Monthly Technical Report

PROJECT TITLE	Constraining NO_x Emissions Using Satellite NO_2 Measurements Over The Southeast Texas	PROJECT #	14-014
PROJECT PARTICIPANTS	University of Houston	DATE SUBMITTED	7/8/2015
REPORTING PERIOD	From: June 1, 2015 To: June 30, 2015	REPORT #	1
	University of Houston	Invoice # N/A	Amount $0.00

A Financial Status Report (FSR) and Invoice will be submitted separately from each of the Project Participants reflecting charges for this Reporting Period. I understand that the FSR and Invoice are due to the AQRP by the 15th of the month following the reporting period shown above.

Detailed Accomplishments by Task

1. Evaluated impact of emission changes on model NO_x concentrations.

In previous report, we finished inverse modeling and obtained posteriori emissions (named NEI2011n). In addition, we finished CMAQ modeling using the posteriori emissions and calculated surface ozone statistics. We also showed that the posteriori emissions constrained by OMI tropospheric NO_2 have improved the simulated tropospheric NO_2 compared to satellite, as well as ozone on September 25th compared to aircraft measurement.

Here, we provide additional comparisons to investigate the impact of inverse modeling.

Surface NO_x in 4-km Domain Using NEI 2011 and NEI 2011n

Typically NO_x concentrations reach maximum in morning time, hence we present the spatial contour for simulated NO_x. Figure 1 shows the simulated NO_x mixing ratios with original NEI2011, averaged over 06-12 local time. High NO_x area located in the urban regions: Houston, Beaumont, and Lake Charles. Comparison of CAMS sites and model simulation shows a correlation coefficient of 0.85, mean bias of 3.6 ppbv and RMSE of 4.72 ppbv. The comparison is made with hourly data averaged over all observation sites. The positive NO_x biases are likely the results of high NO_x emissions in the original inventory.
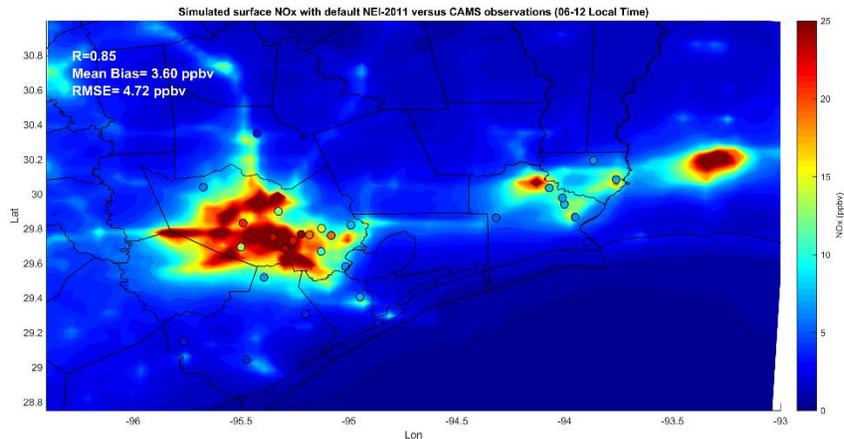
Figure 1. Comparison of simulated surface NO_x overlaid with CAMS observations (small circles) in morning time -- original NEI2011.

In order to reduce the high biases in NO_x emissions, we performed inverse modeling by using OMI tropospheric NO_2 measurements to constrain the emissions. The updated emission through inverse modeling is named NEI2011n. The simulated surface NO_x with NEI2011n is shown in Figure 2. Although the correlation coefficient was not improved, the mean bias (2.88 ppbv) and RMSE (3.83 ppbv) decreased. The largest bias reduction is seen at the center of Houston.
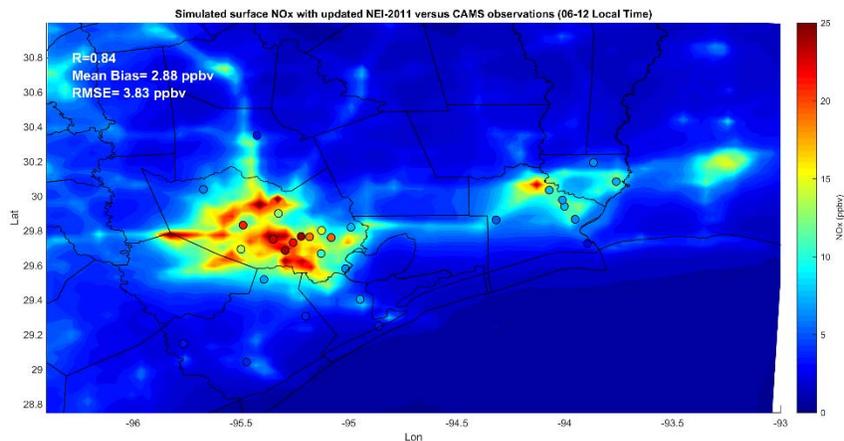

Figure 2. Comparison of simulated surface NO_x overlaid with CAMS observations (small circles) in morning time -- NEI2011n.

Time Series of Simulated and Observed Surface NOx Levels

In order to study the temporal variations in measured NO_x levels and our model simulation, we compare the time series of observed and simulated NO_x levels in Houston Metro Area using data from more than 20 CAMS sites. Figure 3 shows consistent overprediction of daily NO_x peaks by using original NEI2011 in most of the days. With adjusted NEI2011 emissions, new simulation shows that mean bias and RMSE of NO_x decreased by 24% and 15% respectively. The simulated NO_x biases decrease for most of the days, except Sep. 25th. The large NO_x biases for Sep. 25th might be caused by a missing source in the model.
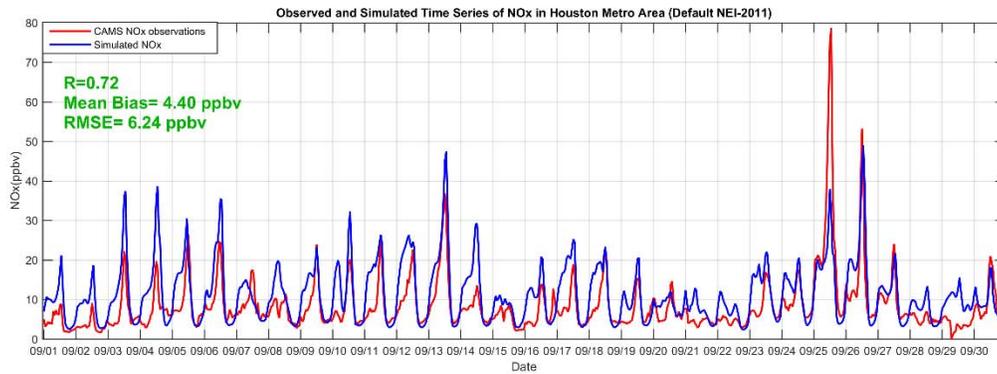
Figure 3. Time series of simulated and observed surface NOₓ levels in Houston Metro Area -- NEI2011 (original)
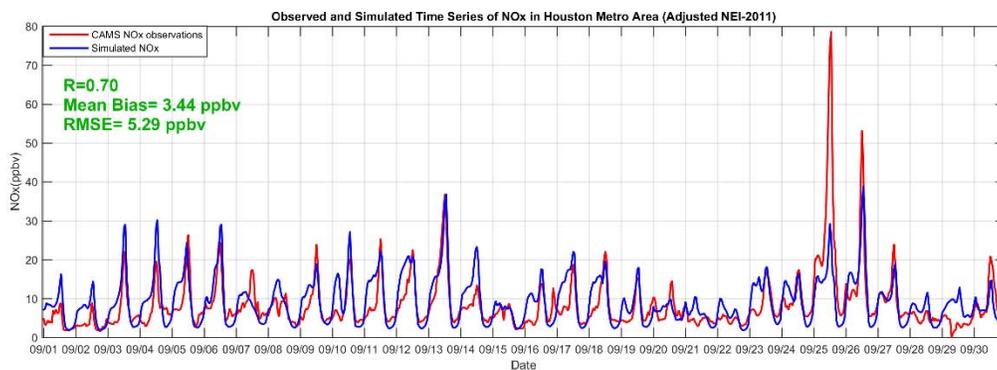

Figure 4. Time series of simulated and observed surface NOₓ levels in Houston Metro Area -- NEI2011n (updated)

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments

We have not encountered any problems in June.

Goals and Anticipated Issues for the Succeeding Reporting Period

We expect to finalize all the analyses and prepare for the final report.

Detailed Analysis of the Progress of the Task Order to Date

The completion of each of the project tasks and the draft and final reports are expected to be on the schedule from the Work Plan schedule.

Submitted to AQRP by: Yunsoo Choi

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