

Meteorological Pursuit in University of Gujrat, Pakistan (Part 1)

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Title Page

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METEROLOGICAL PURSUIT IN UNIVERSITY OF GUJRAT

ABSTRACT

Being an important phenomenon “Weather Observation” or “Meteorology” is not only interesting for Meteorologists but also for environmentalists and geologists as well. So for this an internship program was held at University of Gujrat Hafiz Hayat Campus, in a newly maintained Met Office, where appointed Official Weather Observers supervised this work. So in this way this is a wonderful chance to become a part of Starting Weather observation at UOG, being the students of Environmental Sciences. A group of students worked as interneers. Observation under certain parameters, by taking scheduled readings of outdoor installed instruments, then accordingly filling of Pocket Register, by consulting Hydrometric table, Aeronautical Code book 1995, & Surface Weather code book 1995 of Pakistan Meteorological Department 2008. Making Metar (after 1 hour reporting) and Synaptic (after 3 hours reporting), then reporting it to the Regional Meteorological headquarter Lahore through cell phone message sending or directly uploading it to their website. Discussion sections on different weather changes as shown by readings, along with instruments working accordingly, are the different steps of Starting of Weather Observation at UOG. Chapter one and two are included in this part 1 of this Meteorological pursuit.

Keywords: Meteorology, Meteorology & Climate, Meteorological Observation at UOG, Weather, Weather Observation, Weather Observatory at UOG, Weather Observation in Pakistan.

CHAPTER ONE

1.0-INTRODUCTION

Sun's energy is an ultimate source of heat and light for our Planet Earth from millions of years. The face of Earth, as it appears today, was not like that from the time of its beginning, but series of gradual changes affect its appearance, finally it becomes able to sustain life. This sustaining of life demands mainly food, shelter, growth, and reproduction facilitated by the earth and its surroundings, which still undergo continuous changing. The change which is constant, actually brighten the color of life.

On the Planet earth, its surrounding possesses air, essential for life, and Sun is major source of energy. **Weather** is created by Sun's energy that is somewhere more and less on the other, while air in which all the weather processes occur. As changing in the Weather patterns are responsible for life style, food or crop yield, and construction designs at any place. So the information about weather conditions became essential. The raise of knowledge of weather inspires to know about it more and more, although human access limits. Weather is observed, to update and forecast that refers as **Meteorology**.

Set up of weather observation is a Met office /Met Station. A Met Station started working with one official observer in April 2013 at University Of Gujrat Hafiz Hayat Campus. This type of weather observation is termed as Surface Weather observation. Each Met Station has a Specific code however here with Station code used UOG, because it is a new set up so no code has allotted right now. At a certain place on Planet earth when weather variation is officially observed and reported. It is based on these Meteorological elements: Temperature (dry & wet), Wind, Visibility, Sky condition, Dew point, Time, Atmospheric pressure, and Relative humidity along with area's location that shows it's longitudinal and latitudinal position. Reporting is done in the form of coding. Meteorological Observation is

required for taking weather update; alert, and forecast that are important for various fields of agriculture, aviation, research, disaster management and of every day's life.

1.1-History of Weather Observation

In 350 BC, with the description of Hydrological cycle weather observation starts. So Muslim Scientists play very important role in developing of Meteorological Sciences. As weather is not only concerned with ground level changes, expect it is much more linked with atmosphere or air. Earlier observations of atmospheric conditions are limited like that is taken at the height of mountains, and then kites were used to measure temperature of higher altitudes. It was discovered by using kites, that lightening is an electrical discharge. Cameras were tied with the pigeons, during their flight pictures from altitude were captured in this way, that on their return were available to the observers, this provides the bases for Arial photography that leads to GIS, Geographical Information System, working.

Certain instruments like Thermometer, Barometer, and tools have developed for studying weather parameters and these are improved and standardized through experimentation. Taking the risk, dangerous manned balloons were used to study upper atmosphere. Later Unmanned balloons with instruments can go to more height, but there were no assurance of instrument's recovery.

Till 18th century no regular and official Weather observation is considered. So there were no Reporting and Record gathering, however ordinary forecasting was in practice that is limited to a local level. After Second World War airplanes were used to collect weather information from upper atmosphere. With the network developing in many countries from the 19th century onward weather forecasting, and other studies related to climate are introduced. From 1960's onward Environmental changes, Pollution, Hydrology, Climatology, studies have gained importance resulting to recognize Climate Change that emphasis study of Meteorology.

In this regard weather radar and satellites have developed. In 1960, "**TIROS-I**" the first meteorological satellite was send to space.

1.2-Worldover Weather Observations

National or state Weather Stations are serving in almost all over the world with their available resources and Instruments. In developed countries more advance ways are applied to observe weather alterations at all levels while under developing countries are relaying on manual working rather than Automated Weather Observation Systems. As Weather observation is in demand for certain routine matters and catastrophic conditions for serving Humanity. So weather Observations are shared on the websites both by manual and automated data collection systems. For Example almost 15,000 data collection points working for Hydro meteorological Automated Data System are in record that works for Office of Hydrologic development of The National Weather Service.

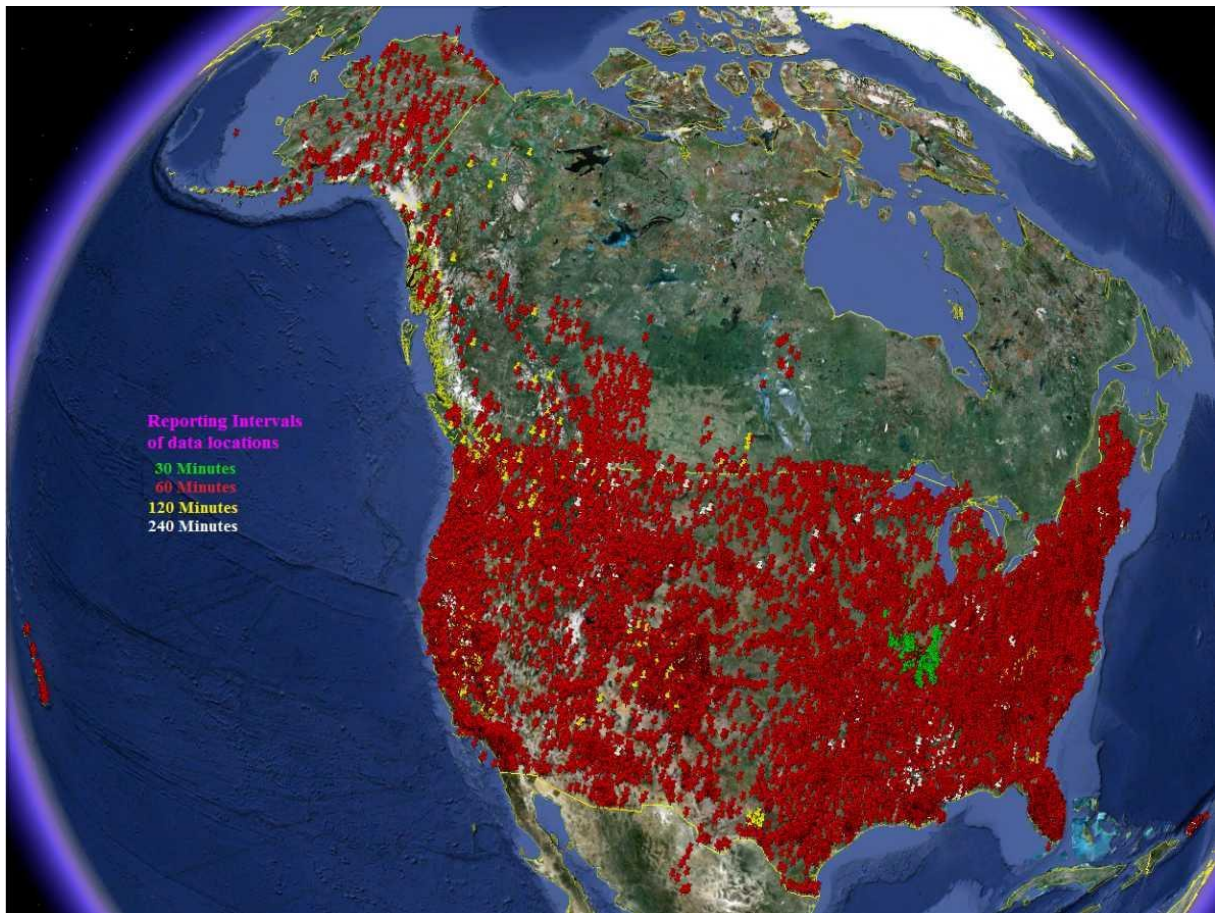


Figure1.1: More than 15,000 Data collection points of Hydro meteorological Automated Data System.
Source1.1: National Weather Service

hadstream@gateway2.nws.noaa.gov <http://www.nws.noaa.gov/oh/hads/> Accessed at 29-05-2021.

Not only National and international weather observation is in demand also local level information is a matter of interest. But this information can only provide forecast of that specific location. In this regard Manual work where observer directly observes and takes readings from instruments to consider Meteorological elements is a common practice from long ago, the data collected in this way is urgently send to the headquarter where it is uploaded to the website so it become a part of main stream to predict weather conditions of that area. And is helping in scientific and research purposes to update, forecast, developing strategies, trade, irrigation, shipping, seismic warnings, construction of dams and buildings, flying, Tourism, Sports defense, and disaster management cells, according its demand in that area. Once a data of some area is uploaded it is now available to everyone on the internet that can be utilized.

However now, Local level Automated Observation Systems are also introduced, on all levels. Because people all over the world not only consider reliable, updates of mobile companies, television channels, and internet rather they are interested in taking direct weather observation even in their home stations, to enjoy knowing the variation of weather patterns and be alert to the drastic effects of weather. These observations are either part of official working or just for once own interest.

Anything that has a sensor and can give readout regarding weather is a part of Weather Station/ Weather Observatory. This sensor could be a single one that takes observation of one of the weather parameters at a time like only temperature or that one which could transmit readings of a set of other sensors, setup for taking readings of Meteorological elements, and this transmitter is connected to readout display like a computer screen. With the advancement in technology Weather Observation has become more convenient with outdoor setup of sensors and indoor readouts. The indoor readout displays are mostly connected with outdoor one /more sensors or a transmitter sensor that take observations of weather parameters/Meteorological parameters and are effective where weather conditions are tough to bear like: Extremely hot/cold weather areas.



Figure1.2: Local level outdoor sensor for Automated Weather Observation System
Source1.2: Weather Station Transmitter _IPJ,

<http://www.practicalarduino.com/sitebuilder/projects/knowledge/asset/medium/38/weather-station-transmitter-sml.jpg> , Accessed at 29-05-2013.



Figure1.3: Local level indoor readouts.

Source 1.3: Local Weather Observation, by MetEd,
<https://www.google.com.pk/search?hl=en&q=local+weather+observations&tbm=isch&tbs=simg:CAQSYgkNtWH6alxXlxpOCxCwjKclGjwKOggBEhSVA5kDgQOUA8UDpwOeA7sDggOTAxogmnjlsEhosxTVaVO1u7XDAbUcaLuPp3aluQmOu2i6548MCxCOrv4IGgAMIUfXxEUj-ZYc&sa=X&ei=wX29Uaj9OMSn4AT324HoDQ&ved=0CCMQwg4oAA&biw=1280&bih=709> ,Accessed at 29-05-2013

1.3-Weather Observation in Pakistan

Pakistan is situated in a highly sensitive area of Asia with respect to weather conditions. In 1947 with 15 Weather observatories working in the entire country, **PMD**, Pakistan Meteorological Department was established. This is a National level entity that officially works to fulfill the technical weather observation responsibility to update, forecast and Monsoon Alert. At present in Pakistan a network of observing stations is operating, as a National Headquarter in the capital Islamabad, 4 Regional/Provincial headquarters at Lahore, Karachi, Peshawar, Quetta, and more than 20 local level officially operating Meteorological Stations. These are working for PMD under the Ministry of Defense. These stations are tried to equip with automatic instruments. However Manual working is in practice as a previous routine and is considered more reliable by the experienced observers. With the availability of Automated Observation Systems obtained data is compared with manually obtained data that helps to overcome deficiencies in manual work.

Overall Weather Observation in Pakistan has its practical application in the field of Agriculture as Pakistan is big Agricultural land area possessing country. Aviation, Shipping, Sports and irrigation requirements are second main purpose of Meteorological working in the country; however there are so many lacks of technology in this respect. Adaptations of precautionary measures for catastrophic conditions are also dependent on efficiency of Weather Observation Stations; this is a matter of special attention as due to lack of arranged resources and mismanagements in the political circle of country Weather updates are not followed accordingly to avoid big disasters. Working of PMD is also concerned with nuclear explosion detection system, radar, satellite, dam designing with respect of seismic effects,

information technology, science and Research work. PMD is a member of **WMO**, World Meteorological Organization.

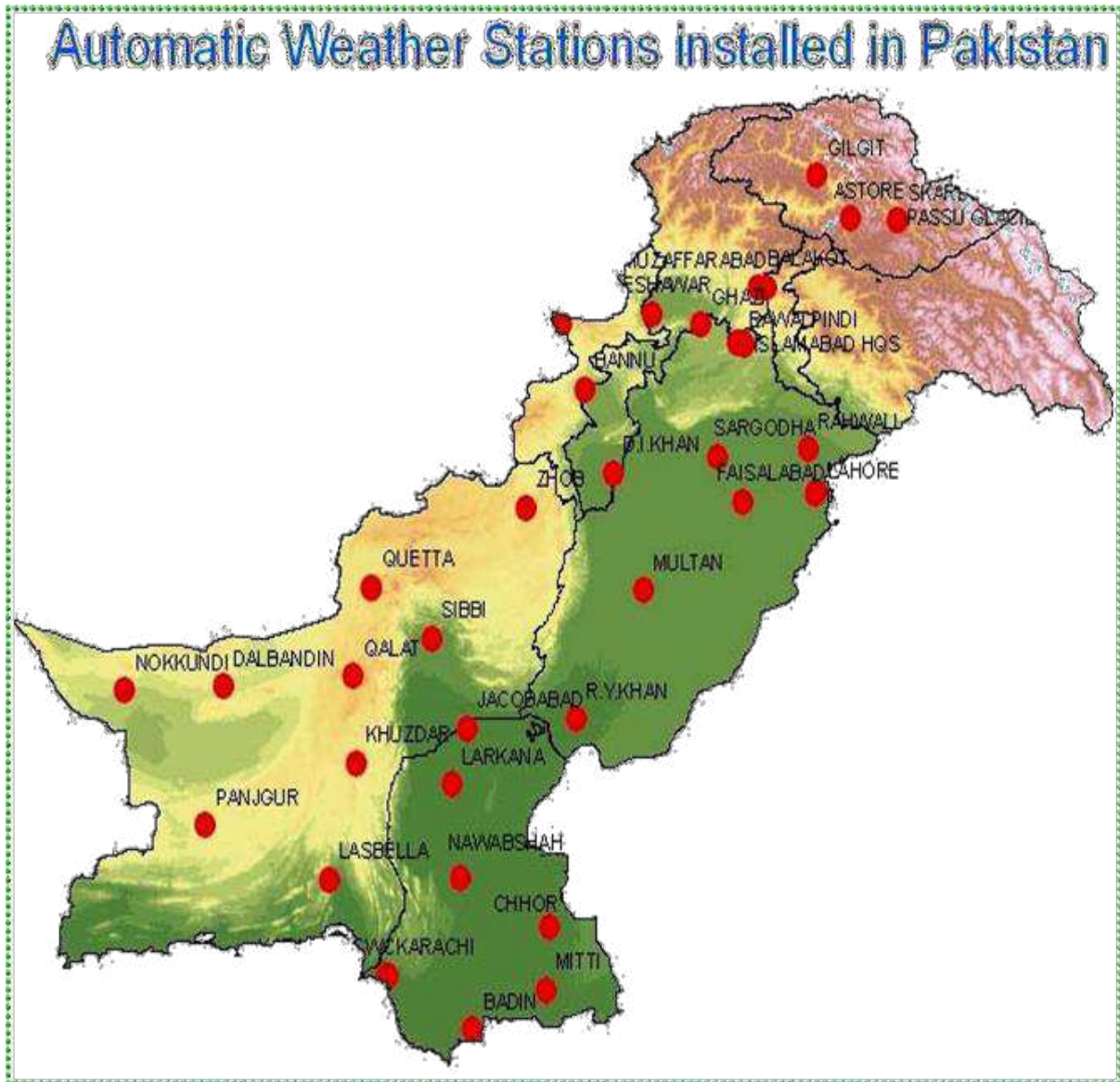


Figure1.4: Automatic Weather Stations in Pakistan.

Source1.4: PMD-WFP joint project Government of Pakistan,

<http://pmd.gov.pk/wfp/weather.html>, Accessed at 2-06-2021.

1.4-National Headquarter OF PMD Islamabad



Figure1.5: PMD, Pakistan Meteorological Department, Islamabad.

Source1.5: PMD, Islamabad

https://fbcdn-sphotos-d-a.akamaihd.net/hphotos-ak-prn1/947038_590408417657917_920706467_n.jpg
Accessed at 16-06-2013.

Organizational rank of PMD, Islamabad is National Agro met Centre (NAMC), Islamabad. Where it serves to coordinate National authorities of agriculture and water. Monthly “Agro met Bulletin of Pakistan”, in both Urdu and English is issued. Research and technological developments in the field of agriculture are published by computer data processing. Acknowledgment of various issues like: water requirements to major crops, plant and animal diseases, and soil moisture conditions. Weather Surveillance Radar is installed in Islamabad

with the help of Japan Government. This Radar is with an ability of Monitoring Weather Systems up to a radius of 400kms.

A study tour was arranged by our Instructor respected Dr. Mushahid Anwar to visit PMD, Islamabad on 30th May, 2013. That was a precious chance to meet Dr. Haneef the 1st PHD, degree holder of Pakistan in Meteorological Sciences. Also there is a chance to listen his lecture along with valuable discussion of Dr. Haneef and Dr. Mushahid, on visiting the Monitoring Radar & other Instruments working there.



Figure1.6: Lecture and discussion in PMD, Islamabad

Source1.6: PMD, Pakistan Meteorological Department, Islamabad.

<https://www.facebook.com/photo.php?fbid=590408480991244&set=pcb.590409344324491&type=1&permPage=%20Accessed%20at%2031-05-2013>. Accessed at 15-06-2013.

1.5-Weather Observation at UOG

A Weather Observation Station /Meteorological Observatory / Met Office have started working in the month of March 2013, at University of Gujrat Hafiz Hayat Campus, under the supervision of Respected Sir Dr. Muhammad Mushahid Anwar Chairman of Department of Geosciences & Geography.

Respected Sir Abdul Ghani Gondal an Official Weather Observer appointed in this Met Office.



Figure1.7: Meteorological Observatory at UOG

Source1.7: Photos by Muhammad Mushahid Anwar, about Meteorological Observatory

<https://www.facebook.com/photo.php?fbid=590405850991507&set=pcb.590406947658064&type=1&perm%20Page=1%20A>

Accessed: 02 June, 2021.

1.6- Weather Observation in Meteorological Observatory UOG

Weather Observation is done by observing Numerical values, of certain parameters named as Meteorological Elements; this is through general observation calculation, use of instruments, and documentary tools.

Following steps are performed by a Weather Observer at UOG: **Intake of readings**, take the reading and check it (that is on the experience base and personal excellence) before note down to make sure that all instruments are in proper working condition, or anyone's maintenance is required. For example: Due to outdoor installation of Weather Instruments, their exposure to the surrounding needs care for their safe existence and proper working like: High speed wind can drop them if their position is not strongly fitted, and extreme weather conditions like NW & SW winds result experiencing an excessive dryness, that can cause wet thermometer's thread to become dry, as the moisture it sucks continuously from its water/moisture bottle evaporates with a rate comparatively very high than the previous less dry weather/wind condition. Recovery of it could be simple as reduce the distance of moisture bottle from the thermometer bulb so it experiences less exposure to the dry winds, drop some water on thread every time you come to take reading, so that it remains full of moisture, make sure don't take reading at once, after you dropped water on the thread, take at least 5 minutes time to remain close Stevenson Screen's door/opening side, then take reading, and in the long run to face and handle effects of these winds increase thread's amount so that its thick layer can maintains it to remain wet by retaining the amount of moisture it sucks, or to increase its moisture holding capacity, although rate of evaporation is a changing factor of weather that can be observed but can't be altered by will.

Filling of pocket Register: is actually based on general observation of some of the parameters and intake of Instrumental readings and making its note by using Meteorological coding from Hydrometric table, and weather code book. **Making Metar and Synaptic:** that is Official/Professional method of reporting from a Weather Observatory. **Sending its message:** to headquarter Lahore or uploading it to the internet. Usually reading observations are taken for 24 hours, but because of working with this newly set up Observatory, and University timing's restrictions, reading are taken for only 0300z to 1200z.

CHAPTER TWO

2.0-METHODOLOGY

Weather Observation is an outdoor lab work as the Instruments or sensors are installed in such a way that their exposure with outdoor environment is kept permanent, and indoor data collection is performed by manual work or via transmitters connected to the indoor readouts, for finding Meteorological Elements, with the use of relevant Instruments and tools in document form, intake of readings, making record in the Meteorological coding, interpreting data, and preparing its message for sending.

2.1- Tools in the Form of Documents

Necessary Documents used in manual Surface Observation are:

- A) – Hydrometric Table
- B) –Surface Weather Code Book
- C) – Aeronautical Code Book

– **Hydrometric Table:** Hydro means water, and meter is for measuring, Hydrometer is used to measure the density of liquids. While Hydrometric table is used for taking reading of such parameters which are relatively measured, that is these are measured with reference to certain other elements. These reference values, that are note down and published via this document, are calculated through a series of experimentation, under controlled conditions, by the expert, trained, and experienced technical staff.

These calculations after getting national & international approval are certified, for being authentic, and are considered as standards. These standards are then established.

In Meteorological Observation, Hygrometric Table is used for finding values of some parameters like: Dew Point & Relative Humidity, (these two considerations are indirectly measuring amount of water in the atmosphere). Values of D.P & R.H are picked by using the reference of dry & wet thermometer readings at a certain place for a specific time.

B) – Surface Weather Code Book: is a tool, used in Surface Meteorological Observation. This tool is in the form of a document that have a record of codes in it, these codes are actually the real requirement of an observer as Meteorological observation is reported in form of specific codes, these codes are highly specific for their relative considerations. Along with codes some symbols are also considered and used in weather reporting. Generally codes for Time, Cloud type, Cloud Cover and Rain are picked while symbols for visibility, thunder storm, and Rain are taken, by Met observer.

Surface Weather Code 1995, Pakistan Meteorological Department, 2008 is prepared for using in order to consult codes and symbols, required for surface weather observation. It is being consulted in more than 20 Local, 4 Provincial /Regional, and 1 National level, headquarters of Meteorological Observation / Met Stations.

C) – Aeronautical Code Book: Aeronautical Meteorological Codes, 1995 Edition that is revised in 2008 is used for Reporting Metar, as it have all the coding record for Metar.

Metar Reporting is rather simple and is with lesser use of codes; however it is also very specific for its application so codes given in book are carefully consulted. The more and more experience or even practice for Reporting Metar makes the observer so efficient that there is no need to consult this code book in each Reporting.

Aeronautical is for air navigation or related to aerial, as Metar Reporting is of much more importance in flight, so its codes possessing book is named Aeronautical Code Book.

2.2-Meteorological Elements

Weather Observation is carried out with the help of certain parameters that are measured either manually or automated observation systems. At UOG Meteorological Observatory, observation is through manual system. These parameters/ Meteorological Elements are:

- a) – Area
- b) – Location
- c) – Temperature
- d) – Time
- e) – Wind Direction
- f) – Wind Speed
- g) – Atmospheric Pressure
- h) – Cloud Type
- i) – Cloud Cover
- j) – Cloud Position / Cloud Height
- k) – Visibility
- l) – Rain / Precipitation
- m) – Dew Point
- n) – Relative Humidity

Description of these Meteorological Elements

a) – Area: Pakistan is one of Asian countries which are at less distance from Equator, and is possessing a melt sea, so Pakistan has three types of Ecological Zones: Tropical, Sub

Tropical, and Temperate. Area Geographically from Gujrat to Sibi is **Tropical**, where temperature can be more than 40 degree centigrade; Humidity 40%, height from sea level is about 0-200miles.

Hafiz Hayat Campus of University of Gujrat is in upper Punjab at the border of Azad Jammu and Kashmir, 10km from main Gujrat city. As Gujrat is in between two rivers Chenab and Jhelum so possess wet land and northern forest range that creates a variety of weather conditions to be experienced.

Areas are divided for Weather Observation, area division for UOG Meteorological Observatory; Surface Weather Observation is carried out. From four sections (111, 222, 333, and 444) of Weather Reporting Methodology, UOG Meteorological Observatory works for two sections (111 & 333), and other sections are concerned with Weather Reporting in Oceans etc.



Figure2.1: Gujrat location Map, shows Area of Gujrat, this city is situated between two rivers Chenab and Jhelum

Source2.1: Weather Forecast location Gujrat, <https://www.weather-forecast.com/locations/Gujrat/forecasts/latest>
Accessed: 02 June, 2021.

b) – Location: Pakistan's latitude is 30° 00' N (25° 00' - N 35° 00' N) and its longitude is 70° 00' E (65° 00' E -75° 00' E), accordingly Gujrat city's latitude is about 30° 00' - N 35° 00' N and its longitude 70° 00' E -75° 00' E.

For Meteorological Observatory UOG, latitude 32° 38' N, longitude 74° 09' E, and height above Sea level is 799feet.

c) – Temperature: is the major factor for weather considerations, temperature variations are basically the cause of creating different conditions of weather, Spring, Summer, Winter, Autumn, that is generated by the varying exposure Earth to the Sun. Measured by Stevenson Screen.

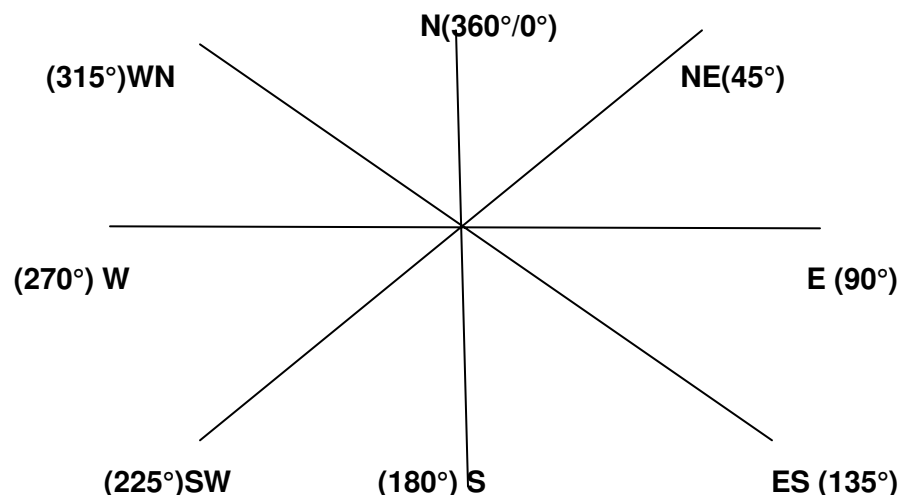
d) –Time: Official Weather Observation is very much concerned with time. In Meteorology GMT "Greenwich Mean Time" is taken as standard world over. "Pakistan's Standard Time" PST is converted into GMT for Meteorological Observation.

Conversion Formula:

$$\text{GMT} + 5 = \text{PST}$$

Meteorological Observation deals with GMT as 0300z, 0600z, 0900z, 1200z, 1500z, 1800z, 2100z, 2400z / 0000z.

e) – Wind Direction: Is a special phenomenon in relation with weather alterations, and is measured by Wind Vane. For example: NW & SW Winds result excessive dryness.



Meteorological Observation is conveyed in the form of Reporting. This Reporting is done in the form of special coding. Wind Direction codes used in Weather Reporting, according Surface Weather Code Book 1995, Pakistan Meteorological Department, 2008 are as follows:

Table2.1: Codes for Wind Direction

Wind Direction	Code used for Reporting	Wind Direction	Code used for Reporting
NNE	02	SSW	20
NE	05	SW	23
ENE	07	WSW	25
E	09	W	27
ESE	11	WNW	29
SE	13	NW	31
SSE	16	NNW	34
S	18	N	36

Source2.2: Surface Weather Code book 1995, Pakistan Meteorological Department, 2008

f) – Wind Speed: is also an important parameter that plays a specific role in weather alteration like: winds move clouds that if retain can result shower at one place and where these clouds move they can result a rain spell over there, and so on...Wind Speed in manual observation can be measured by Wind Anemometer.

g) – Atmospheric Pressure: is essential to measure for an observer, because pressure difference can be caused due to heat variations on the earth surface. So the term, high pressure (more atmospheric mass above that very location), or low pressure (less atmospheric mass over that very location) is a relative term. Warmer air can hold more moisture than cooler air, and warm air is less dense than cold air. In Stormy weather barometric pressure will tends to be lower, as moist air is less dense than dry air. Atmospheric Pressure is measured by Barometer.

h) – Cloud Type: it is through General Observation & perceptions to notice what type of clouds are present at a time on the sky, here experience of observer is a remarkable factor. Clouds are divided into 3 major categories with respect to their height, as Low, Medium, & High. These are further divided into 10 types:

Table2.2: Cloud Types with their codes & Symbols used in Meteorological Observation

Code figure	Cloud type Name	Symbol(cloud type)	of 3 major categories
0	Cirrus	Ci	High
1	Cirrocumulus	CC	High
2	Cirrostratus	CS	High
3	Alto cumulus	AC	Medium
4	Altostratus	AS	Medium
5	Nimbostratus	NS	Medium
6	Stratocumulus	SC	Low
7	Stratus	St	Low
8	Cumulus	Cu	Low
9	Cumulonimbus	Cb	Low

Source2.3: Surface Weather Code book, 1995. Accessed at 07-05-2013

Also

Table2.3: Slash or Oblige as Cloud Symbol

Cloud measurement symbol	Its relative description
/ (slash or oblige)	Cloud not visible owing to darkness fog, storm, dust (sand), or other.

Source2.4: Surface Weather Code, 1995. Accessed at 07-05-2013

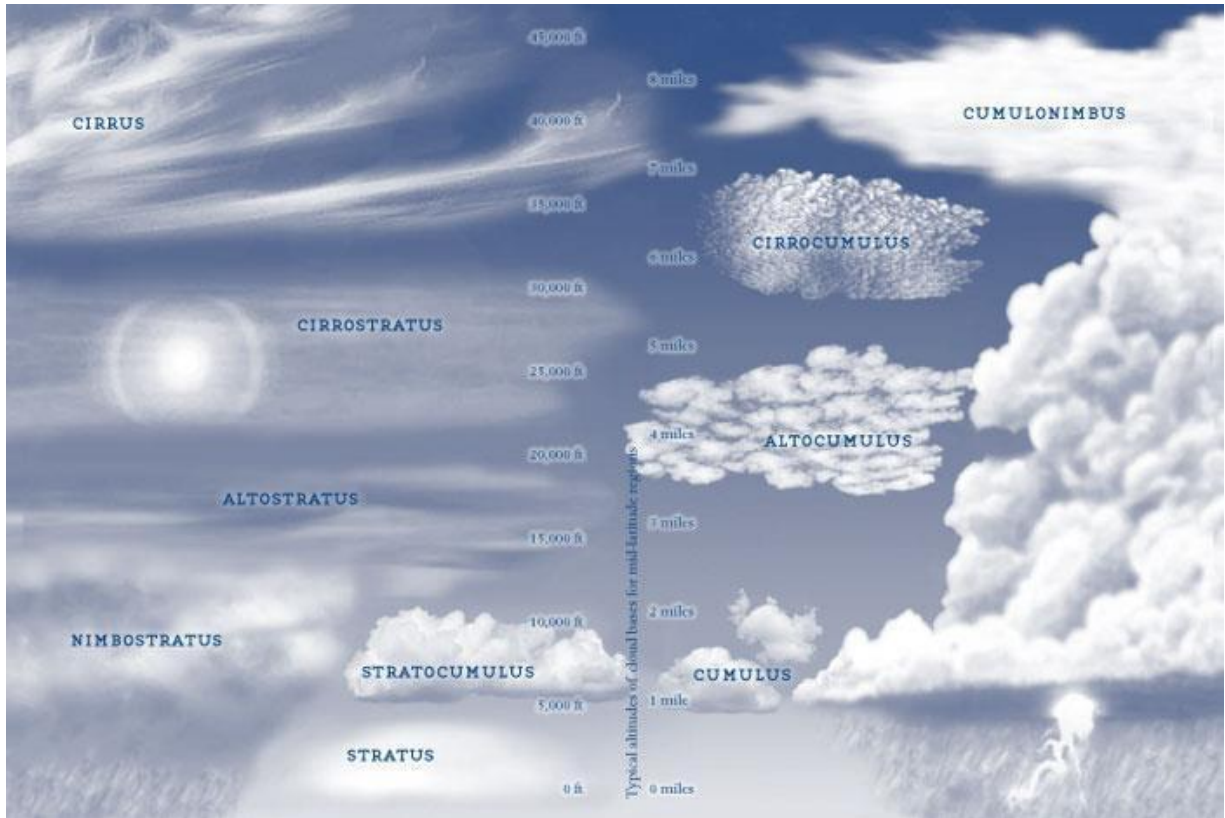


Figure2.2: Cloud Types

Source2.5: <http://nimbus.davelynch.net/wp-content/uploads/2012/08/endpapers.jpeg>, Accessed at 20-6-13
Most common types of clouds experienced at UOG Meteorological Observatory are given below in_____ Table2.4: Generally experienced Cloud types & their Codes

CH (High Clouds)

Ci	1
----	---

CM (Medium Clouds)

AS	2
AC	3
AC + AS	7

CL (Low Clouds)

Cu	2
SC + Cu	4
SC	5
SC + Cu + Cb	9

Source2.6: Notes prepared by, Sir Abdul Ghani Gondal, Official Met Observer at UOG.

i)-Cloud Cover



Figure2.3: Cloud Cover on Sky at UOG

Source2.7: UOG's Face book page, <http://www.pakimag.com/tourism/beautiful-university-of-gujrat.html/attachment/university-of-gujrat-1>, Accessed at 2-06-2013.

Clouds are measured in **Octas**, the vale ranges from **0-8 Octas**, in Meteorological Observation, Sky fully covered with clouds is noted as **8 Octas**, half sky covered **4 Octas**, less than 2 parts Sky covered with clouds **6 Octas**, only 1 part of sky naked/empty from clouds **7 Octas**.

Table2.3: Cloud Cover range for # of Octas, their relative codes & symbols

Range for number of Octas	Their relative names or Meteorological codes	Symbols for names or codes
1 – 2	Few	few
3 – 4	Scatter	Sct
5 – 6	Broken	BKN
7 – 8	Overcast	Overcast

Source2.8: Surface Weather Code, 1995. Accessed at 08-05-2013.

j) – Cloud Position/Cloud Height: Clouds seen from ground level are at which level of height. This can be estimated manually with Temperature, & Humidity values, / in automated system with laser called ceilometers.

For Manual work Formula:

[Difference of {Surface Temperature (in °c) & Dew Point} × 400] = {Height (above Ground level)}

AGL in feet}

[[{Height AGL (above ground level)} + Station Height in feet] = {Height (Above Sea level)}

ASL in feet}

Weather Balloons are in practice to measure Cloud Position from when they start flying to get enter into the cloud after how many kilometers, reading (Pilot message) is continuously being calculated, as after every 2 minutes, in this way Cloud Height can be calculated, also angular position (Horizontal & vertical) can be noted with **Theodolite**.

Table2.4: Codes for Cloud Height

Code Figure	Range of height in feet	Range of Height in meters
0	0 to 150 feet	0 to 50 meters
1	150 to 300 feet	50 to 100 meters
2	300 to 600 feet	100 to 200 meters
3	600 to 1000 feet	200 to 300 meters
4	1000 to 2000 feet	300 to 600 meters
5	2000 to 3000 feet	600 to 1000 meters
6	3000 to 5000 feet	1000 to 1500 meters
7	5000 to 6000 feet	1500 to 2000 meters
8	6000 to 8000 feet	2000 to 2500 meters
9	8000 feet or more of	2500 meters or more or No Clouds.

And

Code Figure	Description
/ (slash or oblige)	Height of base of cloud not known or base of clouds at 9 at a level lower and tops at a level higher than that of Station.

Source2.9: Surface Weather Code, 1995. Accessed at 09-05-2013.

k)-Visibility: refers for, up to what limit of horizontal distance sight is clear, it is considered as, at Surface for weather observation.

Visibility considered with respect to (R.H) Relative Humidity's value:

Table2.7: Visibility with respect to R.H value

Range of values of R.H in %	Visibility's position (name)	Relative symbol
50% or less than 50% R.H	Less visibility present weather Haze	Hz
50% to 85/90% R.H	Smoke Haze	Fu
85% to 94% R.H	Mist	Br
95% and above R.H	Fog	Fog
100% R.H	Rain	RA

Source2.10: Surface Weather Code, 1995. Accessed at 10-05-2013.

Also consider

Table2.8: Horizontal Visibility at Surface

Code figure	Day light observation	Night observation (Distance at which the lamp of 100 candle power just disappearing)		
		A	B	C
90	Objects not visible at 50 meters(55yards)	130 m 140yards	150m 160yards	180m 200yards
91	Objects visible at 50 meters but not at 200 meters (220 yards)	340m 370yards	440m 480yards	
92	.	.	.	.
93	.	.	.	.
94	.	.	.	.
95	Objects visible at 2000 meters but not at 4000 meters	2750m.	..	..
96	// at 10,000 meters not at 20,000 meters	..	..	..
97	.	.	.	.
98	.	.	.	.
99	.	.	.	.

Source2.112: Surface Weather Code, 1995. Accessed at 11-05-2013.

Distance considered here is taken in meters other than kilometers, like 5000m except 5km. AT **96** that is 10,000meters/10km if (Cloud + Visibility) is ok then it is called as **CaVoK**.

I) – Rain: Rain, precipitation, or shower is a major factor regarding weather observation at some place. Rain is measured with Rain Gauge.



Figure2.4: Rain in UOG

Source2.12: Face Book page, University of Gujrat, PK.

<https://www.facebook.com/photo.php?fbid=649922575021911&set=pb.291931487487690.-2207520000.1371653947.&type=3&theater>, Accessed at 12-05-2013.

Rain is calculated for last 3hours, 6hours, 12hours, and 18hours.

Table2.5: Amount of Rain in mm & its codes used in Meteorological Observation

Code figure	Amount of Rain in millimeter(mm)	Code figure	Amount of Rain in millimeter (mm)
000	000 mm	990	Trace
001	1 mm	991	0.1 mm
002	2 mm	992	0.2 mm
....	.....	993	0.3 mm
....	.....	994	0.4 mm
.....	.....	995	0.5 mm
.....	.....	996	0.6 mm
.....	.....	997	0.7 mm
988	988 mm	998	0.8 mm
989	989 mm / more	999	0.9 mm

Source2.13: Surface Weather Code, 1995. Accessed at 12-05-2013.

m) – Dew Point: is water to air saturation temperature. It is necessary to observe and note, as the dew point shows mole fraction of water vapor in the air. Its value is related with Temperature and Relative humidity.

n) – Relative Humidity: is that Humidity which is required and consumed that is available in the surrounding for a living one. Living bodies absorb moisture from their surroundings according to their needs, so it is not a constant rather differs for one entity to other. For Example: Relative Humidity of an individual's need with respect to Humidity of the room in which he/she lives.

The values of these two parameters of weather observation, Dew Point & Relative Humidity are together noted in the Hydrometric Table after calculation, available to the observer for almost every range of dry & wet thermometer readings.

***As 1st calculate** temperature difference from dry and wet thermometer readings:

dry thermometer reading: **21.0 °c** (always big value)

—

wet thermometer reading: **19.0 °c** (always low value)

difference of readings: **2.0 °c**(should not be zero)

**** 2nd notice** vales of Dew Point (D.P) & Relative Humidity (R.H) from Hydrometric Table concerning vales of dry thermometer reading and difference of readings.

Table2.6: How to pick values of D.P & R.H?

↓ Dry thermometer reading	Check diff.→ 0.0 D.P & R.H	Depression 0.5 D.P & R.H	Of Wet Bulb 1.0 D.P & R.H	bulb(degree 1.5 D.P & R.H	Centigrade)_ 2.0 D.P & R.H
20.0 & & & & &
20.5	... & & & & &
21.0	<u> </u> & <u> </u>	<u> </u> & <u> </u>	<u> </u> & <u> </u>	<u> </u> & <u> </u>	Values need
21.5 & & & & &

Source2.14: Hydrometric Table, PMD, PK. Accessed at 13-05-2013.

2.3- Instrumentation

Necessary outdoor Instruments installed in the UOG Meteorological Observatory, which generally used in manual Surface Weather Observation are:

- I) – Stevenson screen
- II) – Barometer
- III) – Wind Vane
- IV) – Anemometer
- V) – Rain Gauge
- VI) – Evaporation Tank

Handling and Working of these Instruments, to take reading in Met Observation:

I) – **Stevenson Screen:** from exterior is a wooden box, placed straight on an iron stand_



Figure8.5: Working with Stevenson Screen

Source3.15: Weather Observatory UOG

<https://www.facebook.com/photo.php?fbid=546505668714859&set=pb.100000662924245.-2207520000.1371707323.&type=3&theater>, Accessed at 15-06-2013.

___ in the outdoor environment. According standards of **WMO** (World Meteorological Organization), its stand is fitted tightly on the ground, at a proper distance from the buildings/trees in surrounding, the door of screen facing North (according to the Northern hemisphere). Its walls are of double-louvered design that is window blinds with horizontal slats, angled to admit air & light can pass through, but not direct exposure of rain, sunlight, and sound.

From its inside, 4 Thermometers are fitted there making a square, wet Thermometer on right, dry on left, Thermometer for measuring maximum temperature is above, and for minimum is below, these thermometers are at a height of 4 feet/2m above the ground.

Thermometer giving dry temperature reading is with naked bulb; while Thermometer that gives reading for wet, its bulb is wrapped with cloth with an extended thread that is dipped in the water bottle, so can continuously suck water. In order to avoid wet bulb from dryness, because it is essentially needed to keep it moist.

In other two thermometers that have to give maximum & minimum temperature readings, not only Mercury is filled in their bulbs, some other material totally or in combination with Mercury is used in their composition, to fulfill their work requirement.

Method of taking readings from Stevenson Screen: Screen door is opened carefully, notice & read (once, twice /thrice as you feel satisfied) with full concentration, position of Mercury (in general bulb filling material), in dry and wet Thermometers & others as needed, then close the screen door. And make note of these readings.

Precautions for taking reading

- > Don't keep the door of screen opened for long period of time.
- > Every time when reading is taken check water level in the wet thermometer bottle, pour water in it so sucking of thread don't disturb, and wet bulb refrains from drying.
- > Reading of dry Thermometer should always be greater than wet Thermometer's reading.

II) – Barometer: is used for measuring atmospheric pressure, sometimes Stevenson Screen also holds a Barometer/ is present alone, still not available at Meteorological Observatory University of Gujrat.

III) – Wind Vane: is fitted at the highest point of building, as its tail end is of large area so it allows the front end or arrow head to move in the direction of wind, taking a careful notice of its arrow head's rotation & stability once, twice or thrice to make sure your notice/observation. The wind is blowing in the direction, which the arrow head point out.



Figure2.6: Wind Vane & Anemometer at Meteorological observatory UOG, PK.

Source416: Meteorological Observatory University of Gujrat, PK.

<https://www.facebook.com/photo.php?fbid=546505608714865&set=pb.100000662924245.-2207520000.1371707527.&type=3&theater>, Accessed at 15-06-2013.

IV) – Anemometer: its $\frac{3}{4}$ cups spin with wind speed and its meter shows readings. Take 1st reading and after 3 to 4 minutes take 2nd reading, calculate the difference between 1st & 2nd reading and multiply it with 2, to get value of Wind Speed in Knots. Wind speed & its pressure gradient are relative to measure.

Formula: Wind Speed in Knots = $[(1^{\text{st}} \text{ reading} - 2^{\text{nd}} \text{ reading}) \times 2]$

For Example: Wind Speed in Knots = $[(66673 - 66675) \times 2]$, so 0.4 Knots = $[(0.2) \times 2]$.

IV) - Rain Gauge: is an instrument, used to measure the amount of rainfall. It measures, for a certain amount of time, depth of precipitation, in millimeters (mm). The Gauge is fitted, in the open ground, with the copper funnel that is up to 30 cm above ground. The funnel is tapering with standard dimensions to allow rain-water to be collected in the calibrated cylinder.



Figure2.7: Rain Gauge & Evaporation Tank at Meteorological Observatory UOG.

Source5.17: Meteorological Observatory University of Gujrat, Hafiz Hayat Campus.

<https://www.facebook.com/photo.php?fbid=546505682048191&set=pb.100000662924245.-2207520000.1371707527.&type=3&theater>, Accessed at 15-06-2013.

VI) - Evaporation Tank: is a circular pane to determine the day-to-day amount of evaporation, at a certain location, where it is placed. This corrosion resistant pan with 47.5inches diameter & 10inches depth rests on a leveled wooden-frame. In the Start of measurement pan is filled 2inch from the top, after 24 hours the water amount required to refill it to 2inch is measured. In case of precipitation, anytime during the 24 evaporation measuring hours and if the rate of precipitation was more than evaporation, the increase in water from pan should exclude.

Precaution: Keep safe from animal drinking, splashing, and freezing of tank's water, for the accurate measurement.

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Availability of data and material

Hafiz Hayat Campus, University of Gujrat, Pakistan.

Code availability 'Not applicable'

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