Wind Power Forecasting Pilot Project

Event Analysis

Dec 2-6, 2007

Reliable **Power**

Reliable **Markets**

Reliable **People**

Operations and Reliability

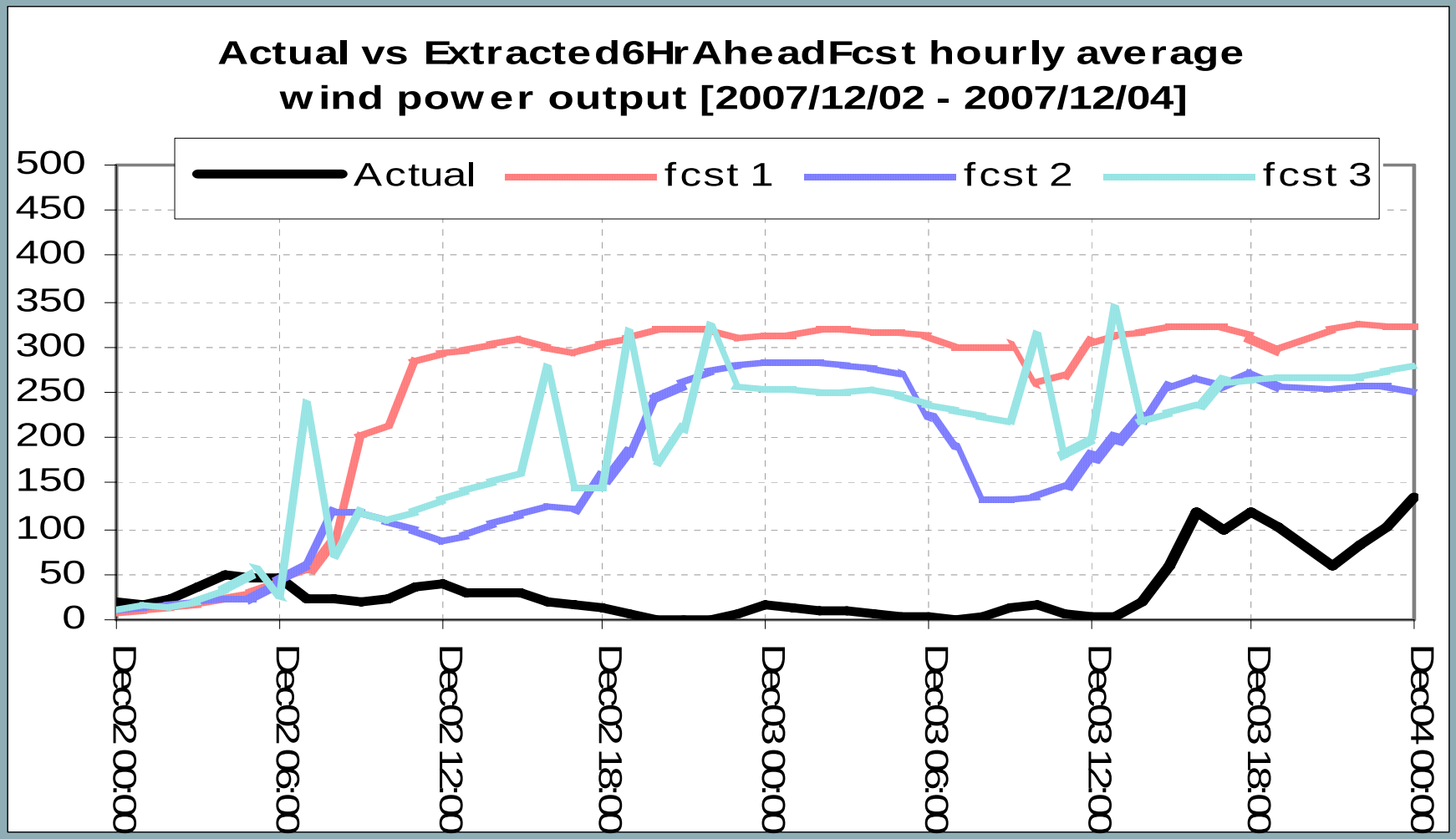
aeso
ALBERTA ELECTRIC SYSTEM OPERATOR

Event Description

- The wind power was forecasted to be high for three days, but the wind power remained very low
- Each hour the forecasts corrected to where the wind power actually was, but then predicted a ramp up over the next few hours to high levels which never unfolded
- The wind power never did come up, rather the forecasts eventually came down on the fourth day
- What is it that was leading the forecast models to believe that the wind power was going to rise and why did this not happen?
- How can we avoid this in the future? What data is needed to correct for this?
- We chose the 6 hr timeframe on the next few pages as it seemed that every hour, the forecasts predicted a renewed ramp up over the next 6 hours to a leveling out at high levels after that

Extracted 6 hour timeframes

T-6 hr timeframe from every 48 hour forecast dataset plotted



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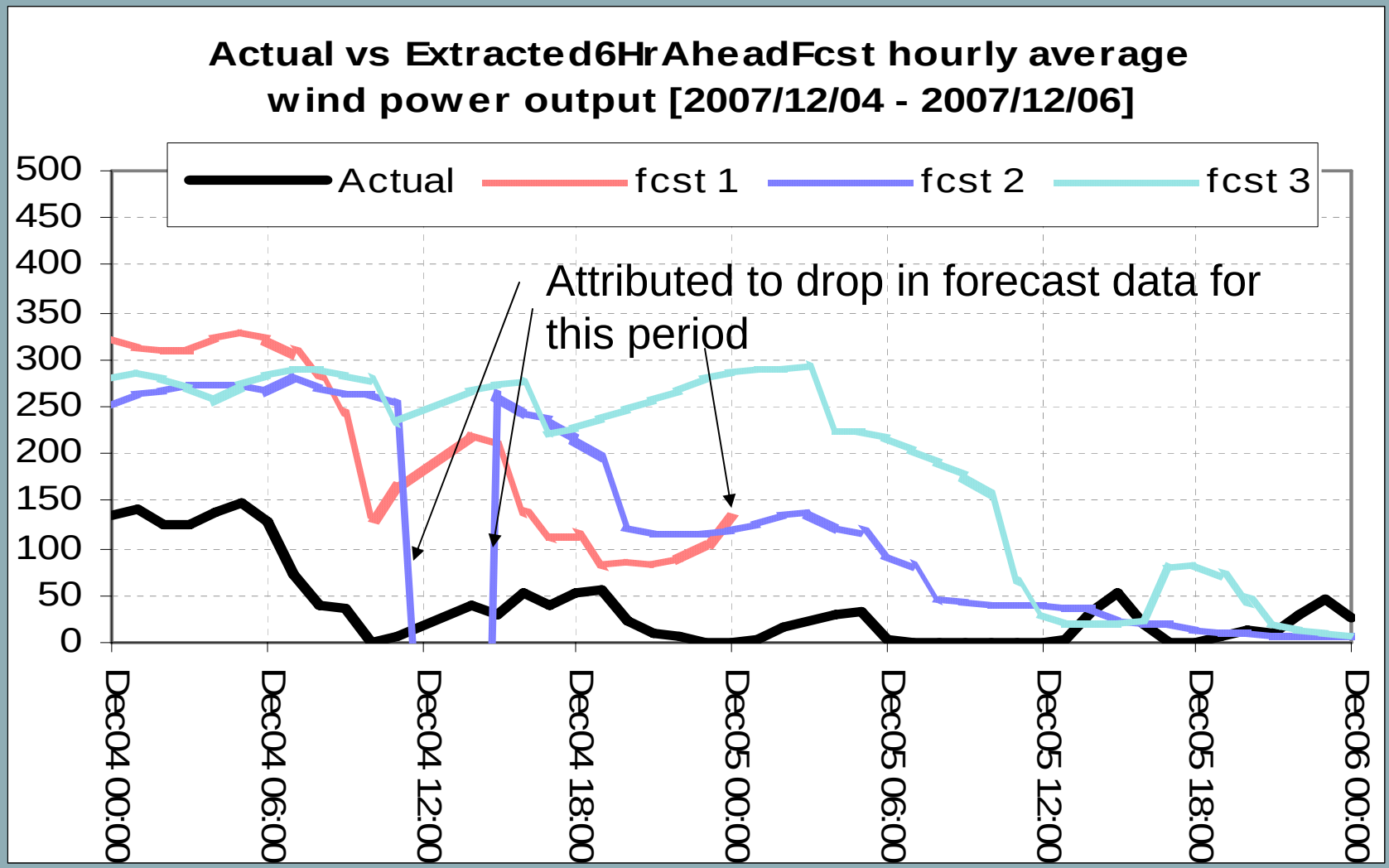


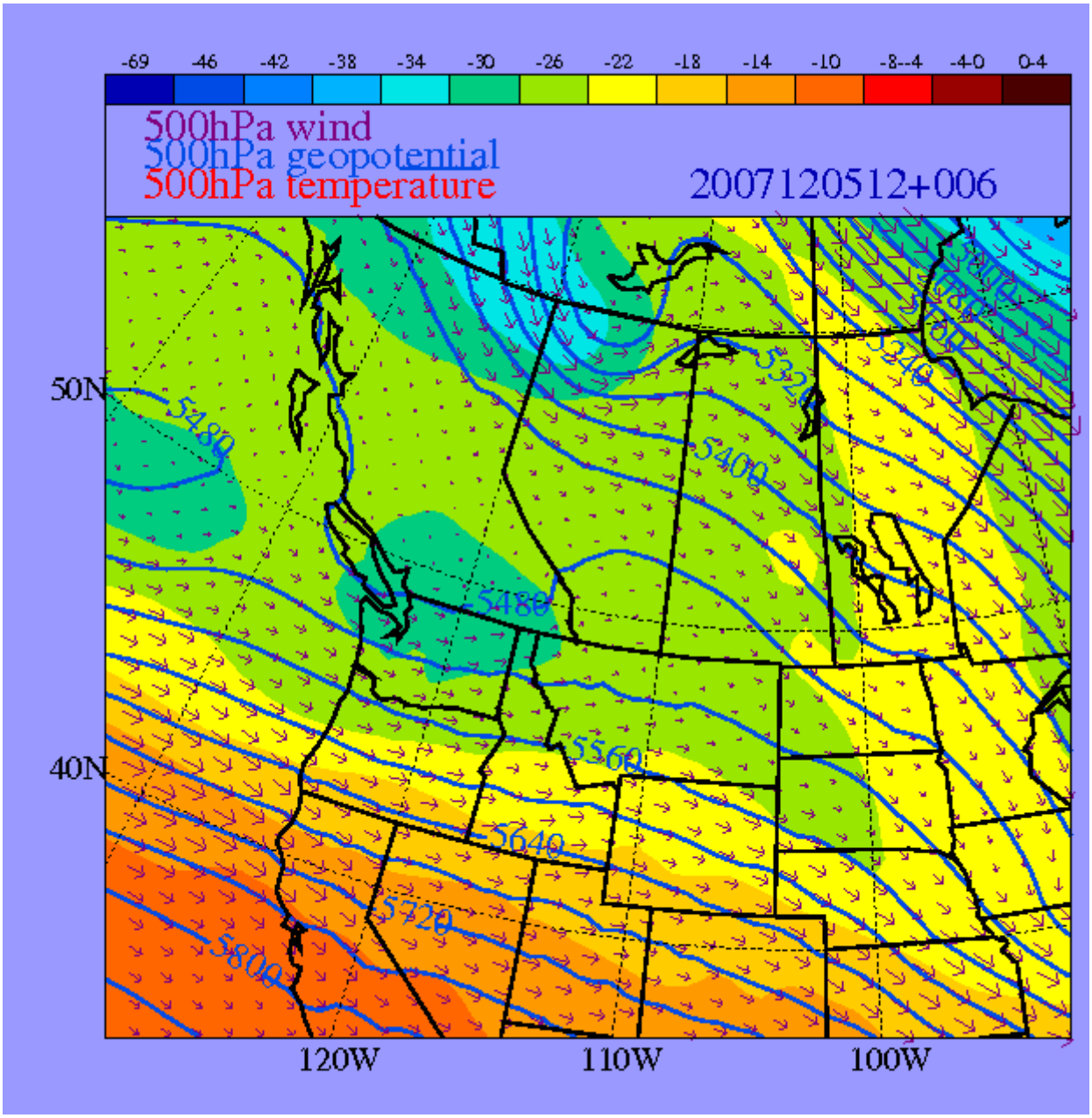
Contributing Factors

- At 1530 on Dec. 3, two facilities tripped off due to a system disturbance. These facilities stayed offline until noon on Dec. 4.
- The forecasters don’t have vision of which facilities have tripped offline so would have forecasted for power output and been in error
- The lesson learned is that the forecasting process in the future needs to account for facility trips or turbine availability
- Wind speed measurements also went to zero with the facility trip indicating that they are tied to facility power
- These wind speed measurements need to separated from facility power to ensure forecasters are given a complete picture of local observations to be able to accurately forecast

Comments from WEPROG on the December 2-6 event

The event on the 2-6th December seems to be a similar problem than the 6th of September, but with opposite sign. Figure 1 gives an indication of how extreme the stability was between the ground and 500hPa (approximately 5km above sea level). There exists a rule that precipitation falls as snow, if the temperature in 500hPa is -42 deg C or less. On the attached figure it can be seen that the temperature is about 16 deg warmer than the ``snow border'' above Calgary at that time.

In average there would be a temperature difference between the ground at Calgary and 500hPa of -36 deg. This means that there should have been about 10deg C at the ground at that time, if that rule is applied and no snow!



Firgure 1: Weather situation at the 5th December 2007 at 18UTC.

Therefore, a standard meteorological prediction based on the 500hPa will simply provide a wrong forecast. Nevertheless, this is the basis that forecasters on duty often use to generate the forecast (at least in Europe). Although 5km above sea level is not far away, the correlation between that level and the ground is not good in such cases.

Additionally, this unusual event has a ``long history'' over 12 days, where it gradually built up with stronger and stronger flow from south west in the Pacific. This situation created a lot of latent heat release on the way up over the mountains. The result was a situation that is so extreme that the normal parametrisation of the friction process does not work in the model.

However, with this event we also enter a topic in meteorology that has to break up with 25 years of practice in how the friction process is simulated, because it is incorrect to assume a constant mixing length in the free atmosphere (above 1500m above ground). This approximation is used widely and is

strictly speaking wrong, because it does not consider inversions or low and strong static stability in the mid troposphere. The most commonly applied parameterization is valid for average conditions and not for conditions like the one experienced in the beginning of December. It is our opinion, that this seems to be the core problem, while the resolution is likely to be the secondary issue. Higher resolution will help, but it will most likely not be enough.

The 6th of September case was also an opposite sign event. It was shown by AWS that there existed a flow from a northerly direction in approximately 500hPa, which was not forecasted to give wind power generation.

Unfortunately, it seems that most of today's NWP models are built on the same incorrect assumption, which has partly to do with the fact that the physical parameterization are computed in columns. Inside these columns it can not be detected well enough, if there is a suppression or amplification of vertical momentum exchange depending on the exact dynamic conditions. To change this fundamental source code changes would be required. However if it would improve the predictability of the atmospheric stability in the model system, it would be a break through.

One reason, why the meteorological society has not worked out solutions to this problem before is lack of focus on the wind close to ground. This problem has only received stronger attention since the requirements for wind forecasts to the wind energy industry have become stronger.

It is somewhat frustrating that the ensemble which contains 5 different parameterisations of this problem is biased in this case. However, as mentioned above, it is a fundamental problem in the way the parameterisations is coded in the NWP models. In a project like this, it is also necessary to be able to produces reproducible results in order to correctly interpret the results at the end of projects.

To conclude, the above described event shows that current technology does not yet solve AESO's problem in the extreme events. To solve these issues, it seems that additional resources would have to be spent to carry out changes in the NWP model's physical parameterisations. Such changes re required to be demonstrated over some time and would by far go beyond the scope of this project. However, if the significance of such events could be demonstrated by the industry and the transmission operator and hence funds provided to carry out such developments, a problem with a long history may be solved and a breakthrough achieved in the predictability of wind power.