NOAA Air Resources Laboratory
Quarterly Activity Report
FY2016 Quarter 1
(October - December, 2015)

Contents

DISPERSION AND BOUNDARY LAYER

1. HYSPLIT

Glenn Rolph and Ariel Stein traveled to the Oak Ridge National Laboratory (ORNL) October 22 and 23 to give HYSPLIT training to five ORNL employees. The emphasis of the training was on deposition, input meteorological data, and the puff versus the particle calculation methods. The ORNL employees are involved in a project to combine the HYSPLIT transport and dispersion model with the Cloud Rise Module of the Defense Land Fallout Interpretive Code (DELFIC), headed by Dr. Vincent Jodoin. DELFIC currently uses a rather simple Gaussian plume model to transport the nuclear material and they have been tasked with incorporating a more sophisticated dispersion model into DELFIC. ARL is supporting them in this task. glenn.rolph@noaa.gov

Ariel Stein attended the Expert Team on Emergency Response Activities (ET-ERA) meeting in Buenos Aires, Argentina, from November 30th to December 4th, 2015, representing the US Regional Specialized Meteorological Center (RSMC). He presented the new HYSPLIT model updates that will shortly be implemented at NOAA's NWS and led the discussion on the new implementation of the Transfer Coefficient Matrix approach that will be used by the rest of the RSMCs. ariel.stein@noaa.gov

Computer code for the next HYSPLIT system upgrade was given to NCEP, which runs HYSPLIT to predict transport and dispersion of wildfire smoke, dust, volcanic ash, and radiological substances and to estimate radiological source regions. The HYSPLIT system also includes creation of HYSPLIT-compatible meteorology files that are transferred to NOAA's Web Operation Center (WOC) to support NWS Weather Forecast Office forecasters in running HYSPLIT and to ARL for use on the Real-time Environmental Applications and Display sYstem (READY) website. The NCEP implementation is planned for March, 2016. Primary changes include an upgraded wet deposition algorithm, transfer of the password-protected Washington, DC, Regional Specialized Meteorological Center (RSMC) web site from ARL's R&D setting to NCEP operations, the addition of trajectories for Alaska volcanoes, and the extension of the NAM 4 km meteorology file from a 24-hour to 48-hour forecast. barbara.stunder@noaa.gov

2. Volcanic Ash

Barbara Stunder and Alice Crawford attended the World Meteorological Organization Seventh International Volcanic Ash Workshop in Anchorage, Alaska from October 19-23. The theme of the meeting was "Science into Operations: Now and into the future." Representatives from volcanic ash advisory centers, volcano observatories, the aviation industry, the remote sensing community and the modeling community met to discuss scientific advances in the detection, measurement and forecasting of volcanic ash clouds and how these advances can be applied to reduce risk to aircraft from volcanic ash. Preliminary recommendations regarding modeling relate to development of better model validation datasets and probabilistic modeling. Alice presented a poster titled, "Using Satellite Based Volcanic Ash Products to Improve HYSPLIT Transport and Dispersion Model Predictions." Barbara gave a presentation titled "HYSPLIT volcanic

ash dispersion modeling R&D, NOAA NWS NCEP operations, and transfer to operations." Dov Bensimon from the Montreal Volcanic Ash Advisory Center (VAAC) presented work done by Alice and Barbara on the development of a prototype web site which could facilitate the exchange of model information between VAACs during a volcanic eruption. barbara.stunder@noaa.gov, Alice Crawford

Alice Crawford and Ariel Stein participated in a 2-day research project planning meeting dealing with volcanic ash re-suspension. The project, sponsored by the Department of Energy (DOE), has a main objective to assess the impact of a potential volcanic eruption over the nuclear waste management facility at Hanford, WA. Scientists from the US Geological Survey, Desert Research Institute, DOE, and ARL participated in this meeting. For this project, ARL will develop and test new ash re-suspension algorithms that will be incorporated into the HYSPLIT modeling system. alice.crawford@noaa.gov

3. Convective Initiation Project

Mike Buban has largely completed a set of Large Eddy Simulations (LES) to investigate the effects of horizontal variations of surface fluxes on the initiation of convection. Such variations in fluxes due to changes in surface properties may be an important factor in triggering convection in the Southeastern U.S., where synoptic triggers such as fronts and drylines are less common during the summer months. Results from the Convective Initiation project will be presented during a session at the 2016 American Meteorological Society annual meeting in New Orleans. A presentation discussing the LES results entitled “The Simulated Effect of Surface Flux Heterogeneity on Convection Initiation in the Southeast U.S.” will be included in that session. richard.eckman@noaa.gov, Michael Buban, Tilden Meyers, Bruce Baker

ATDD received approval of the Section 333 exemption for the 20-minute fuel reserve requirement from the Federal Aviation Administration (FAA) on October 8, 2015. This was followed by approval from NOAA/Aircraft Operations Center to fly the DJI S-1000 small Unmanned Aerial System (sUAS). The first test flight was performed at Knox County Radio Control Society’s model flying field on October 13, 2015, with an additional flight on October 14, 2015.

The sUAS was then taken to Belle Mina, Alabama to perform profile comparisons with the microwave profiler and several radiosonde balloons. Six flights were made on October 20 and two flights were made on October 21, 2015. Simultaneous balloon launches were made during three of the flights on October 20 and one of the flights on October 21. The launches on October 20 occurred at 14:22 GMT, 18:31 GMT, and 21:20 GMT while the launch on October 21 occurred at 14:21 GMT.

The sUAS carried three International Met Systems iMet-XQ sensors to measure air temperature, relative humidity (RH), and pressure, a downward-looking Forward Looking Infrared (FLIR) Tau2 infrared camera with a resolution of 336x256 pixels, and a downward-looking GoPro Hero3 visible camera.

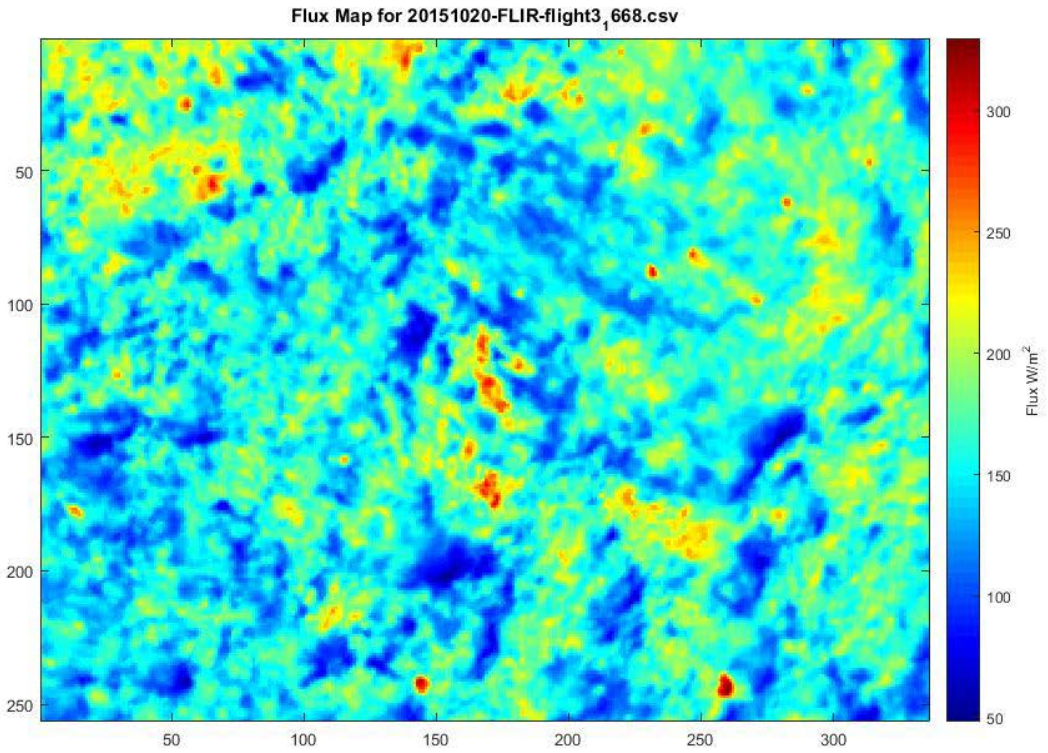
In addition to the profiles, several flights were made near the flux tower in the south

grassland to investigate the possibility of measuring heat flux (H) from the sUAS using fluxes measured from the tower as a ground-truth calibration. The technique uses the following method:

$$H = \gamma \sigma_w (T_s - T_a)$$

Where: γ = proportionality constant
σ_w = variance of vertical wind
T_s = surface temperature
T_a = air temperature at altitude

The quantity σ_w was measured by the flux tower at the same time as the sUAS flights. The quantity γ was determined using the tower heat flux. The quantities T_s and T_a are measured by the sUAS using the FLIR IR camera and the iMet-XQ temperature, respectively. An example of the heat flux map generated using this technique is shown below:



Following the deployment to Belle Mina, several flights have been made at KCRC to further investigate the validity of the temperature, RH, and pressure measurements. These flights resulted in several significant findings.

During a visit by Stephen DeWekker of the University of Virginia, flights were made on November 3 and November 4 to investigate the configuration of the iMet sensors on the vehicle, as well as to investigate the orientation of the vehicle with respect to the prevailing wind. A total of eight flights were flown on these two days.

The next set of flights occurred on December 16, 2015 as a follow-up to the heat flux flights in October. Flights occurred over the land-water interface adjacent to KCRC with the purpose to investigate the altitude at which the air temperature is constant above the step-change interface of surface temperature.

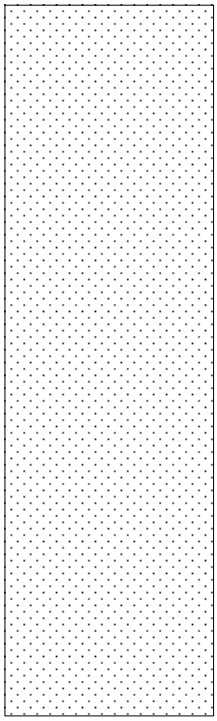
While flying back and forth over a land-water interface at KCRC, a correlation between the attitude angle of the sUAS (octocopter) and several of the temperature sensors was noticed. A series of flights were then designed to investigate the relationship between the octocopter's orientation with respect to the wind, the location of the temperature sensors, and the pitch and roll angles of the octocopter. These four flights were flown on December 29, 2015.

In each flight the vehicle was hovered adjacent to the met tower at KCRC and the heading adjusted every three minutes as shown in the table below:

Flight	Altitude	Heading 1	Heading 2	Heading 3	Heading 4
1	3-4 meters AGL*	0º to wind	90º to wind	180º to wind	270º to wind
2	3-4 meters AGL	0º true (North)	90º true (East)	180º true (South)	270º true (West)
3	20 meters AGL	0º to wind	90º to wind	180º to wind	270º to wind
4	20 meters AGL	0º true (North)	90º true (East)	180º true (South)	270º true (West)

*AGL = above ground level

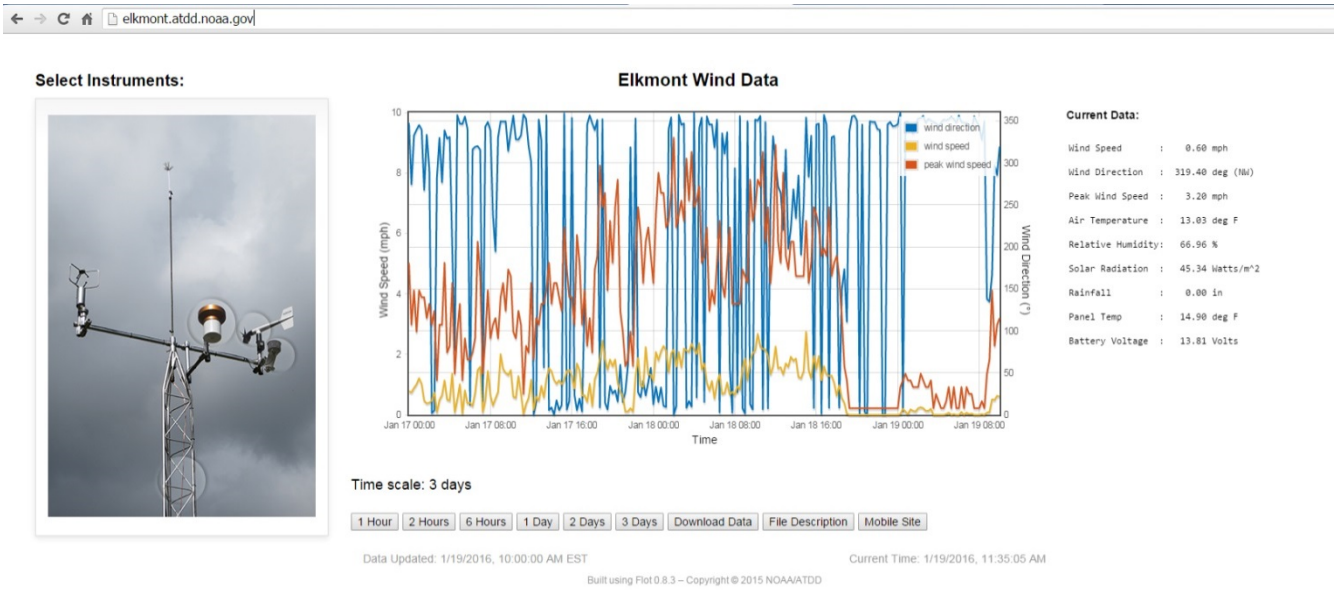
The following graph shows the relationship between the relative wind direction, the yaw angle of the vehicle, the pitch angle of the vehicle and the three temperature measurements.



The data shown above is from flight 1. Notice the correlation between the yaw angle and a decrease in temperature from the downwind sensor. Additional work to follow next quarter will be to add another iMet temperature sensor to the remaining location and repeat the test series. We expect that corrections to the temperature sensor can be developed for the vehicle's angle relative to the wind.

The operation of the octocopter this quarter has been very successful, with a total of 24 flights flown without incident. ed.dumas@noaa.gov, W. Pendergrass, T. Meyers, T. Lee, M. Buban, C. Brown, B. Baker

Websites were created to display real-time data from the following towers: Knox County Radio Control (KCRC), Elkmont, and CORE. These websites use modern Javascript libraries to render graphs of real-time data efficiently across a variety of devices. An example of the Elkmont data is shown below:



The following table shows the addresses of each site:

Tower Location	Main website	Mobile website
Elkmont	http://elkmont.atdd.noaa.gov/	http://elkmont.atdd.noaa.gov/mobile/
CORE	http://core.atdd.noaa.gov/	http://core.atdd.noaa.gov/mobile/

ed.dumas@noaa.gov W. Pendergrass, S. Klemenz

4. Project Sagebrush

The manuscript 'Revisiting the Values of the Horizontal Plume Spread Parameters σ_θ and σ_y' has been renamed 'Project Sagebrush: Revisiting the Value of the Horizontal Plume Spread Parameter σ_y' to better emphasize the focus of the material included. The key points are an introduction to Project Sagebrush and that the magnitudes of σ_y, measured during Phase 1 of Project Sagebrush (PSB1), tended to be much larger than those determined from earlier field studies. Both older stability class models and newer models based on PBL theory rely in some way on results from older tracer field studies. The manuscript is being revised for the Journal of Applied Meteorology and Climatology and will be resubmitted in January. A second manuscript 'An Investigation into the Magnitude and Variation in the Standard Deviation of Horizontal Wind Direction σ_θ' will be sent to the journal pending acceptance of the first manuscript.

Planning for phase 2 of the Project Sagebrush field study (PSB2) is in progress. Tentatively, this phase will emphasize low wind conditions during daytime (approx. late August, 2016) and nighttime (approx. late October, 2016). Assistance is still being provided to Bruce Hicks in support of his work on nighttime turbulence in the stable boundary layer. dennis.finn@noaa.gov, Rick Eckman and staff

A manuscript entitled “How Should Sample Statistics be Defined for the Wind Direction?” was completed. It discusses the large number of sample statistics that have been proposed for the wind direction and derives alternate formulas that are more consistent with the circular nature of the variable. The manuscript is a spin-off of the Project Sagebrush data analysis. The plan is to submit the manuscript to an AMS journal. richard.eckman@noaa.gov

5. Birch Creek Valley Wind Flow Study

The manuscript ‘Evidence For Gap Flows and the Topographic Amplification Factor in the Birch Creek Valley, Idaho’ has been prepared. It is based upon data generated by FRD, the U.S. Forest Service Fire Sciences Laboratory, and the Lab for Atmospheric Research at Washington State University and collected during a summer 2013 field deployment. It has been reviewed by all co-authors and revisions are in progress. dennis.Finn@noaa.gov

6. Wind Forecast Improvement Project (WFIP2)

The goal of this field experiment is to improve wind turbine hub height wind forecasts in areas of complex terrain. FRD is focused on the improvement of forecast model boundary layer processes and estimates of surface fluxes of solar and longwave radiation, sensible heat, latent heat, and soil heat fluxes. Instrumentation including sonic anemometers, infrared gas analyzers, sodars, a radar wind profiler, and surface-flux stations were deployed in late September. Since the deployment, the incoming data have been monitored by Matt Brewer for quality and consistency with recent weather conditions.

Although most instruments have performed well, some issues have arisen. After multiple occasions in which the Boardman surface-flux system locked up, it was taken down and sent to LI-COR for repair. It was also discovered that the heater in the Prineville sodar was not operating, and this was fixed on Dec 23rd. Finally, our soil moisture/temperature instrumentation at Prineville ceased to function, and the cause for this is unknown. All instrumentation was inspected and a few instruments were repaired by Shane Beard when he visited the site on Dec 22-23. matt.brewer@noaa.gov, Shane Beard, and staff

An important task has been setting up data transfers to the WFIP2 central data repository. Brad Reese and Bill Behymer have created scripts to automatically load data to the repository as it comes in, and much of the data are now available. Kirk Clawson and Matt Brewer are developing detailed metadata information for each system for the end users. brad.reese@noaa.gov, Bill Behymer, Matt Brewer, Kirk Clawson

7. Potential Tracer Project

In November, Jeff French (former FRD employee) and Bart Geerts at the University of Wyoming contacted FRD regarding the use of tracers for some of their cloud-seeding research. In their National Science Foundation proposal, they discuss plans to use one aircraft to seed clouds and a second trailing aircraft to observe the effects of the seeding. Currently, the trailing research aircraft has no way of determining when it is

inside the seeding plume, so they want to investigate whether FRD's tracer technology can be adapted for this application. This would involve releasing a gaseous tracer from the seeding aircraft and installing tracer samplers on the trailing aircraft. Mounting one of FRD's fast-response Trace Gas Analyzers in the research aircraft is the best option from a science perspective, but this approach has been ruled out for now due to the costs and logistics involved. A simpler alternative is to use bag samplers, which have limited temporal resolution but could be added to the aircraft payload with far less effort. They expect to be notified of the proposal acceptance status in February 2016. richard.eckman@noaa.gov, Kirk Clawson

8. Consequence Assessment for the Nevada National Security Site

James Wood, Rick Lantrip, Kip Smith, and Walt Schalk participated in three emergency response Functional Exercises and Drills as the Consequence Assessment Team (CAT) for the NNSA Nevada Field Office. These exercises were conducted on the Nevada National Security Site (NNSS). In these exercises, facility specific weather data and weather forecasts were provided and dispersion products were generated based on the worst case event information provided for the different scenarios. The events included both simulated radiological and chemical scenarios. These events were conducted with the DOE/NNSA/NFO Emergency Response Organization. Walt Schalk was the CAT facilitator for these exercises. kip.smith@noaa.gov, Rick Lantrip, James Wood, Walter Schalk

9. SORD Mesonet Upgrade

The SORD Mesonet Tower Upgrade installation has been completed. Sensor installations have also been completed. The communications portion of the new system is currently being tested. Final tower/sensor configurations and data logger programming are in process. Calibration and comparisons will be completed next quarter and the new system should become the operational system then. walter.w.schalk@noaa.gov, Kip Smith, James Wood, Phil Abbott, Rick Lantrip, Bobby Gates

10. Support to DOE/NNSA NNSS Projects and Experiments

SORD continued to participate in the Shock Physics Experiment (SPE) series. Walt Schalk attended a status meeting for the next experiment (#5) and also participated in a kick-off meeting for the experiment (#6). Goals, time lines, contacts, and changes were presented for experiment #5.

James Wood and Walt Schalk continued work on the project to tether a balloon to act as an elevated platform that will likely be used during experiment #5. There is a desire to measure the infrasound signal from an elevated location. SORD is working with Los Alamos National Lab in tethering a weather balloon to lift an instrument package about 50 meters above the ground. The initial proof of concept was successful. Several areas of improvement were identified and are being addressed. walter.w.schalk@noaa.gov, Kip Smith, Rick Lantrip

AIR QUALITY

11. Atmospheric Mercury Modeling with HYSPLIT-Hg

Analyses continued with the HYSPLIT-Hg fate and transport model for atmospheric mercury. An error was found in the global Eulerian portion of the model that incorrectly specified the thickness of the lowest model layer in the atmosphere. This error was corrected and several new sets of 2005 simulations were carried out, using a 5-year model spin-up period. The primary objective of the analysis was to estimate the source attribution for atmospheric mercury deposition to the Great Lakes. The model was run in a base-case and ten alternative configurations, with different assumptions regarding the atmospheric chemistry of mercury and mercury emissions. Model evaluation was carried out by comparison of the results against mercury concentration measurements and mercury wet deposition measurements, with emphasis on sampling sites in the Great Lakes region. The model showed excellent skill in estimating elemental mercury concentrations and mercury wet deposition in the region. The model tended to overestimate concentrations of the other forms of atmospheric mercury, similar to the findings of other modeling studies. The reasons for the model vs. measurement discrepancy are believed to be due to a combination of model and measurement uncertainties, as well as known differences in the fractions of atmospheric mercury being compared. For example, the model outputs *total* particulate mercury but the measurements only reflect *fine-particle* mercury. So, the model outputs *should* be higher than the measurements. In the source-attribution results, the differences in total deposition and source attribution between Lake Erie, estimated by the model to be the most impacted by direct anthropogenic emissions (58% of the base case total deposition), and Lake Superior, estimated to be the least impacted (28%), was generally larger than differences among the alternative configurations. The U.S. was the largest national contributor, followed by China, contributing 25% and 6%, respectively, of the total modeled deposition on average for the Great Lakes. These results illustrate the importance of emissions reductions both regionally and globally to reduce atmospheric deposition of mercury to the Great Lakes. The results were compiled in a Final Report (for FY13 funding) to the Great Lakes Restoration Initiative program, and have formed the basis for a manuscript, being developed for journal submission.

A new Post-Doc, Dr. Chris Loughner, joined ARL. His initial work focuses on parallelizing the HYSPLIT-Hg code so that it can be run across multiple computer processors. mark.cohen@noaa.gov

12. Improved Calibration Methods for Mercury

Paul Kelley, Xinrong Ren, and Winston Luke designed and constructed two new and improved calibration methods for the Tekran® mercury measurement systems deployed throughout the National Atmospheric Deposition Program's Atmospheric Mercury Network (AMNet). The first method uses the mercury detector's onboard gaseous elemental mercury (GEM) permeation tube to deliver a controlled pulse of GEM to the inlet of the speciation system, a preferred method of calibration as it quantifies any losses of GEM through the entire sampling path of the system. Existing Tekran® calibration methodologies assess only the analytical integrity of the detector itself. While

such an inlet-spiking scheme is available as an extra-cost option on Tekran's newest 2537X detector, it is not available on the older older 2537A and 2537B detectors, which constitute the majority of instrumentation deployed throughout the AMNet.

The second calibration method developed is a permeation tube-based source of gaseous oxidized mercury (GOM) compounds. GOM species are difficult to manipulate and control owing to their instability and affinity for a variety of surfaces, which promote GOM decomposition to GEM. The ARL source uses powdered mercury dibromide (HgBr2) in a short length of heat-shrink Teflon tubing to generate gas phase concentrations of HgBr2, believed to be the dominant GOM species. The permeation tube is placed within a stainless steel housing rendered inert by coating with a thin layer of silica. This inert material, combined with high-precision temperature control and the use of inert argon gas carrier flow, allows the introduction of nearly 100% HgBr2 in the gas phase to a detector inlet, with negligible decomposition to GEM. This represents a significant advancement in GOM calibration techniques. Testing of these methods continues in the ARL laboratory and will be expanded to field deployment in the coming months. winston.luke@noaa.gov, Paul Kelley, Xinrong Ren

13. Particulate Matter Research Forecast

The Executive Affairs Division (EAD) of NOAA's Office of Marine and Aviation Operation contacted ARL regarding wildfire plumes from illegal biomass burning in Indonesia that were impacting air quality in Malaysia, Singapore and much of Southeastern Asia. The US Pacific Commanding Officer was concerned about the potential health hazards imposed by the bad air quality on the naval personnel in the area. ARL air quality scientists who specialize in the development of the National Air Quality Forecasting Capability project quickly summoned tools and real-time emission data from NESDIS to study the situation. A forecast product was produced on surface concentrations of fine particulate matter in 9 km horizontal grid spacing over Malaysia, Singapore, Brunei and large parts of Indonesia. The product was shared with the EAD.
pius.lee@noaa.gov

CLIMATE

14. Federal Senior Scientists Workshop

The Council of NOAA Fellows hosted a Federal Senior Scientific Professionals Workshop on Friday, 13 November 2015, at the NOAA Science Center in Silver Spring, MD. This first-of-its-kind workshop was a unique opportunity for senior scientists from across the federal government to learn about each other and their roles within their various agencies, to share best practices, and to identify ways to cooperate to strengthen the US federal science enterprise. About 60 scientists from 11 agencies (7 departments) participated in the one-day meeting, organized by Dian Seidel and Council of NOAA Fellows colleagues. Follow-up activities, including a possible second workshop, are being planned by a cross-agency group.

15. Stratospheric Temperature Study

A paper on “Stratospheric Temperature Changes during the Satellite Era” by Dian Seidel and colleagues has been accepted for publication in the *Journal of Geophysical Research – Atmospheres*. The work is a product of the WCRP/SPARC (World Climate Research Programme/Stratosphere-Troposphere Processes and their Role in Climate) Stratospheric Temperature Trends activity, from which Seidel recently stepped down as co-chair. This group has periodically studied changes in stratospheric temperature from observational and modeling perspectives. In recent years, the group identified significant uncertainties in stratospheric temperature observations from satellites, which motivated research teams to re-examine their methods for producing climate data records from raw observations. This paper comprehensively examines all available long-term satellite-based stratospheric temperature climate data records; finds some previously unrecognized differences among records from different research centers; quantitatively identifies the space and time structure of statistically significance signals of natural variability in stratospheric temperature; and estimates trends not associated with known natural causes of variability. Trend estimates indicate stratospheric cooling before 1995 and no trend thereafter, consistent with increases in atmospheric carbon dioxide and a slowdown in stratospheric ozone depletion (both of which cool the stratosphere). The results provide an updated and more comprehensive basis for understanding past stratospheric change and for evaluating climate model simulations than was previously available. dian.seidel@noaa.gov

16. Stratospheric Sudden Warmings Paper

Sudden stratospheric warmings (SSWs) are extreme events in the polar wintertime stratosphere in which temperature increases rapidly and winds reverse direction. These stratospheric events can descend into the troposphere and cause cold winter weather outbreaks at the surface. Over the past four decades, the definition of SSWs has evolved, leading to ambiguities and inconsistencies that result in confusion and discrepancies in different studies and applications. To help resolve these, a paper on "Defining sudden stratospheric warmings" by Amy Butler (ESRL, CIRES), Dian Seidel (ARL), Steven Hardiman, Neal Butchart, Thomas Birner, and Aaron Match was published in the *Bulletin of the American Meteorological Society.*

17. FOCAL – Alaska Study

A final, quality-checked, version of processed concentrations of methane and water vapor has been produced by our Harvard collaborators in Flux Observations of Carbon from an Airborne Laboratory (FOCAL) –Alaska Study. The data were acquired during the 2013 August expedition to the North Slope of Alaska using a new Harvard-developed gas sampler based on Integrated Cavity Output Spectroscopy to measure not only the flux of total methane and water vapor, but also the concentrations of their isotopologues (same molecule, specific isotopes). The isotopologues help identify the process that produced the observed flux. ATDD contributed the Best Airborne Turbulence (BAT) probe and expertise in calculating the flux. Fluxes were computed from six flights and results will be presented at the American Meteorological Society's annual meeting. For the three flights with strongest insolation, latent heat flux from the tundra was significantly stronger than from the small lakes. For two of these flights, the

same was true for methane flux. The northeast end of the track for one of these flights passed the ARL surface tower. Flux of both latent heat and methane increased from southwest to northeast over this track. Within 1500 m of the tower, airborne and tower fluxes matched very closely. The latent heat flux matched less well but still within a 95% confidence interval. ron.dobosy@noaa.gov, E. Dumas, (D. Sayres and C, Healy from Harvard)

18. Climate Reference Network (CRN)

USCRN personnel made 36 Annual Maintenance Visits and one Unscheduled Maintenance Visit in 39 days. mark.e.hall@noaa.gov

In October, November, and December the National Centers for Environmental Information (NCEI) retrieved 49 data files from USCRN sites through the ATDD server ftp.atdd.noaa.gov. Data are passed to the NCEI by this path when retrieved episodically by ATDD from individual site visits to fill data gaps. Characteristics of the instruments for each site are maintained in the ISIS (Integrated Station Information System) database on NCEI's server, along with a record of events that affect data quality. New ISIS events are identified from ATDD's field crews and archived data. lynne.satterfield@noaa.gov

Working with collaborators from NCEI, ATDD began re-analyzing the results of an air temperature bias experiment focused on the effects of different types of air temperature measurement systems prevalent in US climate networks. This work will also be used to evaluate air temperature biases caused by siting near artificial heat sources such as roadways and buildings. john.kochendorfer@noaa.gov

19. Support for Alaska National Park Service's Climate Network Measurements

In response to a request for support, ATDD tested several temperature sensors used by the Alaska National Park Service (NPS). The way that the Alaska NPS was calculating temperature was causing large errors. For the USCRN stations, ATDD uses the NIST-traceable calibration system. Different calibration equations were developed and the errors inherent in using the recommended linear equation were demonstrated. The results were shared with the Alaska NPS and can be used to significantly improve the Alaska NPS climate measurements. john.kochendorfer@noaa.gov, Mark Hall

20. World Meteorological Organization – SPICE

Using data from the NOAA/FAA/NCAR and Haukeslister precipitation testbeds, located in Marshall, CO, and Norway, precipitation corrections for several different types of shielded and unshielded gauges were developed and tested. These results were presented to the WMO Solid Precipitation InterComparison Experiment (WMO-SPICE) group in preparation for analyzing all of the WMO-SPICE results using the same methods. john.kochendorfer@noaa.gov

21. NOAA/INL Mesonet

FRD installed a Campbell Scientific CR6 data logger at the Roberts station of the NOAA/INL Mesonet in early October. It integrated smoothly into the existing radio communication network and has operated for the remainder of the quarter without any significant problems. FRD also began testing the new Esteem radio modems, but snow

has blocked access to the mountain top radio repeater station thereby preventing any further testing. roger.carter@noaa.gov, Shane Beard

FRD has experienced several episodes of radio frequency interference with the NOAA/INL Mesonet telemetry system at the FRD office. This effectively shuts down communications with the mesonet stations. Idaho Falls Power has assisted us in investigating the source of the problems and has made some repairs which corrected some of the problems. However, the interference currently being experienced has different characteristics and has not been resolved. FRD was forced to operate with a remote base station at the Grid 3 facility that is connected to the computers in the Idaho Falls office with a telephone line. This arrangement is subject to occasional telephone line problems making it less reliable than the local base station. roger.carter@noaa.gov, Shane Beard

Earlier in 2015, FRD purchased a closed-path LI-COR 7200 gas analyzer to measure H_2O and CO_2 concentrations at a permanent flux station located at the INL site. This instrument replaced an open-path LI-COR 7500 analyzer that had been operating at the site for many years. During the summer, however, both instruments were in operation simultaneously along with another LI-COR 7500 that was being field-tested as part of the WFIP2 project. Comparisons of the three instruments indicated that they were all providing similar measurements of the H_2O vapor concentration. But the CO_2 concentrations from the 7200 gas analyzer are missing the high-frequency fluctuations observed in the two open-path systems. The CO_2 spectra from the latter two systems exhibit the -5/3 slope expected at high frequencies, but the spectrum from the 7200 gas analyzer drops off rapidly to white noise at high frequencies. As a result, the 7200 gas analyzer was sent back to LI-COR for repairs. Their initial tests did not indicate any problems with the instrument. So far, neither LI-COR nor the FRD staff has come up with an explanation for the instrument's odd behavior during the summer tests. kirk.clawson@noaa.gov, Rick Eckman

ARL FY16 Quarter 1 Publications

Butler, Amy H., Dian J. Seidel, Steven C. Hardiman, Neal Butchart, Thomas Birner, and Aaron Match, 2015: Defining Sudden Stratospheric Warmings. Bulletin of the American Meteorological Society. 96, 1913–1928. doi: 10.1175/BAMS-D-13-00173.1

Huang, M., D. Tong, P. Lee, L. Pan, Y. Tang, I. Stajner, R.B. Pierce, J. McQueen, and J. Wang (2015). Toward enhanced capability for detecting and predicting dust events in the western United States: the Arizona case study, Atmospheric Chemistry and Physics, 15, 12595-12610, doi:10.5194/acp-15-12595-2015

Ling, T., **M. Xu**, **X.-Z. Liang**, J. X. L. Wang, and **Y. Noh** (2015), A multilevel ocean mixed layer model resolving the diurnal cycle: Development and validation, Journal of Advances in Modeling Earth Systems (AGU), *07*, doi:10.1002/2015MS000476.

Nault, Benjamin. A., Charity Garland, Paul J. Wooldridge, William H. Brune, Pedro Campuzano-Jost, John D. Crounse, Douglas A. Day, Jack Dibb, Samuel R. Hall, L. Gregory Huey, José L. Jimenez, Xiaoxi Liu, Jingqiu Mao, Tomas Mikoviny, Jeff Peischl, Ilana B. Pollack, Xinrong Ren, Thomas B. Ryerson, Eric Scheuer, Kirk Ullmann, Paul O. Wennberg, Armin Wisthaler, Li Zhang, and Ronald C. Cohen.(2015) Observational Constraints on the Oxidation of NOx in the Upper Troposphere The Journal of Physical Chemistry A Article On-Line doi:10.1021/acs.jpca.5b07824

Pusede, S. E.,X. Ren…et al. (2015). An Atmospheric Constraint on the NO2 Dependence of Daytime Near-Surface Nitrous Acid (HONO). Environmental Science & Technology 49(21): 12774-12781. doi: 10.1021/acs.est.5b02511

Russell, E. S., Heping Liu, Zhongming Gao, Dennis Finn, and Brian Lamb (2015). Impacts of soil heat flux calculation methods on the surface energy balance closure. Agricultural and Forest Meteorology 214–215: 189-200. doi:10.1016/j.agrformet.2015.08.255

Stein, A. F., R. R. Draxler, G. D. Rolph, B. J. B. Stunder, M. D. Cohen, and F. Ngan (2015) NOAA's HYSPLIT atmospheric transport and dispersion modeling system. Bulletin of the American Meteorological Society. http://dx.doi.org/10.1175/BAMS-D-14-00110.1
The article was featured on the cover of the December issue of the Bulletin of the American Meteorological Society (BAMS). This work presents HYSPLIT's historical evolution over the last three decades along with recent model developments and applications. BAMS is one of the scientific publication outlets with the highest impact factor (A measure of the frequency with which the average article in a journal has been cited in a particular year) in the area of atmospheric sciences.

Tang, Youhua, Tianfeng Chai, Li Pan, Pius Lee, Daniel Tong, Hyun-Cheol Kim, and Weiwei Chen (2015). Using optimal interpolation to assimilate surface measurements and satellite AOD for ozone and PM2.5: A case study for July 2011. Journal of the Air & Waste Management Association. 65 (10) 1206-1216. doi:10.1080/10962247.2015.1062439

Turner, M. D.,…Tianfeng Chai (2015). Premature deaths attributed to source-specific BC emissions in six urban US regions. Environmental Research Letters 10(11): 114014 http://stacks.iop.org/1748-9326/10/i=11/a=114014

Conference Presentations & Invited Talks

Pius Lee, Hyuncheol Kim, Li Pan, Nina Randazzo, Youhua Tang, and Daniel Tong attended and presented 8 papers in the 14th Annual Community Modeling and Analysis System (CMAS) conference from October 5-7, 2015 in Chapel Hill, NC. The meeting had nearly 300 participants, including scientists and program managers from EPA, NOAA, DOE, USDA, FAA, states, academia and the private sector, and featured progress in CMAQ model development, emissions modeling and model applications on air quality, climate, public health and policy.

Barry Baker and Rick Saylor also made presentations at the CMAS Conference. One presentation "A Comparison of Particle Dry Deposition Algorithms in Air Quality Models," outlined results comparing several particle dry deposition algorithms currently used in contemporary air quality models, highlighting significant uncertainties in a model process that has not received much research attention, lately. The second presentation, "Improving the Nocturnal Wind Speed Bias and Daytime Ozone Prediction Using a Dynamic Bulk Critical Richardson Number," shared results from a modeling study investigating improvements in the representation of the nighttime mixed layer depth.

Rick Saylor participated in the annual Science Steering Committee Meeting for the Interagency Monitoring of Protected Visual Environments (IMPROVE) network at Grand Canyon National Park in Arizona. The IMPROVE network was established in 1985 to support implementation of the Clean Air Act's protection of visibility in national parks and wilderness areas. The network monitors current visibility conditions, tracks changes in visibility and provides critical data for understanding the causal mechanisms for visibility impairment in national parks and wilderness areas. The Science Steering Committee meets annually to review network operations and provide guidance on future direction of the network.

LaToya Myles presented two research posters at the 2015 American Geophysical Union Fall Meeting in San Francisco, CA. One poster, "Exchange of atmospheric ammonia in a mature corn canopy," was presented in the Biogeosciences Section, and the second poster, "Thinkers and Doers: Strategies for Communicating Science," was presented in the Public Affairs Section.

Rick Artz, Winston Luke, Ariel Stein and Xinrong Ren attended the 9th International Conference on Acid Deposition (Acid Rain 2015) October 19-23, 2015 in Rochester, NY. During the conference, research was presented that represents the most recently available data and current understanding of emissions, deposition, and related environmental effects across the globe. Winston gave a poster presentation entitled "Measurement of Gaseous Oxidized and Particulate Bound Mercury in a Commercial Mercury Speciation System". Ariel gave a poster presentation entitled "Three Years of Continuous Wet Deposition Monitoring in Central Argentina." Xinrong gave a poster presentation entitled "Long-term Monitoring of Atmospheric Mercury Species at a Coastal Site in the Northern Gulf of Mexico." Rick also chaired a meeting of the WMO Global Atmosphere Watch Science Advisory Group (SAG) on Precipitation Chemistry.

This was his last meeting as SAG Chair; the new Chair is ARL's Ariel Stein and the group mandate has been expanded to cover Total Atmospheric Deposition as a result of previous work to produce a global deposition assessment. Rick, Winston, and Ariel also attended the National Atmospheric Deposition Program subcommittee meetings being held along with the conference.

Outreach

LaToya Myles served as a panelist for Opportunities Beyond Academia, a workshop sponsored by the Earth Science Women's Network and American Geophysical Union Education Section during the Fall Meeting.

ATDD hosted two groups of 10th grade students from Hardin Valley Academy, a public school in Knoxville. Both groups are competing in the CSPAN StudentCam Competition, an annual event that selects the best current-affairs video documentaries created by middle and high school students. The 2016 theme is "Road to the White House: What's the issue you most want candidates to discuss during the 2016 presidential campaign?" These students selected air pollution and climate change as their topics and interviewed Latoya Myles, Will Pendergrass, Rick Saylor, and Ron Dobosy.

Walt Schalk met with the Meteorologist In Charge, the Scientific Operations Officer, and the Watch Coordination Meteorologist from the NWS, Las Vegas Weather Forecast Office. The topics included a discussion of the upgrades to the NNSS/SORD mesonet, the NWS WFO Operations layout, ways to increase interaction between the offices, StormReady certification, and recent local weather events.