



## **Familiarization Visit to WMO 25-27 September 2019**

# **An Overview of National Center for Hydrology and Meteorology (NCHM) *(A scientific and technical autonomous agency of the Royal Government of Bhutan)***

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Geneva : Switzerland  
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[www.nchm.gov.bt](http://www.nchm.gov.bt)**

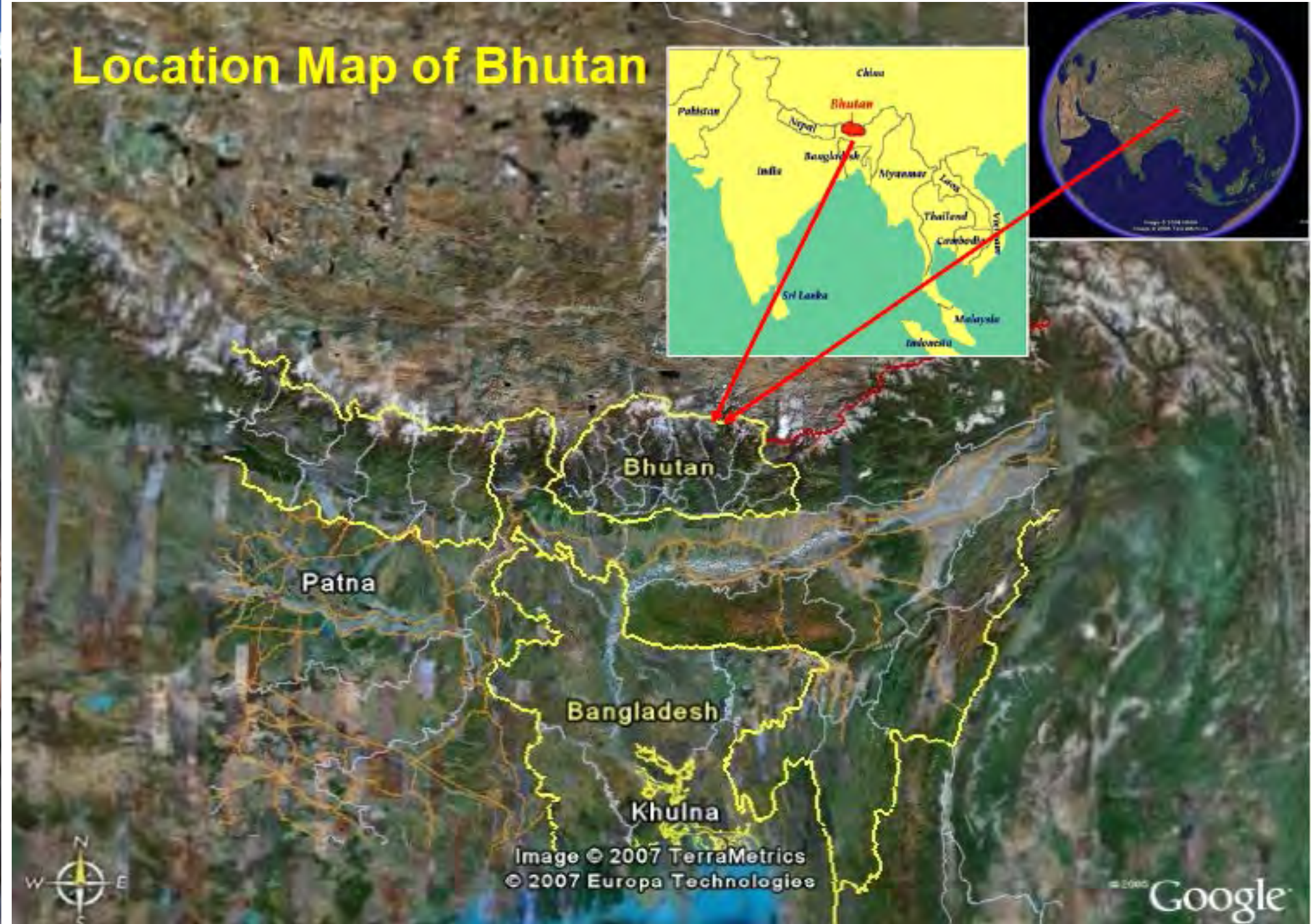


# Presentation Outline

1. General Background Bhutan and NMHS
  - Bhutan locations and its vulnerability and risks to climate change
  - Institutional framework of Hydro-met services in Bhutan
  - Vision, Mission, Mandates and functions
2. Current Services and Products
3. Challenges and opportunities
4. Plans and Priority needs



# Location Map of Bhutan







# River System of Bhutan



## Legend

- Rivers
- International Boundary
- Basin Boundary

1:1,500,000

0 12.5 25 50 75 100 Kilometers

## Disclaimer Note:

The new International boundary have been abstracted from available sources and shouldnot be taken as authoritative

## Data Sources:

DEM: ALOS- 10 mtr resolution

HD, DHMS, MOEA





# About Bhutan

- Located in the eastern Himalayas
- Relatively small mountainous country **38,394 sq.km**
- Total population **735,553** (*Source: 2017 PHCB*)
  - **62.2%** in Rural Area; **37.8%** in Urban Area
  - Population density around **19 persons/km<sup>2</sup>**
- Altitude range from **160 to 7500** meters above sea level
- Distance: around **170 km** north-south and **340 km** east-west
- Fragile mountain ecosystem, rich biodiversity
- Climate – Wet summer monsoon and cool dry winters
- Country is divided into:
  - 20 Dzongkhag (Districts)
  - 205 Gewog (Blocks)

*Source: <http://www.nsb.gov.bt/publication/files/pub6sh3499go.pdf>*



# Bhutan is a Carbon Neutral

- Forest Cover: 72% of total area
- GHG emissions still relatively low
  - Total emissions: 2.2 million tons CO<sub>2</sub> equivalent in 2013
  - Forests Sink: 6.3 million tons CO<sub>2</sub> estimated
- 100% Electricity generated through hydropower
- Bhutan isn't just carbon neutral - it's carbon negative



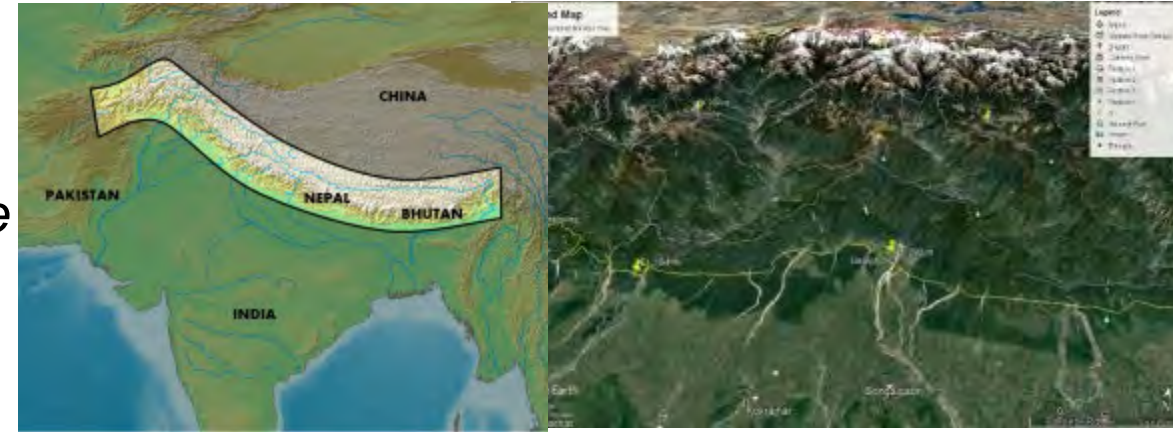


# Bhutan's Vulnerability to Climate Change and Disasters

## Bhutan's Geography and location

## Bhutan's Economy

- *Heavy dependence and climate sensitive sectors*
  - *Agriculture*
  - *Hydropower*
- *Population: 720,000*
  - *36% urban and 64% rural*
  - *Mainly dependent on*
- *Subsistence farming*
- *Tourism*





# Current Threats, Hazards and Vulnerabilities

- **Glacial Lake Outburst Floods**
  - due to rise temperature
- **Land Degradation**
  - Landslides, erosion due to changes in weather patterns, high intensity of rainfall, cyclones etc.
- **Flash floods**
  - Intense rainfall periods, cyclones during and around monsoon season
- **Wind/thunder/hail storms**
  - Premonsoon monsoon season
- **Droughts**
  - Especially in dry season
- **Forest fire**
  - During the dry winter
- **Epidemics, pests and diseases:** Dengue
- **Earthquake**

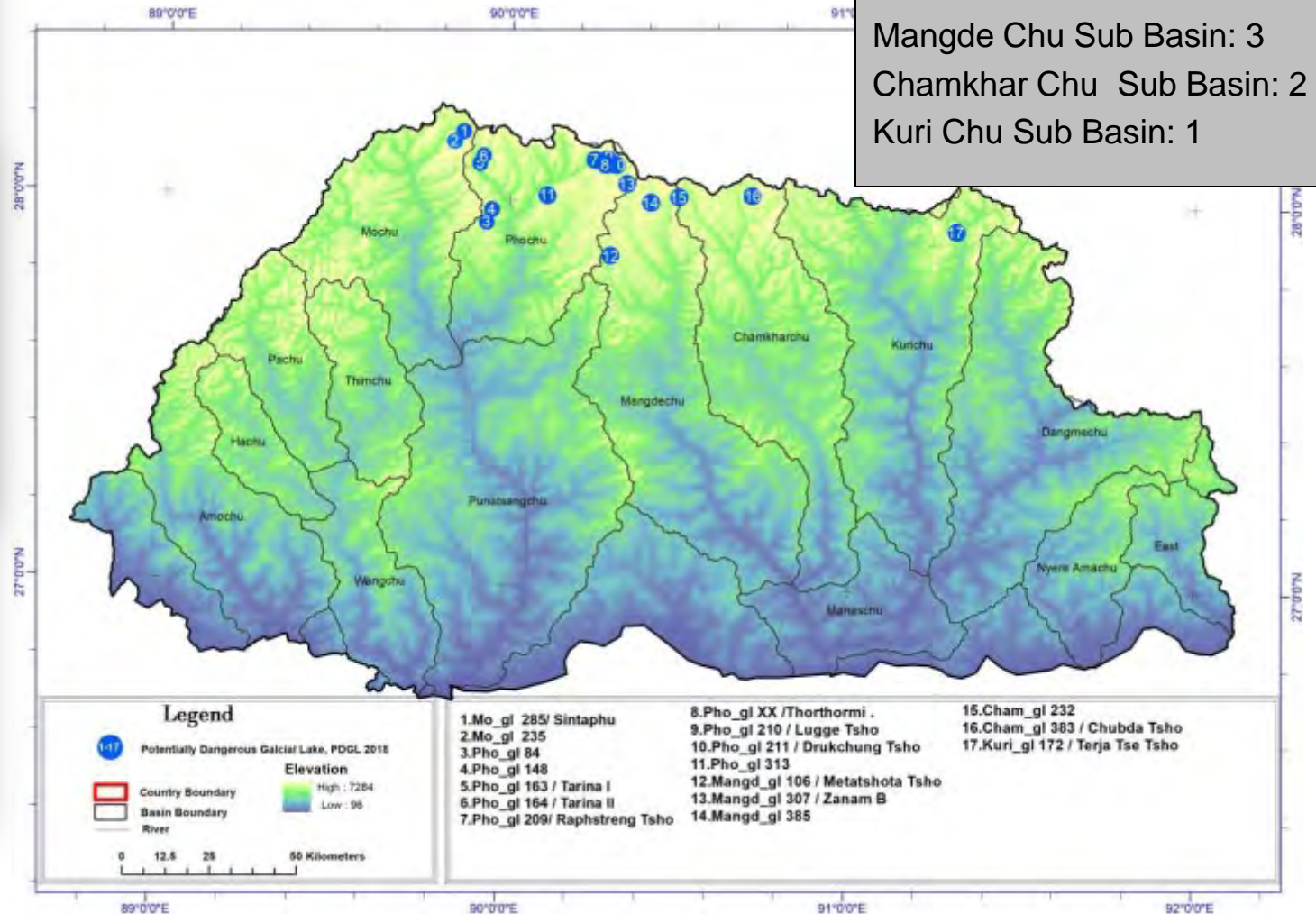






# Potentially dangerous glacial lakes of Bhutan

Pho Chu Sub Basin : 9  
Mo Chu Sub Basin : 2  
Mangde Chu Sub Basin: 3  
Chamkhar Chu Sub Basin: 2  
Kuri Chu Sub Basin: 1

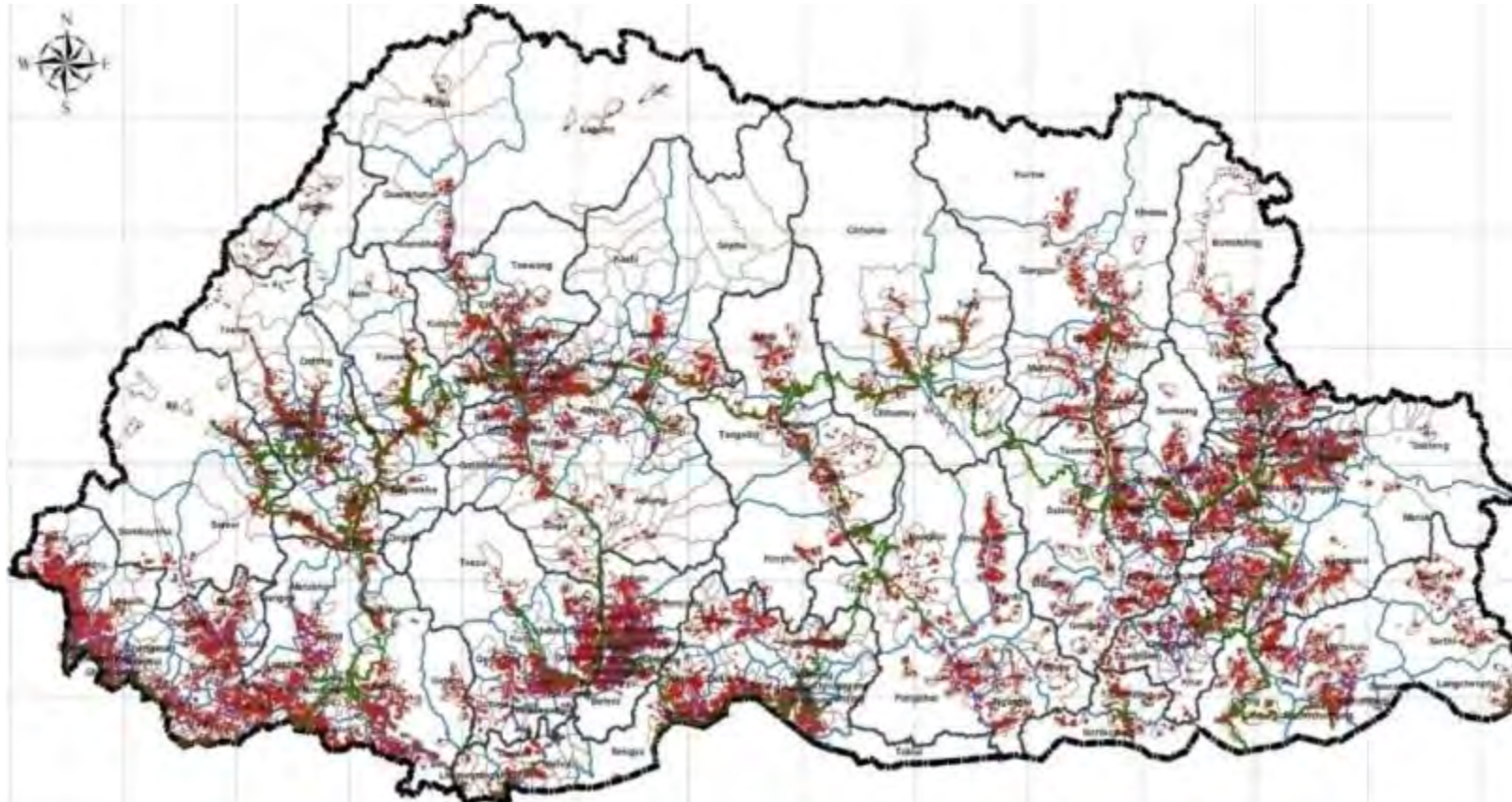


Out of **2674** glacial lakes and 700 glaciers **17** has been identified as potentially dangerous lakes *Source: NCHM, 2018*



# Flooding Risks

- Over 70 percent of the settlements are located along the main drainage basins
- Infrastructure (urban areas, hydropower plants, roads, airports, etc) and most of the settlements, fertile agricultural land are located along the valleys.

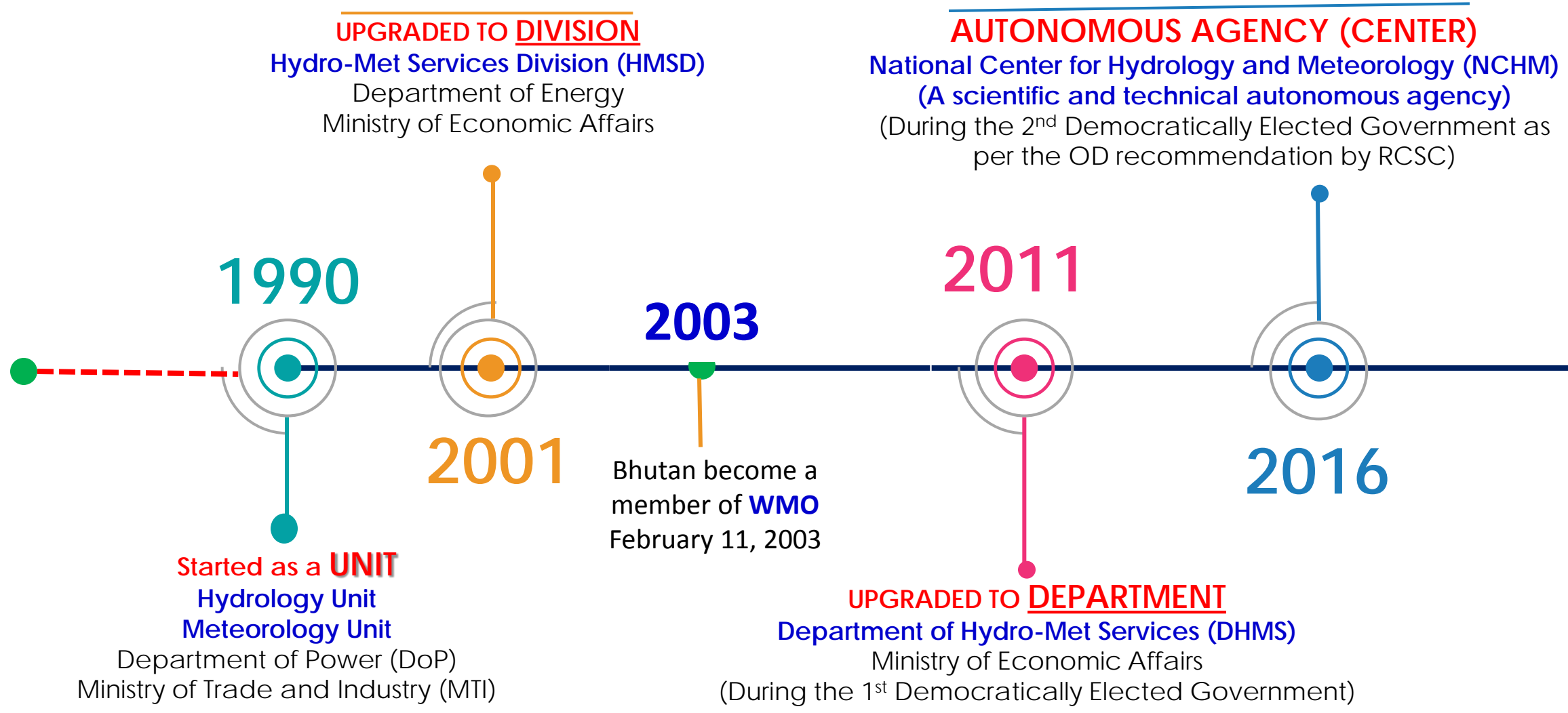


Map : Settlement point data of Bhutan (NSB, 2005)





# Organizational Development of Hydro-Met Services in Bhutan



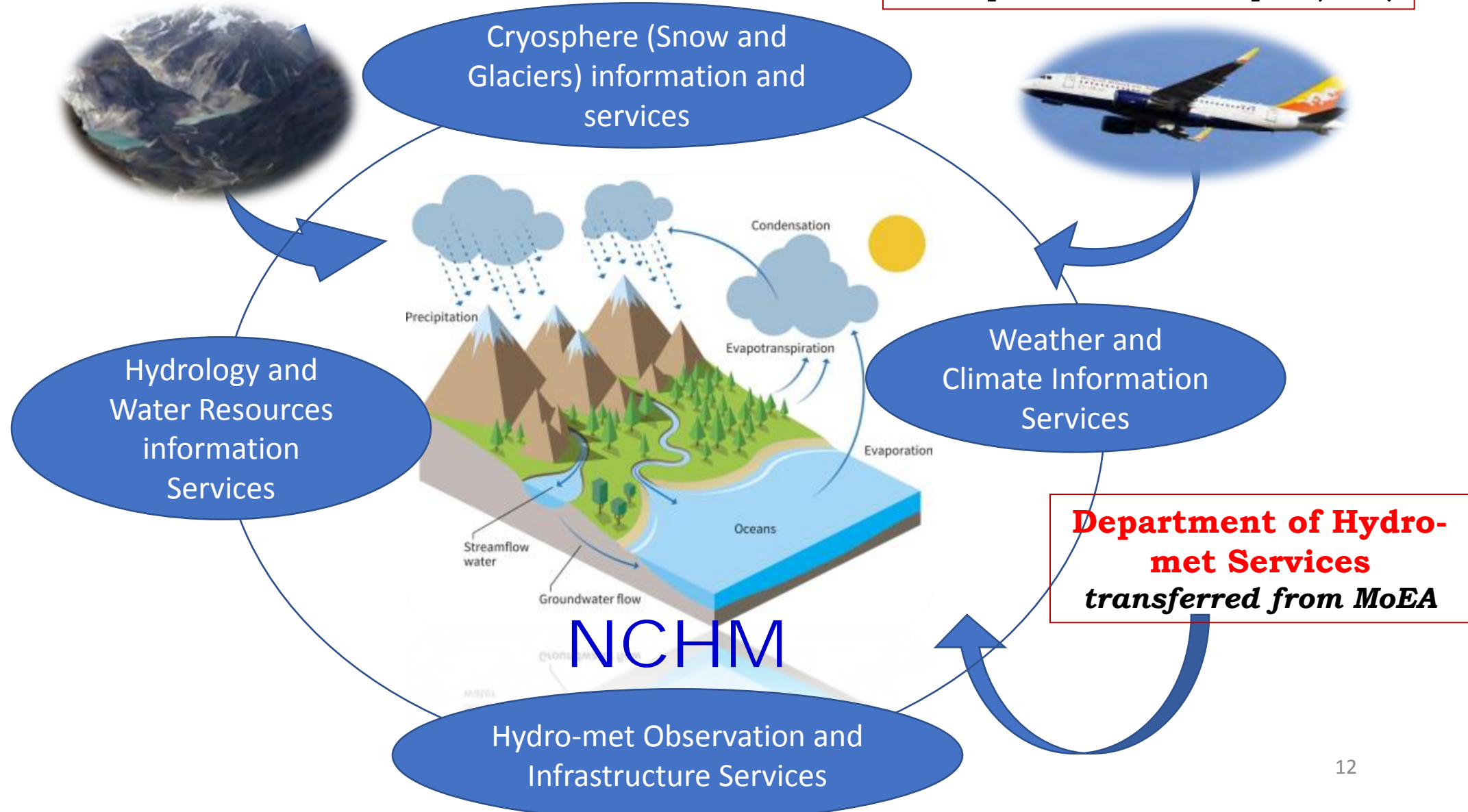


# Restructuring of the Department Hydro-met Services to NCHM in 2016

## Glaciology Division

*transferred from the Department of Geology and Mines (DGM), MoEA*

**Aviation met** transferred from the Department Air Transport (MoIC)





# Vision, Mission and Mandates

**NCHM is the scientific and technical autonomous agency of RGoB with :**

## **MANDATES**

*Provide scientific and technological services in hydrology, water resources, meteorology, climatology, and cryosphere to ensure the safety and socio-economic well-being of society and to support national and international needs.*

## **MISSION**

*Monitoring and understanding of hydrology, weather, climate and cryosphere, for timely provision of information and services to protect lives and property and support national needs for ecologically balanced sustainable development.*

## **VISION**

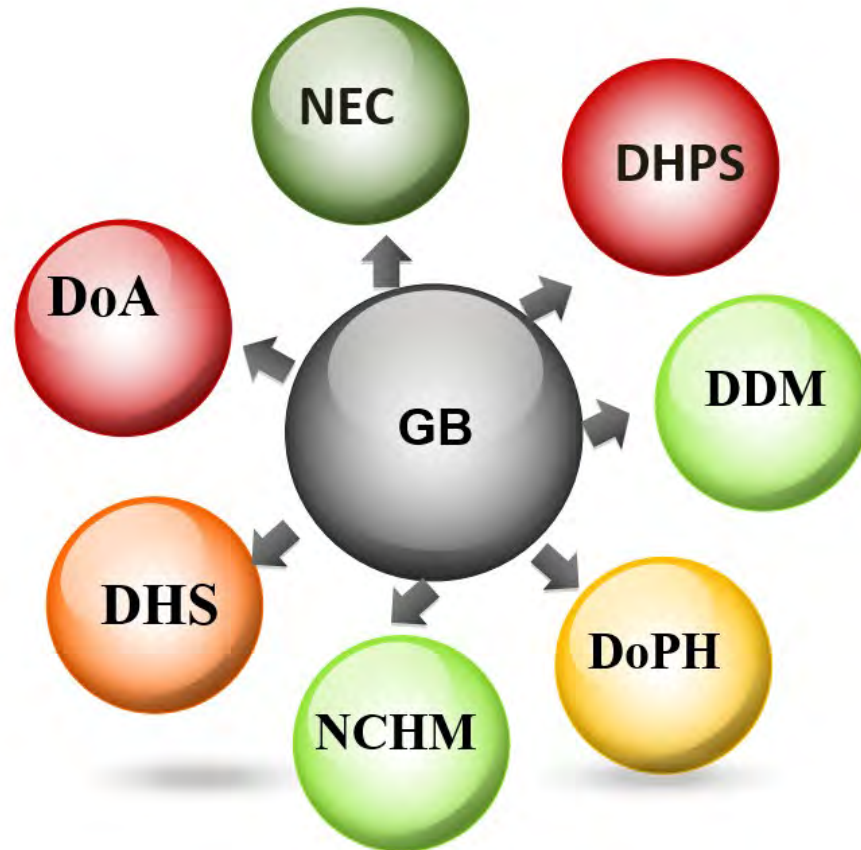
*Center of Excellence in Hydrology, Meteorology and Cryosphere Science and Services*

**The Center is the national designated focal point of Bhutan with WMO and IPCC**



# Governance of NCHM

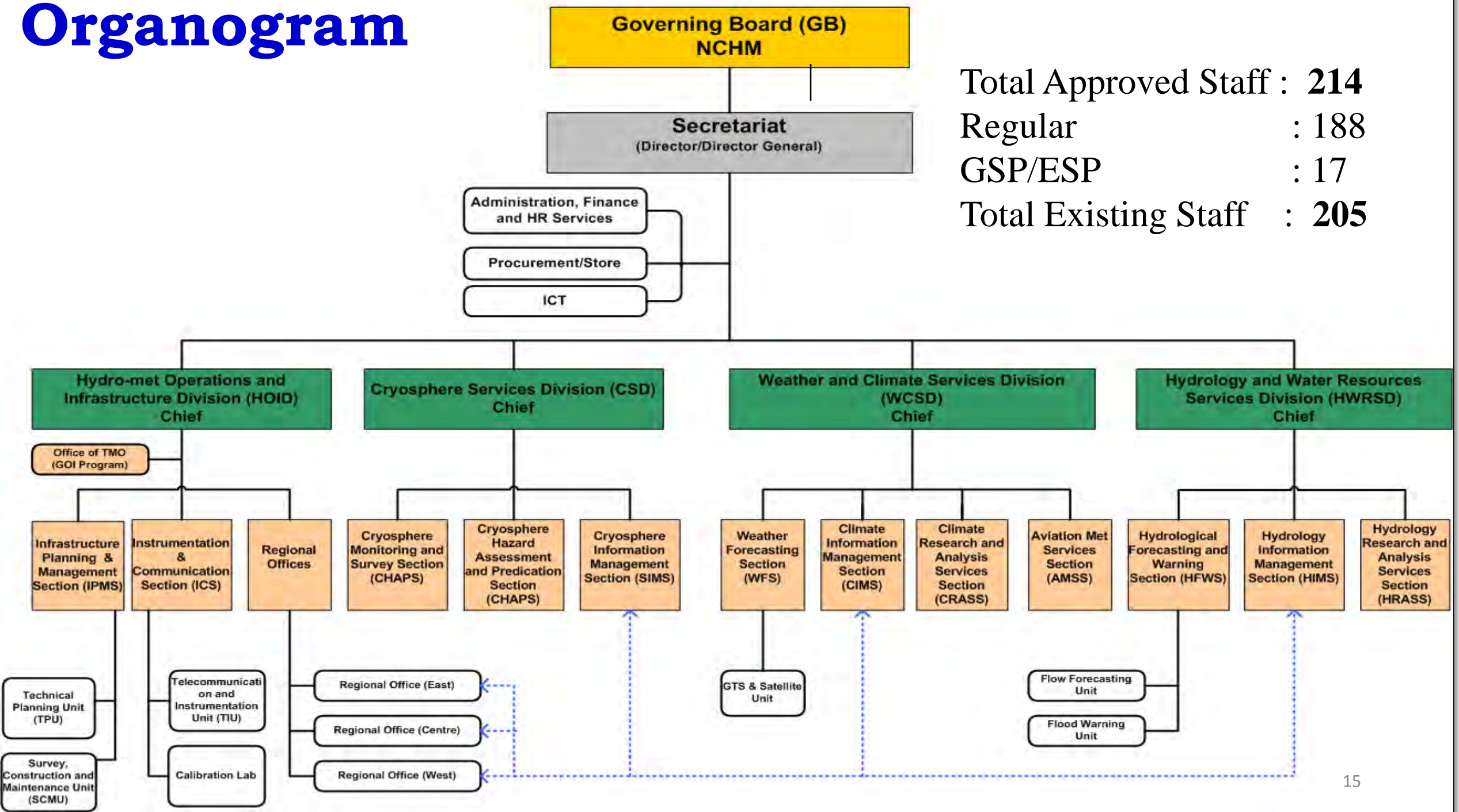
The Center is governed by a Governing Board (GB) with its members nominated from the relevant sectors approved by the Cabinet.



## **GB composition:**

1. National Environment Commission (NEC);
2. Department of Hydro Power and Power Systems (DHPS), MoEA;
3. Department of Disaster Management (DDM), MoHCA;
4. Department of Public Health (DoPH), MoH;
5. Department of Human Settlement (DHS), MoWHS;
6. Department of Agriculture (DoA), MoAF; and
7. National Center for Hydrology and Meteorology (NCHM)

# Organogram



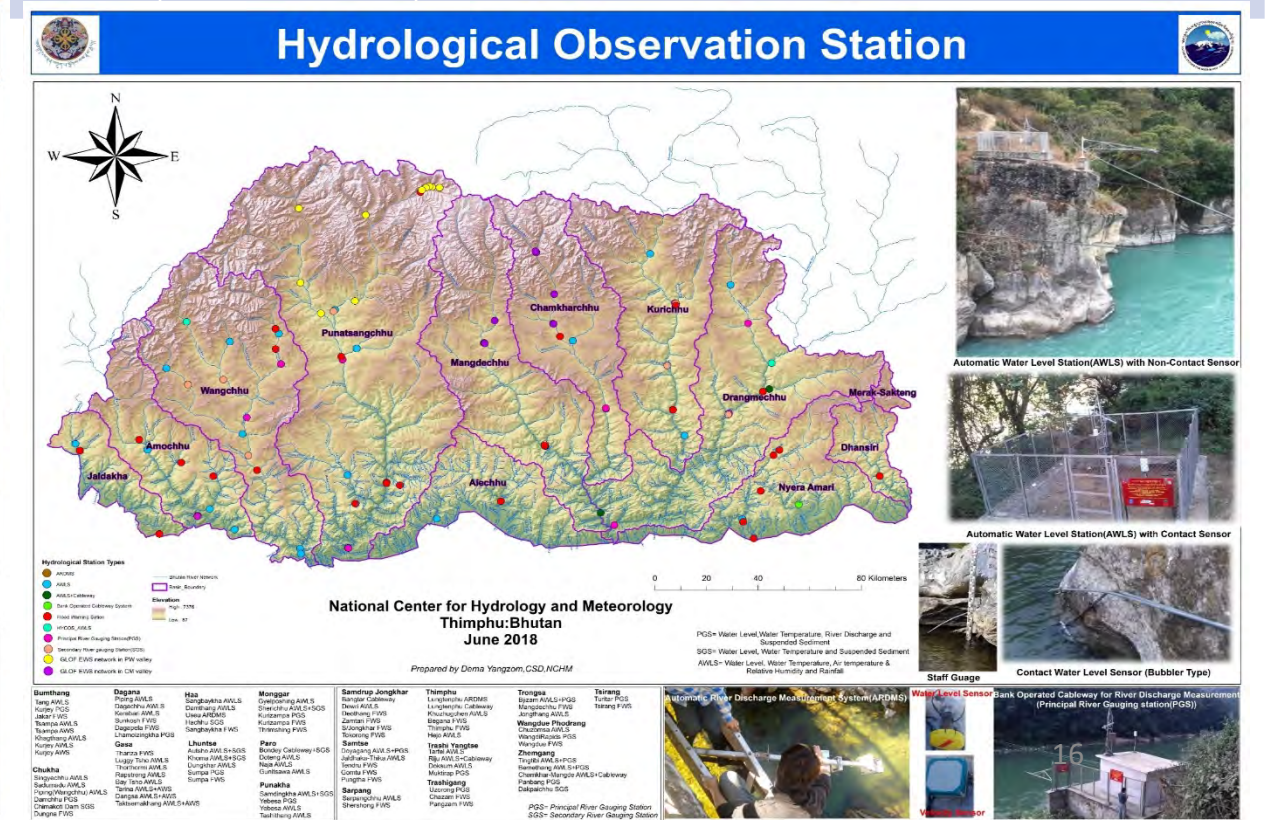
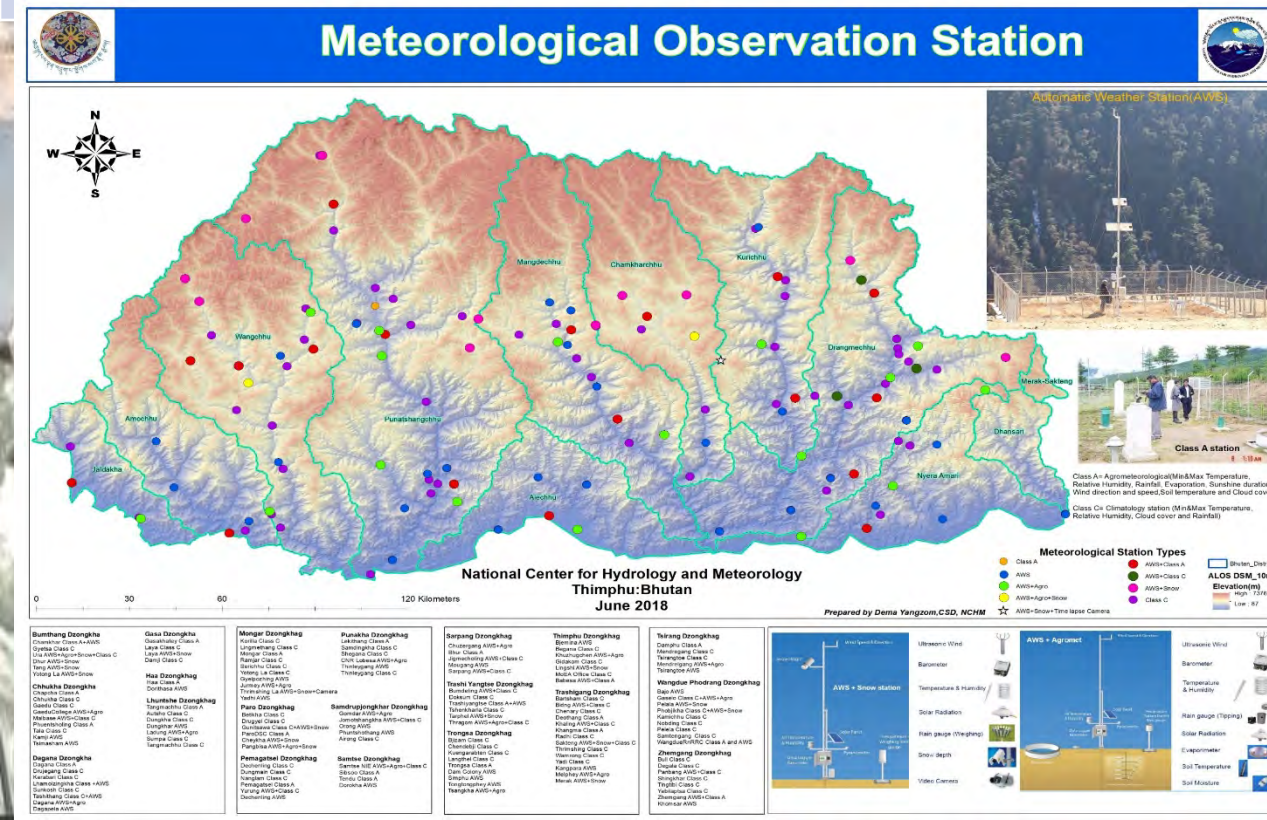


# National Hydro-met Observation Network

## Type of Monitoring Station

1. Meteorology/Climate Station	155	AWS/Manuals
2. Cryosphere (Snow and Glaciers) monitoring Station	20	AWLS/AWS/Snow
3. Hydrological/Flood Observation Station	59	AWS/AWLS
4. Sediment Sampling Station	16	Suspended Sediments

**Total 250**





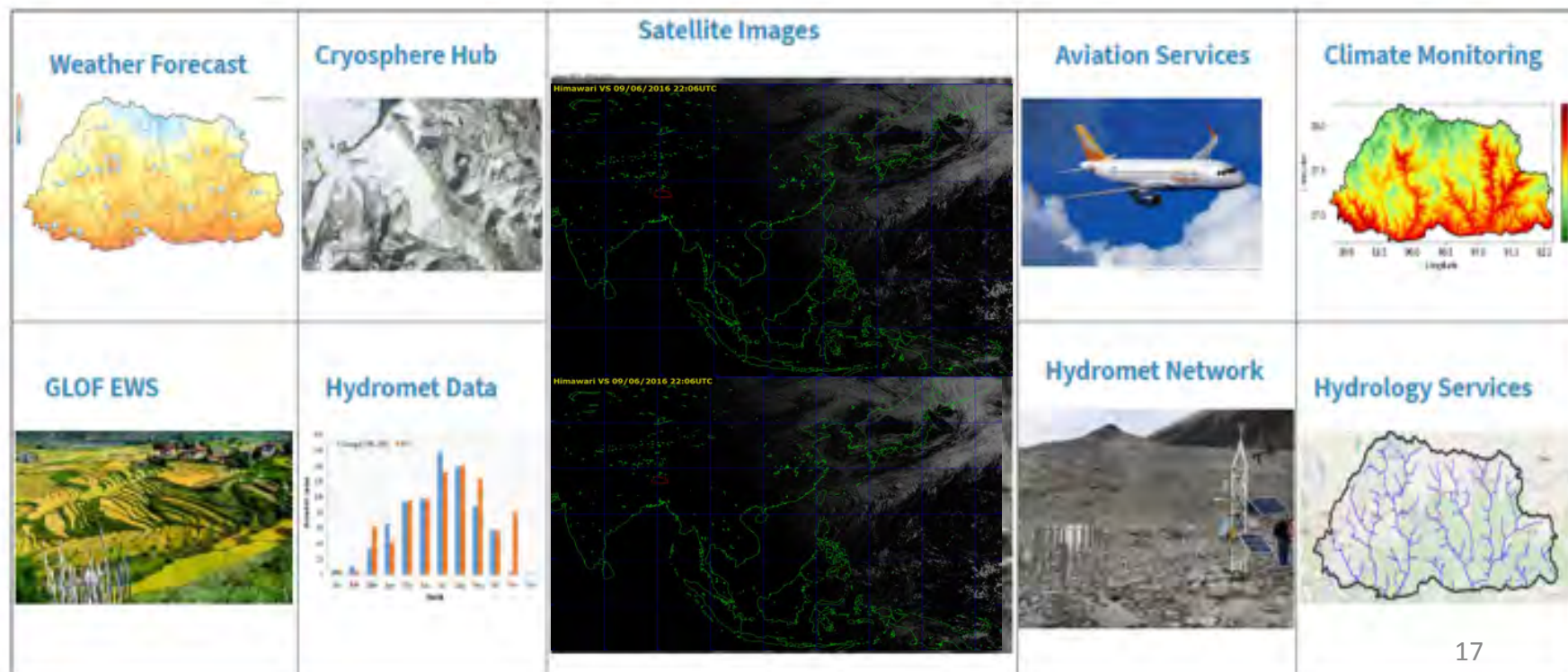


## Our Services and products

- Public Weather Services
- Climate Information Services
- Aviation Services
- Cryosphere Information and Services
- Hydrology and Water Resources Services
- GLOF/Flood Warning Services
- Observational Network
- Hydro-met Data Request
- Technical and Specialist Services

## Our Products and Services Quick View

Our Products and Services Quick View





# 24/7 National Weather and Flood Warning Center (NWFWC), NCHM



Satellite image receiver  
(HimawariCast)



**2nd floor:**  
Weather forecasting room/  
GTS/MSS Operation room

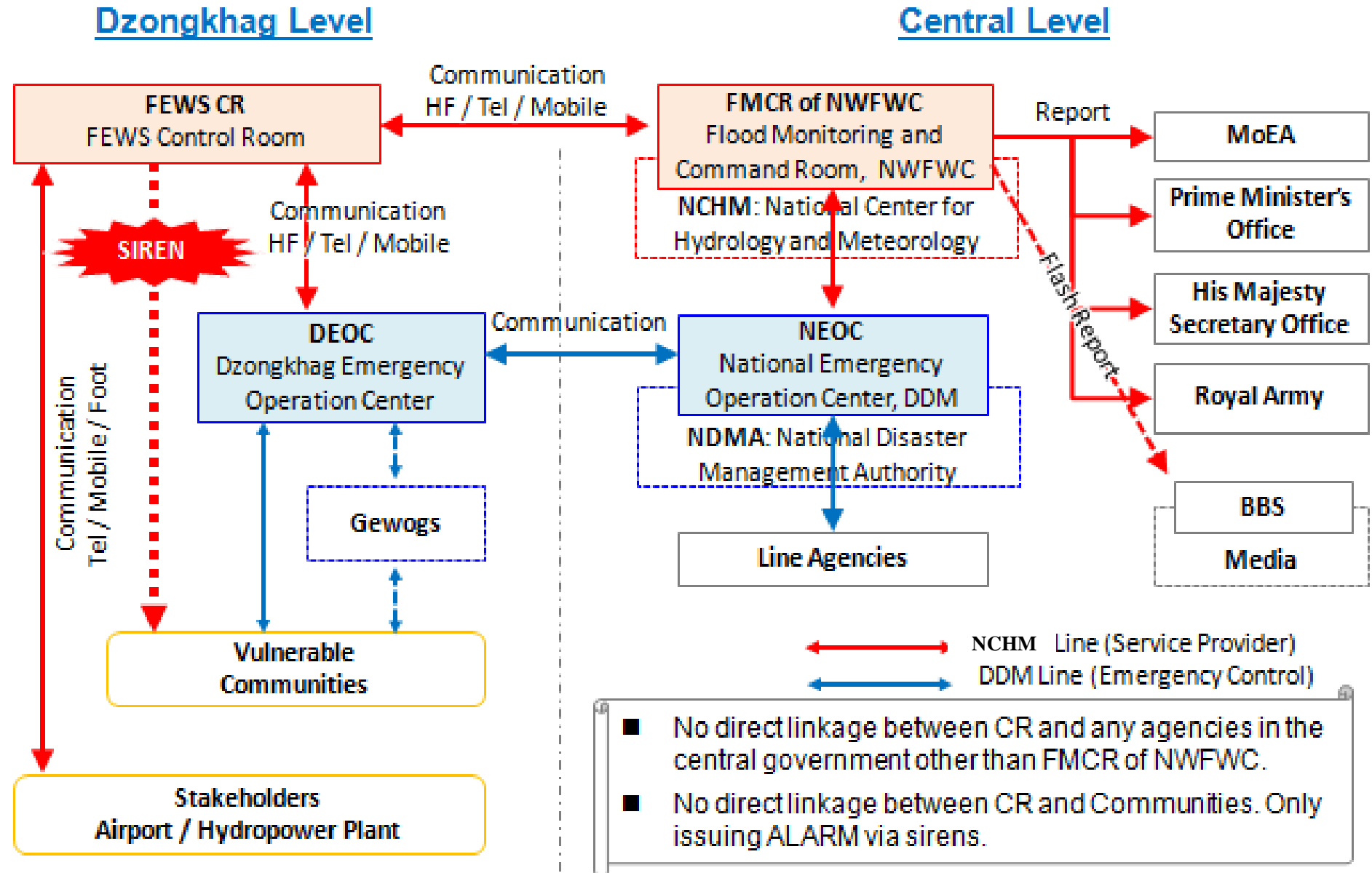


Ground floor:  
Day-care center



**1st floor:**  
Flood Monitoring Command Room/  
Emergency Meeting Room

# General Communications and Information Flow in the Central and Dzongkhag Levels





# Long Term Cryosphere Monitoring Program

*Thana Glacier*



**Type:** Clean type

**Area:** 3.0 km<sup>2</sup>

**Location:** **Coordinates:**

**Latitude:** 28° 1'17.90"N

**Longitude:** 90°36'39.16"E

**Elevation:** 5340m a.s.l

**Maximum Elevation:** 5600m a.s.l

**Minimum Elevation:** 5250m a.s.l

**Basin:** Headwater of Chamkhar Chhu, Manas Basin

**Initial Survey:** 2013

**Status of Study:** Ongoing

*Gangjula Glacier*



**Type:** Clean type

**Area:** 0.3 km<sup>2</sup>

**Location:** **Coordinates:**

**Latitude:** 27°56'24.17"N

**Longitude:** 89°56'53.70"E

**Elevation:** 5145m a.s.l

**Maximum Elevation:** 5200m a.s.l

**Minimum Elevation:** 4900m a.s.l

**Basin:** Headwater of Pho Chhu, Punatsang Chhu basin.

**Initial Survey:** 2004

**Status of Study:** Ongoing

Identified Benchmark Glaciers

# NCHM Partnership at International Level



- Center is the designated national focal point with World Meteorological Organization (WMO)
- Head of the Center is designated as the **Permanent Representative (PR) of Bhutan with WMO;**
- Center is closely working with WMO and National Meteorological and Hydrological Services (NMHS) of its member States through MFA



- NCHM is the designated national focal point for IPCC



With ICAO as the aeronautic meteorological services provider of Bhutan



# MODERNIZATION ROAD MAP

## Short term ( 1-2 years)

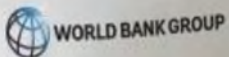
- a. Prepare Strategic Plans based on users needs;
- b. Strengthen sectoral collaboration and partnership;
- c. Strengthen national level organizational profile;
- d. Develop training plan and staffing;
- e. Develop regional collaboration plans (like MoU RIMES)
- f. Develop education and awareness programs for (School, local governments and communities);
- g. Prepare plan to enhance priority monitoring/observation system based on sectoral needs;
- h. Climate Projection of Bhutan

### Modernizing Weather, Water, and Climate Services:

A Road Map for Bhutan



Prepared in Collaboration between the  
Royal Government of Bhutan and the World Bank



# MODERNIZATION ROAD MAP

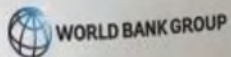
## Medium Term (2-5 Years)

### Modernizing Weather, Water, and Climate Services:

A Road Map for Bhutan



Prepared in Collaboration between the  
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- a. Develop Policy and legal framework (Hydromet Policy)
- b. Strengthen Center Infrastructure and ICT facilities
- c. National Water Resources Assessment;
- d. End-to-end early warning systems;
- e. Enhance Observation network based on the sectoral needs
- f. Establish Regional Offices to enhance service delivery;
- g. Improve Agromet and Aviation meteorological services
- h. Strengthen sector specific climate services (Partnership)
- i. Establish longterm climate and cryosphere monitoring program



# NCHM 12 FYP-2018-2023)



**National Goal**

**Objective**

**NKRAs**

**SKRA**

**Programme**

## 12 Five Year Plan: Just, Harmonious and Sustainable Society enhanced through Decentration

Prepare and responsive society to hydrometeorological threats and benefits through provision of decision support services on weather, climate and water resources

*Outputs will contribute indirectly to almost all the 16 NKRA's and is directly linked to NKRA's 6 and 8.*

NRKA 6: Carbon Neutral, Climate and Disaster Resilient Development Enhanced  
NKRA 8: NKR Water, Food and Nutrition Security Ensured

1.1 End to end National Framework for Climate Services

1.2 Hydro-meteorological and Cryosphere Disasters Assessed and Reduced

Programme 1: Weather and Climate Services for Building Climate Resilience

2.1 Access to hydrological information and understanding of national water availability improved

2.2 Water quality improved

Programme 2: Enhancing Hydrology, Cryosphere and Water Resources Information and Early Warning Services



# Challenges and Issues

1. No Hydro-met Policy and Legal Framework
2. NCHM Strategic Plan
3. Limited Professional Capacity
4. Limited climate station in norther high alpine areas
5. Inaccessibility, Remote, High Hazard and Risk areas
  - a. Difficult to provide reliable weather and hydrological forecast due to natural topography;
  - b. Flood/GLOF EWS is based on flood detection system rather than forecasting
  - c. Lack of proper database management system
  - d. Short time series historical record for climate projection studies
  - e. Lack of dedicated Center's office space and scientific facilities



# Inaccessibility, Remote, High Hazard and Risks areas







## Priority Needs:

- a. Construction of NCHM HQ and Scientific facilities
- b. Formulation of Hydro-met Policy/Hydro-met Act
- c. Formulation of NMHS Strategic plans
- d. Establishment of long term climate and cryosphere monitoring station in northern high alpine area



# Conceptual Plan for NCHM Center and Facilities



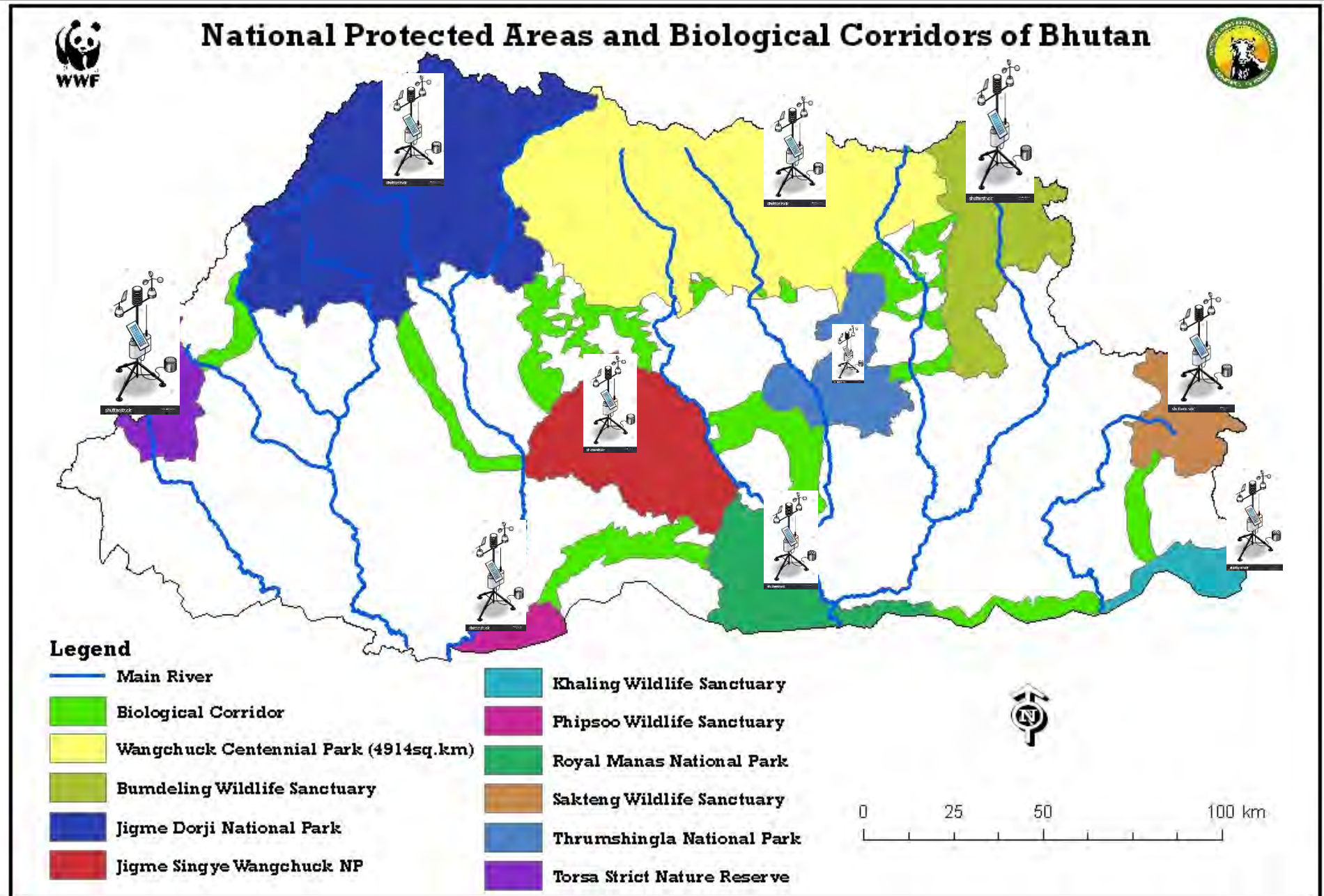


# Facilitate Students Learning on Weather Climate and Water Resources through Visits and Internships





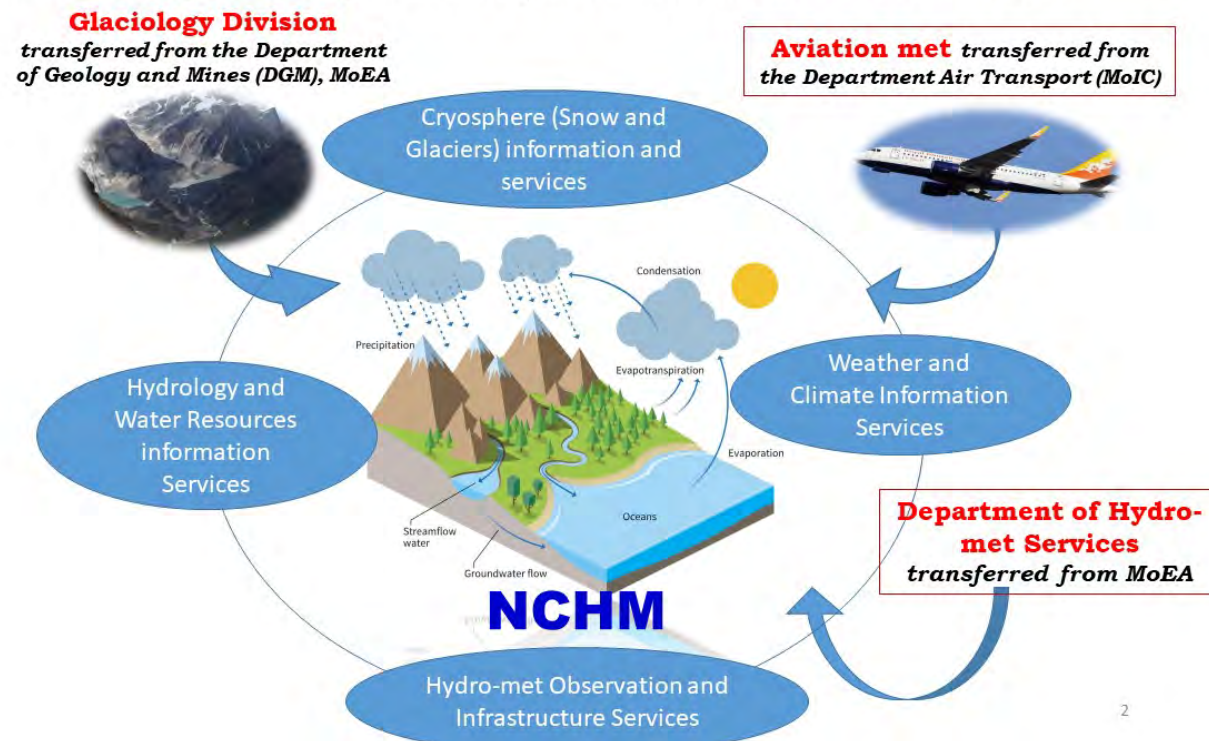
# Long Term Climate Monitoring Program in Protected Areas



# Opportunity: Institutional Set up of NCHM in Bhutan

- National Level: Able to bring Meteorology, Aviation Meteorology, Hydrology and Cryosphere under the organization aligned to WMO
- NCHM focal point for WMO, IPCC and other regional Climate Centers/organizations


## Restructuring of the Department Hydro-met Services to NCHM in 2016











***“If you want to know your past life,  
look at your present condition.  
If you want to know your future life,  
look at your present actions.”***

**— Padmasambhava**







**Thank you very much !**

**Web Site:** [www.nchm.gov.bt](http://www.nchm.gov.bt)

**Facebook:**

<https://www.facebook.com/NationalCenterforHydrologyandMeteorology/>

# Center's Recent Publications

(Launched on 22 March, 2019)

