MSc. Thesis Proposal

Title: Data-based energy resources forecast and extension to hybrid forecast

Supervisors

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Introduction

Motivation

As the complexity of energy systems grows, it becomes crucial to accurately forecast the different energy resources (wind, waves, current, irradiance) to enable smooth and smart grid management. In fact, the amount of kW available on the grid is highly dependent on the weather conditions and influences significantly the price of energy. Control strategies can be implemented to regulate the energy production of certain technologies in case of excess of resources, but this requires short and medium-term forecasts that so far have been based on large scale models and cannot consider local boundary effects.

blueEnergy

blueOASIS is developing blueEnergy (https://blueoasis.pt/products/blueenergy/) an online energy map that presents the wind and solar energy potential of onshore areas based on locally measured data. blueEnergy also wants to utilize the real time data to offer more accurate forecasts, albeit more local and maybe with a shorter time range, than the models produced by ECMWF (https://www.ecmwf.int/).

Existing work

blueOASIS collected more than 1 year of data at its office in Ericeira, Portugal. In parallel, the historical hourly data at the same location of the global irradiance (W/m2), the air temperature at 2m (ºC) and total wind speed at 10m (m/s) from 2010 to 2020 were downloaded via the JRC API [1], which were derived from PVGIS-SARAH2[2], a satellite-based climate data record provided by EUMETSAT with a resolution of approximatively 6km. The comparison between the two datasets showed that, even if the trends are well represented, the measured irradiance is up to 50% lower than the values from SARAH2, and the wind speed is up to 4 times lower due to its interaction with the neighboring buildings and the topography. This highlights the fact that, regardless of the quality of the modeling, local, recent, and measured data is crucial to accurately forecast the power production of a renewable energy farm.

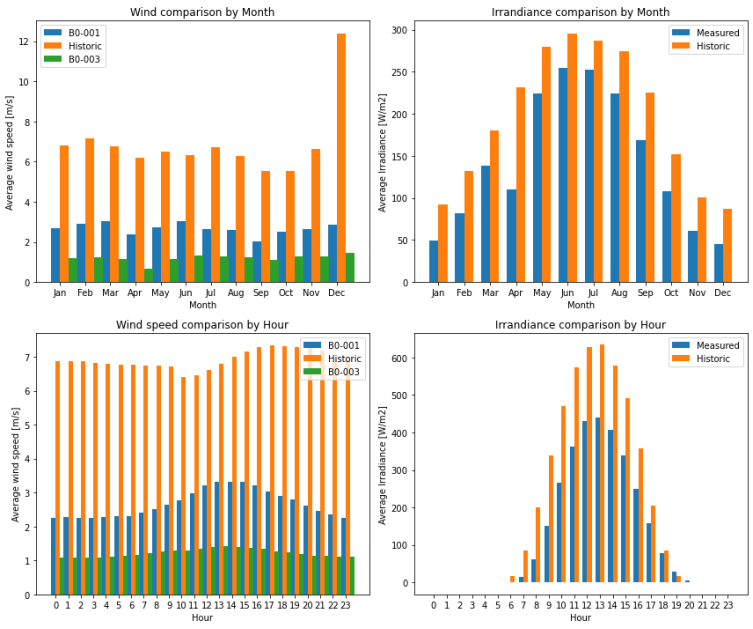

Figure 1: Difference between historical data based on satellite data and modeling and local measured data.

Objectives

The objective of this thesis is to:

- Review of forecasting algorithms and selection of the most promising one.
- Develop, test, and optimize a data-based forecast model for temperature, irradiance and wind speed based on historical data at one location (data from 2010 to 2020).
- Evaluation of the model performance on more recent measured data (2023).
- Correction of the forecasting models to better match the most recent measured data.

Depending on the student and on the time available, one of the following tasks can be chosen:

- Analysis of the transferability of the model and method to other sites.
- Correction of the forecast available from ECMWF using real time locally measured data.

Requisites

Applicants must have:

- Coding experience with python or similar
- General knowledge on Artificial Intelligence
- General knowledge on time series forecasting
- Affinity with data processing and sensors installation
- Dedication to sustainability and decarbonization

Good to have:

- Linux experience
- LateX experience
- Git experience

Location

blueOASIS (www.blueoasis.pt), Utrecht, the Netherlands or Ericeira, Portugal. The student **must be present at the office at least 3 days per week**. This is mandatory to pursue a thesis with blueOASIS.

Company involved

blueOASIS is a young team, originally based in Portugal with a recently opened office in Utrecht and Faial, Azores. Despite its recent creation, blueOASIS' team is composed of highly experienced engineers and biologists who all bring dedicated and state-of-the-art skills. blueOASIS focuses on offshore renewable energy and underwater impact assessment, mostly from an acoustic perspective. In each of their projects and products, blueOASIS strives towards digitalization, real-time data and optimization of its resources.

Bibliography

[1] *JRC Photovoltaic Geographical Information System (PVGIS)—European Commission*. (n.d.). Retrieved March 20, 2024, from https://re.jrc.ec.europa.eu/pvg_tools/en/

[2] Kulesza, K., Martinez, A., & Taylor, N. (2023). Assessment of Typical Meteorological Year Data in Photovoltaic Geographical Information System 5.2, Based on Reanalysis and Ground Station Data from 147 European Weather Stations. *Atmosphere*, *14*(12), Article 12. https://doi.org/10.3390/atmos14121803