

Climate Change

Case study: Understanding changes in risk of cold, high demand winters using the ECEM projections

Emma Suckling University of Reading

e.suckling@reading.ac.uk







MOTIVATION

- Using a case study approach to:
 - Demonstrate the value of climate information for understanding variability and informing risk

Understanding Variability

Seasonal Forecasting

Future Change

Return times of particular classes of events and their impacts

Pattern based analysis of large-scale drivers using historical reanalysis

How can seasonal forecasts be used for the energy sector?

Changes in risk of events under future climate

Identifying vulnerabilities under future power systems



ΜΟΤΙΥΑΤΙΟΝ

Climate Change

- Using a case study approach to:
 - Get the best out of the ECEM demonstrator tool and datasets
 - How might demonstrator tool be used to understand risks of particular events?





ECEM CASE STUDIES

Less

Lear

The

over a ray

Warn

Some d

ECEM do

must be

Want

Inne

Wat

Cièr

contr

A series of case study documents available from the ECEM demonstrator

How d

know th

are lin

vank

ownload the El demons Scatte

How ca

demons

to learn

The hi

eanalysis

be used past clim

into co

Coor

use



Can we anticipate cold spells and their impacts?

in the northern extra-tropics wintertime climate shows large fluctuations compared to other regions and seasons. Large-scale weekly to monthly fluctuations, such as the NAO, are a source of long-range climate predictability. across northern Europe. Seasonal forecast systems have recently demonstrated a moderate level of success at predicting winter NAO (5), which consequently leads to some skill in reproducing near surface wind speeds and temperatures. during winter [6].

While the winter 2010 event was unusually cold compared to recent history, it was warmer than winter 1963, despite exhibiting similar atmospheric conditions. It has been suggested that winter 2010 might have been cooler without the background of global warming observed in the 20° Century [7]. The ECEM climate projections allow investigation of changes in risk to the energy sector from events such as cold winters under future climate change scenarios.

Can we trust the data?

The skill in seasonal prediction systems is still relatively low (depending on the variable, season and region) when assessed over multiple years, so caution is advised for some analyses. Extreme events, however, in which stronger driving factors are present, may offer higher levels of predictability. The Met Office GloSeaS Seasonal Forecast System, for example, found signals of a negative NAO and consequent cold temperatures for retrospective foreacasts covering winter 2010 up to a season in advance [6]. This suggests seasonal forecasts could be useful when planning for extremes and worse case events.

The current historical reanalysis, while reliable for many variables and countries, shows some weaknesses in wind capacity factor. The next generation reanalysis dataset (ERA5) is, however, likely to provide improved estimates of wind speed and therefore the related energy variables.

References and links

 National Grid, Winter Consultation Report 2010/2011, 28 June 2010.
The UK's Energy Supply: security or independence? 26 May 2011, https://www.publications.parliament.uk/pa/cm201012/cn

supply/m49.htm

C ECMWF

[3] G. Outers, et al., Geophysical Research Letters, 38, 11 (2011). [4] Wind Power in the United Kingdom, https://en.wikipedia.org/wiki/Wind.power in the United Kingdom#cite noterenewableuk.com-3 [5] A. A. Gcaile, et al., Geophysical Research Letters, 41, 2514-2519 (2014). IEI R. T. Clark, et al., Environmental Research Letters, 12, 024002 (2017).

[7] J. Cellena, et al., Geochysical Research Letters, 37, L20704 (2010).

If you have something you'd like to add to this case study story (e.g., date, image, narrative) or would like to suggest another event for analysis, please submit your feedback via the feedback form on the Demonstrator.



Peak in demand sensitive to cold spells

Temperature is a dominant driver of demand across Europe (electricity and residential gas heating), with a negative relationship between the two. Relative humidity, solar radiation and wind speed also play a role in influencing demand. The ECEM reanalysis shows a high correlation between temperature and weather-sensitive electricity demand in the UK.



historical reanalysis in the UK

What if winter 2010 happened today?

The ECEM historical reanalysis provides estimates of renewable energy supplies based on today's energy mix and the historical climate drivers. This allows assessment of potential impacts of past climate events if they happened today. A winter like 2010, which saw persistent cold and still conditions, would have a larger impact on the energy sector today due to increased renewables capacity. In 2010 wind power contributed around 2% to electricity generation in the UK, rising to 11% in 2015 [4]. The winter conditions in 2010 would have led to a substantial reduction in wind power capacity factor compared to average winter conditions.



Figure 4: Estimated winter mean wind power capacity factor based on today's energy mix and the historical climate delease for the UK.







University of

Figure 2: Left: Mean temperature anomaly (differences compared to 1981-2010 mean) across Europe for winter 2010, Right: Historical winter mean temperatures in France and UK.

Atlantic Oscillation, or NAO-) [3].

C ECMWF







Version 2, Date of publication: 1 September 2017

For more information visi

os-contact the ECEM team at support@ecem.climate.copernicus.eu

www.ecem.climate.copernicus.e



future risks through:

Seasonal forecasts

Climate projections

Climate Change

- Use ECEM demonstrator and data to boost decision-making
 - Fewer temperature-related winter demand peaks seen in future
 - Increasing sensitivity of power system to weather as renewables generation increases
 - Likelihood of low wind winters in future is similar to their occurrence in past
- The ECEM datasets:
 - Bring together credible climate and energy data
 - Processed in a consistent way over Europe
 - Covering a range of time scales and resolutions
- Historical data and projections data has been used to:
 - Explore the changes in occurrence and impact of winters like 2009/10
 - Highlight the changing balance between temperature/demand-driven power systems and renewables generation driven systems
 - Ask 'what if' questions
 - Help to anticipate future risks







CASE STUDIES - WINTER 2009/2010

Climate Change

• What if winter 2009/2010 happened today?



European Commission

• Can we anticipate cold spells and their impacts?

7.5

Climate

Change

- Climate projections useful to anticipate changes in risk
 - Fewer cold winters likely in future, although still possible

Climate Projection – United Kingdom | Winter (DJF/Dec-Feb) — adjERAI — WFDEI — RCP 8.5 — RCP 4.5



 1
 0²
 1
 0⁴
 1
 0⁵
 0⁵</t

Europear

• Anticipating future demand (UK)

Climate

Change

ECEM Timeseries: Demand (DEM) Anomaly Power (PWR)



European Commissio

Climate Change

Future potential for renewables supply (wind - UK)

ECEM Timeseries: Wind (WIN) Capacity Factor (CFR) — avg R85 — avg R45 — UK WIN CFR PhM03 12m





Climate Change

Risk to supply under future energy mixes (wind - UK)

ECEM Timeseries: Wind (WIN) Power (PWR)





• Current cases:

Climate

Change

- Winter 2010
- Climate projections of cold, still winters
- Seasonal Forecasting (focus on the Balkans region)
- Spanish heat wave 2015
- Technical report on historical variability
- Other cases:
 - Get in touch if you have cases you'd like to explore!



CASE STUDIES – SUMMARY

Climate Change

- Use ECEM demonstrator and data to boost decision-making
 - Unusually cold winter of 2009/2010 can be seen in the ECEM data
 - Impact of a winter like 2009/2010 would have bigger impact on energy sector today
 - In future fewer temperature related winter demand peaks are expected
 - Low wind winters still possible in future and will have a larger impact due to increased wind power capacity
- Reanalysis, seasonal forecasts and climate projection data can:
 - Reveal dependencies and risks across Europe
 - Put an event into context of recent history
 - Ask 'what if' questions
 - Help to anticipate future risks

