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:
11/19/2024	JIMENEZ2

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:	University Corporation for Atmospheric Research

* b. Employer/Taxpayer Identification Number (EIN/TIN):	* c. UEI:
840412668	YEZEE8W5JKA3

d. Address:

* Street1:	3090 Center Green Drive
Street2:	
* City:	Boulder
County/Parish:	Boulder
* State:	CO: Colorado
Province:	
* Country:	USA: UNITED STATES
* Zip / Postal Code:	80301-2252

e. Organizational Unit:

Department Name:	Division Name:
Nat'l Ctr for Atmospheric Res	Research Applications Lab

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

Prefix:	Ms.	* First Name:	Melinda
Middle Name:			
* Last Name:	Arnold		
Suffix:			

Title:	Manager, Pre-Award Administration

Organizational Affiliation:
NCAR

* Telephone Number:	303-497-1114	Fax Number:	

* Email:	ncarprop@ucar.edu

Application for Federal Assistance SF-424

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

M: Nonprofit with 501C3 IRS Status (Other than 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:**

Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS

Attach supporting documents as specified in agency instructions.

File Name:

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: CO-002
* b. Program/Project: CO-002

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	1,049,775.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	1,049,775.00

*** 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: Mr. * First Name: Nathan

Middle Name:

* Last Name: Aderhold

Suffix:

* Title: Budget Analyst III

* Telephone Number: 303-497-1143 Fax Number:

* Email: fedaward@ucar.edu

* Signature of Authorized Representative: Nathan Aderhold * Date Signed: 11/19/2024

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 . Weather and Air Quality Research	11.459			$1,049,775.00		$1,049,775.00
2 .						$0.00
3 .						$0.00
4 .						$0.00
5. Totals				$1,049,775.00		$1,049,775.00

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)
	(1) Weather and Air Quality Research	(2)	(3)	(4)	
a. Personnel	$132,848.00	$130,797.00	$129,674.00		$393,319.00
b. Fringe Benefits	$74,394.00	$73,247.00	$72,617.00		$220,258.00
c. Travel	$6,290.00	$6,514.00	$6,863.00		$19,667.00
d. Equipment					
e. Supplies					
f. Contractual					
g. Construction					
h. Other	$15,372.00	$18,839.00	$20,004.00		$54,215.00
i. Total Direct Charges (*sum of 6a-6h*)	$228,904.00	$229,397.00	$229,158.00		$687,459.00
j. Indirect Charges	$121,073.00	$120,475.00	$120,768.00		$362,316.00
k. TOTALS (*sum of 6i and 6j*)	$349,977.00	$349,872.00	$349,926.00		$1,049,775.00
7. Program Income					

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 . Weather and Air Quality Research					$0.00
9 .					$0.00
10 .					$0.00
11 .					$0.00
12. TOTAL (sum of lines 8-11)					
SECTION D - FORECASTED CASH NEEDS					
	Total for 1st Year	**1st Quarter**	**2nd Quarter**	**3rd Quarter**	**4th Quarter**
13. Federal	$349,977.00	$87,495.00	$87,494.00	$87,494.00	$87,494.00
14. Non-Federal					
15. TOTAL (*sum of lines 13 and 14*)	$349,977.00	$87,495.00	$87,494.00	$87,494.00	$87,494.00
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 . Weather and Air Quality Research		$349,872.00	$349,926.00		
17 .					
18 .					
19 .					
20. TOTAL (*sum of lines 16-19*)		$349,872.00	$349,926.00		
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: Modified Total Direct Costs (MTDC) = $639,004			22. Indirect Charges: Indirect Costs on MTDC = $362,316		
23. Remarks: Indirect Costs = FY24 rate of 56.7% x MTDC = .567 x $639,004 = $362,316					

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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

University Corporation for Atmospheric Research

* AWARD NUMBER	*PROJECT NAME
Not yet assigned	Development of two-way coupling between fire behavior...

Prefix: Mr.	* First Name: Nathan	Middle Name:
* Last Name: Aderhold		Suffix:
* Title: Budget Analyst III		

*** SIGNATURE:**	*** DATE:**
Nathan Aderhold	2024-11-19

ASSURANCES - NON-CONSTRUCTION PROGRAMS

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

Public reporting burden for this collection of information is estimated to average 15 minutes per response, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to the Office of Management and Budget, Paperwork Reduction Project (0348-0040), Washington, DC 20503.

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
Nathan Aderhold	Budget Analyst III
* APPLICANT ORGANIZATION	* DATE SUBMITTED
University Corporation for Atmospheric Research	11-19-2024

Standard Form 424B (Rev. 7-97) Back

Proposal title: Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS

Principal investigator: Dr. Pedro A. Jimenez Munoz, project scientist III, National Center for Atmospheric Research (NCAR). Phone: 303-497-8201, Email: jimenez@ucar.edu
Address: Research Applications Laboratory
National Center for Atmospheric Research
3450 Mitchell Ln., Boulder, CO 80301
Co-PI: Dr. Rajesh Kumar, project scientist III, NCAR,
Phone: 303-497-1413, email: rkumar@ucar.edu
Co-Investigators:
Dr. Forrest Lacey, project scientist II, NCAR
Phone: 303-497-1863, email: lacey@ucar.edu
Dr. Masih Eghdami, project scientist I, NCAR
Phone: 303-497-2839, email: masih@ucar.edu
Daniel Rosen, software engineer III, NCAR,
Phone: 303-497-1304, email: drosen@ucar.edu
Unfunded collaborators: Ravan Ahmadov (NOAA/OAR/GSL), and Jianping Huang (NOAA/EMC)

Institutional Representative: Ms. Anna L. Thomas, Manager, UCAR Contracts, University Corporation for Atmospheric Research (UCAR). Phone: 303-497-2005, Email: fedaward@ucar.edu

Total requested funds:

	Year 1	Year 2	Year 3	Total
NCAR	**$349,977**	**$349,872**	**$349,926**	**$1,049,775**

Funding Opportunity Number: NOAA-OAR-WPO-2025-28603
Funding competition: Air Quality Research and Forecasting (AQRF)
Relevant competition priorities: We will contribute to **AQRF-1** by coupling the UFS fire behavior model to UFS Air Quality Model (UFS-AQM) and connecting UFS-AQM aerosols to atmospheric radiation in the Common Community Physics Package (CCPP) to capture air-quality and weather interactions. We will also contribute to **AQRF-2** focusing on "*key variables dictating AQ forecast (ozone and $PM_{2.5}$) performance at the gray zone*"; and to **AQRF-3** with "*Improved spatial and temporal estimates of [...] natural pollutant emissions, including smoke from wildland fires*".
Readiness levels (RLs): The starting readiness level of the project is RL6. At the end of the project, we will reach RL8.

ABSTRACT

Title: Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS

Project Goal: Implement the release of chemical species emitted from biomass burning in the UFS fire behavior model that explicitly resolves the fires evolution, and couple them to the UFS-AQM to explicitly account for fire-chemistry interactions. The UFS-AQM aerosols will be connected to atmospheric radiation to strengthen the fire-weather-chemistry interactions.

Problem opportunity statement: The coupling of the UFS fire behavior model, the Community Fire Behavior model (CFBM, Jimenez y Munoz et al., 2024), to UFS-AQM will address our urgent need and long-standing inability to predict the evolution of fire emission in air quality forecasting systems around the world.

Methodology/Activities to be performed: First, we will implement the emissions of chemical species in the CFBM. Then, we will connect the fire emissions to UFS-AQM. Afterward, the AQM aerosols will be connected to radiation. Finally, we will run a real-time demonstration of the coupled fire-weather-chemistry UFS to quantify its performance.

Primary project products/outputs: The main product will be a novel fully coupled fire-atmosphere-chemistry capability in the UFS model to improve the realism of both fire behavior and especially air quality forecasts.

Expected results, outcomes, and benefits: The project will quantify the value of explicit fire behavior modeling for NOAA's operational air-quality forecasts. Expected outcomes include explicit simulation of fire-weather-chemistry with UFS for the first time, and better air-quality forecasts during wildland fire episodes. Benefits include better forecasts to limit exposure to unhealthy air-quality.

Intended beneficiaries or recipients: Beneficiaries include the National Air-Quality Forecasting Capability (NAQFC) at NOAA who can use the coupled fire-weather-chemistry UFS for better early warning forecasts to limit exposure to unhealthy air-quality. Beneficiaries also include any researcher doing fire-weather science or air quality impacts of wildland fires.

c. Problem/opportunity statement

Wildland fires are becoming more frequent and larger which aggravates the adverse impacts of smoke on air quality, especially as anthropogenic contributions to poor air quality are decreasing (Burke et al., 2023). Among the chemical species released by biomass combustion, fine particulate matter ($PM_{2.5}$) is the most concerning for health leading to large and disparate health burdens throughout the U.S. (Connolly et al., 2024; Gould et al., 2024; Maji et al., 2024). A recent study reported that wildfire-specific $PM_{2.5}$ was found to be ~10 times more harmful to children's (0-5 years) respiratory health than $PM_{2.5}$ from other sources (Aguilera et al., 2021). In addition, ozone (O_3) can be formed by chemical reactions within the smoke and tropospheric O_3 is a main concern for health (Turner et al., 2015), agricultural crops (Emberson et al., 2017), and a vital player in atmospheric chemistry and climate. The NAQFC at the National Oceanic and Atmospheric Administration (NOAA) produces 72-hour operational air quality forecasts twice a day, which are then used by decision-makers across the nation to issue early warnings of acute air pollution episodes to the public. As a result, having accurate predictions of the air quality impacts of the smoke released in wildland fires is critical to minimize exposure to unhealthy air.

Unfortunately, the accuracy of the NAQFC air quality forecasts is affected by many factors, such as the inability to predict fire emissions at run time along with their plume rise and chemical composition. Most of the operational air quality models, including NAQFC need information about the fire emissions for the duration of the forecast, and these emissions are unknown because we do not know how fire activity, burned area, and fuel load is going to change. Therefore, operational models need to make assumptions about the evolution of fire emissions (e.g., Kumar et al., 2020). For example, the near-real-time (NRT) fire emissions within the NAQFC, which uses the Air Quality Model (AQM) within the UFS, are based on the Regional ABI (Advanced Baseline Imager) and VIIRS (Visible Infrared Imaging Radiometer Suite) fire Emissions (RAVE, Li et al. 2022), retrievals over North America. During the simulation, NAQFC employs a persistence fire emission assumption that assumes constant repetition of NRT fire emissions available with a latency of one day for every day of the forecast (Huang et al. 2024). Hence NAQFC does not scout for fire-weather interactions that can produce large deviations in the emissions when the atmospheric state deviates from climatology.

The uncertainties in fire emissions and the persistence assumption lead to large errors in air quality forecasts, particularly during the wildfire season in the Western US, as shown in Figure 1 (Golbazi et al., 2023; NOAA Grant # NA19OAR4590083). Figure 1 shows that the Root Mean Squared Error (RMSE) in $PM_{2.5}$ simulated by the UFS driven Community Multiscale Air Quality Model (CMAQ) is highly correlated with the high values of CO-Fire (a tracer tracking carbon monoxide (CO) emitted from fires within the model domain) in the Environmental Protection Agency (EPA) defined regions 8-10 representing the Western U.S.

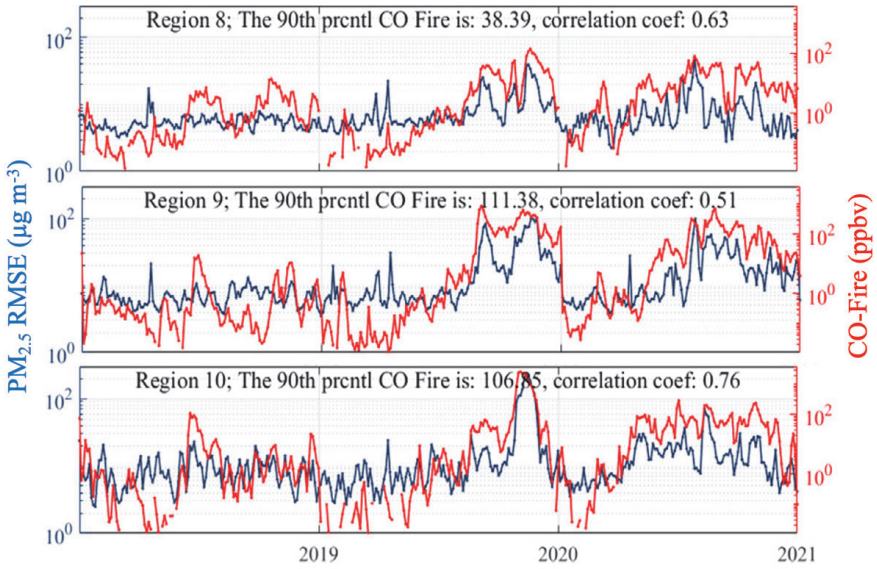

Figure 1: The relationship between the $PM_{2.5}$ RMSE from UFS-CMAQ forecasts (blue color, left axis), and CO-Fire (red color, right axis) in EPA regions 8-10. Note the logarithmic scale on Y-axis. The text on each plot shows the correlation coefficient between the $PM_{2.5}$ RMSE and Co-Fire in every region when CO-Fire was higher than the 90th percentile value. Figure reproduced from Golbazi et al. (2023).

Another limitation affecting air quality forecasts is that the AQM uses aerosol climatologies in the radiation parameterization to account for the aerosol direct effects. This is a main limitation for fire applications wherein the large concentration of aerosols in the smoke plume produces large deviations with respect to climatology. As a result, the current method does not account for any effect of the fire plume on radiation, hampering the fire-weather-chemistry interactions. For example, it does not account for the reduction of solar radiation at the ground, the impacts on atmospheric stability, and subsequent impacts on mixing and chemical reactions.

In this project, we aim to address this urgent need and long-standing inability to predict the evolution of fire emissions at run time in air quality forecasting systems around the world with a focus on the US. Specifically, we will leverage the recent implementation of a fire behavior module led by PI and members of this team. The UFS fire behavior model, the Community Fire Behavior model (CFBM, Jimenez y Munoz et al., 2024), has been implemented within the framework of a NOAA WPO project entitled "Implementing a state-of-the-science fire behavior model in the Unified Forecast System" (award number NA22OAR4590514). The CFBM is a process-oriented model, available as a National Unified Operational Prediction Capability (NUOPC), to explicitly resolve the evolution of wildland fires accounting for fire-atmosphere interactions (Fig. 2, left gray box). The fire model runs in a different domain than the atmospheric one to reach fine horizontal grid spacing (~100 m) to accurately represent the fire progression and fuel consumed. This ongoing project will end in July 2025 when the transition plan will be completed allowing NOAA to activate the fire behavior for selected fires over the contiguous U.S. Current efforts are devoted to parallelizing the CFBM code. The computational

cost of running the CFBM will be much smaller than the one required for running the UFS-Atmosphere once parallelization is in place.

We, therefore, propose to implement a novel capability within the CFBM to emit the relevant chemical species online, connect them to the AQM to account for fire-chemistry interactions, and connect the AQM aerosols to radiation to account for the direct effects of the fire plume on the weather. The proposed coupling of the CFBM with AQM is illustrated in Figure 2. We will first add an algorithm to calculate the emissions of the CMAQ species online from fuel burned by an evolving fire simulated by the CFBM. For this purpose, we will use the Next-generation Emission InVentory expansion of Akagi (NEIVA, Binte Sahid et al., 2024) emission factor database. NEIVA generates chemical mechanism-specific emission factors as a function of the fuel burning and meteorological conditions as look-up tables that will be implemented in the CFBM. We will create NEIVA look-up tables mapped to the gas-phase chemical mechanism and aerosol model used by the AQM. The fire emissions at the surface will be distributed in the vertical column using UFS-Atmosphere's plume rise parameterization (Sofiev et al., 2012) inside the CFBM, to take advantage of the finer grid spacing of the fire grid (~100 m). We are proposing to do a plume rise within the CFBM compared to UFS-AQM because the variables communicated from the CFBM are averaged to the UFS-Atmosphere grid, i.e., go from a 100 m grid spacing to 13 km grid spacing. This reduces the realism of the fire plume rise if done in the UFS-Atmosphere. The resulting three-dimensional (3D) distribution of fire emissions will be passed to the AQM (Fig. 2). The vertically distributed fire emissions will be translated into mixing ratios of chemical species within the regional AQM so that they participate in all gas- and aerosol-phase processes. Our final step will be to improve the representation of aerosol-radiation interactions in the UFS Common Community Physics Package's (CCPP, Heinzeller et al. 2023) radiation parameterizations, currently based on aerosol climatologies, through frequent updates via chemistry. Specifically, spectrally resolved aerosol optical properties will be fed to the short- and long-wave radiation parameterizations. The coupled fire-atmosphere-chemistry UFS model will be exercised on fires well sampled in the Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ) campaign to confirm the adequacy of our implementation. To demonstrate the performance, we will run the fire-atmosphere-chemistry UFS model in quasi-operational mode over the Western U.S., using VIIRS to initialize fire perimeters, to compare results with the current method based on RAVE. The performance will be evaluated using the Model EvaLuation using Observations, DIagnostics and Experiments Software (MELODIES) project at NCAR with the Model and ObservatioN Evaluation Toolkit (MONET) project at NOAA. MELODIES-MONET integrates atmospheric chemistry observations with chemistry models for the evaluation of air quality and atmospheric composition. **This will make UFS the first operational model to have an explicit simulation of the evolution of fire emissions connected dynamically to air quality and radiation.**

Relevance to AQRF priorities: The proposed efforts fit well into AQRF-1 by coupling the CFBM that runs at ~100 m grid spacing, to UFS-AQM and connecting UFS-AQM aerosols to atmospheric radiation in order to contribute to the "*development and evaluation of high-*

resolution (1-3 km) air quality forecasts capabilities that are consistent with NOAA weather forecast models [...] including two-way coupled models that capture air quality-weather interactions". It also contributes to "*work focusing on representation of local phenomena such as fine scale processes [...] over complex terrain*" because many wildland fires in the contiguous U.S. take place in the complex terrain of Western U.S. We will also contribute to AQRF-2 focusing on "*key variables dictating AQ forecast (ozone and $PM_{2.5}$) performance at the gray zone*"; and to AQRF-3 with "*Improved spatial and temporal estimates of [...] natural pollutant emissions, including smoke from wildland fires [...] using NOAA satellite remote sensing*".

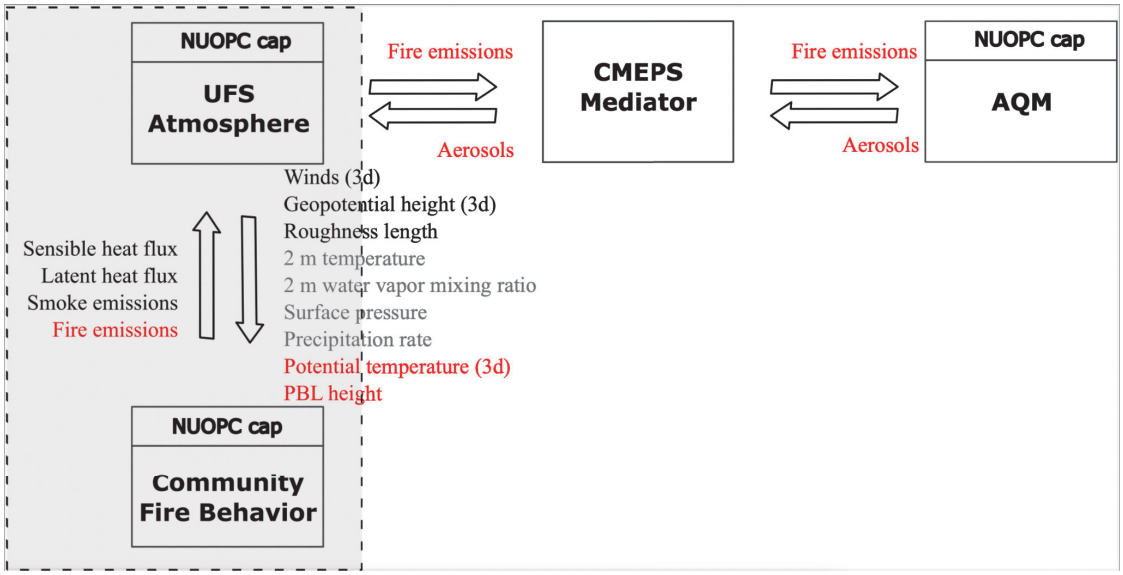

Figure 2: Illustration of the coupling between the UFS-Atmosphere, the CFBM, and the AQM. The gray box highlights the current coupling. The variables in gray are only needed if the dynamic fuel moisture model is activated. The connection of the variables highlighted in red between the different NUOPC components will be implemented in this project. Adapted from Jimenez y Munoz et al. (2024).

d. Methods and activities

d.1 Task 1: Online biomass burning emissions and CBFM-AQM coupling

The CFBM is a process-oriented model that explicitly simulates the evolution of wildland fires. It is available as a NUOPC and it is already two-way coupled to the Community UFS to allow for fire-atmosphere interactions (Fig. 2, gray box). The UFS-Atmosphere passes to the fire NUOPC the surface winds and other near surface variables that drive the fire evolution. In turn, the fire feedbacks to the atmosphere heat and moisture as a result of the biomass burning at the surface. The fire simulation runs over a refined domain that is independent of the atmospheric one to achieve fine horizontal grid spacing (~100 m) to accurately track the propagation of the fire front and fuel consumption. A percentage of the fuel burned at the surface is released as smoke, which is currently a passive tracer in the UFS-Atmosphere. Hence, the fire emissions are largely simplified and are not connected to any UFS component, such as the air quality model.

Hence, our first step will be to implement a **novel methodology** to calculate the emissions of the relevant gas and aerosol species for AQM in the CFBM. To achieve this, we

will introduce a new option in the air quality configuration (aqm.rc) to allow the users to select between 1) online CBFM fire emissions matching those used in the AERO7 and Carbon Bond (CB6) based chemical mechanism currently used in UFS-AQM; and 2) the precalculated offline fire emissions (Fig. 3) such as those available from Blended Global Biomass Burning Emissions Product (GBBEPx) and RAVE, which are currently used for fire emissions within UFS-AQM.

The online emissions in the CFBM will be calculated using the emission factors from NEIVA that have been mapped to the AQM chemical species. NEIVA provides species-specific look up tables as a function of the burned area and land cover types as ascii files that we will add to the CFBM. We will calculate the emissions of all the gaseous (34 species) and aerosol (21 species) required by the current version of AQM within UFS using NEIVA emission factors as a function of the fuel burned. We will also compute the plume rise within the CFBM to ensure that buoyancy related to fire heat flux is incorporated in the plume rise at the scale of fire evolution itself. The emissions will be distributed linearly between the surface and identified plume height to avoid artificial dilution of fire heat flux.

The 3D emissions will be passed to AQM using UFS infrastructure (Figs. 2 and 3). To this end, we will interface CFBM with the aqm_emis_update subroutine so that the 3D distribution of online fire emissions from CFBM will be added to the appropriate emission arrays in the DESID and ELMO modules of CMAQ model version 5.4. CMAQ 5.4 is expected to replace the current implementation of CMAQ 5.2.1 as the AQM within the UFS. If the CMAQ 5.4 implementation is delayed for any reason, online fire emissions will be added to the "VDEMIS" array in the "GET_EMIS" subroutine. The next step is to translate the fire emission fluxes into chemical concentrations ("CONC"). The "cmaq_advance" subroutine then will automatically process these fire emissions through the rest of the physical and chemical processes on the grid, i.e., VDIFF (vertical mixing and dry deposition), CLDPROC (cloud processing), CHEM (gas-phase chemistry), and AERO (aerosol processes including nucleation, coagulation, thermodynamics, secondary organic aerosol formation, etc.).

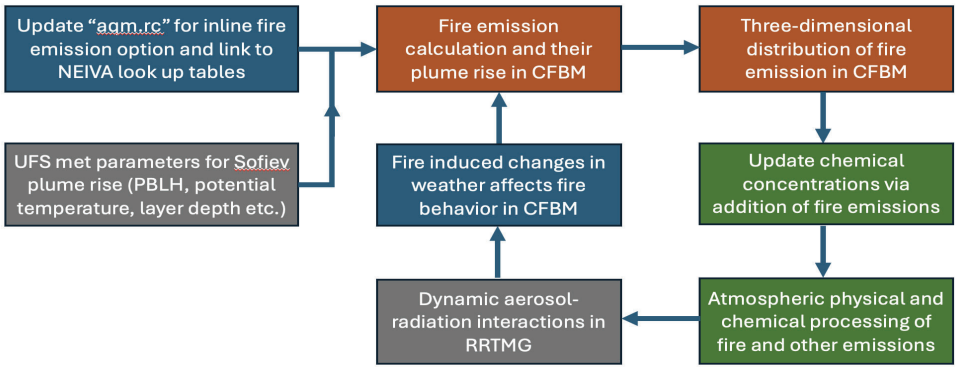

Figure 3: Illustration of the UFS developments. Orange boxes highlight the changes in the CFBM, green boxes in the AQM, and gray boxes in UFS-Atmosphere (or CCPP). Blue boxes highlight other aspects.

d.2 Task 2: Coupling the AQM aerosols to atmospheric radiation and system testing

Coupling to radiation: Once the fire emissions (Task 1), along with other emissions, have been processed by all the physical and chemical processes, they are ready to be translated to

aerosol optical properties (aerosol optical depth, single scattering albedo, and asymmetry parameter) for interaction with the radiation parameterization (i.e., Rapid Radiative Transfer Model for General Circulation Models, RRTMG, Iacono et al. 2008) in order to improve the current approach based on aerosol climatologies. This is an important design question not only for aerosol-radiation interactions within the UFS but also for data assimilation applications within the Joint Effort for Data assimilation Integration (JEDI) framework. Both the Community Radiative Transfer Model (CRTM) and RRTMG use the same look up tables for calculation of aerosol optical properties, but these look up tables are tied to the Goddard Chemistry Aerosol Radiation and Transport Second Generation (GOCART-2G, Collow et al. 2024) aerosol model. Hence, we will map the AERO7 chemical mechanism to GOCART-2G for the calculation of aerosol optical properties for feedback to radiation. The AERO7 mechanism tracks the size, mass, and number of aerosol species using 3 lognormal modes, namely, Aitken, accumulation, and coarse modes whereas GOCART-2G is a bulk aerosol model that only tracks the mass of aerosols except dust and sea-salt for which size is also tracked. AERO7 aerosol species will be mapped to GOCART-2G following similar methods to Tang et al. (2019) for AERO6 chemical mechanism.

System testing: After linking the aerosols to radiation, we will turn our attention to testing the developments (Fig. 3). We have identified three fires from the FIREX-AQ campaign (Warneke et al. 2023). The FIREX-AQ field campaign was a multi-faceted investigation into the emissions, chemical transformations, and transport of smoke plumes originating from various biomass burning sources. The campaign deployed a suite of instruments on multiple platforms, including the National Aeronautics Space Administration (NASA) DC-8 and two NOAA Twin Otter aircraft, as well as ground-based measurements such as the Aerodyne Mobile Laboratory (AML). The field campaign measured a wide array of atmospheric variables, including both modeled and observed measures of comprehensive composition of trace gasses and aerosols with physical parameters and processes (NASA/LARC/SD/ASDC, 2021). This dataset aids model evaluation of emissions, plume rise, photolysis, and OH reactivity, providing diverse cases across different meteorological conditions and fuel types to study fire emissions' impact on air quality and weather. The fires selected (Fig. 4) cover a variety of atmospheric conditions:

1. The *Williams Flats Fire* ignited on August 2, 2019, initially burning through grasslands before expanding into Douglas fir and Pacific ponderosa pine forests, covering a total area of 179.9 km^2 before containment on August 25, 2019. We will focus on the clear sky conditions (Fig. 4a) for this fire. The fire was sampled with both NASA DC-8 and ER-2 aircraft with 4 and 3 crossings, respectively. The DRAGON measurements of aerosol optical depth (AOD) are available at distances downwind of the fire, to evaluate the AOD as a function of distance (up to 250 km, Warmeke et al. 2023).
2. The *Castle Fire* started on July 12, 2019, and burned through a mix of Ponderosa pine-two-needle and pinyon-Utah juniper forest, eventually covering 78.4 km^2 before burning out on October 15, 2019. Smoke from Castle Fire is mixed with Ikes fire which will also be included in this simulation. The fire started under clear sky conditions followed by cumulus

activity the day after DC-8 observations were available (Fig. 4b). There are two passes of the NOAA Twin Otter aircraft.

3. The *Cow Fire* ignited on Aug 9, 2019, and reached an area of 39.1 km^2 by Sep 15, 2019. The primary fuel consisted of Douglas-fir-Pacific ponderosa pine and oceanspray forest. There are six passes of the NOAA Twin Otter aircraft, including data at night. The measurements for this case coincide with generally clear sky conditions (Fig. 4c).

Additional datasets will be used in the evaluation. MELODIES-MONET provides a suite of NOAA and NASA flight campaigns, including FIREX-AQ observations of the Williams Flat fire. It is currently being extended to include observations from the Tropospheric Emissions: Monitoring of POllution (TEMPO) and other satellites. We will also use the ensemble of model runs performed for the Williams Flat fire during the FIREX-AQ campaign (NASA/LARC/SD/ ASDC, 2021; Ye et al., 2021) to compare our errors with those of other models.

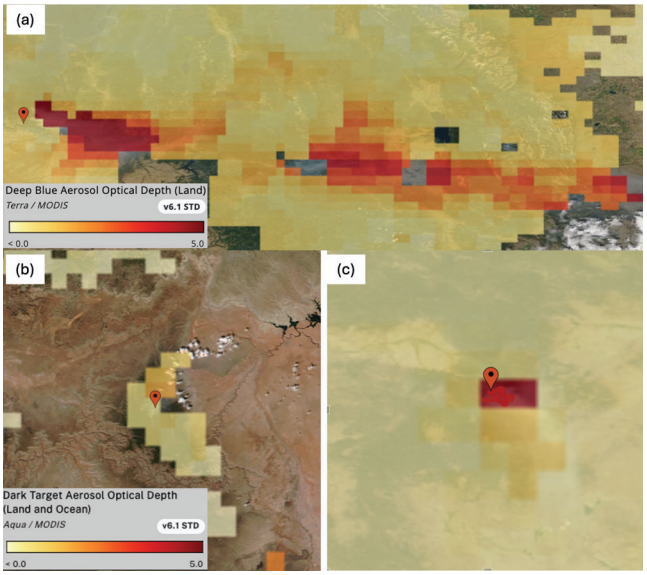

Figure 4: Selected cases from FIREX-AQ: (a) Williams Flats Fire, August 7th 2019; (b) Castle Fire, August 13th 2019; (c) Cow Fire, August 26th 2019. The shaded color represents the AOD from the Deep Blue algorithm from Terra in panels (a) and (c) and from the Dark Target algorithm from Aqua in panel (b), with 80% transparency. The background in each panel shows the NOAA-20 true color image.

d.3 Task 3: Real-time demonstration of the fire-weather-chemistry UFS

Once we have developed the online fire-weather-chemistry capability (Figs. 2 and 3) we will proceed to demonstrate it. To this end, we will mimic the operational AQM runs in NCAR's Derecho high performance computer (HPC) but use the CFBM to have the online fire emissions in Western U.S. where wildland fires are more frequent. Over the eastern portion of the domain, we will use the current method based on RAVE. This will be achieved by zeroing out all the RAVE emissions in the areas covered by CFBM before supplying RAVE files to the UFS-AQM workflow, which is already working on Derecho. We will launch forecasts on a daily frequency using VIIRS fire detections to ignite the fires in the CFBM. Our strategy is to have multiple non-overlapping fire domains, and, for efficiency, individual fire domains will be activated on demand when VIIRS retrievals indicate the presence of active fires. This allows for scaling up prediction capabilities and resources as needed. Having CFBM directly coupled to UFS (Fig. 2, gray box) allows for having multiple fire domains easily. The NUOPC framework, based on

Earth System Modeling Framework (ESMF) libraries, is already capable of multiple domain coupling. Each fire domain will have 100 m grid spacing, much finer than the 13 km grid spacing of the atmosphere (or 9 km if AQMv8 becomes operational in 2026), without the need for high resolution atmosphere simulations. Coupling to a lower resolution atmosphere is already handled through ESMF regridding.

We will use standard performance metrics to estimate the bias, random errors, and the correlation between model predictions and the observations like our past studies for both the meteorological and air quality variables (Kumar et al., 2020; Golbazi et al., 2023). The evaluation will be performed at the site level, CONUS scale, and in each of the ten EPA defined regions to understand regional variability in the model performance. The evaluation will be performed based on MELODIES-MONET. We will focus on the formation and fate of health-relevant pollutants such as $PM_{2.5}$ and O_3. MELODIES-MONET is usable with NRT observations and will be configured with the operational AQM forecast (provided by collaborator Jianping Huang) and the forecasts from the fire-weather-chemistry application. The team is already using MELODIES-MONET to evaluate model performance (see example in Figure 5).

This task will be completed by updating the UFS documentation to explain the model developments and by providing virtual training with the UFS fire-weather-chemistry capability.

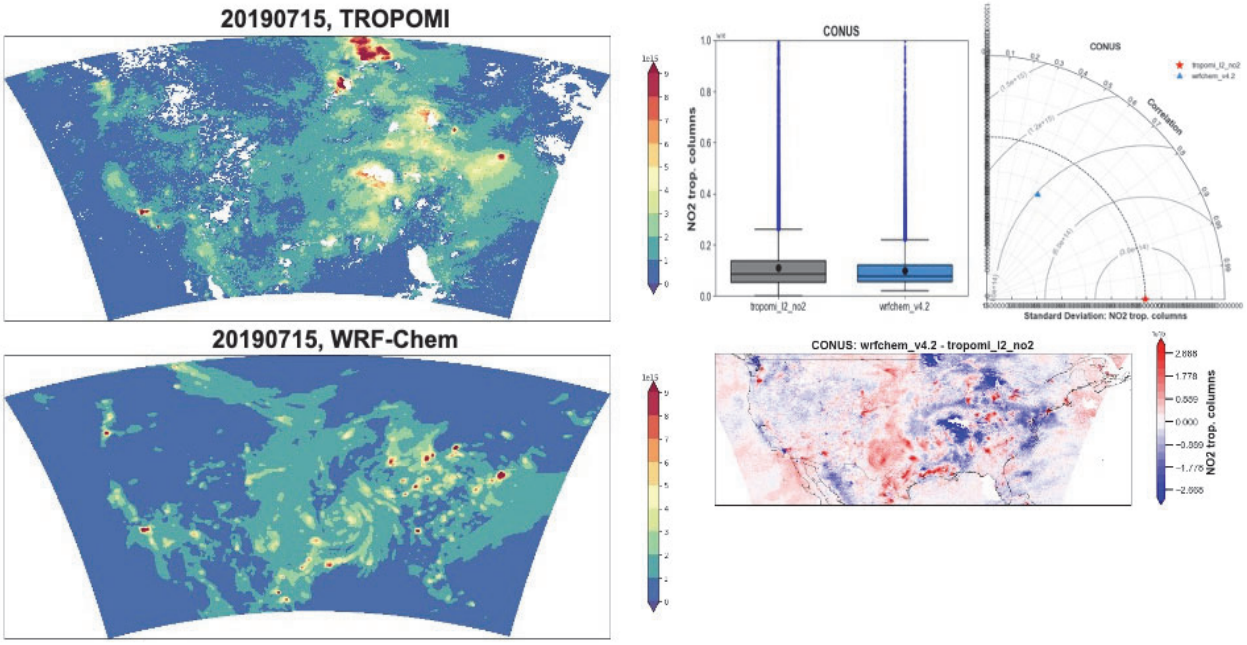

Figure 5: Example MELODIES-MONET Forecast output for NO_2 including comparison to satellite observations over the contiguous U.S. The proposed work will include similar outputs customized for ground-based observations, wildfire pollutants, and exposure estimates.

e. Project products/outputs

The primary product of the project is the software that will be incorporated into UFS repositories to allow for the online emissions of chemical species in the CFBM and its connection to the AQM; and the software that connects the aerosols from the AQM to the radiation in CCPP. In addition, we will update the CFBM documentation to describe the project

developments. The documentation is available in the CFBM public Git repository. In addition to enhancing the documentation, we will also provide a virtual tutorial for users with minimal experience with UFS and CFBM, and training materials (slides and videos from the tutorial). More details in the documentation, tutorial, and training materials are provided in Section h. We will also contribute with a public dataset with the most relevant variables from the UFS simulations from the real-time demonstration. The dataset will be publicly available either in the NCAR DASH archive or a THREDDS server we are already using to share datasets.

Readiness level: The CFBM is already merged into the Community UFS model at RL5. We will be at RL6 at the end (July 2025) of our current NOAA WPO funded project (NA22OAR4590514). The RL6 will be achieved after demonstrating that the UFS results are consistent with the ones from WRF-Fire (the CFBM is largely based on WRF-Fire at this point, see Jimenez y Munoz et al., 2024). During the present project we aim to reach RL8. We will reach RL7 after running the real-time demonstration in NCAR's Derecho HPC which is like the HPC used operationally at NOAA (Task 3) and comparing results with the current method of prescribing the emissions with RAVE to demonstrate its potential (functionality demonstrated in a near-real world environment). At the end of the project, we will be at RL8 after showing that the fire-weather-chemistry UFS model operates as expected in the demonstration and we have completed the documentation and the training materials (see Section h for further details).

f. Project impacts, benefits, outcomes, & recipients

The main outcome of the project is to explicitly simulate the fire-chemistry feedback with UFS for the first time, which will allow for more realistic air quality predictions with UFS-AQM. The proposed efforts will also couple the UFS-AQM aerosols to radiation to simulate the impacts of the smoke plume on the atmospheric and fire evolution through dynamic coupling of fire emissions to atmospheric chemistry, followed by dynamic interactions of aerosols in the fire plume with radiation.

Hence, there will be many beneficiaries of the project outcomes. For example, we expect the outcomes to be relevant for the NAQFC for better early warning forecasts to limit exposure to unhealthy air-quality and we include collaboration with Dr. Jianping Huang (NOAA/EMC; see letter of support). Similarly, the outcomes should be relevant for the ongoing air quality research with AQM, and we plan to work closely with AQM developers during the project. The outcomes are also of interest for the smoke predictions with the Rapid Refresh Forecasting System (RRFS), and we have included collaboration with Dr. Ravan Ahmadov (NOAA/OAR/GSL; see letter of support). These collaborations will ensure that we strengthen the value of the project outcomes for the different relevant departments at NOAA. Additionally, the outcomes should prove useful for data assimilation efforts through JEDI and the assimilation of fire radiative power from the NASA retrievals from the Moderate Resolution Imaging Spectroradiometer (MODIS), the NOAA ABI, or VIIRS. The JPSS Fire & Smoke initiative should also benefit from an improved forecast of smoke and the PI is interacting with this group through a NOAA JPSS funded project entitled "Real-time fuel moisture content estimations at high spatio-temporal resolution based on reflectances from VIIRS and GOES-R ABI". Finally,

accounting for the fire-weather-chemistry interactions will also benefit the wider UFS community that will be able to perform fundamental and applied fire research involving chemistry, potentially increasing the number of users of this community model.

Several recipients can be identified at this early stage. NAQFC should find the developments of value for improving early air quality warnings. Other researchers at NOAA using AQM or the RRFS should also be interested in the new capability as well as the broader UFS community. All the developments of the project will be incorporated to the UFS community repositories (e.g., CFBM, UFS Community model, CCPP). Relevant variables from the demonstration will be made publicly available in a dataset that can be used by researchers interested in the performance of the new capability.

The impact of the project is clear. It will address our urgent need and long-standing inability to predict the evolution of fire emissions in air quality forecasting around the world.

The success of the project will be determined after quantifying the added value of the fire-weather-chemistry UFS capability with respect to RAVE in a real-time demonstration.

g. Schedule with key milestones

An estimated timeline for the three tasks is shown in Table 1. We aim to reach RL 7 during Task 3, when we will be running the real-time demonstration of the fire-weather-chemistry UFS. We aim to increase the RL further to 8 at the end of the project when we have the user training and documentation completed. Milestones for each task include:

Task 1: Online biomass burning emissions and CBFM-AQM coupling

- The fire behavior model emits the AQM chemical species
- The online fire emissions are coupled to UFS-AQM

Task 2: Coupling AQM aerosols to atmospheric radiation and system testing

- Connect the AQM aerosols to RRTMG
- Exercise the fire-weather-chemistry UFS model in case studies from FIREX-AQ

Task 3: Real-time demonstration of the fire-weather-chemistry UFS

- Develop software to allow for multiple fire domains to interact with UFS-Atmosphere.
- Develop software to initialize the fire perimeters based on VIIRS retrievals
- Real-time demonstration running the AQM with 1) the current approach based on RAVE, and 2) the fire-weather-chemistry model with online fire emissions
- Quantify the performance of the real-time demonstration

Table 1: Expected number of months to accomplish each specific task of the project.

Tasks	First year	Second year	Third year
1. Fire emissions in AQM	**x|x|x|x|x|x|x|x|x|x|x|x**	**x|x|x|x|x|x|** | | | | |	| | | | | | | | | | |
2. Aerosols, radiation, testing	| | | | | **|x|x|x|x|x|x**	**x|x|x|x|x|x|x|x|x|x|x|x**	| | | | | | | | | | |
3. Demonstration	| | | | | | | | | | |	| | | | | **|x|x|x|x|x|x**	**x|x|x|x|x|x|x|x|x|x|x|x**

h. Outreach and education

Our results will be shared with the community through different channels:

- Presentation of our progress every year of the project at the AMS annual meeting and at the Unifying Innovations and Forecasting Capabilities Workshop (UIFCW)
- Three peer-reviewed publications to disseminate results to a wider audience
- Enhance the existing documentation of the CFBM to describe the new developments
- Provide training with the fire-weather-chemistry UFS model designed for potential users with minimal experience with UFS and CFBM (e.g., undergraduate students, graduate students, postdocs, etc). The training will be virtual and will be advertised through relevant channels with enough time to promote a large attendance
- Produce a training tutorial with the slides and videos of the relevant parts of the virtual training that will be made publicly available
- Enhance the CFBM website as needed, including links to updated documentation or other sources of information related to the project
- Share our code developments through the community UFS repositories
- A dataset will be created and shared with the community with relevant variables from the demonstration of the fire-weather-chemistry capability
- Our findings will also be disseminated through relevant NOAA branches thanks to our collaboration with Dr. Jianping Huang at NOAA/EMC using the NAQFC, and Dr. Ravan Ahmadov (NOAA/OAR/GSL) who leads smoke research with the RRFS

The project also has an educational component. During summers of years 2 and 3, we will train graduate students (one each summer) to use the UFS fire-weather-chemistry model. The students will use the model in hands-on activities involving real-world simulations of wildland fires. They will learn how the fuel characteristics and the meteorological conditions impact the fire spread and the atmospheric chemistry. The students will also be exposed to stakeholders of the UFS fire-weather-chemistry model to learn how having this new capability is a potentially useful application to society. The main outcomes of these activities will be to train future generations in fire spread and air quality simulations with the UFS model. The students are intended to come from minority populations, as described in the following section.

i. Diversity, equity, inclusion, accessibility (DEIA)

NCAR is committed to enhancing diversity, equity, and inclusion (DEI), and has a DEI office and strategic DEI plan from 2019, and the team shares this vision. We are a diverse project team composed of mid-career and early-career scientists of multiple ethnicities and places of origin and most of them speak English as a second language. Our team consists of scientists originally from four different countries (India, Iran, Spain, and the U.S.). We also expect our hires in the project, two graduate students, to increase the diversity in our team and to this end we will advertise the positions in minority serving institutions (MSI). These institutions include Howard University, a Historically Black College and University (HBCU) and Texas A&M Corpus Christi, a Hispanic Serving Institution (HSI). We will also advertise the position through

UCAR Commons which has members of a broader range of MSIs. We will also target increasing diversity by advertising the positions through NCAR's Rising Voices Center for indigenous and Earth Sciences, the Earth Science Women's Network (ESWN), and NCAR's MSI partners engaged through our Collaborative Opportunities for Research Engagement (CORE) project.

Another aspect contributing to DEIA is the training with the fire-weather-chemistry UFS model described in Section h. The training will be virtual, and it will be advertised in MSI and other science, technology, engineering, and mathematics (STEM) networks.

To foster inclusive workforce the PI has been applying the principles of improvisation towards inclusive leadership. The PI was exposed to the fundamentals of improvisation for inclusive environments through the Forcing Allies and Connections for Equity in STEM (FACES) initiative at NCAR. Realizing the potential, the PI learned more about improvisation methods (Leonard and Yorton 2015; Dudeck and McClure 2018, 2021) and has been applying them in the projects that he manages (e.g., NOAA WPO NA22OAR4590514). The techniques were developed by actors in improvisational theater, to play without a script, and have been proven effective managerial techniques for inclusiveness, teamwork, and boosting innovation (Leonard and Yorton 2015). The main aspects include 1) giving every idea a chance, 2) reconciling the needs of individuals with the broader team, 3) the importance of dialogue, 4) authenticity, 5) learning from failure, 6) giving any member of the group the chance to assume a leadership role, and 7) listening to understand. All these aspects are well aligned with DEIA and the PI will apply these techniques in the project. To this end, early on in the project the PI will provide training to the rest of the team about the improvisation fundamentals. This will be the basis for the team interactions. The PI will continue learning about these techniques during the project, and he will provide updates to the team to foster inclusive workforce.

Members of the team are also involved in several NCAR Early Career Innovator projects that are aimed at inclusive and convergent science projects, many of which recruit from MSI schools. Co-I Lacey is on the core science team for this initiative and as such has developed knowledge and expertise in many aspects of working with and recruitment targeting underserved schools and communities. Co-I Eghdami has been serving as a mentor in the Significant Opportunities in Atmospheric Research and Science program. Co-I Kumar is the chair of RAL's DEI committee which is responsible for developing and evaluating activities focused on enhancing DEI at the workplace including creating an environment that provides everyone an opportunity to express themselves without the fear of negative consequences.

To evaluate the inclusiveness of our project team and measure our progress towards inclusivity, we will conduct an anonymous survey every year. This survey will evaluate potential systemic barriers (e.g., implicit biases, unequal access to resources), code of conduct during meetings (e.g., being respectful and engaged, raising your hand before speaking, and not interrupting others), transparency, collaboration, contribution of everyone's opinion to in the decision-making process, etc. on a scale of 1 (not aware/not at all) to 5 (aware/always). The survey will be conducted using Google Forms and the results of these surveys will be presented in our annual progress report to NOAA.

j. Data and software management plan

j.1 Data management

Types of data: We will generate data from numerical simulations with UFS and the CFBM. This data includes simulations of case studies from the FIREX-AQ and the simulations from the real-time demonstration. The data from the simulations will be in Network Common Data Form (NetCDF) format. We will also generate information such as the documentation of the fire-weather-chemistry capability, the training materials that we will prepare, and better understanding of fire-weather-chemistry interactions.

Data storage: The relevant output from the simulations of the case studies will be archived in our institutional data sharing repository, NCAR Digital Asset Services Hub (DASH). The data from the real-time demonstration will be shared with the community in real-time during the demonstration via our Thematic Real-time Environmental Distributed Data Services (THREDDS) server (https://tds.rap.ucar.edu/thredds/catalog/wsap/catalog.html). The slides and videos with the training materials that we will generate during the virtual workshop will be shared on YouTube and the links and background material will be posted on the CFBM website (https://ral.ucar.edu/model/community-fire-behavior-model). The documentation will be compliant with UFS standards, Read the Docs format, of existing UFS documentation which include the CFBM (under development, https://fire-behavior.readthedocs.io/en/latest/), the Short Range Weather Application (SRWApp), etc. The main findings of the project will be shared with the community via three peer-reviewed publications and conference presentations at the annual meeting of the American Meteorological Society (which are recorded and available online after the conference) and the Unifying Innovations in Forecasting Capabilities Workshop. The main scientific findings will be published in peer-reviewed publications and will be available from the journals' website.

Data availability: the data generated will be publicly available in the storage locations already described by the end of the project.

Data formats: The data from the simulations will be available in NetCDF format which is the standard output format of UFS and the CFBM. The metadata is contained in the files as attributes to the file and the variables stored. The videos of the training material (recordings of the virtual workshop) will be in MPEG-4 (MP4) format which is the recommended format to store videos in YouTube. The slides with the training material will be in Portable Document Format (pdf). The background information of the videos will be described on the website of the CFBM which will include links to the YouTube videos. The documentation will be in Reads the Docs format which is standard in UFS documentation. The peer-reviewed publications will be available in pdf format.

Data volume: The data archived from the UFS and CFBM simulations of the FIREX-AQ case studies is estimated to be under 1TB. The data generated during the demonstration is estimated to be around 2 TB. The size of the videos for the training material is estimated to be 4 GB (1 GB per hour with a total of 4 hours of training videos). The slides with the training material will be around 100 MB. The size of the documentation that we will generate is

estimated to be smaller than 100 MB. The pdfs of the peer-reviewed publications are expected to be around 30 MB (3 articles with ~10 MB per article).

Previous experience: The team has wide experience in making data publicly available. They have created numerous datasets at the NCAR DASH sharing repository. The team also has wide experience in running real-time demonstrations and making data publicly available via, for example, a THREDDS server (e.g. ongoing demonstration of fuel moisture content retrievals, https://fmc.ral.ucar.edu/). In addition, we are currently developing the CFBM documentation, including updates to the SRWapp, in Read the Docs format. The team has an established record of peer-reviewed publications and presentations at conferences to disseminate research results.

j.2 Software management

Our developments of the CFBM, UFS (including CMAQ), and CCPP will be made publicly available in their respective public Git repositories. Our software development approaches will be in accordance with UFS and Earth Prediction Innovation Center (EPIC) best practices. The team is already conforming to these standards in the ongoing project that is developing and coupling the CFBM to UFS-Atmosphere.

We will generate software in the analysis of case studies. This software, written in freely available analysis software such as Python, will be included with the data that we will share through NCAR's DASH repository if it is beyond standard scripts to compare simulations and observations.

Finally, we will also generate software to run the real-time demonstration. The bash scripts that we will generate will be publicly available. To this aim, we will create a dedicated Git repository which will be made public at the end of the project. The scripts should prove useful for other scientists or engineers developing real-time applications with the Community UFS model.

All the software will be publicly available by the end of the project.

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Education and Training

Complutense University of Madrid	Physics	BS 2001
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Complutense University of Madrid	Physics	PhD 2009

Appointments

2022-present: Project Scientist III, Research Applications Laboratory, NSF NCAR
2017-2022: Project Scientist II, Research Applications Laboratory, NSF NCAR
2014-2017: Project Scientist I, Research Applications Laboratory, NSF NCAR
2012-2014: Project Scientist, Renewable Energy Division of CIEMAT
2007-2012: Research Scientist, Renewable Energy Division of CIEMAT
2002-2006: PhD fellowship, Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas.

Publications and Conference Presentations – All relevant in last 3 years

2024

Jimenez y Munoz, P.A., M. Frediani, M. Eghdami, D. Rosen, M. Kavulich, and T. W. Juliano: The Community Fire Behavior Model for coupled fire-atmosphere modeling: Implementation in the Unified Forecast System. Geosci. Mod. Dev. Discuss. https://doi.org/10.5194/gmd-2024-124.

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2021

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Education and Training

Sharif University of Tech., Tehran	Civil Engineering	BS 2014
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NSF NCAR	Atmospheric Science	Postdoc 2020-2023

Appointments

2023-present: Project Scientist I, Research Applications Laboratory, NSF NCAR
2015-2020: PhD Graduate Assistant at Duke University, Durham, NC
2014-2015: PhD Research Fellowship at Duke University, Durham, NC

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2024

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Education and Training

Indra Bhan College, Panipat, India	Physics, Math & Computer Sci.	BS 2004
Kurukshetra Univ., Haryana, India	Physics	MS 2006
Univ. of Hamburg, Hamburg, Germany	Earth Sciences	PhD 2012
NSF NCAR	Atmospheric Sciences	Postdoc 2013-2016

Appointments

2023-present	Interim Lab Deputy Director, NSF National Center for Atmospheric Research
2021-present	Project Scientist III, RAL, NSF National Center for Atmospheric Research
2018-2021:	Project Scientist II, RAL, NSF National Center for Atmospheric Research
2016-2018:	Project Scientist I, RAL, NSF National Center for Atmospheric Research
2011-2012:	Visiting Scientist, Max Planck Institute for Meteorology/Climate Service Center, Hamburg, Germany
2006-2012:	Research Fellow, Aryabhatta Research Institute of Observational Sciences, Nainital, India

Publications and Conference Presentations – All relevant in last 3 years (2024-2022)

2024

Kumar, R., Bhardwaj, P., He, C., Boehnert, J., Lacey, F., Alessandrini, S., Sampson, K., Casali, M., Swerdlin, S., Wilhelmi, O., Pfister, G. G., Gaubert, B., and Worden, H.: A long-term high-resolution air quality reanalysis with public facing air quality dashboard over the Contiguous United States (CONUS), Earth Syst. Sci. Data Discuss. [preprint], https://doi.org/10.5194/essd-2024-180, in review, 2024.

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2022

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Other Publications and Conference Presentations

2020

Kumar, R., S. Alessandrini, A. Hodzic, J. Lee (2020), A novel ensemble design for probabilistic predictions of fine particulate matter over the contiguous United States (CONUS), 125 (16), JGR-Atmospheres, https://doi.org/10.1029/2020JD032554.

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temperature forecasts during paddy crop-residue burning season in Delhi via chemical data assimilation, 125 (17), JGR-Atmospheres, https://doi.org/10.1029/2020JD033019.

2019

Kumar, R., Delle Monache, L., Bresch, J., Saide, P. E., Tang, Y., Liu, Z., da Silva, A. M., Alessandrini, S., Pfister, G. G., Edwards, D., Lee, P., Djalalova, I.: Towards improving short-term predictions of fine particulate matter over the United States via assimilation of satellite aerosol optical depth retrievals (2019), J. Geophys. Res. – Atmos., 124 (5), 2753-2773, https://doi.org/10.1029/2018JD029009.

Kumar, R., Lee, J. A., Delle Monache, L., and Alessandrini, S.: Effect of meteorological variability on fine particulate matter simulations over the contiguous United States (2019), J. Geophys. Res. – Atmos., 124 (10), 5669-5694, https://doi.org/10.1029/2018JD029637.

Kumar, R., Douglas A. Mitchell, Daniel F. Steinhoff, Pablo Saide, Branko Kosovic, Nicole Downey, Doug Blewitt, Luca Delle Monache, Evaluating the Mobile Flux Plane (MFP) Method to Estimate Methane Emissions using Large Eddy Simulations (LES), JGR-Atmospheres, 126(5), e2020JD032663, https://doi.org/10.1029/2020JD032663.

Kumar, R., P. Bhardwaj, G. G. Pfister, C. Drews, S. Honomichl, and G. D'Atillo, Description and evaluation of the fine particulate matter forecasts in the NCAR regional air quality forecasting system, Atmosphere, 12, 302. doi:10.3390/atmos12030302.

Kumar, R., Peuch, V.-H., Crawford, J. H., and Brasseur, G. P.: Five steps to improve air quality forecasts, Nature, 561, 27-29, doi:10.1038/d41586-018-06150-5.

Forrest Lacey
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ORCID iD: 0000-0003-4578-8375

Education and Training

Kettering University, Flint	Mechanical Engineering	BS 2006
University of Colorado, Boulder	Mechanical Engineering	PhD 2016

Appointments

2024 – Present: Project Scientist II, Research Applications Laboratory, NSF NCAR
2020 – 2024: Project Scientist I, Research Applications Laboratory, NSF NCAR
2016 – 2020: Postdoctoral Researcher, University of Colorado, NSF NCAR
2011 – 2016: Graduate Research Assistant, University of Colorado, Boulder

Publications and Conference Presentations – All relevant in last 3 years

2024

Binte Shahid, S.; **Lacey, F. G.**; Wiedinmyer, C.; Yokelson, R. J.; Barsanti, K. C. NEIVAv1.0: Next-Generation Emissions InVentory Expansion of Akagi et al. Version 1.0. EGUsphere 2024, 1–49. https://doi.org/10.5194/egusphere-2024-633.

Kumar, R.; Bhardwaj, P.; He, C.; Boehnert, J.; **Lacey, F.**; Alessandrini, S.; Sampson, K.; Casali, M.; Swerdlin, S.; Wilhelmi, O.; Pfister, G. G.; Gaubert, B.; Worden, H. A Long-Term High-Resolution Air Quality Reanalysis with Public Facing Air Quality Dashboard over the Contiguous United States (CONUS). Earth System Science Data Discussions 2024, 1–61. https://doi.org/10.5194/essd-2024-180.

2023

Albores, I. S.; Buchholz, R. R.; Ortega, I.; Emmons, L. K.; Hannigan, J. W.; **Lacey, F**.; Pfister, G.; Tang, W.; Worden, H. M. Continental-Scale Atmospheric Impacts of the 2020 Western U.S. Wildfires. Atmospheric Environment 2023, 294, 119436. https://doi.org/10.1016/j.atmosenv.2022.119436.

2022

Kumar, R.; He, C.; Bhardwaj, P.; **Lacey, F.**; Buchholz, R. R.; Brasseur, G. P.; Joubert, W.; Labuschagne, C.; Kozlova, E.; Mkololo, T. Assessment of Regional Carbon Monoxide Simulations over Africa and Insights into Source Attribution and Regional Transport. Atmospheric Environment 2022, 277, 119075. https://doi.org/10.1016/j.atmosenv.2022.119075.

Tang, W.; Emmons, L. K.; Buchholz, R. R.; Wiedinmyer, C.; Schwantes, R. H.; He, C.; Kumar, R.; Pfister, G. G.; Worden, H. M.; Hornbrook, R. S.; Apel, E. C.; Tilmes, S.; Gaubert, B.; Martinez-Alonso, S.-E.; **Lacey, F**.; Holmes, C. D.; Diskin, G. S.; Bourgeois, I.; Peischl, J.; Ryerson, T. B.; Hair, J. W.; Weinheimer, A. J.; Montzka, D. D.; Tyndall, G. S.; Campos, T. L. Effects of Fire Diurnal Variation and Plume Rise on U.S. Air Quality During FIREX-AQ and WE-CAN Based on the Multi-Scale Infrastructure for Chemistry and Aerosols (MUSICAv0). Journal of Geophysical Research: Atmospheres 2022, 127 (16), e2022JD036650. https://doi.org/10.1029/2022JD036650.

Other Relevant Publications and Conference Presentations

2022

Schwantes, R. H.; **Lacey, F. G.**; Tilmes, S.; Emmons, L. K.; Lauritzen, P. H.; Walters, S.; Callaghan, P.; Zarzycki, C. M.; Barth, M. C.; Jo, D. S.; Bacmeister, J. T.; Neale, R. B.; Vitt, F.; Kluzek, E.; Roozitalab, B.; Hall, S. R.; Ullmann, K.; Warneke, C.; Peischl, J.; Pollack, I. B.; Flocke, F.; Wolfe, G. M.; Hanisco, T. F.; Keutsch, F. N.; Kaiser, J.; Bui, T. P. V.; Jimenez, J. L.; Campuzano-Jost, P.; Apel, E. C.; Hornbrook, R. S.; Hills, A. J.; Yuan, B.; Wisthaler, A. Evaluating the Impact of Chemical Complexity and Horizontal Resolution on Tropospheric Ozone Over the Conterminous US With a Global Variable Resolution Chemistry Model. Journal of Advances in Modeling Earth Systems 2022, 14 (6), e2021MS002889. https://doi.org/10.1029/2021MS002889.

Lacey, F.; Kumar, R.; Pfister, G.; Lamarque, J.-F.; O'Lenick, C.; Brasseur, G. Air Quality: WHO Guidelines Could Deepen Inequities. Nature 2021, 598 (7882), 566–566. https://doi.org/10.1038/d41586-021-02883-y.

Thompson, C. R.; **Lacey, F**.; et al., The NASA Atmospheric Tomography (ATom) Mission: Imaging the Chemistry of the Global Atmosphere. Bulletin of the American Meteorological Society 2022, 103 (3), E761–E790. https://doi.org/10.1175/BAMS-D-20-0315.1.

2017

Lacey, F. G.; Henze, D. K.; Lee, C. J.; van Donkelaar, A.; Martin, R. V. Transient Climate and Ambient Health Impacts Due to National Solid Fuel Cookstove Emissions. Proceedings of the National Academy of Sciences 2017, 114 (6), 1269–1274. https://doi.org/10.1073/pnas.1612430114.

Anenberg, S. C.; Miller, J.; Minjares, R.; Du, L.; Henze, D. K.; **Lacey, F**.; Malley, C. S.; Emberson, L.; Franco, V.; Klimont, Z.; Heyes, C. Impacts and Mitigation of Excess Diesel-Related NOx Emissions in 11 Major Vehicle Markets. Nature 2017, 545 (7655), 467–471. https://doi.org/10.1038/nature22086.

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ORCID iD: 0000-0001-9772-8775

Education and Training

University of Colorado, Boulder	Computer Science	MS 2014
Rutgers University, N.J.	Computer Science	BS 2006

Appointments

2020 - Present	Software Engineer, Programmer III, Climate & Global Dynamics, NSF NCAR
2014 - 2020	Software Engineer, Associate Scientist III, GSL, NOAA
2012 - 2014	System Administration, Desktop Support, Computational and Information Systems Lab, NSF NCAR
2006 - 2012	Systems Analyst, Random House Publishing

Publications and Conference Presentations – All relevant in last 3 years

2024

Kim, H. S. & Liu, B., Thomas, B., **Rosen, D**., Wang, W., Hazelton, A., Zhang, Z., Zhang, X., and Mehra, A. (2024). Ocean component of the first operational version of Hurricane Analysis and Forecast System: Evaluation of HYbrid Coordinate Ocean Model and hurricane feedback forecasts. Frontiers in Earth Science. 12. https://doi.org/10.3389/feart.2024.1399409

2022

Kim, H. S. & Liu, B., Thomas, B., **Rosen, D**., Wang, W., Hazelton, A., Zhang, Z., Zhang, X., and Mehra, A. (2024). Ocean component of the first operational version of Hurricane Analysis and Forecast System: Evaluation of HYbrid Coordinate Ocean Model and hurricane feedback forecasts. Frontiers in Earth Science. 12. https://doi.org/10.3389/feart.2024.1399409

Scientific, Technical and Management Performance on Relevant Prior Research Efforts

Lead software developer on multiple Earth system model coupling applications using the Earth System Modeling Framework (ESMF) and the National Unified Operational Prediction Capability (NUOPC). The projects I have worked on include multiple Unified Forecast System (UFS) applications, NASA's Land Coupler (NLC), the Naval Research Laboratory's Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS), and NCAR's Community Mediator for Earth Prediction Systems (CMEPS). I have developed several NUOPC model interfaces including NASA's Land Information System (LIS), NCAR's WRF-Hydro, the Hybrid Coordinate Ocean Model (HYCOM), NOAA's UFS atmosphere (UFSATM), the COAMPS atmosphere model, the ParFlow hydrologic model, and the Community Fire Behavior Model. As a member of the ESMF core team I am responsible for developing and maintaining the Earth System Modeling Framework as well as auxiliary products, such as the National Unified Operational Prediction Capability (NUOPC) and the Earth System Modeling Executable (ESMX).

CURRENT AND PENDING SUPPORT

"In the event that an unanticipated overlap does occur, the level of effort would be adjusted and/or additional personnel would be added, in concurrence with funding sources."

Principal Investigator: Jimenez Munoz, Pedro DATE: October 2024

CURRENT SUPPORT

Project Title: Real-time fuel moisture content estimations at high spatio-temporal resolution based on reflectances from VIIRS and GOES-R ABI Source of Support: Joint Polar Satellite System; Contract # NA21OAR4310383 Total Award Amount: $509,810 Total Award Period Covered: 04/01/2021 – 09/30/2025 Person-Months Committed to the Project: 2.13

Project Title: Implementing a state-of-the-science fire behavior model in the Unified Forecast System Source of Support: DOC-NOAA-OAR-WPO/Weather Program Office; Contract # NA22OAR4590514 Total Award Amount: $1,049,514 Total Award Period Covered: 08/01/2022 – 07/31/2025 Person-Months Committed to the Project: 5.14

Project Title: DEVELOPMENT AND IMPLEMENTATION OF MAGEN RAPID REFRESHING FORECASTING CAPABILITY Source of Support: Government of Israel Ministry of Defense / DOD-USAF/United States Air Force; Contract # 4441320108 Total Award Amount: $1,735,175 Total Award Period Covered: 03/01/2024 – 02/28/2026 Person-Months Committed to the Project: 1.33

PENDING SUPPORT

Proposal Title: Improved numerical weather prediction of dust impacts on solar surface irradiance: building capacity with probabilistic forecasting and assimilation of aerosol optical depth retrievals Source of Support: Dubai Electricity & Water Authority Total Award Amount: $399,881 Total Award Period Covered: 12/01/2023 – 11/30/2025 Person-Months Committed to the Project: 2.31 Y1-2

Proposal Title: Advice for using the MAD-WRF model for short-term solar surface irradiance predictions in cloudy conditions Source of Support: Dubai Electricity & Water Authority Total Award Amount: $327,628 Total Award Period Covered: 03/01/2023 – 08/31/2024 Person-Months Committed to the Project: 2.3

Proposal Title: Collaborative Research: SRS RN: GREENPATHS - Great Lakes Regional Energy and Environmental Network for Progress and Acceleration Towards Human Sustainability Source of Support: University of Illinois - Discovery Partners Institute / National

Science Foundation Total Award Amount: $1,234,948 Total Award Period Covered: 09/01/2024 – 08/31/2029 Person-Months Committed to the Project: .52 Y1, 1.03 Y2-3, .41 Y4-5

Proposal Title: Fuel moisture content impacts on wildland fire emissions, aerosol effects, and air quality Source of Support: NASA Total Award Amount: $541,396 Total Award Period Covered: 03/01/2025 – 02/29/2028 Person-Months Committed to the Project: 3.17 Y1, 2.42 Y2, 2.31 Y3

Proposal Title: Technology Transfer of Kuwait Renewable Energy Prediction System Source of Support: Kuwait Institute for Scientific Research Total Award Amount: $99,204 Total Award Period Covered: 01/01/2024 – 09/30/2024 Person-Months Committed to the Project: 0.46

Proposal Title: Improving Smoke Predictions in NOAA's Rapid Refresh Forecast System with Smoke (RRFS-Smoke) Model Through Advanced Fuel Moisture Integration Source of Support: University of Colorado CIRES / DOC-NOAA-OAR-WPO/Weather Program Office Total Award Amount: $523,263 Total Award Period Covered: 08/01/2025 – 07/31/2028 Person-Months Committed to the Project: 2.77 Y1, 2.54 Y2, 2.42 Y3

Proposal Title: Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS (THIS PROPOSAL) Source of Support: NOAA - Oceanic and Atmospheric Research Total Award Amount: $1,049,775 Total Award Period Covered: 08/01/2025 – 07/31/2028 Person-Months Committed to the Project: 3.95 Y1, 3.42 Y2, 3.41 Y3

Proposal Title: Understanding the three-dimensional cloud variability and associated cloud radiative effects and their representation in general circulation models based on multiyear retrievals from CALIPSO and CloudSat Source of Support: NASA - Science Mission Directorate Total Award Amount: $641,654 Total Award Period Covered: 06/01/2025 – 05/31/2028 Person-Months Committed to the Project: 3.46 Y1-3

Proposal Title: Optimal fire initialization and rate of spread propagation for fire behavior simulations with UFS Source of Support: NOAA - Oceanic and Atmospheric Research Total Award Amount: $899,693 Total Award Period Covered: 08/01/2025 – 07/31/2028 Person-Months Committed to the Project: 3.46 Y1, 3.01 Y2, 3.03 Y3

CURRENT AND PENDING SUPPORT

In the event an unanticipated overlap does occur, the level of effort would be adjusted and/or additional personnel would be added, in concurrence with funding sources.

Principal Investigator: Eghdami, Masih **DATE: October 2024**

CURRENT SUPPORT

Project Title: Implementing a state-of-the-science fire behavior model in the Unified Forecast System Source of Support: DOC-NOAA-OAR-WPO/Weather Program Office; Contract #: NA22OAR4590514 Total Award Amount: $1,049,514 Total Award Period/Duration: 08/01/2022 - 07/31/2025; Person-Months: 4.05

Project Title: Cloud-seeding feasibility and design for the Lemhi Mountains and associated cloud-seeding research. Source of Support: Idaho Department of Water Resources; Contract #: CON01612
Total Award Amount: $1,300,995 Total Award Period/Duration: 09/26/2022 - 09/30/2025
Person-Months: 0.54

Project Title: Quantifying the impact of light absorbing aerosols on snow cover and water availability in South America using NASA satellite observations. Source of Support: NASA/National Aeronautics and Space Administration; Contract #: 80NSSC24K1553
Total Award Amount: $195,563 Total Award Period/Duration: 07/18/2024 - 07/17/2026
Person-Months: 3.46 Y1-2

PENDING SUPPORT

Proposal Title: Improved numerical weather prediction of dust impacts on solar surface irradiance: building capacity with probabilistic forecasting and assimilation of aerosol optical depth retrievals. Source of Support: Dubai Electricity & Water Authority
Total Award Amount: $399,881 Total Award Period/Duration: 12/01/2023 - 11/30/2025
Person-Months: 3.41 Y1, 3.09 Y2

Proposal Title: Fuel moisture content impacts on wildland fire emissions, aerosol effects, and air quality. Source of Support: NASA
Total Award Amount: $541,396 Total Award Period/Duration: 03/01/2025 - 02/29/2028
Person-Months: 2.77 Y1, 2.31 Y2, 2.19 Y3

Proposal Title: Optimal fire initialization and rate of spread propagation for fire behavior simulations with UFS Source of Support: NOAA - Oceanic and Atmospheric Research
Total Award Amount: $899,693 Total Award Period/Duration: 08/01/2025 - 07/31/2028
Person-Months: 2.31 Y1, 1.44 Y2, 1.62 Y3

Proposal Title: Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS (THIS PROPOSAL)
Source of Support: NOAA - Oceanic and Atmospheric Research
Total Award Amount: $1,049,775 Total Award Period/Duration: 08/01/2025 - 07/31/2028
Person-Months: 3.46 Y1,3.17 Y2, 2.88 Y3

CURRENT AND PENDING SUPPORT

In the event an unanticipated overlap does occur, the level of effort would be adjusted and/or additional personnel would be added, in concurrence with funding sources.

Principal Investigator: Kumar, Rajesh **DATE: October 2024**

CURRENT SUPPORT

Project Title: Constraining the Deposition of Light Absorbing Particles in High Mountain Asia (HMA) via Assimilation of Two Decades of NASA Observations of Atmospheric Composition
Source of Support: NASA/National Aeronautics and Space Administration; Contract #: 80NSSC20K1342
Total Award Amount: $867,158 Total Award Period/Duration: 08/01/2020 - 12/31/2024
Person-Months: 0.66

Project Title: Making pollution sources more visible to create pathways to cleaner air.
Source of Support: Max Planck Institute for Meteorology / USAID/United States Agency for International Development; Contract #: 20200668
Total Award Amount: $76,950 Total Award Period/Duration: 07/20/2021 - 05/31/2025
Person-Months: 0.1

Project Title: Enhancing air quality decision-making activity in Indian megacities through assimilation of NASA Earth observations and development of a decision support system.
Source of Support: NASA-HQ/Headquarters; Contract #: 80NSSC22K1045
Total Award Amount: $733,515 Total Award Period/Duration: 05/13/2022 - 05/12/2025
Person-Months: 2.67

Project Title: A novel dynamical ensemble design for probabilistic air quality predictions during wildfires based on RRFS-CMAQ. Source of Support: DOC-NOAA-OAR-WPO/Weather Program Office; Contract #: NA22OAR4590513
Total Award Amount: $747,722 Total Award Period/Duration: 08/01/2022 - 07/31/2025
Person-Months: 2.67

Project Title: Enhancing air quality decision-making activity in eastern and southern Africa.
Source of Support: NASA-SMD/Science Mission Directorate; Contract #: 80NSSC23K0181
Total Award Amount: $ 659,936 Total Award Period/Duration: 01/01/2023 - 12/31/2025
Person-Months: 1.33

Project Title: Air pollution exposure and emerging depression risk: Testing the role of peripheral inflammatory cytokines during adolescence. Source of Support: University of Denver / DHHS-NIH/National Institutes of Health; Contract #: C3831301
Total Award Amount: $ 659,936 Total Award Period/Duration: 07/01/2023 - 07/31/2025
Person-Months: 0.2

Project Title: International partnerships for accelerating climate-ready, sustainable, and clean urban transportation. Source of Support: University of Illinois Urbana - Champaign / NSF-OD-OISE/International Science and Engineering; Contract #: 110444-19478
Total Award Amount: $199,991 Total Award Period/Duration: 01/01/2023 - 12/31/2025
Person-Months: 0.21

Project Title: Tropospheric Regional Atmospheric Composition and Emissions Reanalysis - 1 (TRACER-1) 2005 2024. Source of Support: NASA-ARC/Ames Research Center;
Contract #: C80NSSC23K1111
Total Award Amount: $ 67.030 Total Award Period/Duration: 06/15/2023 - 05/14/2026
Person-Months: 0.75 Y2-3

Project Title: Improved assessment of recent trends in NOx and VOC emissions and ozone production sensitivity regimes using satellite data. Source of Support: NASA-ARC/Ames Research Center; Contract #: 80NSSC24K0349
Total Award Amount: $ 82,912 Total Award Period/Duration: 06/01/2023 - 05/31/2026
Person-Months: 0.67 Y2-3

Project Title: MUSICA for ASIA-AQ: Urban to Global Modeling to Understand Air Quality in Asia. Source of Support: NASA-HQ/Headquarters; Contract #: 80NSSC23K0823
Total Award Amount: $ 695,407 Total Award Period/Duration: 0 5/01/2023 - 04/30/2026
Person-Months: 0.59 Y2-3

Project Title: Quantifying the impact of light absorbing aerosols on snow cover and water availability in South America using NASA satellite observations. Source of Support: NASA/National Aeronautics and Space Administration; Contract #: 80NSSC24K1553
Total Award Amount: $196,563 Total Award Period/Duration: 07/18/2024 - 07/17/2026
Person-Months: 0.57 Y2-3

Project Title: Global Centers Track 1: CLEETS - CLean Energy and Equitable Transportation Solutions. Source of Support: University of Illinois Urbana - Champaign / NSF/National Science Foundation; Contract #: 115077-19881
Total Award Amount: $196,563 Total Award Period/Duration: 10/01/2023 - 09/30/2028
Person-Months: 0.4 Y2, 0.25 Y3-5

Project Title: Comprehensive evaluation of SIP modeling and emission inputs.
Source of Support: Colorado Department of Public Health and Environment;
Contract #: 2025-0171
Total Award Amount: $196,563 Total Award Period/Duration: 07/25/2024 - 06/30/2026
Person-Months: 0.05 Y1-2

Project Title: Development of a high-resolution meteorological community dataset for Colorado.
Source of Support: Colorado Department of Public Health and Environment;
Contract #: 20243196
Total Award Amount: $196,563 Total Award Period/Duration: 02/01/2024 - 06/30/2025
Person-Months: 0.05 Y1

PENDING SUPPORT

Proposal Title: Improved numerical weather prediction of dust impacts on solar surface irradiance: building capacity with probabilistic forecasting and assimilation of aerosol optical depth retrievals. Source of Support: Dubai Electricity & Water Authority
Total Award Amount: $399,881 Total Award Period/Duration: Dec 1, 2023 - Nov 30, 2025
Person-Months: 0.69 Y1-2

Proposal Title: NSF Engineering Research Center for Community Pyro-Resilience, Equitability, and Sustainability (CyPRES). Source of Support: University of California Los Angeles / National Science Foundation
Total Award Amount: $1,497,240 Total Award Period/Duration: Sep 1, 2024- Aug 31, 2029
Person-Months: 1.73 Y1-3, 1.62 Y4, 1.59 Y5

Proposal Title: Bridging the Weather to Climate Continuum for Climate Resilience.
Source of Support: Electric Power Research Inst / Department of Defense
Total Award Amount: $575,087 Total Award Period/Duration: Jun 1, 2024 - Jan 31, 2028
Person-Months: 0.21 Y1-2, 0.12 Y3

Proposal Title: Advanced air quality forecasting through coupled data assimilation of hyperspectral PACE aerosol retrievals and all-sky radiances from multiple satellite-based sensors. Source of Support: NASA
Total Award Amount: $1,370,248 Total Award Period/Duration: Oct 1, 2024 - Sep 30, 2027
Person-Months: 0.84 Y1-2, 0.78 Y3

Proposal Title: Wildland Fire Potential Index predictions in the sub-seasonal scale using satellite retrievals. Source of Support: NASA

Total Award Amount: $788,921 Total Award Period/Duration: Oct 1, 2024 - Sep 30, 2027
Person-Months: 0.58 Y1-3

Proposal Title: Leveraging NASA Earth Observations to Enhance Community Resilience for City of Denver. Source of Support: NASA
Total Award Amount: $ 1,047,269 Total Award Period/Duration: Oct 1, 2024 - Sep 30, 2027
Person-Months: 0.69 Y1, 0.46 Y2, 0.35 Y3

Proposal Title: Enhancing Disaster Risk Management and Community Resilience in Bihar using Earth Observations and Multiscale Modeling. Source of Support: NASA
Total Award Amount: $1,212,886 Total Award Period/Duration: Nov 1, 2024 - Oct 31, 2026
Person-Months: 1.55 Y1-2

Proposal Title: Collaborative Research: SRS RN: GREENPATHS - Great Lakes Regional Energy and Environmental Network for Progress and Acceleration Towards Human Sustainability. Source of Support: University of Illinois - Discovery Partners Institute / National Science Foundation
Total Award Amount: $1,234,948 Total Award Period/Duration: Sep 1, 2024 - Aug 31, 2029
Person-Months: 1.24 Y1-5

Proposal Title: Feasibility Studies to Determine if Clouds in Panama are Amenable to Cloud Seeding to Enhance Rainfall, with an Option to Assess Seasonal to Decadal Climate Forecasts. Source of Support: Centro de Innovacion Investigacion y Tecnologia Hidroambiental
Total Award Amount: $1,212,886 Total Award Period/Duration: Nov 1, 2024 - Feb 28, 2026
Person-Months: 1.03 Y1, 0.51 Y2

Proposal Title: A Near-Real-Time Air Dispersion Modeling Platform for supporting the State of Colorado permitting and monitoring process. Source of Support: NASA
Total Award Amount: $1,212,886 Total Award Period/Duration: Jan 9, 2025 - Jan 08, 2029
Person-Months: 0.29 Y1-2, 0.31 Y3-4

Proposal Title: Fuel moisture content impacts on wildland fire emissions, aerosol effects, and air quality. Source of Support: NASA
Total Award Amount: $ 541,396 Total Award Period/Duration: Mar 1, 2025 - Feb 29, 2028
Person-Months: 0.23 Y1, 0.12 Y2-3

Proposal Title: Advancing India's Smart City Vision through Enhanced Air Quality Management with NASA Earth Observations. Source of Support: NASA
Total Award Amount: $ 1,054,421 Total Award Period/Duration: Feb 1, 2025 - Jan 31, 2028
Person-Months: 2.58 Y1, 2.06 Y2, 2.58 Y3

Proposal Title: Infusing NASA Earth Observation Products to Improve Health Surveillance in Underserved Neighborhoods In New York State. Source of Support: State University of New

York Albany / NASA
Total Award Amount: $ 311,714 Total Award Period/Duration: Feb 01, 2025 - Jan 31, 2028
Person-Months: 0.58 Y1-3

Proposal Title: Multi-scale analysis of particulate matter sources near high-ways and transportation corridors by integrating satellite observations with multi-scale modeling.
Source of Support: Coordinating Research Council
Total Award Amount: $186,414 Total Award Period/Duration: Jan 1, 2025 - Dec 31, 2025
Person-Months: 0.93

Proposal Title: Understanding impacts of wildland-urban interface fires on urban air quality and weather over the western United States via chemistry-meteorology interactions.
Source of Support: NASA
Total Award Amount: $634,606 Total Award Period/Duration: Mar 1, 2025 - Feb 29, 2028
Person-Months: 1.96 Y1, 1.42 Y2, 1.43 Y3

Proposal Title: Very High-Resolution Reanalysis of Methane, Ammonia, Aerosols, and Formaldehyde/Non-Methane Volatile Organic Compounds for the United States Based on TRACER-I with Assimilation of TROPOMI and TEMPO Retrievals. Source of Support: NASA
Total Award Amount: $84,346 Total Award Period/Duration: Mar 1, 2025 - Feb 29, 2028
Person-Months: 0.72 Y1-3

Proposal Title: Development of a Near-real-time Air Dispersion Modeling Pilot Project.
Source of Support: Colorado Department of Public Health and Environment
Total Award Amount: $252,617 Total Award Period/Duration: Oct 31, 2024 - Oct 30, 2027
Person-Months: 0.21 Y1-3

Proposal Title: Trade-offs of stratospheric aerosol intervention on public health through competing impacts of weather extremes and air quality.
Source of Support: NOAA-OAR-Climate Program Office
Total Award Amount: $896,884 Total Award Period/Duration: Sep 01, 2025 - Aug 31, 2028
Person-Months: 0.52 Y1, 0.41 Y2-3

Proposal Title: Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS (THIS PROPOSAL).
Source of Support: NOAA - Oceanic and Atmospheric Research
Total Award Amount: $1,049,775 Total Award Period/Duration: Aug 01, 2025 - July 31, 2028
Person-Months: 0.35 Y1, 0.23 Y2-3

CURRENT AND PENDING SUPPORT

In the event an unanticipated overlap does occur, the level of effort would be adjusted and/or additional personnel would be added, in concurrence with funding sources.

Principal Investigator: Lacey, Forrest **DATE: October 2024**

CURRENT SUPPORT

Project Title: Successful Aging in a Time of Wildfires. Source of Support: New York University / DHHS-NIH/National Institutes of Health; Contract #: F2328-02
Total Award Amount: $218,723 Total Award Period/Duration: 09/01/2022 - 08/31/2025
Person-Months: 4.46

Project Title: Enhancing air quality decision-making activity in eastern and southern Africa. Source of Support: NASA-SMD/Science Mission Directorate; Contract #: 80NSSC23K0181
Total Award Amount: $659,936 Total Award Period/Duration: 01/01/2023 - 12/31/2025
Person-Months: 1.55

Project Title: Air pollution exposure and emerging depression risk: Testing the role of peripheral inflammatory cytokines during adolescence. Source of Support: University of Denver / DHHS-NIH/National Institutes of Health; Contract #: C3831301
Total Award Amount: $ 147,722 Total Award Period/Duration: 07/01/2023 - 07/31/2025
Person-Months: 0.81

Project Title: Comprehensive evaluation of SIP modeling and emission inputs. Source of Support: Colorado Department of Public Health and Environment; Contract #: 2025-017
Total Award Amount: $340,248 Total Award Period/Duration: 07/25/2024 - 06/30/2026
Person-Months: 2.6

Project Title: Advanced air quality forecasting through coupled data assimilation of hyperspectral PACE aerosol retrievals and all-sky radiances from multiple satellite-based sensors. Source of Support: NASA/National Aeronautics and Space Administration; Contract #: 80NSSC24K1786
Total Award Amount: $976,515 Total Award Period/Duration: 10/01/2024 - 09/30/2027
Person-Months: 1 Y1-3

PENDING SUPPORT

Proposal Title: Center for Climate, Health, and Next Generation Ecological (CHANGE) Research. Source of Support: New York University / National Institutes of Health
Total Award Amount: $374,183 Total Award Period/Duration: Jun 1, 2024 - May 31, 2027
Person-Months: 2.79 Y1-3

Proposal Title: Leveraging NASA Earth Observations to Enhance Community Resilience for City of Denver. Source of Support: NASA
Total Award Amount: $1,047,269 Total Award Period/Duration: Oct 1, 2024 - Sep 30, 2027
Person-Months: 2.42 Y1, 0.87 Y2, 1.04

Proposal Title: Multi-scale analysis of particulate matter sources near high-ways and transportation corridors by integrating satellite observations with multi-scale modeling.
Source of Support: Coordinating Research Council
Total Award Amount: $ 186,414 Total Award Period/Duration: Jan 1, 2025 - Dec 31, 2025
Person-Months: 5.16

Proposal Title: Trade-offs of stratospheric aerosol intervention on public health through competing impacts of weather extremes and air quality.
Source of Support: NOAA-OAR-Climate Program Office
Total Award Amount: $896,884 Total Award Period/Duration: Sep 01, 2025 - Aug 31, 2028
Person-Months: 1.75 Y1, 2.06 Y2, 3.72 Y3

Proposal Title: Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS (THIS PROPOSAL).
Source of Support: NOAA - Oceanic and Atmospheric Research
Total Award Amount: $1,049,775 Total Award Period/Duration: Aug 01, 2025 - July 31, 2028
Person-Months: 3.75 Y1, 3.17 Y2, 2.88 Y3

CURRENT AND PENDING SUPPORT

In the event an unanticipated overlap does occur, the level of effort would be adjusted and/or additional personnel would be added, in concurrence with funding sources.

Principal Investigator: Rosen, Daniel **DATE: October 2024**

CURRENT SUPPORT

Project Title: Advancing UFS Infrastructure in Support of Coastal Coupling. Source of Support: DOC-NOAA-NWS/National Weather Service; Contract #: 224F0135
Total Award Amount: $391,296 Total Award Period/Duration: 4/15/24 - 10/14/25
Person-Months: 0.85

Project Title: Unified Forecast System - Research to Operations Project Plan. Source of Support: NOAA Development; Contract #: NA23OAR4310383B
Total Award Amount: $212,850 Total Award Period/Duration: 4/1/24 - 6/30/25
Person-Months: 0.3

Project Title: Advancing UFS Infrastructure in Support of Coastal Coupling. Source of Support: DOC-NOAA-NWS/National Weather Service; Contract #: 224F0135
Total Award Amount: $391,296 Total Award Period/Duration: 04/15/24 - 10/14/25
Person-Months: 0.85

Project Title: An advanced coupled surface-subsurface hydrologic modeling and data assimilation system using LIS and ParFlow. Source of Support: NASA;
Contract #: 80NSSC20K1330
Total Award Amount: $399,986 Total Award Period/Duration: 07/02/20 - 07/01/25
Person-Months: 0.52

PENDING SUPPORT

Proposal Title: Advancing the representation of land surface heterogeneity and anthropogenic processes in coupled land-atmosphere systems. Source of Support: NASA
Total Award Amount: $335,628 Total Award Period/Duration: Jan 01, 2023 - Dec 31, 2026
Person-Months: 3.06 Y1

Proposal Title: Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS (THIS PROPOSAL).
Source of Support: NOAA - Oceanic and Atmospheric Research
Total Award Amount: $1,049,775 Total Award Period/Duration: Aug 01, 2025 - July 31, 2028
Person-Months: 1.5 Y1, 1.23 Y2-3

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Office of Oceanic and Atmospheric Research
Global Systems Laboratory
325 Broadway – David Skaggs Research Center
Boulder, Colorado 80305-332

November 12, 2024

Dr. Pedro A. Jimenez Munoz
Research Applications Laboratory
National Center for Atmospheric Research
3450 Mitchell Ln., Boulder, CO 80301

Re: Proposal "**Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS**" in response to FY2024 Weather Program Office NOAA-OAR-WPO-2025-28603 funding opportunity

My team at NOAA Global Systems Laboratory's Earth Prediction Advancement Division has been developing state-of-the-art smoke forecast models, such as HRRR-Smoke [https://rapidrefresh.noaa.gov/hrrr/HRRRsmoke/]. In recent years my team has been implementing the fire weather and smoke capabilities in the new UFS-based regional RRFS-Smoke model [https://rapidrefresh.noaa.gov/RRFS-SD/]. I have been collaborating with Dr. Jimenez and his team on using fuel moisture to improve fire emission estimates in our smoke forecast models. I want to express my strong support for this project led by Dr. Jimenez. Adding wildfire behavior simulation capability to NOAA's AQM model will significantly improve the air quality forecasting capabilities of the model for 1-3 days of time scales, consequently providing more timely and accurate air quality alerts during major wildfire events. I will be collaborating with the project team by providing guidance on the UFS model, fire emissions and other aspects of the project.

Sincerely,

Dr. Ravan Ahmadov
Physical Scientist
Earth Prediction Advancement Division, Global Systems Laboratory
National Oceanic and Atmospheric Administration
325 Broadway, Boulder, CO 80305
Google voice: (307) 696-2529
ravan.ahmadov@noaa.gov

Dear Representative,

On behalf of the National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS), National Centers for Environmental Prediction (NCEP), Environmental Modeling Center (EMC), Regional Air Quality Modeling, I am writing to express strong support for the proposal titled "Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS".

NOAA/NWS/NCEP/EMC and Dr. Pedro A. Jimenez Munoz's group at the NSF National Center for Atmospheric Research (NCAR) have a long-standing collaborative history focused on advancing the National Air Quality Forecasting Capability (NAQFC) and delivering valuable numerical guidance for air quality forecasting across the nation. Our joint efforts span a range of initiatives, including the development and enhancement of the UFS-based online air quality prediction system, fire behavior and emissions modeling.

Dr. Jimenez Munoz's proposal is well-aligned with NOAA's mission to advance air quality forecasting through innovative approaches that better simulate wildfire emissions and capture the interactions between weather, air quality, and atmospheric chemistry. This proposal's goals to enhance model performance and increase the precision of air quality forecasts are in close alignment with our priorities at EMC. Should this proposal be funded, EMC will collaborate with Dr. Jimenez Munoz's team as part of our commitment to adopting new approaches, though no funding from this proposal will be allocated to support EMC's activities.

Our potential collaborative efforts may include:

- Providing updates and guidance on the use of NOAA's UFS-based online air quality prediction system.
- Offering operational NAQFC input/output files necessary for testing fire behavior interactions with meteorology and atmospheric chemistry, to further refine NAQFC forecast products.
- Supporting the preparation and submission of publications and presentations to disseminate project findings.

These joint activities between EMC and Dr. Jimenez Munoz's team will help advance NOAA's UFS-AQM online systems, significantly improving NAQFC forecast products and expanding their utility for providing timely and accurate air quality guidance to the public.

We are enthusiastic about this opportunity to collaborate with NSF NCAR on the development of this two-way coupling model, which promises to enhance NAQFC forecast products further. We strongly encourage its consideration for funding.

Sincerely,

Jianping Huang, Ph.D.
Physical Scientist and Project Lead, National Air Quality Forecasting Capability
National Oceanic and Atmospheric Administration
National Weather Service/National Centers for Environmental Prediction
Environmental Modeling Center (EMC)

Should this proposal be selected for funding, we request that a financial assistance agreement (e.g. grant, subaward, etc.) be awarded to the University Corporation for Atmospheric Research (UCAR). The National Center for Atmospheric Research (NCAR) is a Federally Funded Research Development Center (FFRDC), sponsored by the National Science Foundation (NSF) and managed by UCAR. The proposed scope of work outlined in the proposal narrative will be performed by NCAR. All staff performing effort within NCAR are UCAR employees, not federal employees.

UCAR

UCAR Proposal Budget Detail

Proposal #	2024-0811
Proposal Title:	Development of two-way coupling between fire behavior modeling with dynamic biomass burning emissions and air quality within the UFS
UCAR Entity:	NCAR
Period of Performance:	08-01-2025 - 07-31-2028
Principal Investigator	Pedro Jimenez Munoz

			Unit / Rate	Effort Year 1	Effort Year 2	Effort Year 3	Year 1 NOAA - Oceanic and Atmospheric Research	Year 2 NOAA - Oceanic and Atmospheric Research	Year 3 NOAA - Oceanic and Atmospheric Research	Cumulative Grand Total
Salaries	Regular Salaries	Proj Scientist III	Hours	685.00	592.00	591.00	51,115	45,945	47,700	144,760
		Soft EngProg III	Hours	60.00	50.00	50.00	3,870	3,354	3,488	10,712
		Proj Scientist I	Hours	600.00	550.00	500.00	32,544	31,026	29,330	92,900
		Proj Scientist II	Hours	650.00	550.00	500.00	40,040	35,239	33,315	108,594
		Interim Dep Lab Director	Hours	60.00	40.00	40.00	5,279	3,660	3,807	12,746
		Student Asst II CAS (TBD)	Hours	0.00	480.00	480.00	0	11,573	12,034	23,607
	Subtotal Salaries						**132,848**	**130,797**	**129,674**	**393,319**
Fringe Benefits		Regular Benefits @	56.00 %				74,394	73,247	72,617	220,258
	Subtotal Fringe Benefits						**74,394**	**73,247**	**72,617**	**220,258**
	Total Salaries and Benefits						**207,242**	**204,044**	**202,291**	**613,577**
Materials and Supplies		Publication / Page Charges					0	1,920	3,840	5,760
	Subtotal Materials and Supplies						**0**	**1,920**	**3,840**	**5,760**
Travel		Domestic - Attend AMS Annual Meeting					2,644	2,758	2,994	8,396
		Domestic - Present at UIFCW					3,646	3,756	3,869	11,271
	Subtotal Travel						**6,290**	**6,514**	**6,863**	**19,667**
	Modified Total Direct Costs (MTDC)						**213,532**	**212,478**	**212,994**	**639,004**
Indirect Costs		NCAR Indirect Cost Rate (MTDC)	56.70 %				121,073	120,475	120,768	362,316
	Total Indirect Costs						**121,073**	**120,475**	**120,768**	**362,316**
MTDC Costs that Include Indirect Costs	**Computing Service Center**	Computing Service Center	$7.48 / hr				15,372	16,919	16,164	48,455
	Subtotal MTDC Costs that Include Indirect Costs						**15,372**	**16,919**	**16,164**	**48,455**
	Total MTDC + Applied Indirect Costs						**349,977**	**349,872**	**349,926**	**1,049,775**
	Total Funding To UCAR						**349,977**	**349,872**	**349,926**	**1,049,775**

NCAR Proposal 2024-0811 – Budget Justification

Proposed Total Budget: $1,049,775

A. Personnel: $393,319

Salaries are based on the current fiscal year: October 1 through September 30. The salary budget includes direct labor charges for time worked only. % Time is based on hours budgeted for project divided by 2080 work hours per year. Salaries are calculated based on the anticipated effort/time staff will contribute to the project and adjusted for non-work time for holidays, paid time off, etc., which is charged to the fringe benefit category. A 4% escalation is applied to salaries each fiscal year, beginning October 1, allowing for anticipated annual merit increases and/or reclassifications per approval of our cognizant audit agency.

Name & Position Title	Annual Salary	% of Time	# of Months	Salary Request
Dr. Pedro Jimenez Munoz, PI, Project Scientist III	Year 1: $155,213	32.9%	3.95	$51,115
	Year 2: $161,422	28.5%	3.42	$45,945
	Year 3: $167,881	28.4%	3.41	$47,700
	TOTAL	**-**	**10.78**	**$144,760**

Dr. Masih Eghdami, Co-I, Project Scientist I	Year 1: $112,814 Year 2: $117,326 Year 3: $122,022	28.8% 26.4% 24.0%	3.46 3.17 2.88	$32,544 $31,026 $29,330
	TOTAL	**-**	**9.51**	**$92,900**
Dr. Rajesh Kumar, Co-PI, Interim Deputy Lab Director	Year 1: $183,026 Year 2: $190,347 Year 3: $197,965	2.9% 1.9% 1.9%	0.35 0.23 0.23	$5,279 $3,660 $3,807
	TOTAL	**-**	**0.81**	**$12,746**
Dr. Forrest Lacey, Co-I, Project Scientist II	Year 1: $128,131 Year 2: $133,256 Year 3: $138,589	31.3% 26.4% 24.0%	3.75 3.17 2.88	$40,040 $35,239 $33,315
	TOTAL	**-**	**9.80**	**$108,594**
Mr. Daniel Rosen, Co-I, Software Engineer / Programmer III	Year 1: $134,152 Year 2: $139,518 Year 3: $145,101	2.9% 2.4% 2.4%	0.35 0.29 0.29	$3,870 $3,354 $3,488
	TOTAL	**-**	**0.93**	**$10,712**
TBD, Graduate Student, Student Assistant II	Year 1: $48,214 Year 2: $50,149 Year 3: $52,146	0% 23.1% 23.1%	0 2.77 2.77	$0 $11,573 $12,034
	TOTAL	**-**	**5.54**	**$23,607**

Dr. Pedro Jimenez Munoz, Project Scientist III will serve as NCAR's Principal Investigator and charge approximately 3.95 months in Year 1, 3.42 months in Year 2, and 3.41 months in Year 3 of this project. Dr. Jimenez Munoz' primary responsibilities for this project include oversee the overall project management and contribute to all tasks of the project. He will lead Task 1 where he will implement the plume rise model in the Community Fire Behavior model (CFBM) and contribute to linking the fire emissions from the CFBM to the AQM. In Task 2 he will provide guidance in the coupling of the aerosols to radiation and contribute to team efforts in the analyses of case studies. He will also lead Task 3. In this task he will implement the real-time demonstration and he will be responsible for maintaining its proper real-time operations. He will also contribute to the virtual tutorial. He will supervise and mentor the two graduate students that will be hired in the summers of years 2 and 3. He will contribute to team efforts to analyze results and summarize main findings in presentations, reports, and peer-reviewed publications.

Dr. Masih Eghdami, Project Scientist I will serve as NCAR's Co-Investigator and charge approximately 3.46 months in Year 1, 3.17 months in Year 2, and 2.88 months in Year 3 of this project. Dr. Eghdami's primary responsibilities for this project include contributing to all tasks of the project. In Task 1 he will implement the sharing of variables, through the NUOPC connectors, between UFS-Atmosphere and the CFBM. He will also contribute to couple the fire emissions to the AQM. In Task 2 he will focus on the analysis of case studies from FIREX-AQ to ensure a proper implementation of the developments and introduce refinements as needed. In Task 3 he will contribute to implementing the capability of running multiple fire domains, preparing the documentation, and leading the virtual tutorial and preparing the training material. He will

contribute to team efforts to analyze results and summarize main findings in presentations, reports, and peer-reviewed publications.

Dr. Rajesh Kumar, Interim Deputy Lab Director will serve as NCAR's Co-Principal Investigator and charge approximately 0.35 months in Year 1, 0.23 months in Year 2, and 0.23 months in Year 3 of this project. Dr. Kumar's primary responsibilities for this project include providing scientific advice with the UFS AQM and CMAQ as well as with relevant atmospheric chemistry processes. He will contribute to team efforts to analyze results and summarize main findings in presentations, reports, and peer-reviewed publications.

Dr. Forrest Lacey, Project Scientist II will serve as NCAR's Co-Investigator and charge approximately 3.75 months in Year 1, 3.17 months in Year 2, and 2.88 months in Year 3 of this project. Dr. Lacey's primary responsibilities for this project include contributing to all tasks of the project. During Task 1 he will implement the fire emissions from NEIVA in the CFBM and contribute to team efforts to link the fire emissions to the AQM. He will lead Task 2. In this task he will link the AQM aerosols to radiation in collaboration with the PI and contribute to the analysis of case studies from FIREX-AQ. In Task 3 he will be responsible for the implementation of the MELODIES-MONET evaluation, and he will contribute to the virtual tutorial and the documentation. He will contribute to team efforts to analyze results and summarize main findings in presentations, reports, and peer-reviewed publications.

Mr. Daniel Rosen, Software Engineer / Programmer III will serve as NCAR's Co-Investigator and charge approximately 0.35 months in Year 1, 0.29 months in Year 2, and 0.29 months in Year 3 of this project. Mr. Rosen's primary responsibilities for this project include providing advice with the ESMF libraries in UFS and the implementation of the capability to run several concurrent fires. He will contribute to team efforts to analyze results and summarize main findings in presentations, reports, and peer-reviewed publications.

TBD, Graduate Student, Student Assistant II will serve as NCAR's Other Personnel and charge approximately 0.0 months in Year 1, 2.77 months in Year 2, and 2.77 months in Year 3 of this project. The Student Assistant II's primary responsibilities for this project include learning how to use the UFS model coupled to the CFBM and the AQM and interact with stakeholders to learn about the value of fire simulations for society.

B. Fringe Benefits: $220,258

Name & Position Title	Annual Salary	Salary Request	% Rate	$ Fringe
Dr. Pedro Jimenez Munoz, PI, Project Scientist III	Year 1: $155,213	$51,115	56.0%	$28,624
	Year 2: $161,422	$45,945	56.0%	$25,729
	Year 3: $167,881	$47,700	56.0%	$26,712
	TOTAL	**$144,760**	**56.0%**	**$81,065**
Dr. Masih Eghdami, Co- I, Project Scientist I	Year 1: $112,814	$32,544	56.0%	$18,225
	Year 2: $117,326	$31,026	56.0%	$17,375
	Year 3: $122,022	$29,330	56.0%	$16,425
	TOTAL	**$92,900**	**56.0%**	**$52,025**

Dr. Rajesh Kumar, Co-PI, Interim Deputy Lab Director	Year 1: $183,026 Year 2: $190,347 Year 3: $197,965	$5,279 $3,660 $3,807	56.0% 56.0% 56.0%	$2,956 $2,050 $2,132
	TOTAL	**$12,746**	**56.0%**	**$7,138**
Dr. Forrest Lacey, Co-I, Project Scientist II	Year 1: $128,131 Year 2: $133,256 Year 3: $138,589	$40,040 $35,239 $33,315	56.0% 56.0% 56.0%	$22,422 $19,734 $18,656
	TOTAL	**$108,594**	**56.0%**	**$60,812**
Mr. Daniel Rosen, Co-I, Software Engineer / Programmer III	Year 1: $134,152 Year 2: $139,518 Year 3: $145,101	$3,870 $3,354 $3,488	56.0% 56.0% 56.0%	$2,167 $1,878 $1,953
	TOTAL	**$10,712**	**56.0%**	**$5,998**
TBD, Graduate Student, Student Assistant II	Year 1: $48,214 Year 2: $50,149 Year 3: $52,146	$0 $11,573 $12,034	56.0% 56.0% 56.0%	$0 $6,481 $6,739
	TOTAL	**$23,607**	**56.0%**	**$13,220**

The salary budget includes a full-time employee benefit rate of 56.0% for non-work time of vacation, sick leave, holidays, and other paid leave, as well as standard staff benefits. NCAR's negotiated indirect cost rate agreement (NICRA) with NSF, outlining our fringe and other indirect rates, is provided at the end of this narrative document.

C. Travel: $19,667

A total of $19,667 is requested for domestic travel, which includes 6 total trips over the duration of the project. Unless otherwise noted, the point of origin for all trips is Boulder, Colorado. The following are the basis for NCAR's travel cost estimates:

- 3% annual escalation of all travel costs beginning Year 2
- For roundtrip **Airfare** costs, a search for comparable flights between Denver International Airport (DIA) and the closest major airport near the travel destination conducted using NCAR's web-based travel system, Concur
- FY2025 GSA rates for domestic travel **Lodging** (per night) and M&IE **Per Diem.** Lodging rates include any associated taxes and fees. Per Diem includes a reduced 75% rate for first and last days of travel
- Current U.S. Department of State rates for foreign travel **Lodging** and M&IE **Per Diem**, including a reduced 75% per diem rate for first and last days of travel
- For **Ground Transportation** costs, NCAR's average prior travel rates for taxi, rail, bus, airport parking, etc. for both domestic and foreign locations, as applicable
- For **Mileage**, a total of 90 miles to/from DIA (45 miles each way) at a rate of $0.67 per mile, based on the current IRS standard mileage rates, is applied for each traveler on all trips involving airfare
- For **Car Rental** costs, a search for an intermediate car to be picked up/dropped off at the destination airport conducted using NCAR's web-based travel system, Concur. Unless otherwise noted, car rentals are shared among travelers

- For **Registration** fees, an online search for the most recent in-person registration rate available for the given conference

Domestic Travel: $19,667

Trip 1: $2,644

Destination	Houston, TX						
# of Travelers	1						
Days (Nights)	7 (6)						
Cost Type	**Unit Cost**	**Qty.**	**Base Cost per Traveler**	**Requested Funds**			
				Y1	**Y2**	**Y3**	**Total**
Airfare	$291	1	$291	$291	$0	$0	$291
Lodging	$154	6	$922	$922	$0	$0	$922
Per Diem	$80	6.5	$520	$520	$0	$0	$520
Ground Trans.	$100	1	$100	$100	$0	$0	$100
Mileage	$30	2	$61	$61	$0	$0	$61
Car Rental	$0	0	$0	$0	$0	$0	$0
Registration	$750	1	$750	$750	$0	$0	$750
TOTAL			$2,644	**$2,644**	**$0**	**$0**	**$2,644**

PI Jimenez Munoz will travel to Houston, TX for 7 days and 6 nights in Year 1. The estimated dates of travel are in January of that year. The trip includes mileage to/from the airport for all travelers, as well as registration costs and costs to cover Ground Transportation at the destination. The project-specific purpose of this trip is to attend the AMS annual meeting to provide an update to the community of the fire-weather-chemistry capability that we will develop in the project and interact with other UFS developers.

Trip 2: $2,758

Destination	Denver, CO						
# of Travelers	1						
Days (Nights)	7 (6)						
Cost Type	**Unit Cost**	**Qty.**	**Base Cost per Traveler**	**Requested Funds**			
				Y1	**Y2**	**Y3**	**Total**
Airfare	$0	0	$0	$0	$0	$0	$0
Lodging	$198	6	$1,188	$0	$1,224	$0	$1,224
Per Diem	$92	6.5	$598	$0	$616	$0	$616
Ground Trans.	$100	1	$100	$0	$103	$0	$103
Mileage	$20	2	$40	$0	$42	$0	$42
Car Rental	$0	0	$0	$0	$0	$0	$0
Registration	$750	1	$750	$0	$773	$0	$773
TOTAL			$2,676	**$0**	**$2,758**	**$0**	**$2,758**

PI Jimenez Munoz will travel to Denver, CO for 7 days and 6 nights in Year 2. The estimated dates of travel are in January of that year. The trip includes mileage to/from the conference for all travelers, as well as registration costs and miscellaneous costs for parking, etc. at the destination. The project-specific purpose of this trip is to attend the AMS annual meeting to provide an update to the community of the fire-weather-chemistry capability that we will develop in the project and interact with other UFS developers.

Trip 3: $2,994

Destination	Baltimore, MD						
# of Travelers	1						
Days (Nights)	7 (6)						
Cost Type	**Unit Cost**	**Qty.**	**Base Cost per Traveler**	**Requested Funds**			
				Y1	**Y2**	**Y3**	**Total**
Airfare	$271	1	$271	$0	$0	$288	$288
Lodging	$180	6	$1,080	$0	$0	$1,146	$1,146
Per Diem	$86	6.5	$559	$0	$0	$593	$593
Ground Trans.	$100	1	$100	$0	$0	$106	$106
Mileage	$30	2	$61	$0	$0	$65	$65
Car Rental	$0	0	$0	$0	$0	$0	$0
Registration	$750	1	$750	$0	$0	$796	$796
TOTAL			$2,821	**$0**	**$0**	**$2,994**	**$2,994**

PI Jimenez Munoz will travel to Baltimore, MD for 7 days and 6 nights in Year 3. The estimated dates of travel are in January of that year. The trip includes mileage to/from the airport for all travelers, as well as registration costs and costs to cover Ground Transportation at the destination. The project-specific purpose of this trip is to The project-specific purpose of this trip is to attend the AMS annual meeting to provide an update to the community of the fire-weather-chemistry capability that we will develop in the project and interact with other UFS developers

Trips 4-6: $11,271

Destination	Washington, D.C.						
# of Travelers	1						
Days (Nights)	6 (5)						
Cost Type	Unit Cost	Qty.	Base Cost per Traveler	Requested Funds Y1	Y2	Y3	Total
Airfare	$573	1	$573	$573	$590	$608	$1,771
Lodging	$331	5	$1,656	$1,656	$1,706	$1,757	$5,119
Per Diem	$92	5.5	$506	$506	$521	$537	$1,564
Ground Trans.	$100	1	$100	$100	$103	$106	$309
Mileage	$30	2	$61	$61	$63	$65	$189
Car Rental	$0	0	$0	$0	$0	$0	$0
Registration	$750	1	$750	$750	$773	$796	$2,319
TOTAL			$3,646	**$3,646**	**$3,756**	**$3,869**	**$11,271**

PI Jimenez Munoz will travel to Washington, DC for 6 days and 5 nights in each year. The estimated dates of travel are in June of that year. The trip includes mileage to/from the airport for all travelers, as well as registration costs and costs to cover Ground Transportation at the destination. The project-specific purpose of this trip is to attend the Unifying Innovations in Forecasting Capabilities Workshop to provide an update to the UFS community of the fire-weather-chemistry capability that we will develop in the project and interact with other UFS developers.

Foreign Travel: None

D. Equipment: None

E. Supplies: None

F. Contractual: None

G. Construction: None

H. Other: $54,215

Subawards: None

Publication Costs: $5,760

A total of $5,760 is budgeted for 3 publication(s) in the Journal of Applied Meteorology and Climatology (JAMC) – one publication in Year 2 and two publications in Year 3. The estimated cost is based upon a 16-page publication in an AMS technical journal at the rate of $120 per page. The publications will be used for publishing, sharing, and communicating the scientific findings of this project.

Computer Services: $48,455

Scientific and computing support costs have been allocated to this project through the Computer Service Center (CSC), in accordance with OMB circulars and NCAR management policy. The

FY2024 NCAR Research IT (NRIT) CSC rate is applied to staff within NCAR at a rate of $7.48 per labor hour, with approximately 6,478 total hours proposed.

Data Management Storage and Processing: None

I. Total Direct Charges: $687,459

A.	Personnel	$393,319
B.	Fringe	$220,258
C.	Travel	$19,667
D.	Equipment	$0
E.	Supplies	$0
F.	Contractual	$0
G.	Construction	$0
H.	Other	$54,215
TOTAL DIRECT		**$687,459**

J. Indirect Charges: $362,316

Indirect Costs are applied to all modified total direct costs (MTDC). Excluded from MTDC are items of equipment, participant costs, service center rates such as computing services, machine shop, data storage, etc., and individual subaward and subcontract amounts in excess of $50,000 per fiscal year. (UCAR is working with our cognizant agency to update the MTDC methodology based upon the updated Uniform Guidance.) The provisional FY2024 rate for Indirect Costs is 56.7%. Cognizant Agency: U.S. National Science Foundation (NSF).

A.	Personnel	$393,319
B.	Fringe	$220,258
C.	Travel	$19,667
E.	Supplies	$0
H.	Other	$5,760
TOTAL (MTDC)		$639,004
Multiplied by		56.7%
TOTAL INDIRECT		**$362,316**

A copy of NCAR's most recent negotiated indirect cost rate agreement (NICRA) is provided at the end of this narrative document.

UCAR Management Fee: None

K. Totals – Direct and Indirect Charges: $1,049,775

Standard Information:

1. The National Center for Atmospheric Research (NCAR) is operated by the University Corporation for Atmospheric Research (UCAR), UEI# YEZEE8W5JKA3, under the sponsorship of the National Science Foundation (NSF). NSF, our cognizant audit agency, approves UCAR rates annually. Budgets include provisional rates, which are subject to review and approval of NSF. Out year rates are estimated based on current provisional rates and are subject to change.

2. The salary budget includes direct labor charges only for time worked. The employee benefit rate includes direct charges for non-work time of vacation, sick leave, holidays and other paid leave, as well as standard staff benefits. The casual benefit rate applies to casual employees who do not receive the full benefit package.

3. Indirect Costs are applied to all modified total direct costs (MTDC). Items excluded from MTDC are equipment, participant costs, service center rates such as computing services, machine shop, data storage, etc. and individual subcontract amounts in excess of $50,000 per fiscal year. (UCAR is working with our cognizant agency to update the MTDC methodology based upon the updated Uniform Guidance.)

4. The budget may include a charge for scientific computing and networking support in accordance with 2 CFR 200, OMB Uniform Guidance and NCAR management policy allocating the costs of scientific computing system infrastructure.

5. Non-NSF and NSF Grant research at NCAR is monitored by our sponsor, the U.S. National Science Foundation, in accordance with criteria and guidelines approved by NSF/Division of Atmospheric and Geospace Sciences (AGS).

For funds provided by direct agreement with UCAR, contractual arrangements should be made with Ms. Anna Thomas, Manager, UCAR Contracts, 3090 Center Green Drive, Boulder, CO 80301-2252, Phone (303) 497-2005, Fax (303) 497-8501. Please refer to NCAR's proposal number on all correspondence with UCAR.

NATIONAL SCIENCE FOUNDATION
2415 Eisenhower Avenue
Alexandria, VA 22314

Division of Institution and Award Support
(703) 292-8244 VOICE

November 27, 2023

Geoff Cheeseman
Director, UCAR Budget and Planning
University Corporation for Atmospheric Research
P. O. Box 3000
Boulder, CO 80307-3000

Dear Mr. Cheeseman:

We have completed our review of the indirect cost proposal and supporting financial data submitted to the National Science Foundation (NSF) for your fiscal year ended September 30, 2022.

The enclosed rate agreement indicates the rates approved by this office. Please indicate your concurrence with these rates by signing, dating and returning a copy of the agreement to my attention at the above address. The rates included in the agreement may not be used until the agreement has been ratified through signatures from both your organization and NSF.

Should you wish to appeal any of the indirect cost pool adjustments NSF made as part of this rate negotiation, you may follow the dispute resolution procedures contained in Chapter XII of the NSF Proposal & Award Policies and Procedures Guide (PAPPG). These may be found online at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papp.

Per the rates that have been established, the organization will not be required to submit a new indirect cost rate proposal until the end of your FY 2023. This proposal should be submitted to this office within 6 months after the end of the organization's fiscal year and should follow NSF's current submission procedures (https://www.nsf.gov/bfa/dias/caar/docs/idcsubmissions.pdf). If you have any questions concerning the contents of this letter or the rate agreement, please contact James Deans at jdeans@nsf.gov or at (703) 292-2636.

Sincerely,

Meghan A. Benson

Dr. Meghan A. Benson
Lead Analyst, Indirect Cost Rates
Cost-Analysis and Pre-Award Branch (CAP)
Division of Institution and Award Support

Enclosure: Rate Agreement

NATIONAL SCIENCE FOUNDATION

OFFICE OF BUDGET, FINANCE & AWARD MANAGEMENT
Division of Institution and Award Support

NON-PROFIT ORGANIZATION
NEGOTIATED INDIRECT COST RATE AGREEMENT (NICRA)

EIN #: 84-0412668

NSF INS CODE: 4062600000

ORGANIZATION:
University Corporation for Atmospheric Research (UCAR)
P. O. Box 3000
Boulder, CO 80307-3000

DATE: November 27, 2023

FILING REF: The preceding agreement was dated December 12, 2022.

The indirect cost rates contained herein are for use on grants, contracts, and other agreements with the Federal Government to which 2 CFR Part §200 apply, subject to the terms and conditions of Section II of this agreement. The rates were negotiated by the National Science Foundation and the subject organization in accordance with the authority contained in applicable regulations.

SECTION I: RATES

FY 2022 - FINAL

Rate Description	Effective Period	Rate	Base
UCAR			
UCAR G&A	10/01/21 – 09/30/22	13.29%	(a)
UCAR Community Programs (UCP) G&A			
Onsite	10/01/21 – 09/30/22	35.03%	(b)
Offsite	10/01/21 – 09/30/22	21.54%	(b)
NCAR			
NCAR G&A			
Onsite	10/01/21 – 09/30/22	56.47%	(b)
Offsite/NWSC	10/01/21 – 09/30/22	44.92%	(b)
Fringe Benefits			
Full Benefits	10/01/21 – 09/30/22	57.47%	(c)
Reduced Benefits	10/01/21 – 09/30/22	9.24%	(c)

FY 2024 - PROVISIONAL

Rate Description	Effective Period	Rate	Base
UCAR			
UCAR G&A	10/01/23 – 09/30/24	13.10%	(a)
UCAR Community Programs (UCP) G&A			
Onsite	10/01/23 – 09/30/24	36.00%	(b)
Offsite	10/01/23 – 09/30/24	23.20%	(b)
NCAR			
NCAR G&A			
Onsite	10/01/23 – 09/30/24	56.70%	(b)
Offsite/NWSC	10/01/23 – 09/30/24	46.10%	(b)
Fringe Benefits			
Full Benefits	10/01/23 – 09/30/24	56.00%	(c)
Reduced Benefits	10/01/23 – 09/30/24	8.70%	(c)

SECTION I: RATES (cont'd)

Rate Application Bases

(a) Total direct costs of each entity, excluding equipment, participant support, Intergovernmental Personnel Assignments (IPAs), subaward or subcontract costs and other direct costs that are in excess of $25,000 per year, plus entity G&A before the allocation of UCAR G&A. The UCAR G&A rate is part of the National Center for Atmospheric Research (NCAR) and UCAR Community Program (UCP) rates and is generally not proposed separately on grant, contract, or cooperative agreement proposal budgets.

(b) Total direct costs, excluding equipment, participant support, Intergovernmental Personnel Assignments (IPAs), subaward or subcontract costs, and other direct costs that are in excess of $25,000 per year.

(c) Direct salaries and wages excluding paid absences. The Reduced Benefit rate is applicable to the salaries of student assistants, student visitors and other hourly staff that work "on call." The Full Benefit rate is applicable to the salaries of "regular" employees.

Fringe Benefits: Fringe benefits consist of: Payroll Taxes, Group Life and Major Medical Insurances, Retirement Contributions (TIAA/CREF), Unemployment Insurance, Worker's Compensation, Disability Insurance, Severance, Educational Assistance, Travel Accident Insurance, Transportation Benefits (RTD Bus Passes), and Employee Wellness. Fringe Benefits also include the costs of Paid Time Off (holiday, vacation, sick leave and other "non-work" time).

cont'd

SECTION II: GENERAL TERMS

A. LIMITATIONS: Use of the rates contained in this agreement is subject to any applicable contractual or grant limitations. Acceptance of these rates agreed to herein is predicated upon the conditions: (1) that no costs other than those incurred by the contractor or grantee were included in its indirect cost proposal and that such costs are legal obligations of the contractor or grantee, (2) that the same costs that have been treated as indirect costs have not been claimed as direct costs, and (3) that similar types of costs have been accorded consistent treatment.

B. AUDIT: All costs, direct and indirect, Federal and non-Federal are subject to audit. Adjustments to amounts resulting from audit of cost allocation plan or indirect rate proposal upon which the negotiation of this agreement was based will be compensated for in subsequent negotiation.

C. ACCOUNTING CHANGES: The rates contained in this agreement are based on the accounting system in effect at the time the proposal was prepared and the rates were negotiated. Changes to the method of accounting which effect the amount of reimbursement resulting from the use of these rates require the prior approval of this office. Failure to obtain such approval may result in subsequent cost disallowances.

D. RATE TYPES:

1. Provisional/Final Rate: Within six (6) months after fiscal year end, a final indirect cost rate proposal must be submitted based on actual costs. Billings and charges to federal grants and contracts must be adjusted if the final rate varies from the provisional rate. If the final rate is greater than the provisional rate and there are no funds to cover the additional indirect costs, the organization may not recover all indirect costs. Conversely, if the final rate is less than the provisional rate, the organization will be required to pay back the difference to the funding agency.

2. Predetermined Rate: Predetermined rates are applicable to a current or future period and are based upon an estimate of the costs to be incurred during the period. A predetermined rate is not subject to adjustment.

E. NOTIFICATION TO FEDERAL AGENCIES: Copies of this document may be provided to other Federal offices as a means of notifying them of the rates agreed to herein.

SECTION III: ACCEPTANCE

BY THE ORGANIZATION:

University Corporation for Atmospheric Research (UCAR)
(Organization)

DocuSigned by:
Erika Smith
7A7DDB066E374DA...
(Signature)

Erika Smith
(Name)

CFO
(Title)

11/28/2023
(Date)

ON BEHALF OF THE FEDERAL GOVERNMENT:

National Science Foundation
(Agency)

MEGHAN A BENSON
Digitally signed by MEGHAN A BENSON
Date: 2023.11.27 15:16:55 -05'00'
(Signature)

Meghan A. Benson
(Name)

Lead Analyst, Indirect Cost Rates
Cost-Analysis and Pre-Award Branch
(Title)

November 27, 2023
(Date)

NSF Negotiator: James P. Deans
Telephone: 703-292-2636

UCAR
UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH

April 28, 2023

The National Science Foundation
Division of Institution and Award Support
Attn: CAP Branch – Indirect Cost
2415 Eisenhower Avenue
Alexandria, Virginia 22314

Dear Ms. Meghan Benson:

Enclosed for review and approval are UCAR's proposed **FY 2024 Aircraft Maintenance Rates (AMR), Service Center Rates** (Computer Service Center (CSC) and Machine Shop), **User Rates** (System User Rates (SUR) and Core Hour Rate), and **Data Management Services Rates** (data processing and storage).

Please note in FY 2024 the addition of three new System User Rates for instrumentation operated by the Atmospheric Chemistry and Modeling Laboratory (ACOM). These instruments are available to the community, and are listed in the Project Requests Online (PRESTO) platform.

As with previous rate submissions, the attached summary page has an approval line for the NCAR/Facilities Section Head signature. If you have any questions regarding these FY 2024 proposed rates, please do not hesitate to contact me: (303) 497-1116 or charliem@ucar.edu.

Sincerely,

Charlie Mitchell
Assistant Director, NCAR Budget & Planning

cc: K. Spencer (NSF)
S. Ruth (NSF)
UCAR CFO
UCAR Budget & Planning
NCAR Administrators
UCAR President's Council:
A. Busalacchi E. Joseph
A. Swofford (interim) W. Kuo

Section 11
National Center for Atmospheric Research
Proposed Rate Summary

1. Aircraft Maintenance Rate

Aircraft Maintenance Rate (AMR)	FY 2022 Actual	FY 2023 Submitted	FY 2024 Proposed
C-130 Aircraft	$1,204 /Hour	$648 /Hour	$69 /Hour
GV Aircraft (Gulfstream HIAPER)	$3,226 /Hour	$3,781 /Hour	$5,556 /Hour

2. Service Center Rates

Computing Service Centers	FY 2022 Actual	FY 2023 Submitted	FY 2024 Proposed
Climate and Global Dynamics (CGD)	$7.44 /Hour	N/A /Hour	N/A /Hour
Atmospheric Chemistry Observations & Modeling (ACOM)	$8.31 /Hour	N/A /Hour	N/A /Hour
High Altitude Observatory (HAO)	$6.36 /Hour	N/A /Hour	N/A /Hour
NCAR Research IT (NRIT)	N/A /Hour	$8.01 /Hour	$7.48 /Hour
Mesoscale & Microscale Meteorology (MMM)	$7.03 /Hour	$6.50 /Hour	N/A /Hour
Research Applications Laboratory (RAL)	$7.17 /Hour	$7.75 /Hour	N/A /Hour
Machine Shop			
Machine Shop Rate	$87 /Hour	$88 /Hour	$90 /Hour

3. System User Rates

Earth Observing Laboratory (EOL)	FY 2022 Actual	FY 2023 Submitted	FY 2024 Proposed
ISFS	$289 /Day	$271 /Day	$271 /Day
ISS	$1,650 /Day	$1,689 /Day	$1,689 /Day
Dropsonde Data System	$820 /Day	$893 /Day	$908 /Day
Calibration Lab / Wind Tunnel	$346 /Day	$968 /Day	$968 /Day
S-Pol Radar	$6,253 /Day	$9,132 /Day	$9,132 /Day
HCR	$2,213 /Day	$5,313 /Day	$5,313 /Day
MPD	$934 /Day	$1,722 /Day	$1,722 /Day
HAIS	$309 /Day	$599 /Day	$849 /Day
C-130 Aircraft	$5,594 /Day	$11,738 /Day	$11,738 /Day
Gulfstream Aircraft (HIAPER)	$20,885 /Day	$10,759 /Day	$10,759 /Day
Mechanical Design	$949 /Day	$923 /Day	$923 /Day
Machine Shop	$683 /Day	$315 /Day	$315 /Day

Comp. & Information Systems Lab (CISL)	FY 2022 Actual	FY 2023 Submitted	FY 2024 Proposed
Rate Per Core Hour	$0.0062 /Hour	$0.0060 /Hour	$0.0056 /Hour
Rate per 100 Core Hours	$0.62 /100 Hours	$0.60 /100 Hours	$0.56 /100 Hours
GPU Rate	N/A /Hour	N/A /Hour	$1.30 /Hour

High Altitude Observatory (HAO)	FY 2022 Actual	FY 2023 Submitted	FY 2024 Proposed
Vacuum Tunnel	$955 /Day	$988 /Day	$1,038 /Day

Atmospheric Chemistry Observations & Modeling (ACOM)	FY 2022 Actual	FY 2023 Submitted	FY 2024 Proposed
TOGA-TOF	N/A /Day	N/A /Day	$573 /Day
2 Channel Chemi Luminescence Instrument	N/A /Day	N/A /Day	$157 /Day
Fast Ozone (non-HAIS)	N/A /Day	N/A /Day	$363 /Day

4. Data Management Services Rate (DMSR)
Assume data preservation commitment of 5 years *(include set-up costs*)*

Comp. & Information Systems Lab (CISL) - DMPSR	FY 2022 Actual	FY 2023 Submitted	FY 2024 Proposed
Processing Services*: Vol < 5 TB	$874.00 /Project	$938.00 /Project	$1,084.00 /Project
Processing Services: 5 TB <= Vol <10 TB	$1,311.00 /Project	$1,407.00 /Project	$1,626.00 /Project
Processing Services: 10 TB <= Vol < 25 TB	$2,622.00 /Project	$2,814.00 /Project	$3,252.00 /Project
Processing Services*: 25 TB <= Vol < 50 TB	$4,370.00 /Project	$4,960.00 /Project	$5,420.00 /Project
Processing Services: 50 TB <= Vol < 100 TB	$6,555.00 /Project	$7,035.00 /Project	$8,130.00 /Project
Processing Services: 100+ TB <= Vol	$8,740.00 /Project	$9,380.00 /Project	$10,840.00 /Project
CISL Storage Services Rate**	$45.00 /TB/Yr (ea.)	$45.00 /TB/Yr (ea.)	$45.00 /TB/Yr (ea.)

Comp. & Information Systems Lab (CISL) - DMPSSUR	FY 2022 Actual	FY 2023 Submitted	FY 2024 Proposed
Processing Services*: Vol < 5 TB	N/A /Project	$1,876.00 /Project	$2,168.00 /Project
Processing Services: 5 TB <= Vol <10 TB	N/A /Project	$2,814.00 /Project	$3,252.00 /Project
Processing Services: 10 TB <= Vol < 25 TB	N/A /Project	$5,628.00 /Project	$5,628.00 /Project
Processing Services*: 25 TB <= Vol < 50 TB	N/A /Project	$9,380.00 /Project	$6,504.00 /Project
Processing Services: 50 TB <= Vol < 100 TB	N/A /Project	$14,070.00 /Project	$16,260.00 /Project
Processing Services: 100+ TB <= Vol	N/A /Project	$18,760.00 /Project	$21,680.00 /Project
CISL Storage Services Rate**	N/A /TB/Yr (ea.)	$75.00 /TB/Yr (ea.)	$75.00 /TB/Yr (ea.)

**Processing Services costs assume estimated data volume is known at the time of proposal and current SE-II fully loaded salary midpoint.*
***All projects may be assessed the Processing Services fee plus the storage rate.*

APPROVED:

Sarah L. Ruth, Ph.D.
Section Head, NCAR and Facilities Section

Section 11
National Center for Atmospheric Research
Proposed Service Center Rates

Computing Service Centers (CSC)	Actual FY 2022	Submitted FY 2023	Proposed FY 2024
Climate & Global Dynamics			
Operating Expenses	$1,312,448	N/A	N/A
Worktime Hours	176,450	N/A	N/A
CGD CSC Rate/Hour	**$7.44**	**N/A**	**N/A**
Atmospheric Chemistry Observations & Modeling			
Operating Expenses	$709,338	N/A	N/A
Worktime Hours	85,336	N/A	N/A
ACOM CSC Rate/Hour	**$8.31**	**N/A**	**N/A**
High Altitude Observatory			
Operating Expenses	$559,085	N/A	N/A
Worktime Hours	87,953	N/A	N/A
HAO CSC Rate/Hour	**$6.36**	**N/A**	**N/A**
NCAR Research IT (NRIT) Rate (CGD, ACOM, HAO)			
Operating Expenses	N/A	$3,047,266	$8,915,030
Worktime Hours	N/A	$380,424	1,192,516
NRIT CSC Rate/Hour	**N/A**	**$8.01**	**$7.48**
Mesoscale & Microscale Meteorology			
Operating Expenses	$716,625	$732,915	N/A
Worktime Hours	101,932	112,740	N/A
MMM CSC Rate/Hour	**$7.03**	**$6.50**	**N/A**
Research Applications Laboratory			
Operating Expenses	$1,845,258	$2,052,394	N/A
Worktime Hours	257,336	264,825	N/A
RAL CSC Rate/Hour	**$7.17**	**$7.75**	**N/A**
Machine Shop			
Operating Expenses	$350,339	$528,884	$473,881
Number of Hours	4,037	5,984	5,246
Machine Shop Rate/Hour	**$87**	**$88**	**$90**

Section 11
National Center for Atmospheric Research
Proposed Aircraft Maintenance Rates (AMR)

Aircraft Maintenance Rates (AMR)	Actual FY 2022	Submitted FY 2023	Proposed FY 2024
C-130 Aircraft			
Operating Expenses	$6,235	$130,882	$17,263
Number of Hours	5	202	250
C-130 AMR Rate/Hour[1]	**$1,204**	**$648**	**$69**

[1] Actual aircraft flight hours are dependent on NSF approved deployments and the deployment schedule. Additionally, revenue and expenditures are not always realized in the same fiscal year.

GV Aircraft Maintenance Rate (AMR)	Actual FY 2022	Submitted FY 2023	Proposed FY 2024
Operating Expenses[2]	$1,168,824	$786,448	$805,620
Number of Hours	219	208	145
GV Rate/Hour[2]	**$3,226**	**$3,781**	**$5,556**

[2] The operating expenses for 2022 and component include COVID relief funding received in 2022 to offset the aircraft not flying due to the pandemic.

Section 11
National Center for Atmospheric Research
Proposed System User Rates

Earth Observing Laboratory (EOL)	Actual FY 2022	Submitted FY 2023	Proposed FY 2024
Systems User Rates (SUR)			
ISFS			
Operating Expenses	$1,510,514	$1,407,857	$1,414,620
Number of Systems	20	20	20
Number of Days[1]	261	260	261
ISFS Rate/Day[2]	**$289**	**$271**	**$271**
ISS/MISS/GAUS/MGAUS			
Operating Expenses	$1,722,965	$1,756,554	$1,763,316
Number of Systems	4	4	4
Number of Days[1]	261	260	261
ISS Rate/Day[2]	**$1,650**	**$1,689**	**$1,689**
ISS / GAU combined in FY 2007.			
Dropsonde Data System			
Operating Expenses	$641,852	$696,802	$710,964
Number of Systems	3	3	3
Number of Days[1]	261	260	261
Dropsonde Data System Rate/Day[2]	**$820**	**$893**	**$908**
Calibration Lab / Wind Tunnel			
Operating Expenses	$90,176	$251,789	$252,648
Number of Systems	1	1	1
Number of Days[1]	261	260	261
Calibration Lab Rate/Day[2]	**$346**	**$968**	**$968**
S-Pol Radar			
Operating Expenses	$1,631,967	$2,374,320	$2,383,452
Number of Systems	1	1	1
Number of Days[1]	261	260	261
S-Pol Rate/Day[2]	**$6,253**	**$9,132**	**$9,132**
HIAPER Cloud Radar (HCR)			
Operating Expenses	$577,536	$1,381,380	$1,386,693
Number of Systems	1	1	1
Number of Days[1]	261	260	261
HCR Rate/Day[2]	**$2,213**	**$5,313**	**$5,313**
MicroPulse DIAL (MPD)			
Operating Expenses	$1,218,233	$1,343,541	$1,797,768
Number of Systems	5	3	4
Number of Days[1]	261	260	261
MPD Rate/Day[2]	**$934**	**$1,722**	**$1,722**
HIAPER Aircraft Solicitation Instrumentation (HAIS)			
Operating Expenses	$726,507	$1,245,920	$1,772,644
Number of Systems	9	8	8
Number of Days[1]	261 #	260	261
HAIS Rate/Day[2]	**$309**	**$599**	**$849**
C-130 Aircraft			
Operating Expenses	$1,460,086	$3,051,880	$3,063,618
Number of Days[1]	261	260	261
C-130 Aircraft Rate/Day[2]	**$5,594**	**$11,738**	**$11,738**
GV (HIAPER) Gulfstream Aircraft			
Operating Expenses	$5,450,962	$2,797,340	$2,808,099
Number of Days[1]	261	260	261
GV Aircraft Rate/Day[2]	**$20,885**	**$10,759**	**$10,759**
Mechanical Design			
Operating Expenses	$569,915	$479,960	$385,445
Number of FTEs	2.3	2	1.6
Number of Days[1]	261	260	261
Mechanical Design Rate/Day[2]	**$949**	**$923**	**$923**
Machine Shop			
Operating Expenses	$410,209	$409,500	$312,417
Number of FTEs	2.3	5	3.8
Number of Days[1]	261	260	261
Machine Shop Rate/Day[2]	**$683**	**$315**	**$315**

This represents an add on user rate for non-NSF users, for recovery of base funded supervisory and support staff.

[1] *For all SUR rates, the number of working days in a year is 5 days per week for 52 weeks in a year, per NSF-AGS.*
[2] *For all SUR rates, duration and complexity of field programs may affect the required size of the base funded field crew. Subject to NSF Program Official approval, the SUR can be adjusted to reflect lower or higher labor requirements.*

Comp. & Information Systems Laboratory (CISL)	Actual FY 2022	Submitted FY 2023	Proposed FY2023[4]
Core Hours			
Operating Expenses	$20,532,908	$19,022,642	$19,783,547
Estimated Core Hours	3,300,000,000	3,151,425,000	3,510,825,000
CISL Core Hour Rate	**$0.0062**	**$0.0060**	**$0.0056**
CISL Core Hour Rate per 100 Core Hours	**$0.62**	**$0.60**	**$0.56**
CISL GPU Hour Rate	**N/A**	**N/A**	**$1.30**

[4] *In FY23/FY24, the estimated Core Hours are based on the current best estimate of Derecho deployment and the overlap of machines. The rate includes Cheyenne Core and Derecho Core. 1 Derecho GPU hour is equal to 230 Derecho core-hours.*

High Altitude Observatory (HAO)	Actual FY2022[5]	Submitted FY2023	Proposed FY2024
Vacuum Tunnel			
Operating Expenses	$ 249,288	$ 256,766	$ 270,923
Number of Days	261	260	261
Vacuum Tunnel Rate/Day	**$955**	**$988**	**$1,038**

[5] *In FY23 no NSF funds were spent on vacuum tunnel O&M.*