SF 424

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Application for Federal Assistance SF-424

* 1. Type of Submission:	* 2. Type of Application:	* If Revision, select appropriate letter(s):
❍ Preapplication	● New	
● Application	❍ Continuation	* Other (Specify)
❍ Changed/Corrected Application	❍ Revision	

* 3. Date Received:	4. Applicant Identifier:
11/26/2024	daniel.tong

5a. Federal Entity Identifier:	5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:	7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name:	George Mason University

* b. Employer/Taxpayer Identification Number (EIN/TIN):	* c. UEI:
54-0836354	EADLFP7Z72E5

d. Address:

* Street1:	4400 University Dr.
Street2:	
* City:	Fairfax
County/Parish:	
* State:	VA: Virginia
Province:	
* Country:	USA: UNITED STATES
* Zip / Postal Code:	220304422

e. Organizational Unit:

Department Name:	Division Name:
Office of Sponsored Programs	

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:	Mrs.	* First Name:	Margaret
Middle Name:			
* Last Name:	Ewell		
Suffix:			

Title:	Director, Pre Award
Organizational Affiliation:	
* Telephone Number:	703-993-4806
Fax Number:	
* Email:	proposal@gmu.edu

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

H: Public/State Controlled Institution of Higher Education

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

DOC NOAA - ERA Production

11. Catalog of Federal Domestic Assistance Number:

11.459

CFDA Title:

Weather and Air Quality Research

*** 12. Funding Opportunity Number:**

NOAA-OAR-WPO-2025-28603

* Title:

FY2025 Weather Program Office Research Programs Announcement - Air Quality Research and Forecasting (AQRF)

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

File Name:

*** 15. Descriptive Title of Applicant's Project:**

Improving High-resolution Anthropogenic and Fire Emissions to Support National Air Quality Forecasts over North America

Attach supporting documents as specified in agency instructions.

File Name:

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: VA-011 * b. Program/Project: VA-011

Attach an additional list of Program/Project Congressional Districts if needed.

17. Proposed Project:

* a. Start Date: 08/01/2025 * b. End Date: 07/31/2028

18. Estimated Funding ($):

* a. Federal	880,000.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	880,000.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

❍ a. This application was made available to the State under the Executive Order 12372 Process for review on .

❍ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

● c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes", provide explanation in attachment.)**

❍ Yes ● No

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☑ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: Mrs. * First Name: Margaret

Middle Name:

* Last Name: Ewell

Suffix:

* Title: Director, Pre Award

* Telephone Number: 703-993-4806 Fax Number:

* Email: proposal@gmu.edu

* Signature of Authorized Representative: Margaret.Ewell * Date Signed: 11/26/2024

BUDGET INFORMATION - Non-Construction Programs

OMB Approval No. 4040-0006
Expiration Date 02/28/2025

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1 . NOAA-OAR-WPO-2025-28603	11.459	$0.00	$0.00	$330,000.00		$330,000.00
2 . NOAA-OAR-WPO-2025-28603	11.459	$0.00	$0.00	$250,000.00		$250,000.00
3 . NOAA-OAR-WPO-2025-28603	11.459	$0.00	$0.00	$300,000.00		$300,000.00
4 .						$0.00
5. Totals		$0.00	$0.00	$880,000.00	$0.00	$880,000.00

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)
	(1) NOAA-OAR-WPO-2025-28603	(2) NOAA-OAR-WPO-2025-28603	(3) NOAA-OAR-WPO-2025-28603	(4)	
a. Personnel	$148,463.00	$112,561.00	$136,896.00		$397,920.00
b. Fringe Benefits	$31,392.00	$19,662.00	$26,386.00		$77,440.00
c. Travel	$5,428.00	$5,428.00	$5,428.00		$16,284.00
d. Equipment	$0.00	$0.00	$0.00		$0.00
e. Supplies	$3,000.00	$0.00	$0.00		$3,000.00
f. Contractual	$0.00	$0.00	$0.00		$0.00
g. Construction	$0.00	$0.00			$0.00
h. Other	$25,655.00	$26,211.00	$26,796.00		$78,662.00
i. Total Direct Charges (*sum of 6a-6h*)	$213,938.00	$163,862.00	$195,506.00		$573,306.00
j. Indirect Charges	$116,062.00	$86,138.00	$104,494.00		$306,694.00
k. TOTALS (*sum of 6i and 6j*)	$330,000.00	$250,000.00	$300,000.00		$880,000.00
7. Program Income					$0.00

Standard From 424A (Rev. 7-97)
Prescribed by OMB Circular A-102

SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program		(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS
8 . NOAA-OAR-WPO-2025-28603		$0.00	$0.00	$0.00	$0.00
9 . NOAA-OAR-WPO-2025-28603		$0.00	$0.00	$0.00	$0.00
10 . NOAA-OAR-WPO-2025-28603		$0.00	$0.00	$0.00	$0.00
11 .					$0.00
12. TOTAL (sum of lines 8-11)		$0.00	$0.00	$0.00	$0.00
SECTION D - FORECASTED CASH NEEDS					
13. Federal	**Total for 1st Year**	**1st Quarter**	**2nd Quarter**	**3rd Quarter**	**4th Quarter**
	$330,000.00	$82,500.00	$82,500.00	$82,500.00	$82,500.00
14. Non-Federal	$0.00				
15. TOTAL (*sum of lines 13 and 14*)	$330,000.00	$82,500.00	$82,500.00	$82,500.00	$82,500.00
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program		FUTURE FUNDING PERIODS (Years)			
		(b) First	(c) Second	(d) Third	(e) Fourth
16 . NOAA-OAR-WPO-2025-28603		$330,000.00	$0.00	$0.00	
17 . NOAA-OAR-WPO-2025-28603		$0.00	$250,000.00	$0.00	
18 . NOAA-OAR-WPO-2025-28603		$0.00	$0.00	$300,000.00	
19 .					
20. TOTAL (*sum of lines 16-19*)		$330,000.00	$250,000.00	$300,000.00	$0.00
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 573,305			22. Indirect Charges: 306,695		
23. Remarks: MTDC 59.1% Office of Naval Research, 875 North Randolph Street, Ste. 1425, Arlington, Virginia 22203-1995 Contact: Linda Wood, (703) 588-2254					

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FORM **CD511** U.S. DEPARTMENT OF COMMERCE

(REV 1-05) CERTIFICATION REGARDING LOBBYING

Applicants should also review the instructions for certification included in the regulations before completing this form. Signature on this form provides for compliance with certification requirements under 15 CFR Part 28, 'New Restrictions on Lobbying.' The certifications shall be treated as a material representation of fact upon which reliance will be placed when the Department of Commerce determines to award the covered transaction, grant, or cooperative agreement.

LOBBYING

As required by Section 1352, Title 31 of the U.S. Code, and implemented at 15 CFR Part 28, for persons entering into a grant, cooperative agreement or contract over $100,000 or a loan or loan guarantee over $150,000 as defined at 15 CFR Part 28, Sections 28.105 and 28.110, the applicant certifies that to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, 'Disclosure Form to Report Lobbying.' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure occurring on or before October 23, 1996, and of not less than $11,000 and not more than $110,000 for each such failure occurring after October 23, 1996.

Statement for Loan Guarantees and Loan Insurance

The undersigned states, to the best of his or her knowledge and belief, that:

In any funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this commitment providing for the United States to insure or guarantee a loan, the undersigned shall complete and submit Standard Form-LLL, 'Disclosure Form to Report Lobbying,' in accordance with its instructions.

Submission of this statement is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required statement shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure occurring on or before October 23, 1996, and of not less than $11,000 and not more than $110,000 for each such failure occurring after October 23, 1996.

As the duly authorized representative of the applicant, I hereby certify that the applicant will comply with the above applicable certification.

* NAME OF APPLICANT
George Mason University

* AWARD NUMBER
FP4459

*PROJECT NAME
Fire Emissions Support National Air Quality Forecasts

Prefix: Mrs. * First Name: Margaret Middle Name:
* Last Name: Ewell Suffix:
* Title: Director, Pre Award

*** SIGNATURE:**
Margaret.Ewell

*** DATE:**
2024-11-26

ASSURANCES - NON-CONSTRUCTION PROGRAMS

OMB Approval No. 4040-0007
Expiration Date 02/28/2025

PLEASE DO NOT RETURN YOUR COMPLETED FORM TO THE OFFICE OF MANAGEMENT AND BUDGET. SEND IT TO THE ADDRESS PROVIDED BY THE SPONSORING AGENCY.

NOTE: Certain of these assurances may not be applicable to your project or program. If you have questions, please contact the awarding agency. Further, certain Federal awarding agencies may require applicants to certify to additional assurances. If such is the case, you will be notified.

As the duly authorized representative of the applicant, I certify that the applicant:

1. Has the legal authority to apply for Federal assistance and the institutional, managerial and financial capability (including funds sufficient to pay the non-Federal share of project cost) to ensure proper planning, management and completion of the project described in this application.
2. Will give the awarding agency, the Comptroller General of the United States and, if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.
3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.
4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.
5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. §§4728-4763) relating to prescribed standards for merit systems for programs funded under one of the 19 statutes or regulations specified in Appendix A of OPM's Standards for a Merit System of Personnel Administration (5 C.F.R. 900, Subpart F).
6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1964 (P.L. 88-352) which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. §§1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. §794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. §§6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1970 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) §§523 and 527 of the Public Health Service Act of 1912 (42 U.S.C. §§290 dd-3 and 290 ee- 3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. §§3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and, (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.
7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646) which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally-assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.
8. Will comply, as applicable, with provisions of the Hatch Act (5 U.S.C. §§1501-1508 and 7324-7328) which limit the political activities of employees whose principal employment activities are funded in whole or in part with Federal funds.

9. Will comply, as applicable, with the provisions of the Davis- Bacon Act (40 U.S.C. §§276a to 276a-7), the Copeland Act (40 U.S.C. §276c and 18 U.S.C. §874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§327- 333), regarding labor standards for federally-assisted construction subagreements.

10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§1451 et seq.); (f) conformity of Federal actions to State (Clean Air) Implementation Plans under Section 176(c) of the Clean Air Act of 1955, as amended (42 U.S.C. §§7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended (P.L. 93-523); and, (h) protection of endangered species under the Endangered Species Act of 1973, as amended (P.L. 93- 205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. §470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. §§2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§4801 et seq.) which prohibits the use of lead-based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act Amendments of 1996 and OMB Circular No. A-133, "Audits of States, Local Governments, and Non-Profit Organizations."

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations, and policies governing this program.

19. Will comply with the requirements of Section 106(g) of the Trafficking Victims Protection Act (TVPA) of 2000, as amended (22 U.S.C. 7104) which prohibits grant award recipients or a sub-recipient from (1) Engaging in severe forms of trafficking in persons during the period of time that the award is in effect (2) Procuring a commercial sex act during the period of time that the award is in effect or (3) Using forced labor in the performance of the award or subawards under the award.

* SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL	* TITLE
Margaret .Ewell	Director, Pre Award
* APPLICANT ORGANIZATION	* DATE SUBMITTED
George Mason University	11-26-2024

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DISCLOSURE OF LOBBYING ACTIVITIES

Complete this form to disclose lobbying activities pursuant to 31 U.S.C. 1352

OMB Number: 4040-0013
Expiration Date: 02/28/2025

1. * Type of Federal Action:	2. * Status of Federal Action:	3. * Report Type:
_ a. contract	X a. bid/offer/application	X a. initial filing
X b. grant	_ b. initial award	_ b. material change
_ c. cooperative agreement	_ c. post-award	For Material Change Only:
_ d. loan		year quarter
_ e. loan guarantee		date of last report
_ f. loan insurance		

4. Name and Address of Reporting Entity:	5. If Reporting Entity in No.4 is Subawardee, Enter Name and Address of Prime:
X Prime _ SubAwardee Tier if known:	
* Name: George Mason University	
* Street 1: 4400 University Drive	
Street 2:	
* City: Fairfax	
State: VA: Virginia	
Zip: 22030-4422	
Congressional District, if known: VA-011	

6. * Federal Department/Agency:	7. * Federal Program Name/Description: Weather and Air Quality Research
DOC NOAA - ERA Production	CFDA Number, if applicable: 11.459

8. Federal Action Number, if known:	9. Award Amount, if known:

10. a. Name and Address of Lobbying Registrant:	b. Individual Performing Services (including address if different from No. 10a):
Prefix: * First Name: NA Middle Name:	Prefix: * First Name: NA Middle Name:
* Last Name: N/A Suffix:	* Last Name: NA Suffix:
* Street 1:	* Street 1:
Street 2:	Street 2:
* City: State: Zip:	* City: State: Zip:

11. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when the transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

* Signature: Margaret.Ewell

* Name:	Prefix: Mrs.	* First Name: Margaret	Middle Name:
	* Last Name: Ewell		Suffix:
Title: Director, Pre-Award		Telephone No.: 7039934806	Date: 11-26-2024

Federal Use Only:	Authorized for Local Reproduction Standard Form - LLL (Rev. 7-97)

Proposal in response to *NOAA-OAR-WPO-2025-28603*
NOFO Priories: *AQRF-3 (Emission), 1 (High-Resolution), 2 (Evaluation), and 7 (Chemistry)*

Improving High-resolution Anthropogenic and Fire Emissions to Support National Air Quality Forecasts over North America

Principal Investigator:
Daniel Tong, Associate Professor, George Mason University (GMU)
Department of Atmospheric, Oceanic and Earth Sciences
4400 University Drive, Fairfax, VA 22030
Phone: (919) 280-6656; Email: qtong@gmu.edu
Institutional Representative, George Mason University (GMU)
Margaret Ewell, Associate Director, Proposals & Award Management
Office of Sponsored Programs, George Mason University
4400 University Drive, MSN 4C6, Fairfax, VA 22030-4422
Phone: 703-993-4806, Email: ospaor@gmu.edu

Co-Principal Investigator:
Xiaoyang Zhang, Professor, South Dakoda State University (SDSU)
Phone: 605-688-6714; Email: xiaoyang.zhang@sdstate.edu
Institutional Representative, South Dakoda State University (SDSU)
Dianne Nagy, Assistant Vice President for Research Development and Administration
1015 Campanile Ave, Box 2201, SAD 200
Brookings, SD 57007-0001
Phone: 605-688-6696, Email: Grants.contracts@sdstate.edu

Co-Investigator:
Patrick Campbell, Research Associate Professor, George Mason University

Collaborators:
Meiyun Lin, Physical Scientist, NOAA Geophysical Fluid Dynamics Laboratory (GFDL)
Howard Diamond, Division Director, NOAA Air Resources Laboratory (ARL)
Bok-Haeng Bok, Senior Scientist, George Mason University

Funding requested:

Institution	Year 1	Year 2	Year 3	Total
George Mason University	$330,000	$250,000	$300,000	$880,000
South Dakoda State University	$20,000	$100,000	$ 50,000	$170,000
Total Funds Requested	$350,000	$350,000	$350,000	$1,050,000

No salary or travel funding are requested for NOAA Co-I and collaborators.

Starting Readiness Level: 4-5 **Expected Ending Readiness Level:** 8-9
Project Period: August 1, 2025 – July 31, 2028

Improving High-resolution Anthropogenic and Fire Emissions to Support National Air Quality Forecasts over North America

Principal Investigators:	Daniel Tong (GMU) and Xiaoyang Zhang (SDSU)
Co-Investigators:	Patrick Campbell (GMU)
Collaborators:	Meiyun Lin (NOAA GFDL); Howard Diamon (NOAA ARL); B.H. Baek (GMU)

Abstract:

Project Goal: The overall goal is to improve spatial and temporal variations of anthropogenic and fire emissions for the Unified Forecast System-Air Quality Model (UFS-AQM) to support the National Air Quality Forecast Capability (NAQFC).

Problem/Opportunity Statement: Due to fast changes in emission sources and the complexity in compiling NEIs, anthropogenic emission data are often outdated and does not account for weather influence, imposing large uncertainty on forecasting results. Substantial uncertainties also exist in fire emissions, including emission factors, plume chemistry and plume rise calculation.

Methodology/Activities to be Performed: We will improve anthropogenic emissions with 2023 national emission inventories, dynamic weather adjustments and satellite rapid refresh. Fire emissions will be updated with new chemical speciation, fire plume chemistry, plume rise parameterization and small fire assessment. Effects of individual and combined updates on air quality predictions will be evaluated within UFS-AQM.

Primary Project Products/Outputs: 1) Anthropogenic emission data, one for 2023 and another in forecast year, in model-ready format at 13km, 9km or 3km resolutions; 2) improved nitrogen oxides (NOx) and volatile organic compounds (VOCs), emissions from Regional ABI and VIIRS fire Emissions (RAVE); 3) new plume rise parameterization; 4) peer-reviewed papers and presentations.

Expected Results, Outcomes, and Benefits: This planned work is expected to reduce spatiotemporal uncertainty in the emission inputs and improve the accuracy of national air quality forecasts, which are widely used to support state and local early warnings to mitigate adverse impacts of air pollution on human health and the economy.

Intended Beneficiaries and Recipients: 1) NOAA Air Resources Laboratory who is leading NOAA's development of UFS-AQM along with EMC and other labs; 2) NWS/NCEP who will provide guidance for research to operation transition; 3) NESDIS/STAR: The fire emission work can help further improve RAVE products produced by NESDIS. The high-resolution emission datasets will also benefit the broader air quality modeling community.

High-Performance Computing and Testbed: GMU and SDSU have existing computing infrastructure, including the GMU hopper cluster, to conduct the proposed emission modeling. Team members also have access to NOAA supercomputer resources. This work will use the USF-AQM testbed developed NOAA ARL and EMC.

1. Problem/Opportunity Statement

Air pollutants cause 7 million premature deaths each year around the world, making it the number one environmental risk (Anenberg et al., 2010; WHO, 2024). Air quality forecasts, such as the US National Air Quality Forecast Capability (NAQFC) (Lee et al., 2017; Huang et al., 2024), are a critical tool to assist air quality and health managers to mitigate harmful effects of air pollutants on human health (Tong & Tang, 2018). Emission is a key input to deterministic process-based air quality modeling systems such as the NAQFC and the new inline system Unified Forecast System-Air Quality Model (UFS-AQM) (Li et al., 2024; Huang et al., 2024).

The primary objective of this proposed work is to improve anthropogenic and fire emissions to NAQFC. More specifically, this study will address five pressing issues in the emission inputs to NAQFC/UFS-AQM: 1) outdated anthropogenic emissions; 2) inability to reflect weather influence; 3) uncertain chemical speciation of fire emissions; 4) uncertainties in plume rise calculation; and 5) poor estimates of small fires. We explain below each of these issues and the unique opportunities that NAQFC can leverage to address them.

The outdated anthropogenic emissions are a result of several factors. First, updating the National Emission Inventory (NEI) requires substantial resources and is very time-consuming. Consequently, NAQFC emission has been always a few years behind the latest NEIs available (Tong *et al*., 2015; Lee et al., 2017; Huang et al., 2024). Currently, the operational NAQFC is still driven by the 2016 Emission Collaborative data, *9 years behind the forecast year.* Although NAQFC is testing the 2019 Neighborhood Emission Mapping Operation (NEMO) developed by our team (Ma and Tong, 2022), the time lag remains a major issue, not reflecting the emission changes caused by the COVID-19 pandemic (Kondragunta et al., 2021; Campbell et al., 2021).

Another challenge in emission modeling is the lack of weather adjustment for static sources (Baek et al., 2023). The spatial and temporal variations of many emission sources are driven directly or indirectly by weather conditions. While biogenic, fertilizer ammonia (NH_3), and large point source emissions are calculated inline incorporating weather effects, other sources, such as anthropogenic fugitive dust and residential wood combustion, are still based on pre-processed emissions using the meteorology in the NEI year (e.g. 2016), which may differ significantly from the forecast period (Fig 1), causing large uncertainty in forecasting performance (Baek et al., 2023).

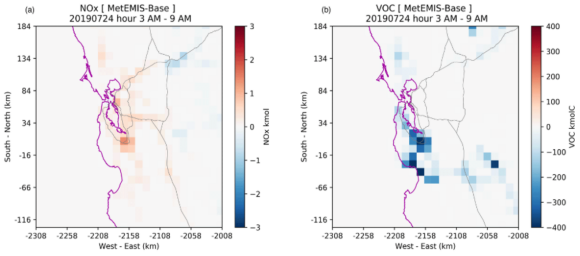

Fig. 1. Changes in NO_x (left) and VOCs (right) emissions caused by dynamic weather adjustment in San Jose, CA (Baek et al., 2023).

Wildfire and small fire emissions are another source of uncertainty for both ozone (O_3) and fine particle ($PM_{2.5}$) forecasts. Fueled by accumulated biomass, heatwaves, and dry winds, a series of large wildfires degraded air quality and caused widespread exceedances of the health-based National Ambient Air Quality Standards (NAAQS) across the nation. During the period from August to October 2020, for example, wildfires were the primary contributor to the 3,720 observed exceedances (Figure 2), highlighting the dominant influence of wildfire emissions on severe air pollution episodes (Li et al., 2021). Many advances have been made by the NAQFC team to improve wildfire air quality forecasts (Huang et al., 2024), but some issues remain. In the operational NAQFC, for example, fire emissions of volatile organic compounds (VOCs) were turned off to avoid unexplained O_3 overprediction. In the new UFS-AQMv8, a candidate for the next-generation operational system, fire VOCs emissions have been turned on. However,

emissions of NO_x and VOCs from wildfires and small fires are derived using the emission ratios to CO based on the Fire INventory from NCAR (FINN) version 1 (Wiedinmyer et al., 2011). This scheme was orginally developed for incorporating into NAQFC the blended Global Biomass Burning Emissions Product GBBEPx version 3 (Zhang et al., 2019), which contained no VOCs emission. The scheme has not been updated to leverage the more advanced NOx and VOCs emissions from the the Regional ABI and VIIRS fire Emissions (RAVE) (Li et all., 2022), the current fire product used by NAQFC. There is a need to reassess these legacy emission ratios and compare them with the RAVE NOx and VOCs emissions. In addition, wildfire emissions can undergo rapid and complex reactions within the fire plumes, which cannot be fully resolved by coarse-resolution Eulerian models such as UFS-AQM, causing uncertainty in O_3 prediction near sources and downwind (Alvarado et al., 2010; Xu et al., 2021). Both demand an in-depth assessment of the chemical speciation of fire VOCs and NO_x emissions.

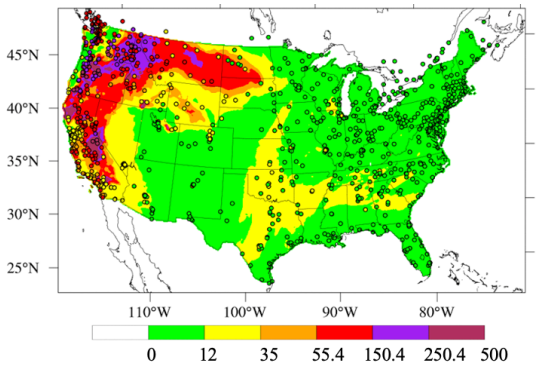

Fig. 2. Wildfire smoke (foreground color) caused 3,720 exceedances of $PM_{2.5}$ standards observed at AirNow sites (closed circles) during the 2020 "Gigafire" (Li et al., 2021). The primary 24-h $PM_{2.5}$ standard is 35μg/m^3.

Adding to this challenge are uncertainties associated with fire plume rise and small fire emissions. Plume rise estimation not only influence where emissions are injected into the atmosphere, but also control ozone chemistry and plume transport (Li, Y., et al., 2023). The current Sofiev plume rise algorithm in AQMv7 often underestimates plume rise, which may be due in part to its approximation of fire-driven turbulence or variability in combustion intensity, which are calculated using three sets of parameterizations (Sofiev et al., 2012; Li, et al., 2023). These plume rise parameterization sets were tuned for earlier weather models and fire products than the current UFS-AQMv7, adding another source of uncertainty to fire-related O_3 and $PM_{2.5}$ predictions. Finally, there is a need to examine emissions from small fires, which are less detectable by satellites but are important and recurring sources.

Recent advances in emission science present unique opportunities for NAQFC to tackle these problems. The US Environmental Protection Agency (EPA) has released the NEIs 2021 and 2022, and the NEI 2023 during the project period. Meanwhile, satellite-based emission rapid refresh capability has been developed to allow timely updates of anthropogenic emissions during the economic recession (Tong et al., 2016) and the COVID-19 (Campbell et al., 2021). Both newer NEIs and the emission rapid refresh can be used to reduce time lag in NAQFC emission inputs. Meanwhile, several weather adjustment algorithms have been developed for different emission sectors, including mobile sources, agricultural NH_3 and anthropogenic fugitive dust (e.g., Baek et al., 2023). Incorporating these weather adjustment modules will produce a more realistic emission input to NAQFC. For fire emissions, the RAVE has now provided explicit NOx and VOCs emissions, which could be used to test and replace the CO ratio-based method. A new comprehensive dataset of fire emission factors, called the Next-generation Emissions InVentory expansion of Akagi et al. (2011) version 1.0 (NEIVAv1.0), has recently been made available (Shahid et al., 2024). Finally, a new method of fire NO_x partitioning has been proposed by Lin et al. (2024a), which could be coupled with plume rise parameterization to improve O_3 prediction in both near-source and downwind regions.

2. Relevance to AQRF Challenges and Priorities Addressed

The proposed project will address 4 of the 7 AQFR priorities. First, it aims to improve spatial and temporal estimates of anthropogenic and fire emissions, addressing AQFR-3: Emission. The improved high-resolution NEMO (1km) and RAVE (3km) emission datasets will support the 13km UFS-AQM, new development of 9km AQM version 8, and future updates of higher resolution air quality forecast, enabling high-resolution model development (AQFR-1: High-resolution). Through improving chemical speciation, NO_x partitioning and plume rise parameterization, this project will enhance fire plume chemistry prediction (AQFR-7: chemistry). Finally, we will conduct evaluation to assess the incremental effect of each update, addressing AQFR-2: Evaluation.

3. Methods and Activities

We assembled a team of emission scientists and air quality modelers from academia, EPA and NOAA to tackle these problems. The list of the pressing issues and proposed updates are summarized in Table 1, followed by detailed tasks and model evaluation to assess their effects on air quality forecasts.

Table 1. Pressing emission and fire chemistry issues in AQMv7 and proposed updates.

Emission Issues	Proposed Updates
Outdated emission inventories	1) Updating 1km emissions to latest NEI2023 2) Developing satellite-based rapid refresh capability
Lacking weather effects on emissions	3) Generating weather-aware emission
Uncertain fire emissions and speciation	4) Improving emission factors of key species 5) New fire NOx partitioning to improve fire chemistry
Uncertainty in plume rise calculation	6) Improving plume rise parameterization
Uncertainty in small fire emissions	7) Comparing bottom-up and top-down emission datasets

Task 1. Updating anthropogenic emissions

In this task, we propose to reduce the time lag in anthropogenic emissions in two steps. First, we will develop a high-resolution (1km) emission dataset, Neighborhood Emission Mapping Operation (NEMO), based on the NEI2023. Next, we will apply satellite-based emission refresh methods to further update the emission from the base year (2023) to the forecast year.

1a) Develop 1km emission dataset from NEI2023

To support multi-scale air quality modeling at NAQFC and UFS-AQM, we will leverage the GMU NEMO modeling system (Ma and Tong, 2022) to generate 1km emission data. The 1km emission dataset can be easily upscaled to 9km or 13km for different applications with the NOAA Emission and eXchange Unified System (NEXUS) system.

The high-resolution emission dataset will be prepared in four steps (Fig. 3). The first step is spatial allocation, in which county-level emissions from nonpoint and mobile sources are allocated into the 1km grid cells using the spatial distribution factors (spatial surrogates). There are more than 100 spatial surrogates for the US sources, and 20-30 surrogates for Canadian and Mexican sources (Ma and Tong, 2022). Spatial surrogates were created based on geographic information systems (GIS) shapefiles. We will update the current

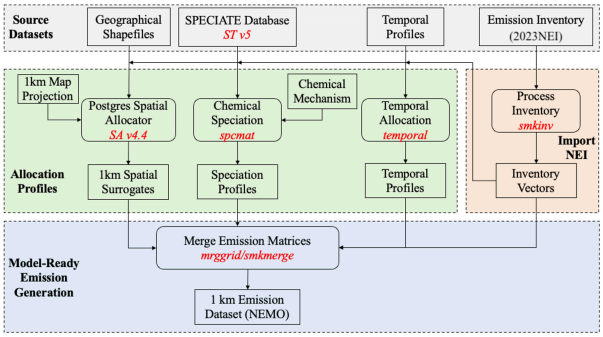

Fig. 3 Procedures to generate the 1 km NEMO emission dataset (source: Ma and Tong, 2022).

surrogates with newer geographical data, such as population, traffic, and oil and gas wells to cover the new UFS-AQM7 domain.

The other three steps include chemical speciation, temporal allocation and merging. We will use the selected chemical mechanism of UFS-AQM8 to speciate gaseous pollutants (NO_x and VOCs), and PM_{10} and $PM_{2.5}$ into required model species using the EPA Speciation Tool. The annual or monthly inventory emissions are distributed to hourly resolution using three temporal allocation profiles (monthly, week-day, and diurnal). The last step will merge all gridding, speciation and temporal matrices into a model-ready format. These four steps will be implemented with a combination of some GMU in-house tools and the Sparse Matrix Operator Kernel Emissions (SMOKE) model. The NEMO dataset has been successfully integrated into ARL NEXUS and is currently being used to incorporate the 2019 emission data into UFS-AQM7. NEMO has resolved spatial emission patterns much better than the 12km data (Figure 4), *significantly reducing the reprojection bias in NEXUS.*

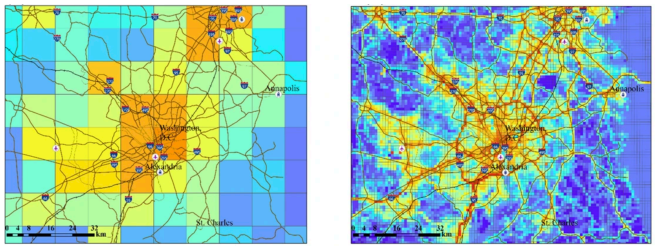

Fig. 4 Annual emission of NO_x in Washington, DC in at 12km (left) and 1km (right) resolution.

1b) Observation-based emission rapid refresh

Next, we will use the emission rapid refresh (ERR) method to further update the emission from 2023 to the forecast year. Although NEI2023 represents the latest inventories available, there will be a 3–5-year lag between the NEI baseline year and the forecast year. ERR relies on the observed trends between the base and forecast years to update NEIs. Previously, PI Tong has developed an ERR approach using fused ground and space observations (Tong et al., 2016), which has latter been applied to examine the air quality effect of the COVD-19 pandemic (Campbell et al., 2021). In this approach, an Adjustment factor (AF) at the city and state scale is obtained based on the emission differences between the base year (2023) and forecast year, a weighting function is introduced to combine the surface-based and satellite-based temporal trends to acquire the monthly AF for each state:

$$AF = \frac{\Delta S \times N_S \times f_S + \Delta G \times N_G \times f_G}{N_S \times f_S + N_G \times f_G} \quad (1)$$

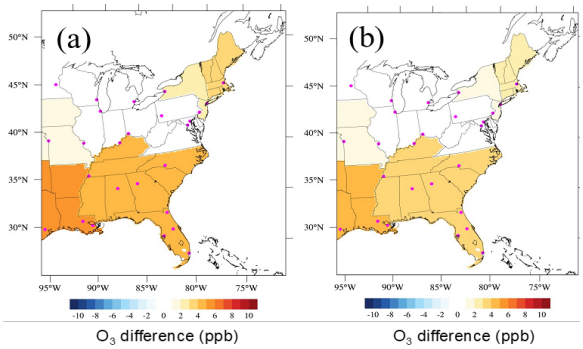

Fig. 4 Mean biases of O_3 simulated without (a) and with (b) emission refresh. The pink dots indicate the metro city locations.

where ΔS and N_S are the change rate of NO_2 VCD (for city scale) and NO_x emission (for city scale) from 2023 to the target year and the number of satellite data, respectively; and ΔG and N_G are the change of NO_2 concentration and the number of surface-based data, respectively. Two weighting factors, f_S and f_G are applied to the satellite and surface data, respectively. Here the value of f_S is set to 1 and f_G to 100 to avoid dominance by either data source (Tong et al., 2015). This retrieval approach will be adopted to update emissions created in the previous task with a base year of 2023 to the latest year (2026 and latter) for air quality forecasting. We will further improve the Tong 2016 approach through enhancing emission trend analysis over large cities with the 2D CTM-Independent SATellite-derived Emission estimation Algorithm for Mixed-sources (MISATEAM; Liu et al., 2024). This

method couples the 1D MISATEAM (Liu et al., 2022) with a 2D divergence method (Beirle et al., 2019) to infer spatially resolved emissions over urban areas.

1c) Weather-aware emission adjustment

Weather conditions influence the spatiotemporal variations of emissions. In this task, we will conduct the weather-aware adjustment to the meteorology-induced emissions sectors (e.g., fugitive dust, residential heating, and on-road mobile sources). According to the method shown in the NEI 2017 platform, the fugitive dust emission is controlled by a ratio between soil moisture and soil saturation over the areas without snow coverage. When the ratio is higher than 0.5, the emission is set to 0, while it keeps its emission value when the ratio is smaller than 0.5. This method was designed for soil moisture calculation from the Pleim-Xiu (PX) land surface model (LSM). Since UFS-AQM uses the Noah LSM, the EPA method is likely to cause large biases. Here we introduce a moisture adjustment from a windblown dust module, FENGSHA. The soim moisture factor is revised Fécan et al., (1999):

$$fmoit = \begin{cases} 1 & w_g \le w_{max} \\ 1/\sqrt{1 + 1.21(w_g - w_{max})^{0.68}} & w_{max} < w_g \le saturation \\ 0 & w_g > saturation \end{cases} \quad (2)$$

where f_{moit} is the moisture factor, w_g is the gravimetric soil moisture, w_{max} is the max adsorb water fraction, *saturation* is the soil saturation for each soil type. In addition, we will replace the snow cover mask (emission = 0 when snow/ice is present).

For onroad emissions, we will follow the method proposed in Baek et al. (2023) to adjust the emissions by fuel types (gasoline and diesel). The residential wood combustion (RWC) sector uses the simulated meteorology-driven month-to-day temporal profiles to allocate annual emissions into hourly emissions. Since RWC is largely controlled by temperature, we will adjust RWC emissions using real-time weather forecast from UFS-AQM. Indoor RWC hourly emission decreases by 80% when the ambient temperature is higher than 45°F. We assume that outdoor RWC contributes approximately 20% of total RWC hourly emissions (Adelman, 2010): $E_{c,h} = E_{c,h} * 0.8$, when ambient temperature at grid cell > 45°F. Initial tests of the weather adjustment show significant effects on anthropogenic emissions (Fig 5), which will alleviate the $PM_{2.5}$ under-prediction problem in some regions.

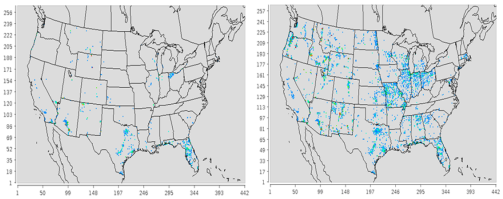

Fig. 5 Fugitive dust emission adjusted by EPA method (left), with the new method (right) in January 2019.

Task 2. Improving RAVE-based Fire Emissions

This task will leverage several recent advances in fire emission science to improve model-ready emission inputs to UFS-AQM in four steps. First, we will update chemical speciation profiles of fire emissions based on explicit emission products from RAVE and a newly compiled database of emission factors, NEIVAv1.0 (Shahid et al., 2024). Second, we will test the NOx emission partitioning proposed by Lin et al., (2024a), which splits NOx into NO, PAN and NO_3 to account for fire plume chemistry not well represented by coarse Eulerian models. Because the plume rise scheme is critical to determine the chemistry and transport of fire smoke, we will investigate and improve the parameterization of the Sofiev scheme currently used in NAQFC. Finally, we will assess small fire emissions by comparing EPA's latest bottom-up emission inventories to the RAVE data to understand the differences between the two datasets.

These tasks are designed to address several major sources of uncertainty in the pre-processor to generate model-ready fire emissions. These pre-processing steps are taken to create the model-ready data for UFS-AQM (Figure 6). Four subtasks are designed to address four sources of uncertainties that, collectively, will help improve RAVE model-ready emission inputs to UFS-AQM.

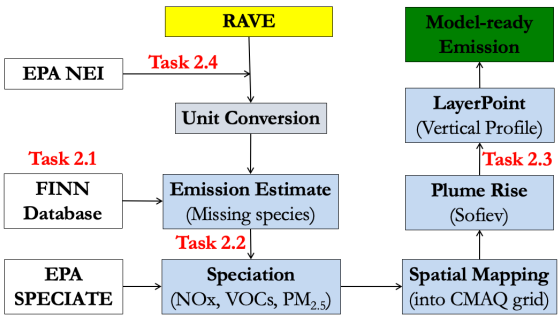

Fig. 6 Pre-processing steps to convert the RAVE emission data into model-ready inputs.

2a) Updating chemical speciation

Chemical speciation profiles are the splitting factors used to allocate NO_x, VOCs and $PM_{2.5}$ into model species (Simon et al., 2010). These model species are required by the chemical mechanisms in air quality models. While some species are provided directly by RAVE, some are not. For instance, the AQMv7 uses the Carbon Band Mechanism for version 6 (CB06), which splits VOCs into 18 species that represent different groups of organic compounds. The chemical speciation profiles used in the current operational NAQFC model were originally developed by PI Tong for the blended Global Biomass Burning Emissions Product (GBBEPx V3, Zhang et al., 2019). To account for missing species in GBBEPx V3, such as VOCs, the post-processing package adopted the emission rate of carbon monoxide (CO) directly and uses the X/CO ratio to derive other gas species. This package was adopted and revised to incorporate the RAVE emission into UFS-AQMv7 (Li et al., 2024).

Table 2. Proposed updates to the chemical speciation of fire emissions.

Emission species	Model-ready Species	Current Speciation	Proposed Updates
CO	CO	RAVE	Comparing against NEIVA1.0
VOCs	ACET, ALD2, ALDX, BENZ, CH4, ETH, ETHA, ETHY, ETOH, FORM, IOLE, ISOP, KET, MEOH, OLE, PAR, PRPA, TERP, TOL, UNR, XYL	Turned off in UFS-AQM7	Total VOCs emissions will be turned on using either 1) RAVE; or 2) NEIVA1.0. Total VOCs will be further speciated with SPECIATE into model-ready species.
NOx	NO, NO_2	NOx/CO ratio from FINNv1	Total NOx emissions from RAVE. NOx will be speciated with EPA SPECIATE into NO and NO_2.
SO_2	SO_2	SO_2/CO ratio from FINNv1	Switch to RAVE SO_2; comparing against NEIVA1.0
NH_3	NH_3	NH_3/CO ratio from FINNv1	Switch to RAVE NH_3; comparing against NEIVA1.0
$PM_{2.5}$	PAL, PCA, PCL, PEC, PFE, PK, PMG, PMN, POTHER, PNA, PNCOM, PNH4, PNO3, POC, PSI, PSO4, PTI	RAVE with speciation from SPECIATE	RAVE $PM_{2.5}$ with speciation from SPECIATE

The current speciation configuration of fire emission has several limitations, compromising the UFS-AQM capability to predict fire-induced high O_3 events. First, the VOCs from fire emissions are turned off, due in part to a previously known over-prediction problem. While turning off fire VOCs may provide a temporary solution, it does not have a scientific basis (VOCs emitted by fires are widely observed). Now that RAVE has provided VOCs emissions, and more observations were made available since the initial development of the GBBEPx package, it is time

to incorporate fire VOCs emissions and carefully assess the impact on O_3 and $PM_{2.5}$ prediction. Second, emissions of gaseous species other than CO were derived using the X/CO ratios (X is NOx, VOCs etc) adopted from the Fire INventory from NCAR (FINN) version 1 (Wiedinmyer et al., 2011). Now RAVE provides direct emission estimates of these gaseous species, offering an opportunity to update these emissions in a more consistent way.

Table 2 summarizes the proposed updates to the chemical speciation of fire emissions. These updates will involve two steps. First, we will replace the outdated X/CO ratios with the actual emissions from RAVE. We will also compare the RAVE emission factors to that of the newly available NEIVA1.0 database (Shahid et al., 2024) to understand the differences among these datasets in order to identify potential sources for further improvement. The second step aims to convert RAVE emission species into model-ready species using the EPA SPECIATE (Simon et al., 2010). These species include NO_x, VOCs and $PM_{2.5}$ (and PM_{10}, not listed here since the coarse portion will not be updated). The chemical speciation profiles may be further adjusted if UFS-AQM adopts new chemical mechanisms.

2b) Testing fire reactive nitrogen partitioning for O_3 prediction

In this task, we will assess the potential benefit of adopting a new fire NOy partitioning scheme, developed by Collaborator Meiyun Lin (Lin et al., 2024ab), to improve prediction of high O_3 events induced by upwind fire sources. This additional NOx emission partitioning aims to address an inherent limitation of coarse resolution Eulerian air quality models in which emitted chemicals are instantaneously mixed across the grid cell, unable to simulate fire plume chemistry accurately. For instance, field measurements shows that HONO and NOx emitted from forest fires are converted into peroxyacyl nitrates (PANs) and particular nitrate (PNO_3) within minutes to a few hours after emissions, shifting O_3 production within smoke plumes to a NOx-limited chemical regime (Alvarado et al., 2010; Xu et al., 2021; Juncosa Calahorrano et al., 2021). Such processes will not be resolved by the 13km or future 9km NAQFC without explicitly implementing the plume-in-grid algorithm.

To account for rapid chemistry in fresh smoke plumes, we will follow Lin et al. (2024ab) to partition fire NO_x emissions from Task 2.1 into NO, NO_2, PAN and PNO_3. Lin et al. (2024a) proposed to parameterize emissions of reactive nitrogen (NO_y) from wildfires into NO (36%), PAN (37%) and PNO_3 (27%), based on data averaged over all fresh plume transects during the 2018 Western Wildfire Experiment for Cloud Chemistry, Aerosol Absorption, and Nitrogen (WE-CAN). Using a global chemistry-climate model with 13 km spatial resolution over the contiguous US (AM4VR), they found that the NO_y partitioning, compared with emitting all NOy as NO, can enhance ozone production by 5-10 ppbv during plume transport, especially when Canadian wildfire plumes travel southward to Colorado and Texas (Figure 7). To implement this new partitioning in NAQFC, we will revise the RAVE post-processing package to add PAN as a new emission species, and change the splitting factors for NO, NO_2, and PNO_3 accordingly. Currently, fire NOx emissions are speciated into NO (90%) and NO_2 (10%). We will first adopt the NO_y parameterization from Lin et al. (2024a) and then explore options for geographically varying, biome-dependent NO_y partitioning.

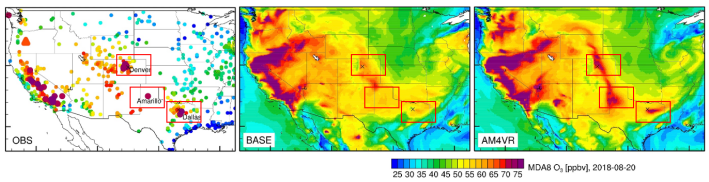

Fig. 7. Surface Max8 O_3 on Aug 20, 2018 from observations (OBS, left) and model simulations with fire NO_y as 100% NO (BASE, center), and fire NO_y partitioning (AM4VR) (Lin et al., 2024a).

2c) Improving plume rise parameterization

Plume rise not only controls transport of fire smoke, but also determines chemical formation of O_3 and secondary $PM_{2.5}$ through placing emitted species at different heights. As explained in Task 2b, the rapid rise of fire emissions allows preservation of NO_x reservoirs, such as PAN, under low temperate at a higher altitude. To achieve a better simulation of fire plumes, the Sofiev et al. (2012) plume rise scheme was implemented into UFS-AQMv7. The Sofiev scheme utilizes fire radiative power (FRP), planetary boundary layer (PBL) height (H_{PBL}), and the Brunt-Vaisala (BV) frequency in the free troposphere to estimate the plume injection height (H_p) for wild-land fires:

$$H_p = \alpha H_{PBL} + \beta \left(\frac{FRP}{FRP_0}\right)^{\gamma} \exp\left(-\frac{\delta BV_{FT}^2}{BV_0^2}\right) \quad (3)$$

Where *FRP* is the daily fire radiative power, FRP_0 is the reference fire power which equals to 106 W, BV_{FT} is the Brunt-Vaisala frequency in the free troposphere (FT), BV_0 is the reference Brunt-Vaisala frequency which equals to 2.5×10^{-4} s^{-2}, and where α, β, γ, δ are constants. The α, β, γ, δ values are based on Sofiev et al. (2012), and Li et al. (2020).

This task will investigate the parameters used in the Sofiev plume rise scheme. In Sofiev et al. (2012), three sets of α, β, γ, δ parameters are used to determine the injection height:

i. $\alpha = 0.15$; $\beta = 102$ m; $\gamma = 0.49$; $\delta = 0$
ii. $\alpha = 0.24$; $\beta = 170$ m; $\gamma = 0.35$; $\delta = 0.6$
iii. $\alpha = 0.93$; $\beta = 298$ m; $\gamma = 0.13$; $\delta = 0.7$

where the parameter set (i) is used to calculate a temporary injection height to compare to the H_{PBL}. If the temporary H_p is lower than the H_{PBL}, parameter set (ii) is used to calculate the final H_p. Otherwise, parameter set (iii) is used to calculate the final H_p. This parameterization was adopted from Sofiev (2012), but its applicability in UFS-AQM has never been examined.

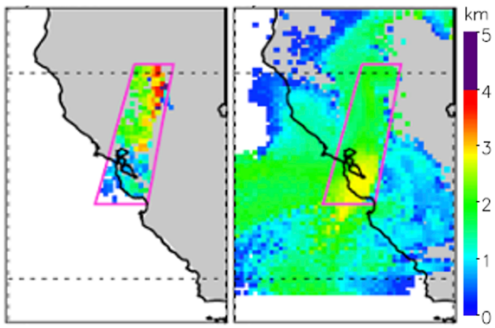

Fig. 8 Comparison of plume height observed by MISR (left) and simulated with the Sofiev scheme (right) during the 2018 Camp Fire (Source: Li et al., 2020).

We propose to improve the Sofiev plume rise parameterization in two steps. First, we will use the Sofiev box model, developed by PI Tong with the help from Dr. Sofiev of Finnish Meteorological Institute (Li et al., 2020; 2023), to test the sensitivity of these parameters to changes in FRP, H_{PBL}, and BV_{FT}. Next, based on the sensitivity results, we will design a number of parameterization schemes and test these sets of parameters in UFS-AQM, and compare the results with satellite observations of aerosol layer heights, either using plume height data from the Multi-angle Imaging SpectroRadiometer (MISR) (Fig. 8) (Li et al., 2023) or the aerosol layer height (ALH) products from TROPOMI as demonstrated by Griffin et al. (2020) over North America wildfires. We will also consider the TEMPO ALH product (Chance et al., 2021; Ciren and Kondragunta, 2024) if made available during the proposed project period.

2d) Comparing small fire emissions between RAVE and NEI

Many small fires occur each year in several biomes, such as croplands and savannas, that are often below the detection limit of the current generation geostationary and polar-orbiting satellite sensors (Randerson et al., 2012). In this task, we will compare the RAVE small fire emissions to the NEI emissions to understand the differences between the two approaches.

Several aspects of the small fire emissions will be compared. First, we will divide the fire sources into three types, including forest fires, prescribed burnings and agricultural fires, following

the classification in the NEI. While RAVE does not use this classification, we will match RAVE fires with the NEI emissions by time and location. For fires in RAVE that does not match any NEI fires, land use types will be used to allocate the fires to a proper category. For instance, all fires over cropland will be put into agricultural fire. Next, we will further group each fire category into large, median, and small fires, based on the emission magnitude of these fires. This will allow us to assess the differences among large and small fires within each fire type. Next, both datasets will be incorporated into UFS-AQM to evaluate their performance in O_3 and $PM_{2.5}$ prediction, keeping everything else the same. Detailed evaluation plans are described in Task 3. The outcomes of the emission and AQM comparisons will be used to inform future improvements of RAVE for small fires to be coordinated with NESDIS through Co-PI Zhang.

Task 3. Incremental Evaluation of Emission Updates with UFS-AQM

In the final task, we will rigorously evaluate the impacts of the proposed updates on air quality predictions within the UFS-AQM modeling framework. To achieve this, we will conduct a series of sensitivity tests for each update individually and in various combinations. First, we will perform a baseline simulation using a select version of the UFS-AQM. Currently, a new AQMv8 is under development using more up-to-date chemistry and dry deposition schemes (Li et al., 2024; Huang et al., 2024). We will use the latest version that will be available during the project period.

Next, we will introduce each proposed update in Tasks 1 and 2 into UFS-AQM to assess the effects of these updates on O_3, NO_2, and $PM_{2.5}$ prediction. These updates, as listed in Table 1, include 1) new anthropogenic inventory NEI2023, 2) observation-based emission rapid refresh; 3) weather adjustment; 4) new chemical speciation for fire emissions; 5) reactive nitrogen partitioning; 6) new plume-rise parameterization, and 7) different small fire emissions. We will test these changes individually and keep other settings unchanged to assess their standalone impacts on model performance. The evaluation will be conducted by comparing simulations against Air Quality System (AQS) and AirNow ground-based measurements, satellite columns, and available field campaigns targeting wildfire events. For instance, we will evaluate the impacts of fire emission updates, including the NO_y partitioning, on simulated PAN, NO_2, and O_3 with recent field campaign data, including WE-CAN 2018, FIREX-AQ 2019, and AEROMMA 2023. Some key performance metrics, such as mean bias (MB), median bias (MB), coefficient of determination (R^2), root-mean-square error (RMSE), and index of agreement (IOA) will be calculated following the standard evaluation procedures adopted by NAQFC. This initial phase will allow us to identify which update provides the most significant improvement. An example of the evaluation after adding the new reactive nitrogen partitioning to RAVE fire emissions (Task 2b) is shown in Figure 9. The new emission partitioning shows some promising results in reducing bias during the high O_3 events influenced by wildfires in western Canada and northwestern US.

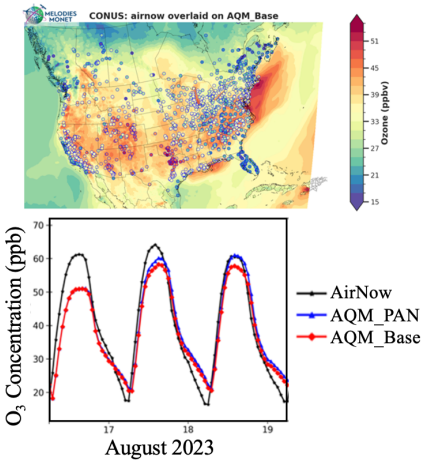

Fig. 9 Comparison of O_3 prediction to AirNow with using default (Base) and fire NO_y partitioning (PAN) setups during August 2023.

Following these individual tests, we will design a combined test in which several updates are applied simultaneously. Starting with the update that shows the greatest improvement, we will incrementally add other updates one by one to the model simulation. After each addition, we will reassess the model's performance using the same metrics as the individual tests. This step-by-step

approach will help us evaluate the cumulative and interactive effects of the updates. By conducting these tests in a controlled manner, we aim to pinpoint the combination of the proposed updates that provides the highest accuracy and reliability in air quality forecasts. The results will also inform future development directions for UFS-AQM and strengthen the system's capability to provide accurate, timely air quality forecasts across diverse environmental conditions.

4. Products/Outputs

This project will develop new model-ready emission datasets for both anthropogenic sources and fires to improve O_3, NO_2, and $PM_{2.5}$ prediction. Detailed deliverables include: 1) two sets of anthropogenic emission data, one for baseline year (2023) and the other one for a forecasting year (e.g., 2026). Both datasets will be model ready at 13km, 9km or 3km resolution depending on the needs of the operational and research system; 2) a package for emission rapid refresh capability with fused satellite and ground observations; 3) a package for real-time weather adjustment for mobile, anthropogenic fugitive dust and residential wood combustion; 4) 2) improved fire NOx and VOCs emissions from PAVE, along with an updated RAVE pre-processor; 5) new parameterization scheme for Sofiev plume rise algorithm; and 6) peer-reviewed papers and presentations at NOAA and other professional meetings.

Readiness Level: We estimate the starting Readiness Level (RL) to be 4-5 as parts of the proposed 1km data and algorithms have been developed and tested. The ending RL is expected to be 8-9. Our team has a long record of generating emission datasets for operational forecasts.

5. Impacts, Benefits, Outcomes, & Recipients

Emission is one of the largest sources of uncertainty in the air quality forecasting systems such as UFS-AQM. This high-resolution comprehensive emission dataset will help NAQFC modelers reduce the emission uncertainty, adjust parameterization, and ultimately improve the forecasting performance. Specifically, the proposed project will improve the accuracy of emission inputs to NOAA UFS-AQM models developed by ARL/GSL/CSL for the NWS. Besides NAQFC, this new set of emission inputs can also be integrated into other regional and global operational and research forecast models such as GEFS-Aerosols. In addition, this work contributes to advancing emission science, atmospheric chemistry modeling, and Earth system modeling. It will also benefit the research communities who need real-time anthropogenic and fire emissions.

Benefits to the society*:* Each year, exposure to outdoor air pollutants has been associated with 4.2 million deaths worldwide. Air quality forecasting is a key tool used by state and local agencies to protect the public from adverse health effects of poor air quality. Improvement in the emission and subsequent forecasts will enable UFS-AQM and GEFS-Aerosols to provide more reliable early warning guidance to help mitigate adverse health effects of elevated air pollution.

Recipients: We will engage three groups of end users: 1) NOAA Air Resources Laboratory who is leading NOAA's development of UFS-AQM along with EMC and other labs; 2) NWS/NCEP who will provide guidance for research to operation transition; 3) NESDIS/STAR: The fire emission work can help further improve RAVE products produced by NESDIS.

6. Schedule and Key Milestones

PI Tong will be responsible for overall project coordination and reporting. He will work with the **postdoc** on anthropogenic emission and fire modeling. **Co-I Campbell** will work with the graduate assistant on emissin integration and model evaluation. **Co-PI Zhang** will lead testing of fire speciation and comparison with NEIs. **Collaborator Diamond**, Director of ARL Atmospheric Sciences Modeling Division, will coordinate collaborations between GMU and ARL (see ARL Letter of Support). **Collaborator Lin** will lead NO_y partitioning design.

The proposed project will adhere to the following schedule, marked by major milestones:

Tasks with Milestones (RL)	Months after Start					
	6	12	18	24	30	36
Task 1. Updating anthropogenic emissions						
1a) Develop 1km emission dataset from NEI2023 (8-9)	■	■	■			
1b) Observation-based emission rapid refresh (8-9)		■	■	■		
1c) Weather-aware emission adjustment (8-9)			■	■		
Task 2. Improving RAVE-based Fire Emissions						
2a) Updating chemical speciation (8-9)	■	■	■			
2b) Testing fire reactive nitrogen partitioning for O_3 prediction (8-9)			■	■		
2c) Improving plume rise parameterization (8-9)			■	■		
2d) Comparing small fire emissions between RAVE and NEI (6-7)			■	■	■	■
Task 3. Incremental Evaluation of Emission Updates w/ UFS-AQM (7-8)				■	■	■

7. Outreach and Education

The project products and outcomes will be disseminated via website posting, conference presentations, and journal publications. The project results will be incorporated into undergraduate and graduate course curricula at GMU (e.g., Atmospheric Chemistry (undergraduate-level) and Aerosols (graduate-level) to train the next generation of air quality modelers and forecasters. Tong at GMU is supervising 8 junior researchers, 4 PhD students, 1 MS students, and 2 undergraduate students for research, all of them are conducting air quality modeling or related data analyses. Tong is also a mentor of GMU's Aspiring Scientists Summer Internship Program (ASSIP), a nationally known education program that provides transformative research opportunities for high school and undergraduate students. Selected participants work one-on-one with faculty researchers at GMU and collaborating institutions using state-of-the-art technology across many disciplines.

9. Diversity, Equity, Inclusion and Accessibility (DEIA)

The proposed work will be conducted in a research environment with unambiguous policies on ethical conduct, sexual harassment, academic integrity, and diversity & inclusion. GMU is committed to meeting the requirements as outlined in the NOAA's Diversity and Inclusion Strategic Plan and managing the project according to the vision and principles stated therein. The investigation team includes a diverse set of researchers in terms of gender, race, ethnicity, career stage, and expertise. Our team will operate in a manner that encourages collaboration, flexibility, and fairness so that each team member will participate and contribute to their full potential. GMU allocates Diversity, Inclusion and Multicultural Education + LGBTQ Resources to engage the various Mason constituents in awareness and exploration of the diversity of our campus community, identity development, and global/cultural competencies (https://odime.gmu.edu). GMU is a national leader in Diversity and Inclusion, and was ranked a top 10 most diverse and innovative public universities by U.S. News & World Report's "2023 Best Colleges List" rankings.

All project team members will follow the GMU, and NOAA's DEIA guidelines throughout this project. Specifically, we are strongly committed to, for example, 1) Actively recruiting female and under-represented minority students and postdoc researcher into the research program; and 2) Encouraging project members to conduct various outreach and recruitment activities to recruit female and underrepresented minorities targeting to students from minority-serving institutions and high schools to increase the workforce in STEM and establish a pipeline for future STEM.

10. Data Management Plan

Type of Environmental Data and Information Created in the Project

The proposed work is expected to generate the following data and information: high-resolution anthropogenic emission data (1km NEMO); RAVE fire emission; packages (code/script/data) for dynamic emission adjustments, and model output and evaluation results. The scientific knowledge and model evaluation results will be documented and published in peer-reviewed journals, and in technical documents. Significant findings and results from this project will be submitted for publication to peer-reviewed, open-source scientific journals, along with detailed supplemental material and reference to the NOAA award number. A summary of presentations and publications will be posted on the project website to allow for easy search and access by interested parties.

The emission modeling code, after being tested and adopted, will be included in the proper NAQFC repository that is accessible online from NCEP. All model data from NAQFC are publicly accessible through NOAA website. The NEMO emission data are publicly available for download from the GMU website http://air.csiss.gmu.edu/nemo.

The Regional ABI and VIIRS fire Emissions (RAVE) product is a regional biomass-burning emissions inventory. It provides hourly emissions at a spatial resolution of 0.03 degree (~3km) across North America. The data are publicly distributed in NOAA (https://www.ospo.noaa.gov/products/land/rave/).

Data/Metadata Format and Content

The emission data will be stored in the netCDF format will include variable names, units, and dimensions in the metadata and will generally follow NOAA model format. The ASCII input and output files for statistical models generally include headers describing the file format (usually a semi-colon separated value file). If necessary, we will provide a separate README file describing the format of the dust and health files. Scripts and source code will be well documented within the code itself.

Data Stewardship

All data generated in the course of this project will be stored in a dedicated project directory in network-attached storage drives. Three years after the project has concluded, the data will be moved to a "static" project directory that is backed up monthly.

During this project period, RAVE product will be reprocessed using the improved algorithm, particularly the emission factors. All the output data will be made available for public access from SDSU (South Dakota State University) GSCE (Geospatial Sciences Center of Excellence) *FTP* server (https://mft.sdstate.edu/) for others to use. In addition, the output data will also be made available from the SDSU Open PRAIRIE (http://openprairie.sdstate.edu/gsce_data/) open access institutional repository maintained by SDSU with the goal of collecting, preserving, and disseminating the intellectual and creative output of SDSU faculty, staff, and students. After completion of the project, we will maintain the data at SDSU by using available computer resources.

We will work with NOAA offices, including ARL, EMC and NESDIS/STAR to discuss future transition of the code and data for operational support.

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11. Curricula Vitae

Daniel Tong: PI, Associate Professor, George Mason University, Fairfax, VA

Dr. Tong has over 25 years of experience in emission and air quality modeling. When working at NOAA Air Resources Laboratory, he led the NOAA effort to develop a comprehensive emission modeling system to incorporate thousands of anthropogenic and natural sources to support the Nation's air quality forecasting operation. Dr. Tong is the lead developer of the dust module for the EPA's CMAQ model, which is being widely used by governmental agencies and researchers worldwide for air quality and climate studies. Dr. Tong is a member of NASA Health and Air Quality Applied Science Team (2016-2025), and serves as the Chair of the WMO Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS) and Founding Co-Chair of WMO Vegetation Fire Smoke Pollution Warning Advisory and Assessment System (VFSP-WAS).

Education

Ph.D. in Atmospheric Sciences, North Carolina State University, Raleigh, NC

Professional Experiences/Appointments

2019 – Present *Associate Professor* and Director of Cooperative Institute of Satellite and Earth System, George Mason University, Fairfax, VA

2011 – 2019 *Research Professor*, George Mason University, Fairfax, VA

2010 – present: *Emission Scientist*, US NOAA National Air Quality Forecast Program

2006 – 2009: *Senior Scientist*, US EPA National Exposure Research Laboratory, on assignment from Science and Technology Corp., RTP, NC

2003 - 2006: *Research Associat*e, Princeton University, Princeton, NJ

2002: *Software Engineer*, International Business Machine (IBM), Raleigh, NC

Honors and Awards

American Geophysical Union (AGU): President, GeoHealth Section, 2025-2026; President-Elect, 2023-2024.

World Meteorology Organization (WMO): Chair, SDS-WAS Global Steering Committee, 2020-present; Member, Global Steering Committees of VFSP-WAS (2023-) and AiR Pollution, Climate Change, Health Effects Nexus (ARCH) (2024-).

Science and Technology Achievement Award (STAA), Environmental Protection Agency (EPA), 2012.

NCAR Early Career Scientist Assembly, National Science Foundation, Boulder, CO 2010;

Outstanding Scientific Service, US Environmental Protection Agency (EPA), 2009;

Participant, the 2nd International Young Scientists' Conference on Global Change, 2006;

START Young Scientist Award, 2006;

Professional Activity

Membership: American Geophysical Union; American Meteorological Society; American Association for Aerosol Research; Air and Waste Management Association;

Grant Review: US Environmental Protection Agency; US National Oceanic and Atmospheric Administration; US Department of Agriculture; National Science Foundation

Manuscript Review: Nature; Journal of Geophysical Research; Atmospheric Chemistry and Physics; Atmospheric Environment; Journal of Air and Waste Management Association; Environmental Science & Technology; Advancements in Atmospheric Sciences; Journal of Applied Meteorology and Climatology.

Selected Publications (48 in the past 3 years)

1. Marina Romanello, et al.. The 2024 report of the Lancet Countdown on health and climate change: facing record-breaking threats from delayed action (2024). The Lancet. (404) 10465, p1847-1896, DOI: 10.1016/S0140-6736(24)01822-1.
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8. Chappell, A., Hennen, M., Schepanski, K., Dhital, S., & Tong, D. (2024). Reducing resolution dependency of dust emission modeling using albedo-based wind friction. *Geophysical Research Letters*, *51*(5), e2023GL106540.
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Research Forecasting of Smoke and Air Quality Around the World. Landscape Fire, Smoke, and Health: Linking Biomass Burning Emissions to Human Well-Being, pp.149-191.
14. Chappell, A., Webb, N.P., Hennen, M., Zender, C.S., Ciais, P., Schepanski, K., Edwards, B.L., Ziegler, N.P., Balkanski, Y., Tong, D. and Leys, J.F., 2023. Elucidating hidden and enduring weaknesses in dust emission modeling. Journal of Geophysical Research: Atmospheres, 128(17), p.e2023JD038584.
15. Chappell, A., Webb, N.P., Hennen, M., Zender, C.S., Ciais, P., Schepanski, K., Edwards, B.L., Ziegler, N.P., Balkanski, Y., Tong, D. and Leys, J.F., 2023. Elucidating hidden and enduring weaknesses in dust emission modelling. Journal of Geophysical Research: Atmospheres, p.e2023JD038584. https://doi.org/10.1029/2023JD038584.
16. Baek, B. H., Coats, C., Ma, S., Wang, C.-T., Xing, J., Tong, D., Kim, S., and Woo, J.-H.: Dynamic Meteorology-Induced Emissions Coupler (MetEmis) development in the Community Multiscale Air Quality (CMAQ): CMAQ-MetEmis, Geoscientific Model Development 16 (16), 4659-4676.
17. Christopoulos, J., Tong, D., Campbell, P. C., & Ma, S. (2023). Impacts of the COVID-19 economic slowdown on soybean crop yields in the United States. Scientific Reports, 13(1), 12574.
18. Tong, DQ., et al. (2023). Health and safety effects of airborne soil dust in the Americas and beyond. Reviews of Geophysics, 61(2), e2021RG000763.
19. Tong, D., I. Feng, T. E. Gill, K. Schepanski, and J. Wang, 2023: How Many People Were Killed by Windblown Dust Events in the United States? Bull. Amer. Meteor. Soc., https://doi.org/10.1175/BAMS-D-22-0186.1, 104 (5), E1067-E1084.
20. Li, Y., Tong, D., Ma, S., Freitas, S.R., Ahmadov, R., Sofiev, M., Zhang, X., Kondragunta, S., Kahn, R., Tang, Y. and Baker, B., 2023. Impacts of estimated plume rise on $PM_{2.5}$ exceedance prediction during extreme wildfire events: a comparison of three schemes (Briggs, Freitas, and Sofiev). Atmospheric Chemistry and Physics, 23(5), pp.3083-3101.
21. East, J.D., Henderson, B.H., Napelenok, S.L., Koplitz, S.N., Sarwar, G., Gilliam, R., Lenzen, A., Tong, D.Q., Pierce, R.B. and Garcia-Menendez, F., 2022. Inferring and evaluating satellite-based constraints on NO x emissions estimates in air quality simulations. Atmospheric Chemistry and Physics, 22(24), pp.15981-16001.
22. Ardon-Dryer, K., Gill, T. E., & Tong, D. Q. (2023). When A Dust Storm Is Not A Dust Storm: Reliability of Dust Records from the Storm Events Database and Implications for Geohealth Applications. GeoHealth, e2022GH000699.
23. Ma, S., & Tong, D. Q. (2022). Neighborhood Emission Mapping Operation (NEMO): A 1-km anthropogenic emission dataset in the United States. Scientific Data, 9(1), 1-10.
24. Campbell, Patrick C., Daniel Tong, Rick Saylor, Yunyao Li, Siqi Ma, Xiaoyang Zhang, Shobha Kondragunta, and Fangjun Li. "Pronounced increases in nitrogen emissions and deposition due to the historic 2020 wildfires in the western US." *Science of The Total Environment* 839 (2022): 156130.
25. Tong, D. Q., Gorris, M. E., Gill, T. E., Ardon-Dryer, K., Wang, J., & Ren, L. Dust Storms, Valley Fever, and Public Awareness. GeoHealth, e2022GH000642.
26. Li, Y., Tong, D., Ma, S., Zhang, X., Kondragunta, S., Li, F., & Saylor, R. (2021). Dominance of Wildfires Impact on Air Quality Exceedances During the 2020 Record-Breaking Wildfire Season in the United States. Geophysical Research Letters, 48(21), e2021GL094908.

Co-PI: Xiaoyang Zhang
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Research Interests

Remote sensing of biomass burning emission estimate and vegetation properties, vegetation response to climate change, and land surface data analysis and modeling.

Education

Ph.D. 1999 Geography, King's College London, University of London, London
M.S. 1991 Geography, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, Nanjing
B.S. 1984 Geography, Peking University, Beijing

Professional Experience

8/2013-present: Distinguished Professor (6/2024-), Professor (6/2018-5/2024), and Associate Professor (8/2013-5/2018) of Geography & Senior Research Scientist at the Geospatial Sciences Centers of Excellence (GSCE), South Dakota State University (SDSU), Brooking, SD. USA

6/2012-8/2013: Visiting Associate Research Scientist, University of Maryland at NOAA/NESDIS/STAR, College Park, MD, USA

4/2005-5/2012: Senior research scientist, Earth Resources Technology (ERT) at NOAA/NESDIS/STAR, Camps Springs, MD, USA

6/1999-3/2005: Research Associate and made as Research Assistant Professor in 2003, Department of Geography, Boston University

10/1988-2/1995: Research Assistant Professor (1988-1992) and Research Associate Professor (1992-1995), Deputy of Department of Natural Resources and Land Use, Institute of Geodesy & Geophysics, Chinese Academy of Science, Wuhan, China

7/1984-9/1988: Research Assistant, Institute of Hydrobiology, Chinese Academy of Science, Wuhan, China

Professional Activities

- Editor of "*Earth Interactions*" 10/2017-10/2024.
- Associate Editor Associate Editor of "*International Journal of Applied Earth Observation and Geoinformation*", since January 2023
- Member of Editorial Board of "*Remote Sensing of Environment*", since July 2020
- A member of Editorial Board of "*Insights of Forest Research",* since 2017.
- NASA Suomi-NPP Land Science Team from 2014 to present
- American Geophysical Union (AGU)
- International Association of Wildland Fire (IAWF)
- America Meteorological Society (AMS)

Selected Publications

Li, Y., Tong, D., Ma, S., Freitas, S.R., Ahmadov, R., Sofiev, M., **Zhang, X.**, Kondragunta, S., Kahn, R., Tang, Y., Baker, B., Campbell, P., Saylor, R., Grell, G., Li, F., 2023, Impacts of estimated plume rise on $PM_{2.5}$ exceedance prediction during extreme wildfire events: a

comparison of three schemes (Briggs, Freitas, and Sofiev), *Atmospheric Chemistry and Physics*, 23 (5): 3083-3101. https://doi.org/10.5194/acp-23-3083-2023

Campbell, P.C., Tong, D., Saylor, R., Li, Y., Ma, S., **Zhang, X**., Kondragunta, S., Li, F., 2022, Pronounced increases in nitrogen emissions and deposition due to the historic 2020 wildfires in the western US, *Science of The Total Environment*, 839, 156130, https://doi.org/10.1016/j.scitotenv.2022.156130

Zhang, X., Shen, Y., Gao, S., Wang, W., & Schaaf, C., 2022, Diverse responses of multiple satellite-derived vegetation greenup onsets to dry periods in the Amazon, *Geophysical Research Letters*, 49, e2022GL098662. https://doi.org/10.1029/2022GL098662

Li, F., **Zhang, X**., Kondragunta, S., Lu, X., Csiszar, I., Schmidt, C.C., 2022, Hourly biomass burning emissions product from blended geostationary and polar-orbiting satellites for air quality forecasting applications, *Remote Sensing of Environment,* 281, 113237, https://doi.org/10.1016/j.rse.2022.113237

Lu, X., **Zhang, X**., Li, F., Cochrane, M.A., 2022, Improved estimation of fire particulate emissions using a combination of VIIRS and AHI data for Indonesia during 2015–2020, *Remote Sensing of Environment,* 281,113238, https://doi.org/10.1016/j.rse.2022.113238

Lu, X., **Zhang, X**., Li, F., Cochrane, M.A., Ciren, P., 2021, Detection of Fire Smoke Plumes Based on Aerosol Scattering Using VIIRS Data over Global Fire-Prone Regions, *Remote Sensing*, 13 (2), 196, https://doi.org/10.3390/rs13020196

Lu, X., **Zhang, X**., Li, F., Gao, L., Graham, L., Vetrita, Y., Saharjo, B., Cochran, M., 2021, Drainage canal impacts on smoke aerosol emissions for Indonesian peatland and non-peatland fires, *Environmental Research Letters*, 16(9), 095008, https://doi.org/10.1088/1748-9326/ac2011

Li, F ., **Zhang, X**., Kondragunta, S., Lu, X., 2020, An evaluation of advanced baseline imager fire radiative power basedwildfire emissions using carbon monoxide observed by the TroposphericMonitoring Instrument across the conterminous United States, *Environmental Research Letters*, 15, 094049, https://doi.org/10.1088/1748-9326/ab9d3a

Li, F., **Zhang, X**., Kondragunta, S., Schmidt, C.C., Holmes, C.D., 2020, A preliminary evaluation of GOES-16 active fire product using Landsat-8 and VIIRS active fire data, and ground-based prescribed fire records, *Remote Sensing of Environment*, 237: 111600; https://doi.org/10.1016/j.rse.2019.111600

Li, F., **Zhang, X.**, Roy, D.P., Kondragunta, S. 2019, Estimation of biomass-burning emissions by fusing the fire radiative power retrievals from polar-orbiting and geostationary satellites across the conterminous United States, *Atmospheric Environment*, 211, 274-287, https://doi.org/10.1016/j.atmosenv.2019.05.017

Lu, X., **Zhang, X**., Li, F., Cochrane, M.A., 2109, Investigating Smoke Aerosol Emission Coefficients using MODIS Active Fire and Aerosol Products — A Case Study in the CONUS and Indonesia, *Journal of Geophysical Research: Biogeosciences,* https://doi.org/10.1029/2018JG004974

Zhang, X., Kondragunta, S., and Roy, D.P., 2014. Interannual variation in biomass burning and fire seasonality derived from geostationary satellite data across the contiguous United States from 1995 to 2011. *Journal of Geophysical Research-Biogeosciences,* https://doi.org/10.1002/2013JG002518

Zhang, X., Kondragunta, S., Ram, J., Schmidt, C., Huang,H-C, 2012. Near Real Time Global Biomass Burning Emissions Product from Geostationary Satellite Constellation. *Journal of Geophysical Research-Atmosphere, https://*doi.org/10.1029/2012JD017459

Dr. Patrick C. Campbell
Research Associate Professor
Center for Satellite and Earth science Research (CSER)
George Mason University
Cooperative Institute for Satellite Earth System Studies (CISESS)
National Oceanic and Atmospheric Administration, Air Resources Laboratory Affiliate

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BIO

Dr. Campbell heads up air composition, emissions, and surface-atmospheric exchange research and development projects to support and advance the U.S. National Weather Service's National Air Quality Forecasting Capability (NAQFC), based on the NOAA's Unified Forecast System (UFS) and next-generation global and regional atmospheric aerosol and composition prediction systems at NWS/NOAA. He has significant experience in land, meteorological, and air quality model development, while synthesizing multiplatform measurements using novel data analysis techniques and modeling methods.

EDUCATION

- University of Wyoming *2008 - 2013*
  Doctor of Philosophy in Atmospheric Science
  Dissertation: "The Climatology, Extent, and Impact of Stratospheric Condensation Nuclei, including their formation in polar regions"
- University of Massachusetts at Lowell *2004 - 2006*
  Master of Science in Environmental Studies – Atmospheric Science Concentration
  Thesis: "A Short Range Ensemble Forecast Experiment on Jet Streaks to Improve Forecasters' Model Diagnoses 2004 – 2006"
- University of Massachusetts at Lowell *2000 - 2004*
  Bachelor of Science in Meteorology

AWARDS & DISTINCTIONS

- NOAA OAR Certificate of Accommodation (2021), For Implementing and Upgrading NOAA's NAQFC
- Top Paper Download for *Campbell et al.* (2018), JAMES, 2018-2019
- NRC Research Fellowship Award, NAS, 2016
- Research Spotlight for *Campbell et al.* (2014), AGU, 2014
- Antarctic Service Medal of the United States of America, NSF, 2012

AREAS OF SPECIALIZATION

- Coupled (atmosphere-biosphere-chemical) air quality model development.
- Emissions and surface-atmosphere exchanges of heat, moisture, gases, and aerosols.
- Wildfire behavior, emissions, terrestrial interactions, and ecosystem impacts.
- Atmospheric composition model predictions, applications, and forecasting.

SELECT/RELEVANT EXPERIENCE (< 3 years)

Research Associate Professor. Center for Spatial Information Science and Systems/Cooperative Institute for Satellite Earth System Studies, George Mason University, ARL/NOAA Affiliate, College Park, MD, *2023 - Current.*

Research Assistant Professor. Center for Spatial Information Science and Systems/Cooperative Institute for Satellite Earth System Studies, George Mason University, ARL/NOAA Affiliate, College Park, MD, *2019 - 2023.*

- Co-lead researcher and developer of NOAA's operational Unified Forecast System – Air Quality Model (UFS-AQM).
- Research, development, and application of in-canopy vegetative parameterizations and models (e.g., "canopy-app") and implications for next-generation air quality forecasting under the UFS – AQM.
- Lead developer of the Global Forecast System (GFS)-driven NOAA-EPA Atmosphere Chemistry Coupler (NACC) for the Advanced National Air Quality Forecasting Capability (NAQFC).
- Research and development on the NOAA Emission and eXchange Unified System (NEXUS) and connections with next-generation regional and global atmospheric aerosol and composition forecast models.
- Research on anthropogenic, wildfires and other process-based emissions, atmospheric deposition and composition, air quality, and air-surface exchange processes, specifically vegetative in-canopy processes and impacts on atmospheric composition.
- Research on coupled meteorological, photochemical, and chemical transport/air quality modeling.

SELECT/RELEVANT PUBLICATIONS (< 3 years)

- Hung, W.-T., **Campbell, P. C.,** Baker, B., (2024a). High Resolution Global Land Surface Datasets using Satellite Measurements for Application to Earth System Models. https://doi.org/10.25923/d06p-2333.
- Hung, W.-T., **Campbell, P.C.** et al. (2024b). Hung, W.-T., Campbell, P. C., Moon, Z., Saylor, R., Kochendorfer, J., Lee, T. R., & Massman, W. (2024b). Evaluation of an in-canopy wind and wind adjustment factor model for wildfire spread applications across scales. Journal of Advances in Modeling Earth Systems, 16, e2024MS004300. https://doi.org/10.1029/2024MS004300.
- **Campbell, P.C.**; Jiang, W.; Moon, Z.; Zinn, S.; Tang, Y. NOAA's Global Forecast System Data in the Cloud for Community Air Quality Modeling. Atmosphere 2023, 14, 1110. https://doi.org/10.3390/atmos14071110.
- Li, Y., Tong, D., Ma, S., Freitas, S. R., Ahmadov, R., Sofiev, M., Zhang, X., Kondragunta, S., Kahn, R., Tang, Y., Baker, B., **Campbell, P.**, Saylor, R., Grell, G., and Li, F.: Impacts of estimated plume rise on PM2.5 exceedance prediction during extreme wildfire events: A comparison of three schemes (Briggs, Freitas, and Sofiev), EGUsphere [preprint], https://doi.org/10.5194/egusphere-2022-713, 2022.
- **Campbell, P. C.**, D. Tong, R. Saylor, Y. Li, S. Ma, X. Zhang, S. Kondragunta, and F. Li (2022). Pronounced increases in nitrogen emissions and deposition due to the historic 2020 wildfires in the western U.S. STOTEN, 839, 156130. https://doi.org/10.1016/j.scitotenv.2022.156130.
- **Campbell, P. C**., Y. Tang, P. Lee, B. Baker, D. Tong, R. Saylor, A. Stein, F. Yang, J. Huang, H.-C. Huang, J. McQueen, I. Stajner, J. Sims, J. Tirado-Delgado, Y. Jung, F.

Yang, T. Spero, and R. Gilliam (2022). Development and evaluation of an advanced National Air Quality Forecast Capability using the NOAA Global Forecast System version 16. Geosci. Model Dev., 15, 3281–3313. https://doi.org/10.5194/gmd-15-3281-2022.

- **Campbell, P. C.**, D. Tong, Y. Tang, B. Baker, P. Lee, R. Saylor, A. Stein, S. Ma, and L. Lamsal (2021). Impacts of the COVID-19 Economic Slowdown on Ozone Pollution in the U.S. Atmospheric Environment, https://doi.org/10.1016/j.atmosenv.2021.118713.

SELECT/RELEVANT CONFERENCE PRESENTATIONS (< 3 years)

- **Campbell, P.C.** et al. (2024). Landscape fires, nitrogen emissions, and deposition: Implications for downwind ecosystems. 23rd Annual CMAS Conference, Chapel Hill, NC. October, 2024.
- Ivanova, I., **Campbell, P. C.**, Makar, P., Hung, W.-T., Baker, B., Tang, Y., Moon, Z., Saylor, R., Yang, F., Huang, J., Stajner, I., Montuoro, R. (2024). Explicit Effects of Forest Canopy Shading & Turbulence on Boundary Layer Ozone in USF-SRW Air Quality Model, UIFCW24, Virtual Presentation, July 2024.
- **Campbell, P.C.** et al. (2023). Beyond the Big-Leaf Model for NOAA's Unified Air Quality Forecasting Capabilities. 22st Annual CMAS Conference, Chapel Hill, NC. October, 2023.
- Moon, Z., **Campbell, P.C**. et al. (2023). A Model for Forest Canopy Effects on Weather and Atmospheric Composition in the NOAA Unified Forecast System. 35th Conference on Agricultural and Forest Meteorology/14th Fire and Forest Meteorology Symposium/Sixth Conference on Biogeosciences, Minneapolis, MN. May 2023.
- Hung, W.-T., Baker, B., **Campbell, P.C.** et al. (2023). Development and evaluation of a machine learning based wildfire spread prediction model for regional air quality forecasting. 35th Conference on Agricultural and Forest Meteorology/14th Fire and Forest Meteorology Symposium/Sixth Conference on Biogeosciences, Minneapolis, MN. May 2023.
- **Campbell, P.C**. et al. (2023). Beyond the Big-Leaf Model for NOAA's Unified Air Quality Forecasting Capabilities. 35th Conference on Agricultural and Forest Meteorology/14th Fire and Forest Meteorology Symposium/Sixth Conference on Biogeosciences, Minneapolis, MN. May 2023.
- **Campbell, P.C.** et al. (2022). Pronounced increases in nitrogen emissions and deposition due to the historic 2020 wildfires in the western U.S. National Atmospheric Deposition Program 2022 Fall Meeting, Knoxville, TN. (Virtual). November, 2022.
- **Campbell, P.C**. et al. (2022). Impacts of Wildfire Emissions on Nitrogen Deposition in the U.S. International Association of Wildland Fire, Fire & Climate Conference, Pasadena, CA. (Virtual). May 2022.
- **Campbell, P.C.** et al. (2021). Advancement of the National Air Quality Forecast Capability Using the NOAA Global Forecast System: Model Development and Community Applications. 10th International Workshop on Air Quality Forecasting Research (IWAQFR), World Meteorological Organization (Virtual). October, 2021.

12. Current and Pending Support

i) Daniel Tong, Principal Investigator
ii) Xiaoyang Zhang, Co-Principal Investigator
iii) Patrick Campbell, Co-Investigator

CURRENT AND PENDING SUPPORT FORM

OMB Approval: 0648-0384
Expiration Date: 01/31/2025

The following information must be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Daniel Tong

Other agencies to which this proposal has been/will be submitted:

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Identifying Public Health Applications of Satellite-derived Drought Indicators: Improved Monitoring for Respiratory Health

Source of Support: NASA

Total Award Amount: $209,802

Total Award Period Covered: 5/2022-5/2025

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .45 Total: .45

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Data-driven Forecasts of Hazardous Air Quality Events over North America

Source of Support: National Aeronautics and Space Administration (NASA)

Total Award Amount: $130,000

Total Award Period Covered: 6/2023-5/2024

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .90 Total: .90

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Developing Capabilities for Wildfire Pollution Forecasts with NOAA Disaster Supplemental Projects - FY22DRSA-FIRE2 and FY22DRSA-FIRE3

Source of Support: Oak Ridge Associated Universities (ORAU)/ National Oceanic & Atmospheric Administration (NOAA)

Total Award Amount: $1,260,594

Total Award Period Covered: 9/2022-8/2025

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25:.01 Total: .01

Support: __x_ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Improving Subseasonal to Seasonal (S2S) Fire Emissions and Weather Forecasts

Source of Support: National Oceanic & Atmospheric Administration (NOAA)

Total Award Amount: $479,203

Total Award Period Covered: 5/2023-5/2025

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .90 Total: .90

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Wildfire Infrastructure (IIJA)

Source of Support: Oak Ridge Associated Universities (ORAU)/ National Oceanic & Atmospheric Administration (NOAA)

Total Award Amount: $818,178

Total Award Period Covered: 9/2022-9/2025

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .05 FY 26: .05 Total: .10

Support: __x_ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Enhancing high resolution forecasting capability of RRFS-CMAQ

Source of Support: US Department of Commerce (US DOC)/ National Oceanic & Atmospheric Administration (NOAA)

Total Award Amount: $420,000

Total Award Period Covered:8/2022-7/2025

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .50 Total: .50

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Environmental and Climate Justice using Earth Observations

Source of Support: George Washington University

Total Award Amount: $149,290

Total Award Period Covered: 5/2023-5/2026

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .09 FY 26: .09 Total: .18

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Breaking technical, cultural, and language barriers of air quality services for underserved communities

Source of Support: Environmental Protection Agency (EPA)

Total Award Amount: $1,245,235

Total Award Period Covered:5/2025-3/2028

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 26: 1 FY 27: 1 FY 28: 1 Total: 3

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Elucidating the Air Pollution Exposure Burdens and Enhancing Community Awareness of the Rio Grande Valley Region of South Texas on the U.S. - Mexico Border Using a Suite of Monitoring and Modeling Methodologies and Citizen Science Approaches.

Source of Support: University of Texas Rio Grande Valley/ Environmental Protection Agency (EPA)

Total Award Amount: $530,067

Total Award Period Covered: 5/2025-4/2029

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .03 FY 26: .03 FY 27:.03 FY 28:.03 FY29:.03 Total: 1.5

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Air Quality Environmental Justice (AQEJ) Data Tools

Source of Support: University of Arizona/ Environmental Protection Agency (EPA)

Total Award Amount: $254,560

Total Award Period Covered: 1/2025-12/2028

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .15 FY 26: .15 FY 27: .15 FY 28: .15 Total: .60

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Impact-based Forecasts of Air Pollution from Intermittent Sources for Public Health and Aviation Safety over Hawaii and North America

Source of Support: National Aeronautics and Space Administration (NASA)

Total Award Amount: $598,738

Total Award Period Covered: 1/2025-1/2029

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .90 FY 26: .90 FY 27: .90 FY 28: .90 FY29: .90 Total: 4.5

Support: ___ Current __x_ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Using Earth Observations to Enhance Modeling and Decision-Making of Health-Related Hazards in Africa

Source of Support: Northeastern University/ National Aeronautics and Space Administration (NASA)

Total Award Amount: $299,849

Total Award Period Covered: 3/2025-2/2028

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 26:.45 FY 27: .45FY 28: .45 Total: 1.35

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: CISESS: GMU Air Surface Exchange and Atmospheric Composition Research

Source of Support: University of Maryland, College Park/ National Oceanic & Atmospheric Administration (NOAA)

Total Award Amount: $749,869

Total Award Period Covered: 7/2024-6/2025

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .15 Total: .15

Support: ___ Current __x_ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Spatiotemporal Fusion of TEMPO-Inferred and Bottom-Up Estimates for High-resolution Nitrogen Oxide Emissions

Source of Support: Morgan State University/ National Aeronautics and Space Administration (NASA)

Total Award Amount: $211,711

Total Award Period Covered: 5/2025-4/2028

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 26: .45 FY 27: .45 FY 28: .45 Total:1.35

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Research and Engagement for Action on Climate change and Health (REACH) Center

Source of Support: George Washington University/ National Institutes of Health (NIH)

Total Award Amount: $845,557

Total Award Period Covered: 6/2024-5/2027

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: .90 FY 26:.90 FY 27: .90 Total: 2.7

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Towards improved representations of wildfire-ABL interactions in the UFS modeling suite: parameterization development, emissions modeling, and air quality impact assessment

Source of Support: National Oceanic & Atmospheric Administration (NOAA)

Total Award Amount: $845,557

Total Award Period Covered: 7/2024-6/2026

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 25: 3.75 FY 26: 3.75 Total: 7.5

This Submission

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Improving High-resolution Anthropogenic Emissions and Fire Emissions to Support Air Quality Forecasts over North America

Source of Support: National Oceanic & Atmospheric Administration (NOAA)

Total Award Amount: $880,000

Total Award Period Covered: 08/2025 - 07/2028

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 26: 1 FY 27: 1 FY 28: 1 Total: 3

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Accelerating National Air Quality Forecasts with Reduced Chemistry

Source of Support: National Oceanic & Atmospheric Administration (NOAA)

Total Award Amount: $472,475

Total Award Period Covered: 08/2025 - 07/2028

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 26: .45 FY 27:.45 FY 28: .45 Total: 1.35

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Bridging Cultural and Language Barriers in Hazardous Weather Communication for Underserved Communities

Source of Support: National Oceanic & Atmospheric Administration (NOAA)

Total Award Amount: $343,895

Total Award Period Covered: 08/2025 - 07/2028

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 26: .45 FY 27: .45 FY 28: .45 Total: 1.35

Support: ___ Current _x__ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Advancing JEDI-Based Chemical Data Assimilation and Emission Inversion to Improve the National Air Quality Forecast Capability

Source of Support: National Oceanic & Atmospheric Administration (NOAA)

Total Award Amount: $450,445

Total Award Period Covered: 08/2025 - 07/2028

Location of Project: George Mason University

Months of Your Time Committed to the Project: FY 26: .15 FY 27: .15 FY 28: .0 Total: .30

CURRENT AND PENDING SUPPORT FORM

OMB Approval: 0648-0384
Expiration Date: 01/31/2025

Investigator: Xiaoyang Zhang

Other agencies to which this proposal has been/will be submitted:

Support: __x_ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Maintenance, Evolution, and Validation of the Global Land Surface Phenology Product from Suomi NPP and JPSS VIIRS Observations

Source of Support: NASA

Total Award Amount: $664K

Total Award Period Covered: 09/2021- 08/2025

Location of Project: SDSU

Months of Your Time Committed to the Project: FY 21: 1.2, FY 22: 1.2, FY 23: 1.2, FY 23: 1.2 Total: _4.8__

Support: __x_ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Detection of Species-specific Plant Phenology from PlanetScope Time Series for Rangeland Management of the Western United States

Source of Support: NASA

Total Award Amount: $300K

Total Award Period Covered: 12/2023-11/2025

Location of Project: SDSU

Months of Your Time Committed to the Project: FY 24: 0.84, FY 25: 0.84, FY XX: _ FY XX:_ Total: 1.68

Support: __x_ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Democratic Republic of the Congo swamp and peatland extent mapping demonstration in support of Wildlife Works Carbon LLC Reduction Emission Deforestation and Forest Degradation (REDD+) projects

Source of Support: Wildlife Works Carbon LLC

Total Award Amount: $250K

Total Award Period Covered: 2/2024-1/2027

Location of Project: SDSU

Months of Your Time Committed to the Project: FY 24: 0.48, FY 25: 0.48, FY 25: 0.48, FY XX: Total: 1.44

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Characterizing and monitoring changing fire regimes and the risk of extreme wildfire events in the United States using biophysical models and satellite observations

Source of Support: NASA

Total Award Amount: $1,504K

Total Award Period Covered: 01/2024-12/2026

Location of Project: UMD

Months of Your Time Committed to the Project: FY 24: 0.6, FY 25: 0.6, FY 26: 0.6 FY XX: __ Total: 1.8

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: PARTNERSHIP: Developing an enhanced geospatial tool for operationally monitoring species-specific crop progress and growth condition in near real time from Geostationary Satellite Observations and Harmonized Landsat-8 and Sentinel-2 Time Series

Source of Support: USDA

Total Award Amount: $759K

Total Award Period Covered: 9/2023-08/2027

Location of Project: SDSU

Months of Your Time Committed to the Project: FY 24: 0.38, FY 25: 0.38, FY 26: 0.95, FY 27: 0.95 Total: 2.66

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Fire Emissions Reprocessing Activities

Source of Support: NOAA

Total Award Amount: $188K

Total Award Period Covered: 10/2022-6/2025

Location of Project: SDSU

Months of Your Time Committed to the Project: FY 23: 1.2, FY 24: 1.2, FY 25: 1.2 FY XX: __ Total: 3.6

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Enhancement of RAVE emissions algorithm and transition to operations

Source of Support: NOAA

Total Award Amount: 222K

Total Award Period Covered: 10/2022-6/2025

Location of Project: SDSU

Months of Your Time Committed to the Project: FY 24: 0.3, FY 25: 0.3, FY 26: 0.3 FY XX: __ Total: 0.9

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Expansion of RAVE algorithm for hourly biomass burning emissions estimation in Asia and Europe for air quality forecast applications

Source of Support: NOAA

Total Award Amount: $250K

Total Award Period Covered: 09/2023-8/2025

Location of Project:

Months of Your Time Committed to the Project: FY 24: 0.45, FY 25: 0.9, FY XX: __ FY XX: __ Total: 1.35

Support: _x__ Current ___ Pending ___ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: Reprocess and refinement of Global Biomass Burning Emissions Product in Support of Air Quality and Smoke Predictions

Source of Support: NOAA

Total Award Amount: $35K

Total Award Period Covered: 07/2024-6/2025

Location of Project: SDSU

Months of Your Time Committed to the Project: FY 24: 0.2, FY 25: 0.25, FY XX: __ Total: 0.45

Support: ___ Current ___ Pending _x__ Submission Planned in Near Future ___ *Transfer of Support

Project/Proposal Title: AI-powered Crop Diseases Early Forecasting using Multisource Data Fusion in Support of Agricultural Management

Source of Support: USDA

Total Award Amount: 650K

Total Award Period Covered: 7/2025-6/2029

Location of Project: SDSU

Months of Your Time Committed to the Project: FY 25: 0.25, FY 26: 0.25, FY 27: 0.25, FY 28: 0.25 Total: 1.0

Investigator: Dr. Patrick Campbell
Other agencies to which this proposal has been/will be submitted: None

Current Support

Project/Proposal Title: Beyond the "Big-Leaf" Model at NOAA: Use of Novel Satellite Data and In-Canopy Processes to Improve U.S. Air Quality Predictions
Source of Support (w/Grant#): National Oceanic & Atmospheric Administration (NOAA) #NA22OAR4590516
Total Award Amount: $685,218 Total Award Period Covered: 08/2022-07/2025
Months of Your Time Committed to the Project: FY25: 9 Total: 9

Project/Proposal Title: CISESS: GMU Air Surface Exchange and Atmospheric Composition Research
Source of Support (w/Grant#): National Oceanic & Atmospheric Administration (NOAA) #NA19NES4320002
Total Award Amount: $2,771,083 Total Award Period Covered: 08/2020-06/2025
Months of Your Time Committed to the Project: FY25: 1.32 Total: 1.32

Project/Proposal Title: Transitioning Weather-Aware Rapid Refresh Emission Modeling Capability (WAR2EMC) to Support National Air Quality Forecast Capability Operations
Source of Support (w/Grant#): National Oceanic & Atmospheric Administration (NOAA) #NA22OAR4590167
Total Award Amount: $598,383 Total Award Period Covered: 09/2022-08/2025
Months of Your Time Committed to the Project: FY25: 1.2 Total: 1.2

Pending

Project/Proposal Title: Using Artificial Intelligence to Achieve Faster and Adaptive Air Quality and Weather Forecasting
Source of Support (w/Grant#): National Oceanic & Atmospheric Administration (NOAA) #FP4439
Total Award Amount: $404,700 Total Award Period Covered: 08/2025-07/2028
Months of Your Time Committed to the Project: FY26: 2 FY27: 2 Fy28: 2 Total: 6

Project/Proposal Title: Short-term forecasting of hourly ambient pollutant levels from TEMPO and Chemical Transport Model via machine learning
Source of Support (w/Grant#): National Aeronautics and Space Administration (NASA) #FP4173
Total Award Amount: $665,890 Total Award Period Covered: 04/2025-03/2028
Months of Your Time Committed to the Project: FY25: 1.2 FY26: 1.2 FY27: 1.2 Total:3.6

Project/Proposal Title: Impact-based Forecasts of Air Pollution from Intermittent Sources for

Public Health and Aviation Safety over Hawaii and North America
Source of Support (w/Grant#): National Aeronautics and Space Administration (NASA) #FP3749
Total Award Amount: $598,738 Total Award Period Covered: 01/2025-01/2029
Months of Your Time Committed to the Project: FY25: 1.68 FY26: 1.68 FY27: .72 FY28: .12 Total: 4.2

Project/Proposal Title: Satellite-Based Emission Estimation Verified by Chemical Transport Model and Multi-platform Measurements
Source of Support (w/Grant#): National Aeronautics and Space Administration (NASA) #FP3844
Total Award Amount: $623,758 Total Award Period Covered: 03/2025-02/2028
Months of Your Time Committed to the Project: FY25: 1.0 FY26: 1.0 FY27: 1.0 Total:3.0

Project/Proposal Title: RuralAirGuard: Transforming NASA Earth Data into Near-Real-Time Environment-related Disease Risk Alerts: Enhancing One Health through Advanced Air Quality Monitoring in Rural Areas
Source of Support (w/Grant#): National Aeronautics and Space Administration (NASA) #FP3815
Total Award Amount: $1,085,634 Total Award Period Covered: 02/2025-02/2028
Months of Your Time Committed to the Project: FY25: 1.0 FY26: 1.0 FY27: 0 Total: 2.0

Project/Proposal Title: Advancing vegetative canopy and surface-atmosphere exchange processes in the UFS to improve weather and air quality predictions
Source of Support (w/Grant#): National Oceanic & Atmospheric Administration (NOAA) #FP4342
Total Award Amount: $1,047,522 Total Award Period Covered: 08/2025-07/2028
Months of Your Time Committed to the Project: FY26: 3 FY27: 3 FY28: 3 Total: 9

This Submission
Project/Proposal Title: Improving High-resolution Anthropogenic Emissions and Fire Emissions to Support Air Quality Forecasts over North America
Source of Support (w/Grant#): National Oceanic & Atmospheric Administration (NOAA)
Total Award Amount: $880,000 Total Award Period Covered: 08/2025-07/2028
Months of Your Time Committed to the Project: FY26: 1.2 FY27: 1.2 FY28: 1.2 Total: 3.6

13. Letters of Support

i) NOAA Air Resources Laboratory

ii) NOAA Geophysical Fluid Dynamics Laboratory

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
OFFICE OF OCEANIC AND ATMOSPHERIC RESEARCH
Air Resources Laboratory
NOAA Center for Weather and Climate Prediction
5830 University Research Ct., Suite 4216
College Park, MD 20740

November 25, 2024

Dr. Daniel Tong
George Mason University
Fairfax, VA 22030 USA

Dear Dr. Tong,
This letter expresses the enthusiastic support from NOAA's Air Resources Laboratory (ARL) for your proposal entitled: "***Improving High-resolution Anthropogenic and Fire Emissions to Support National Air Quality Forecasts over North America***", for submission to NASA's Earth Science Directorate in response to call NOAA-OAR-WPO-2025-28603.

NOAA/ARL's Atmospheric Sciences and Modeling Division (ASMD), located in College Park, Maryland, is working with the National Weather Service (NWS) and the University of Maryland to develop, test, and refine the National Air Quality Forecast Capability (NAQFC) to produce nationwide numerical air quality guidance. The NAQFC is one of the major gateways to disseminate NOAA model prediction and satellite observations of atmospheric composition to the public.

Anthropogenic and fire emission data are critical inputs to both the NAQFC and other atmospheric composition models developed by ARL and partners to generate air quality forecasts. The estimation of NAQFC emissions is associated with large uncertainties, including the outdated anthropogenic emissions and severe underestimates of wildfire emissions, both issues that are addressed in this proposal. Novel solutions to improve emissions estimates are highly desirable for operational air quality forecasters to improve the accuracy of model prediction. NAQFC forecasts are used by a host of state and local agencies in support of key public air quality decision making.

We are excited by the prospect of the opportunity to collaborate with GMU, South Dakota State University, the U.S. Environmental Protection Agency, and other partners on the development of new emission data assimilation capability. If you have any questions or concerns, please contact the ARL/ASMD Division Director, Dr, Howard Diamond. The ultimate goal is to integrate these research efforts outputs into NWS' NAQFC operations.

Sincerely,

Ariel F. Stein, Ph.D.
Director, NOAA's Air Resources Laboratory

cc:
R/ARL1 – H. Diamond

Website: http://www.arl.noaa.gov

Meiyun Lin
NOAA Geophysical Fluid Dynamics Laboratory
201 Forrestal Road, Princeton, NJ, USA
Tel: 609-452-6551 (office)
Email: Meiyun.Lin@noaa.gov

November 21, 2024

To: Dr. Daniel Tong
George Mason University
Fairfax, VA 22030 USA

Dear Dr. Tong,

This letter expresses my enthusiastic support for your proposal entitled: "Improving High-resolution Anthropogenic and Fire Emissions to Support National Air Quality Forecasts over North America", submitted to NASA Earth Science Directorate in response to call NOAA-OAR-WPO-2025-28603.

I am a *Physical Research Scientist* at NOAA Geophysical Fluid Dynamics Laboratory (GFDL). I recently served on the review panel for NOAA National Air Quality Forecast Capability (NAQFC). My research focuses on land-biosphere feedbacks to air quality extremes in a changing climate, such as increases in wildfire and dust emissions as well as reductions in ozone removal by vegetation during compound drought and heat events. I lead the development of the GFDL variable-resolution global chemistry-climate model (AM4VR) for research at the nexus of U.S. climate and air quality extremes (Lin et al., JAMES 2024).

My recent paper, Reactive Nitrogen Partitioning Enhances the Contribution of Canadian Wildfire Plumes to US Ozone Air Quality, proposed a new method to improve ozone prediction during large wildfires, an important issue for NAQFC. Should this proposal be selected, I will collaborate with GMU, SDSU, EPA, and other partners to implement and test reactive nitrogen partitioning in wildfire plumes with the NAQFC system. I look forward to the opportunity to working with your team.

Sincerely,

George Mason University
BUDGET JUSTIFICATION
$880,000

PERSONNEL COSTS **$397,920**

Key Personnel
NOAA

Names	Person Month	Base Salary	Effort %	Period 1	Period 2	Period 3	Total
Daniel Tong	**1.00**	$50,468.60	33.33%	**$16,821** ($50,468.60 x .3333)	**$17,662** ($50,468.60 x .3333)	**$18,545** ($50,468.60x .3333)	$53,029
Patrick Campbell	**1.20**	$127,167	10%	**$12,762** ($127,1675 x .10)	**$13,400** ($127,167 x .10)	**$14,070** ($127,167 x .10)	$40,231
TBD Researcher	**9.33**	$110,000	77.77%	**$85,547** ($110,000 x .7777)			$85,547
TBD Researcher	**4.83**	$115,500	40.259%		**$46,499**($ $115,500 x .40259)		$46,499
TBD Researcher	**6.68**	$121,275	55.6838 %			**$67,531** ($121,275 x .556838)	$67,531
						Subtotal	$292,837

Principal Investigator – Dr. Daniel Tong will serve as the PI of this project and will dedicate sufficient time to the project to administer the project and ensure that milestones are met, and status reports/reviews are presented to lead PI and program managers. He will lead emission modeling of anthropogenic emission sources and plume rise parameterization, and collaborate with South Dakoda State University to improve fire emissions.

Co-Investigator – Dr. Patrick Campbell will be responsible for integrating the GMU emission datasets into NAQFC and UFS-AQM model ready emissions using the NEXUS system.

Post Doc Researcher – 1 TBD Post Doc researcher will be responsible for updating anthropogenic and fire emissions and conduct model simulations to evaluate the effects of these updates.

Other Personnel

Graduate Students							
	No.	Hours	Rate	Period 1	Period 2	Period 3	Total

Doctoral Academic	1 GRA	720	$34.724	$25,000	$0	$0	$25,000
Doctoral Academic	1 GRA	720	$36.458	$0	$26,250	$0	$26,250
Doctoral Academic	1 GRA	720	$38.2809	$0	$0	$27,563	$27,563
Doctoral Summer	1 GRA	240	$34.724	$8,333	$0	$0	$8,333
Doctoral Summer	1 GRA	240	$36.458	$0	$8,750	$0	$8,750
Doctoral Summer	1 GRA	240	$38.2809	$0	$0	$9,188	$9,188
						Subtotal	$105,083

Graduate Research Assistant (GRA) – Assist the PI and researcher to conduct model simulations and evaluation. The GRA will also help data analysis and develop manuscripts for publication.

NOTE:
Mason provides annual merit increases to Faculty and Staff. An escalation factor of 5% has been included for all personnel each year.

The estimate of hours and/or hourly rates is furnished solely for the purpose of this proposal. It is understood that the University will not be required to maintain a record of hours of effort under any resultant award. The University operates per 2 CFR 200.430 (h) and (i), and its financial system is based on a percent of effort, not hours worked.

FRINGE BENEFITS $77,439

George Mason University's negotiated fringe benefit rates for Fiscal Year 2025 are applied as follows:

Faculty (Admin, Teaching, & Post-Docs) 30.70%
FICA Only (summer, adjunct, non-student wages) 7.2%

The rates quoted above shall, at the time of funding be subject to adjustment, if superseding Government approved rates have been established. Salaries, wages and fringe benefits are estimates only and will be paid and billed in accordance with University policy.

B. FRINGE BENEFITS	Period 1	Period 2	Period 3	**Total**
Faculty, Academic & Calendar	30.70%			
Patrick Campbell	**$3,917.84** ($12,762 x .3070)	**$4,113.73** ($13,400 x .3070)	**$4,319.42** ($1,725 x .3070)	$12,171
TBD Researcher	**$26,262.93** ($85,547 x .3070)	**$14,275.24** ($46,499 x .3070)	**$20,731.87** ($20,731.87 x .3070)	$61,270
FICA ONLY	7.20%			
Daniel Tong	**$1,211** ($16,821 x .072)	**$1,272** ($17,662 x .072)	**$1,335** ($18,545 x .072)	$3,818

TOTAL FRINGE	$77,439

TRAVEL COSTS **$16,283**

Domestic Travel

All travel will be in accordance with University travel regulations and mileage will be charged at the current rate on the date of travel. Travel estimates are based on costs that were incurred on previous projects of a similar nature for federal and state agencies. Funds are requested for Travel to San Francisco to Attend AGU or AMS Meetings and Conferences. Additionally, Travel is also requested to attend a regional meeting such as the CMAS meetings in Chapel Hill North Carolina. Travel estimates include costs for transportation, lodging, per diem, and other related expenses.

San Francisco Travel Y1-Y3

Round trip airfare	1 trip x 2 staff x $400 per flight	$800
Lodging	1 trip x 3 night stay x 2 staff x $272	$1,632
Meals and other per day	1 trip x 2 days x 2 staff x $69	$276
Meals and other per day	1 trip x 2 days x 2 staff x $92	$368
Conference fees	1 conference x 2 staff x $660	$1,320
	Total requested per year	$4,396
	Subtotal (3 years)	$13,188

CMAS Chapel Hill Travel Y1-Y3

Lodging	1 trip x 2 night stay x 1 staff x $140	$280
Meals and other per day	1 trip x 2 days x 1 staff x $60	$120
Meals and other per day	1 trip x 1 days x 1 staff x $80	$80
Car Rental	1 trip x 1 staff x 3 days x $66.67	$200
Mileage	1 trip x 525 miles x $.67 per mile	$352
	Total requested per year	$1,032
	Subtotal (3 years)	$3,095

GENERAL COSTS

GRA Health Insurance & Institutional (Tuition) Allowances **$54,363**

Tuition is requested for each student during the academic year for 18 credits at a rate of $618/credit; an 5% escalation rate will apply each year to tuition. A mandatory student fee of $159.5 per credit hour is also included.

Full-Time Graduate Student Health Benefits are budgeted at $3,552/year for students who meet the minimum requirements.

GRA Health Insurance & Institutional Allowances			Period 1	Period 2	Period 3	Total
GRA Health Insurance	No.	Rate: Annual				
	1	$3,552	$3,552	$3,552	$3,552	$10,656
Tuition & Fees:	*Credits*	*$ per credit*				

PHD GRA COS	18	$618	$11,132	$11,689	$12,273	$35,094
Mandatory Student Fee	18	$159.50	$2,871	$2,871	$2,871	$8,613
SUBTOTAL GRA TUITION, FEES, & HEALTH SUBSIDY			$17,555	$18,112	$18,696	**$54,363**

Materials & Supplies **$18,300**

Supply and expense items categorized as project specific are for expenses that specifically benefit this project, are reasonable and necessary for the performance of this work, and can be readily allocable to this project. Funds are requested to include the purchase of a laptop in Year 1 dedicated to the project. Funds are also requested to pay for 85TB storage on GMU super computer cluster. The emission project is very data intensive.

Description	#	**Price**	**Total Price**
Computers Year 1	1	$3,000	$3,000
Data Storage Year 1	85 TB	$60	$5,100
Data Storage Year 2	85 TB	$60	$5,100
Data Storage Year 3	85 TB	$60	$5,100
SUBTOTAL			$18,300

Publication Costs

Funding is requested for publications to pay for journal page fees and for publishing colored figures. $3,000 per year is budgeted based on similar projects.

Description	#	**Price**	**Total Price**
Publications TBD Year 1	1	$3,000	$3,000
Publications TBD Year 2	1	$3,000	$3,000
Publications TBD Year 3	1	$3,000	$3,000
SUBTOTAL (3 years)			$9,000

Total Direct Charges **Total Requested $573,305**

A. Personnel $397,920
B. Fringe $77,439
C. Travel $16,283
D. Animal Purchases $0
E. Consultant Services: $0
F. Equipment: $0
G. GRA Health/Tuition/Fees: $54,363
H. Materials and Supplies: $18,300
I. Other General Costs: $0
J. Publication Costs: $9,000
K. Research Payment Costs: $0
L. Participant/Trainee Support: $0
M. Subawards: $0

Total Direct Costs $573,305

FACILITIES AND ADMINISTRATIVE COSTS (F&A)

$306,695

George Mason University has a predetermined F&A rate of 59.1%, Modified Total Direct Costs (MTDC), approved by the Office of Naval Research.

	Indirect Base total	F&A Rate	Indirect Total	Direct Costs	Total
Period 1	$196,383	.591	$116,062	$213,938	$330,000
Period 2	$145,750	.591	$86,138	$163,862	$250,000
Period 3	$176,809	.591	$104,494	$195,506	$300,000
		Total Requested	$306,695	$573,305	$880,000

Summary Budget Table

GMU	Year 1	Year 2	Year 3	Tota
Personnel	$ 148,463	$ 112,561	$ 136,896	$ 397,920
Fringe Benefits	$ 31,392	$ 19,661	$ 26,386	$ 77,439
Travel	$ 5,428	$ 5,428	$ 5,428	$ 16,284
Equipment	$ -	$ -	$ -	$ -
Supplies	$ 8,100	$ 5,100	$ 5,100	$ 18,300
Contractual	$ -	$ -	$ -	$ -
Construction	$ -	$ -	$ -	$ -
Other	$ 20,555	$ 21,111	$ 21,696	$ 63,362
Total Direct Charges	$ 213,938	$ 163,862	$ 195,506	$ 573,305
Indirect Charges	$ 116,062	$ 86,138	$ 104,494	$ 306,695
Total	$ 330,000	$ 250,000	$ 300,000	$ 880,000

NAU	Year 1	Year 2	Year 3	Tota
Personnel	$ 7,181	$ 49,543	$ 26,518	$ 83,242
Fringe Benefits	$ 1,699	$ 14,748	$ 6,852	$ 23,299
Travel	$ 3,049	$ 3,049	$ -	$ 6,098
Equipment	$ -	$ -	$ -	$ -
Supplies	$ 1,539	$ -	$ -	$ 1,539
Contractual	$ -	$ -	$ -	$ -
Construction	$ -	$ -	$ -	$ -
Other	$ -	$ -	$ 300	$ 300

Total Direct Charges	$ 13,468	$ 67,340	$ 33,670	$ 114,479
Indirect Charges	$ 6,532	$ 32,660	$ 16,330	$ 55,522
Total	$ 20,000	$ 100,000	$ 50,000	$ 170,000

SUBTOTAL	**$ 350,000**	**$ 350,000**	**$ 350,000**	**$ 1,050,000**

DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
875 NORTH RANDOLPH STREET
SUITE 1425
ARLINGTON, VA 22203-1995

IN REPLY REFER TO:

Agreement Date: June 28, 2023

NEGOTIATION AGREEMENT

INSTITUTION: **GEORGE MASON UNIVERSITY**
FAIRFAX, VA 22030

The Facilities and Administrative (F&A) Cost rates contained herein are for use on grants, contracts and/or other agreements issued or awarded to the George Mason University by all Federal Agencies of the United States of America, in accordance with the provisions and cost principles mandated by 2 CFR Part 200. These rates shall be used for forward pricing and billing purposes for the George Mason University Fiscal Years 2024 through 2026. This rate agreement supersedes all previous rate agreements/determinations related to these rates for Fiscal Years 2024 through 2026.

Section I: RATES – TYPE: PREDETERMINED (PRED)

F&A Rates:

Type	From	To	Rate	Location	Base	Applicable to
PRED.	7/1/23	6/30/26	59.1%	On Campus	(a)	Organized Research (1)
PRED.	7/1/23	6/30/26	26.0%	Off Campus Remote *	(a)	Organized Research (1)
PRED.	7/1/23	6/30/26	28.2%	Off Campus Adjacent **	(a)	Organized Research (1)
PRED.	7/1/23	6/30/26	73.3%	On Campus	(a)	Organized Research (2)
PRED.	7/1/23	6/30/26	40.2%	Off Campus Remote *	(a)	Organized Research (2)
PRED.	7/1/23	6/30/26	42.4%	Off Campus Adjacent **	(a)	Organized Research (2)
PRED.	7/1/23	6/30/26	55.5%	On Campus	(a)	Instruction
PRED.	7/1/23	6/30/26	26.0%	Off Campus Remote *	(a)	Instruction
PRED.	7/1/23	6/30/26	35.2%	Off Campus Adjacent **	(a)	Instruction
PRED.	7/1/23	6/30/26	41.8%	On Campus	(a)	Other Sponsored Activities
PRED.	7/1/23	6/30/26	26.0%	Off Campus Remote *	(a)	Other Sponsored Activities
PRED.	7/1/23	6/30/26	27.3%	Off Campus Adjacent **	(a)	Other Sponsored Activities
PRED.	7/1/23	6/30/26	10.0%	All	(a)	IPA ***

*Off-Campus Remote – activities performed outside the commuting area of the university.
**Off-Campus Adjacent/Vicinity – off campus activities performed within the commuting area of the university.
***Intergovernmental Personnel Act

DISTRIBUTION BASE

(a) Modified total direct costs, consisting of all direct salaries and wages, applicable fringe benefits, materials and supplies, services, travel, and up to the first $25,000 of each subaward (regardless of the period of performance of the subawards under the award). Equipment, capital expenditures, charges for patient care and tuition remission, rental costs, scholarships, and fellowships, participant support costs as well as the portion of each subaward in excess of $25,000 shall be excluded from modified total direct costs.

APPLICABLE TO

(1) Applies to DOD contracts awarded before November 30, 1993, all Non-DOD Instruments, and all DOD grants and other agreements (See Section II, paragraph E). (Capped)

(2) Applies to only DOD contracts awarded on or after November 30, 1993 in accordance with and under the authority of DFARS 231.303(1) (See Section II, paragraph E). (Uncapped)

SECTION II - GENERAL TERMS AND CONDITIONS

A. **LIMITATIONS**: Use of the rates set forth under Section I is subject to availability of funds and to any other statutory or administrative limitations. The rates are applicable to a given grant, contract or other agreement only to the extent that funds are available and consistent with any and all limitations of cost clauses or provisions, if any, contained therein. Acceptance of any or all of the rates agreed to herein is predicated upon the following conditions: (1) that no costs other than those incurred by the institution were included in this indirect cost pool as finally accepted and that such costs are legal obligations of the institution and allowable under governing cost principles; (2) that the same costs that have been treated as indirect costs are not claimed as direct costs; (3) that similar types of costs have been accorded consistent accounting treatment; and (4) that the information provided by the institution which was used as a basis for acceptance of the rates agreed to herein, and expressly relied upon by the Government in negotiating and accepting the said rates is not subsequently found to be materially incomplete or inaccurate.

B. **ACCOUNTING CHANGES**: The rates contained in Section I of this agreement are based on the accounting system in effect at the time the agreement was negotiated. Changes to the method(s) of accounting for costs, which affect the amount of reimbursement resulting from the use of these rates require the prior written approval of the authorized representative of the cognizant agency for indirect costs. Such changes include but are not limited to changes in the charging of a particular type of cost from indirect to direct. Failure to obtain such approval may result in subsequent cost disallowances.

C. **PREDETERMINED RATES**: The predetermined rates contained in this agreement are not subject to adjustment in accordance with the provisions of 2 CFR Part 200, subject to the limitations contained in Part A of this section.

D. **USE BY OTHER FEDERAL AGENCIES**: The rates set forth in Section I are negotiated in accordance with and under the authority set forth in 2 CFR Part 200. Accordingly, such rates shall be applied to the extent provided in such regulations to grants, contracts, and other agreements to which 2 CFR Part 200 applies, subject to any limitations in part A of this section. Copies of this document may be provided by either party to other federal agencies to provide such agencies with documentary notice of this agreement and its terms and conditions.

E. **APPLICATION OF INDIRECT COST RATES TO DEPARTMENT OF DEFENSE (DOD) CONTRACTS**: In accordance with DFARS 231.303, no limitation may be placed on the reimbursement of otherwise allowable indirect cost incurred by an institution of higher education under a DoD contract awarded on or after November 30, 1993, unless the same limitation is applied uniformly to all other organizations performing similar work. It has been determined by DoD that such limitation is not being uniformly applied. Accordingly, the rates cited (2) of Section I, as explained under the title, "APPLICABLE TO" do not reflect the application of the 26% limitation on administrative indirect costs imposed by 2 CFR Part 200, whereas (1) does so.

F. **DFARS WAIVER**: Signature of this agreement by the authorized representative of George Mason University and the Government acknowledges and affirms the University's request to waive the prohibition contained in DFARS 231.303(1) and the Government's exercise of its discretion contained in DFARS 231.303(2) to waive the prohibition in DFARS 231.303(1) for the Instruction and Other Sponsored Activities rates. The waiver request by George Mason University is made to simplify the University's overall management of DoD cost reimbursements under DoD contracts.

G. **SPECIAL REMARKS**: The Government's agreement with the rates set forth in Section I is not an acceptance of the George Mason University's accounting practices or methodologies. Any reliance by the Government on cost data or methodologies submitted by George Mason University is on a non-precedence-setting basis and does not imply Government acceptance.

Accepted:

FOR GEORGE MASON UNIVERSITY:	FOR THE U.S. GOVERNMENT:
Sharon L. Heinle	WOOD.LINDA.MORGAN.1514688946 Digitally signed by WOOD.LINDA.MORGAN.1514688946 Date: 2023.06.29 13:00:28 -04'00'
Sharon L. Heinle	Linda Morgan Wood
Vice President for Finance	Contracting Officer
6/29/2023	6/29/23
Date	Date

For information concerning this agreement contact:

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