Comparison of Automatic Raingauge Station with Observatory and its performance in Indian Subcontinent

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Abstract

An Automatic Raingauge Station (ARG) is defined as a "meteorological stations at which observations are made and transmitted automatically". Automatic Rainguage Stations are used for increasing the number and reliability of real time rainfall data. Rainfall is a highly variable parameter in space and time as the heterogeneities on local scale in land surface features (hills) rivers, vegetation etc. affect its distribution. It is also a very important parameter for agricultural operations, water resource management and as well as result in hydro-climatic disasters on local and regional scales.

A network of 1350 Automatic Raingauge Stations (JINYANG make) is under installation by IMD during the year 2008-10 across India. Each ARG Station is configured to measure Hourly rainfall and Cumulative rainfall for the day. In addition to rainfall sensor, 500 ARG are equipped with Air temperature sensor. Each ARG station transmits a data stream at an interval of **ONE SECOND** in a Time Division Multiple Access via UHF transmitter and a dedicated meteorological satellite INSAT-3A to the central AWS data receiving Earth Station facility established at IMD, Pune.

A network of 100 ARG Station have been installed during 2008 and its performance have been encouraging during SW Monsoon-2008.After implementation of 1350 ARG network all over India in 2010, real time rainfall data will be very much useful for agricultural operations, water resource management and flood forecast. Another network of 2250 ARG will be established by India Meteorological Department during 2011-2012.

Key words: AWS, ARG, IMD

1. Introduction

Rainfall monitoring on real-time daily basis has been acutely felt by the IMD in order to keep watch on the performance of rainfall in the two monsoon seasons viz. SW and NE Monsoons and provide inputs to central and state agricultural authorities on the adequacy or otherwise of the rainfall to take appropriate steps to save the crops in the face of an impending drought.

Similarly, rainfall is an important parameter in Flood Forecasting set up of the CWC for different river basins.

In First Phase of India Meteorological Department (**IMD) Modernisation,**a network of 1350 Automatic Raingauge Stations (ARG) is under installation by IMD during the year 2008-10 across India. Each ARG Station is configured to measure Hourly rainfall and Cumulative rainfall for the day. In addition to rainfall sensor, 500 ARG are equipped with Air temperature sensor. Each station transmits a data stream at an interval of **ONE SECOND** in a Time Division Multiple Access via UHF transmitter and a dedicated meteorological satellite INSAT-3A to the central AWS data receiving Earth Station facility established at IMD, Pune.

In Second Phase of IMD Modernization, a network of 2250 Automatic Raingauge Station (ARG) will be installed by IMD during 2011-2012 across India.

A total network of 3600 ARG Stations will be all over India and **rainfall data quality assurance is one of the essential parts of IMD ARG network.**

2. Automatic Raingauge System

An automatic Raingauge Station (ARG) is defined as a "meteorological stations at which observations are made and transmitted automatically". It consists of Rainfall sensor but in addition it has also Air Temperature and Relative Humidity sensor at 500 places.

The ARG system includes a data logger, UHF transmitter, sensor, crossed Yagi antenna, GPS antenna, NEMA 4 standard enclosure, 10 m tower and12V/65 AH SMF battery float charged through a 30 W solar panel. Sensor is interfaced to all Automatic Raingauge Stations is **Tipping Bucket Rain Gauge (TBRG)-Rainfall sensor. In addition to rainfall sensor, 500 ARG are equipped with sensor for Air Temperature and Relative Humidity.**

The ARG network consists of three components (1) Remote station (2) Telemetry system (3) Data Receiving Earth Station. Remote station and receiving Earth Station are commercially procured modules and telemetry system is made available by Indian Space Research Organization (ISRO).

(i) Tipping Bucket Rain Gauge (TBRG)-Rainfall sensor

A stainless steel tipping bucket rain gauge is used for measurement of rainfall volume. The collector diameter is 20 cm and the **resolution of the gauge is 0.5 mm**. **Thus, 15.7 cm^3 (product of collector area and resolution) of rain water corresponds to 0.5 mm of rainfall**. The large collector area helps prevent the loss of rainfall due to evaporation. The rain water enters the funnel inside the gauge and is directed to one of the two tipping bucket. Each bucket is calibrated to tip when 15.7 cm^3 of rain water is collected in it. At any given time one bucket is always in collection mode. As the bucket tips it causes a

magnet to pass by a ruggedized mercury switch, momentarily (0.05 sec) closing the switch. The contact closure initiates event or count accumulation in the data logger. Once the rain is measured, the rain water is directed into drain tubes that allow it to exit through the base of the gauge. **The accuracy of the rain gauge is within 2% at 240 mm/h. Hourly rainfall (count reset at every full hour UTC) and daily rainfall (count reset everyday at 0300 UTC) and** is transmitted to the satellite.

(ii) Air Temperature and Relative Humidity (AT/RH)

An Air Temperature/ Relative Humidity measurements are taken at a height of 2 m above ground level. The sensor is mounted in naturally ventilated radiation shield. The sensor uses **THERMISTOR** for air temperature measurement and **HYGROMER** sensor for humidity. A sample of one minute is taken for hourly Maximum and Minimum Temperature measurement. A 5 volts excitation voltage is required for the sensor and is continuously powered. The hourly air temperature and relative humidity along with hourly maximum and minimum temperature are transmitted from field station.

The range accuracy and resolution of AT/RH sensor is given below:

Sensor	Range	Accuracy	Resolution
Air Temperature	- 40°C to + 60°C	0.2 °C	0.1°C
Relative Humidity	0 to 100 %	3 %	0.1 %

ARG SYTEM IN PASHAN, PUNE, INDIA

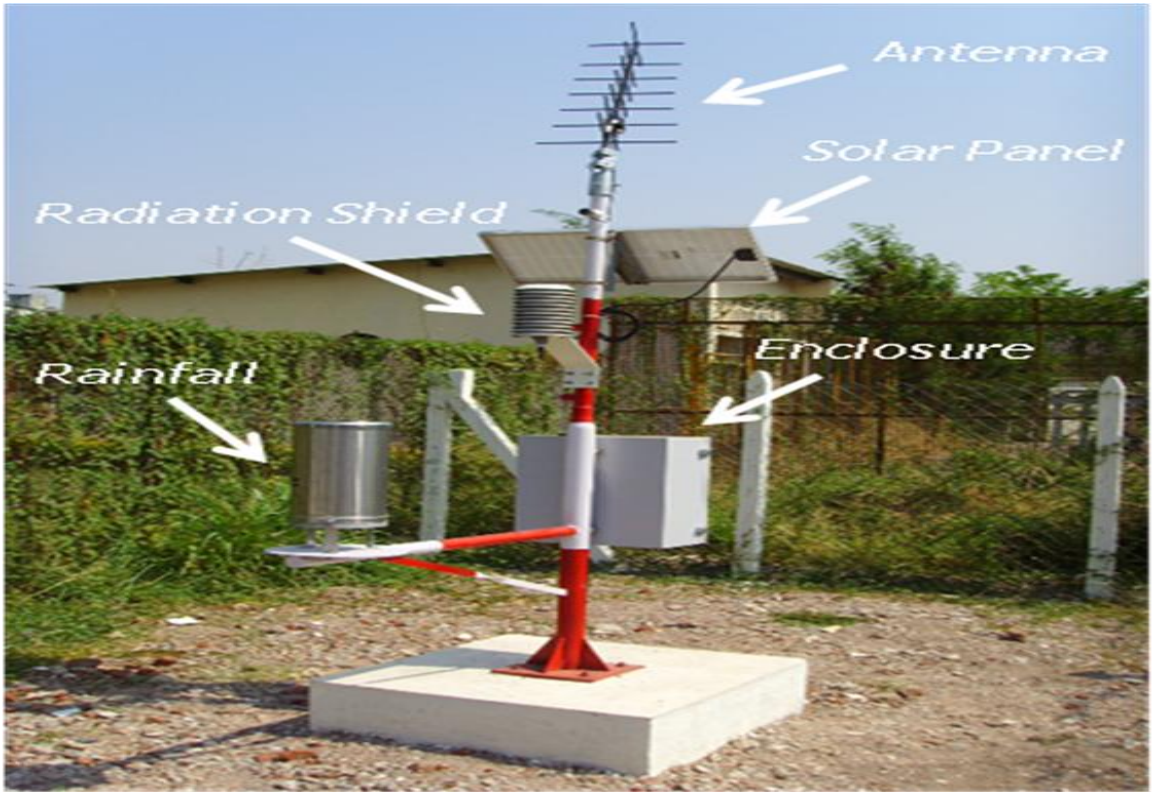

Figure-1

3. Data Comparison of ARG with Observatory

The Rainfall data of ARG System with Bhubaneshwar (Orissa) Observatory have been analyzed during South-West Monsoon Period and bar graphs have been drawn and is shown below:Figure 2,3,4,5. The accuracy of rainfall data is as per WMO specification.

COMPARISON OF BHUBANESHWAR, ORISSA (INDIA) SURFACE RAINFALL AND ARG RAINFALL

Month	Observatory Rainfall Data (in mm)	ARG Rainfall Data (in mm)
June 2009	92.3	85.0
July 2009	488.4	465.0
August 2009	378.2	363.0
September 2009	214.2	201.0

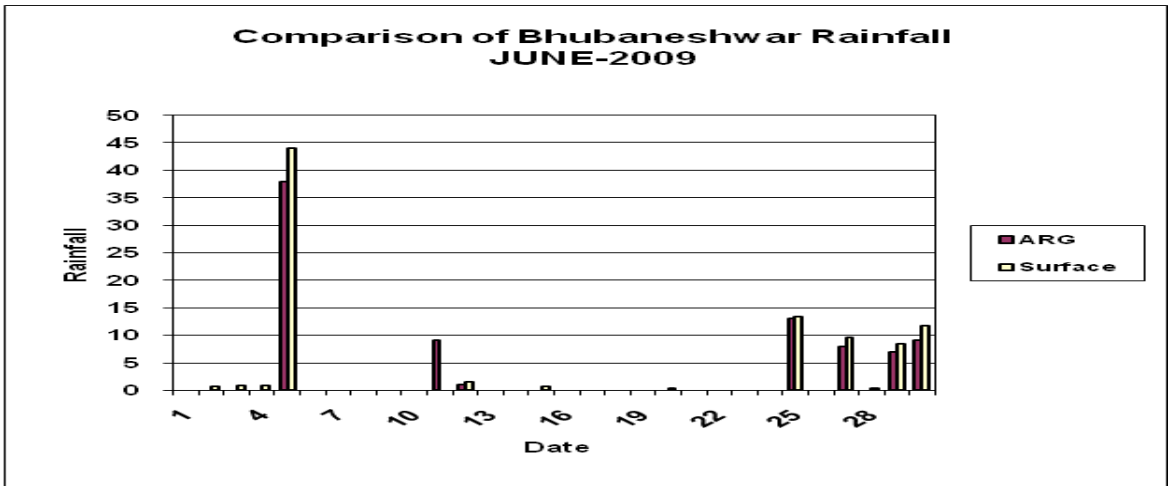

Figure -2

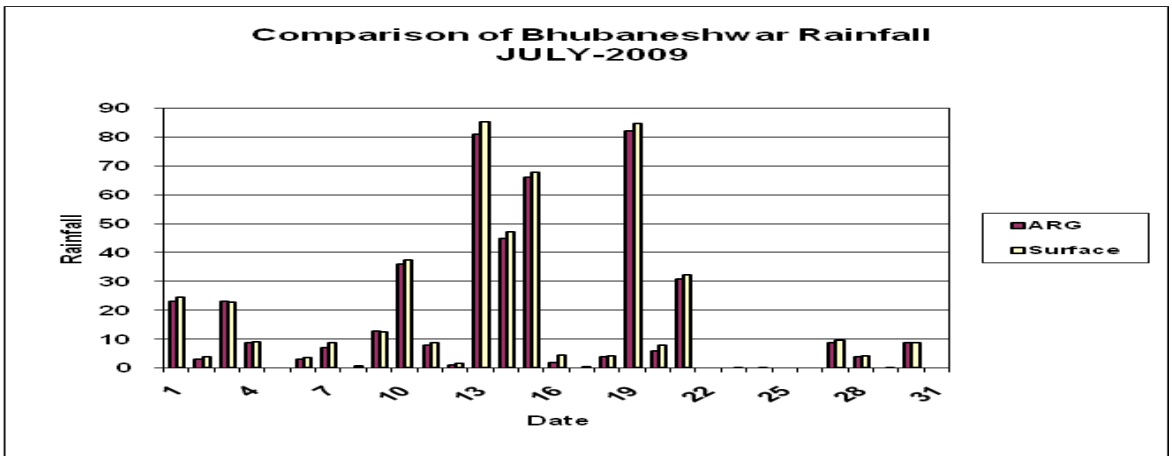

Figure-3

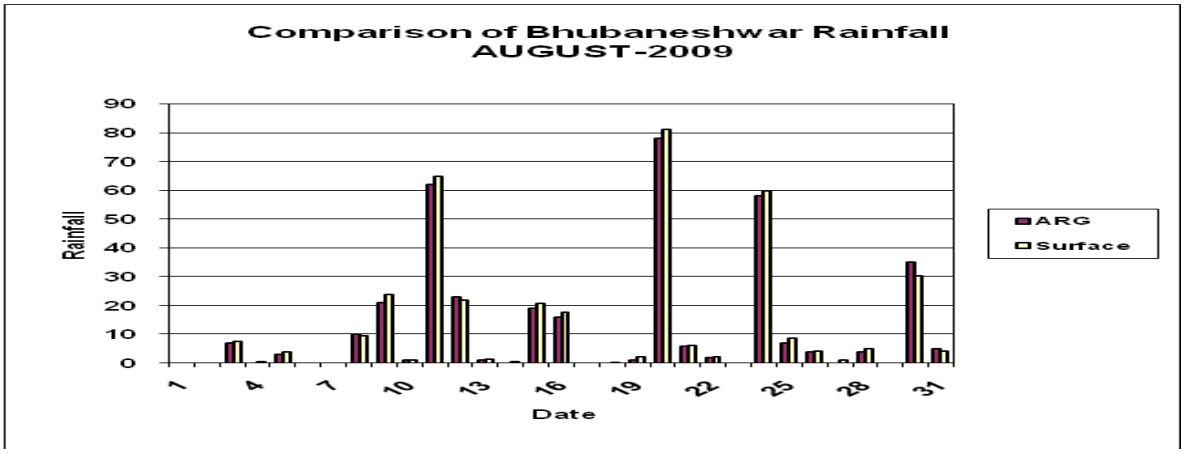

Figure-4

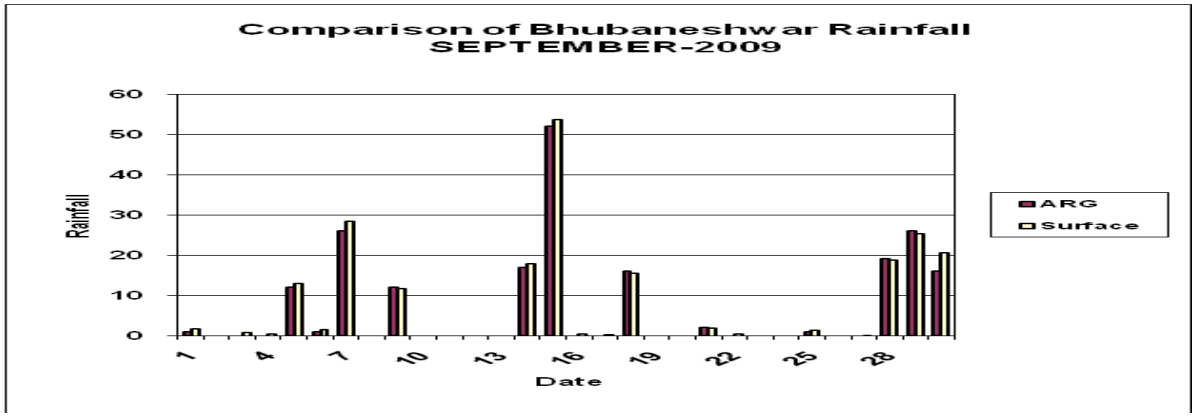

Figure-5

4. Importance of ARG network in India during Monsoon Period

India actually has two monsoons – the southwest monsoon and the northeast monsoon. The southwest monsoon, which is the main monsoon, comes in from the sea and starts making its way up India's west coast in early June. By mid July, most of the country is covered in rain. This gradually starts clearing from most places in northwest India by October.

The northeast monsoon affects India's east coast during November and December. It's a short but intense monsoon. The states of Tamil Nadu, Karnataka, and Kerala receive most of their rainfall from the northeast monsoon, while the rest of the country receives most of its rainfall from the southwest monsoon.

The monsoon doesn't appear all at once. Rather, it builds up over a couple of days of "pre-monsoon showers". Its actual arrival is announced by an intense period of heavy rain, booming thunder and plenty of lightening. This rain injects an amazing amount of vigor into people, and it's common to see children running about, dancing in the rain, and playing games. Even the adults join in because it's so refreshing.

After the first initial downpour, which can last for days, the monsoon falls into a steady pattern of raining for at least a couple of hours most days. It can be sunny one minute and pouring the next. The rain is very unpredictable. Some days very little rainfall will occur, and during this time the temperature will start heating up again and humidity levels will rise. The amount of rain that's received peaks in most areas

during July, and starts tapering off a bit in August. While less rain is usually received overall in September, the rain that does come can often be torrential.

Unfortunately, many cities experience flooding at the start of the monsoon and during heavy downpours. This is due to drains being unable to cope with the volume of water, often because of rubbish that has built up over the summer and hasn't been properly cleared.

These are the reasons for the establishment of ARG network in India. The rainfall data in real time during South West Monsoon and North East Monsoon is very useful for agriculture, flood forecasting, water management, availability of local rainfall data from different State and Central Governments/agencies, Irrigation Department ,Hydro Power Generation Stations, media, general public and even insurance sector.

5. Conclusions

Automatic Raingauge Stations are used for increasing the number and reliability of real time rainfall data. Rainfall is a highly variable parameter in space and time as the heterogeneities on local scale in land surface features (hills) rivers, vegetation etc. affect its distribution. It is also a very important parameter for agricultural operations, water resource management and as well as result in hydro-climatic disasters on local and regional scales.

The country has a space-based system which can easily handle communication with the raingauge stations provided the rainfall registration is automated and communication links established via satellite to make the data available at a central place in IMD, New Delhi & Pune. Therefore, modern technology is urgently needed to be introduced in the Rainfall Registration Sub-System so that real-time data are available for effective use.

It can be achieve by:

(i) A space-based system which can easily handle communication with the raingauge stations provided the automatic rainfall data collection via satellite link and to make the data available at a central place.

(ii) Increasing the density of an existing network by providing data from rainfall catchment area, river basin and from sites that are difficult to access and inhospitable.
(iii) Supplying, for manned stations, data outside the normal working hours.
(iv) Increasing the reliability of measurements by using sophisticated technology and modern, digital measurement techniques.
(v) Ensuring the homogeneity of networks by standardizing the measuring techniques.

IMD to install 3600 automatic raingauges in the next 5 years (2007-2012) with recording facilities and reporting the data via satellite communications. Out of 3600 automatic raingauges at least 500 gauges may be equipped with additional sensors for temperature and humidity observations. These stations are to be distributed over inaccessible and weather sensitive regions and also for each of the ten metro cities (Delhi, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad Guwahati, Lucknow, Patna and Ahmedabad). *Automatic raingauge network should be improved in the* flood-prone river basins like Brahmaputra, Ganga, Mahanadi, Tapi, Narmada, Godavari and Krishna.

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