Journal of Energy and Power Engineering 18 (2024) 104-118
doi: 10.17265/1934-8975/2024.03.004

Comparative Study of Satellite Precipitation and Synoptic Observations in the Republic of Guinea

Mamadou Saliou Diallo[1], Amadou Lamarana Bah[2], Fatoumata Sylla[3], Ibrahima Kalil Kante[4] and Idrissa Diaby[2]

1. Higher Institute of Distance Learning, Technical Department, BP 1961, Conakry, Republic of Guinea

2. Applied Energy Teaching and Research Laboratory, University Gamal Abdel Nasser of Conakry, BP 1147, Conakry, Guinea

3. Director General of Research at the Ministry of Higher Education, Scientific Research and Innovation (MERSI), BP 2201, Conakry, Guinea

4. Air Navigation and Aerodrome Safety Department, Guinean Civil Aviation Authority, BP 95, Conakry, Guinea

Abstract: This research work involves a comparative study of satellite rainfall and synoptic observations in the Republic of Guinea over a 30-year period. The methodology used consists, firstly, in assessing rainfall trends over the study period in Guinea's four natural regions, using the temporal averages of the three stations located in each region. Secondly, we calculated the correlations between synoptic and satellite observation data, in order to determine the links between them on the basis of data analysis. The results for synoptic stations on average seasonal rainfall cycles and satellite products show that in Lower Guinea, the CRU (Climatic Research Unit) and GPCC (Global Precipitation Climatology Center) data are good estimates of observations. In the Fouta Djallon region, they also estimate observations well, but at two synoptic stations, with the exception of Mamou, they underestimate them. In Upper Guinea, during the monsoon period, satellites give a good estimate of rainfall in this area. In the forest region, these products show highly variable behavior, sometimes underestimating and sometimes overestimating observations, depending on the stations in the zone.

Key words: Precipitation, observation, satellite data, synoptic station.

1. Introduction

Precipitation plays an important role in the global energy and water cycle. Accurate knowledge of its quantity reaching the earth's surface is of particular importance for freshwater assessment and management related to land use, agriculture and hydrology among others. On a global scale, 60% of precipitation occurs in tropical regions [1, 2], where the Republic of Guinea is located. Atmospheric and oceanic dynamics, which redistribute the excess energy received in these regions towards mid-latitudes, explain the high spatiotemporal variability of rainfall in the tropics [1].

Precipitation is one of the most important meteorological and hydrological parameters, but it is difficult to measure, not least because of its great spatio-temporal variability and the conditions under which instruments are installed and maintained. Given the need for reliable precipitation data, national and international organizations such as the WMO (World Meteorological Organization) have launched and supported numerous research and environmental monitoring programs. In recent years, meteorologists, climatologists and hydrologists [3] have shared a common interest in the undeniable need to estimate rainfall effectively from a practical point of view. It is with this in mind that projects to place meteorological observation satellites into orbit have emerged.

At present, the importance of using satellite data to estimate cumulative rainfall, particularly in regions lacking adequate "conventional means" such as rain gauges, pluviometers or radar, is well recognized [3].

Corresponding author: Mamadou Saliou Diallo, PhD student, research field: environmental science.

This work compares satellite rainfall with synoptic observations in the Republic of Guinea.

2. Materials and Methods

2.1 Presentation of the Study Area

Our study area is shown in Fig. 1, located between latitudes 7°-13° N and longitudes 15°-7° W. The Republic of Guinea is a West African country covering an estimated 245,857 km^2 and made up of four (4) natural regions with different microclimates. These natural regions are: LG (Low Guinea), MG (Middle Guinea), UG (Upper Guinea) and GF (Guinea Forestry). Each region has three (3) synoptic weather stations.

The LG region includes the synoptic weather stations of Boke, Conakry and Kindia, and is also called Guinea Maritime because of its proximity to the ocean. It is the coastal belt between Guinea-Bissau to the north and Sierra Leone to the south (around 300 km), and around 100 to 200 km wide. It covers around 15% of the country's total surface area, with swamps occupying some 360,000 ha, including 260,000 ha of mangroves, the largest in West Africa. It has a humid tropical climate, with rainfall peaking in August and exceeding 4,000 mm/year in Conakry.

The LG region includes the synoptic stations of Faranah, Kankan and Siguiri, covering around 39% of the country's total surface area. It lies between the GF and the Fouta Djallon on the western edge of the vast Niger basin. The region has an average altitude of 500 m, and features a gentle relief that explains the spreading of the rivers. Its climate is Sudanese, with annual rainfall ranging from 1,600 mm in the south to 1,200 mm in the north. It represents the arid, Sahelian zone of Guinea, due to the similarity of the Sahelian climate. Its grassy savannah with plateaus and river plains (Milo River) is ideal for agriculture. Temperatures can vary from 14 ℃ during the rainy season to 37 ℃ during the dry season [4].

The AG includes the synoptic stations of Koundara, Labe and Mamou, and covers around 26% of Guinea's total surface area. The Fouta Djallon massif covers some 80,000 km^2 and its highest point is Mount Loura (1,532 m), comprising Guinea's most mountainous region. Its soil is made up mainly of stepped uplands over 1,000 m in width, with valleys dominating plains and depressions at altitudes of over 750 m, and in some places exceeding 1,200 m.

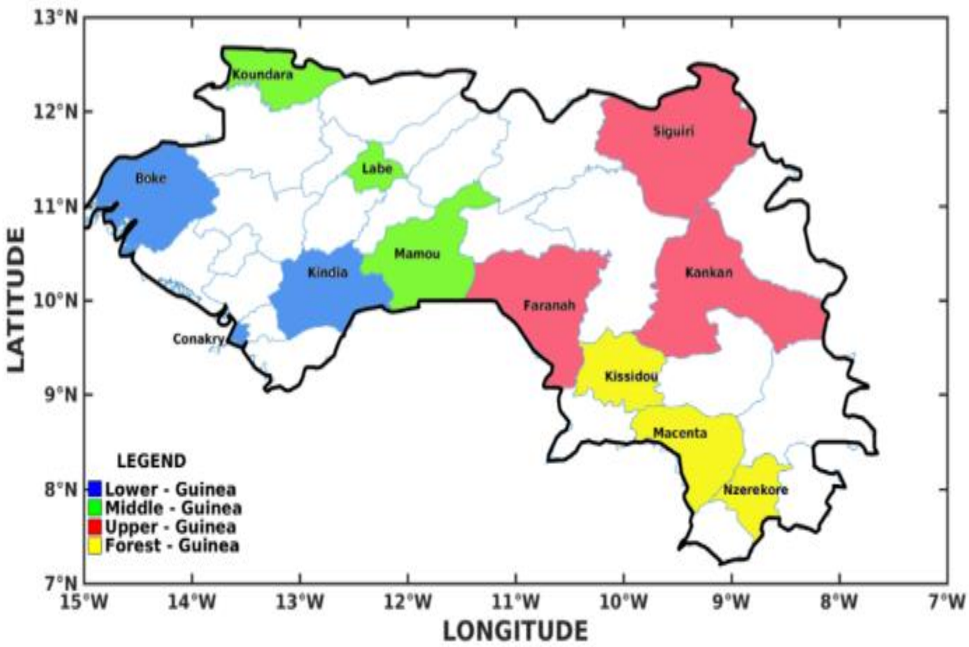

Fig. 1 Guinea's twelve (12) synoptic stations and its four (4) natural regions.

This region is the source of many of West Africa's rivers and streams: the Senegal and Gambia rivers to the north, Koliba, Rio Grande, Fatala and Konkoure to the west. The Kaba and Kolente rivers to the south and the Niger to the east. Its climate is marked by a relatively high diurnal thermal amplitude of up to 19 ℃ in Labe [5]. The rainy season can last from five (5) to eight (8) months between Koundara and Mamou, with rainfall below 1,300 mm in the north.

The FR (Forest Region) comprises the synoptic weather stations of Kissidougou, Macenta and N'Zerekore. This region corresponds to the southern part of Guinea and covers 20% of the country's total area [6]. Its relief features two mountains, Mount Simandou and Mount Nimba (highest point 1,752 m). The Mount Nimba Strict Nature Reserve is a UNESCO (United Nations Educational, Scientific and Cultural Organization) World Heritage Site and covers most of the ecotope, which is home to more than 200 endemic species including duikers, lions and leopards, civets and two species of viviparous amphibians. This region also has a climate characterized by a long rainy season (between 8 and 9 months). More than 1,300 plant species and over 500 animal species can be found in the Ziama Massif Biosphere Reserve.

2.2 Data

Two types of data were used in this work: synoptic observations and satellite data.

2.2.1 Observation Data

These data are provided by the National Directorate of Meteorology in Conakry, over a period of thirty years (30 years). Guinea's meteorological observation network has a very low density due to obsolete meteorological logistics and a lack of efficient meteorological observers. Many of these stations (radio, synoptic, rainfall and agronomic soundings) have several data gaps, which sometimes complicates the use of these data.

To this end, twelve (12) synoptic stations have been selected for this study, with regular observations and reliable data [6], for an evaluation of satellite data. These are monthly point data over a 30-year period.

2.2.2 Satellite Data

In this work, we used the following satellite products: GPCC (Global Precipitation Climatology Center), GPCP (Global Precipitation Climatology Project), CHIRPS (Climate Hazards Group InfraRed Precipitation with Station Data) and CRU (Climatic Research Unit). These data are compared with observations from the twelve (12) synoptic stations in Guinea.

2.3 Processing Tools: MATLAB

MATLAB stands for "Matrix Laboratory". It is a computer environment designed specifically for matrix calculation. It is ideally suited to data analysis, signal and image processing, filter design, control system analysis and many other applications. What is more, its ease of use with complex numbers and graphical plots makes it an interesting tool for many programming problems. MATLAB can also be seen as a programming language. MATLAB can be used in an interactive mode, where instructions are executed immediately after being typed.

2.4 Methodology Adopted

In this work, we adopted the following methodology. We considered synoptic and satellite observation data for a 30-year period from 1981 to 2010. First, using these observation data, we calculate the mean seasonal precipitation cycle for each station, then compare them with satellite data. This first part of the methodology concerns the amount of precipitation and its variability over the period under consideration, compared with satellite products.

We evaluate rainfall trends over the study period in the four (4) natural regions of Guinea, using time averages from the 3 stations located in each region. This enables us to determine the start and end of rainy seasons in Guinea, and to identify satellite products that reproduce observations well.

Secondly, we calculate the correlations between observational and satellite data. The correlation coefficient allows us to determine the link between the observational and satellite data associated with the level of significance.

3. Results and Discussion

3.1 Evaluating Satellite Data from Observations

3.1.1 Data from Lower Guinea

At the Boke station (Fig. 2a), from January to June and October to December, satellite data reproduce observations very well, with a good estimate of observed rainfall. During the monsoon season from July to September, only the CRU and GPCC data reproduce the observed precipitation at this station. The GPCP and CHIRPS satellite products, on the other hand, underestimate the precipitation observed at this coastal station.

Indeed, the Conakry station (Fig. 2b) shows that from January to June and from October to December, satellite data reproduce observations well, with an acceptable estimate. However, at the height of the rainy season (July to September), satellite products reproduce observations less well and therefore underestimate rainfall at Conakry.

For the Kindia station (Fig. 2c), from January to June and from October to December, satellite data provide a good estimate of observations. During the monsoon period, from July to September, the GPCP, CHIRPS and CRU satellite products reproduce observations fairly well. Only the GPCC is less accurate.

3.1.2 Data from Middle Guinea

We can see from the curves for the Koundara station (Fig. 3a), from January to April and from November to December, that the satellite data reproduce the observations well. This shows that during these months, the satellites accurately estimate the precipitation observed at the Koundara synoptic station. On the other hand, we note that GPCP data overestimate synoptic observations. During the months of May to October, only GPCC data reproduce observations very well. However, the following satellite products: GPCP, CHIRPS and CRU estimate less well.

Indeed, for the Labe station (Fig. 3b), we can see that the GPCC, GPCP, CHIRPS and CRU satellite data reproduce well those of the observations. This means that at the Labé synoptic station, the satellites accurately estimate the precipitation observed in this locality.

Satellite data curves from the Mamou station (Fig. 3c), on the other hand, are consistent with observations from January to March and October to December, except for CHIRPS data. During the monsoon season, these satellite products underestimate the observations, especially CHIRPS.

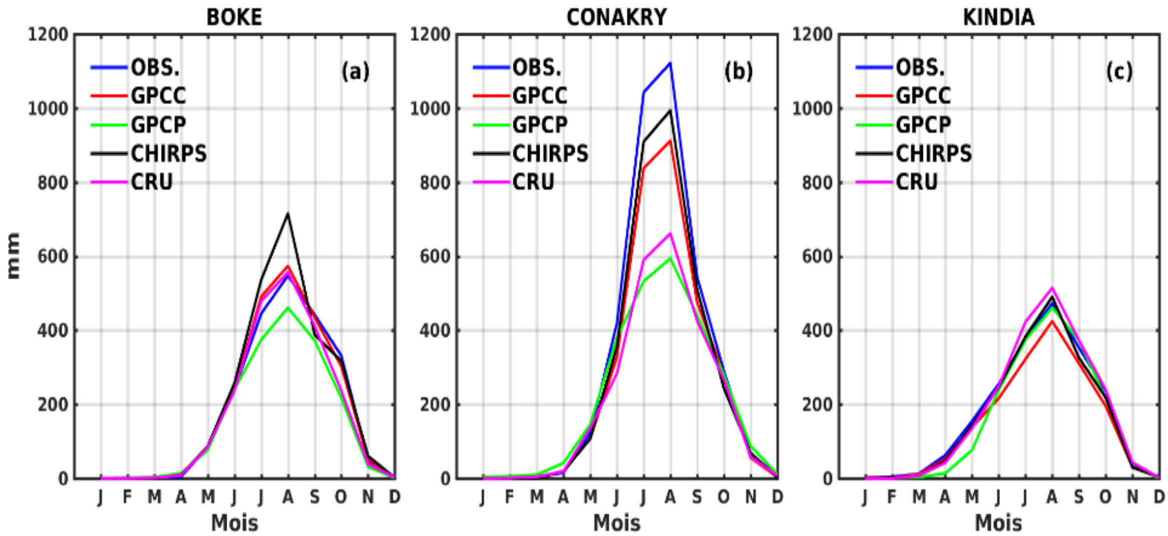

Fig. 2 Evaluation of satellite data based on observations from stations in Lower Guinea: (a) Boke, (b) Conakry and (c) Kindia.

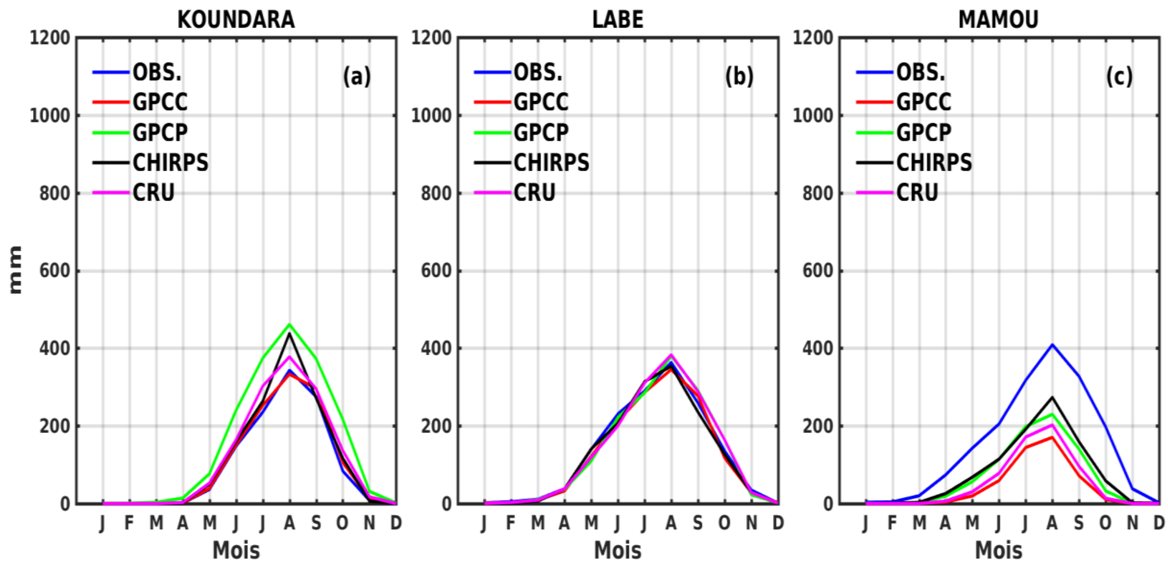

Fig. 3 Evaluation of satellite data from observations at stations in Middle Guinea: (a) Koundara, (b) Labe and (c) Mamou.

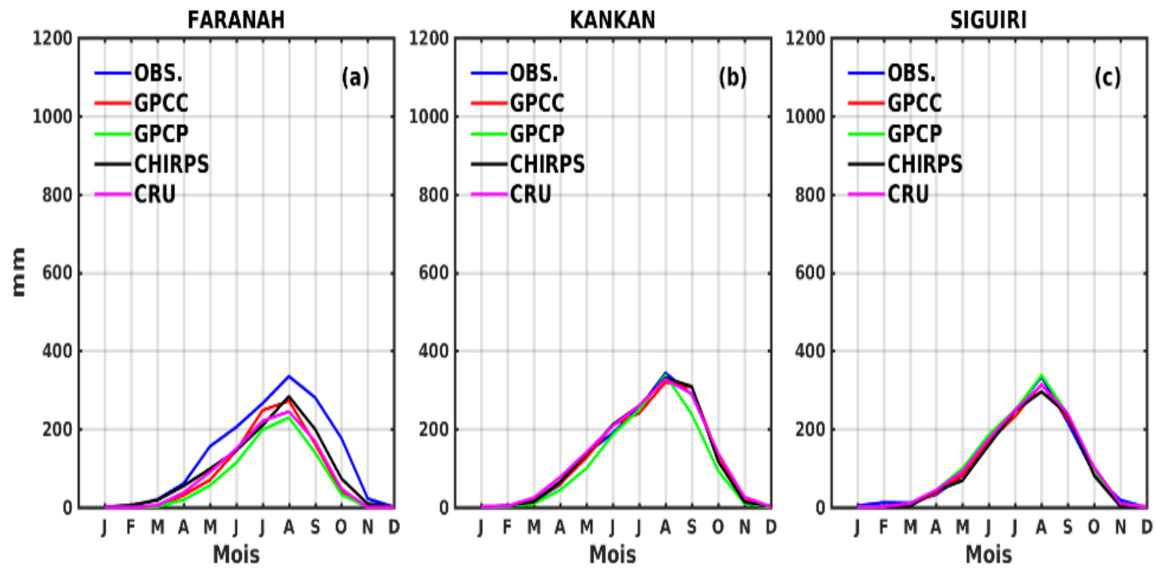

Fig. 4 Evaluation of satellite data from observations at stations in Upper Guinea: (a) Faranah, (b) Kankan and (c) Siguiri.

3.1.3 Data from Upper Guinea

In this arid region of Guinea (Fig. 4), from January to March and from October to December, we note that satellite products are consistent with observation data at its three synoptic stations. This shows that, during these months, the satellites do a good job of estimating rainfall in this Guinean region. However, considering the Faranah station (Fig. 4a), GPCC, GPCP, CHIRPS and CRU data underestimate observations during the other months from April to September. This explains the poor estimation of satellite rainfall during the monsoon season at the Faranah station.

Considering the Kankan (Fig. 4b) and Siguiri (Fig. 4c) stations, we can see that these satellite products reproduce the observation data at these stations very well, with a good estimate of rainfall. On the other hand, GPCP data from the Kankan station virtually underestimate observations.

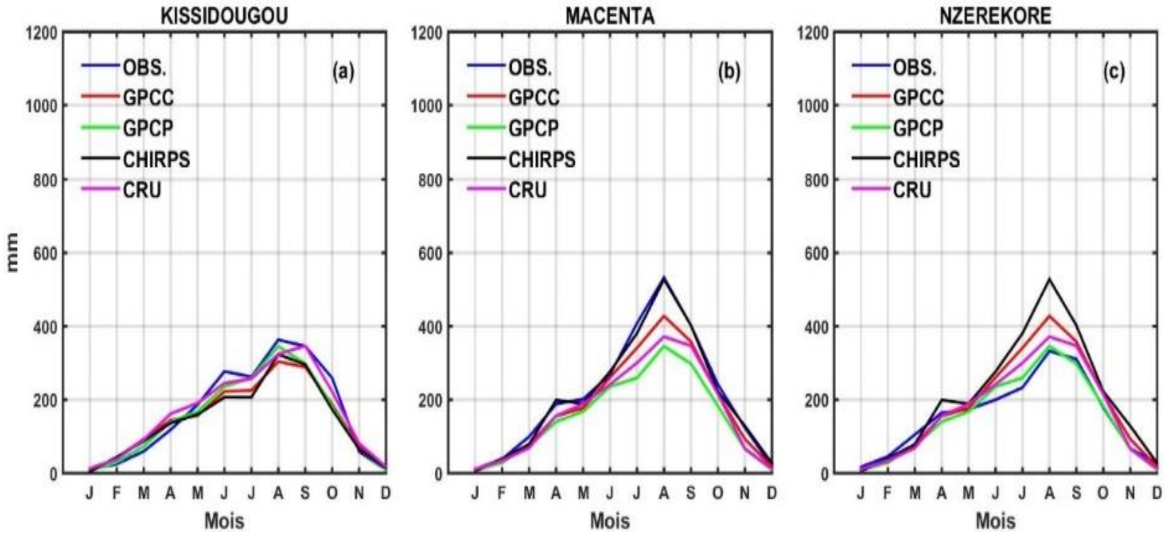

Fig. 5 Evaluation of satellite data based on observations from stations in Guinea Forestry : (a) Kissidougou, (b) Macenta and (c) N'Zerekore.

3.1.4 Data from Forest Guinea

In the forest region of Guinea, Fig. 5 shows a remarkable variability between satellite products and observations at its three synoptic stations. Indeed, if we consider Kissidougou (Fig. 5a), we see that satellites underestimate rainfall observations at this station throughout the year.

As for the Macenta station (Fig. 5b), we note good consistency between satellite products and observations from January to June. However, from September to December, the CHIRPS data faithfully reproduce the rainfall observed at this station. On the other hand, during the monsoon period, from June to August, satellite products underestimate observations.

At the N'Zerekore station (Fig. 5c), CHIRPS, GPCC and CRU data show an underestimation of observations for almost all months of the year. This means that they underestimate the precipitation observed at this synoptic station. On the other hand, GPCP data show a good estimate of observations from January to April and November to December. But during the monsoon period, they show an overestimation of observation data.

3.2 Correlation between Satellite Data and Observations

Correlation is a technique used to study the relationship that might exist between two quantitative variables (X and Y). In this section, we show the correlation between satellite rainfall data and observations of the four Guinean natural regions with these twelve (12) synoptic stations.

3.2.1 Satellite Data and Observations of Lower Guinea

(1) Boke Synoptic Station

Fig. 6 shows the correlation between satellite products and observed rainfall at the Boké synoptic station, with correlation coefficient values ranging from 0.92 to 0.95. Consider Fig. 6a, corresponding to the correlation between GPCC data and Boke observations, whose point clouds show very close clustering on either side of the regression line. This behavior resulted in a positive correlation coefficient equal to 0.95, which is a good correlation. Consequently, GPCC satellite products correlate well with observed precipitation at this station.

In Fig. 6b, the relationship between GPCP satellite data and observations shows scattered clouds of points on either side of the regression line. This is explained by the positive correlation coefficient of 0.94, which means that the GPCP data are well correlated with the Boke observations. Fig. 6c shows the correlation between CHIRPS data and observations, with scattered clouds of points. Consequently, the relationship between these two (2) data informs us of a good correlation between them, with a correlation coefficient equal to 0.92.

In the study of the relationship between CRU satellite products and observed rainfall at the Boké station, Fig. 6d shows a good correlation with a coefficient equal to 0.95. This means that CRU data correlate well with rainfall observation data from the Boke station. Consequently, CRU data correlate well with rainfall observation data from the Boke station.

(2) Conakry Synoptic Station

For this station in the Guinean capital Conakry, shown in Fig. 7, we can see from the scatterplots that follow the regression line on either side that the observations correlate well with the GPCC data (Fig. 7a), with a correlation coefficient equal to 0.95. At the same time, Fig. 7b shows the correlation between the observations and the GPCP satellite data. At the same time, Fig. 7b shows the correlation between observations and GPCP satellite data, which are fairly representative on either side of the regression line, indicating a coefficient equal to 0.89.

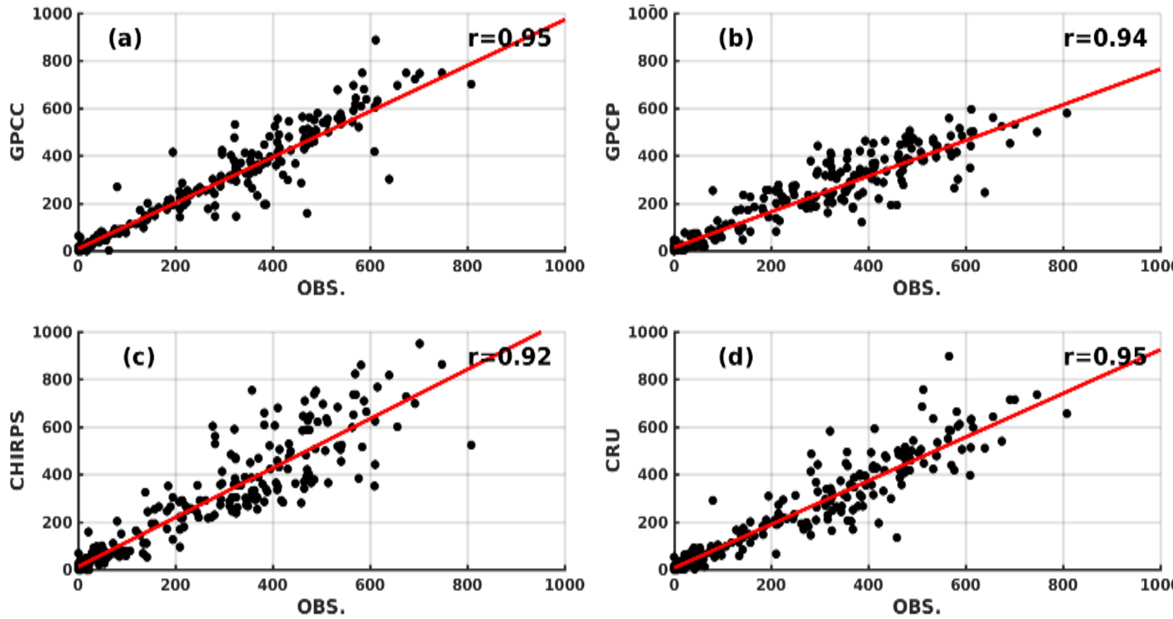

Fig. 6 Correlations between satellite data and observations from the Boke station. (a), (b), (c) and (d) are GPCC, GPCP, CHIRPS and CRU respectively, which are correlated with the observations.

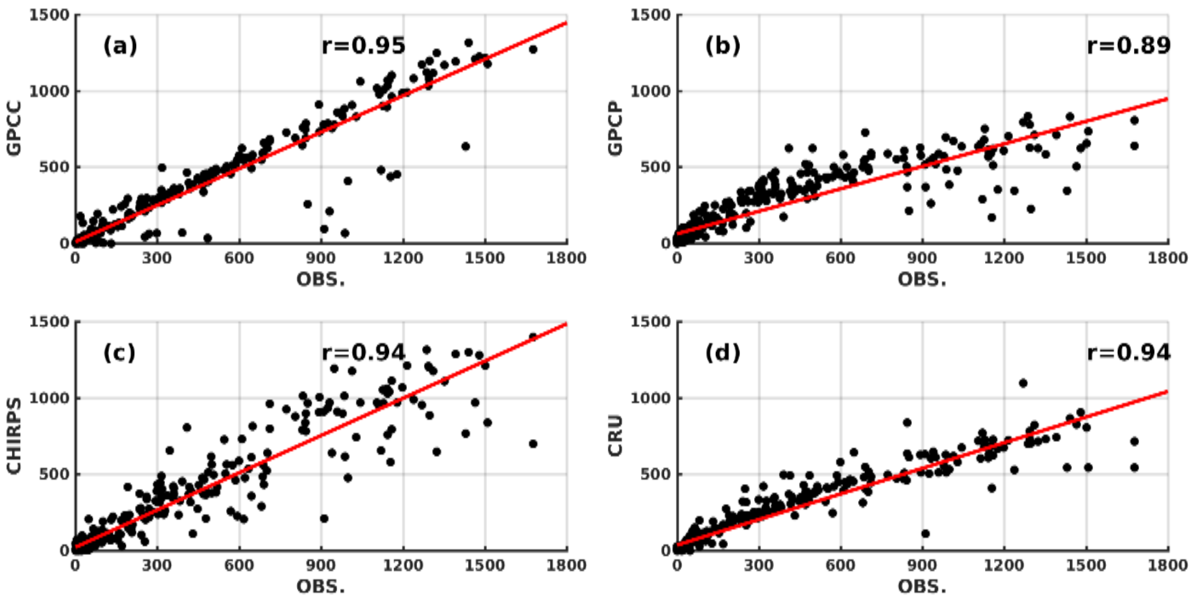

Fig. 7 Correlations between satellite data and observations from the Conakry station. (a), (b), (c) and (d) are GPCC, GPCP, CHIRPS and CRU respectively, which are correlated with the observations.

Fig. 7c shows an acceptable correlation between the synoptic observations and the CHIRPS satellite data, with the distribution of the scatterplots following the regression line with a correlation coefficient of 0.94. This correlation value indicates that there is a good relationship between the observations from the Conakry station and the CHIRPS data.

In Fig. 7d, the observations reproduce the CRU data well, with a correlation coefficient equal to 0.94. It should be noted that at this Conakry station, there is a remarkable correlation between the observations and the satellite products used in this analysis.

(3) Kindia Synoptic Station

A study of the correlation at the Kindia synoptic station (Fig. 8) shows that, for Fig. 8a, the observations correlate well with the GPCP data, with a correlation coefficient equal to 0.89. Fig. 8b shows a near-perfect correlation between observations and GPCP data, with the scatterplots distributed on either side of the regression line at a coefficient of 0.93.

Meanwhile, the observations correlate very well with the CHIRPS data (Fig. 8c), which has a coefficient of 0.95, at this station in the citrus-growing town of Kindia. CRU data correlate well with synoptic observations at the Kindia station (Fig. 8d), with a coefficient of 0.96. Consequently, the CRU data reproduce well the observation data from Kindia.

3.2.2 Satellite Data and Observations of Middle Guinea

(1) Koundara Synoptic Station

Considering the synoptic station of Koundara (Fig. 9) from Middle Guinea, it shows a good correlation between observations and satellite products. Fig. 9a shows a good relationship between observations and GPCC data, with a correlation equal to 0.94. Considering Fig. 9b, it shows 0.89 as the correlation value between observations and GPCP data. Consequently, this value corresponds to a good relational relationship between these two types of data at this station.

The CHIRPS satellite data (Fig. 9c) from this analysis also show a good correlation with the observations from the Koundara station. The corresponding correlation coefficient is 0.91, which is an interesting value. In the same context, we note in Fig. 9d that the CRU data reproduce well those of observations from Koundara, with a correlation value equal to 0.90.

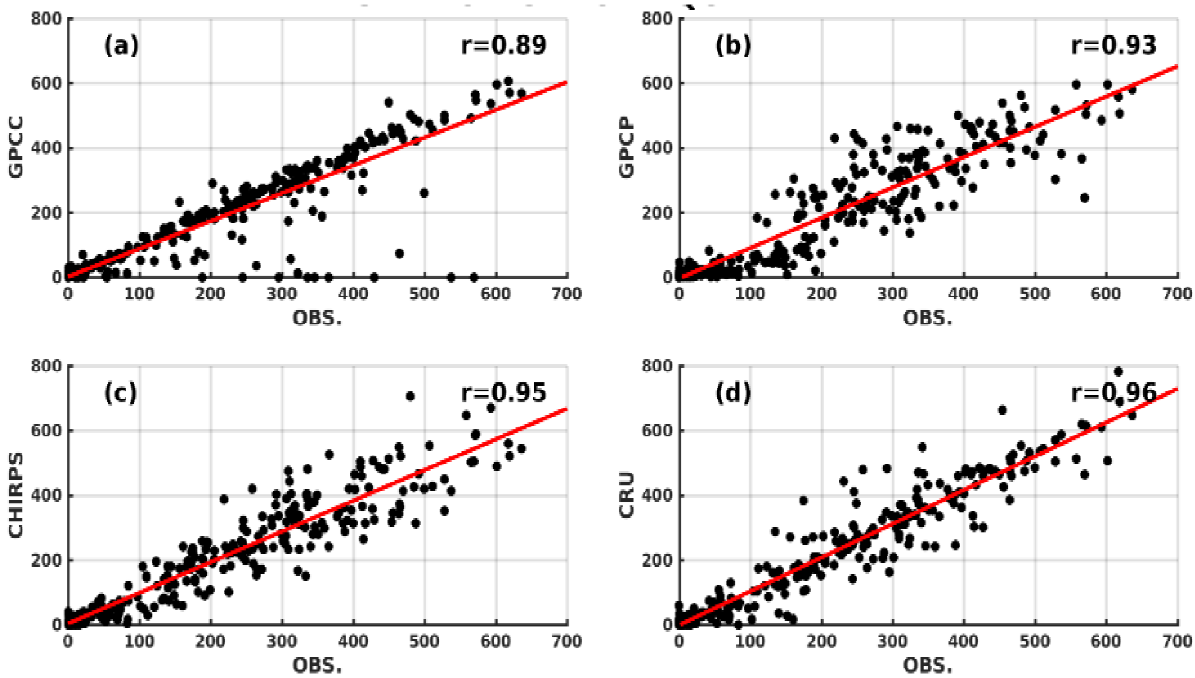

Fig. 8 Correlations between satellite data and observations from the Kindia station. (a), (b), (c) and (d) are GPCC, GPCP, CHIRPS and CRU respectively, which are correlated with the observations.

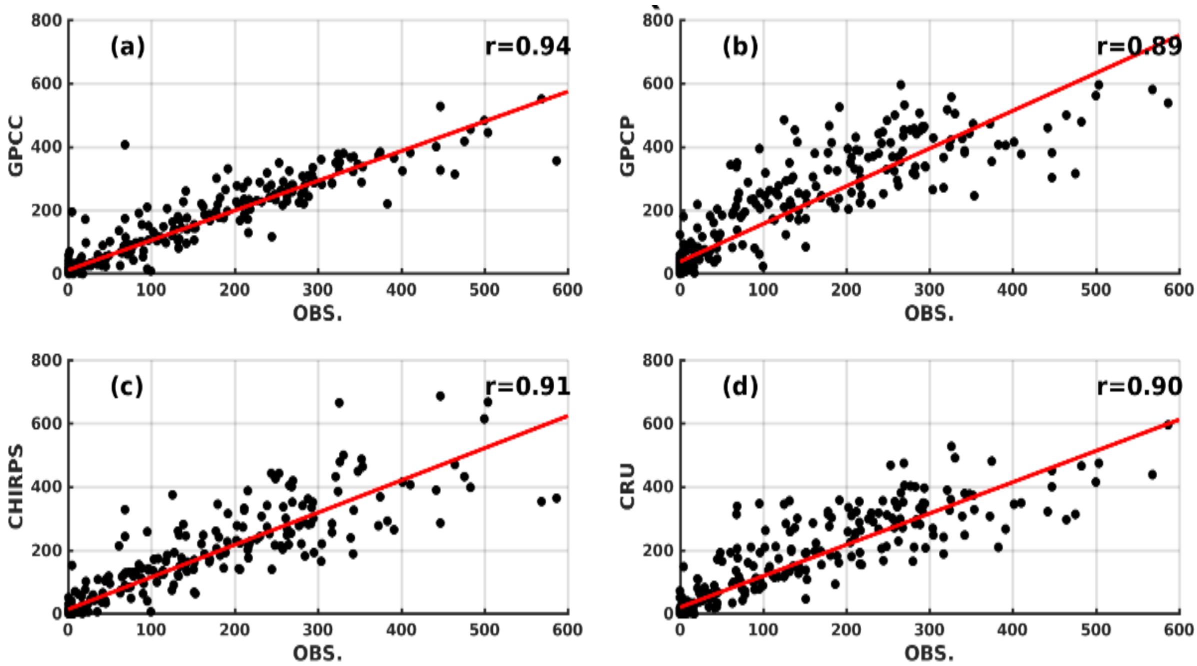

Fig. 9 Correlations between satellite data and observations from the Koundara station. (a), (b), (c) and (d) are respectively GPCC, GPCP, CHIRPS and CRU which are correlated with the observations.

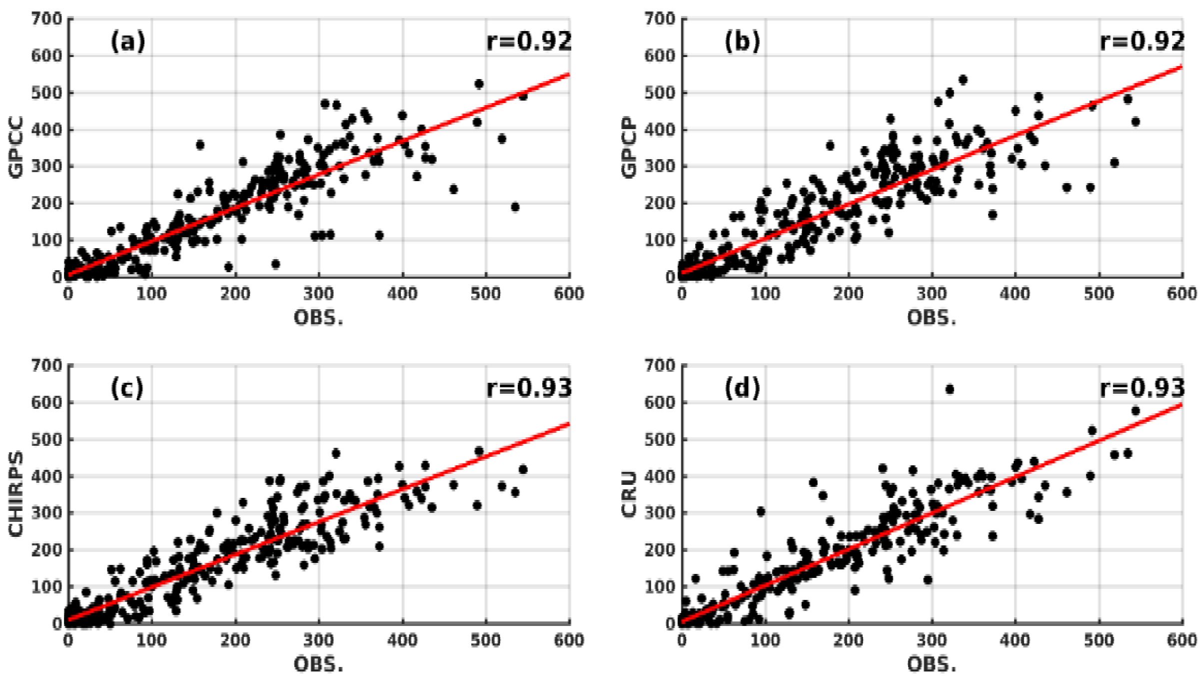

Fig. 10 Correlations between satellite data and observations from Labe station. (a), (b), (c) and (d) are GPCC, GPCP, CHIRPS and CRU respectively, which are correlated with the observations.

(2) Labe Synoptic Station

In the Fouta Djallon region, Fig. 10 shows that the satellite data used in our study correlate well with observations from the Lab é station. The GPCC (Fig. 10a), GPCP (Fig. 10b), CHIRPS (Fig. 10c) and CRU (Fig. 10d) data respectively give the following high correlation values: 0.92, 0.92, 0.93 and 0.93. Consequently, Labe is the station whose satellites reproduce well the observations of s data.

(3) Mamou Synoptic Station

In the Middle Guinea region, Fig. 11 (Mamou) shows low correlation values compared with other stations in the region. In fact, the satellite data used in this study are fairly well correlated with observations from the Mamou station. The GPCC (Fig. 11a), GPCP (Fig. 11b), CHIRPS (Fig. 11c) and CRU (Fig. 11d) data respectively give the following correlation values: 0.79, 0.86, 0.88 and 0.79. Consequently, the Mamou station is the one whose satellites reproduce the observations of the data least well.

3.2.3 Satellite Data and Observations of Upper Guinea

(1) Faranah Synoptic Station

In this semi-arid region of Guinea, correlations were studied at three (3) stations. Starting with the Faranah synoptic station (Fig. 12), we found that the observations correlated fairly well with the GPCC data (Fig. 12a), with a scattering of point clouds on either side of the regression line, having a coefficient of 0.82.

In the same vein, Fig. 12b shows the fairly representative correlation between GPCP data and synoptic observations from the Faranah station, with a correlation coefficient equal to 0.84. Continuing the same analysis, we note that the CHIRPS data (Fig. 12c) are also well correlated with the observations, with a good distribution of point clouds. As for the Faranah station, we note that the observations are almost well correlated with the CRU data (Fig. 12d), with a correlation coefficient equal to 0.85.

(2) Kankan Synoptic station

The study of correlations between satellite products and synoptic observations from the Kankan station (Fig. 13), shows a good correlation varying between 0.89 and 0.91. Fig. 13a shows good relationships with observations, with a correlation coefficient equal to 0.90. In Fig. 13b, the GPCP data and the observations show a correlation of 0.89, indicating a good estimation of the observations by the satellites.

At the same Kankan station, the CHIRPS data (Fig. 13c) correlate well with the satellite data, with a correlation coefficient of 0.91. The CRU data (Fig. 13d) provide a correlation value of 0.90. As for the CRU data (Fig. 13d), they provide a correlation value of 0.90. This explains why the CRU data give a good reproduction of the observations at this HG station.

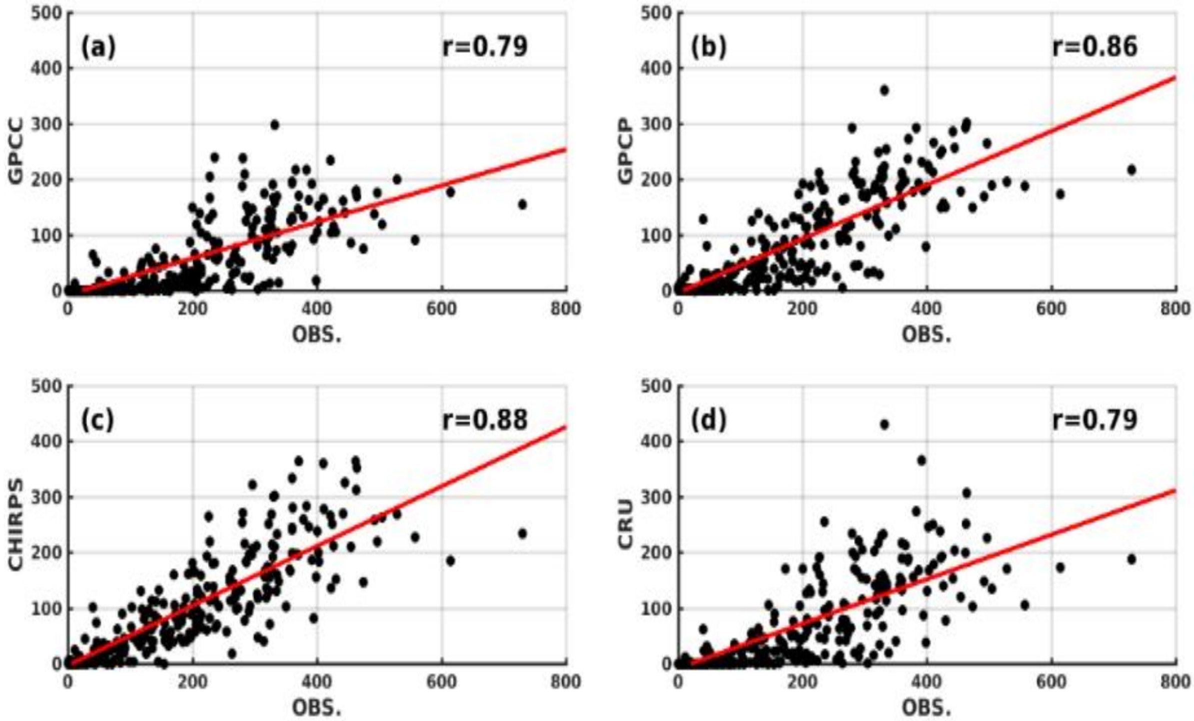

Fig. 11 Correlations between satellite data and observations from the Mamou station. (a), (b), (c) and (d) are GPCC, GPCP, CHIRPS and CRU respectively, which are correlated with the observations.

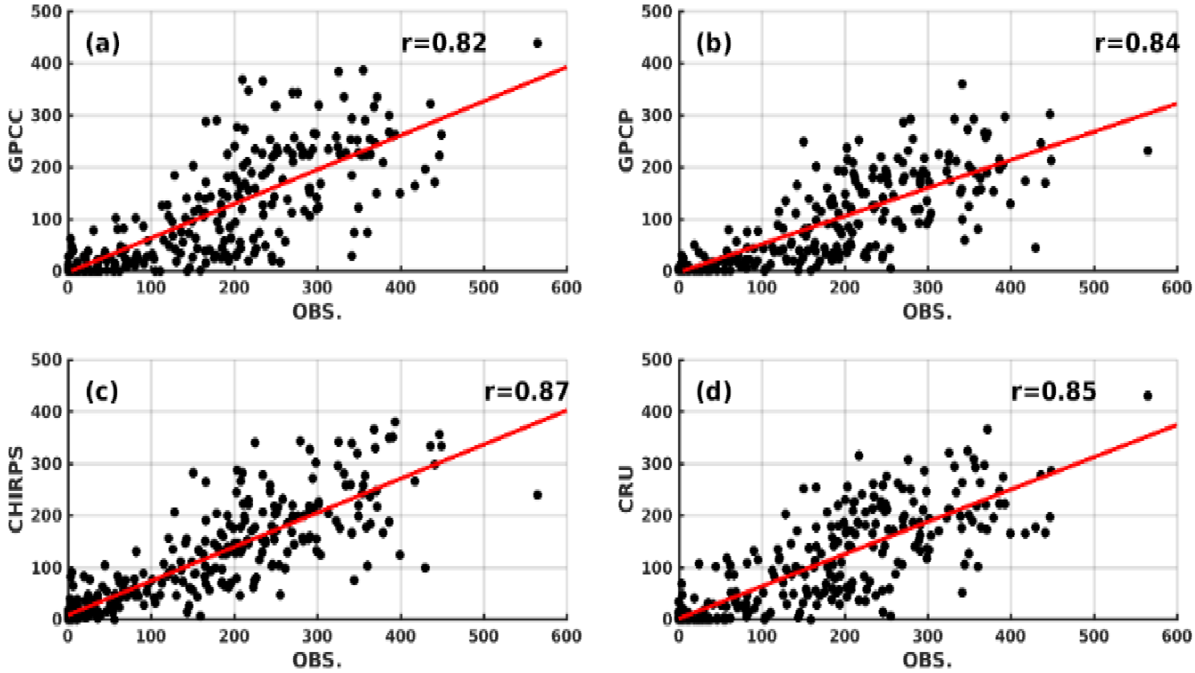

Fig. 12 Correlations between satellite data and observations from the Faranah station. (a), (b), (c) and (d) are respectively GPCC, GPCP, CHIRPS and CRU which are correlated with the observations.

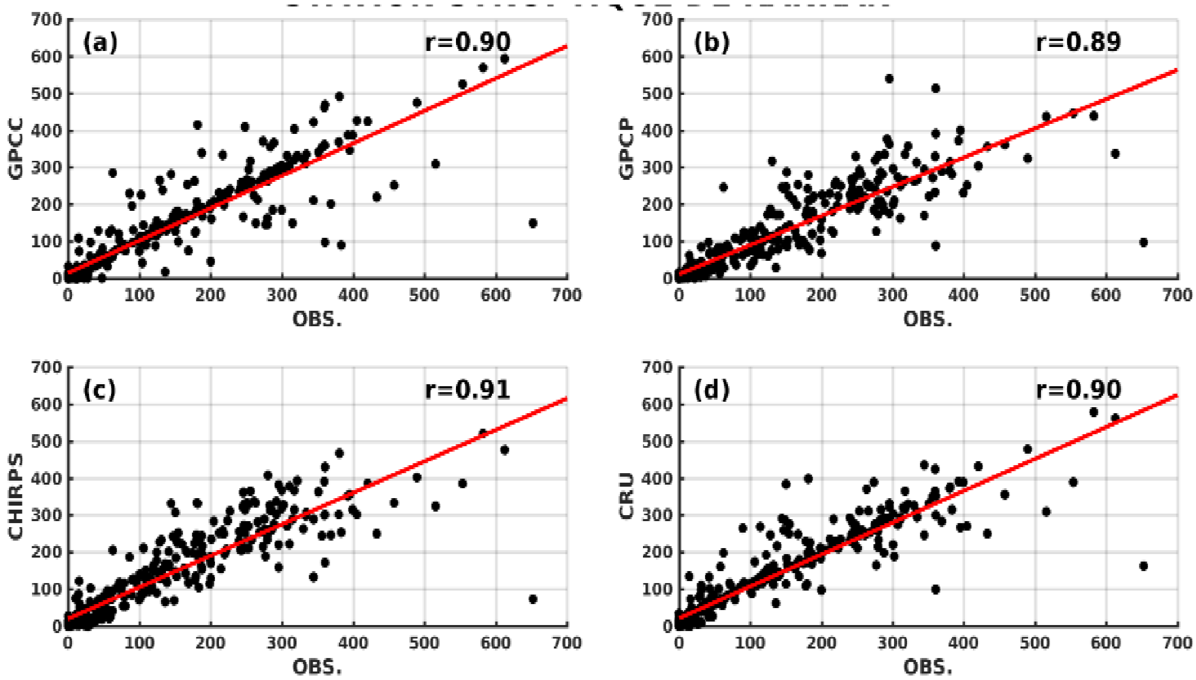

Fig. 13 Correlations between satellite data and observations from the Kankan station. (a), (b), (c) and (d) are respectively GPCC, GPCP, CHIRPS and CRU which are correlated with the observations.

(3) Siguiri Synoptic Station

At the Siguiri synoptic station (Fig. 14), satellite data reproduce observations well, with good correlation values. In Fig. 14a, the relationship between GPCC data and observations shows a correlation equal to 0.90, so this satellite product reproduces observations well. As for the GPCP data (Fig. 14b), we can see that they correlate fairly well with the Siguiri observations, with a correlation coefficient equal to 0.88.

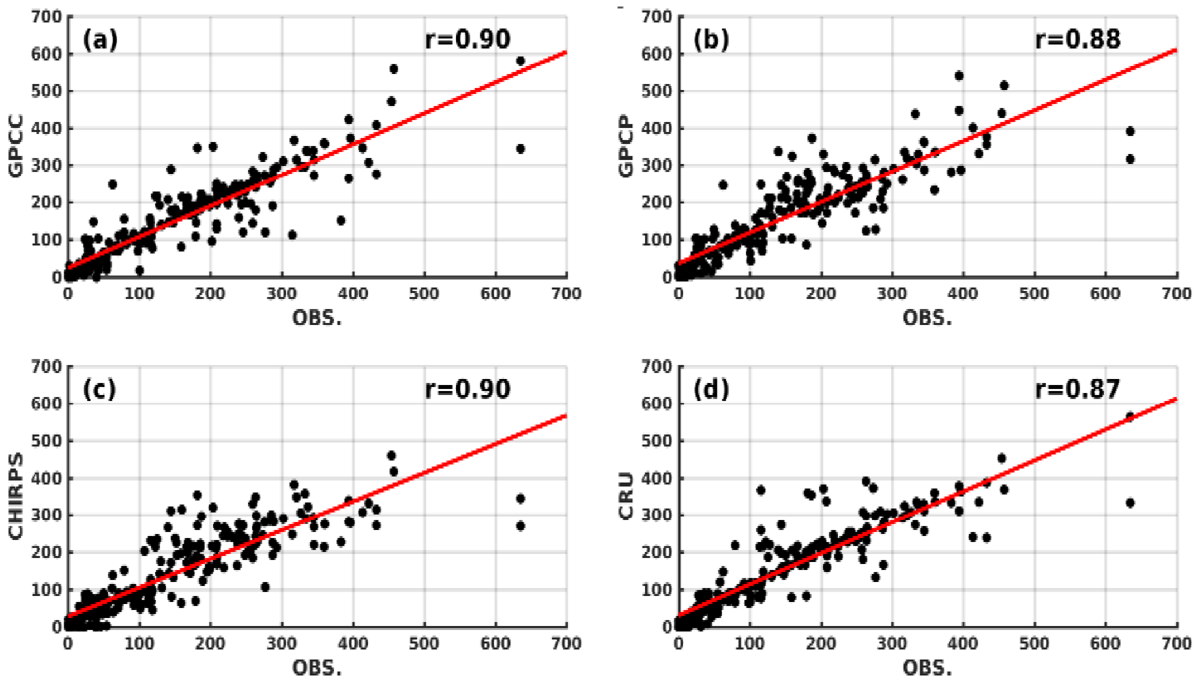

Fig. 14 Correlations between satellite data and observations from the Siguiri station. (a), (b), (c) and (d) are respectively GPCC, GPCP, CHIRPS and CRU which are correlated with the observations.

Fig. 14c shows that the CHIRPS data reproduce well the synoptic observations from the Siguiri station, with a good correlation value equal to 0.90. This result reflects the good reliability of the information provided by the CHIRPS satellite products for this station. However, the CRU satellite products inform us from Fig. 14d that they are correlated with the observations with a coefficient of 0.87.

Representing the observations to those of satellite data (GPCC, GPCP, CHIRPS and CRU), visible in figures (a, b, c and d), following a distribution of point clouds on either side of the regression lines, a correlation coefficient ranges from 0.87 to 0.90 for the Siguiri station.

3.2.4 Satellite Data and Observations of Guinea Foresti ère

(1) Kissidougou Synoptic Station

In this forested region of Guinea, which has the longest rainy season (7 to 9 months), we find that the relationship between satellite products and observational data from the synoptic stations that make up the region shows very scattered point clouds. This arrangement of point clouds would indicate a fairly good correlation compared with other regions. Indeed, in the synoptic station of Kissidougou (Fig. 15) and considering the GPCC data (Fig. 15a) in relation to the observations, we obtain a correlation coefficient equal to 0.72. As for GPCP products (Fig. 15b), its relationship with observation data from the same station provides a correlation of 0.76.

In Fig. 15c, we note that the satellite data (CHIRPS) reproduce the Kissidougou observations well compared with the other products, with a correlation value equal to 0.80. In Fig. 15d, the CRU products reproduce fairly well the observation data from the aforementioned station, with a correlation coefficient equal to 0.75.

(2) Macenta Synoptic Station

The synoptic station at Macenta (Fig. 16), where the Ziama classified forest is located, is one of the sources of precipitation initiation, which is compared with satellite products. Fig. 16a shows a good correlation between GPCC products and observation data from the Macenta station, with a coefficient equal to 0.89. While GPCP products (Fig. 16b) also reproduce observation data well, this good relationship between these two types of data resulted in a correlation coefficient of 0.87.

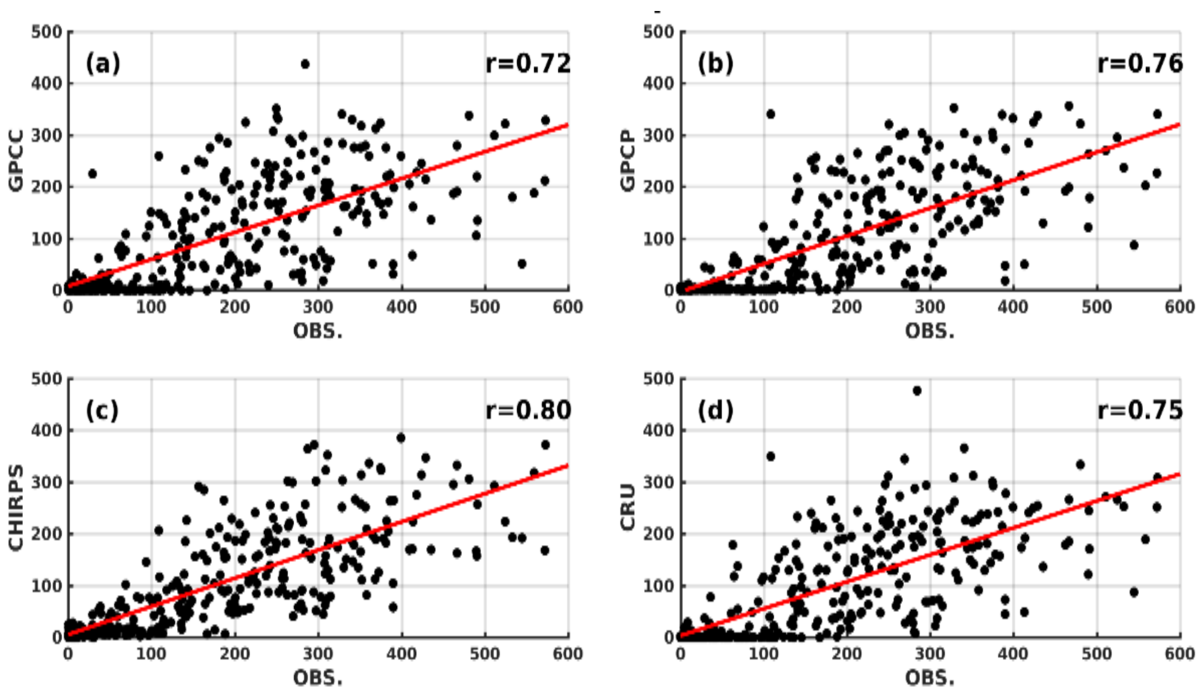

Fig. 15 Correlations between satellite data and observations from the Kissidougou station. (a), (b), (c) and (d) are GPCC, GPCP, CHIRPS and CRU respectively, which are correlated with the observations.

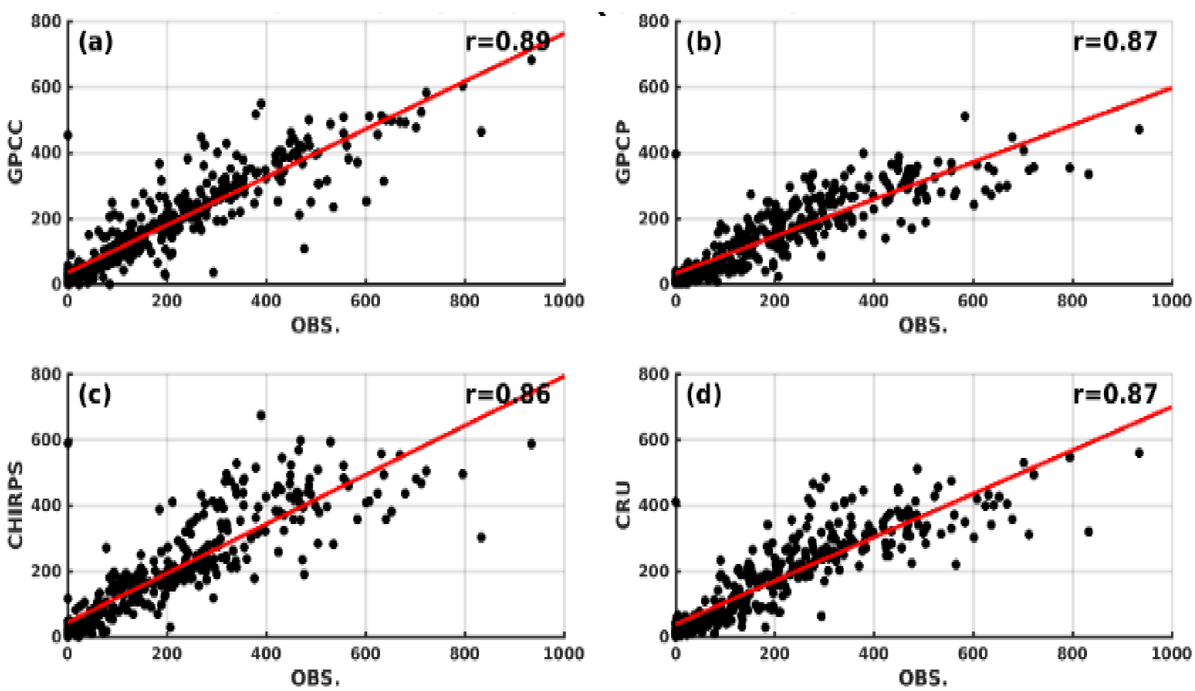

Fig. 16 Correlations between satellite data and observations from the Macenta station. (a), (b), (c) and (d) are GPCC, GPCP, CHIRPS and CRU respectively, which are correlated with the observations.

Continuing with the same study, we can see from Fig. 16c that the CHIRPS data are also fairly well correlated with the observations, with a good distribution of point clouds. The correlation value obtained from this analysis is 0.86. Correlating the CRU products (Fig. 16d) with the synoptic observation data from Macenta gives a correlation coefficient of 0.87.

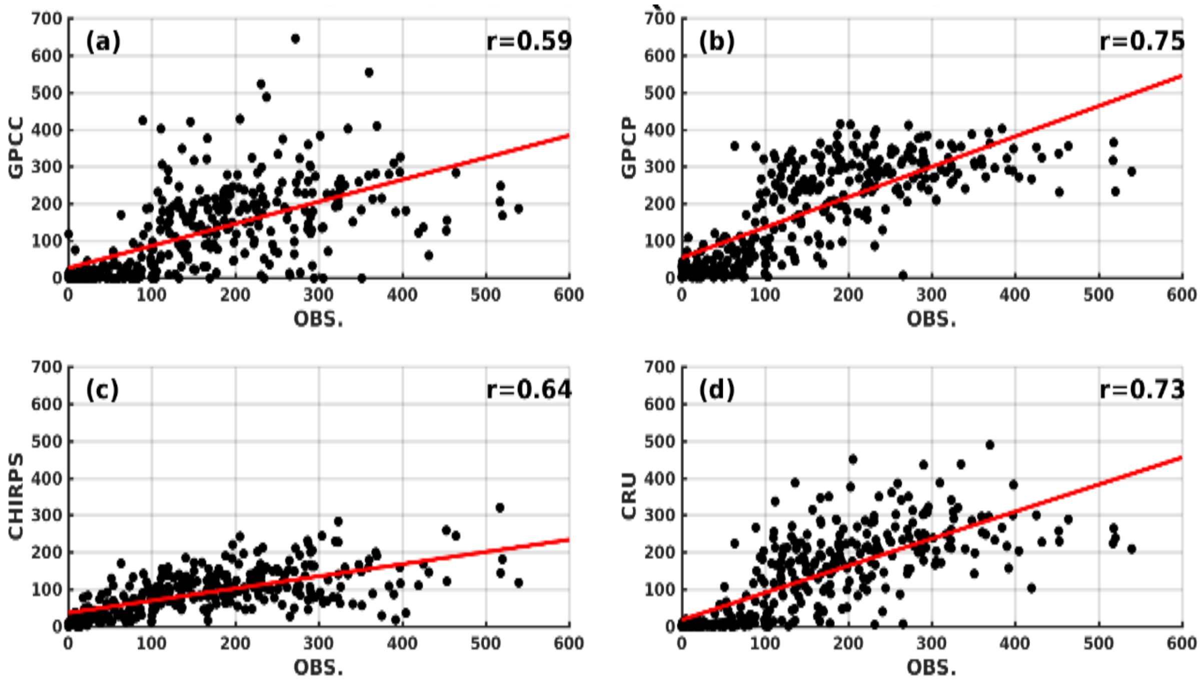

Fig. 17 Correlations between satellite data and observations from the N'Zerekore station. (a), (b), (c) and (d) are GPCC, GPCP, CHIRPS and CRU respectively, which are correlated with the observations.

(3) N'Zerekore synoptic station

The N'Zerekore synoptic station (Fig. 17) in the forest region was also the subject of our comparative study between observational data and satellite products (GPCC, GPCP, CHIRPS, CRU). Fig. 17a shows the correlation between GPCC products and observation data from the N'Zerekore station. The result obtained shows a fairly low coefficient, equal to 0.59. This means that GPCC satellite products do not reproduce observations from this station well enough. In Fig. 17b, the relationship between GPCP satellite products and observations produces a fairly representative correlation, with a coefficient equal to 0.75.

In the same direction of analysis, CHIRPS satellite data (Fig. 17c), are correlated with N'Zerekore observations with a correlation coefficient of 0.64. Whereas with CRU data, Fig. 17d shows a good correlation between these satellite products and the observation data from this station. The correlation coefficient obtained equals 0.73.

The evaluation of satellite data from observations in Guinea showed that at the twelve (12) stations, from January to June and from October to December, satellite products reproduce observation data well. During the monsoon period (JAS), satellite data underestimated rainfall only at the Conakry, Mamou and Faranah stations.

A study of the correlations between satellite products and observed precipitation at the 12 synoptic stations produced correlation coefficients ranging from 0.59 to 0.96. This result led us to deduce that satellite precipitation correlates well with synoptic observations in Guinea. This suggests that satellite rainfall correlates well with synoptic observations in Guinea.

A study of the climatic variability of precipitation has been carried out on the Guyana Plateau by Ringard [2]. They compared *in situ* data with ERA-40 reanalyses, with a spatial resolution of 1.125°, at monthly and annual scales. They showed that monthly and annual variations in precipitation are much less well modeled than temperature. Nevertheless, the reanalyses do capture some climatic details, such as wet or dry periods, enabling precipitation maps to be obtained.

As the Guyana Plateau has been little studied, we have used satellite precipitation products, which are remarkable tools for estimating precipitation. The temporal and spatial resolutions, refined through reanalysis, aim to improve our knowledge of precipitation variability on the Guyana Plateau. The work undertaken is based on a daily database comprising 93 *in situ* stations distributed between French Guiana and northern Brazil. This study reveals the presence of estimation errors depending on the season, intensity, topography and climate regime. This limitation leads to relatively high uncertainties in hydrological modeling and applications.

4. Conclusions and Suggestion

A study of the correlations between satellite products and observed precipitation at the 12 synoptic stations in Guinea, with correlation coefficients ranging from 0.59 to 0.96, and with scatter plots closely spaced on either side of the regression line, shows that satellite precipitation (GPCC, GPCP, CHIRPS and CRU) correlates well with synoptic observations in Guinea.

Finally, we would like to continue this work as part of an in-depth study, with other data such as ACR2, TRMM and Era5, so that we can take this research further, also taking into account other statistical calculation methods:

- Bias,
- RMSE (root mean square error),
- CHA (ascending hierarchical classification),
- EOFs (empiric orthogonal function),
- PCAs (principal component analysis).

References

[1] Delahaye, F. 2013. "Comparative Analysis of Different Satellite Products for Rainfall Estimation in the Brazilian Amazon." Ph.D. thesis, University of Rennes 2.

[2] Ringard, J. 2017. "Estimation of Precipitation on the Guiana Shield through the Contribution of Satellite Remote Sensing." Ph.D. thesis, Université de La Réunion.

[3] Maia-Bresson, A. 1996. "Satellite Precipitation Estimation: Analysis and Application of a Combined Infrared/Microwave Method." Ph.D. thesis, Institut de Recherche Pour le Developpement.

[4] Kante, I. K., Sall, S. M., Badiane, D., Diouf, I., Dieng, A. L., Diaby, I., and Guichard, F. 2020. "Analysis of Rainfall Dynamics in Conakry, Republic of Guinea." *Atmospheric and Climate Sciences* 10 (1): 1-20.

[5] Siebert, S., Döll, P., Hoogeveen, J., Faures, J. M., Frenken, K., and Feick, S. 2005. "Development and Validation of the Global Map of Irrigation Areas." *Hydrology and Earth System Sciences* 9 (5): 535-47.

[6] Kante, I. K., Sall, S. M., Badiane, D., Diaby, I., and Diouf, I. 2019. "Seasonal Variability of Rainfall and Thunderstorm in Guinea over the Period 1981 to 2010." *African Journal of Environmental Science and Technology* 13 (9): 324-41.