COMPARISON OF SOLARIMETRIC DATABASES FOR PHOTOVOLTAIC ENERGY PLANNING IN SERGIPE

COMPARAÇÃO ENTRE BASES SOLARIMÉTRICAS PARA PLANEJAMENTO ENERGÉTICO FOTOVOLTAICO EM SERGIPE

COMPARACIÓN ENTRE LAS BASES DE SOLARIMETRÍA PARA LA PLANIFICACIÓN DE LA ENERGÍA FOTOVOLTAICA EN SERGIPE

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ABSTRACT

This study performs a comparative analysis of solar irradiation data provided by the Brazilian Solar Energy Atlas and the Global Solar Atlas for the state of Sergipe. It was identified that the data provided by the databases present relevant differences in the solar irradiation estimate, in which the values of the Global Solar Atlas are systematically higher with an average difference of 1.8% in relation to the Brazilian Atlas. These variations can be attributed mainly to the different data collection and modeling methodologies, spatial resolution and analysis periods adopted by each database. These divergences have relevant practical implications for the technical and economic planning of photovoltaic systems, reinforcing the importance of local measurements to increase the reliability of solar projects. The study provides important subsidies for strategic decisions about solar energy in Sergipe, contributing to energy efficiency and local sustainability.

Keywords: Solar Irradiation. Photovoltaic Planning. Sergipe.

RESUMO

Este estudo realiza uma análise comparativa dos dados de irradiação solar disponibilizados pelo Atlas Brasileiro de Energia Solar e pelo Global Solar Atlas para o estado de Sergipe. Foi identificado que os dados disponibilizados pelas bases apresentam diferenças relevantes na estimativa de irradiação solar, em que os valores do Global Solar Atlas são sistematicamente mais elevados com uma diferença média de 1.8% em relação ao Atlas Brasileiro. Essas variações podem ser atribuídas principalmente às metodologias distintas de coleta e modelagem dos dados, resolução espacial e períodos de análise adotados por cada base. Essas divergências têm implicações práticas relevantes para o planejamento técnico e

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econômico de sistemas fotovoltaicos, reforçando a importância de medições locais para aumentar a confiabilidade dos projetos solares. O estudo fornece subsídios importantes para decisões estratégicas sobre energia solar em Sergipe, contribuindo para a eficiência energética e sustentabilidade local.

Palavras-chave: Irradiação Solar. Planejamento Fotovoltaico. Sergipe.

RESUMEN
Este estudio realiza un análisis comparativo de los datos de irradiación solar proporcionados por el Atlas Brasileño de Energía Solar y el Atlas Solar Global para el estado de Sergipe. Se identificó que los datos de estas bases de datos presentan diferencias significativas en las estimaciones de irradiación solar, siendo los valores del Atlas Solar Global sistemáticamente superiores, con una diferencia promedio del 1,8 %, en comparación con el Atlas Brasileño. Estas variaciones se atribuyen principalmente a las distintas metodologías de recopilación y modelado de datos, la resolución espacial y los periodos de análisis adoptados por cada base de datos. Estas discrepancias tienen importantes implicaciones prácticas para la planificación técnica y económica de los sistemas fotovoltaicos, lo que refuerza la importancia de las mediciones locales para aumentar la fiabilidad de los proyectos solares. El estudio proporciona información importante para la toma de decisiones estratégicas en materia de energía solar en Sergipe, contribuyendo a la eficiencia energética y la sostenibilidad local.

Palabras clave: Irradiación Solar. Planificación Fotovoltaica. Sergipe.

1 INTRODUCTION

The growing global demand for clean and renewable energy sources has driven investments and research focused on solar energy, considered one of the most promising alternatives due to its abundance, technical feasibility, and contribution to climate change mitigation. In the Brazilian context, the highlight is even greater: the country has one of the highest solar incidences on the planet, with the Northeast being one of the regions with the greatest potential for photovoltaic generation (Moreira Júnior & Souza, 2020; Bursztyn, 2020).

In the state of Sergipe, the climatic conditions are especially favorable to the use of this resource, justifying the expansion of the energy matrix through solar systems. However, the effective use of this potential depends fundamentally on the accuracy and reliability of the solarimetric data used in the planning and dimensioning of photovoltaic plants (Morais et al., 2021; Rocha et al., 2022; Araújo et al., 2024).

Several databases are used for this purpose, the main ones being the Brazilian Atlas of Solar Energy, prepared by the National Institute for Space Research (INPE), and the Global Solar Atlas, maintained by the World Bank and operated by the company Solargis. Both provide estimates of Global Horizontal Irradiation (GHI) and Normal Direct Irradiation (DNI), among other variables. However, recent studies show that these bases may present significant discrepancies in the estimated values, which directly impact the technical and financial feasibility of photovoltaic projects (Porfirio et al., 2020; Uchôa, 2022; Reis et al., 2023).

In addition, the Brazilian Atlas, despite its technical detail and history of local validations through the SONDA network, has been outdated since 2017, which may compromise its accuracy in the face of recent climate change (Martins et al., 2019; INPE, 2025a). On the other hand, the Global Solar Atlas updates its data periodically based on multi-satellite imagery, but its global semi-empirical model may not capture regional nuances, such as microclimates or superirradiance events common in the northeastern semi-arid region (Freitas, 2023; Araújo, 2024).

In this scenario, analyses that critically compare these bases, pointing out their limitations and practical impacts, become increasingly relevant. The wrong choice of a database can lead to errors in sizing, under- or over-sizing systems, and negatively influencing the financial return of solar projects (Tiba, Azevêdo, 2023).

Therefore, this study aims to perform a detailed comparative analysis between the Global Solar Atlas and the Brazilian Atlas of Solar Energy in the state of Sergipe, evaluating their GHI estimates and discussing the technical, economic and strategic implications of these differences for local energy planning.

2 METHODOLOGY

2.1 FIELD OF STUDY

The study adopted the geographic division of the State of Sergipe based on the definition of mesoregions and microregions established by the Brazilian Institute of Geography and Statistics (IBGE). Sergipe is composed of three mesoregions, which, in turn, encompass a total of 13 microregions, as shown in Table 1. Aiming at a better understanding, throughout the present work, each micro-region was represented by a prominent municipality, considering its relevance in terms of installed power of Distributed Generation (DG) with photovoltaic systems. Data collection required the definition of geographic coordinates for each location. Considering that most of the systems are concentrated in urban areas, the points were defined in the central region of the reference cities, aiming to reflect real installation conditions.

Table 1

List of Municipalities and Coordinates chosen

Mesoregion	Microregion	Reference Municipality	Geographic coordinates
Sergipe Sertão	Sergipe from the Sertão do São Francisco	Canindé do São Francisco	-9.657751, -37.794373
	Carira	Carira	-10.358032, -37.704920
	Our Lady of Sorrows	Our Lady of Sorrows	-10.480661, -37.220805
Agreste Sergipano	Agreste de Itabaiana	Itabaiana	-10.689492, -37.431162
	Tobias Barreto	Tobias Barreto	-11.181965, -38.000390
	Agreste de Lagarto	Lizard	-10.893367, -37.662981
East Sergipe	Propriá	Propriá	-10.218359, -36.838090
	Cotinguiba	Chapel	-10.475648, -37.031843
	Japaratuba	Japaratuba	-10.592197, -36.944591
	Lower Cotinguiba	Orange trees	-10.803993, -37.166900
	Aracaju	Aracaju	-10.951906, -37.078516
	Bobby	Bobby	-11.146917, -37.620025
	Resort	Resort	-11.261429, -37.438354

Source: Prepared by the authors (2025).

2.2 DATABASES USED

The Brazilian Atlas of Solar Energy – 2nd Edition (2017), produced by the National Institute for Space Research (INPE) (Pereira et al. 2017), and the Global Solar Atlas,

developed by the World Bank in partnership with the International Finance Corporation (IFC) and operated by Solargis (World Bank, 2019), provide essential data on solar radiation and photovoltaic potential. This information helps planners, investors, and researchers assess the feasibility of solar projects in Brazil and around the world.

Although both atlases provide detailed information on solar radiation and meteorological variables, they differ in scope and methodology. The Brazilian Atlas of Solar Energy focuses on the national territory, while the Global Solar Atlas offers a comprehensive view of the availability of solar energy on a global scale, allowing for comparative analysis between different regions.

Despite these differences, both share the objective of quantifying the solar potential, using different approaches that will be analyzed in the "Results and Discussion" section.

2.3 DATA AVAILABLE IN THE DATABASES

The databases provide information on solar radiation, photovoltaic generation, and environmental and geographic factors, each with its own data coverage (Table 2). With regard to solar radiation, the following are available:

- Diffuse Irradiation: Portion of solar radiation dispersed in the atmosphere before it reaches the surface.
- Horizontal Diffuse Irradiation: A component of solar radiation dispersed before it reaches the ground.
- Normal Direct Irradiation (DNI): A direct component of solar radiation incident perpendicular to the direction of the sun.
- Global Horizontal Irradiation (GHI): Total solar radiation incident on a horizontal surface.
- Irradiation on the Inclined Plane: Solar radiation received on an inclined surface, considering different angles of inclination.
- Irradiation Photosynthetically Active Radiation (PAR): Range of solar radiation used in the process of photosynthesis by plants.
  With regard to data related to photovoltaic generation, the following are available:
- Specific Photovoltaic Power Output (PVOUT): Estimated energy that a photovoltaic system can generate in a given location.
- Optimal Inclination of Photovoltaic Modules: Best inclination angle for installing solar panels in a given location.

- Optimal Global Inclined Plane Irradiation: Radiation received on a surface inclined at the optimal angle to maximize uptake.

  With regard to environmental and geographical factors, the following are available:

- Terrain Elevation: Altitude of the site, which can influence the radiation received.

- Air Temperature: Climatic information relevant to the efficiency of photovoltaic systems.

Table 2

Data available for each database

Group	Available Data	Brazilian Atlas	Global Solar Atlas
Solar radiation	Diffuse Irradiation	Yes	No
	Horizontal Diffuse Irradiation	No	Yes
	Normal Direct Irradiation (DNI)	Yes	Yes
	Global Horizontal Irradiation (GHI)	Yes	Yes
	Irradiation on the Inclined Plane	Yes	No
	Irradiation Photosynthetically Active Radiation (PAR)	Yes	No
	Specific Photovoltaic Generation Potential (PVOUT)	No	Yes
Photovoltaic generation	Optimal Inclination of Photovoltaic Modules	No	Yes
	Global Irradiance in the Optimal Inclined Plane	No	Yes
Environmental and geographical factors	Air Temperature	No	Yes
	Land Elevation	No	Yes

Source: Prepared by the authors (2025).

Considering the scope of the information provided by the two databases, the Brazilian Atlas of Solar Energy stands out for offering more detailed data on specific components of solar radiation, such as diffuse irradiation, irradiation on the inclined plane and photosynthetically active radiation (PAR). The Global Solar Atlas provides useful data for the sizing of photovoltaic plants, providing the data of Generation Potential (PVOUT), Optimal Inclination and Irradiation in the Optimal Plan. In addition, this base includes environmental variables such as air temperature and terrain elevation, which are not provided by the Brazilian Atlas.

2.4 COMPARATIVE ANALYSIS OF THE DATA PROVIDED BY THE DATABASES

To compare the data provided by the Brazilian Atlas of Solar Energy (2017) and the Global Solar Atlas (2024), the parameter of Global Horizontal Irradiation (GHI) was selected. The choice of GHI as the main metric is due to the fact that it is the variable present in both databases and expressed in the same unit of measurement: kWh/m² per day. Although

Normal Direct Irradiation (NID) is also present in both databases and is a relevant variable for projects that use solar tracking systems, the focus of this study is on the general energy planning of the State of Sergipe. Thus, the GHI was considered more suitable to represent the availability of solar energy for photovoltaic generation in different scenarios.

The values referring to the GHI parameter were collected from the databases and recorded in a Microsoft Excel spreadsheet.

GHI values were compared directly, without temporal adjustments, considering that both sources provide estimates based on the annual average.

Then, the following statistical measures were calculated, each with a complementary role in the evaluation of the discrepancies between the solar irradiation data:

- **Average Error (ME):** It was chosen because it allows the identification of whether there is a systematic bias, that is, whether one database consistently tends to provide higher or lower values in relation to the other.

- **Mean Absolute Error (MAE):** Selected because it provides a clear measure of the average magnitude of deviations, without negative and positive errors canceling each other out, offering a direct view of the average accuracy between data sets.

- **Mean Square Error (RMSE):** Essential to detect and penalize larger discrepancies, being especially useful to evaluate extreme cases or significantly discrepant values, ensuring a detailed perception of the existence of relevant errors that may compromise more detailed studies.

- **Standard Deviation of Differences:** Fundamental to understand the variability of the observed differences, helping to identify consistencies or inconsistencies in the divergences between the bases.

- **Pearson's correlation:** Chosen to evaluate the intensity and direction of the linear association between the sets, crucial to determine if there is a common trend in the variations of the databases.

- **Coefficient of Determination (R^2):** Indispensable to quantify how much the variations in one database explain the variations observed in the other, providing a deeper understanding of the predictive relationship between the sets.

These combined metrics provide a comprehensive and detailed assessment, which is essential to ensure informed decisions in selecting the most appropriate data sources for energy planning.

Equation (1) - Mean Error (ME): The mean error measures the mean difference between the observed values (yi) and the estimated values (): $\hat{y}i$

$$ME = \frac{1}{n}\sum_{i=1}^{n}(yi - \hat{y}i)$$

(1)

Equation (2) - Mean Absolute Error (MAE): The MAE calculates the average of the absolute values of the differences between the observed and estimated values:

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|yi - \hat{y}i|$$

(2)

Equation (3) - Root Mean Squared Error (RMSE): The RMSE measures the mean squared error, penalizing larger errors due to squared:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(yi - \hat{y}i)^2}$$

(3)

Equation (4) - Standard Deviation of Differences: The standard deviation of differences measures the dispersion of differences between the observed and estimated values:

$$\sigma_d = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(d_i - \bar{d})^2}$$

(4)

Where:

$d_i = yi - \hat{y}i$ represents the differences between the observed and estimated values.

$\bar{d}$ is the average of the diferenças.com topics divided by semicolons.

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Equation (5) - Pearson's correlation: Pearson's correlation measures the strength of the linear relationship between two variables:

$$r = \frac{Cov(X,Y)}{\sigma_X \sigma_Y} \quad\quad\quad (5)$$

Where:

σX and σY are the standard deviations of the variables X and Y.

Equation (6) - Coefficient of Determination (R^2): The coefficient of determination measures the proportion of variability of the observed values explained by the model:

$$R^2 = 1 - \frac{\sum_{i=1}^{n}(yi - \hat{y}i)^2}{\sum_{i=1}^{n}(yi - \bar{y})^2} \quad\quad\quad (6)$$

Where:

$\bar{y}$ It is the average of the values observed in *Yi*.

3 RESULTS

3.1 ANALYSIS OF THE METHODOLOGICAL DIFFERENCES OF THE DATABASES

To analyze the differences between the values provided by the databases, it is necessary to understand their methodological distinctions, which explain the variations in the results. Table 3 presents the main comparative characteristics between the atlases, highlighting that the Brazilian Atlas of Solar Energy, developed by INPE, uses the BRASIL-SR radiative transfer model, focusing exclusively on the Brazilian territory and without updates since its second edition in 2017. In contrast, the Global Solar Atlas, maintained by the World Bank in partnership with Solargis, employs a semi-empirical satellite-based model, with global coverage, including oceans, and undergoing monthly recalibrations that incorporate recent atmospheric data. In addition, Global Solar Atlas undergoes frequent improvements and updates with its latest version made available in May 2024 (version 2.11).

Table 3

Comparison of database characteristics

Column 1	Column 2	Column 3
Accountable	LABREN/INPE	World Bank/Solargis
Geographic focus	Brazil	Global (including oceans)
Base model	BRASIL-SR radiative transfer model	Semi-empirical satellite-based Solargis model
Primary source	SONDA network (ground stations) + GOES satellite	Multi-satellites (Meteosat, GOES and Himawari) + global ground stations
Last updated	2017 (2nd edition)	May/2024 (v2.11)
Recalibration	There is no	Monthly, including recent atmospheric data
Interface	Digital book	Interactive maps and monthly/yearly time series

Source: Prepared by the authors (2025).

3.1.1 Brazilian Atlas of Solar Energy

In the Brazilian Atlas, obtaining the data that underlie the Atlas is based on the integration of in situ measurements and advanced computational modeling. The measurements were carried out by the Brazilian Network of Solarimetric Monitoring Stations (SONDA), a program that maintains meteorological stations equipped with sensors for monitoring solar radiation in different regions of Brazil. These sensors include pyranometers for measuring global irradiance and radiometers for direct and diffuse components of solar radiation (INPE, 2025b).

In addition to the measured data, the Atlas incorporates numerical modeling based on images from geostationary satellites, such as those operated by the GOES (Geostationary Operational Environmental Satellites) program. The modeling uses algorithms to estimate solar irradiance on the Earth's surface, combining atmospheric information, such as aerosols and cloud cover, with calibration techniques from data from SONDA stations. This approach allows a high spatial and temporal resolution estimate of the availability of solar energy in the Brazilian territory (INPE, 2025a).

The result of this process is a comprehensive database that subsidizes scientific research, photovoltaic energy generation projects and the formulation of public policies for the energy sector.

3.1.2 Global solar atlas

The Global Solar Atlas data is obtained from advanced numerical modeling, combining measurements from geostationary satellites and ground-based sensors. The methodology uses images from meteorological satellites, such as those from the Meteosat and GOES

programs, to estimate solar irradiance on the Earth's surface. This estimate is improved through atmospheric models that consider factors such as cloud cover, aerosols, and water vapor (World Bank, 2024a).

In addition to satellite-based modeling, the Global Solar Atlas incorporates calibration data from solarimetric measuring stations in various regions of the world. The company Solargis performs systematic validations to ensure the accuracy of the data, comparing the model estimates with the actual solar irradiance measurements. The platform provides interactive maps and time series of parameters such as horizontal global radiation (GHI), direct normal radiation (DNI) and photovoltaic generation potential, with a spatial resolution of up to 1 km (World Bank, 2024b).

The integration of numerical modeling and terrestrial measurements allows Global Solar Atlas to provide highly reliable information, being an essential tool for feasibility studies and global energy planning.

3.2 ANALYSIS OF THE METHODOLOGICAL DIFFERENCES OF THE DATABASES

Initially, a detailed comparative analysis of the data provided by the Brazilian Atlas of Solar Energy and the Global Solar Atlas for the state of Sergipe was carried out.

As presented in the study area, 13 reference municipalities were used, covering all micro-regions of Sergipe. Table 4 shows the annual average values of Global Horizontal Irradiation (GHI) in kWh/m² per day.

Table 4

Tables should have their titles at the top

Reference Municipality	Geographic coordinates	Average annual GHI (kWh/m² per day)	
		Brazilian Atlas	Global Solar Atlas
Canindé do São Francisco	-9.657751, -37.794373	5,41	5,539
Carira	-10.358032, -37.704920	5,28	5,355
Our Lady of Sorrows	-10.480661, -37.220805	5,28	5,471
Itabaiana	-10.689492, -37.431162	5,28	5,463
Tobias Barreto	-11.181965, -38.000390	5,22	5,312
Lizard	-10.893367, -37.662981	5,22	5,301
Propriá	-10.218359, -36.838090	5,43	5,592
Chapel	-10.475648, -37.031843	5,26	5,352
Japaratuba	-10.592197, -36.944591	5,41	5,555
Orange trees	-10.803993, -37.166900	5,39	5,590
Aracaju	-10.951906, -37.078516	5,50	5,912
Bobby	-11.146917, -37.620025	6,20	5,441
Resort	-11.261429, -37.438354	5,42	5,558

Source: Research data - Prepared by the authors (2025).

Notable differences are observed in the estimates of global horizontal solar irradiance (GHI). These differences result from the different methods employed in each Atlas, considering historical series, data acquisition periods, and different spatial resolutions.

There is also a difference in the way the data is presented, depending on the platform used, the consolidated data for the state of Sergipe are presented below.

3.2.1 GHI in Sergipe – Global solar atlas

In Sergipe, the global horizontal solar irradiation (GHI) varies between 5.26 and 5.98 kWh/m² per day, with an average of 5.51 kWh/m².

Figure 1

GHI (Global horizontal irradiation) in Sergipe
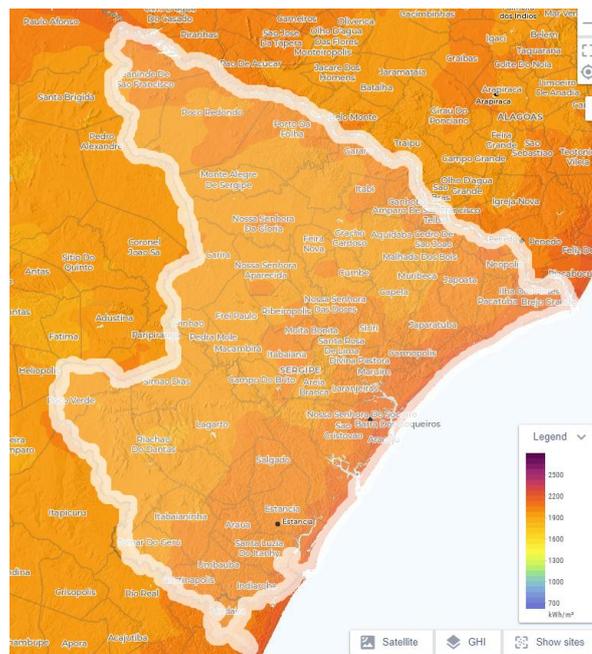
Source: Global Solar Atlas (2025).

These values are considered favorable for photovoltaic energy generation, surpassing the average of many regions of the world that invest in this type of energy. The distribution of GHI in the state reveals that 5.5% of the area has values above 5.80 kWh/m², while 15.1% registers between 5.80 and 5.60 kWh/m². Most of the territory (61.3%) has irradiation between 5.60 and 5.40 kWh/m², and the remaining 18.2% have values below 5.40 kWh/m².
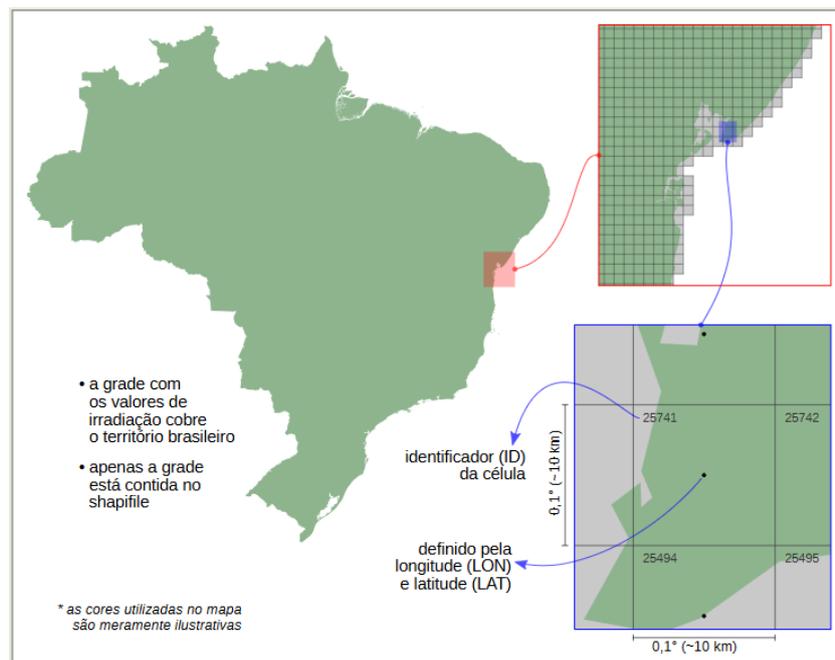
3.2.2 GHI in Sergipe – Brazilian Atlas

The Global Horizontal Irradiation in the Brazilian Atlas is presented indirectly, to obtain the data, it is necessary to fill out a form with the Geographic Coordinates (Latitude and Longitude) on the Solar Potential - SunData v 3.0 platform, made available by CRESEB (Reference Center for Solar and Wind Energy Sérgio de S. Brito).

This is because, in the Brazilian Atlas, the database is composed of 72,272 records containing the annual and monthly averages of the total daily Global Horizontal, Diffuse, Direct Normal, Inclined Plane and PAR irradiation in Wh/m2.day. Spatial resolution of 0.1° x 0.1° (approximately 10 km x 10 km). Longitude and latitude define the centroid of the entities, or cells, of 0.1° x 0.1°.

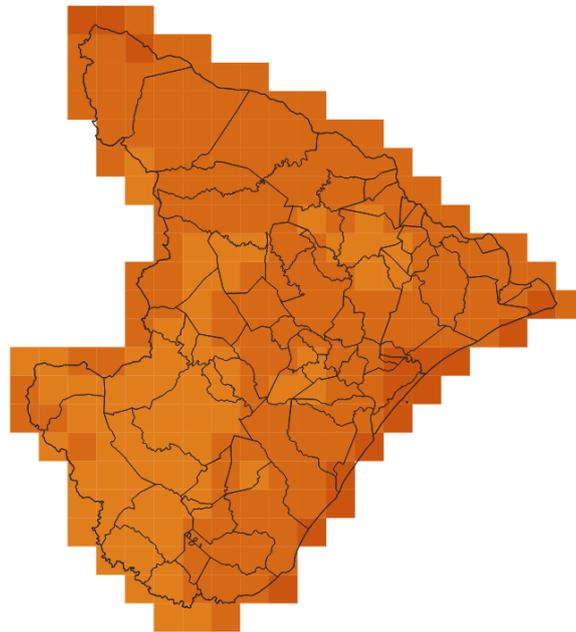**Figure 2**

Representation of 1 block of record

Source: Brazilian Atlas (2025).

Thus, as shown in Figure 3, the blocks of the state of Sergipe are represented in the Brazilian Atlas.

Figure 3

GHI (Global horizontal irradiation) in Sergipe

Source: Brazilian Atlas (2025).

Applying the equations to the data in the spreadsheet, here are the results of the statistical metrics calculated based on the differences between the Global Horizontal Irradiance (GHI) values, expressed in kWh/m² per day, from the two sources:

- Mean Error (ME): 0.088
- Mean Absolute Error (MAE): 0.205
- Mean Square Error (RMSE): 0.273
- Standard Deviation of Differences: 0.269
- Pearson's correlation: 0.230
- Coefficient of Determination (R²): 0.053

4 DISCUSSION

4.1 INTERPRETATION OF STATISTICAL METRICS

The results indicate that there are considerable differences between the Global Horizontal Irradiation (GHI) values provided by the Brazilian Atlas of Solar Energy and the Global Solar Atlas. Some analyses can be done to better understand these differences and their impacts.

The results of the statistical analyses indicate considerable differences between the databases of the Brazilian Atlas of Solar Energy and the Global Solar Atlas, with important implications for energy planning in Sergipe.

- **Mean Error (ME = 0.088):** The positive value indicates that, on average, the Global Solar Atlas presents values slightly higher than those of the Brazilian Atlas. This suggests a slight systematic bias between the two bases.

- **Mean Absolute Error (MAE = 0.205) and Mean Square Error (RMSE = 0.273):** These values confirm that there are differences of relevant magnitude between the data sets, especially the RMSE, which emphasizes that some divergences can be significant and need to be considered in the planning phase.

- **Standard Deviation of Differences (0.269):** This value shows a significant variability in the differences between the bases, indicating that the divergences are not constant, varying according to the location studied.

- **Pearson's correlation (0.230) and Coefficient of Determination (R^2 = 0.053):** The low correlation and the low value of R^2 indicate that the bases have a weak linear relationship with each other, highlighting that the differences observed do not follow a consistent pattern. The low coefficient of determination reinforces that one database does not satisfactorily explain the variations observed in the other, suggesting that local and methodological factors significantly influence the results.

4.2 POSSIBLE CAUSES OF DIFFERENCES

The divergences found between the analyzed databases can be attributed to different methodological and technical factors used by each source. The Brazilian Atlas of Solar Energy is predominantly based on local measurements obtained through the solarimetric stations of the SONDA network, complemented by specific modeling that uses geostationary satellite images calibrated to the local atmospheric conditions of Brazil. The Global Solar Atlas, on the other hand, uses a global numerical modeling methodology, based on data from international satellites and calibrated through global terrestrial measurements. Thus, it may not fully capture regional particularities, such as specific microclimates, small topographic variations, or local atmospheric conditions, including cloud cover and relative humidity levels.

Another significant factor is the differentiated spatial resolution. The Brazilian Atlas has a more detailed spatial resolution, adapted specifically for the national territory, while the Global Solar Atlas presents a global approach with less detailed spatial resolution, which can generate less precision in smaller regions. In addition, temporal differences in the periods analyzed may also contribute to the divergences, since the Brazilian Atlas is based on historical data up to 2017, while the Global Solar Atlas uses data from 2024, in which climate change or atmospheric variations can influence the availability of solar radiation. As the historical series used by each atlas belong to different periods, 2017 in the case of the Brazilian Atlas and 2024 in the Global Solar Atlas, the differences found may be associated not only with modeling methodologies, but also with climate change and atmospheric variations over time.

4.3 POSSIBLE CAUSES OF DIFFERENCES

The divergences between the two databases have important implications for the energy and technical planning of photovoltaic systems in Sergipe. Small variations in solar irradiance values can have a significant impact on the sizing and efficiency of solar systems. Underestimated values can lead to oversizing of systems, resulting in unnecessary additional costs, while overestimated values can result in undersized systems that do not achieve the expected results in terms of energy generation.

These differences also have important strategic consequences for the development of public policies and investment decisions in energy infrastructure. The use of databases that do not adequately represent the regional reality can negatively affect the economic and technical viability of solar projects, harming both investors and end consumers. From an academic and scientific point of view, such divergences can also negatively influence the results of environmental and climate studies, highlighting the need for greater caution and complementation with local measurements in the analysis and interpretation of solar data.

5 CONCLUSION

This study performed an in-depth comparative analysis between the solar irradiation data provided by the Brazilian Atlas of Solar Energy and the Global Solar Atlas, with a specific focus on the state of Sergipe. The results indicated significant differences between the two databases, with the Global Solar Atlas presenting

systematically higher GHI values, on average, 1.8% higher than those of the Brazilian Atlas. Although this difference seems modest, statistical analyses revealed a low degree of linear correlation (R^2 = 0.053), indicating an inconsistent relationship between the bases.

The divergences observed are due to relevant methodological factors, such as the collection and calibration model, spatial resolution, and the reference period adopted by each database. The Brazilian Atlas, despite offering specific data for the national territory with relevant technical detail, is outdated (last edition in 2017), not reflecting recent climatic variations. On the other hand, the Global Solar Atlas, with monthly updates and global coverage, may not accurately capture local climatic particularities, as evidenced by Araújo (2024) and Porfirio *et al*. (2020).

These differences are not merely academic: they have substantial practical implications for the design of photovoltaic systems. Underestimated irradiation values can lead to oversizing and increased costs, while overestimated values can lead to failures in meeting projected demand, compromising the economic viability of solar projects (Rocha et al., 2022; Uchôa, 2022; Araújo et al., 2024).

In addition, the study reinforces the importance of complementary strategies to mitigate the limitations of each database. This includes the use of local measurements whenever possible, and, more recently, the use of hybrid modeling with the support of machine learning algorithms (Reis et al., 2023), which have shown potential to significantly reduce prediction errors.

Therefore, it is recommended that technical, strategic, or political decisions related to solar energy in Sergipe be based on the critical integration of different data sources, with local validations and sensitivity analyses. This multidimensional approach contributes to increasing the robustness of feasibility studies, minimizing financial risks, and promoting the sustainable development of the state's energy matrix.

This work also signals the urgency of updating and modernizing the Brazilian Atlas of Solar Energy, in order to ensure its continuity as a technical reference for the national energy sector, especially in a scenario of energy transition and growth of distributed generation in Brazil.

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