Case study 8

Winter weather and energy system balancing

Focus: The use of seasonal forecasts by the UK National Grid Operator

Industrial and research partners

The SECLI-FIRM project aims to demonstrate how improving and using long-term seasonal climate forecasts can add practical and economic value to decision-making processes and outcomes, in the energy and water sectors. To maximise success, each of the nine SECLI-FIRM case studies is co-designed by industrial and research partners.

For this case study, the research partner is the UK Met Office and the industrial partner is National Grid, one of the world's largest investor-owned utilities focused on transmission and distribution activities in electricity and gas in the UK and the US. National Grid play a vital role in connecting millions of people to the energy they use, safely, reliably and efficiently.

Boosting decision making

- The main objective of this case study is to illustrate the benefits of using seasonal forecast information to better predict the UK winter mean electricity demand and wind power.

The seasonal forecasting context

- This case study focuses on demonstrating the impact of using seasonal temperature, wind and atmospheric circulation forecast information for the United Kingdom (UK) National Grid operator.
- This climate forecasts will be translated into energy information, to give a forecast of winter UK energy demand and wind power.

Sectoral challenges and opportunities

- The grid network has a central role to play in the future energy mix. In a fast-changing energy landscape, National Grid is working to meet ambitious low carbon energy targets, connect new sources of energy to the people who use them, and find innovative ways to enable the decarbonisation of heat and transport.
- Ahead of each winter, the UK grid operator must estimate the demand over the coming winter, with a particular focus on peak electricity demand. This is to ensure there is sufficient electricity supply available to meet this demand.
- By identifying potential risks to the system ahead of the winter, we will explore whether it is possible to reduce balancing costs over the winter period.

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Essential climate variables

- Wind speed
- Temperature
- Mean sea level pressure

Essential energy variables

- UK energy demand
- UK wind power production

Energy demand and supply balancing

National Grid operate the electricity transmission network and the gas National Transmission System (NTS) in England and Wales, with day-to-day responsibility for balancing supply and demand. As we move away from a historical reliance on large thermal power generation there is now a greater diversity of supply and flexible demand than ever before. Therefore, the electricity transmission network has a vital role to play in the future energy mix.

Winter weather and energy demand

The UK experienced a spell of severe winter weather with very low temperatures and significant snowfalls from late February to mid-March 2018. This was associated with a sudden stratospheric warming event, which was predicted from early February. Daytime temperatures remained widely below freezing with a strong east wind and significant accumulations of snow across much of the country. This was the most significant spell of snow and low temperatures for the UK overall since December 2010.

Industry context

Day-to-day responsibility for balancing energy resources supply and demand

Climate event

Winter 2017/18 – snow and low temperatures

Sector impact

Supply and demand balancing is vital for maintaining network reliability and limiting the cost of energy

Business process

Currently an estimate of winter demand is made ahead of the winter using historical data, assuming the climatological risk of weather and associated demand. This case study will assess whether seasonal forecasts of weather can be used to improve upon this demand estimation. A second focus for this case study will be to assess whether seasonal forecasts of wind speeds can improve estimation of UK winter wind power. The availability of wind power during winter is of particular interest because, if wind power output is strong, it can help to alleviate extreme demand periods.

Progress update - Task 1

To date, this case study has been focussing on the following two tasks:

Task 1: Assessing whether the hindcast data set (DePreSys) assessed in task 2.5 could be applied to improve the representation of extreme weather events when calculating the ACS.

Task 2: Optimising and integrating seasonal forecasts of weather parameters that are currently used by NG to forecast demand over the winter.

Task 1 has been exploring pairing the DePreSys hindcasts with NG's ACS demand model. TheDePreSys hindcasts are on a global grid with a 60km resolution. NG's ACS demand model requires hourly observations from representative observing sites across the UK. The grid squares in which NG's observation sites fall have therefore been chosen to best represent the climatology at that observation site. To ensure that the data at these grid squares is representative of the climatology currently used by NG, the distribution in the hindcasts ensembles of the representative grid squares have been compared with daily weather recordings made at the observation sites. Figure 1 shows the distribution of DePreSys hindcast ensembles for the grid square in which one of the observation sites is located and observed minimum temperatures. The figure shows that the distributions are similar, however, there is a cold bias in the hindcast data set which will need to be adjusted for.

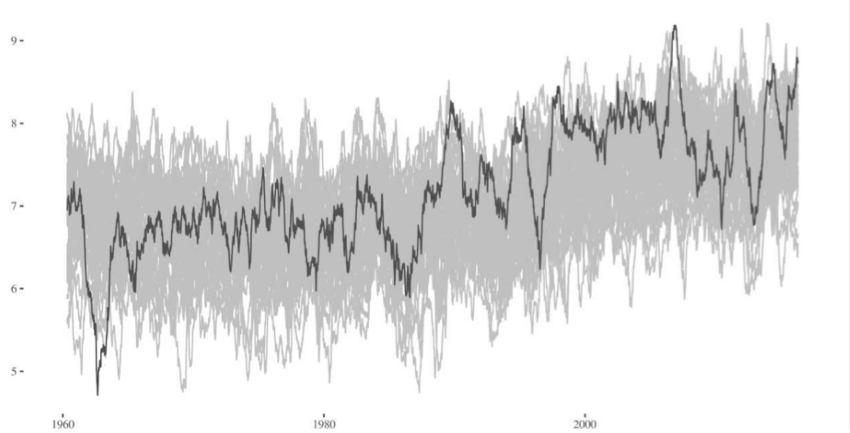

Figure 1: Hindcast ensembles compared with observed minimum temperature at relevant observation station (black line)

Business process

Estimate of energy demand ahead of the winter using historical data to assess the risk of under-supply

Application of seasonal forecasting to optimise grid and transmission supply and demand balancing

Next steps - Task 1

The DePreSys hindcasts have a daily temporal resolution, whereas NG's demand model has been calibrated using hourly data. Therefore, in order to ensure that the new data set is compatible with NG's ACS model, hourly values will need to be statistically inferred. As such case study 8 has been exploring the relationship between observed daily data at the observation stations with hourly recordings. Case study 8 will now look at using this observed relationship between daily observations and hourly observations to develop a new data set which can be run through NG's ACS demand model. Assessment of improvements in risk management will be carried out by providing comparisons in the new techniques ability to capture extreme events to that of the current methodology.

Progress update - Task 2

Research suggests that at longer lead-times broad-scale circulation types are more predictable than the actual weather itself. Investigations are being carried out to understand which method of tailoring is best for this case study. Research suggests that there is skill in directly linking winter demand to the NAO and Weather patterns however this approach is not easily integrated into NG's current demand forecasting processes. As such, focus has been placed on developing a seasonal forecast of the parameters that drive the demand model.

Next steps - Task 2

The following methodologies are being evaluated:

1. Weather parameters that drive NG's demand model have been taken directly from seasonal forecast systems and tailored for NG's demand model e.g. statistical tailoring to generate hourly rather than daily temporal resolution and ensuring the data is representative of the observations sites that drive NG's demand model.
2. Use the skill in forecasting weather patterns to improve skill in the seasonal forecast of weather parameters used in NG's demand model (i.e. using data from Task 2.3).
3. Direct correlation of demand with broad scale circulation types i.e. Weather Patterns and North Atlantic Oscillation

Find out more

For more about this and other SECLI-FIRM case studies, visit www.secli-firm.eu

The Added Value of Seasonal Climate Forecasting for Integrated Risk Management (SECLI-FIRM)

For more information visit:

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