AQRP Monthly Technical Report

PROJECT TITLE	A synthesis study of the role of mesoscale and synoptic-scale wind on the concentrations of ozone and its precursors in Houston	**PROJECT #**	18-010
PROJECT PARTICIPANTS	Qi Ying, John Nielsen-Gammon	**DATE SUBMITTED**	5/20/2019
REPORTING PERIOD	**From:** 4/1/2019 **To:** 4/30/2019	**REPORT #**	7

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

Task 1: Synthesis of mesoscale wind structures in the synoptic-scale context

Dr. Nielsen-Gammon has completed his rewrite of my software for ingesting, interpolating, plotting, and analyzing the radar wind profiler data. The older version was not set up to work properly on the MADIS profiler data archive. Also, the original software was the first major programming task we performed in Python, and we are able to streamline the software and improve its accuracy and functionality. Now that the semester is over, We'll begin intensive work on analyzing the data and working up case studies. We are also involving an undergraduate student, Yijun Sun, in the programming and data analysis.

Task 3: Analysis of the interaction of mesoscale winds and ozone formation during key episodes

Continued to analyze the age distribution of ozone and its precursors. We invented a novel 2D age distribution diagram to visualize age distribution data. In the 2D age distribution plot (Figure 1), the x-axis represents time and the y-axis is the atmospheric age of species. In this plot, it is easy to find the age distribution of a species at a specific time and the times when regional transport is significant can also be determined easily.

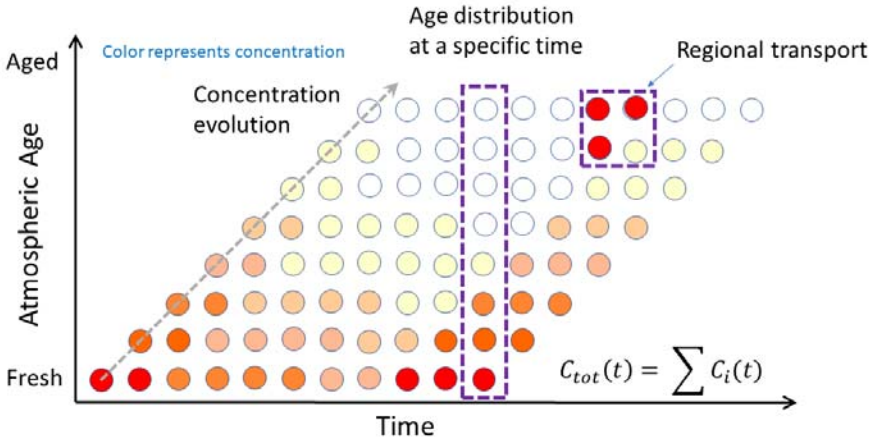

Figure 1 Conceptual illustration of the 2D atmospheric age distribution plot. For emissions at a given time, its concentration decreases as it spends more time in the atmosphere. This concentrations evolution can be tracked by following a diagonal line with a slope of 1 in the 2D plot. The age distribution at a specific time can be determined directly from the diagram.

Preliminary Analysis

Figure 2 shows the 2D age distribution plot for O3, NOy and NOx at Conroe, Texas from 8/20/2000 to 9/7/2000 based on a series of simulations (1 h, 3 h, and 6 h age resolutions) for the eastern US with a spatial resolution of 36 km. Concentrations of NOx shows clear diagonal evolutions for most of the days, indicating local contributions. From 8/26 to 8/28, concentrations of NOy (panel b) shows an abrupt increase for atmospheric ages of 3 to 7 hours, indicating some short-range regional transport. Corresponding, non-background O3 concentrations with similar atmospheric ages are also increased, leading to higher O3 concentrations on these days. The appearance of much aged NOy (without aged NOx) and O3 occurs almost every day during the first part of September.

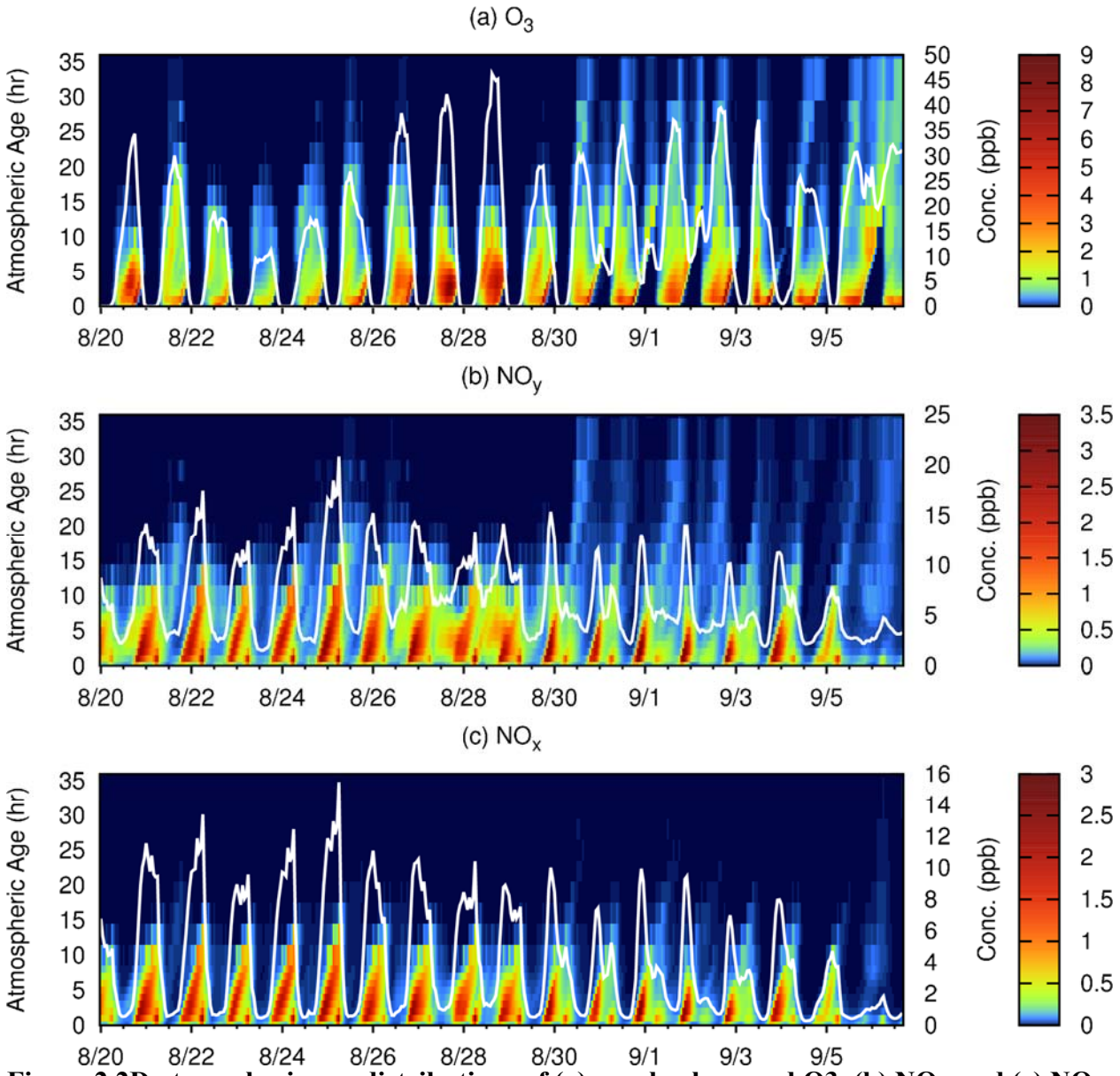

Figure 2 2D atmospheric age distributions of (a) non-background O3, (b) NOy and (c) NOx at Conroe, Texas.

Figure 3 shows the two high ozone periods at Galveston (8/30-31, and 9/4-5) are associated with different age distributions. The 9/4-5 high ozone days (especially on 9/5) are accompanied with much higher concentrations of NOx and NOy with a broader age distribution and a long aged tail. It is clear that the few-hours-old NOy and NOx (on 8/30 and 8/31) are recirculated local emissions but the 10-20 hours old species on 9/5 are more likely due to long-range transport from other regions. Figure 4 shows the same age distribution analysis for Port Arthur, Texas. The general patterns are similar to that of Galveston but a significant regional transport of O3 can be clearly seen on the night of 9/4. Transport of NOx and NOy can also be seen but NOy transport is much more significant.

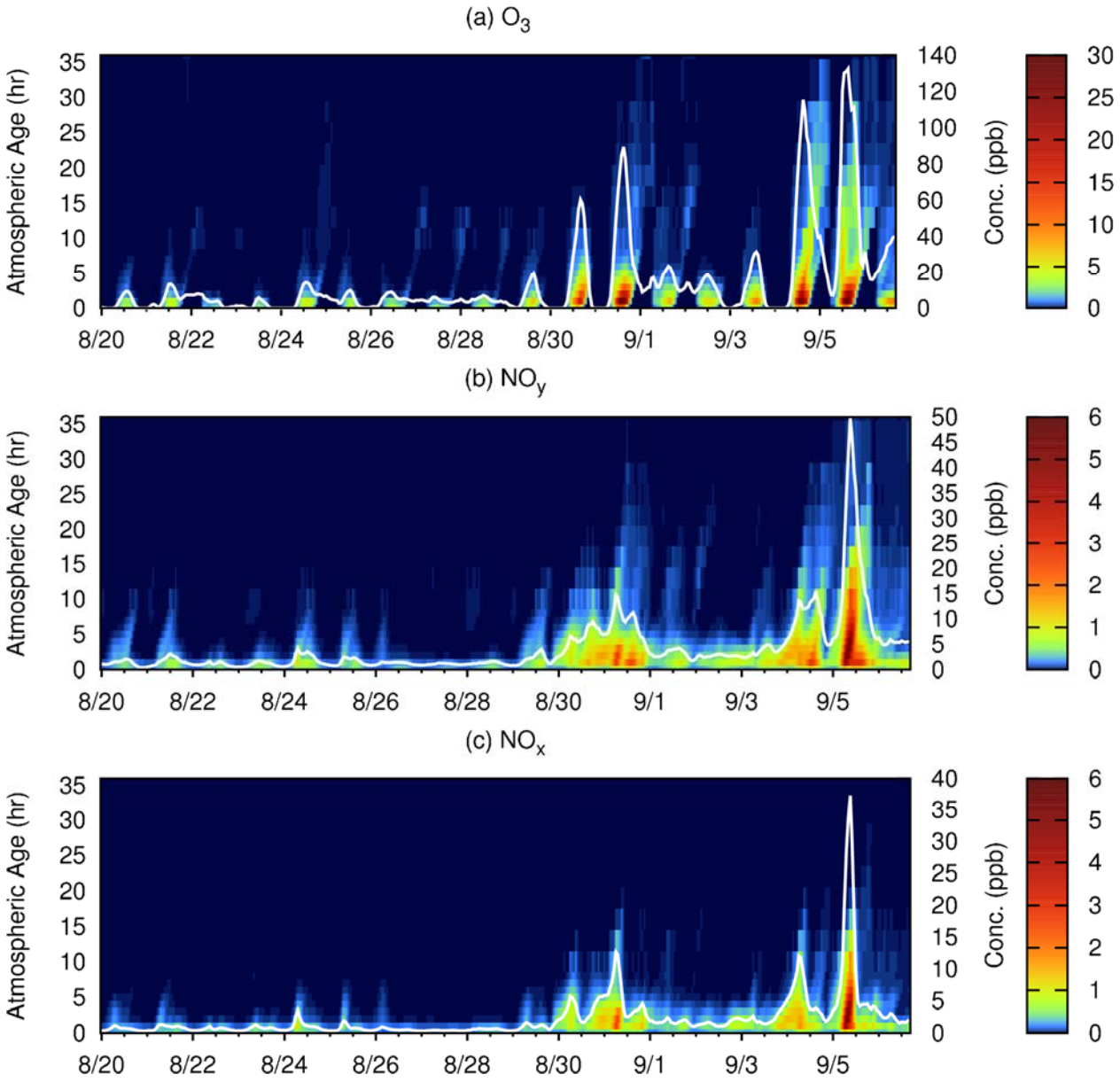

Figure 3 Same as Figure 2 but for Galveston, Texas.

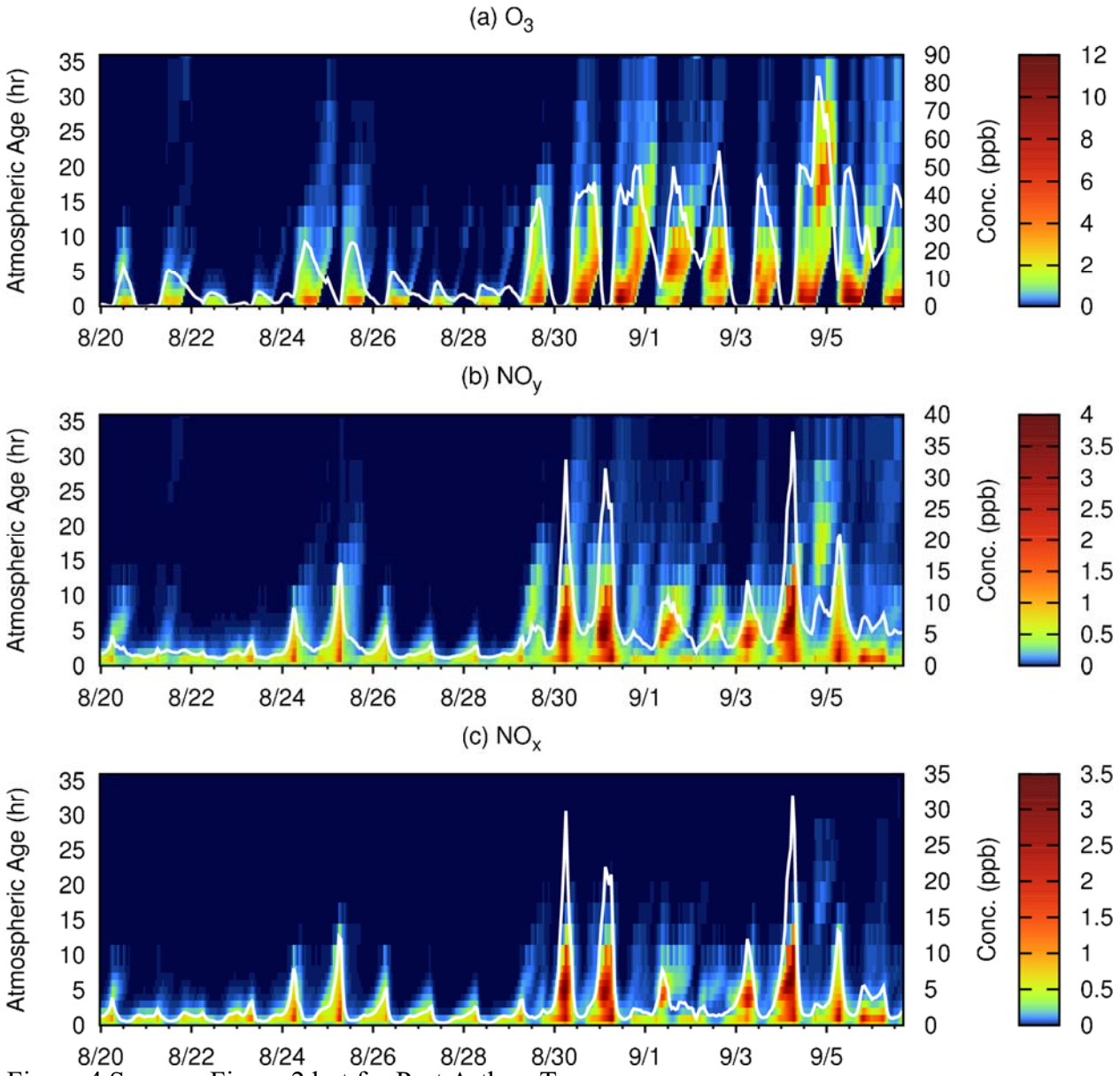

Figure 4 Same as Figure 2 but for Port Arthur, Texas.

Data Collected

No additional data were collected during this period.

Identify Problems or Issues Encountered and Proposed Solutions or Adjustments
None to report.

Goals and Anticipated Issues for the Succeeding Reporting Period

The 2D atmospheric age distribution plot is a powerful tool to analyze the time evaluation of O3 and its precursors. We will continue to do more data analysis with this tool. We plan to run the 12-km simulations to refine the model results. We will also report modeling preparation for other ozone episodes when such periods are identified.

Detailed Analysis of the Progress of the Task Order to Date

Task 2 (source and age resolved model development) has been completed. Task 1 is currently on-going with all necessary data retrieved. Task 3 is on-going for the year 2000 with good results. We believe that sufficient progress has been made in order to complete the project on time.

Do you have any publications related to this project currently under development? If so, please provide a working title, and the journals you plan to submit to.

_X__Yes ___No

We are working on a manuscript with a preliminary title "Improve the computation efficiency of source-oriented chemical mechanisms for the source apportionment of secondary gaseous and particulate pollutants", which we plan to submit to Atmospheric Environment.

Do you have any publications related to this project currently under review by a journal? If so, what is the working title and the journal name? Have you sent a copy of the article to your AQRP Project Manager and your TCEQ Liaison?

___Yes __X_No

Do you have any bibliographic publications related to this project that have been published? If so, please list the reference information. List all items for the lifetime of the project.

___Yes _X__No

Do you have any presentations related to this project currently under development? If so, please provide working title, and the conference you plan to present it (this does not include presentations for the AQRP Workshop).
___Yes _X__No

Do you have any presentations related to this project that have been published? If so, please list reference information. List all items for the lifetime of the project.

___Yes _X__No

Submitted to AQRP by Qi Ying, on May 20, 2018.

Principal Investigator