 13 stations shared on GTS and update frequency
- Data logger: types: Sutron 8310_ 35 stations, Atcom_24 stations, Wetdex_27 Station, The data format: excel file

3. Radio-sounding network:

- There are no number of radio-sounding existing at the present
- From 1988-2006, there one radio-sounding station, which was observed one time a day at 7:00am. Data recorded in the achieve.

Data Collection and Processing Systems

1. Data Collection:

Some AWS transmit real-time data, while others rely on manual observation., operates Doppler weather radars , Japan Meteorological Agency (Himawari-9 satellite), Korean Meteorological Administration (KMA), AWS, Manual

2. Data Aggregation:

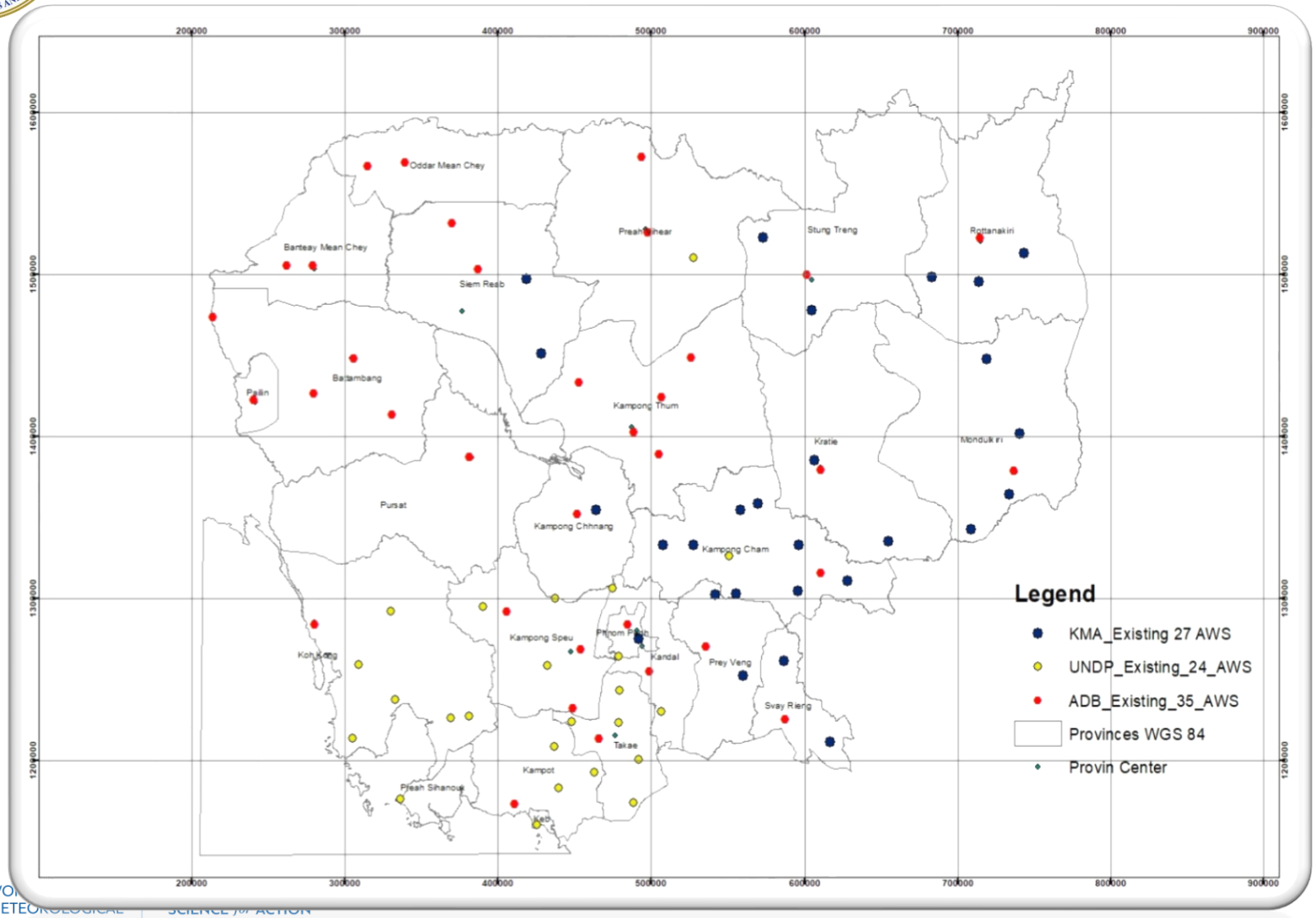
At smaller provincial weather stations, observers still record readings (temperature, rainfall, pressure, wind) by handing logbooks., These are then sent daily to the central office in Phnom Penh (by email, phone, or scanned forms), Data is later entered into the national database for archiving., AWS transmit data in near real-time via GSM, radio, or internet, Data is automatically compiled at the National Meteorological Center server in Phnom Penh, Helps reduce human error and speeds up data availability.

Data Aggregation by QC: Data undergoes validation and cross-checking:, Comparing AWS vs manual observations., Checking for missing or abnormal values, Using WM, recommended QC procedures (e.g., rejecting outliers)., Shares basic weather observations internationally and receives global forecast products.,

3. International Data Sharing: Cambodia participates in WMO's GTS, Shares basic weather observations internationally and receives global forecast products, Also collaborates with ASMC, for haze and regional monitoring, We have no published the data yet in currently. In the near as planning.

4. IT Infrastructure: Observation Equipment, AWS: Measurement, Weather Radars: Doppler radars, Hydrological Instruments: River gauges, water level sensors (for flood monitoring). Regional Platforms ASMC Provides haze monitoring, regional forecasts, (MRC): Hydrological & flood data sharing, APEC Climate Centre (APCC, Korea): Seasonal outlooks and climate data exchange, Satellite Data Tools (HimawariCast, JMA/JAXA software), Quality Control Software, Clicom/CLIMSOFT modules → check for missing/outlier values, Python/R scripts developed with WMO/ASEAN partners. Data Transmission & IT Infrastructure, Servers & Databases: For central data storage at National Meteorological Center., Computers & Workstations: For forecast officers., Networking Hardware: Internet/GSM modules for AWS data transfer., Backup Power (UPS/Generators): For data centers during outages, WMO Global Systems: GTS: Exchange of international observations, WIS: For global data sharing and access WMO Severe Weather Forecasting Programmed (SWFP-Asia): Provides global model guidance to Cambodia, Public Dissemination Platforms, Official Website (Cambodiameteo), Social Media: Facebook Page (very widely used in Cambodia for weather alerts), Telegram Group, SMS warning systems (in cooperation with National Committee for Disaster Management).

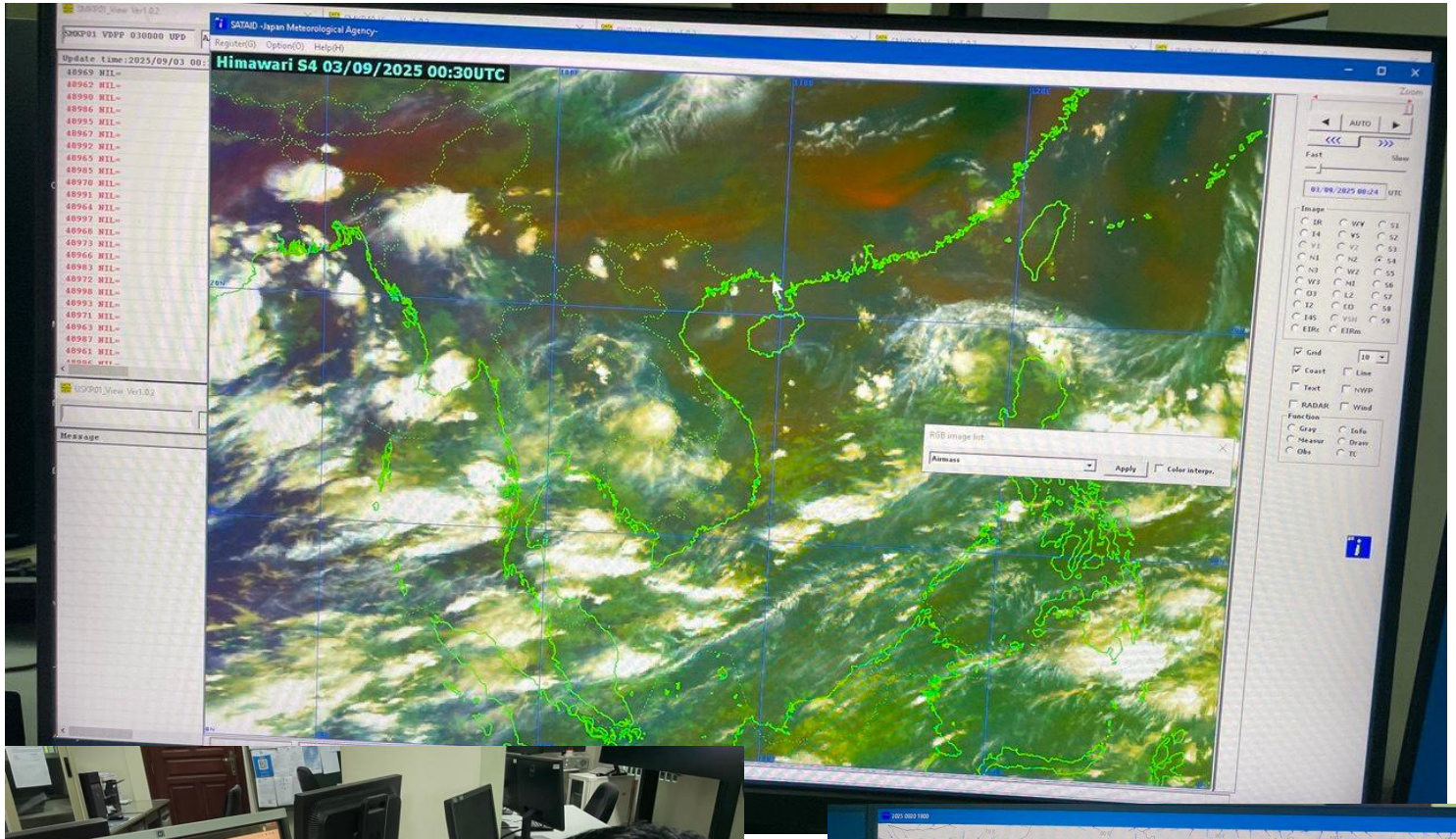
Automatic Weather Station in Cambodia

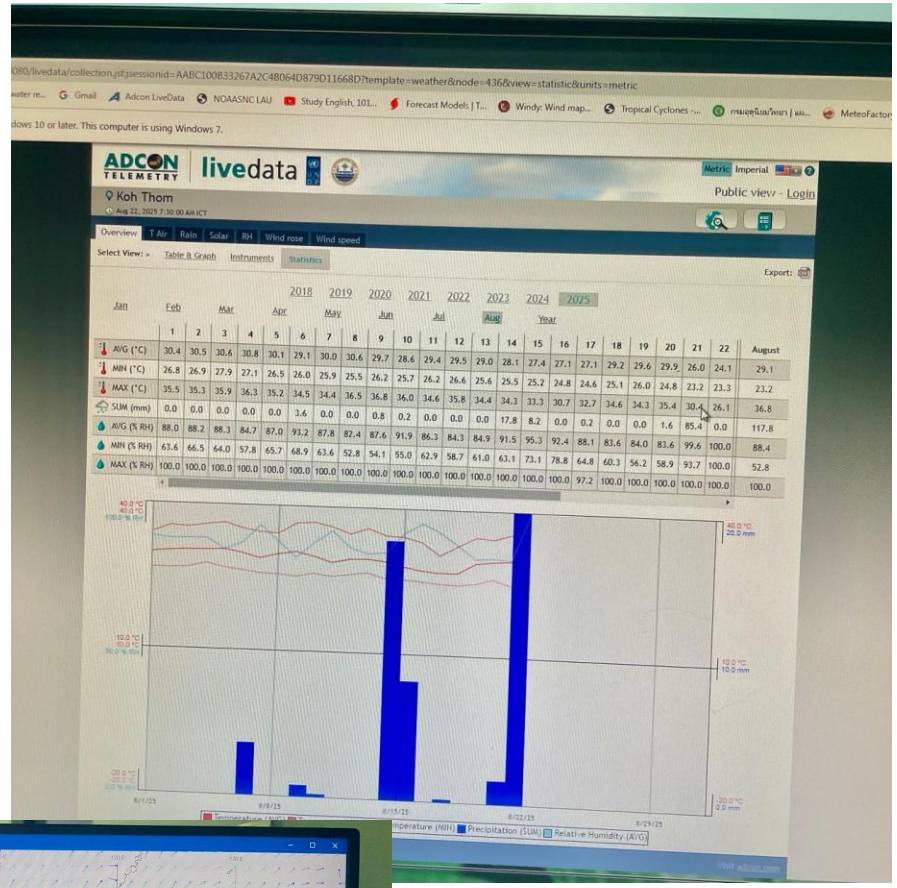


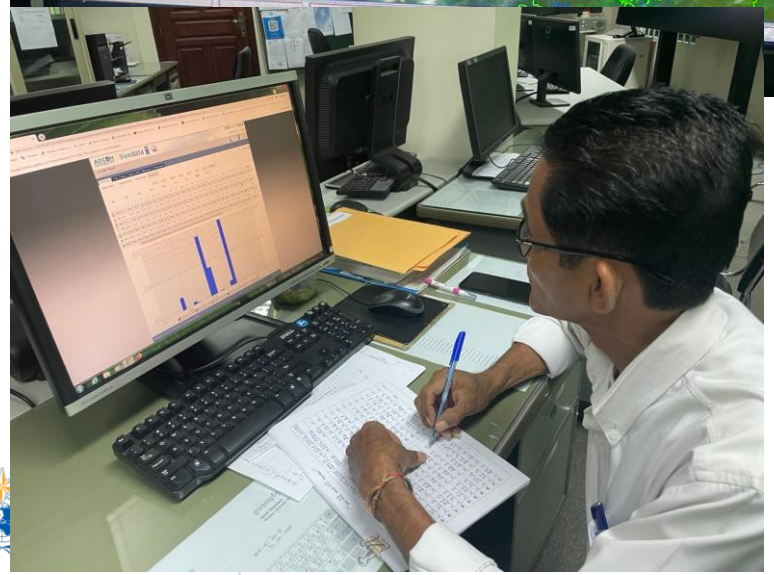
There are 86 AWS and 25 Manuals:

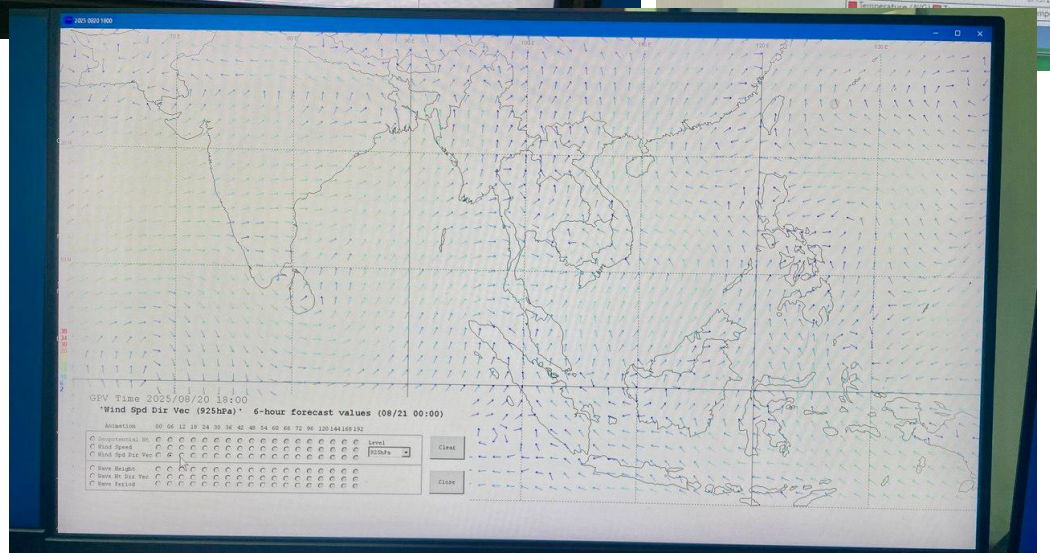
1. KMA_Existing 27 AWS
2. UNDP_Existing 24 AWS
3. ADB_Existing 35 AWS
4. Cambodia Manual 25

Synoptic Station and AWS

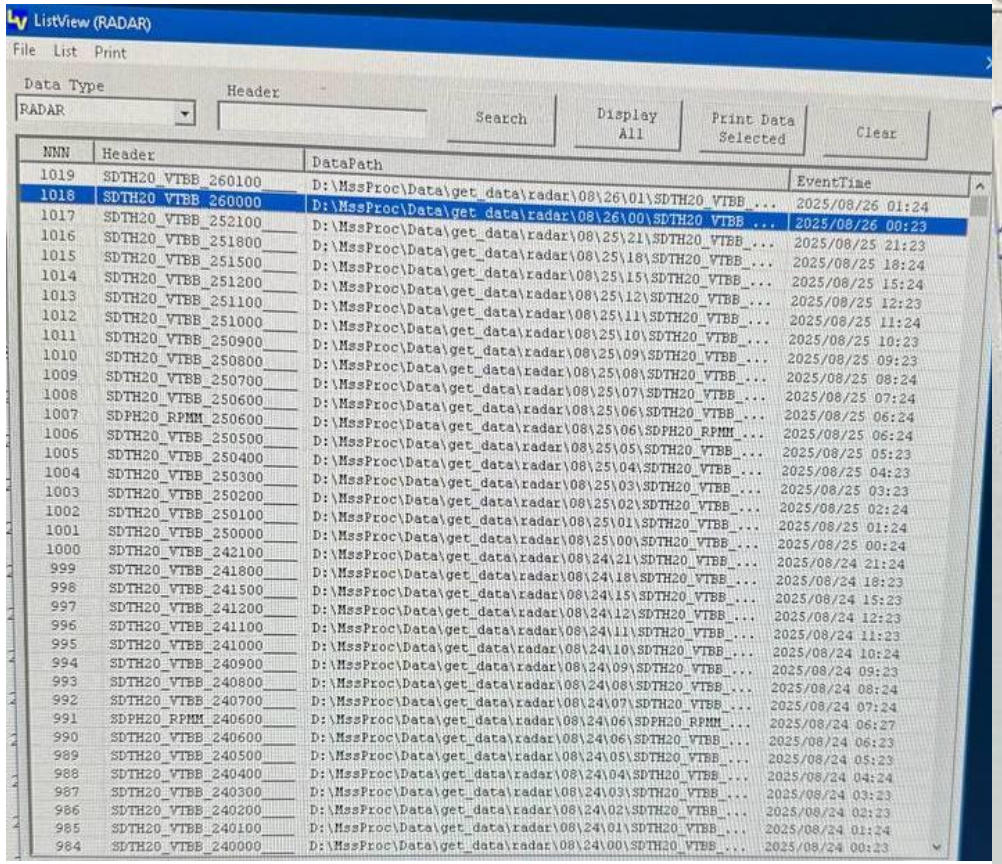

SATAID -Japan Meteorological Agency-
Himawari S4 03/09/2025 00:30UTC

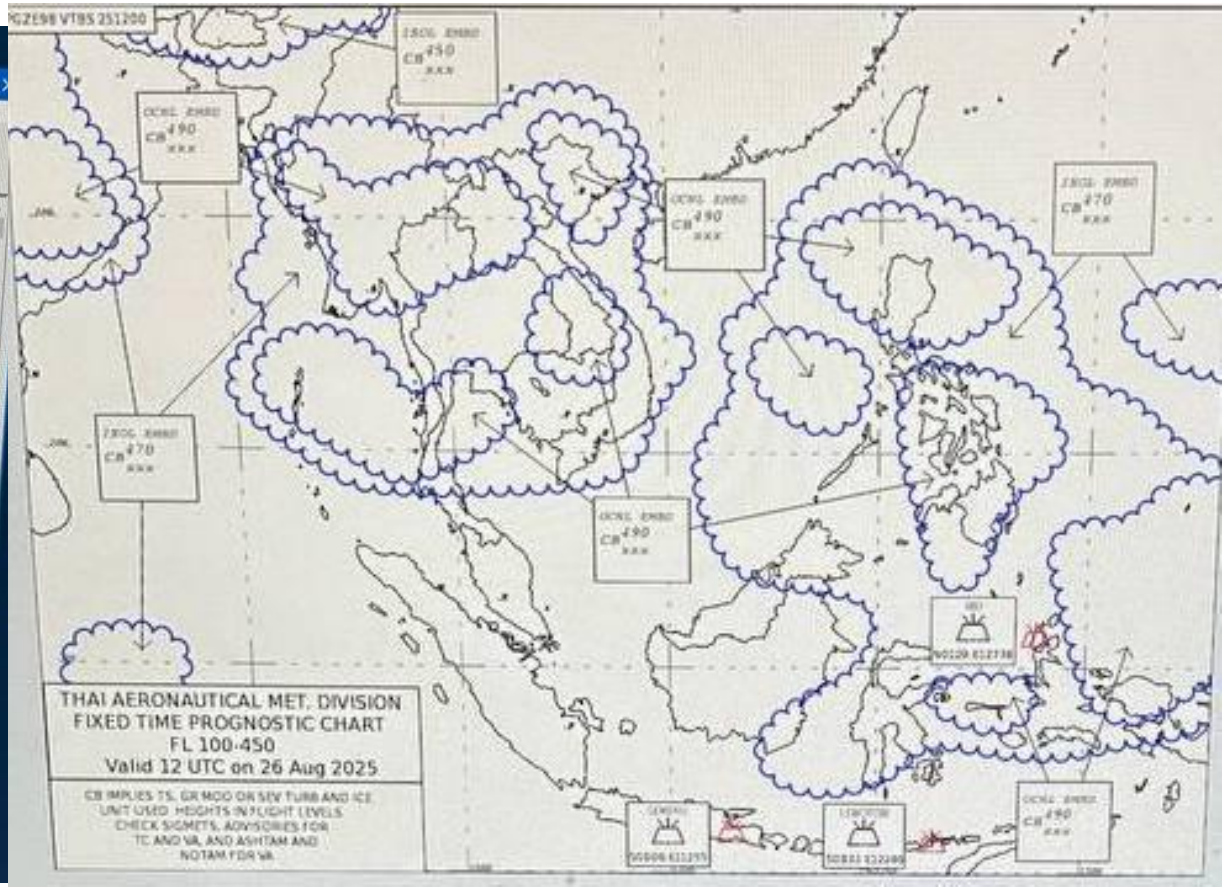

ADCON TELEMETRY
livedata
Koh Thom
Public view - Login




GFV Time 2025/08/20 18:00
'Wind Spd Dir Vec (925hPa)' 6-hour forecast values (08/21 00:00)

Synoptic-BUFR





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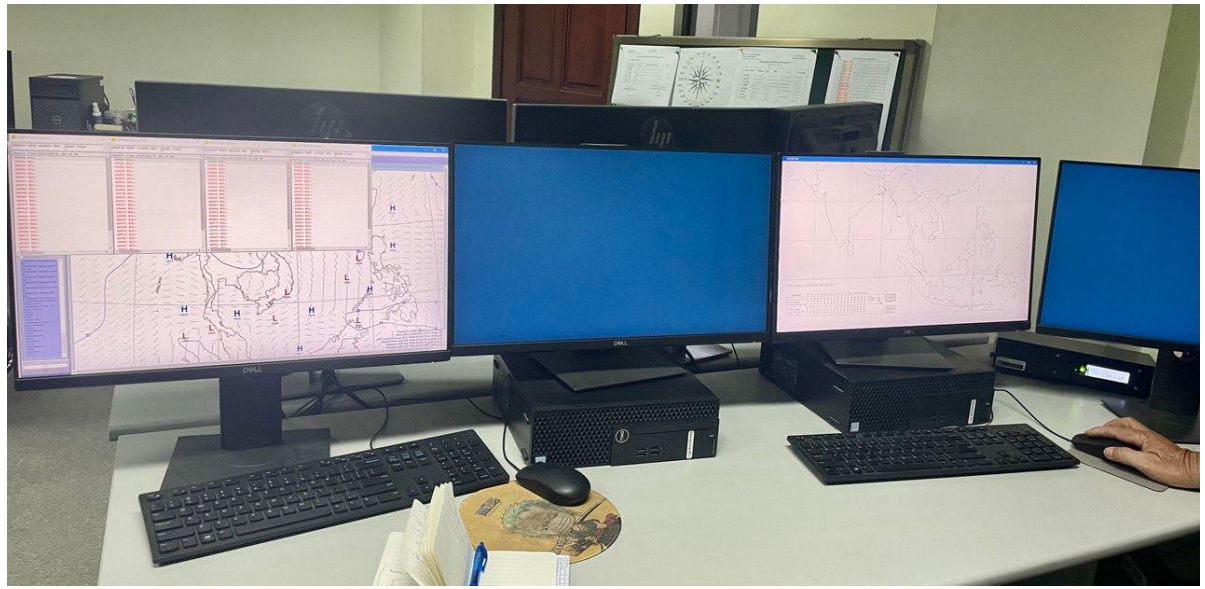
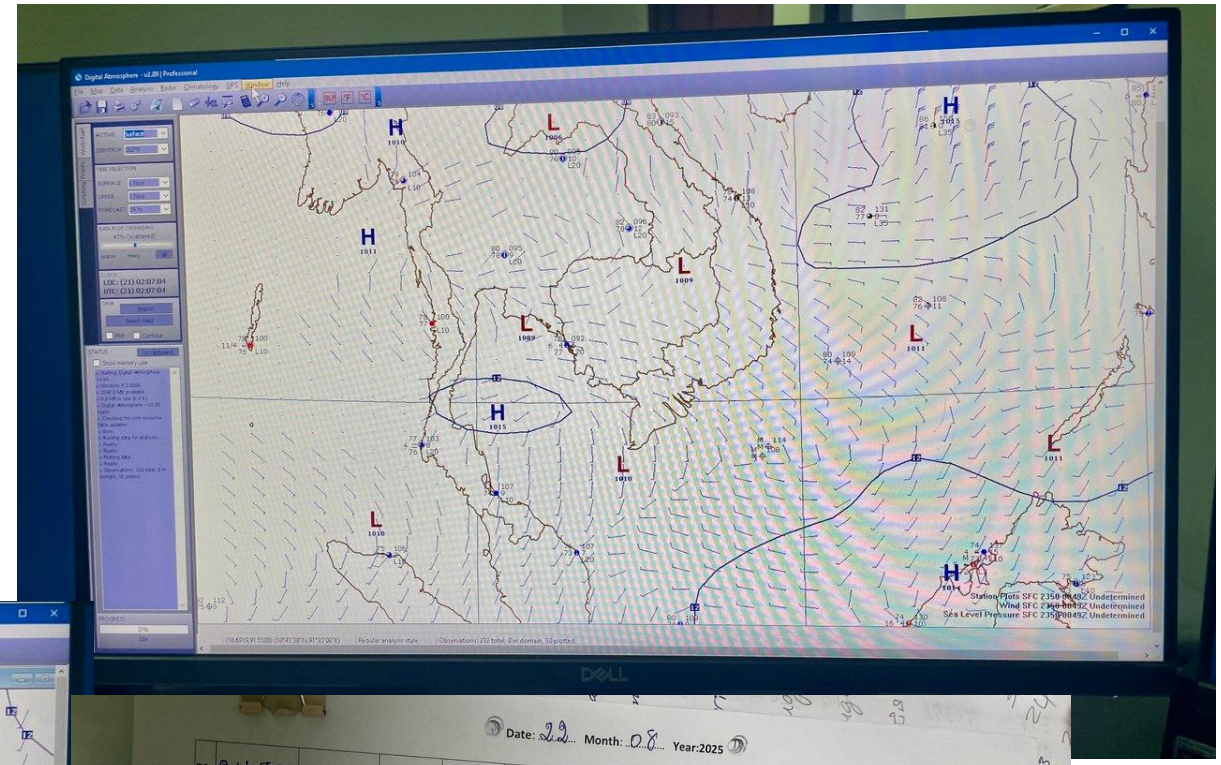
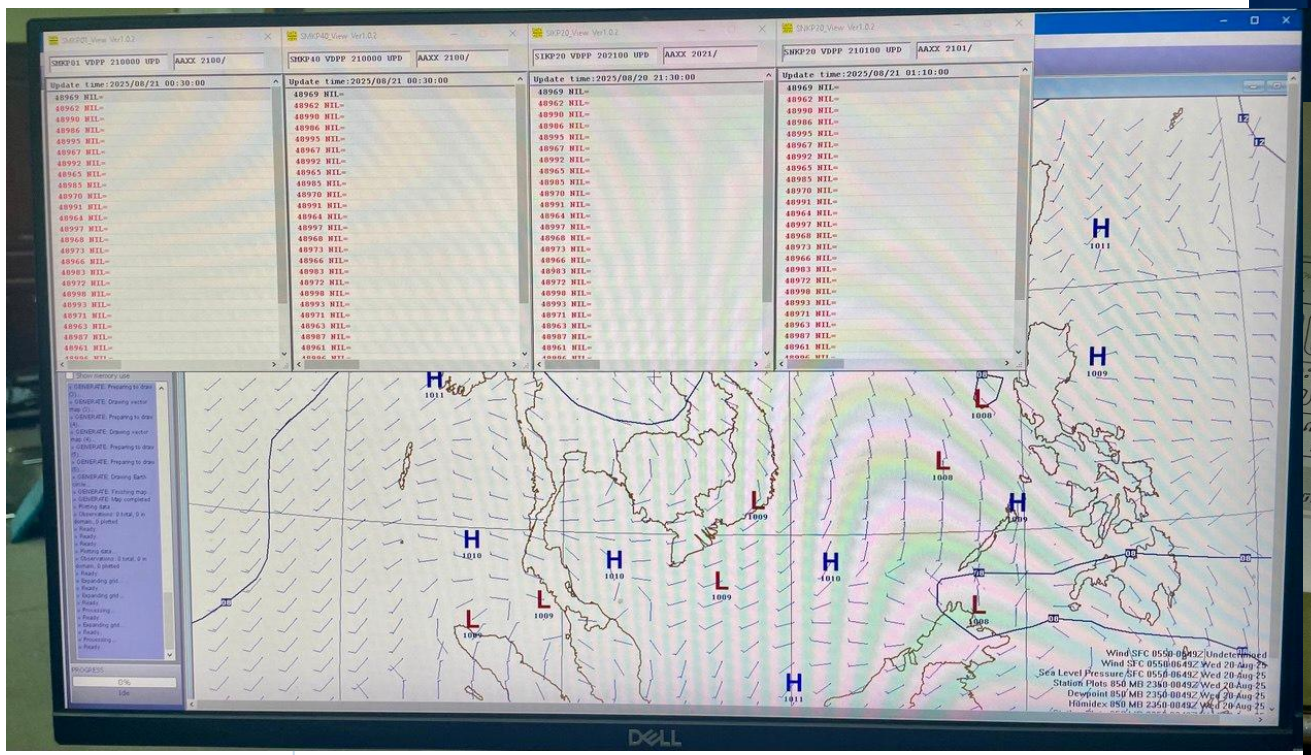
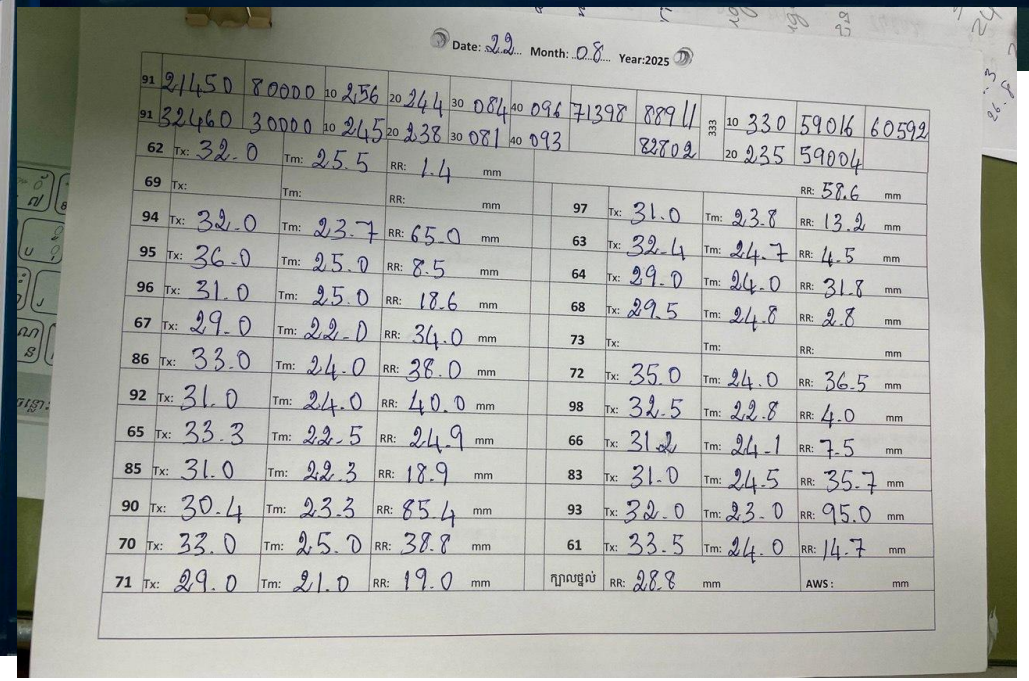


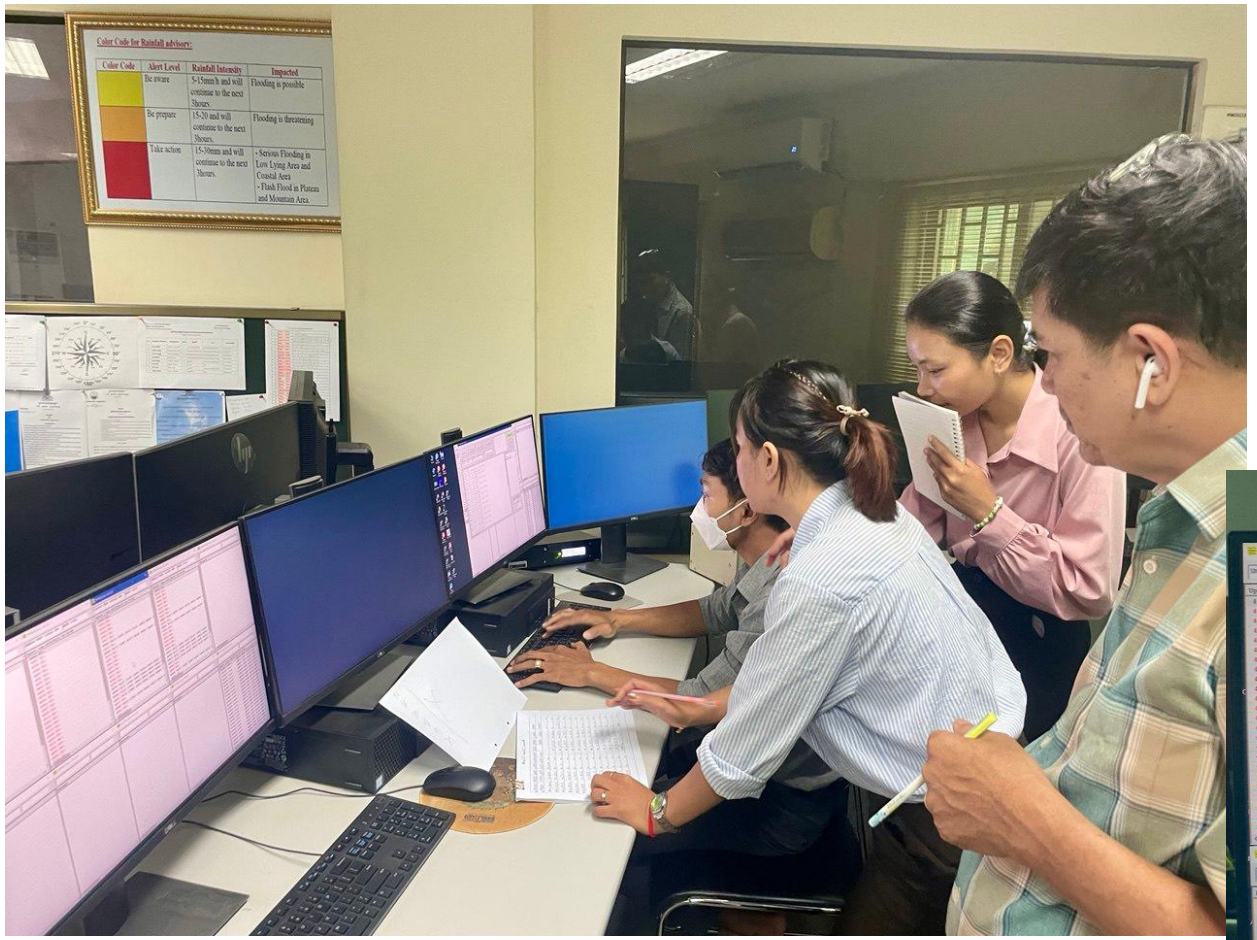


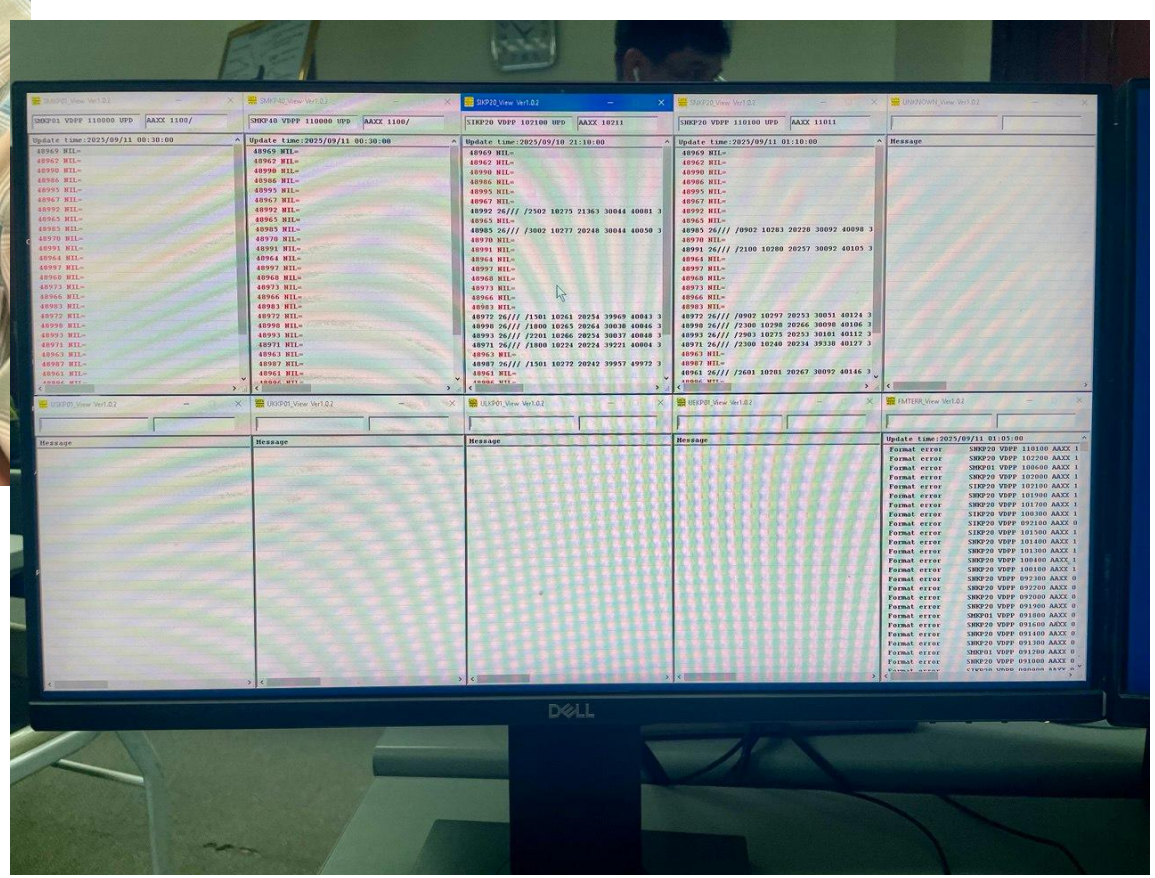




Date: 22 Month: 08 Year: 2025

91	21450	80000	10	256	20	244	30	084	40	096	71398	8891//	333	10	330	59016	60592			
91	32460	30000	10	245	20	238	30	081	40	093		82802		20	235	59004				
62	Tx: 32.0	Tm: 25.5	RR: 1.4 mm													RR: 58.6 mm				
69	Tx:	Tm:	RR: mm										97	Tx: 31.0	Tm: 23.8	RR: 13.2 mm				
94	Tx: 32.0	Tm: 23.7	RR: 65.0 mm										63	Tx: 32.4	Tm: 24.7	RR: 4.5 mm				
95	Tx: 36.0	Tm: 25.0	RR: 8.5 mm										64	Tx: 29.0	Tm: 24.0	RR: 31.8 mm				
96	Tx: 31.0	Tm: 25.0	RR: 18.6 mm										68	Tx: 29.5	Tm: 24.8	RR: 2.8 mm				
67	Tx: 29.0	Tm: 22.0	RR: 34.0 mm										73	Tx:	Tm:	RR: mm				
86	Tx: 33.0	Tm: 24.0	RR: 38.0 mm										72	Tx: 35.0	Tm: 24.0	RR: 36.5 mm				
92	Tx: 31.0	Tm: 24.0	RR: 40.0 mm										98	Tx: 32.5	Tm: 22.8	RR: 4.0 mm				
65	Tx: 33.3	Tm: 22.5	RR: 24.9 mm										66	Tx: 31.2	Tm: 24.1	RR: 7.5 mm				
85	Tx: 31.0	Tm: 22.3	RR: 18.9 mm										83	Tx: 31.0	Tm: 24.5	RR: 35.7 mm				
90	Tx: 30.4	Tm: 23.3	RR: 85.4 mm										93	Tx: 32.0	Tm: 23.0	RR: 95.0 mm				
70	Tx: 33.0	Tm: 25.0	RR: 38.8 mm										61	Tx: 33.5	Tm: 24.0	RR: 14.7 mm				
71	Tx: 29.0	Tm: 21.0	RR: 19.0 mm										ក្បាលផ្ទះ	RR: 28.8 mm			AWS: mm			





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Thank You!

Observation network and data collection and processing systems

Md. Abdul Matin
Bangladesh Meteorological Department(BMD)
Bangladesh

Observation Network

Provide a summary of your observation network:

1. **Synoptic stations**
   - number of stations: 58
   - number shared in GTS: 47, (GTS station 10)
   - Frequency: 3 hourly
   - Which format (SYNOP or BUFR): TAC and BUFR (both format)

2. **Automatic Weather Stations**
   - Total number of stations: 60
   - Number of stations shared on GTS: 00
   - update frequency: we receive hourly data
   - Data logger types: SIAP+MICROS MicroDA-LTE
   - data formats: CSV

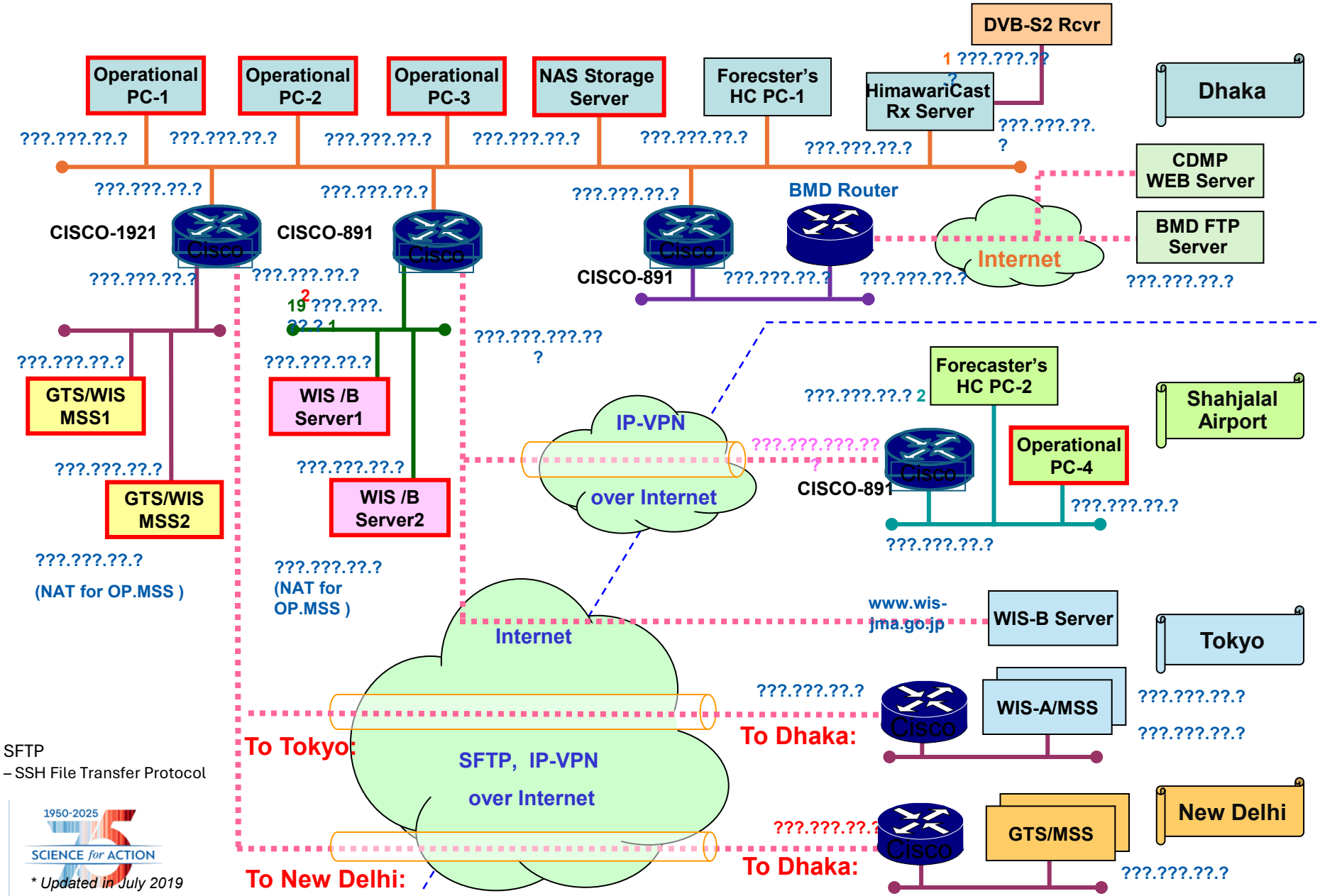
3. **Radio-sounding network**
   - Total number of stations: 6
   - Number of stations shared on GTS and update frequency: 4 (1 station(Dhaka) twice in a day and 3 stations once in every alternate day)
   - Data formats used (ASCII, BUFR, or other to specify): TAC and BUFR (both format)

Data Collection and Processing Systems from Manual Stations

1. **Data Collection**: Data from different observatories are received through internet by using web based customized software.
2. **Data Aggregation**: Collected data are compiled and organized manually by using customized software to create secondary products, to provide relevant users and to share in international circuit.
3. **International Data Sharing**: GTS/WIS system in BMD has two international network connections for exchanging most Meteorological information bi-directionally. One connection is to RTH New Delhi which is GTS circuit another connection is to GISC Tokyo in Japan which is WIS1.0 as a backup. We share our data in both network simultaneously.
4. **IT Infrastructure**: The platform currently used for the GTS/WIS system is a Windows-based server machines, those are duplicated and redundant with Cisco network equipment.

   Software running on the Windows platform uses dedicated MSS processing software which was commissioned by BMD and developed by a specialized company.

Network Structure of the GTS/WIS System of BMD



SFTP
– SSH File Transfer Protocol

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* Updated in July 2019

Data Collection and Processing Systems from Automatic Stations

1. Data Collection: Data is gathered from the observation network through automatic weather stations equipped with SIAP+MICROS data loggers.

Stations transmit meteorological parameters (rainfall, temperature, humidity, wind, etc.) via GPRS/GSM cellular networks.

Raw data is sampled at defined intervals and transmitted automatically to the central server running Polaris Web.

2. Data Aggregation: The Polaris Web platform compiles and organizes the collected data into a central PostgreSQL + PostGIS database.

Data is processed in two forms: raw data (unaltered logger output) and validated data (checked/corrected via the built-in Validator and Quality Assistant modules).

Data can be aggregated by time intervals (hourly, daily, monthly), by measurement type, or by station/network groups.

The system supports tabular and graphical reports, GIS visualizations, isolines, and synoptic dashboards for rapid interpretation.

3. International Data Sharing: Currently AWS data are not published on the GTS

Data Collection and Processing Systems from Automatic Stations

4. IT Infrastructure

Server Side:

Operating System: Windows Server, Database: PostgreSQL + PostGIS

Web server: Apache 2.4, Application stack: PHP, Python, GDAL for GIS functions

Client Side:

Accessible from standard web browsers (Firefox, Chrome) on both desktop and mobile devices.

Hardware:

Server – Inspur Rack Server

CPU: 2 × Intel Xeon Gold 5318Y (2.10 GHz, 24 cores total)

Memory: 384 GB RAM

Storage: 2 × 240 GB SSD (RAID 1, OS), 3 × 960 GB SSD (RAID 0, Data)

Backup System – Inspur Backup Server

12 × 4 TB 7.2K SAS HDD (RAID 6, Data)

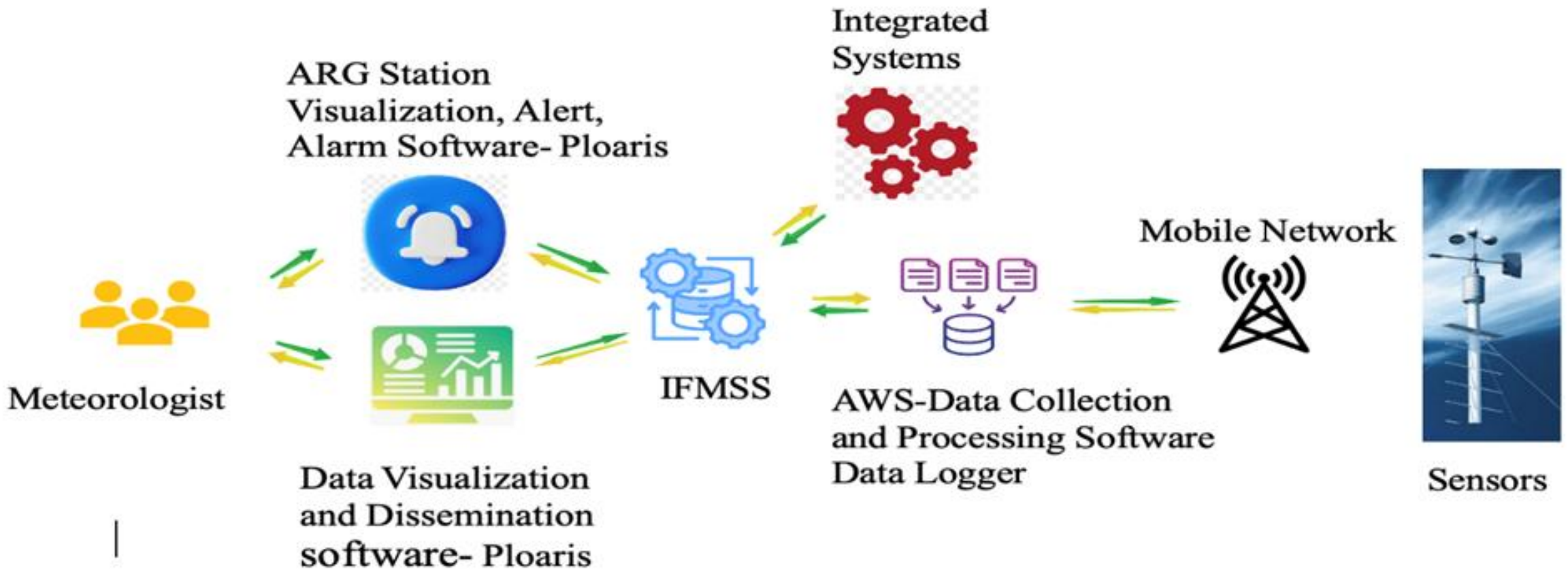
Storage – Inspur SAN/NAS Storage

Drives: 24 × 1.2 TB 10K SAS HDD (expandable), Usable Capacity: 100 TB+ after RAID

RAID Levels: RAID 5

Connectivity: 10GbE iSCSI & FC ports

Data Collection and Processing Systems from Automatic Stations



Thank You

Observation network and data collection and processing systems

Santa Kumar Maharjan
Department of Hydrology and Meteorology
Nepal

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Observation Network

A summary of the observation network:

1. **Synoptic-8 and Aero-Synoptic-14 stations**
   - ❖ number of stations: 22
   - ❖ number shared in GTS, Update frequency: 3 hourly 3 times (Except KTM: 24-hour data is being sent)
   - ❖ Which format (SYNOP or BUFR): SYNOP

Observation Network

A summary of the observation network:

2. Automatic Weather Stations

- Total number of AWS stations: 175
- Tipping Bucket only: 194
- Total number of stations (AWS+TPB only): 369
- Number of stations shared on GTS and update frequency: Currently no data sharing
- Data logger types and data formats: N/A

Observation Network

A summary of the observation network:

3. **Radio-sounding network**
   - ❖ Total number of stations: 1 (Kirtipur) & planned to add 1 more station (at Dipayal Synoptic station)
   - ❖ Number of stations shared on GTS and update frequency: None
   - ❖ Data formats used: N/A

Data Collection and Processing Systems

An overview of current data collection and processing systems:

1. Data Collection:

- Observation Data from remote AWS/Telemetry Stations is sent via GPRS/3G/4G network

Data Collection and Processing Systems

An overview of current data collection and processing systems:

2. Data Aggregation:

Manual Stations data:

- Operated by trained observers.
- Data is collected at specific intervals (e.g., every 3 hours for synoptic and aero-synoptic stations and every 24 hours (03 UTC) for rainfall data and climate station data recorded at 03 UTC and 12 UTC).
- Observations are manually recorded and entered via the Manual Data Management System (DMS). And recorded at DMS.

Automatic Stations data:

- Every 10-min interval of data is recorded in DMS.

Data Collection and Processing Systems

An overview of current data collection and processing systems:

3. **International Data Sharing**: (How is your data currently published on the GTS?)

-MICS Teleterminal → Coded Data→ CMA (GTS)

Data Collection and Processing Systems

An overview of current data collection and processing systems

4. IT Infrastructure:(What hardware, software, and platforms used for these tasks)

- Hardware : Datacenter with PostgreSQL database
- FTP Server is used to send data to GTS
- MICS Terminal is used for sending data to GTS

Observation network and data collection and processing systems

Guangzhou, China
15-19 September 2025

Natthaporn Lertsamranpinit
Thai Meteorological Department (TMD)
Thailand

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Observation Network

Observation Network

1. Synoptic stations

- Total: 127 stations (all shared in GTS)
- Hourly observation (manually observed at 00,03,06,09,12,15,18,21 UTC and remaining automatically observed by AWS hourly)
- Data formats: TAC and BUFR

2. Automatic Weather Stations

- Total: 127 stations (all shared in GTS)
- Hourly observation
- Data logger: JDL-740C
- Raw data in csv format (encoded to TAC)

DATA LOGGER

Data Logger JDL-740C

- Processor
  32bit ARM Processor
- Communications
  RS-232, RS-485, SDI-12, USB, LAN
- Display
  2 line 16 character alphanumeric LCD
- Clock
  RTC, Synchronized with GPS
- Memory
  Code Memory (SRAM) : 256Kb
  Data Memory (SRAM) : 4M (MAX 16Mb)
  Flash Memory : 512KByte
  Expanded Data Storage : CF memory

Observation Network

3. Radio-sounding network

- Total: 12 stations (all shared in GTS)
- Observations: 4 times a day at 00, 06, 12 and 18 UTC

  TEMP: Radiosonde 00,12UTC
  PILOT: Pilot Balloon 00,06,12,18UTC

- Data formats: TAC and BUFR

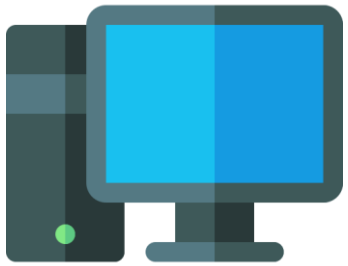
Data collection and Processing systems

Data Collection and Aggregation

Observation Network

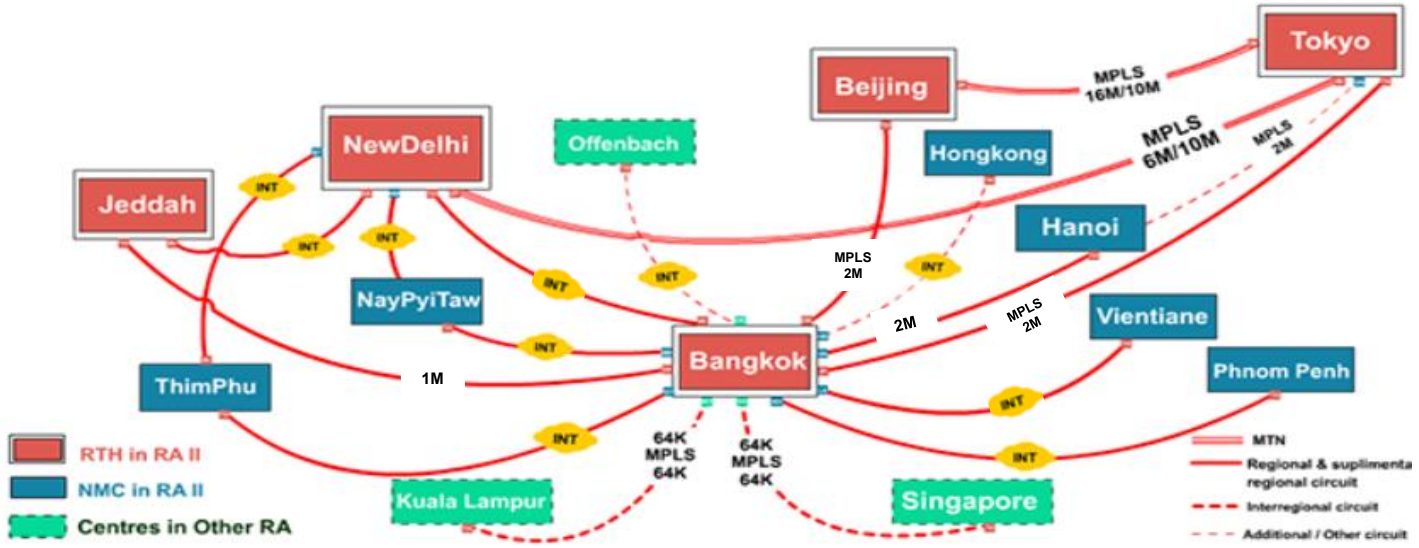
AMSS
(RTH Bangkok)

GTS



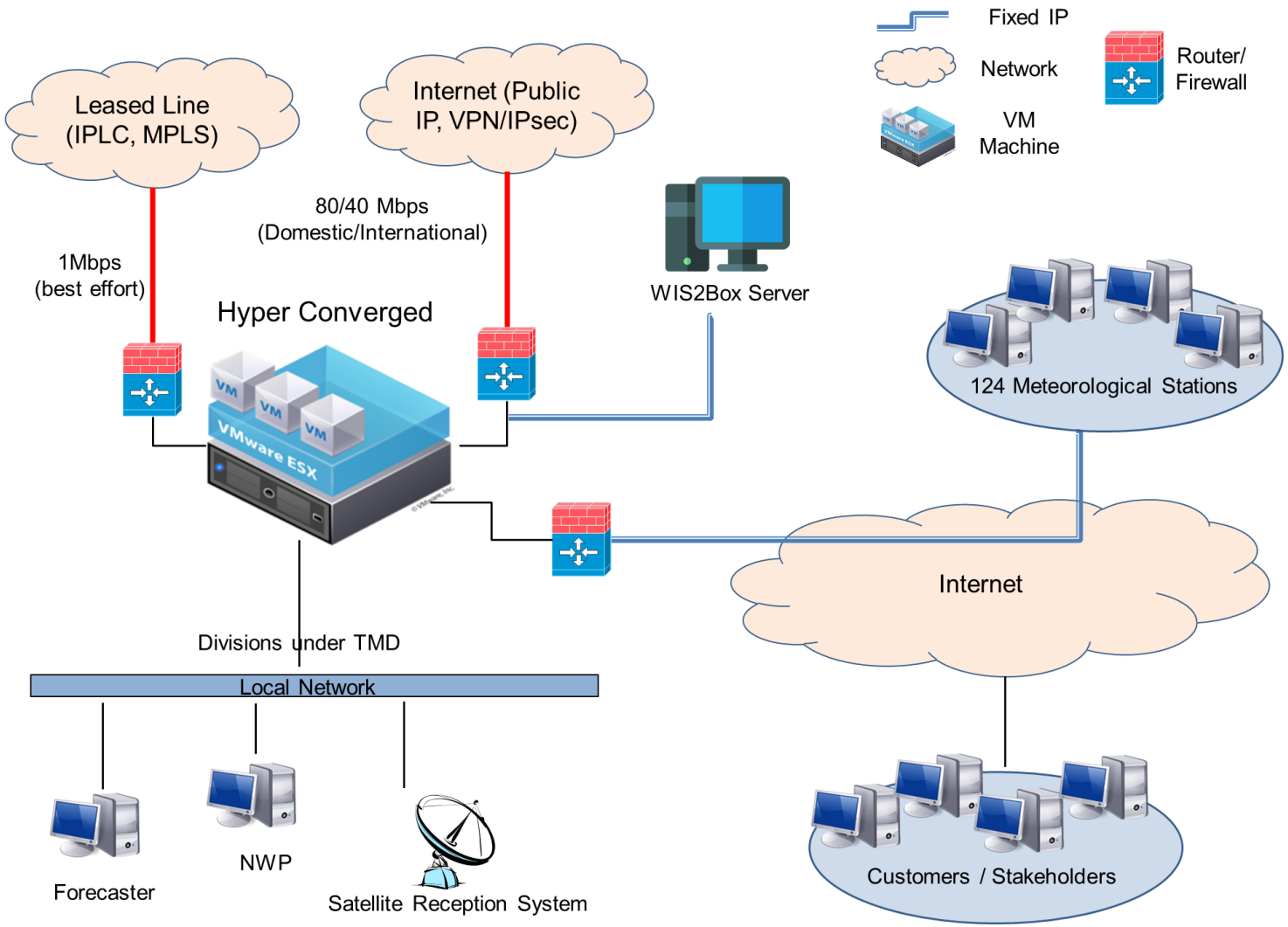
WIS2Box Server
(WIS2.0 Node)

International Data Sharing (GTS)



No.	Country	Wan Topology	Protocol	Speed
1	Beijing	Leased Line (MPLS)	FTP	2 Mbps
2	Japan	Leased Line (MPLS)	Socket	2 Mbps
3	New Delhi	Internet (Public IP)	FTP	80/40 Mbps
4	Jeddah	Leased Line (MPLS)	FTP	1 Mbps
5	Malaysia	Leased Line (MPLS)	Socket	64 Kbps
6	Singapore	Leased Line (MPLS)	Socket	64 Kbps
7	Hongkong	Internet (Public IP)	SFTP	80/40 Mbps
8	Naypyitaw, Cambodia, Thimpu (AoR)	Internet (VPN/IPsec)	FTP	80/40 Mbps
9	Hanoi (AoR)	Leased Line (IPLC)	FTP	2 Mbps
10	Laos (AoR)	Internet (Public IP)	FTP	80/40 Mbps

IT Infrastructure



IT Infrastructure

❖ **Recent history and update plan for MSS**

- 2018: Started operation of the current system (Netsys)

❖ **Service level by system supplier (Genomath & Netsys)**

- 24/7

❖ **Application on the MSS**

- AMSS, WEB, Forecaster In-house application, etc.

❖ **Operating system**

- RedHat 6.9 64bit for MSS, CentOS 6.9 64bit for Workstation.

Thank You

香港天文台
HONG KONG OBSERVATORY

OBSERVATION NETWORK AND DATA COLLECTION AND PROCESSING SYSTEMS

September 2025

YIP, Kai-hou, Scientific Officer

Hong Kong Observatory

Hong Kong, China

HKO'S OBSERVATION NETWORK

1. SYNOPTIC STATIONS

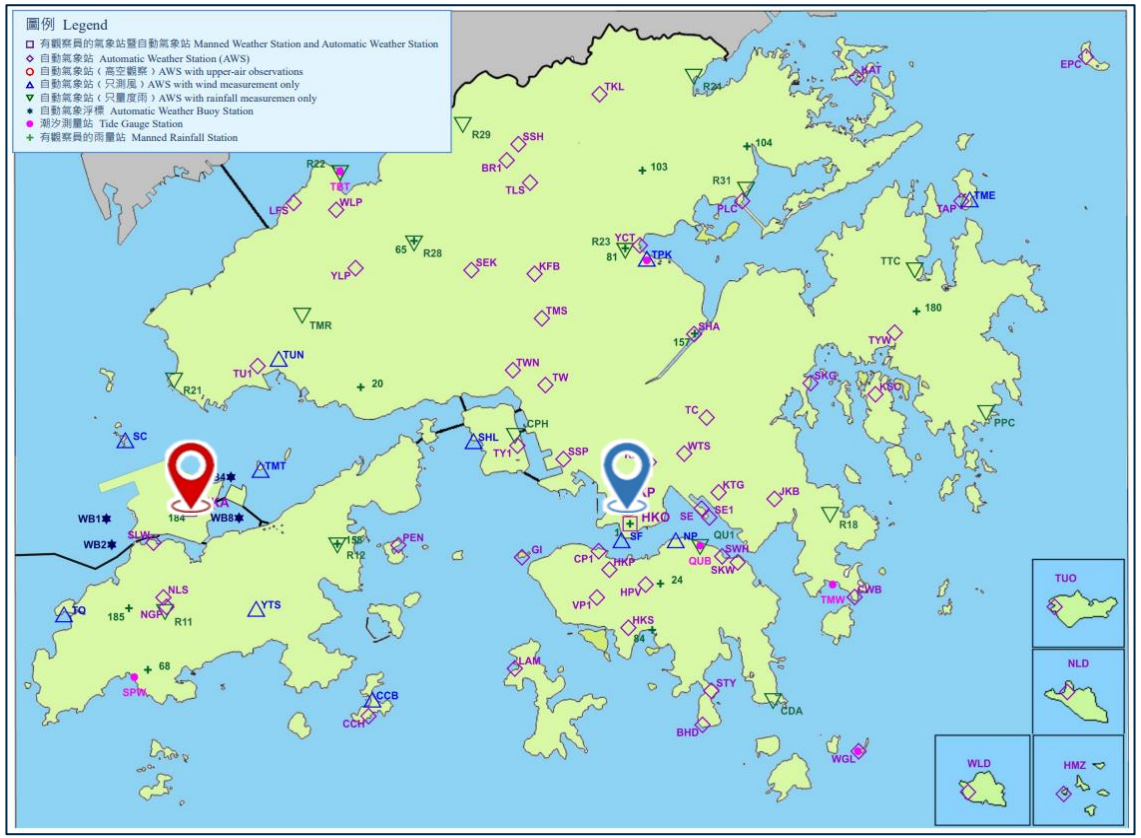
- **Hong Kong International Airport**

- SYNOP: SMHK01 VHHH 00, 06, 12, 18Z
  SIHK20 VHHH 03, 09, 15, 21Z
  SNHK20 VHHH hourly when TC near HK

- BUFR: ISIC01, ISMC01 VHHH

2. AUTOMATIC WEATHER STATIONS

- 87 stations
- ASCII (BUFR):
  SXHK40, S[M|N]HK22 (ISAC01) 3hrly global 5 stations
  SEHK01 10 min 2 stations
- collect met data:
  - in-house AWS field processing unit
  - fixed length ASCII
    - with predefined element code to represent each measurement data
  - followed by the measured value



3. RADIO-SOUNDING NETWORK

- King's Park
- ASCII: U[S|K|L|E]HK01VHHH 6/12h once
- BUFR: IUKC01, IUSC01, IUSC02 VHHH

DATA COLLECTION AND PROCESSING SYSTEMS

DATA COLLECTION

- Raw Data ----(via GPRS/minilink/private wire/Government Security Network/…)----> HKO Device Gateway
- Perform quality check (range, trend, spatial consistency…) >-----> Database

DATA AGGREGATION

- In-house developed software to compile bulletins
- Use ECMWF bufrdc/Eccode to encode bulletins

INTERNATIONAL DATA SHARING

- SFTP to RTH Tokyo & RTH Beijing via dedicated link & internet
- Backup SFTP RTH Bangkok via internet

INFRASTRUCTURE

- Hardware: PowerPC, Oracle Database
- Software: Oracle database, Linux system, SFTP, Shell Scripts, Perl, C/Fortran, PHP
- Platform:
    - Application server, FTP server, Database
    - for data collection, manipulation, dissemination

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HONG KONG OBSERVATORY

Observation network and data collection and processing systems

Yuni LEE
KMA
Republic Of KOREA

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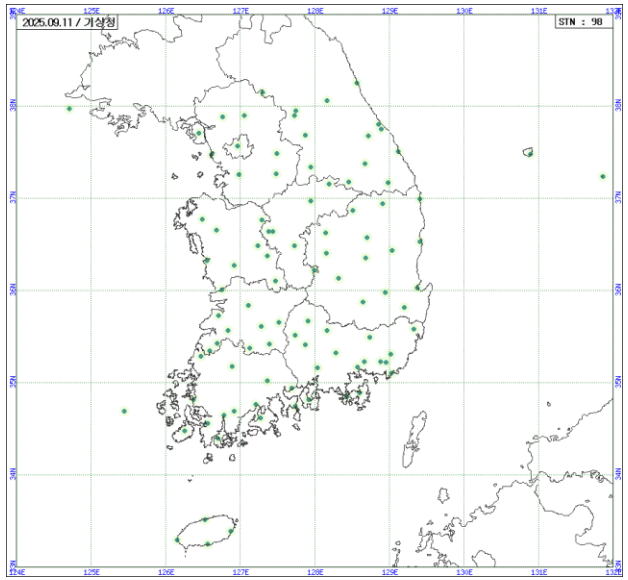
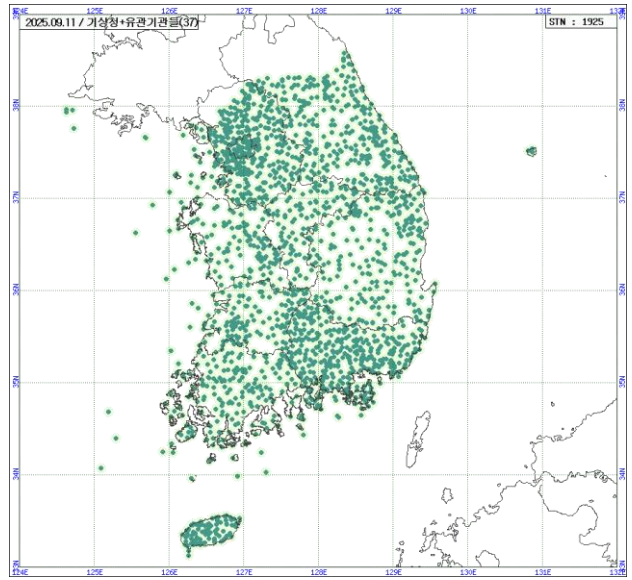
Synoptic stations



- number of synoptic stations : 98
- number of stations shared in GTS : 53
- Data collection Frequency : 1min
- Frequency shared in GTS : 1Hr
- Production Data format : KMA3(aws3)and text(16 antilogarithm)
- Data format in GTS is TAC and BUFR

Automatic Weather Stations



- Total number of stations : 1925 (553 in KMA, 1372 other organizations)
- Number of stations shared in GTS: No
- update frequency : 1min
- Data logger types and data formats KMA3(aws3)and text(16 antilogarithm)

Radio-sounding network

- Total number of stations : 10
(8 observation of kma, 2 observation of air force)

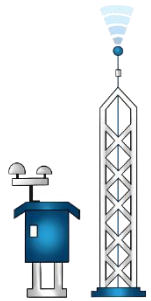
- Number of stations shared on GTS : 8

- update Frequency : 12Hourly, stormy 6Hourly

- Data formats used both ASCII and BUFR

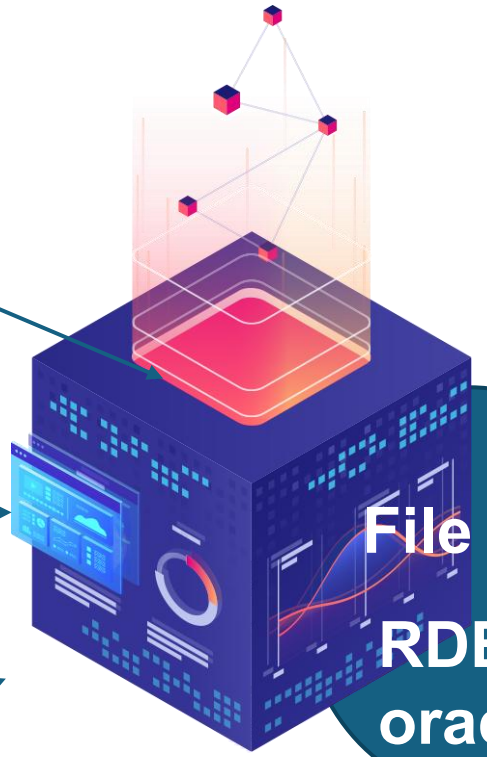
Data Collection and Processing Systems

Satellite network



LTE

AWS
ETC



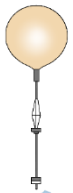
File DB

RDB
oracle

COMIS

GTS
publish
server

GTS
progress
server



FTP

ser
ver

Radio-
sounding

data receive

- TAC organize using DB(observation data)and station id
- BUFR is converted in this server

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IT and Telecommunication Infrastructure

COMIS

Collecting All Data & Rapid Processing

- Processing over 20,000 data per second in real time
- Collected : 1TB (per day) / Disseminated : 1.2TB (per day)

Providing Visualization (Web Portal)

- Comprehensive display of observations and forecasting data
- Plot and analyze meteorological data

Real time service to end users

- To 100 agencies including government, media, disaster management agencies, research institutes

Public service, Industry, Research

Global data exchange (WIS/GTS)

Met. Info system for disaster prevention

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Thank you
Merci
Gracias
شكرا
谢谢