



NOAA Air Resources Laboratory

Quarterly Activity Report

FY2017 Quarter 2 (January-February-March, 2017)

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DISPERSION AND BOUNDARY LAYER

1. HYSPLIT

In 2016, over one million (1,094,305) HYSPLIT simulations were performed on the READY web server (<http://www.ready.noaa.gov>), exceeding the previous record set in 2014 (1,020,081). HYSPLIT simulations have seen a steady increase since 2009 when statistics were started for user's HYSPLIT runs. READY users can create air parcel trajectories or air concentration maps with HYSPLIT using archived or forecast meteorological data, although the primary HYSPLIT simulation has been trajectories using archived meteorological data. READY is celebrating its 20th year. An ARL Highlight has been posted (www.arl.noaa.gov). glenn.rolph@noaa.gov

The HYSPLIT computer code was delivered to NCEP for operational implementation coincident with NCEP's Global Forecast System (GFS) model upgrade planned for June 2017. This was a relatively minor HYSPLIT upgrade since only changes related to the global meteorological models were implemented. ARL scientists closely collaborated with NCEP to generate HYSPLIT-formatted files from the GFS model output on the GFS native vertical levels, in contrast to the more coarse, but traditional, meteorological pressure levels. Barbara.stunder@noaa.gov

2. Unmanned Aircraft Systems and VORTEX-SE

ATDD continued their evaluation of the iMet-XF instrumentation that goes aboard the Coyote small Unmanned Aircraft Systems (sUAS). Three iMet-XF systems were tested in the Thunder Scientific temperature / humidity (T/RH) chamber to characterize their response in a controlled temperature and humidity environment.

Custom software was used to control the T/RH chamber, as well as to collect data from the devices during the test. Differences between each sensor were calculated for the steady-state portion of each set point, as well as ratios of the data reported by the instruments to the measured values of T and RH from the reference instruments in the chamber. A complete report was generated and sent to Joe Cione with the NOAA Atlantic Oceanographic and Meteorological Laboratory's Hurricane Research Division.

Ed Dumas and Mark Heuer traveled to Raytheon in Arizona and were trained to install and remove the iMet-XF payloads. ed.dumas@noaa.gov, Mark Heuer, Bruce Baker

ATDD began participating in the VORTEX-SE 2017 experiment by flying their sUAS DJI S-1000 to collect temperature and humidity profile data to an altitude of 700 feet above ground level in Cullman, AL. The VORTEX-SE experiment, which is taking place in the vicinity of Huntsville, AL, is focused on studying severe storms and tornado genesis in the southeastern US. Data analysis is on-going. ed.dumas@noaa.gov, Temple Lee, Michael Buban, Bruce Baker

In preparation for the VORTEX-SE study, flights of both the DJI S-1000 and the MD4-1000 sUASs were made at the Knox County Radio Control (KCRC) Society's model flying field on March 8, 2017 to compare temperature and relative humidity as a function of altitude with the ATDD tether sonde. Each sUAS was flown in turn adjacent to the tether sonde. ed.dumas@noaa.gov, Temple Lee, Michael Buban, Randy White, David Senn, Bruce Baker

Two flights were made with the DJI S-1000 sUAS at KCRC to document the performance of the GoPro camera as it relates to capturing personally identifiable information (PII). The camera was tested at an altitude of 400 feet above ground level and was not capable of capturing PII from street signs, car license plates, or people's faces. Simone Klemenz was the observer for these two flights. ed.dumas@noaa.gov, Simone Klemenz, Temple Lee

Ed Dumas, Temple Lee, and Bruce Baker attended the National Center for Atmospheric Research (NCAR) small UAS symposium on February 20-24, 2017. Ed and Bruce each chaired several sessions to discuss the interplay of current and future UAS capabilities with respect to the scientific, regulatory, operational, and platform specific viewpoints. The purpose of the conference was for NCAR to get feedback about its role in using UAS for its mission serving academic and government institutions. There were nearly 100 attendees from academic, private, and government entities that represented a cross-section of UAS operators and researchers. ed.dumas@noaa.gov, Temple Lee, Bruce Baker

3. Project Sagebrush

The ARL Field Research Division (FRD) provided comprehensive quality control reviews of all bag sampler and fast-response analyzer tracer measurements collected last October as part of Project Sagebrush Phase 2 (PSB2). All data were flagged as appropriate and a bag sampler database was prepared. The fast response analyzer data will be finalized once the latitude and longitude information is inserted into the data files. A set of experiments was conducted to evaluate the possibility of bag leaks occurring during the colder nighttime tests in October. Large concentration differences were sometimes observed between duplicate samplers placed side-by-side for quality control purposes during the October tests. The question was whether these large differences were due to a measurement artifact or an accurate portrayal of the turbulent mixing process in cold, very stable nighttime conditions. The results, although not conclusive, suggest it is likely that the October measurements do reflect, at least in part, a real physical phenomenon. Research based on the Project Sagebrush data is now moving forward.

The comprehensive suite of meteorological measurements made during PSB2 was also consolidated. Results will be presented in an upcoming NOAA Technical Memorandum. dennis.finn@noaa.gov, Roger Carter

4. Wind Forecast Improvement Project (WFIP2)

A great deal of valuable and high quality observational data has been collected by FRD for the WFIP2. Field deployments will come to an end in April 2017. While most instruments performed well, a few struggled during the cold season due to heavy precipitation and moisture condensing on the instruments. FRD is undertaking a substantial quality-control effort to clean-up the datasets, which will then be uploaded to the data archive. All of the data affected by the cold weather will need to be analyzed and potentially flagged.

Initial comparisons of the WFIP2 observations to the forecasts from the High Resolution Rapid Refresh (HRRR) model data show large model biases in sensible heat flux, soil heat flux, outgoing longwave radiation, and soil temperature/moisture. These results, from surface flux stations at Boardman and Prineville within the WFIP2 domain, have been corroborated by a third flux station near FRD in Idaho and by soil data from U.S. Climate Reference Network stations in Oregon and Washington. FRD has also been able to reproduce the biases seen in the HRRR model by running its own Weather Research and Forecasting (WRF) model simulations using the same physics configuration as the HRRR model. Other WRF configurations will be tested to see if similar biases exist. matt.brewer@noaa.gov

5. HYSPLIT for Annual DOE Assessments

FRD made significant progress on configuring the HYSPLIT model for the annual Department of Energy (DOE) environmental site assessments. HYSPLIT will provide more realistic simulations than an older puff model that FRD had been using to generate annual estimates of the radiological exposures from site activities. The annual estimates are included in the DOE Idaho National Laboratory site environmental reports published each year. richard.eckman@noaa.gov, Dennis Finn, Roger Carter

6. Consequence Assessment for the Nevada National Security Site

SORD staff, James Wood, Rick Lantrip, and Walt Schalk, participated in three emergency response training events as the Consequence Assessment Team for the NNSA Nevada Field Office. The training was conducted on the Nevada National Security Site (NNS). The events consisted of a table-top drill, a hands-on drill, and a field exercise. In these events, the activities including providing local weather data and weather forecasts and generating dispersion products based on the worst case event

information provided for the scenarios. The events included both radiological and chemical scenarios at different facilities. These events were conducted with the DOE/NNSA/NFO Emergency Response Organization. rick.lantrip@noaa.gov, James Wood, Walter Schalk

7. SORD Mesonet

SORD continued to improve the SORD/NNSS mesonet. James Wood installed, updated, and refurbished the alter shields for the precipitation gauges in the network. James Wood and Rick Lantrip nearly completed the current instrumentation calibration cycle. Rick Lantrip updated the lightning strike climatology and the wind rose climatology for the weather stations on the NNSS. Walt Schalk provided processed data from the NNSS weather towers for use in the annual federal compliance report and the annual update to the NNSS Environmental Report. walter.w.schalk@noaa.gov, James Wood, Rick Lantrip

8. Support to DOE/NNSA NNSS Projects and Experiments

James Wood, and Rick Lantrip participated in the Plan of the Day activities on the Nevada National Security Site (NNSS) by providing daily weather forecasts and weather surveillance focusing on winds and lightning.

Walt Schalk participated in several planning meetings in preparation for Phase II of the non-proliferation experiments. Phase I was the Source Physics Experiments (SPE) and Phase II is Dry Alluvium Geology. Walt had discussions with Los Alamos scientists to determine collaborative and support areas. These activities will continue to evolve over the fiscal year.

Walt Schalk continued to develop a portable micro-net of weather stations to support experiments on the NNSS, such as the SPE. A proof of concept with one station was deployed in support of SPE-6. A test system had been operating at the Desert Rock Weather Observatory at the NNSS for a couple of weeks. The proof of concept station during the SPE-6 experiment was a success and greatly appreciated by the National Laboratory scientists. The main challenge is communications. walter.w.schalk@noaa.gov, James Wood, Rick Lantrip

ATMOSPHERIC CHEMISTRY AND DEPOSITION

9. Fluxes of Greenhouse Gases in Maryland (FLAGG-MD) project

Xinrong Ren participated in the Fluxes of Greenhouse Gases in Maryland (FLAGG-MD) project for the third year to characterize the greenhouse gas (GHG) emissions from the Baltimore-Washington area. Xinrong collected data using the University of Maryland's

Cessna 402B research aircraft, which flew over the area to measure GHGs, meteorological variables, as well as other trace gas and aerosol optical properties. The emissions of GHGs were estimated based on the aircraft measurements and are compared to the emissions in the state and US EPA inventories. The FLAGG-MD project has produced policy-relevant science to provide improved quantification of anthropogenic GHG emissions to the scientific community and to regulatory agencies such as Maryland Department of Environment through direct analysis of ambient measurements and model simulations. xinrong.ren@noaa.gov

10. Atmospheric Mercury Modeling

Mark Cohen carried out numerous simulations with the HYSPLIT-Hg model to estimate the 2011 transport and deposition of mercury to the Great Lakes in conjunction with a Great Lakes Restoration Initiative-funded project. Mark collaborated with personnel from NOAA's Office of Response and Restoration who work with the Data Integration, Visualization, Exploration, and Reporting/Environmental Response Mapping Application ([DIVER/ERMA](#)) system to begin the process of displaying HYSPLIT-Hg model results in this data visualization system. Further simulations, post-processing analysis, and DIVER/ERMA integration will be conducted in the coming quarter.

Mark Cohen also developed a speciated mercury emissions inventory of point and area sources in the United States and Canada for 2011. The inventory is based on data from the USEPA National Emissions Inventory, Environment Canada's National Pollutant Release Inventory, and Environment Canada's Air Pollution Emission Inventory. Mark also worked on speciating the mercury in the U.S. point source inventory by collaborating with the State of Maryland. mark.cohen@noaa.gov

Chris Loughner made additional progress on parallelizing the HYSPLIT-Hg model, to enable the parallelized version to be used with additional meteorological datasets. Chris also made substantial progress developing a nested-grid capability with the Eulerian modeling framework of HYSPLIT-Hg. christopher.loughner@noaa.gov

CLIMATE OBSERVATIONS AND ANALYSES

11. Climate Reference Network (CRN)

ATDD staff made 24 annual maintenance visits to USCRN sites. mark.e.hall@noaa.gov.

12. NOAA/INL Mesonet

FRD is developing and testing programs for the Campbell Scientific CR6 data logger that will allow it to be inserted seamlessly into the NOAA/INL Mesonet for testing. FRD

plans to purchase enough data loggers to switch six stations to the new data logger and VHF internet communication system by the summer, 2017. If the new communication system works well, then updates will be made to the entire Mesonet.

Devin.Clinger@noaa.gov, Roger Carter

ARL 2nd Quarter Publications

Buisán, S. T., M. E. Earle, J. L. Collado, **J. Kochendorfer**, J. Alastrué, M. Wolff, C. D. Smith, and J. I. López-Moreno (2017). Assessment of snowfall accumulation underestimation by tipping bucket gauges in the Spanish operational network, *Atmospheric Measurement Techniques*, 10, 1079-1091, doi:10.5194/amt-10-1079-2017

Butler, A. H., J. P. Sjöberg, **D. J. Seidel**, and K. H. Rosenlof (2017) A sudden stratospheric warming compendium, *Earth System Science Data*, 9, 63-76, doi:10.5194/essd-9-63-2017.

Chai, T., A. Crawford, **B. Stunder**, M. J. Pavolonis, **R. Draxler**, and **A. Stein** (2017). Improving volcanic ash predictions with the HYSPLIT dispersion model by assimilating MODIS satellite retrievals, *Atmospheric Chemistry and Physics*. 17, 2865-2879, doi:10.5194/acp-17-2865-2017

Lee, Pius, Jeffery McQueen, Ivanka Stajner, Jianping Huang, Li Pan, Daniel Tong, Hyuncheol Kim, Youhua Tang, Shobha Kondragunta, Mark Ruminski, Sarah Lu, Eric Rogers, **Rick Saylor**, Perry Shafran, Ho-Chun Huang, Jerry Gorline, Sikchya Upadhyay, and **Richard Artz** (2017). NAQFC developmental forecast guidance for fine particulate matter (PM2.5), *Weather and Forecasting*, Volume 32, Issue 1, 343–360, <http://dx.doi.org/10.1175/WAF-D-15-0163.1>

Zhou, Hao, Chuanlong Zhou, Mary M. Lynam, J. Timothy Dvonch, James A. Barres, Philip K. Hopke, **Mark Cohen**, and Thomas M. Holsen (2017). Atmospheric Mercury Temporal Trends in the Northeastern United States from 1992 to 2014: Are Measured Concentrations Responding to Decreasing Regional Emissions? *Environmental Science & Technology Letters*. 4, 3, 91-97 doi:10.1021/acs.estlett.6b00452. This paper was featured on the cover of ES&T Letters (March 2017)

Conferences, Presentations, & Invited Talks

ARL staff participated in the 97th Annual Meeting of the American Meteorological Society in Seattle, WA.

Glenn Rolph gave a presentation entitled: *Real-time Environmental Applications and Display sYstem: READY*. The presentation gave an overview of the READY web site and plans for additional functionality.

Scientists from ATDD provided seven scientific presentations.

Temple Lee: *Leveraging Observations from the Verification of the Origins of Rotation in Tornadoes Experiment-Southeast to Investigate the Role of Boundary Layer Heterogeneities on Convection Initiation*

Michael Buban: *The Sensitivity of Convection Initiation to Surface Heterogeneities during VORTEX-SE*

John Kochendorfer: *The WMO Solid Precipitation Intercomparison and the determination of universal wind speed corrections*

Ed Dumas: *Use of a Small Unmanned Aircraft System in VORTEX-SE*

Rick Saylor: *A Re-evaluation of Particle Dry Deposition over Forested Landscapes*

Will Pendergrass: *Evaluation of NOAA/NCEP's North American Mesoscale (NAM) 12-km and 4-km High-Resolution Next (NAM4) Forecast for a Typical Southern Temperate Deciduous Forest*

Sheridan Green (2017 NOAA Hollings Scholar Intern) and Rick Saylor: *A Comparison of Two Chemical Mechanisms Using Data from the Southern Oxidant and Aerosol Study*

Bruce Baker organized and served as Program Chair for the [Special Symposium on Meteorological Observations and Instrumentation](#). Bruce, John Kochendorfer, and Ed Dumas served as session chairs during that special symposium. Bruce Baker also Co-chaired the session titled: [Unmanned Aerial Systems: Environmental Monitoring and Impacts on Operations, which was a joint session between the 18th Conference on Aviation, Range and Aerospace Meteorology and the Special Symposium on Meteorological Observations and Instrumentation](#)

Richard Artz and Ariel Stein participated in the Workshop on Measurement-Model Fusion for Global Total Atmospheric Deposition (MMF-GTAD) in Geneva, Switzerland from February 28 to March 2, 2017 organized by the World Meteorological Organization's (WMO) Science Advisory Group on Total Atmospheric Deposition (SAG-TAD) of which Stein is the current Chair and Artz is the former Chair. The objective of this workshop was to review the state-of-the-science and establish a Global Atmosphere Watch (GAW) project on Measurement-Model Fusion for Global Total Atmospheric Deposition for the purpose of generating global maps of total atmospheric

deposition and ambient gases and particle species. Over 40 participants were involved in the workshop. In addition, Stein and Artz organized a 1-day SAG-TAD steering committee meeting on March 3, 2017 to discuss current and future activities regarding total deposition in the WMO.

Ariel Stein participated as an invited lecturer of the Master Interunivesitario en Ingenieria Ambiental teaching the graduate course entitled "Contamination Atmosferica: Origen, Tratamiento y Control", at the Universidad Internacional de Andalucia in Huelva, Spain. This graduate course is considered one of the top courses in Spain regarding environmental pollution and air quality. The lectures covered an introduction to the NOAA HYSPLIT model and hands on exercises.

Daniel Tong and Pius Lee were session chairs and speakers at the 8th International Workshop on Air Quality Forecasting and Research (IWAQFR) held in Toronto, Canada in January, 2017. Daniel provided a talk entitled: "Rapid update of anthropogenic NOx emission with fused satellite and ground observations: initial application for NOAA forecasting during the summer 2016." Pius provided a talk entitled: "Towards an unified emission system for regional dust forecast in NOAA, USA."

Pius Lee spoke at the 3rd Pollen Summit held at the Centers for Disease Control and Prevention in Atlanta, GA. Pius' talk was on a possible prototype of pollen monitoring and forecasting system leveraging the wealth of near real time observations from NOAA and NASA satellites. Those in attendance agreed that a national pollen monitoring network would be critical for clinical and respiratory disease trend studies. Initial thoughts expressed were to take advantage of the existing National Atmospheric Deposition Program (NADP) sites as potential sites for the future national pollen monitoring network.

Pius Lee gave a talk to the Environmental Engineering Department at Georgia Tech. The talk was entitled: "The future dynamic-core scheme at NCEP: The basis for all operational meteorological numerical prediction models (NWP) at NOAA."

Pius Lee and Daniel Tong attended the 2nd annual NASA Health and Air Quality Applied Sciences Team (HAQAST) meeting at the University of Washington in Seattle. The meeting involved principal- and co-investigators of the HAQAST's 13 research teams funded by NASA to spearhead satellite applications in air quality and public health. Daniel and Pius gave the following talks, respectively: "Challenges of Air Quality Services in a Changing World", and "Possibility of establishing a national pollen monitoring network and seasonal and peaking forecast for pollen outbreaks."

Outreach & Engagement

ATDD launched a new website that uses the WordPress Content Management System. The URL is <http://www.atdd.noaa.gov/>. For more information, contact: michael.potter@noaa.gov.

Walt Schalk and James Wood hosted a tour of SORD for 15-20 DOE National Laboratory scientists and Department of Defense representatives. The tour was part of the Federal Expertise Training program hosted by NNSA. The tour took place at the Desert Rock Weather Observatory at the Nevada National Security Site. A verbal history of the SORD program and support of the testing program was given. SORD's current activities were also presented. The numerous instrumented sites that SORD maintains for NNSA Programs (SODAR, mesonet and lightning detection network) and hosts for a variety of NOAA Programs (Climate Reference Network, SURFRAD, GPS Water Vapor soundings – ESRL) located in the immediate Desert Rock area were discussed. As a finale, a Pilot Balloon release was demonstrated.