

AESO Wind Power Forecasting Pilot Project

The Quantitative Analysis ORTECH

June 12, 2008
Calgary, Alberta

Presentation at final workshop and web cast

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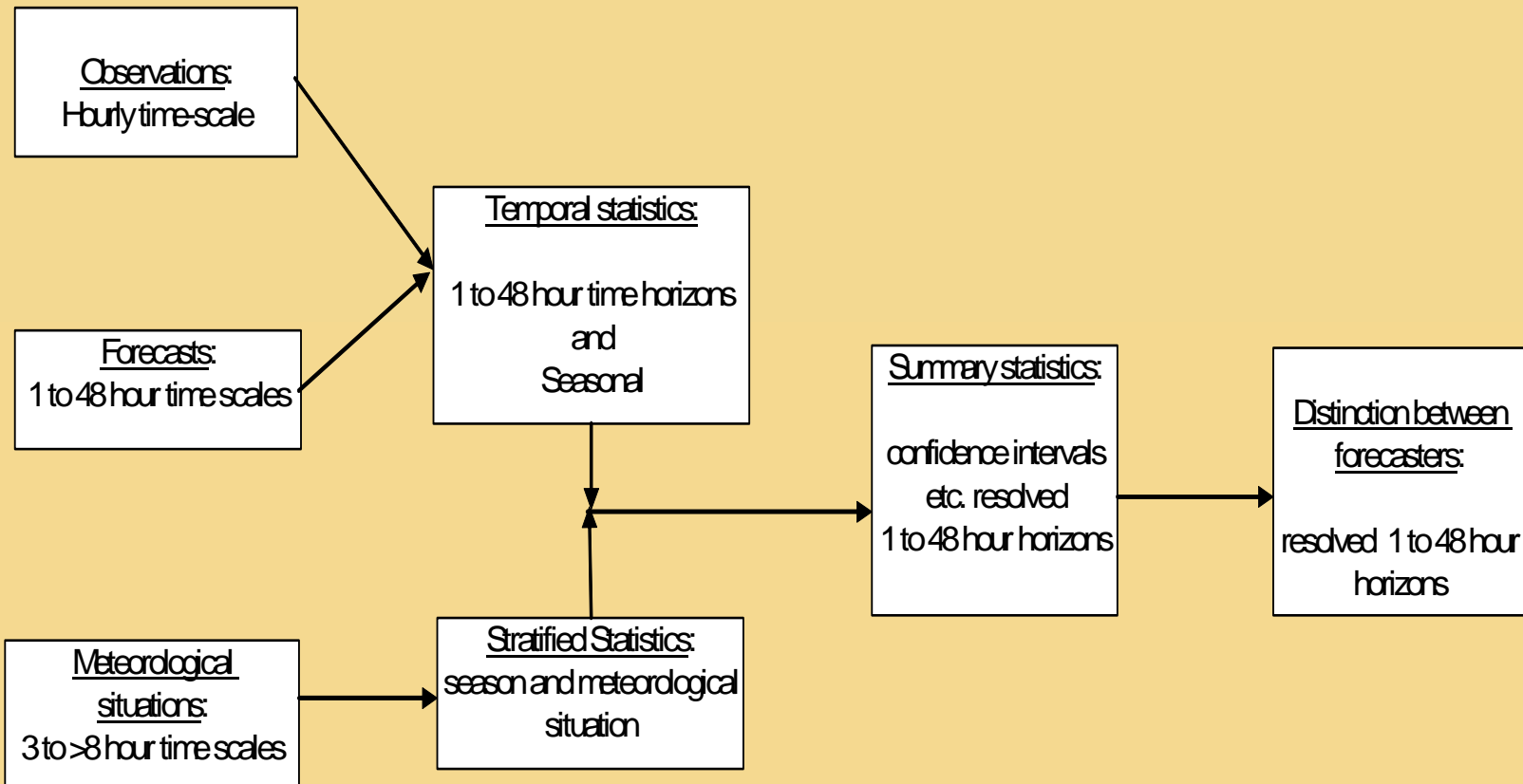
Project Team

- **Trevor Scholtz M.A.Sc., Ph.D.**
- **Ram Acharya Ph.D.**
- **Ranin Nseir M. Eng.**
- **Hong Liu M.Sc.**
- **Adarsh Mehta M.Sc.**
- **Aaron Long M.Sc.**
- **Don McKay Ph.D., MBA**

Purpose

Quantitative Analysis

- **To provide evaluation of forecasting models at specific sites and on a regional basis**
- **To provide input into the development of recommendations by AESO on wind power forecast methods to be incorporated into the technical requirements of wind power facilities, operational procedures and policies &/or market design**



Questions Posed by the Working Group

- What is the general accuracy of the Forecasts?
- What is the accuracy of the Forecasts at the different forecast horizons studied (T=1 hour to T=48 hours)?
- What is the accuracy of the Forecasts at different hours of the day and seasons of the year?
- What is the accuracy of the Forecasted Meteorological Data before running through the Power Conversion models?
- What is the accuracy of the Power Conversion?

Questions Posed by the Working Group - Cont'd

- What is the Potential co-variance from given data samples?
- What is the accuracy of the Forecast at different wind speeds or different points of a Wind Power Facility's power curve?
- What is the relative comparison between Forecasts?
- Which is the region with the least amount of error?
Which forecaster forecasts best in that region and why?
- What is the effect of spatial smoothing on forecast error?

Questions Posed by the Working Group - Cont'd

- How well do the forecasts predict fast ramp up and ramp down times, event analysis (CSI)?
- What is the Impact on data availability?
- Are there times (day/month/weather pattern) when there is more uncertainty in the forecasts than other times?
- What is the relationship between the spread of the min/max and the forecast error?
- What is the correlation factor between all three forecasts? Is this related to the forecast error?

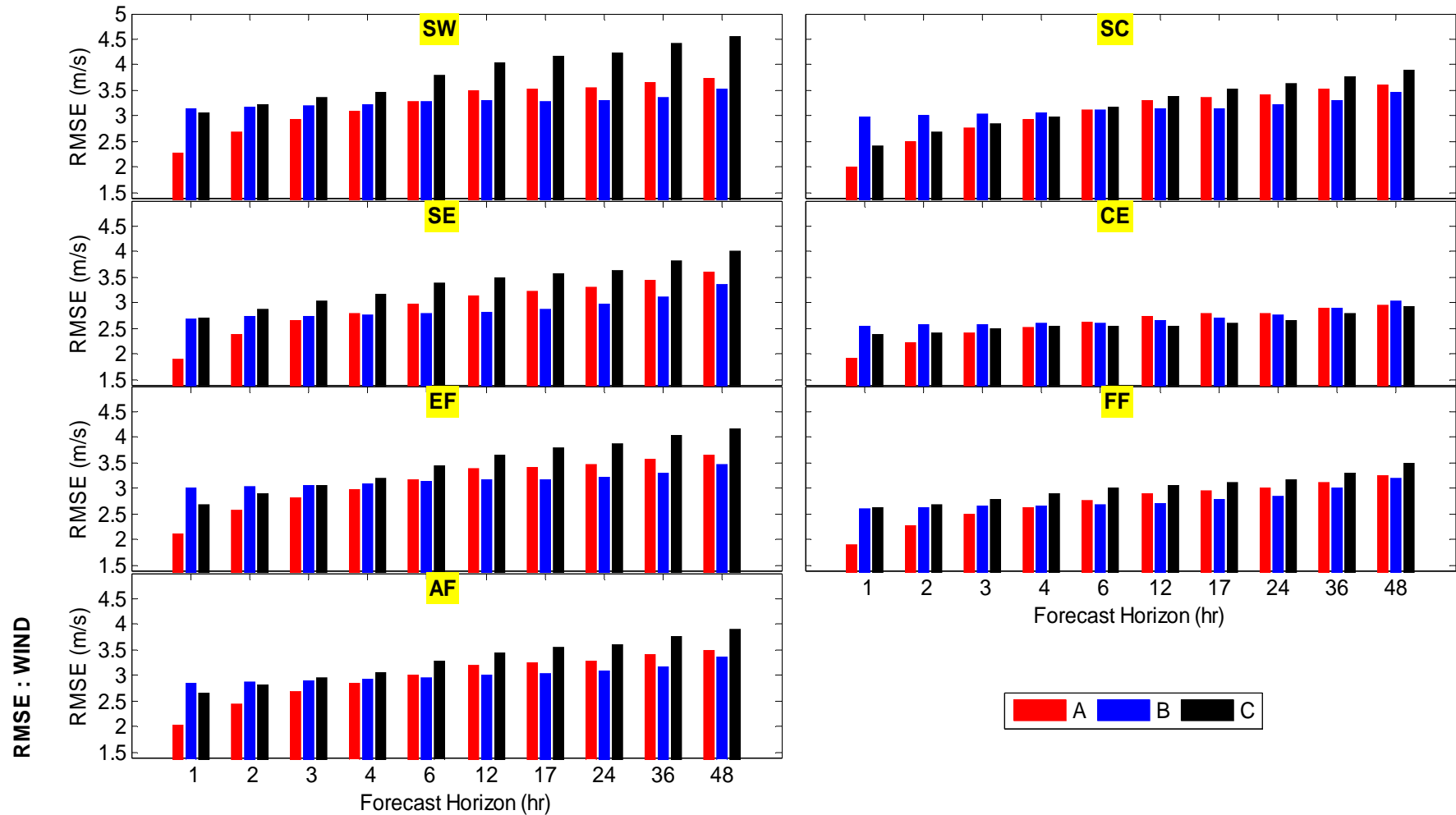
JUST GIVE ME
THE DETAILS
NEVER MIND
THE FACTS!



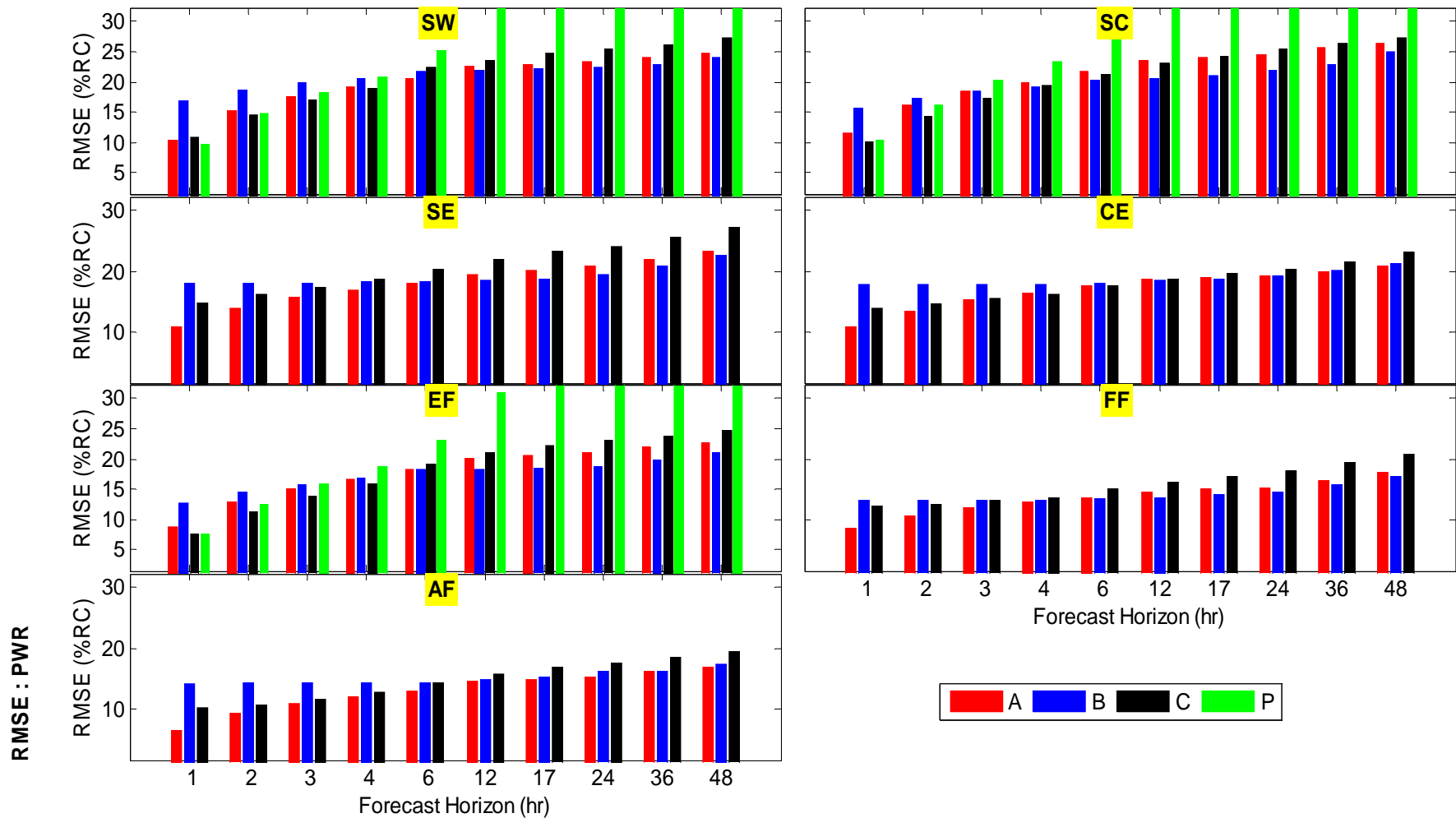
Findings

- **Forecasting wind energy in the regions examined in Alberta over a 48 hour time horizon is possible (all sections)**
- **All three forecasters can provide general forecasts in the regions examined over the 48 hour time horizon. (sections 3.1 and 3.8)**
- **The largest error in the forecasts is due to phase errors. The different regions show a consistent behaviour for phase error suggesting a similar property affects all regions in a similar manner. (sections 3.1 and 3.2)**

Annual RMSE Comparison for Wind by Region

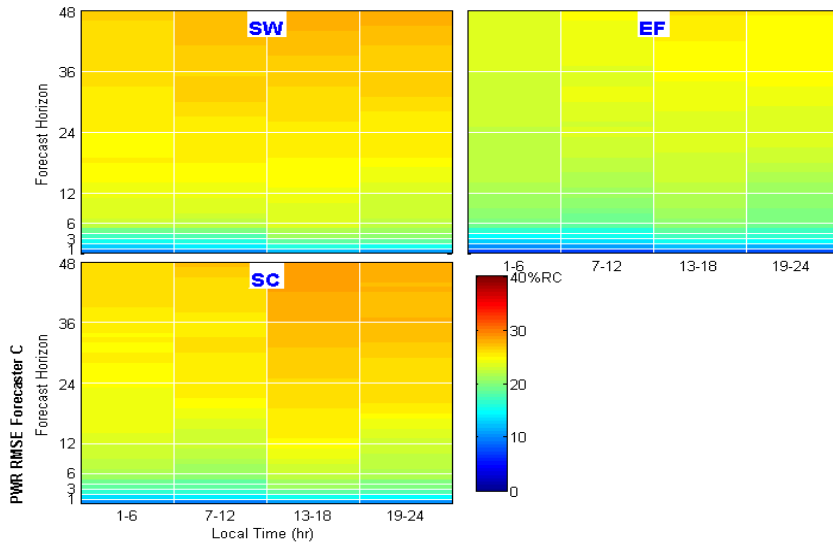
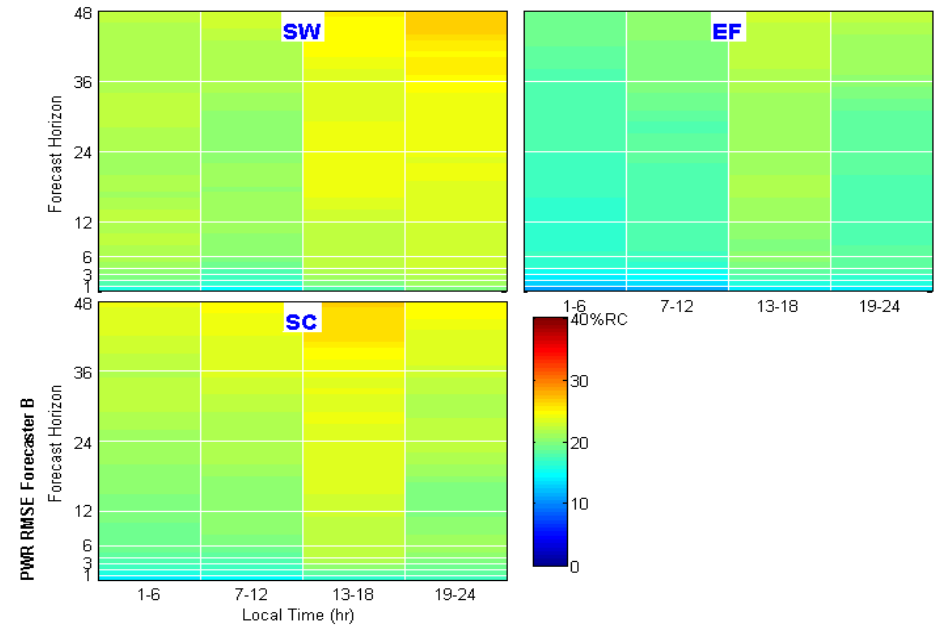
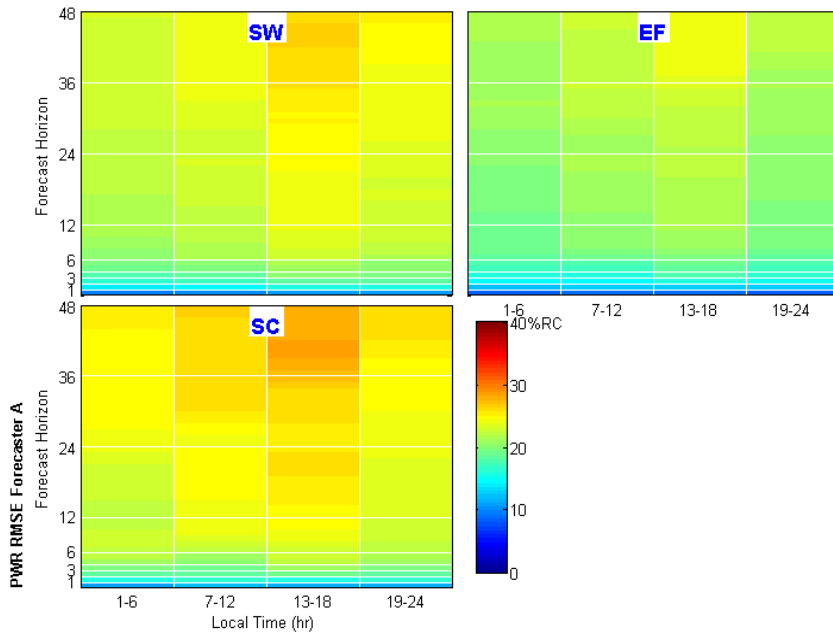


Annual RMSE Comparison (Norm. % Rated Capacity) for Power By Region and Comparison against Persistence for SW, SC and EF

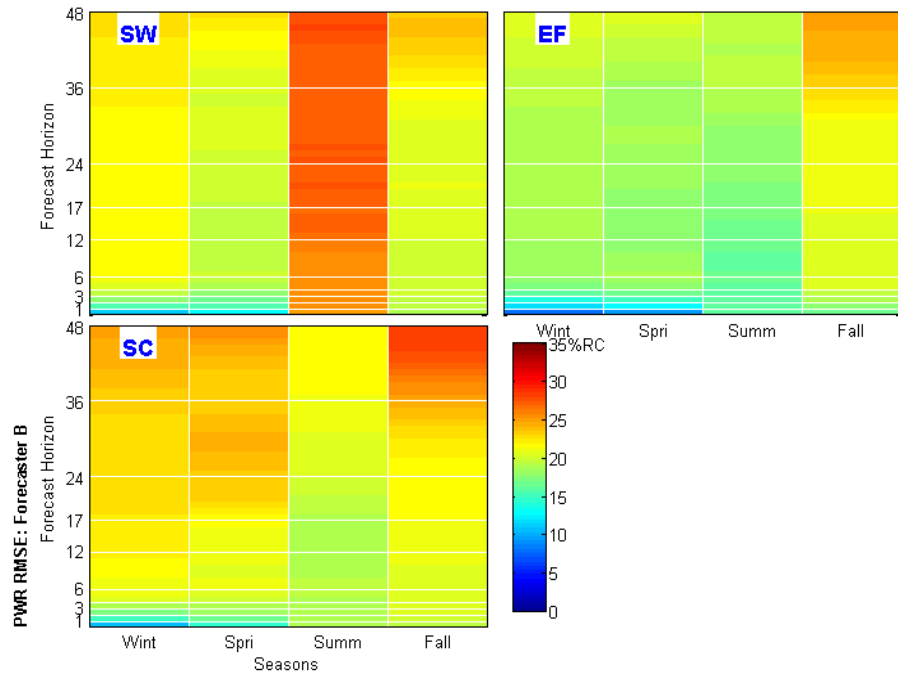
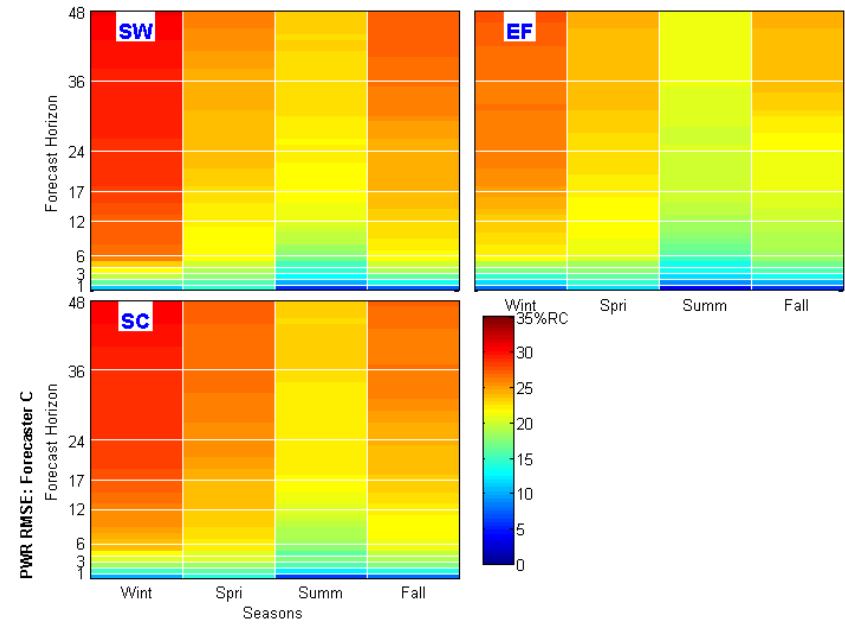
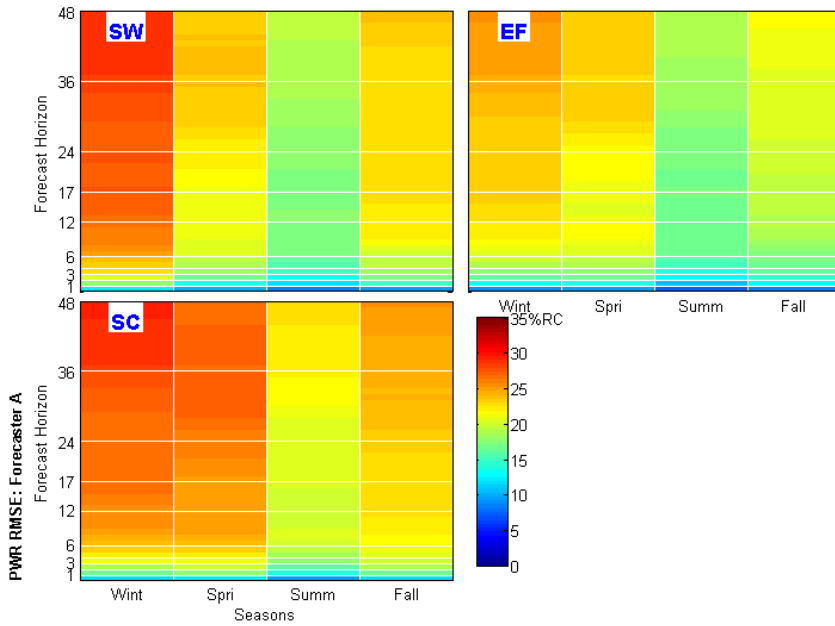


Findings

- **The accuracy of the forecasts in general decreases as the forecast horizon increases. While there is a variation between forecasters in accuracy at each forecast horizon, the trend of decreasing accuracy as the forecast horizon increases is preserved by each forecaster. (sections 3.1 and 3.2)**
- **The wind power forecasts are the least accurate during the afternoon periods between hours 13 and 18 after forecast horizon $T=6$. (section 3.3)**
- **The least accurate wind power forecasts are during the winter season (November, December, January, February) for all forecasters. The best accuracy is during the summer season (June, July, and August). (section 3.3)**



Accuracy of Power Forecast per 6 hour time Frame



Seasonal Accuracy of Power Forecast

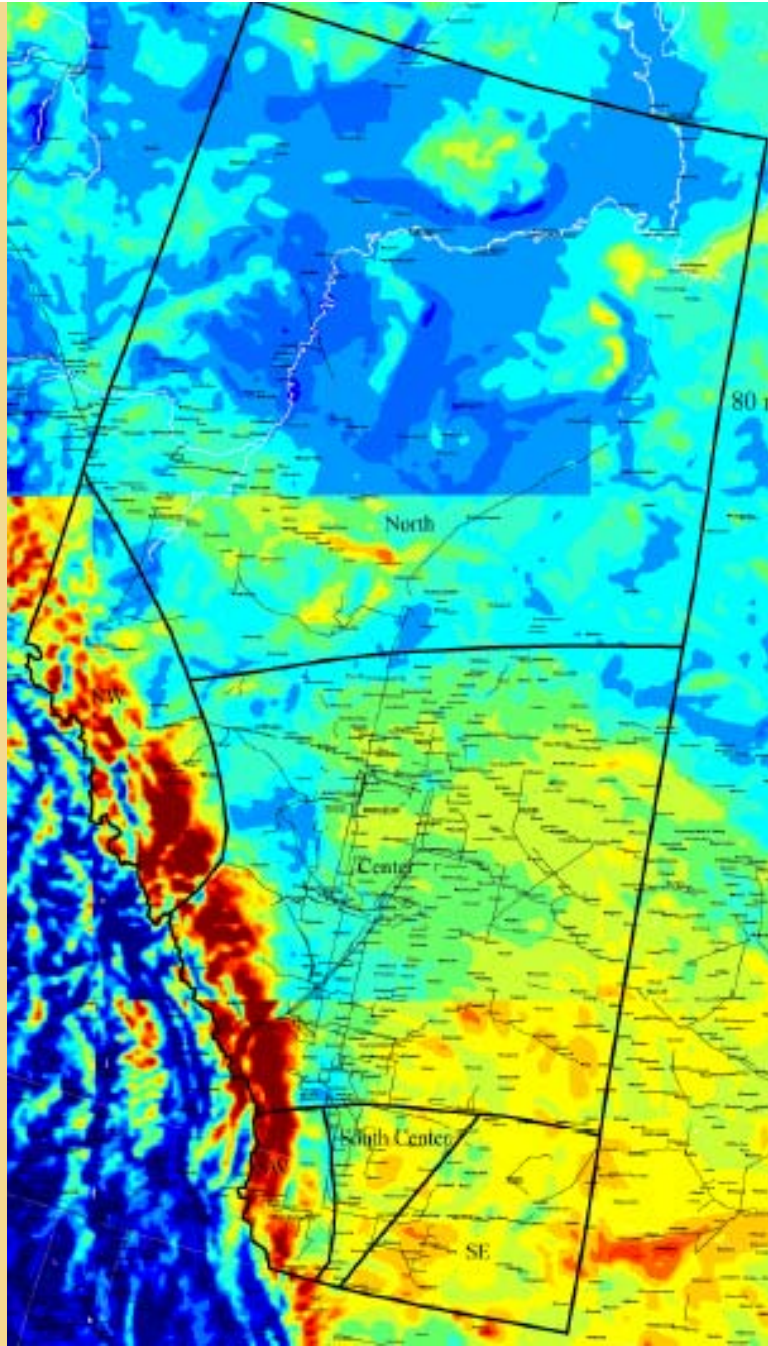
Seasonal Accuracy of Power Forecast

Findings

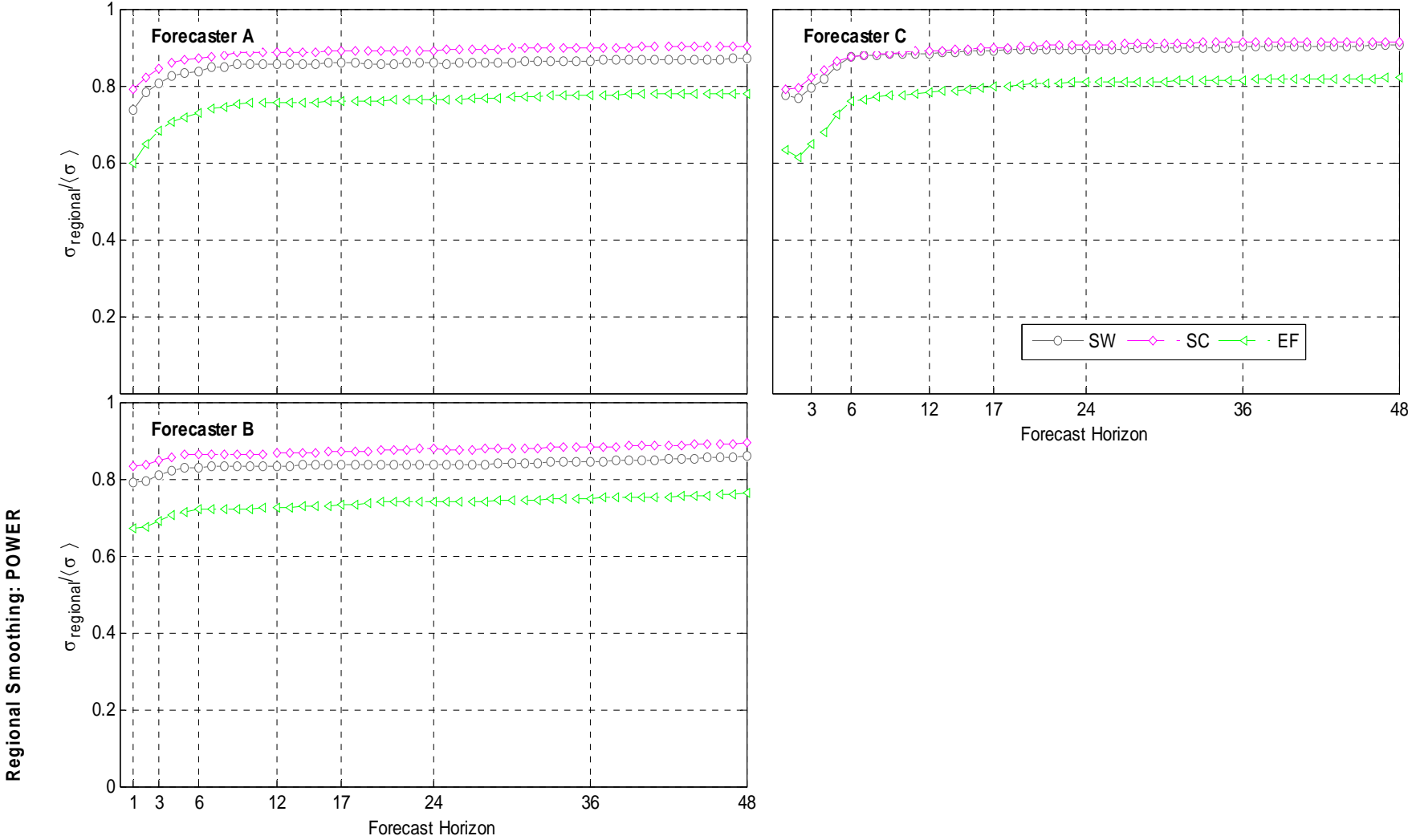
- **Wind speed prediction errors are amplified by 1.0 – 1.5 due to power conversion. (section 3.5)**
- **The power prediction errors peak at the predicted wind speed of 10 m/s and show a different pattern from the wind speed error. (section 3.7)**
- **The region with the least amount of error for wind speed is the central region (CE). The region with the largest amount of error is the Southwest Region (SW). (section 3.9)**

Findings

- **For power forecasts, the accuracy for both SW and SC regions are similar. (section 3.9)**
- **Spatial smoothing reduces the error as the number of wind farms and the size of the area covered increases. (section 3.10)**
- **All forecasters do not predict ramp events effectively. The reason may be that the forecasters were not given this specific objective. (section 3.11)**
- **In examining the min-max spread for predicted power it was found that the measured values fell between the min-max predicted power 81%-95% of the time. (section 3.14)**



Spatial Smoothing Effect



% Ramp Events Captured by Forecasters up to 12 hours before event

Region	SW			SC			EF		
Measured Ramp-Up	280			321			126		
Measured Ramp-Down	239			285			108		
Total Ramp	519			606			234		
Forecaster	A	B	C	A	B	C	A	B	C
T = 1	0.15	0.17	0.18	0.10	0.21	0.23	0.08	0.14	0.30
T = 2	0.37	0.19	0.16	0.30	0.28	0.20	0.30	0.19	0.26
T = 3	0.17	0.21	0.14	0.14	0.36	0.19	0.11	0.27	0.24
T = 4	0.12	0.21	0.13	0.16	0.38	0.17	0.14	0.27	0.20
T = 6	0.13	0.19	0.11	0.17	0.38	0.17	0.16	0.24	0.16
T = 12	0.07	0.18	0.11	0.15	0.34	0.12	0.16	0.19	0.14
T = 24	0.07	0.18	0.08	0.15	0.36	0.10	0.13	0.17	0.11
T = 36	0.10	0.19	0.07	0.13	0.35	0.09	0.08	0.15	0.06
T = 48	0.10	0.20	0.06	0.19	0.40	0.05	0.16	0.17	0.05
Average for 48 horizons	0.11	0.19	0.08	0.17	0.33	0.10	0.14	0.18	0.12

General Observations and Recommendations

- **DATA**
 - data provider supplies a detailed QC/QA report
 - receive final and unchanged values in the measured data sets
 - receive data availability reports from forecasters
 - receive from the forecasters any prescreening reports

General Observations and Recommendations

- **Trial Period**
- **Freeze the Models**
- **Existing vs. Future Sites**
- **Focus on Priorities**