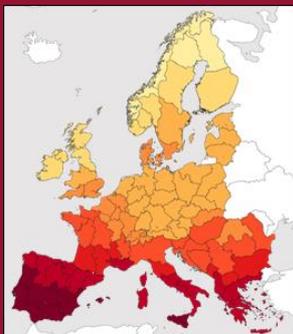


EUROPEAN CLIMATIC ENERGY MIXES (ECEM)

KEY MESSAGES

ECEM KM 05

Solar radiation changes



A series of Key Messages for the European energy sector based on the analysis of data in the ECEM Demonstrator.

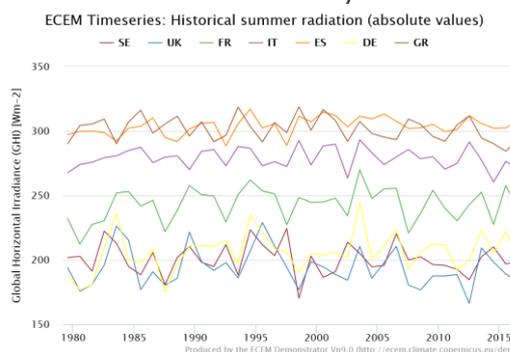


Key messages: Solar radiation changes

- Given the robust warming across Europe and the projected reduction in total rainfall (and thus cloud cover) for southern Europe, large increases in solar radiation might be expected for southern Europe
- In general, however, the projected changes for solar radiation are rather small - around 2-4% on average in summer for Spain, France and Italy at the end of the century
- Both observed and projected solar radiation are dominated by large year-to-year variability
- Understanding how the changes in solar radiation translate into changes in solar (PV) capacity factor requires further analysis and interpretation

Can changes in radiation be identified?

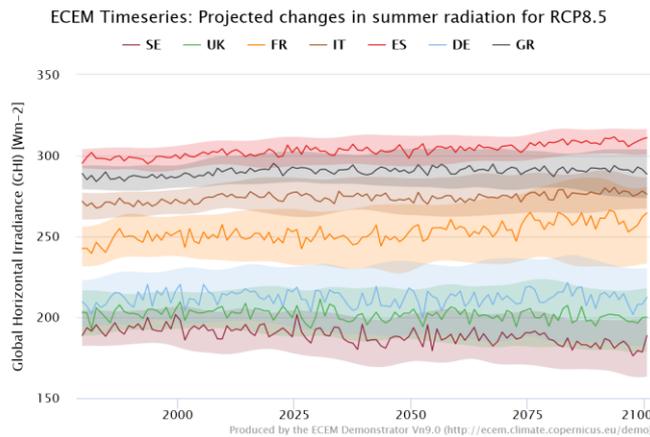
The plot below shows historic radiation for summer (JJA) for seven representative European countries (Sweden, UK, France, Italy, Spain, Germany, and Greece). There is little evidence of a trend for any of these countries.



The Demonstrator also allows the user to plot these data as percentage anomalies from the long-term 1981-2010 average. In this case, it is evident that some countries have quite large year-to-year variability - more than 30% for Germany and the UK and around 25% for France and Sweden - while for others it is around 10% (Spain, Greece and Italy).

For more information visit
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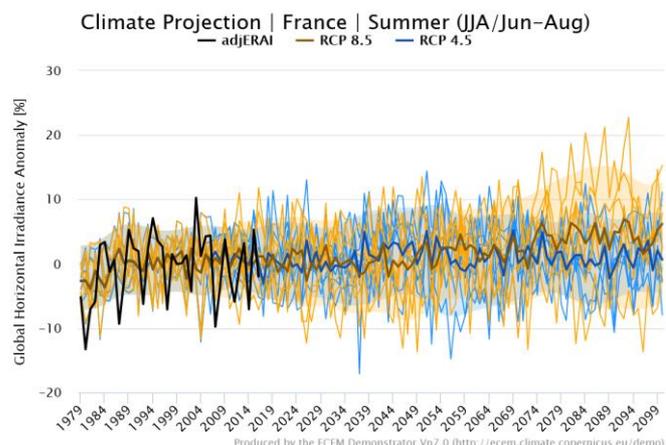
On the left are summer radiation projections for the same seven countries for a high greenhouse gas emissions scenario (RCP8.5). The thick lines show the average of seven different regional climate models. The shaded area shows the range or spread between these models. The plot indicates small increases in radiation in southern Europe and small decreases in northern Europe, with little change in central Europe, over the next several decades.

This pattern of change is supported by the percentage differences in the model averages for 2071-2100 and 1981-2010, for the high emissions scenario:

| Sweden | UK | France | Italy | Spain | Germany | Greece |
|--------|-----|--------|-------|-------|---------|--------|
| -4% | -1% | +4% | +2% | +3% | 0% | +1% |

It is also broadly consistent with the pattern of projected changes in rainfall, with increases in northern Europe and decreases in the south (see ECEM KM04).

The model averages shown above smooth out year-to-variability. The plot on the right shows projections for France, also for individual climate models (thin lines), for: i) a lower emissions scenario (RCP4.5, blue), ii) RCP8.5 (orange) and iii) observations (black line). Whereas the plot above gives radiation in $W m^{-2}$, here it is shown as the percentage difference or anomaly from the 1981-2010 average. Some models indicate future years with large positive anomalies of around +20%, but there appears to be little change in the occurrence of negative anomalies (i.e. those around -10%).



What does this mean for the energy sector?

The ECEM capacity factor projections for PV are produced using a physical model with both solar radiation and temperature as climate input data. Here it is shown that the projected changes in radiation are rather small compared with the large and robust projected increases in temperature (see KM 02). Further analysis is needed to understand how these combined changes may affect future PV generation.

All the above figures were produced and downloaded from the ECEM Demonstrator. The numbers in the table were obtained by downloading the relevant data file in csv format. Data for other countries and/or seasons can be explored in the Demonstrator. If you have questions or comments on these Key Messages please submit your feedback via the Feedback link in the ECEM Demonstrator.