NOAA Air Resources Laboratory

Quarterly Activity Report

(January – March 2009)

Contents

Highlights

1. Lester Machta Memorial Lecture. To honor the memory of Dr. Lester Machta, Director of the Air Resources Laboratory from its inception in 1948 until 1989, a lecture on "A World of Change: Climate Yesterday, Today, and Tomorrow" was presented by Dr. Susan Solomon, NOAA Earth Systems Research Laboratory. The lecture, sponsored by the Machta family, was held Sunday, March 29, at Temple Adat Shalom, Bethesda, Maryland, and was attended by about 150-175 people. Dian Seidel introduced the speaker, highlighting Dr. Machta's pioneering and varied contributions to environmental science, including climate, air quality, and stratospheric ozone research, and the strong parallels between his and Dr. Solomon's professional activities and personal styles. dian.seidel@noaa.gov

2. Progress on the GCOS Reference Upper Air Network (GRUAN). This quarter saw several milestones in the realization of the GRUAN, a network for climate-quality observations of the vertical profile the atmosphere, including:

1) Publication of the first article on the network to appear in the peer-reviewed literature: Seidel, D.J., F.H. Berger, H. Diamond, J. Dykema, D. Goodrich, F. Immler, W. Murray, T. Peterson, D. Sisterson, M. Sommer, P. Thorne, H. Vömel, and J. Wang, 2009: Reference upper-air observations for climate: Rationale, progress, and plans. *Bull. Amer. Meteorol. Soc.*, 90, DOI: 10.11752008BAMS2540.1.

2) First GRUAN Implement and Coordination Meeting. held March 2-4, 2009, in Norman, Oklahoma. At this meeting, agreements were reached and elements of a workplan were developed to move the GRUAN toward full operations.

3) Establishment of an international research team to identify and carry out a series of well-defined, limited-scope, retrospective analyses relevant to key GRUAN science issues. The unifying purpose of this series of studies will be to obtain insight from past observations for optimizing the design and implementation of the GRUAN observational program. Dian Seidel is leading this effort.

More information about GRUAN is available at http://www.arl.noaa.gov/GRUAN.php and www.gruan.org. dian.seidel@noaa.gov

3. USCRN/NIDIS Workshop. Soil moisture and soil temperature were the focus of a workshop, 3-5 March 2009, sponsored by NOAA's Climate Reference Network (USCRN) and the National Integrated Drought Information Service (NIDIS) and hosted by ATDD, Oak Ridge, TN. Twenty experts invited from NOAA, USDA, USGS, NCAR, and various state agencies and universities participated. The wide-ranging discussion provided guidance regarding instruments and their installation, and established connections to related *in-situ* networks, remote observing systems, and modeling activities. tilden.meyers@noaa.gov

4. EPA Roadside Sound Barrier Tracer Study. The Roadside Sound Barrier Tracer Study, conducted in 2008, was completed at the end of January. A comprehensive draft document and final quality controlled data were delivered on schedule to the EPA. The draft document *Roadside Sound Barrier Tracer Study 2008* will be published as a NOAA Technical Memorandum and has already passed ARL review. It contains details of all phases of the work including the experimental design, construction of the barrier and sampling grids, tracer measurements made with bag samplers and fast response analyzers, standard meteorological and turbulence measurements, tracer line source release systems, and a section summarizing the results and presenting conclusions. The report provided the basis for two other papers that were submitted during the quarter. A summary of the roadway barrier study and the main conclusions of the research were previously presented in FRD's first quarter report for 2009. kirk.clawson@noaa.gov and staff

5. National Ambient Air Quality Standards/EPA. Marc Pitchford assisted EPA with its review of the Particulate Matter (PM) National Ambient Air Quality Standards (NAAQS) Scope and

Methods Plan for Urban Visibility Impact Assessment. EPA staff is considering a proposed welfare-based secondary PM NAAQS designed to address visibility impacts in urban areas at PM concentrations below the health related Primary PM NAAQS 24-hour mean control level of 35$\mu g/m^3$. To do so EPA must determine the urban haze level that would be considered adverse to public welfare, which requires input from surveys of public response to various haze conditions depicted in urban scenic photographs. The technical issues and approaches used to conduct these surveys was the topic of an EPA-sponsored workshop. Dr. Pitchford and others are using the information disseminated at the workshop to draft plans to conduct the surveys, which if approved would be started after OMB approval, probably next year. marc.pitchford@noaa.gov

Air Resources Laboratory – Headquarters

6. Ozone Paper Accepted. A paper by Jim Angell and Melissa Free entitled "Ground-based observations of the slowdown in ozone decline and onset of ozone increase" was accepted by the Journal of Geophysical Research-Atmospheres. The paper shows five-year trends changing from negative to positive for global total ozone and for the north temperate, north polar and tropical regions. A change from negative to positive trends also occurs for the most recent period in Umkehr and ozonesonde data but is not statistically significant. In the north temperate zone, the largest share of the increase in trend comes from the lower stratosphere. melissa.free@noaa.gov

7. ENSO Effects on the Stratosphere. A study of the effect of El Nino on temperatures in the stratosphere was submitted for internal review. The paper by Melissa Free shows a statistically significant cooling effect in the tropical stratosphere and large warming in the north polar stratosphere in boreal winters that coincide with El Ninos. The results were also presented at the AMS annual meeting in Phoenix in January. melissa.free@noaa.gov

8. Climatological Planetary Boundary Layer Study. In collaboration with Dr. Chi Ao at NASA/JPL, Dian Seidel is investigating climatological aspects of the global planetary boundary layer (PBL). Initial work involves intercomparison of PBL height estimates derived using seven different methods, some traditional (based on meteorological data) and some novel (based on refractivity data from the Global Positioning System (GPS) radio occultation method). The aim is to understand how estimates obtained from different observing systems and using different methods influence our understanding of the climatology of PBL height. Preliminary results show large differences among the methods, in terms of PBL height and in terms of seasonal and diurnal patterns. Eventually, by determining the nature and cause of these differences, we hope to contribute to:

- evaluations of model representations of the PBL, as there are currently no global PBL datasets for this purpose
- understanding the differences between radiosonde- and GPS-based PBL determinations
- understanding long-term changes in PBL structure and their potential connection with long-term trends in tropospheric and surface temperature

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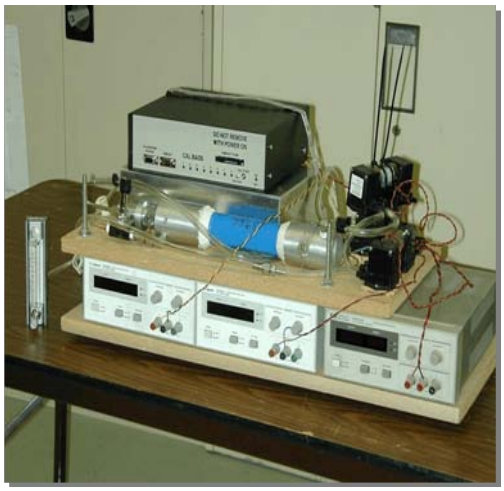
Atmospheric Turbulence and Diffusion Division

9. Joint Gulf Coast Field Study. A new intensive data base for mesoscale atmospheric features on the Gulf Coast will be developed this summer in a joint field project between Air Resources Laboratory and Jackson State University in Mississippi. A particular focus will be the development of the mixing depth in the planetary boundary layer during sea-breeze conditions. Profiles of wind and temperature will be sampled by radiosonde, while turbulence and mixing are sampled from short towers. Additionally, air-quality measurements at two sites at differing inland distance will sample ammonia, sulfur dioxide, nitric acid, and fine particulate nitrate and sulfate ($PM_{2.5}$). latoya.myles@noaa.gov

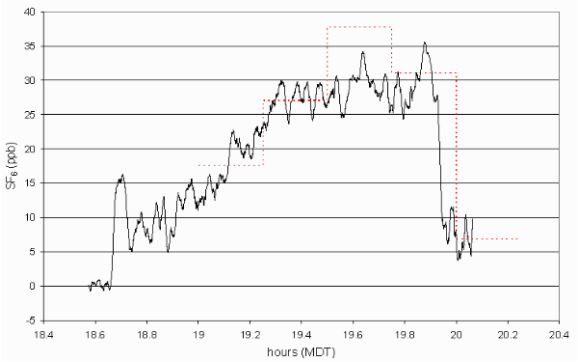
10. Atmospheric Mercury Field Activities. Atmospheric mercury's transformation among (chemical) species and its deposition to the surface are being explored in ever-widening settings. In Pennsylvania, a long-term rural site frequently but not always downwind of three major coal-fired power plants will sample the three main atmospheric mercury species at various times of day during plume strikes and apart from them. A short intercomparison in Michigan among mercury samplers used by practitioners in multiple nations demonstrated a readily measureable relation between concentration of reactive gaseous mercury and its dry (i.e. not by rain) deposition to the surface. Uncertainty in these measurements, however, indicates further study. The Texas Study of Houston Atmospheric Radical Precursors (SHARP), which ends in May 2009, focuses on ozone but includes a mercury component. The three mercury species are being measured within 2 km of the Houston Ship Channel, a heavily industrialized region having numerous small sources. This offers comparison of mercury speciation in "young" plumes (1-2 km downwind) to that in the "older" plumes (30 km downwind) in Pennsylvania, albeit in a potentially different chemical regime. steven.brooks@noaa.gov

Field Research Division

11. Low Cost Tracer Detector. For several years, FRD has been researching new methods of measuring atmospheric tracers that may allow development of a lower cost fast response analyzer. During the EPA Roadside Sound Barrier Tracer Study, a prototype tracer measurement instrument was assembled using a semi-permeable membrane from Membrane Technology Inc. and a detector assembled at FRD (see figure). This prototype was collocated with a sampler during Test 5 of the study. Comparison of the concentrations measured by this prototype instrument and the 15-minute average



concentrations measured by the sampler showed surprisingly good agreement (the dotted line shows the bag sampler concentrations), demonstrating that a lower cost fast response analyzer could be practical. roger.carter@noaa.gov



12. ET Probe. FRD has started upgrading the ET probes on the assumption that NOAA funding will be available once the budget has been approved. The primary focus is on design changes that will allow the probes to operate over extended deployments at marine locations. The pressure ports on the ET sphere have been made more robust by replacing the plastic tubing with metal tubing. In the 2004 hurricane deployments, the temperature housing at the top of the probe was a weak point, so the original housing has been replaced by a new one based on the housings used on the INL Mesonet towers. There has been some debate about the best approach for upgrading the probe's data acquisition system. Initially, it was thought that using a small computer that could fit inside the probe itself would be ideal. However, the drawback of this approach for marine deployments in hurricanes is that the computer and archived data are automatically lost if the probe is dislodged and falls into the water. Having the computer system in a separate housing increases the chances of recovering data even if the probe itself is lost.
rick.eckman@noaa.gov

13. Transport and Dispersion Modeling. A major effort started in the second quarter to develop a new dispersion modeling system for INL applications. This system will be based on the NOAA HYSPLIT model. Several members of the FRD staff are involved in the effort. The following entries describe some of the progress that has been made on specific features of the system. In some cases, other divisions in ARL have already developed software that may potentially meet FRD's needs, and this existing software is being adopted when possible. The plan is to have a prototype of the dispersion system working by the end of summer. rick.eckman@noaa.gov and FRD staff

One major goal of the effort to use HYSPLIT for INL applications is the inclusion of a more robust radiological module that can serve the needs of FRD's INL clients more effectively than is presently available within MDIFF. This has called for the development of code that can convert the "concentrations" (Ci/m^3) of multiple nuclides into multiple dose types in rem. Some significant development work on converting concentrations into rem for multiple dose types has already been done by Glenn Rolph and Roland Draxler in the ARL HYSPLIT group. They have also developed a prototype program for plotting the final doses. We have drawn heavily on their efforts and are using their prototype concentration-to-dose conversion and plotting programs as bases for our work. The main limitations of the existing prototypes with respect to our needs are (1) the concentration-to-dose program presently can only calculate doses for one nuclide concentration and (2) our INL clients have somewhat different plume contouring requirements than is presently available. We have re-written the concentration-to-dose program such that it can now calculate multiple doses using the individual contributions from multiple nuclides. We are in the process of making the necessary modifications to the dose plotting program to

accommodate our specific contouring needs. The biggest improvements offered by the new radiological module compared to the previous MDIFF scheme are (1) accounting for the individual contributions of each nuclide to each type of dose when multiple nuclides are present and (2) deposition is now available and can be customized for each nuclide. dennis.finn@noaa.gov and Jason Rich

Another important facet of the work is development of the user interface for the INL client. Our initial emphasis is on developing the simplest and most user-friendly interface possible. Advanced options will be gradually be added to permit setting up more customized dispersion scenarios. Output will be produced using the Google Maps API. This will provide a dynamic environment for easy rescaling and the plotting of multiple dose types. Development of the user interface and manipulation of the output will be written using the Flex programming environment. This will allow the application to run within the Adobe Flash browser plug-in. Work is presently focused on developing the software that builds the input-output interface, the control file for passing parameters into HYSPLIT and subsequent program modules, and the master control program. brad.reese@noaa.gov, Dennis Finn, and Jason Rich

FRD has also been working with INL to provide our Mesonet data in formats required for regulatory requirements. INL is now using the EPA AERMOD model for certain applications and requested that FRD reformat the Mesonet data in a suitable form for that model. This turned out to be more difficult than anticipated, mainly because the 915 MHz radar wind profiler data turned out to be insufficient as a stand-alone vertical sounding for the model's purposes. Also, AERMOD does not appear to handle some specialized turbulence and flux measurements as well as is suggested in the user's manual. More recently, FRD also received a request to process Mesonet data and put it in formats suitable for Nuclear Regulatory Commission (NRC) models. This is part of a re-licensing effort for the Advanced Test Reactor. rick.eckman@noaa.gov and Neil Hukari

Special Operations and Research Division

14. Rocky Mountain Atmospheric Nitrogen and Sulfur (RoMANS) Study. A plan for conducting a formal peer review of the Rocky Mountain Atmospheric Nitrogen and Sulfur (RoMANS) Study Report was drafted. The RoMANS Study was designed to characterize the deposition levels, mechanisms involved and emission sources responsible for an increasing trend in sulfur and nitrogen deposition levels at Rocky Mountain National Park that exceed critical load levels for the park's ecosystems. The study included two seasonal field measurement campaigns in 2006 at a number of sites in the region. This formal review is the first of its kind within the NPS, and conforms to a new policy with respect to required reviews of sources of influential scientific information. marc.pitchford@noaa.gov

15. Western Regional Air Partnership (WRAP). Marc Pitchford participated in a Western Regional Air Partnership (WRAP) Technical Oversight Committee (TOC) in Salt Lake City (3/11 - 3/12). The purpose of the meeting was to review the WRAP proposed 2010/2011 budget for continued work on regional haze and, optionally to expand their technical assessment work to include other regional air quality issues (e.g. ozone, mercury and nitrogen deposition, and impacts of renewable energy development) in the western half of the country. WRAP includes

participation of state, tribal, federal and private organizations. EPA discontinued funding of all of the Regional Planning Organizations, including WRAP for the 2009 fiscal year, but this budget was specifically requested by the western state air managers who will pursue renewed and expanded funding of WRAP. marc.pitchford@noaa.gov

16. House Committee on Science and Technology. Marc Pitchford represented ARL in a NOAA teleconference briefing of staff from the House Committee on Science and Technology on monitoring/ assessment of atmospheric constituents contributing to global climate change (e.g. CO2, trace gases and particulate matter including black carbon). The overall question was how can NOAA science help to ensure that the changes mandated by climate change legislation and treaties are being adhered to? Much of the briefing included discussions of NOAA's Carbon Tracker program, as well as global trends monitoring at the Mauna Loa Observatory and air quality field monitoring research studies. A major deficiency identified by NOAA monitoring/assessment activities is the quality of current emissions inventories. marc.pitchford@noaa.gov

17. SORD Publication. The following paper was accepted for publication in the Journal of the Air and Waste Management Association:

Pitchford, M.L., Poirot, R.L. Schichtel, B.A., and Malm, W.C., "Characterization of the Winter Midwestern Particulate Nitrate Bulge, Journal of the Air and Waste Management Association. In press, February 2009. marc.pitchford@noaa.gov

18. Weather Research and Forecasting (WRF) Model Bias Research. The WRF ARW model has been run at least once per day for more than two years at SORD to provide additional guidance in support of daily operations, experiments, special projects, and exercises on the Nevada Test Site (NTS). Since late 2007 the model has been run 4 times per day in cycling mode with data assimilation. During the fall 2008-early winter 2008/9 period, WRF ARW forecasts showed a pronounced diurnal temperature bias at 4 sites in southern Nevada. The largest bias was found around sunrise in the valleys and on the dry lake beds of the NTS where predicted temperatures were occasionally more than 15 C warmer than observed. Temperature bias at the urban, heat island affected McCarran Airport and at the high elevation site on Rainier Mesa was much less than in the valleys and on the dry lake beds where strong night time inversions were common. Dewpoint bias was less than temperature bias and was quite low at McCarran Airport and relatively high in the valleys and on the dry lake beds of the NTS where dewpoints were higher than observed around sunrise. Wind speed bias was low except on the dry lake beds where winds were on average about 1 m/s weaker than predicted. The temperature bias from the 12 UTC forecasts was noticeably less than that from the 00 UTC forecasts for most hours at all 4 sites. At the end of the forecast cycle, 12 UTC the following day, the difference was about 0.5 C. Differences in dewpoint and wind speed bias between the 00 and 12 UTC forecasts were small. kip.smith@noaa.gov

19. DOE Meteorological Coordinating Council. Walt Schalk ***c***haired bi-monthly teleconference; developed the agenda for the DMCC Annual Conference to be held in conjunction with the DOE Emergency Management Issues – Special Interest Groups (EMI-SIG) Conference in May and reviewed comments from Hanford personnel on the draft Meteorological

Program Assist Visit Report for the Hanford Site. Walt also participated in a review of the Oak Ridge National Laboratory Meteorology and Consequence Assessment Program and participated in the development of the out brief, and the preliminary report. walter.w.schalk@noaa.gov