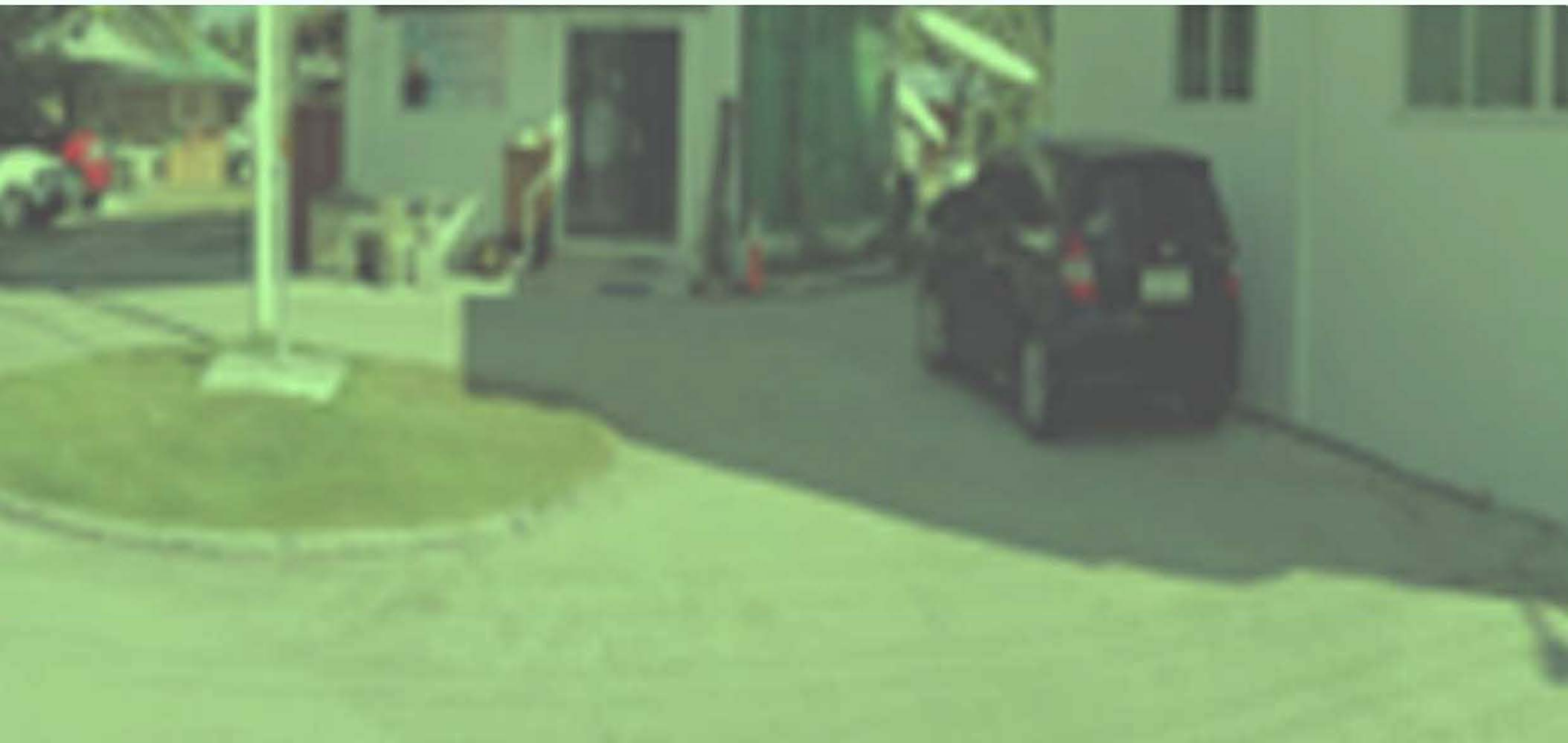
SYNOPTIC STATION PROFILE:

Mindanao PAGASA Regional Services Division



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Climatology and Agrometeorology Division
Climate and Agrometeorological Data Section

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ABOUT THE PUBLICATION

The Synoptic Station Profile: Mindanao PAGASA Regional Services Division aims to provide general information about the station history, current station profile, observational methods, instruments, observed meteorological parameters, and personnel complement of operational synoptic stations in the Mindanao PAGASA Regional Services Division.

Synoptic stations are weather-observing surface stations that collect and observe several meteorological elements such as rainfall, temperatures, wind speed, and direction. Synoptic observations are conducted at predetermined times (i.e., 8 AM, 11 AM, 2 PM, 5 PM, 8 PM, 11 PM, 2 AM, and 5 AM) and transmit these observed data to the Mindanao PRSD Regional Office and PAGASA Central Office. Additionally, synoptic stations provide information to the general public through weather forecasts, heavy rainfall warnings, thunderstorm advisories, and severe weather bulletins. Researchers also benefit from this publication when attributing detected environmental changes to the history and changes in the synoptic station accordingly.

The information listed here is based on surface observations from various PAGASA Synoptic Stations in Mindanao PRSD, as mandated by standards set with the World Meteorological Organization (WMO) Integrated Global Observing System (WIGOS). This data is supplemented by historical documents (e.g., logbooks, Special Orders, pictures, etc.) and accounts obtained through personal communications and discussions with key personalities in PAGASA Synoptic Stations included in this publication.

All data in this document were compiled as of the time of writing in May 2024.

For more information, please send a message to cadpagasa@gmail.com.

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MINDANAO PAGASA REGIONAL SERVICES DIVISION

Mindanao is the second-largest island group in the Philippines, with a land area of 97,530 km² and home to approximately 26 million people. It is located in the southern part of the Philippine archipelago and contributes 14% of the country's total gross domestic product. According to the Modified Coronas Climate Classification System (MCCS), Mindanao Island experiences three types of climates: Climate Types II, III, and IV (Figure 1). The MCCS is based on the country's monthly rainfall amount and seasonal rainfall patterns. Climate Type II has no dry season and a pronounced maximum rainfall from December to February. A Climate Type III region has no pronounced maximum rainfall period, with one to three months of a dry season. Regions with more or less evenly distributed rainfall throughout the year are classified as Climate Type IV.

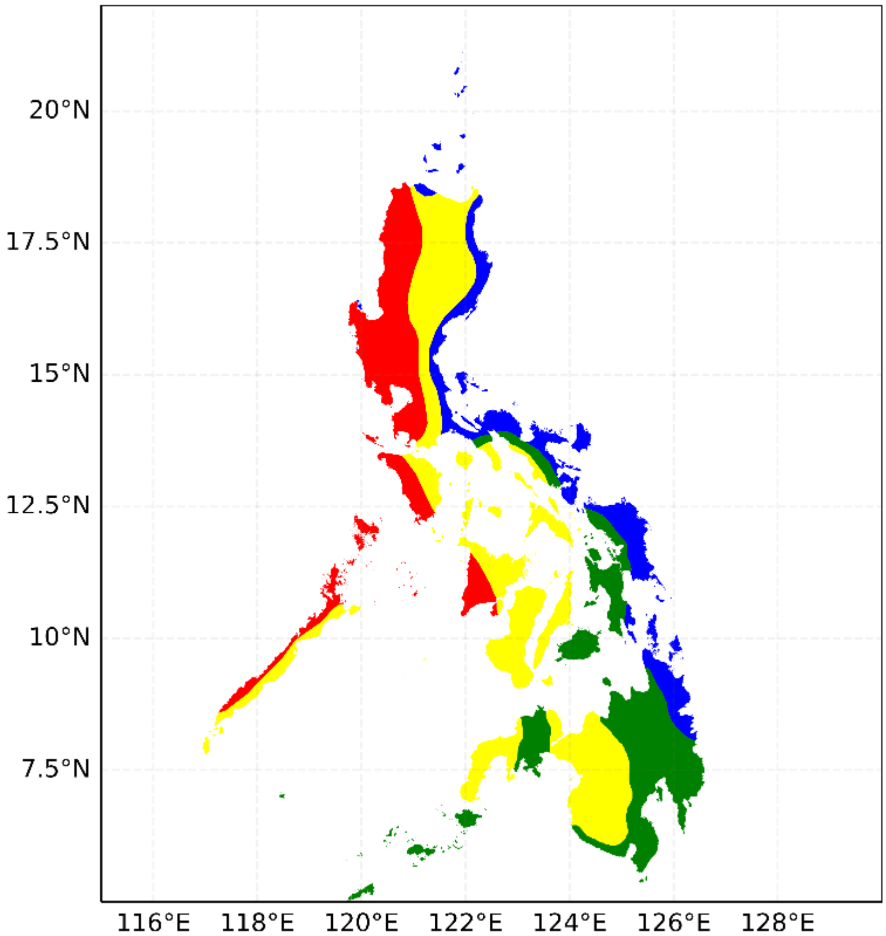


Figure 1. Modified Coronas Climate Classification. Red areas denote Climate Type I, blue is for Type II, yellow is for Type III, and green areas denote Type IV.

Due to its location, Mindanao is seldom affected by tropical cyclones (TC). However, it remains influenced by several weather and climate systems, such as the Intertropical Convergence Zone, El Niño Southern Oscillation, and Madden-Julian Oscillation.

The Mindanao PAGASA Regional Services Division (MPRSD) is tasked with observing, monitoring, and recording the atmospheric changes caused by weather and climate systems that influence the Mindanao region. MPRSD was formed when PAGASA underwent restructuring as part of the Rationalization Plan in compliance with Executive Order No. 366. In 2009, MPRSD started its operations under the leadership of Mr. Ricardo A. Mercado, and Mr. Anthony Joseph R. Lucero currently leads it.

ORGANIZATIONAL STRUCTURE

The MPRSD office is located at Zone 10, Barangay Molugan, El Salvador City, Misamis Oriental. It consists of the Office of the Division Chief, Technical Services, Field Stations, Flood Forecasting Warning Centers, and Support Services. Figure 2 shows the MPRSD's organizational structure. The Office of the Division Chief directly supervises the MPRSD's overall operations.

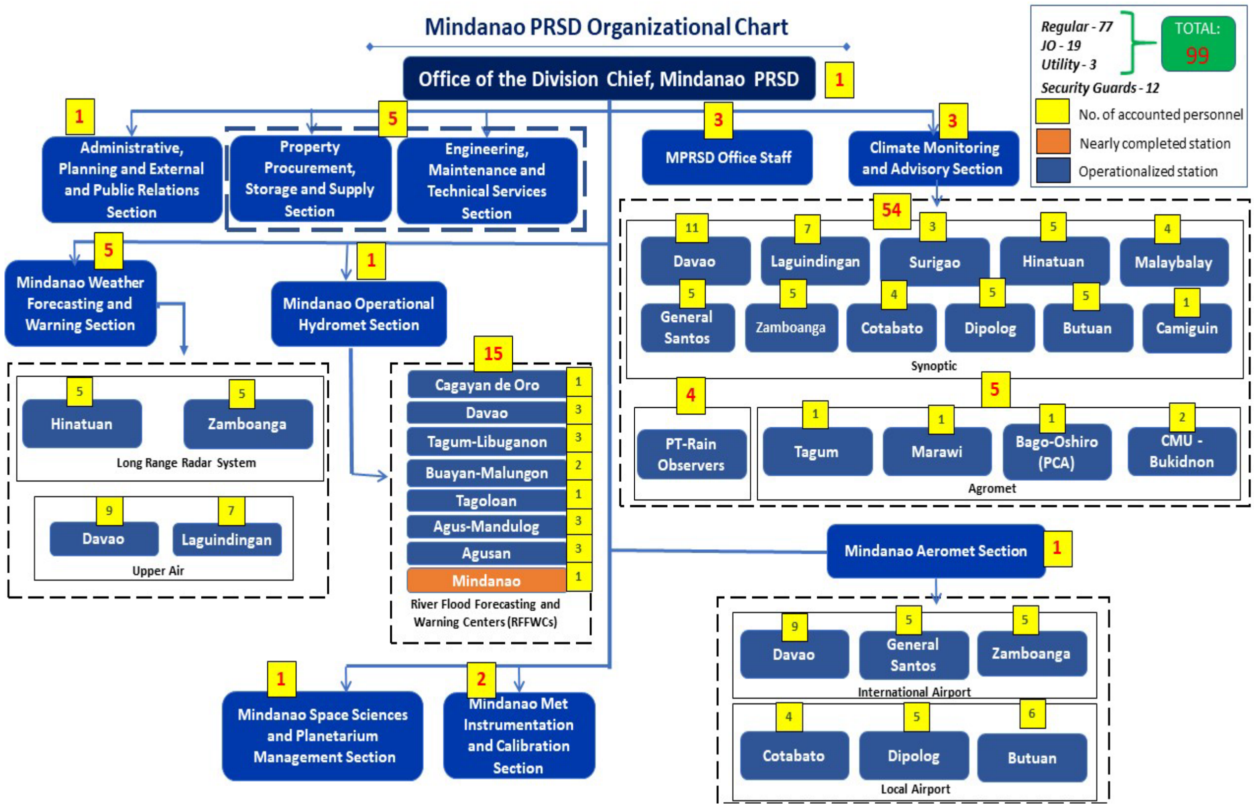


Figure 2. MPRSD Organizational Chart. Yellow box denotes the personnel, orange is for nearly completed stations and blue is for operational stations

OFFICE OF THE DIVISION CHIEF, MPRSD

The Office of the Division Chief (MPRSD) has key functions, which include coordinating MPRSD operations with other PAGASA divisions, government, and non-government partners, as well as managing MPRSD plans and policies. The Division Chief is also tasked with coordinating information dissemination with the local Disaster Risk Reduction and Management Council (DRRMC) and local government units (LGU). Improving PAGASA products and services in Mindanao through maintaining its science and technology linkage is also entrusted to the Division Chief. Under the direct supervision of the Division Chief are the Chief Meteorological Officers (CMOs) and administrative and support staff including Engineering and Infrastructure, Plans and Programs, Financial Management, Supply and Services, External Affairs, Information and Communication Technology.

The CMOs supervise MPRSD field stations, river centers, and technical services. Their duties and responsibilities include conducting quality control checks on surface, agrometeorological, and Meteorological Aerodrome Report (METAR) observations, submitting monthly reports to the Communications and MPRSD Planning Officer, and actively participating in inter-agency disaster risk reduction management (DRRM)- related programs and activities. The Administrative and Support staff play an important role in MPRSD.

The Administrative and Support staff handles supply procurement, inventory management, and distribution; maintains external relations and connections; prepares short, medium, and long-term plans and programs for improving the MPRSD's operations and services; and coordinates with local executives and offices to establish infrastructure, facilities, and equipment at PAGASA Field stations in Mindanao.

MINDANAO WEATHER FORECASTING AND WARNING CENTER (MIN-WFWC)

Min-WFWC consists of two long-range radar systems in Hinatuan and Zamboanga and two upper-air stations in Davao and Laguindingan (Figure 2). Min-WFWC monitors, analyzes, and predicts atmospheric conditions in Mindanao. Using surface and upper-air maps, meteorological satellite imagery, and radar data, Min-WFWC performs routine atmospheric analysis. Min-WFWC also utilizes Numerical Weather Prediction (NWP) products for real-time prognostication of synoptic conditions. Min-WFWC is tasked with distributing and broadcasting local public weather forecasts, specialized forecasts for specific clients, heavy rainfall warnings, and thunderstorm advisories in coordination with local DRRMCs, LGUs, media, and other concerned institutions. Min-WFWC conducts operational studies and investigations to continuously develop and improve MPRSD’s weather analysis and prediction techniques.

MINDANAO RIVER BASIN FLOOD FORECASTING AND WARNING CENTERS (MIN-RBFFWC)

Min-RBFFWC monitors the meteorological and hydrological conditions of the concerned river basin in coordination with the Flood Forecasting and Warning Section (FFWS). Min-RBFFWC is composed of FFWS located in Cagayan de Oro, Davao, Tagum-Libuganon, Buayan-Malungon, Tagoloan, Agus-Mandulog, Agusan, and Cotabato (Figure 2). The critical functions of the Min-RBFFWC include conducting post-flood investigations in their respective river basins in coordination with the FFWS, conducting public information drives on floods and related topics at the local level, and collaborating with local institutions involved in flood disaster mitigation and other related activities.

MINDANAO CLIMATE MONITORING AND WARNING UNIT (MIN-CMWU)

The newest unit added to MPRSD is the Min-CMWU, which provides climatological information, products, and services tailored to the specific needs of clients and users in Mindanao. Min-CMWU is tasked with disseminating climate advisories, assessments, and outlooks, particularly related to extreme climate events influencing Mindanao, such as dry conditions, dry spells, and droughts. Min-CMWU actively collaborates with stakeholders in Mindanao, especially with policy and decision-makers involved in food security, energy sustainability, and water sufficiency.

MPRSD Field Stations

The MPRSD supervises 10 Synoptic stations, four Agromet (agrometeorology) stations, two Radar Stations, two Upper-Air stations, and eight FFWCs spread across Mindanao Island. Synoptic or surface synoptic field stations conduct standard meteorological observations according to World Meteorological Organization standards.

These observations assess the state of the atmosphere, including sky cover, rainfall amount, temperatures, wind speed and direction, barometric pressure, visibility, and occurrence of tropical cyclones or remarkable phenomena near the station.

Observations are conducted eight times daily at fixed intervals (e.g., 8 AM, 11 AM, 2 PM, 5 PM, 8 PM, 11 PM, 2 AM, and 5 AM) and transmitted to the PAGASA Central Office. Synoptic stations also disseminate local public weather forecasts, heavy rainfall warnings, thunderstorm advisories, and severe weather bulletins. MPRSD previously had two synoptic stations in Cagayan de Sulu (now Mapun) and Jolo Sulu, which ceased operating in 1981. The location of operational MPRSD synoptic stations is shown in Figure 3. Detailed historical profiles of each station, including personnel, instruments, and history, are provided in subsequent chapters.

Figure 3. Location of operational PAGASA Synoptic Stations in MPRSD denoted by black circles.

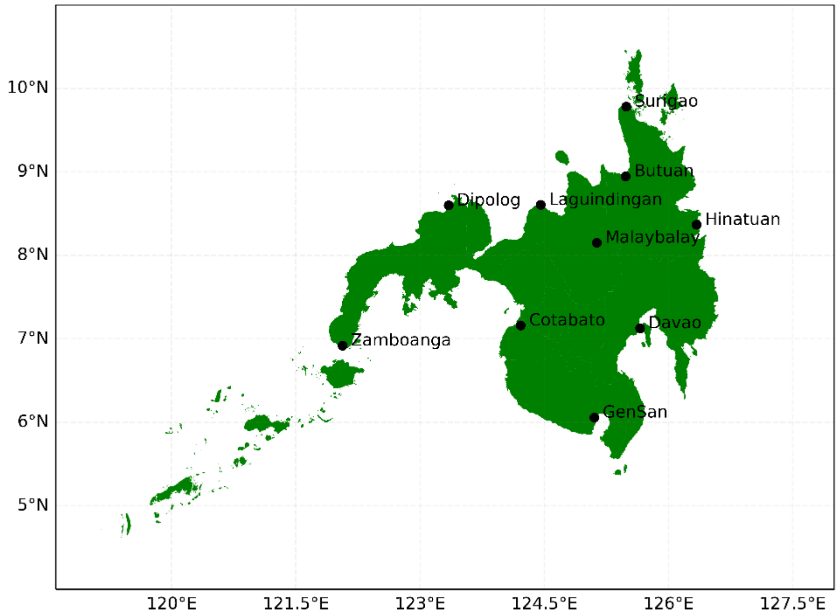


Table 1.1 shows the operational synoptic stations under the MPRSD. The earliest station, Malaybalay, was established in 1946, while the most recent addition is the Laguindingan Station in 2021.

Table 1.1. List of operational PAGASA Synoptic Stations in MPRSD

Station Name	Station Code	Year Established
Butuan	752	1980
Cotabato	746	1982
Davao	753	1976
Dipolog	741	1951
General Santos	851	1951
Hinatuan	755	2011
Laguindingan	747	2021
Malaybalay	751	1946
Surigao	653	-
Zamboanga	836	1972

Aside from synoptic stations (Figure 3), MPRSD also operates upper-air stations, Aeromet (aerometeorology) stations, radar stations, and Agromet stations (Figure 4). Upper-air stations conduct observations (typically in conjunction with a synoptic Station) of atmospheric pressure, temperature, humidity, wind speed, and direction at various levels of the upper atmosphere.

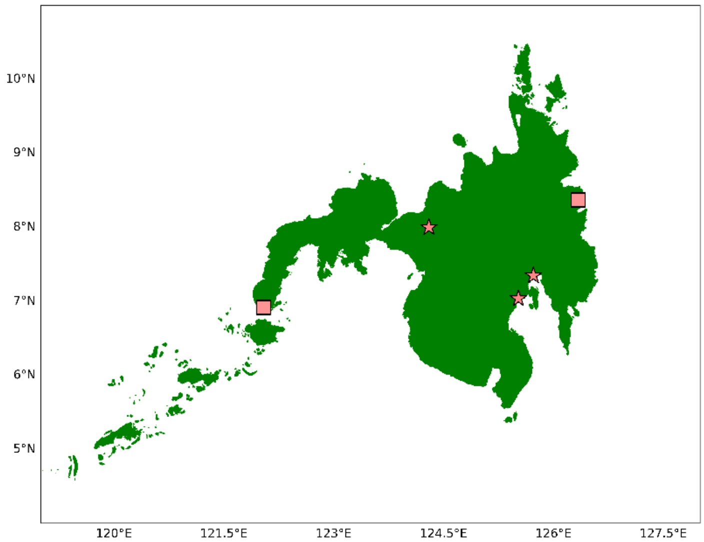


Figure 4. Location of Radar (square) and Agromet Stations (star) under MPRSD

Observations are typically conducted at least twice daily (i.e., 8 AM and 8 PM). However, during a tropical cyclone or extreme weather events, observations are increased to four times daily (i.e., 8 AM, 2 PM, 8 PM, and 2 AM). MPRSD's upper-air stations are located in Davao and Laguindingan, respectively. Aeromet stations in airports provide weather data, information, and advice essential for aviation activities. Davao, General Santos, Zamboanga, Cotabato, Dipolog, and Butuan Stations also serve as Aeromet stations. Radar stations are stations that utilize long-range Doppler radar. Radar stations transmit data every 10 minutes on a 24-hour basis to the PAGASA Central Office. MPRSD has two radar stations located at Zamboanga (C-band Dual-polarization) and Hinatuan (S-band Single-polarization) (Figure 5).

Figure 5. Zamboanga (left) and Hinatuan (right) Radar Stations

Lastly, Agromet field stations disseminate agricultural meteorological advice, forecasts, warnings, bulletins, and other relevant information farmers need. MPRSD's Agromet stations are located at Central Mindanao University (CMU) in Bukidnon, Bago-Oshiro Philippine Coconut Authority (PCA), Marawi City, and Tagum City.

CHAPTER 2:

BUTUAN SYNOPTIC AND AEROMET STATION

Butuan City, known as the Timber City of the South, is a highly urbanized city home to approximately 370,000 people. The climate of Butuan City is classified as a Type IV Climate, wherein rainfall is more or less evenly distributed throughout the year. Due to flooding, the original settlers migrated from the original location of Pinamanculan by the Masao River banks to Baog (now the Municipality of Magallanes), to Lapaca (now the Linungsuran in Banza), and finally settled in its present site. The frequent flooding of the Agusan River induced rich, fertile soil that created a boom in the logging industry, hence the origin of the name Timber City of the South. Butuan City is the commercial, industrial, and administrative center of the Caraga region. Popular tourist destinations in the city include Mt. Payapay, Magellan's Landing Site, Butuan National Museum, and Balangay Shrine Museum.

Figure 6. Facade (left) and Observation Garden (right) of Butuan Station

Located in Bancasi, Butuan City, Agusan del Norte, the Butuan Aeromet and Synoptic Station (hereinafter referred to as Butuan Station) is detailed in Table 2.1. The station is situated on open and flat terrain, with a slope of less than 3^0 degrees, resembling grazing land surrounded by a landscape with minimal obstructions (Figure 6). It is located in a region with minimal elevation, less than 100 meters below mean sea level. Notable visibility markers near the station include Butuan Bay to the north, Butuan City Proper and the Agusan River to the east, and Mt. Mayapay to the south.

Table 2.1. Butuan Station Information

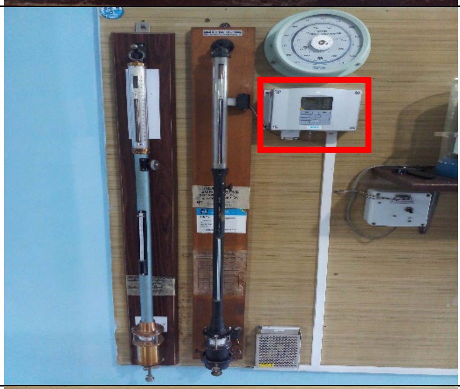
Station Name	Butuan Aeromet and Synoptic Station
Station Number (ID)	98752
Latitude	08° 56'
Longitude	125° 28'
Elevation	17.7 m
Altimeter Correction	-

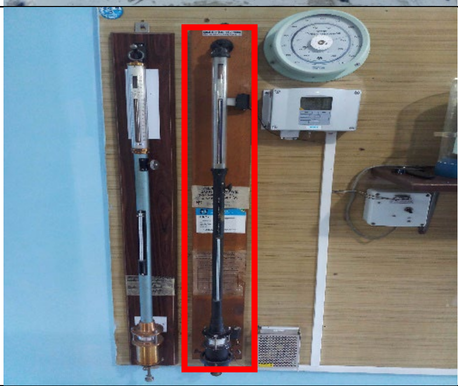
Following the WMO standards for meteorological stations, Butuan Station is designed to make representative measurements according to its type. As a synoptic station, Butuan Station collaborates closely with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction. It submits monthly weather observation reports to the PAGASA Central Office and the MPRSD and processes weather certifications for concerned stakeholders. As an Aeromet station, the Butuan Station coordinates with the Butuan Airport aviation personnel to provide critical weather information for aviation operations.

Butuan Station is equipped with multiple instruments capable of measuring surface weather parameters (Table 2.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and other local weather-dependent operations such as airport and construction work and climate and weather research.

The station follows the WMO standard (WMO-No.8), which emphasizes meticulous calibration and quality control in data generation and information on weather, climate, and water, ensuring accuracy and reliability. Detailed information about each instrument will be provided in the subsequent subchapter.

Table 2.2 Butuan Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Barograph*		Make use of aneroid cells, which are flexible metal chambers that expand or contract in response to changes in atmospheric pressure, also known as "Dry Barographs"
Digital Barometer		A Digital Barometer uses pressure sensing micro-electromechanical sensor to measure atmospheric pressure
Event Recorder*		An event recorder is simultaneously used with a tipping bucket rain gauge to log precipitation
Hygrothermograph*		A hygrothermograph is an instrument that measures humidity and temperature using a recording pen and a rotating chart mechanism

Instrument	Picture	Description
Instrument Shelter		An enclosure, typically painted white, is designed to house thermometric instruments (such as thermometers and psychrometers) and protect them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.
Maximum Thermometer*		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Mercurial Barometer*		It measures atmospheric pressure using a column of mercury trapped inside a glass tube, typically 32 inches long. The mercury rises or falls in response to changes in atmospheric pressure.
Minimum Thermometer*		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Psychrometer*		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from both direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube

Instrument	Picture	Description
Standard Rain Gauge*		A Standard Rain Gauge measures precipitation. It consists of a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When the smaller tube fills up, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.
Sunshine Recorder*		A spherical lens measures sunshine duration by concentrating a solar beam onto a special dark paper
Tipping Bucket Rain Gauge*		An instrument that measures precipitation and is typically attached to an event recorder is an upright cylinder with a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once it reaches 0.2 mm in volume.
Vane Anemometer*		Anemometers measure wind speed and direction. A vane anemometer is a type of anemometer where a vane is attached to either a stationary or rotating shaft. The vane is connected to a sensor that records the rotation of the shaft.

Instruments marked with an asterisk (*) contain metadata. See the Metadata subchapter for more information.

PERSONNEL COMPLEMENT

Butuan station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Mr. Ver Lancer D. Galanida. The individuals listed in Table 2.3 ensure the efficient operation of the station, accurate data collection, and the delivery of reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are responsible for conducting synoptic and/or climatological observations using appropriate instruments, noting their uncertainties and representativeness. They also maintain instruments and document metadata. In cases where automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 2.3. List of Butuan Station Personnel

Name	Role/Job Description	Email Address
Ver Lancer Galanida	CMO/ Weather Specialist I	verlancergalanida@yahoo.com
Efren delos Angeles	Weather Observer III	delosanglesian@gmail.com
Glazia Zambrano	Weather Observer III	jobbeeaiza@yahoo.com
Marnell Bacordio	Weather Observer III	marnelltwink85@yahoo.com
Mizpah Amba	Weather Observer II	mizpahamba@gmail.com

**As of the time of writing in May 2024*

INSTRUMENTS METADATA

Aside from the data itself, users of these meteorological observations must also be knowledgeable about the instrument's condition, type, and exposure. Maintaining quality-controlled metadata is important as the observed data (see Chapter 12 for more information). Even with advancements in data homogeneity methods, recorded metadata still accurately identifies inhomogeneities. Changes that occur at the station and its maintenance history should be documented. Instrument metadata (data about data) provides detailed information about the instruments, including model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in data collection.

Table 2.4. Metadata for Barograph in Butuan Station

Manufacturer / Brand	Lambrecht
Observed Parameter	Station Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.32
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	8112160-020

Table 2.5. Metadata for Event Recorder in Butuan Station

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Rainfall Amount, Duration, and Intensity
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.32
Instrument Exposure	Class 2
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	6454

Table 2.6. Metadata for Hygrothermograph in Butuan Station

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Temperature, Relative Humidity
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.60
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Quarterly, Upon Request
Model No.	-
Serial No.	1103262

Table 2.7. Metadata for Minimum and Maximum Thermometers in Butuan Station

Manufacturer / Brand	NovaLynx
Observed Parameter	Maximum and Minimum Temperatures
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.6
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	236-1055

Table 2.8. Metadata for Mercurial Barograph in Butuan Station

Manufacturer / Brand	Societe Precis - Mecanique
Observed Parameter	Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	0.6
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	2256
Serial No.	-

Table 2.9. Metadata for Psychrometer in Butuan Station

Manufacturer / Brand	Assman Type
Observed Parameter	Temperatures (Dry Bulb and Wet Bulb)
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.60
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	1094/1097

Table 2.10. Metadata for Standard Rain Gauge in Butuan Station

Manufacturer / Brand	8-inch Rain Gauge
Observed Parameter	Rainfall Amount
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	0.28
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	Quarterly
Serial No.	-

Table 2.11. Metadata for Sunshine Recorder in Butuan Station

Manufacturer / Brand	Campbell Stokes
Observed Parameter	Sunshine Duration
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.44
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	22536

Table 2.12. Metadata for Tipping Bucket in Butuan Station

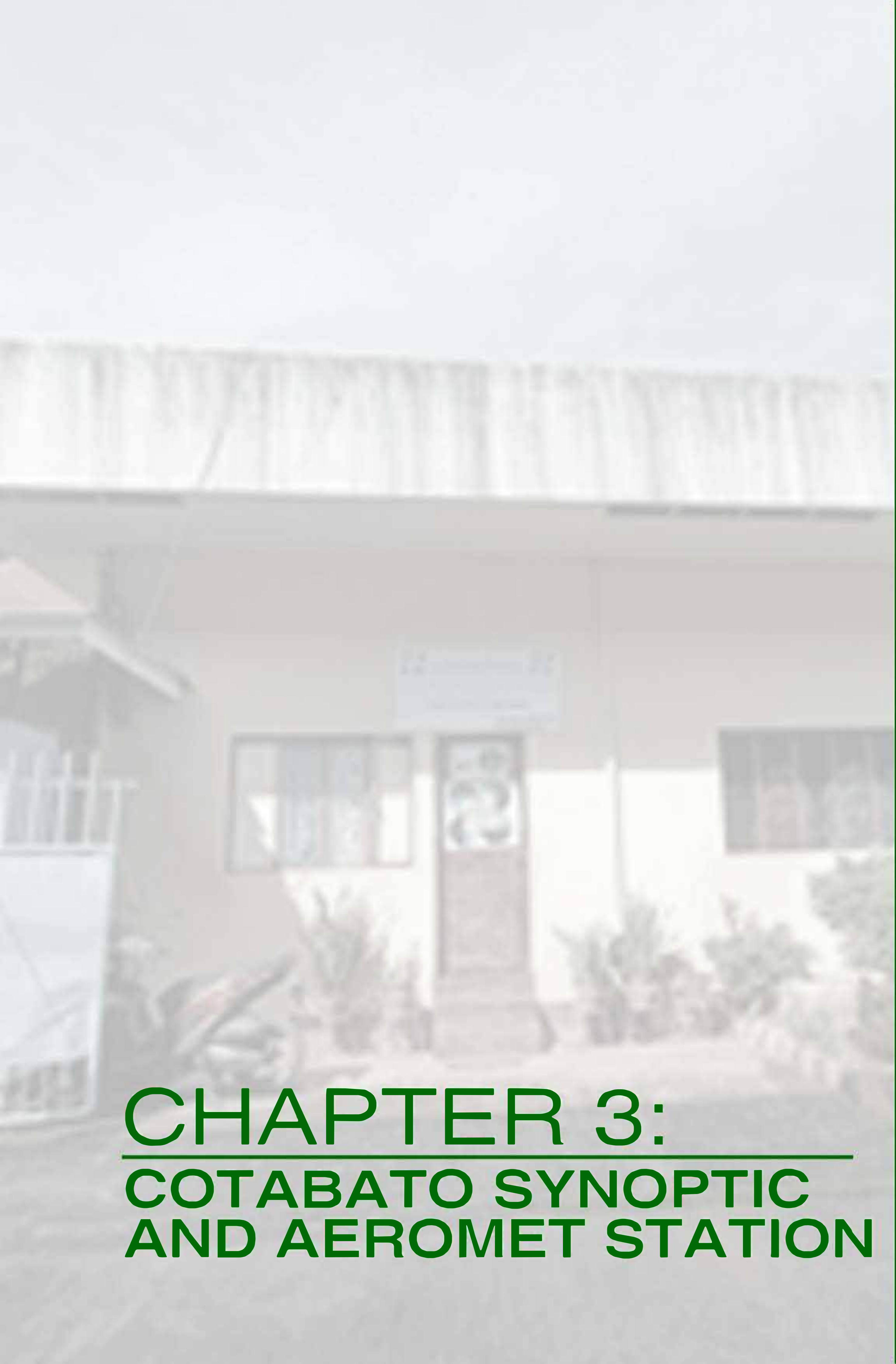
Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Rainfall Amount, Duration, and Intensity
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	0.56
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Quarterly, Upon Request
Model No.	-
Serial No.	15433

Table 2.13. Metadata for Vane Anemometer in Butuan Station

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Wind Direction, Wind Speed
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.32
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	BH14183
Serial No.	-

Table 2.14. Metadata for Ultrasonic Anemometer in Butuan Station

Manufacturer / Brand	Gill Wind (Observer 90)
Observed Parameter	Wind Direction, Wind Speed, Wind Gust, Wind Rose
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	10
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	1534030
Serial No.	-



CHAPTER 3:
COTABATO SYNOPTIC AND AEROMET STATION

Cotabato City is a highly urbanized city with a population of 325,079. Cotabato City is situated at the delta of the Tamontaka River and Rio Grande de Mindanao. Hence, it is known as a city of rivers and islets. Settlements near Rio Grande de Mindanao were established as early as 1475. The etymology of the word ‘Cotabato’ is from two Maguindanaon words: “Kuta,” meaning fortress, and “Wato,” meaning stone. Cotabato’s economy varies from trade, agriculture, and aquaculture products. Due to its location, Cotabato City is a major transshipping point, linking other cities in Mindanao, such as Davao in the east and Zamboanga in the west. Cotabato City is in a Climate Type III region with a brief dry season and no pronounced maximum rainfall period. Popular tourist destinations in the city include the largest mosque in the Philippines, the Cotabato City Grand Mosque, Tantawan Park, and Kutawato Caves.

Figure 7. Facade (left) and Observation Garden (right) of Cotabato Station

Cotabato weather station is an Aeromet and Synoptic Station (hereinafter referred to as Cotabato Station) located in Awang Airport, Datu Odin Sinsuat City, Maguindanao, in the newly formed BARMM region (Region XII). Detailed information about the station's location is given in Table 3.1. The weather station is situated on open, flat terrain with a slope of less than 3^0 in an urban area with an artificial surface cover (Figure 7). The station is located in a region with an elevation between 100 and 300 meters above mean sea level. The Tamontaka River to the east and Mount Cabalalaan to the west are notable visibility markers near the station.

Table 3.1. Cotabato Station Information

Station Name	Cotabato Synoptic Station
Station Number (ID)	98746
Latitude	07°09’42.4”
Longitude	124°12’53.5”
Elevation	44.9 m
Altimeter Correction	-

Following the WMO's standard for a meteorological station, Cotabato Station is designed to make representative measurements according to its type. As an Aeromet station, the Cotabato Station coordinates with the Cotabato Airport aviation personnel to provide critical weather information for aviation operations. The weather station collaborates closely with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction as a synoptic station. Cotabato Station submits monthly weather observation reports to the PAGASA Central Office and the MPRSD, along with processing weather certifications for concerned stakeholders.

Cotabato Station is equipped with multiple instruments capable of measuring surface weather parameters (Table 3.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and other local weather-dependent operations such as airport and construction work and climate and weather research.

The station follows the WMO standard (WMO-No.8), which emphasizes meticulous calibration and quality control in data generation and information on weather, climate, and water, ensuring accuracy and reliability. Detailed information about each instrument will be provided in the subsequent subchapter.

Table 3.2 Cotabato Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Digital Barometer*		A Digital Barometer uses pressure sensing micro-electromechanical sensor to measure atmospheric pressure
Event Recorder		An event recorder is simultaneously used with a tipping bucket rain gauge to log precipitation
Instrument Shelter		An enclosure, typically painted white, is designed to house thermometric instruments (such as thermometers and psychrometers) and protect them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.
Maximum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.

Instrument	Picture	Description
Mercurial Barometer*		It measures atmospheric pressure using a column of mercury trapped inside a glass tube, typically 32 inches long. The mercury rises or falls in response to changes in atmospheric pressure.
Minimum Thermometer*		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Psychrometer		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from both direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube
Standard Rain Gauge		A Standard Rain Gauge measures precipitation. It consists of a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When the smaller tube fills up, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.
Sunshine Recorder*		A spherical lens measures sunshine duration by concentrating a solar beam onto a special dark paper

Instrument	Picture	Description
Thermograph*		A thermograph is an instrument that continuously measures air temperature via a recording pen and a rotating chart mechanism
Tipping Bucket Rain Gauge*		An instrument that measures precipitation and is typically attached to an event recorder is an upright cylinder with a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once it reaches 0.2 mm in volume.
Vane Anemometer*		Anemometers measure wind speed and direction. A vane anemometer is a type of anemometer where a vane is attached to either a stationary or rotating shaft. The vane is connected to a sensor that records the rotation of the shaft.

Instruments marked with an asterisk (*) contain metadata. See the Metadata subchapter for more information.

PERSONNEL COMPLEMENT

Cotabato station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Ms. Charlyn Jamero. The individuals listed in Table 3.3 ensure the efficient operation of the station, accurate data collection, and the delivery of reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are responsible for conducting synoptic and/or climatological observations using appropriate instruments, noting their uncertainties and representativeness. They also maintain instruments and document metadata. In cases where automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 3.3. Cotabato Station Personnel

Name	Role/Job Description	Email Address
Charlyn Jamero	CMO	cotabatopagasa746@yahoo.com
Gleziel May Calipay	Weather Specialist I	gleziel1989@gmail.com
Alvin Bautista	Communications Equipment Operator	alvin.bautista309@gmail
Samuel Salaver	Science Aide	samuelsalaver2@gmail.com
Phoebe Ladonna Bautista	Weather Observer I	ladyhet@gmail.com

**As of the time of writing in May 2024*

INSTRUMENTS METADATA

Aside from the data itself, users of these meteorological observations must also be knowledgeable about the instrument's condition, type, and exposure. Maintaining quality-controlled metadata is important as the observed data (see Chapter 12 for more information). Even with advancements in data homogeneity methods, recorded metadata still accurately identifies inhomogeneities. Changes that occur at the station and its maintenance history should be documented. Instrument metadata (data about data) provides detailed information about the instruments, including model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in data collection.

Table 3.4. Metadata for Digital Barometer in Cotabato Station

Manufacturer / Brand	Vaisala
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	Aug 21, 2019
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Microscale
Maintenance Activity	Upon Request
Model No.	2019
Serial No.	R0720176

Table 3.5. Metadata for Mercurial Barometer in Cotabato Station

Manufacturer / Brand	Mercurial Barograph
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	1993
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Microscale
Maintenance Activity	Upon Request
Model No.	1702070193
Serial No.	-

Table 3.6. Metadata for Minimum Thermometer in Cotabato Station

Manufacturer / Brand	Minimum Thermometer
Observed Parameter	Lowest Temperature
Date Installed / Deployed	Dec 16, 2022
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	6 Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Microscale
Maintenance Activity	Quarterly
Model No.	-
Serial No.	1023

Table 3.7. Metadata for Sunshine Recorder in Cotabato Station

Manufacturer / Brand	Casella London Sunshine Recorder
Observed Parameter	Amount of Sunshine
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	6 Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Microscale
Maintenance Activity	Upon Request
Model No.	1701050032
Serial No.	10140

Table 3.8. Metadata for Thermograph in Cotabato Station

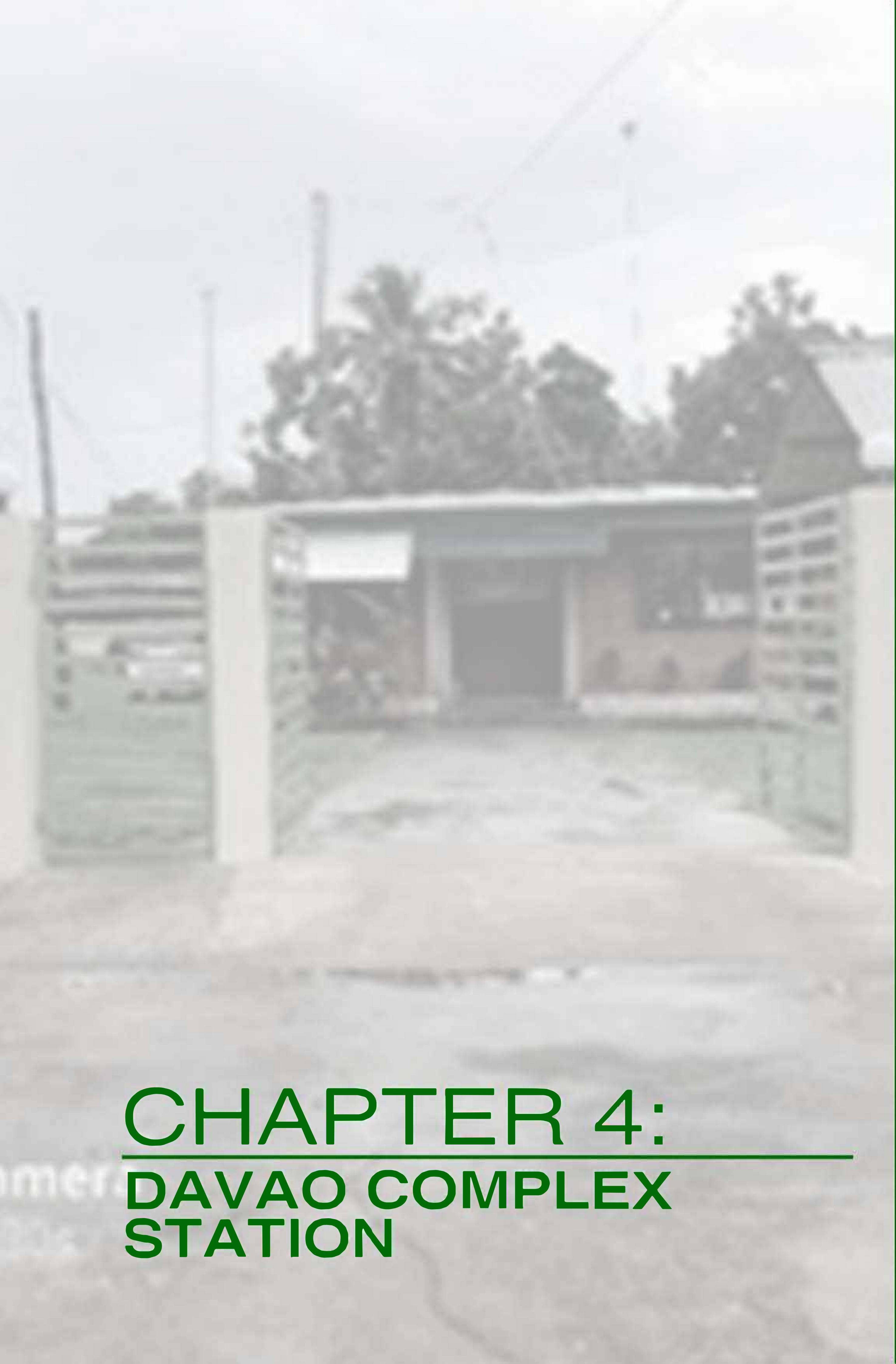
Manufacturer / Brand	SIGMA II
Observed Parameter	Temperature
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Weekly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Microscale
Maintenance Activity	Upon Request
Model No.	7230-00
Serial No.	-

Table 3.9. Metadata for Tipping Bucket Rain Gauge in Cotabato Station

Manufacturer / Brand	SK Sato
Observed Parameter	Rainfall event, Intensity and Duration
Date Installed / Deployed	June 2014
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Weekly
Height from Ground (m)	1.5
Instrument Exposure	Class 1
Representativeness of Observation	Microscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	10140

Table 3.10. Metadata for Vane Anemometer in Cotabato Station

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Wind Speed and Direction
Date Installed / Deployed	Jan. 1, 1991
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Microscale
Maintenance Activity	Upon Request
Model No.	7790
Serial No.	P40655



CHAPTER 4:

DAVAO COMPLEX STATION

Davao City is a highly urbanized city with a total land area of 2,444 km². The city is home to 1,776,949 people from 11 ethno-linguistic tribes, making it the third most populous city in the country. The name of the city comes from the blending of three words: "Dabo," "Duhwow," and "Davoh," which were names of the Davao River given by Bagobo subgroups (Tagabawa, Guiangan, and Obo). During the pre-Spanish rule, the Davao River served as an avenue for trade between locals and Chinese traders. The economy of Davao is driven by its agricultural sector, which is known as the largest exporter of Mangoes, Bananas, and Durian. In 2021, Davao City was named "The Chocolate Capital of the Philippines" due to its growing chocolate industry. Endemic to Davao are the largest eagle in the world, the Philippine eagle, and the "Queen of Philippine Flowers," the Orchid Waling-Waling. Popular tourist destinations in the city include the Philippine Eagle Foundation, Mt. Apo, and Davao Crocodile Farm.

Figure 8. Davao Complex Station. (left) Facade (right) Observation Garden

Davao Complex Station (hereinafter referred to as Davao Station) is a synoptic, Aeromet, and Upper-air station in the Old Airport Compound, Barangay Sasa, Davao City, Davao del Sur (Region XI). Table 4.1 provides detailed information about the station's location. With a Type IV climate, Davao City experiences rainfall that is more or less evenly distributed throughout the year. The weather station is situated on generally flat terrain (see Figure 8).

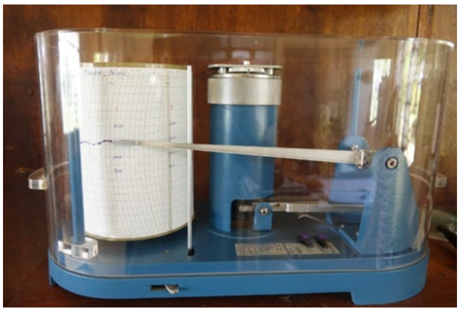
Table 4.1. Davao Station Information

Station Name	Davao PAGASA Complex Sation
Station Number (ID)	98753
Latitude	07°07'
Longitude	125°39'
Elevation	18 m
Altimeter Correction	+2.1
Climate Zone	Equatorial – Monsoon (Fixed)
Climate Type	Type IV

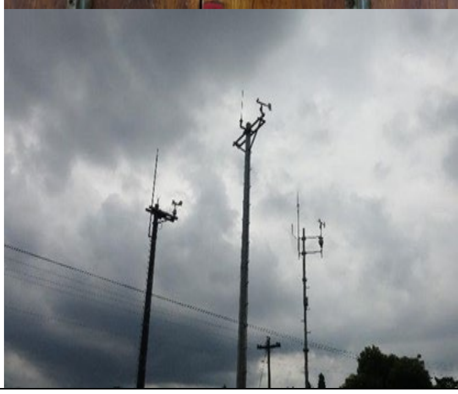
Following the WMO's standards for meteorological stations, Davao Station is designed to make representative measurements according to its type. Davao Station serves multiple roles. The weather station collaborates closely with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction as a synoptic station. As an Aeromet station, the Davao Station coordinates with Davao Airport aviation personnel to provide critical weather information for aviation operations hourly. Additionally, as a local instrument center, it ensures more precise measurements of meteorological instruments to enhance the accuracy of weather, flood, and climate forecasts. Lastly, as an upper-air station, it conducts observations of atmospheric pressure, temperature, humidity, wind speed and direction, or a combination of these parameters at various levels of the upper atmosphere.

Davao Synoptic Station is equipped with multiple instruments capable of measuring surface weather parameters (see Table 4.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and other local weather-dependent operations such as airport and construction work and climate and weather research. The station follows the WMO standard (WMO-No.8), which emphasizes meticulous calibration and quality control in data generation and information on weather, climate, and water, ensuring accuracy and reliability. Detailed information about each instrument will be provided in the subsequent subchapter.

Table 4.2 Davao Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Automated Weather Observing System*		The Automated Weather Observing System (AWOS) is a fully configurable airport weather system that provides continuous, real-time information and reports on weather conditions. AWOS stations are primarily operated, maintained, and controlled by PAGASA personnel.
Barograph		Make use of aneroid cells, which are flexible metal chambers that expand or contract in response to changes in atmospheric pressure, also known as "Dry Barographs"
Dry Bulb Thermometer		A dry-bulb thermometer measures air temperature using a bulb that is exposed to the air and protected from radiation and moisture. The air temperature is then determined by the amount of heat transferred to the bulb.
Event Recorder		An event recorder is simultaneously used with a tipping bucket rain gauge to log precipitation

Instrument	Picture	Description
Instrument Shelter		An enclosure, typically painted white, is designed to house thermometric instruments (such as thermometers and psychrometers) and protect them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.
Lightning Detector*		The Lightning Sensor captures comprehensive lightning data for accurate and reliable real-time weather monitoring. Obtain the most reliable information, especially when severe weather and lightning pose a threat.
Maximum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Minimum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Standard Rain Gauge		A Standard Rain Gauge measures precipitation. It consists of a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When the smaller tube fills up, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.

Instrument	Picture	Description
Thermograph		A thermograph is an instrument that continuously records air temperature using a pen attached to a rotating chart mechanism.
Tipping Bucket Rain Gauge		An instrument that measures precipitation and is typically attached to an event recorder is an upright cylinder with a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once it reaches 0.2 mm in volume.
Upper-Air Station*		Radiosonde sensors measure upper-air conditions, including atmospheric pressure, temperature, humidity, wind speed, and direction. These data are crucial for aviation safety, predicting severe weather, and providing valuable input for numerical weather models.
Vane Anemometer	 	Anemometers measure wind speed and direction. A vane anemometer is a type of anemometer where a vane is attached to either a stationary or rotating shaft. The vane is connected to a sensor that records the rotation of the shaft.

Instrument	Picture	Description
Wet Bulb Thermometer		A wet-bulb thermometer is an instrument used to measure the lowest temperature, which can be reached by evaporating water into the air at constant pressure. It consists of a thermometer bulb covered with a wet wick or cloth that evaporates moisture into the air surrounding it.

Instruments marked with an asterisk (*) contain metadata. See the Metadata subchapter for more information.

PERSONNEL COMPLEMENT

Davao Complex Station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Ms. Lolita L. Vinalay. The individuals listed in Table 4.3 ensure the efficient operation of the station, accurate data collection, and the delivery of reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are responsible for conducting synoptic and/or climatological observations using appropriate instruments, noting their uncertainties and representativeness. They also maintain instruments and document metadata. In cases where automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 4.3. Davao PAGASA Station Personnel

Name	Role/Job Description	Email Address
Lolita Vinalay	Senior Weather Specialist (CMO)	lolita_vinalay@yahoo.com
Bema Tajones	Weather Specialist I	bemacominador@gmail.com
Diza Chio	Weather Specialist I	diza.chio@gmail.com
Grace Nulud	Weather Specialist I	gracenulud@gmail.com
Jocelyn Taboclaon	Weather Observer IV	taboclaon_jojo@yahoo.com.ph
Edgar Gambuta	Weather Observer III	gambuta.edgar@gmail.com
Guillermo Vinalay Jr.	Weather Observer II	bobotvinalay08@gmail.com
Honey Perez	Weather Observer I	perezhoney38@yahoo.com
Dhina Dumingag	Weather Observer I	journey081882@gmail.com
Jonathan Guya	Weather Observer I	jonathanguya881@gmail.com
James John Divinagracia	Driver (Job Order)	jforcedivinegrace@gmail.com
Junwine Maestrado	Utility (Agency)	

**As of the time of writing in May 2024*

INSTRUMENTS METADATA

Aside from the data itself, users of these meteorological observations must also be knowledgeable about the instrument's condition, type, and exposure. Maintaining quality-controlled metadata is important as the observed data (see Chapter 12 for more information). Even with advancements in data homogeneity methods, recorded metadata still accurately identifies inhomogeneities. Changes that occur at the station and its maintenance history should be documented. Instrument metadata (data about data) provides detailed information about the instruments, including model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in data collection.

Table 4.4 Metadata for Automated Weather Observing System in Davao

Manufacturer / Brand	AWOS
Observed Parameter	Visibility, Clouds
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	-

Table 4.5 Metadata for Lightning Detector in Davao

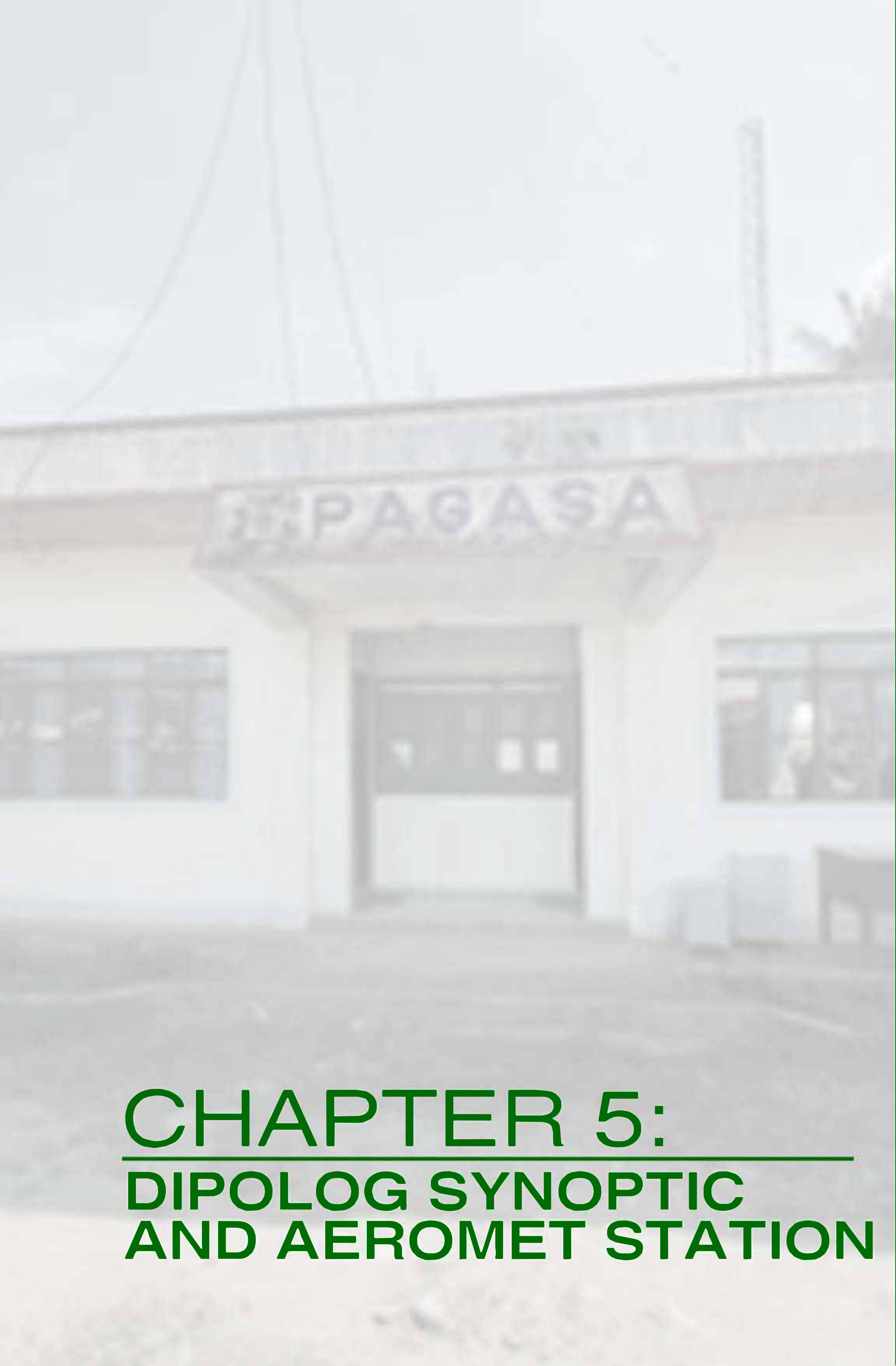
Manufacturer / Brand	Lightning Detector
Observed Parameter	-
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	P2PUS 18110

Table 4.6 Metadata for Sunshine Recorder in Davao

Manufacturer / Brand	Solar Radiation
Observed Parameter	Sunshine Duration
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Daily
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	-

Table 4.7 Metadata for Upper-Air Receiver in Davao

Manufacturer / Brand	LMG 6 (Upper-Air Receiver)
Observed Parameter	Dry and Wet Bulb Temperature, Relative Humidity, Station Pressure, Wind Speed and Direction
Date Installed / Deployed	2010
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Twice Daily
Height from Ground (m)	-
Instrument Exposure	Class 2
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	-



CHAPTER 5:

DIPOLOG SYNOPTIC AND AEROMET STATION

Dipolog is a component city with a population of 138,141 and a total land area of 136.28 km^2. The city's name originates from the Subano word "Dipag," which means "across the river." According to historical records, "Dipag" was the response given by an unnamed local to a Spanish Missionary inquiring about the Captain of the Tulawan town site. Dipolog falls under a type IV climate characterized by evenly distributed rainfall throughout the year and a dry season lasting from one to three months. The city is renowned for its 1.6 km long foreshore Sunset Boulevard, which serves as the venue for various events, including the annual "Pagsalabuk" Festival. The city's economy thrives on the food industry, particularly coconut, rice, and sardine production. Its popular tourist destinations are Sunset Boulevard, the Cathedral of Our Lady of the Most Holy Rosary, and Linabo Peak.

Figure 9. Dipolog Synoptic Station. (left) Facade (right) Observation Garden

Dipolog Aeromet and Synoptic Station (hereinafter referred to as Dipolog Station) is located on Airport Road, Barangay Minaog, Dipolog City, Zamboanga del Norte (Region IX). Detailed information about the station location is given in Table 5.1. Dipolog station is located on a flat terrain, a cultivated area with regular cover of low crops (Figure 9). It is located in a region with minimal elevation, less than 100 m below mean sea level. The sea lies west of the station, and on the east lies Linabo Mountain.

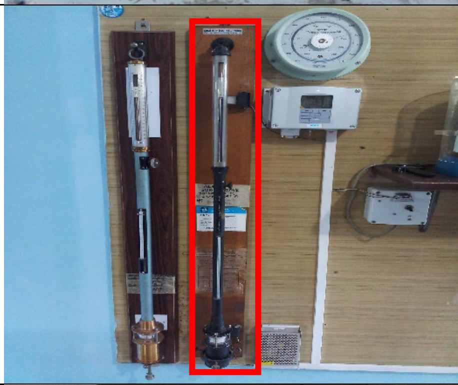
Table 5.1 Dipolog Station Information

Station Name	Dipolog Synoptic station
Station Number (ID)	98741
Latitude	08°36’
Longitude	123°21’
Elevation	3.7 m
Altimeter Correction	-
Temporal resolution	-
Archived Data	-

Dipolog Station is equipped with multiple instruments capable of measuring surface weather parameters (Table 5.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and other local weather-dependent operations such as airport and construction work and climate and weather research. The station follows the WMO standard (WMO-No.8), which emphasizes meticulous calibration and quality control in data generation and information on weather, climate, and water, ensuring accuracy and reliability. Detailed information about each instrument will be provided in the subsequent subchapter.

Table 5.2 Dipolog Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Barograph*		Make use of aneroid cells, which are flexible metal chambers that expand or contract in response to changes in atmospheric pressure, also known as "Dry Barographs"
Digital Barometer*		A Digital Barometer uses pressure sensing micro-electromechanical sensor to measure atmospheric pressure
Event Recorder		An event recorder is simultaneously used with a tipping bucket rain gauge to log precipitation
Hygrothermograph*		A hygrothermograph is an instrument that measures humidity and temperature using a recording pen and a rotating chart mechanism
Instrument Shelter		An enclosure, typically painted white, is designed to house thermometric instruments (such as thermometers and psychrometers) and protect them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.

Instrument	Picture	Description
Maximum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Mercurial Barograph		It measures atmospheric pressure using a column of mercury trapped inside a glass tube, typically 32 inches long. The mercury rises or falls in response to changes in atmospheric pressure.
Minimum Thermometer		Liquid-in-glass thermometers use the differential expansion of pure liquid with respect to its glass container to indicate temperature. They are used to measure maximum temperature.
Psychrometer*		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from both direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube,
Standard Rain Gauge		A Standard Rain Gauge measures precipitation. It consists of a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When the smaller tube fills up, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.

Instrument	Picture	Description
Sunshine Recorder		A spherical lens measures sunshine duration by concentrating a solar beam onto a special dark paper.
Tipping Bucket Rain Gauge*		An instrument that measures precipitation and is typically attached to an event recorder is an upright cylinder with a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once it reaches 0.2 mm in volume.
Vane Anemometer*	 	Anemometers measure wind speed and direction. A vane anemometer is a type of anemometer where a vane is attached to either a stationary or rotating shaft. The vane is connected to a sensor that records the rotation of the shaft.

Instruments marked with an asterisk (*) contain metadata. See the Metadata subchapter for more information.

PERSONNEL COMPLEMENT

Dipolog station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Ms. April Love E. Castillon. The individuals listed in Table 5.3 ensure the efficient operation of the station, accurate data collection, and the delivery of reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are responsible for conducting synoptic and/or climatological observations using appropriate instruments, noting their uncertainties and representativeness. They also maintain instruments and document metadata. In cases where automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 5.3. Dipolog Station Personnel

Name	Role/Job Description	Email Address
April Love E. Castillon	CMO/ Weather Specialist I	alecstillon23@gmail.com

**As of the time of writing in May 2024*

INSTRUMENTS METADATA

Aside from the data itself, users of these meteorological observations must also be knowledgeable about the instrument's condition, type, and exposure. Maintaining quality-controlled metadata is important as the observed data (see Chapter 12 for more information). Even with advancements in data homogeneity methods, recorded metadata still accurately identifies inhomogeneities. Changes that occur at the station and its maintenance history should be documented. Instrument metadata (data about data) provides detailed information about the instruments, including model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in data collection.

Table 5.4. Metadata for Anemometer in Dipolog

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Wind Speed and Direction
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 2
Representativeness of Observation	Mesoscale
Maintenance Activity	Annual, Upon Request
Model No.	-
Serial No.	BH14233

Table 5.5. Metadata for Barograph in Dipolog

Manufacturer / Brand	Vaisala
Observed Parameter	Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Annual, Upon Request
Model No.	PTB330
Serial No.	R0740263

Table 5.6. Metadata for Barometer in Dipolog

Manufacturer / Brand	Lambrecht
Observed Parameter	Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Annual, Upon Request
Model No.	00.02929.110002
Serial No.	811215.0010

Table 5.7. Metadata for Hygrothermograph in Dipolog

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Temperature Trend
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly, 3 hourly
Height from Ground (m)	-
Instrument Exposure	Class 2
Representativeness of Observation	Mesoscale
Maintenance Activity	Annual, Upon Request
Model No.	7230-00
Serial No.	585184

Table 5.8. Metadata for Psychrometer in Dipolog

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Dry and Wet Bulb Temperature
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 2
Representativeness of Observation	Mesoscale
Maintenance Activity	Annual, Upon Request
Model No.	SK-RHG 7450
Serial No.	18617

Table 5.9. Metadata for Tipping Bucket in Dipolog

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Rainfall
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 2
Representativeness of Observation	Mesoscale
Maintenance Activity	Annual, Upon Request
Model No.	-
Serial No.	6464

CHAPTER 6:

GENERAL SANTOS SYNOPTIC AND AEROMET STATION

General Santos City, commonly known as "GenSan," is a Highly Urbanized City with a total population of 697,315 people. Being in a type III climate, the city experiences no pronounced maximum rainfall period and has a dry season lasting from one to three months. The city was named after Paulino Torres Santos Sr., a former Commanding General of the Philippines, in tribute to his heroic legacy in the area. General Santos City is renowned as the largest producer of sashimi-grade tuna, earning its title as the "Tuna Capital of the Philippines." The city's economy thrives on agricultural and fishing industries. One of the city's most notable personalities is the world boxing champion, Manny Pacquiao. Popular tourist destinations in the city include the General Santos City Fish Port Complex and Sarangani Island.

Figure 10. General Santos Station. (left) Facade (right) Observation Garden

General Santos Aeromet and Synoptic station (hereinafter referred to as General Santos Station) is located in Airport Compound, Barangay Tambler, General Santos City, in the SOCSARGEN province (Region XII). Detailed information about the station location is provided in Table 6.1. The station is on open, flat terrain with a slope of less than 3^0, resembling grazing land surrounded by minimal obstructions (Figure 10). General Santos Station is 300 to 1000 meters above mean sea level. A notable visibility marker near the station is Sarangani Bay to the East.

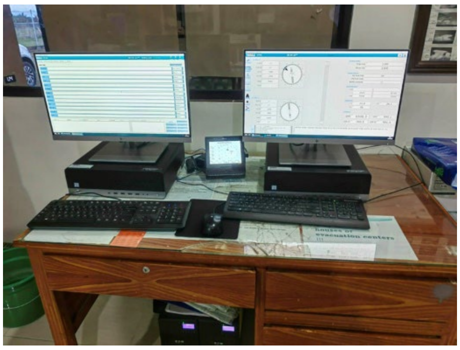
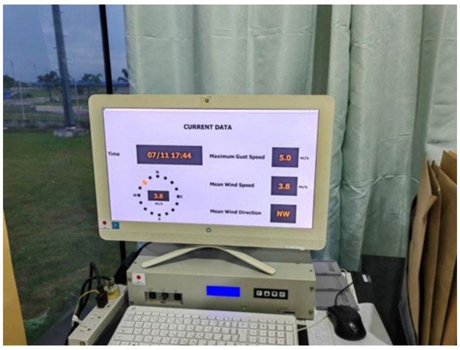
Table 6.1. General Santos Synoptic Station Information

Station Name	General Santos Airport station
Station Number (ID)	98851
Latitude	06°03’
Longitude	125°06’
Elevation	132 m
Altimeter Correction	-

Following the WMO's standards for a meteorological station, General Santos Station is designed to make representative measurements according to its type. The weather station collaborates closely with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction as a synoptic station. General Santos Station submits monthly weather observation reports to the PAGASA Central Office and MPRSD and processes weather certifications for concerned stakeholders.

General Santos Station is equipped with multiple instruments capable of measuring surface weather parameters (Table 6.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and other local weather-dependent operations such as airport and construction work and climate and weather research. The station follows the WMO standard (WMO-No.8), which emphasizes meticulous calibration and quality control in data generation and information on weather, climate, and water, ensuring accuracy and reliability. Detailed information about each instrument will be provided in the subsequent subchapter.

Table 6.2 General Santos Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Automated Weather Observing System*		The Automated Weather Observing System (AWOS) is a fully configurable airport weather system that provides continuous, real-time information and reports on weather conditions. AWOS stations are primarily operated, maintained, and controlled by PAGASA personnel.
Digital Anemometer*		A digital anemometer is a modern meteorological instrument used to measure wind speed and direction
Digital Barometer*		A Digital Barometer uses pressure sensing micro-electromechanical sensor to measure atmospheric pressure

Instruments marked with an asterisk (*) contain metadata. See the Metadata subchapter for more information.

PERSONNEL COMPLEMENT

General Santos station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Mr. Binrio Binan. The persons listed in Table 6.3 ensure the efficient operation of the station, accurate data collection, and the delivery of reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are responsible for conducting synoptic and/or climatological observations using appropriate instruments, noting their uncertainties and representativeness. They also maintain instruments and document metadata. In cases where automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 6.3. General Santos Station Personnel

Name	Role/Job Description	Email Address
Binrio Binan	CMO	rio.binan@gmail.com
Roy Jumawan	Weather Observer III	balongjumawan@gmail.com
Eduard Panolino	Weather Observer I	-
Ron Pacifar	Job Order	ronpacifar@gmail.com
Kenneth Aberca	Job Order	-

**As of the time of writing in May 2024*

INSTRUMENTS METADATA

Aside from the data itself, users of these meteorological observations must also be knowledgeable about the instrument's condition, type, and exposure. Maintaining quality-controlled metadata is important as the observed data (see Chapter 12 for more information). Even with advancements in data homogeneity methods, recorded metadata still accurately identifies inhomogeneities. Changes that occur at the station and its maintenance history should be documented. Instrument metadata (data about data) provides detailed information about the instruments, including model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in data collection.

Table 6.4. Metadata for Automated Weather Observing System in General Santos

Manufacturer / Brand	Vaisala AVIMET
Observed Parameter	Atmospheric Pressure, Humidity, Dry Bulb, Dew Point, Wind Direction, Wind Speed, Overhead Clouds, Visibility
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	Rwy 35: 142 m, Rwy 17: 153 m
Instrument Exposure	Class 3
Representativeness of Observation	Toposcale
Maintenance Activity	Annual
Model No.	-
Serial No.	-

Table 6.5. Metadata for Digital Anemometer in General Santos

Manufacturer / Brand	JICA
Observed Parameter	Wind
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	10 minutes
Height from Ground (m)	142 m
Instrument Exposure	Class 2
Representativeness of Observation	Toposcale
Maintenance Activity	Discrete
Model No.	-
Serial No.	-

Table 6.6. Metadata for Digital Barograph in General Santos

Manufacturer / Brand	Vaisala
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	2021
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	133
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Semi-Annual
Model No.	PTB330
Serial No.	-

CHAPTER 7:
HINATUAN SYNOPTIC AND RADAR STATION

Hinatuan is a municipality in Surigao del Sur on the eastern coast of Mindanao, home to 43,841 people. The climate of Hinatuan is classified as type III, with rainfall more pronounced from December to February. Two stories are told regarding the origin of the municipality's name. One suggests that it derived from "Hatoan," a native term describing a place for preserving fish. The other story claims it originated from "Hinatudan," a word overheard by a local native from a Boholano immigrant asking in Visayan dialect where to deliver people and food. Hinatuan is renowned for its Enchanted River, which has unexplored depths and local legends.

Figure 11. Hinatuan Synoptic Station. (left) Facade (right) Observation Garden

Hinatuan Synoptic and Radar Station (hereinafter referred to as Hinatuan Station) is located in Barangay Aquino, Municipality of Hinatuan, Surigao del Sur (Region XIII). Detailed information about the station's location is provided in Table 7.1. Hinatuan Station is situated in a suburban area near the sea with flat terrain (Figure 11). The station is at a very low altitude, less than 100 m above mean sea level. A notable visibility marker near the station is Hinatuan Bay to the East.

Table 7.1. Hinatuan Station Information

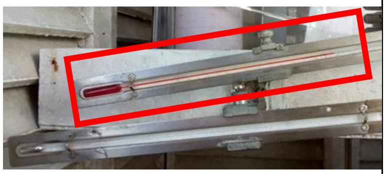
Station Name	Hinatuan Synoptic and Radar Station
Station Number (ID)	98755
Latitude	08° 22'
Longitude	126° 20'
Elevation	3 m
Altimeter Correction	-

Following the WMO's standard for a meteorological station, the Hinatuan Station is designed to make representative measurements according to its type. The weather station collaborates closely with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction as a synoptic station. Hinatuan station submits monthly weather observation reports to the PAGASA Central Office and MPRSD and processes weather certifications for concerned stakeholders. As a radar station, it also provides regular radar observations and sends radar images to the PAGASA Central Office and MPRSD.

Hinatuan Station is equipped with multiple instruments capable of measuring surface weather parameters (Table 7.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and other local weather-dependent operations such as airport and construction work and climate and weather research. The station follows the WMO standard (WMO-No.8), which emphasizes meticulous calibration and quality control in data generation and information on weather, climate, and water, ensuring accuracy and reliability. Detailed information about each instrument will be provided in the subsequent subchapter.

Table 7.2 Hinatuan Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Barograph*		Make use of aneroid cells, which are flexible metal chambers that expand or contract in response to changes in atmospheric pressure, also known as "Dry Barographs"
Digital Barometer*		A Digital Barometer uses pressure sensing micro-electromechanical sensor to measure atmospheric pressure
Event Recorder*		An event recorder is simultaneously used with a tipping bucket rain gauge to log precipitation
Instrument Shelter		An enclosure, typically painted white, is designed to house thermometric instruments (such as thermometers and psychrometers) and protect them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.
Maximum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.

Instrument	Picture	Description
Mercurial Barometer *		It measures atmospheric pressure using a column of mercury trapped inside a glass tube, typically 32 inches long. The mercury rises or falls in response to changes in atmospheric pressure.
Minimum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Psychrometer*		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from both direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube,
Standard Rain Gauge		A Standard Rain Gauge measures precipitation. It consists of a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When the smaller tube fills up, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.
Thermograph*		A thermograph is an instrument that continuously measures air temperature via a recording pen and a rotating chart mechanism.

Instrument	Picture	Description
Tipping Bucket Rain Gauge*		An instrument that measures precipitation and is typically attached to an event recorder is an upright cylinder with a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once it reaches 0.2 mm in volume.
Vane Anemometer*	 	Anemometers measure wind speed and direction. A vane anemometer is a type of anemometer where a vane is attached to either a stationary or rotating shaft. The vane is connected to a sensor that records the rotation of the shaft.

Instruments marked with an asterisk (*) contain metadata. See the Metadata subchapter for more information.

PERSONNEL COMPLEMENT

Hinatuan station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Mr. Alan Ray C. Ribo. The persons listed in Table 7.3 ensure the efficient operation of the station, accurate data collection, and the delivery of reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are responsible for conducting synoptic and/or climatological observations using appropriate instruments, noting their uncertainties and representativeness. They also maintain instruments and document metadata. In cases where automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 7.3. Hinatuan Station Personnel

Name	Role/Job Description	Email Address
Alan Ray Ribo	Weather Specialist II	alanrayribo@yahoo.com
Rumark Leopoldo Bompat	Weather Observer III	rumarkbompat@yahoo.com
Miland Arlan	Weather Observer I	milandgen@yahoo.com
Jill Galicha	Weather Observer II	Pagasa_hin755@yahoo.com

**As of the time of writing in May 2024*

INSTRUMENTS METADATA

Aside from the data itself, users of these meteorological observations must also be knowledgeable about the instrument's condition, type, and exposure. Maintaining quality-controlled metadata is important as the observed data (see Chapter 12 for more information). Even with advancements in data homogeneity methods, recorded metadata still accurately identifies inhomogeneities. Changes that occur at the station and its maintenance history should be documented. Instrument metadata (data about data) provides detailed information about the instruments, including model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in data collection.

Table 7.4. Metadata for Barograph in Hinatuan

Manufacturer / Brand	Lambrecht
Observed Parameter	Pressure
Date Installed / Deployed	September 2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	-
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	00.02920.110002
Serial No.	811216.0006

Table 7.5. Metadata for Digital Barograph in Hinatuan

Manufacturer / Brand	Vaisala
Observed Parameter	Pressure
Date Installed / Deployed	Nov 2019
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	-
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	R0810619

Table 7.6. Metadata for EEC Radar System in Hinatuan

Manufacturer / Brand	EEC
Observed Parameter	Rainfall, cloud, reflectivity, wind
Date Installed / Deployed	2009
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	10 minutes
Height from Ground (m)	-
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Quarterly, Semi-Annual, Upon Request
Model No.	-
Serial No.	-

Table 7.7. Metadata for Event Recorder in Hinatuan

Manufacturer / Brand	Sato
Observed Parameter	Rainfall
Date Installed / Deployed	September 30, 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	-
Instrument Exposure	Class 2
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	6451

Table 7.8. Metadata for Mercurial Barograph in Hinatuan

Manufacturer / Brand	Fortin
Observed Parameter	Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	6 hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	K12192

Table 7.9. Metadata for Psychrometer in Hinatuan

Manufacturer / Brand	Assman
Observed Parameter	Dry and Wet Bulb (Relative Humidity and Dew Point)
Date Installed / Deployed	September 30, 2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	-
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	7450
Serial No.	18591

Table 7.10. Metadata for SELEX Radar System in Hinatuan

Manufacturer / Brand	Germatronix
Observed Parameter	Rainfall, cloud, reflectivity, wind
Date Installed / Deployed	2016
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	10 minutes
Height from Ground (m)	-
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Quarterly, Semi-Annual, Upon Request
Model No.	-
Serial No.	-

Table 7.11. Metadata for Thermograph in Hinatuan

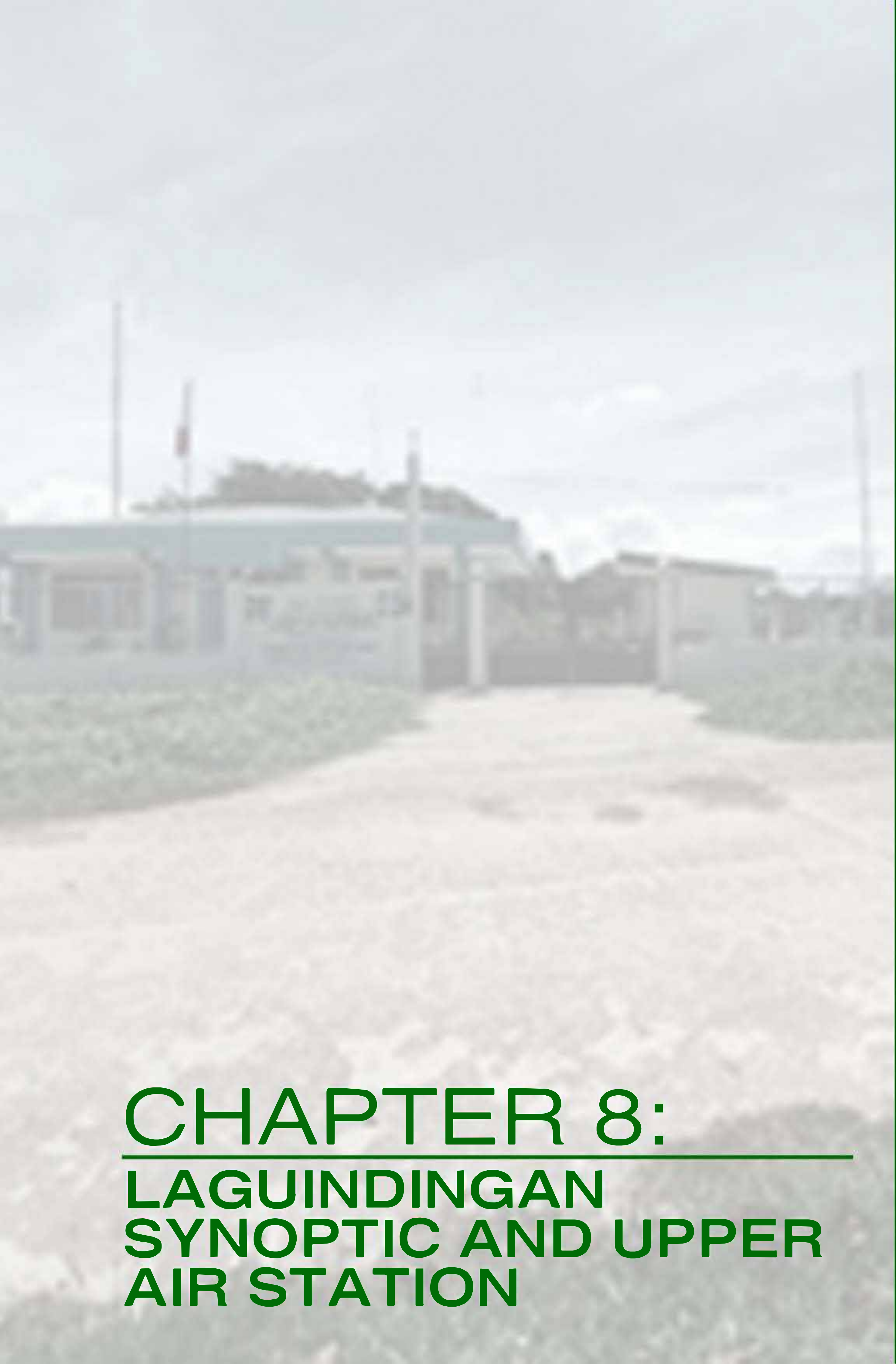
Manufacturer / Brand	Sato
Observed Parameter	Temperature
Date Installed / Deployed	September 30, 2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	7230-00
Serial No.	-

Table 7.12. Metadata for Tipping Bucket Rain Gauge in Hinatuan

Manufacturer / Brand	Sato
Observed Parameter	Rainfall
Date Installed / Deployed	September 30, 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	-
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	6451

Table 7.13. Metadata for Vane Anemometer in Hinatuan

Manufacturer / Brand	Sato
Observed Parameter	Wind Speed and Wind Direction
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	-
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	BH14231



CHAPTER 8:

LAGUINDINGAN SYNOPTIC AND UPPER AIR STATION

Laguindingan is known for its famous Seafood Market and beautiful beaches. The climate of Laguindingan is classified as a type III climate wherein rainfall is more pronounced from December to February.

Figure 12. Laguindingan Synoptic Station. (left) Facade (right) Observation Garden

Laguindingan Synoptic and Radiosonde (Upper Air) station (hereinafter referred to as Laguindingan Station) is located in the Laguindingan Airport, Municipality of Laguindingan, Misamis Oriental (Region X). Table 8.1 provides detailed information about the station's location. The station is situated within hills with more than 3^0 degrees of slope, which resembles grazing land surrounded by a landscape with minimal obstructions (Figure 12).

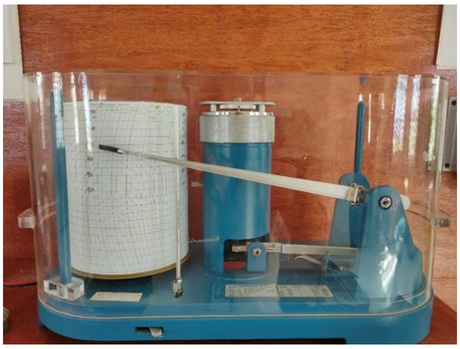
Table 8.1. Laguindingan Station Information

Station Name	Laguindingan Synoptic Station
Station Number (ID)	98747
Latitude	08° 32’8.4”
Longitude	124° 33’28.8”
Elevation	8 m
Altimeter Correction	-

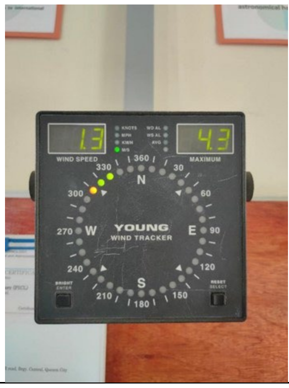
Following the WMO's standard for a meteorological station, the Laguindingan station is designed to make representative measurements according to its type. As an upper-air station, it conducts observation of atmospheric pressure, temperature, humidity, wind speed, and direction or a combination of all these parameters at different levels of the upper atmosphere. The weather station collaborates closely with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction as a synoptic station. Laguindingan station submits monthly weather observation reports to the PAGASA Central Office and MPRSD and processes weather certifications for concerned stakeholders.

Laguindingan Station is equipped with multiple instruments capable of measuring surface weather parameters (Table 8.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and other local weather-dependent operations such as airport and construction work and climate and weather research. The station follows the WMO standard (WMO-No.8), which emphasizes meticulous calibration and quality control in data generation and information on weather, climate, and water, ensuring accuracy and reliability. Detailed information about each instrument will be provided in the subsequent subchapter.

Table 8.2 Laguindingan Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Aneroid Barometer*		A nonliquid barometer called the aneroid barometer is widely used in portable instruments and aircraft altimeters because of its smaller size and convenience. It contains a flexible-walled evacuated capsule, the wall of which deflects with changes in atmospheric pressure.
Barograph*		Make use of aneroid cells, which are flexible metal chambers that expand or contract in response to changes in atmospheric pressure, also known as "Dry Barographs"
Event Recorder*		An event recorder is simultaneously used with a tipping bucket rain gauge to log precipitation
Instrument Shelter		An enclosure, typically painted white, is designed to house thermometric instruments (such as thermometers and psychrometers) and protect them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.
Mercurial Barometer*		It measures atmospheric pressure using a column of mercury trapped inside a glass tube, typically 32 inches long. The mercury rises or falls in response to changes in atmospheric pressure.

Instrument	Picture	Description
Minimum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Psychrometer*		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from both direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube,
Standard Rain Gauge*		A Standard Rain Gauge measures precipitation. It consists of a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When the smaller tube fills up, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.
Sunshine Recorder*		A spherical lens measures sunshine duration by concentrating a solar beam onto a special dark paper
Thermograph*		A thermograph is an instrument that measures humidity and temperature via a recording pen and a rotating chart mechanism

Instrument	Picture	Description
Tipping Bucket Rain Gauge*		An instrument that measures precipitation and is typically attached to an event recorder is an upright cylinder with a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once it reaches 0.2 mm in volume.
Ultrasonic Anemometer*	 	Anemometers measure wind speed and direction. An ultrasonic anemometer uses ultrasonic sound waves to determine instantaneous wind speed by measuring how much sound waves traveling between a pair of transducers are sped up or slowed down by the effect of the wind.

Instruments marked with an asterisk (*) contain metadata. See the Metadata subchapter for more information.

PERSONNEL COMPLEMENT

Laguindingan station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Ms. Genalyn Mercado. The persons listed in Table 8.3 ensure the efficient operation of the station, accurate data collection, and the delivery of reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are responsible for conducting synoptic and/or climatological observations using appropriate instruments, noting their uncertainties and representativeness. They also maintain instruments and document metadata. In cases where automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 8.3. Laguindingan Station Personnel

Name	Role/Job Description	Email Address
Genalyn Mercado	Weather Observer II	genalynmercado27@gmail.com
Marconi Paiso Jr.	Weather Observer IV	m_paiso@yahoo.com
Liezl Olamit	Weather Observer II	liezlmacutay_83@yahoo.com
Ruderick Leysa	Weather Observer II	rickyleysa@gmail.com
Iveil Mae Behiga	Weather Observer I	veilabajuyo@gmail.com
Geovanni Larede	Weather Observer I	laredeevan200@gmail.com

**As of the time of writing in May 2024*

INSTRUMENTS METADATA

Aside from the data itself, users of these meteorological observations must also be knowledgeable about the instrument's condition, type, and exposure. Maintaining quality-controlled metadata is important as the observed data (see Chapter 12 for more information). Even with advancements in data homogeneity methods, recorded metadata still accurately identifies inhomogeneities. Changes that occur at the station and its maintenance history should be documented. Instrument metadata (data about data) provides detailed information about the instruments, including model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in data collection.

Table 8.4. Metadata for Anemometer in Laguindingan

Manufacturer / Brand	Young
Observed Parameter	Wind Direction and Speed
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	10 m
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	06201
Serial No.	WT18292

Table 8.5. Metadata for Aneroid Barometer in Laguindingan

Manufacturer / Brand	Yanagi
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Drainage Scale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	16806

Table 8.6. Metadata for Barograph in Laguindingan

Manufacturer / Brand	Lambrecht
Observed Parameter	Station Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Drainage Scale
Maintenance Activity	Upon Request
Model No.	00.02920.110002
Serial No.	8112-16.0025

Table 8.7. Metadata for Digital Barograph in Laguindingan

Manufacturer / Brand	Vaisala
Observed Parameter	Station Pressure
Date Installed / Deployed	September 29, 2019
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Drainage Scale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	RO720172

Table 8.8. Metadata for Event Recorder in Laguindingan

Manufacturer / Brand	-
Observed Parameter	Rainfall
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	6425

Table 8.9. Metadata for Mercurial Barograph in Laguindingan

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Drainage Scale
Maintenance Activity	-
Model No.	-
Serial No.	552

Table 8.10. Metadata for Psychrometer in Laguindingan

Manufacturer / Brand	Assman Type
Observed Parameter	Temperatures (Dry Bulb and Wet Bulb)
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Drainage Scale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	1124/1125

Table 8.11. Metadata for Standard Rain Gauge in Laguindingan

Manufacturer / Brand	-
Observed Parameter	Rainfall
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	-

Table 8.12. Metadata for Sunshine Recorder in Laguindingan

Manufacturer / Brand	Casella
Observed Parameter	Sunshine Duration
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	10142

Table 8.13. Metadata for Thermograph in Laguindingan

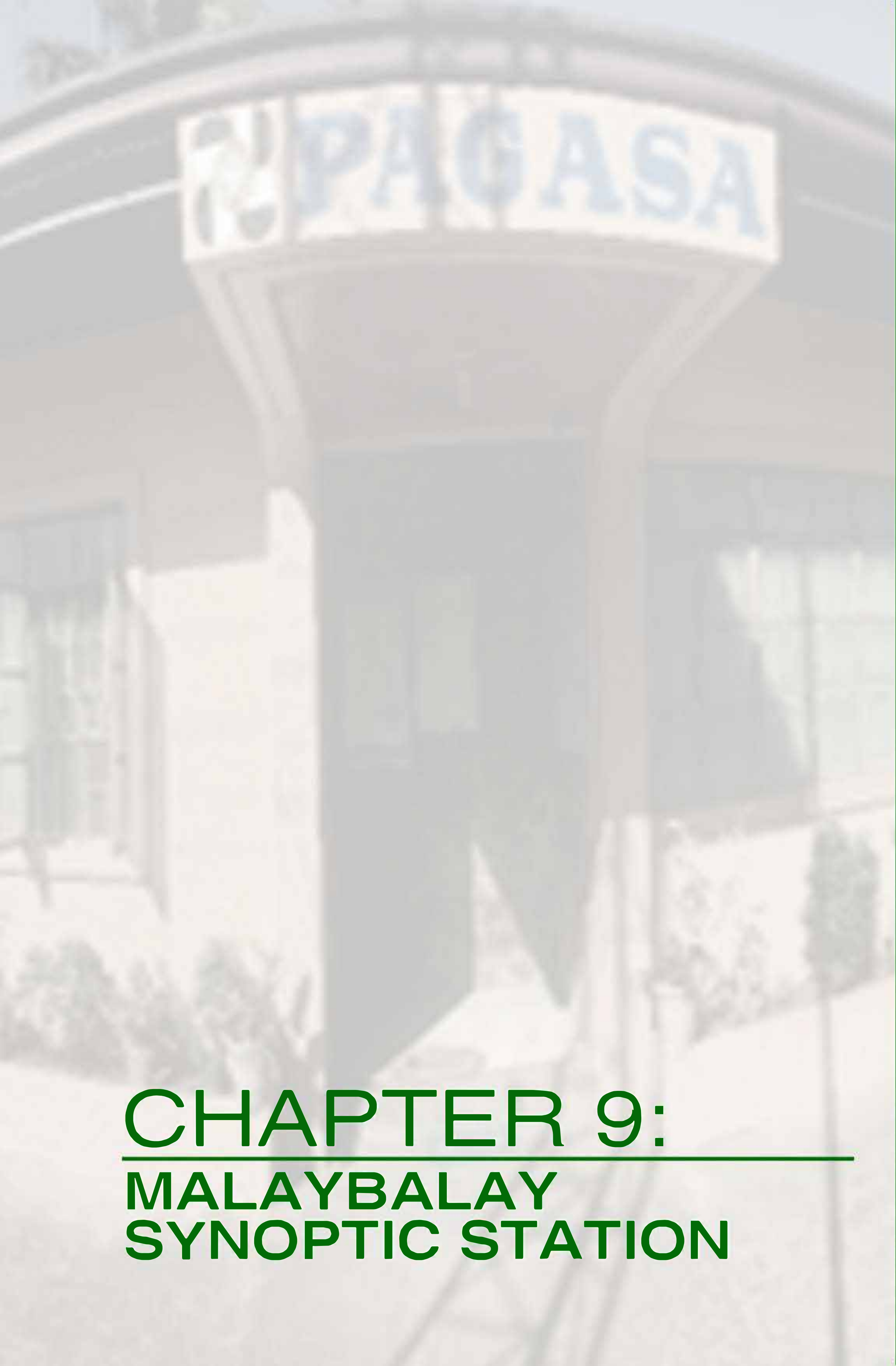
Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Temperature
Date Installed / Deployed	2022
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Drainage Scale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	587918

Table 8.14. Metadata for Tipping Bucket Rain Gauge in Laguindingan

Manufacturer / Brand	-
Observed Parameter	Rainfall
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	15404

Table 8.15. Metadata for Ultrasonic Wind Vane in Laguindingan

Manufacturer / Brand	-
Observed Parameter	Wind Direction, Wind Speed, Wind Gust, Wind Rose
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	10 m
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	1534035



CHAPTER 9:

MALAYBALAY SYNOPTIC STATION

Malaybalay is a city located in the province of Bukidnon, Philippines, and it is renowned for its role as a significant producer of agricultural products such as rice, sugarcane, pineapple, and other commercial crops. The fertile land of Malaybalay makes it ideal for agriculture, enabling local farmers to grow high-quality crops for domestic and international markets. The climate of Malaybalay is classified as type IV, characterized by evenly distributed rainfall throughout the year. This allows for year-round crop cultivation without concerns about droughts or seasonal floods. The temperature in Malaybalay ranges from 17 to 31 degrees Celsius, with the coldest months being December to February and the warmest from March to May.

Figure 13. Malaybalay Synoptic Station. (left) Facade (right) Observation Garden

Malaybalay Synoptic Station (hereinafter referred to as Malaybalay Station) is located in Barangay 9, Malaybalay City, Bukidnon (Region X). Detailed information about the station location is given in Table 9.1. Malaybalay station is in an urban area with a flat terrain and a high altitude of around 1000 to 3000 m above mean sea level (Figure 13). The station is in the city center, with a mixture of low-rise buildings. Mount Dulang-dulang and Kalatungan Mountains are the two notable markers located west of the station.

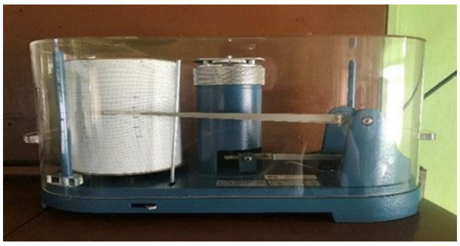
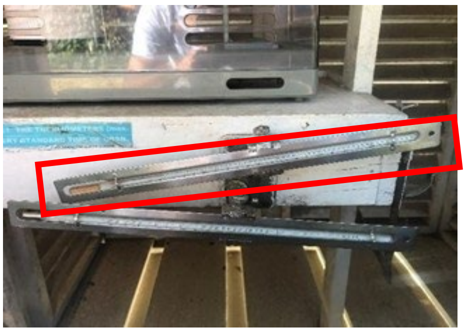
Table 9.1. Malaybalay Station Information

Station Name	PAGASA Malaybalay Station
Station Number (ID)	98751
Latitude	08° 9’4.8”
Longitude	125° 8’2.1”
Elevation	609.31 m
Altimeter Correction	-

Following the WMO's standard for a meteorological station, the Malaybalay station is designed to make representative measurements according to its type. The weather station collaborates closely with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction as a synoptic station. The station submits monthly weather observation reports to the PAGASA Central Office and MPRSD and processes weather certifications for concerned stakeholders.

Malaybalay Station is equipped with multiple instruments capable of measuring surface weather parameters (Table 9.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and other local weather-dependent operations such as airport and construction work and climate and weather research. The station follows the WMO standard (WMO-No.8), which emphasizes meticulous calibration and quality control in data generation and information on weather, climate, and water, ensuring accuracy and reliability. Detailed information about each instrument will be provided in the subsequent subchapter.

Table 9.2 Malaybalay Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Automated Rain Gauge		An instrument that measures precipitation and is typically attached to an event recorder is an upright cylinder with a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once it reaches 0.2 mm in volume.
Barograph*		Make use of aneroid cells, which are flexible metal chambers that expand or contract in response to changes in atmospheric pressure, also known as "Dry Barographs"
Digital Barometer*		A Digital Barometer uses pressure sensing micro-electromechanical sensor to measure atmospheric pressure
Instrument Shelter		An enclosure, typically painted white, is designed to house thermometric instruments (such as thermometers and psychrometers) and protect them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.
Maximum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.

Instrument	Picture	Description
Minimum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Psychrometer		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from both direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube
Standard Rain Gauge		A Standard Rain Gauge measures precipitation. It consists of a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When the smaller tube fills up, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.
Thermograph		A thermograph is an instrument that measures humidity and temperature via a recording pen and a rotating chart mechanism.
Tipping Bucket Rain Gauge*		An instrument that measures precipitation and is typically attached to an event recorder is an upright cylinder with a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once it reaches 0.2 mm in volume.

Instrument	Picture	Description
Vane Anemometer*		Anemometers measure wind speed and direction. A vane anemometer is a type of anemometer in which a vane is attached to either a stationary or rotating shaft. The vane is connected to a sensor that records the shaft's rotation.

Instruments marked with an asterisk (*) contain metadata. See the Metadata subchapter for more information.

PERSONNEL COMPLEMENT

Malaybalay station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Ms. Cheryl Bulangis. The persons listed in Table 9.3 ensure the efficient operation of the station, accurate data collection, and the delivery of reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are responsible for conducting synoptic and/or climatological observations using appropriate instruments, noting their uncertainties and representativeness. They also maintain instruments and document metadata. In cases where automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 9.3. Malaybalay Station Personnel

Name	Role/Job Description	Email Address
Cheryl Bulangis	Weather Observer III/ OIC	almond_heart2002@yahoo.com
Tito Sagun	Weather Observer II	-
Marilou Ubaldo	Weather Observer II	maloubaldo@gmail.com
Ybonne Mae Gabales-Pedraza	Weather Specialist I	ybonnegabales@gmail.com

**As of the time of writing in May 2024*

INSTRUMENTS METADATA

Aside from the data itself, users of these meteorological observations must also be knowledgeable about the instrument's condition, type, and exposure. Maintaining quality-controlled metadata is important as the observed data (see Chapter 12 for more information). Even with advancements in data homogeneity methods, recorded metadata still accurately identifies inhomogeneities. Changes that occur at the station and its maintenance history should be documented. Instrument metadata (data about data) provides detailed information about the instruments, including model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in data collection.

Table 9.4. Metadata for Barograph in Malaybalay

Manufacturer / Brand	Lambrecht
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	September 23, 2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	2.25 m
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Annual
Model No.	-
Serial No.	811216.0039

Table 9.5. Metadata for Digital Barograph in Malaybalay

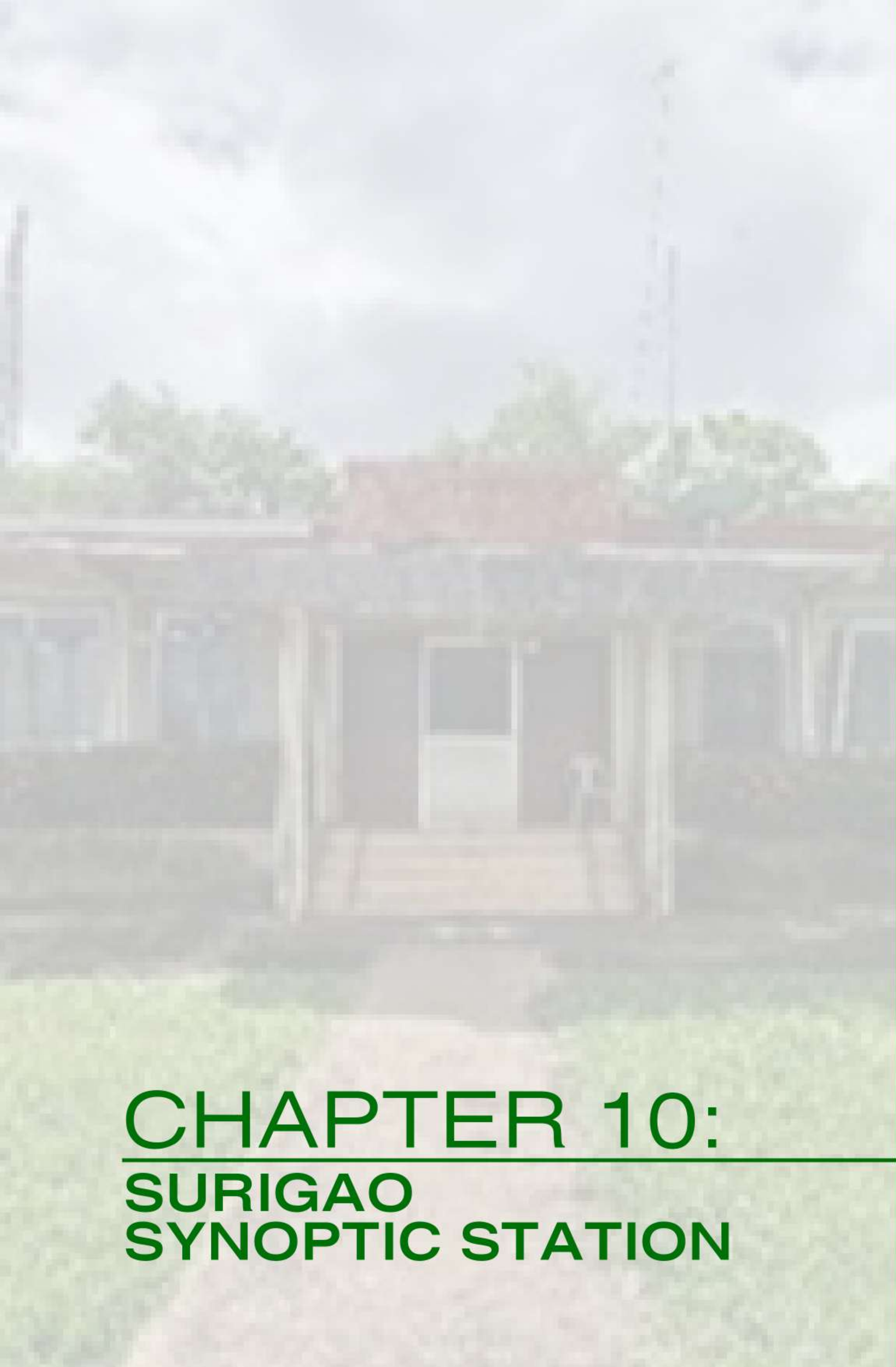
Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Wind Speed and Direction
Date Installed / Deployed	September 25, 2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Discrete Hourly
Height from Ground (m)	1.5
Instrument Exposure	Class 1
Representativeness of Observation	Microscale
Maintenance Activity	Upon request
Model No.	SK013A
Serial No.	BH14246

Table 9.6. Metadata for Tipping Bucket in Malaybalay

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Rainfall
Date Installed / Deployed	September 25, 2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Discrete Hourly
Height from Ground (m)	1.5
Instrument Exposure	Class 2
Representativeness of Observation	Microscale
Maintenance Activity	Upon request
Model No.	SK013A
Serial No.	6465

Table 9.7. Metadata for Vane Anemometer in Malaybalay

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Wind Speed and Direction
Date Installed / Deployed	September 25, 2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Discrete Hourly
Height from Ground (m)	1.5
Instrument Exposure	Class 2
Representativeness of Observation	Microscale
Maintenance Activity	Upon request
Model No.	SK013A
Serial No.	BH14246



CHAPTER 10:
SURIGAO SYNOPTIC STATION

Surigao City is a first-class city with a population of 171,107 people. The capital city of Surigao del Norte has a total land area of 245.34 km2. Due to its abundance of rare materials such as gold, copper, and nickel, the city was once dubbed as the mining capital. The mining industry primarily drives the province's economy. Aside from its mining industry, Surigao City also exports fish and crustaceans to countries such as Hong Kong, Japan, and China. The climate of Butuan City is classified as a Type II Climate, wherein rainfall is more pronounced from November to January.

Figure 14. Surigao Synoptic Station. (left) Facade (right) Observation Garden

Surigao Synoptic Station (hereinafter referred to as Surigao Station) is located in Barangay Washington, Surigao City, Surigao del Norte (Region XIII). Detailed information about the station location is given in Table 10.1. Surigao City is an exporter of fish and crustaceans and is home to 171,000 people. The climate of Surigao is classified as a type II climate wherein rainfall is pronounced from December to February. The weather station is on a hilltop (Figure 14).

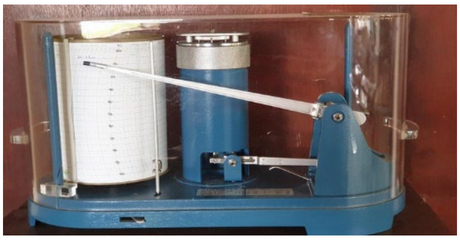
Table 10.1. Surigao Station Information

Station Name	PAGASA Surigao Station
Station Number (ID)	98653
Latitude	09° 46’57.6”
Longitude	125° 29’22.1”
Elevation	39.27 m
Altimeter Correction	-

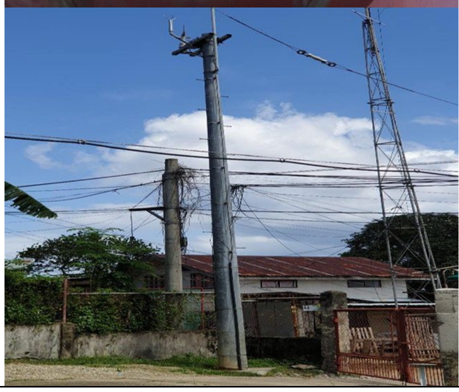
Following the WMO's standard for a meteorological station, Surigao Station is designed to make representative measurements according to its type. The weather station collaborates closely with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction as a synoptic station. Surigao Station submits monthly weather observation reports to the PAGASA Central Office and MPRSD and processes weather certifications for concerned stakeholders.

Surigao Station is equipped with multiple instruments capable of measuring surface weather parameters (Table 10.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and other local weather-dependent operations such as airport and construction work and climate and weather research. The station follows the WMO standard (WMO-No.8), which emphasizes meticulous calibration and quality control in data generation and information on weather, climate, and water, ensuring accuracy and reliability. Detailed information about each instrument will be provided in the subsequent subchapter.

Table 10.2 Surigao Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Barograph*		Make use of aneroid cells, which are flexible metal chambers that expand or contract in response to changes in atmospheric pressure, also known as "Dry Barographs."
Digital Barometer*		A Digital Barometer uses pressure sensing micro-electromechanical sensor to measure atmospheric pressure
Event Recorder		An event recorder is commonly used with a tipping bucket rain gauge to record precipitation
Instrument Shelter		An enclosure, typically painted white, is designed to house thermometric instruments (such as thermometers and psychrometers) and protect them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.
Maximum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.

Instrument	Picture	Description
Mercurial Barometer		It measures atmospheric pressure using a column of mercury trapped inside a glass tube, typically 32 inches long. The mercury rises or falls in response to changes in atmospheric pressure.
Minimum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Psychrometer*		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from both direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube,
Standard Rain Gauge		A Standard Rain Gauge measures precipitation. It consists of a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When the smaller tube fills up, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.
Thermograph*		A thermograph is an instrument that measures humidity and temperature via a recording pen and a rotating chart mechanism.

Instrument	Picture	Description
Tipping Bucket Rain Gauge*		An instrument that measures precipitation and is typically attached to an event recorder is an upright cylinder with a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once it reaches 0.2 mm in volume.
Ultrasonic Anemometer*	 	Anemometers measure wind speed and direction. A vane anemometer is a type of anemometer where a vane is attached to either a stationary or rotating shaft. The vane is connected to a sensor that records the rotation of the shaft.

Instruments marked with an asterisk (*) contain metadata. See the Metadata subchapter for more information.

PERSONNEL COMPLEMENT

Surigao station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Mr. Frances Semorlan. The persons listed in Table 10.3 ensure the efficient operation of the station, accurate data collection, and the delivery of reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are responsible for conducting synoptic and/or climatological observations using appropriate instruments, noting their uncertainties and representativeness. They also maintain instruments and document metadata. In cases where automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 10.3. Surigao Station Personnel

Name	Role/Job Description	Email Address
Frances Semorlan	Chief Meteorological Office	semorlanfa@yahoo.com
Jonathan Cahanap	Science Aide	jonathan.cahanap16@gmail.com
Verna Velasco	Science Aide	bing21dong24@gmail.com

**As of the time of writing in May 2024*

INSTRUMENTS METADATA

Aside from the data itself, users of these meteorological observations must also be knowledgeable about the instrument's condition, type, and exposure. Maintaining quality-controlled metadata is important as the observed data (see Chapter 12 for more information). Even with advancements in data homogeneity methods, recorded metadata still accurately identifies inhomogeneities. Changes that occur at the station and its maintenance history should be documented. Instrument metadata (data about data) provides detailed information about the instruments, including model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in data collection.

Table 10.4. Metadata for Barograph in Surigao

Manufacturer / Brand	Lambrecht
Observed Parameter	Station Pressure
Date Installed / Deployed	October 9, 2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Toposcale
Maintenance Activity	-
Model No.	-
Serial No.	811216.0024

Table 10.5. Metadata for Digital Barograph in Surigao

Manufacturer / Brand	Vaisala
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	November 10, 2019
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Toposcale
Maintenance Activity	-
Model No.	-
Serial No.	-

Table 10.6. Metadata for Psychrometer in Surigao

Manufacturer / Brand	Assman Type
Observed Parameter	Temperatures (Dry Bulb and Wet Bulb)
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Toposcale
Maintenance Activity	-
Model No.	7450
Serial No.	-

Table 10.7. Metadata for Thermograph in Surigao

Manufacturer / Brand	Sato
Observed Parameter	Temperature
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Toposcale
Maintenance Activity	-
Model No.	7230-00
Serial No.	585142

Table 10.8. Metadata for Tipping Bucket Rain Gauge in Surigao

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Rainfall
Date Installed / Deployed	October 9, 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Daily
Height from Ground (m)	-
Instrument Exposure	Class 2
Representativeness of Observation	Toposcale
Maintenance Activity	-
Model No.	-
Serial No.	15406

Table 10.9. Metadata for Ultrasonic Anemometer in Surigao

Manufacturer / Brand	Trans Molitor Technologies
Observed Parameter	Wind Direction, Wind Speed, Wind Gust, Wind Rose
Date Installed / Deployed	October 12, 2016
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 2
Representativeness of Observation	Toposcale
Maintenance Activity	-
Model No.	1535009
Serial No.	-

CHAPTER 11:

ZAMBOANGA SYNOPTIC AND AEROMET STATION

Zamboanga City, also known as "Asia's Latin City," is a highly urbanized city with a total land area of 1,414.70 km^2. Home to 977,234 residents, Zamboanga is the 5th most populous and 3rd largest city in the Philippines by area. The climate of Zamboanga City is classified as Climate Type III. The earliest settlers were the Subanons, who called the region "Jambangan," meaning the Land of Flowers. Later, when the Samals and Badjaos settled along the shore, they were mistakenly called "Jambangan" instead of "Samboangan." When the Spanish colonizers reached the region, they had difficulty stating "Samboangan" and called it "Zamboanga." Due to the abundance of Sardines, the city is also hailed as the Sardines Capital of the Philippines. With 11 out of 12 sardine companies in the country located in the city, sardine fishing and production account for about 70% of the city's economy.

Figure 15. Zamboanga Synoptic Station. (left) Facade (right) Observation Garden

Zamboanga Aeromet and Synoptic Station (hereinafter referred to as Zamboanga Station) is located in Barangay Canelar, Zamboanga City, Zamboanga del Sur (Region IX). Detailed information about the station's location is provided in Table 11.1. The station is in the center of a large town with a mixture of low-rise buildings. The local topography is flat terrain with a slope of less than 3^0 and shallow relief (Figure 15). Notable visibility markers near the station include Butuan Bay to the north, Butuan City Proper and the Agusan River to the east, and Mt. Mayapay to the south.

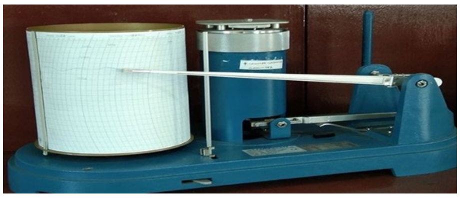
Table 11.1. Zamboanga Station Information

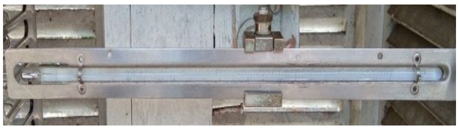
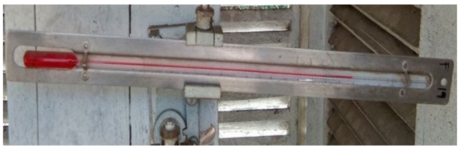
Station Name	PAGASA Zamboanga Station
Station Number (ID)	98836
Latitude	06° 54'
Longitude	122° 5'
Elevation	6.9 m
Altimeter Correction	-

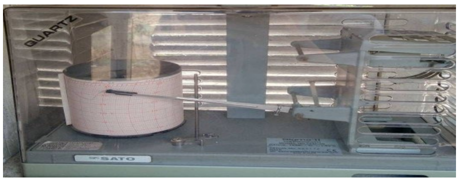
Following the WMO standard for a meteorological station, Zamboanga station is designed to make representative measurements according to its type. The weather station collaborates closely with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction as a synoptic station. Zamboanga station submits monthly weather observation reports to the PAGASA Central Office and MPRSD and processes weather certifications for concerned stakeholders. As an Aeromet station, Zamboanga Station coordinates with the Zamboanga Airport aviation personnel to provide critical weather information for aviation operations.

Zamboanga Station is equipped with multiple instruments capable of measuring surface weather parameters (Table 11.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and other local weather-dependent operations such as airport and construction work and climate and weather research. The station follows the WMO standard (WMO-No.8), which emphasizes meticulous calibration and quality control in data generation and information on weather, climate, and water, ensuring accuracy and reliability. Detailed information about each instrument will be provided in the subsequent subchapter.

Table 11.2 Zamboanga Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Altimeter Setting*		The instrument measures an object's altitude above a fixed level.
Barograph*		Make use of aneroid cells, which are flexible metal chambers that expand or contract in response to changes in atmospheric pressure, also known as "Dry Barographs"
Digital Barometer*		A Digital Barometer uses pressure sensing micro-electromechanical sensor to measure atmospheric pressure
Event Recorder*		An event recorder is simultaneously used with a tipping bucket rain gauge to log precipitation
Instrument Shelter		An enclosure, typically painted white, is designed to house thermometric instruments (such as thermometers and psychrometers) and protect them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.

Instrument	Picture	Description
Maximum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Mercurial Barograph*		It measures atmospheric pressure using a column of mercury trapped inside a glass tube, typically 32 inches long. The mercury rises or falls in response to changes in atmospheric pressure.
Minimum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of a pure liquid within its glass container. They are commonly used to measure maximum temperature.
Psychrometer		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from both direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube,
Standard Rain Gauge		A Standard Rain Gauge measures precipitation. It consists of a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When the smaller tube fills up, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.

Instrument	Picture	Description
Sunshine Recorder		A spherical lens measures sunshine duration by concentrating a solar beam onto a special dark paper
Thermograph		A thermograph is an instrument that continuously measures air temperature via a recording pen and a rotating chart mechanism
Tipping Bucket Rain Gauge		An instrument that measures precipitation and is typically attached to an event recorder is an upright cylinder with a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once it reaches 0.2 mm in volume.
Vane Anemometer*	 	Anemometers measure wind speed and direction. A vane anemometer is a type of anemometer where a vane is attached to either a stationary or rotating shaft. The vane is connected to a sensor that records the rotation of the shaft.

Instruments marked with an asterisk (*) contain metadata. See the Metadata subchapter for more information.

PERSONNEL COMPLEMENT

Zamboanga Station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Mr. Rodel Inclan. The persons listed in Table 11.3 ensure the efficient operation of the station, accurate data collection, and the delivery of reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are responsible for conducting synoptic and/or climatological observations using appropriate instruments, noting their uncertainties and representativeness. They also maintain instruments and document metadata. In cases where automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 11.3. Zamboanga Station Personnel

Name	Role/Job Description	Email Address
Rodel Inclan	CMO	rodellinclan@gmail.com
Raul Aytin	Weather Observer IV	raulaytin@gmail.com
Maribel Enriquez	Weather Specialist II	-
Alan Gelani	Weather Observer I	alan_gelani@yahoo.com
Elton John Castillo	Electronics and Communications Equipment Technician (.J.O)	ejcastillo.mtc17@gmail.com
Jayson Albay	Science Aide (J.O)	jaysonalbay52@gmail.com
Norman Joseph Montano	Driver (J.O)	njosephmontano94@gmail.com
Markville Winters	Utility (J.O)	wintersmarkvill@gmail.com

*As of the time of writing in May 2024

INSTRUMENTS METADATA

Aside from the data itself, users of these meteorological observations must also be knowledgeable about the instrument's condition, type, and exposure. Maintaining quality-controlled metadata is important as the observed data (see Chapter 12 for more information). Even with advancements in data homogeneity methods, recorded metadata still accurately identifies inhomogeneities. Changes that occur at the station and its maintenance history should be documented. Instrument metadata (data about data) provides detailed information about the instruments, including model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in data collection.

Table 11.4. Metadata for Altimeter Setting in Zamboanga

Manufacturer / Brand	Kollsman
Observed Parameter	Altimeter Setting
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	-

Table 11.5. Metadata for Anemometer in Zamboanga

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Wind Speed and Direction
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	BH1423
Serial No.	-

Table 11.6. Metadata for Barograph in Zamboanga

Manufacturer / Brand	Lambrecht
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	811215.009

Table 11.7. Metadata for Digital Barograph in Zamboanga

Manufacturer / Brand	Vaisala
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	October 10, 2019
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	PTB330
Serial No.	R0740264

Table 11.8. Metadata for Event Recorder in Zamboanga

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Rainfall Rate
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	7820-00
Serial No.	6453

Table 11.9. Metadata for Mercurial Barograph in Zamboanga

Manufacturer / Brand	K.S.F Tokyo
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly, 3-hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	170502001

CHAPTER 12:

DATA HOMOGENIZATION AND SYNOPTIC STATION PROFILING

The Philippine Atmospheric Geophysical and Astronomical Service Administration (PAGASA), through the Climatology and Agrometeorology Division (CAD) Climatology and Agrometeorological Data Section (CADS), maintains an archive of observed climate records from various observing stations (e.g., Synoptic Station, Agrometeorological Station, and Radar Station) spread throughout the country. Observing stations experience changes over time (i.e., location, personnel, environmental, and equipment upgrading). These changes impact climate records by creating non-natural variations that mimic the natural changes in the environment. Non-natural variations can potentially lead to significant data issues because they create sudden changes or shifts (i.e., inhomogeneity, breakpoints) in the time series, making the climate record unrepresentative of the actual climate.

Data homogenization is a method developed to address this problem. Data homogenization reveals that apparent climate changes are attributed to inhomogeneities in the time series data. The World Meteorological Organization (WMO) defines data homogenization as identifying these breakpoints and applying appropriate correction factors on the time series to reduce and adjust the non-climatic variations accordingly. Knowing when the station underwent such changes becomes vital information. Station metadata, also called station histories, contains such information. Metadata contains all information regarding the station, including the initial set-up, type, and time of changes that occurred during the station's history. Metadata can be treated as an administrative record that can include station information (administrative information, location) and individual instrument information (type, model, manufacturer, etc.). In case of little to no metadata, breakpoint identification can be done using statistical tests such as the Standard Normal Homogeneity test (SNHT) (Alexandersson, 1986; Alexandersson & Moberg, 1997). SNHT is a relative homogeneity test applied to a ratio between station values and a reference value.

Daily rainfall, maximum, and minimum temperature data were taken from 49 synoptic stations from 1951 to 2022. Daily datasets exhibit high variability that lowers the effectiveness of breakpoint detection. To address this problem, the daily dataset was converted to a monthly series. Climatol offers three types of normalization. Normalization was set to average ratio normalization (series divided by the mean climatological value) for zero-limited variables such as rainfall. Normalization for temperature was done by standardization (series subtracted by the mean and divided by series standard deviation). Climatol returns SNHT values, a test statistic that measures inhomogeneity. SNHT is a unitless value wherein the lower the value, the higher the chance that the series is homogeneous. (Kuya et al., 2022) suggest that one must be careful when choosing a SNHT threshold. The threshold must be low enough to include as many valid breaks as possible but high enough to exclude most outlier and falsely detected breaks. Climatol has a default threshold of 25 for both overlapping temporal window and whole series (SNHT1 = SNHT2 = 25). This value is appropriate for temperature on a monthly scale and was chosen for this study. For rainfall, a threshold of SNHT1 = 10, SNHT2 = 15 was chosen. The values from the output histogram of maximum SNHT seemed appropriate during the exploratory mode. Climatol produced breakpoints and outliers for each data variable. Breakpoints were given to the MPRSD stations for validation. After validation, Climatol will be rerun to adjust the data. To highlight the importance of data homogenization and the crucial role of station metadata, PAGASA conducted a workshop-dialogue for concerned PAGASA personnel on data homogenization and station profiling last June 20 and 22, 2023 (Table 12.1, Table 12.2).

Table 12.1 Agenda for PAGASA workshop dialogue on data homogenization and station profile on June 20, 2023

Activity	Time	Personnel		
Opening remarks	1:00 – 1:20 PM	Ms. Rosalina G. De Guzman, AWSC, CADS		
Roll Call of Stations	1:20-1:25 PM	Ms. Daizy Flores, WS I, MPRSD		
Climate Data Homogenization	1:25 – 1:45 PM	Mr. Noel Bangquiao, Research Fellow, PAGASA		
Mechanics and expectations	1:45 – 1:55 PM	Mr. Rex Abdon Jr., SWS, CADS		
Breakout Room	1:55 – 4:30 PM	Panel Interview		
Panel 1 Station Name: DIPOLOG	**Panel 2 Station Name: BUTUAN**	**Panel 3 Station Name: ZAMBOANGA**	**Panel 4 Station Name: LAGUINDINGAN**	**Panel 5 Station Name: DAVAO**
Mr. Rex Abdon Jr – Chair Ms. April Love Castillon Ms. Maria Krista Rona Borbon Ms. Rosanna Nicolas Mr. Irwin Aguilar / Mr. Willie Tuazon	Ms. Abigail Vicente – Gatuz – Chair Mr. Ver Lancer D. Galanida Ms. Carina Joy Labian Mr. Lope Dacanay Mr. Irwin Aguilar / Mr. Willie Tuazon	Mr. Noel Bangquiao – Chair Mr. Rodel Inclan Ms. Remia Paolo Borbon- MGSS Ms. Nelson Delampasig – Maintenance Mr. Irwin Aguilar / Mr. Willie Tuazon	Ms. Kimberli Aquino – Chair Mr. Alexander Namoco Mr/s. Azmi Zerxes Layugan Mr. Nolan Rosel Celestino Cameros and Mr. Eugene Balon Mr. Irwin Aguilar / Mr. Willie Tuazon	Mr. Christian Mark Ison – Chair Ms. Lolita Vinalay and Mr. Alberto Luma-ad Mr. Nolan Rosel Mr. Mario Gaspar and Mr. Marlon Selpa Mr. Irwin Aguilar / Mr. Willie Tuazon
Break	4:30 – 4:35			
Way forward and synthesis	4:35 – 4:50	Dr. Joseph Basconcillo, WS II, CADS		
Closing Remarks	4:50 – 5:00 PM	Ms. Rosalina de Guzman, AWSC, CADS		
Host	Dr. Joseph Basconcillo, WSII, CADS			

Table 12.2 Agenda for PAGASA workshop dialogue on data homogenization and station profile on June 22, 2023

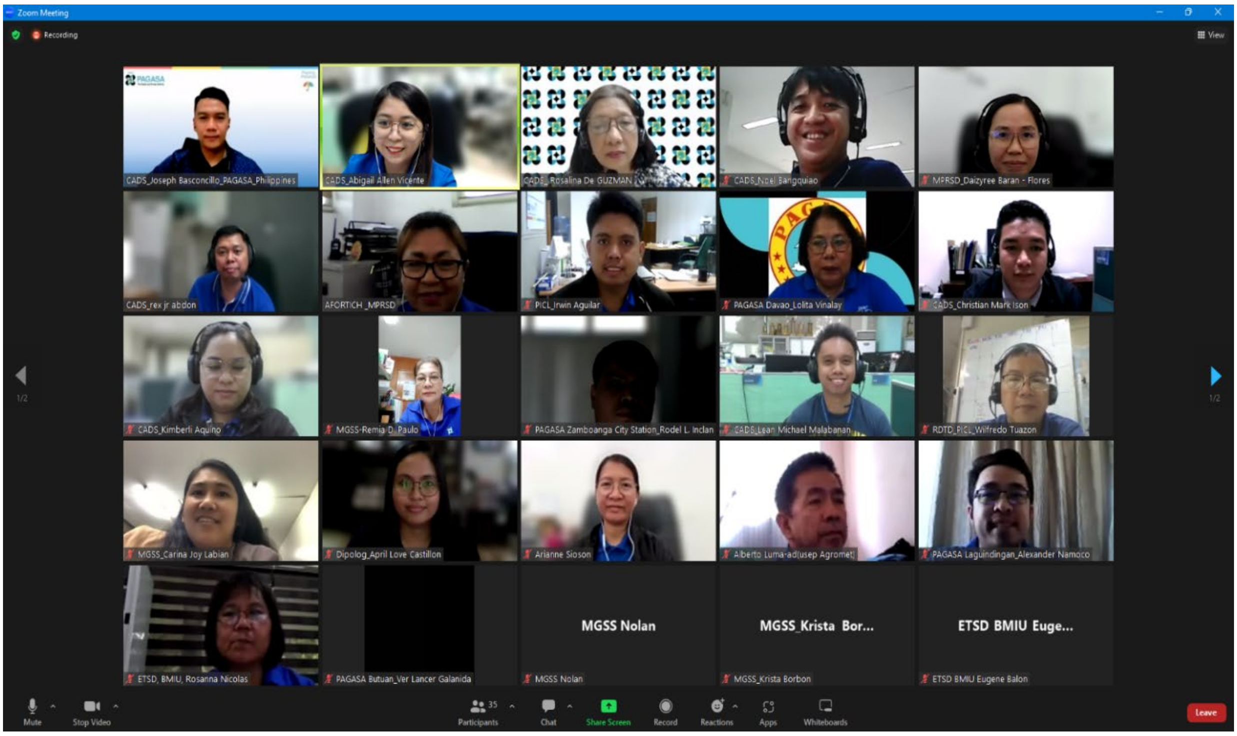
Activity	Time	Personnel		
Opening remarks	1:00 – 1:20 PM	Mr. Anthony Joseph R. Lucero, WSC, MPRSD Ms. Rosalina G. De Guzman, AWSC, CADS		
Roll Call of Stations	1:20-1:25 PM	Ms. Daizy Flores, WS I, MPRSD		
Climate Data Homogenization	1:25 – 1:45 PM	Mr. Noel Bangquiao, Research Fellow, PAGASA		
Mechanics and expectations	1:45 – 1:55 PM	Mr. Rex Abdon Jr., SWS, CADS		
Breakout Room	1:55 – 4:30 PM	Panel Interview		
Panel 1 Station Name: MALAYBALAY	**Panel 2 Station Name: COTABATO**	**Panel 3 Station Name: HINATUAN**	**Panel 4 Station Name: GENERAL SANTOS**	**Panel 5 Station Name: SURIGAO**
Ms. Cherry Cada and Ms. Abigail Vicente – Chair Ms. Cheryl C. Bulangis and Ms. Hannah Salvador Ms. Maria Krista Rona Borbon Ms. Rosanna Nicolas Mr. Irwin Aguilar / Mr. Willie Tuazon	Mr. Rex Abdon – Gatuz – Chair Ms. Charlyn A. Jamero and Ms. Gleziel May P. Calipay Ms. Carina Joy Labian Mr. Lope Dacanay M Mr. Irwin Aguilar / Mr. Willie Tuazon	Mr. Noel Bangquiao – Chair Mr. Alan Ray C. Ribo and Mr. Miland E. Arlan Ms. Remia Paolo Borbon Ms. Nelson Delampasig Mr. Irwin Aguilar / Mr. Willie Tuazon	Ms. Kimberli Aquino – Chair Mr. Binrio L. Binan and Eduard Panolino Mr/s. Azmi Zerxes Layugan Mr. Nolan Rosel Celestino Cameros and Mr. Eugene Balon Mr. Irwin Aguilar / Mr. Willie Tuazon	Mr. Christian Mark Ison – Chair Mr. Frances Semorlan Mr. Nolan Rosel Mr. Mario Gaspar and Mr. Marlon Selpa Mr. Irwin Aguilar / Mr. Willie Tuazon
Break	4:30 – 4:35 PM			
Way forward and synthesis	4:35 – 4:50 PM	Dr. Joseph Basconcillo, WS II, CADS		
Closing Remarks	4:50 – 5:00 PM	Ms. Rosalina de Guzman, AWSC, CADS		
Host	Dr. Joseph Basconcillo, WSII, CADS			

WORKSHOP-DIALOGUE ON DATA HOMOGENIZATION AND SYNOPTIC STATION PROFILING

The Workshop-Dialogue on Data Homogenization and Synoptic Station Profiling was first participated in by MPRSD. It was a two-half-day workshop (1:00 PM to 5:00 PM) and was held online via Zoom meeting on June 20 and 22, 2023. The workshop was conducted to highlight the importance of updating metadata for station profiles and inform the participants regarding data homogenization and its significance for climate monitoring and prediction. As the introduction explains, studying climate change and its variability requires a homogenized climate time series. Rainfall, minimum, and maximum temperatures were selected because such variables are the most commonly studied for climate monitoring. These climate variables were from different PAGASA synoptic stations from 1951 to 2022. Participants from different PAGASA offices attended the first day of the workshop (Figure 16). The attendees are MPRSD station personnel (Dipolog, Butuan, Zamboanga, Laguindingan, and Davao), CADS-CAD, the Instrumentation and Calibration section, and the Maintenance and Installation section.

Dr. Joseph Basconcillo of CAD-CADS hosted the first workshop. Ms. Rosalina de Guzman, CAD-CADS chief, gave her opening remarks to start the workshop. She emphasized the importance of using homogeneous climatic records in studying the climate and keeping a well-written documentation of station history. This was followed by the roll call of the station personnel given by Ms. Daizyree Bazan-Flores of the MPRSD climatological unit. Attendees were given an introductory lecture on data homogenization, presented by Mr. Noel Bangquiao, a DOST graduate fellow assigned to CAD-CADS. Prior to the workshop, MPRSD was given breakpoints from the stations under their authority to be validated. These breakpoints were derived from Climatol, wherein monthly mean values of rainfall and minimum and maximum temperatures are the input data. Mr. Rex Abdon Jr of CAD-CADS introduced the breakout rooms. Breakout rooms were created to present and update station metadata in the WMO Integrated Global Observing System (WIGOS) and have a focus discussion on breakpoint validation. Each room is headed by a panel chair, with assigned participants from each station, the Instrumentation and Calibration section and the Maintenance and Installation section. During the breakout sessions, participants shared their knowledge and experiences regarding the station histories and recalled past events that may have affected the climate records. A short break was taken after breakout sessions. Dr. Basconcillo and the panel chairs quickly summarized the discussions in each breakout session. They checked if all station information was available in WIGOS and whether all the breakpoints were validated, and they highlighted any problems encountered. To close the workshop, Ms. de Guzman delivered her closing remarks by emphasizing the need for an updated station profile and well-documented station history for future reference by the researchers and stakeholders.

A different set of participants attended the second day of the workshop (Figure 17). The attendees are MPRSD station personnel (Malaybalay, Cotabato, Hinatuan, General Santos, and Surigao), CADS-CAD, the Instrumentation and Calibration section, and the Maintenance and Installation section.



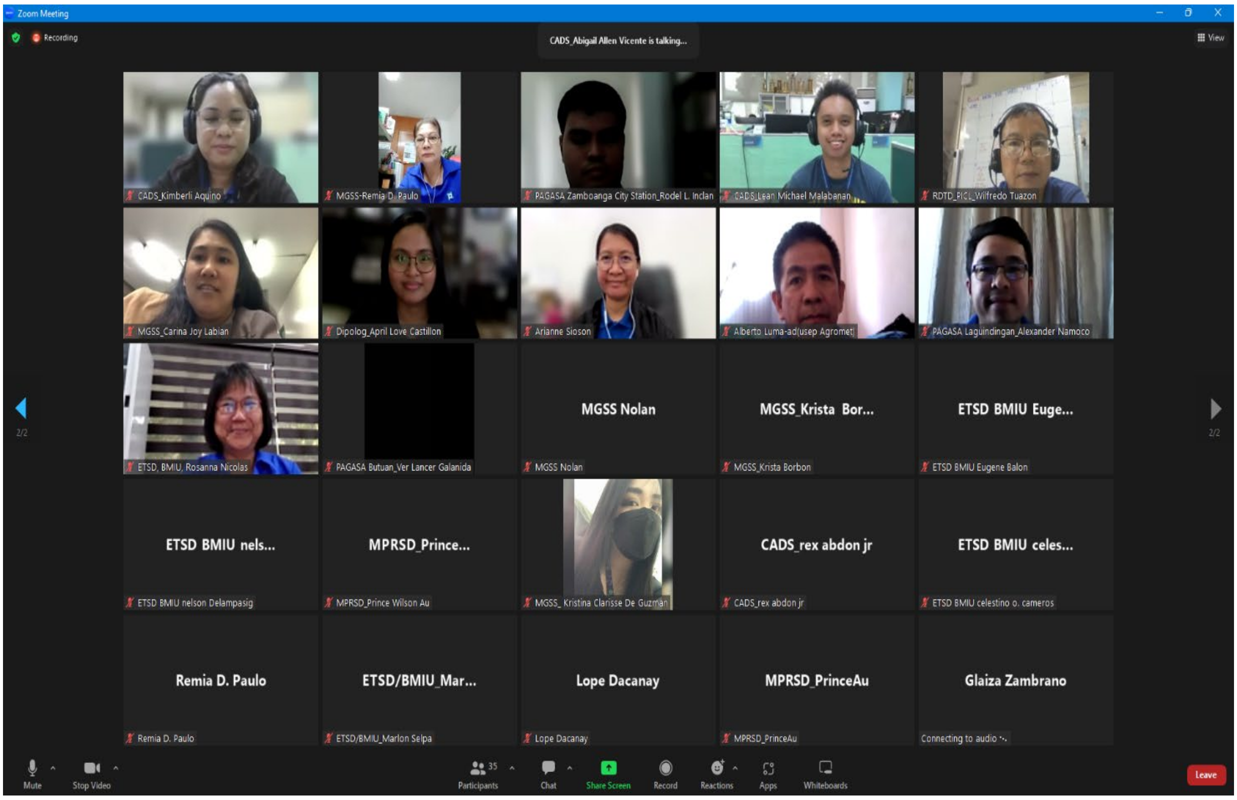


Figure 16. Participants of the workshop-dialogue on June 20, 2023

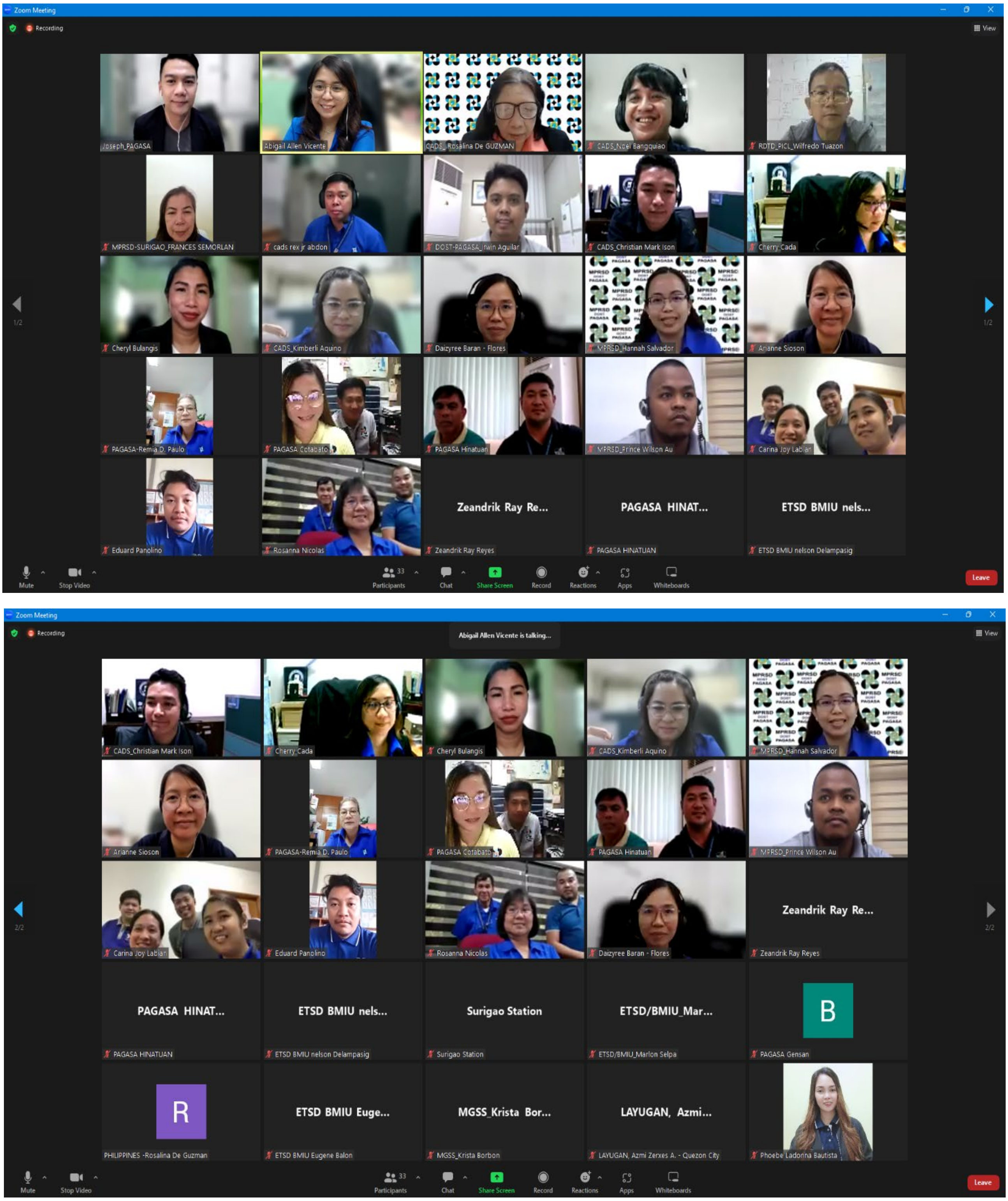


Figure 17. Participants of the workshop-dialogue on June 22, 2023

Dr. Basconcillo, as the host, introduced Mr. Anthony Joseph R. Lucero, the chief of MPRSD, for an opening remark. Mr. Lucero noted the need for functioning climate services in Mindanao (i.e., a monthly and annual summary of weather observation, ENSO documentation, and past and current climate monitoring). Ms. Bazan-Flores presented the participating stations. Mr. Bangquiao gave an introductory lecture on Data homogenization. After the lecture, breakout rooms were created. Mr. Abdon explained that in each breakout room, participants are free to share knowledge and experiences regarding the station's history and give insights on validating the breakpoints.

A quick break followed the breakout session. Dr. Basconcillo gave a short recap, and to end the workshop, Ms. De Guzman delivered concluding comments emphasizing the benefits of thoroughly recorded station profiles and histories for the stakeholders, researchers, and station personnel.

BREAKPOINT VALIDATION

One of the objectives of conducting the workshop-dialogue was to validate and identify the causes of the breakpoints by creating an updated station profile and history. This was done by interviewing past and present station personnel knowledgeable of the station's history and revisiting old documents such as logbooks and old station profiles. This subchapter discusses the product of the breakout sessions during the two-half-day sessions and follow-up communication. PAGASA stations suffer from little to no metadata, which is vital for breakpoint validation. By accumulating the testimonies and records, reliable station metadata can be made. Note that the breakpoints listed in Table 12.3, Table 12.4, and Table 12.5 are only for stations under MPRSD.

RAINFALL

According to studies, rainfall is the most challenging variable to be homogenized due to its high spatial and temporal variability. Only Cotabato and Dipolog had breakpoints out of all stations under MPRSD for rainfall, as indicated in Table 12.3. Instrument relocation was Cotabato's primary cause of inhomogeneity in 1991. Breakpoints in 2003 and 2010 remain unvalidated, but it was noted that those were in the El Nino and La Nia years. Due to its observational garden near the Cotabato Airport parking area, the Cotabato station has poor instrument exposure. The garden is surrounded by obstructions such as tall trees and lacks fences to deter unauthorized personnel and animals. The single breakpoint for Dipolog that occurred in 1999 can be explained by the existence of a tree that might have affected the rainfall catchment. The maximum SNHT value is only 28.4; if the default SHNT value (25) is used, only two breakpoints will be identified. When the threshold is lowered, the effects of natural phenomena can be seen. Also, note that the Dipolog Airport has developed its facilities due to a recent spike in air travel. The recent developments impacted the stations’ ability to carry out weather observations.

Few identified breakpoints for rainfall can be explained by the low density of stations. In Mindanao, with approximately 95,000 km^2 of land area, only ten stations are operational, and some stations only started in the 1980s. This massive gap in space and time can be problematic because it creates unreliable reference series to which the dataset is compared. To address this issue, plans for data homogeneity involve using gridded reanalysis data as a reference series.

Table 12.3. Breakpoint identification and validation for rainfall

Code	Date	SNHT	Name	Remarks	
746	1991-05	27	Cotabato	• Instrument relocation • **El Nino year**	Personal communication (MPRSD Workshop in June 2023)
746	1991-10	28.4	Cotabato	• Instrument relocation • **El Nino year**	Personal communication (MPRSD Workshop in June 2023)
746	2003-03	18.4	Cotabato	• **No information available** • **El Nino year**	
746	2010-12	15.7	Cotabato	• **No information available** • **La Nina year**	
741	1999-10	16	Dipolog	• Problem with the instrument exposure. The wind comes from the Northwest, and a big Talisay tree near the instrument might affect the rainfall observation capture. • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)

MAXIMUM TEMPERATURE

All stations except the Hinatuan station have breakpoints for maximum temperature (Table 12.4). Verified breakpoints only account for 67% of the total breakpoint. The most common causes of inhomogeneity are observational changes, which account for 31% of the total verified breaks, and environmental change, which accounts for 27%. In addition, anecdotal evidence from station personnel, written records, and news agencies helped validate the breakpoints. The minimum SNHT value is 25, recorded in Surigao in November 1989, and the maximum is 169, recorded in Zamboanga in November 1983.

Inhomogeneity for Butuan during the 1980s can be explained by overworked station personnel working more than eight hours daily. Based on the workshop dialogue, it was known that from 1980 to 2003, illegal settlers surrounded the station. Shifts in maximum temperature for Cotabato may be influenced by limited observation activity due to insurgencies in October 2006 and transboundary haze from Indonesia in 2016. Cotabato station relocated in 1994, according to anecdotal testimony. For the Davao station, inhomogeneities are caused by station relocation, a defective maximum thermometer, and an incident of a fire near the station. Breakpoints for Dipolog and General Santos have been related to instrument and instrument shelter issues. The relocation from El Salvador has been the source of shifts for Laguindingan station. For Malaybalay, relocation and changes in environment and personnel were the sources of inhomogeneity. Environmental change and damaged instruments cause inhomogeneity in Surigao and Zamboanga, respectively.

Unlike rainfall, spatial and temporal variability of temperature is low. This makes temperature homogeneity relatively easy. The default value of SNHT is good enough to detect the shifts. Climatol captured the most common non-natural factors, such as relocation and failing or destroyed instruments. When a station relocates, the difference in exposure or climate conditions causes breaks. This is the case for Laguindingan station, which transferred more than 10 km away from El Salvador. Using old and damaged instruments creates inaccuracy in measurement, which, when left unchecked, also creates inhomogeneity. Changes in observational practice also cause breaks. This is evident for Cotabato, as external factors hindered the observation activities. Environmental changes such as obstructions (e.g., trees and unauthorized dwellers) create breaks, affecting instrument exposure. However, the fire incident near the Davao station may have temporarily affected the temperature. However, the error will not accumulate over time, leading to inhomogeneity.

Table 12.4. Breakpoint identification and validation for maximum temperature

Code	Date	SNHT	Name	Remarks	Source
752	1984-09	30.5	Butuan	• Field personnel took more than 8 hours of duty. • Change of personnel • Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station. • **La Nina year**	• Form 1001-AB • Personal communication (MPRSD Workshop in June 2023)
752	1985-10	29.4	Butuan	• Field personnel took more than 8 hours of duty. • Change of personnel • Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station.	• Form 1001-AB • Personal communication (MPRSD Workshop in June 2023) •
752	1989-05	34.5	Butuan	• Field personnel took more than 8 hours of duty. • Change of personnel • Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station. • Change in the surrounding environment. • **La Nina year**	• Form 1001-AB • Personal communication (MPRSD Workshop in June 2023)
752	1990-05	31.1	Butuan	• Overwork field personnel • Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station. • Change in the surrounding environment.	• Form 1001-AB • Personal communication (MPRSD Workshop in June 2023)

Table 12.4. Breakpoint validation for maximum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
752	1998-01	28.2	Butuan	• Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station. • Change in the surrounding environment. • **El Nino year**	Personal communication (MPRSD Workshop in June 2023)
752	2001-11	34.8	Butuan	• Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station. • Change in the surrounding environment	Personal communication (MPRSD Workshop in June 2023)
746	1994-11	25.4	Cotabato	• Station Relocation	Personal communication (MPRSD Workshop in June 2023)
746	1997-06	32.4	Cotabato	• **No information available** • **El Nino year**	
746	2006-11	31.2	Cotabato	• Terrorist Attack occurred in Oct 2006. Personnel have limited observation activity for safety reasons. • **El Nino year**	• News
746	2015-11	44.6	Cotabato	• **No information available** • **El Nino year**	
746	2016-11	43.7	Cotabato	• Haze from Indonesia reached the field station. Field personnel have limited observation activity due to access restriction • **La Nina year**	• News
753	1957-10	30.7	Davao	• Possible relocation • **El Nino year**	Personal communication (MPRSD Workshop in June 2023)
753	1996-06	34	Davao	• Defective Maximum thermometer.	Personal communication (MPRSD Workshop in June 2023)
753	2013-09	40.3	Davao	• A fire incident occurred near the station	Personal communication (MPRSD Workshop in June 2023)
741	1989-07	63.3	Dipolog	• **No information available**	

Table 12.4. Breakpoint validation for maximum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
741	2004-04	54.4	Dipolog	• Defective instruments	Personal communication (MPRSD Workshop in June 2023)
741	2004-12	67	Dipolog	• **No information available** • **El Nino year**	
741	2007-01	49.9	Dipolog	• **No information available** • **El Nino year**	
741	2014-03	31.6	Dipolog	• Defective Instrument Shelter	
741	2019-02	55.7	Dipolog	• Relocation of Instrument shelter • **El Nino year**	
851	2019-05	27.5	GenSan	• Defective Maximum Thermometer • **El Nino year**	Personal communication (MPRSD Workshop in June 2023)
747	1990-03	25.6	Laguindingan	• **No Information Available**	
747	1996-09	88	Laguindingan	• **No Information Available**	
747	2021-10	40.4	Laguindingan	• Relocated from El Salvador to Laguindingan • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
751	1983-12	31.2	Malaybalay	• Change in the surrounding environment. Ongoing construction of the new building within the compound • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
751	1984-11	48.9	Malaybalay	• Relocation of the Instrument Shelter • Change of personnel (1985) • **La Nina year**	Personal communication (MPRSD Workshop in June 2023
751	1990-05	26.6	Malaybalay	• Additional Personnel	Personal communication (MPRSD Workshop in June 2023)
751	2009-12	27.2	Malaybalay	• 3-hourly observation Reading is 32.4°C at 18th ***Lat 08.9°7.3' & Long 125.7°57.1' Elev 609.31m*** • **El Nino year**	Personal communication (MPRSD Workshop in June 2023)

Table 12.4. Breakpoint validation for maximum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
653	1971-06	27.8	Surigao	• **No Information Available** • **La Nina year**	
653	1989-11	25	Surigao	• **No Information Available**	
653	2010-08	43.2	Surigao	• Change in the surrounding environment. Houses were built beside the station. • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
653	2014-06	37.6	Surigao	• Change in the surrounding environment. Trees were cut down beside the station.	Personal communication (MPRSD Workshop in June 2023)
653	2019-10	37.4	Surigao	• Change in the surrounding environment. Houses were built beside the station	Personal communication (MPRSD Workshop in June 2023)
836	1965-10	28	Zamboanga	• **No Information Available** • **El Nino year**	
836	1983-11	169	Zamboanga	• **No Information Available** • **La Nina year**	
836	1984-11	33	Zamboanga	• **No Information Available** • **La Nina year**	
836	1991-04	29	Zamboanga	• **No Information Available** • **El Nino year**	
836	2014-01	79.7	Zamboanga	• Damaged Thermometer	Personal communication (MPRSD Workshop in June 2023)
836	2019-11	32.4	Zamboanga	• Damaged Thermometer	Personal communication (MPRSD Workshop in June 2023)

MINIMUM TEMPERATURE

All stations under MPRSD have unhomogenized minimum temperatures (Table 12.5). Metadata can only explain around 48% of the identified breakpoints, although some unidentified breakpoints coincide with ENSO events. Damaged or defective instruments and environmental changes are the significant causes of breaks, which account for 42% and 30% of all the verified breakpoints, respectively. This is followed by station relocation at 23% and changes in observational practices at around 5%. Davao station has 12 breaks, the maximum, while Laguindingan has the least number of breaks, with only five.

Environmental changes, damaged instruments, and limited observational activities caused inhomogeneity at the Butuan station. SNHT value of 80.7 is the maximum for Butuan. This can be attributed to illegal settlers surrounding the station. Only two breakpoints were not explained by metadata for Cotabato station, with station relocation being its primary source of inhomogeneity. Defective instruments are what caused the majority of breaks in Davao Station. However, the relocation of Davao Station from the city proper to the airport recorded a SNHT value of 68.5. The highest SNHT value is 68.6, possibly due to using a dry bulb thermometer to measure minimum temperature. Out of nine breakpoints, only one has been validated for the Dipolog Station. The breakpoint occurred due to replacing a sling psychrometer with an Assmann psychrometer, which recorded an SNHT value of 33.9. Only one breakpoint out of eight was validated for General Santos station. This was caused by the station's relocation from the city proper to the airport. The use of old instruments is what caused the highest SNHT value of 61.7 for Hinatuan station. The relocation from Lumbia to El Salvador and from El Salvador to Laguindingan was recorded by Climatol, with corresponding SNHT values of 34.4 and 25.4, respectively. Malaybalay recorded the highest SNHT value of 111.4 in March 1986. The transfer of Malaybalay station from its old building is thought to be the cause of this break. All validated breaks for Surigao station are caused by changes in the station's surrounding environment. Zamboanga's highest SNHT value of 82.4 can be attributed to using a damaged thermometer. The transfer to Zamboanga airport was recorded and may have caused the break in May 1976 with a SNHT value of 38.6.

With the default SNHT value, Climatol produced 82 breakpoints for MPRSD stations, averaging eight breaks per station. The minimum temperature has the most breaks compared to rainfall and maximum temperature, indicating that the minimum temperature is the most sensitive to changes. Even small environmental changes, such as tree obstructions, may create breaks. The results highlight the importance of keeping the instruments maintained and free of damage, as well as recording station history to mitigate inhomogeneity.

Table 12.5. Breakpoint identification and validation for minimum temperature

Code	Date	SNHT	Name	Remarks	Source
752	1986-11	28.0	Butuan	• Field personnel took more than 8 hours of duty. • Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station. • Change in the surrounding environment. Calamansi trees cut down. • **El Nino year**	• Form 1001-AB • Personal communication (MPRSD Workshop in June 2023)

Table 12.5. Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
752	1986-11	28.0	Butuan	• Field personnel took more than 8 hours of duty. • Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station. • Change in the surrounding environment. Calamansi trees cut down. • **El Nino year**	• Form 1001-AB • Personal communication (MPRSD Workshop in June 2023)
752	1993-08	31.7	Butuan	• Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station. • Change in the surrounding environment. Calamansi Trees cut down.	• Form 1001-AB • Personal communication (MPRSD Workshop in June 2023)
752	1995-05	80.7	Butuan	• Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station. • Change in the surrounding environment. Calamansi Trees cut down.	• Form 1001-AB • Personal communication (MPRSD Workshop in June 2023)
752	2012-01	28.6	Butuan	• Field station is surrounded by many residential houses (illegal settlers), but a fence was already installed around the station. • Change in the surrounding environment. Calamansi Trees cut down and trimmed the Talisay tree. • **La Nina year**	• Station logbook • Personal communication (MPRSD Workshop in June 2023)
752	2012-08	34.3	Butuan	• Change of Instrument. Maximum/Minimum Thermometer w/ Townsend supp. Novalynx (acquired 7/30/2012)	
752	2017-11	41.5	Butuan	• Destroyed Thermometer • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)

Table 12.5. Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
746	1956-04	48.4	Cotabato	• Field station is located at ORC Near Telecom Office with only one observer (different location from the current) • **La Nina year**	• Personal communication (MPRSD Workshop in June 2023)
746	1958-04	79.4	Cotabato	• Field station is located at ORC Near Telecom Office with only one observer (different location from the current • **El Nino year**	• Personal communication (MPRSD Workshop in June 2023)
746	1960-09	45.9	Cotabato	• 1961 - 1982 - no data	• Personal communication (MPRSD Workshop in June 2023)
746	1993-05	27.7	Cotabato	• Defective max & min temp instrument due to instrument relocation, taken from thermograph. • 1990 Sep - Station relocation from Awang airport to Original DOST XII office (including instrument)	• Personal communication (MPRSD Workshop in June 2023)
746	1996-05	41.3	Cotabato	• 1995 - Station transfer from Telecom ORG to Awang airport CAP office (current location)	• Personal communication (MPRSD Workshop in June 2023)
746	1997-05	41.8	Cotabato	• **No information available** • **El Nino year**	•
746	2009-10	36.6	Cotabato	• 2007 - terrorist raid in Awang Airport. Limited observation activity due to access restrictions and safety • **El Nino year**	• Personal communication (MPRSD Workshop in June 2023)
753	1960-06	26.6	Davao	• Location of Station in the downtown area of Davao City	•
753	1962-04	25.7	Davao	• **No information available**	•
753	1969-07	48.2	Davao	• **No information available** • **El Nino year**	•
753	1978-09	68.5	Davao	• Relocation of the Station from the Davao City Downtown area to the Ato Compound in Davao Airport, Brgy. Sasa, Davao City from 1976 to present. • Instrument issues.	• Personal communication (MPRSD Workshop in June 2023)

Table 12.5. Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
753	1987-03	42.9	Davao	• Defective minimum thermometer • **El Nino year**	Personal communication (MPRSD Workshop in June 2023)
753	1993-08	36.2	Davao	• Defective minimum thermometer	Personal communication (MPRSD Workshop in June 2023)
753	1996-03	76.8	Davao	• Defective minimum thermometer • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
753	2001-04	29.2	Davao	• Buildings and houses were built near the station outside the perimeter fence.	Personal communication (MPRSD Workshop in June 2023)
753	2004-07	28.9	Davao	• Defective Minimum thermometer. • **El Nino year**	Personal communication (MPRSD Workshop in June 2023)
753	2014-02	68.6	Davao	• Instrument issues. Defective minimum thermometer. Observed hourly dry bulb temperature readings used to determine the 6-hourly minimum temperature.	Personal communication (MPRSD Workshop in June 2023)
753	2016-12	29.9	Davao	• Cutting of trees surrounding the station outside the station perimeter fence • The Sling psychrometer was changed to the Assman psychrometer. • On-going construction of Davao River Basin Flood Forecasting and Warning Center • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
753	2022-02	26.8	Davao	• Cutting down of big mango and coconut trees inside the station compound • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
741	1981-06	27.6	Dipolog	• **No information available**	
741	1995-09	25.5	Dipolog	• **No information available**	
741	1996-04	91.5	Dipolog	• **No information available** • **La Nina year**	
741	1996-05	93.8	Dipolog	• **No information available**	
741	1998-06	38.1	Dipolog	• **No information available** • **El Nino year**	
741	2010-09	91.3	Dipolog	• **No information available** • **La Nina year**	

Table 12.5. Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
741	2015-07	37.2	Dipolog	• **No information available** • **El Nino year**	
741	2017-06	33.9	Dipolog	• The Assmann Psychrometer replaced the Sling psychrometer	
741	2017-09	31.2	Dipolog	• **No Information Available** • **La Nina year**	
851	1951-06	25.2	GenSan	• **No Information Available** • **El Nino year**	
851	1960-10	57.2	GenSan	• **No Information Available**	
851	1963-12	77.9	GenSan	• **No Information Available** • **El Nino year**	
851	1965-12	27.6	GenSan	• **No Information Available** • **El Nino year**	
851	2001-11	33.1	GenSan	• **No Information Available**	
851	2003-05	57.2	GenSan	• Relocation from the City to the Airport. Around November 2003 to January 2004.	• Form 1001 • Personal communication (MPRSD Workshop in June 2023)
851	2011-02	29.4	GenSan	• **No Information Available** • **La Nina year**	
851	2016-12	25.1	GenSan	• **No Information Available** • **La Nina year**	
755	1961-11	26.1	Hinatuan	• **No Information Available**	
755	1965-03	51.4	Hinatuan	• **No Information Available**	
755	1966-01	60.1	Hinatuan	• **No Information Available** • **El Nino year**	
755	1969-12	25.7	Hinatuan	• **No Information Available** • **El Nino year**	
755	1983-07	43.8	Hinatuan	• **No Information Available** • **El Nino year**	
755	1995-07	61.7	Hinatuan	• Operating using old instruments • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)

Table 12.5. Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
755	2004-01	27.8	Hinatuan	• **No Information Available**	
755	2021-08	29.2	Hinatuan	• **No Information Available** • **La Nina year**	
755	2021-11	25.8	Hinatuan	• **No Information Available** • **La Nina year**	
747	2001-07	33.8	Laguindingan	• **No Information Available**	
747	2006-03	48.5	Laguindingan	• **No Information Available** • **La Nina year**	
747	2009-09	32	Laguindingan	• **No Information Available** • **El Nino year**	
747	2013-11	34.4	Laguindingan	• Relocation (from Lumbia to El Salvador)	Personal communication (MPRSD Workshop in June 2023)
747	2021-09	25.4	Laguindingan	• Relocation (from El Salvador to Laguindingan) • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
751	1985-03	49.6	Malaybalay	• On-going construction of the new building • Change personnel • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
751	1986-03	111.4	Malaybalay	• November 1986 (estimated), they transferred to the new building.	Personal communication (MPRSD Workshop in June 2023)
751	1986-03	111.4	Malaybalay	• November 1986 (estimated), they transferred to the new building.	Personal communication (MPRSD Workshop in June 2023)
751	1986-03	111.4	Malaybalay	• November 1986 (estimated), they transferred to the new building.	Personal communication (MPRSD Workshop in June 2023)
751	1986-03	111.4	Malaybalay	• November 1986 (estimated), they transferred to the new building.	Personal communication (MPRSD Workshop in June 2023)
751	1986-03	111.4	Malaybalay	• November 1986 (estimated), they transferred to the new building.	Personal communication (MPRSD Workshop in June 2023)

Table 12.5. Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
751	2019-12	27	Malaybalay	• Installation of Digital Barometer	Personal communication (MPRSD Workshop in June 2023)
653	1960-08	43.2	Surigao	• **No Information Available**	
653	1978-01	46	Surigao	• **No Information Available** • **El Nino year**	
653	1987-04	53.7	Surigao	• **No Information Available** • **El Nino year**	
653	1995-10	31.4	Surigao	• Change in the surrounding environment. Trees were cut down inside the PAGASA premises. • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
653	2002-06	80.4	Surigao	• Change in the surrounding environment. Houses were built around the station. • **El Nino year**	Logbook / Personal communication (MPRSD Workshop in June 2023)
653	2008-10	74.6	Surigao	• Change in the surrounding environment. Trees were cut down beside the station • **La Nina year**	Logbook / Personal communication (MPRSD Workshop in June 2023)
653	2014-10	27.1	Surigao	• Change in the surrounding environment. Trees were cut down beside the station • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
653	2016-01	31.8	Surigao	• Change in the surrounding environment. Trees were cut down beside the station • **El Nino year**	Logbook / Personal communication (MPRSD Workshop in June 2023)
653	2021-04	40.5	Surigao	• Change in the surrounding environment. Trees were cut down beside the station • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
836	1955-06	38.3	Zamboanga	• **No Information Available** • **La Nina year**	
836	1962-05	25.7	Zamboanga	• **No Information Available**	
836	1966-09	34.9	Zamboanga	• **No Information Available**	

Table 12.5. Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
836	1974-09	55.2	Zamboanga	• **No Information Available** • **La Nina year**	
836	1976-05	38.6	Zamboanga	• Station Relocation • **La Nina year**	Picture of Septic Tank showing the year it was built.
836	1987-02	53.5	Zamboanga	• **No Information Available** • **El Nino year**	
836	2000-06	27.6	Zamboanga	• **No Information Available** • **La Nina year**	
836	2009-10	73.3	Zamboanga	• Damaged Thermometer • **El Nino year**	Personal communication (MPRSD Workshop in June 2023)
836	2011-03	82.4	Zamboanga	• Damaged Thermometer • **La Nina year**	Personal communication (MPRSD Workshop in June 2023)
836	2014-09	50.9	Zamboanga	• Damaged Thermometer • **El Nino year**	Personal communication (MPRSD Workshop in June 2023)

CHAPTER 13:

REFERENCES

Alexandersson, H. (1986). *A homogeneity test applied to precipitation data*. Journal of Climatology, 6(6), 661–675. https://doi.org/10.1002/joc.3370060607

Alexandersson, H., & Moberg, A. (1997). *Homogenization Of Swedish Temperature Data. Part I: Homogeneity Test for Linear Trends*. International Journal of Climatology, 17(1), 25–34. https://doi.org/10.1002/(SICI)1097-0088(199701)17:1<25::AID-JOC103>3.0.CO;2-J

Britannica, T. Editors of Encyclopaedia (2024, July 3). *Mindanao*. Encyclopedia Britannica. https://www.britannica.com/place/Mindanao

City Government of Butuan. (n.d.). Retrieved August 9, 2023, from https://www.butuan.gov.ph/about/

City Government of Cotabato. (n.d.). Mysite. Retrieved August 15, 2023, from https://cotabatocitygov.wixsite.com/mysite/copy-of-mission-vision

City Government of Davao. (n.d.). City Government of Davao. Retrieved August 24, 2023, from https://www.davaocity.gov.ph/know-davao-city/history/

City Government of Dipolog. (n.d.). Retrieved August 24, 2023, from https://dipologcity.gov.ph/history/

City Government of General Santos. (n.d.). OFFICIAL WEBSITE OF GENERAL SANTOS CITY. Retrieved August 30, 2023, from https://gensantos.gov.ph/history/

City Government of Zamboanga. (2018, August 12). https://www.zamboangacity.gov.ph/city/2018/08/12/history-of-the-city/

Guijarro, J. A. (2021). *Homogenization of climatic series with Climatol*. https://climatol.eu/homog_climatol-en.pdf

Khaliq, M. N., & Ouarda, T. B. M. J. (2007). *On the critical values of the standard normal homogeneity test (SNHT)*. International Journal of Climatology, 27(5), 681–687. https://doi.org/10.1002/joc.1438

Kuya, E. K., Gjelten, H. M., & Tveito, O. E. (2022). *Homogenization of Norwegian monthly precipitation series for the period 1961–2018*. Advances in Science and Research, 19, 73–80. https://doi.org/10.5194/asr-19-73-2022

Municipal Government of Hinatuan. (n.d.). *Municipality of Hinatuan*. Retrieved August 30, 2023, from http://visithinatuan.com/history/

Philippine Statistics Authority. (2020). *2020 Census of Population and Housing* https://psa.gov.ph/content/2020-census-population-and-housing-2020-cph-population-counts-declared-official-president