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**	8/8/2015
REPORTING PERIOD	**From:** July 1, 2015 **To:** July 31, 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 ozone and NOx concentrations. Both surface and aloft concentrations are compared.

2. Compared model HCHO with aircraft data.

Last month, 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.

Surface NO_2 Statistics Using NEI 2011 and NEI 2011n

We have finished a pair of CMAQ simulations with NEI 2011 and NEI2011n over Southeast Texas. Meteorology case, "1Hr-Objective Analysis (OA)", is used for both CMAQ simulations. In this meteorology, OA is run at 1-hr interval input.

The statistics for NO_2 is shown in Table 1. The statistics are based on CAMS data.

Table 1 Statistics of hourly surface NO_2

Case	N	Corr	IOA	RMSE	MAE	MB	O_M	M_M	O_SD	M_SD
NEI2011	19804	0.65	0.74	6.9	4.5	2.6	5.6	8.2	5.7	8.4
NEI2011n	19804	0.61	0.75	6.0	4.0	1.6	5.6	7.3	5.7	7.1

- N – data points; Corr – Correlation; IOA – Index of Agreement; RMSE – Root Mean Square Error; MAE – Mean Absolute Error; MB – Mean Bias; O – Observation; M - Model; O_M – Observed Mean; M_M – Model Mean; SD – Standard Deviation
- Units for RMSE/MAE/MB/O_M/M_M/O_SD/M_SD: ppb

It can be seen that the updated emission overall improved surface NO_2 statistics, with IOA increased by 0.01. A decrease in correlation is offset by better matches in mean and standard deviation. This is expected as NO_2 emission decreased in updated inventory.

Ozone Vertical Biases for NEI 2011 and NEI 2011n

Figure 1 shows ozone vertical biases (against aircraft measurements) for the old and updated emissions. Overall the differences are small after emission update. The only moderate change occurred at 200-300 meters level on 09/26 when NEI2011n case showed a smaller negative bias.

Above 1.5 km, the two cases are virtually the same. This is reasonable as the NO_2 emissions are only adjusted near surface. At higher altitude, NO_2 concentration is quite low and does not affect ozone level.

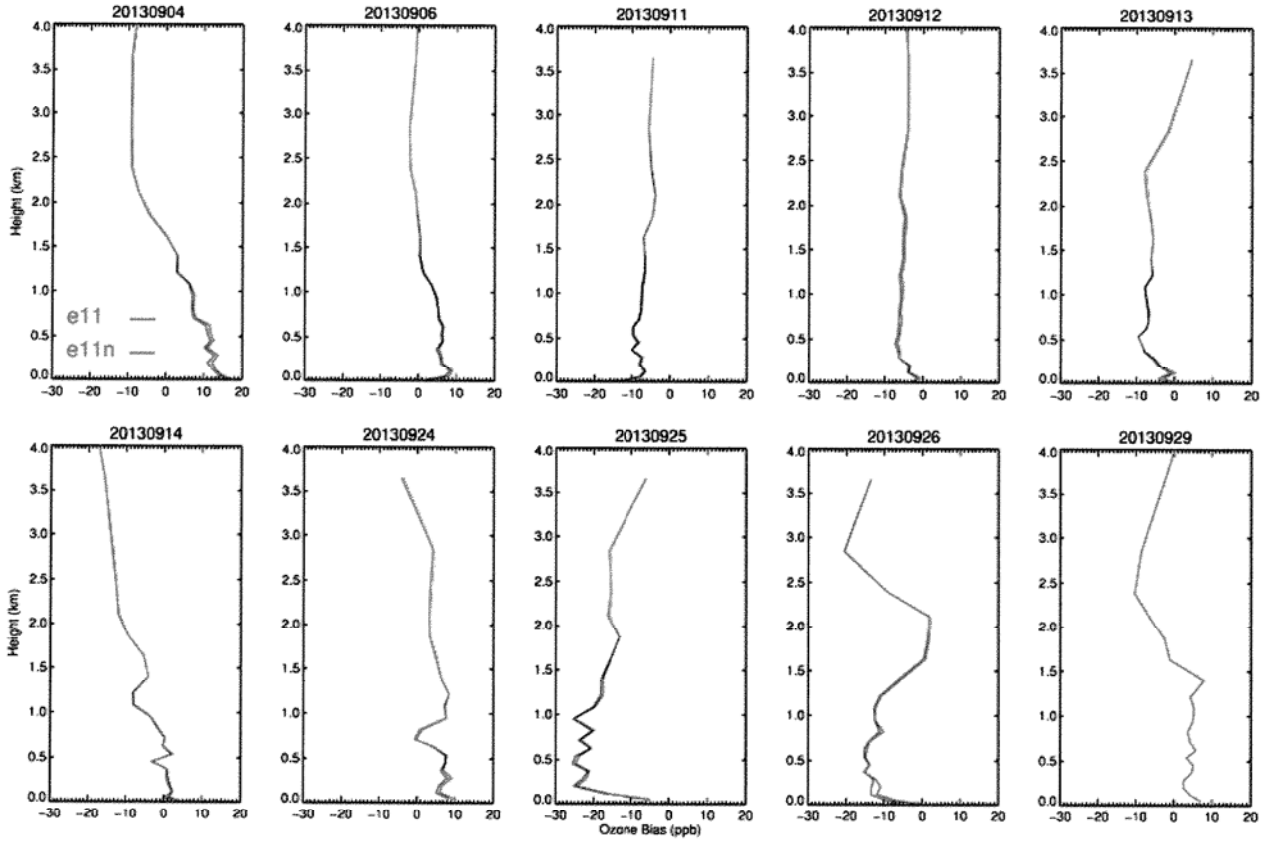

Figure 1. Ozone vertical biases for NEI2011 (red) and NEI2011n (blue). Measurements are aggregated over model grid cells

NO_2 Vertical Biases for NEI 2011 and NEI 2011n

Figure 2 shows NO_2 vertical biases (against aircraft measurements) for the old and updated emissions. The results are mixed – depending on the individual day and the height level. When the old case (NEI2011) showed a positive bias, the new case would improve the simulation by reducing the bias. On the other hand, when the old case had a negative bias, the new case would make the bias worse.

Above ~1.5 km, NO_2 concentrations fall below 1 ppb for both model and observation. There is usually minimal difference between the two cases.

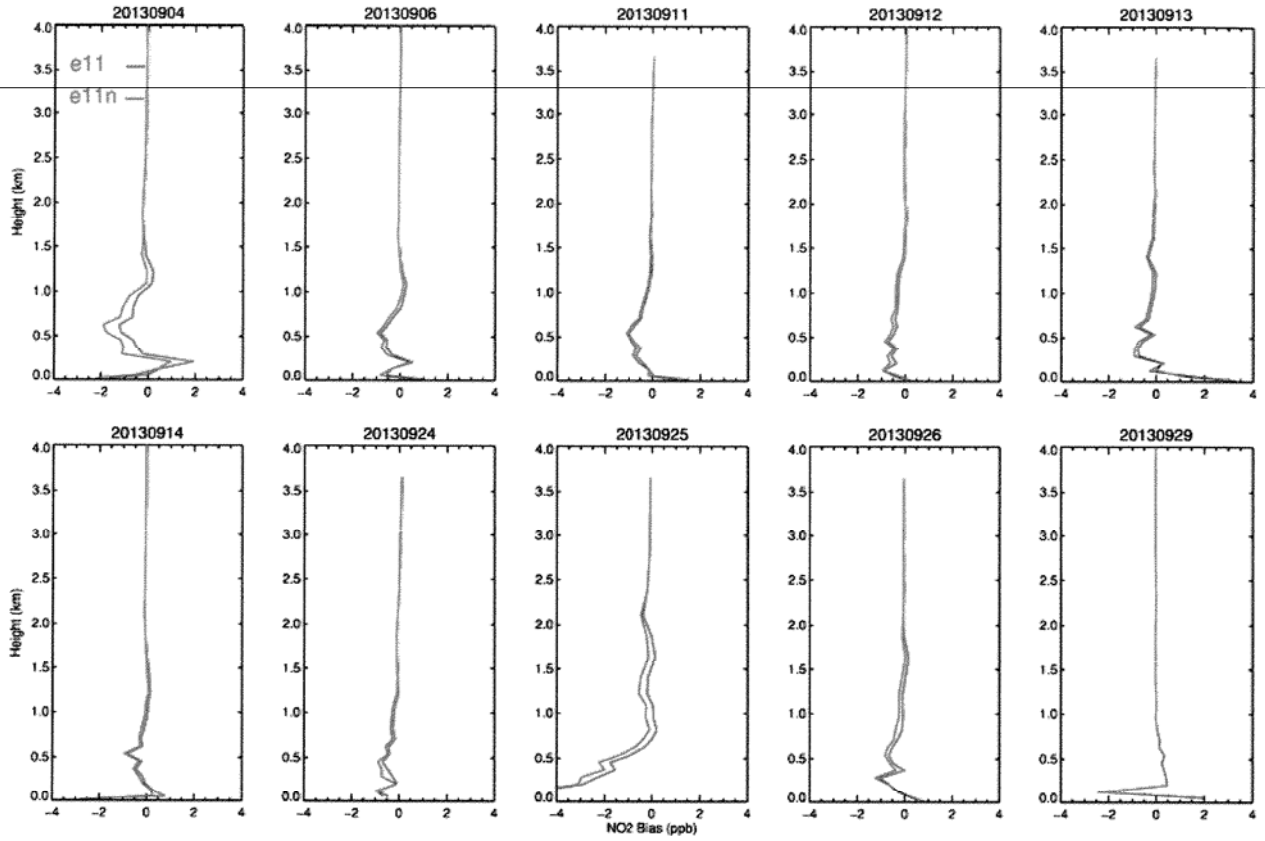

Figure 2. NO_2 vertical biases for NEI2011 (red) and NEI2011n (blue). Measurements are aggregated over model grid cells

Modeled HCHO Time Series for NEI 2011 and NEI 2011n

Figure 3a and 3b show HCHO time series as well as aircraft measurements for the old (NEI2011) and updated (NEI2011n) emission inventory.

The two figures have only minor difference, reflecting the fact that the HCHO sources are largely biogenic and there is no change in the underlying biogenic emissions after reverse modeling. Overall, the model has less oscillations and slightly lower values. There is a high observed peak on 09/25, corresponding to observed peaks in O_3 and NO_2. Similar to the situation in O_3 and NO_2, model did not capture the observed high values. We are still investigating the cause for the model misses on 09/25, and current results suggest problem in model winds played a role while the emission inventory could be also at fault.

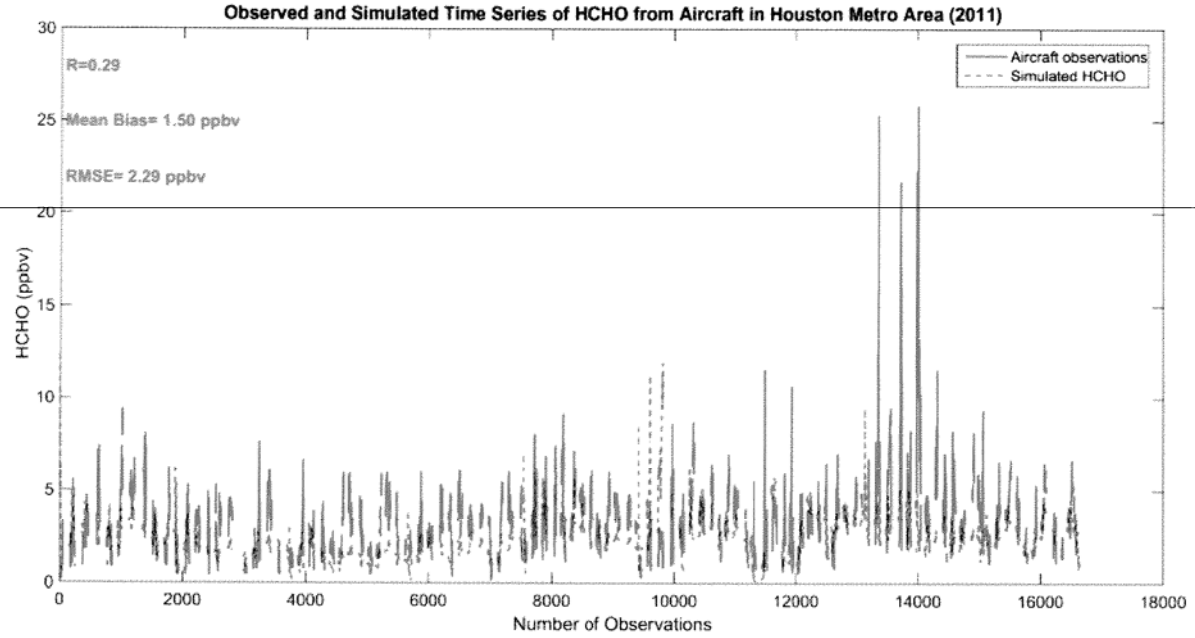

Figure 3a. Model and observed (aircraft) HCHO using NEI2011

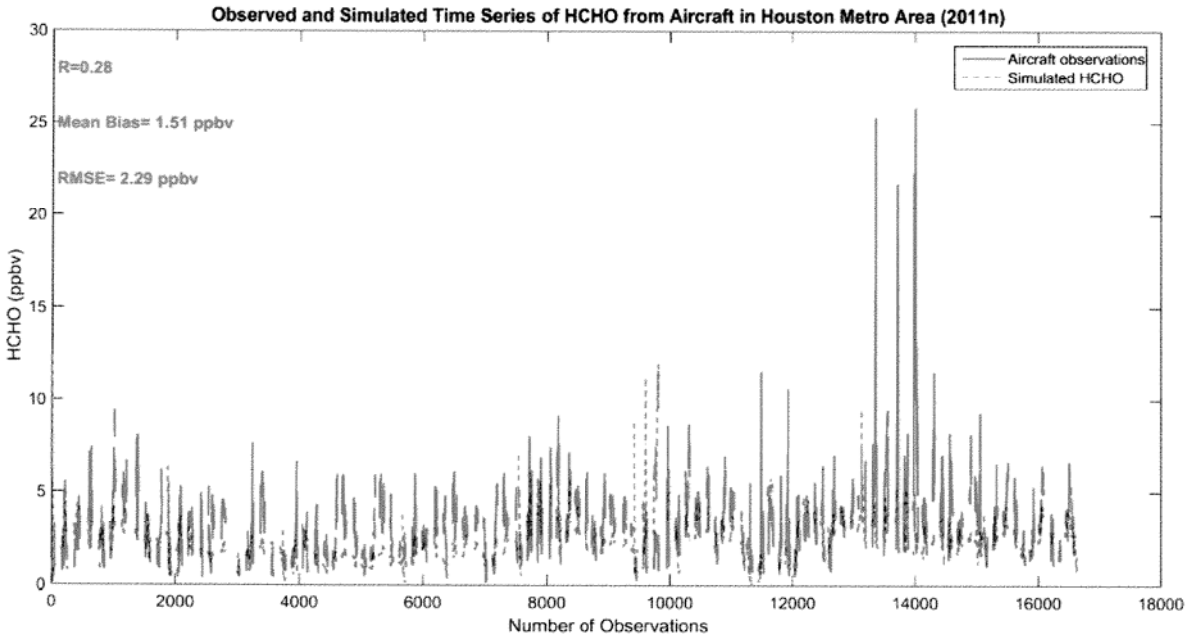

Figure 3b. Model and observed (aircraft) HCHO using NEI2011n

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments

We have not encountered any problems in July.

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

Principal Investigator: Yunsoo Choi