

Sunshine Duration in Ireland

Historical Analysis and Future Predictions

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Introduction

Although solar energy has become more common worldwide in recent years, Ireland still lags behind in terms of primary energy production from solar energy, even though many parts of the country get sunshine levels comparable to southern Europe. While sunshine duration does not equate exactly to solar irradiation, several methods have been developed which show they give quite similar results, and it is often the best measure for historical values [2]. We examine sunshine duration as Met Éireann has collected historic data at many of the observation stations. We first examine this historic data at several stations throughout the country, before comparing the results to those obtained from climate models applied to similar periods. Finally we look at future predictions from these climate models and compare the output to historic data.

Main Objectives

1. Collect and examine historic data provided by Met Éireann at six of their weather observing stations.
2. Collect and examine output from historic model and compare this output with Met Éireann data.
3. Examine output from forecast models and determine what if any changes can be expected in Sunshine Duration in future scenarios.

Data Used

Met Éireann provides historical data online for each of their 25 weather observing stations, many of which record sunshine duration [1]. We have used monthly sunshine data for the past thirty years, 1985-2015. We examined data from six stations. Three of these stations, Belmullet, Valencia, and Malin, which are unmanned, have incomplete or missing data for recent years (since 2012) which has been excluded. Dublin, Cork and Shannon airports are all manned stations and have complete data up to this year.

Output from several climate scenario models was provided by Dr. Paul Nolan. The data used is based on a model embedding regional climate models, which give high resolution detail of Ireland within global climate model simulations. The models used are the UK Met Office's HadGEM2-ES and the EC-EARTH consortium global model. Two different emission scenarios were used for the HadGEM model and one for the EC-EARTH model for future forecasts. [3].

Historic Data

Met Éireann Data.

As would be expected, there is clear seasonality in the data at all locations, with the most sunshine occurring during the summer months. It is also clear that stations in the south west of the country receive the most sunshine, which decreases further north and west. No other underlying patterns are immediately obvious. However, on looking at the data on an annual basis, it becomes clear that there is actual a linear trend in the data, with the annual amount of sunshine increasing, something which is seen at all six stations. On examining this trend further, it is actually caused by a gradual increase in the sunshine seen particularly in March and April. There has been no increase over time in the sunshine duration during May, June, July or August.

Comparison between Historic Data and Model Output

Two different models were examined which provided historic data across Ireland. This data was then compared at the location of each station. Although these models seemed to give estimates which were generally higher than the values obtained from the sunshine data, the overall pattern present was very similar, indicating quite good agreement between the data collected by Met Éireann and the data obtained from each model. Similarly the linear trend in annual sunshine is also present in the EC data, while over a shorter interval does not appear in the HadGEM data (from 1980-2000). Some summary information is included below.

Data Source	Time Interval	Mean Annual Sunshine	Trend Present?
Met Éireann	1984-2014	1457.407	Yes
CLM4-ECEarth	1981-2009	2094.31	Yes
CLM4-HadGEM	1980-2000	2208.753	No

Table 1: Summary data for each model with mean sunshine at Dublin Airport shown.

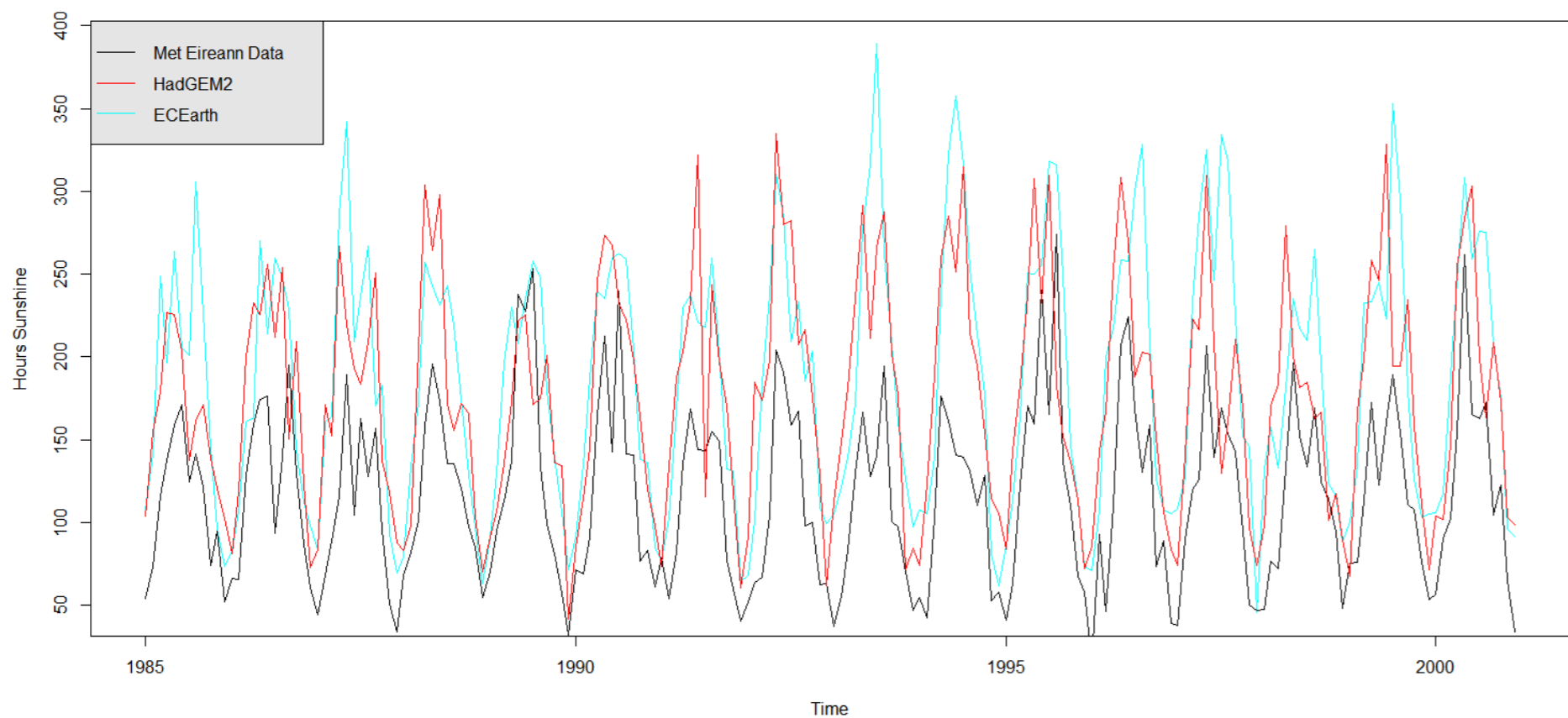


Figure 1: Time Series of Each Historic Dataset.

Results from Future Scenarios

Three different future climate scenarios were analysed, each giving similar output. Summary data for Dublin Airport is provided below.

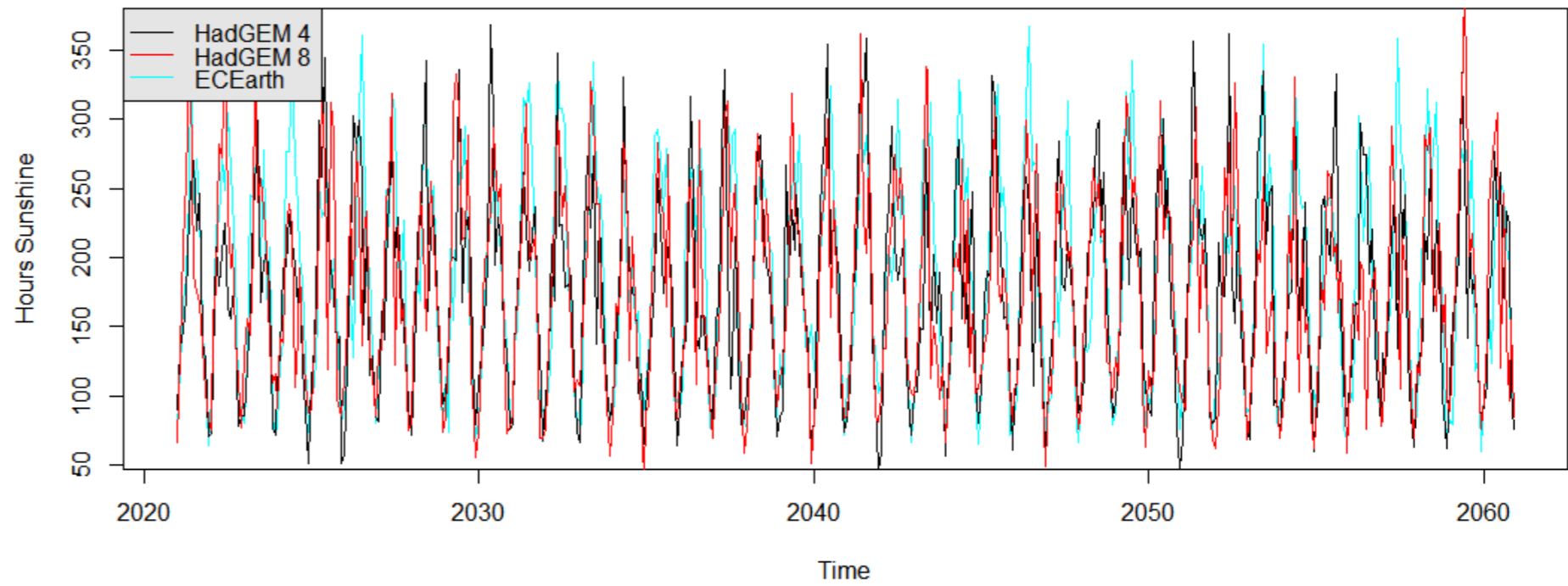


Figure 2: Time Series of each Future Scenario, Dublin Airport.

Data Source	Time Interval	Mean Annual Sunshine Hours
CLM4-HadGEM4.5	2021-2060	2107.438
CLM4-ECEarth	2021-2060	2237.032
CLM4-HadGEM8.5	2021-2060	2110.881

Table 2: Summary data for each future model at Dublin Airport.

While mean sunshine differs from the observed data, it hardly differs from the values in the historical model. However, none of these future climate models suggest any statistically significant linear trend is present in future data. This is illustrated by data from Dublin Airport below.

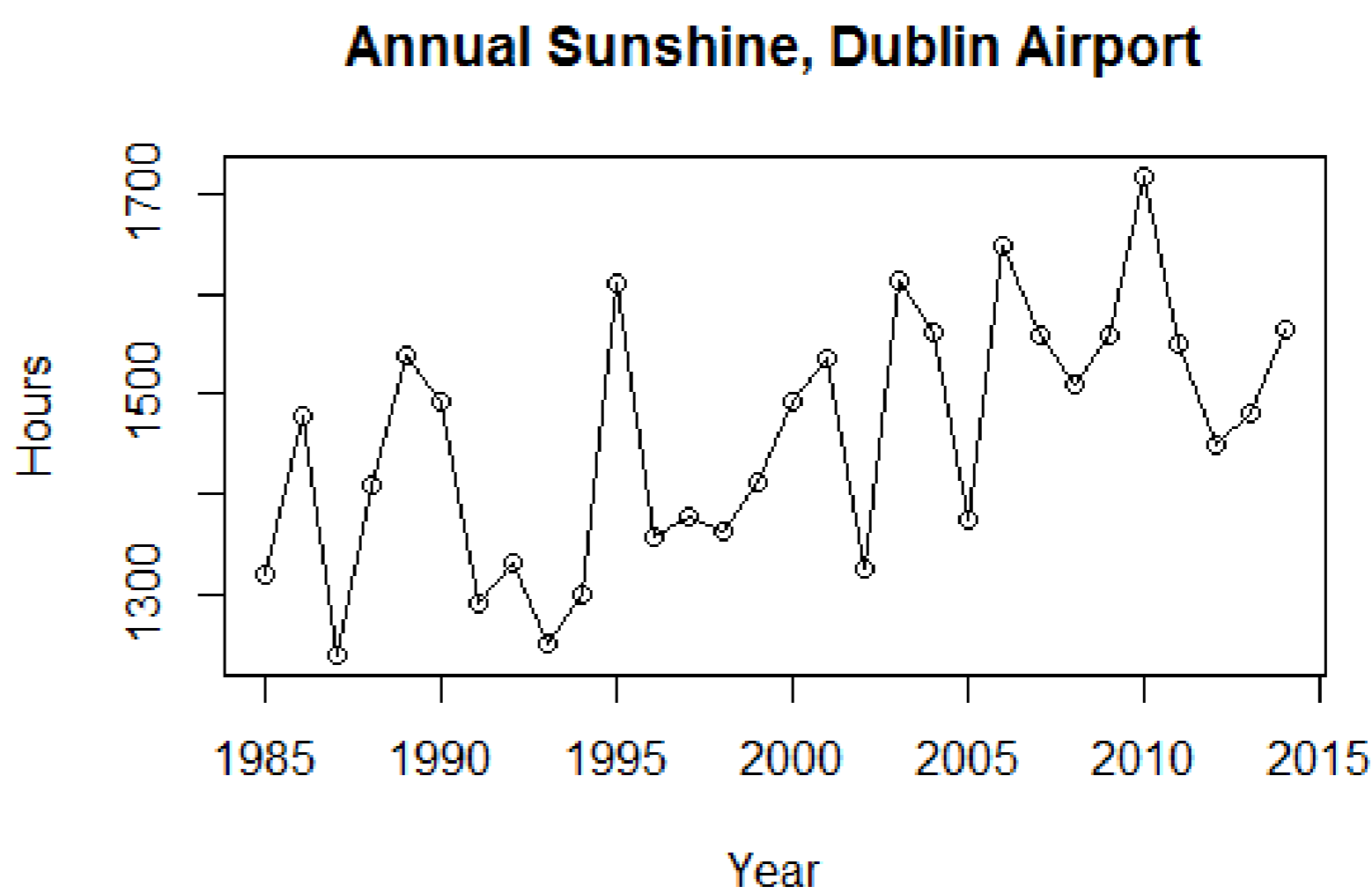


Figure 3: Annual Sunshine from Met Éireann data.

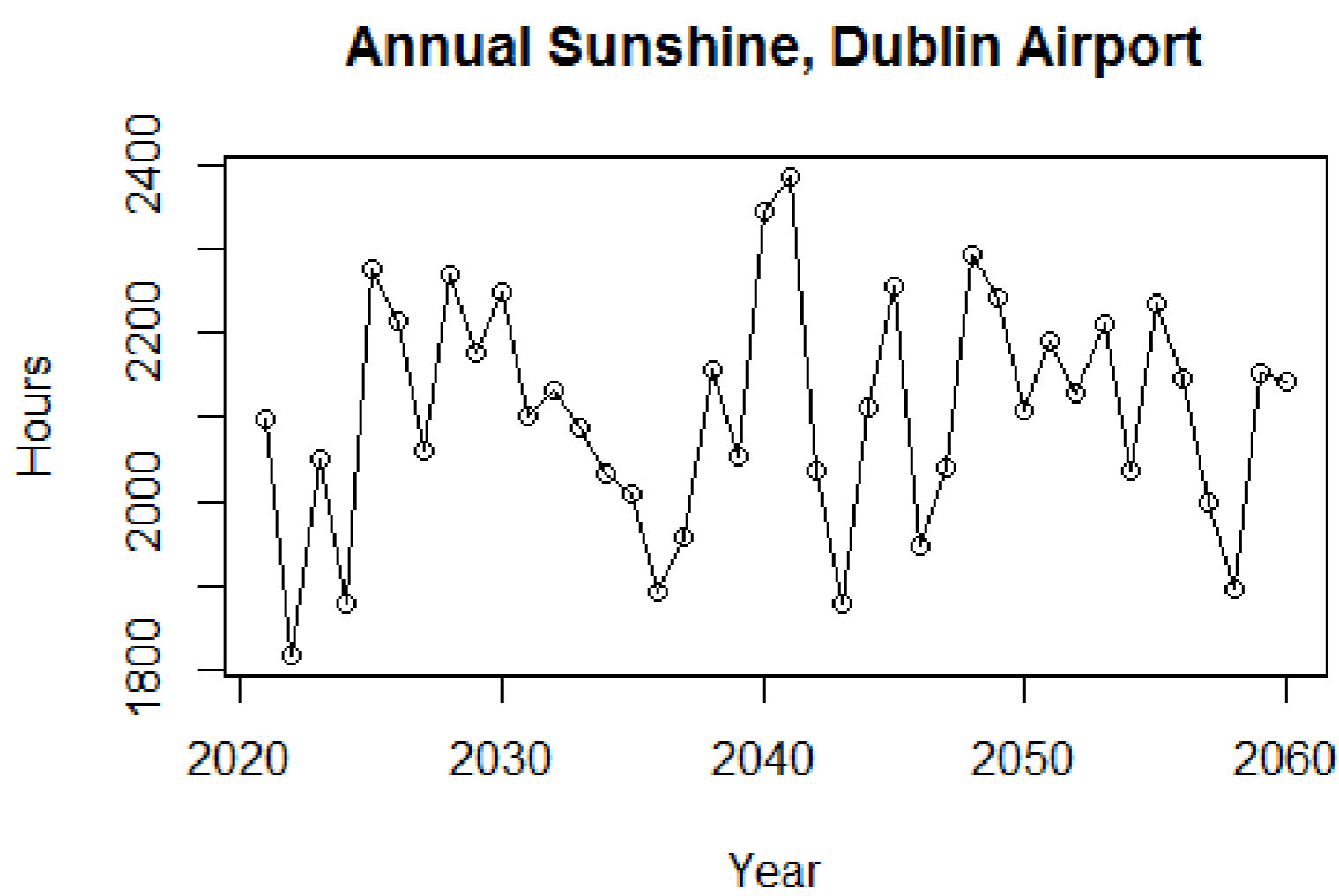


Figure 4: Future Simulation from HadGEM2-ES RCP4.5

While there are large fluctuations seen in annual sunshine both in historic data and in future simulations, there is a clear lack of trend in the output from each future climate scenario, at all locations. Future work could examine whether the linear trend is related to seasonal changes.

Conclusions

- There is a linear trend present in historical sunshine data.
- Historical data taken from the model is similar to observed data, although generally gives larger values.
- Future scenarios don't predict an overall change in sunshine duration compared to current levels.
- However there is no linear trend present in the future scenarios, unlike historic data.

References

- [1] Met Éireann historic climate data. www.met.ie/climate-request/. Accessed: 2015-08-01.
- [2] Gareth P. Harrison Dougal Burnett, Edward Barbour. The uk solar energy resource and the impact of climate change. *Renewable Energy*, 71(1):333–343, November 2014.
- [3] Paul Nolan. *Ensemble of Regional Climate Model Projections for Ireland*.

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