

Evaluation of Eta-CMAQ O₃ Forecasts During the Summer of 2005 Over the Eastern and Continental US domains

Rohit Mathur¹, Daiwen Kang², Shaocai Yu², Kenneth Schere¹

¹Atmospheric Sciences Modeling Division
ARL/NOAA
NERL/U.S. EPA

²Science and Technology Corporation



RESEARCH & DEVELOPMENT

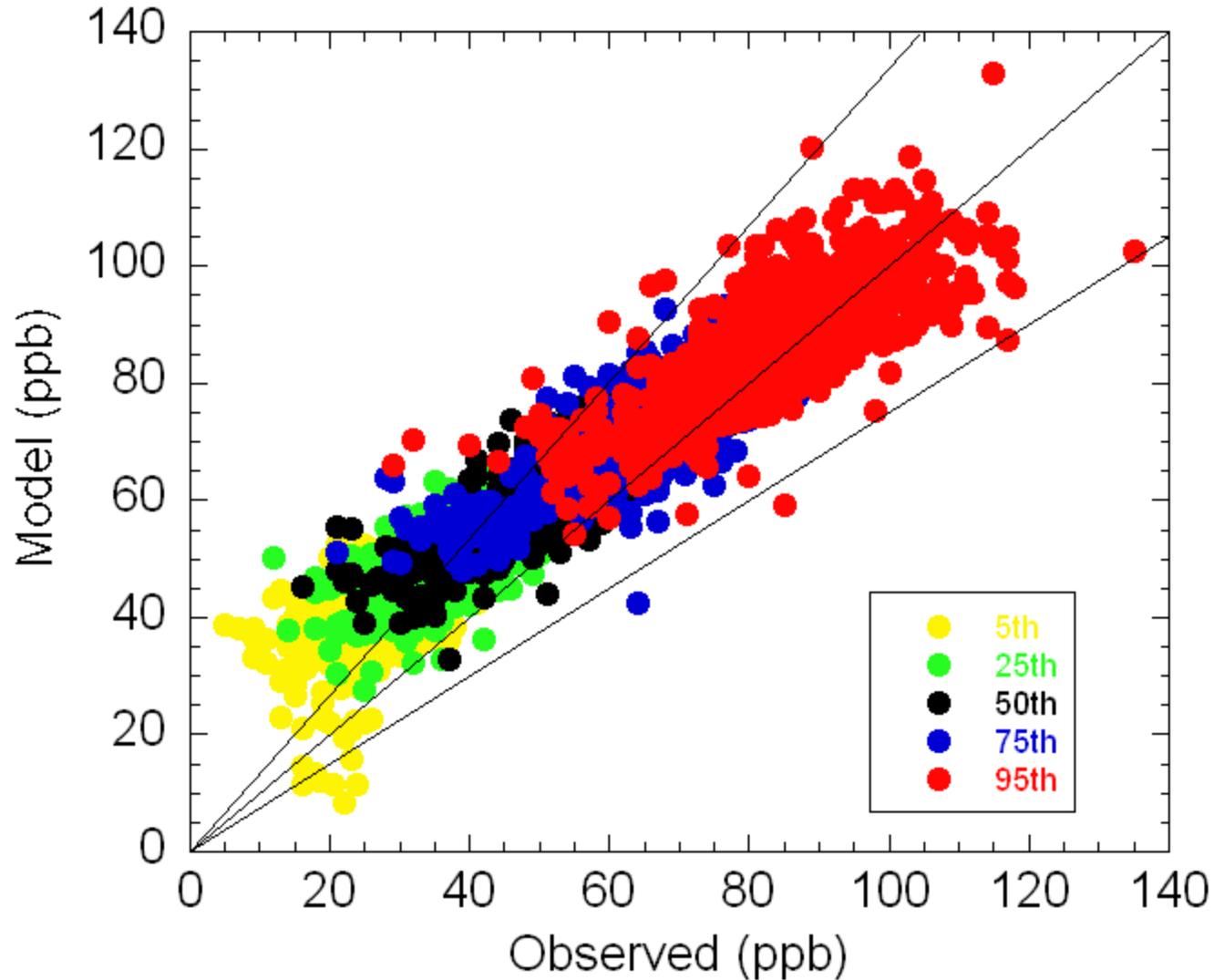
Building a scientific foundation for sound environmental decisions

Outline

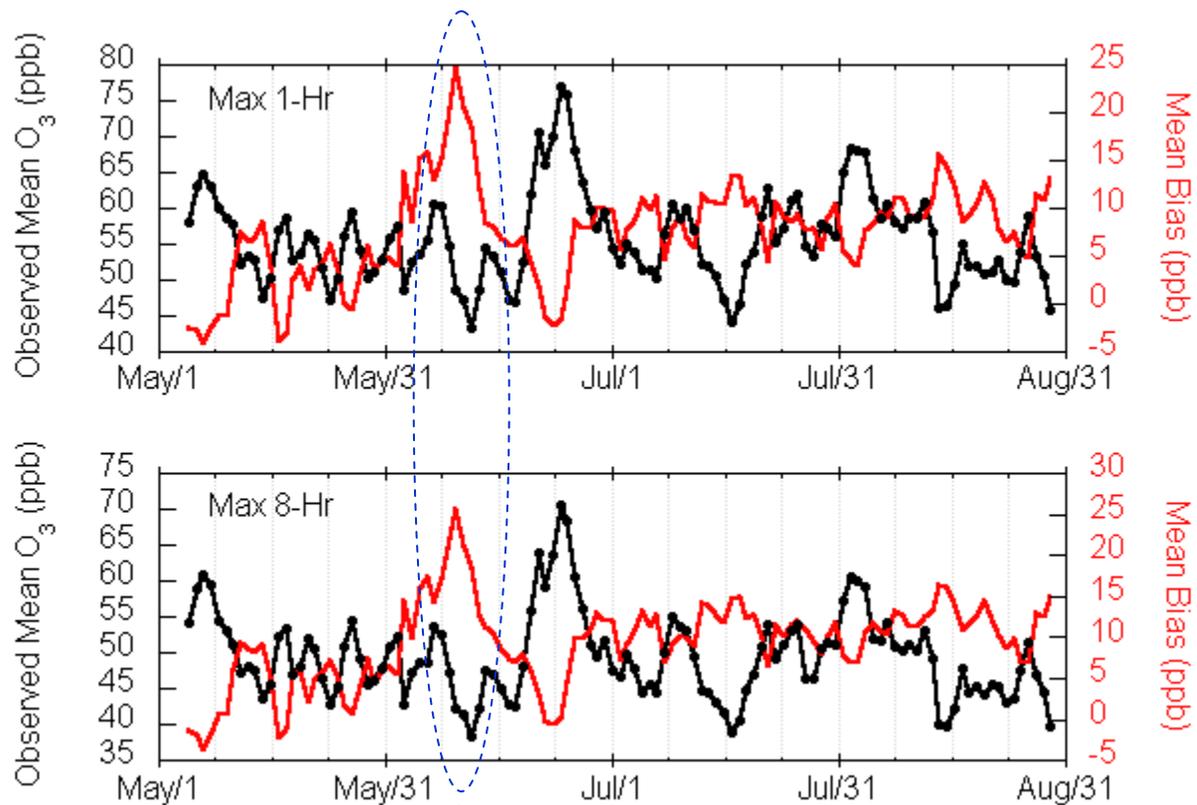
- Performance Summary
 - Regional perspective
- Performance characteristics during regional enhancement episode in June 2005
- Evaluation of differing model configurations
 - Comparison of 3x and 5x forecasts
 - Impacts of changes in LBC specification
- Practical considerations for categorical statistics

Performance Characteristics: 3x domain

Percentiles, Daily 1-Hr. Max. O₃, June 15 - August, 2005

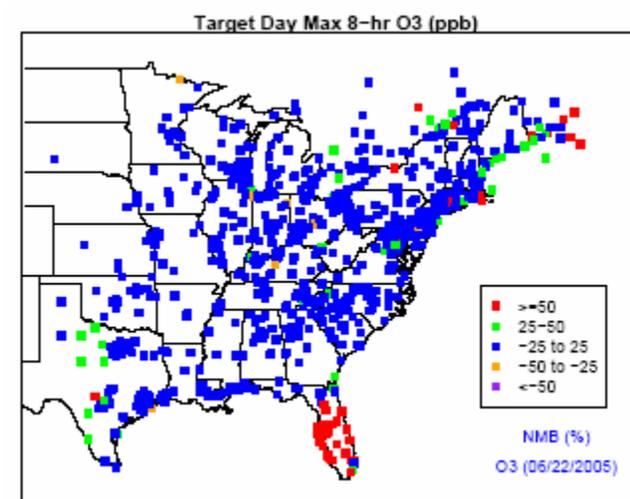
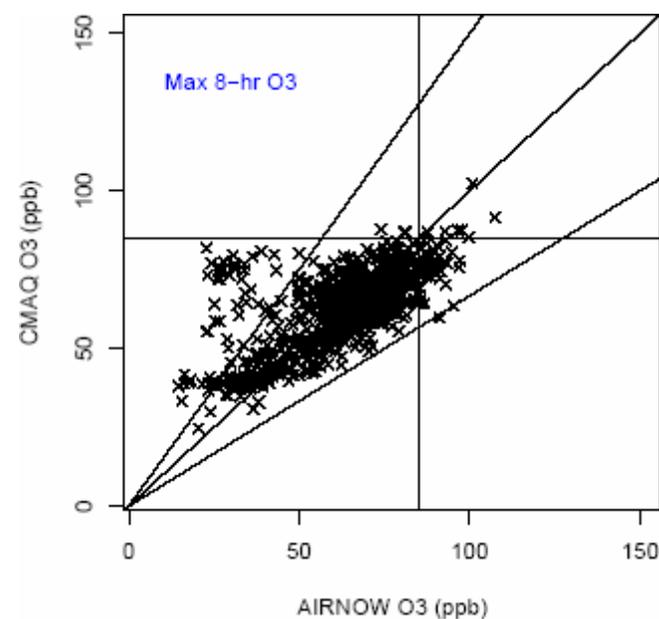
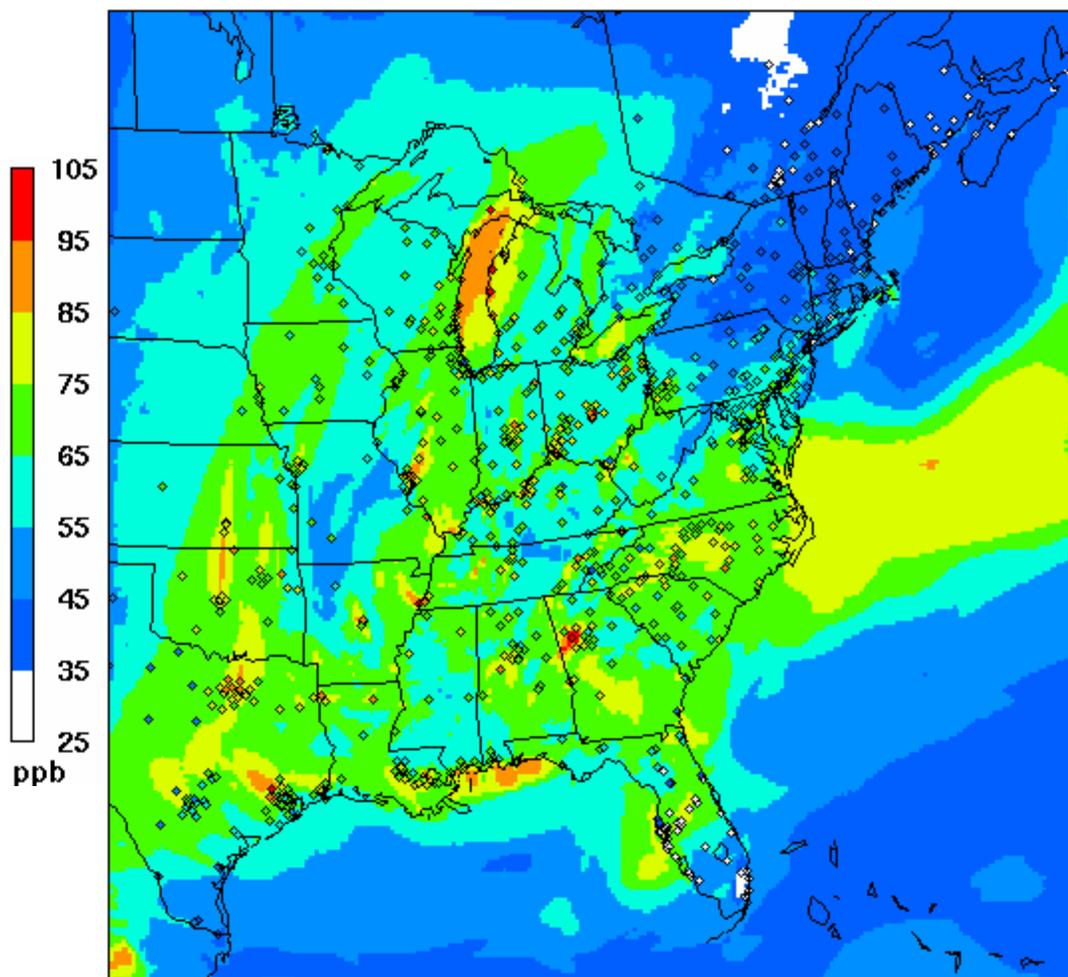


Performance Characteristics: 3x domain



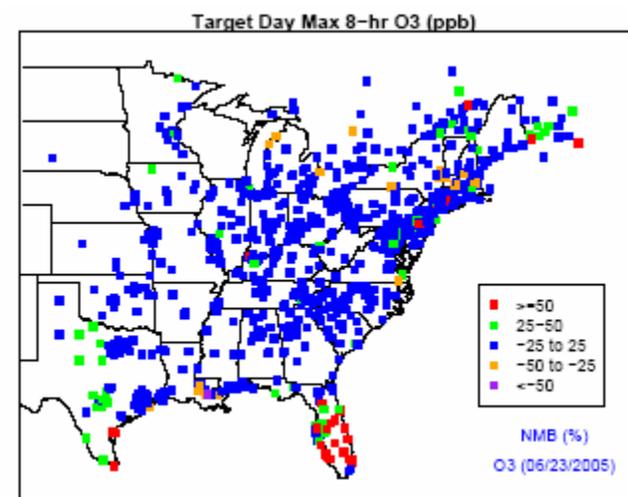
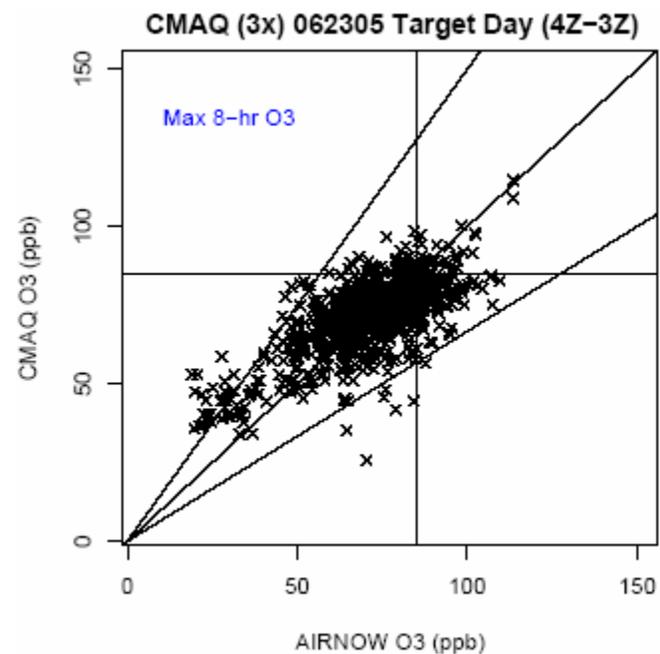
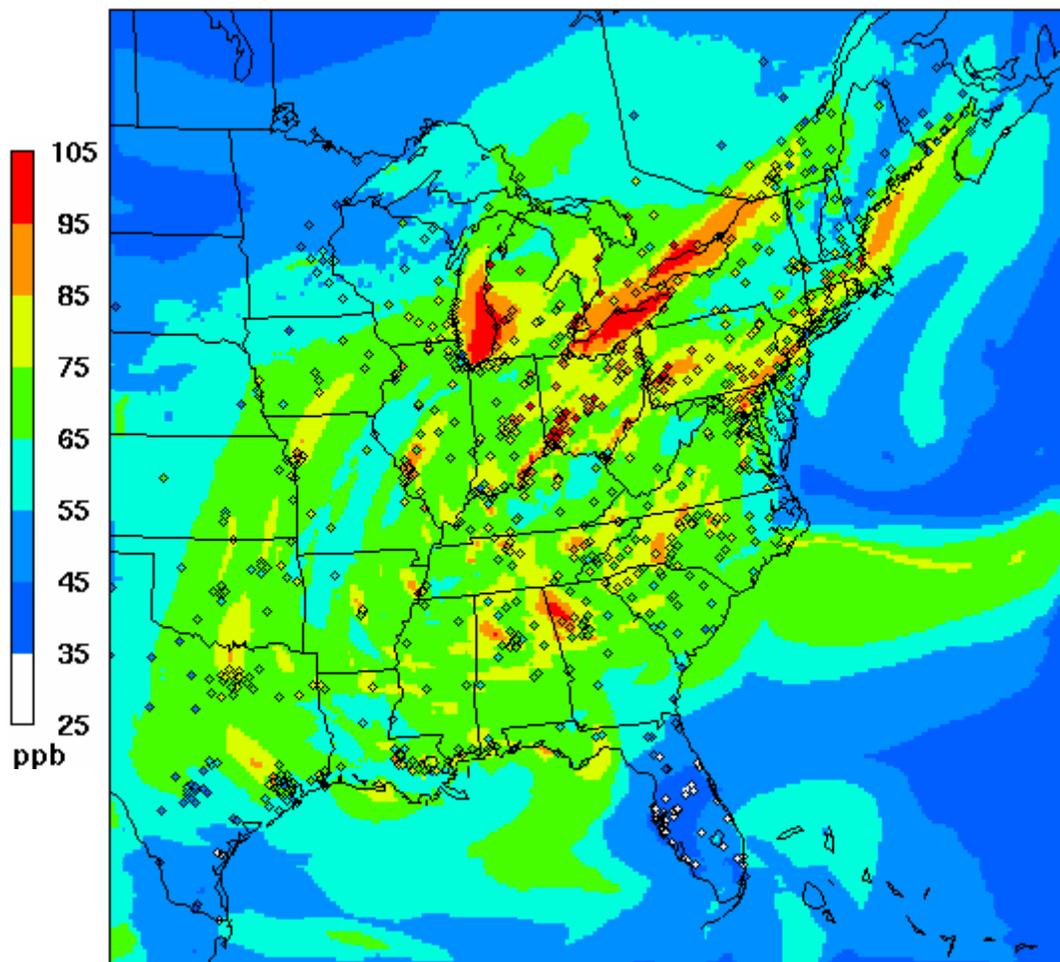
June 1-9 influenced by error in interpolation of GFS data

Max. 8-Hr O₃ Performance: June 23, 2005



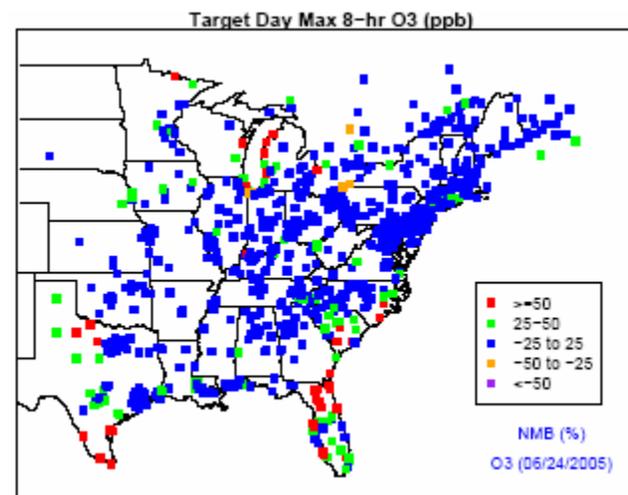
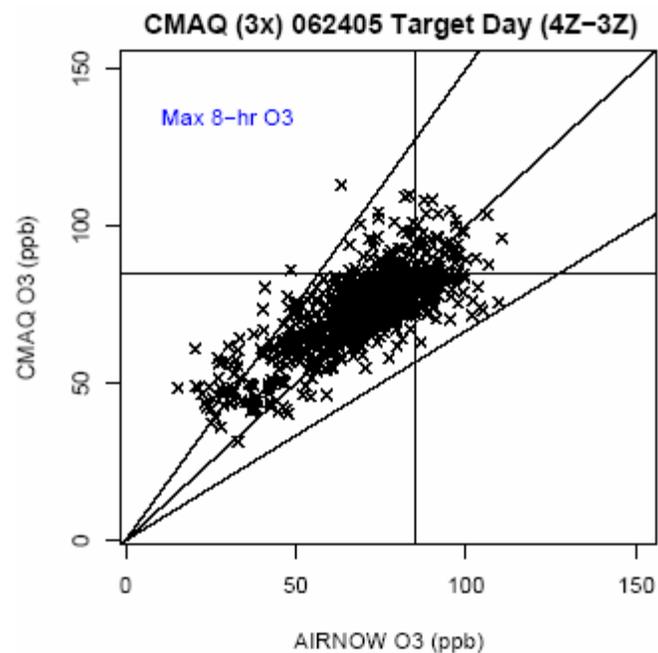
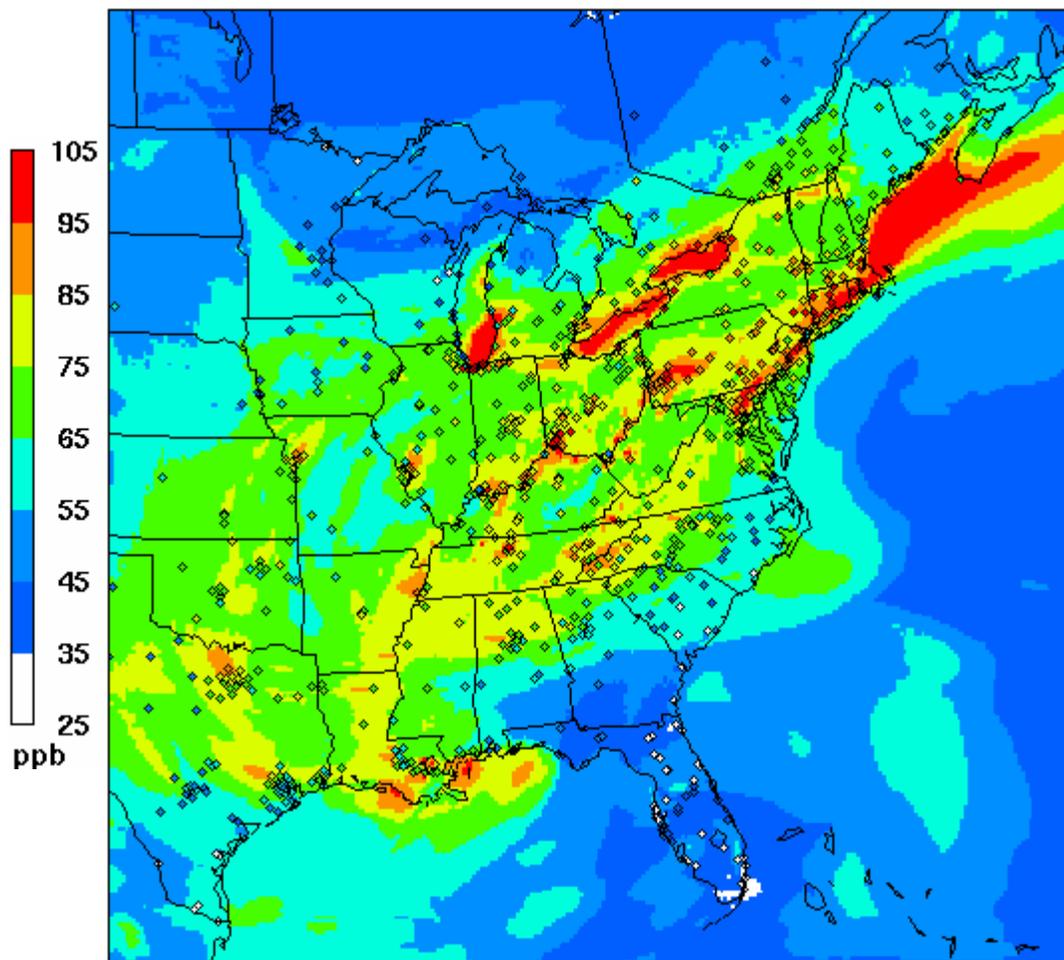
Obs. Mean	Model Mean	RMSE	NME	MB	NMB	R
63.58	62.98	12.27	13.98	-0.60	-0.95	0.68

Max. 8-Hr O₃ Performance: June 24, 2005



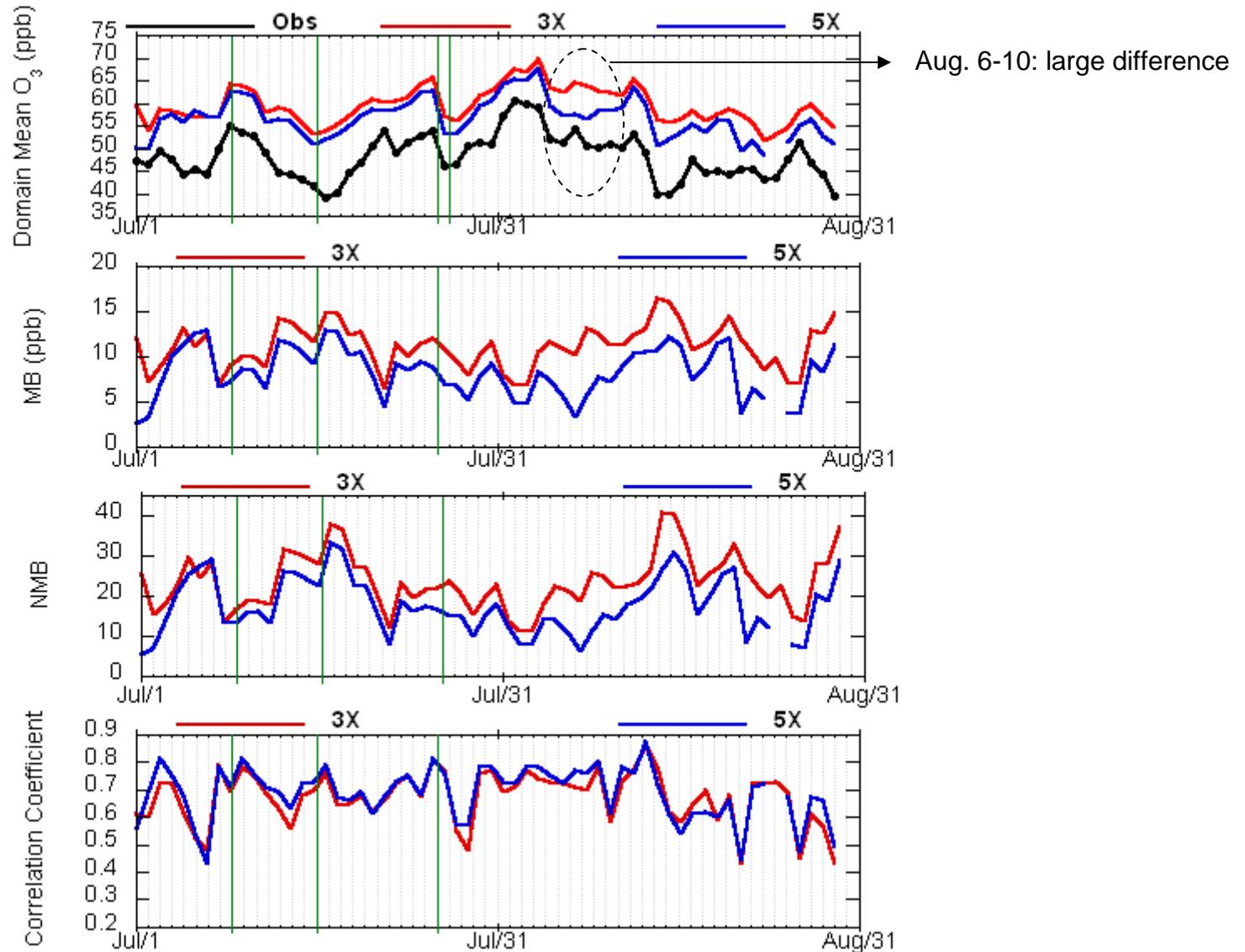
Obs. Mean	Model Mean	RMSE	NME	MB	NMB	R
70.69	70.89	11.18	12.25	0.20	0.29	0.71

Max. 8-Hr O₃ Performance: June 25, 2005



Obs. Mean	Model Mean	RMSE	NME	MB	NMB	R
68.43	73.02	11.66	13.12	4.59	6.71	0.76

Comparison of 3x and 5x Performance: Max. 8-Hr O₃

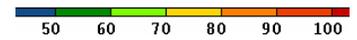
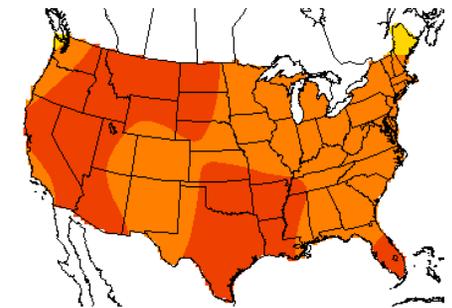
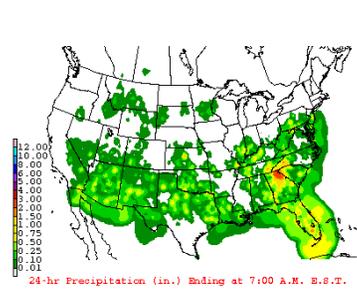
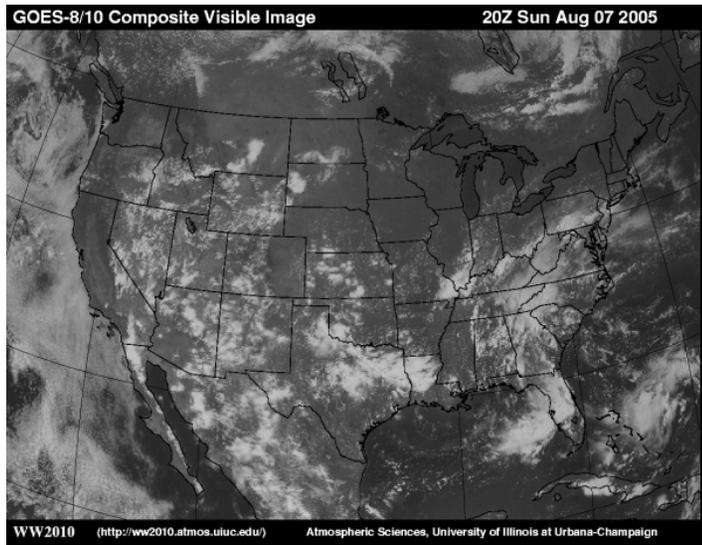


7/9: S4 config. Replaced with S3 (5x)

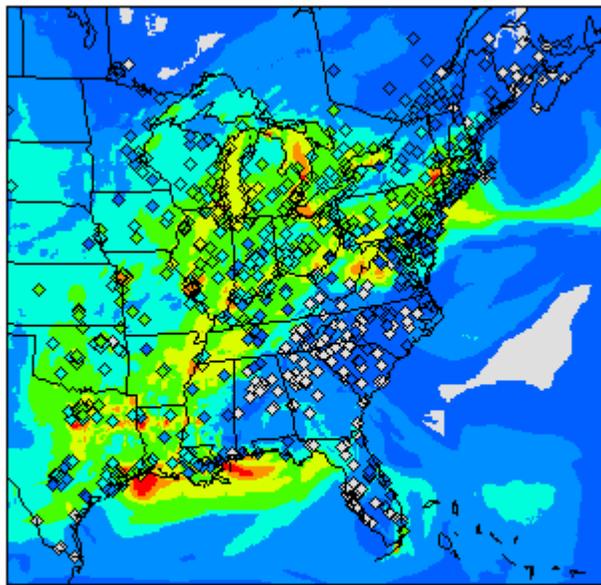
7/16: S3 with static LBC(5x)

7/26: S4 with static LBC(5x)

Comparison of 3x and 5x Performance: Max. 8-Hr O₃ August 7, 2005



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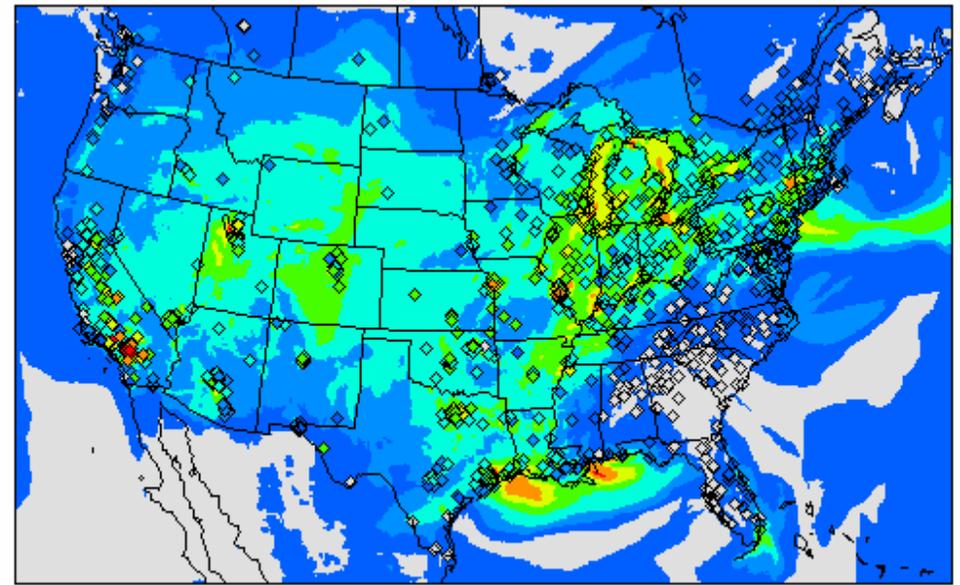


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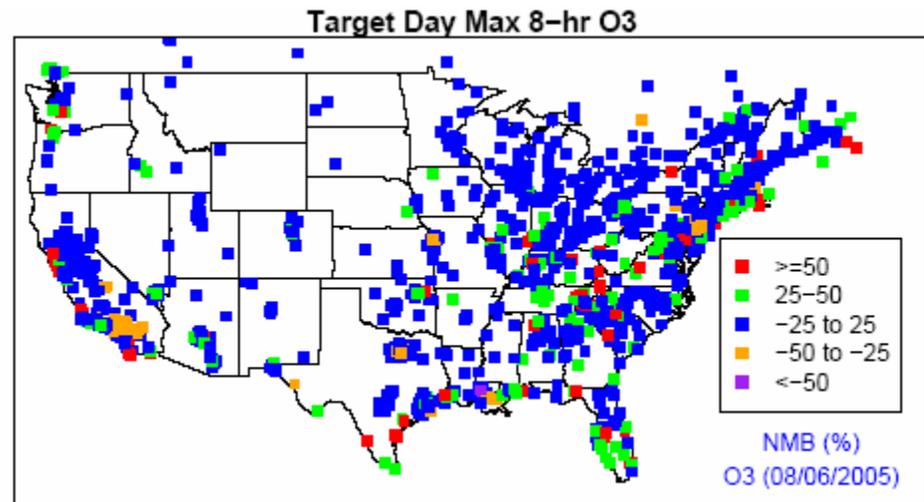
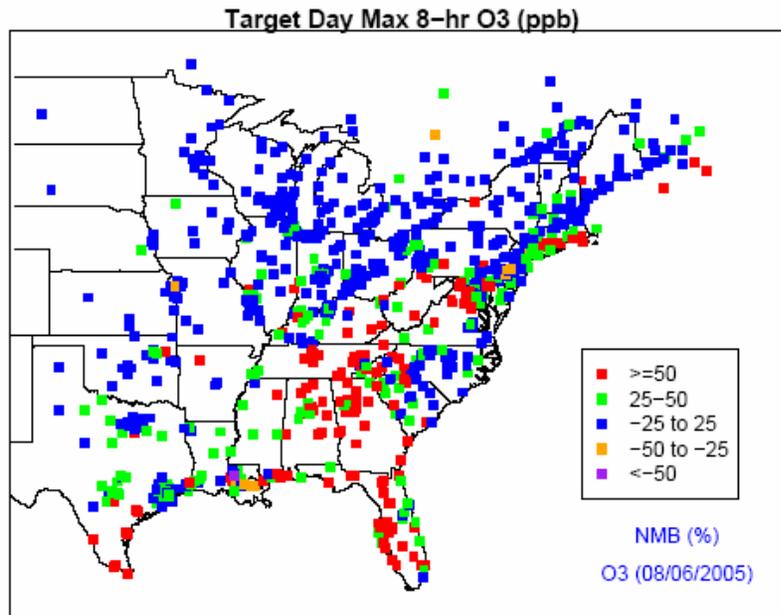
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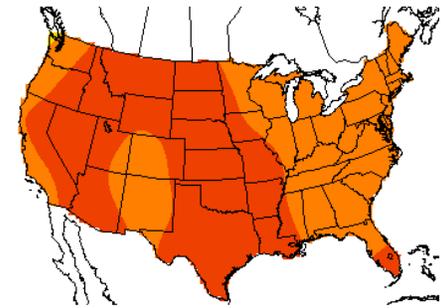
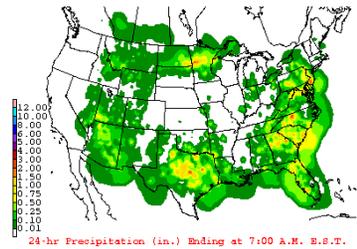
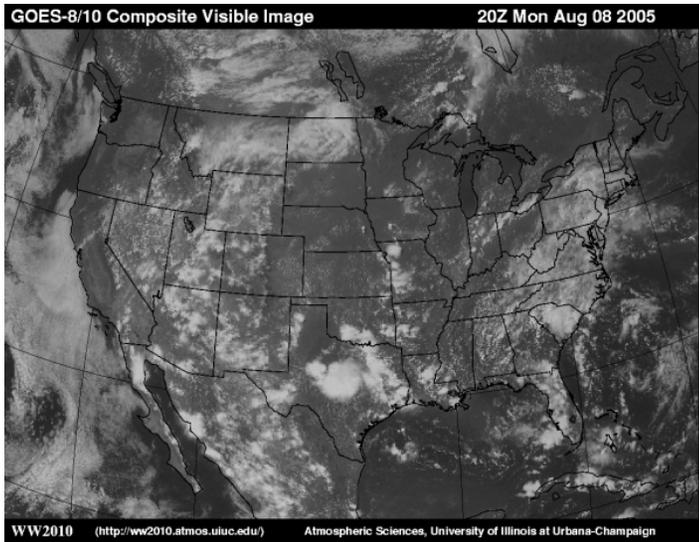
Comparison of 3x and 5x Performance: Max. 8-Hr O₃ August 7, 2005

TYPE (mx8_dt)	N	Obs Mean	Model Mean	RMSE (ppb)	NME (%)	MB (ppb)	NMB (%)	r
3x	847	54.12	64.56	16.14	23.7	10.44	19.28	0.71
window3x-5x	846	54.19	57.64	11.86	16.23	3.41	6.29	0.77

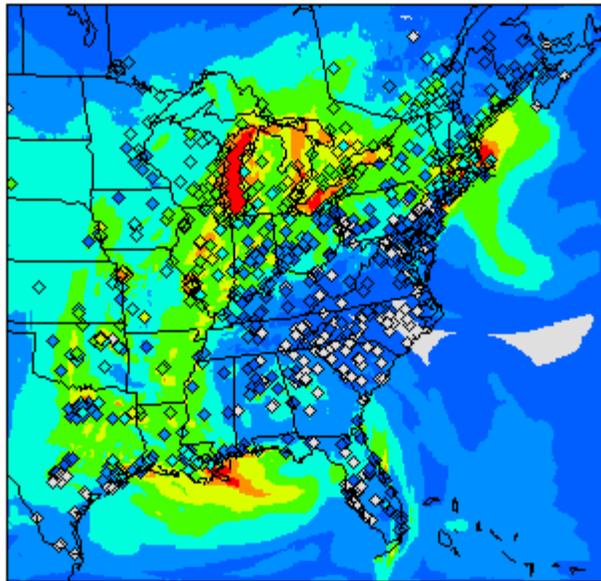


Improved performance with 5x configuration under cloudy conditions

Comparison of 3x and 5x Performance: Max. 8-Hr O₃ August 8, 2005



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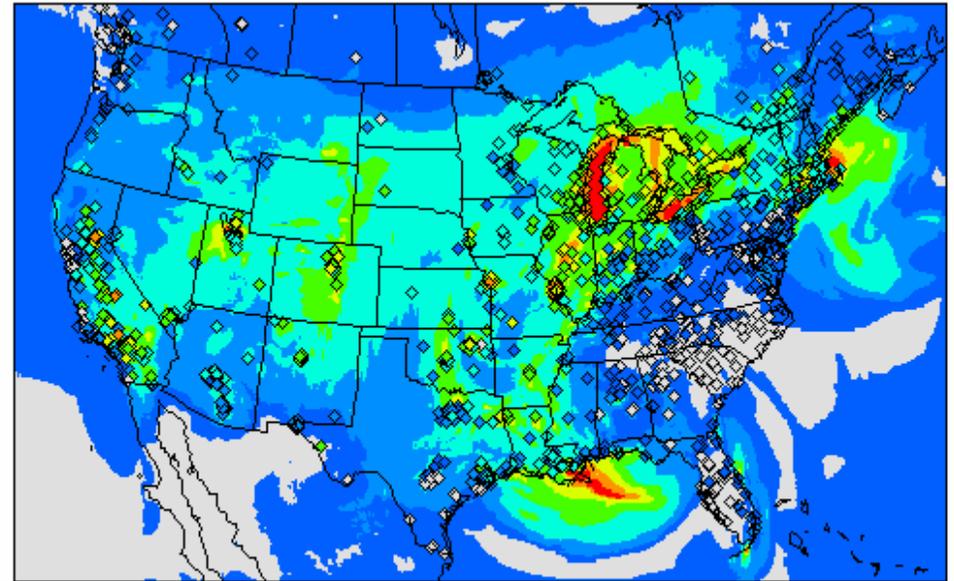
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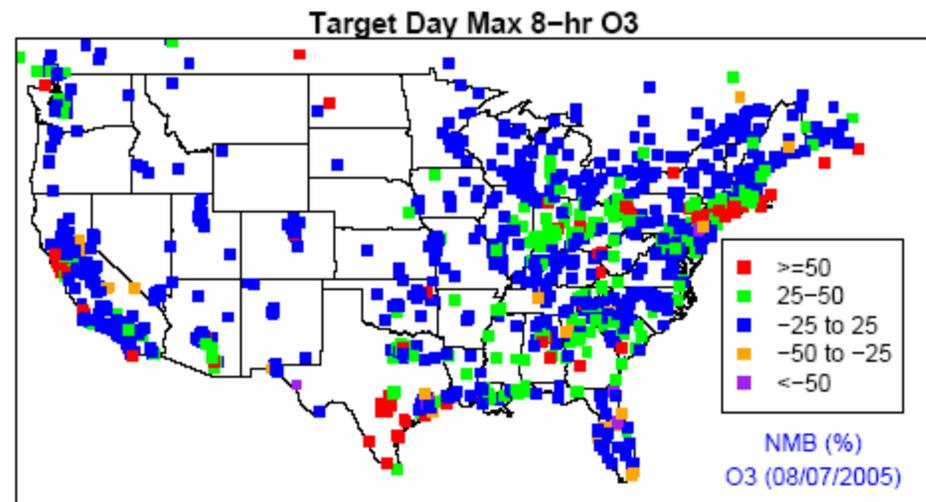
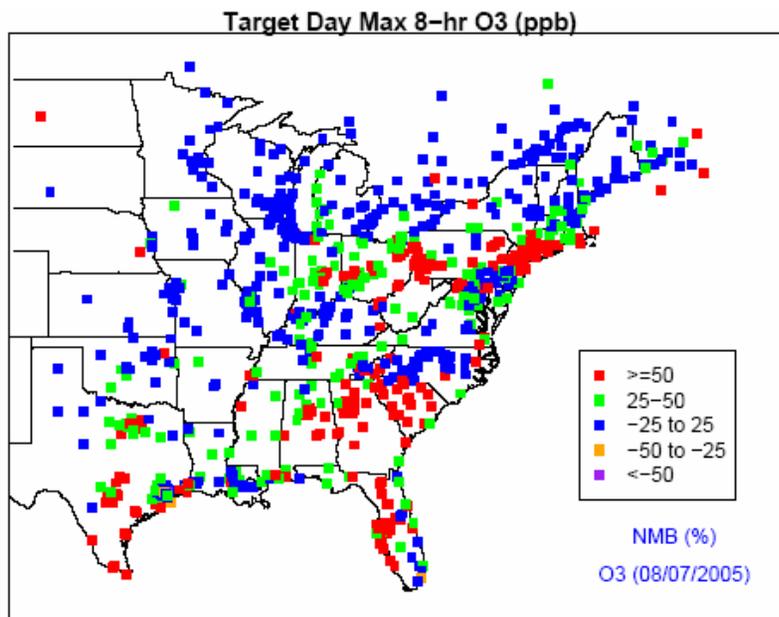
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Comparison of 3x and 5x Performance: Max. 8-Hr O₃ August 8, 2005

TYPE (mx8_dt)	N	Obs Mean	Model Mean	RMSE (ppb)	NME (%)	MB (ppb)	NMB (%)	r
3x	855	50.79	64.07	18.36	28.87	13.28	26.15	0.7
window3x-5x	855	50.79	56.69	13.84	20.72	5.89	11.59	0.76

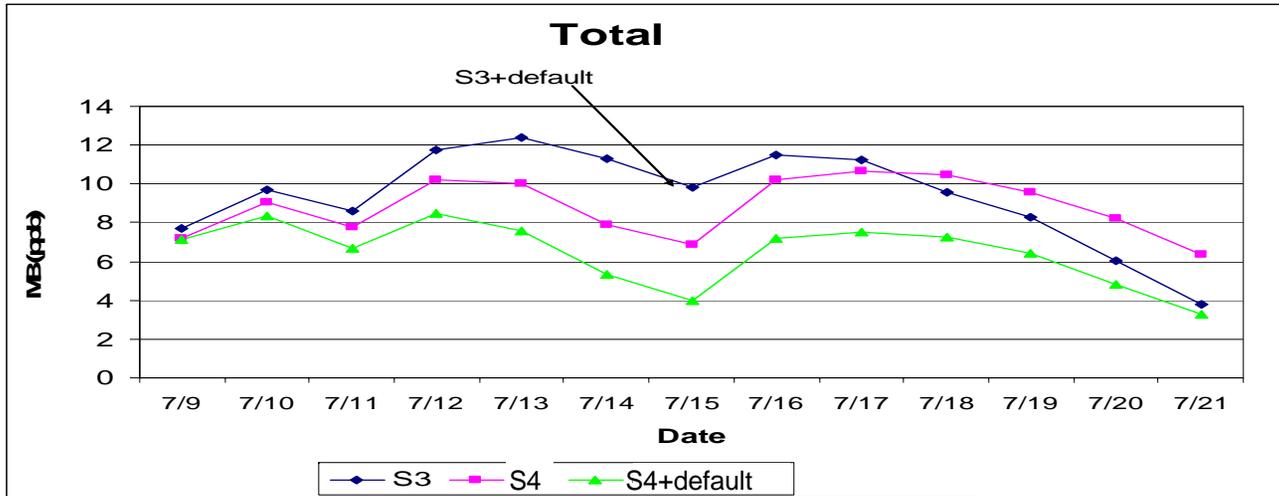


Improved performance with 5x configuration under cloudy conditions

Static vs. GFS derived LBC Effects: 5x Domain

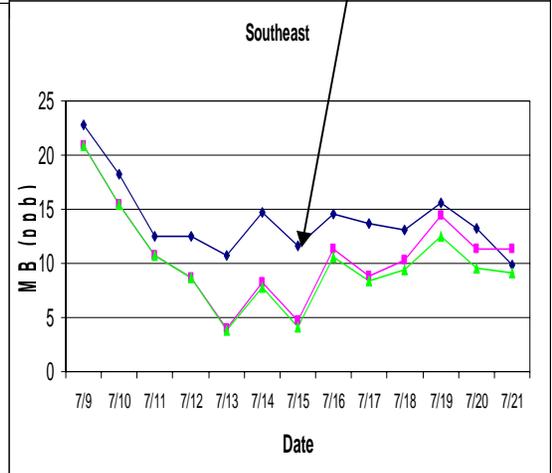
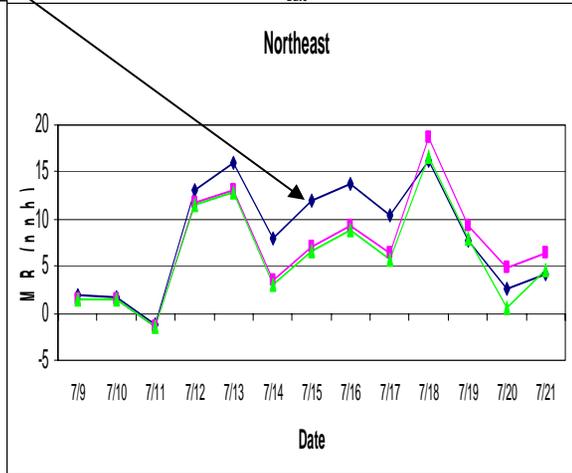
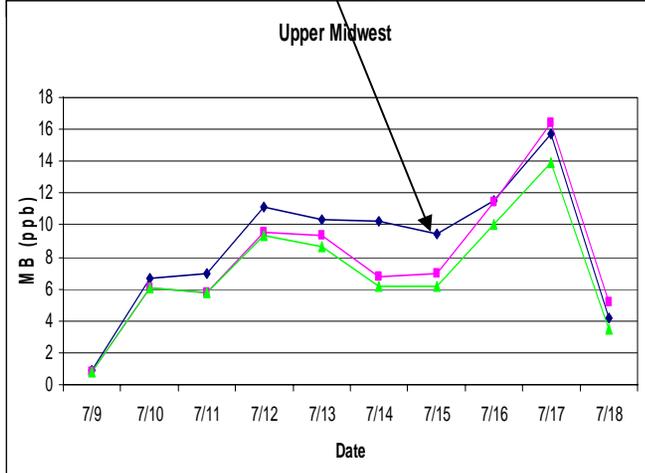
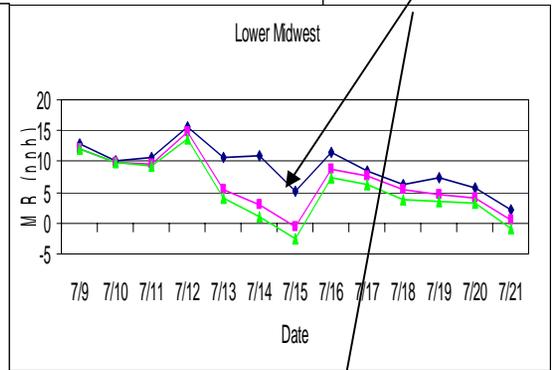
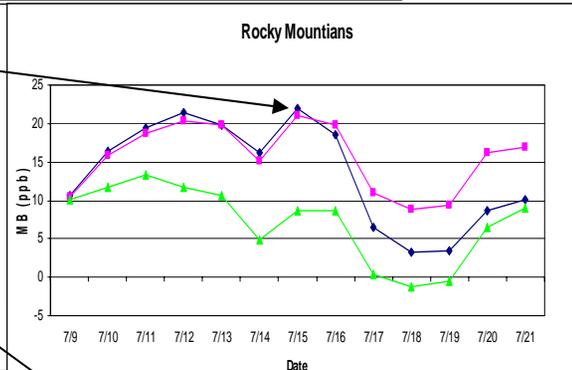
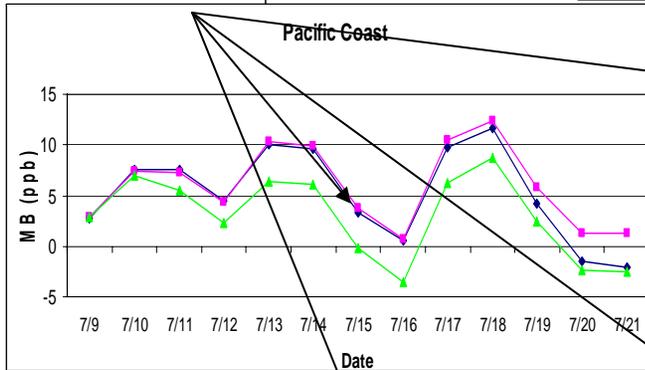
S3: switch-off above cloud entrainment

S4: ACM-based cloud mixing + Photolysis change

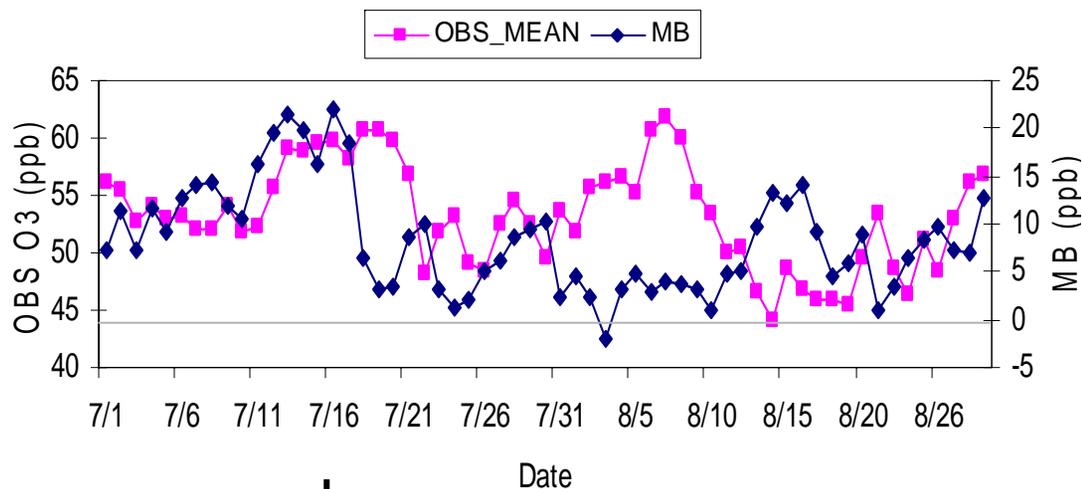


S3+default

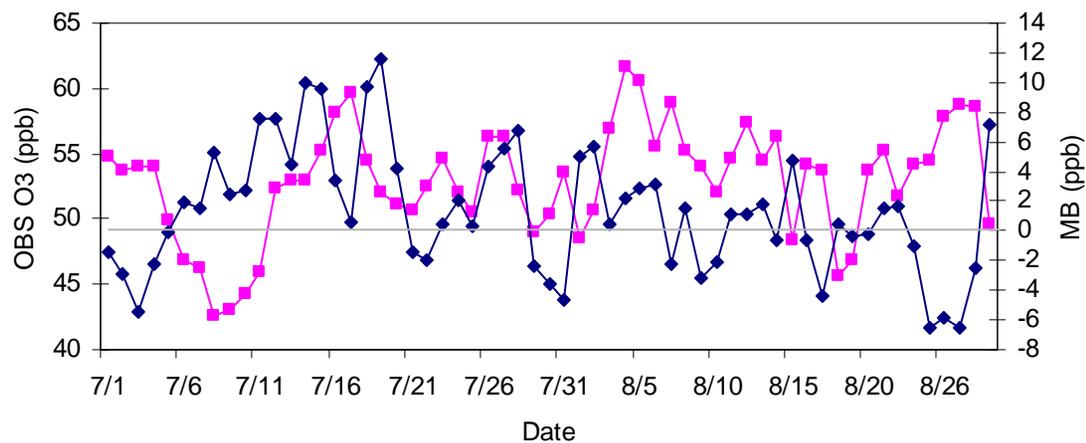
S3+default



5x Domain: Sub-region Analysis

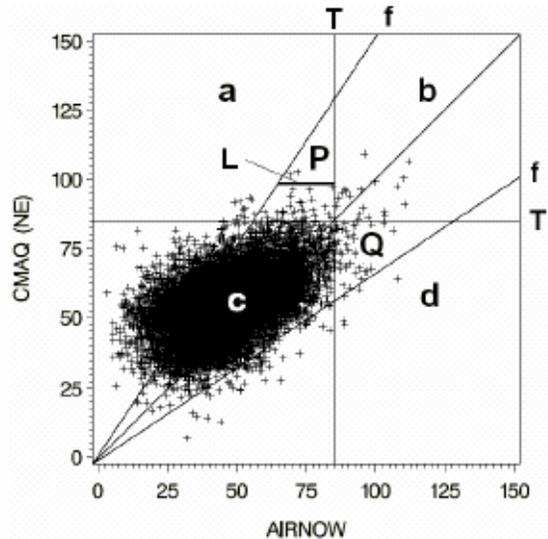


Consistent high bias with GFS LBC ← | → Reduced bias after implementation of static LBCs



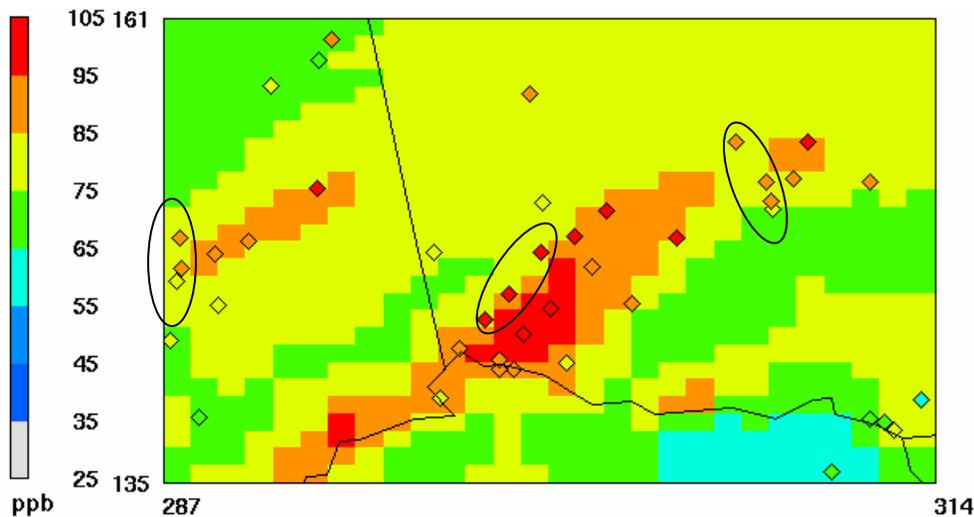
Typically under-predict in CA?

Practical Extension of the Concept of Hit Rate



$$H = \left(\frac{b}{b + d} \right) \cdot 100\%$$

% of Observed exceedances that are forecasted

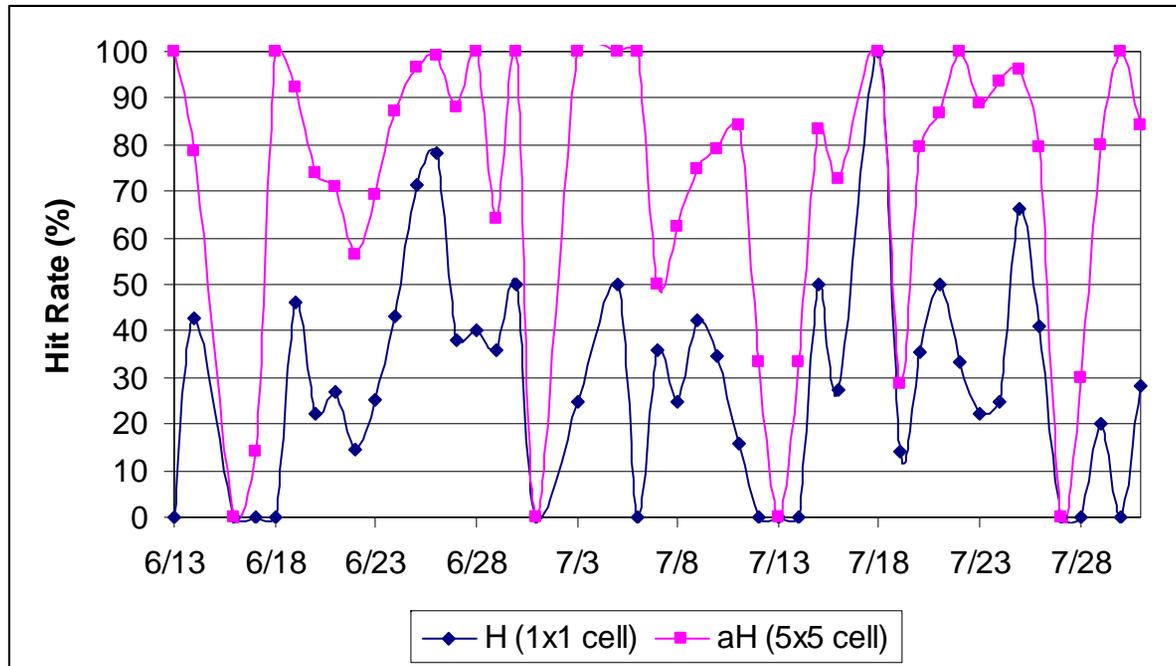


“Area” Hit Rate

$$aH = \left(\frac{Ab}{Ab + Ad} \right) \cdot 100\%$$

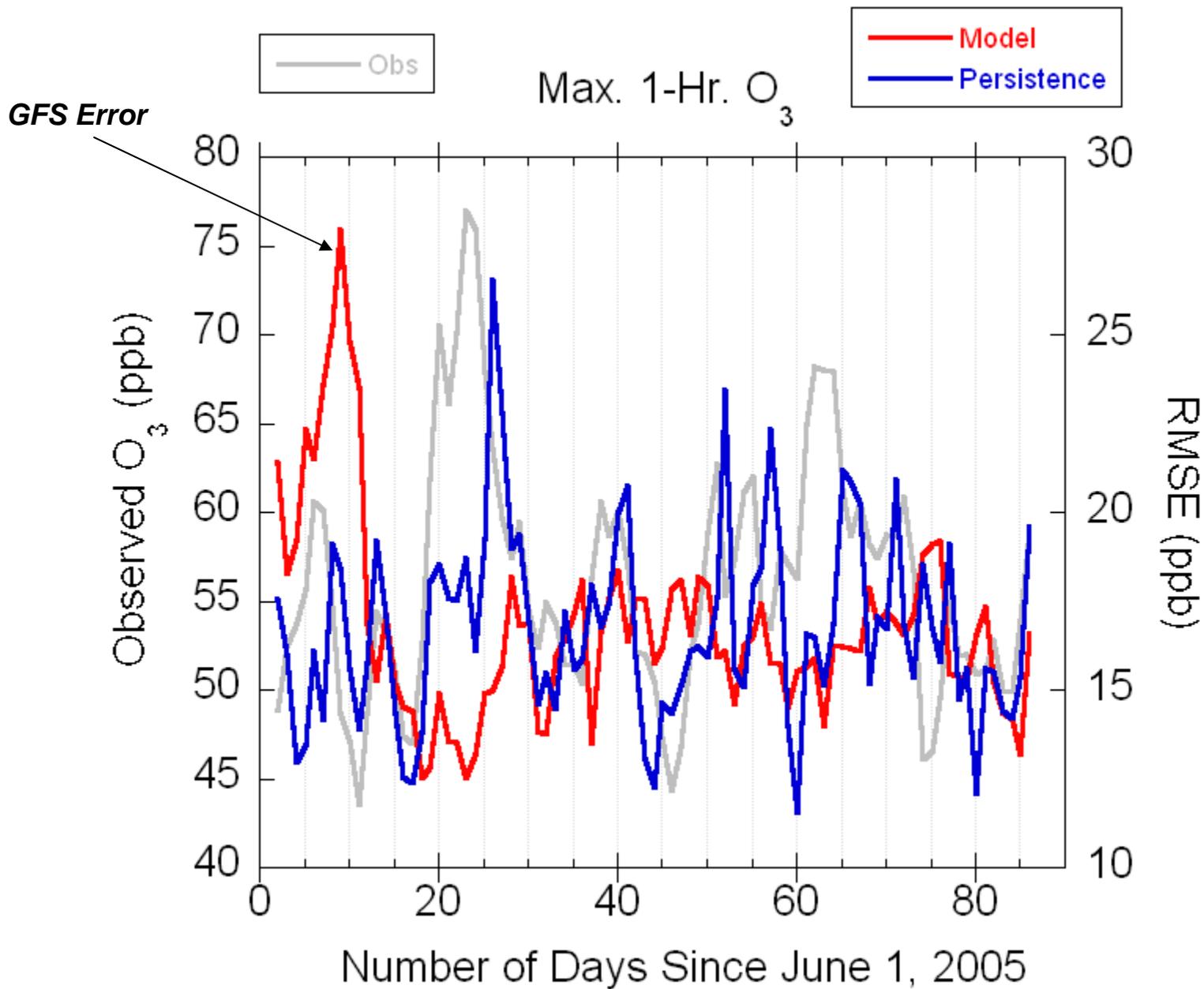
% of Observed exceedances that are forecasted within a **region** surrounding the observation location

Practical Extension of the Concept of Hit Rate



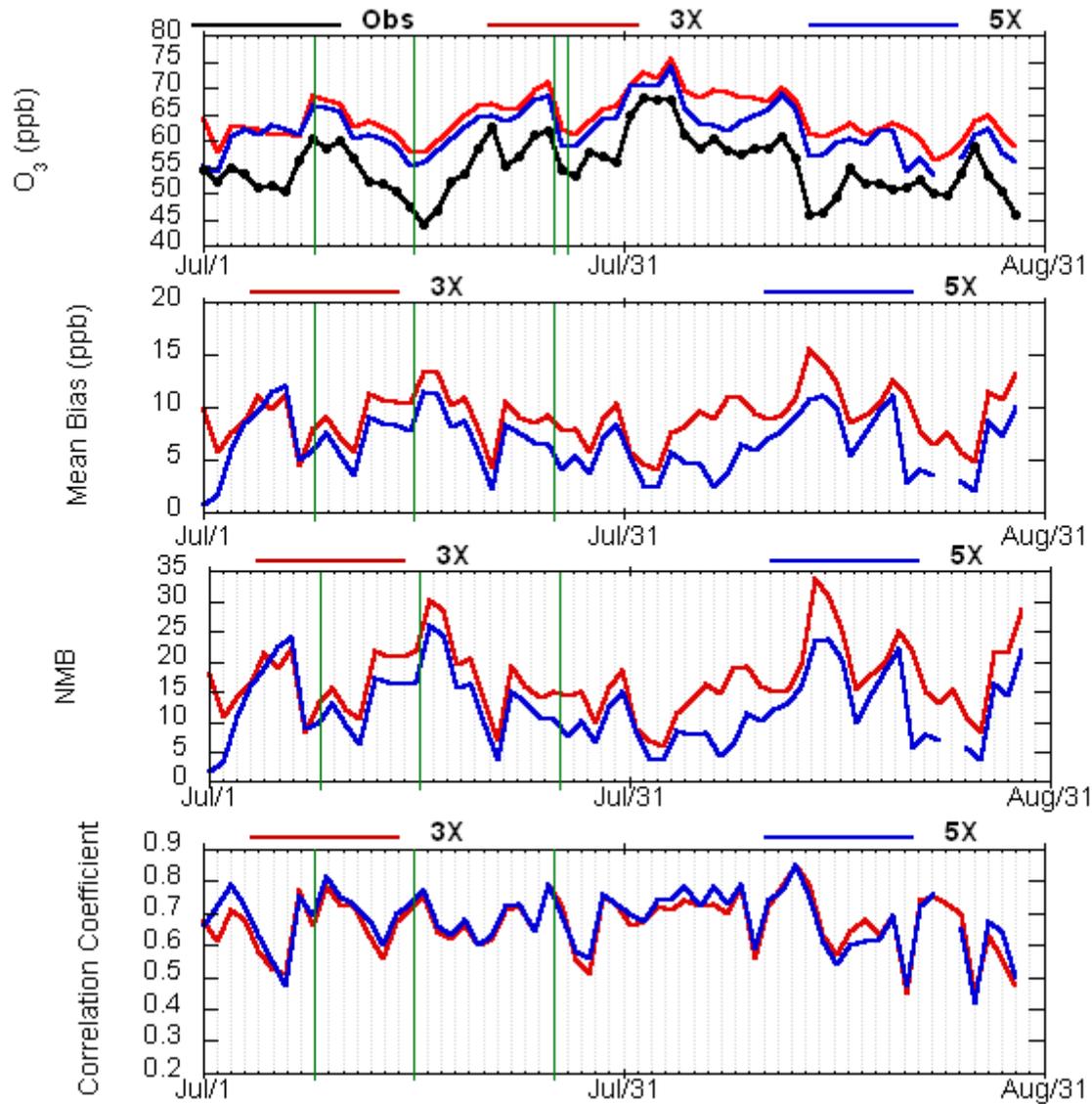
Next step: Extend the definition of area to be a metropolitan region

Comparison with Persistence: 3x Domain



Disclaimer: *The research presented here was performed under the Memorandum of Understanding between the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) and under agreement number DW13921548. This work constitutes a contribution to the NOAA Air Quality Program. Although it has been reviewed by EPA and NOAA and approved for publication, it does not necessarily reflect their views or policies.*

Comparison of 3x and 5x Performance: Max. 1-Hr O₃



7/9: S4 config. replaced with S3 (5x)

7/16: S3 with static LBC(5x)

7/26: S4 with static LBC(5x)