NOAA Air Resources Laboratory

Quarterly Activity Report

FY2020 Quarter 1 (October - November - December 2019)

Contents:

BOUNDARY LAYER CHEMICAL TURBULENT MIXING CHARACTERIZATION & PREDICTION

1. Meetings on Volcanic Ash

Alice Crawford and Barbara Stunder participated in the Meteorological Panel Working Group on Meteorological Information and Service Development Volcanic Ash Sulfur Dioxide work stream meeting on November 20, 2019. Ms. Stunder presented an information paper titled "Research and Operations: Perspective on Quantitative Ash Products" at the meeting, co-authored by Dr. Crawford, Jamie Kibler, Nathan Eckstein and Jeff Osiensky.

Crawford and Stunder also participated in the Conjoint World Meteorological Organization (WMO) Volcanic Ash Advisory Center (VAAC) Best Practices (BP)/7 and WMO/International Union of Geodesy and Geophysics (IUGG) Volcanic Ash Scientific Advisory Group (VASAG)/9 on November 21-22, 2019. The final report from the meeting can be found at https://www.wmo.int/aemp/VAAC-BP-7-VASAG-9. Claire Witham from the United Kingdom's Meteorological Office and Larry Mastin from the U.S. Geological Survey gave a presentation titled "Advancements in modeling of eruptive plumes, transport and dispersion" which included information provided by Crawford and Stunder on developments in volcanic ash forecasting being undertaken at ARL. (alice.crawford@noaa.gov)

Attendees at the Conjoint WMO VAAC BP/7 and IUGG VASAG/9 meeting. *Pictured left to right: Dave Schneider, Philippe Héreil, Ian Lisk,* ***Alice Crawford, Barbara Stunder****, Paula Acethorp, Sigrún Karlsdóttir, Jeff Osiensky, Claire Witham, Yuichi Imamura, Klaus Sievers, Sam Engwell, Jarrad Denman, Larry Mastin, Anton Muscat, Marcel Roux, Matt Hort, Rory Clarkson, Dov Bensimon, Jamie Kibler, Mike Pavolonis, Tristan King, Nickolay Krotkov, Tammy Flowe, Arnau Folch, Ellen Ramirez, Soledad Osores, Greg Brock, Raul Romero and Pierrick Mialle. [Not pictured: Larry Burch and Tom Helms]*

2. HYSPLIT Update Implemented Operationally

The HYSPLIT package at NOAA's National Centers for Environmental Prediction (NCEP) was revised and tested to operate successfully on the new NCEP Dell supercomputer (Phase 3), and implemented on the Dell operationally as NCEP version hysplit.v7.7.0 on December 30, 2019. Only computer architecture type changes were made; HYSPLIT and associated pre- and post-processing programs were not upgraded to a more current ARL HYSPLIT version. The HYSPLIT package at NCEP includes conversion of native model level output [Global Forecast Sys-

tem (GFS), North American Mesoscale (NAM), and High-Resolution Rapid Refresh (HRR)], and GFS and NAM output on pressure levels, to ARL-format for input to HYSPLIT. These files are transferred to the NOAA Web Operations Center for use by National Weather Service (NWS) Weather Forecast Offices (WFO) for hazardous materials-type modeling incidents and used on the Dell supercomputer for automated wildfire smoke and dust HYSPLIT modeling and on-demand HYSPLIT modeling of volcanic ash and radiological species. (barbara.stunder@noaa.gov)

3. HYSPLIT Python Graphics

Python programs CONCPLOT and TRAJPLOT for plotting concentration contours and trajectories, respectively, are being integrated with HYSPLIT. Making the programs and their dependencies work well across Linux and Microsoft Windows operating systems posed challenges. For example, a simple trajectory plot would take 60 times longer on Windows, which was attributed to a package included by one of the dependencies. This speed issue was resolved via a tighter configuration management of dependencies. (sonny.zinn@noaa.gov)

4. HYSPLIT Center-of-Mass Trajectory

An experimental feature for center-of-mass trajectory is being added to HYSPLIT. A concentration run can optionally output both a concentration dump and a center-of-mass trajectory of particles. Since the center-of-mass trajectory is computed using many particles, it overcomes the occasional situation where a trajectory run (which employs a single particle) yields unrealistic results because it has a particle hitting the ground and staying. (sonny.zinn@noaa.gov)

5. Optimized, Experimental Version of NAQFC

ARL optimized an experimental version of NAQFC to provide near real-time, 72-hour air quality (AQ) forecasts within the operational clock requirement for the AQ Focus Group forecasters for summers 2018 and 2019. This provided an additional, third day, forecast when compared to the 48-hour operational NAQFC forecast. Third day forecast evaluations were discussed during the recent annual AQ Focus Group meetings and the forecasters liked the accuracy and forecast length extension that gave them useful forecasts with more lead time. (pius.lee@noaa.gov)

6. Initial Developmentof a New ARL Meteorological Pre-Processor System Based on the Meteorolgy-Chemistry Interface Processor, Version 5 (MCIPv5), for Upcoming Coupling of the Global Forecast System (GFS) Version 16 and the National Air Quality Forecasting Capability (NAQFC)

Dr. Patrick Campbell is overhauling the current meteorological pre-processor to the Community Multiscale Air Quality (CMAQ) model, PREMAQ, used to offline couple GFS version 15 to ARL's NAQFC (which employs the CMAQ model). This overhaul is based on a new adaptation of MCIPv5 and will allow for a flexible, ARL-supported, coupling of the updated GFS version 16 to NAQFC, i.e., "MCIP-ARL".

The MCIP-ARL system is currently under development, with functionality to read global GFSv16 Network Common Data Form input files, subset and window domain, and write necessary files to drive NAQFC-CMAQ simulations (not yet fully tested). The MCIP-ARL system codes are found on the NOAA-ARL GitHub site at: https://github.com/noaa-oar-arl/CMAQ/tree/mcip-noaa-arl/PREP/mcip. In this way, the MCIP-ARL system will be community-based, while future code updates made to MCIP to support CMAQ version releases can easily be integrated into the MCIP-ARL GitHub branch for easing the transition to later versions of CMAQ for NAQFC advancement. (patrick.c.campbell@noaa.gov)

7. Global Ensemble Forecast System (GEFS) - Aerosols Application and Near Real-Time Tests / Evaluation Using the NOAA Emissions and eXchange Unified System (NEXUS)

Dr. Patrick Campbell previously reported on the initial development of NEXUS, as well as preliminary tests with the GEFS-Aerosols modeling system. Following promising evaluation against the Open-AQ (https://openaq.org) fine particulate matter (PM2.5) surface monitoring network, we have now extended this test to near real-time (NRT) tests and evaluation using GEFS-Aerosols, version 088 with NEXUS. The model tests use July 2019 as spin-up with NRT evaluations against both the Open-AQ PM2.5 and Aerosol Robotic Network (AERONET; https://aeronet.gsfc.nasa.gov/) column aerosol optical depth (AOD) beginning in August 2019.

Preliminary monthly average results continue to demonstrate very similar results (< +/- 1%) using NEXUS (Sens1) compared to the current emissions modeling system employed in NOAA Aerosols and Atmospheric Composition (AAC) models, i.e., PREP-Chem-Sources (Base Run) for August–October 2019 (Figures

1-3 below). Evaluation of the November-December 2019 runs are ongoing. These results continue to show promise for NEXUS to replace current emission modeling system at NOAA. (patrick.c.campbell@noaa.gov)

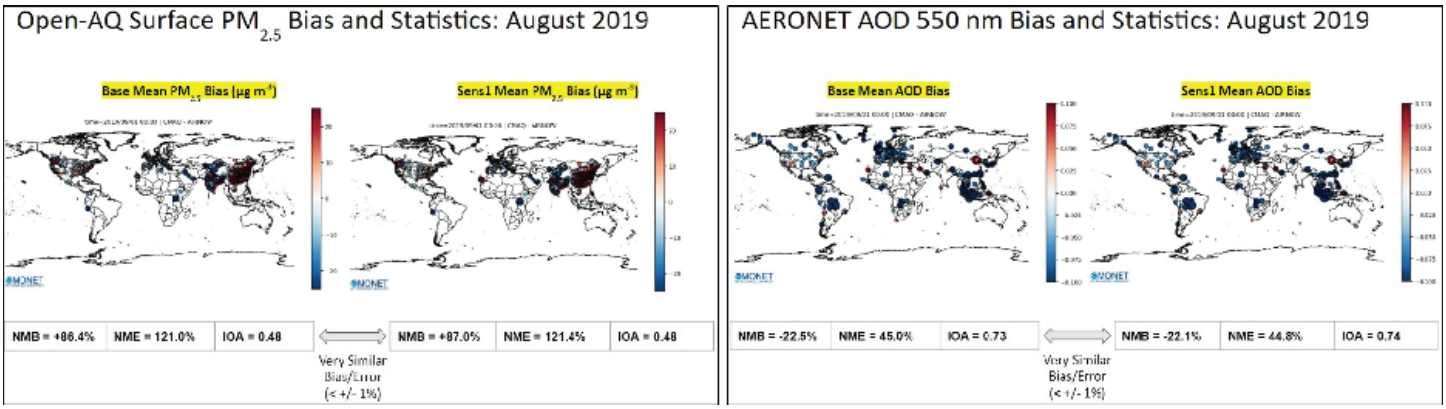


Figure 1a (left). *August 2019 average spatial bias plot comparisons of GEFS/Aerosols-Global Ozone Chemistry Aerosol Radiation and Transport (GOCART) simulations compared to Open-AQ observations of PM2.5 for the East Asia and North America Giorgi regions. Sens 1 (left) refers to the GEFS/Aerosols-GOCART simulations using the default NOAA-AAC Community Emissions Data System 2014 and Hemispheric Transport of Air Pollution 2010 global emissions with PREP-Chem-Sources, while Sens 1 (right) uses the same emissions with NEXUS. The statistics below the plots are defined as follows: NMB = Normalized Mean Bias, NME = Normalized Mean Error, and IOA = Index of Agreement.* ***Figure 1b (right).*** *Same as in Figure 1a, but for comparison against the AERONET AOD observation network.*

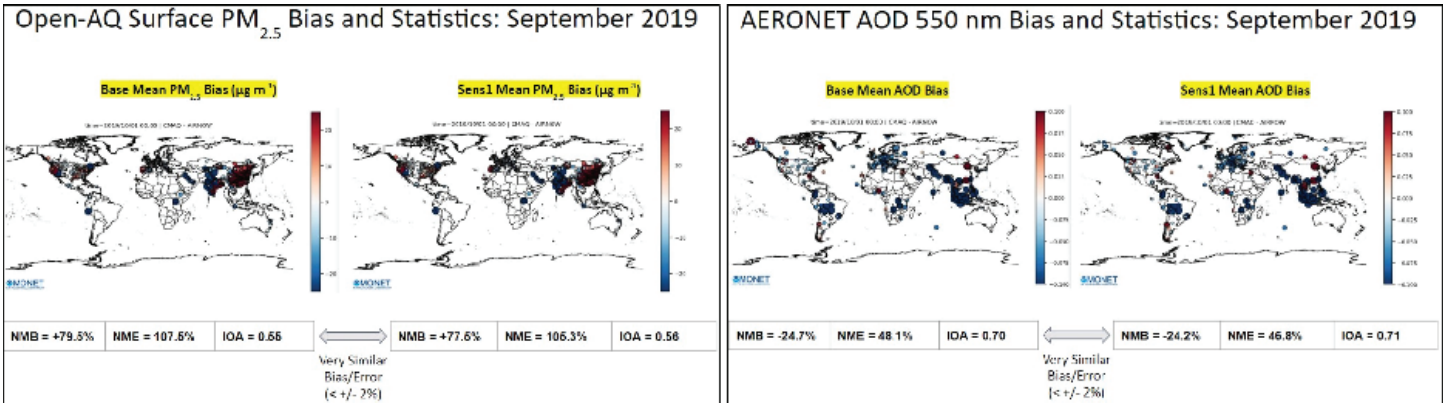


Figure 2a (left). *Same as in Figure 1a, but for September 2019.* ***Figure 2b (right).*** *Same as in Figure 2a, but for comparison against the AERONET AOD observation network.*

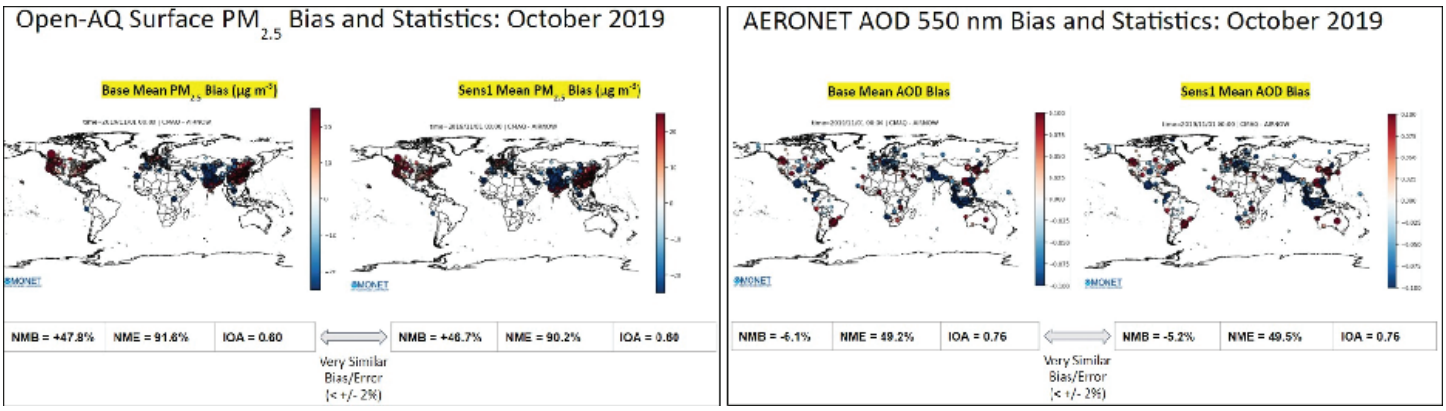


Figure 3a (left). *Same as in Figure 2a, but for October 2019.* ***Figure 3b (right).*** *Same as in Figure 3a, but for comparison against the AERONET AOD observation network.*

8. Ozone Water-Land Environmental Transition Study (OWLETS) Team Members Honored with Prestigious NASA Group Achievement Award

Barry Baker, Mark Cohen, Paul Kelley, Pius Lee, Chris Loughner, Winston Luke, and Xinrong Ren were honored with NASA's prestigious Group Achievement Award for their work as members of the OWLETS team. Co-Principal Investigator Tim Berkoff of NASA's Langley Research Center accepted a plaque on behalf of the entire team during the center's 2019

Honor Awards Ceremony on September 17, after which each individual team member received a certificate. Signed by NASA Administrator Jim Bridenstine, the certificates read: *"For designing and executing an unprecedented scientific investigation in the upper and lower Chesapeake Bay to understand the ozone pollution at the land-water interface."* While none of ARL's recipients made the long journey to Hampton, Virginia for the event, all were invited to attend with guests.

ARL's scientists played crucial roles in the OWLETS campaigns, with the modeling group supporting both studies and the measurements group joining to enhance OWLETS-2. For more information, please visit https://www.arl.noaa.gov/about/news-photos/asmds-owlets-team-members-honored-with-prestigious-nasa-group-achievement-award/. (winston.luke@noaa.gov)

9. National Atmospheric Deposition Program (NADP) Meeting

Winston Luke attended the NADP Scientific Symposium and Fall Meeting in Boulder, Colorado from November 4-8. He serves as the outgoing Secretary and incoming Vice Chair of NADP's Network Operations Subcommittee, which provides a forum for discussion and evaluation of issues pertaining to station siting, equipment, and procedures for sampling and analysis in all NADP networks. As Secretary, Dr. Luke assisted the Chair and Vice Chair with meeting preparation, and recorded meeting minutes to provide to the Executive Committee.

Two events of importance to ARL's mercury monitoring program occurred at the meeting. First, a new ad hoc science subcommittee, Mercury in the Environment and Links to Deposition (MELD), convened its inaugural meeting at the symposium. Luke attended this meeting along with Dr. Mark Cohen, an internationally recognized expert in mercury biogeochemistry, who participated remotely. MELD will provide an ongoing forum for the technical exchange of information on current and emerging issues relevant to atmospheric mercury deposition research and monitoring efforts within a broad multi-organization context. Then, at the NADP's Executive Committee meeting, Luke presented a summary and overview of a global monitoring initiative, the Global Observing System for Mercury (GOS4M), to inform NADP's consideration of membership in the initiative. GOS4M is a flagship initiative of the Group on Earth Observations, a partnership of 100+ national governments and 100+ participating organizations to create innovative solutions to global environmental challenges. The purpose of GOS4M is to build a partnership with institutions conducting research and/or formulating policy related to mercury in the environment and to share information, experience and data. GOS4M will be built on existing networks and observing infrastructures and seeks to provide quality assured/quality controlled mercury speciation measurements and ancillary data, or links thereto. The integration of all existing monitoring networks will provide a unique set of monitoring data in support of the implementation and effectiveness evaluation of the Minamata Convention. While the initial focus of GOS4M is on mercury in air and precipitation, the initiative would encompass all compartments of the ecosystem (air, terrestrial and aquatic), human health, biota, and mercury modelling. The members of NADP's Executive Committee unanimously supported joining GOS4M as a formal participant, and the resolution was adopted. (winston.luke@noaa.gov)

10. Dr. Akane Yamakawa Concludes Five Month Stint at ARL

On December 6, ARL bade farewell to visiting scientist Dr. Akane Yamakawa of Japan's National Institute for Environmental Studies, whose expertise as a mercury geochemist was invaluable in supporting ARL's activities. She collected air samples at the lab's mercury monitoring sites to determine isotopic composition of atmospheric mercury species, which is affected by both mass-dependent and mass-independent fractionation. Competing processes (e.g., natural and anthropogenic emissions, transport, oxidation/reduction, deposition, and re-emission, etc.) are characterized by different fractionation mechanisms, so measuring mercury's isotopic composition at a number of locations can be a powerful tool to trace the sources, sinks, and transformational cycles of atmospheric mercury. This understanding is needed to better inform policy-relevant global mercury models, such as that developed at ARL, to explain spatio-temporal trends in atmospheric mercury deposition and provide scientifically robust information to aid efforts to reduce mercury contamination around the globe. Yamakawa also measured mercury concentrations as part of the Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ) field experiment to determine emission factors and chemical processing of mercury compounds emanating from natural grassland and forest fires near Missoula, Montana.

With assistance from ARL staff, Yamakawa fabricated a sampler to collect Gaseous Oxidized Mercury (GOM) species for isotopic analysis. As a divalent (oxidized) form of mercury, GOM is readily deposited from the atmosphere to sensitive ecosystems, where it can preferentially enter the aquatic food web. Yamakawa will deploy the sampler at NOAA's Mauna Loa Observatory to make some of the first measurements of GOM isotopic composition in the middle free troposphere.

Reducing mercury's impacts requires a better understanding of its atmospheric behavior. Yamakawa's work at NOAA was designed to improve our understanding of mercury's behavior in the atmosphere and our ability to more accurately measure this important neurotoxin. The improved modeling and measurement techniques arising from her work will enable better understanding and prediction of mercury's effects on sensitive ecosystems, and can be adapted to investigate other chemicals and processes important to NOAA. (winston.luke@noaa.gov)

11. Establishment of Mercury Measurements in the Arctic

Massive perturbations to the biogeochemical cycling are occurring in Arctic regions in response to climate change. With widespread temperature rise and accompanying melting of tundra and permafrost regions, increases in both riverine and atmospheric mercury release have been observed. In order to better quantify, understand, and predict the magnitude of these increases, ARL scientists have prepared to establish a monitoring capability for atmospheric mercury at the ESRL/Global Monitoring Division's Barrow Observatory in Utqiaġvik (formerly Barrow), Alaska. In order to facilitate these measurements, our existing mercury monitoring site at the Grand Bay National Estuarine Research Reserve in Moss Point, Mississippi will be closed. Scientific equipment at Grand Bay will be removed from the site for deployment to Alaska, and the 10 meter sampling scaffold there will be disassembled and transported to ATDD for future deployments. The timeline for completion of this transition is summer 2020. (winston.luke@noaa.gov)

12. Visiting Mercury Scientist from Tanzania

ARL hosted Professor Clavery Tungaraza from Sokoine University of Agriculture in Morogoro, Tanzania, from November 11-13, 2019. Discussion focused around the potential future use of atmospheric mercury measurements and modeling in his research on the environmental impacts of artisanal and small-scale gold mining (ASGM) activities in Tanzania. Globally, ASGM is believed to be the largest source of anthropogenic mercury to the environment. Tungaraza's home laboratory is establishing a measurement capability that is relatively rare in Africa and will support the Minamata Convention, a global treaty addressing mercury pollution.

Dr. Ren and Professor Tungaraza checking a rain gauge at the U.S. EPA's NADP site in Beltsville, MD. Credit: NOAA

Dr. Mark Cohen is Professor Tungaraza's U.S. research partner under a three-year United States Agency for International Development Partnerships for Enhanced Engagement in Research (PEER) grant designed to partner U.S. government-funded researchers with scientists and engineers in developing countries to address global development challenges. In addition to working with Cohen on modeling methodologies, Tungaraza worked with Winston Luke, Xinrong Ren, and Paul Kelley on measurement techniques and visited ARL's long-term monitoring site at Beltsville, Maryland. (mark.cohen@noaa.gov, winston.luke@noaa.gov, xinrong.ren@noaa.gov, paul.kelley@noaa.gov)

BOUNDARY LAYER METEOROLOGICAL CHARACTERIZATION & PREDICTION

13. Field Research Division (FRD) Mesonet

The NOAA/INL Mesonet primary radio repeater on Jumpoff Peak was successfully repaired by site owner American Communications during the summer; however, the mounting hardware needed to be upgraded due to potential noise interference. New mounting hardware parts were installed in October. (roger.carter@noaa.gov)

FRD continued its fall season semi-annual calibration and maintenance of the NOAA/INL Mesonet, completing 28 of the 34 stations. In addition to normal maintenance, we continued testing new data loggers (model CR1000X), pro-

grams required for the mesonet stations, and communications between the data loggers and computers in the lab. Instrument setups vary slightly among the stations, so multiple data logger programs are required and each of them had to be tested individually. The planned mesonet upgrade is taking place in three phases. First, we installed and tested the new radios at about six stations, which proved very reliable over the last several years. Phase two, the installation of 17 new radios and 19 data loggers, was completed this fall. Twenty-three stations are currently using the new radios and, so far, they've run robustly and provided better services than the old ones. The new components significantly increased the speed and capabilities of the communication system and potentially allow the connection of other types of meteorological equipment to the mesonet. We'll implement the final phase this spring, which includes upgrades to all remaining stations. Phased implementation of upgrades is enabling us to verify that the equipment works as intended before committing the entire mesonet operation to the new equipment. (roger.carter@noaa.gov, brad.reese@noaa.gov, jason.rich@noaa.gov, bai.yang@noaa.gov)

The NOAA/INL Weather Center issued eight weather alerts last quarter, seven for winds and one for lightning. (jason.rich@noaa.gov and bai.yang@noaa.gov).

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

James Wood, Rick Lantrip, and Walt Schalk participated in an emergency response training exercise/drill as the Consequence Assessment Team (CAT) for the National Nuclear Security Administration (NNSA) Nevada Field Office (NFO). This activity was conducted on the NNSS and consisted of a field exercise/drill that occurred there. During the event, the activities conducted were discussed, local weather data and weather 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. The event was conducted with the U.S. Department of Energy/NNSA/NFO Emergency Response Organization. Dispersion and consequence assessment products were developed for use during exercise play as "ground truth". The exercise/drill 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)

15. Special Operations and Research Division (SORD) Mesonet

SORD continued researching several areas to improve the SORD/NNSS Mesonet. Communications, three-dimensional sonic anemometer improvements/upgrades, weighing precipitation gauge replacement, and radio communications top the list of improvements. A couple of precipitation gauges were "winterized" to better measure snowfall water. In addition, a sonic snow depth sensor was installed with radio communications and has been recording snowfall on the highest point of the NNSS. We will be co-locating a laser snow depth sensor this spring/summer.

Wayne Bailey continued performing routine monthly maintenance and verification checks on the NNSS Mesonet. He found some irregularities while looking into communications issues and is now working to make the radio and logger settings uniform across the site. Bailey, Rick Lantrip, and James Wood completed the fall semi-annual mesonet verifications and calibrations.

Walt Schalk and Lantrip provided NNSS Mesonet and lightning 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. SORD continued working with our partners to install a new lightning sensor to the north, but connecting and getting information is challenging. (walter.w.schalk@noaa.gov, james.s.wood@noaa.gov, rick.lantrip@noaa.gov, wayne.bailey@noaa.gov)

16. Support to DOE/NNSA NNSS Projects and Experiments

Walt Schalk participated in several planning discussions in preparation for the next set of non-proliferation experiments. Discussions continued with regards to the number and location of additional surface stations to be fielded. Radiosonde releases and forecasting are also planned to support the 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)

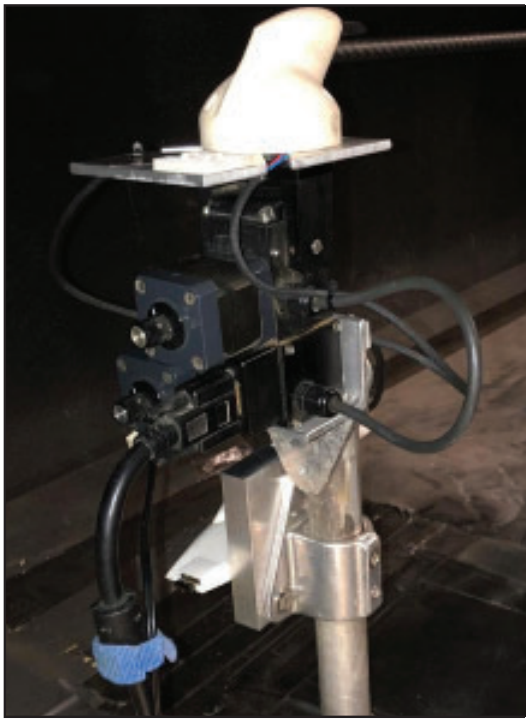


Figure 1 – BST MHP mounted in ATDD's wind tunnel

17. Unmanned Aircraft Systems (UAS) Program Office Support

Testing of the wind measurement system on the second Meteomatics Meteodrone Severe Storms Edition (SSE) aircraft was performed at Oliver Springs Airport in Tennessee prior to the Albuquerque International Balloon Fiesta (AIBF). Several last minute adjustments were made to the wind system before shipping the aircraft to Albuquerque, New Mexico. ARL's Atmospheric Turbulence and Diffusion Division (ATDD) participated in the AIBF from October 5-13, 2019. Mark Rogers and Nikki Chappelle from NOAA's Office of Marine and Aviation Operations/Aircraft Operations Center each participated as aircraft pilot-in-command, along with ARL's Ed Dumas. Flown throughout the event, the two aircraft provided near real-time vertical profiles of temperature, relative humidity, and winds to Randy Lefever and Brad Temeyer, who provided daily targeted forecasting for the pilots. The AIBF was well-attended with 550 balloons and 650 pilots participating over nine days. We are pursuing the creation of a NOAA Postcard from the Field highlighting our participation in this event.

An upgraded MD4-1000 LIDAR and control system was received in late October, and Microdrone representatives provided operations training for Ed Dumas and Nikki Chappelle. Both are now certified to fly the aircraft with the new LIDAR and control system. (ed.dumas@noaa.gov, T. Lee, M. Buban, B. Baker)

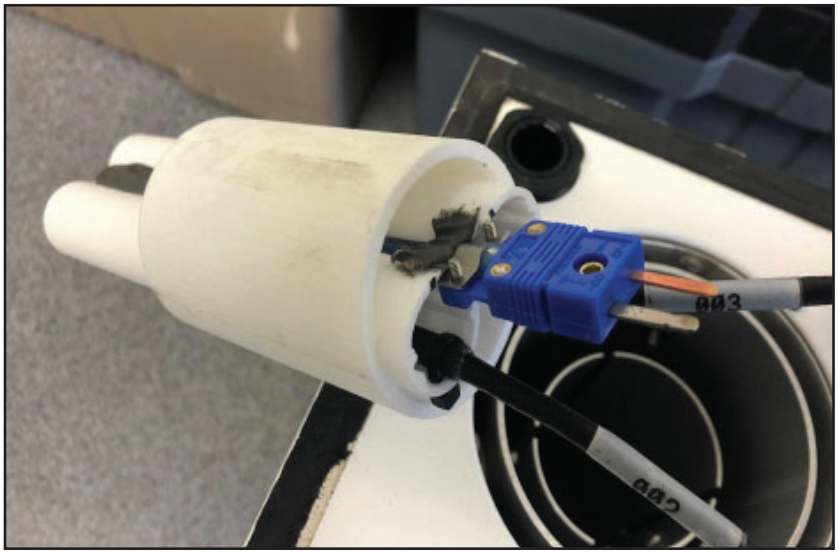


Figure 2 – Custom 3-D printed housing to mount two F-TUTN sensors and fine-wire thermocouple in a MetOne aspirated shield

The BlackSwift Technologies multi-hole probe (BST MHP) was received this quarter and testing in ATDD's wind tunnel resumed in late December 2019. Initial results still show significant noise in all of the pressure transducers, but this will be filtered to remove any unnecessary noise from the signals during post-processing. Flight testing of the new MHP probe will commence immediately.

A custom 3-D printed housing was made for a new UPSI F-TUTN sensor with a fast-response temperature probe. This housing allows two F-TUTN sensors to be placed side-by-side in a MetOne aspirated shield, along with a fine-wire thermocouple. The new F-TUTN sensor is currently being tested with an existing F-TUTN sensor to compare the frequency response of the temperature sensors of each device. The system is currently being tested in ATDD's side yard with a Campbell C-SAT sonic anemometer being used as a reference for the temperature measurement.

We received a Radiometrics MP-3000A microwave radiometer from NOAA's Earth System Research Laboratory (ESRL). During the next quarter, this system will be installed at the Oliver Springs Airport for use with the various small UAS systems that will be tested there. (ed.dumas@noaa.gov, T. Lee, M. Buban, B. Baker)

ARL First Quarter Publications

Bae, C., Kim, B-U, Kim, H. C., Yoo, C. and Kim, S. (2020). Long-Range Transport Influence on Key Chemical Components of PM2.5 in the Seoul Metropolitan Area, South Korea, during the Years 2012–2016. *Atmosphere*, 11(1), 48; https://doi.org/10.3390/atmos11010048

Bae, C., Kim, H. C., Kim, B.-U., and Kim, S. (2019). Surface ozone response to satellite-constrained NOx emission adjustments and its implications, *Environmental Pollution*, 113469. https://doi.org/10.1016/j.envpol.2019.113469

Campbell, P. C., J. Bash, C. Nolte, T. Spero, E. J. Cooter, K. Hinson, and L. Linker (2019). Projections of Atmospheric Nitrogen Deposition to the Chesapeake Bay Watershed. *J. Geophys. Res. Biogeosci.*, 124 (11), 3307-3326, https://doi.org/10.1029/2019JG005203

Dreessen, J., Orozco, D., Boyle, J., Szymborski, J., **Lee, P.**, Flores, A., Sakai, R. K. (2019) Observed Ozone over the Chesapeake Bay Land-Water Interface: The Hart-Miller Island Pilot Project, *Journal of the Air & Waste Management Association*, 69 (11), 1312-1330, https://doi.org/10.1080/10962247.2019.1668497

Halliday, H. S., DiGangi, J. P., Choi, Y., Diskin, G.S., Pusede, S. E., Rana, M., Nowak, J. B., Knote, C., Ren, X., He, H., Dickerson, R. R., Li, Z. (2019). Using Short-Term CO/CO2 Ratios to Assess Air Mass Differences over the Korean Peninsula During KORUS-AQ. *JGR Atmospheres*, 124 (20), 10951-10972, https://doi.org/10.1029/2018JD029697

Lyu, C., Capps, S. L., Hakami, A., Zhao, S., Resler, J., Carmichael, G. R., Sandu, A., Russell, A. G., Chai, T., Henze, D. K. (2019) Elucidating emissions control strategies for ozone to protect human health and public welfare within the continental United States. *Environ. Res. Lett.* 14 (12), 124093. https://doi.org/10.1088/1748-9326/ab5e05

Markowski, P. M., Lis, N. T., Turner, D. D., Lee, T. R., and Buban, M. S. (2019). Observations of near-surface vertical wind profiles and vertical momentum fluxes from VORTEX-Southeast 2017: Comparisons to Monin-Obukhov similarity theory. *Monthly Weather Review*, 147 (10), 3811-3824, https://doi.org/10.1175/MWR-D-19-0091.1

Ngan, F., Loughner, C. P., **Stein, A.** (2019). The evaluation of mixing methods in HYSPLIT using measurements from controlled tracer experiments. *Atmospheric Environment*, 219, 117043, https://doi.org/10.1016/j.atmosenv.2019.117043

Conference Presentations and Invited Talks

18th Community Modeling and Analysis System (CMAS) Conference, October 21-23 in Chapel Hill, North Carolina: Dr. Campbell gave a presentation on the initial development of a NOAA Emissions and eXchange Unified System (NEXUS). (patrick.c.campbell@noaa.gov)

NOAA Climate Program Office (CPO) Earth System Science and Modeling (ESSM) Workshop, November 18-19 in Silver Spring, Maryland: Dr. Rick Saylor presented a lightning talk entitled "Potential Impacts of Extreme Heat on Air Quality Forecasting," which outlined recent work in ARL focused on windblown dust and smoke from wildfires in support of NOAA air quality forecasting. As the climate continues to warm, air pollution episodes triggered by wildfires or windblown dust may become more frequent and widespread. ARL is conducting research to improve emission estimates of pollutants from these two intermittent sources that are likely to become vastly more important for accurate air quality forecasting under extreme heat climate scenarios.

NOAA CPO Climate Connections Meeting, November 20-21 in Silver Spring, Maryland: Dr. Rick Saylor presented a poster by Bruce Baker, John Kochendorfer, Tilden Meyers and Howard Diamond entitled

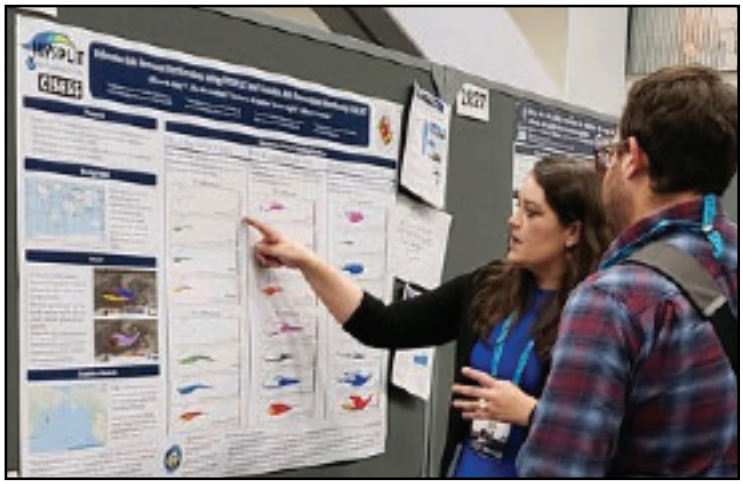
"Climate Observing System: Where are we and where do we need to be in the future?". The poster highlighted the U.S. Climate Reference Network (USCRN), especially the USCRN in Alaska, and the Surface Energy Balance Network as examples of high-quality climate observations that are critical for long-term monitoring and enhanced understanding of changes to the climate system. (rick.saylor@noaa.gov)

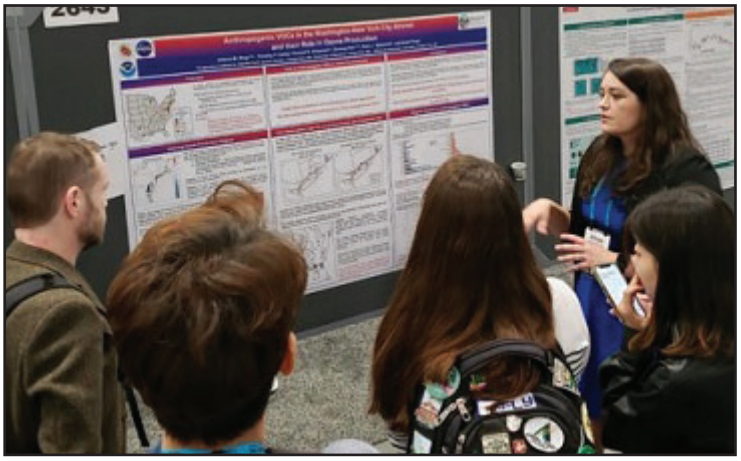
Research Seminar at the U.S. Environmental Protection Agency (EPA) Center for Environmental Measurement and Modeling, December 4 in Research Triangle Park, North Carolina: Dr. Rick Saylor presented "Dynamic NH3 Exchange within a Deciduous Forest Canopy in the Southern Appalachians," describing recent model results for an EPA-NOAA collaboration investigating ammonia deposition and emissions in and above a deciduous forest in western North Carolina. (rick.saylor@noaa.gov)

U.S. EPA New Insights in Atmospheric Science Seminar Series, December 5 in Research Triangle Park, North Carolina: Dr. Rick Saylor presented "The NOAA UFS Global Aerosol and Atmospheric Composition Model: Description, Evaluation and Future Directions." This seminar described recent efforts in NOAA to create a new global aerosol and atmospheric composition model within the Unified Forecast System and highlighted the work done by ARL to implement a new dust emission algorithm in the global model, in collaboration with the Boulder, Colorado-based Global Systems and Chemical Sciences Divisions of ESRL. (rick.saylor@noaa.gov)

100th American Geophysical Union (AGU) Annual Meeting, December 9-13 in San Francisco, California: ARL staff authored / co-authored the following presentations:

- Allison Ring, **Alice Crawford** and **Barbara Stunder**, "Volcanic Ash Forecast Verification using HYSPLIT and Satellite Ash Observations Identified by VOLCAT." This study used satellite observations processed by VOLCAT and modeled ash dispersion results from HYSPLIT to calculate verification statistics for multiple volcanic eruptions including the recent eruption of Raikoke in the Kuril Islands in the northwest Pacific Ocean. The authors explored different verification techniques for volcanic ash forecasts and provided thorough discussion of the information garnered from each statistical method.
- Allison Ring, Xinrong Ren and Daniel Tong, "Anthropogenic VOCs in the Washington-New York City Air shed and their Role in Ozone Production." Observations acquired during the 2017 NASA OWLETS campaign suggest there are some anthropogenic volatile organic compounds (VOCs) acting as important, yet largely overlooked, contributors to poor air quality, particularly in urban areas. Authors used a combination of observations and air quality model output to identify the most important anthropogenic VOCs on ozone production in the densely populated Washington - New York City corridor.





Dr. Ring presenting her papers at the December 2019 AGU meeting.

- **LaToya Myles**, "Cross-disciplinary studies of atmospheric ammonia along the coasts"

- Nebila Lichiheb, "Trace gas effluxes at night - the virtual chamber statistical methodology"
- Nebila Lichiheb, Mark Heuer, **LaToya Myles**, **Rick Saylor**, "Atmospheric ammonia measurements over a coastal salt marsh ecosystem along the Mid-Atlantic U.S."
- Praveena Krishnan **John Kochendorfer**, **Tilden Meyers**, and Mark Heuer, "Long-term observations of energy, water vapor and CO2 fluxes over a temperate deciduous forest in Tennessee"
- **Tilden Meyers**, **John Kochendorfer**, Mark Heuer, Timothy Wilson, "Observing and Modeling the Seasonal Profile of Leaf Area for a Mid-western No-till Corn/Soybean Field"
- Youhua Tang, Daniel Tong, **Pius Lee**, Barry Baker, Patrick Campbell, **Alice Crawford**, **Winston Luke**, **Ariel Stein**, "Development of a Fast-Response Volcanix SO2 Prediction System: A Study for the 2018 Mt. Kilauea Eruption using a Chemical Transport Model and Satellite Data

Outreach and Engagement

No input this quarter.

Training

In October, Roger Carter and Bai Yang completed INL Aerial Lift Operator training required for operating a bucket truck. (roger.carter@noaa.gov and bai.yang@noaa.gov)

Other

Dr. Rick Saylor attended the Geophysical Fluid Dynamics Laboratory's external laboratory review held at Princeton University on October 29-31 in Princeton, New Jersey. OAR laboratories hold external reviews every five years to obtain feedback on the laboratory's scientific direction, its quality, and its alignment with NOAA's mission and OAR's goals and objectives. (rick.saylor@noaa.gov)

DOE Meteorological Subcommittee (DMSC) Activities: Walt Schalk plans and conducts now monthly teleconferences with DOE and DOE/NNSA site meteorology representatives. These calls provide a forum for an exchange of information ranging from interesting weather events to instrumentation issues and successes. DOE's definition of a "Qualified Meteorologist" continues to be a topic of discussion and has been encompassed in a larger discussion. The DOE/NNSA headquarters DMSC now has a project to develop guidelines for meteorology programs in DOE. (walter.w.schalk@noaa.gov)

SORD Website: Work is ongoing to replace the webserver in the new IT construct. We will continue to add improvements, updates and new capabilities to the website, which has a new address: www.sord.nv.doe.gov. (walter.w.schalk@noaa.gov)