NOAA Air Resources Laboratory

Quarterly Activity Report

FY2019 Quarter 4 (July-August-September 2019)

Contents:

DISPERSION AND BOUNDARY LAYER

1. HYSPLIT Python Graphics

A new Python program called TOAPLOT was created for generating time-of-arrival plots. TOAPLOT was developed mainly for ARL to use at the monthly international Regional Specialized Meteorological Center exercise. New options were added to all Python plot programs, including an option to display a street map in the background for enhanced geographical view of plume boundaries or trajectories and the ability to specify a time zone to which times are automatically converted from Coordinated Universal Time and displayed for convenient reading without time zone conversion. (sonny.zinn@noaa.gov)

2. Real-Time Environmental Application and Display sYstem (READY) Web Application

The current READY web application is being modernized using a Java web framework. We rewrote the volcanic ash part of READY, keeping existing essential capabilities such as HYSPLIT interface and plot generation. The new volcanic ash web application is being deployed to a development server for further testing. (sonny.zinn@noaa.gov)

3. Unmanned Aircraft Systems (UAS) Program Office Work

ARL's Atmospheric Turbulence and Diffusion Division (ATDD) participated in three intensive operating periods (IOPs) for the Chequamegon Heterogeneous Ecosystem Energy-balance Study Enabled by a High-density Extensive Array of Detectors experiment, nicknamed CHEESEHEAD, in Park Falls, Wisconsin, in July, August, and September 2019. NOAA's Office of Marine and Aviation Operations Aircraft Operations Center participated as pilot-in-command for the Meteomatics Meteodrone Severe Storms Edition (SSE) aircraft for IOPs 1 and 2.

- IOP 1 (July 8-13, 2019): A total of 17 flights were flown with the DJI S-1000 to map the spatial variability of heat flux around the second tower in the southwest quadrant of the CHEESEHEAD domain (SW2) and 25 flights were flown with the Meteomatics Meteodrone SSE to measure vertical profiles of temperature and relative humidity above the SW2 tower.

- IOP (August 18-24, 2019): The DJI S-1000 made a total of seven flights to map the spatial variability of heat flux around the Park Falls tall tower and the Meteomatics Meteodrone SSE

made 47 flights to measure wind speed and direction at each level of the sonic anemometers mounted on the Park Falls tall tower.

- IOP 3 (September 23-27, 2019): A total of 51 flights were made with the Meteomatics Meteodrone SSE to measure vertical profiles of temperature and relative humidity above the SW2 tower and to measure temperature variations above the forest canopy at various locations around the SW2 tower.

ATDD's second BlackSwift S2 (S/N 20007) was test-flown twice on August 29, 2019, at Oliver Springs airport, Tennessee. Autopilot functions for flying mapping missions were tested.

Ed Dumas participated in the 2019 International Society for Atmospheric Research Using Remotely Piloted Aircraft meeting in Lugo, Spain, from July 15-19, 2019, where he gave presentations for Bruce Baker and Temple Lee on recent small UAS work at ATDD. He also made contact with representatives of several international groups. (Ed.Dumas@noaa.gov, T. Lee, M. Buban, B. Baker)

4. Emissions Monitoring and Analysis

Mark Cohen led an analysis in support of the Tracers of Opportunity project examining atmospheric sulfur dioxide (SO2) and mercury (Hg) at ARL's Beltsville, Maryland, monitoring site and other regional sites. Alice Crawford, Fantine Ngan, Winston Luke, Paul Kelley, and Xinrong Ren collaborated on the project. Large point emissions sources in the region were modeled for the year 2009 using the HYSPLIT model and Continuous Emissions Monitoring System data obtained from a U.S. Environmental Protection Agency (EPA) database. Model-predicted concentrations were compared against measured concentrations to evaluate the realism of the simulations. Several illustrative episodes were selected for detailed study, and an extensive set of sensitivity simulations were carried out, varying meteorological data inputs and HYSPLIT model parameters, to examine the influence of these variations on the ability of the model to reproduce observations. The use of both SO2 and Hg as simultaneous Tracers of Opportunity added additional power to the analysis. Dr. Cohen presented the study's findings at the 14th International Conference on Mercury as a Global Pollutant held September 8-13, 2019, in Krakow, Poland. The presentation title was "Atmospheric Mercury Model Evaluation vs. Realistic Limits of Deterministic Predictions: What is Success?" (mark.cohen@noaa.gov)

5. HYSPLIT Simulations for Hazardous Chemicals

Mark Cohen made a presentation to, and led a discussion among, representatives from ARL and NOAA's National Ocean Service Office of Response and Restoration (OR&R) during a meeting on August 27, 2019. This portion of the meeting considered the results of a screening analysis carried out to examine the use of chemical-specific deposition and transformation parameters for the more than 800 chemicals in OR&R's Computer-Aided Management of Emergency Operations (CAMEO®)/Areal Locations of Hazardous Atmospheres (ALOHA®) air hazard modeling system. HYSPLIT has been integrated into the CAMEO/ALOHA system to provide additional emergency response capability, and this analysis explored questions about the best way to apply HYSPLIT

in these simulations. The talk, "HYSPLIT Simulations for ALOHA Chemicals: Possibilities and Suggestions," was based on a December 2018 report and more detailed presentation. (mark.cohen@noaa.gov)

6. Experimental HYSPLIT Product: Volcanic Ash

Allison Ring and Alice Crawford participated in the bi-annual Joint Polar Satellite System volcanic hazards initiative user meeting on September 17 via WebEx. Dr. Ring briefed participants on the development status of new HYSPLIT tools for volcanic ash forecasts. (alice.crawford@noaa.gov)

7. Consequence Assessment for the Nevada National Security Site (NNSS)

James Wood, Rick Lantrip, and Walt Schalk participated in two emergency response training exercises/drills as the Consequence Assessment Team (CAT) for the National Nuclear Security Administration (NNSA) Nevada Field Office (NFO). These activities were conducted on the NNSS and consisted of field exercises/drills that occurred there. In these events, the activities to be conducted were discussed, local weather data and forecasts were provided, and dispersion products were generated based on the worst case event information provided for the scenario. In addition, the CAT worked with field measurement teams to help identify/locate the plume. These events were conducted with the U.S. Department of Energy (DOE)/NNSA/NFO Emergency Response Organization. Dispersion and consequence assessment products were developed for use during exercise play as "ground truth". These exercises/drills simulated chemical, radiological, and transportation accidents on NNSS and at NNSS facilities. Routine training and practice are required to maintain consequence assessment qualifications and expertise. (rick.lantrip@noaa.gov, james.s.wood@noaa.gov, walter.w.schalk@noaa.gov)

8. Special Operations and Research Division (SORD) Mesonet

SORD continued researching several areas in an attempt to improve the SORD/NNSS Mesonet. Communications, three-dimensional sonic anemometer improvements/upgrades, precipitation gauge replacement, and gauges that can better record snow, snow depth sensors, and radio communications top of the list of improvements. Sonic anemometers have to be reset on occasion, but have been better lately. Initial planning began for snow depth sensor installation.

Wayne Bailey continues to perform routine monthly maintenance and verification checks on the NNSS mesonet. It was determined that a firmware upgrade was necessary after several Global Positioning System sensors began reverting to the year 2000. An update schedule was developed, implemented, and completed.

Bailey, Rick Lantrip, and James Wood began the fall semi-annual mesonet verifications and calibrations.

Walt Schalk and Lantrip provided NNSS Mesonet data to several groups on the site for use in planning experimental and construction activities. Wood provided monthly precipitation data to the Environmental Monitoring Group.

Lightning Detection System: SORD continued working with its partners to install a new lightning sensor to the north, but getting information is challenging. We also continued working to solidify our information technology support. Vaisala returned to upgrade the detection data processing software that improved location accuracy and better delineated between inter-cloud and cloud-to-ground strikes. (walter.w.schalk@noaa.gov, james.s.wood@noaa.gov, rick.lantrip@noaa.gov, wayne.bailey@noaa.gov)

9. Support to U.S. DOE/National Nuclear Security Administration (NNSA) NNSS Projects and Experiments

Walt Schalk participated in an initial data/results meeting from the fourth and final experiment in Phase II of non-proliferation experiments (Source Physics Experiments – Phase I, Dry Alluvium Geology – Phase II), which discussed the final report and data repository. Schalk also participated in several planning discussions in preparation for the next set of non-proliferation experiments (low yield nuclear monitoring). Continuing discussions centered on the number and location of additional surface stations to be fielded, as well as planned radiosonde releases to be conducted in support of experiments.

Schalk continues monthly meetings with NFO contractor personnel to discuss NNSS efforts to complete the vulnerability screening activity for the mandated Site Sustainability Project – Climate Resiliency. (walter.w.schalk@noaa.gov, james.s.wood@noaa.gov, rick.lantrip@noaa.gov)

10. Consequence Assessment for the Idaho National Laboratory (INL)

Jason Rich and Bai Yang participated in two emergency response training exercises/drills supporting the CAT for DOE Idaho. These activities, which simulated accidents on the INL, were conducted on-site and required the provision of local weather data and forecasts, as well as the generation of dispersion (HYSPLIT) products based on the worst case event information provided for the scenario.

Two wildland fires were ignited by lightning this quarter. Both required activation of INL's Emergency Operations Center, with participation by Jason Rich and Bai Yang. The first, in July, burned grass and sagebrush on the INL and was declared the largest wildland fire in INL's history after burning over 112,000 acres in two days. ARL's Field Research Division (FRD) provided short term forecasts and activated a number of high volume samplers. The second, in September, was a short-lived event that consisted of several small fires that were extinguished quickly.

Routine training and practice to maintain qualifications and expertise were conducted. (Jason.Rich@noaa.gov, Bai.Yang@noaa.gov)

11. Field Research Division (FRD) Mesonet

FRD began its fall season semi-annual overhauls of its weather observation mesonet. This task is ongoing and is expected to finish in November.

The NOAA/INL Mesonet primary radio repeater on Jumpoff Peak was successfully repaired by site owner American Communications.

In addition to normal maintenance, FRD received new dataloggers and radios as part of a planned upgrade to the NOAA/INL Mesonet weather stations. Bai Yang and Roger Carter tested the new dataloggers (model CR1000X), their connections with the instruments, programs, and control software, and communications between the dataloggers and computers in the lab. Multiple tests will be needed since instrument setups vary slightly from one station to another; each test is specifically designed for one setup. This upgrade was planned in three phases. For the past few years, we operated six stations with the new radios as a test of the system and proved very reliable. The next phase includes new radios and data loggers for about half of the stations remaining on the old radio system. The new components will be installed this fall and, if the system works well over the winter, the final phase of upgrades (all remaining stations) will be implemented next spring. Phased implementation of upgrades allows us to verify that the equipment will work as intended before committing the entire mesonet operation to the new equipment. The new system significantly increases the speed and capabilities of communications and potentially allows the connection of other types of meteorological equipment to the mesonet. These will be installed as time permits.

FRD met with INL researchers regarding their request for wind gust data extending back to 1950. While FRD does have some historical records covering 1950 to present, not all the measurements we make are available and records are sparse for some periods. We discussed the available digital records and showed some paper records from past periods that could provide more information with expensive manual extraction efforts. The available records were provided on a CD and the researchers were invited to go through and scan the paper records in the future. (roger.carter@noaa.gov, brad.reese@noaa.gov, Jason.rich@noaa.gov, bai.yang@noaa.gov)

ATMOSPHERIC CHEMISTRY AND DEPOSITION

12. **Long Island Sound Tropospheric Ozone Study (LISTOS)**

In July 2019, Xinrong Ren and a few researchers at the University of Maryland (UMD) conducted research flights over New York City and the Long Island Sound during the LISTOS campaign. ARL's air pollution measuring equipment, including ozone (O_3) and SO_2 analyzers, were aboard UMD's research aircraft. Measurements taken included smog pollutant ozone and its precursors, such as nitrogen oxides (NO_X) and volatile organic compounds. The goal of LISTOS was to understand the contributing chemicals, their emission sources, and the underlying weather patterns that influence the formation of ozone events. LISTOS was a multi-agency collaborative research project involving NOAA, the Northeast States for Coordinated Air Use Management (lead), U.S. EPA, NASA, state environmental agencies from New York, New Jersey, Connecticut, and Maine, Massachusetts, and several universities. The study focused on the Long Island Sound because the region perpetually suffers from high ozone concentrations and resulting poor air quality that negatively affects the health and well-being of over 20 million people from the

New York City metropolitan area to the Atlantic coast of Massachusetts. More information is available at http://www.nescaum.org/documents/listos. (xinrong.ren@noaa.gov)

13. An Updated Wildfire Emission System in the National Air Quality Forecasting Capability (NAQFC): Application and Evaluation During the Williams Flats Fires of August 2019

With comprehensive air quality simulation and near real-time wildfire detection from NOAA satellites similar to the Atmospheric Sciences Modeling Division (ASMD)- developed NAQFC, Dr. Patrick Campbell provided forecasting support to the NOAA-NASA joint Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ) campaign underway in the Western U.S. between July 15 and early September 2019. Preliminary results compared meteorological, trace gas, and aerosol measurements along the flight tracks using ASMD's Model and ObservatioN Evaluation Toolkit verification system, developed by Dr. Barry Baker, and Dr. Campbell's python verification package to validate the forecasts. In general, the comparison revealed encouraging agreements, as many of the simulations skillfully captured the spatiotemporal variability of the pollution plumes downwind of wildfire sources.

The figure below demonstrates the good match for ozone from the Williams Flat Fire on August 7, one of the most prominent fire events of the campaign, along a flight track by NASA's DC8 Science Flight #8, shown in the comparative time series and the model-observation bias color shadings in the isometric diagram (Figure 1). The color intensity showed discrepancies of the model prediction when subtracting from it the measured values onboard the DC8 when traversing much of the Northern Plains and flying up to approximately 10 kilometers in altitude, as indicated by the ordinate axis. The diagram represents a three-hour flight with consistently small, model-predicted discrepancies where the measured values typically laid in the 60 parts per billion (ppb) range. The unit of the color bar is also ppb.

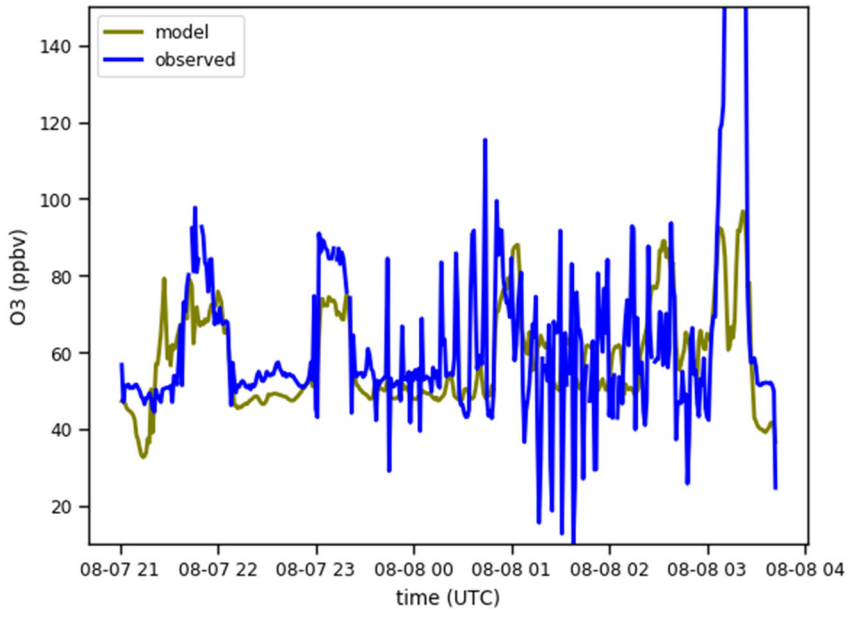


Figure 1 (top). *Time series for the NAQFC model ozone mixing ratio (ppbv) compared to the NASA DC8 Science Flight #8 observations during the Williams Flats fires of August 07, 2019 during FIREX-AQ.*

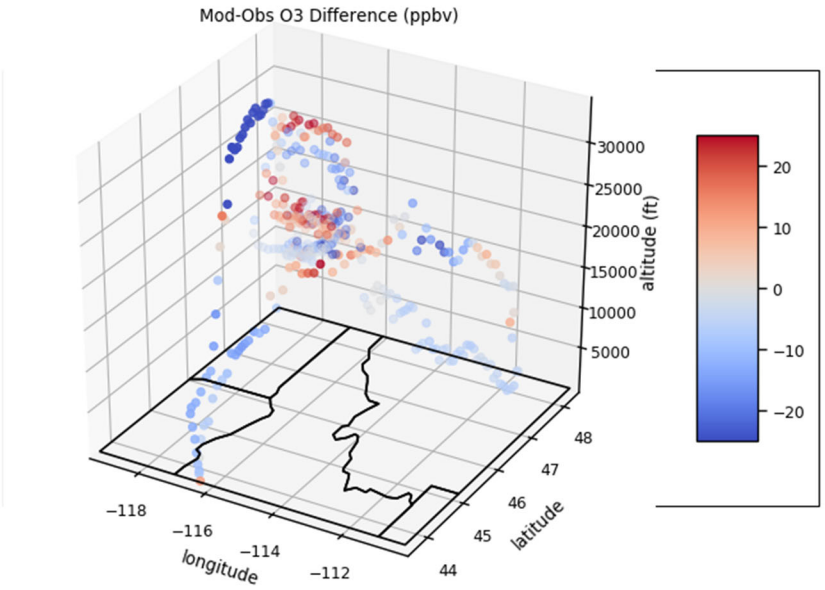


Figure 1 (bottom). *Isometric mean bias plot for the NAQFC model ozone mixing ratio (ppbv) compared to the NASA DC8 Science Flight #8 observations during the Williams Flats fires of August 07, 2019 during FIREX-AQ.*

14. U.S. EPA 2016-Beta Emissions Modeling Platform and Collaboration

Dr. Patrick Campbell was involved in processing the recently released (March 2019) U.S. EPA 2016-beta emissions modeling platform collaboration and preparation for its use in the GEOS-Chem model with colleagues at Harvard and NASA. In particular, this included collaboration with the GEOS-Chem Emissions and Deposition Working Group, and performance of initial tests of the EPA 2016-beta emissions processing in the standalone version of the Harvard-NASA Emissions Component (HEMCO). Project updates are listed on the Harvard Wiki page: http://wiki.seas.harvard.edu/geos-chem/index.php/Emissions_and_Deposition_Working_Group. (patrick.c.campbell@noaa.gov)

15. Initial Development of a NOAA Emissions and eXchange Unified System (NEXUS)

The past decade has experienced rapid advances in global aerosols and atmospheric composition (AAC) model prediction capabilities. AAC models are key components of unified forecast systems that often employ an Earth System Model Framework (a high-performance, flexible software infrastructure for building and coupling weather, climate, and related Earth science models) for weather and climate predictions. Emissions of trace gases and primary aerosols are a critical component of AAC models and are often the most important component to ensure accurate predictions of trace species distributions. However, developing these emissions inputs to AAC models is often a laborious, time-consuming process, especially to ensure that the datasets are suitable for a range of spatial scales and applications. Furthermore, inventory-based emission inputs are subject to a bottom-up approach that is prepared separately (offline) and suffers distinct time lags from the AAC models, which affects both the timing and accuracy of trace gas predictions. Due to these issues with emissions and surface-atmosphere exchange in

AAC models, Dr. Campbell performed the initial development of a NOAA NEXUS, which is based on the Harvard-NASA Emissions Component (HEMCO), and performed preliminary tests and evaluation of HEMCO for anthropogenic emissions in NOAA's Global Ensemble Forecast System (GEFS) - Aerosols with Global Ozone Chemistry Aerosol Radiation and Transport (GOCART) simulations.

Preliminary results demonstrated very similar results (< +/- 5%) using NEXUS compared to the current emissions modeling system employed in NOAA AAC models, i.e., PREP-Chem-Sources (emissions preprocessor). Furthermore, Dr. Campbell demonstrated the use of NEXUS to rapidly incorporate both top-down (e.g., the blended Ozone Monitoring Instrument-Hemispheric Transport of Air Pollution (OMI-HTAP) emission inventory; Liu et al, 2018) and bottom-up (U.S. EPA 2016-beta emissions; *see #15 above*) emission inventories, and how they can improve the predictions of global fine particulate matter (PM2.5) predictions compared to OpenAQ observation sites in different Giorgi world regions (Figure 2). These results show promise for NEXUS to replace current emission modeling system at NOAA.

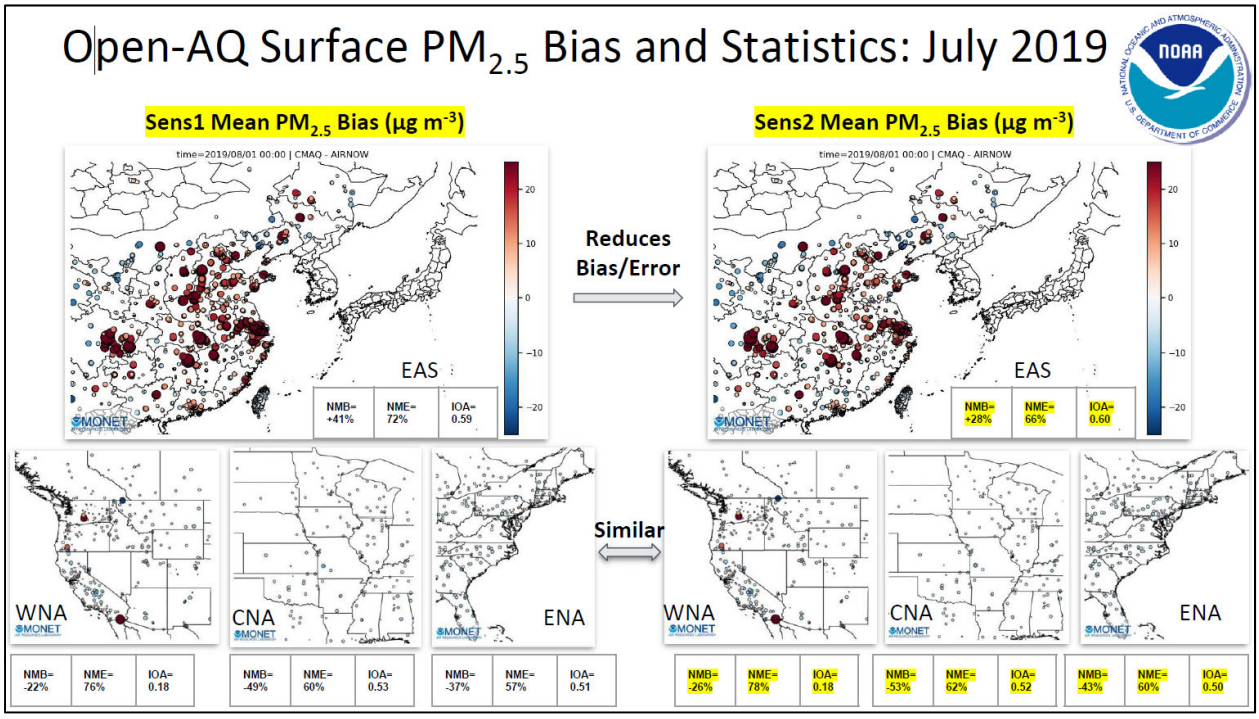


Figure 2. *Spatial bias plot comparisons of GEFS/Aerosols-GOCART simulations compared to Open-AQ observations of PM2.5 for the East Asia and North America Giorgi regions. Sens 1 (left) refers to the GEFS/Aerosols-GOCART simulations using the default NOAA-AAC CEDS 2014 and HTAP 2010 global emissions, while Sens 2 (right) uses a blend of CEDS 2014, OMI-HTAP 2017 global SO_2 emissions (Liu et al., 2018), and EPA 2016-Beta emissions for CONUS (see EPA emissions progress above). The statistics below the plots are defined as follows: NMB = Normalized Mean Bias, NME = Normalized Mean Error, and IOA = Index of Agreement.*

Working with Dr. Barry Baker, Dr. Campbell also assisted in implementing, testing, and evaluating the FENGSHA (Mandarin for "windblown dust") emission model in NEXUS with an enhanced Baker-Schepanski (B-S) Sediment Supply Map (SSM). Preliminary offline NEXUS simulations show that the FENGSHA model with the 0.1°x0.1° B-S SSM leads to more dust sources and

higher spatial inhomogeneity compared to Dust Entrainment and Deposition model (DEAD) using a coarser resolution SSM (default in the GEOS-Chem model at NASA) (Figure 3). (patrick.c.campbell@noaa.gov)

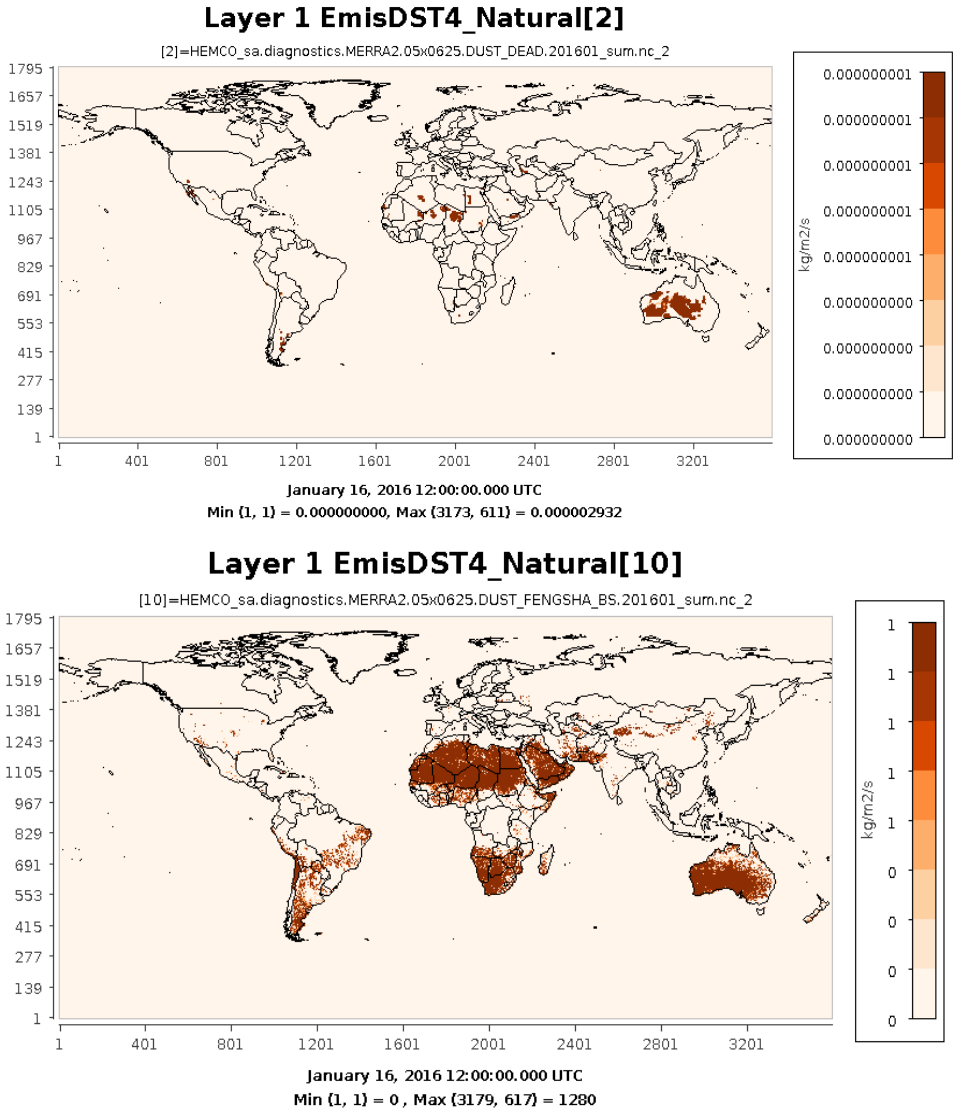


Figure 3 (Top & middle). Total January 2019 dust flux (brown) for the HEMCO /GEOS-Chem default DEAD model with 2.5° SSM (top) compared to the new FENGSHA dust model and 0.1° B-S SSM implementation (middle), and compared with the locations of world major deserts (bottom; shaded in yellow; Image Source: www.nationalgeographic.com – *next page*)

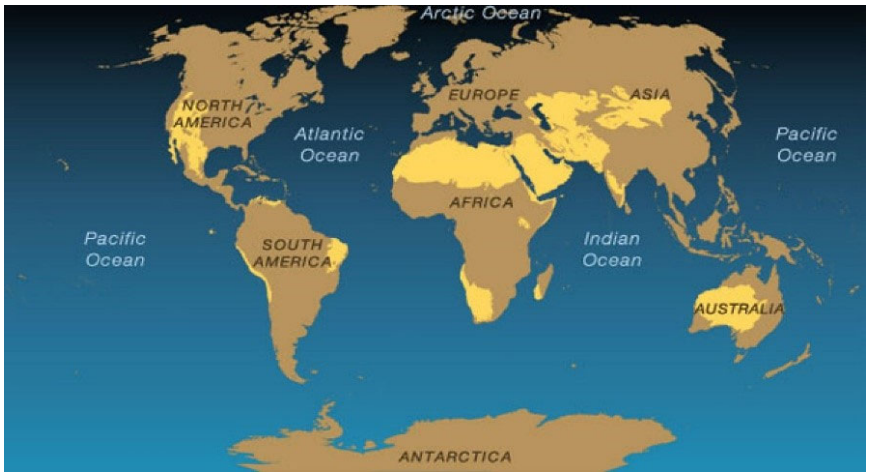


Figure 3 (bottom). Locations of the world's major deserts, shaded in yellow. (Image Source: www.nationalgeographic.com)

16. Model Update: Finite-Volume Cubed-Sphere Dynamical Core (FV3) Global Forecast System (GFS)-Chemistry

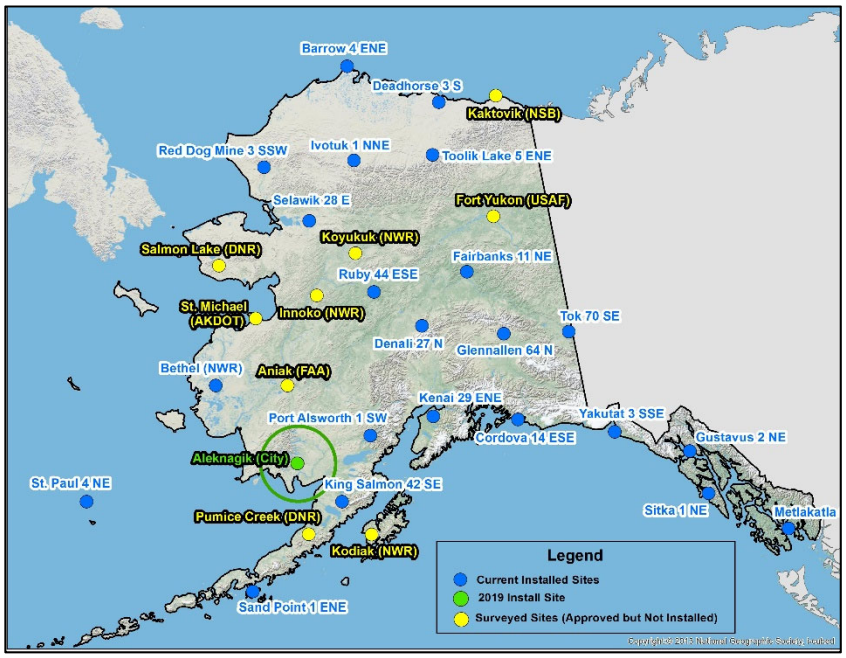
Rick Saylor gave a remote presentation entitled "Update on the NOAA FV3GFS - Chem Global Aerosol Model" during the International Cooperative for Aerosol Prediction's (ICAP) 11th working group meeting in Tsukuba City, Japan. The presentation updated the ICAP community on the developmental progress of NOAA's new FV3-based global aerosol model. ARL has been actively involved in the development of the new aerosol model over the past two years, and has been working closely with colleagues in the National Weather Service's National Centers for Environmental Prediction and the Earth System Research Laboratory's Global Systems Division (GSD) and Chemical Sciences Division. The new global aerosol model is scheduled to begin operations in spring 2020. (Rick.Saylor@noaa.gov)

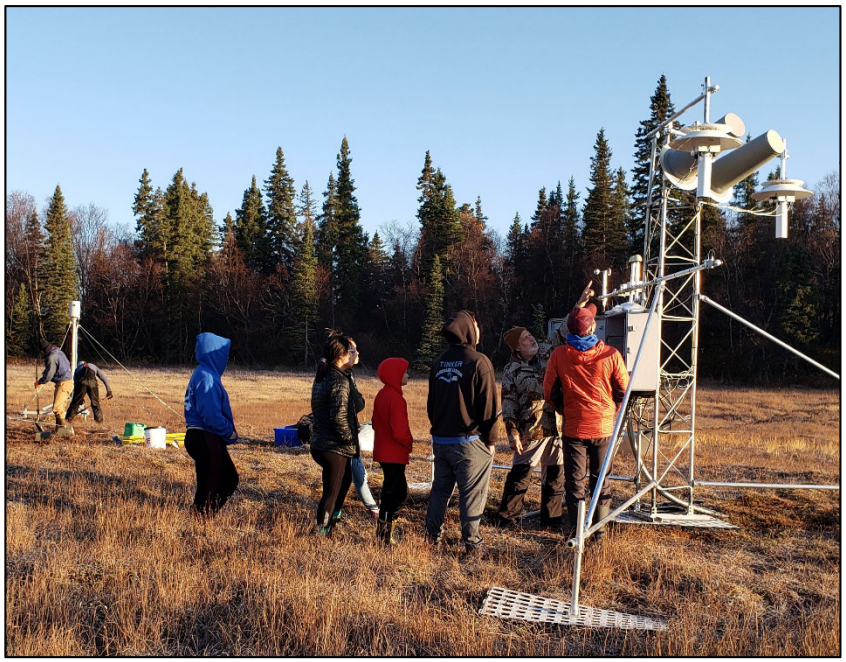
17. Collaborative Review Paper Focused on Nitrogen Deposition

Rick Saylor co-authored a multi-agency, multi-institution review paper entitled "Toward the improvement of total nitrogen deposition budgets in the United States," which was published in *Science of the Total Environment* (Walker et al. – *see in publications list below*). Deposition of reactive nitrogen compounds (NOx, NOy, NHx, etc.) to terrestrial and aquatic ecosystems may have harmful effects on the environment, including soil and lake acidification, changes in biodiversity, drinking water contamination, and reduced ecosystem resilience. The article summarizes the state of the science of reactive nitrogen deposition budgets in the U.S. and provides recommendations where research is needed to improve deposition measurements and modeling to reduce uncertainties in the components of budget estimates. (Rick.Saylor@noaa.gov)

CLIMATE OBSERVATIONS AND ANALYSES

18. **U.S. Climate Reference Network (USCRN)**





The USCRN met its two Fiscal Year 2019 (FY19) performance measurements as follows: (1) USCRN has a standard for maintaining an annual data receipt rate of 98%. The FY19 rate was 99.5%, well above the standard, and down only slightly from the 99.6% rate reported for FY18. The decrease was due to some unavoidable data outages in Alaska that happen as a result of winter conditions. The 99.5% rate still significantly exceeds this key USCRN performance measure. (2) At least one additional USCRN station was to be installed in Alaska in FY19. This measure was successfully achieved with the installation of a station in Aleknagik (in the southwestern corner of AK – note the green circle on the map), bringing the total number of operational USCRN stations in Alaska to 23; well on the way to achieving the goal of 29 total stations in the state by the end of FY2022.

Installation of the new station also gave ARL a local opportunity for Science, Technology, Engineering,

and Mathematics (STEM) outreach. Arrangements were made with Ms. Kay Andrews, the mayor of Aleknagik (population ~250), for a tour of the completed station. Mayor Andrews brought several high school students and their science teacher, Mr. Ryan Hickel, to see the completed station *(see attached photo)*. During their visit, the students were given a detailed overview of how the USCRN station works, including the significance of the measurements being taken, and were informed about the importance of gathering high quality climate data in stable settings. Mr. Hickel was also give a more in-depth overview of the Geonor rain gauge so that he can serve as a local contact to empty the rain gauge bucket on the rare occasion that it approaches maximum capacity. The partnership with the town and school has been a great benefit to both ARL and the local population. (howard.diamond@noaa.gov)

19. **USCRN Maintenance Visits**

USCRN staff made 50 annual maintenance visits this quarter, fifteen of which were in Alaska. There was also one unscheduled maintenance visit. (Mark.E.Hall@noaa.gov)

ARL 4th Quarter Publications

Battye, W. H., Bray, C. D., Aneja, V. P., Tong, D., **Lee, P.**, and Tang, Y. (2019). Evaluating Ammonia (NH3) Predictions in the NOAA NAQFC for Eastern North Carolina Using Ground Level and Satellite Measurements, *Journal of Geophysical Research: Atmospheres*, 124(14), https://doi.org/10.1029/2018JD029990

Dickerson, R. R., Anderson, D. C., Ren, X. (2019). On the use of data from commercial NOx analyzers for air pollution studies. *Atmospheric Environment*, 214, 116873, https://doi.org/10.1016/j.atmosenv.2019.116873

Etyemezian, V., Gillies, J. A., Mastin, L. G.**, Crawford, A**., Hasson, R., Van Eaton, A. R.**,** & Nikolich, G. (2019). Laboratory experiments of volcanic ash resuspension by wind. *Journal of Geophysical Research: Atmospheres*, 124, https://doi.org/10.1029/2018JD030076

Jung, M., Son, S., Kim, H., Kim, S., Park, R. J., Chen, D. (2019). Contrasting synoptic weather patterns between non-dust high particulate matter events and Asian dust events in Seoul, South Korea. *Atmospheric Environment*, 214, 116864, https://doi.org/10.1016/j.atmosenv.2019.116864

Pal, S. and Lee, T. R. (2019). Advected Air Mass Reservoirs in the Downwind of Mountains and Their Roles in Overrunning Boundary Layer Depths Over the Plains. *Geophysical Research Letters*, 46(16), 10140-10149, https://doi.org/10.1029/2019GL083988

Qu, Z., Henze, D. K., Li, C., Theys, N., Wang, Y., Wang, J., Wang, W., Han, J., C. Shim, C., Dickerson, R. R. and Ren, X. (2019). SO2 Emission Estimates Using OMI SO2 Retrievals for 2005–2017. *JGR Atmospheres*, 124(14), 8336-8359, https://doi.org/10.1029/2019JD030243

Walker, J.T.; Beachley, G.; Amos, H.; Baron, J.S.; Bash, J.; Bell, M.D.; Benedict, K.; Chen, X.; Clow, D.W.; Cole, A., Coughlin, J.G.; Cruz, K.; Daly, R.W.; Decina, S.M.; Elliott, E.M.; Fenn, M.F.; Ganzeveld, L.; Gebhart, K.; Isil, S.S.; Kerschner, B.M.; Larson, R.S.; Lavery, T.; Lear, G.G.; Macy, T.; Mast, M.A.; Morris, K.; Padgett, P.E.; Pouyat, R.V.; Puchalski, M.; Pye, H.; Rea, A.W.; Rhodes, M.F.; Rogers, C.M.; **Saylor, R.**; et al. (2019). Toward the improvement of total nitrogen deposition budgets in the United States. *Science of the Total Environment*, 691, 1328-1352, https://doi.org/10.1016/j.scitotenv.2019.07.058

Conference Presentations & Invited Talks

6th NASA Health and Air Quality Applied Sciences Team (HAQAST6) Meeting, July 10-12 in Pasadena, CA: Dr. Campbell presented recent updates of satellite applications for our NAQFC. Detailed information is available at https://haqast.org/haqast6/. (patrick.c.campbell@noaa.gov)

18th Annual Community Modeling and Analysis System Conference, October 21-23 in Research Triangle Park, NC: ARL staff co-authored the following presentations:

- Dorothy Koch, Ivanka Stajner, Jeff McQueen, **Pius Lee**, Jianping Huang, Ho-Chun Huang, Li Pan, Youhua Tang, Daniel Tong, Patrick Campbell, **Ariel Stein**, James Wilczak, Irina Djalalova, Dave Allured, Phil Dickerson, Jose Tirado, "NOAA's National Air Quality Forecast Capability operational and experimental updates."
- Daniel Tong, Barry Baker, Kerstin Schepanski, Shobha Kondragunta, Pubu Ciren, Benjamin Murphy, Youhua Tang, **Pius Lee**, Patrick Campbell and **Rick Saylor**, "Implementation of new satellite-based source maps in the FENGSHA dust module and initial application with the CMAQ-based NAQFC system."
- Youhua Tang, Daniel Tong, **Pius Lee**, Barry Baker, Patrick Campbell, Jeff McQueen, Ho-Chun Huang, Li Pan, Jianping Huang, Jose Tirado, Shobha Kondragunta, Xiaoyang Zhang, and Ivanka Stajner, "Development of a Fast Fire Emission Processor and Its application with HMS-Bluesky and GBBEPx Inventories."
- Patrick Campbell, Barry Baker, **Rick Saylor**, Daniel Tong, Youhua Tang, **Pius Lee**, Stuart McKeen, Gregory Frost, and Christoph Keller, "Initial Development of a NOAA Emissions and eXchange Unified System (NEXUS)."
- Jianping Huang, Jeff McQueen, Perry Shafran, Ho-Chun Huang, Li Pan, Youhua Tang, Patrick Campbell, **Pius Lee**, Ivanka Stajner, Jack Kain, Jose Tirado-Delgado, and Dorothy Koch, "Evaluation of GFS-driven CMAQ predictions of PM2.5 and O3 at NOAA."

Outreach & Engagement

Dr. Patrick Campbell, an Air Quality Meteorologist at ARL's ASMD, gave the keynote address at the Books Motivate Foundation's 2019 National Climate Outreach Program Breakfast of Champions fundraiser on August 31, 2019. The event took place in Washington, D.C. during the 2019 National Book Festival. His talk, "Tipping points in the climate system: Global and national concerns for U.S. citizens and policymakers," focused on the implications of future climate change and atmospheric composition at a high level, as well as feedback loops, policy concerns, and the importance of educating and engaging students on the topic. Campbell also shared his expert opinion and constructive comments on the positive aspects of the inaugural winning student essay funded by the Books Motivate Foundation's newly-formed National Climate Outreach Program and book publication campaign. The organization aspires to raise public awareness of climate change and climate responsibility through an annual student essay competition; eventually culminating in the publication of a book comprised of winning essays written by high school students from every U.S. state. This year's winning essay was written by a high school student in West Virginia. For more information, please visit: https://www.arl.noaa.gov/outreach/news-photos/asmds-patrick-campbell-to-give-keynote-address-at-climate-outreach-event/ (patrick.c.campbell@noaa.gov)

Mark Cohen prepared and gave a one-day hands-on HYSPLIT Workshop September 8, 2019 at the 14th International Conference on Mercury as a Global Pollutant in Krakow, Poland. Participants were guided in carrying out trajectory and dispersion simulations on their own computers and were introduced to the use of scripts in running the HYSPLIT model. A dedicated web page was set up for participants to use before and after the workshop. Individual meetings were also held with participants at the conference to provide additional assistance on specific issues related to using the HYSPLIT model in their research. (mark.cohen@noaa.gov)

Alice Crawford took part in the Facilitating a Continuum of Environmental Threats (FACETs) workshop held at the University of Oklahoma's National Weather Center from September 23-25. One of the workshop's objectives was to provide an orientation for a postdoc cohort executing work across several areas of FACETs. One of the post-docs, Jorge Guerra, is working on a joint project between ARL, GSD and the National Severe Storms Laboratory. A second objective was to provide FACETS paradigm working group members with an opportunity to discuss and update the FACETs maturity assessment matrix. (alice.crawford@noaa.gov)

On September 20, Ariel Stein, Howard Diamond, and Alice Crawford participated in the NOAA Cooperative Science Center in Atmospheric Sciences and Meteorology (NCAS-M) ProjectFest held at NCWCP in College Park, MD. The event was designed to match prospective NOAA science mentors with students from NCAS-M, a consortium of 13 universities spanning the U.S. and Puerto Rico. During ProjectFest, Drs. Diamond and Crawford made three-minute presentations on their work in climate science and the HYSPLIT model, respectively. These "lightning presentations" were followed by individual meetings between the students and prospective mentors. NOAA Experiential Research and Training Opportunities (NERTO) (see https://www.noaa.gov/office-education/epp-msi/nerto) are 12-week studies performed at a NOAA

facility. Students in the NCAS-M program are required to complete one NERTO project as part of their degree requirement (either undergraduate or graduate). The largest benefit of this exchange was for the universities to make even better contact with NOAA scientists willing to be involved in student mentoring efforts. So, even if nothing arises from this specific session, there are long-term benefits that will build as a result of ProjectFest. (alice.crawford@noaa.gov)

Training

Roger Carter, Brad Reese, Jason Rich, and Bai Yang took fall protection training at the INL as the first step toward qualifying to operate aerial lifting equipment, such as a bucket truck. Rich, Carter and Yang also took aerial lifting training, the second step towards qualification. Aerial lifting equipment is being considered as an alternative to tower climbing capability.

Yang successfully completed tower climbing safety training in September in Las Vegas and received a certificate.

Other

A USCRN Technical Memorandum, USCRN-19-001, was finalized and is available at: https://www1.ncdc.noaa.gov/pub/data/uscrn/documentation/research/NOAA-Tech-Memo-Soil-FINAL-AUGUST%202019.pdf. The citation for this internal program document is:

Diamond, H., T. Wilson, **T. Meyers**, **J. Kochendorfer**, and M. Hall (2019), An evaluation of the use of the Acclima Soil Moisture/Temperature Probe for the U.S. Climate Reference Network (USCRN) as a replacement for the existing Hydra Soil Probe, *NOAA Technical Memo USCRN-19-001*.

DOE Meteorological Subcommittee (DMSC) Activities: Walt Schalk finalized the agenda and schedule and conducted the annual meeting held in September in Knoxville, TN. Topics discussed included the use of unmanned aerial vehicles to measure meteorological parameters, presented by Dr. Bruce Baker from ARL/ATDD; using Next Generation Weather Radar precipitation estimates rather than old “wedge” precipitation gauges at Savannah River National Laboratory; a testing update of sonic anemometers and snow depth sensors at Los Alamos National Laboratory; and testing updates of the “all-in-one” sensors being used at the Hanford Site. In a separate discussion, the DMSC debated what a “qualified meteorologist” is for DOE per tasking from NNSA to provide a guideline for meteorology programs in DOE. (walter.w.schalk@noaa.gov)

SORD Website: Work is ongoing to replace the web server in the new information technology construct. With this, work will continue to add improvements, updates and new capabilities to the website at www.sord.nv.doe.gov. (walter.w.schalk@noaa.gov)

Walt Schalk also visited with ARL/ATDD while in the Knoxville area.