

1st Steering Committee Meeting (SCM 1)

SOUTH ASIA FLASH FLOOD GUIDANCE (SAsiaFFG) Project

New Delhi, India

26-28 April 2016

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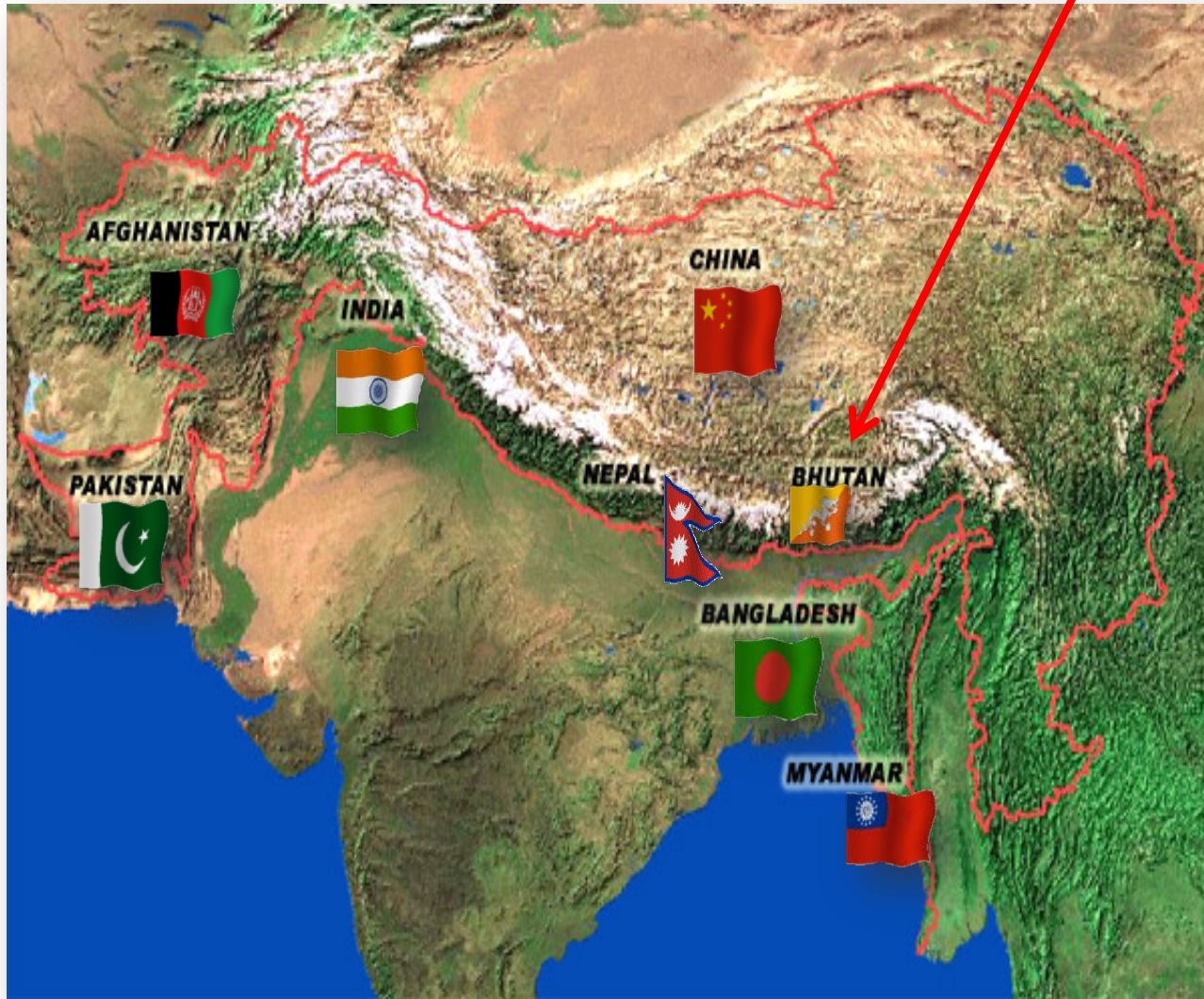
26 April 2016

Presentation Outline

- Introduction & Organization Structure
- Current Hydro-meteorological Networks
- Hydro-Meteorological data
- Weather Forecasting and Nowcasting
- Flood Early Warning System
- Products & Services
- Collaboration agencies
- Challenges
- Conclusion/Remarks

Location Map of Bhutan

88.7⁰ - 92.2⁰ East
26.7⁰ - 28.4⁰ North

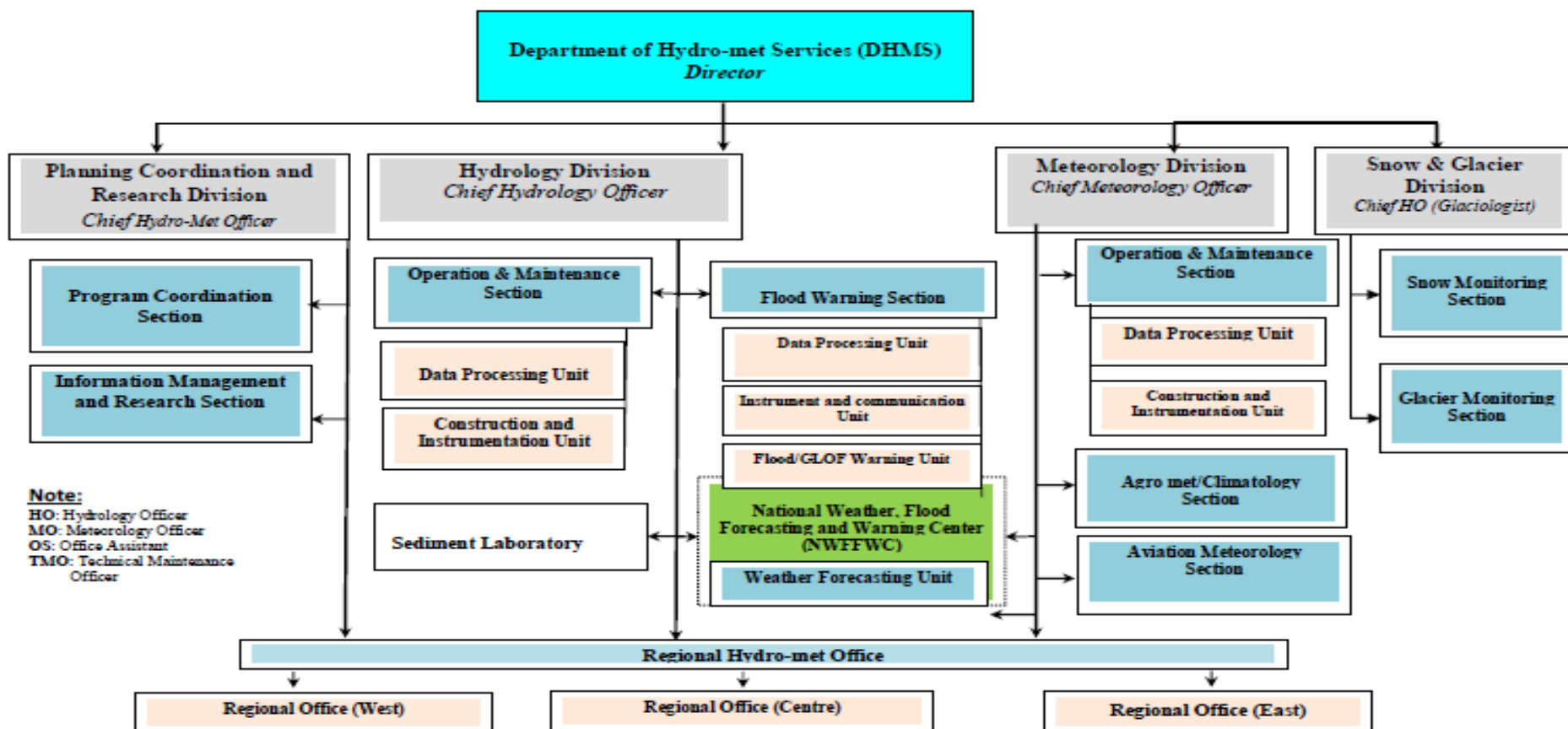


Organization Chart

Organogram of new Department of Hydrology and Meteorology Services (DHMS)

Ministry of Economic Affairs

(Approved by RCSC Order No. RCSC/HRMD/7/2011/316 dated 21 July 2011)



Infrastructure

National Weather & Flood Warning Center (NWFWC)



Facilities installed inside the NWFWC

Mission

- Provide weather, water and climate data, forecasts and warnings for the protection of life and property and enhancement of national economy.
- One of the important mandate is weather & flood forecasting and early warning.

Presentation Outline

- Introduction & Organization Structure
- **Current Hydro-meteorological Networks**

Network and Current Status

1. Hydrological Network:

- Principal Station 15
- Secondary Station 09

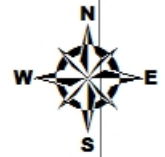
2. Meteorological Network:

- Class A Met Station 20
- Class C Met Station 61
- Automatic Weather Station 20

3. Flood Warning Network:

- Flood Warning Station 15

Map Showing the Hydrological Network Stations



Legend

- AWLS
- Principle_Stns
- Secondary_Stns

28°00'N

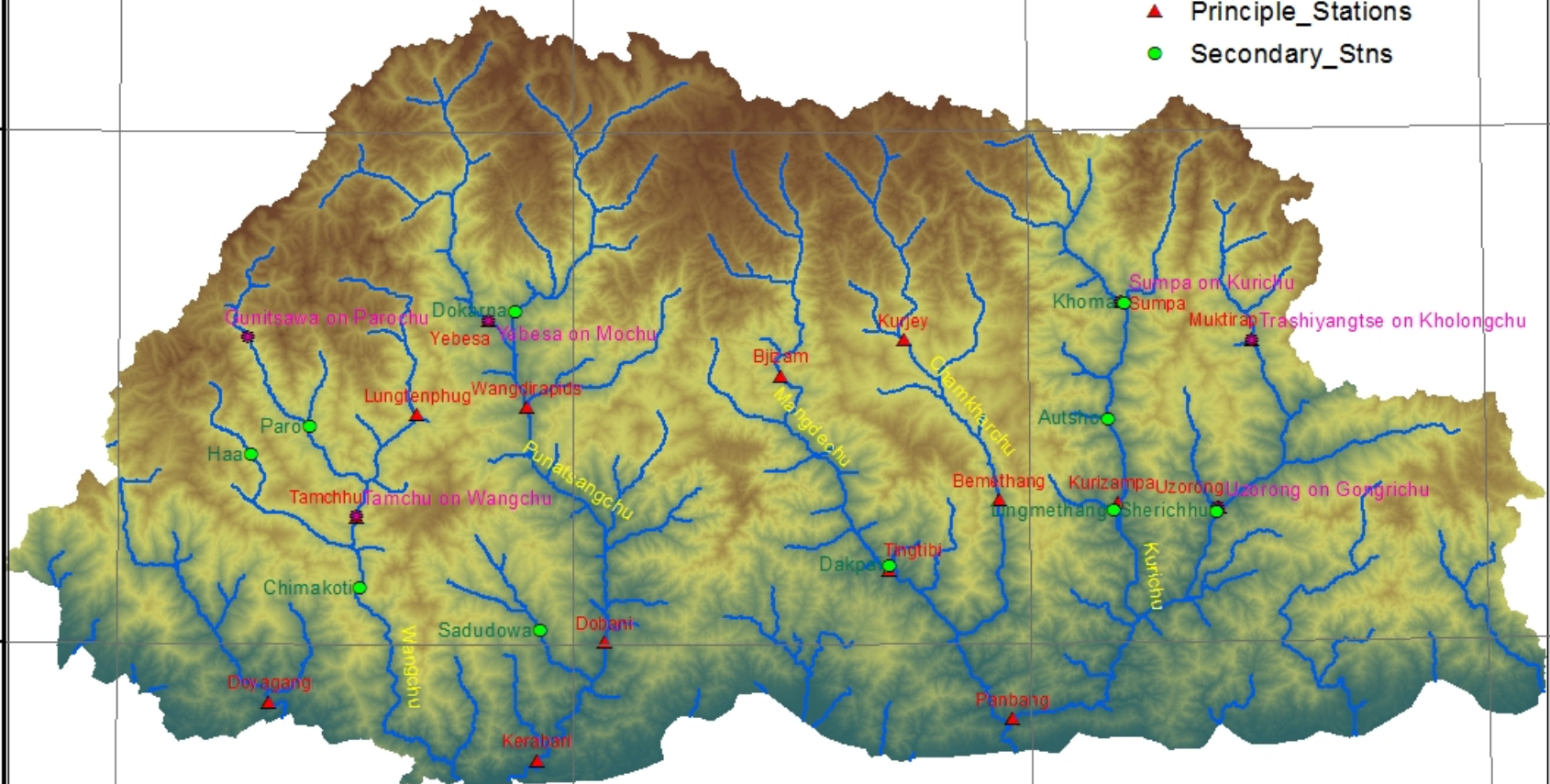
27°00'N

89°00'E

90°00'E

91°00'E

92°00'E



Map Source:
Hydrology Division
Department of Hydromet Services
Ministry of Economic Affairs
Thimphu: Bhutan

1 cm = 13 km

0 5 10 20 30 40
Kilometers

Map Showing the HKH-HYCOS Stations in Bhutan



Gunitsawa AWLS

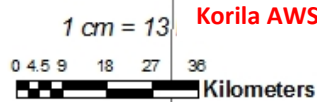
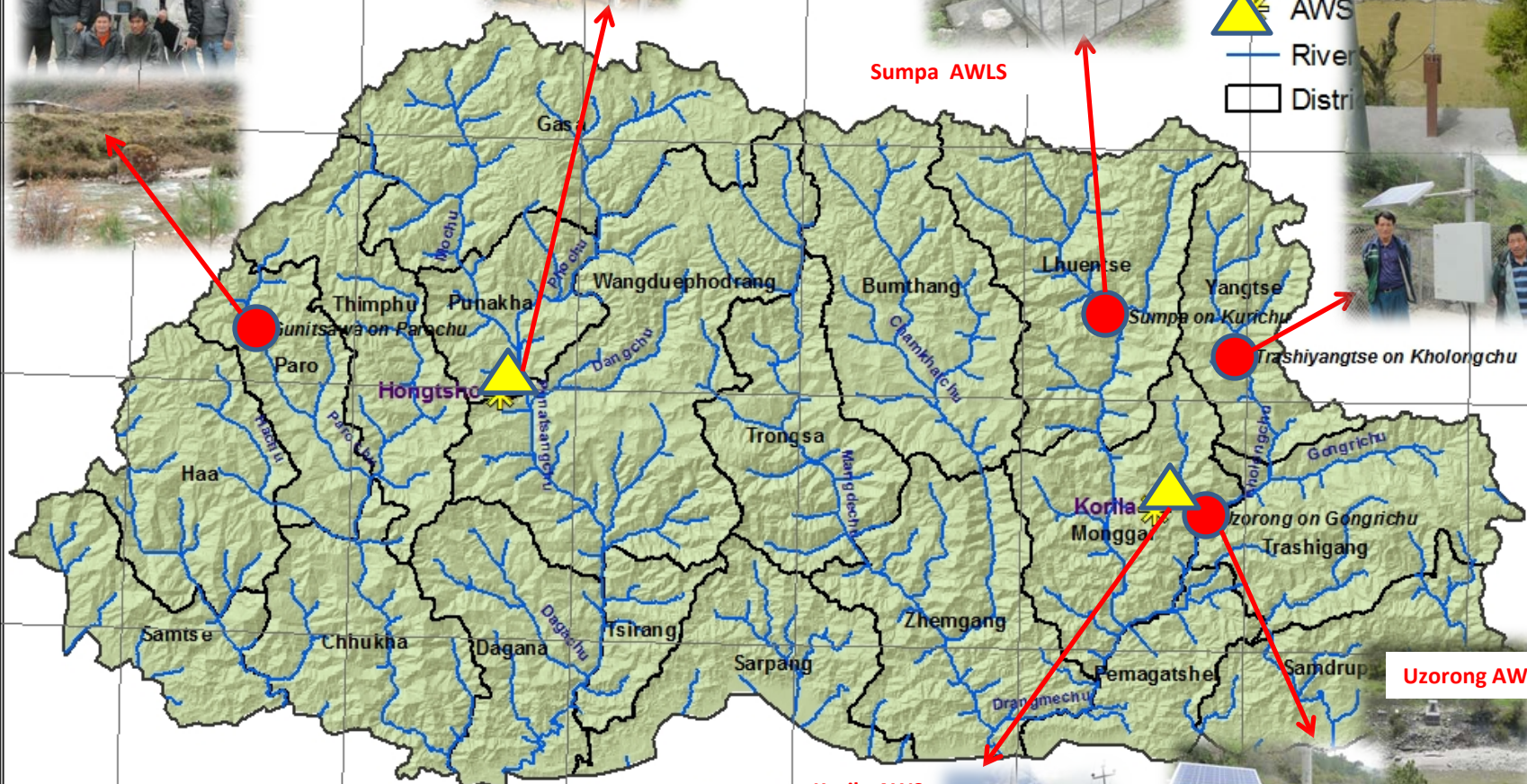
Hongtsho AWS

Sumpa AWLS

Legen

- AWL
- ▲ AWS
- River
- Distri

Trashi Yangtse



Produced by: Pema Wangdi, DHMS, MoEA



Automatic Water Level Station (Contact Type)

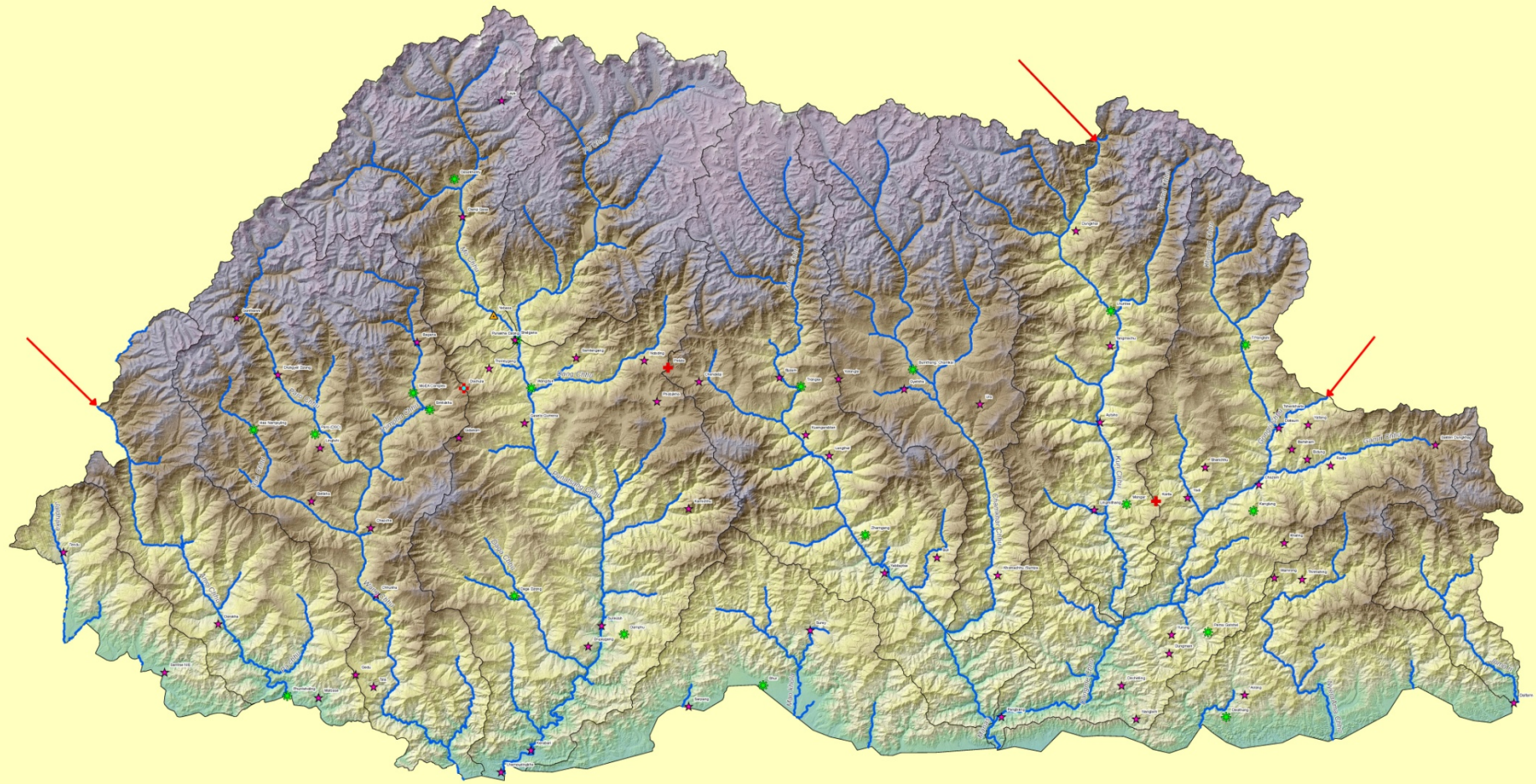


Automatic Water Level Station (Non-contact)





Map showing Meterology Station in Bhutan



Legend

- Class A
- C/S
- Class C
- Rainfall Station
- river_Bhutan

1:300,000
0 5 10 20 30 40 km

Hydrology Division
Department of Hydro-met Services
MoEA

Automatic Weather Station Network



Photo 4: Automatic Weather Station installed at Semtokha, Thimphu along with rain gauge

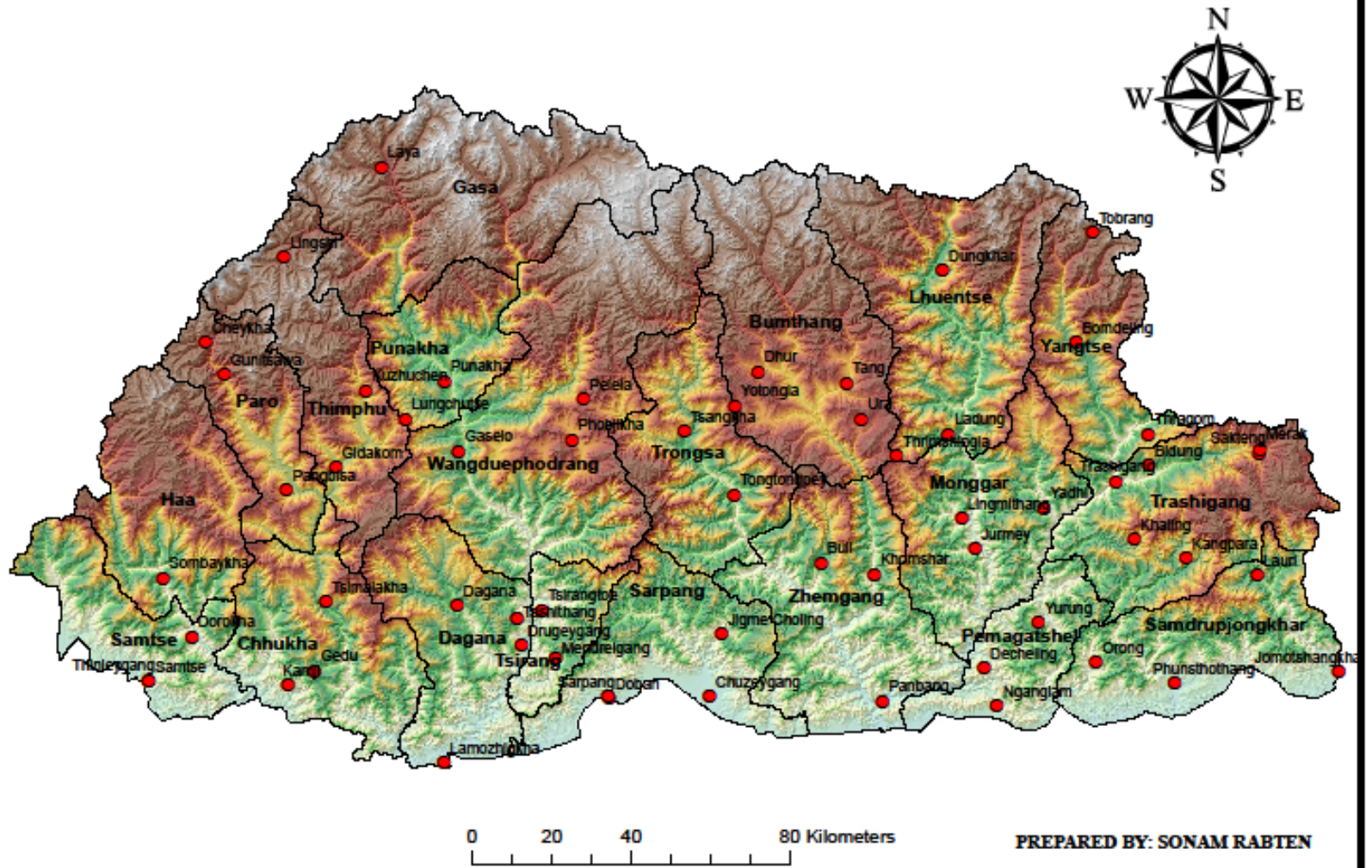


Photo 7: AWS installed at Chamkhar, Bumthang



Photo 8: AWS installed at Kanglung, Trashigang

MAP OF BHUTAN SHOWING NAPA AWS



Presentation Outline

- Introduction & Organization Structure
- Current Hydro-meteorological Networks
- **Hydro-Meteorological data**

Data Availability (Historical) since 2012

- Precipitation data:(hourly, daily, monthly) for past 5 year from current real-time rain gauge available
- Pan evaporation data: (daily, monthly) from few stations
- Soil moisture data: (daily, weekly, monthly) – No
- Streamflow discharge data: local streams with drainage areas less than 2000 km² – (hourly, weekly, monthly) = not available, but only lean data for some stream (once in a year)
- Snow data: snow depth, snow water equivalent & snowfall – available since 2013 for only few stns.

Current Data Availability (Real Time)

- Real-time rain gauge data: (hourly, daily) = both
- Surface Weather data: (Temp, RH, WS, WD, Pressure, Solar Radiation (few) and Cloud Cover)
- Snow data: snow depth, snow water equivalent & snowfall – from few stations on high passes
- Real-time soil moisture data: Not sure when it can be made available

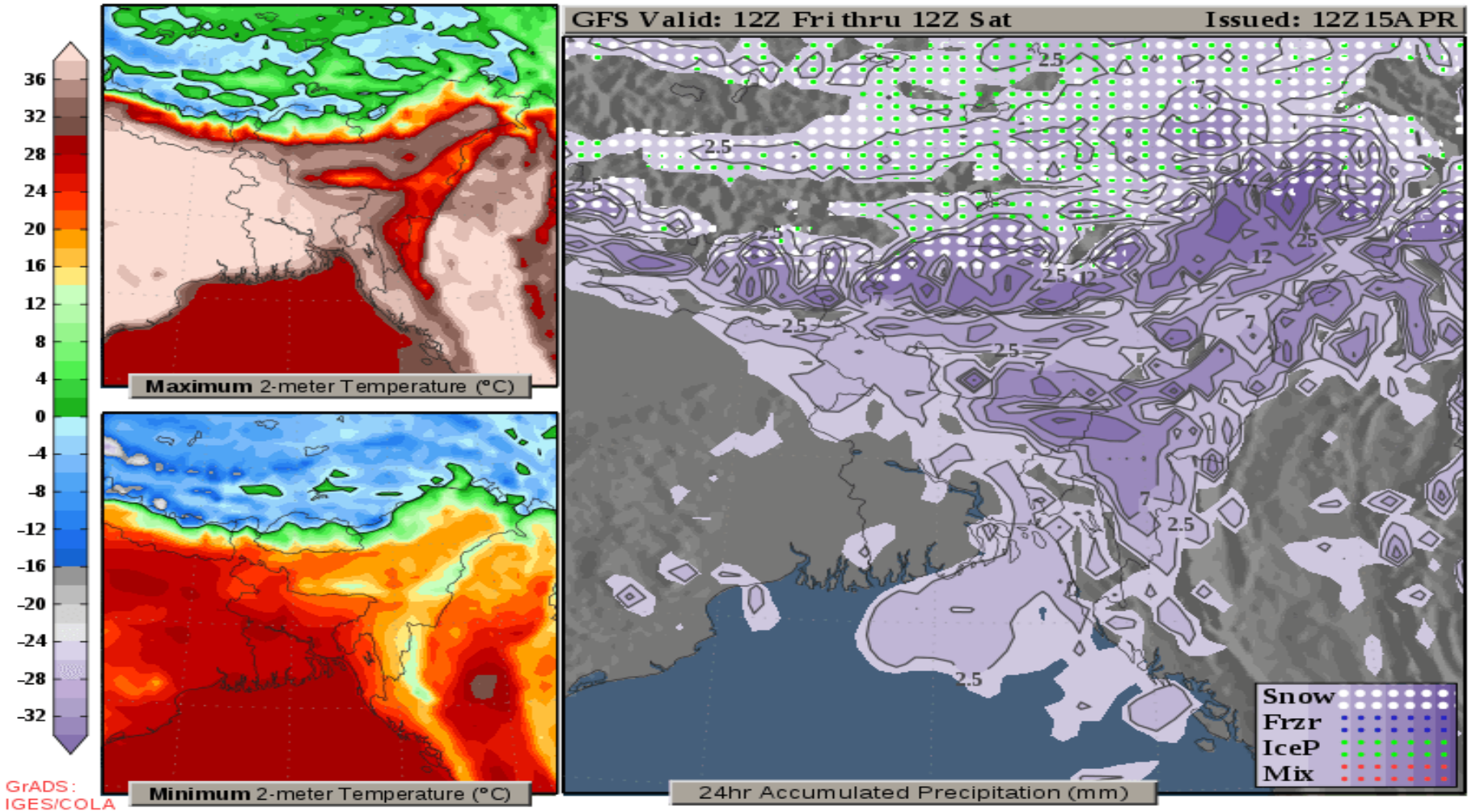
Presentation Outline

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- Hydro-Meteorological data
- **Weather Forecasting and Nowcasting**

Weather forecasting & Nowcasting

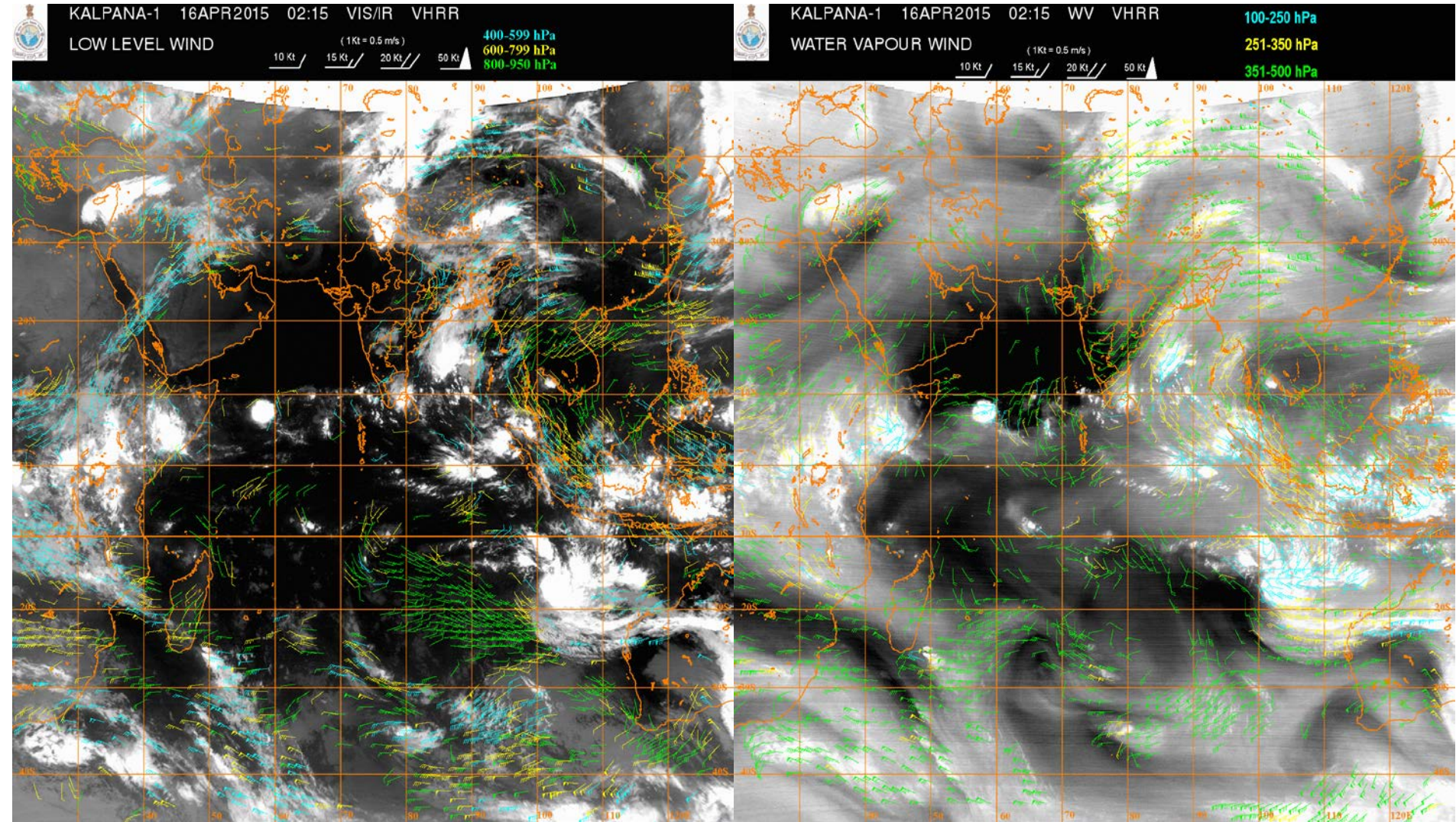
- ✓ Nowcasting = No
- ✓ Weather forecasting system in Bhutan Officially started = October 2007
- ✓ Weather forecast system are based on (Temperature forecast) = trained by Sr. JICA volunteer
- ✓ Later Satellites images used for weather forecasting in Bhutan = kalpana-1, IMD
- ✓ Total weather forecaster at DHMS = 6 Nos. (System operational by 24/7 = March 2016)

Provide Forecast (72 hrs)



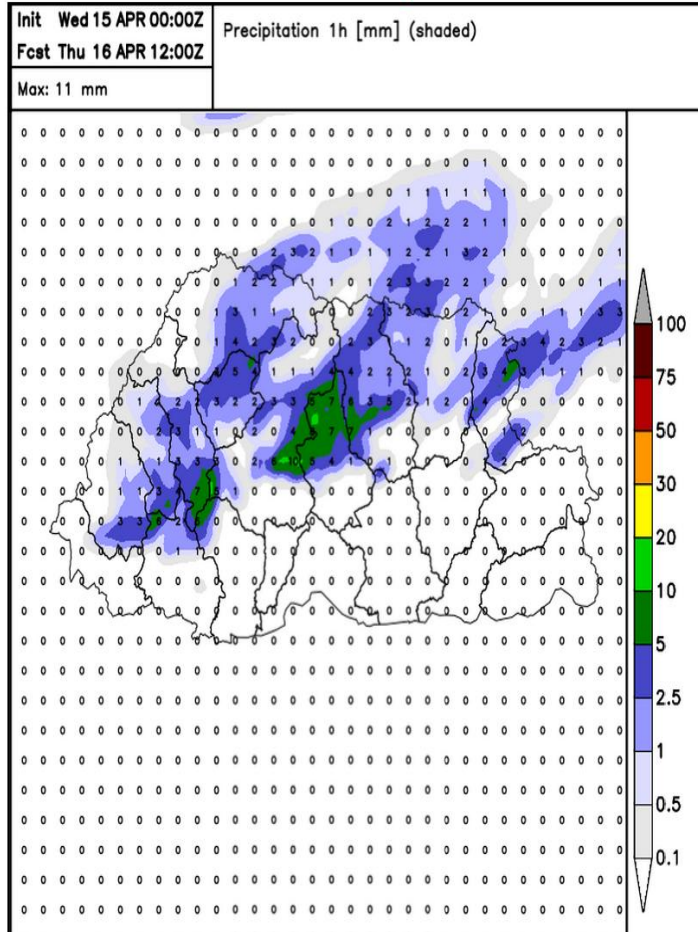
Source: DHMS

Satellite Image of kalpana-1, IMD for Visualization & interpretation

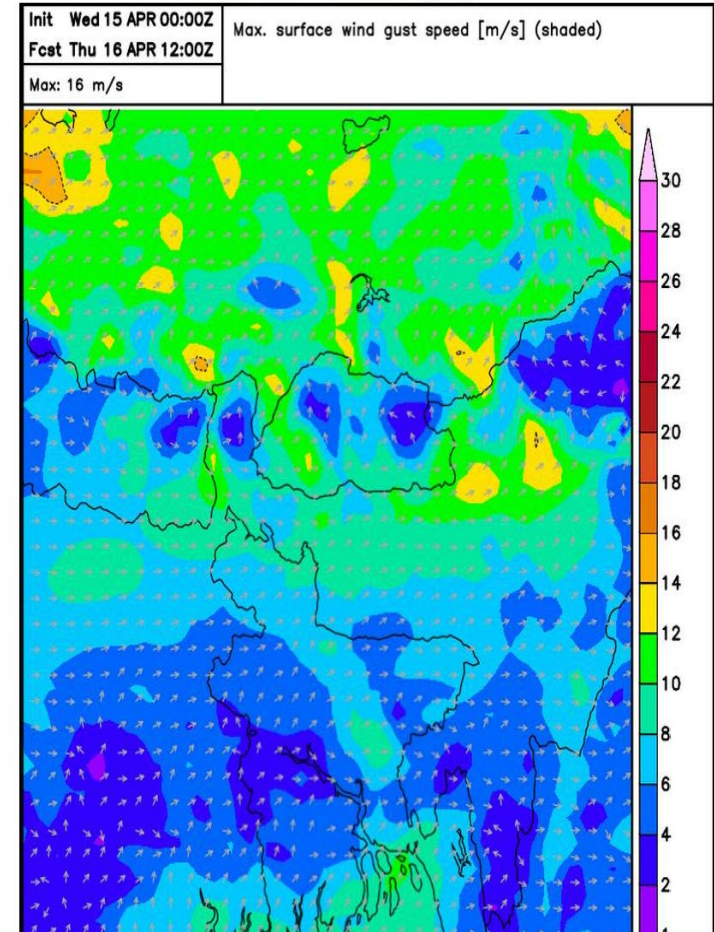


Weather Research & Forecasting (WRF) Model Products

Run : 00 Product : prec1h



Run : 00 Product : gust



Source: DHMS

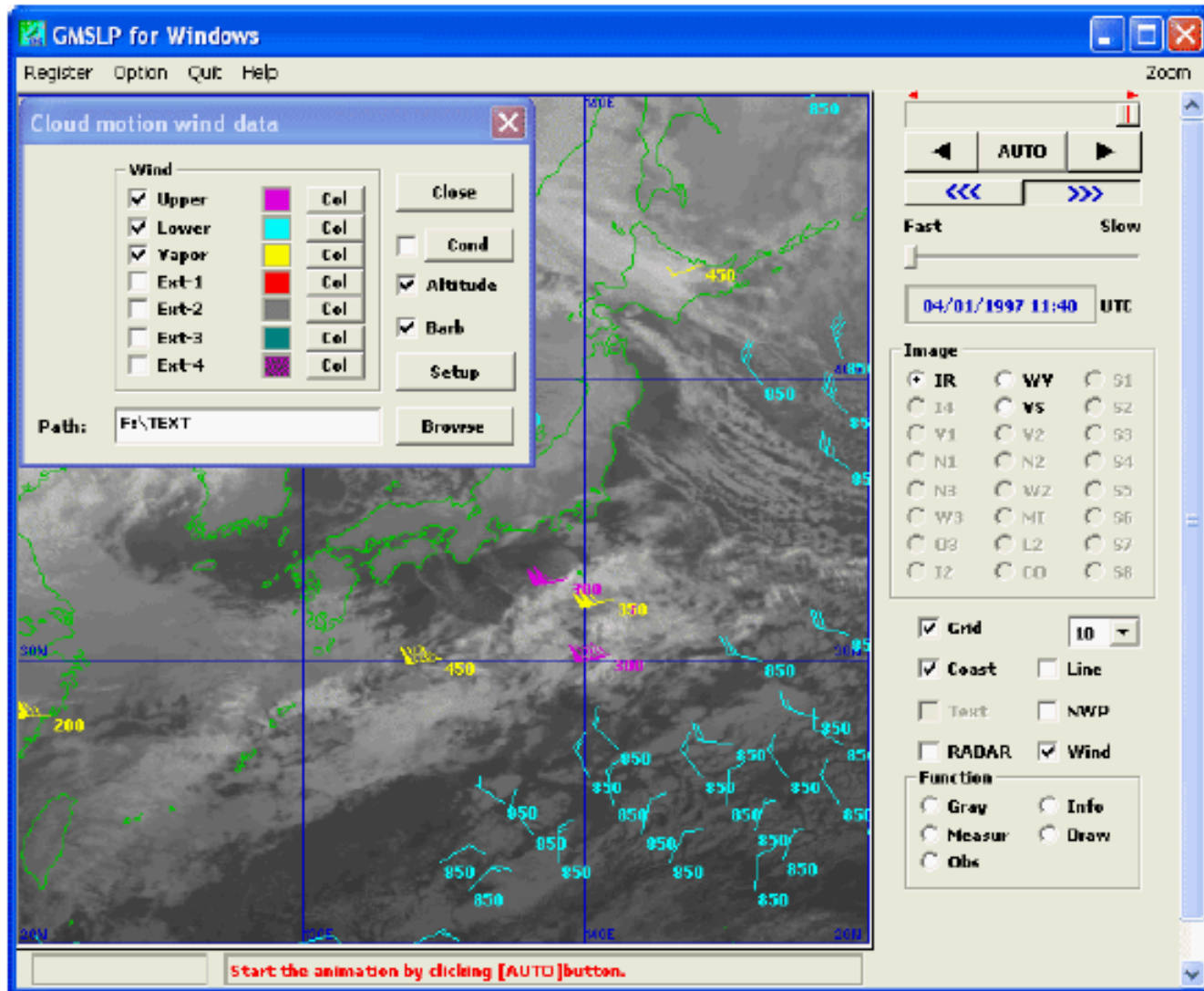
Himawari -8 satellite receiver

- ✓ Receiver installed in March 2016



Visualization & Processing

- Till march satellite images were subjectively analyzed through human eyes
- The Meteorological Satellite Center has developed a Computer Aided Learning System (MSC-CAL) called “SATAID” (Satellite Animation and Interactive Diagnosis) for improving images analysis skill.



A Satellite Image Synthesized with Cloud Wind Vector Data(The image contains Upper Wind and Lower Wind, Water Vapor Wind, and altitudes)

Database

- ✓ For Met: Climsoft
- ✓ For Hydro: Hydata
- ✓ New Central DMS is under development phase (ICIMOD, FMI, RTS)



GTS Reporting

- ✓ Data exchange on GTS with New Delhi and Bangkok



Radiosonde station

- ✓ Launched at Paro International Airport = 2 times a day for the month of AMJ (started with the support of Indian Space Research Organization (ISRO), IMD, India).

Presentation Outline

- Introduction & Organization
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- Current Hydro-meteorological
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- **Flood Early Warning System**



Flood disaster related situation Bhutan



2009 Cyclone Aila caused damages of approximately \$17 million for farmland and infrastructure (GNHC, 2013).

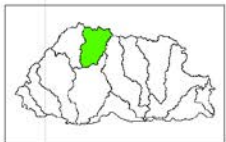


Flood Warning System

- Flash Flood Warning System = Not exactly
- However, we have: GLOF & Rainstorm Early Warning System in 3 sub-basins.



GLOF Early Warning System in Pho chhu Sub-basin



Bay Tbu AWIS



Rapsteng AWIS



Thorthomi AWIS



Thaza AWS



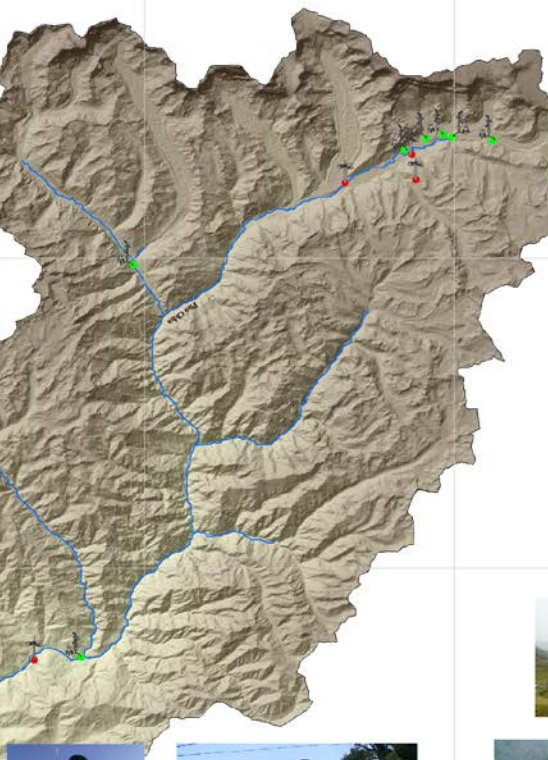
Tacta-Wachet AWS



Sandingkha Siren



Khawajee Siren



Punakha Dzong Siren



Wadhang Siren



Dango AWS



Loggy AWIS



Thaza-Tenchey Siren



Lhochi Siren



Tibste Siren

Legend



Sensor



Siren



phochhu

Elevation

High / 7189

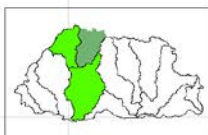
Low / 1205

1:160,000

0 1.5 3 6 9 12 Km



GLOF Early Warning System in Mochu and Punatshangchhu Basin



Takumarshang AWIS



Takusa AWIS



Punakha Dzong



Taktshang AWIS



Wajusa Siren



Akhorshang Siren



Digma-Nel Siren



Punatshang Chhu 1 Dam Siren



Basu Chhu Siren



Basu Chhu Siren



Punatshang Chhu 1 Power House Siren



Sandhang Siren



Mingkar Control Center



Wangkar Siren



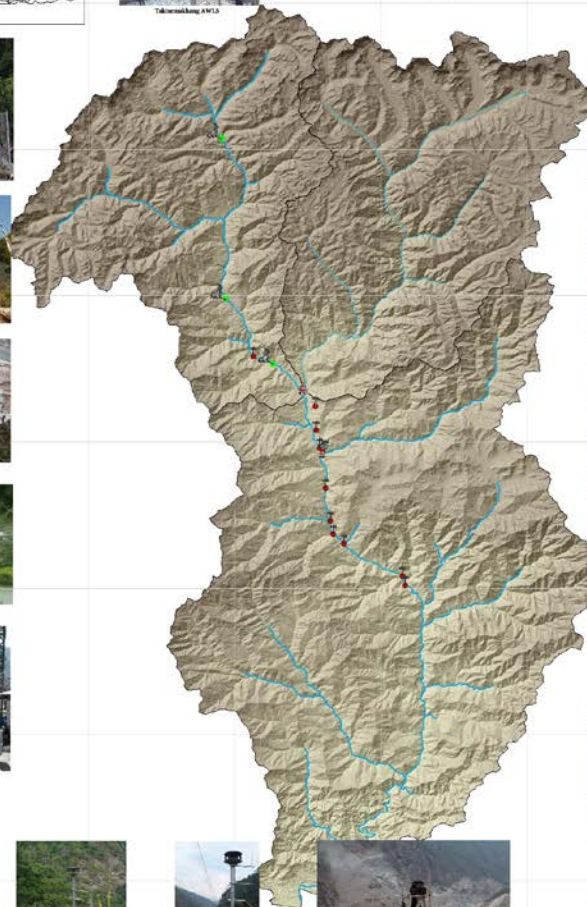
Wangkar Phoshang Dzong



Kani Chhu Siren



Punatshang Chhu 1 Siren



Legend



Control Center



Dzong



Sensor



Siren



Mochu

Elevation

High / 7189

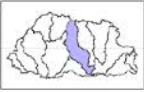
Low / 67

1:300,000

0 3 6 12 18 24 Km



GLOF Early Warning System Facilities along the MangdeChhu Sub-basin



Siren at Bjizam Pry. School



Automatic Water Level Station at Jonghang



Automatic Water Level Station at Bjizam



Trongsa Dzong



Siren at MHPA Dam Site



Siren at MHPA Power Plant



Control Center at MHPA DAM Colony

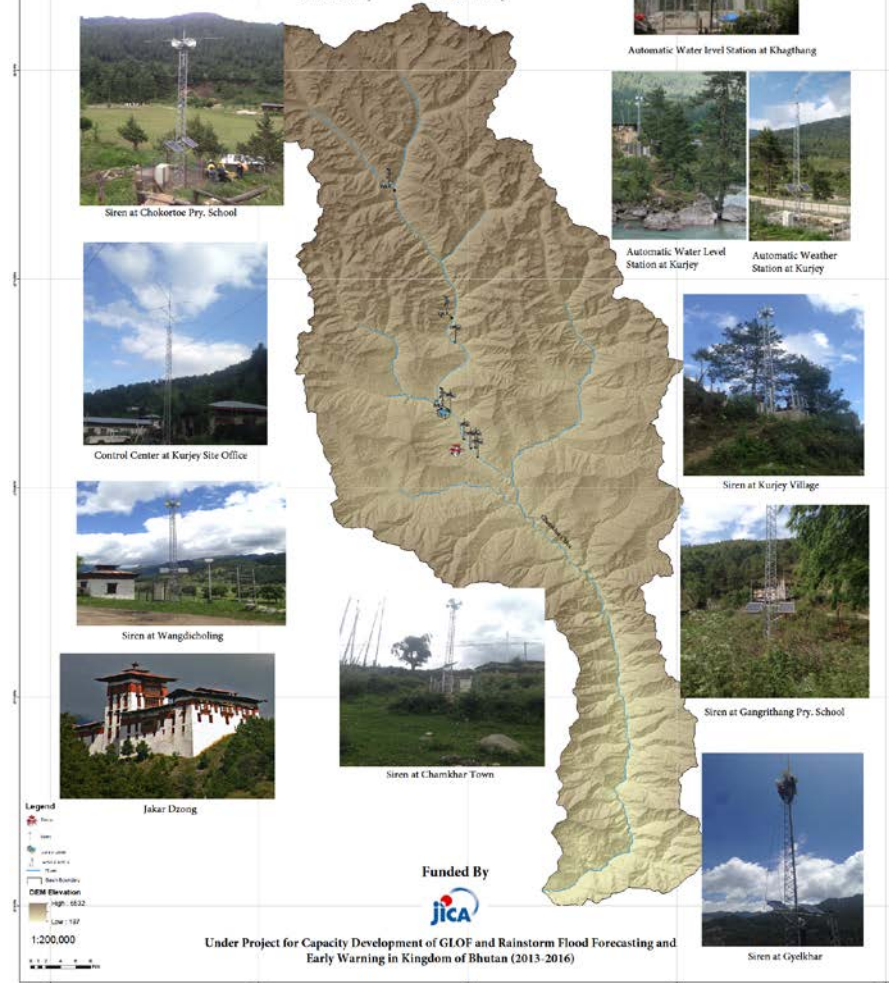
Funded By



Under Project for Capacity Development of GLOF and Rainstorm Flood Forecasting and Early Warning in Kingdom of Bhutan (2013-2016)



GLOF & Rainstorm Early Warning System Facilities along the Chamkharchhu Sub-basin



Automatic Water Level Station at Tsampa



Automatic Weather Station at Tsampa



Automatic Water Level Station at Khagthang



Siren at Chokortoe Pry. School



Automatic Water Level Station at Kurje



Automatic Weather Station at Kurje



Control Center at Kurje Site Office



Siren at Kurje Village



Siren at Wangdicholing



Siren at Gangrithang Pry. School



Jakar Dzong



Siren at Chamkhar Town



Siren at Gyelbar

Funded By

Funded By



Under Project for Capacity Development of GLOF and Rainstorm Flood Forecasting and Early Warning in Kingdom of Bhutan (2013-2016)

Flood Warning....Cont.

✓ Total human resources working in GLOF & Rainstorm Early Warning System at DHMS = 12 Nos. (for 4 control rooms monitoring 24/7)


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- **Products & Services**

Product & Services


- Provide Data based on user need (upon requisition)
- Forecast Information (media, print media, TV, Radio and mobile weather apps under development)
- Seasonal outlook (monsoon and winter) two times a year

Dissemination: currently Website www.hydromet.gov.bt



ལྷ་དང་གནམ་གཤིས་བརྟུན་ཡུལ་ཁྲུང་།
Department of Hydro Met Services
Ministry of Economic Affairs


The National Center for Weather, Climate & Water Resources



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ABOUT DHMS

[Read More about DHMS](#)



NOTICES

Press Release

Sensitization workshop on Hydro-Met Data Use on 10th and 11th Oct, 2014

[▶ READ MORE](#)

DAILY FORECAST FOR 2015, APR 16

Min: 13 °C	Min: 14 °C	Min: 15 °C
Dagana Max: 21 °C Min: 10 °C	Zhemgang Max: 22 °C Min: 11 °C	Chhukha Max: 24 °C Min: 10 °C
Trashigang Max: 28 °C Min: 11 °C	Monggar Max: 29 °C Min: 13 °C	Trashi Yangtse Max: 24 °C Min: 9 °C
Lhuentse Max: 30 °C Min: 13 °C	Sarpang Max: 31 °C Min: 22 °C	Samdrup Jongkhar Max: 29 °C Min: 15 °C

NEWS AND EVENTS

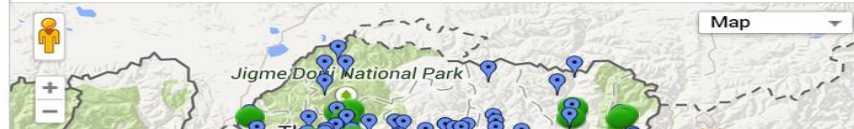
Outline of Project on Capacity Development of GLOF and Rainstorm Flood Forecasting and Early Warning, funded by JICA

REAL TIME WATER LEVEL

Water Level of Bemethang HD-Principal at 2012-12-31 09:00:00 is 1.18m

Water Level of Pangbang HD-Principal at 2013-01-01 09:00:00 is 2.76m

AUTOMATIC STATIONS IN THE COUNTRY



Map

Jigme Dori National Park

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- **Collaboration agencies**

Collaborating agencies

- **Legal System**

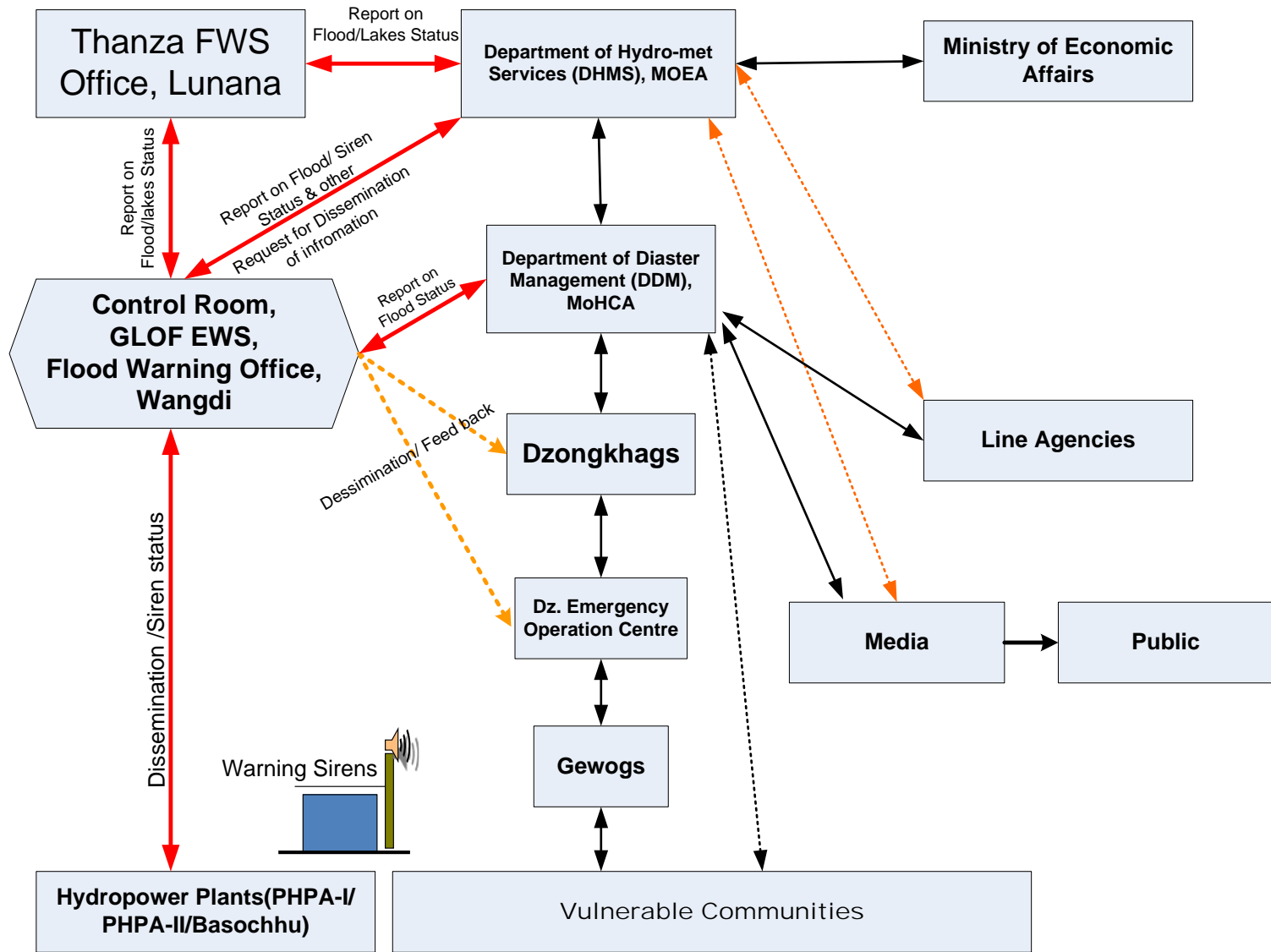
- ✓ **The Article 8 of the Constitution of Bhutan**

- ✓ **The Disaster Management Act of Bhutan, 2013**

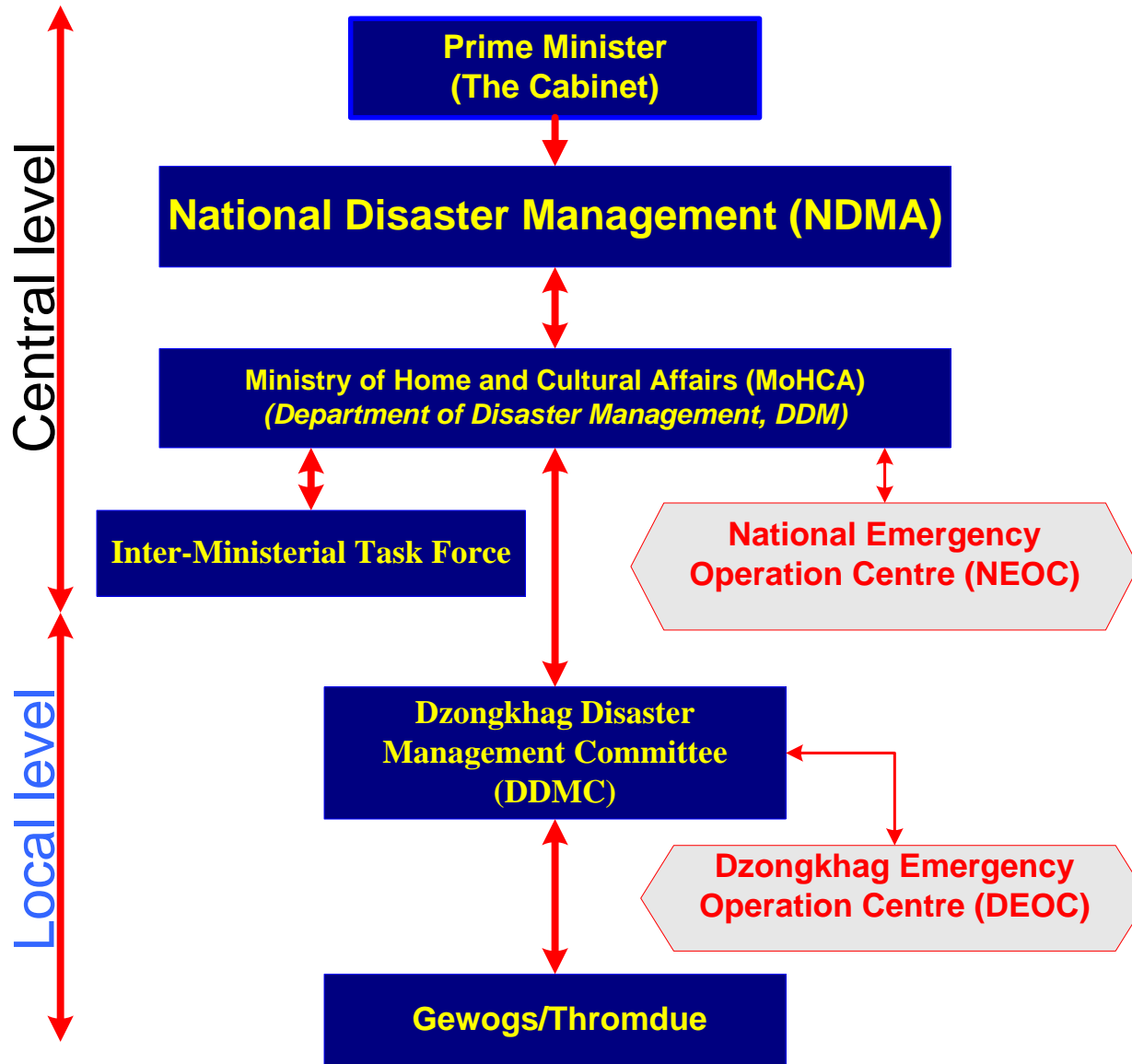
- ✓ **Water Act of Bhutan, 2011**

Standard Operation Procedure (SOP)

Information Flow chart



■ Governmental System



Source:DDM, MoHCA

Implementation Structure

[Goal]

Reduce flood disasters through flood forecasting and warning



[Purpose]

Build Capacity of DHMS in flood forecasting using appropriate model/Tools & Technology

[Output 1]

Flood forecasting and warning capacity enhanced

[DHMS, DoEs, Hydropower company, Local Govt. Communities]

[Output 2]

Communities sensitized and educated about flood

[DDM, DHMS, Local Govt. and Communities]

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- **Challenges**

Challenges of DHMS

- **Low** density of hydrological and rainfall monitoring network
- Real time telemetry hydro-meteorological stations are in the **early stage of development.**
- **Limited trained professional** in the field of hydrology and meteorology to carry out weather & flood forecasting and warning.
- **No flood forecasting system and use of modelling tools are** just being initiated earlier
- **No standard Flood hazard maps** are available
- **No Standard Operating Procedures (SOP)** at national as well as local level for effective communication or dissemination of flood warning

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Conclusion/Remarks

- Optimistic that FFG system will provide us adequate provision of knowledge & technology transfer
- We wish to avoid any “black-box” modeling situation
- Capacity development of DHMS in Flash Flood is our priority
- Joint regional initiative of WMO, NOAA, HRC and IMD with funding support from USAID/OFDA will continue and takes us to next level

THANK YOU & TASHI DELEK!