

# AQRP Monthly Technical Report

<b>PROJECT TITLE</b>	Source-sector NO <sub>x</sub> emissions analysis with sub-kilometer scale airborne observations in Houston during TRACER-AQ	<b>PROJECT #</b>	22-023
<b>PROJECT PARTICIPANTS</b>	George Washington University Ramboll	<b>DATE SUBMITTED</b>	4/10/2023
<b>REPORTING PERIOD</b>	<b>From:</b> March 1, 2023 <b>To:</b> March 31, 2023	<b>REPORT #</b>	8

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 15<sup>th</sup> of the month following the reporting period shown above.

## Detailed Accomplishments by Task for reporting period

### *Task 1: Simulate NO<sub>2</sub>, HCHO, O<sub>3</sub> at 444 × 444 m<sup>2</sup> spatial resolution using WRF-CAMx*

The first WRF-CAMx simulation was completed in February 2023. There is model output for the two GCAS measurement periods: August 30 – September 11, 2021 and September 23 – September 27, 2021 with additional days of spin-up prior to each episode that will not be utilized. The QA/QC of the simulation – comparison with ground monitor data – is currently on-going. Model output for all days in August and September for which there is GCAS data has been provided to the full team. In March 2023, the model was re-run to fix some of the model source apportionment tagging. QA/QC of the model output is on-going.

### *Task 2. Process the GCAS measurements*

The reprocessing of the GCAS aircraft measurements with very minor adjustments was completed in February 2023, and all new files were made available to the full team, and posted on the TRACER-AQ data archive (<https://www-air.larc.nasa.gov/cgi-bin/ArcView/traceraq.2021>). The GCAS measurements are now being re-processed with the CAMx model output.

This task should be completed in April 2023.

### *Task 3. Process the satellite NO<sub>2</sub> data*

The satellite air mass factor has been processed for all days in September using the CAMx model output, and the resulting data has been provided to the team. Further minor adjustments may be made in April 2023.

This task should be completed in April 2023.

### *Task 4. Calculating NO<sub>x</sub> from NO<sub>2</sub> airshed measurements*

NO<sub>x</sub> emissions from several point sources (W.A. Parish Power Plant, Texas City, Bayview ExxonMobil, Lyondell Basell Channelview, and Mont Belvieu) were calculated from the new GCAS data. The team was able to generate reasonable NO<sub>x</sub> emissions estimates from these point

sources. Additional QA/QC on the methodology – and comparison with the CEMS data when available – will occur in April 2023.

Additionally, NO<sub>2</sub> divergence has been calculated for the Houston area. On-going work is determining which assumptions should be made in order to calculate NO<sub>x</sub> emission rates.

This task should be completed in April 2023.

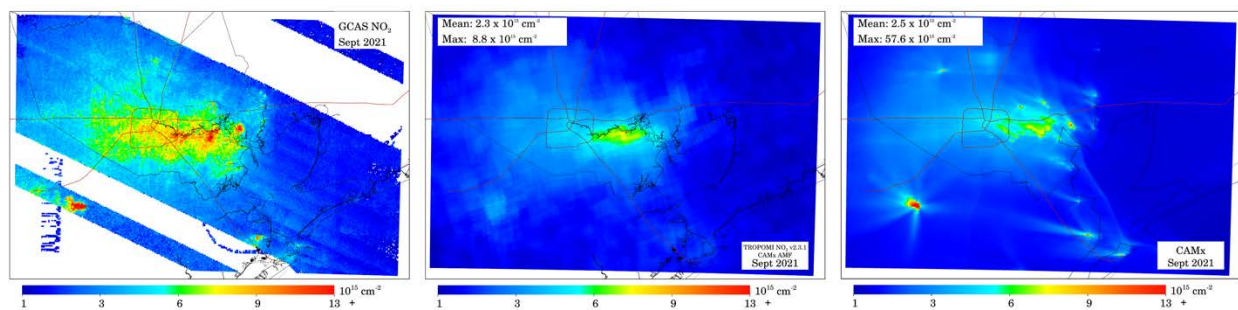
#### Task 5. Comparison of NO<sub>2</sub>, HCHO, O<sub>3</sub> between model, aircraft, and satellite

An in-depth comparison between the aircraft, satellite, model, and Pandora instruments for NO<sub>2</sub> is on-going. Additional results are expected in April 2023.

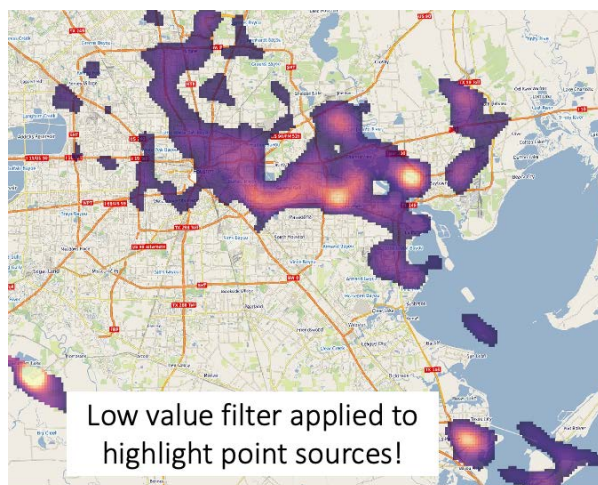
#### Task 6. Use of machine learning to estimate emission factors for individual sectors

Task 6 has not yet been initiated.

### Preliminary Analyses



**Figure 1.** Column NO<sub>2</sub> averaged during the early afternoon for September 2021. Left panel shows the monthly average from the aircraft (GCAS). Center panel shows the monthly average from the satellite (TROPOMI) with an air mass factor re-processed using the CAMx model simulation. Right panel shows the monthly average from the CAMx model simulation. All datasets are on the same grid.



**Figure 2.** Smoothed NO<sub>2</sub> flux divergence – incremental addition of NO<sub>2</sub> in each grid cell – using all the measurements from the GCAS aircraft. Lighter color are larger values, darker colors are smaller values; *a low value filter is applied to highlight point sources*. Additional assumptions will need to be made to derive NO<sub>x</sub> emission rates.

**Data Collected**

None.

**Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments**

Project approvals occurred later than anticipated. Development of the WRF-CAMx simulation was delayed by approximately 8-weeks. Model simulation output was delivered to the full team at the end of February 2023 instead of the end of December 2022. Effort for Tasks 3 – 6 will be back-loaded, and we do not anticipate any end-of-project delays.

The TEMPO launch has been delayed to April 2023, and data is not expected to be made public until September 2023 and therefore will not be available during our project period. The inclusion of TEMPO data was a minor aspect of Task 3 of this project, and therefore exclusion of its data will not affect any end-of-project deliverables.

**Goals and Anticipated Issues for the Succeeding Reporting Period**

Task 1 – Relevant *source apportionment* WRF-CAMx model output for NO<sub>2</sub> for the two GCAS measurement periods: August 30 – September 11, 2021 and September 23 – September 27, 2021 will be provided to the full team. The model output will continue to go through a QA/QC check and a comparison of the model output with the ground monitors will be conducted.

Tasks 2 & 3 – Re-processing of the air mass factor for the satellite and aircraft (GCAS) data should be completed by the end of April 2023.

Task 4 – NO<sub>x</sub> emissions estimates from the point sources and using the flux divergence method will be go through additional QA/QC.

Task 5 – Intercomparison between the aircraft (GCAS), satellite (TROPOMI), and model (WRF-CAMx) will continue.

Task 6 – This will start in April 2023.

**Detailed Analysis of the Progress of the Task Order to Date**

None.

**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.**

Yes       No

**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       No

**Do you have any bibliographic publications (ie: publications that cite the project) 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       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       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       No

**Have any personnel changes occurred that were not listed in the original proposal? If so, please include a detailed description of the personnel change(s) below.**

Yes       No

**Are any delays expected in the progress of the research? If so, please include a detailed description of the potential delay below.**

Yes       No

**Describe any possible concerns/issues (technical or non-technical) that AQRP should be made aware of.**

None.

**Are you anticipating using all the available funds allocated to this project by the end date? If not, why and approximately what is the amount to be returned?**

Yes       No

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Submitted to AQRP by      Daniel Goldberg

Principal Investigator      Daniel Goldberg