S2S4E
Climate Services for Clean Energy

CASE STUDY #5

ICING EVENT IN ROMANIA

February 2014

BASIC FACTS

- **Area:** Romania
- **Season:** winter
- **Year:** 2014
- **Forecast range:** sub-seasonal
- **Main interest:** wind energy
- **Forecast variables:** average temperature and minimum temperature

This factsheet is based on S2S4E deliverable 4.1. To access the full report, please visit s2s4e.eu.

WHAT happened

An unexpected cold spell resulted in extremely low temperatures, freezing the rotors of wind turbines and stopping power production in several wind farms.

WHERE it affected

The anomaly was observed over eastern Europe, by the shores of the Black Sea. Romania was one of the countries highly affected.

WHEN it occurred

The cold spell was registered during mid winter in 2014, from January 28th to February 3rd, 2014.

Analysis of the event

The temperature anomaly of extremely cold temperatures was confined to Eastern Europe, around the Black Sea, mainly in Romania and Bulgaria (Figure 1). The cold spell hit Romania abruptly, fluctuating from above normal temperatures in January (Figure 2) to extremely low temperatures in February (well below p10), with a weekly average below -5°C and daily averages reaching -15°C.

Wind speeds were above normal, with fairly high daily means (Figure 3). However, due to the extreme low temperatures, ice began to form in the turbines of wind farms. In some wind farms located in central and southern Romania, the rotors of wind turbines were affected by ice, stopping energy production. The problem could not be detected and solved promptly because the road that gives access to the park was also frozen. For several days, the park manager could not access the site, and the day ahead market offers had to be corrected manually. The shutdowns created an imbalance in the energy supply of the area. Consequently, as reported by the European Commission, the cold spell caused power outages and was responsible for 8,500 families suffering from power failures in Prahova, Romania (Reliefweb, 2014).

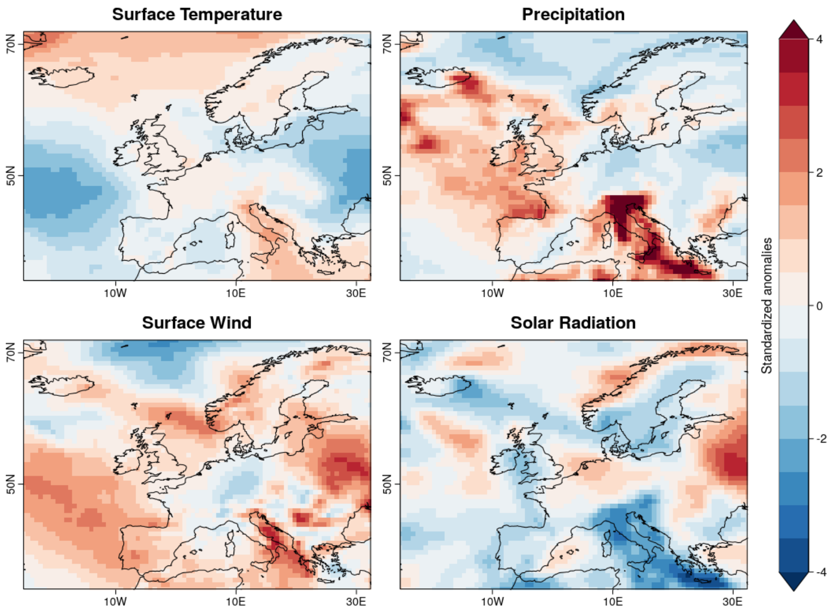

Figure 1. Standardized anomalies of temperature, precipitation, surface wind and solar radiation for January 28th through February 3rd, 2014. ERA-Interim reanalysis.

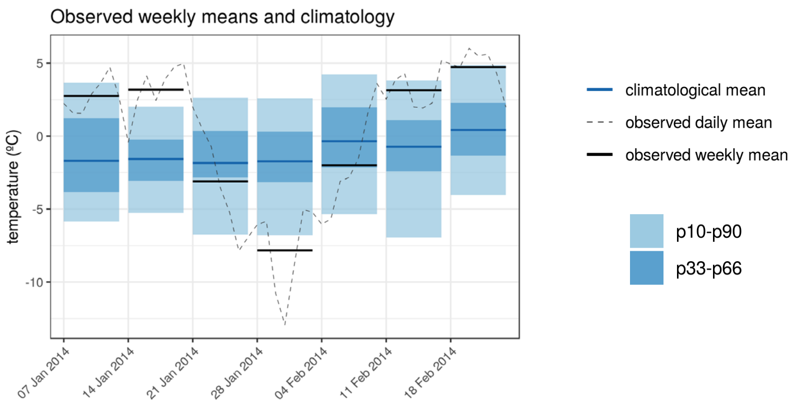

Figure 2. Observed temperature means for January through February 2014. ERA-Interim reanalysis.

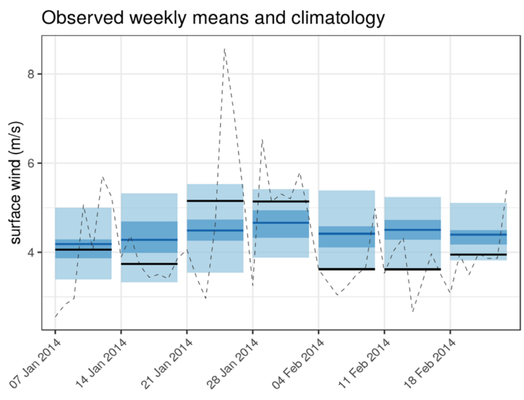

Figure 3. Observed wind speed means for January through February 2014. ERA-Interim reanalysis.

Available forecasts

S2S4E sub-seasonal forecasts for average and minimum temperatures were produced with ECMWF Monthly Prediction System as a means to anticipate ice formation in the study region. The skill scores for average temperature forecasts were slightly positive four to three weeks in advance (fRPSS: 0.08, 0.03, 0.01) and increased to 0.20 the week before the event (Table 1). Minimum temperature forecasts, on the other hand, demonstrated to have high potential value due to their higher skill for the location and time period (Table 2), with skill scores of 0.13, 0.16, 0.28 and 0.49 (4 to 1 week before the event).

Although the skill for this region and period was positive, both average and minimum temperature S2S4E forecasts generally did not predict the correct below normal tercile for this event in study. The average temperature forecasts (Figure 4) predicted a 25%, and 27% probability of below normal conditions four and three weeks before the event. However, at the two and one week lead times, the average temperature forecasts did show potential value, as they predicted a 40% probability of the below normal tercile and 26% probability of extremely below normal conditions (below p10).

The minimum temperature forecasts (Figure 5) also generally did not predict the correct below normal tercile. Forecasts issued four to one week in advance indicated 22%, 27%, 27% and 36% probability of below normal conditions. However, each of these forecasts did show some potential value as they also predicted 13%, 17%, 22% and 26% of extremely below normal conditions.

Table 1. Probability skill scores for average temperature.

Skill (Average Temperature)	**Forecast lead time** Days 26-32	Days 19-25	Days 12-18	Days 5-11
RPSS	0.08	0.03	0.01	0.20
BSS P10	0.08	0.10	0.06	0.03
BSS P90	-0.10	0.07	0.21	-0.01

Table 2. Probability skill scores for minimum temperature.

Skill (Minimum Temperature)	**Forecast lead time** Days 26-32	Days 19-25	Days 12-18	Days 5-11
RPSS	0.13	0.16	0.28	0.49
BSS P10	0.06	0.03	0.38	0.58
BSS P90	-0.03	-0.04	0.19	0.21

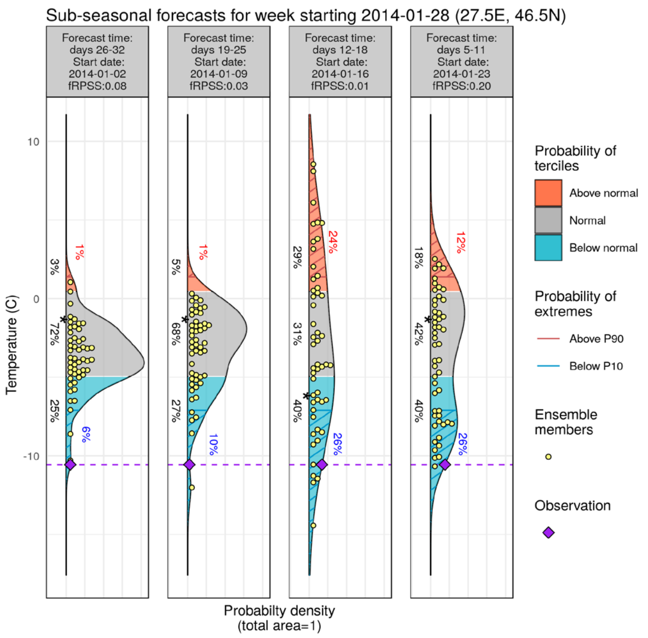

Figure 4. Sub-seasonal average temperature forecasts for January 28th through February 3rd, 2014. Issued four, three, two and one week in advance.

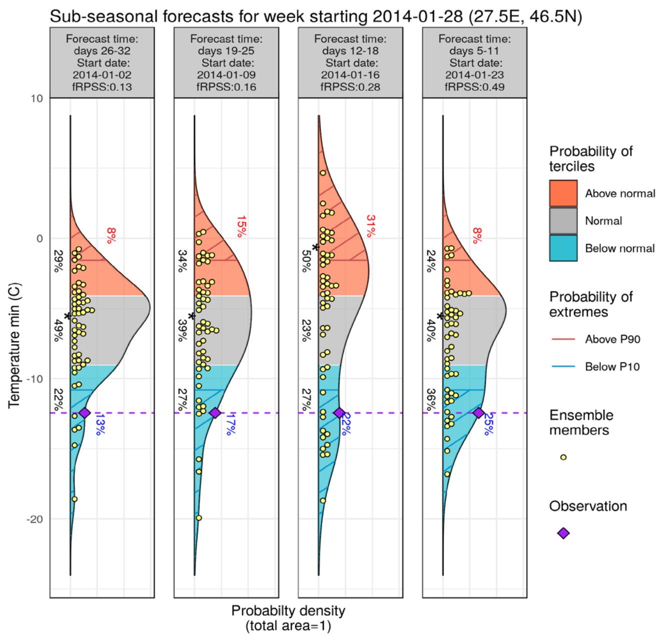

Figure 5. Sub-seasonal minimum temperature forecasts for January 28th through February 3rd, 2014. Issued four, three, two and one week in advance.

Conclusions

Ice formation can heavily damage wind turbines and is therefore a critical issue to study for the wind industry. For the time period and region analyzed in this case study, skill scores were positive for both minimum and average temperature S2S4E forecasts. The fRPSS values were significantly higher for minimum temperature forecasts, demonstrating that these forecasts have greater potential value for decision-making than average temperature forecasts.

Although fRPSS values were positive, average temperature and minimum temperature forecasts had difficulty predicting the correct below normal tercile for this icing event in Romania. The forecasts, did, however, predict greater probabilities for the extreme below normal conditions that occurred, especially at shorter lead times.

Another factor to consider in this case study, is that the ECMWF monthly system model used for the forecasts was a previous version (CY4OR1). This choice was made because the case study occurs in 2014 and the newer model system was not available then. However, if the newer ECMWF monthly versions had been used, better forecasts could have potentially resulted.

References:

Reliefweb. (2014, January 31). 31 January 2014: Eastern / Central Europe – Severe Weather. Available at: https://reliefweb.int/map/romania/31-january-2014-eastern-central-europesevere-weatherl Research: Atmospheres, 123, 4837– 4849. doi:10.1029/2017JD028019.

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