



**STANDARD OPERATING PROCEDURE FOR  
METEOROLOGICAL SERVICE DIVISION  
(Revision Version 2.0)**

**National Center for Hydrology and Meteorology  
Royal Government of Bhutan  
2023**



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# 1. Standard Operating Procedure (SOP)

## 1.1 Title

This document is the Standard Operating Procedure for Meteorological Services Division (MSD), NCHM, hereafter referred to as revised SOP 2023 for MSD.

## 1.2 Purpose

The SOP provides the operating procedures for the MSD to fulfill the vision, mandates and functions of the Center. It provides standardized linkages and approaches amongst the sections within the Division including the management and technical support.

## 1.3 Effective

This revised SOP 2023 for MSD would come into effect from 1<sup>st</sup> July 2023

## 2. MSD mandate, functions and structure

### 2.1 Mandate of MSD

*The Meteorological Services Division (MSD) is mandated to observe and provide public weather services, severe weather warnings, climate data management and services, long range forecasting, climate change information and services, agro-meteorology, and aviation meteorological services.*

### 2.2 Functions of Meteorological Services Division (MSD)

Following are the functions of MSD:

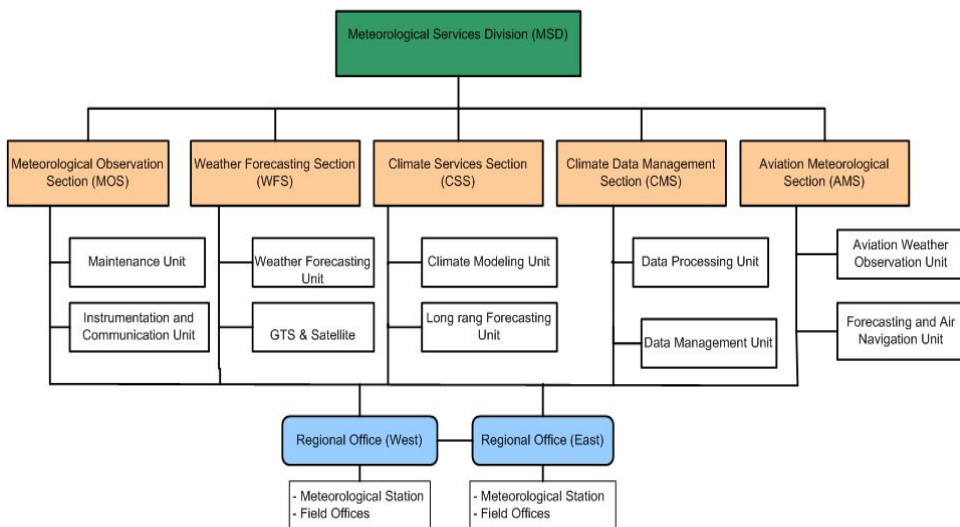
- a. Operation of national meteorological observation network
- b. Provide Public Weather Services (PWS);
- c. Monitor extreme weather events and issue warnings/bulletins/advisories.
- d. Operate and maintain national climate database management system;
- e. Climate modelling, downscaling and climate change projections.

- f. Provide climate services including agro-meteorological services.
- g. Prepare and provide short, medium, extended range and seasonal forecasts.
- h. Research and development in the field of weather and climate change.
- i. Aviation meteorological service provider within Bhutan
- j. Education, training and awareness programs on weather and climate

### 2.3 Structure of MSD

Meteorological Services Division (MSD) is organized into five Sections (Figure 1):

1. Meteorological Observation Section (MOS)
2. Climate Data Management Section (CDMS)
3. Weather Forecasting Section (WFS)
4. Climate Services Section (CSS)
5. Aviation Meteorological Section (AMS)



*Figure 1: MSD Organization Structure*

### 3. Functions of Meteorological Observation Section (MOS)

- a. Planning and establishment of national meteorological network and air-quality monitoring network in consultation with the services divisions and line agencies;
- b. Review meteorological and communication network and infrastructure development plans for implementation;
- c. Operate and maintain national Synoptic, Climatological, Agro-meteorological and Automatic Weather Station (AWS) network
- d. Operate and maintain Air Quality monitoring network
- e. Prepare drawing, cost estimates, tendering and implementation of works related to establishment of meteorological stations and related infrastructures
- f. Operation and maintenance of national meteorological observation networks including communication networks and related infrastructure
- g. Inventory of meteorological observation network stations and infrastructure
- h. Technical backstopping services to other agencies in meteorological observation and instrumentation.

#### 3.1 SOP for Climate Observation Section (COS)

*Table 1: SOP for Climate Observation Section*

| Action | Time Frame | Operator | Result/Action Required |
|--------|------------|----------|------------------------|
|--------|------------|----------|------------------------|

|   |         |   |  |
|---|---------|---|--|
| Plan & design of Meteorological networks in consultation with other section in the division or with other divisions | 2 weeks | Service Section within Division and other service Divisions and COS staff | Desk studies carried out. collect field data & information   |
| Carry out field survey for site selections  | 1 month | Engineer/Surveyor/ Field Team   | Prepare Bid<br>Field visit & site survey carried out;<br>Collect geo-coordinates<br>Land follow up                         |
| Cost estimates for installation & maintaining the networks  | 1 week  | Engineer/Surveyor/ Field Team   | Prepare tentative cost analysis for setting up station/related infrastructures<br>Submit the estimates and drawing to TSRD |
| Submitting estimates and drawings for approval  | 1 week  | Engineers/Relevant Heads  | TSRD Division  |

|  |          |                          |   |
|--|----------|--------------------------|---|
| Tendering and Awarding of works or goods     | 2 Months | Engineers/Relevant Heads | Prepare Bid Documents using SBD and relevant rules<br>Advertise in the media<br>Opening of submitted bid documents<br>Evaluate bidders using SBD and PRR<br>Present the Evaluation report<br>Award the work to contractor<br>Sign the contract and issue work order |
| Possession of sites to initiate construction | 14 days  | Field Team/Contractor    | - Hand contractor   |
| Monitor and supervise on-going construction  | 2 days   | Site staffs/Engineer     | Monitor construction from Head Office<br>Ask nearest Site office Technician to monitor  |



|   |           |                          |   |
|---|-----------|--------------------------|---|
| Review the activity implementation as per work plan & tender specifications | 5-10 days | Engineers                | Review the progress report, Inspection visits & monitor at sites;<br>Corrective measures provided |
| Take joint-measurement and takeover of sites                                | 2 weeks   | Engineer/Contractor      | Measurement of construction with contractor;<br>Takeover of the sites by Agency                   |
| Verification and passing of bills   | 1 week    | Engineer/AFS             | Verification of submitted bills;<br>Clear the bills and make payment                              |
| Planning maintenance work after consultation with site staffs               | 7 days    | Engineer/Site Staffs/HoD | Correspond with site officials for maintenance work<br>Budget mobilized                           |
| Arranging logistics to carry out maintenance                                | 2 days    | Engineer                 | Arranging equipment<br>Procurement of equipment   |

|   |  |                      |  |
|---|--|----------------------|--|
| Field visit to carry out maintenance  | 1 day to 3 months based on the nature of the work and number of stations | Field Team           | Field visit<br>Tour Report                                   |
| Inventory of meteorological observation network stations and infrastructures                        | 1 day to 3 months based on the nature of the work and number of stations | Field Team           | Metadata of stations and inventories of spares in the stores |
| Technical backstopping services to other agencies in meteorological observation and instrumentation | 1 day to several months depending on the nature of the work              | Engineers/Technician | Mails<br>Training<br>Minutes of the meeting<br>Reports       |

### 3.2 Observation of Meteorological Network Stations:

| Action   | Time Frame       | Operators  | Output/ Result   |
|--|------------------|------------|--|
| 1. Weather data collection from Class A Manual Station | Hourly/<br>Daily | Technician | Collect data from the observation site as per schedule/predetermine time and format (Log Book) |
|  |                  |            | a. Monsoon Weather data (June-September)<br>- Class A: Hourly                                  |
|  |                  |            | b. Weather data (October- May):<br>- Class A: 0900 and 1500<br>- Class C: 0900                 |
| 2. Weather data collection from Class C Manual Station | Hourly/<br>Daily | Technician | c. Monsoon Weather data (June-September)<br>- Class C: 0900<br>- Hourly data based on need     |

|  |  |  |  |
|--|--|--|--|
|  |  |  | d. Weather data<br>(October- May):<br>- Class C: 0900<br>- Hourly data<br>based on<br>need |
|--|--|--|--|

*Table 2: SOP for Meteorological Observation Stations*

#### **4. Functions of Weather Forecasting Section (WFS)**

- Provide public weather services, daily and three days' weather forecast
- Monitor weather (24/7) attend to hotline and provide weather updates
- Monitor extreme weather events (24/7)
- Conduct weather briefings and media briefings
- Issue extreme weather advisories and warnings
- Provide aviation weather forecasts
- Provide city forecast for World Meteorological Organisation (WMO)
- Provide tailor made forecasts and information
- Provide Impact Based Forecast (IBF)
- Operate and maintain Weather Forecasting Control Room (WFCR)
- Operate and maintain the Weather Forecasting and Command Room (WFCR) of the National Weather and Flood Warning Centre (NWFWC) 24/7 in coordination with the Flood Monitoring and Command Room (FMCR).
- Operate and maintain Global Telecommunication System (GTS)
- Operate and maintain satellite image reception and processing system (24/7)
- Share local observation data to the Regional Telecommunications Hubs (RTH)

- Monitor and archive meteorological and climatological events
- Maintain and operate Common Operating Platform (COP) for weather forecasting (SMARTMET system)
- Conduct Weather Research Forecast Modelling (WRF) and validation
- Carry out verification of forecast
- Carry out data assimilation

#### 4.1 SOP for Weather Forecasting Section (WFS)

The following table provides the general SOP for the weather forecasting section. For details refer SOP for weather forecasting.

| <b>WFS Actions</b>  | <b>Time Frame</b>  | <b>Operator</b>                               | <b>Result/Action Required</b>  |
|---|--|---|--|
| 1. Monitor, prepare and provide daily weather forecasts       | Monitor weather on 24/7 and issue forecast every day before 5pm                      | Weather forecasters and forecasting officials | Weather forecast issued  |
| 2. Monitor and issue extreme weather advisories/press release | Monitor weather on 24/7 and issue warnings/advisories for 72 hrs, 48 hrs and 12 hrs. | Weather forecasters and forecasting officials | - Inform any extreme/severe weather occurrence to the Division Chief /Center<br>- Prepare and issue advisories/press release to stakeholders and general public for safety |

|   |                  |  |  |
|---|------------------|--|--|
| 3. Maintain records of extreme meteorological events                          | Every day        | Designated officials                     | - Events archived and reports generated annually   |
| 4. Operate and maintain GTS data transmission and reception                   | Every day (24/7) | Weather forecasters and officers on duty | Continuous operation of GTS system<br>- GTS data submitted for weather forecast and warnings               |
| 5. Operate and maintain the Himawari Satellite System, and archival of images | Every day (24/7) | Weather forecasters and officers on duty | - Ensured continuous reception of satellite images<br>- Images submitted for weather forecast and warnings |
| 6. NWP modeling and validation  | Every day        | Designated Official                      | Ensured smooth functioning of WRF<br>- Output of WRF validated   |

|   |        |                     |  |
|---|--------|---------------------|--|
| 7. Undertakes research in NWP, understanding weather pattern and extreme events | Yearly | Designated Official | - Reports published and shared<br>- Planned strategy to improve modeling for weather forecasts |
|---|--------|---------------------|--|

*Table 3: SOP for Weather Forecasting Section*

## **5 Functions of Climate Services Section (CSS)**

- Provide extended range forecasts (weekly forecasts)
- Provide medium range weather forecasts (7-10 days' forecasts)
- Carry out NWP modelling for long range forecasting
- Issue seasonal monsoon forecasts
- Issue monthly forecasts
- Carry out forecast verification
- Monsoon studies and provide monsoon outlook
- Coordinate National Framework for Climate Services and WMO Climate Services activities
- Carry out research on long range forecasting
- Carry out research and provide agro-met services
- Carry out climate studies, research, modelling and analysis
- Carry out climate projection and downscaling
- Produce climate maps and charts, publish climate normal and indices
- Support climate change impact modelling and studies
- Policy guidance on climate adaptation
- Provide tailor made climate service
- Provide policy guidance on climate change adaptation

## 5.1 SOP for Climate Services Section (CSS)

| CSS Actions  | Time Frame                | Operator             | Result/Action Required  |
|--|---------------------------|----------------------|---|
| 1. Develop, verify and issue seasonal forecasts                                      | Seasons (summer & winter) | Designated Officials | - Seasonal forecast prepared<br>- Seasonal Outlook disseminated to the users                    |
| 2. Monitor seasonal and monthly climate  |                           | Designated Officials | - Reports printed/published<br>- Extremes in climate reported and discussed within the Division |
| 3. Climate modeling, downscaling, analysis and interpretation of climate change data |                           | Designated Officials | Reports printed/published   |
| 4. Develop and provide extended range forecast information                           | Weekly                    | Designated Officials | Forecast issued   |
| 5. Develop agro-met services and provide awareness workshops/meetings                |                           | Designated Officials | - Agro-met information and services developed<br>- Collaborated with Department of Agriculture  |



|  |           |                      |  |
|--|-----------|----------------------|--|
| 6.Coordinate National Climate Forums (NCFs)/Seminars   | Annual ly | Designated Officials | - NCFS/ seminars conducted for stakeholders and user                             |
| 7. Conduct research/collaborative studies on climate/climate change with other sectors and user agencies |           | Designated Officials | Report printed/published<br>- Collaborated with others sectors and user agencies |

*Table 4: SOP for Climate Service Section*

## **6 Functions of Climate Data Management Section (CDMS)**

- Receive and compile meteorological data from manual stations
- Data entry into database
- Digitization of data
- Extract data from Automatic Weather Stations (AWS)
- Operate and maintain national Climate Database Management System
- Archive historical synoptic, climatological, agrometeorological and AWS data
- Carry out data processing and analysis
- Carry out data backups and ensure data security
- Carry out data quality control
- Provide climatological data to government, private and users
- Publish Climate data book
- Publish monthly climate reports
- Publish the state of climate report

## 6.1 SOP for Climate Data Management Section (CDMS)

| CDMS Actions   | Time Frame | Operator                                 | Result/Action Required   |
|--|------------|--|--|
| 1. Processing and archival of data from manual meteorological stations (Class A and Class C) | Everyday   | Data assistants and designated officials | <ul style="list-style-type: none"> <li>- Data processed and archived in the system</li> <li>- Inform for any missing and spurious data to the Chief of Division</li> </ul>                     |
| 2. Retrieval and quality control of climate data   | Everyday   | Data management team                     | <ul style="list-style-type: none"> <li>- Quality controlled data</li> <li>- Missing historical data retrieved</li> </ul>   |
| 3. Retrieval of AWS data from the database.  | Everyday   | Data management team                     | <ul style="list-style-type: none"> <li>- AWS data retrieved for further processing and analysis</li> <li>- Inconsistencies in AWS data, missing of data report to Chief of Division</li> </ul> |
| 4. Managing, quality control and dissemination of data for users and research/studies        | 1-5 days   | Designated Officials                     | <ul style="list-style-type: none"> <li>- Quality controlled data for analysis</li> <li>- Maintained the log of data issued</li> </ul>  |

|   |          |                      |  |
|---|----------|----------------------|--|
| 5. Generate standard statistical products and annual climate data book                                | Annually | Designated Officials | - Data statistics produced and printed<br>- Climate data book developed/printed (soft/hard copy) |
| 6. Undertakes researches on the quality of climate data, extremes and other climatological statistics | Annually | Data Management Team | - Reports printed/published  |

*Table 5: SOP for Climate Information Management Section*

## **7 Functions of Aviation Meteorology Section (AMS)**

The Aviation Meteorological Office is mandated to provide aviation weather services to contribute to safety, regularity, and efficiency of air navigation. The Aviation Meteorological Office of NCHM in Bhutan operates in accordance to:

- Bhutan Civil Aviation Authority (BCAA requirement wherein NCHM is designated as the national Aeronautical Meteorological Service Provider (AMSP) within Bhutan vide letter ref. BCAA/ANS-MET/010/196 dated August 29, 2017 in pursuant to section 12(1)(e) & 57 of Civil Aviation Act of Bhutan 2016,
- ICAO Documents Annex 3 - Meteorological Services for International Air Navigation, DOC 8896-AN/893/4 - Manual of Aeronautical Meteorological Practices, DOC 7030 - Regional Supplementary Procedures.

Functions of AMS includes the followings;

- Provide aviation met services for safe and regular operation of flights
- Operate and Maintain the Aviation Met Station network
- Collect and maintain the records of meteorological observations of all aerodromes
- Collect weather information (MET REPORT/SPECIAL REPORT) at half hourly intervals
- Provide METAR/SPECI at half hourly intervals to Air Traffic Control, Airlines, Flight dispatchers and Pilots
- Disseminate meteorological information (METAR/SPECI) to the originating aerodromes, Airlines, ATC and domestic airports through Automatic Message Handling System (AMHS)
- Monitor aerodrome weather conditions and report to ATC for updating the pilots for landing and take-off
- Monitor and operate aviation met infrastructure in respective airports for safe operation of flights as per Bhutan Civil Aviation Authority (BCAA) and ICAO norms
- Coordinate with Air Traffic Controllers and Air Traffic Services
- Liaise with BCAA, ICAO, WMO, DoAT and Airlines
- Provide aerodrome weather conditions for landing and take off
- Provide Now casting
- Provide SIGMET
- Coordinate with Air Traffic controllers and Air Traffic Services

## 7.1 SOP for Aviation Meteorological Section (AMS)

The following table provides the general SOP for the aviation meteorological section. For details refer SOP for aviation met section.


| AMS Actions   | Time Frame           | Operator                | Result/Action Required  |
|---|----------------------|-------------------------|---|
| 1. Operate and maintain Aviation met station network (AWOS, Manual & RWP) | Everyday             | Aviation MET Technician | - Ensured seamless operation of AWOS<br>- Maintenance of system as and when required                      |
| 2. Installation of new AWOS and other equipment                           | As and when required | Aviation MET Technician | - Procurement (PPR 2019) processed completed<br>- New system installed and commissioned                   |
| 3. Collect and record observational data of aerodromes in all airports    | Everyday             | Aviation MET Observers  | - Data collected and recorded<br>- Any fault in AWOS data collection reported to AMS head/ Division Chief |
| 4. Prepare and provide METAR/SPECI to the aerodromes                      | 30 minutes           | Aviation MET Observers  | - METAR/SPECI issued via AMHS   |

|   |  |                          |   |
|---|--|--------------------------|---|
| 5. Prepare and provide MET briefing   | On regular basis/ as and when required | Aviation MET Forecasters | - MET Briefing issued via email and whatsApp group  |
| 6. Coordination with Air Traffic Controllers, Air Traffic Services and ICAO | On regular basis/ as and when required | Head                     | - Coordinated with the relevant agencies<br>- Kept update of the events to the chief of Division<br>- Head of the Center informed |

*Table 6: SOP for Aviation Meteorological Section*

## **8. Amendment and Revision**

TSRD in consultation with the Division will review and update this SOP from time to time and submit to the management for approval



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