SAES-422 Multistate Research Activity Accomplishments Report

Project No. and Title:	NRSP-3, The National Atmospheric Deposition Program – A Long-Term Monitoring Program in Support of Research on the Effects of Atmospheric Chemical Deposition
Report Period:	10/1/2014 through 9/30/2015
Date of Report:	December 28, 2015
Meeting Dates:	Fall, October 21-24, 2014; Spring, April 13-15, 2015.

Participants

A listing of the attendees for our latest Fall Meeting (FY15) is available at the meeting summary location at the NADP website (nadp.isws.illinois.edu/nadp2015/).

Meeting Minutes

The NADP is comprised of a technical committee (all participants), an executive committee, several scientific committees, and a series of subcommittees focusing on specific areas of the ongoing project, including operations, quality assurance, ecological response and outreach, and data management. All approved meeting minutes from our FY2015 Spring and Fall Meetings (and all other meetings) are available on our website (nadp.isws.illinois.edu/committees/minutes.aspx). Some subcommittee minutes will be delayed for approval, but they will be posted when approved at the same address.

Accomplishments

The NRSP-3 provides a framework for cooperation among State Agricultural Experiment Stations (SAES), the U.S. Department of Agriculture-National Institute of Food and Agriculture, and other cooperating governmental and non-governmental organizations that support the National Atmospheric Deposition Program (NADP). The NADP provides quality-assured data and information on the exposure of managed and natural ecosystems and cultural resources to acidic compounds, nutrients, base cations, and mercury in precipitation and through dry deposition of several of these compounds. NADP data support informed decisions on air quality and ecosystem issues related to precipitation chemistry.

Specifically, researchers use NADP data to investigate the impacts of atmospheric deposition on the productivity of managed and natural ecosystems; the chemistry of estuarine, surface, and ground waters; and the biodiversity in forests, shrubs, grasslands, deserts, and alpine vegetation. These research activities address "environmental stewardship," one of the Agricultural Experiment Station's research challenges (Science Road Map #6). Researchers also use NADP Mercury Deposition Network data to examine the role of atmospheric deposition in affecting the mercury content of fish, and to better understand the link between environmental and dietary mercury and human health. This fits with another research priority of "relationship of food to human health."

The NADP operates three precipitation chemistry networks: the National Trends Network (NTN), the Atmospheric Integrated Research Monitoring Network (AIRMoN), and the Mercury Deposition Network (MDN). This report is specifically for the 48 NTN sites operated at the miscellaneous State Agricultural Experimental Stations (SAES), and in part supported by this agreement. This report focuses on the accomplishments and impacts from this network.

The NTN provides the only long-term nationwide record of basic ion wet deposition in the United States. Sample analysis includes free acidity (H^+ as pH), specific conductance, and concentration and deposition measurements for calcium, magnesium, sodium, potassium, sulfate, nitrate, chloride, bromide, and ammonium. We also measure orthophosphate ions (PO_4^{3-}, the inorganic form), but only for quality assurance as an indicator of sample contamination. At the end of September 2015, 261 NTN stations were collecting one-week precipitation samples in 48 states, Puerto Rico, the Virgin Islands, Canada, and in Argentina. Additionally, there are multiple quality assurance and testing sites. Complementing the NTN is the 6-site AIRMoN which are essentially NTN sites operated on a daily basis (i.e., single precipitation events). Samples are collected to support continued research of atmospheric transport and removal of air pollutants and development of computer simulations of these processes.

The 113-site MDN offers the only long-term and routine measurements of mercury in North American precipitation. Measurements of total mercury concentration and deposition (and optional methyl-mercury) are used to quantify mercury deposition to water bodies, some of which have fish and wildlife mercury consumption advisories. Since 2008, every state and 10 Canadian provinces listed advisories warning people to limit fish consumption due to high mercury levels. Coastal advisories are also in place for Atlantic waters from Maine to Rhode Island, from North Carolina to Florida, for the entire U.S. Gulf Coast, and for coastal Hawaii and Alaska.

The NADP operates two newer gaseous atmospheric chemistry networks: the Atmospheric Mercury Network (AMNet) and the Ammonia Monitoring Network (AMoN). In each case, the network goal is to provide atmospheric concentrations of these particular gases, and then to estimate the rate of dry deposition (without precipitation) of the gas. In many cases, dry deposition of the gas could far exceed the wet deposition of the same compound.

At the end of September 2015, 20 AMNet sites were collecting five-minute estimates of gaseous elemental mercury and two-hourly average concentrations of gaseous oxidized mercury and particulate bound mercury. The AMNet provides the only long-term region-wide record of basic atmospheric mercury concentrations in the United States. The AMoN has 94 sites operating as of September 2015, where two-week averages of atmospheric ammonia gas are being collected with passive devices. This low-cost network is designed to provide long-running estimates of ammonia in the atmosphere. These data are particularly important to agriculture, since many sources of ammonia are agricultural (Roadmap Challenge #6). Data from both gaseous networks support continued research of atmospheric transport and removal of air pollutants and development of computer simulations of these processes.

Short-term Outcomes and Outputs.

Samples Collected. NADP's principal objective and accomplishment/outcome is the collection, analysis and quality assurance of samples for precipitation and atmospheric chemistry. Briefly, there were 13,824 precipitation samples collected and analyzed by the NTN (including 243 QA samples), for all network sites. The analyses included observations of 10 different analyte concentrations and precipitation volume, which allow for calculation of deposition flux for each analyte. In the other networks not included in the SAES subset of sites were 1,068 precipitation samples from the AIRMoN, 3,078 gaseous ammonia samples collected by the AMoN, 6,261 total mercury samples collected by the MDN, and 1,145,200 hourly mercury fraction concentrations. QA samples are run at the individual sites and not part of these sample counts.

NADP Database. Our second most important accomplishment/outcome is making data available to all for the support of continued research. Scientists, policymakers, educators, students, and others are encouraged to access data at no charge from the NADP website (nadp.isws.illinois.edu). This website offers online retrieval of individual data points, seasonal and annual averages, trend plots, concentration and deposition maps, reports, manuals, and other data and information about the program.

The NTN database is now populated by over 450,000 observations of precipitation chemistry. As of today, 2014 calendar year data are complete and online, and the 2015 data through August 2015 is online with final QA to be completed in 2016.

Internet disbursement of data is the primary route of dissemination for the NADP project. Website usage statistics provide evidence that our data are being used. During this reporting period, website usage remained strong. We have recorded approximately 34,019 registered who accessed our website information and there were 28,018 data downloads from the site (about our typical number). The website received over 1.27 million "hits." Maps (single or multiple) were downloaded 23,921 different times. We continually divide users into types, and this year was again very typical; about 40% were from federal and state agencies, 36% from universities, 16% from K-to-12 schools, and 8% from other individuals or organizations. The NADP website has registered users from more than 150 countries across the globe. These statistics demonstrate that NADP continues to be relevant to both the scientific and educational communities.

Map Summary. The 2014 annual map series of atmospheric concentrations, wet deposition fluxes, and Map Summary Report was developed during June 2015 and finalized and printed in September/October 2015. Each calendar year the NADP produces a series of 23 national maps of wet deposition concentration and flux maps for all of our analytes and networks. For the gaseous networks, we produce similar types of summary figures. These maps are used widely and constitute one of the major products of the network. Individual maps are filed by network, year, and constituent, and can be downloaded in several formats (nadp.isws.illinois.edu/data/annualmaps.aspx). Individual maps are compiled into annual Map Summary reports, and the 2014 Map Summary is also available for download (nadp.isws.illinois.edu/lib/dataReports.aspx). We printed 3,000 copies of the 2014 Annual Summary, and about 80% of these have been distributed thus far. The 2015 data is still being collected at this writing, and the map development will begin in 2016, and be available about September 1, 2016.

Fall Scientific Meeting (FY2015). At the end of each federal year, a combined business and scientific meeting is held to showcase some of the latest deposition research that occurred during the year. The latest report-period meeting was "The Global Connection of Air and Water" held in Indianapolis, IN, October 21-24, 2014. The meeting included 140 attendees, six oral sessions, 31 oral presentations, and 34 posters. The meeting was highlighted by a presentation from Dr. David A. Wolf, NASA Astronaut (retired), and a presentation on the interconnectedness of air and water on

the planet. This talk was followed by a global review of precipitation chemistry by Robert Vet, of Environment Canada. The workshop included discussions of measurement of both wet and dry deposition measurement, and agricultural emissions and atmospheric deposition (4 speakers), and a session specifically on deposition within urban areas.

FY16: "Acid Rain 2015". The FY16 Fall NADP Meeting (Oct 2015) was held in Rochester, NY (and discussed in the next annual report). This meeting was organized specifically to coincide with the every 5 year International Conference on Acid Deposition 2015 (see AcidRain2015.org). The NADP business meeting was combined with the scientific ICAD and attract an international audience of about 400. Information and presentations for the meeting will be moved to the NADP site and available before next year's report.

Business Meeting (FY15, Spring 2015). Every spring, NADP holds a 3 day business meeting (Technical Committee, subcommittees, Executive Committee). The Spring 2015 meeting was held in Pacific Grove, CA on April 13-15, 2015. All final committee meeting minutes are available on our website (nadp.isws.illinois.edu/committees/minutes.aspx).

These basic activities fulfilled the project objectives: (1) coordination of these networks; (2) quality assurance to ensure consistency; and (3) analytical, site support, and data validation services for the sites financed directly through this agreement. Again, this report is for the approximately 50 SAES sites, but the network results are equivalent for all sites. Over the year, 48 SAES sites operated, none were lost, including a new site operating at North Carolina Agricultural and Technology University (NCA&T). It became an active NTN site on Jan 30, 2015. NCA&T is a historically black university and is an 1890 Land-Grant Universities. This site operation is in cooperation with the U.S. Department of Energy.

One particularly noteworthy milestone for NADP was the collection of our 400,000th NTN sample at our Little Bighorn Battlefield National Monument site (MT00) on March 28, 2015. This is quite a milestone for the NADP.

Our Puerto Rico site (PR01), in cooperation with the USDA-FS, has now become the first site in our network with 4 different networks operating (NTN since 1985, MDN, AMoN, MDN).

<u>Additional Operation Notes.</u>

The NADP continues to convert our precipitation gages to an all-digital network, originating with a Technical Committee decision in 2006 (nadp.isws.illinois.edu/newissues/newgages/newequip.aspx). An added advantage to this change is that digital stations will have a very accurate, hourly record of precipitation. As of 10/1/2015, there are only 25 sites remaining with older gages, representing < 8% of the NTN without digital gages available or installed. Only two of these sites are SAES sites (Cornell/Aurora, UI/Shabbona). Another improvement is to digitize all of the individual field precipitation records (back to 1978) and make them available to researchers via the NADP website, for a more complete site and sample collection record. This is ongoing and should be completed during 2016.

During CY2015, 174 journal articles and reports were generated using the NADP data (counting not yet complete), and are listed in the publication section of this report. This is again evidence that NADP continues to produce data that are both valuable and useful.

In support of our education and outreach responsibilities, four new text books used NADP information during 2015: (1) Boucher, O., 2015. Atmospheric Aerosols: Properties and Climate Impacts. Springer, (2) Press, D., 2015. American Environmental Policy: The Failures of Compliance, Abatement and Mitigation. Edward Elgar Publishing, (3) Shaddick, G., & Zidek, J. V., 2015. Spatio-Temporal Methods in Environmental Epidemiology. CRC Press, and (4) Sullivan, T. J., 2015. Air Pollutant Deposition and Its Effects on Natural Resources in New York State. Cornell University Press.

Additionally, fourteen dissertations and theses used NADP data, and are noted in the publications listing. The authors include Anderson, Bluck, Coble, Ganzlin, Sungshik, Kronholm, Kuschner, Maas, Menger, Moragas, Mullen, Rose, Sabo and Wisniewski. There was also one senior honors thesis (White).

Continued Quality Assurance Audits. NADP contract laboratories and the Program Office are each reviewed annually in rotation to identify problems, improve performance, and provide external checks to the program. These audits are a mix of external and NADP member scientists. The NTN laboratory was audited in 2011 and 2014; the mercury laboratory in 2012 and 2015; and the Program Office (management) in 2010 and 2013, and will be re-audited in 2016 (July). Results were reporting back to the Executive Committee at the respective Fall meetings.

Impacts

As a National Research Support Project, the NADP's most important impact is that our data are used in research, per our research support mission. For 2015, we identified 172 journal articles and reports (as yet not complete for the year) that used NADP data, maps, and procedures in their own research, for modeling applications, and for comparison to NADP results, etc. These articles are included in our online listing of NADP publications and attached to this report.

Here is a short summary of 10 articles (and theses/dissertations) published in 2015 that are of particular interest to the agricultural community.

1. Arnott, J. C., Osenga, E. C., Cundiff, J. L., & Katzenberger, J. W., 2015. Engaging Stakeholders on Forest Health: A Model for Integrating Climatic, Ecological, and Societal Indicators at the Watershed Scale. Journal of Forestry 113(5), 447-453.

   The authors developed an ecologically-driven numerical model of forest health indices to be used for outreach and education of populations, and as a decision support tool. The model uses climatic, sociological and ecological data to make its estimate of forest health. NADP data is used (the model was developed in/for Colorado) as an air quality input along with CASTNET data to determine an air quality score, which can then be blended into predictions of different public goals.

2. Balasubramanian, S., Koloutsou-Vakakis, S., McFarland, D. M., & Rood, M. J., 2015. Reconsidering Emissions of Ammonia from Chemical Fertilizer Usage in Midwest USA. J. Geophys. Res. Atmos. 120, 6232–6246, doi:10.1002/2015JD023219.

   In this paper, the authors develop a new ammonia (NH3) emissions model (Improved Spatial Surrogate (ISS)) which estimates spatial and temporal distribution of emissions based on chemical fertilizer input, crop location, nitrogen management, and a biogeochemical model. NADP wet deposition data for ammonia were used in the model inputs. Significant changes in emissions were noted versus commonly used emissions models over the Midwestern US.

3. Batte, M. T., & Forster, D. L. Old is New Again: The Economics of Agricultural Gypsum Use. Journal of the American Society of Farm Managers and Rural Appraisers, 2015 Edition, http://www.asfmra.org/2015-journal-of-asfmra/#.

   The authors used surveys of area farmers to better understand the use of Gypsum on U.S. farms in the Midwest. The farmers reported significant benefits of gypsum addition related to soil fertility, water management and crop performance related to gypsum addition and its long-term use. A benefits to cost ratio was found to be high. NADP data was used over multiple years to show the reduction in sulfate deposition over wide areas of the country, and therefore the importance of sulfur contributions from gypsum.

4. David, M. B., Mitchell, C. A., Gentry, L. E., & Salemme, R. K. (2015). Chloride Sources and Losses in Two Tile-Drained Agricultural Watersheds. Journal of Environmental Quality. doi:10.2134/jeq2015.06.0302

   The authors evaluated chlorine loading to local rivers (central IL) with respect to atmospheric deposition, road salt, or agricultural fertilizer sources. Their observations show an increase in chloride concentrations as potash use increased (60s & 70s), with an important lag in loading of 2-6 years with field tile drainage. Fertilizer contribution was the dominant source, with long-term records of NADP chloride deposition data used for the accounting of atmospheric deposition loading.

5. Haupt, G., Lauzon, D., & Hall, B. (2015). Sulfur fertilization: Improving alfalfa yield and quality. Crops and Soils 48(4), 26-30.

   The authors developed this outreach/education magazine article to address concerns of sulfur deficiencies in alfalfa. The widespread decrease in sulfate deposition across Canada and the United States is described (long-term NADP data). The authors note deficiency symptoms, and discuss a controlled sulfur addition experiment. Discussed are in the increases in alfalfa yield, stand quality, sulfur uptake rates, and suggestions for managing sulfur addition.

6. Kennedy, C. D., Buda, A. R., Kleinman, P. J., & DeMoranville, C. J. (2015). Chemical and Isotopic Tracers Illustrate Pathways of Nitrogen Loss in Cranberry Floodwaters. Journal of environmental quality 44(4), 1326-1332.

   The authors report phosphate loading during floods from natural and agricultural cranberry bogs in the Northeast. Important sources of phosphorus include

hydrological, edaphic, and agricultural management factors (additions). Export loading variability is high (<0.8 to 4.7 kg P ha-1) with high values related to flooding conditions of rich organic soils. Agricultural management showed reduced phosphorus release. NADP chloride data from local sites was used to help separate irrigation water from atmospheric precipitation contributions.

7. Kleinman, P. J., Church, C., Saporito, L. S., McGrath, J. M., Reiter, M. S., Allen, A. L., ... & Joern, B. C. (2015). Phosphorus leaching from agricultural soils of the Delmarva Peninsula, USA. Journal of Environmental Quality 44(2), 524-534.

   The authors investigated the leaching of phosphorus from soils before and after poultry litter application in Eastern Delaware. With application, leachate P increased dramatically, with a majority of the leachate P thought to be from the application. The authors used two NADP sites and long-term chemistry to make synthetic precipitation that matched the analyte concentrations of local precipitation.

8. Landa, E. R., & Shanley, J. B. (2015). Ahead of His Time: Jacob Lipman's 1930 Estimate of Atmospheric Sulfur Deposition for the Conterminous United States. Soil Science 180(3), 87-89.

   The authors provide a historical perspective review of the early work of Jacob Lipman's early estimate of sulfur deposition (~1930). The approach used by Lipman was replicated in early acid rain work during the 70s and 80s, and show that his estimates of sulfur deposition were very close to more recent backcasts of 1930s deposition and early estimates by NADP for the coterminous US.

9. Sardans, J., & Peñuelas, J. (2015). Potassium: a neglected nutrient in global change. Global ecology and biogeography 24(3), 261-275.

   The authors provide a review article on Potassium in the environment and in plant processes, and note the fundamental nature of K to plants, in their water use efficiency and the potential impact to global climate change. They point to examples from the scientific literature that suggest K can be as limiting to plant productivity as N, and that anthropogenic K deposition from the atmosphere can be much higher than natural sources. Specifically, K's important role in water use by plants makes it very important under changing climate conditions. The NADP network is held up as a model for monitoring of K, where few other observations exist.

10. Steiner, J., Strickland, T., Kleinman, P., Havstad, K., Moorman, T., Moran, M., ... & McCarty, G. (2015, March). The Long Term Agroecosystem Research Network-Shared research strategy. In Interagency Conference on Research in the Watersheds.

    The authors (ARS scientists) lay out a shared research strategy for the Long Term Agro-Ecosystem Research Network (LTAR). The goals and outcomes are presented. Deposition of pollutants is listed as one of their "foundation science measurements" within the LTAR, and note the role of NADP in these measurements and the LTAR sites that are part of the NADP.

Other Impacts

In conjunction with the Ecological Response and Outreach Subcommittee (EROS), and the hiring of a part time Outreach Coordinator, the NADP began both a quarterly NADP newsletter (November 1, 2014 was the first issue), and has initiated an NADP presence on social media through Facebook and Twitter (Fall 2014). A significant part of the newsletters are descriptions of recent NADP map products. This is aimed at nonprofessionals and educators. The Twitter feed is designed to build an audience (again of nonprofessionals), but also educators and other interested parties to alert them to new products, updates from NADP, and new educational products as they become available. Both the newsletter and the Twitter feed will increase the information dissemination and the community of interest size beyond just researchers and scientists**.**

The Technical Committee has requested that NADP publish its digital precipitation record (approximately 300 gages) as an independent precipitation database to be used as our other wet and dry deposition databases. This should be added during FY16 and provide additional data with no additional expenditures. This will allow researchers to access the precipitation data as a stand-alone product.

NADP's Total Deposition Subcommittee (TDEP) continued its collaboration with EPA's Clean Air Markets Division, produced a new web-based data tool for mapping of total deposition (wet and dry deposition together) using NADP wet deposition measurements of nitrate, sulfate, and ammonium) combined with observations from the Clean Air Status and Trends Network (CASTNET), NADP's AMoN, and the SouthEastern Aerosol Research and Characterization (SEARCH) gaseous measurements

and dry deposition estimates. These maps consider other factors, such as emissions, monitoring networks, and environmental variables (nadp.isws.illinois.edu/committees/tdep/tdepmaps/). Results are also described in Schwede and Lear, Atmospheric Environment, 2014 (92): 207-220.

Training: During the next year, we intend to produce online "training classes" that operators can take on their own schedule. These classes will use video footage of the earlier training classes (discussed above), and utilize one-on-one questioning periods with the site liaisons to provide a chance for the operators to ask questions, and for the site liaisons to assure that the operators/students understand what is needed and expected at our NADP sites.

Publications

Includes 174 publications that used NADP data or resulted from NRSP 3 activities in 2015 (articles published in 2014 Oct-Dec are not listed here). A publically available online listing of citations using NADP data is accessible at: nadp.isws.illinois.edu/lib/bibliography.aspx.

1. Adane, Z. A., & Gates, J. B., 2015. Determining the impacts of experimental forest plantation on groundwater recharge in the Nebraska Sand Hills (USA) using chloride and sulfate. Hydrogeology Journal, 23(1), 81-94.
2. Anderson, J., 2015. Geochemical Assessment and Separation of Source Waters in the Upper Boulder River Watershed Near Boulder, MT. Master's Thesis, Montana Tech of the University of Montana.
3. Anderson, L., Berkelhammer, M., & Mast, M. A., 2015. Isotopes in North American Rocky Mountain Snowpack 1993–2014. Quaternary Science Reviews. http://dx.doi.org/10.1016/j.quascirev.2015.03.023
4. Area, W. M., 2015. Reinitiation of Consultation for the Colowyo Coal Company, LP "Colowyo" Mine, Permit C-81-019–South Taylor/Lower.
5. Argyilan, E. P., Avis, P. G., Krekeler, M. P., & Morris, C. C., 2015. The origin of collapse features appearing in a migrating parabolic dune along the southern coast of Lake Michigan. Aeolian Research, 19, 137-149.
6. Ariya, P. A., Amyot, M., Dastoor, A., Deeds, D., Feinberg, A., Kos, G., ... & Toyota, K., 2015. Mercury Physicochemical and Biogeochemical Transformation in the Atmosphere and at Atmospheric Interfaces: A Review and Future Directions. Chemical reviews 115, 3760−3802.
7. Arnott, J. C., Osenga, E. C., Cundiff, J. L., & Katzenberger, J. W., 2015. Engaging Stakeholders on Forest Health: A Model for Integrating Climatic, Ecological, and Societal Indicators at the Watershed Scale. Journal of Forestry, 113(5), 447-453.
8. Asao, S., Sun, Z., & Gao, W. (2015, September). Effects of bias in solar radiation inputs on ecosystem model performance. In SPIE Optical Engineering+ Applications (pp. 96100C-96100C). International Society for Optics and Photonics. Remote Sensing and Modeling of Ecosystems for Sustainability XII, edited by Wei Gao, Ni-Bin Chang, Proc. of SPIE Vol. 9610, 96100C
9. Axler, R. P., Tikkanen, C. A., & Rose, C., 2015. An assessment of phytoplankton nutrient deficiency in Northern Minnesota acid-sensitive lakes. Technical Report NRRI/TR-91/18, Minnesota Pollution Control Agency Division of Air Quality Attn: Rick Strassman St. Paul, MN 55155
10. Balasubramanian, S., Koloutsou-Vakakis, S., McFarland, D. M., & Rood, M. J., 2015. Reconsidering Emissions of Ammonia from Chemical Fertilizer Usage in Midwest USA. J. Geophys. Res. Atmos., 120, 6232–6246, DOI:10.1002/2015JD023219.
11. Bardsley, A. I., Hammond, D. E., von Bitner, T., Buenning, N. H., & Townsend-Small, A., 2015. Shallow Groundwater Conveyance of Geologically Derived Contaminants to Urban Creeks in Southern California. Environmental science & technology, 49(16), 9610-9619.
12. BassiriRad, H., Lussenhop, J. F., Sehtiya, H. L., & Borden, K. K., 2015. Nitrogen deposition potentially contributes to oak regeneration failure in the Midwestern temperate forests of the USA. Oecologia, 177(1), 53-63.
13. Batte, M. T., & Forster, D. L. Old is New Again: The Economics of Agricultural Gypsum Use. Journal of the American Society of Farm Managers and Rural Appraisers, 2015 Edition, http://www.asfmra.org/2015-journal-of-asfmra/#.
14. Beal, S., Osterberg, E. C., Zdanowicz, C., & Fisher, D., 2015. An ice core perspective on mercury pollution during the past 600 years. Environmental science & technology 49, 7641−7647, DOI: 10.1021/acs.est.5b01033.
15. Bettez, N. D., Duncan, J. M., Groffman, P. M., Band, L. E., O'Neil-Dunne, J., Kaushal, S. S., ... & Law, N., 2015. Climate Variation Overwhelms Efforts to Reduce Nitrogen Delivery to Coastal Waters. Ecosystems, 1-13. DOI: 10.1007/s10021-015-9902-9.
16. Bhaskar, A. S., & Welty, C., 2015. Analysis of subsurface storage and streamflow generation in urban watersheds. Water Resources Research, 51(3), 1493-1513.

17. Blackwell, B. D., & Driscoll, C. T., 2015. Using foliar and forest floor mercury concentrations to assess spatial patterns of mercury deposition. Environmental Pollution, 202, 126-134.
18. Blackwell, B. D., & Driscoll, C. T., 2015. Deposition of mercury in forests along a montane elevation gradient. Environmental science & technology,49(9), 5363-5370.
19. Bluck, G. M., 2015. Soybean Yield Response in High and Low Input Production Systems. Master's Thesis, The Ohio State University).
20. Bluck, G. M., Lindsey, L. E., Dorrance, A. E., & Metzger, J. D., 2015. Soybean Yield Response to Rhizobia Inoculant, Gypsum, Manganese Fertilizer, Insecticide, and Fungicide. Agronomy Journal, 107(5), 1757-1765.
21. Borne, K., Fassman-Beck, E., Winston, R., Hunt, W., and Tanner, C., 2015. "Implementation and Maintenance of Floating Treatment Wetlands for Urban Stormwater Management." J. Environ. Eng., 10.1061/(ASCE)EE.1943-7870.0000959, 04015030
22. Boucher, O., 2015. Atmospheric Aerosols: Properties and Climate Impacts. Springer.
23. Bowen, G. J., & Good, S. P., 2015. Incorporating water isoscapes in hydrological and water resource investigations. Wiley Interdisciplinary Reviews: Water, 2(2), 107-119.
24. Bowie, R., Brown, J., & Felix, F., 2015. Excellence in Research, Education, and Public Service since 1951. UC Berkeley's Sagehen Creek Field Station Biennial Report, FY 2013-2015. http://sagehen.ucnrs.org/pubs/2015/FY13-15_Report-Final.pdf.
25. Brahney, J., Ballantyne, A. P., Kociolek, P., Leavitt, P. R., Farmer, G. L., & Neff, J. C., 2015. Ecological changes in two contrasting lakes associated with human activity and dust transport in western Wyoming. Limnology and Oceanography, 60(2), 678-695.
26. Brookshire, E. N. J., & Weaver, T., 2015. Long-term decline in grassland productivity driven by increasing dryness. Nature communications, 6:7148 | DOI: 10.1038/ncomms8148
27. Buck, C., Hammerschmidt, C. R., Bowman, K., Gill, G. A., & Landing, W. M., 2015. Flux of total and methyl mercury to the northern Gulf of Mexico from US estuaries. Environmental science & technology. DOI: 10.1021/acs.est.5b03538.
28. Butler, C. G., & Vasconcelos, J. G. The Effect of Highway Stormwater runoff on Water Quality in the Little Cahaba Creek. World Environmental and Water Resources Congress 2015: Floods, Droughts, and Ecosystems.
29. Butler, T., R. Marino, D. Schwede, R Howarth, J. Sparks, K. Sparks, 2015. Atmospheric ammonia measurements at low concentration sites in the northeastern USA: implications for total nitrogen deposition and comparison with CMAQ estimates. Biogeochemistry 122:191–210 (AMON).
30. Campbell, D. R., & Powers, J. M., 2015. Natural selection on floral morphology can be influenced by climate. Proceedings of the Royal Society of London B: Biological Sciences, 282(1808), 20150178.
31. Campbell, L. M., & Drevnick, P. E., 2015. Use of Catalogued Long-term Biological Collections and Samples for Determining Changes in Contaminant Exposure to Organisms. In Environmental Contaminants (pp. 431-459). Springer Netherlands.
32. Castro, M. S., & Sherwell, J., 2015. Effectiveness of Emission Controls to Reduce the Atmospheric Concentrations of Mercury. Environmental Science & Technology. DOI: 10.1021/acs.est.5b03576
33. Chapman, S. K., Devine, K. A., Curran, C., Jones, R. O., & Gilliam, F. S., 2015. Impacts of Soil Nitrogen and Carbon Additions on Forest Understory Communities with a Long Nitrogen Deposition History. Ecosystems, 1-13. DOI: 10.1007/s10021-015-9922-5
34. Cheng, I., Zhang, L., & Mao, H., 2015. Relative contributions of gaseous oxidized mercury and fine and coarse particle-bound mercury to mercury wet deposition at nine monitoring sites in North America. Journal of Geophysical Research: Atmospheres, 120(16), 8549-8562.
35. Chumchal, M. M., & Drenner, R. W., 2015. An environmental problem hidden in plain sight? Small Human-made ponds, emergent insects, and mercury contamination of biota in the Great Plains. Environmental Toxicology and Chemistry, 34(6), 1197-1205.
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38. Clingerman, J., Petty, T., & Boettner, F. Chesapeake Bay Watershed Brook Trout Habitat and Climate Change Vulnerability Assessment.
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