SYNOPTIC STATION PROFILE:

Southern Luzon PAGASA Regional Services Division

PHILIPPINE ATMOSPHERIC, GEOPHYSICAL AND ASTRONOMICAL SERVICES ADMINISTRATION
Climatology and Agrometeorology Division
Climate and Agrometeorological Data Section

Republic of the Philippines
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
Department Of Science and Technology (DOST)

ISBN 978-621-95882-9-4

Published by:
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)
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This document should be cited as:

DOST-PAGASA, (2024). *Synoptic Station Profile: Southern Luzon PAGASA Regional Services Division.* [Joseph Basconcillo, Noel Bangquiao, Nancy Lance, Neil John Miranda, Ferdinand Valdeavilla, Jemmy Pedrola, Reniel Mago, Ryan Orogo, Lilian Guillermo, Rizza Bartolata, Richard Magayam, Juan Pantino Jr., Vicki Ann Bagulbagul, Rosalina de Guzman]

ABOUT THE PUBLICATION

The Synoptic Station Profile: Southern Luzon 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 Southern Luzon 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 Southern Luzon 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 Southern Luzon 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 This data is supplemented by historical documents (e.g., logbooks, Special Orders, pictures, etc.)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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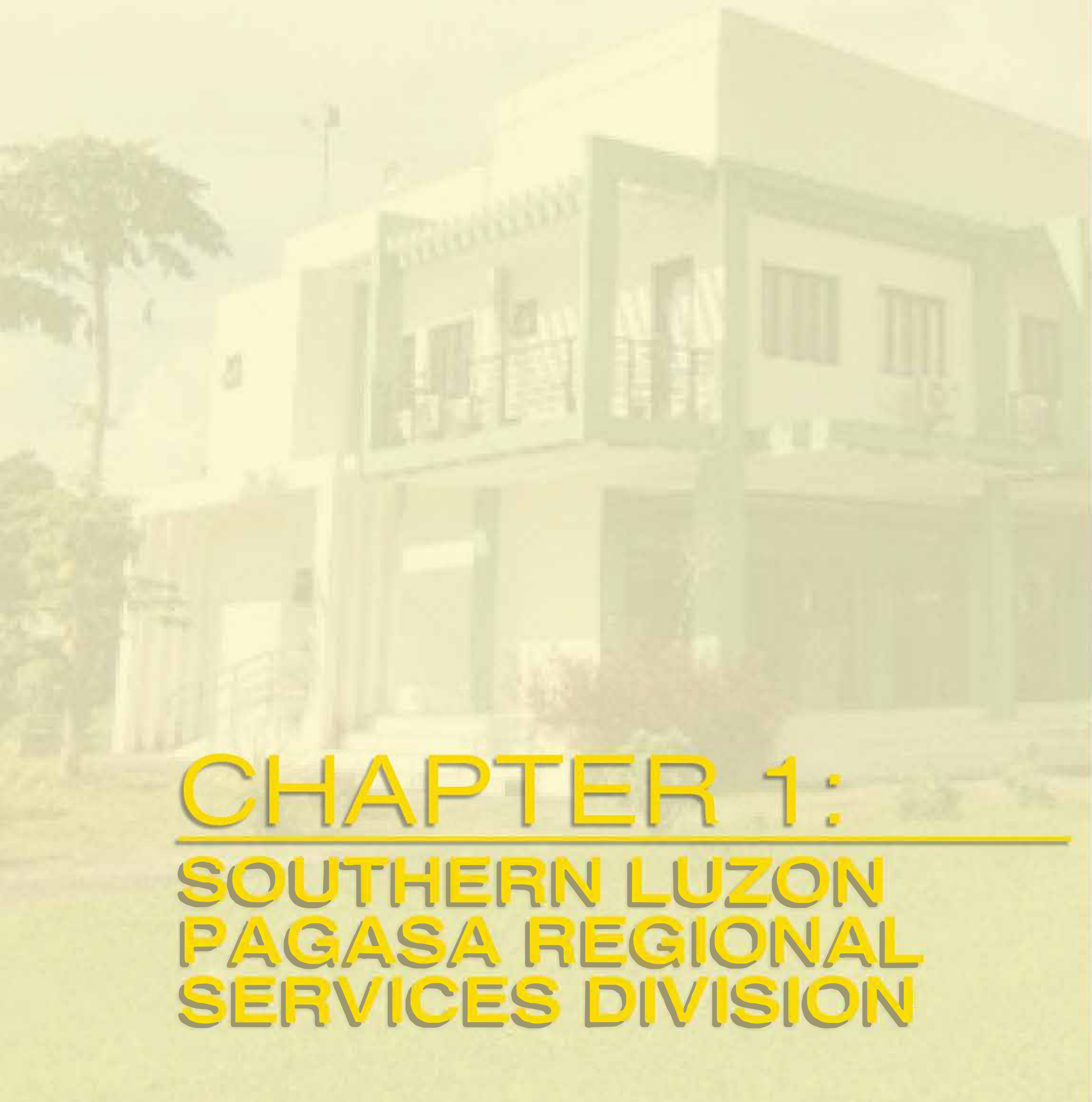


CHAPTER 1:

SOUTHERN LUZON PAGASA REGIONAL SERVICES DIVISION

The Southern Luzon PAGASA Regional Services Division (SLPRSD) serves as PAGASA's dedicated regional service arm, covering the southern part of Luzon and extending into parts of the Visayas. This expansive coverage encompasses the entire Bicol Region, portions of MIMAROPA (an acronym for Mindoro, Marinduque, Romblon, and Palawan Region), and a section of Region VIII, particularly Northern Samar (Figure 1). Areas under SLPRSD are herein called SLPRSD regions.

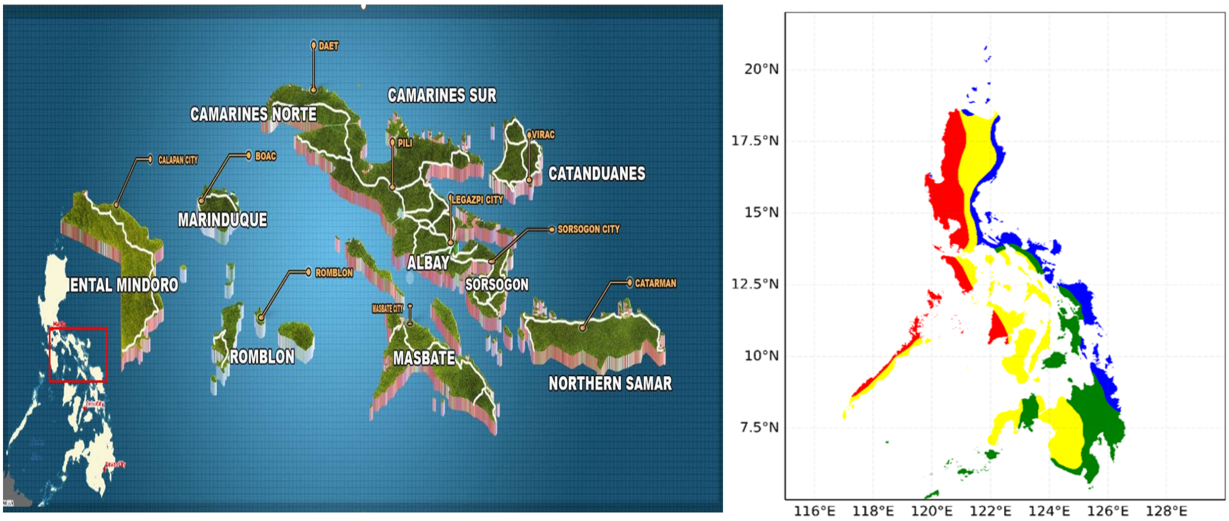


Figure 1 Southern Luzon PRSD map (left) and the Modified Coronas Climate Classification (right)

According to the Modified Coronas Climate Classification System (MCCS), areas under SLPRSD experience three types of climates. These are Climate Type II, III, and IV (Figure 1). The MCCS is based on the amount of monthly and seasonal rainfall patterns in the country. Detailed Climate Classification can be found in Table 1.1.

Table 1.1 Climate types of provinces under SLPRSD

Region	Province	Climate Type
V-Bicol Region	Camarines Norte	II
	Camarines Sur	II, III, IV
	Albay	II, III, IV
	Sorsogon	II, III, IV
	Masbate	III
	Catanduanes	II
IV-B MIMAROPA	Oriental Mindoro	III
	Marinduque	III
	Romblon	III
VIII-Eastern Visayas	Northern Samar	II, IV

As an archipelagic nation, the Philippines experiences various weather systems, which is also true for the SLPRSD region (Table 1.2). Easterlies and the Intertropical Convergence Zone (ITCZ) affect the area from April to May. The Northeast monsoon and the Shear line influence the region from November to February, while the Southwest monsoon dominates from June to September. Lastly, systems such as localized thunderstorms (TSTM) up to tropical cyclones influence the region throughout the year.

Table 1.2 Calendar of Weather systems affecting the SLPRSD region

Weather System	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Easterlies				✓	✓							
Localized TSTM	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
LPA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Northeast Monsoon	✓	✓									✓	✓
ITCZ				✓	✓							
Southwest Monsoon						✓	✓	✓	✓			
Tail-end of a Frontal System (Shear line)	✓	✓									✓	✓
Tropical Cyclone	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

ORGANIZATIONAL STRUCTURE

The SLPRSD Regional Office is located in Barangay Cruzada, Legazpi City, Albay (Figure 2). It has been operational since 2010. The SLPRSD Regional Office consists of the Office of the Weather Services Chief, the Regional Forecasting group, the Administrative, Planning, Property and Supply group, and the Maintenance group (Figure 3). SLPRSD coordinates and collaborates with other national agencies and stakeholders, particularly during severe weather and climate events. It participates and contributes to the Pre-Disaster Risk Assessment (PDRA). Long-term planning and collaboration are also engaged through the assistance in preparing Local Climate Change Action Plans (LCCAP), Climate and Disaster Risk Assessment (CDRA), and other non-governmental organizations projects. SLPRSD maintains its close relations with the community through the regular conduct of Information, Education, and Communication Campaigns (IECs) and technical assistance to academic researchers.

Figure 2 Southern Luzon PRSD Building

Office of the Weather Services Chief, SLPRSD

The Office of the Weather Services Chief supervises the overall operations of the SLPRSD. It directly supervises all Chief Meteorological Officers (CMO) of different weather observing and warning stations of the division, forecasting group, the Administrative, Planning, Property, and Supply Group, and the Maintenance Group. The weather services chief is responsible for formulating organizational plans and methods for the internal operations of PAGASA, the mother agency of SLPRSD (Table 1.3). The office also supervises and controls the division's technical operations and support services. It initiates developing, adopting, and enforcing internal organizational policies, rules, and regulations to fulfill the division's objectives and functions effectively. Lastly, the office supervises, monitors, and coordinates SLPRSD-implemented programs and projects initiated in collaboration with DOST Councils, Institutes, and other attached agencies.

Table 1.3 List of SLPRSD Personnel

Name	Role/Job Description	Year Started
Allan Almojuela	Assistant Weather Services Chief	1993
Ken Occidental	Weather Facilities Specialist I	2012
Dan Dominic Triumfante	Weather Facilities Specialist I	2021
Vince Karlo Iglesia	Weather Observer IV	2012
Mark Anthony Maraño	Weather Observation Aide-Full Time	2023

Regional Forecasting Group

The Regional Forecasting Group provides weather forecast and climate outlook for the SLPRSD region. Weather forecasts include the issuance of 24-hour local weather forecast (twice a day), specialized forecast for Mayon Volcano (twice a day), Rainfall Advisory and Heavy Rainfall Warning System, thunderstorm advisory and warning system, and tropical cyclone products (i.e., Tropical Cyclone Advisories, Tropical Cyclone Bulletins). For climate outlook, the group provides regional rainfall outlook and 10-day climate forecasts.

Administrative, Planning, Property and Supply, and the Maintenance Group

The SLPRSD's Administrative personnel are responsible for processing all documents that need to be acted upon by the Office of the Weather Services Chief. The Planning personnel are responsible for the division's short-, medium-, and long-term plans. The Property and Supply Group manages the organization's procurement and distribution of supplies and equipment. On the other hand, the Maintenance group is responsible for repairing and preventive maintenance of automatic weather stations, facilities, and other related tasks.

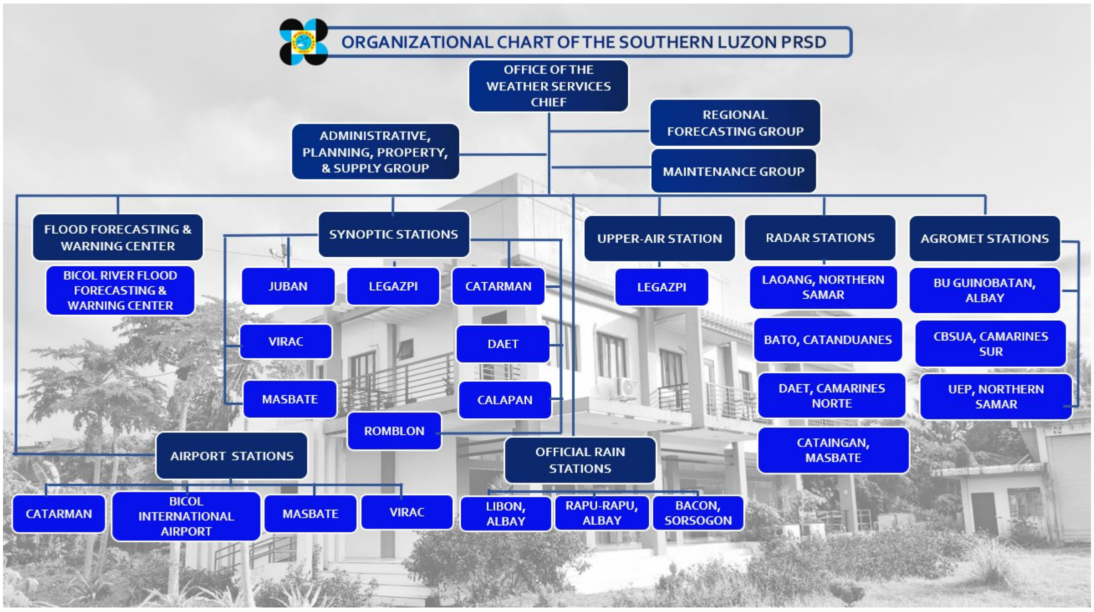


Figure 3 SLPRSD Organizational Chart

SLPRSD FIELD STATIONS

The networks of observation and warning stations operated, monitored, and maintained by SLPRSD are the surface synoptic, agromet, flood forecasting and warning center, upper-air, airport, RADAR, and official rain stations located throughout SLPRSD. These stations enable quality observation of almost all meteorological elements necessary to utilize the data in the formulation of weather and climate products provided by the agency. The SLPRSD comprises eight surface synoptic stations, three agrometeorological stations, one flood forecasting warning center, one upper air station, four airport stations, four radar stations, and three official rain stations. The location of these stations is shown in Figure 4.

Surface Synoptic Stations (Synop) are stations where observation of almost all meteorological elements is made at fixed observation times and are transmitted to the Central Office. These stations are maintained and operated by PAGASA. It is responsible for disseminating public weather forecasts, tropical cyclone bulletins, warnings and advisories, and other related information to protect the lives and property of the general populace. A list of operational synoptic stations is given in Table 1.4.

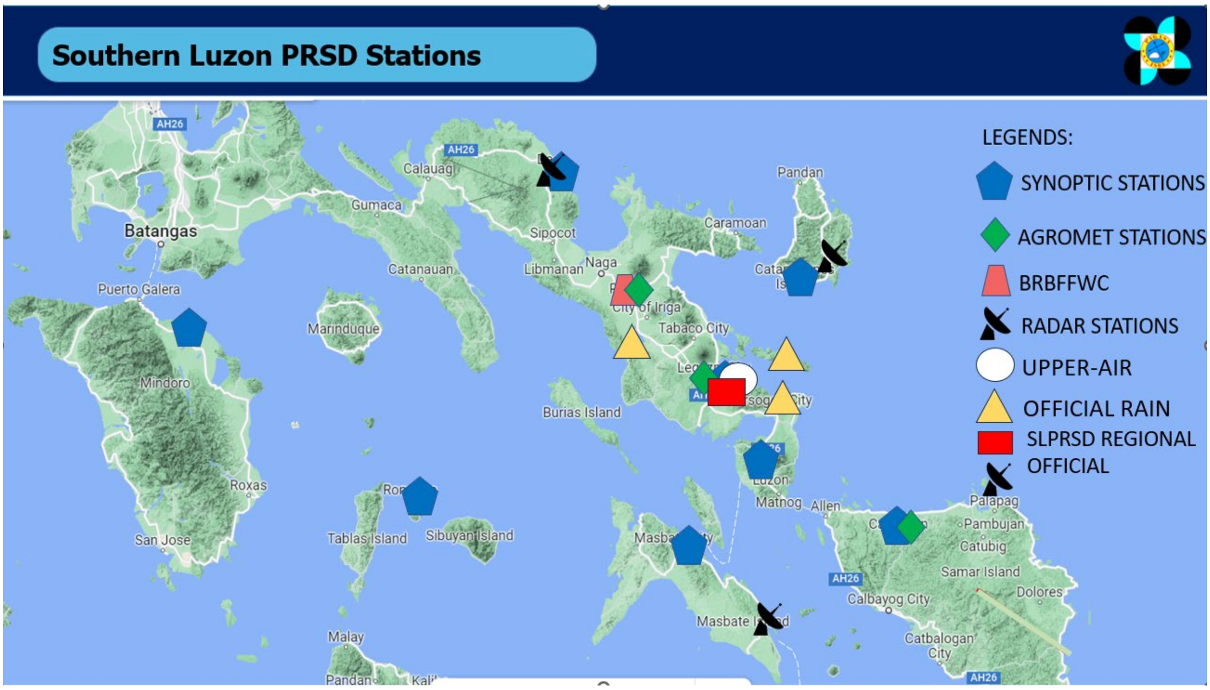


Figure 4 Location of PAGASA stations in SLPRSD

Agrometeorological stations (Agromet) gather and provide simultaneous meteorological and biological information on a routine basis. They are also responsible for disseminating agricultural meteorological advice, warnings, forecasts, bulletins, and other essential information farmers need. The Flood Forecasting Warning Center monitors the meteorological and hydrological conditions of the country's river basins/systems and the Flood Forecasting Warning System for Dam operations. The warning center is located at Pili Camarines Sur.

Table 1.4 List of operational PAGASA Synoptic Stations in SLPRSD

Station Name	Station Code	Year Established
Calapan	98431	1929
Catarman	98546	1948
Daet	98440	1950
Legazpi	98444	1902
Masbate	98543	1951
Romblon	98536	-
Sorsogon	98545	2010
Virac	98446	1922

Upper-air stations, normally combined with synoptic stations, conduct observation of atmospheric pressure, temperature, humidity, wind speed, and direction or a combination of all of these variables at several layers of the upper atmosphere using electronic means. International weather data exchange commitments require these stations to conduct at least two observations daily (0000 UT; 1200 UT), notwithstanding the high costs of electronic transmitters, meteorological balloons, and other consumables used during every observation. The upper air station is located at Legazpi City, Albay. A station where a radar is installed is called a radar station. It could be a combined synoptic-radar station or an independent (purely) RADAR station. RADAR stations conduct regular observations. If there is a tropical cyclone within the Philippine Area of Responsibility, all radar stations may need to operate 24 hours a day, depending on their proximity to the cyclone or the effective range of the radar. The station should transmit radar reports every hour or every 30 minutes, if possible, to the Central Office. Lastly, rain stations are where rainfall observations are made twice daily. It is maintained and operated by PAGASA and manned by at least a Weather Observation Aide (Part-Time).

CHAPTER 2:

CALAPAN SYNOPTIC STATION

Calapan is bounded to the north and northeast by Calapan Bay, south and southeast by the municipality of Naujan, and to the West by the municipality of Baco. It is approximately 28 nautical miles (52 km. 32 mi) from the nearest point of Batangas Province, 45 km. (28 mi) South of Batangas City and 130km. (81 mi) South of Manila. The city has an area of 250.06 km (96.55 sq. mi) and comprises 62 Barangays, of which 22 are classified as urban and 40 rural. The overall land characteristics are a wide plain with rivers, interspersed with wetlands at the seacoast periphery. The highest elevation is 187 m. (614 ft) above sea level at Bulusan Hill, a six (6) Kilometer (3.7mi) long landform east of the city, which interrupts the primarily flat terrain northeast of the Halcon-Baco Mountain Range.

Figure 5 Facade (left) and Observation Garden (right) of Calapan Station

The Weather Station of Calapan (hereinafter referred to as Calapan Station) was initially established in 1929. Detailed information about the station location is given in Table 2.1. A Type B Prefabricated Office Building was erected at the back of Oriental Mindoro Provincial Hospital. It was functioning as Agromet, Port, and Synoptic Station before and later on to be purely synoptic as of today. The location from where it was established is at the exact location in Purok 7, Ilaya, Calapan City, Oriental Mindoro. Calapan Station is on a recently developed “young” landscape with high crops or crops varying in height and scattered obstacles (Figure 5). The station is situated in a region with low relief, less than 100 m below mean sea level. The Port of Calapan is north of the station, more than two kilometers away. To the south are the rice fields of Calapan and Naujan towns. The mountain of Halcon separates Oriental Mindoro to the east from the coastal barangay of Calapan and Naujan Municipality, and to the West is the small island called Isla Berde.

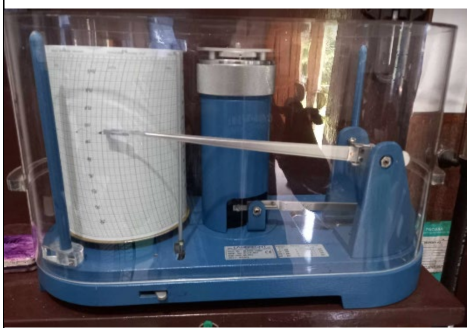
Table 2.1 Calapan Station Information

Station Name	Calapan Synoptic Station
Station Number (ID)	431
Latitude	13°25’
Longitude	121° 11’
Elevation	40.5 meters
Altimeter Correction	4.7 meters

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

Calapan Station is equipped with multiple instruments capable of measuring surface parameters (Table 2.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, local weather-dependent operations such as airport and construction work, climate, and weather research. The station closely follows the WMO standard (WMO-No.8), highlighting meticulous calibration and quality control in generating data and information on weather, climate, and water. This ensures that the weather data are accurate and reliable. Detailed information regarding each instrument will be shown in the subsequent subchapter.

Table 2.2 Calapan Meteorological Instruments and Observed Parameters

Instrument	**Picture**	**Description**
Aerovane		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 attached to a sensor that records the rotation of the shaft.
Automated Weather System (AWS)		These automated stations have meteorological instruments built in. These instruments use electronic sensors to measure the air temperature, pressure, sun radiation, rainfall, and wind speed at ground level. The data is not used at the station but instead in a project.
Barograph*		Make use of aneroid cells, flexible metal chambers that expand or contract with regard to changes in atmospheric pressure. Also called “Dry Barograph
Digital Barometer*		Digital barographs use micro-electromechanical pressure sensors to monitor air pressure

Instrument	Picture	Description
Hydro thermograph		A hygrothermograph is an instrument that measures humidity and temperature via a recording pen and a rotating chart mechanism.
Instrument Shelter		An enclosure typically painted white houses thermometric instruments (e.g., thermometers, psychrometers, etc.) and protects them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.
Minimum Thermometer		Liquid-in-glass thermometers use the differential expansion of pure liquid with respect to its glass container to indicate temperature. Used to measure maximum temperature.
Standard Rain gauge And Tipping Bucket* Rain Gauge		The Standard Rain Gauge measures precipitation. It is a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When this smaller tube is filled, 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
Wet bulb thermometer and Dry bulb thermometer		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube. The psychrometer measures wet and dry bulb temperatures.

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

PERSONNEL COMPLEMENT

Calapan station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Mr. Ferdinand Valdeavilla. The personnel 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 make synoptic and/ or climatological observations using the appropriate instruments, noting their uncertainties and representativeness. The observers maintain instruments and document metadata. If automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 2.3 List of Calapan Personnel

Name	Item	Length Of Stay (years)
Ferdinand Valdeavilla	Chief Meteorological Officer	26
Edmundo Muning	Weather Observer IV	13
Katherine Joy Bejasa	Weather Observer I	6
Rhyss Bati	Job Order	2
Ghail Macutong	Job Order	2 months

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

INSTRUMENT 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 as important as the data (see Chapter 10 for more information). Even with the advancement of methods in data homogeneity, recorded metadata still provides high-precision information on the occurrence of inhomogeneities. Changes that happened in the station should be kept, as well as maintenance history. 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 the data collection.

Table 2.4 Metadata for Barograph in Calapan Station

Manufacturer / Brand	Lambrecht
Observed Parameter	Atmospheric Pressure
Date Installed / Deployed	04/28/2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.5
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	-
Serial No.	811215-0026

Table 2.5 Metadata for Digital Barometer in Calapan Station

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

Table 2.6Metadata for Rain Recorder in Calapan Station

Manufacturer / Brand	-
Observed Parameter	Rainfall
Date Installed / Deployed	02/17/2015
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	-
Serial No.	6436

Table 2.7 Metadata for Tipping Bucket in Calapan Station

Manufacturer / Brand	Tipping Bucket
Observed Parameter	Rainfall
Date Installed / Deployed	02/17/2015
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	-
Serial No.	-

CHAPTER 3:

CATARMAN SYNOPTIC AND AEROMET STATION

Catarman is a first-class municipality and the capital of Northern Samar, Philippines. It is the largest town in terms of land area, with 464.43 square kilometers, and is politically subdivided into 55 barangays, 17 of which are in Poblacion. According to the 2020 Census (PSA, 2021), it has a population of 97,879, making it the most populous municipality in Eastern Visayas. It serves as the central hub for the province's commerce, education, finance, politics, and government affairs. It is situated in the northern region of Samar Island, with Mondragon to the east, Bobon to the west, Lope de Vega to the south, and the Philippine Sea to the north. The coastal areas along the Pacific Ocean are characterized by flat lowlands, while the inland terrain features scattered low hills. Mount Puyao in Barangay Liberty is the highest peak in this vicinity. The Catarman River, a significant watercourse in the province, separates the town into its eastern and western sections.

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

Located at the coastal barangay of Dalakit, Catarman, Northern Samar, is the PAGASA Catarman Synoptic and Aeromet Station (hereinafter referred to as Catarman Station). Detailed information about the station is given in Table 3.1. PAGASA Catarman Field Station is one of the earliest established synoptic stations in the country and has been operational since 1948. The station is on a flat terrain slope of less than 3 degrees and not a hilltop, ridge, valley bottom, or depression (Figure 6). It is positioned at the corner of the barangay intersection in J.N. Frigilliana Street, bounded by the Philippine Postal Corporation – Catarman Main to the north, Provincial Kauswagan Center Cum Isolation Facility to the east, Eastern Visayas Central Colleges to the west, and residential houses to the south. Its surroundings are obstructed by buildings and without notable visibility markers except for three telecommunication towers, which are a few meters southwest of the station, thus limiting visibility. Further, its proximity to the Pacific Ocean exposes it to the prevailing onshore and offshore winds, which can vary seasonally and are subject to the influence of tropical storms year-round. This unique coastal setting provides valuable meteorological data for the accurate forecasting of weather patterns in the locality and insights into the impacts of coastal systems on climate and weather conditions.

Table 3.1 Catarman Station Information

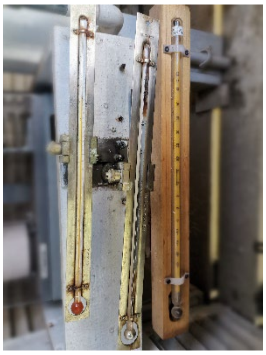
Station Name	Catarman Aeromet and Synoptic Station
Station Number (ID)	98546
Latitude	12° 30’
Longitude	124° 38’
Elevation	6.58 m
Altimeter Correction	+0.74

Following the meteorological standards set by the WMO, the Catarman Station is specifically designed to obtain measurements that accurately represent its designated type. Functioning as a synoptic station, it maintains a close collaborative relationship with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction. Additionally, it consistently submits monthly surface weather observation reports to the PAGASA Central Office and the Southern Luzon – PAGASA Regional Services Division. It also provides weather certifications to stakeholders. As an aero-meteorological station, it coordinates closely with aviation personnel to furnish vital weather information for operations.

Catarman Station is equipped with multiple instruments capable of measuring surface parameters (Table 3.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, local weather-dependent operations such as airport and construction work, climate, and weather research. The station closely follows the WMO standard (WMO-No.8), which highlights meticulous calibration and quality control in the generation of data and information on weather, climate, and water. This ensures that the weather data are accurate and reliable. Detailed information regarding each instrument will be shown in the subsequent subchapter.

Table 3.2 Catarman Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Aneroid Barometer		It is made by removing the air from a thin, circular, metallic box. With practically no air on the inside, the box would collapse. A spring is installed to limit the collapse of the box proportional to the air pressure or weight of the column of air on the box. If one side of the box is fixed, the other side will move due to changes in atmospheric pressure. The metallic box's surface is corrugated so the box can collapse and return uniformly. The movement of the spring causes a pointer to move over a scale of figures corresponding to the readings of a mercury barometer.
Assmann Psychrometer		It determines the air temperature and humidity of the ambient air. It consists of two thermometers, each inside a double tube for minimizing radiative heating by the direct sun and longwave radiation exchange between the thermometer and the surrounding tube. It is also ventilated during measurement by a manually winded fan. One of the thermometers is covered by a cotton gaze that has to be wetted before the measurement. Depending on the ambient humidity, water evaporates from the wet gaze and cools down the damp thermometer, reaching the so-called wet-bulb temperature after a few minutes. From the wet bulb temperature, the air temperature is measured simultaneously by the dry thermometer, and the air pressure and humidity can be calculated.
Campbell-Stokes Sunshine Recorder		It records the hours of sunshine per day. It consists of a solid glass sphere that focuses sunlight rays onto a light-sensitive card on which a line is burnt.

Instrument	Picture	Description
Digital Barometer		It uses a pressure-sensing micro-electromechanical sensor to measure atmospheric pressure.
Instrument Shelter/ Stevenson Screen		It is a box-like structure designed to protect certain thermometric instruments, such as psychrometers, maximum and minimum thermometers, thermographs, etc., from exposure to direct sunshine, precipitation, and condensation while providing adequate ventilation. It is painted white, has double-louvered sides and double-top roofing, and is mounted on a stand a meter or so above the ground with the door side facing poleward.
Maximum-Minimum Thermometers		Maximum and minimum thermometers are used to measure the temperature range. A maximum thermometer has a constriction above the bulb that permits the mercury to rise in the capillary tube but does not allow it to descend the capillary tube unless the thermometer is reset. The highest point the mercury reaches indicates the maximum temperature for the period. The minimum thermometer, on the other hand, gives the lowest temperature. It uses colored alcohol (because of its low freezing point). It is placed at an angle of about 20° from the horizontal. The black float called the index needle is pulled downslope to the lowest temperature of the day by two forces: a) the surface tension at the top of the alcohol column and b) the force of gravity.
Mercurial Barometer		It is a simple barometer made by filling a 32-inch-long glass tube with mercury and inverting it so that the open end of the tube is below the surface of mercury in a cistern. The height of the mercury column is measured by sliding a vernier attached to a scale. To obtain accurate measurements, corrections are made for the instrument's temperature expansion, gravity, and latitude. Values are read in millibars, millimeters, or inches.
Microbarograph		It is a recording barometer. The pen point that traces the pressure curve on the paper moves up or down by means of a series of levers attached to aneroid cells (metallic boxes) in tandem. Using aneroid cells in tandem provides a more pronounced response to changes in pressure than would be indicated by a single aneroid cell of the same size.

Instrument	**Picture**	**Description**
Rainfall Recorder		It automatically records the amount, intensity, and duration of rainfall on a graph attached to a clock-driven drum.
Standard (8-inch) Rain Gauge		It is so called because the inside diameter of the collector is exactly eight inches above a funnel that conducts rainfall into a cylindrical measuring tube or receiver. When this receiver is filled, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement. A thin wooden meter stick measures the amount of rainfall accumulated in the measuring tube.
Thermograph		It records the air temperature continuously on graphing paper. It usually consists of a cylinder made to revolve once weekly through clockwork inside. A sheet of graph paper is fastened on the outside. A pen-point that rests on the paper traces the temperature curve according to the expansion and contraction of a sensitive metallic coil or strip corresponding to the reading of a thermometer.
Tipping Bucket Rain Gauge		It is an upright cylinder that has a funnel-shaped collector. The precipitation collected by the collector empties into one side of a "tipping bucket," an inverted triangular contraption partitioned transversely at its center and is pivoted about a horizontal axis. Once one compartment is filled with rain, it tips, spilling out the water and placing the other half of the bucket under the funnel. The tipping activates a mercury switch, causing an electrical current to move the pen in the recorder. Each tipping is equal to 0.2 millimeters of rainfall.
Ultrasonic Anemometer		Due to its acoustic measuring principle, it allows the measurement of quickly changing wind parameters. Gust and peak values are acquired inertia-free with the highest precision.

Instrument	Picture	Description
Vane Anemometer		It measures 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 attached 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

The PAGASA Catarman Field Station is staffed with a well-trained team, which includes meteorological technicians/observers led by Mr. Jemmy Pedrola, the Chief Meteorological Officer. The individuals detailed in Table 3.3 perform a crucial role in ensuring the station's smooth operation, precise data collection, and the provision of dependable weather forecasts and alerts to the public and relevant stakeholders. Meteorological observers are responsible for conducting synoptic and climatological observations using the appropriate instruments while noting any uncertainties and representativeness in the data. They also maintain instruments and document metadata. In cases where automated equipment experiences technical issues, they provide supplementary or backup observations.

Table 3.3. List of Catarman Personnel

Name	Designation	E-Mail Address
Jemmy Pedrola	CMO/ Weather Observer IV	pedrola_jemmy@yahoo.com
Tess Cinco	Weather Observer IV	
Jose Angelo Muñoz	Weather Observer II	joseangelo17.zonum@gmail.com
Polaris Corona	Weather Observer II	polaris.corona@yahoo.com

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

INSTRUMENT METADATA

In addition to the meteorological data, users of these observations must possess knowledge about the instrument's condition, type, and exposure. The meticulous maintenance of quality-controlled metadata is just as critical as the data. Despite advancements in data homogeneity methods, recorded metadata still accurately reveals instances of inconsistency. It is essential to document any changes that occur at the station and maintain a history of maintenance activities (see Chapter 10 for more information). The instrument metadata, which essentially comprises information about the data, offers a comprehensive account of the instruments, encompassing model specifications, manufacturer details, calibration dates, measurement range, and accuracy. Utilizing metadata ensures transparency and enables the tracing of data collection processes.

Table 3.4 Metadata for Assmann Psychrometer in Catarman Station

Manufacturer / Brand	Sato Keiryuki Mfg. Co., Ltd (Japan)
Observed Parameter	Temperature (Dry Bulb and Wet Bulb)
Date Installed / Deployed	October 26, 2022
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	1.60
Instrument Exposure	-
Representativeness of Observation	
Maintenance Activity	Quarterly / Upon Request
Model No.	7450
Serial No.	30292

Table 3.5 Metadata for Barograph in Catarman Station

Manufacturer / Brand	Vaisala
Observed Parameter	Station Pressure
Date Installed / Deployed	October 11, 2022
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	1.32
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	R07 40226

Table 3.6 Metadata for Maximum and Minimum Thermometer in Catarman Station

Manufacturer / Brand	-
Observed Parameter	Maximum and Minimum Temperatures
Date Installed / Deployed	10/26/2022
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	1.60
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	
Serial No.	10033

Table 3.7 Metadata for Mercurial Barograph in Catarman Station

Manufacturer / Brand	Ota Keiki Seisaksho (Japan)
Observed Parameter	Pressure
Date Installed / Deployed	September, 1993
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	1.32 meter
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	
Serial No.	259094

Table 3.8 Metadata for Rainfall Recorder in Catarman Station

Manufacturer / Brand	Sato Keiryuki Mfg. Co., Ltd (Japan)
Observed Parameter	Rainfall Amount, Duration, Intensity
Date Installed / Deployed	May 31, 2019
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3-hourly
Height from Ground (m)	1.0 meter
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	7820-00
Serial No.	6421

Table 3.9 Metadata for Standard Rain Gauge in Catarman 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	-
Representativeness of Observation	-
Maintenance Activity	Quarterly / Upon Request
Model No.	-
Serial No.	-

Table 3.10 Metadata for Sunshine Recorder in Catarman 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	-
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	-

Table 3.11 Metadata for Tipping Bucket in Catarman Station

Manufacturer / Brand	Sato Keiryuki Mfg. Co., Ltd (Japan)
Observed Parameter	Rainfall Amount, Duration, Intensity
Date Installed / Deployed	April 2016
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	0.56
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Quarterly/ Upon Request
Model No.	-
Serial No.	16121

Table 3.12 Metadata for Ultrasonic Anemometer in Catarman Station

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

Table 3.13 Metadata for Vane Anemometer in Catarman Station

Manufacturer / Brand	Sato Keiryuki Mfg. Co., Ltd (Japan)
Observed Parameter	Wind Speed & Direction
Date Installed / Deployed	May 31, 2019
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.	-
Serial No.	-

CHAPTER 4:

DAET SYNOPTIC AND RADAR STATION

Daet is the provincial capital of the 12 towns of Camarines Norte, which lie along the northeastern coast of the Bicol Peninsula and face the Pacific Ocean. To its east are the fishing community of Mercedes Town, a stretch of water known as Camino Pass, and the Pacific Ocean. Directly north and northeast is the wide expanse of ocean water. West and southwest of the town are mountains lining the boundaries the province shares with its neighboring Quezon province. As of the 2020 census, Daet comprises 111,700 individuals in its 25 barangays. Rolling hills, mountains in the interior areas, and fertile plains along the valley coast characterize its topography. The long stretch of beach makes it a famous surfing and kiteboarding spot. Camarines Norte has a Type II climate, wherein the region does not have a dry season but a very pronounced maximum rainfall period. The northeasterly wind flow brings tremendous moisture as it crosses the vast ocean and drenches Camarines Norte with a deluge of heavy rains from October to December. The tropical cyclone season in Camarines Norte and the whole Bicol Region coincides with the prevalence of northeast monsoon, causing more rains received during the period.

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

Daet Complex Weather Station serves as Synoptic and Radar Station (hereinafter called Daet Station). The station is near Daet Airport Compound, Barangay Bagasbas, Daet Camarines Norte (Region V). Detailed information about the station location is given in Table 4.1. Being a type II climate, the municipality of Daet has a rainfall period of a minimum from March to May. The weather station is located on a recently developed “young” landscape with high crops or crops of varying height and scattered obstacles (Figure 7).

Table 4.1 Daet Station Information

Station Name	Daet Complex Weather Station
Station Number (ID)	98440
Latitude	14 ° 07’ N
Longitude	122 ° 59’ E
Elevation	4.0 m
Altimeter Correction	-

Following WMO's standard for a meteorological station, Daet Station is designed to make representative measurements and data according to its type. As a Weather Station, Daet Station collaborates closely with local DRRMCs, LGUs, media outlets, and other relevant institutions within its jurisdiction. Daet Station submits monthly weather observation reports to the PAGASA Central Office in Quezon City and the SLPRSD Regional Office in Legazpi City.

As a radar station, it coordinates with weather forecasting and SLPRSD regional forecasting to provide critical weather information for the rainfall warning system (color-coded heavy rainfall warning system, rainfall, and thunderstorms advisory) and typhoon tracking monitoring.

Daet Station is equipped with multiple instruments capable of measuring surface parameters (Table 4.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and local weather-dependent operations such as airports, construction work, climate, and weather research. The station closely follows the WMO standard (WMO-No.8), which highlights meticulous calibration and quality control in generating data and information on weather and climate. This ensures that the weather data are accurate and reliable. Detailed information regarding each instrument will be shown in the subsequent sub-chapter.

Table 4.2 Daet Meteorological Instruments and Observed Parameters

<table>
<tr><th>Instrument</th><th>Picture</th><th>Description</th></tr>
<tr><td>Automatic Weather system (JAMSTEC)*</td><td>

</td><td>They have built-in weather instruments with electronic sensors for measuring surface-level air temperature pressure, solar radiation, rainfall amount, wind speed, and other meteorological observations.</td></tr>
<tr><td>Barograph*</td><td>

</td><td>Make use of aneroid cells, flexible metal chambers that expand or contract with regard to changes in atmospheric pressure. Also called “Dry Barograph</td></tr>
<tr><td>Digital Barometer*</td><td>


</td><td>Digital Barographs uses pressure sensing micro-electromechanical sensors to measure atmospheric pressure</td></tr>
</table>

Instrument	Picture	Description
Earth Network Lightning Detector (AWS)*		Earth Networks utilizes its high total lightning detection efficiency data and customized algorithms to issue Dangerous Thunderstorm Alerts, which provide significant lead times for impending severe weather.
Event Recorder*		An event recorder is usually used with a tipping bucket rain gauge. Precipitation is logged in an event recorder.
Instrument Shelter		An enclosure typically painted white houses thermometric instruments (e.g., thermometers, psychrometers, etc.) and protects 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, usually 32 inches long. Mercury rises or falls in response to changes in atmospheric pressure.

Instrument	Picture	Description
Minimum Thermometers*		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.
Standard Rain Gauge*		The Standard Rain Gauge measures precipitation. It is a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When this smaller tube is filled, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.
Sunshine Recorder*		A spherical lens that measures sunshine duration via concentrating a solar beam on a special dark paper.
Tipping Bucket Rain Gauge*		An instrument that measures precipitation and is usually attached to an event recorder. It is an upright cylinder that has a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a “tipping bucket” once filled (0.2 mm).

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 attached to a sensor that records the rotation of the shaft.
Wet and dry Thermometer (Psychrometer)		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube. The psychrometer measures wet and dry bulb temperatures.

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

PERSONNEL COMPLEMENT

PAGASA Daet Complex Weather Station is headed by its Chief Meteorological Officer, Mr. Reniel R. Mago, Weather Facilities Specialist II (Table 4.3). Prior to his assignment and designation in this station, he was previously assigned to SLPRSD Regional Forecasting in Legazpi City Albay as a Weather Forecaster for the past ten years and in Calapan Synoptic Station Oriental Mindoro as a Weather Observer. PAGASA Daet Complex Weather Station personnel are highly trained and can manage Radar and Synoptic stations. They are meteorologists mandated to perform meteorological observation using appropriate instruments, maintain and troubleshoot meteorological instruments, collect accurate data, and ensure efficient operation of the stations. Capable of delivering reliable and precise weather data and disseminating weather forecasts, warnings, advisories, and updates to the public and various stakeholders.

Table 4.3 List of Daet Personnel

Name	Role/Job Description	Email Address
Reniel R. Mago	Chief Meteorological Officer / WFS 2	renielmago@yahoo.com.ph
Raymund Gerard L. Ordinario	Weather Specialist 1	raymundgerard@gmail.com
Anjanette V. Ebron	Weather Observer 2	eanjanette@yahoo.com
Michael N. Abordo	Weather Observer 1	mabordo69@yahoo.com
Ronito A. Rodulfo Jr.	Weather Observer 1	ronitorodulfojunior@gmail.com
Lorie L. Salvador	Weather Observer Aide (Full Time)	salvadorlorie31@yahoo.com
Jay-R T. Teanila	Weather Observer Aide (Full Time)	Teanila0001@gmail.com

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

INSTRUMENT 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 as important as the data (see Chapter 10 for more information). Even with the advancement of methods in data homogeneity, recorded metadata still provides the occurrence of inhomogeneities with high precision. Changes that happened in the station should be kept, as well as maintenance history. Instrument metadata (data about data) provides detailed information about the instruments, which includes model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in the data collection.

Table 4.4 Metadata for Aspiration Psychrometer in PAGASA Daet Station

Manufacturer / Brand	SATO
Observed Parameter	Temperature
Date Installed / Deployed	February 16, 2023
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	2.0 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Annual
Model No.	SK-RHG
Serial No.	30288

Table 4.5 Metadata for Automatic Weather System in Daet Station

Manufacturer / Brand	JAMSTEC / Hydro Tech
Observed Parameter	Meteorological Data
Date Installed / Deployed	2004
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	10 meters
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Annual
Model No.	-
Serial No.	22370 (Rain Gauge)

Table 4.6 Metadata for Barograph in Daet Station

Manufacturer / Brand	Lambrecht
Observed Parameter	Station Pressure
Date Installed / Deployed	March 28, 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	1.30 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Annual
Model No.	Cert No. 198 series 2004
Serial No.	811215-0023

Table 4.7 Metadata for Digital Barometer in Daet Station

Manufacturer / Brand	Vaisala
Observed Parameter	Station Pressure & MSL Pressure
Date Installed / Deployed	February 16, 2023
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	1.5 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Annual
Model No.	-
Serial No.	R0730095

Table 4.8 Metadata for Earth Network Lightning Detector in Daet Station

Manufacturer / Brand	Earth Network
Observed Parameter	Meteorological Data
Date Installed / Deployed	January 15, 2019
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Hourly
Height from Ground (m)	10 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Annual
Model No.	-
Serial No.	-

Table 4.9 Metadata for Mercurial Barometer in Daet Station

Manufacturer / Brand	SATO
Observed Parameter	Station Pressure
Date Installed / Deployed	October 9, 2014
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	6 hourly
Height from Ground (m)	0.70 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Annual
Model No.	-
Serial No.	546

Table 4.10 Metadata for Minimum Thermometer in Daet Station

Manufacturer / Brand	
Observed Parameter	Minimum Temperature
Date Installed / Deployed	February 16, 2023
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	6 hourly
Height from Ground (m)	2.0 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Upon request
Model No.	-
Serial No.	1033

Table 4.11 Metadata for Rain Recorder in Daet Station

Manufacturer / Brand	Sato
Observed Parameter	Rainfall
Date Installed / Deployed	December 2, 2014
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	1.30 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Upon Request
Model No.	7820-00
Serial No.	6471

Table 4.12 Metadata for Standard Rain Gauge in Daet Station

Manufacturer / Brand	PAGASA
Observed Parameter	Rainfall
Date Installed / Deployed	December 2, 2014
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	1.0 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Annual
Model No.	-
Serial No.	-

Table 4.13 Metadata for Sunshine Recorder in Daet Station

Manufacturer / Brand	Precis Mecanique
Observed Parameter	Solar Radiation / Sunshine Radiation
Date Installed / Deployed	December 2, 2014
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Hourly
Height from Ground (m)	1.20 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Upon Request
Model No.	95’70 Bezon - France
Serial No.	-

Table 4.14 Metadata for Thermograph in Daet Station

Manufacturer / Brand	SATO
Observed Parameter	Temperature, Time Occurrence
Date Installed / Deployed	February 16, 2023
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	2.0 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Annual
Model No.	Sigma II
Serial No.	587960

Table 4.15 Metadata for Tipping Bucket Rain Gauge in Daet Station

Manufacturer / Brand	SATO
Observed Parameter	Rainfall & Intensity
Date Installed / Deployed	December 2, 2014
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	6 hourly
Height from Ground (m)	1.0 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Annual
Model No.	-
Serial No.	15442

Table 4.16 Metadata for Vane Anemometer in Daet Station

Manufacturer / Brand	
Observed Parameter	Wind Speed & Direction
Date Installed / Deployed	April 28, 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	10 m
Instrument Exposure*	Class 1
Representativeness of Observation*	Mesoscale
Maintenance Activity	Annual
Model No.	
Serial No.	BH14155

CHAPTER 5:

JUBAN SYNOPTIC STATION

Juban, Sorsogon, is a fourth-class municipality situated in the 2nd district of the province. It is renowned for its remarkable natural beauty and cultural heritage, making it a notable destination in the Bicol Region. Situated on the southeastern coast of the island of Luzon, Juban borders the serene waters of Sorsogon Bay to the northwest, providing a natural harbor and influencing the town's maritime activities, trade, and connectivity with neighboring areas. To the west, Juban is dominated by the imposing presence of Mount Bulusan, an active volcano. Juban's strategic location near Mount Bulusan also makes it prone to occasional volcanic activities, contributing to its unique geological features and fertile soil for agriculture. The mountain's towering peak and lush slopes loom over the municipality, creating a striking backdrop and influencing the local climate.

Figure 8 Facade (left) and Observation Garden (right) of Juban Station

The Juban Synoptic station (hereinafter referred to as Juban Station) was established on July 22, 2010 (Figure 8). Detailed information about the station location is given in Table 5.1. Its primary function is to conduct 3-hourly surface weather observations daily and hourly surface weather observations during severe weather conditions, particularly during tropical cyclones that may affect the locality. The station also plays a vital role as a member of the Sorsogon Provincial Disaster Risk Reduction and Management Council, providing essential Tropical Cyclone Briefings during the Provincial Pre-Disaster Risk Assessment (PDRA) when tropical cyclones are imminent. Moreover, a station representative attends local media interviews and radio broadcasts to provide real-time weather updates and warnings, is a knowledgeable resource speaker on PAGASA's Products and Services and other weather and climate-related topics, and participates in implementing PAGASA's special projects.

Table 5.1 Juban Station Information

Station Name	Juban Synoptic Station
Station Number (ID)	98545
Latitude	12°50’ N
Longitude	123°59’ E
Elevation	18 m
Altimeter Correction	-

Following WMO's standard for a meteorological station, the Juban station is designed to make representative measurements according to its type. In addition to its core responsibilities, the station is actively disseminating weather bulletins, warnings, and forecasts to local government units, media outlets, and other concerned agencies and individuals within the province. Juban Station submits monthly weather observation reports to the PAGASA Central Office and the SLRSD and weather certifications to concerned stakeholders.

Juban Station is equipped with multiple instruments capable of measuring surface parameters (Table 5.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, local weather-dependent operations such as airport and construction work, climate, and weather research. The station closely follows the WMO standard (WMO-No.8), highlighting meticulous calibration and quality control in generating data and information on weather, climate, and water. This ensures that the weather data are accurate and reliable. Detailed information regarding each instrument will be shown in the subsequent subchapter.

Table 5.2 Juban Meteorological Instruments and Observed Parameters

Instrument	**Picture**	**Description**
Digital Barometer*		Digital Barographs use pressure sensing micro-electromechanical sensors to measure atmospheric pressure.
Thermograph*		A thermograph is an instrument that measures temperature via a recording pen and a rotating chart mechanism.
Maximum and Minimum* Thermometer	 	Maximum and minimum thermometers are weather instruments that measure and record the highest and lowest temperatures over a specific period (e.g., 6 hours). They consist of two separate thermometers: one for recording the maximum temperature and the other for recording the minimum temperature. They often utilize mercury and alcohol or a similar substance to track temperature changes accurately.

Instrument	Picture	Description
Mercurial Barometer*		It measures atmospheric pressure using a column of mercury trapped inside a glass, usually 32 inches long. Mercury rises or falls in response to changes in atmospheric pressure.
Instrument Shelter		An enclosure typically painted white houses thermometric instruments (e.g., thermometers, psychrometers, etc.) and protects them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.
Microbarograph*		They use aneroid cells, flexible metal chambers that expand or contract in response to changes in atmospheric pressure. They are also called “Dry Barographs.”
Psychrometer*		Comprising two thermometers, namely wet and dry bulb thermometers, each housed within a double tube to minimize radiative heating from direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube. The psychrometer measures wet and dry bulb temperatures.

Instrument	Picture	Description
Remote Indicating Wind Vane*	 	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 rotation of the shaft.
Standard Rain Gauge*		Standard Rain Gauge measures precipitation. It is a cylindrical container with an 8-inch lid directing rainwater down a smaller tube inside. When this smaller tube is filled, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement
Sunshine Recorder*		A spherical lens that measures sunshine duration via concentrating a solar beam on a special dark paper.
Tipping Bucket Rain Gauge*		An instrument that measures precipitation and is usually attached to an event recorder. It is an upright cylinder that has a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once filled (0.5 mm).

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

PERSONNEL COMPLEMENT

Juban station is manned by a team of highly trained personnel, including meteorologists, technicians, and support staff headed by Mr. Ryan Orogo. The personnel 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 tasked to make synoptic and/ or climatological observations using the appropriate instruments, noting their uncertainties and representativeness. The observers maintain instruments and document metadata. If automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 5.3 List of Juban Personnel

Name	Role/Job Description	Email Address
Ryan Orogo	CMO	ryanorogo@gmail.com
Manuel Grutas	Weather Observer	mannygrutas@yahoo.com
Eugene Marrah Hainto	Weather Observer	eugenebasta24@gmail.com
Michael Cayetano	Weather Observer (.JO.)	mcayetano016@gmail.com

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

INSTRUMENT 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 as important as the data (see Chapter 10 for more information). Even with the advancement of methods in data homogeneity, recorded metadata still provides the occurrence of inhomogeneities with high precision. Changes that happened in the station should be kept, as well as maintenance history. Instrument metadata (data about data) provides detailed information about the instruments, which includes model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in the data collection.

Table 5.4 Metadata for Digital Barometer in Juban Station

Manufacturer / Brand	Vaisala
Observed Parameter	Station Pressure
Date Installed / Deployed	February 13, 2023
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	2
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	RO730451
Serial No.	RO730595

Table 5.5 Metadata for Hygrothermograph in Juban Station

Manufacturer / Brand	SATO
Observed Parameter	Dry Bulb Temperature
Date Installed / Deployed	August 15, 2022
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	2
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	SIGMA 7230-00
Serial No.	587900

Table 5.6 Metadata for Mercurial Barometer in Juban Station

Manufacturer / Brand	Sato
Observed Parameter	Station Pressure
Date Installed / Deployed	July 2010
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	344
Serial No.	-

Table 5.7 Metadata for Microbarograph in Juban Station

Manufacturer / Brand	Sato
Observed Parameter	Station Pressure
Date Installed / Deployed	July 2010
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.5
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	7237-00
Serial No.	579-350

Table 5.8 Metadata for Minimum Thermometer in Juban Station

Manufacturer / Brand	-
Observed Parameter	Minimum Temperature
Date Installed / Deployed	November 7, 2022
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.2
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	-
Serial No.	1030

Table 5.9 Metadata for Psychrometer in Juban Station

Manufacturer / Brand	Sato
Observed Parameter	Wet and Dry Bulb Temperature
Date Installed / Deployed	November 7, 2022
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	2
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	7450
Serial No.	30306

Table 5.10 Metadata for Remote Indicating Wind Vane in Juban Station

Manufacturer / Brand	Sato
Observed Parameter	Wind Speed and Direction
Date Installed / Deployed	July 2010
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	10
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	779000
Serial No.	BH12360

Table 5.11 Metadata for Standard Rain Gauge in Juban Station

Manufacturer / Brand	-
Observed Parameter	Rainfall Amount
Date Installed / Deployed	July 2010
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.2
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	-
Serial No.	-

Table 5.12 Metadata for Sunshine Recorder in Juban Station

Manufacturer / Brand	Precis Mecanique
Observed Parameter	Sunshine Duration
Date Installed / Deployed	July 2010
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	2
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	-
Model No.	95870
Serial No.	A10047

Table 5.13 Metadata for Tipping Bucket Rain Gauge in Juban Station

Manufacturer / Brand	Sato
Observed Parameter	Rainfall amount and duration
Date Installed / Deployed	February 2015
Mode (Source) of Observation	-
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.5
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	
Model No.	782000
Serial No.	6411

CHAPTER 6:

LEGAZPI SYNOPTIC AND UPPER-AIR STATION

Legazpi City lies along the Albay Gulf and the eastern coast of Albay province. North-northwest of the city is the Mayon Volcano. South of the city lies the equally mountainous province of Sorsogon, and to the east is the Albay Gulf, which leads into the Pacific Ocean. Several small islands aligned in an east-to-west direction provide a barrier for the city, protecting it from the high waves of the Pacific, especially during the typhoon season. The island province of Catanduanes is found north-northwest of the city. Northwest of Legazpi City lies Camarines Sur.

Figure 9 Facade (left) and Observation Garden (right) of Legazpi Station

The Legazpi Synoptic and Upper-Air Station (hereinafter referred to as Legazpi Station). is located at Old Airport Site, Magayon Drive, Brgy. Cruzada, Legazpi City (Figure 9). North and South of the station are residential areas. The topographical features of Legazpi City and its nearby areas have little effect on the wind patterns over the city. The city's climate is categorized as Type II, where the highest rainfall is experienced during December. The Legazpi station was originally established in 1902 and is located near Legazpi Airport. In September 1948, a prefabricated type B office building and a type D storage house were erected as part of a renovation. Alongside the essential meteorological equipment, the station was furnished with a quadruple recorder, ceiling light, and ceilometers for upper-air observations. Hourly observations were conducted throughout the day. The renovation project concluded in 1962. In 1966, the station was relocated to the ground level of the ATO building, approximately 50 meters from its original position. Finally, in 1984, it was moved to its present location, where hourly observations continue. Detailed information regarding the station is shown in Table 6.1.

Table 6.1 Legazpi Station Information

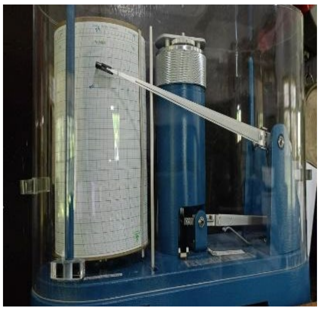
Station Name	PAGASA Legazpi Complex Station
Station Number	98444
Category	Surface Synoptic and Upper-Air Station
Date Established	January 1902
Latitude	13°09'N
Longitude	123°43'E
Elevation	15.487m
Altitude Correction	1.8 m

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

Legazpi Station is equipped with multiple instruments capable of measuring surface parameters (Table 6.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, local weather-dependent operations such as airport and construction work, climate, and weather research. The station closely follows the WMO standard (WMO-No.8), highlighting meticulous calibration and quality control in generating data and information on weather, climate, and water. This ensures that the weather data are accurate and reliable. Detailed information regarding each instrument will be shown in the subsequent subchapter.

Table 6.2 Legazpi Meteorological Instruments and Observed Parameters

Instruments	Photo	Description
Aerovane and Indoor Wind Indicator*	 	An instrument that measures both wind direction and speed
Altimeter Setting*		It is a device that measures altitude, the distance of a point above the sea level.
Aneroid Barometer*		Without using any liquids, this instrument measures air pressure.

Automatic Rain Gauge		It is a weather instrument to gauge and track rainfall totals and rates.
Barograph*		Use aneroid cells and flexible metal spaces that can alter in size in response to changes in air pressure. Also called “Dry Barograph”
Barometer*		This instrument is used to measure atmospheric pressure in a specific location.
Digital Pressure Recorder*		Digital barographs use micro-electromechanical pressure sensors to monitor air pressure.

Dry Bulb Thermometer and Wet Bulb Thermometer*		An instrument called a dry bulb thermometer and wet bulb thermometer gauges air humidity and temperature. It comprises two identical regular thermometers, a dry bulb thermometer and a wet bulb thermometer, which measure air temperature.
Instrument Shelter		An enclosure that is often painted white and is made to hold thermometric instruments (such as thermometers and psychrometers) to shield them from direct sunlight, precipitation, and condensation while providing adequate ventilation
Project-Based Automatic Weather Station	 	These automated stations have meteorological instruments built in. These instruments use electronic sensors to measure the air temperature, pressure, sun radiation, rainfall, and wind speed at ground level. The data is not used at the station but instead in a project.
Rainfall Recorder*		This instrument provides a continuous graphic record of rainfall over time.

Standard Rain Gauge		Rainfall is gauged using a standard rain gauge. Rainwater runs down a smaller tube inside a cylindrical container with an 8-inch cover. When the smaller tube is full, the bigger outer container serves as a reservoir, capturing the overflow without spilling a drop for subsequent measurement.
Sunshine Duration Recorder		A spherical lens that counts the length of time there is sunlight by focusing a solar beam on a specific type of dark paper.
Sunshine Radiation Recorder	  	Calculates the direct radiation intensity using a variety of photodiodes with varying levels of exposure. The instrument's data is sent to the central Office and is not used at the station.
Thermograph*		A device that continuously records the temperature over a day or a week

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

PERSONNEL COMPLEMENT

The Legazpi Synoptic and Upper-Air Station are staffed by a proficient team led by Ms. Lilian Guillermo, the Chief Meteorological Officer (CMO). Table 6.3 shows current Legazpi personnel. They guarantee the data collected are accurate and reliable before releasing it to the public.

Table 6.3 List of Legazpi Personnel

Name	Role/Job Description	Year Started
Lilian Guillermo	Senior Weather Specialist	1991
Michelle Tibi	Weather Observer III	2011
Neil John Miranda	Weather Observer IV	2012
Louren Berial	Weather Observer II	2019
Rommel Tulay	Weather Facilities Technician I	2019
Ma. Alma Barona	Weather Observer I	2024
Ronna Anne Azul	Job Order	2023
Shiena Mae Bonagua	Job Order	2023

*As of the time of writing in May 2024

INSTRUMENT 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 as important as the data (see Chapter 10 for more information). Even with the advancement of methods in data homogeneity, recorded metadata still provides the occurrence of inhomogeneities with high precision. Changes that happened in the station should be kept, as well as maintenance history. Instrument metadata (data about data) provides detailed information about the instruments, which includes model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in the data collection.

Table 6.4 Metadata for Altimeter Setting in Legazpi Station

Manufacturer/Brand	Wallace & Tiernan
Observed Parameter	Atmospheric Pressure
Date Installed/Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Toposcale
Maintenance Activity	Annual
Model No.	FA 139
Serial No.	ZZ 10763

Table 6.5 Metadata for Aneroid Barometer in Legazpi Station

Manufacturer/Brand	P. Frederico Faura
Observed Parameter	Atmospheric Pressure
Date Installed/Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Toposcale
Maintenance Activity	Annual
Model No.	-
Serial No.	-

Table 6.6 Metadata for Barograph in Legazpi Station

Manufacturer/Brand	Vaisala
Observed Parameter	Atmospheric Pressure
Date Installed/Deployed	28 August 2019
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	10 Minutes
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Toposcale
Maintenance Activity	Annual
Model No.	PTB330
Serial No.	R0730594

Table 6.7 Metadata for Digital Barometer in Legazpi Station

Manufacturer/Brand	Sato Keiryoki Mfg. Co, Ltd.
Observed Parameter	Atmospheric Pressure
Date Installed/Deployed	28 May 2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	6 Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Toposcale
Maintenance Activity	Annual
Model No.	575
Serial No.	

Table 6.8 Metadata for Mercurial Barometer in Legazpi Station

Manufacturer/Brand	Assman
Observed Parameter	Temperature (wet & dry bulb)
Date Installed/Deployed	20 May 2014
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Annual
Model No.	-
Serial No.	-

Table 6.9 Metadata for Psychrometer in Legazpi Station

Manufacturer/Brand	Assman
Observed Parameter	Temperature (wet & dry bulb)
Date Installed/Deployed	20 May 2014
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Annual
Model No.	-
Serial No.	-

Table 6.10 Metadata for Rainfall Recorder in Legazpi Station

Manufacturer/Brand	Sato Keiryoki Mfg. Co, Ltd.
Observed Parameter	Rainfall
Date Installed/Deployed	27 February 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 2
Representative of Observation	Microscale
Maintenance Activity	Annual
Model No.	7820-00
Serial No.	6491

Table 6.11 Metadata for Rainfall Sensor Tipping Bucket in Legazpi Station

Manufacturer/Brand	Sato Keiryoki Mfg. Co, Ltd
Observed Parameter	Rainfall
Date Installed/Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	10 Minutes
Height from Ground (m)	-
Instrument Exposure	Class 2
Representativeness of Observation	Microscale
Maintenance Activity	Annual
Model No.	798-S-40
Serial No.	15414

Table 6.12 Metadata for Thermograph in Legazpi Station

Manufacturer/Brand	Sigma-II
Observed Parameter	Temperature
Date Installed/Deployed	27 February 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	10 Minutes
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Annual
Model No.	7230-00
Serial No.	58118

Table 6.13 Metadata for Wind Tracker in Legazpi Station

Manufacturer/Brand	YOUNG USA
Observed Parameter	Wind
Date Installed/Deployed	15 July 2009
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	10 Minutes
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	Toposcale
Maintenance Activity	Annual
Model No.	06201
Serial No.	WT 18291

CHAPTER 7:

MASBATE SYNOPTIC AND AEROMET STATION

The islands of Masbate lie exactly in the center of the Philippine archipelago. It is bounded north by Burias and Ticao Pass, east by the San Bernardino Strait, south by the Visayan Sea, and west by the Sibuyan Sea. Masbate City is the lone city in the province of Masbate. It is the home of the provincial and city seats of power and the provincial offices of the national government agencies. Masbate's topography ranges from slightly undulating to rolling and from hilly to mountainous. Rugged topography is concentrated in the north-northeastern and gradually recedes to blunt hills and rolling areas in the south, southeast, and southwest. With climate Type III characterized by no pronounced maximum rain period with a short dry season, Masbate has the lowest rainfall volume in the region.

Figure 10 Facade (left) and Observation Garden (right) of Masbate Station

The weather station in Masbate (hereinafter referred to as Masbate Station) was initially established in 1951. Originally, the station was a Port Meteorological Station situated near Masbate Sea Port to cater to the needs of sea travelers during that time. In 1983, the station was relocated near Masbate Airport to cater to the needs of meteorological information for the air traffic controller. To date, the station located on Nursery Street, Masbate City, is still near the Airport; however, due to population growth and migration, informal settlers have occupied the area (Figure 10). These settlers limited the capacity of the station to conduct its aerometeorological duty. The station environment (land use and vicinity within ten sq. km.) is characterized by residential areas to the north of the station; to the east are some residential and trees; to the south, are subdivisions, grassland, and residential areas; and to the west are buildings and houses. Detailed information about the station is given in Table 7.1 below.

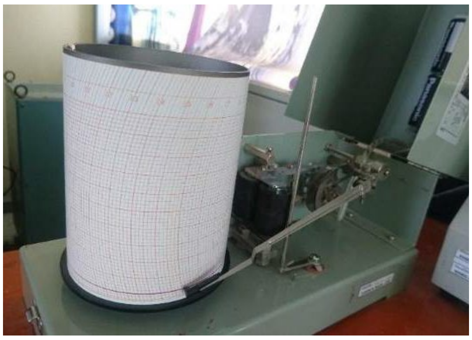
Table 7.1 Masbate Station Information

Station Name	Masbate Synoptic Station
Station Number (ID)	98543
Latitude	12° 22'
Longitude	123° 37'
Elevation	10 m
Altimeter Correction	1.1

With the city's ongoing economic development, in the next 10 to 20 years, this area will be surrounded by buildings. When this station was built, the station was the only concrete structure in the area. But now, the station seems to be the lowest building in the region, which means that our area now serves as the catch-basin of all the floodwaters from the upstream area. Engineering intervention is now needed here, maybe to make the station building a 2-story building to abate flooding incidents in the future.

Masbate Station is equipped with multiple instruments capable of measuring surface parameters (Table 7.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, local weather-dependent operations such as airport and construction work, climate, and weather research. The station closely follows the WMO standard (WMO-No.8), which highlights meticulous calibration and quality control in the generation of data and information on weather, climate, and water. This ensures that the weather data are accurate and reliable. Detailed information regarding each instrument will be shown in the subsequent subchapter.

Table 7.2 Masbate Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Barograph*		Make use of aneroid cells, flexible metal chambers that expand or contract with regard to changes in atmospheric pressure. Also called "Dry Barograph."
Digital Barometer*		Digital Barographs use pressure sensing micro-electromechanical sensors to measure atmospheric pressure.
Event Recorder		An event recorder is usually used with a tipping bucket rain gauge. Precipitation is logged in an event recorder.
Instrument Shelter		An enclosure typically painted white is designed to house thermometric instruments (e.g., thermometers, psychrometers, etc.) and protect them from direct exposure to sunlight, precipitation, and condensation while providing adequate ventilation.

Instrument	Picture	Description
Maximum Thermometers		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of the pure liquid with respect to its glass container. They are used to measure maximum temperature.
Mercurial Barometer		It measures atmospheric pressure using a column of mercury trapped inside a glass, usually 32 inches long. 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 the pure liquid with respect to its glass container. 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 direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube. The psychrometer measures wet and dry bulb temperatures.
Standard Rain Gauge		The Standard Rain Gauge measures precipitation. It is a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When this smaller tube is filled, 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 that measures sunshine duration via concentrating a solar beam on a special dark paper.
Thermograph*		A thermograph is an instrument that measures temperature via a recording pen and a rotating chart mechanism.
Tipping Bucket Rain Gauge*		An instrument that measures precipitation and is usually attached to an event recorder. It is an upright cylinder that has a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once filled (0.2 mm).
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 attached 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

The Masbate synoptic station, headed by Mr. Christian Alen Torrevillas (formerly by Ms. Rizza G. Bartolata), is manned by highly trained personnel, including meteorologists and observers. The personnel 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 tasked to make synoptic and/ or climatological observations using the appropriate instruments, noting their uncertainties and representativeness. The observers maintain instruments and document metadata. If automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 7.3 List of Masbate Personnel

Name	Role/Job Description	Email Address
Christian Alen Torrevillas	Weather Specialist I-OIC	alen.torrevillas@gmail.com
Eduardo Salvador Cayetano	Weather Observer II	ecayetano@rocketmail.com
Melissa Claire Garamay	Weather Observer II	melissa.garamay10@gmail.com
Kimberly Ann Barrun	Weather Observer I	k_barrun@yahoo.com

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

INSTRUMENT METADATA

Information about meteorological instruments is essential for identifying, locating, and describing their type, history, condition, and exposure. Through time, instrument data lead to uncertainty due to possible reasons such as wear, urbanization, ambient changes, etc., which may cause inhomogeneity (see Chapter 10 for more information). Instrument metadata provides detailed information about its specifications, usage, manufacturer, and location.

Table 7.4 Metadata for Aneroid Barometer in Masbate Station

Manufacturer / Brand	Short & Mason London
Observed Parameter	Pressure
Date Installed / Deployed	April 21, 1994
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.8
Instrument Exposure	-
Representativeness of Observation	-
Maintenance Activity	Upon Request/ Quarterly
Model No.	170230037
Serial No.	WB 480-5

Table 7.5 Metadata for Assmann Psychrometer (Alcohol-based) in Masbate Station

Manufacturer / Brand	Sato Keiryoki Mfg. Co. Ltd.
Observed Parameter	Temperatures (Dry Bulb and Wet Bulb)
Date Installed / Deployed	October 15, 2022
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Hourly/ 3 hourly
Height from Ground (m)	1.30
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	7450
Serial No.	18601 / 30293

Table 7.6 Metadata for Assmann Psychrometer (Mercury) in Masbate Station

Manufacturer / Brand	Sato Keiryoki Mfg. Co. Ltd.
Observed Parameter	Temperature
Date Installed / Deployed	February 28, 2015
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.30
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	7450
Serial No.	-

Table 7.7 Metadata for Barograph in Masbate Station

Manufacturer / Brand	Lambrecht Meteorological Instruments Germany
Observed Parameter	Station Pressure
Date Installed / Deployed	February 28, 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3-hourly/6-hourly
Height from Ground (m)	1.21
Instrument Exposure	Class 2
Representativeness of Observation	-
Maintenance Activity	Upon Request/ Quarterly
Model No.	00.02920.110002
Serial No.	8112160.0046

Table 7.8 Metadata for Digital Barometer (Vaisala) in Masbate Station

Manufacturer / Brand	Vaisala
Observed Parameter	Pressure
Date Installed / Deployed	October 15, 2022
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Hourly/ 3-hourly
Height from Ground (m)	1.35
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	PTB330
Serial No.	R0750090

Table 7.9 Metadata for Event Recorder in Masbate Station

Manufacturer / Brand	Sato Keiryoki Mfg. Co. Ltd.
Observed Parameter	Rainfall Amount, Duration, and Intensity
Date Installed / Deployed	February 28, 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.2
Instrument Exposure	Class 2
Representativeness of Observation	-
Maintenance Activity	Upon Request/ Quarterly
Model No.	7820-00
Serial No.	6466

Table 7.10 Metadata for Microbarograph in Masbate Station

Manufacturer / Brand	Sato Keiryoki Mfg. Co. Ltd.
Observed Parameter	Pressure
Date Installed / Deployed	May 3, 2018/ (for service)
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 3
Representativeness of Observation	-
Maintenance Activity	Upon Request/ Quarterly
Model No.	7237-00
Serial No.	579919

Table 7.11 Metadata for Minimum Thermometer in Masbate Station

Manufacturer / Brand	-
Observed Parameter	Minimum Temperature
Date Installed / Deployed	October 15, 2022
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	6 hourly
Height from Ground (m)	1.84
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	1075

Table 7.12 Metadata for Sunshine Recorder in Masbate Station

Manufacturer / Brand	Precis. Mecanique
Observed Parameter	Sunshine Duration
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	1.2
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request/ Quarterly
Model No.	-
Serial No.	-

Table 7.13 Metadata for Thermograph in Masbate Station

Manufacturer / Brand	Sato Keiryoki Mfg. Co. Ltd.
Observed Parameter	Temperature
Date Installed / Deployed	February 28, 2015/ October 15, 2022
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	6 hourly
Height from Ground (m)	1.30
Instrument Exposure	Class 2
Representativeness of Observation	-
Maintenance Activity	Upon Request/ Quarterly
Model No.	7230-00
Serial No.	585117

Table 7.14 Metadata for Tipping Bucket in Masbate Station

Manufacturer / Brand	Sato Keiryoki Mfg. Co. Ltd.
Observed Parameter	Rainfall Amount, Duration, and Intensity
Date Installed / Deployed	February 28, 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	0.50
Instrument Exposure	Class 2
Representativeness of Observation	-
Maintenance Activity	Quarterly, Upon Request
Model No.	7980-S-40
Serial No.	15437

Table 7.15 Metadata for Wind Vane (Speed and Direction) in Masbate Station

Manufacturer / Brand	Sato Keiryoki Mfg. Co. Ltd.
Observed Parameter	Wind Speed and Direction
Date Installed / Deployed	February 28, 2015
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	Hourly/3-hourly
Height from Ground (m)	0.85
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	7790-00
Serial No.	BH14241

CHAPTER 8:
ROMBLON SYNOPTIC STATION

Romblon Province is known as the “Marble Capital of the Philippines.” The islands of Romblon lie on the Sibuyan Sea, south of Marinduque Island and north of Panay Island. To the east is the Island of Masbate, and to the west is the Island of Mindoro. The province comprises three major islands: Romblon, where the capital city of Romblon is located; Tablas, the largest island in the province; and Sibuyan, the easternmost island. Most of Romblon Island has a mountainous, rugged topography of volcanic origin. The highest elevation in the province is Mount Guiting-Guiting in Sibuyan, which stands at 2,058 m. The peak boasts one of the most challenging climbs in the country due to its jagged summit. Due to its geography, the province is endowed with lush vegetation and mineral resources. The fertile soil nurtures various agricultural activities.

Romblon’s climate is a type III climate based on the Modified Coronas Classification. It has no very pronounced maximum rain period and a dry season lasting only one to three months, from December to February or from March to May. Areas of this climate type are partly shielded from the northeast monsoon and benefit from the rainfall caused by tropical cyclones.

Figure 11 Facade (left) and Observation Garden (right) of Romblon Station

The Romblon Synoptic Station (hereinafter referred to as Romblon Station) is situated at Sitio Wireless, Brgy Lonos Romblon, Romblon. Detailed information about the station location is given in Table 8.1. Romblon station is a roughly open area with a slope of more than 45^0, cropland/natural vegetation, and a ridge at the middle elevation within hills surrounded by crops with minimal obstructions. (Figure 11) The station is situated at a low altitude, more than 100 m above mean sea level. Notable visibility markers near the station are the Wind Mill in the Southeast, Mt. Iso in the Southeast, and Barangay Li-o Hills in the East.

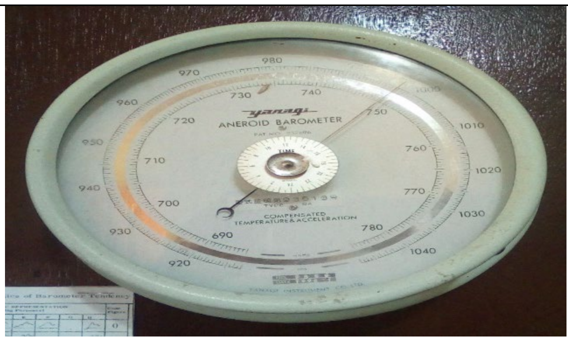
Table 8.1 Romblon Station Information

Station Name	Romblon Synoptic Station
Station Number (ID)	98536
Latitude	12° 34’ 257’’
Longitude	122° 15’ 388’’
Elevation	176.55 m

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

Romblon Station is equipped with multiple instruments capable of measuring surface parameters (Table 8.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, and local weather-dependent operations such as construction work, climate, and weather research. The station closely follows the WMO standard (WMO-No.8), highlighting meticulous calibration and quality control in generating data and information on weather, climate, and water. This ensures that the weather data are accurate and reliable. Detailed information regarding each instrument will be shown in the subsequent subchapter.

Table 8.2 Romblon Meteorological Instruments and Observed Parameters

Instruments	Pictures	Description
Aerovane and Anemometer	 	Anemometers measure wind speed and direction. A vane anemometer is an anemometer in which an Aerovane is attached to a stationary or rotating shaft. The vane is attached to a sensor that records the shaft's rotation.
Aneroid Barometer		An aneroid barometer measures air pressure using a method that does not involve liquid.
Barograph		They use aneroid cells, flexible metal chambers that expand or contract in response to changes in atmospheric pressure. They are also called “Dry Barographs.”

Event Recorder		An event recorder is normally used with a tipping bucket rain gauge. Precipitation is logged in an event recorder.
Instrument Shelter		An enclosure typically painted white is designed to house thermometric instruments (e.g., thermometers, psychrometers, etc.) 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 the pure liquid with respect to its glass container. They are used to measure maximum temperature.
Mercurial Barometer		It measures atmospheric pressure using a column of mercury trapped inside a glass, usually 32 inches long. 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. 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 direct sunlight and longwave radiation exchange between the thermometer and the surrounding tube. The psychrometer measures wet and dry bulb temperatures.
Pyranometer and Meteon	 	A type of actinometer used for measuring solar irradiance on a planar surface, it is designed to measure the solar radiation flux density (W/m2) from the hemisphere above within a wavelength range of 0.3 µm to 3 µm.
Standard Rain Gauge		The Standard Rain Gauge measures precipitation. It is a cylindrical container with an 8-inch lid that directs rainwater down a smaller tube inside. When this smaller tube is filled, the larger outer container acts as a reservoir, catching the overflow without spilling a drop for later measurement.
Sunshine Recorder		A spherical lens that measures sunshine duration via concentrating a solar beam on a special dark paper.
Thermograph		A thermograph is an instrument that measures temperature via a recording pen and a rotating chart mechanism.

Tipping Bucket Rain Gauge		An instrument that measures precipitation and is usually attached to an event recorder. It is an upright cylinder that has a funnel-shaped receiver. The precipitation collected by the receiver empties into one side of a "tipping bucket" once filled (0.5 mm).

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

PERSONNEL COMPLEMENT

Romblon station is manned by a team of trained Meteorological observer personnel, including technicians, radio operators, and support staff headed by Mr. Richard Magayam. The personnel listed in Table 8.3 ensure the smooth operation of the station, accurate data collection, and reliable weather forecasts and warnings to the public and various stakeholders. Meteorological observers are tasked to make synoptic observations using the appropriate instruments, noting their uncertainties and representativeness. The observers maintain instruments and document metadata. If automatic equipment experiences technical errors, the observers provide supplementary or backup observations.

Table 8.3 List of Romblon Personnel

Name	Role/Job Description	Email Address
Richard Magayam	WO-I/CMO	magayamrichard27@gmail.com
Bryan Riva	WO-I	riva.bryan30@yahoo.com
Dony Marcelino Jr	Job Order (JO)	jrmarcelino1989@gmail.com
Patrick Kirk Indonila	Job Order (JO)	patrickindonila291994@gmail.com

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

INSTRUMENT 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 as important as the data (see Chapter 10 for more information). Even with the advancement of methods in data homogeneity, recorded metadata still provides the occurrence of inhomogeneities with high precision. Changes that happened in the station should be kept, as well as maintenance history. Instrument metadata (data about data) provides detailed information about the instruments, which includes model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in the data collection.

Table 8.4 Metadata for Aerovane and Anemometer in Romblon Station

Manufacturer / Brand	Komatsu Factory
Observed Parameter	Wind Direction and Wind Speed
Date Installed / Deployed	June 23, 2016
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3 Hourly
Instrument Condition	Operational
Height from Ground (m)	1(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	BH14167

Table 8.5 Metadata for Aneroid Barometer in Romblon Station

Manufacturer / Brand	Yanagi
Observed Parameter	Pressure
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	6 Hourly
Height from Ground (m)	1.6(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	OSK16649
Serial No.	-

Table 8.6 Metadata for Barograph in Romblon Station

Manufacturer / Brand	Lambrecht
Observed Parameter	Pressure
Date Installed / Deployed	June 23, 2016
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3 Hourly
Height from Ground (m)	0.8(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Quarterly, Upon Request
Model No.	-
Serial No.	8112150025

Table 8.7 Metadata for Event Recorder in Romblon Station

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Rainfall Amount, Duration, and Intensity
Date Installed / Deployed	August 14, 2014
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3 Hourly
Height from Ground (m)	1.2(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Quarterly, Upon Request
Model No.	-
Serial No.	6152

Table 8.8 Metadata for Mercurial Barometer in Romblon Station

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Pressure
Date Installed / Deployed	June 23, 2016
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	6 Hourly
Height from Ground (m)	0.8(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	605
Serial No.	-

Table 8.9 Metadata for Minimum and Maximum Thermometers in Romblon Station

Manufacturer / Brand	-
Observed Parameter	Maximum and Minimum Temperatures
Date Installed / Deployed	-
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	6 Hourly
Height from Ground (m)	1.5(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Upon Request
Model No.	-
Serial No.	-

Table 8.10 Metadata for Psychrometer in Romblon Station

Manufacturer / Brand	Assman Type (Sato)
Observed Parameter	Temperatures (Dry Bulb and Wet Bulb)
Date Installed / Deployed	August 14, 2014
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3 Hourly
Height from Ground (m)	1.7(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Quarterly, Upon Request
Model No.	7450
Serial No.	18585

Table 8.11 Metadata for Pyranometer in Romblon Station

Manufacturer / Brand	KIPP and ZONEN
Observed Parameter	Solar Radiation
Date Installed / Deployed	August 26, 2016
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Monthly
Height from Ground (m)	2(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Quarterly
Model No.	-
Serial No.	138246

Table 8.12 Metadata for Standard Rain Gauge in Romblon Station

Manufacturer / Brand	8-inch Rain Gauge
Observed Parameter	Rainfall Amount
Date Installed / Deployed	June 14, 2014
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Three hourly
Height from Ground (m)	1(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Quarterly
Model No.	-
Serial No.	-

Table 8.13 Metadata for Sunshine Recorder in Romblon Station

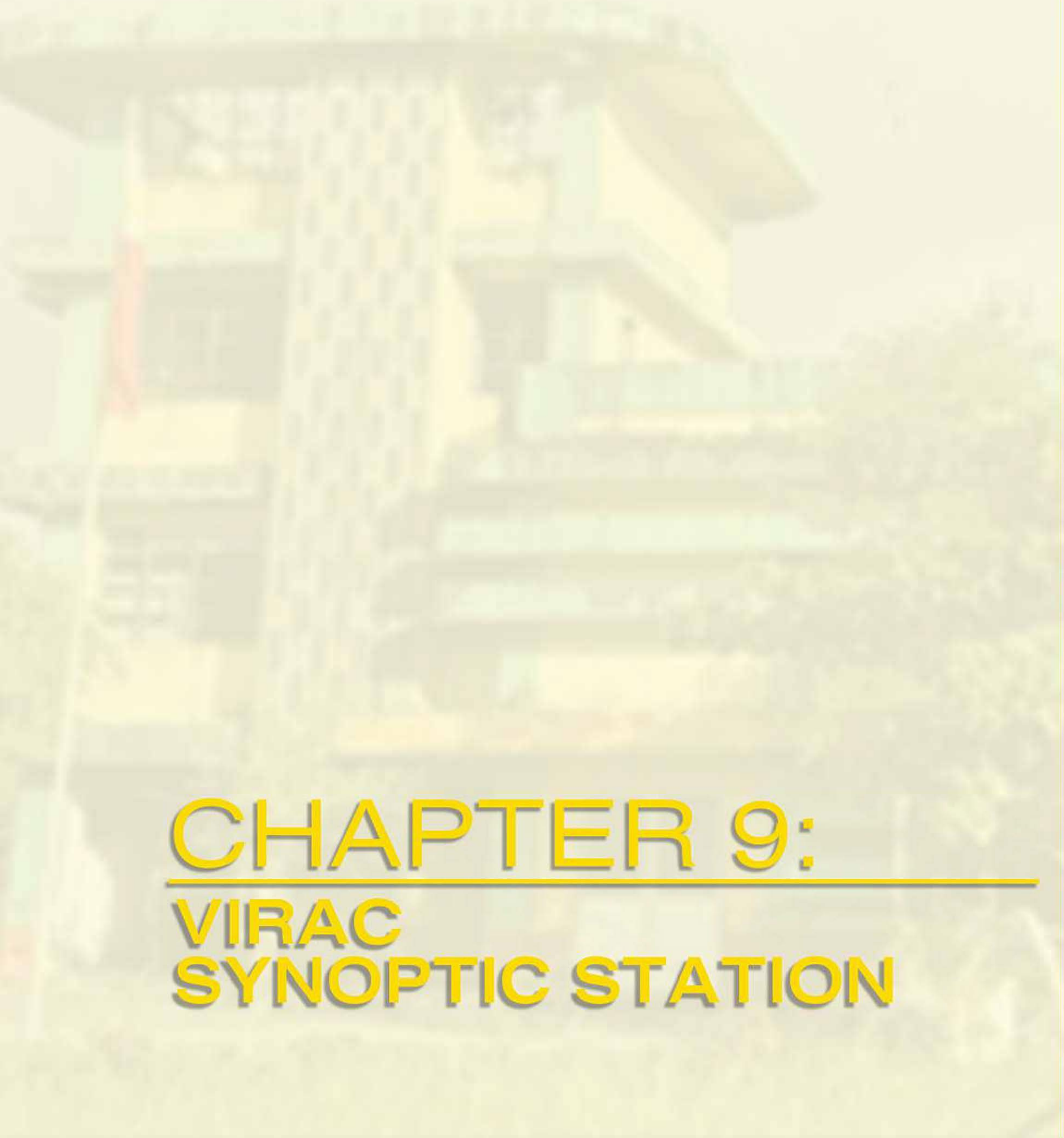
Manufacturer / Brand	Societe Precis Mecanique (Campbell-Stoke)
Observed Parameter	Sunshine Duration and Intensity
Date Installed / Deployed	August 14, 2014
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	Daily
Height from Ground (m)	2(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Quarterly
Model No.	-
Serial No.	-

Table 8.14 Metadata for Thermograph in Romblon Station

Manufacturer / Brand	Sato Sigma-II
Observed Parameter	Temperature
Date Installed / Deployed	June 14, 2022
Mode (Source) of Observation	Manual
Temporal Reporting Period (Sampling Interval)	3 Hourly
Height from Ground (m)	1.5(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Quarterly, Upon Request
Model No.	-
Serial No.	587965

Table 8.15 Metadata for Tipping Bucket in Romblon Station

Manufacturer / Brand	Sato Keiryoki
Observed Parameter	Rainfall Amount, Duration, and Intensity
Date Installed / Deployed	August 14, 2014
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 Hourly
Height from Ground (m)	1(m)
Instrument Exposure	Class 1
Representativeness of Observation	Mesoscale
Maintenance Activity	Quarterly, Upon Request
Model No.	-
Serial No.	-



CHAPTER 9:

VIRAC SYNOPTIC STATION

The Municipality of Virac is a 1st class municipality and the capital of the province of Catanduanes, Philippines. Its Climate falls under Type II of the “Coronas Classification” for the climatic zones, having no dry season with a very pronounced rainfall, usually from November to January when storms are more frequent and low-pressure systems are active. The region’s dependence on agriculture means that these weather disturbances have always hampered economic development.


Figure 12 Facade (left) and Observation Garden (right) of Virac Station

In 1922, the Virac Synoptic Station (hereinafter referred to as Virac Station) was established. In 1946, the station underwent restoration due to the impact of the Second World War and occupied one of the rooms of the Old Capitol Building. A new building was constructed in 1949 to house the station at the heart of the town proper (The triangle now called the Virac fountain). After the advent of Typhoon Sening in 1970, a new building was constructed near the Virac airport, which became the location of the Virac station since then, which is at Brgy. San Isidro Village, Virac, Catanduanes.

Virac Synoptic is an open and flat terrain slope of less than 3 degrees (Figure 12). It is surrounded by a landscape with minimal obstructions. Its land area is approximately 103,359 m^2 (7,000 m^2 with cyclone wire fence). The elevation of the station is 40 meters above sea level. The Mountain (East), with a 4 km distance from the station, and the telecommunication tower (East North East), with a 3.5km distance, are the visibility markers near the station. Detailed information about the station is given in Table 9.1 below.

Table 9.1 Virac Synoptic Station

Station Name	Virac Synoptic Station
Station Number (ID)	98446
Latitude	13° 35’
Longitude	124° 14’
Elevation	40 m
Altimeter Correction	-

The Virac Synoptic station is designed according to WMO standards. It collaborates closely with the local media, provincial and municipal DRRM, and the other Disaster Risk Council members. The station also submits monthly weather reports to the PAGASA Central Office and the Southern Luzon Regional Office. In 2018, it reported METAR to Virac CAAP to provide critical weather information for aviation operations.

Virac Station is equipped with multiple instruments capable of measuring surface parameters (Table 9.2). Data obtained from these instruments are used for weather forecasting, severe weather warnings, local weather-dependent operations such as airport and construction work, climate, and weather research. The station closely follows the WMO standard (WMO-No.8), which highlights meticulous calibration and quality control in the generation of data and information on weather, climate, and water. This ensures that the weather data are accurate and reliable. Detailed information regarding each instrument will be shown in the subsequent subchapter.

Table 9.2 Virac Meteorological Instruments and Observed Parameters

Instrument	Picture	Description
Aerovane/ Receiver Wind Indicator	 	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 attached to a sensor that records the rotation of the shaft.
Barograph		A barograph is a recording barometer. The pen point that traces the pressure curve on the paper is made to move up or down by means of a series of levers attached to aneroid cells (metallic boxes) in tandem. Using aneroid cells in tandem provides a more pronounced response to changes in atmospheric pressure than would be indicated by a single aneroid cell of the same size.

Instrument	Picture	Description
Digital Barometer		Digital Barographs use pressure sensing micro-electromechanical sensors to measure atmospheric pressure.
Instrument Shelter		Instrument shelters are usually painted white, have louvered sides, usually a double roof, and are mounted on a stand a meter or so above the ground with the door side facing poleward. It is designed to protect specific meteorological instruments from exposure to direct sunshine, precipitation, and condensation while at the same time providing adequate ventilation.
Maximum Thermometer		A maximum thermometer has a constriction above the bulb that permits the mercury to rise in the capillary tube but does not allow it to descend the capillary tube unless the thermometer is reset. The highest point the mercury reaches indicates the maximum temperature for the period.

Instrument	Picture	Description
Mercurial Barometer		A mercurial barometer is a simple barometer made by filling a glass tube 32 inches long with mercury and inverting it so that the tube's open end is below the mercury surface in a cistern. The height of the mercury column is measured by sliding a vernier attached to a scale. To obtain accurate measurements, corrections are made for temperature expansion of the instrument, gravity, and latitude. Values are read in millibars, millimeters, or inches of mercury.
Minimum Thermometer		Liquid-in-glass thermometers indicate temperature by measuring the differential expansion of the pure liquid with respect to its glass container. They are used to calculate minimum temperature.
Psychrometer		Determine the air temperature and humidity of the ambient air. They consist of two thermometers inside a double tube to minimize radiative heating by the direct sun and longwave radiation exchange between the thermometer and the surrounding tube. In addition, the instrument is ventilated during measurement by a manually winded fan. One of the thermometers is covered by a cotton gaze that has to be wettened before the measurement. Depending on the ambient humidity, water evaporates from the wet gaze, and cooling down, the damp thermometer reaches the so-called wet-bulb temperature after a few minutes. From the wet bulb

Instrument	Picture	Description
		temperature, the air temperature is measured simultaneously by the dry thermometer, and the air pressure and humidity can be calculated.
Standard Rain Gauge		Standard Rain Gauge measures precipitation. It is a cylindrical container with an 8-inch lid directing rainwater down a smaller tube inside. When filling this smaller tube, 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 records air temperature on graphing paper. It usually consists of a cylinder made to revolve once weekly through clockwork inside. A sheet of graph paper is fastened on the outside. A pen-point that rests on the paper traces the temperature curve according to the expansion and contraction of a sensitive metallic coil or strip corresponding to the reading of a thermometer. These instruments are housed in a thermometer shelter with double-louvered sides and double-top roofing designed to permit air to circulate freely.

Instrument	Picture	Description
Tipping Bucket Rain gauge		A type of rainfall recording instrument. It is an upright cylinder that has a funnel-shaped collector. The precipitation collected by the collector empties into one side of a "tipping bucket," an inverted triangular contraption partitioned transversely at its center and is pivoted about a horizontal axis. Once one compartment is filled with rain, it tips, spilling out the water and placing the other half of the bucket under the funnel. The tipping activates a mercury switch, causing an electrical current to move the pen in the recorder. Each tipping is equal to one-half millimeter of rainfall.

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

PERSONNEL COMPLEMENT

Virac Station is manned by highly trained personnel (Table 9.3). It is headed by Mr. Juan Pantino Jr. The Weather Observers collect, analyze, and report weather-related data and observations. If the observers encounter a technical issue, they provide backup observations. Each personnel has specific responsibilities and expertise that contribute to weather observations' overall accuracy and reliability.

Table 9.3 List of Virac Personnel

Name	Role/Job Description	Email Address
Juan Pantino Jr	Weather Observer IV CMO – Synoptic station and Bato Doppler Radar	jpantino_oragon@yahoo.com
Nilo Gianan Jr.	Weather Observer III	gianan999@gmail.com
Grace De Nava	Weather Facilities Technician I	gracetimola@yahoo.com
April Joy Orasa	Weather Observer I	apriljoytarnate@yahoo.com
Evan Tabios	Weather Observer I	evantabios0326@gmail.com
Rommel Tulay	Weather Facilities Technician I	tulayrommel@yahoo.com

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

INSTRUMENT 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 just as important as the data itself (see Chapter 10 for more information). Even with the advancement of methods in data homogeneity, recorded metadata still provides the occurrence of inhomogeneities with high precision. Changes that happened in the station should be kept, as well as maintenance history. Instrument metadata (data about data) provides detailed information about the instruments, which includes model specifications, manufacturer, calibration dates, measurement range, and accuracy. Using metadata ensures transparency and traceability in the data collection.

Table 9.4 Metadata for Aerovane in Virac Station

Manufacturer / Brand	Aerovane
Observed Parameter	Wind Direction, Wind Speed
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.	-

Table 9.5 Metadata for Barograph in Virac Station

Manufacturer / Brand	Barograph/ Lambrecht
Observed Parameter	Atmospheric Pressure
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.	811216.003

Table 9.6 Metadata for Digital Barometer in Virac Station

Manufacturer / Brand	Digital Barometer/ Vaisala
Observed Parameter	Atmospheric Pressure
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.	R0730450

Table 9.7 Metadata for Event Recorder in Virac Station

Manufacturer / Brand	Event Recorder/ Sato Keiryoki
Observed Parameter	Rainfall Amount, Duration, Intensity
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	-
Height from Ground (m)	-
Instrument Exposure	Class 2
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	6432

Table 9.8 Metadata for Maximum Thermometer in Virac Station

Manufacturer / Brand	Maximum Thermometer
Observed Parameter	Highest Temperature
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.	-

Table 9.9 Metadata for Minimum Thermometer in Virac Station

Manufacturer / Brand	Minimum Thermometer
Observed Parameter	Lowest Temperature
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.	1049

Table 9.10 Metadata for Psychrometer in Virac Station

Manufacturer / Brand	Pyschrometer/ Assman Type
Observed Parameter	Temperature (Dry and Wet Bulb)
Date Installed / Deployed	-
Mode (Source) of Observation	Automatic
Temporal Reporting Period (Sampling Interval)	3 hourly
Height from Ground (m)	-
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	7450
Serial No.	30287

Table 9.11 Metadata for Receiver Wind Indicator in Virac Station

Manufacturer / Brand	Receiver Wind Indicator/ Komatsu Factory Co. Ltd
Observed Parameter	Wind Speed and Wind Direction
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.	BH1415159
Serial No.	-

Table 9.12 Metadata for Standard Rain Gauge in Virac Station

Manufacturer / Brand	Standard Rain Gauge
Observed Parameter	Rainfall, Intensity
Date Installed / Deployed	-
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.	-
Serial No.	-

Table 9.13 Metadata for Thermograph in Virac Station

Manufacturer / Brand	Thermograph/ Sato Keiryoki
Observed Parameter	Records Highest and Lowest Temperature
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.	7230-00
Serial No.	587961

Table 9.14 Metadata for Tipping Bucket in Virac Station

Manufacturer / Brand	Tipping Bucket/ 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)	-
Instrument Exposure	Class 1
Representativeness of Observation	-
Maintenance Activity	Upon Request
Model No.	-
Serial No.	-

CHAPTER 10:

DATA HOMOGENIZATION AND SYNOPTIC STATION

The Philippine Atmospheric Geophysical and Astronomical Service Administration (PAGASA), through the Climatology and Agrometeorology Division (CAD) Climate 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 environmental changes. 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 revealed that apparent climate changes are attributed to inhomogeneities in the time series data. The World Meteorological Organization 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 includes all information regarding the station, including the initial set-up, type, and time of changes that occurred during the station's life 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 combat 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. Kuya et al., 2022 suggest that one must be careful when choosing an 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 25 for overlapping temporal window and whole series ($SNHT_1$ = $SNHT_2$ = 25). This value is appropriate for temperature on a monthly scale and was chosen for this study. For rainfall, a threshold of $SNHT_1$ = 10, $SNHT_2$ = 30 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 SLPRSD 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 August 22 and 23, 2023 (Table 10.1, Table 10.2).

Table 10.1. Agenda for PAGASA workshop dialogue on data homogenization and station profile on August 22, 2023

Activity	Time	Personnel		
Opening remarks	1:00 – 1:20 PM	Dr. Nathaniel T. Servando, OIC, PAGASA Dr. Bonifacio G. Pajuelas, DA for O&S Ms. Shirley J. David, OIC, DA for R&D Ms. Nancy T. Lance., WSC, SLPRSD		
Roll Call of Stations	1:20-1:25 PM	Mr. Neil John Miranda, SLPRSD		
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: DAET	**Panel 2 Station Name: LEGAZPI**	**Panel 3 Station Name: MASBATE**	**Panel 4 Station Name: JUBAN**	
Mr. Rex Abdon Jr – Chair Mr. Reniel R. Mago Ms. Maria Krista Rona Borbon/ Mr. Zeanrick Ray Reyes Ms. Rosanna Nicolas Mr. Irwin Aguilar / Mr. Willie Tuazon	Mr. Christian Mark Ison – Chair Ms. Lilian N. Guillermo Mr. Azmi Zerxes Layugan Mr. Marlon E. Selpa/Mr. Lope Dacanay Mr. Irwin Aguilar / Mr. Willie Tuazon	Mr. Noel Bangquiao – Chair Ms. Rizza G. Bartolata Ms. Remia Paolo Borbon/ Ms. Kristina Clarisse De Guzman Ms. Nelson Delampasig/ Mr. Mario A. Gascar Mr. Irwin Aguilar / Mr. Willie Tuazon	Ms. Abigail Vicente – Gatuz – Chair Mr. Ryan R. Orogo Nolan Rosel/ Carina Joy Labian Mr. Celestino O. Cameros/ Mr. Eugene B. Balon 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	Mr. Rex Abdon Jr., SWS, CADS		
Host	Dr. Joseph Basconcillo, WSII, CADS			

Table 10.1.Agenda for PAGASA workshop dialogue on data homogenization and station profile on August 23, 2023

Activity	Time	Personnel		
Opening remarks	1:00 – 1:20 PM	Dr. Nathaniel T. Servando, OIC, PAGASA Dr. Bonifacio G. Pajuelas, DA for O&S Ms. Shirley J. David, OIC, DA for R&D Ms. Nancy T. Lance., WSC, SLPRSD		
Roll Call of Stations	1:20-1:25 PM	Mr. Neil John Miranda, SLPRSD		
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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: CALAPAN	**Panel 2 Station Name: ROMBLON**	**Panel 3 Station Name: CATARMAN**	**Panel 4 Station Name: Virac**	**Panel 5 Station Name:**
Mr. Rex Abdon – Chair Mr. Ferdinand Valdeavilla–CMO Mr. Nolan Rosel/ Carina Joy Labian Mr. Celestino O. Cameros/ Mr. Eugene Balon Mr. Irwin Aguilar / Mr. Willie Tuazon	Ms. Abigail Vicente-Gatuz – Chair Mr. Richard M. Magayam Mr. Azmi Zerxes Layugan Mr. Mario A. Gascar / Marlon E. Selpa Mr. Irwin Aguilar / Mr. Willie Tuazon	Mr. Noel Bangquiao – Chair Mr. Jemmy D. Pedrola Ms. Maria Krista Rona Borbon / Mr. Zeanrick Ray Reyes Ms. Rosanna R. Nicholas Mr. Irwin Aguilar / Mr. Willie Tuazon	Mr. Christian Mark Ison – Chair Mr. Juan T. Pantino Jr Ms. Remia Paolo/Kristina Clarisse De Guzman Mr. Nelson Delampasig/ Mr. Lope Dacanay 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 G. De Guzman, AWSC, CADS		
Host	Dr. Joseph Basconcillo, WSII, CADS			

WORKSHOP-DIALOGUE ON DATA HOMOGENIZATION AND SYNOPTIC STATION PROFILING

SLPRSD participated in the Dialogue on Data Homogenization and Synoptic Station Profiling workshop. It was a two-half-day workshop (1:00 PM to 5:00 PM) and was held online via Zoom meeting on August 22 and 23, 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 12). The attendees are SLPRSD station personnel (Daet, Legazpi, Masbate, and Juban), CADS-CAD, Instrumentation and Calibration, and Maintenance and Installation.

Dr. Joseph Basconcillo of CAD-CADS hosted the first day of the workshop. Dr. Nathaniel Servando, Officer in Charge of PAGASA, started the program with his opening remarks. Dr. Servando emphasized that for a quality forecast, the observed data must be free from errors and that any signs of irregularity in the data must be reported to the forecasters as soon as possible. Dr. Bonifacio Pajuelas, Deputy Administrator for Operations and Services, also provided an opening statement. Dr. Pajuelas stated that this workshop will capacitate PAGASA personnel to deliver reliable and relevant weather knowledge and services to the country. Ms. Shirley David, Officer in Charge and Deputy Administrator for Research and Development, said in her opening statement that the workshop serves as a bridge between the field station in SLPRSD and the PAGASA Central Office. To finish the opening ceremony, Ms. Nancy Lance, Weather Services Chief, provided a heartwarming remark. She highlighted that this workshop aims to improve the quality of climate data, making it a true representative of the regional climate. This was followed by the roll call of the station personnel given by Mr. Neil John Miranda of the SLPRSD. Attendees were given an introductory lecture on data homogenization presented by Mr. Noel Bangquiao, a DOST graduate fellow assigned to CAD-CADS. Before the workshop, SLPRSD was given breakpoints for 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 focused discussions on breakpoint validation. Each room was 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 the breakout sessions. Dr. Basconcillo and the panel chairs quickly recapped the dialogue in each breakout session, including whether all the station information was available in WIGOS, whether all the breakpoints were validated, and what problems were encountered. To close the workshop, Mr. Abdon delivered his closing remarks by highlighting that new and valuable information was obtained and requested the full support of SLPRSD for additional inquiries or validation of the breakpoints.

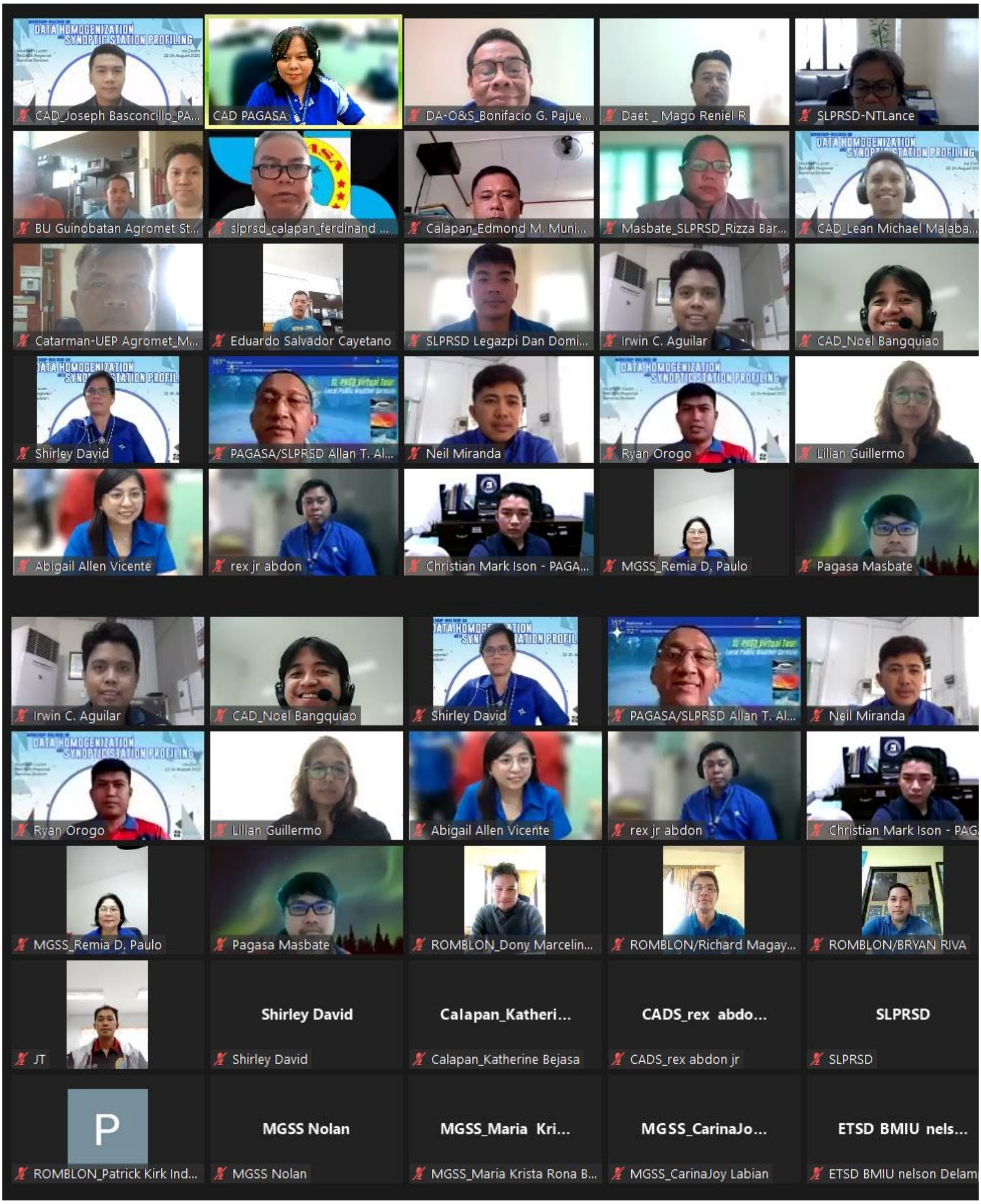

Figure 13 Participants of the workshop-dialogue on August 22, 2023

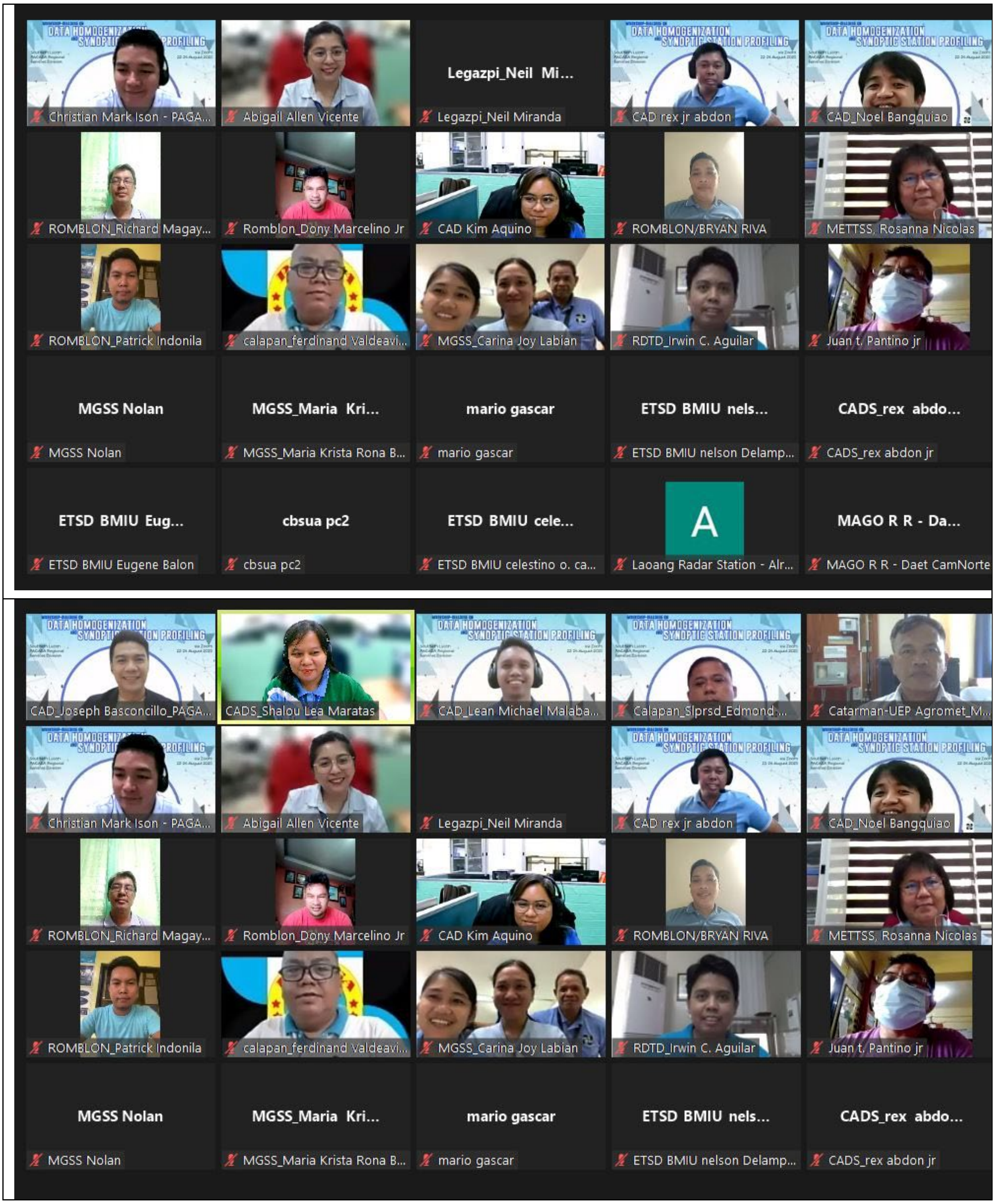

Figure 14 Participants of the workshop-dialogue on August 23, 2023

A different set of participants attended the second day of the workshop (Figure 13). The attendees were SLPRSD station personnel (Calapan, Romblon, Catarman, and Virac), CADS-CAD, Instrumentation and Calibration, and Maintenance and Installation.

Dr. Basconcillo, as the host, introduced Dr. Servando, Dr. Pajuelas, Ms. David, and Ms. Lance. Due to their prior engagements, they could not attend the workshop. However, their statements on day one were recorded and played on the second day. Mr. Miranda 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. Rosalina de Guzman delivered concluding comments emphasizing the importance of having a record of events in the station, such as relocation and instrument maintenance. These records can explain the irregularities in the climate record.

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 10.3, Table 10.4, and Table 10.5 are only for stations under SLPRSD.

Rainfall

Studies show that rainfall is the most challenging variable to be homogenized due to its high spatial and temporal variability. For rainfall, out of all stations under SLPRSD, Catarman, Romblon, and Virac stations have breakpoints, as shown in Table 10.3. Not all points coincided with metadata but occurred during ENSO events. Catarman breakpoints happened during a strong La Nina event. Romblon breakpoints coincided with ENSO events, a weak El Nino during November 2006, and a moderate La Nina in November 2010. Lastly, the Virac breakpoint occurred during a moderate La Nina Event. Catarman and Romblon share a common breakpoint of November 2010.

Stations with breakpoints during the La Nina event experienced a high volume of rainfall. This highlights a potential natural cause of those breakpoints. However, a non-natural cause is still possible since nearby stations also showed La Nina signals, but no breakpoints occurred.

Table 10.3 Breakpoint identification and validation for rainfall

Code	Date	SNHT	Name	Remarks	Source
546	2010-11	30.7	Catarman	• **No information available** • **La Nina year**	
546	2011-06	31	Catarman	• **No information available** • **La Nina year**	
536	2006-11	21.6	Romblon	• **No information available** • **El Nino year**	
536	2010-11	19	Romblon	• **No information available** • **La Nina year**	
446	1995-10	16.2	Virac	• **No information available** • **La Nina year**	

Maximum Temperature

All stations have breakpoints for maximum temperature (Table 10.4). Verified breakpoints account for only 62% of the total breakpoint. Environmental changes are the most common cause of inhomogeneity, at 17.3%. Natural factors such as volcanic activity account for 3.8% of the breakpoints. The minimum SNHT value is 25, recorded in Calapan in October 1996, and the maximum is 91.8, recorded in Virac in August 1969.

Inhomogeneities for Calapan station are mostly unexplained but coincidental with ENSO events. The absence of minimum and maximum thermometers can explain the June 2018 breakpoint. From 1988 to 1999, Catarman station was located in Downtown Catarman, where most of its breakpoints occurred. With no additional information, these breakpoints remain unverified. Daet station underwent relocation in 1974, which is why the breakpoint occurred in December 1973. Breakpoints for the Juban station can be attributed to environmental, instrumental, and personnel changes. Instrumental changes caused inhomogeneity for the Legazpi station. The Legazpi station has used a wet and dry bulb thermometer to measure the maximum temperature for specific years. The volcanic activity of Mayon can explain the station's breakpoints in 1993 and 2010. Similar to Calapan, breakpoints for Masbate are unexplained but occurred during ENSO events. The breakpoint captured Masbate's relocation from Bagumbayan to Airport in 1984. The elevation changes of the Romblon station caused an inhomogeneity with an SNHT value of 85.9. Virac station recorded the highest SNHT value of 91.8 but did not coincide with the metadata.

Climatol captured environmental changes such as station renovation and urbanization of the nearby surroundings. These changes introduce inhomogeneity since they change the exposure of the maximum thermometer. Volcanic activity can be considered an environmental change since it is known to decrease the temperature of the surrounding environment. However, these changes are of natural causes and thus are not labeled as environmental changes. Most of the unverified breakpoints coincide with ENSO events. Though the phenomenon is known to affect Philippine temperature, additional research is needed to conclude that ENSO naturally introduced the inhomogeneity.

Table 10.4 Breakpoint identification and validation for maximum temperature

Code	Date	SNHT	Name	Remarks	Source
431	1961-05	25.1	Calapan	• **No information available**	
431	1969-10	42.6	Calapan	• **No information available** • **El Nino year**	
431	1972-09	25.9	Calapan	• **No information available** • **El Nino year**	
431	1991-07	43.1	Calapan	• **No information available** • **El Nino year**	
431	1996-10	25	Calapan	• **No information available**	
431	1998-07	27.4	Calapan	• **No information available** • **La Nina year**	
431	2005-12	40.7	Calapan	• **No information available** • **La Nina year**	
431	2018-06	28.7	Calapan	• No max and min thermometer	• Personal communication (SLPRSD Workshop in August 2023)
546	1988-06	45.7	Catarman	• During 1988-1999, the station is located near DPWH Building, Downtown Catarman • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
546	1991-07	57.9	Catarman	• During 1988-1999, the station is located near DPWH Building, Downtown Catarman • **El Nino year**	• Personal communication (SLPRSD Workshop in August 2023)
546	1992-06	63.9	Catarman	• During 1988-1999, the station is located near DPWH Building, Downtown Catarman • **El Nino year**	• Personal communication (SLPRSD Workshop in August 2023)
546	1993-02	25.2	Catarman	• During 1988-1999, the station is located near DPWH Building, Downtown Catarman	• Personal communication (SLPRSD Workshop in August 2023)
546	1995-10	56	Catarman	• During 1988-1999, the station is located near DPWH Building, Downtown Catarman • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
546	2014-04	35.5	Catarman	• **No information available**	
546	2014-10	33.3	Catarman	• **No information available** • **La Nina year**	

Table 10.4 Breakpoint identification and validation for maximum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
440	1973-12	33.3	Daet	• Daet Synoptic was removed from the Town Proper, then temporary in-house to Daet Radar (Old) • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
440	2021-03	33.6	Daet	• Phase 1 renovation repair of Synoptic Office and Powerhouse Roofing • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
440	2021-04	29.8	Daet	• Phase 1 renovation repair of Synoptic Office and Powerhouse Roofing • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
545	2014-10	38.5	Juban	• Changed shelter but has the same instruments (October 2013). • **El Nino year**	• Personal communication (SLPRSD Workshop in August 2023)
545	2015-03	35.6	Juban	• Began the construction of government housing near the station, but in 2012, they began cleaning up the area. • **El Nino year**	• Personal communication (SLPRSD Workshop in August 2023)
545	2017-04	38.4	Juban	• Four (4) personnel at the station	• Personal communication (SLPRSD Workshop in August 2023)
545	2020-05	30.4	Juban	• From cyclone wire fences to galvanized iron sheets near the shelter	• Personal communication (SLPRSD Workshop in August 2023)
444	1958-10	38.9	Legazpi	• **No information available** • **El Nino year**	
444	1971-08	40	Legazpi	• **No information available** • **La Nina year**	
444	1989-11	30.3	Legazpi	• **No information available**	
444	1993-11	37.9	Legazpi	• Volcanic activity (February-April 1993)	• Personal communication (SLPRSD Workshop in August 2023)
444	2005-07	35.3	Legazpi	• Installed new instrument shelter and paint repair on shelter base	• Personal communication (SLPRSD Workshop in August 2023)

Table 10.4 Breakpoint identification and validation for maximum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
444	2010-05	43	Legazpi	• Volcanic activity (November 2009-January 2010) • **El Nino year**	• Personal communication (SLPRSD Workshop in August 2023)
444	2019-10	26.9	Legazpi	• Preventive maintenance of basic met instruments	• Personal communication (SLPRSD Workshop in August 2023)
543	1973-01	70.4	Masbate	• **No information available** • **El Nino year**	
543	1981-11	65.2	Masbate	• **No information available** • **La Nina year**	
543	1983-04	59.6	Masbate	• Relocation of the Station Office from Bagumbayan to the Airport (Nursery Street) • **El Nino year**	• Personal communication (SLPRSD Workshop in August 2023)
543	1989-04	55.1	Masbate	• **No information available** • **La Nina year**	
543	1990-03	65.6	Masbate	• Development of surrounding buildings (1990 onwards)	• Personal communication (SLPRSD Workshop in August 2023)
543	1992-10	68.6	Masbate	• Development of surrounding buildings (1990 onwards)	• Personal communication (SLPRSD Workshop in August 2023)
543	2003-06	31.5	Masbate	• Relocation/Installation of new instrument shelter, including. repainting (based on records)	• Personal communication (SLPRSD Workshop in August 2023)
543	2007-08	27.2	Masbate	• The building front of the shelter was constructed • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
543	2012-06	32.5	Masbate	• **No information available**	
543	2017-12	58.3	Masbate	• **No information available** • **La Nina year**	
543	2021-03	34.2	Masbate	• **No information available** • **La Nina year**	
536	1959-08	79.5	Romblon	• **No information available**	
536	1980-04	37	Romblon	• **No information available**	

Table 10.4 Breakpoint identification and validation for maximum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
536	1988-02	34.2	Romblon	• **No information available** • **El Nino year**	
536	2011-07	85.9	Romblon	• Changed station location on June 1, 2011. Station Elevation from 47m to 176.5m • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
446	1960-01	61.3	Virac	• **No information available**	
446	1965-02	41.4	Virac	• **No information available** • **La Nina year**	
446	1969-08	91.8	Virac	• **No information available** • **EL Nino year**	
446	1981-01	41.6	Virac	• Grass cutting/burning of grass near the instrument shelter	• Personal communication (SLPRSD Workshop in August 2023)
446	1988-11	53.4	Virac	• **No information available** • **La Nina year**	
446	1993-01	68.2	Virac	• **No information available**	
446	2000-07	46.9	Virac	• **No information available** • **La Nina year**	
446	2003-10	32.8	Virac	• Grass cutting/burning of grass near the instrument shelter	• Personal communication (SLPRSD Workshop in August 2023)

Minimum Temperature

All stations under SLPRSD have unhomogenized minimum temperatures (Table 10.5). Metadata can only explain around 40% of the identified breakpoints, although some unidentified breakpoints coincide with ENSO events. Instrument and environmental changes are the significant causes of breaks, which account for 14% and 10.5% of all the verified breakpoints, respectively. This is followed by natural changes at 8.8% and station relocation at 7%. Breakpoints for Catarman and Virac stations are all unverified, while Legazpi and Daet stations have more than 50% of their breakpoints validated. The average SNHT value is 45, with minimum and maximum values of 25.4 and 88, respectively.

The majority of the breakpoints for Calapan station did not coincide with the metadata. The breakpoint in May 2007 can be attributed to the change of instrument shelter. The above-average SNHT values for Calapan were recorded before the 1990s. All breakpoints for Catarman are unvalidated. Daet station's relocation and the construction of the perimeter fence have caused inhomogeneity. The addition of the fence recorded an SNHT value of 55.3. The minimum temperature for the Juban station is homogeneous. Volcanic activities of Mayon Volcano are the leading cause of inhomogeneity for Legazpi station, which has the highest SNHT value of 86.9. Relocation, changes in the surrounding environment, and replacement of the instrument induced shifts in the Masbate data. The Legazpi station used a wet and dry Bulb thermometer to measure the maximum temperature for specific years. An SNHT value of 57.7 was recorded when the Romblon station changed its location in July 2011. Lastly, for the Virac station, not all breakpoints are validated.

With the default SNHT value, Climatol produced 58 breakpoints for SLPRSD stations. The minimum temperature has the most breaks compared to rainfall and maximum temperature. Station relocation, calibration and replacement of instruments, and fence addition in the station induced above-normal SNHT values. Natural causes can also induce inhomogeneity, such as volcanic activity that produces above-normal SNHT values. This shows that natural causes also add shifts or breaks in the dataset. Validating the breakpoints identified by Climatol is a significant challenge due to stations having little or unverified metadata. The scarcity of metadata is due to records being damaged by floods and some knowledge products not being properly transferred.

Table 10.5 Breakpoint identification and validation for minimum temperature

Code	Date	SNHT	Name	Remarks	Source
431	1964-06	88	Calapan	• **No information available** • **La Nina year**	
431	1966-07	60.9	Calapan	• **No information available**	
431	1986-08	53.1	Calapan	• **No information available** • **El Nino year**	
431	1986-10	62.4	Calapan	• **No information available** • **El Nino year**	
431	1993-06	41	Calapan	• **No information available**	
431	1996-01	31.2	Calapan	• **No information available** • **La Nina year**	
431	1996-02	31.3	Calapan	• **No information available** • **La Nina year**	
431	1998-03	36.5	Calapan	• **No information available** • **El Nino year**	
431	2002-04	43.9	Calapan	• **No information available**	
431	2002-11	38.6	Calapan	• **No information available** • **El Nino year**	
431	2007-05	37.3	Calapan	• Earlier 2008 possible change of instrument shelter • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
431	2014-02	26.1	Calapan	• **No information available**	
546	1971-01	25.7	Catarman	• **No information available** • **La Nina year**	
546	2006-11	25.8	Catarman	• **No information available** • **El Nino year**	
546	2007-03	32.4	Catarman	• **No information available**	

Table 10.5 Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
546	2011-01	31	Catarman	• **No information available** • **La Nina year**	
440	1959-10	27.6	Daet	• Station is located at the town proper of Daet	• Personal communication (SLPRSD Workshop in August 2023)
440	1973-06	30.3	Daet	• The station was relocated and established in 1968 at Barangay Bagasbas (Daet Airport) • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
440	1976-05	31.2	Daet	• **No information available** • **La Nina year**	
440	1995-09	28.7	Daet	• **No information available** • **La Nina year**	
440	1999-11	27.4	Daet	• In late 2000, all the Outdoor Synoptic Met Instruments were transferred from the East to the Western Side of the Station • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
440	2011-09	26	Daet	• Construction of Perimeter Fence • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
440	2012-04	25.8	Daet	• Construction of Perimeter Fence • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
440	2013-03	55.3	Daet	• Construction of Perimeter Fence	• Personal communication (SLPRSD Workshop in August 2023)
444	1967-08	25.5	Legazpi	• Volcanic activity (April-May 1968), Max VEI : 3	• [Database] Volcanoes of the World
444	1968-09	62.6	Legazpi	• Volcanic activity (April-May 1968), Max VEI : 3 • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023) • [Database] Volcanoes of the World
444	1972-11	57.1	Legazpi	• **No information available**	

Table 10.5 Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
				• El Nino year	
444	1981-01	68	Legazpi	• No information available	
444	1983-03	28.3	Legazpi	• Volcanic activity (Sep - Oct 1984), Max VEI : 3 • El Nino year	• [Database] Volcanoes of the World
444	1988-09	56.5	Legazpi	• No information available • La Nina year	
444	1988-10	57.5	Legazpi	• No information available • La Nina year	
444	1994-04	53.4	Legazpi	• Volcanic activity (February-April 1993)	• Personal communication (SLPRSD Workshop in August 2023) • [Database] Volcanoes of the World
444	2003-09	86.9	Legazpi	• Volcanic activity (March-May 2003), Max VEI: 2 • Preventive maintenance of basic met instruments (May 2002)	• Personal communication (SLPRSD Workshop in August 2023) • [Database] Volcanoes of the World
444	2004-10	58.7	Legazpi	• Volcanic activity (June-September 2003), Max VEI: 1 • Preventive maintenance of basic met instruments • El Nino year	• Personal communication (SLPRSD Workshop in August 2023)
444	2005-12	30.2	Legazpi	• Volcanic activity (August 2005), Max VEI: 1 • Preventive maintenance of basic met instruments • La Nina year	• Personal communication (SLPRSD Workshop in August 2023)
444	2006-03	29.4	Legazpi	• Volcanic activity (February and July-October 2003), Max VEI: 1 • Preventive maintenance of basic met instruments • El Nino year	• Personal communication (SLPRSD Workshop in August 2023)

Table 10.5 Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
444	2010-09	64.2	Legazpi	• Volcanic activity (November 2009-January 2010) • **La Nina year**	• [Database] Volcanoes of the World • Personal communication (SLPRSD Workshop in August 2023)
444	2014-01	83.8	Legazpi	• Volcanic activity (August-October 2014), Max VEI: 0 • Construction of fence around the station • Construction of residential buildings near the station	• Personal communication (SLPRSD Workshop in August 2023)
543	1967-06	31	Masbate	• **No information available**	
543	1978-08	52	Masbate	• **No information available**	
543	1979-12	37.1	Masbate	• **No information available** • **El Nino year**	
543	1983-10	56.2	Masbate	• Relocation of the Station Office from Bagumbayan to the Airport (Nursery Street) • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
543	1990-01	25.5	Masbate	• Development of surrounding buildings (1990 onwards)	• Personal communication (SLPRSD Workshop in August 2023)
543	1993-06	25.4	Masbate	• Development of surrounding buildings (1990 onwards)	• Personal communication (SLPRSD Workshop in August 2023)
543	1996-09	68.9	Masbate	• **No information available**	
543	1998-12	29.9	Masbate	• **No information available** • **La Nina year**	
543	2004-10	28.2	Masbate	• **No information available** • **El Nino year**	
543	2012-05	38	Masbate	• **No information available** • **La Nina year**	
543	2015-07	65.8	Masbate	• Calibration of met instruments (Feb 12, 2014) • **El Nino year**	• Personal communication (SLPRSD Workshop in August 2023)

Table 10.5 Breakpoint identification and validation for minimum temperature (continued)

Code	Date	SNHT	Name	Remarks	Source
543	2019-01	64.3	Masbate	• Replaced maximum and minimum thermometer • **El Nino year**	• Personal communication (SLPRSD Workshop in August 2023)
543	2019-02	64.4	Masbate	• Replaced maximum and minimum thermometer • **El Nino year**	• Personal communication (SLPRSD Workshop in August 2023)
536	1968-01	34.5	Romblon	• **No information available**	
536	2011-07	57.7	Romblon	• Changed station location on June 1, 2011. Station Elevation from 47m to 176.5m. The station location from 1951 to May 2011 is near the port • **La Nina year**	• Personal communication (SLPRSD Workshop in August 2023)
536	2022-08	28.1	Romblon	• **No information available** • **La Nina year**	
446	1967-10	44.9	Virac	• **No information available**	
446	1987-03	71.4	Virac	• **No information available** • **El Nino year**	
446	1994-08	53.4	Virac	• **No information available** • **El Nino year**	

CHAPTER 11:

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