

AQRP Monthly Technical Report

PROJECT TITLE	Using Satellite Observations to Quantify Surface PM_{2.5} Impacts from Biomass Burning Smoke	PROJECT #	20-005
PROJECT PARTICIPANTS	Matthew Alvarado, Archana Dayalu, Qiang Sun (AER)	DATE SUBMITTED	12/08/2020
REPORTING PERIOD	From: 11/01/2020 To: 11/30/2020	REPORT #	4

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 for reporting period

We completed processing of the IASI NH₃ and CO data set, and have created an aggregated data set of NH₃, CO, and NH₃/CO for the 93-day temporal subset in the study domain. We have begun synthesizing key components of Tasks 1 and 2 into a standalone deliverable. In particular, we are in the process of creating a Smoke Confidence Index (SCI) that combines information from the three smoke products (NOAA HMS, GOES ADP, and TROPOMI UVAI) evaluated in Task 1. We are constructing a near-final dataset that merges all Task 1 components as well as plume height and aerosol optical depth values from Task 2. We have also begun synthesizing documentation in preparation for the Task 1 and 2 sections of the final report.

Preliminary Analysis

We are using the HMS, GOES, and UVAI smoke products to establish Smoke Flags and used them to directly derive a simple SCI. NH₃, CO, NH₃/CO, and OMI Brown Carbon data provides important supplementary information for further interpreting output from the SCI including for specific dates or events of interest. The final synthesized data set will be structured according the table below. Additional variables may be included in this table in the future (e.g. Plume horizontal extent, etc). This synthesized dataset also enables our planned Figure of Merit in Space (FMS) calculations using the Smoke_Flag and spatiotemporal variables. For instance, if we wish to examine GOES overlap with HMS for a time period of interest, the FMS can be conducted by selecting all pixels associated with a Smoke_Flag value of “11”. As part of our smoke flag system, we additionally note the following:

1. For a pixel to qualify as a GOES smoke pixel, it must meet the GOES “good quality” criterion; otherwise it is flagged as “no smoke”.
2. For NOAA HMS, we have condensed their semi-qualitative smoke density designation (low/med/high) into a single smoke/no-smoke designation.
3. For TROPOMI UVAI, pixels where $0 < UVAI \leq 3$ are designated as smoke.

Variable	Description
Lon	Longitude, degrees E (range: -120E to -80E)
Lat	Latitude, degrees N (range: 10N to 40N)
Date (YYYYMMDD)	Year, Month, and Day of measurement
Time (UTC)	Time of Measurement (UTC), rounded to hourly
Smoke_Flag	00=No smoke in any product 01=No overlap; HMS only 02=No overlap; GOES only 03=No overlap; UVAI only 11=HMS+GOES overlap 12=GOES+UVAI overlap 13=UVAI+HMS overlap 20=3-way overlap
Smoke_Confidence_Index	Smoke Product Confidence Index: 0-4, none/low/med/high system that simply bins/categorizes the Smoke_Flag variable. Smoke_Flag 00 => SCI = 0 (None/No Smoke) Flag of 01 02 03 => SCI = 1 (low confidence) Flag of 11 12 13 => SCI = 2 (med confidence) Flag of 20 => 3 SCI = (high confidence)
GOES_AOD	Aerosol Optical Depth from GOES
PLUME_HEIGHT_AOD	Plume Height estimated from MAIAC relationship with AOD (based on Cheeseman et al. 2020 relation)
NH3_CO_ratio	Ratio of total columns. Note that only total column measurements that are proximal in time have their ratios calculated. The threshold for temporal proximity is ± 3000 sec (± 49 minutes). The value is set to NA otherwise.
CO_Total_Column	Total column CO (molec cm ⁻²)
OMI_BrC_Cluster_ID	1=potential smoke mixtures, 2=non-smoke, 3=heavy smoke
OMI_AAE	Absorption Ångstrom Exponent
OMI_EAE	Extinction Ångstrom Exponent

Data Collected

We replaced AIRS CO with IASI CO for consistency with IASI NH₃. We collected IASI CO for the 93-day study subset.

Identify Any Problems or Issues Encountered and Proposed Solutions or Adjustments

None

Goals and Anticipated Issues for the Succeeding Reporting Period

We will have a synthesized data set with example FMS calculations and plume height statistics.

Detailed Analysis of the Progress of the Task Order to Date

We have selected 93 dates between January and July 2020 with suspected smoke intrusions in the Texas area. For these dates:

- We are completing and refining our comparisons of three different smoke products, the first milestone of Task 1 from the task order. We will also incorporate time of measurement to further refine our comparisons.
- We have begun our comparison with OMI brown carbon estimates derived from AOD and AAOD measurements.
- We have also begun our comparison with IASI CO and IASI total column NH₃ data.
- We have begun our analysis of plume heights associated with smoke pixels from GOES; we are using a published relationship of MAIAC plume heights and aerosol optical depth associated with GOES smoke pixels.
- Merging/Synthesis of all the Task 1 and 2 components thus far and placing them on a common grid.
- Development of a Smoke Confidence Index

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

Identifying Smoke-Impacted Regions using the Optical Properties of Brown Carbon Aerosol, accepted for poster at AGU Fall Meeting

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

Identifying Smoke-Impacted Regions using the Optical Properties of Brown Carbon Aerosol, accepted as oral presentation at the CMAS Fall Meeting

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

We added AER Sr. Research Associate Qiang Sun to the project to help gather and process data for Task 1.

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

Submitted to AQRP by
Matthew James Alvarado