NOAA ARL Monthly Activity Report

November 2000

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Contents

Highlights

1. Workshop on Ammonia Pollution. On November 15-16, 2000, the 3rd Shared Resources Airsheds & Watersheds workshop was held in Dewey Beach, Delaware. The workshop focused on the significance of ammonia emissions to coastal and estuarine areas. A diverse group of more than 130 people participated in this event. These participants came to an agreement that reduced nitrogen (ammonia/ammonium) deposition is a significant form of nitrogen loadings to terrestrial and aquatic ecosystems and that the largest emission source is agriculture.

Subsequent to the meeting, the Scientific and Technical Advisory Committee of the Chesapeake Bay Program has set up an Ammonia Task Force to ensure that an organized, collaborative research strategy is constructed, which will address the greatest gaps in our scientific knowledge concerning the role and significance of ammonia as a presently uncontrolled nutrient affecting the Chesapeake Bay region. A STAC-sponsored pro-active workshop on the ammonia issue is planned, with the following aims – (a) establish the

key unknowns; (b) agree on areas where studies would best be focused; (c) identify contributing technologies, expertise, and centers of excellence; and (d) establish working arrangements (formal, wherever necessary) among the entities contributing to the programs deemed most necessary. Participation in the workshop would be from all of the relevant research and policy organizations involved, representing academia, government agencies (state and federal), non-government organizations, industry, agriculturists and farmers, advocacy groups, etc. (bruce.hicks@noaa.gov, Kerchner, Silver Spring)

2. Canaan Valley Measurement Program Operational. For several years, ARL and Canaan Valley Institute scientists have been working together to address the environmental concerns of the eastern West Virginia highlands. An AIRMoN station is now operational there, and is soon to be upgraded with the addition of a SURFRAD site. Seasonal variations in wet deposition at the Canaan Valley, WV site are becoming apparent. The samples' acidity is decreasing slightly but noticeably, as the ongoing air-quality monitoring enters the cold season. Efforts are underway to identify likely source regions of pollutants affecting the area. The work uses NOAA/ARL's HYSPLIT model, which can calculate back trajectories of airmasses. Meetings to determine time lines and equipment needs for Spring upgrades in 2001 were held among ATDD staff. Planned instrument suites will measure the full surface energy budget and will comply with NOAA's SURFRAD protocol. (vogel@atdd.noaa.gov, Meyers, Hall – Oak Ridge)

In preparations for the deployment of SURFRAD equipment, a problem was found in the software used to interpolate NWS sounding data to the locations of SURFRAD stations. The entire interpolated sounding data set (1995-present) will be reprocessed after this code is tested and accepted. (John Augustine, 303 497 6415 – Boulder)

Silver Spring

3. Global Total Ozone Updated Through 1999. After a hiatus due to the unavailability of properly formatted ozone data from the World Ozone Data Center in Toronto, The ARL global total ozone record has been updated through 1999 with the invaluable assistance of Becky Ross. Global ozonesonde and Umkehr data are in the process of also being updated through 1999. Due to the relation between total-ozone amount and sunspot number, global total ozone increased by about 2% during the last 4-5 years as sunspot number increased to its 11-year maximum in 1999-2000. With sunspot number now in decline, global total ozone is indicated to be slightly less in 1999 than 1998, but with the value in both years basically 3% below the 1961-1990 average. The recent increase in total ozone is apparent in all climate zones except the south polar zone where the interannual variation in depth of the Antarctic ozone hole swamps any solar-cycle relation. The increase has been most apparent in the north polar zone (about 7%). The relation between global total ozone and sunspot number has not been clean during the last 11 years because of the approximate 3% decrease in global total ozone following the Pinatubo eruption in 1991. (Jim Angell, 301 713 0295, x127)

4. Pacific Disaster Center, Maui -- Ensemble Volcanic Plume Forecasts. Collaboration between the Pacific Disaster Center and ARL is leading to the implementation of an improved volcanic ash forecasting

capability. An ensemble system will be installed at the Pacific Disaster Center with all computations performed at the Maui High Performance Computing Center (MHPCC). The updated HYSPLIT code has been installed at the MHPCC. .File size is a serious issue because each member of the ensemble will create its own full-temporal-spatial-domain air concentration output file. (roland.draxler@noaa.gov)

5. 2nd SPARC General Assembly. During the 2nd General Assembly of the Stratospheric Processes and their Role in Climate (SPARC) program in Mar del Plata, Argentina, the SPARC Stratospheric Temperature Trends Assessment Panel met to discuss its intentions to participate in the next WMO/UNEP Ozone Assessment (which will address temperature trends) and a more comprehensive study of stratospheric indicators of climate change. The main themes of the meeting were: coupling of the stratospheric and tropospheric variations, especially via the Arctic Oscillation, and associated climate predictability; observations of gravity waves and their parameterization in climate models; the tropopause, its definition and variability; water vapor in the upper-troposphere/lower stratosphere; and ozone and UV trends. (dian.seidel@noaa.gov)

6. Volcanic Ash News. Earlier this year, the Washington Volcanic Ash Advisory Center (VAAC) agreed to transfer our volcanic ash modeling capability to the Buenos Aires, Argentina, VAAC. In the interim, Washington would run VAFTAD when requested by Buenos Aires. As a first step in transferring the modeling capability, a computer program was developed to convert the Buenos Aires' meteorological model output into the appropriate format as required by VAFTAD. The resulting ARL-packed files are currently undergoing testing.

During November, VAFTAD output was issued by NCEP for seven eruptions of Popocatepetl, Mexico. (barbara.stunder@noaa.gov)

Boulder

7. American Meteorological Society Committee on Measurements. John Augustine has accepted an invitation to serve a three-year term on the American Meteorological Society's Committee on Measurements. The period of the term is from January 31, 2001 to January 30 2004. (John Augustine, 303 497 6415)

Oak Ridge

8. Brazilian Nuclear Reactor Safety Assessment. Mr. Pedro Paulo de Lima-e-Silva, an employee of the Brazilian Nuclear Regulatory Agency, visited ATDD for about three weeks under an International Atomic Energy Agency program administered by the U.S. National Research Council. He worked on analyses of wind data and balloon and smoke trajectories and dispersion collected by ATDD at a Brazilian nuclear power plant during a 1988 field study. He had previously spent a year at ATDD in the 1980s, has since co-authored two books. (mcmillen@atdd.noaa.gov, Pendergrass, Rao)

9. Climate Reference Network. Planning and equipment testing continued for the new Climate Reference Network. A specialized test bath fluid to span the entire -60°C to the 60°C temperature range was ordered, to streamline the calibration process. NWS max-min digital thermometers were studied, and will be tested for accuracy and precision during December. (hosker@atdd.noaa.gov, Auble, McMillen, Meyers, Hall, Baker-NCDC)

10. Mercury in the Arctic. Seasonal mercury flux from the atmosphere to the surface during winter and spring 2000 at Barrow, AK was estimated by two independent means: accumulation in the snow, and deposition from the atmosphere. Accumulation estimates were derived from measured mercury concentrations in the monthly snow samples and the rate of accumulation of the snowpack's mass over the period. The snow accumulation was determined from snowfall and sublimation rates at Barrow, reported by the National Weather Service. Deposition from the atmosphere was estimated from the observed atmospheric mercury concentration along with other micrometeorological parameters. The results agree closely: 56.9 µgHg m^{-2} from snow accumulation and 55.1 µgHg m^{-2} from atmospheric deposition. If these flux rates (- 55 µg(Hg)m^{-2}) are typical over the circumpolar arctic (33.4 million km^2 defined by UN Arctic Monitoring and Assessment Program), this represents an annual sink of approximately 1,837 metric tons mercury, or about 25% of the total atmospheric mercury burden. (brooks@atdd.noaa.gov, Lindberg-ORNL)

Measurements for Spring 2001 in Barrow have recently been enhanced due to increased funding from the USEPA. Planned additions include airborne measurements in early April, snow sampling along transects, and ancillary sample analyses for lead and cadmium. (brooks@atdd.noaa.gov and Lindberg-ORNL)

11. NSF Multi-User Environmental Research Aircraft. A new MFP system for the Italian National Research Council's Sky Arrow aircraft was constructed this month. Testing of the system is underway, and delivery to the Sky Arrow factory in Rome, Italy, is expected during the first quarter of the year. (brooks@atdd.noaa.gov, Dumas).

Research Triangle Park

12. Community Multi-Scale Air Quality Model (CMAQ) Now Includes Mercury. The CMAQ's cloud chemistry subroutine AQCHEM has now been expanded to include a total of eight reactions involving elemental mercury (Hg^0) and numerous mercury compounds. The following neutral mercury compounds have been added to the mechanism: $HgCl_2$, $Hg(OH)_2$, HgOHCl, HgO, and $HgSO_3$. An aqueous dissociation equilibrium has been added which includes all of these neutral compounds plus the ionic species $Hg(SO_3)_2^{2-}$, $HgOH^-$ and Hg^{2+}. Oxidation of Hg^0 occurs through its reaction with dissolved ozone (O_3), dissolved reactive chlorine (HOCl and OCl^-), and the dissolved OH radical. $Hg(OH)_2$ is slowly photo-reduced by solar radiation to form Hg^0, and $HgSO_3$ is modeled as an unstable compound which decomposes at a temperature-dependent rate to form Hg^0 as described by Van Loon et al. (2000). This new $HgSO_3$ decomposition rate is much slower at normal atmospheric temperatures than had been previously indicated by earlier laboratory determinations, and the resulting CMAQ model simulations showed extremely high Hg^{2+} concentrations in cloud water. It was obvious that chemical reduction of Hg^{2+} species to form Hg^0 in cloud water must be occurring by some other means. Another reaction has been

added to the CMAQ aqueous chemistry mechanism involving the chemical reduction of all Hg^{2+} species by the hydroperoxyl radical (HO_2) as specified by Pehkonen and Lin (1998).

This updated aqueous mercury chemistry mechanism for CMAQ is now being evaluated as part of an international atmospheric mercury model inter-comparison organized by the Meteorological Synthesizing Centre - East (MSC-East) of the European Monitoring and Evaluation Programme (EMEP). MSC-East, located in Moscow, Russia, is providing closed cloud volume test conditions for all modeling participants to use in testing their models. Six separate test conditions have been specified to help identify important differences in model performance and provide explanatory evidence for these differences. Participants are from the United States, Germany, Sweden, and Russia. All closed volume tests are planned to be completed and analyzed by February 2001, at which time a meeting will be held at the MSC-East facilities in Moscow to discuss further model inter-comparison activities including full-scale model simulations over specific locations and time periods where adequate observations data are available. (Russ Bullock, 919 541 1349)

Idaho Falls

13. Refractive Turbulence Study. Flights to test the re-designed Fast, Ultra-Sensitive Temperature (FUST) probe (See October Monthly Report) were conducted in November around Idaho Falls. Goals for these flights were to test the temperature and frequency response of the new design in preparation for a second round of flights for the High-Altitude Refractive Turbulence Study (RTS00-2) to be conducted in Idaho Falls, winter 2000/2001. Preliminary results indicate that the two greatest problems with the original design have been alleviated. The original FUST probe did not respond well to high frequency fluctuations, due in part to the probe housing. The new probe utilizes an open-air design, eliminating any contamination of the air stream due to heat conduction from the walls of the housing. Results from flights in August also indicated that the original probe suffered from noise contamination, severely reducing the resolution of the probe. For the most recent test flights, spectra taken from straight and level legs reveal the new probe responds to temperature fluctuations out to at least 20 Hz. This is even more encouraging given the rather weak signal encountered at the 18,000 feet flight altitude. Further tests will be conducted to determine the recovery factor for the probe as well the investigating frequency response under conditions of both stronger and weaker signal. (jeff.french@noaa.gov, Tim Crawford, Shane Beard, Randy Johnson)

14. Extreme Turbulence (ET) Probe. The 16-inch diameter prototype fiber glass ET Probe sphere is complete, with the necessary physical and electronics mounting hardware. The previously completed and tested electronic transducer board and data acquisition system are mounted inside with the pneumatic connections to the pressure transducers on the electronics board. A ribbon cable connects the transducer board to the Data Translation data acquisition module. Two way data flow and power to the data acquisition module are provided via a small USB cable from a notebook computer. A small diaphragm pump in conjunction with a miniature flow splitter provide back-flow air of a few cubic centimeters per minute through each of the 30 pressure ports on the sphere. The back flow air will keep each of the ports clear of water and small debris that would affect pressure port measurements. (tim.crawford@noaa.gov, Randy Johnson, Eric Egan, Jerry Crescenti)

15. Salt Lake City -- VTMX-CBNP 2000. The field deployment phase of VTMX-CBNP 2000 has come to an end. However, remnants of the study can still be seen around FRD. The analysis of the whole-air bag samplers continued in November, and will be completed in early December. The age of the analysis equipment is evident in the failure of oven controllers to maintain proper column temperature and in the shape of the chromatograph signal. Initial results from the first 4 tests show that whole-air bag sample SF_6 concentrations were below 215,000 ppt. These high concentrations severely challenged the measurement capability of our systems, which are usually used for maximum concentrations 40 times lower. The real-time SF_6 analyzers are also aging. The standing current of the electron capture detector is about one-half its original strength. The detectors have been removed and returned to the manufacturer for reconditioning. (kirk.clawson@noaa.gov and staff)

A 10-m meteorological tower, phased-array Doppler sodar, and a 915-MHZ radar wind profiler acquired more than 3-weeks of surface and upper-air meteorological data during the VTMX-CBNP 2000 field study from October 4 to October 27. These sensors were deployed in a open parking lot on the grounds of the Raging Waters entertainment complex (40 43.92' N, 111 55.65' W, elevation 1291 m). This site, about 5 km southwest of downtown Salt Lake City, was secured for the VTMX-CBNP 2000 field study. A 10-m tower was installed for the measurement of wind speed, wind direction, air temperature, and relative humidity. (jerry.crescenti@noaa.gov, Neil Hukari)

16. INEEL Mesoscale Modeling. Some preliminary comparisons have been made between the MM5 simulations for Southeast Idaho and the meteorological observations from the INEEL Meosnet. Nineteen Mesonet towers are included in the comparison. The observed speeds are taken at about 15 m AGL, whereas the predicted speeds are from the lowest sigma level in the MM5 simulations, about 36 m AGL. A slight positive bias is observed in the early morning hours, which could partly be explained by the greater height AGL of the model predictions. During the afternoon hours, the median model wind speeds are about 2 m/s less than the observations. The height difference between the observations and predictions works against the model in this case. The results confirm previous experience that MM5 tends to underestimate afternoon wind speeds in the Snake River Plain. Larger samples will of course be required before more statistically conclusive results can be obtained. (richard.eckman@noaa.gov)

Las Vegas

17. Cloud-to-Ground (CG) Lightning Project. A detailed analysis of cloud-to-ground flashes on the Nevada Test Site (NTS) was completed for the 1993 through 1999 warm seasons. The seven-year analysis was completed for 1 km^2 areas. The results of the analysis show that for the seven-year period the total number of cloud-to-ground flashes ranges from 1 to 2 flashes/square kilometer (fl/km^2) in much of Area 25 to 12 to 13 fl/km^2 in Areas 10, 12, 19, and in the southern part of Area 23, just south of Mercury, NV. Many of the larger flash counts are located over terrain above 1525 m (5000 ft) above mean sea level. The large flash counts located south of Mercury are generated by thunderstorms that develop over the northern end of the Spring Mountain Range and drift northward toward the NTS. At key facilities, such as, U1a, Hazardous Materials Spills Center, Device Assembly Facility, and Mercury the total flash counts are 2 to 4 fl/km^2. At the Big Explosive Experiment Facility it is 1 to 2 fl/km^2. The data file for the 2000 warm season

is being developed and will be added to the 1993-1999 data base in December. This 8-year data base will be analyzed as soon as possible. (Darryl Randerson, 702 295 1231)