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Status of Weather Data in Meghalaya

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1. Introduction:

Meghalaya one of the seven sister States of northeast India, is mountainous and one of the most rain soaked State of India. The State is known for rich biodiversity. The landscape wrapped in fog, with stretches of valley and highland plateaus is rich in biodiversity. It consists mainly of Archean rock formations. These rock formations contain rich deposits of valuable minerals like coal, limestone, uranium and sillimanite. Meghalaya has many rivers. Most of these are rain fed and seasonal. The important rivers in the Garo Hills region are Daring, Sanda, Bandra, Bhogai, Dareng, Simsang, Nitai and the Bhupai. In the central and eastern sections of the plateau, the important rivers are Wah Umiam, Kynshi (Jadukata), Khri, Umiam or Barapani, Umngot and Myntdu. In the southern Khasi Hills region, these rivers have created deep gorges and several beautiful waterfalls.

The town of Cherrapunji in East Khasi Hills south of capital Shillong holds the world record for most rain in a calendar month, while the village of Mawsynram, near Cherrapunji, holds the record for the most rain in a year. With average annual rainfall as high as 12,000 mm (470 in) in some areas, Meghalaya is the wettest place on earth. The western part of the plateau, comprising the Garo Hills region with lower elevations, experiences high temperatures for most of the year. The Shillong area, with the highest elevations, experiences generally low temperatures. The maximum temperature in this region rarely goes beyond 28 °C (82 °F), whereas sub-zero winter temperatures are common.

About 70% of the state is forested, of which 9,496 km² (3,666 sq mi) is dense primary subtropical forest. The Meghalaya forests are considered to be among the richest botanical habitats of Asia. These forests receive abundant rainfall and support a vast variety of floral and faunal biodiversity. A small portion of the forest area in Meghalaya is under what are known as "sacred groves". These are small pockets of ancient forest that have been preserved by the communities for hundreds of years due to religious and cultural beliefs. These forests are reserved for religious rituals and generally remain protected from any exploitation. These sacred groves harbour many rare plant and animal species. The Nokrek Biosphere Reserve in the West Garo Hills and the Balphakram National Park in the South Garo Hills are considered to be the most biodiversity-rich sites in Meghalaya. In addition, Meghalaya has three wildlife sanctuaries. These are the Nongkhylllem Wildlife Sanctuary, the Siju Sanctuary and the Bhagmara Sanctuary, which is also the home of Pitcher plant *Nepenthes khasiana* is endemic to Meghalaya.

Due to diverse climatic and topographic conditions, Meghalaya forests support a vast floral diversity, including a large variety of parasites, epiphytes, succulent plants and shrubs. Two of the most important tree species are *Shorea robusta* (sal tree) and *Gmelina arboria* (Gumhuri). Meghalaya is also the home to a large variety of fruits, vegetables, spices and medicinal plants. Meghalaya is also famous for its large variety of orchids nearly 325 of them. Of these the large number of species are found in Mawsmi, Mawmluh and Sohrarim forests in the Khasi hills.

2. Importance of weather data:

Weather is an important part of the natural environment. It directly or indirectly affects many of our activities. We tend to be acutely aware of the weather when we are faced with

exceptional or dangerous phenomena that could endanger our property, safety or even lives. Such phenomena are, for example, gale-force winds, hail, heavy rainfall, sleet, ice and frost.

Weather forecasting help to take precautionary measures against natural calamity and disaster such as flood, drought, hurricanes, in agriculture the forecast of weather events helps for suitable planning of farm, undertake or withheld the sowing operation, helps in to take measures to fight frost, helps in transportation and storage of food grains, helps in management of cultural operations like plugging harrowing hoeing, helps in measures to protect livestock and farm operation i.e. to irrigate the crop or not, When to apply fertilizer or not, when to start/complete harvesting or to withhold it etc.

Weather plays an important role in agricultural production. It has a profound influence on the growth, development and yields of crop, incidence of pests and diseases, water needs and fertilizer requirements in terms of differences in nutrients mobilization due to water stresses and timeliness and cultural operations on crops. Weather aberrations may cause (i) physical damage to crops and (ii) soil erosion. The quality of crop produces during movement from field to storage and transport to market depends on weather. Bad weather may affect the quality of produce during transport and viability and vigour of seeds and planting material during storage timeliness and effectiveness of prophylactic and cultural operations on crops. Farmers rely on weather forecasts to decide what work to do on any particular day for example drying hay is only feasible in dry weather. Thus, occurrences of erratic weather conditions is beyond human control so the usefulness of weather forecasts with validity period that enables farmers to organize and carry out appropriate cultural operations to cope with or take advantage of forecasted weather is warranted. Agriculture is among sectors most vulnerable to the impacts of climate change water supply for example, will be critical to sustain agricultural production and provide the increase in food output required to sustain the world's growing population. Fluctuations in the flow of rivers are likely to increase in the twenty-first century. Climate change and agriculture are interrelated processes, both of which take place on a global scale. Climate change affects agriculture in many ways including temperatures, rainfall and climate extremes e.g. heat waves, changes in pests and diseases, changes in the nutritional quality of some foods and changes in sea level.

Weather warnings are important forecasts because they are used to protect life and property. Forecasts based on temperature and precipitation are important to agriculture, and therefore to traders within commodity markets. Temperature forecasts are used by utility companies to estimate demand over coming days. On an everyday basis, people use weather forecasts to determine what to wear on a given day. Since outdoor activities are severely curtailed by heavy rain, snow and the wind chill, forecasts can be used to plan activities around these events, and to plan ahead and survive them.

Meghalaya is in the process of rolling out the State Water Policy for good governance of water resources and ensuring sustainable use of water. Water, although a renewable resource is also turning out to be a scarce commodity. All the rivers in the State are rain fed with the rains dwindling every year, we are likely to face greater water scarcity during the winter months. Climate change could have significant impacts on water resources around the world because of the close connections between the climate and hydrological cycle. Rising temperatures will

increase evaporation and lead to increases in precipitation, though there will be regional variations in rainfall. Both droughts and floods may become more frequent in different regions at different times, and dramatic changes in snowfall and snow melt are expected in mountainous areas. Higher temperatures will also affect water quality in ways that are not well understood. Possible impacts include increased eutrophication. There is now ample evidence that increased hydrologic variability and change in climate has and will continue have a profound impact on the water sector through the hydrologic cycle, water availability, water demand, and water allocation at the global, regional, basin and local levels. Weather data would be very important requirement for management of water resources in the State and also in dealing with the water related disasters.

3. Status of Weather Data in Meghalaya

According to the survey of weather data done by the Meghalaya Institute of Natural Resources the following agencies of the Government of India and the State Government are involved in collection and compilation of data from weather stations in Meghalaya.

- (i) **Indian Meteorological Department:** IMD has been presenting National weather forecasting on extreme weather warning in an area targeted. It collects data, analysed and generates the weather reports and disseminates the information to the state government, concern authorities and other stake holders. IMD established weather station at Upper Shillong in 1st November 1956 and Cherrapunjee in June 1902 which are among the oldest weather stations in the country.
- (ii) **Agriculture Department, GOM:** Agriculture is the main occupation of the State and to protect the agricultural land from any natural calamity the Agriculture Department is also establishing Weather Stations to collect data on meteorological parameters including variability of soil moisture and soil temperature and the contribution of dew to crop growth. The negative impacts of climate in Meghalaya are destruction of crops by heavy rainfall and hail storms, increased soil erosion and loss of soil fertility as a result of increased intensity rainfalls, displacement of people by floods and shortage of drinking water. An agricultural weather forecast also contain the following information i.e. bright hours of sunshine, solar radiation, dew, leaf wetness, pan evaporation, soil moisture stress conditions and supplementary irrigation for rain fed crops, advice for irrigation timing and quantity in terms of pan evaporation, specific information about the evolution of meteorological variables into canopy layer in some specific cases and micro-climate inside crops in specific cases. Thus, the State Agriculture Department aims to minimize the impact to adverse weather on crops and to make use of weather forecasting to boost agriculture production.
- (iii) **Indian Council of Agricultural Research:** ICAR has been supporting agricultural development in the North eastern hills region of the country. It aims for sustainable farming system for different agro-climatic socio economic zone in the states. ICAR has contributed in weather forecast for different districts in the state which is very helpful as it predicts the future weather as well the current weather for the safeguard of the natural disaster in the state.
- (iv) **North Eastern Space Application Centre:** NeSAC helps to search and utilise the natural resources present in the region using remote sensing, provide the North-Eastern states access to satellite services, promote research in the space technology in the region by tying up with the academic institutions in the region. Weather satellite helps to monitor the weather and climate of

the region through meteorological satellite display the cloud system and timely dissemination of warning of impending disaster such as cyclones, floods, thunderstorm, fog etc.

(v) **Meghalaya Energy Corporation Limited:** Weather stations are important to monitor storage of water in the reservoirs. The MeECL collects rainfall data on some locations in the State.

(vi) **Soil and Water Conservation:** The Department of Soil and Water Conservation has been taking up natural resources conservation such as soil, moisture, vegetation, etc. the Department has also set up automatic weather stations at various locations in the State.

4. Data Availability with different Agencies in Meghalaya

The following table presents different Central and State Government Agencies actively involved in Meteorological Data collection compilation of information from the above agencies on the details such as status of climate data availability includes type of observatory, locations status, Period of data collection, parameters, data procurement methods and contact person.

4.1 Indian Meteorological Department (IMD)

Three types of observatory –

1. Departmental observatories (Manual)
2. Part Time Observatories
3. Automatic Weather Station

Departmental Observatories(Manual)		
Locations	Status	Period Of Data Collection
Shillong, Cherrapunjee Barapani	Functioning Functioning Functioning	Data is available for more than 100 years

Part Time Observatories		
Locations	Status	Period Of Data Collection
Mawsynram Cherrapunjee (RKM) Shella Tikrikilla Williamnagar Nongpoh	Functioning Functioning Functioning Functioning Functioning	Except Shella(2009) all the other stations have archived the data for over 30 years

Automatic Weather Stations (AWS)		
Locations	Status	Period Of Data Collection
Shillong Nongstoin Jowai Baghmara Williamnagar Umiam, Agro Tura	Functioning Functioning Functioning Functioning Functioning Not-Functioning Not-Functioning	All the AWS are installed after 2011

Parameters	Rainfall max-min temperature, Dew point Temperature, Total cloud cover, Min max relative humidity, Atmospheric Pressure, Wind Directoin, and hourly sunshine. (Data generated from the part time observatories consist mostly of rainfall data and Min& Max temperature).
Data procurement methods	Data from the manual observatories is available with IMD both in hard and soft copies which can be acquired on PAYMENT (via draft addressed to DDG, IMD, Guwahati) after submitting duly filled in standard form prescribed by IMD. Prescribed form attached. Expected duration to generate the Report: 15 Days Post Payment. AWS data are archived at the IMD, Pune server which could also be availed in the same procedure as above. Expected duration to generate the report: 15-30 days post payment. Available through website (http://www.lmdaws.com/ViewAwsData.aspx) * In the web data for last 10 days is made available. Several real time weather and forecasting information are available on IMD HQ and regional website- www.imd.gov.in and www.imdguwahati.gov.in).
Contact person	Mr.R.N Saha, IMD Guwahati, office Ph.no.03612843508 email id: tsguwahati@gmail.com & Mr Sunit Das, IMD Guwahati, Email id das.sunit@rediffmail.com
Remarks	IMD has been issuing extreme weather warnings whenever situations warrants and disseminates to the State Govt. authorities and other stakeholders. IMD also relies on RADAR data, Satellite images, Upper Air Stations (Ballon) and Chart Analysis. ISRO in collaboration with IMD has installed one DWR at Cherrapunjee and will be operational as soon as power supply in provided by MePDCL.

4.2 North Eastern Space Application Centre

Types of Observatory - Automatic Weather Station

Automatic Weather Station		
Locations	Status	Period Of Data Collection
Umiam, NESAC	Functioning	NESAC has installed 16 AWS in the state of Meghalaya, from the year-2010 onwards.
Shillong	Functioning	
Jowai	Functioning	
Khleiriat	Functioning	
Mairang	Functioning	
Nongstoin	Functioning	
Weiloi	Functioning	
Amlarem	Functioning	
Byrnihat	Functioning	
Williamnagar	Functioning	
Baghmara	Functioning	
Cherrapunjee	Functioning	
Umsining	Functioning	
Sarangma	Functioning	
Tura	Functioning	
Rangmal Gir	Functioning	

Parameters	Each AWS provides hourly data on ambient temperature, relative humidity, wind speed, wind direction, atmospheric pressure, rainfall and sunshine duration.
Data procurement methods	This data is transmitted via geostationary satellite in an hourly basis to space application centre, Ahmedabad where it is archived in the MOSDAC (meteorological and Oceanographic Scientific Data Archival Centre) data server. The Data can be downloaded from the www.mosdac.gov.in website FREE OF COST after formal registration with the website (registration request is verified by Mosdac which could take a week for approval).
Contact person	Mr. Shyam Sundar Kundu, Sci/Engr. SE, NESAC Email id: ssk.nesac@gmail.com Mr Sunit Das, IMD Guwahati, Email id das.sunit@rediffmail.com
Remarks	Due to technical snags, and maintenance issues there did exist an inconsistency/gap in data collection for over a year from most of the installed AWS. However all the 16 AWS are made functional and are operating to their capacity.

4.3 Agriculture Department

Types of Observatory - Automatic Weather Station

Automatic Weather Station		
Locations	Status	Period Of Data Collection
Shillong	Functioning	Data available from 2014 onwards.
Sohra	Functioning	
Mawsynram	Functioning	
Myllem	Functioning	
Nongstoin	Functioning	
Mairang	Functioning	
Mawkyrwat	Functioning	
Nongpoh	Functioning	
Jirang	Functioning	
Khlieriat	Functioning	
Jowai	Functioning	
Amlarem	Functioning	
Tura	Functioning	
Deidengre	Functioning	
Ampati	Functioning	
Williamnagar	Functioning	
Resubelpara	Functioning	
Baghmara	Functioning	

Parameters	Air Temperature, Max & Min Temperature, Relative, Max.& Min. Humidity, Wind Speed Avg. Max. Wind Speed, Wind Direction , Rainfall
Data procurement methods	Data from the above stations are freely available in soft copies in the Department of Agriculture, Shillong
Contact person	The Concern Person: Mr. Elias Nongbet, Monitoring Cum Evaluation Officer, Directorate of Agriculture, Govt. Of Meghalaya, Agriculture Complex, Room No- 327. E-mail: enongbet55@gmail.com Phone No. 9436102132
Remarks	The AWS are operated and maintained by the trained officials of the department at the installed locations. Data is downloaded from the AWS every hour on a daily basis which is then compiled and sent to the Shillong Headquarters on a weekly basis. Department of Agriculture in a phase manner with the help from NABARD will be installing another 60 AWS in the State. 36 AWS in all the remaining CNRD Block Headquarters, 24 AWS in Departmental Circle Offices.

4.4 Indian Council of Agriculture Research (ICAR)

Types of Observatory - Automatic Weather Station

Automatic Weather Station		
Locations	Status	Period of Data Collection
Umiam	Functioning	2012 onwards
Tura	Functioning	2012 onwards

Parameters	Daily Rainfall, Temperature, Wind speed, Wind direction, Solar radiation, air pressure, humidity
Data procurement methods	AWS data under ICAR is retrieved and stored at ICAR , Umiam and CRIDA, Hyderabad. Raw Meteorological data generated by ICAR is not made directly available to the public as the data is meant for internal use of research scientists only. However, Data obtained from different sources is provided to research/non-profit making organizations on REQUEST and PAYMENT basis to the Director, ICAR RC NEH Region, Umiam, Meghalaya ICAR will intimate you about the cost involvement. Data is charged 'unit data per day' basis.
Contact person	Mr. US Saikia Sr. Scientist (Agrometeorology) ICAR RC NEH Region, Umiam 793 103, Meghalaya Phone No. 9402557546 Email id: ussaikia73@gmail.com
Remarks	IMD has been preparing Agromet Advisory Bulletins twice a week (Tuesday and Friday) for the state of Meghalaya in association with ICAR, Barapani through mass media. The districts covered are EGH, WGH, WKH, EKH, Ri-bhoi and JH. Agromet Advisories are uploaded in IMD website as well as ICAR website(www.icarneh.ernet.in) and in KIRAN website(www.kiran.nic.in)

4.5 Meghalaya Electricity Corporation Limited

Types of Observatory - Departmental Observatories (Manual)

Departmental Observatories(Manual)		
Locations	Status	Period of Data Collection
Chibrage	Functioning	Data is available from 2014 onwards
Lumjingshai	Functioning	
Umiam stage 1	Functioning	
Kyrdemkulai	Functioning	

Parameters	Rainfall observatories consist mostly of rainfall data
Data procurement methods	Data from the manual observatories is available with MeECL both in hard and soft copies.
Contact person	K. Tiewsoh Chief Engineer (C) Maintenance & Small Hydro
Remarks	MeECL has been issuing rainfall data and disseminates to the State Govt. authorities and other stakeholders.

4.6 Soil and Water Conservation Department

Types of Observatory - Automatic Weather Station (AWS)

Automatic Weather Station (AWS)		
Locations	Status	Period of Data Collection
Weiloi Khliehriat Amlarem Conservation Training Institute Baghmara Nongstoin Samgong	Not-Functioning Not-Functioning Not-Functioning Not-Functioning Functioning Not-Functioning Not-Functioning	Data is available from 9 th May, 2006 onwards under the supervision of NeSAC.

Parameters	Each AWS provides hourly data on ambient temperature, relative humidity, wind speed, wind direction, atmospheric pressure, rainfall and sunshine duration.
Data procurement methods	Data is transmitted via geostationary satellite in an hourly basis to space application centre. Data from the Automatic Weather Station (AWS) is available from S&WC both in hard and soft copies.
Contact person	Shri. D.Langstieh Director of Soil & Water Conservation Department, 4th administrative building Lower Lachumiere contact-03642224551 Email-megsoil49@gmail.com.
Remarks	Soil and Water Conservation Department in collaboration with NeSAC has installed Automatic Weather Stations at 7 locations in the state of Meghalaya, however collection of data and dissemination of information to the State Government and other stakeholders is done by NeSAC.

5. Conclusion

With over 70% population in Meghalaya dependence on agriculture and allied activities importance of weather data for the State cannot be over emphasized. Realising this, concerned Departments have taken steps to establish network of automatic weather stations. As described in preceding section total number of weather stations in the State are 64 out of which 3 are Departmental Observatories (Manual), 6 are Part Time Observatories, 55 are AWS which have been mainly established in the last 5 to 6 years. Now there is need for coordination between all the weather data gathering Departments/agencies for sharing the data with each other and make the synthesized and analysed data available on a common web portal maintained by a nodal agency. Using real time data from the networks of AWS weather alerts and forecasts can be issued for cross section of people who are involved in agriculture, tourism, health and various other related sectors. Weather data and forecast based on that would be of critical importance in disaster management in the State also.