

Long-term variability of solar irradiance and its implications for photovoltaic power in West Africa

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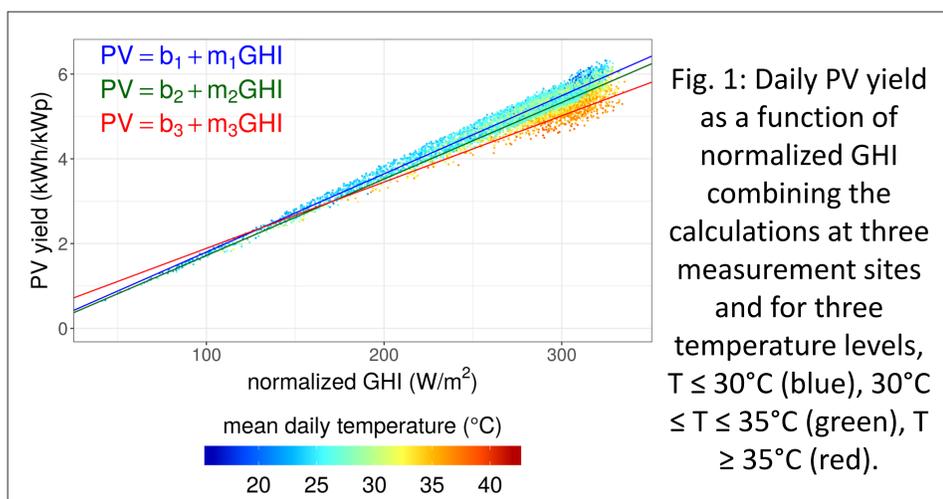
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Neher et al. (2020), submitted to ACP

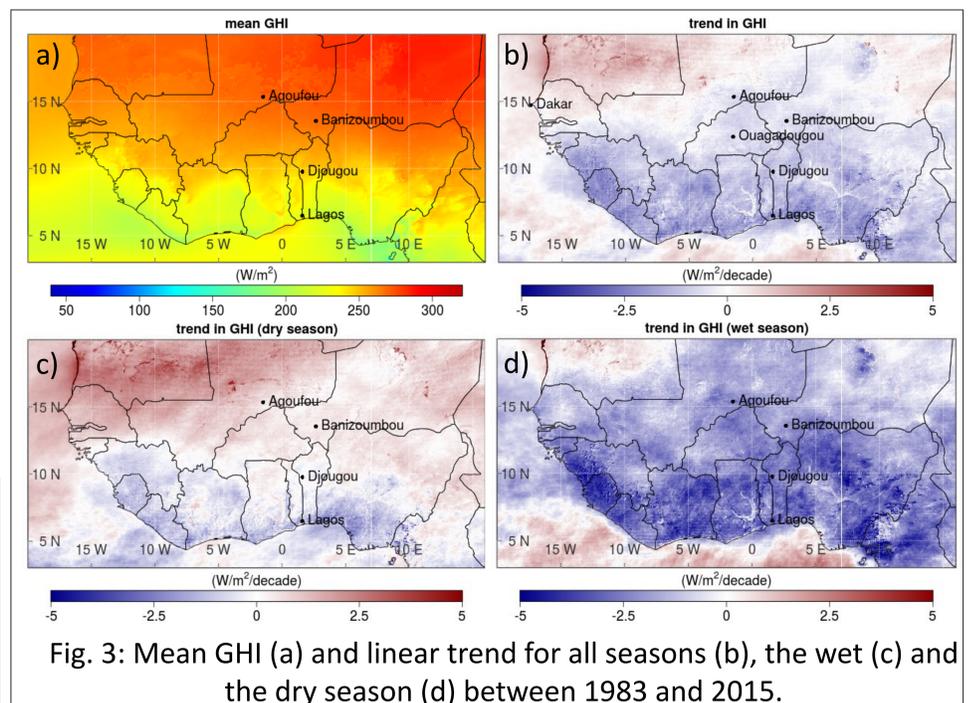
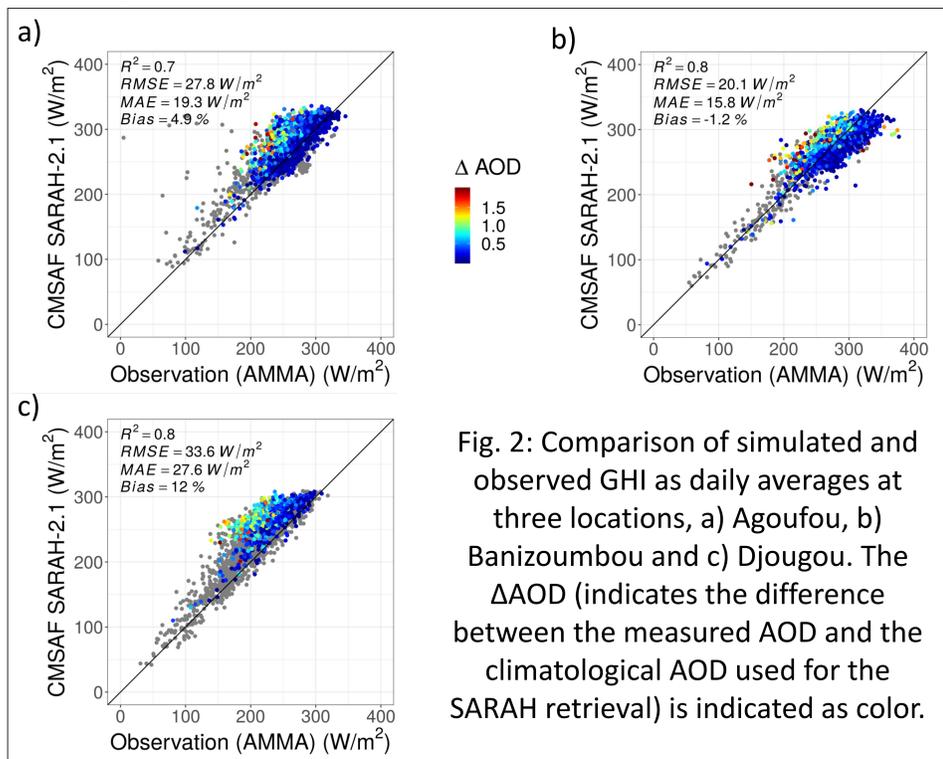
1 Solar power for West Africa

- Solar power can serve the rising global energy demand with low environmental impact.
- West Africa is rich in global horizontal irradiance (GHI) and power generation is lacking.
- Satellite data for GHI can serve as input for a linear photovoltaic (PV) power model, processed with measured data (see Fig. 1).



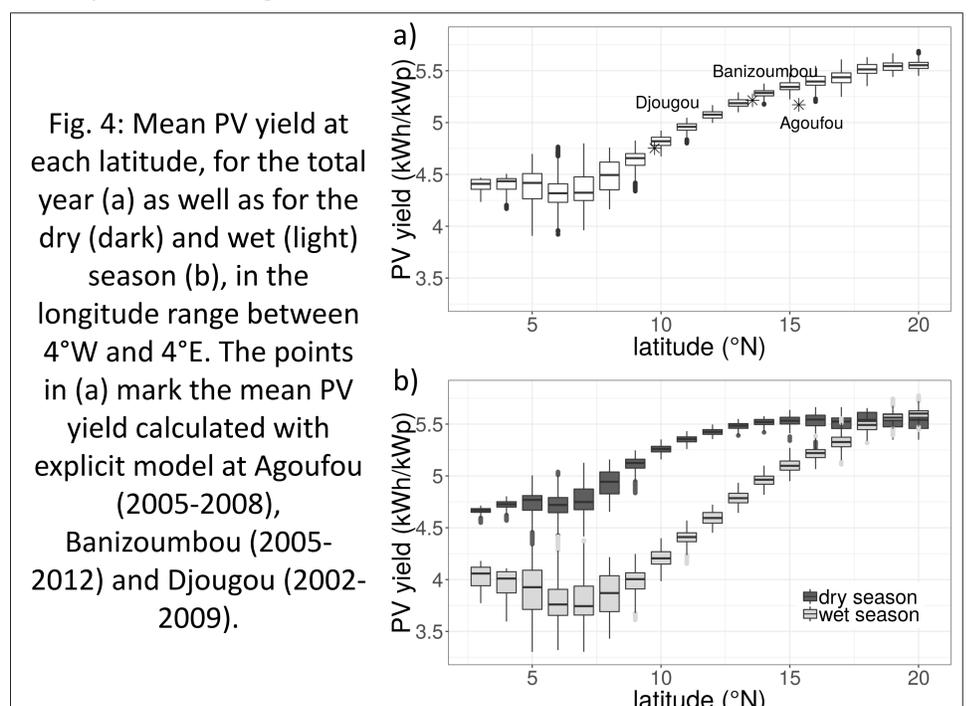
2 Surface Solar Radiation Data Set - SARAH-2.1

- Satellite retrieval of GHI in a daily resolution between 1983 and 2017.
- Comparison of satellite data to measurements in Agoufou (Mali), Banizoumbou (Niger) and Djougou (Benin) (Fig. 2, AMMA dataset).
- RMSE: 20 - 34 W/m^2 ; better agreement in Agoufou and Banizoumbou than in Djougou.
- Normalization of GHI with minimal daily zenith to model PV power.



3 PV potential between 1983 and 2017 and trends

- High potential in Sahel region and Sahara ($\text{GHI} > 250 \text{ W}/\text{m}^2$, Fig. 3 a); PV yield $> 5 \text{ kWh}/\text{kWp}$, Fig. 4 a).
- Positive trend of GHI in the Sahara, marginal trend in Sahel zone and negative trend in Southern West Africa (Fig. 3 b).
- Positive trend of GHI mainly during dry season (October to April, Fig. 3 c).
- Negative trend of GHI mainly during wet season (Mai to September, Fig. 3 d).



4 Conclusion

- Decrease of GHI during wet seasons (likely due to the increase of cloud cover) and increase during dry season (likely due to lower dust movement and clouds).
- PV potential increased over time in regions with low urban density and decreased in regions with high urban density.
- For a solar based electricity system in West Africa, North-South grid and seasonal storage capacities are needed.

