WSU FY24 Annual Report

For the NW-AIRQUEST Consortium

Von P. Walden, Amin Vahidi, and Jun Meng
26 June 2024

Personnel

Personnel

- Dr. Von P. Walden - Principal Investigator / Group Leader

- Dr. Jun Meng - Future PI for FY25

- Dr. Amin Vahidi - Postdoctoral Fellow

- Two new graduate students arriving Fall 2024 (PhD, MS)

- Ana Carla Fernandez-Valdez - Graduate Student

- Joe Vaughan - LAR and NW-AIRQUEST colleague (consultant)

LAR chemical transport modeler

- The WSU CEE has hired a new assistant professor in chemical transport modeling

  - **Dr. Jun Meng**

    - Developer and maintainer of GEOS-Chem

    - Working on health effects of Polycyclic Aromatic Hydrocarbons (PAH) in Canada

  - Started at WSU in January 2024 - Spring semester

Budget Status

FY24 Budget

- **Salaries** = $77,604

    - 8.4 months - Amin Vahidi (postdoc)

    - 4 months (1 semester) for a future graduate student (Jun Meng)

- **Travel** = $1,528

- **Web maintenance** = $10,000

- **HPC Equipment** = $41,000

- **WSU overhead** (12%) = $9,868

- **TOTAL = $140,000**

Budget Status

- FY24 is the second year of a two-year (biennium) budget

- Current remaining budget for FY24 is $0.

  - Amin's salary, travel for Amin, HPC nodes ($40,000), web site updates and maintenance

Budget for FY25

- **TOTAL for FY25 = $160,000**

- Salaries and Benefits ($105,753)

  - Amin (roughly 10 months), Jun (2 months of summer salary)

  - 1.5 months of summer salary for two new grad students

- Web Development ($10,000)

  - Roughly two weeks

- Travel (national CMAS meeting) ($1528)

- Student Qualified Tuition Reduction ($3600)

- Equipment ($25,000)

  - One new HPC node

  - One new computer laptop for MS student

- Overhead - 12% ($14,079)

Equipment

Equipment update

- The Aeolus HPC cluster continues to run the AIRPACT5 modeling system each night.

- Both AIRNAS1 and AIRNAS2 are fully functional

- Forecast data are being backed up daily to AIRNAS1 (then mirrored to AIRNAS2)

- 3 new nodes (192 processers) with 1.5 TB of total RAM (AIRPACT6)

On-going Tasks

ONGOING TASKS

- No major issues.

- Skipping through slides, but can any address questions.

ONGOING TASKS

Task	Status June 2024	
1. Provide daily forecasts of air quality for the three state region that can be used in daily AQ management.	DAY 1, 2 and 3 runs for Feb 2024 thru Jun 2024: (Success rate: 100%)	

ONGOING TASKS

Task	Status June 2024	
2. Provide near real-time verification statistics of the current AIRPACT system accuracy by pollutant, by month, and Provide for user access to AIRPACT results and monitoring data for user-defined periods for download & analysis.	Statistics continue to be maintained.	

ONGOING TASKS

Task	Status June 2024	
3. Track and continue to improve model performance so that model predictions provide useful guidance for air quality forecasting.	Continuing; no issues.	

ONGOING TASKS

Task	Status June 2024	
4. Maintain ambient air monitoring data streams from AIRNow.	Continuing; no issues (Also have Python scripts for easy download upon request)	
5. Maintain satellite retrievals that are still functioning (except for MODIS and OMI).	Satellite data are no longer being actively archived	
6. Continue improvements and requested additions to web graphical display.	New AIRPACT website is online	

ONGOING TASKS

Task	Status June 2024	
7. Maintain the "Change Log", posted on the AIRPACT website.	Ongoing. Now stored at GitHub; https://github.com/wsular/airpact	
8. Archive daily model output of the first 24 hours. Web-based graphical displays for each day's first 24 hours of forecast should be available for the most recent 5 years & gridded files for at least one month.	Ongoing.

Forecast graphics available beginning December 2015. | |

ONGOING TASKS

Task	Status June 2024	
9. Modify AIRPACT as needed to respond to changes in fire emissions produced by other organizations.

10. Continue hosting the link to the latest background concentration lookup tool. | Ongoing as needed

Hosted by IDEQ;
Link will be added to AIRPACT site under
Related Programs -> Graphics and Data | |
| | | |

ONGOING TASKS

Task	Status June 2024	
11. Modeling infrastructure maintenance and updates.	$40,000 investment in FY24 in 2 nodes; nodes are fully operational $25,000 investment in FY25 will add a 3rd node (64 processes each; 192 total) in WSU HPC)	

FY23 Carryover Tasks

TASKS CARRIED FORWARD FROM 2023

FY 2023 Task		Comments
1. Implement the **new AIRPACT6 forecasting framework** as an Apptainer container for use on HPC systems		AIRPACT6 Apptainer container: • Container is based on Ubuntu 22.04 • Development is being tracked on GitHub • netCDF libraries - built and installed • OpenMPI - built and installed for HPC deployment • mcip, bcon, icon, jproc are compiled • Updated logging feature is implemented • MCIP conversion of UW WRF is running • Bluesky framework is running • Daily WACCM acquisition for BCON is running • CCTM is installed and compiled, but needs testing • SMOKEv5.0 is installed and compiled, but needs testing (HDF…) • MEGANv3.2 still needs to be compiled

TASKS CARRIED FORWARD FROM 2023

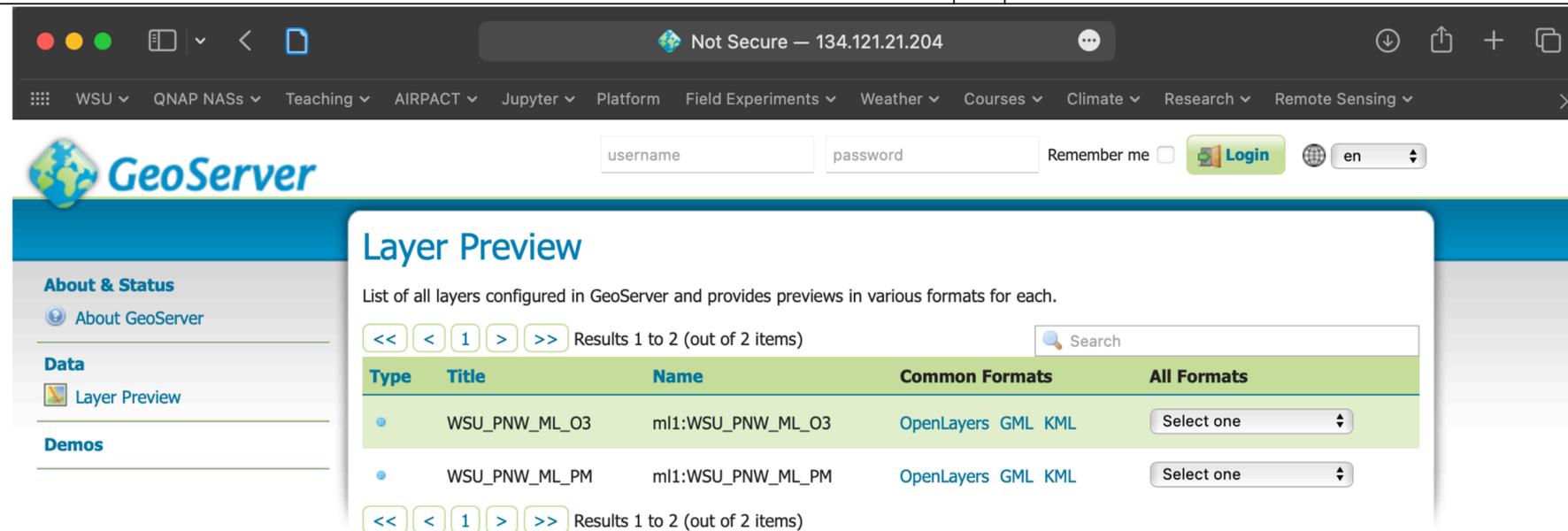| FY 2023 Task	Comments
2. Validate AIRPACT6 by running it concurrently with AIRPACT5 for six months. 3. Run validation case studies for ozone and PM2.5 for events using both AIRPACT5 and AIRPACT6.	Pending AIRPACT6 operations

TASKS CARRIED FORWARD FROM 2023

FY 2023 Task		Comments
4. **Extend the AIRPACT forecast period** from 48 h (2 days) to 72 h (3 days), in AIRPACT5		• Amin has completed the scripting for the 3rd day of AIRPACT5 forecasts • Operational in July 2024 (fire season)

TASKS CARRIED FORWARD FROM 2023

FY 2023 Task	Comments
5. **Continued improvement of Machine Learning forecast** system for ozone and PM2.5.	- LAR continues to run a new version along side original model - Training datasets were recently updated in new model (2017-2022) - PurpleAir data over AIRPACT domain have been downloaded for 2017-2022. - Interpolation will be implemented into LAR's version - This model framework is being integrated with WA Ecology's code. - Work will be performed by new graduate student

TASKS CARRIED FORWARD FROM 2023 (funded by USDA project)

FY 2023 Task	Comments
Availability of LAR forecasting products via GIS server	• GeoServer tested internally at LAR • GeoServer has been deployed on WSU external server • Forecasts will be distributed as GeoPackages • Expected to be operational in July 2024 (either for download from website or via GeoServer)

TASKS CARRIED FORWARD FROM 2023

FY 2023 Task	Comments
6. Experimental **drone flights of opportunity** (e.g., wintertime inversion conditions)	• Available upon request • Deployment in Wapato, Washington (Yakima Valley) in Feb 2024 as part of EPA experiment on wintertime air quality • Funded primarily by EPA, but with a few hours from NW-AIRQUEST for help from undergraduate • Alphasense OPC-N2, Bosch BME280 meteorology (T,P,U), and AtmoTube Pro • Vertical profiles of PM1, PM2.5, PM10, PM sizes between 0.4 and 17 microns, T, P, humidity, VOCs

FY24 Tasks

2024 TASKS

FY 2024 Task	
Update to 2020 EPA National Emissions Inventory (NEI) as data become available.	Is being implemented in AIRPACT6

2024 TASKS

FY 2024 Task	
Incorporate updated Background Concentrations as data become available.	Still need to chat with Idaho about this…

2024 TASKS

FY 2024 Task	

Investigate the possibility of building an AIRPACT container that could run a sub- domain at finer spatial resolution (as requested by consortium members).	Thoughts…
	
	• UW WRF 4-km output could be used to run smaller domain at 800-meter resolution (similar to what Ana Carla is doing…)
	
	• AIRPACT6 container
	  • WRF model
	  • Re-run emissions, CCTM and plotting
	
	• WRF-Chem container ??

New FY25 Tasks

FY25 Tasks

New leadership structure

- Jun Meng will be the Principal Investigator

- Von Walden will be a co-Principal Investigator (for continuity)

- Amin Vahidi will be the Technical Lead

- Prof. Meng will oversee two new graduate students (PhD, MS)

2025 Tasks - Ongoing

Ongoing Tasks
1. Provide daily forecasts of air quality for the three-state region that can be used as guidance in daily air quality management.
2. Provide near real-time verification statistics of the current AIRPACT system accuracy by pollutant and month, as well as provide for user access to AIRPACT results and monitoring data for user-defined periods for download and analysis.
3. Track and continue to improve model performance so that model predictions provide useful guidance for air quality forecasting.
4. Continue improvements and requested additions to AQ websites.
5. Maintain the "Change Log" that is hosted at GitHub: https://github.com/wsular/airpact
6. Archive daily model output of the first 24 hours of forecast for each day and provide access to same upon requests from users. Web-based graphical displays for each day's first 24 hours of forecast should be available for the most recent 5 years. Gridded model output files should remain accessible for up to three years.
7. Modify AIRPACT as needed to respond to changes in fire emissions produced by other organizations.
8. Modeling infrastructure maintenance and updates: Replace failed hardware components, maintain software subscriptions, and incrementally update (purchase new replacements for) as many as possible of the outdated and out-of-warranty components (e.g., nodes, cores, cables, disks, memory, etc., as needed) of the WSU Linux cluster used to run the AIRPACT system. The updates should be optimized to maintain or improve the reliability of the system, and to enable reliable performance and, if possible, earlier delivery of the daily products.

2025 Tasks - Carried Forward

SFY 2024 TASKS CARRIED FORWARD TO 2024-2025 (SFY 2025)		
SFY 2024 Tasks	**Status from SFY 2024**	**Timeline[1]**
1. Implement the new AIRPACT6 forecasting framework as a Singularity container for use on HPC systems.	AIRPACT6 Singularity container: • Container is based on Ubuntu 22.04 • Development is being tracked on GitHub • netCDF libraries - built and installed • OpenMPI - built and installed for HPC deployment • Updated logging feature is implemented • MCIP conversion of UW WRF is running • Bluesky framework is running • Daily WACCM acquisition for BCON is running • SMOKEv5.0 is installed and compiled • MEGANv3.2 is installed but not compiled • Still working on compilation of CCTM	Dec 2024
2. Validate AIRPACT6 by running it concurrently with AIRPACT5 for six months (Jan 2024 – Jun 2024).	Pending AIRPACT6 operations	Jan 2025
3. Run validation case studies for ozone and PM2.5 for events using both AIRPACT5 and AIRPACT6 (previous events for evaluation and study).	Pending AIRPACT6 operations	Jan 2025
4. Extend the AIRPACT5 forecast period from 48 h (2 days) to 72 h (3 days).	3-day forecast is now fully deployed • Currently in testing mode • Expect to be fully operational by July 2024	July 2024
5. Continued improvement of Machine Learning forecast system for ozone and $PM_{2.5}$, including providing a model evaluation report or presentation.	In collaboration with WA Ecology, LAR is creating a containerized model that contains both Python and R scripts to generate 5-day ML forecasts for Idaho, Oregon, and Washington. LAR will eventually host a new website that will serve the 5-day ML forecast results for all 3 states.	Jun 2025
	• Training datasets were recently updated in new model (2017-2022) • Working on adding additional sites from WA Ecology • Working on adding PurpleAir sites (with long records; 2017-2022) • Interpolation will be implemented into LAR's version	
6. Availability of LAR forecasting products (AIRPACT5, ML) via GIS server	GeoServer has been created internally at LAR. • Currently testing various GIS products (shapefiles, netCDF files)	Jun 2025
7. Experimental drone flights of opportunity to study wintertime inversion conditions (e.g., Pinehurst, ID).	Available per request	As needed

2025 Tasks - New

2025 NEW TASKS	
Tasks	**Timeline**
Update to 2020 EPA Emissions Modeling Platform as data become available	Jun 2025
Incorporate updated Background Concentrations as data become available	Jun 2025
Investigate the possibility of building an AIRPACT container that could run a sub-domain at finer spatial resolution (as requested by consortium members)	Jun 2025
Improve AIRPACT's reliability by investing in a new computing node in the university-wide HPC.	Jun 2025

2025 Tasks - Deliverables

2025 Deliverables

Deliverables	Status
AIRPACT5 forecasts will be extended from 48 hours to 72 hours (3 days)	Work is continuing and is nearing completion
Validated AIRPACT6 modeling framework.	Work to develop and validate the new AIRPACT6 forecasting system will be continued in FY 2025.
LAR will operate and host the 5-day ML forecast model for ID, OR and WA	Work has started in collaboration with WA Ecology.
Final Report	Deliver in June 2025

Thank You!!

Questions?