

Air Quality Model Performance Evaluation for Central California Ozone Study Summer 2000

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Oct 09, 2008

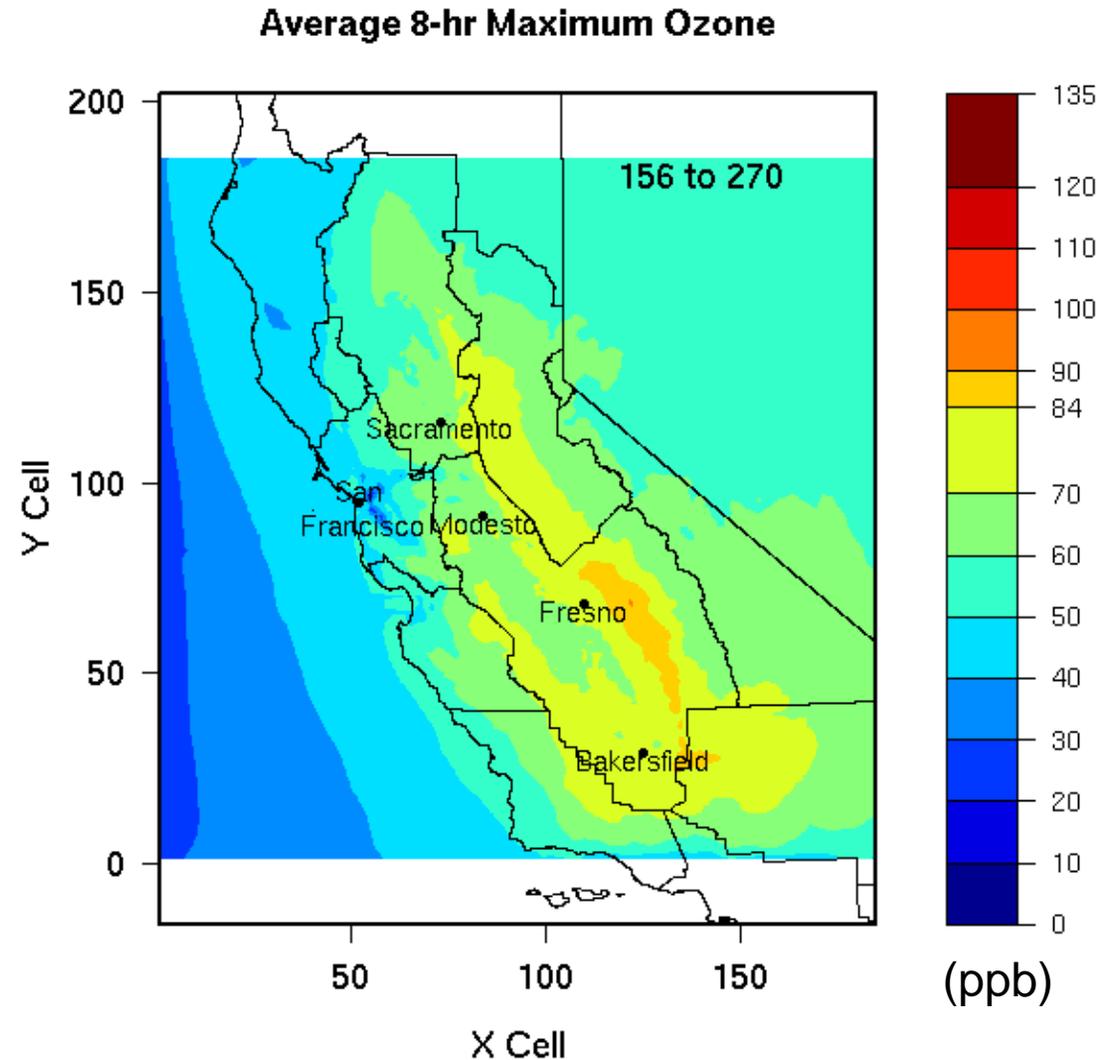
Summer 2000 Simulation Results

117-day Simulation

- Begins on (Day 154)
June 2nd 0 AM (PDT)

- Ends on (Day 270)
Sept 26th 11 PM (PDT).

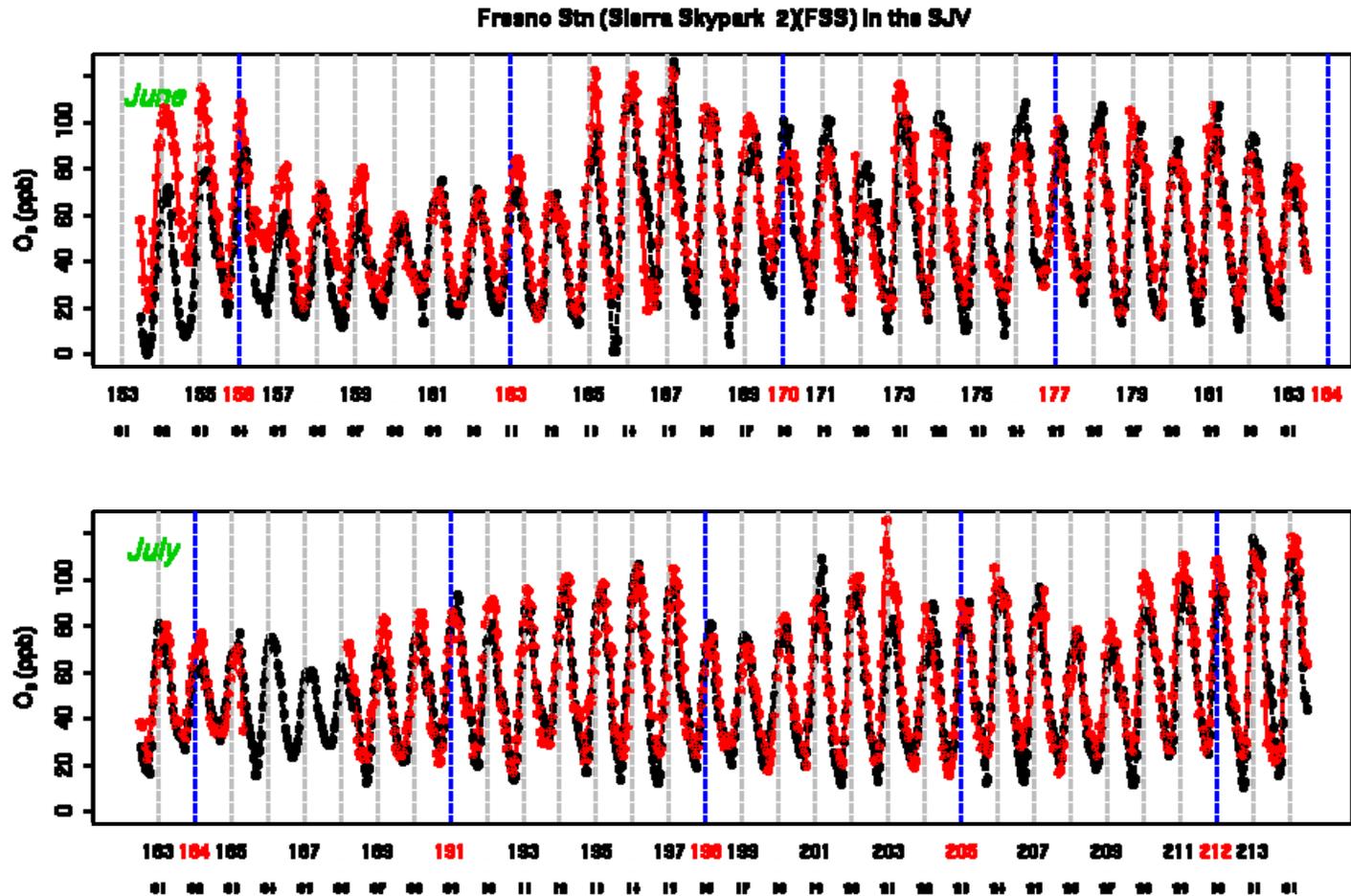
First two days used as
spinup.



Modeled and Observed Ozone Time Series

Fresno (June-July)

Observed
Modeled

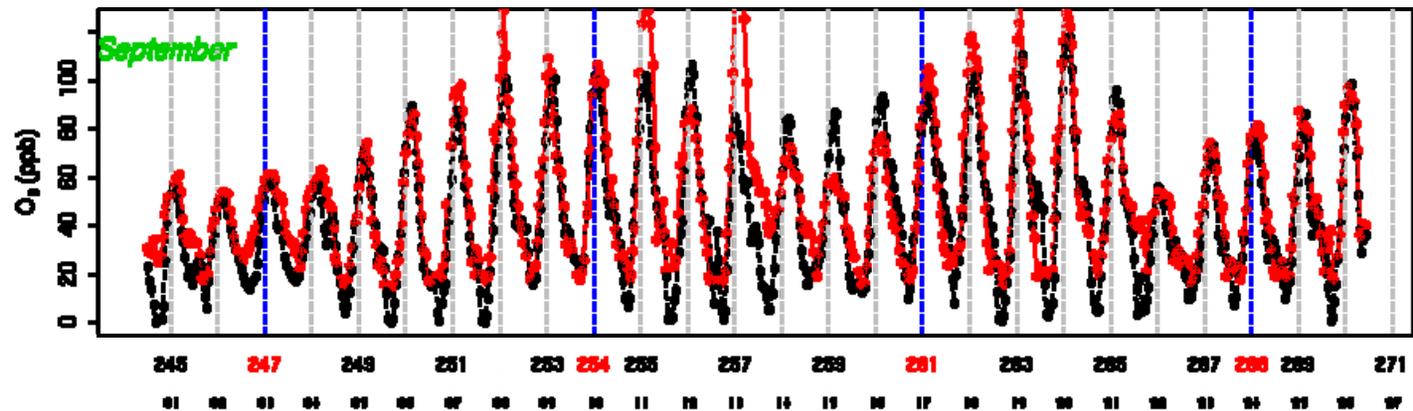
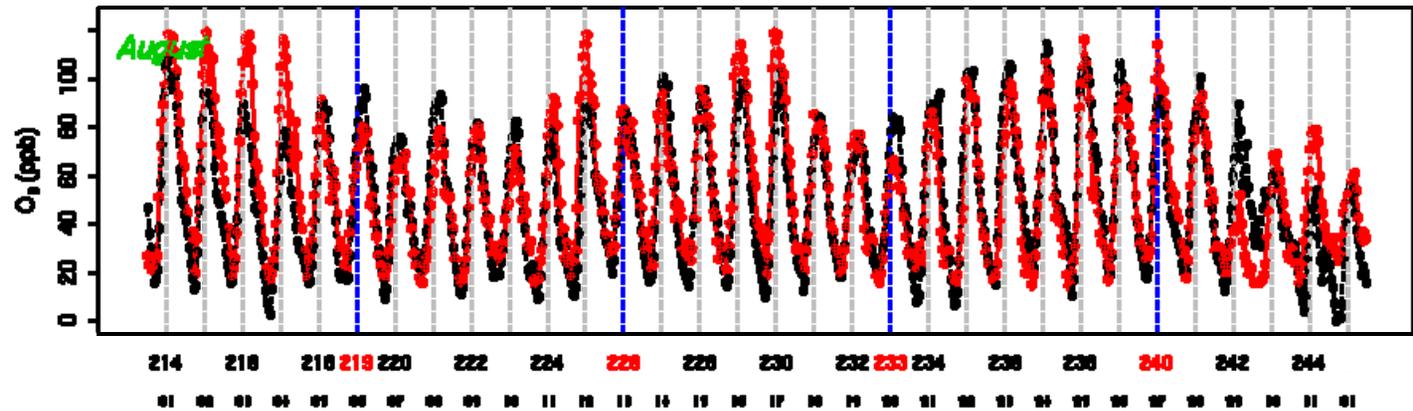


Vertical lines
denote midday (Sundays in blue)

Modeled and Observed Ozone Time Series

Fresno (Aug-Sep)

Observed
Modeled

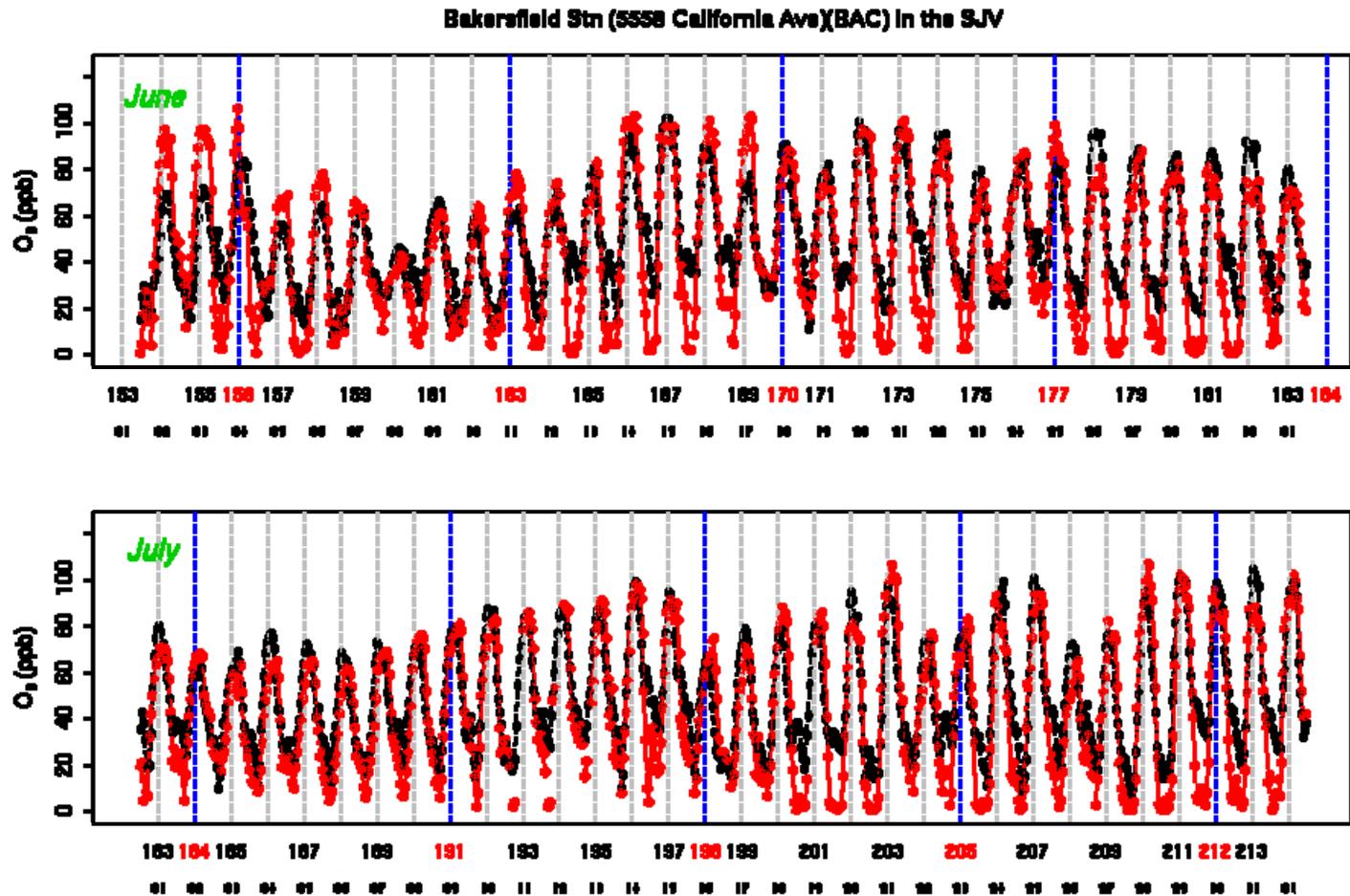


Vertical lines
denote midday (Sundays in blue)

Modeled and Observed Ozone Time Series

Bakersfield (June-July)

Observed
Modeled

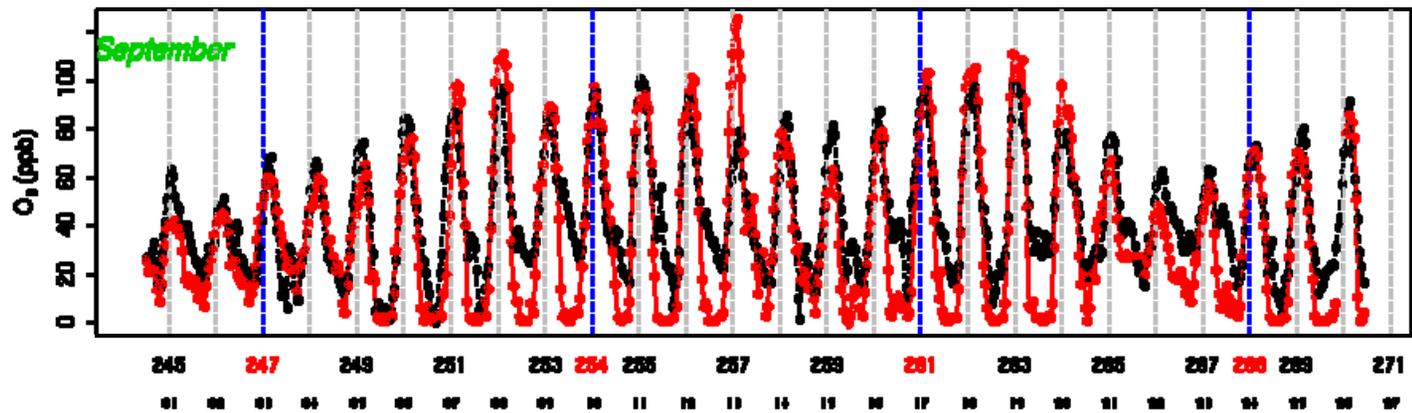
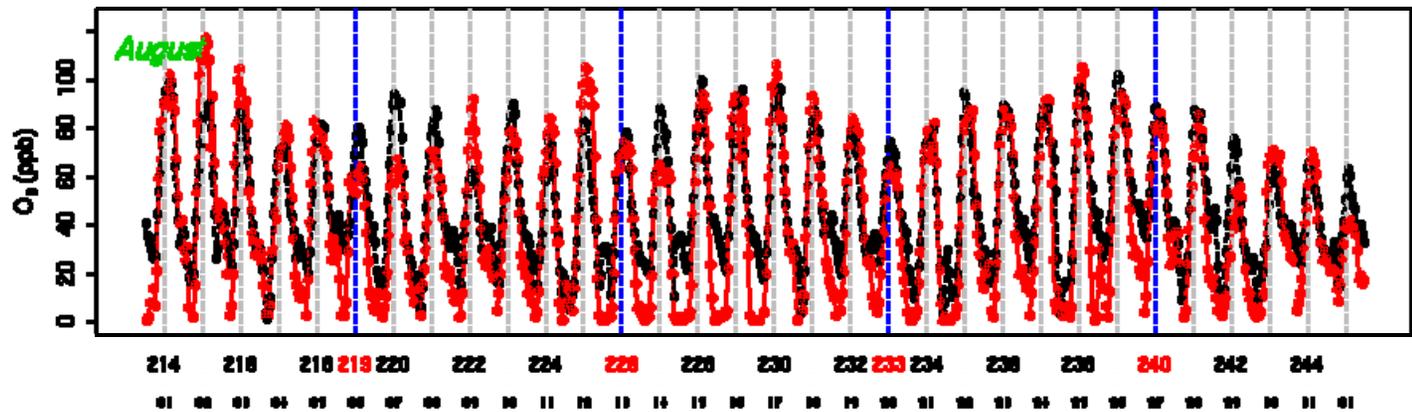


Vertical lines
denote midday (Sundays in blue)

Modeled and Observed Ozone Time Series

Bakersfield (Aug-Sep)

Observed
Modeled



Vertical lines
denote midday (Sundays in blue)

Evaluation Statistics

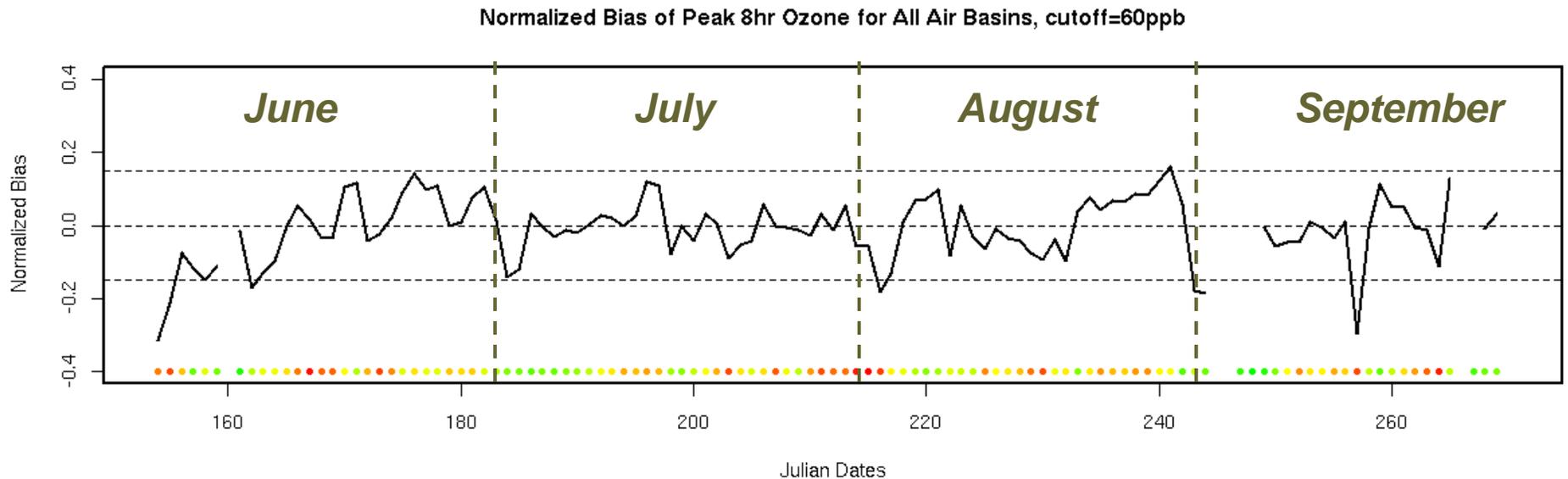
$$\text{Mean Normalized Bias (N. Bias)} = \frac{1}{N} \sum_{i=1}^N \left(\frac{C_{\text{model},i} - C_{\text{obs},i}}{C_{\text{obs},i}} \right)$$

for i where $C_{\text{obs},i} > \text{cutoff}$

$$\text{Mean Normalized Gross Error (N. GrossErr)} = \frac{1}{N} \sum_{i=1}^N \left| \frac{C_{\text{model},i} - C_{\text{obs},i}}{C_{\text{obs},i}} \right|$$

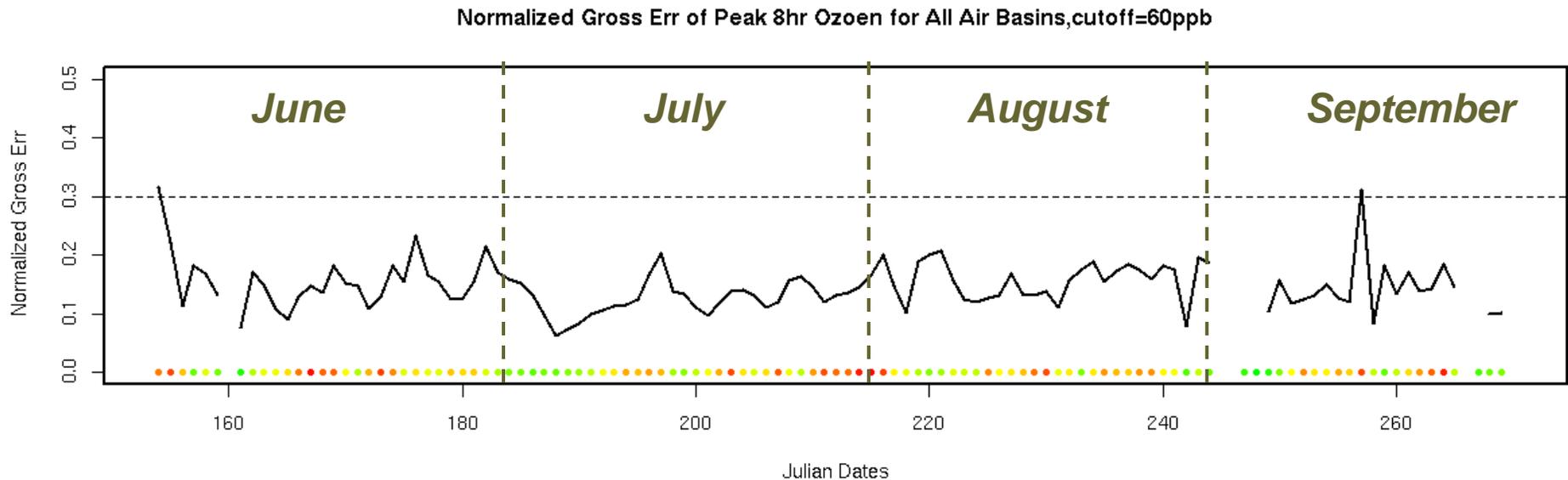
for i where $C_{\text{obs},i} > \text{cutoff}$

Temporal Trend in Model Predictions 8-hr Average Ozone Maxima: Normalized Biases



- EPA guidance for peak ozone predictions:
 - normalized biases within 15% when applied cutoff 60 ppb.
- Colored dots indicate average predicted 8-hr peak ozone levels used in the comparison for each day, ranging from 62 ppb (green) to 85 ppb (red).

Temporal Trend in Model Predictions 8-hr Average Ozone Maxima: Normalized Gross Errors

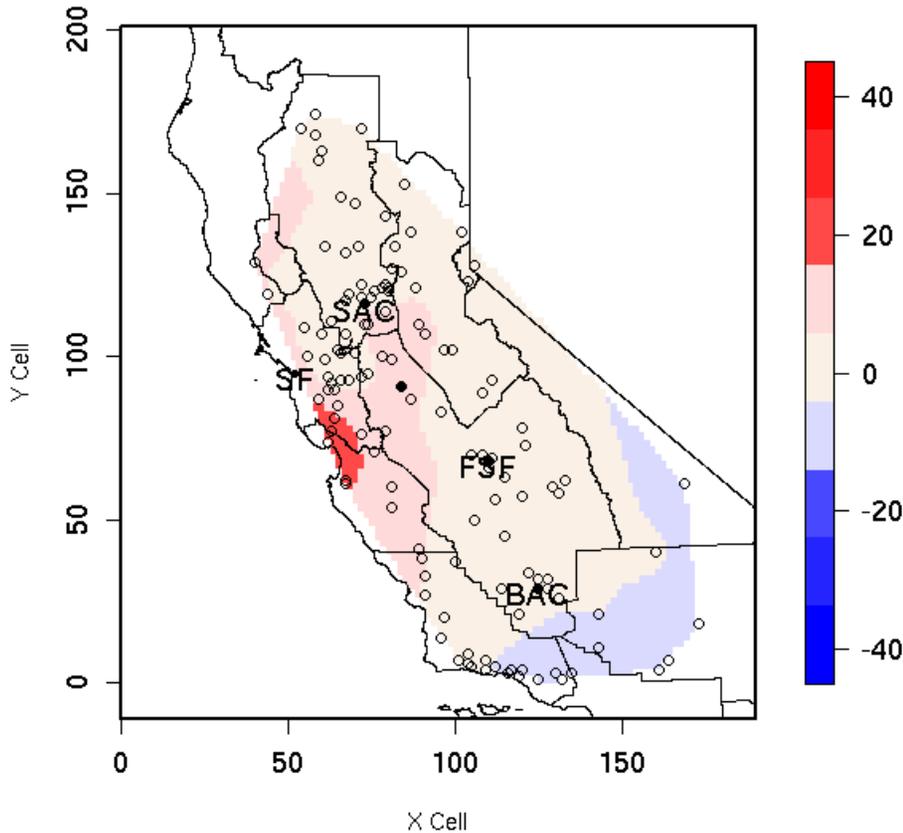


- EPA guidance for peak ozone predictions:
 - normalized gross errors less than 30~35% when applied cutoff 60 ppb.
- Colored dots indicate average predicted 8-hr peak ozone levels used in the comparison for each day, ranging from 62 ppb (green) to 85 ppb (red).

Spatial Trend in Model Predictions

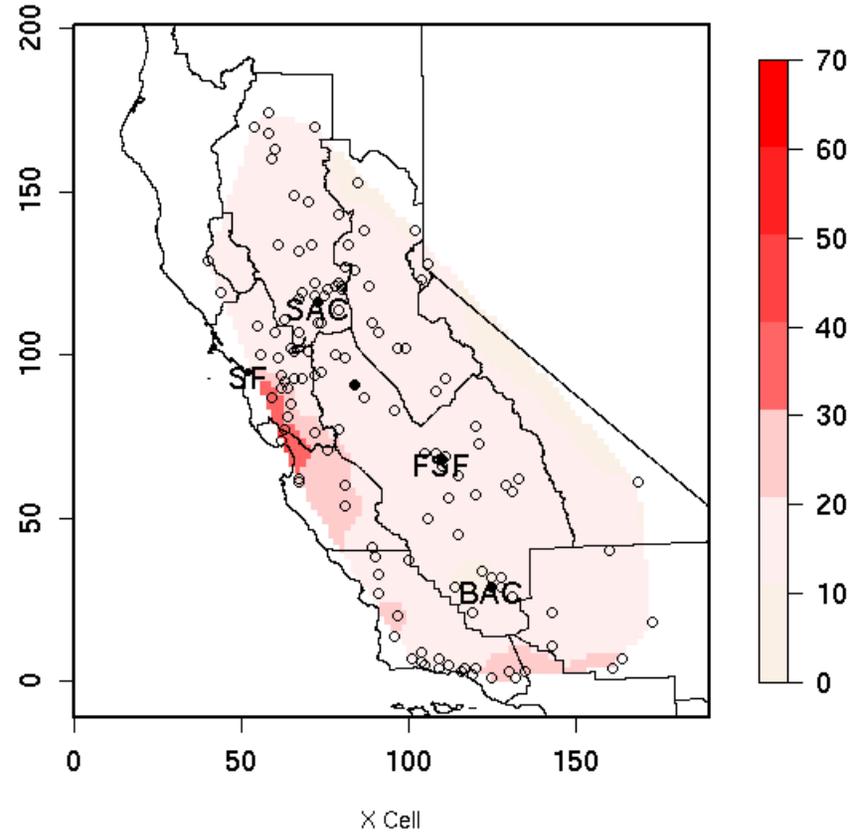
8-hr Average Ozone Maxima

Normalized Biases (%)



Above pink indicates > 15%

Normalized Gross Errors (%)



Above pink indicates > 30%

Dots denote measurement stations.

SF: San Francisco

SAC: Sacramento

FSF: Fresno

BAG: Bakersfield

Model Predictions of Precursor Species

	Normalized Bias	Normalized Gross Error
Daytime NO _y (cutoff = 5 ppb)	32%	72%
NMHC (cutoff = 35 ppbC)	23%	63%
CO (cutoff = 100 ppb)	-17%	45%

Episodic vs Seasonal Modeling

Taylor Diagram Approach

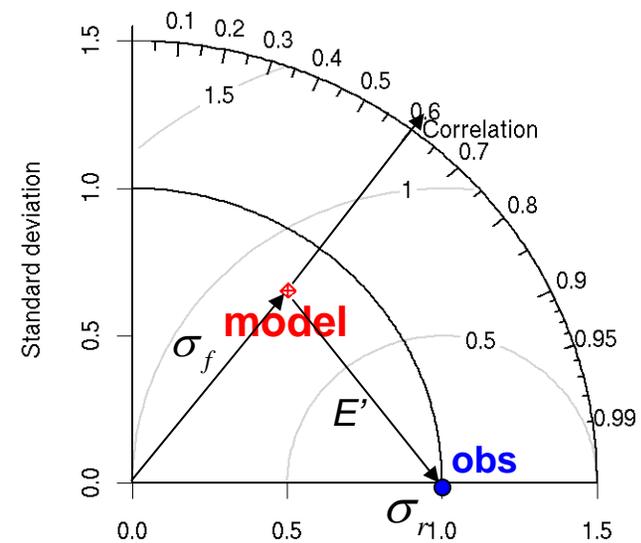
Taylor Diagram visualizes three pattern statistics on a two-dimensional plot. Consider a reference field (r) and a modeled field (f), the three pattern statistics are:

- Standard Deviation (σ_r or σ_f)
- Root Mean Squared Difference

$$E' = \left\{ \frac{1}{N} \sum_{n=1}^N [(f_n - \bar{f}) - (r_n - \bar{r})]^2 \right\}^{1/2}$$

- Correlation

$$R = \frac{\frac{1}{N} \sum_{n=1}^N (f_n - \bar{f})(r_n - \bar{r})}{\sigma_f \sigma_r}$$



Episodic vs Seasonal Modeling

Taylor Diagram showing pattern statistics:

- Standard Deviation
- Root Mean Squared Difference
- Correlation

Legend

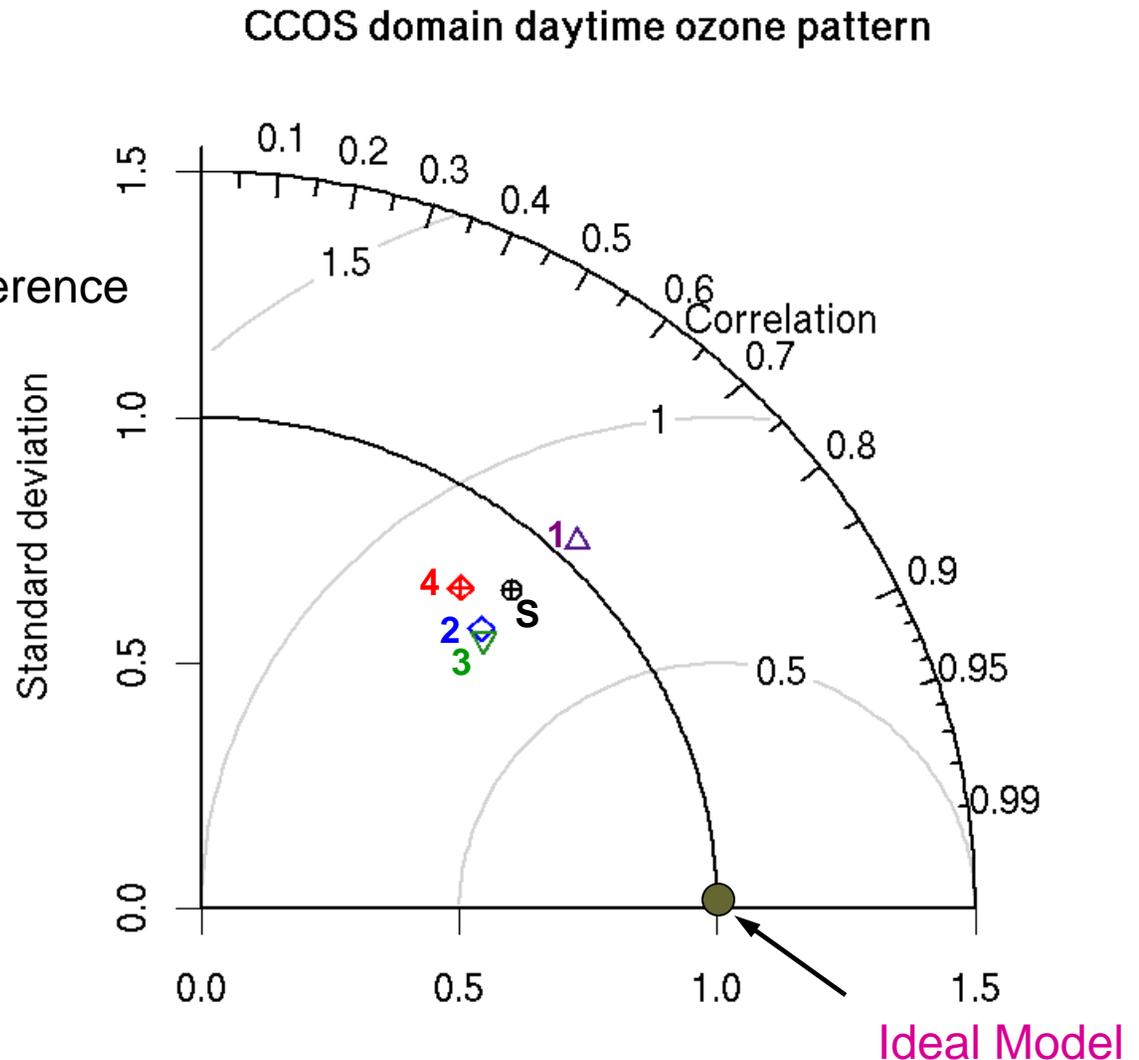
Whole Season

IOP 1 (Jun23-25)

IOP 2 (Jul29-Aug3)

IOP 3 (Aug 14-17)

IOP 4 (Sep 17-20)



Summary

- Model overall produces consistent and acceptable performance over time.
- Model is able to reproduce observed peak ozone levels in most parts of the domain. Overpredictions are seen in limited coastal sites.
- Model is able to match the observed temporal ozone patterns as indicated by Taylor Diagram in individual episodes as well as throughout the season.
- More investigation is needed for evaluating precursor predictions.