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A Comparative Study on Satellite Rainfall Data with Observations from Gauge Station Data of Karwar Taluka, Uttarkannad District

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Abstract: ***Rainfall is one of the most significant processes of hydrological cycle which stands essential for lives on the earth. In recent days it has been recording through satellite usage. Hence the satellite records comparative (quality) check is very important to make use data set for different studies of water resource management. Therefore, in present study two different satellite records namely, CHIRPS & PERSSIAN data sets of 20 years period (2001-2019) have been used for comparative study between gauage station records. In this study the 3 stations namely Karwar, Gopashitta & Kadra are taken under consideration from the study region of Karwar taluka. Basically, taluka has 6 stations out which 3 are newly installed. Hence only above 3 station records are made used for study due to their available length of records. It is observed that both satellite records show very good results for stations Karwar and Gopashitta. But not quite good for Kadra station (R^2= 0.339 to 0.452) for both annual & monsoon rainfalls. This may be due to improper record or may be the issue of resolution of satellite record. The study is carried out for monsoon and annual records for both satellite and ground station. Initially its variation is studied using method of time series analysis. Then the strength of relation between satellite and ground station records is checked using linear regression method. It is resulted well for Karwar and Gopashitta stations for both monsoon and annual records giving R^2 values in the range of 0.605 to 0.673 for monsoon season to 0.659 to 0.698 for annual rainfall.***

Keywords: hydrological cycle, CHIRPS, PERSSIAN, time series analysis, linear regression

1. Introduction

Rainfall is a one of the very significant event of the nature over which the entire creation depends. It is essential for human life's different usages namely, drinking, agriculture, power generation, industrial use etc. therefore if any variation in rainfall event impacts various sectors of life. In recent days the amount of rainfall is recording through satellite media. Therefore for the proper management of water to different sectors the records of the satellite media needs to be undergo accuracy check with the ground station records. So as to have no situations created to human life's threatening kind. Keeping this in mind in present case a small effort is made to carryout a comparative study between rain gauge & satellite records taking into consideration of 3 different ground station records as base records. Karwar is a one of the taluka in Uttarkannada district situated at latitude of 14.81º & longitude of 74.12º & close to coast line. Therefore it experiences very good amount of rainfall in the monsoon season. It contains totally 6 number of rain gauge stations out of which 3 are recently installed. Hence only 3 older station records are taken in to consideration for the study, as recent station records gives short span of data set. These records are compared with satellite record retrieved from web source Climate Engine namely, CHIRPS [Climate Hazards Group InfraRed precipitation with station data] & PERSIANN [Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks].

2. Literature Survey

T.V. LAKSHMI KUMAR (SRM Institute of Science and Technology) In this study continuous scores were used to access the CHIRPS rainfall estimates against ground based observations on a pixel-to-station basis, during 01 January 1981 to 30 June 2019. Results showed that CHIRPS exhibits better performance in inland regions.

D. A.HUGHES (Rhodes University) this paper reports on a preliminary analysis of the potential for using satellite derived rainfall data through a comparison with available gauge data for basins in the southern Africa region.

M.SHAMKIet.al have investigated two scenarios first by using the Tropical Rainfall Measuring Mission (TRRMM) to generate the satellite precipitation data for the 1998-2009 periods and employ that data to compare with the data from the rain gauge stations available in the basin. The second was accomplished by using the prediction of Worldwide Energy Resource data from the NASA POWER for the 1994-2005 periods.

ATYAF J.M In this research, the validity of two types of satellite data viz., the tropical rainfall measuring mission (TRMM) product 3B43 and NASA Prediction of worldwide energy resource (POWER) are verified, using the ground monitoring stations.

TABARAK JAMEEL This paper gives a report on the applicability of the results of the study are in good agreement with the TRMM results obtained in the Western region of the country. Additionally, the NASA POWER data performed better in detecting moderate precipitation, consistent with previous research on CHRPS data.

3. Data

(i)Raingauge Data: The 20 year's monthly rainfall records of rain gauge station data ranging from 2001 to 2020 for

below three stations of Karwar taluka were collected from district statistical office Karwar.

Table 1: Details of raingauge stations.

S. No	Station Name	Latitude	Longitude
1	Karwar	14.8185° N	74.1416° E
2	Gopashitta	14.9073° N	74.2176° E
3	Kadra	14.9056° N	74.3469° E

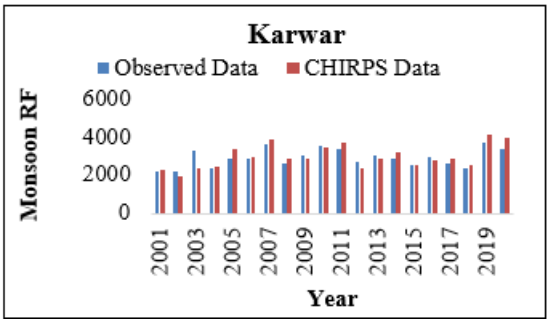
(ii) Satellite Data: The daily rainfall data of above mentioned raingauge stations for 20 year's period ranging from 2001 to 2020 were collected from climate engine web site. Namely, CHIRPS (Climate Hazards Group InfraRed precipitation with station data) & PERSIANN (Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks). Further the values of daily records are converted in to monthly & yearly records to carryout the study.

4. Methodology

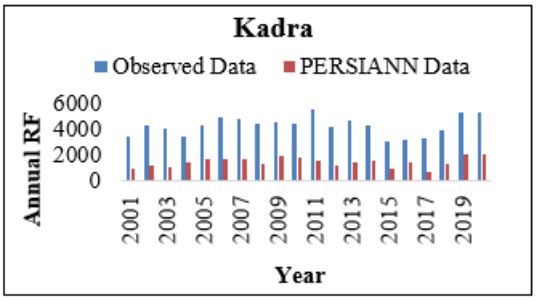
The best approach to evaluate the satellite rainfall data may be to make comparisons between the rain gauge stations and satellite data. The CHIRPS & PERSSIAN data were compared with rainfall measurements station for a period of 20 years, both for monsoon & annual rainfall. To estimate the strength of relationship between the comparison the linear regression method were adopted to calculate the values of simple statistics (R, R^2& slope). The time series analysis was also carried out for visual interpretation to compare observed (station) data records with satellite data records.

5. Results & Discussion

The time series analysis for CHIRPS data set has not shown much variation in rainfall amount respect to the ground station records at all the three stations for both monsoon & annual rainfalls. But the data set of PERSSIAN has exhibited much fluctuation in time series analysis from visual interpretation at all three stations for both monsoon & annual records. This is evident from below graphs.



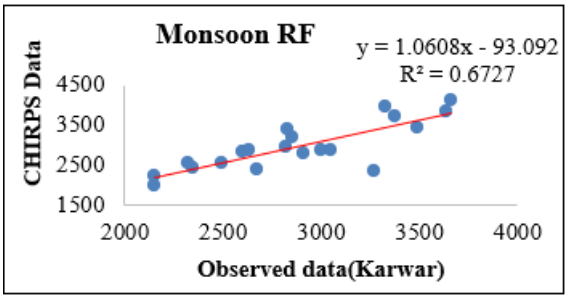
Graph 1: Time series analysis between Observed & CHIRPS data.



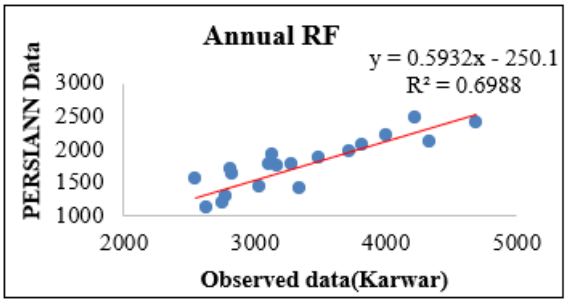
Graph 2: Time series analysis between Observed & PERSSIAN data

The too much variation in PERSSIAN data set may be due to improper record of data during the period of rainfall occurrence. Practically some amount of rain immediately goes back to atmosphere without reaching the earth surface due to heat energy. So there may be little variation in rainfall amount records at the ground and satellite stations but it should not be more.

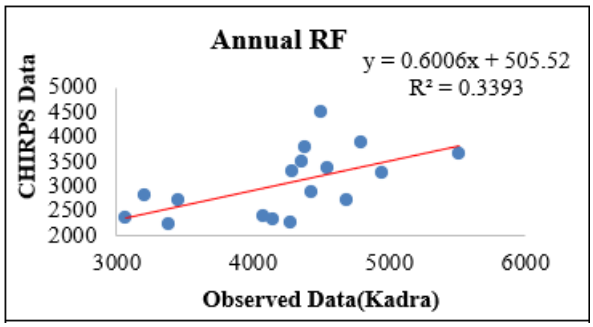
The results of linear regression have shown good for monsoon & annual rainfalls. As the strength between ground station records & satellite records resulted good. But for the station Kadra both satellite records have shown less R^2 value equal to in the range of 0.339 to 0.536 for both monsoon & annual rainfalls. While for Karwar & Gopashitta stations both satellite records have shown good relation with gauge station records resulting R^2 value in the range of 0.605 to 0.698 for both monsoon & annual rainfalls. The results giving not quite good relation at station Kadra may be due to its improper record during the period of rainfall event.



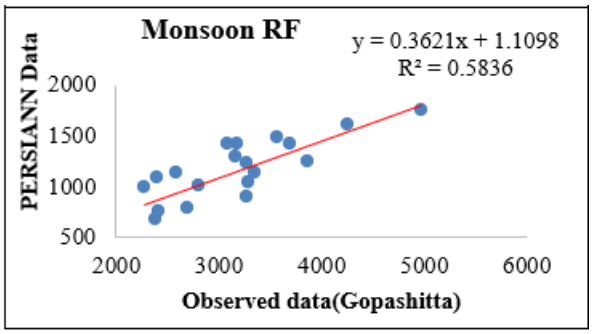
Graph 3: Scatter plot comparison at station Karwar



Graph 4: Scatter plot comparison at station Karwar



Graph 5: Scatter plot comparison at station Kadra



Graph 6: Scatter plot comparison at station Gopashitta

It is evident from graphs 3, 4 & 6 that the strength between the gauge station records & satellite records i.e CHIRPS & PERSIANN is good for stations Karwar and Gopashitta resulting R^2= 0.583 to 0.698 for both monsoon & annual rainfalls. But is quite weak for station Kadra with lowest R^2= 0.339 for annual rainfall records. It is also shown same for monsoon rainfall records (R^2=0.452). This may be due to improper record or issuer of resolution of satellite records.

6. Conclusion

It is concluded from the study that the both satellite records performs better for the ground stations Karwar & Gopashitta from both time series analysis & linear regression methods. Hence the satellite records can be made used in the absence of ground station records during the period of need at above two stations. Especially to run the hydrological model at basin area covering above two stations.

7. Future Scope

The study further can be continued taking in to consideration of remaining three stations of study area. It will give quality check of satellite records for entire study region. Also the same study can be carried out on daily; monthly data set records to have in detailed information of satellite records corresponds to gauge station records.

The other satellite records can also used namely, GPM data, CMORPH data, Power data etc. to perform similar kind of study for different regions also to have quality check on satellite records.

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