

Wind Power Forecasting Pilot Project

Event Analysis

Feb 26

Reliable **Power**

Reliable **Markets**

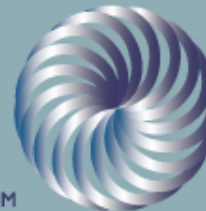
Reliable **People**



Operations and Reliability

aeso

ALBERTA
ELECTRIC
SYSTEM
OPERATOR

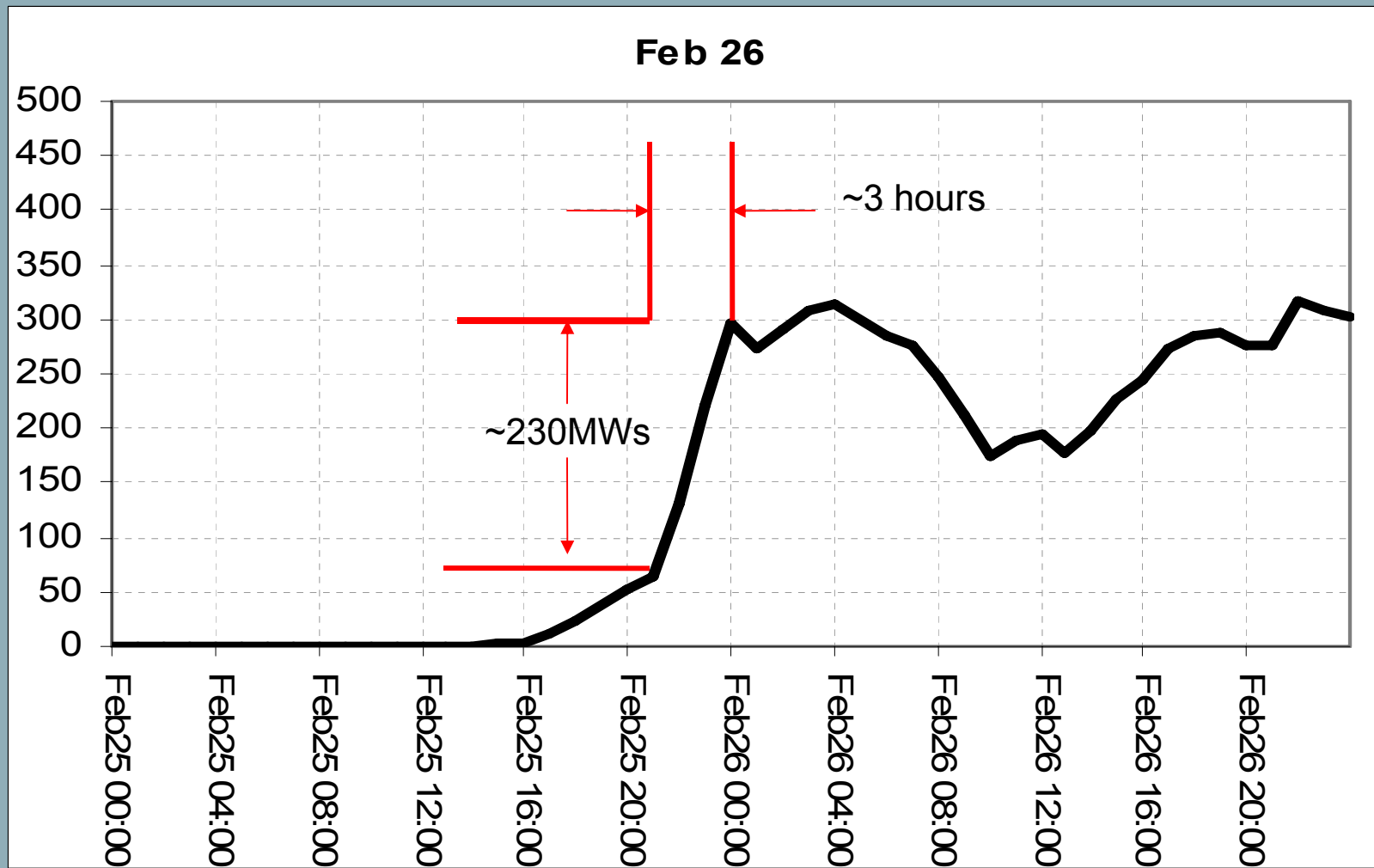


Purpose

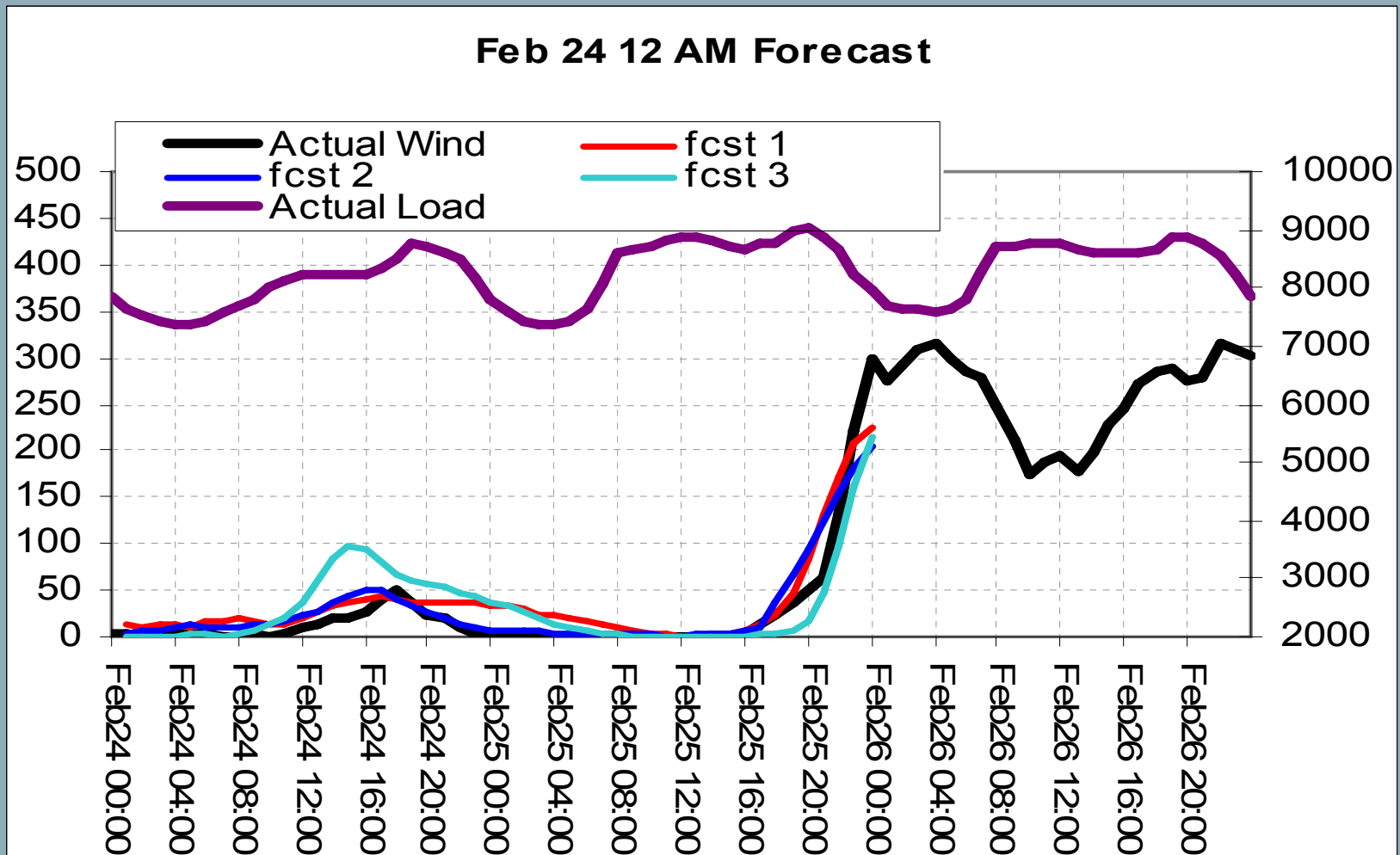


- The purpose of this event analysis is:
 - To show a ramping event that was forecasted well two days in advance
 - To demonstrate and discuss the effects of statistical correction to the physics based model outputs

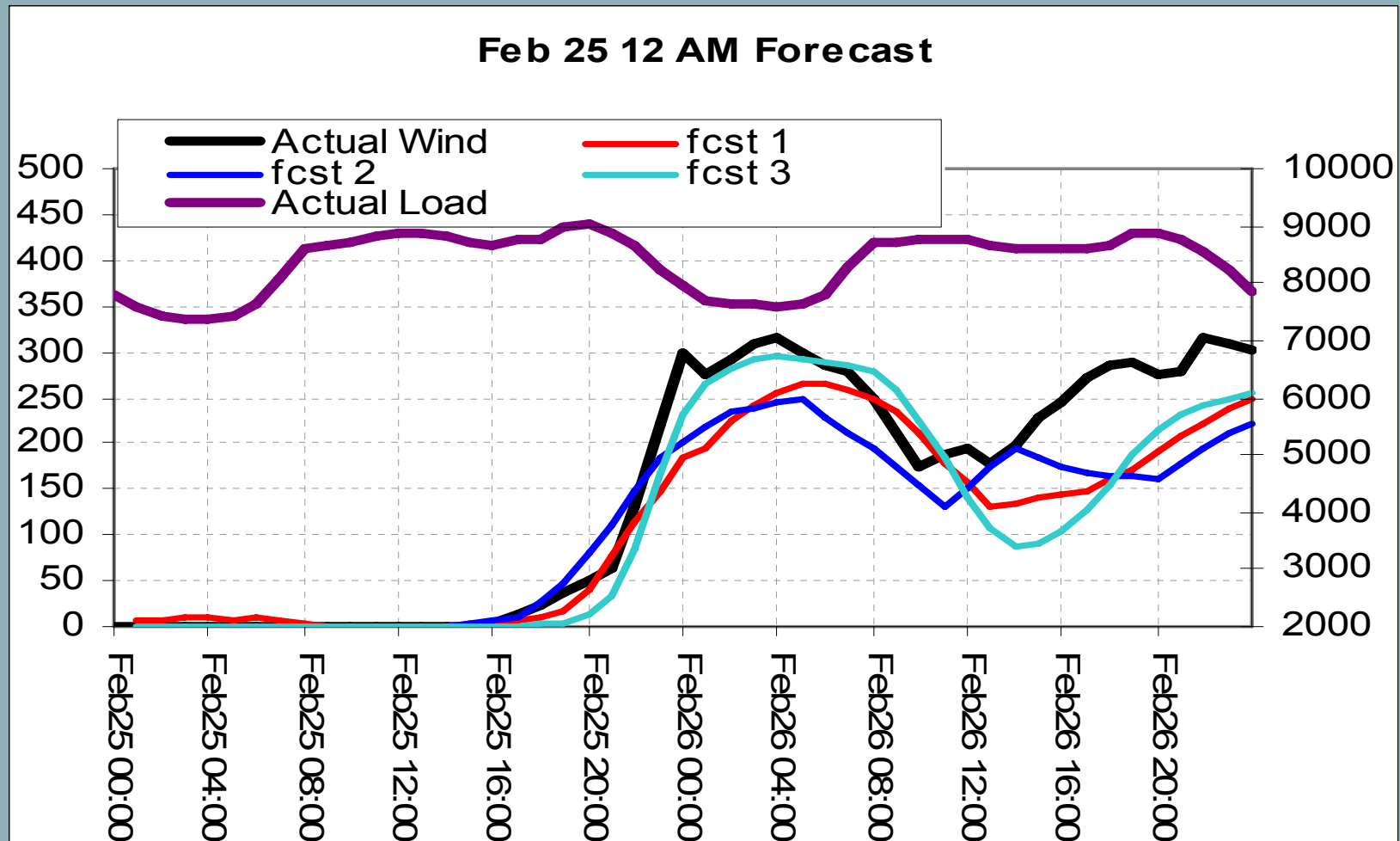
Event Description



Next 48 hour forecast delivered at Midnight on Feb 24 covering Feb 24 & 25



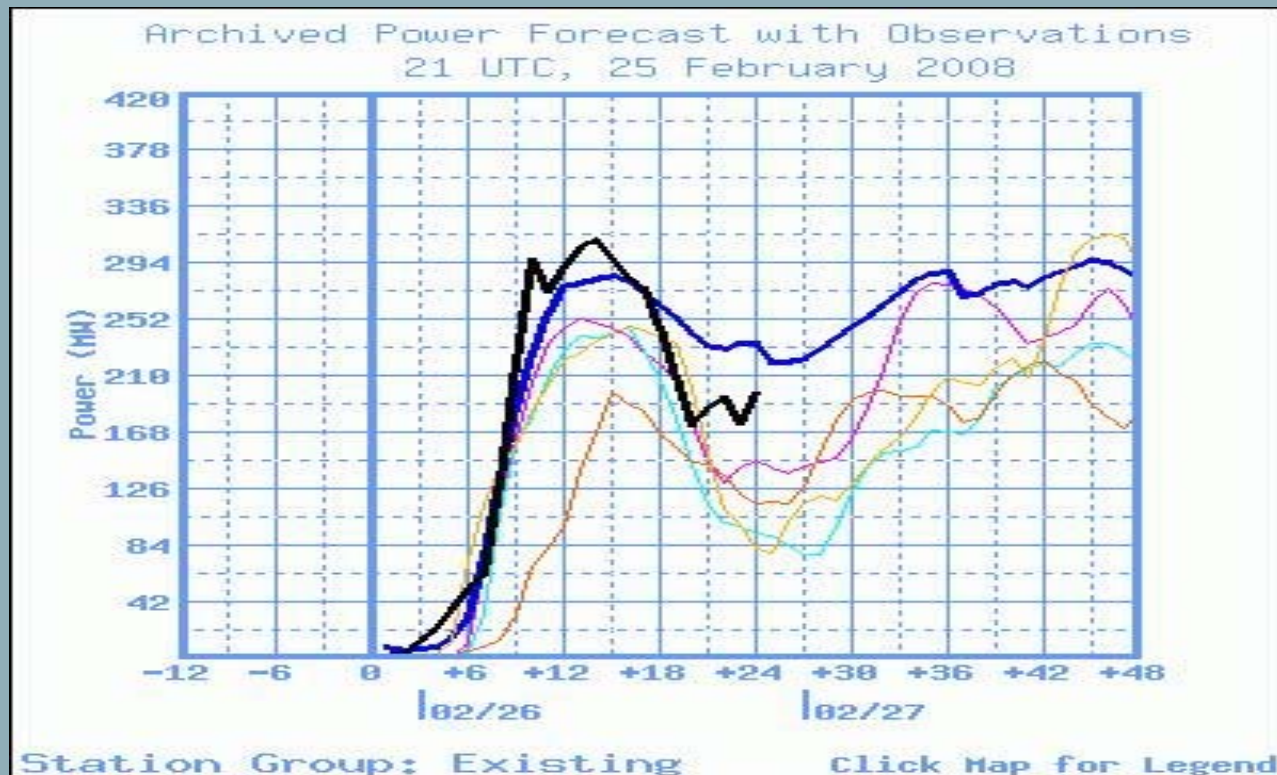
Next 48 hour forecast delivered at Midnight on Feb 25 covering Feb 25 & 26



AWS Ensemble Breakdown from 2pm MST forecast (21 UTC)



- Black is actual wind power
- Dark blue is delivered forecast (optimized ensemble)
- Others are 4 ensemble member physics-based model outputs
- The optimized ensemble, which gives more weight to ensemble members that have done well recently, discounted the poorly performing model (orange) and made an excellent forecast. In fact, it performed better than any of the individual physics-based (NWP) model runs due to the adjustments by the statistical methods to the output from the well-performing NWP models.



AWS Comments



- Over all cases the typical errors (MAE, RMSE etc) are reduced by the statistical methods. This is because the methods remove systematic errors found in the typical cases.
- However, in any individual case, the performance of the statistical methods is less certain since, in general, you don't know if an individual case is representative of the main error modes in the overall sample from which the statistical equation were developed.
- One of the areas of significant research by us and other forecasters is how to effectively differentiate weather regimes with different error modes in small samples.
- If the error patterns are atypical, the statistical process may make the forecast worse since they might be adjusting for a systematic error that is quite different from the one in the particular case under consideration.
- Larger samples (to capture atypical events) and advanced statistical methods (to effectively and efficiently discriminate typical cases from atypical ones) will help to improve the forecast performance.
- That is the main reason why the value added by the statistical models will improve much more over time during the first few years of forecasting for a particular site than the value added by the physics-based models, which benefit mostly from long-term (i.e. ~years) basic research to improve the models and the availability of new types of input data (not more cases of the same type of data).
- You typically need 3 or 4 years of data before the statistical models tend to reach their performance plateau. However, the improvement during that period tends to be more in the atypical cases than in the typical ones.

WEPROG Comments



- The fact that all 3 forecasters with different power prediction methods and weather input predicted the ramp up, shows that there was not much uncertainty in the up ramp event.
- However, the forecasts differ somewhat on the steepness of the ramp and on reaching near “full load” of the ramp which is related to whether a forecast is tuned, or statistically trained to achieve the lowest MAE or RMSE. The difference in tuning is quite pronounced in Alberta, because there are very steep ramps starting directly from zero generation hours and a high variability. (In other countries this is not so pronounced.)
- In the next slides, Figure A (delivered), B (high resolution boundary test system) and C (high resolution boundaries test system with CMC state estimate) show that the high resolution lateral boundaries had a positive impact on the phase of the up-ramp.

Figure A

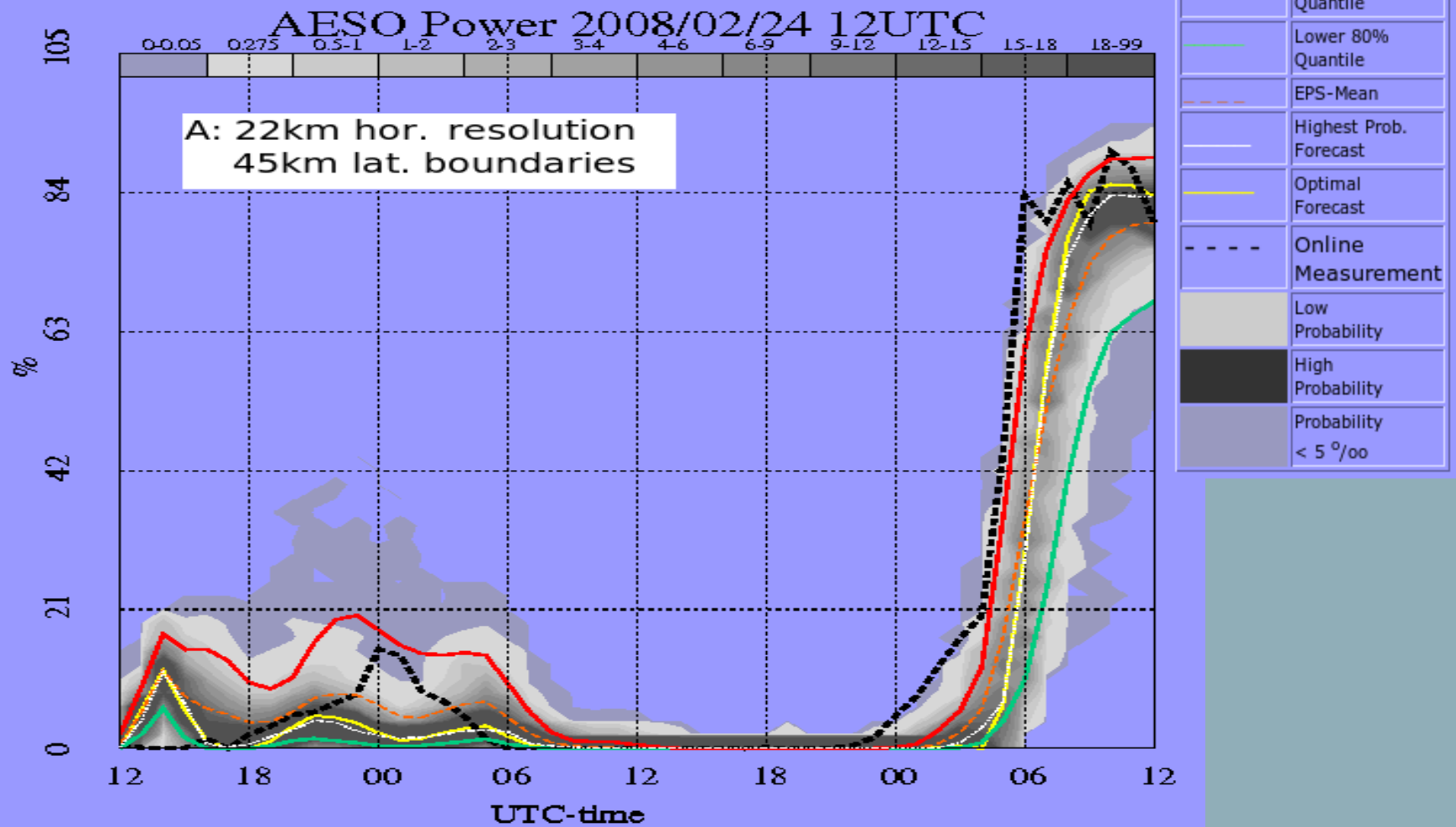


Figure B

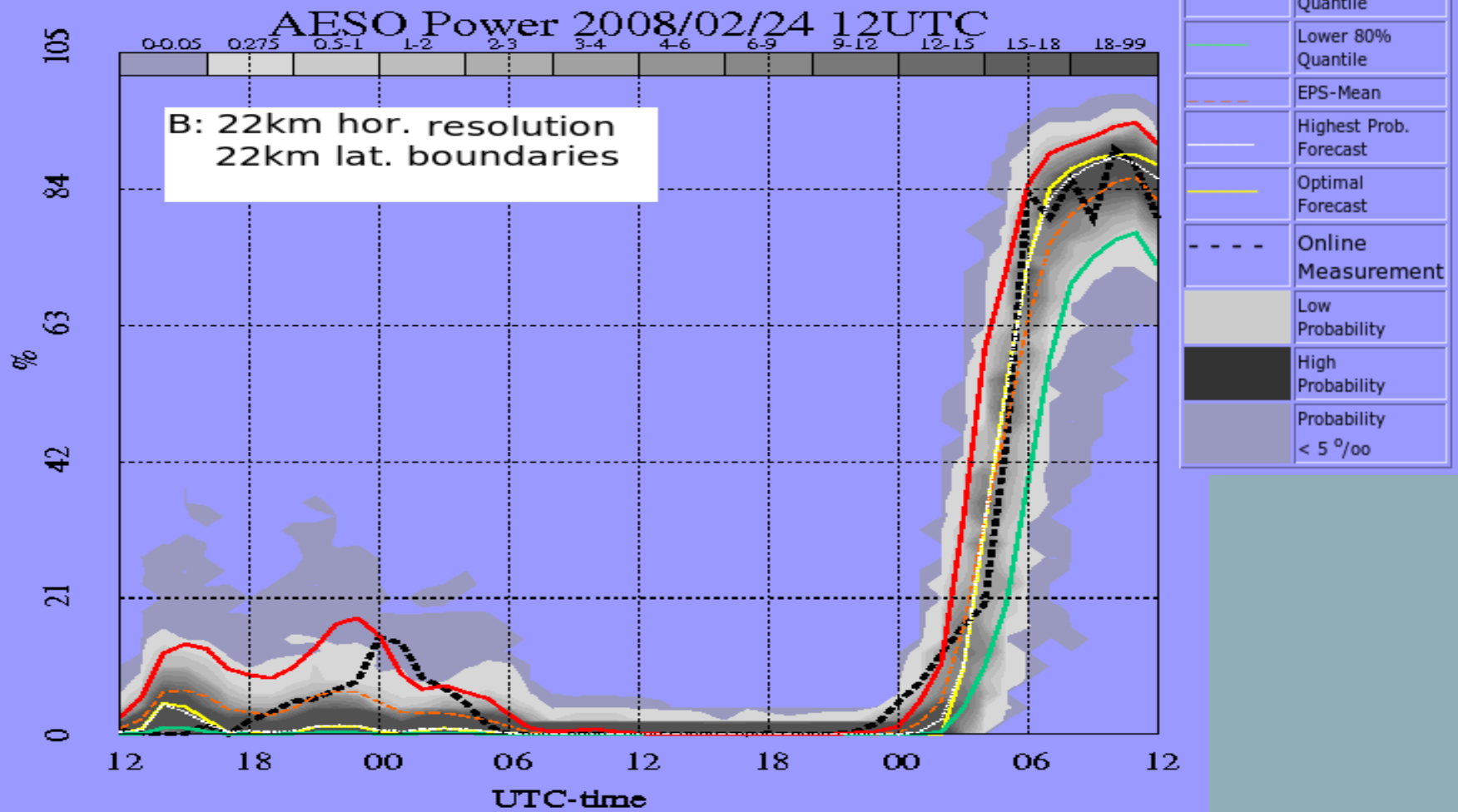
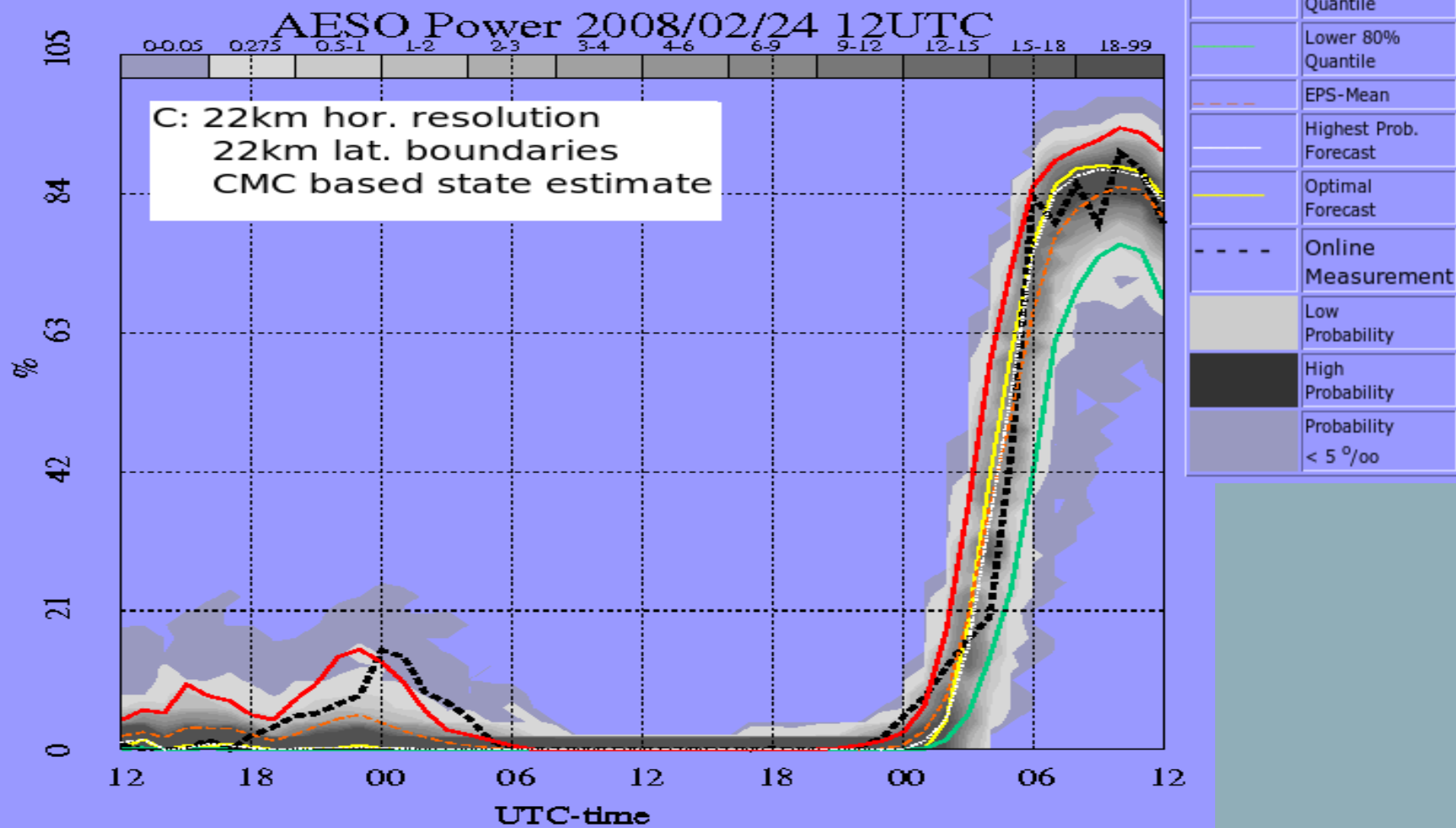


Figure C



WEPROG Comments



- We are rather uncertain on the impact of long term statistical training in the southern Alberta region.
- The statistical training will on the one hand learn which model configurations to believe most in, but the flow in Alberta is on the other hand highly non-stationary, which makes it very difficult for statistical processing to learn the pattern.
- Rapidly changing strong horizontal gradients in the wind speed within the facility area is what characterizes Alberta. This implies high variability in the output of the individual facilities. This is a pattern that is unsuitable for traditional statistical modeling as the purpose is to dampen the variation of forecast output, which is already less variable than the measurement variability.
- One should also note that the frequency distribution of the existing facilities' output is not very useful for statistical processing. There are many 0 generation hours. Apart from that there is a fairly flat generation profile (nearly equally many hours with 10,20..80% of full generation). The statistical processing can therefore hardly exploit that full load should be more frequent than half load.
- The planned large facilities will have even flatter frequency distributions than the current existing facilities. The relative influence of the existing facilities will reduce gradually and the new facilities will have different statistical behavior. Thus even if statistical processing would be good after e.g. 3-4 years, then half of the installed capacity would be newer than the 3-4 years.
- Our view is therefore that the odds for the success of statistical processing in Alberta wind power forecasting are rather limited.
- We think that there are basically 3 ways to attack the Alberta problem:
 - better initial conditions (state estimate)
 - better 3D weather forecasting
 - better short term (0-4 hours) algorithms
- Once these are achieved, then statistical processing can add some accuracy.