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Sensitivity of the Irradiation PVGIS SARAH3 to the Inclination of the Plane of Receipt in Two Areas Peat Bowl Central

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ABSTRACT

Solar radiation contributes to surface energy balance, purpose PVGIS irradiation estimates depend on receiving-planar geometry. We quantified the effect of changing flat tilt from 18° to 30° for Bikoro and Inongo during 2020-2023. Forty-eight monthly peer per site were analysed using absolute and relative differences, paired t-tests and Wilcoxon signed-rank tests. In Bikoro, mean irradiation decreased from 152.43 to 143.85 kWh m⁻2 month⁻1, corresponding to -8.57 kWh m⁻2 month⁻1 (-5.91% on average across months). In Inongo, it decreased from 154.12 to 146.27 kWh m⁻2 month⁻1, corresponding to -7.84 kWh m⁻2 month⁻1 (-5.44%). Differences were statistically clear at both sites (Wilcoxon, $p < 10^{-6}$), but reversed during May–July, when the 30° plane received slightly more energy. T2m remained unchanged because it is an atmospheric variable independent of planar orientation. Tilt is therefore a modelling parameter that must be reported explicitly and should not be interpreted as a change in local climate.

KEYWORDS: *PVGIS-SARAH3; solar irradiation; flat tilt; sensitivity analysis; Central Congo Basin; Bikoro; Inongo.*

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1. INTRODUCTION

The peatlands of the central Basin constitute a vast reservoir of carbon tropical whose conservation is closely dependent on hydrological conditions (Dargie et al., 2017; Crezee et al, 2022; Garcin et al., 2022). Solar irradiation is used to describe the energy received by a surface, and contributes to the interpretation of the energy balance. PVGIS allows you to extract a series of climateand radiative properties for different geometric configurations (European Commission, Joint Research Centre, 2026; Huld et al., 2012). Gold - H(i)m is the irradiation on an inclined plane: its value depends, therefore, not only the atmosphere, but also the tilt and orientation of the chosen.

This distinction is particularly important when the results are generated in an environmental study. A change of the angle asked the software does not change the air temperature or the radiation actually incident on the ecosystem; it modifies the projection of the energy on a theoretical level. To distinguish these levels can create a false interpretation of the climate. The purpose of this note is to quantify the sensitivity of H(i)m at 18° to 30° to Bikoro and Inongo, and then to specify the methodological consequences.

2. Materials and methods

2.1. extraction Areas

The extractions are concerned with two areas of the central Basin in the democratic Republic of the Congo: Bikoro (point PVGIS: 0,740° S; 18,080° E) and Inongo (about 1°55'38,676" S; 18°17'08,174" E). Figure 1 locates the areas used in the source memory.

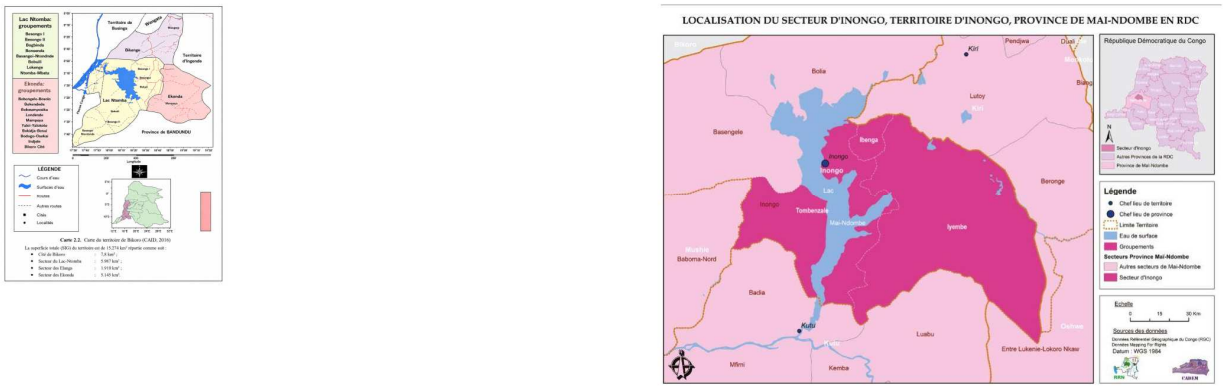

Figure 1. Location map of the mining areas of Bikoro and to Inongo.
Source**:** Republic democratic of Congo (CAID,(2016).

2.2. Protocol comparison

For each site, two extractions PVGIS-SARAH3 have been carried out over the same period (January 2020 through December 2023), with the same coordinates and the same parameters, with the exception of the tilt of theplan: 18°, and 30°. Each set contains 48 monthly values. The difference has been calculated as $\Delta H = H30 - H18$ and the relative variation as $100 \times \Delta H/H18$. The comparison has been summarized by year and by month. A paired t-test and the test is non-parametric Wilcoxon signed rank were applied to pairs monthly; p values to assess a difference in the configuration, not the trend of the climate.

3. Results

Site	Year	18°	30°	ΔH	ΔH (%)
Bikoro	2020	155.20	146.25	-8.95	-5.98
Bikoro	2021	153.97	145.47	-8.50	-5.91
Bikoro	2022	149.79	141.52	-8.26	-5.77
Bikoro	2023	150.75	142.17	-8.58	-5.99
Inongo	2020	157.67	149.39	-8.28	-5.55
Inongo	2021	154.35	146.55	-7.80	-5.40
Inongo	2022	150.76	143.11	-7.65	-5.41
Inongo	2023	153.69	146.04	-7.65	-5.41

Note. H in kWh m⁻2 month⁻1; ΔH = H30 − H18. The annual percentage is the average of the relative changes monthly.

3.1. Average effectand stability interannual

In Bikoro, the radiation averaged over the 48 months is 152,43 kWh m⁻2 month⁻1 at 18° and 143,85 to 30°. The average difference is -8,57 kWh m⁻2 month⁻1, corresponding to -5,91 %. In Inongo, the averages are, respectively, 154,12 and 146,27, with a difference of -7,84 kWh m⁻2 month⁻1 (-5,44 %). The differences matched are confirmed by t-tests ($p < 10^{-8}$) and Wilcoxon ($p < 10^{-6}$) in each site.

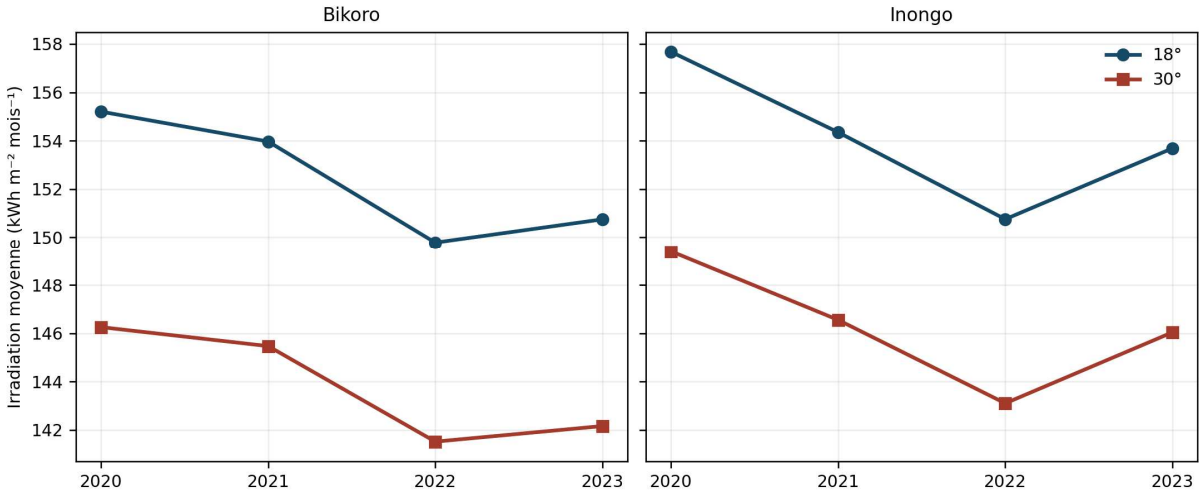

Figure 2. Irradiation annual estimated average for the inclination of 18° and 30°.
Source: author's calculations from PVGIS-SARAH3, 2026.

3.2. Seasonal dependence

The effect of the slope is not uniform during the year. From January to April and from August to December, the plan to 30° generally receives less energy than at 18°. The mean relative difference is maximum in absolute value in December to Bikoro (-13,79 %) and January to Inongo (-12,93 %). From may to July, the sign is reversed: the average gain of the plan to 30° reaches approximately 1.20 % in June to Bikoro and 1.66 % to Inongo. On 48 months, ΔH is negative 36 times and positive 12 times in each of the sites.

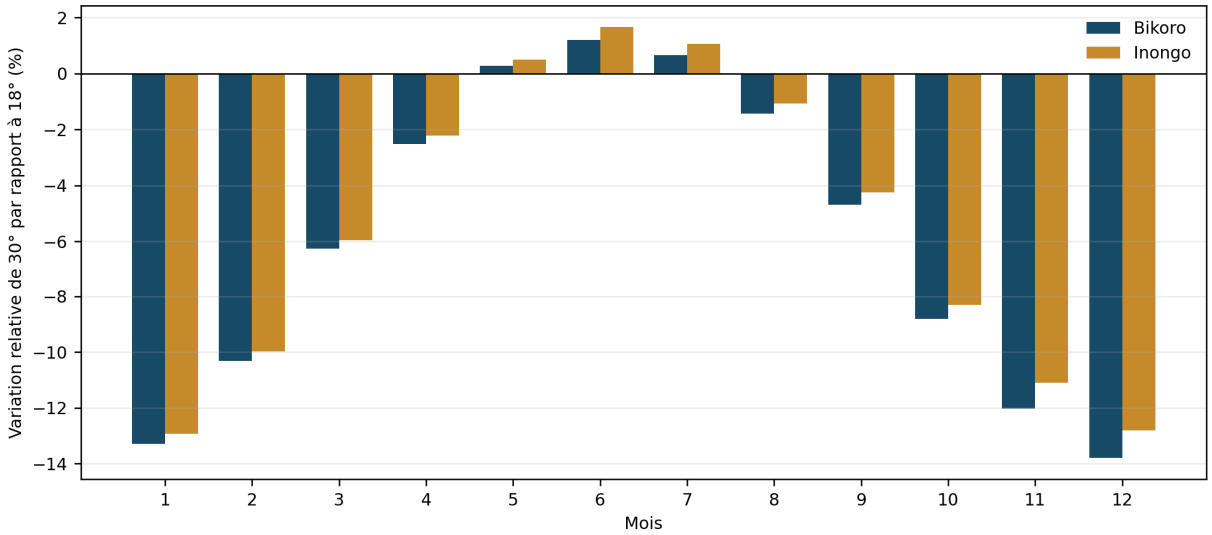

Figure 3. Average monthly Variation of the irradiation to 30° to 18°.

Source: author's calculations from PVGIS-SARAH3, 2026.

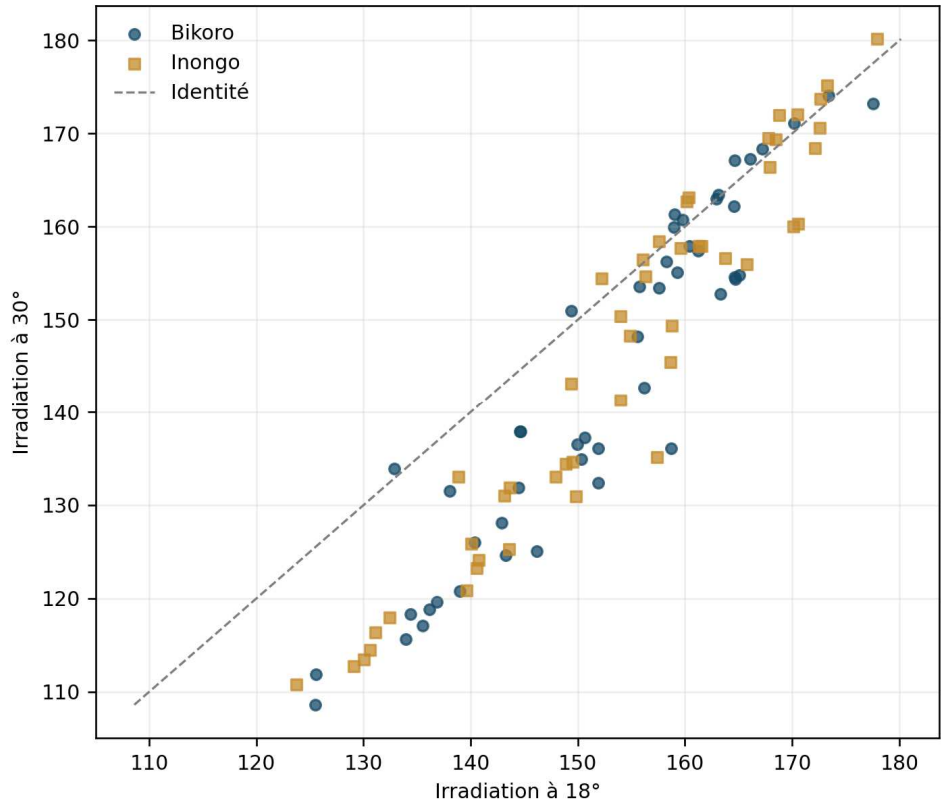

Figure 4. Correspondence between the monthly values obtained at 18° and 30°.

Source: author's calculations from PVGIS-SARAH3, 2026.

4. Discussion

The average reduction of about 5% to 6% obtained with a plan to 30° is the result of a change in geometry of receipt. It does not mean that the atmospheric radiation or climate havedecreased. Reversible seasonal sign is in a physically consistent with the apparent displacement of the Sun in the course of the year, and with the proximity of the sites of the equator. A tilt stronger can better intercept the

radiation during certain months, and then become less supportive for others.

The absence of variation of T2m between the two fetches is also expected: the temperature at 2 m belongs to the set of meteorological data, and is not recalculated according to the plan of a module or a sensor. It thus serves as a consistency check. Any presentation varying T2m with the inclination would probably be a problem to join, labelling, or transcription of the data.

For the study of bogs, the irradiation on an inclined plane can be an indicator of the comparative availability of energy, but it does not replace the net radiation at the surface, the albedo, the cloud cover, the heat flux in the soil and evapotranspiration.The angle of 18° or 30° do not necessarily represent the actual geometry of a forest canopy or surface peat soils. Future analyses should focus on, depending on the issue, the irradiation horizontal or the net radiation, and explicitly state the basic radiative, azimuth and tilt.

This analysis benefits from a protocol paired strict, but it is limited to two coordinates, four years and two angles. The statistical tests show the reproducibility of the gap between configurations in the sample; they do not generalize this gap in the central Basin. A sensitivity study extended should cover multiple angles, orientations and points in space, and then compare PVGIS to ground-based observations.

5. Conclusion

The passage of 18° to 30° reduces the radiation monthly average of about 8,57 kWh $m^{-}2$ in Bikoro and 7,84 kWh $m^{-}2$ in Inongo, while producing a slight gain between may and July. The effect is methodological and seasonal; it does not correspond to a temperature change or the climate. For an international publication, the inclination must therefore be treated as a parameter of the model, which is documented in the methods and separate the variables describing the atmosphere directly or the hydrological status of the peat bogs.

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