

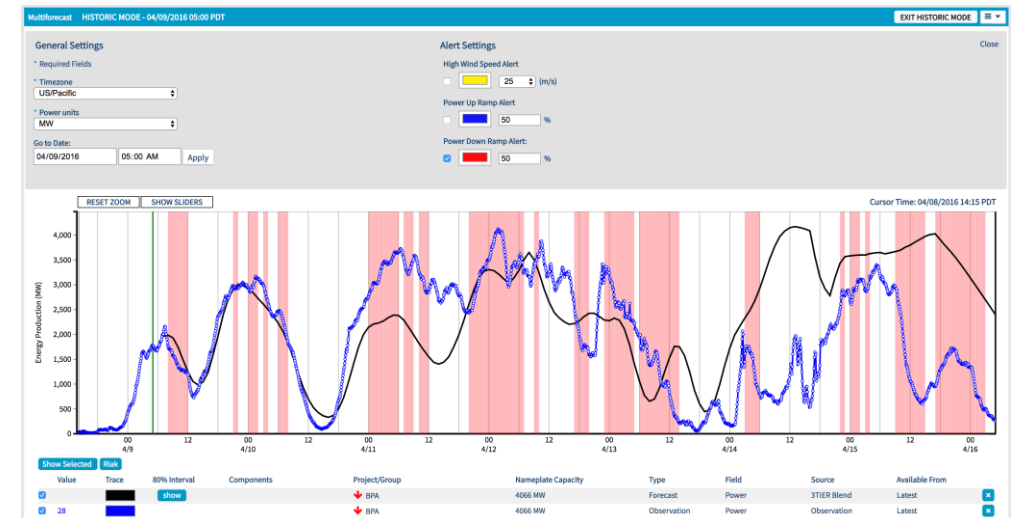
WFIP2 Decision Support Tools

Jim McCaa

ESIG 2018 Forecasting Workshop

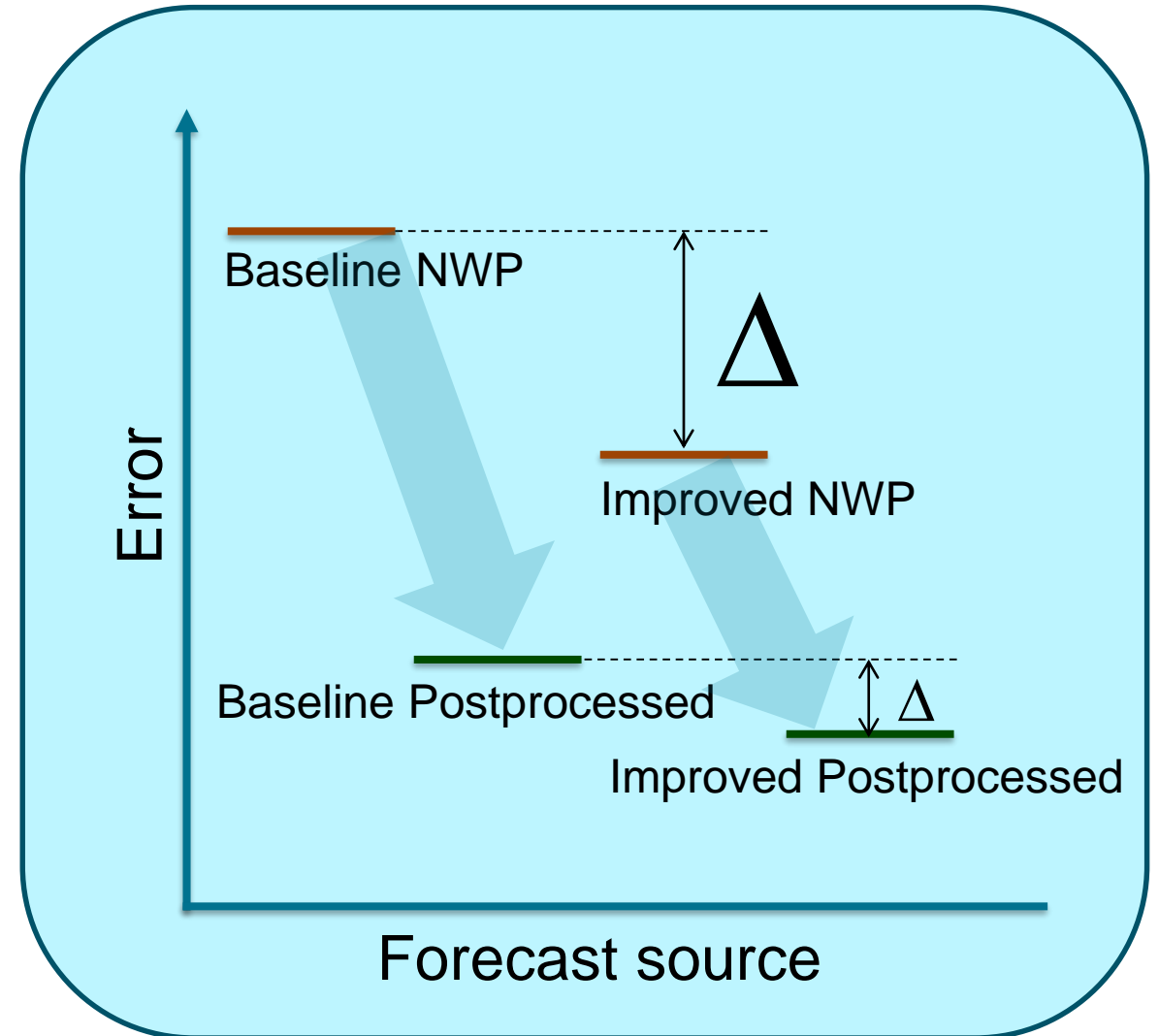
June 19, 2018

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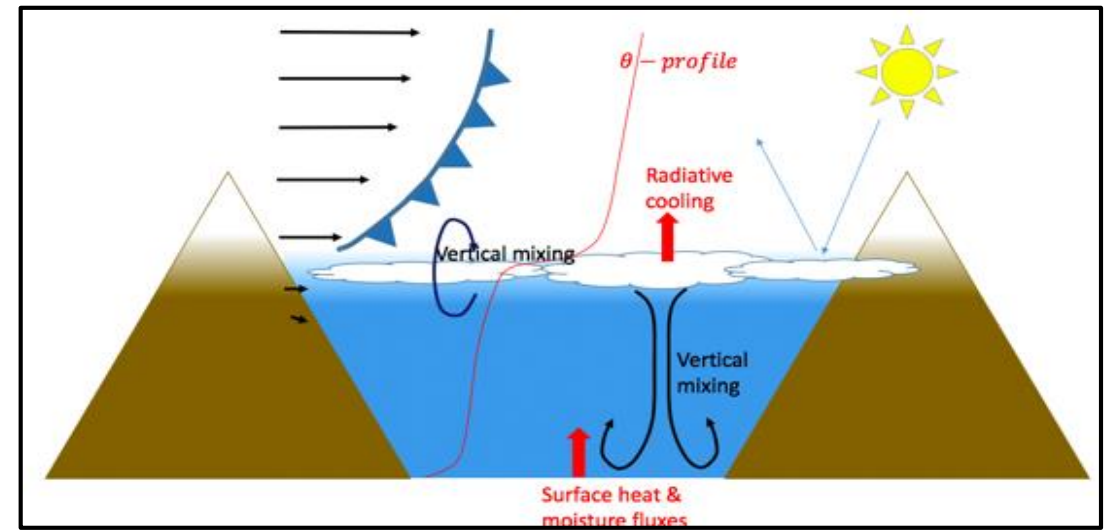
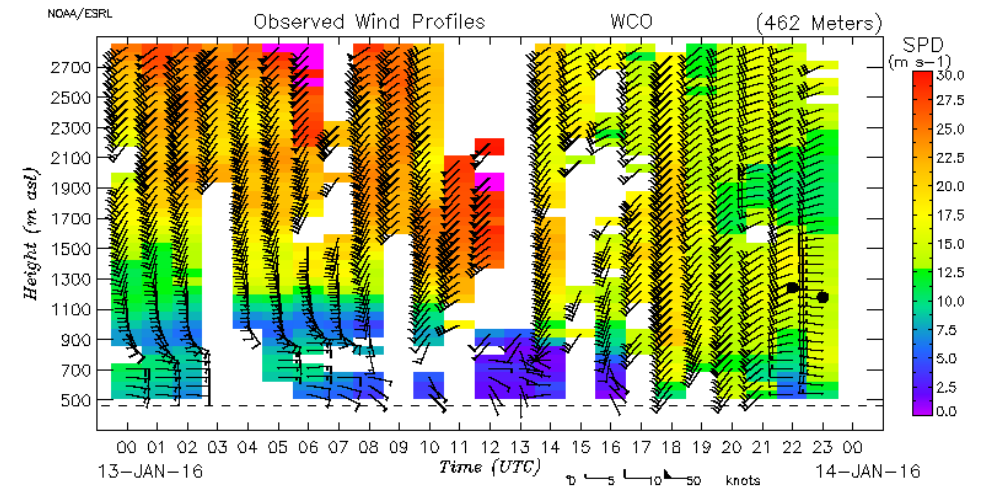
Power forecasting and decision support tools

- WFIP2 largely focused on improvements to fundamental models
- Vaisala transformed output from the WFIP2 HRRR simulations to energy reforecasts using modern forecasting techniques
- Decision support tool work was based on the energy reforecasts
- We expect more subtle improvements to these energy forecasts than to the fundamental models



Decision Support Tools within WFIP 2

- How can we convey the possible impacts of complex phenomena?
- Can we create actionable alerts that will improve revenue?
- **Example: Cold Pool Mix-Out**
 - Stable cold pools act to shield the wind farms from higher momentum air aloft.
 - As the stable layer erodes, higher momentum air can reach the wind farms and a **power up-ramp** often results.
 - NWP models typically struggle to maintain cold pool resulting in over-prediction of power and false alarms for up-ramps



Credit: Joe Olson (NOAA)

Decision Support Evaluation

- Contingency Table:

		Observed		
		Yes	No	Total
Forecast	Yes	<i>hits</i>	<i>false alarms</i>	<i>forecast yes</i>
	No	<i>misses</i>	<i>correct negatives</i>	<i>forecast no</i>
Total		<i>observed yes</i>	<i>observed no</i>	<i>total</i>

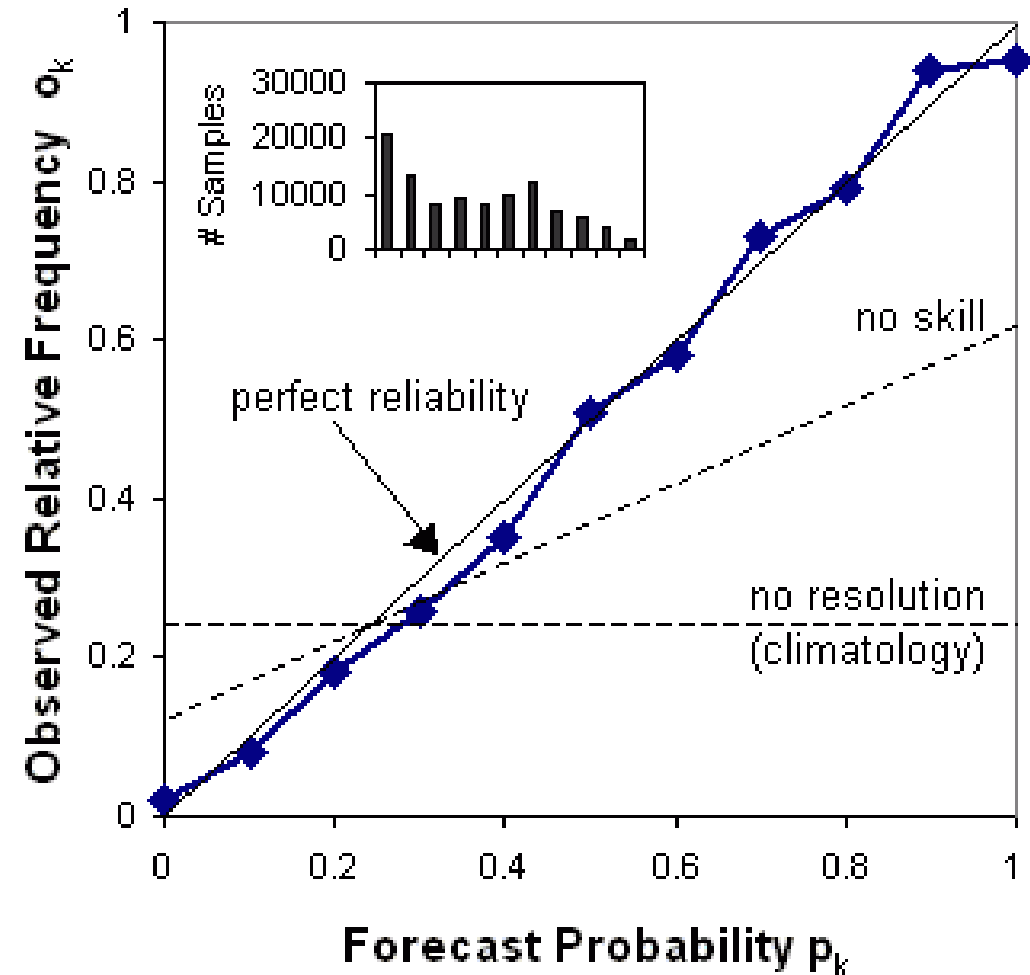
- Cost/Loss Model:

Cost = expense associated with taking action

Loss = expense associated with event occurrence, but no action taken

Decision Support Evaluation

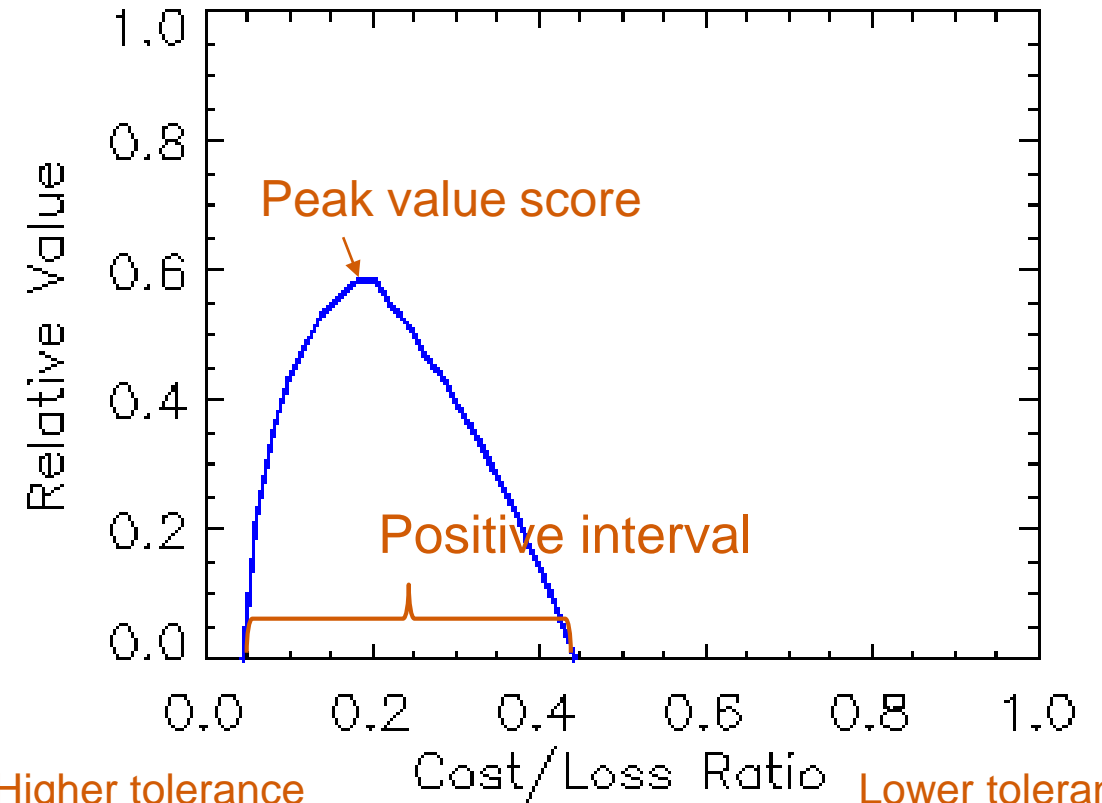
- Reliability diagrams
 - Desire is for curve to lie close to the diagonal (calibration).
 - This means that the observed events happen with about the same frequency as what the probability forecast predicts.
 - Can be summarized by absolute mean or max departure of points from diagonal.



Credit: http://www.cawcr.gov.au/projects/verification/#Wilks_2001

Decision Support Evaluation

- (Economic) Value Score
 - The percentage improvement in expected economic value between climatological and perfect information, as a function of cost/lost ratio.
 - Value depends on the user's tolerance for false alarms
 - Can summarize the values score curve by two attributes:
 - Peak value score
 - Positive interval



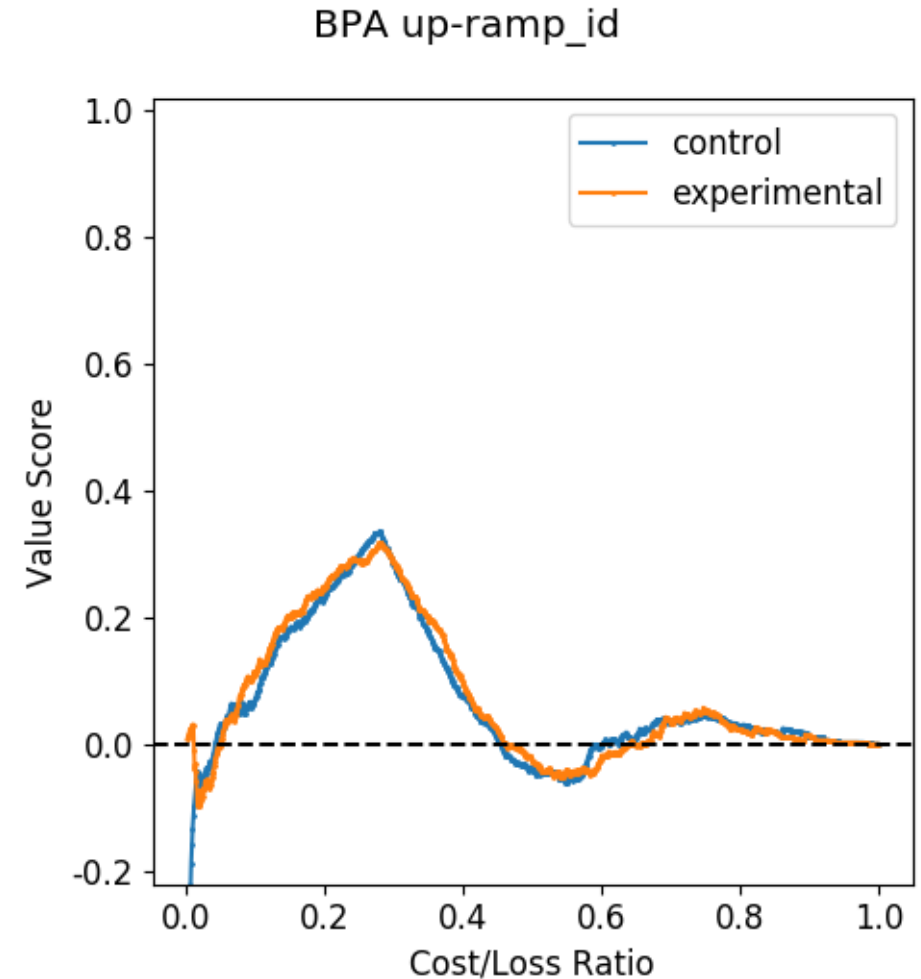
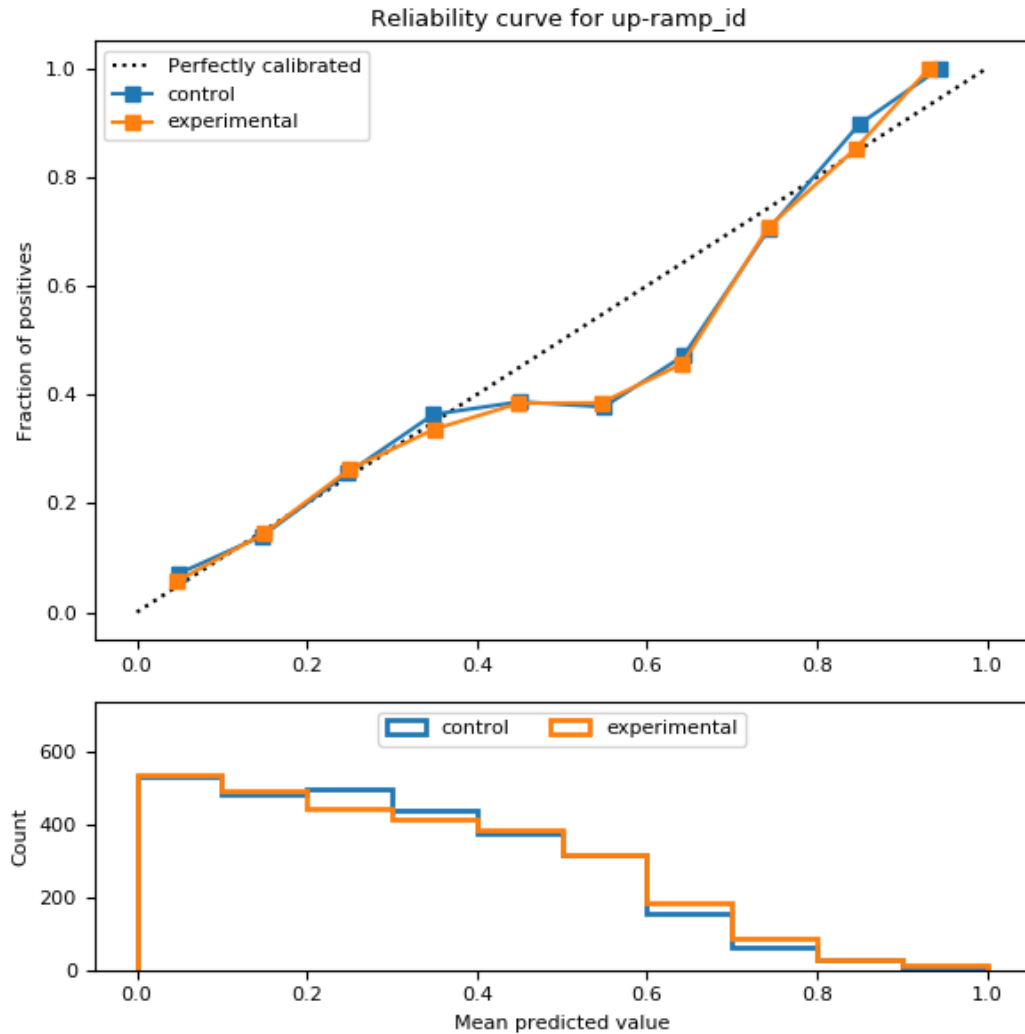
Higher tolerance
for false alarms

Lower tolerance
for false alarms

Credit: http://www.cawcr.gov.au/projects/verification/#Wilks_2001

Decision Support Evaluation: All Up-Ramp Events

BPA Fleet Aggregate Power

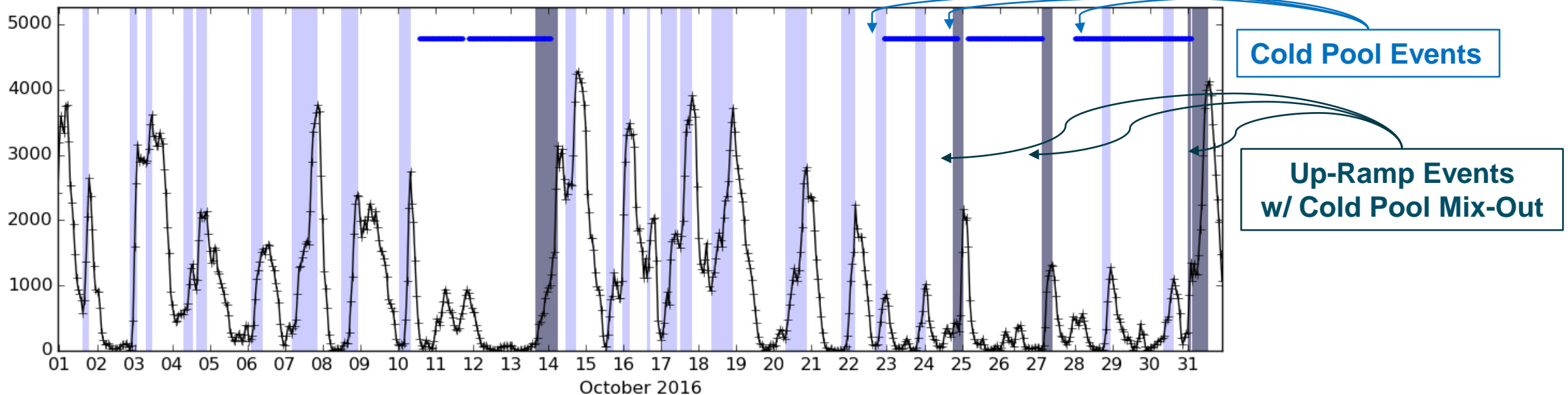


Algorithm Design: Cold Pool Mix-Out

1 Label long-lived cold pool events and up-ramps

McCaffrey-Wilczak (2018) method, with criterion for stability, wind, duration
WFIP1 Ramp Tool & Metric (min-max method), $\geq 15\%$ of normalized capacity over 12 hours (BPA)

2 Find Overlap: Up Ramps + Cold Pool Mix-Out (Tolerance ± 1 hour)



3 Build Classifier Model

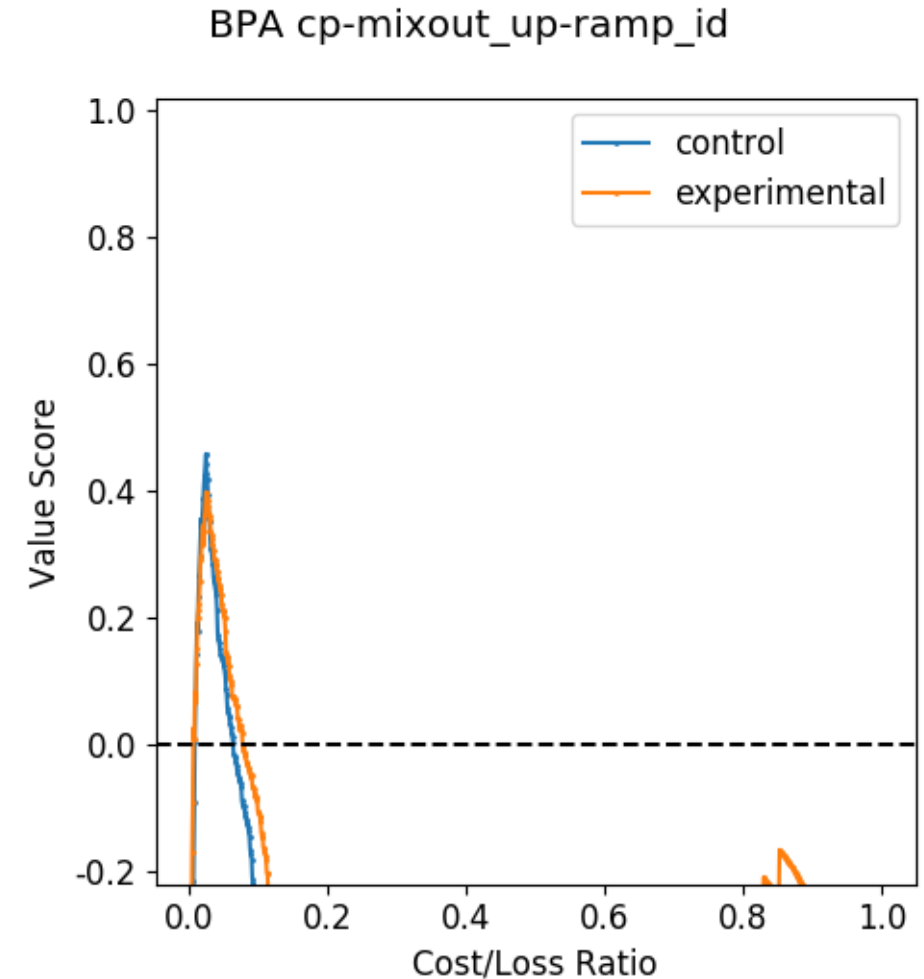
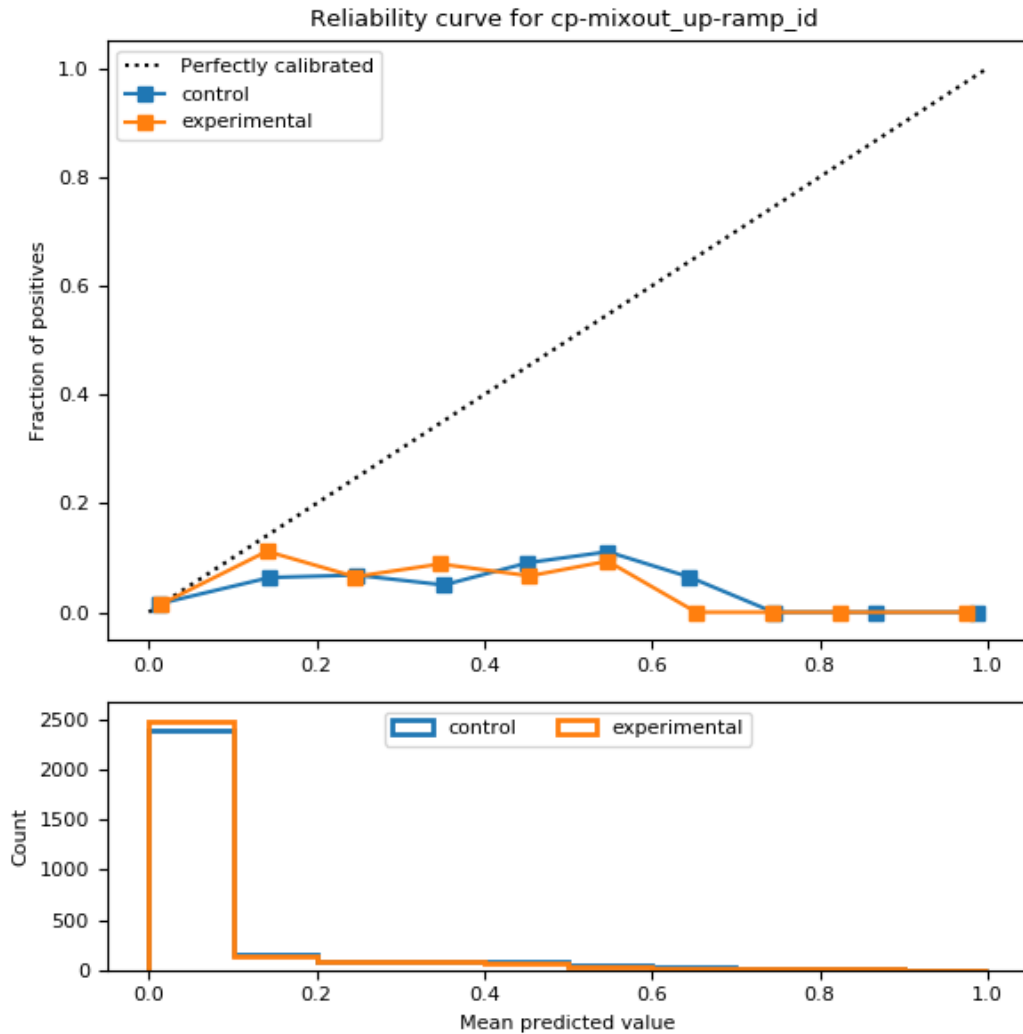
Result: A probabilistic forecast of up-ramps due to cold pool mix-out events

WFIP2 Ramp Event Frequencies

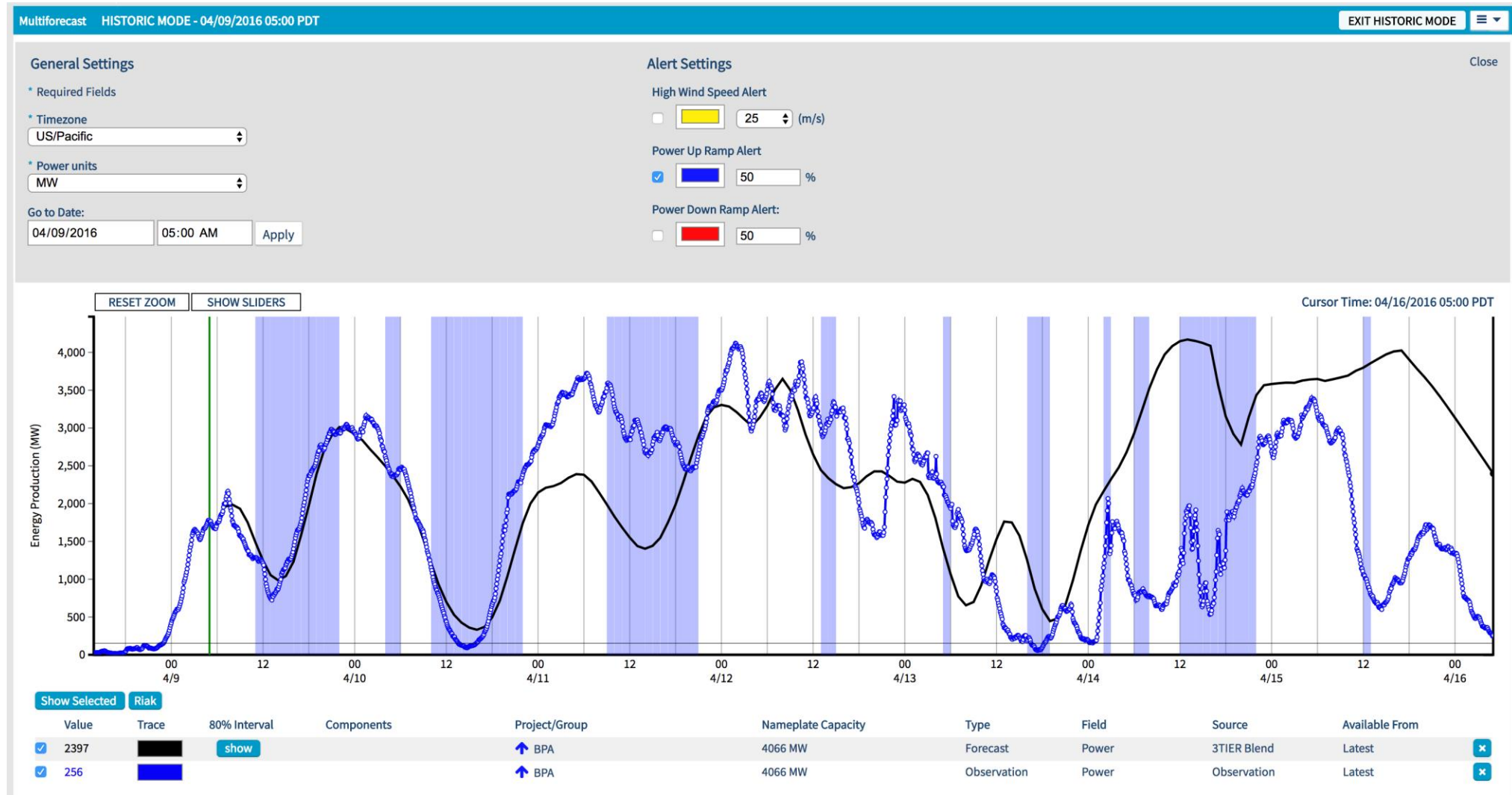
	All up ramps		Cold pool mix-out up ramps	
	# obs	ramp frequency	# obs	ramp frequency
BPA Fleet Aggregate	2952	27.5%	2952	2.4%

Decision Support Evaluation: Cold Pool Mix-Out

BPA Fleet Aggregate Power



Prototype Tool



Industry Feedback: Summary

Prototype DST Tool Attribute	
Customized Probability Threshold for Tuning Ramp Alerts	<ul style="list-style-type: none"> • Best used by BA for reducing reserve requirements during low risk times • Turning alerts on/off important • Changing colors less so
Special Ramp Alerts By Phenomena Type	<ul style="list-style-type: none"> • Helpful for on-staff meteorologists, “pro” users • Probably info overload for RT trader or BA operator • Industry needs to figure out how to value this
Ramp Size/Duration Definition	<ul style="list-style-type: none"> • Pre-set thresholds (aligned with BA requirements) are preferred • When/where (timing/level) of the end of down ramp event is more important • Shorter ramp window is essential (focus is almost entirely on 1-hour ahead, not next 6 hours)
Potential Impact on Decision Making	<ul style="list-style-type: none"> • A useful education tool if both BA and owner/operators have same view • Could target toward improved negotiation for reserve capacity • Potentially useful tool if reserve costs could be dynamically input to help define actions

Special thanks to:



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