



NASA Air Quality Applied Sciences Team Quarterly Newsletter



May 2015, Vol. 13

Earth science serving air quality management needs

New: AQAST publications and presentations



2 -- AQAST researchers have been hard at work, publishing scientific articles and presenting new data at a variety of symposia. Browse through these recent highlights or get the full list online.

Recent and upcoming AQivities



3 -- Read all about this spring's Conference on Transboundary Ozone Pollution, a recent study on global mortality from particulate matter, and a video from Bryan Duncan about observing air quality from space.

From the Media Center: AQAST Spotlights



4 -- Dive into these spot-on stories about Earth science and air quality management applications, featuring the work of AQAST scientists Arlene Fiore, Daniel Jacob, Gabriele Pfister, and Pius Lee.



Welcome.

You have in your hands (or on your screen) the May 2015 quarterly newsletter of NASA Air Quality Applied Sciences Team (AQAST) -- a nationwide collaborative team of researchers, funded by NASA to advance science supporting air quality, in partnership with environmental managers at the local, state, and national levels. By sharing the ideas, accomplishments, and goals of our team members, our newsletter is just one of the many ways NASA AQAST is striving to support air quality management and communicate our work to the public.

Above: Saint Louis University's campus, the site of the 9th semiannual AQAST meeting, AQAST9, this June. (Image courtesy of Saint Louis University)

Coming up

9th semiannual AQAST meeting



Above: A group photo of attendees of the AQAST8 meeting in December 2014 held at Georgia Tech in Atlanta, Georgia.

The 9th AQAST meeting (AQAST9) will be held June 2-4, 2014, at Saint Louis University, hosted by Prof. Jack Fishman. AQAST9 will feature a special session on air quality management issues in the Midwestern states.

AQAST meetings bring together atmospheric scientists and air quality managers to discuss how Earth Science products can be used effectively for air quality applications. Past meetings have been hosted by Georgia Tech, Harvard University, Rice University, University of Maryland, California Air Resources Board, University of Wisconsin, EPA Research Triangle Park, and NCAR.

For more information, visit <http://bit.ly/1RkNS6l> and follow #aqast9 on Twitter.

Recent AQAST presentations

Constraining NO_x emissions with space-based data, invited presentation by B.N. Duncan at the EPA 2015 International Emission Inventory Conference: Air Quality Challenges: Tackling the Changing Face of Emissions in San Diego April 13-16, 2015. [PDF]

OTC Modeling Committee 2015 update, presented by D. Goldberg and R.R. Dickerson at the Ozone Transport Commission Committee Meeting, Washington, DC, April 23, 2015 [PPTX]

Scientific insight from CMAQ modeling for the MDE SIP, presented by Hao He and R.R. Dickerson at the Ozone Transport Commission Committee Meeting, Washington, DC, April 23, 2015 [PPTX]

Characterizing and interpreting changes in U.S. climate and air pollution means and extremes seminar by A.M. Fiore at the Columbia School of Public Health, April 2015. [PDF]

Key drivers of Western U.S. surface ozone variability over recent decades: Stratospheric intrusions, Asian pollution, and climate, invited talk by M.Y. Lin to the CENRS Air Quality Research Subcommittee, Washington, DC, February 2015. [PPTX]

Recently published >>

If you are viewing this as a PDF, the [] indicate an active link; all linked files also available at AQAST.org.

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Huang, M., K. W. Bowman, G. R. Carmichael, M. Lee, T. Chai, S. N. Spak, D. K. Henze, A. S. Darmanov, A. M. da Silva, Improved Western US Background Ozone Estimates via Constraining Non-local and Local Source Contributions using Aura TES and OMI Observations, *J. Geophys. Res.*, in press. [Article]

Lamsal, L.N., Duncan, B.N., Yoshida, Y., Krotkov, N.A., Pickering, K.E., Streets, D.G., Lu, Z., U.S. NO₂ trends (2005-2013): EPA Air Quality System (AQS) data versus improved observations from the Ozone Monitoring Instrument (OMI), *Atmospheric Environment* (2015), doi: 10.1016/j.atmosenv.2015.03.055. [Article]

Lapina, K., D. K. Henze, J. B. Milford, C. Cuvelier, and M. Seltzer, Implications of RCP Emissions for Future Changes in Vegetative Exposure to Ozone in the Western U.S., *Geophys. Res. Lett.*, 42, doi:10.1002/2015GL063529. [Article]

Lee, C. J., R. V. Martin, D. K. Henze, A. van Donkelaar, R. T. Burnett, A. Cohen, H. Wang, R. Lozano, C. J. L. Murray, S. S. Lim, and M. Brauer, Sensitivity of global particulate-matter-related mortality to local precursor emissions, *Environ. Sci. Technol.*, in press. [Article]

Reid, C., Michael Jerrett, Maya L. Petersen, Gabriele G. Pfister, Philip E. Morefield, Ira B. Tager, Sean M. Raffuse, and John R. Balmes, Spatiotemporal Prediction of Fine Particulate Matter During the 2008 Northern California Wildfires Using Machine Learning, *Environ. Sci. Technol.*, 49 (6), pp 3887–3896, 2015. [Article]

Shen, L., L. J. Mickley and A. P. K. Tai, Influence of synoptic patterns on surface ozone variability over the eastern United States from 1980 to 2012, *Atmos. Chem. Phys.*, submitted, 2015. [Article]

Vinciguerra, T., Simon Yao, Joseph Dadzie, Alexa Chittams, Thomas Deskins, Sheryl Ehrman, Russell R. Dickerson, Regional air quality impacts of hydraulic fracturing and shale natural gas activity: Evidence from ambient VOC observations, *Atmospheric Environment*, Volume 110, June 2015, Pages 144-150, ISSN 1352-2310. [Article]

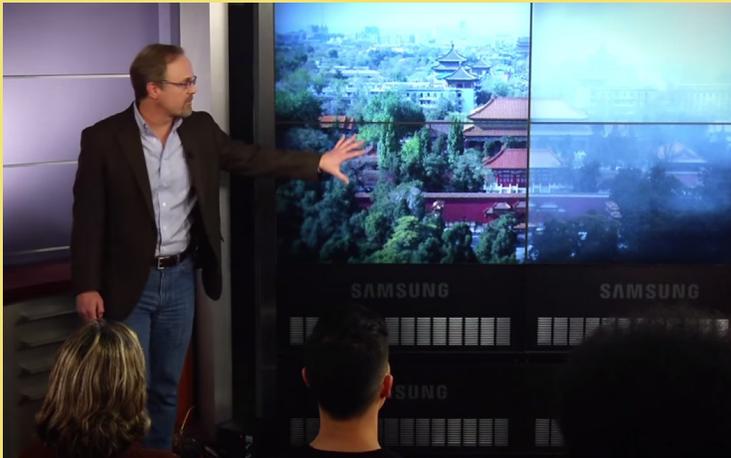
Jiang, Z., D. B. A. Jones, J. R. Worden, H. M. Worden, D. K. Henze, Y. X. Wang, Regional data assimilation of multi-spectral MOPITT observations of CO over North America, *Atmos. Chem. Phys. Discuss.*, 15, 5327-5358, doi:10.5194/acpd-15-5327-2015. [Article]

Visit AQAST.org for a full list of titles.

A TALE OF THREE CITIES

AIR QUALITY AS SEEN FROM SPACE

AQAST member Bryan Duncan discusses observing air quality from space in this TED-style talk: <http://1.usa.gov/1HJOMGN>.



More AQactivities >>

Study Quantifies Global Mortality Risk from PM_{2.5}

Written by Ben Kaldunski

How does energy use affect global health? A new study led by Dalhousie University quantifies the response of global premature mortality rates to reduced emissions of SO₂, NO_x, ammonia, and carbonaceous aerosols worldwide.

It is estimated that PM_{2.5} causes millions of premature deaths each year, but the sources contributing to atmospheric particulates are complex. Whereas some particles are directly emitted – like smoke, and wind-blown dust – many others “cook up” in the atmosphere from gas-phase ingredients. Untangling the linkages between the emitted pollutants and the downwind health impacts requires advanced modeling and analysis tools.

The team found that the largest reductions in mortality associated with a 1 kg/km²-year decrease in emissions were for ammonia and carbonaceous aerosols in Eastern Europe. The greatest reductions in mortality for a 10% decrease in emissions were found for secondary inorganic sources, especially sulfate aerosols, in East Asia. PM_{2.5}, as well as precursors SO₂ and NO₂, are regulated as criteria pollutants under the U.S. Clean Air Act, and part of most health-based air quality standards around the world.

The study “Response of Global Particulate Matter Related Mortality to Changes in Local Precursor Emissions” was published on March 2, 2015, in the journal *Environmental Science & Technology*. On March 24, the article was made publicly available, without subscription access, through the American Chemical Society (ACS) Editors’ Choice initiative, recognizing outstanding articles that exemplify the mission of the ACS.

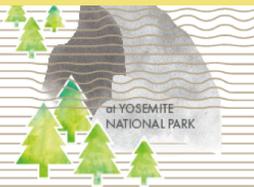
Colin Lee, a graduate student at Dalhousie University in Halifax, Nova Scotia, used the GEOS-Chem model, along with satellite data from NASA’s MODIS and MISR satellite instruments to better align pollution exposure with population density. That exposure was then related to premature mortality using methods developed recently for the Global Burden of Disease project.

One of the co-authors of the study, AQAST member and professor of mechanical engineering at the University of Colorado-Boulder Daven Henze, said the project uses “NASA research capabilities ... to improve our

TRANSBOUNDARY OZONE POLLUTION CONFERENCE

at TENAYA LODGE

Tuesday, March 31 - Thursday, April 2, 2015



Spring 2015 Conference on Transboundary Ozone Pollution

AQAST partnered with the San Joaquin Valley APCD to organize the Transboundary Ozone Pollution Conference at Yosemite National Park from March 31-April 2, 2015. The conference brought together AQAST scientists and air quality managers to better understand the effect of foreign sources of pollution on ozone air quality in the western U.S.

Presentations and discussions focused on long-term background ozone trends in the West, the extent to which meeting ambient air quality standards is hindered by transport of external pollution, what combinations of observations and modeling are needed to better quantify this transport, and how satellite observations can help.

Presentations from the conference are posted at <http://bit.ly/1cgrCLA>. They include contributions by AQAST members Greg Carmichael, Daniel Jacob, Meiyun Lin, Brad Pierce, and Gabi Pfister.

understanding of how different sources of pollution impact human health.”

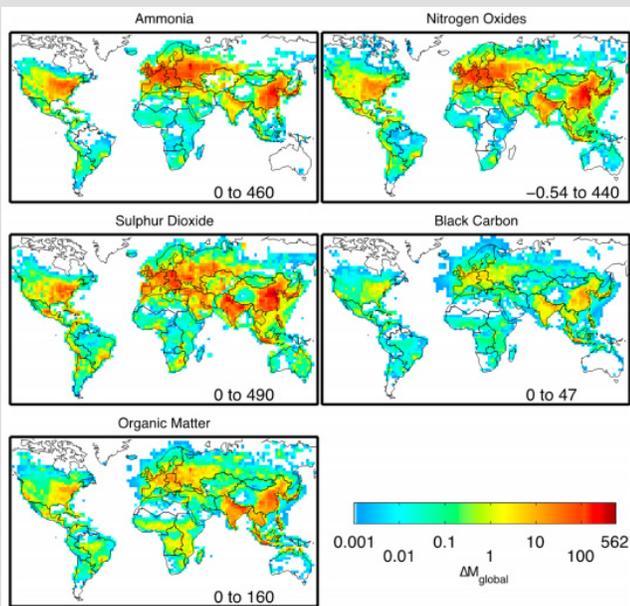
In line with ACAST’s mission to connect advanced research with air quality management needs, the team developed new methods for linking models, satellite data, and health outcomes.

“Satellite observations allowed us to refine the model’s estimated pollution field at a much finer scale, and helped ... make the results much more credible,” Henze said.

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This press release was originally published on the ACAST Media Center, at <http://bit.ly/1Bns2Gc>. Read the full article in *Environmental Science & Technology*, at <http://bit.ly/1BnscNG>.

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Above: These maps show the global change in premature mortality caused by local reductions or increases in emissions that lead to the formation of $\text{PM}_{2.5}$ such as SO_2 and NO_x . The study published in *Environmental Science & Technology* found that reducing SO_2 emissions generally led to the greatest reduction in premature mortality. (Image courtesy of Colin Lee, Dalhousie University)

ACAST Spotlight: Gabriele Pfister

FRAPPÉ Campaign Brews Up Excitement in Colorado

Written by Ben Kaldunski & Tracey Holloway

What does a popular beverage with foam, ice, and coffee have to do with air quality? Well, perhaps not much, unless the tireless scientists involved in the FRAPPÉ (Front Range Air Pollution and Photochemistry Experiment) campaign needed a refreshing jolt of caffeine during the hot summer of 2014. However, any major effort needs a catchy title, and FRAPPÉ was born. FRAPPÉ brought groups together for exciting science, health-relevant data collection, and many late nights of collaboration and coffee.

“FRAPPÉ was designed to look at summertime air quality in the Colorado Front Range to figure out what factors contribute to air pollution in that region,” said Gabriele Pfister, a scientist at the National Center for Atmospheric Research (NCAR) and co-lead investigator of the unprecedented campaign. “We wanted to know the role of different emission sources, what is the role of transport, and why our models often were failing to deliver an accurate representation of summertime ozone,” Pfister said.

Beyond the experience from the research community, Pfister -- a member of NASA’s Air Quality Applied Sciences Team (ACAST) – and her colleagues sought to engage the expertise of Colorado’s air quality managers. Gordon Pierce, Patrick Reddy and Daniel Bon of the Colorado Department of Public Health and Environment (CDPHE), were members of the FRAPPÉ team who played critical roles in defining the campaign, daily flight planning and weather forecasting.

“We would not have had a campaign without the involvement of the Colorado CDPHE,” Pfister said. “Their years of experience with local weather and air quality forecasting were the biggest contributions to successful flight planning during FRAPPÉ.”

The campaign, which received funding from the State of Colorado and the National Science Foundation, utilized a three-pronged approach that combined pollution measurements from satellite instruments, ground monitors, and multiple aircraft flying daily missions around the Front Range.

The massive collaborative effort yielded a treasure trove of data that the FRAPPÉ team has been poring over since the field campaign ended in mid-August 2014.

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While the first big wave of results won't be released until early May, the team is looking to address pressing concerns.

"We will be able to refine our emissions inventories for urban sources, oil and gas operations, agricultural emissions, nitrogen deposition in Rocky Mountain National Park, and improve our understanding of atmospheric chemistry," Bon said.

Nitrogen acts as a fertilizer that favors some plants over others, destabilizing the park's delicate ecosystems. Bon said that about half of the nitrogen deposited in Rocky Mountain National Park originates from agricultural sites in the Front Range. Reddy said the Colorado CDPHE was very interested in understanding the in-flow and out-flow of air masses over the mountains and nearby plains, as well as building a detailed inventory of emissions sources and their contribution to air quality across the Front Range.

"We're convinced that the ground samples and aircraft measurements gave us a very good snapshot of emissions from the oil and gas fields, agriculture, and urban sources," he said. "We're confident that the scientists now have the data necessary to determine which areas are most sensitive to ozone-forming pollutants, and how the previous day's air quality can contribute to the next day's problems."

FRAPPÉ also provided a unique opportunity to test the performance of air quality models in real-time



Patrick Reddy was an integral member of the forecasting team that ensured the FRAPPÉ aircraft successful flights. (Image courtesy of Colorado CDPHE)

Dr. Gabriele Pfister was co-lead investigator for the FRAPPÉ campaign, an unprecedented effort to understand air quality in Colorado's Front Range. (Image courtesy of NCAR/UCAR)



applications. Pfister's group ran a version of the Weather Research and Forecasting (WRF) model that used "tracers" to represent different emissions source categories.

"The model wasn't right all the time, but it was doing very well most of the time," Pfister said.

Reddy was also deeply involved in air quality forecasting during the FRAPPÉ campaign.

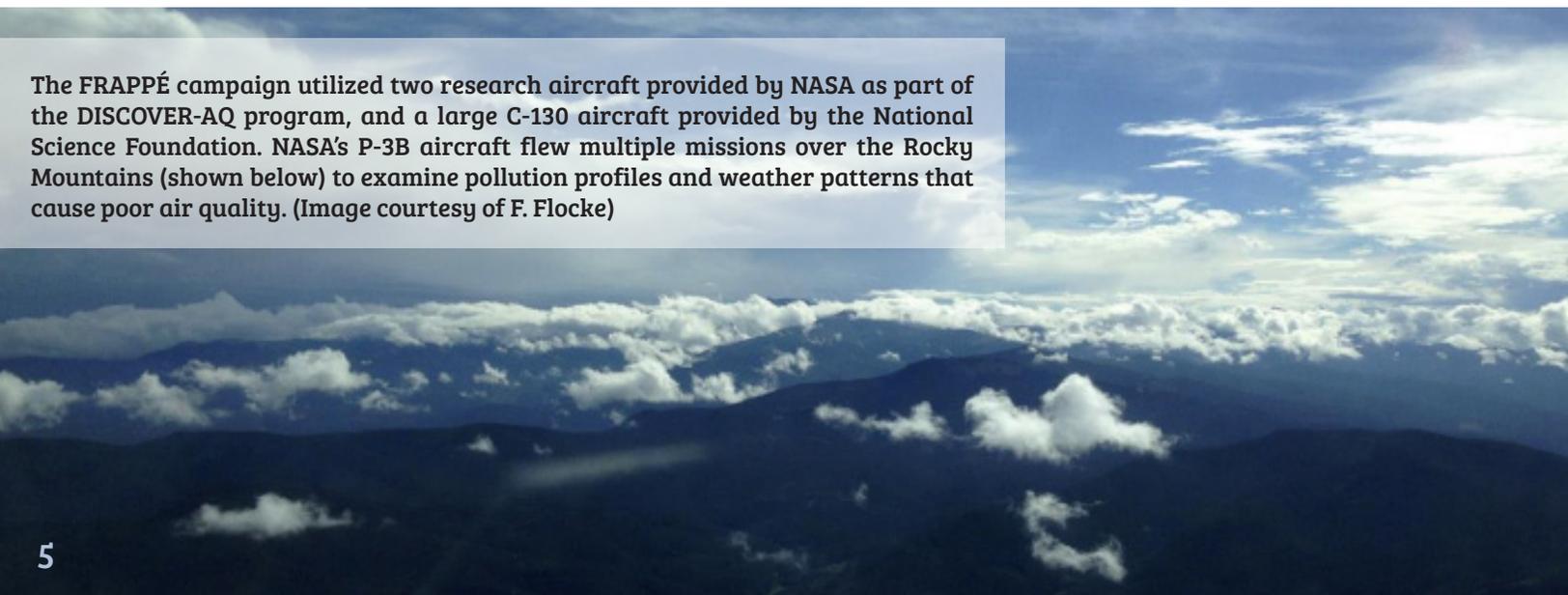
"We got a glimpse this summer of how various models perform in terms of being useful for forecasting and policy-related modeling," he said.

Pfister's work with FRAPPÉ exemplifies the ethos of engagement with the air quality management community that defines ACAST. NCAR scientist Frank Flocke was co-lead investigator with Pfister, and ACAST members Brad Pierce, Pius Lee, Anne Thompson, Russell Dickerson, Jana Milford and Daven Henze were also involved with different aspects of the campaign.

"We've never experienced this level of involvement from the scientific community that included aircraft, modeling, ground monitoring, the whole nine yards," Reddy said.

"The state was extremely pleased with how the campaign was planned and adjusted in order to address our needs and concerns," he added. "I can't imagine the project going any better than it did." §

The FRAPPÉ campaign utilized two research aircraft provided by NASA as part of the DISCOVER-AQ program, and a large C-130 aircraft provided by the National Science Foundation. NASA's P-3B aircraft flew multiple missions over the Rocky Mountains (shown below) to examine pollution profiles and weather patterns that cause poor air quality. (Image courtesy of F. Flocke)



ACAST Spotlight: Daniel Jacob

The ACAST legacy: Science to support decision-making

Written by Ben Kaldunski & Tracey Holloway

Since 2011, the NASA Air Quality Applied Sciences Team (ACAST) has been working to serve air quality managers at the national, state, and local levels through advanced research and technology. As ACAST enters its final year of funding, Team Leader Daniel Jacob, professor at Harvard University, reflects on the impact and legacy of this groundbreaking initiative.

“Our most important accomplishment has been showing air quality managers the value of satellite data, and showing them how to utilize it in their work,” Jacob said. “Satellites have now become a relatively standard tool, both for measuring certain types of air pollution, and for testing the accuracy of air quality models.”

Under Jacob’s leadership, ACAST has been active in engaging air quality managers at biannual meetings, as well as through one-on-one research projects, and “Tiger Teams” that address stakeholder-driven research questions.

Jacob himself has exemplified the ACAST mandate to align research with the most pressing needs in the air quality management community. An expert in global modeling of atmospheric chemistry and air quality, Jacob’s team has a long track record of tackling policy-relevant problems and working with the U.S. Environmental Protection Agency (EPA) to ensure that science is serving the public. This philosophy – that exciting science and user-relevance go hand in hand – have shaped all research activities in ACAST.

For example, Jacob’s group has been active in working with EPA to quantify how much air pollution in the U.S. is coming in from other countries (i.e. “background” ozone). This issue is especially relevant for California, a state downwind from rapidly developing Asia, that is already struggling to meet clean air standards.

“We [ACAST] are hosting a meeting in late March at California’s Yosemite National Park in collaboration with the San Joaquin Air Pollution Control District that will be very important in addressing that issue,” Jacob said.

EPA scientist Joseph Pinto notes how important research on background ozone has been for policy-making.

Dr. Daniel Jacob’s research has helped EPA improve modeling capabilities to produce more accurate estimates of background ozone. (Image courtesy of Harvard University)



“When I first got involved with this issue, I saw that EPA was relying on measurements in areas subject to local and regional pollution to characterize background ozone levels,” Pinto said. “I realized that a global model was needed to address the issue, and that’s when I went to Daniel.”

“Daniel thought that this was an interesting and important problem,” Pinto said. “He worked on the problem with Arlene Fiore, a bright graduate student at the time, who wrote her thesis on the topic.”

Fiore began working on the background ozone problem in the late 1990s and has gone on to become a scientist at the NOAA Geophysical Fluid Dynamics Laboratory, a tenured professor of atmospheric science at Columbia University, and an ACAST member.

Although the roots of ACAST success date back nearly 20 years, NASA investment has been pivotal in defining user-support as a fundamental part of the science process, not just an add-on.

“Support from ACAST helped put the results of this research into EPA’s scientific review process for updating the federal ozone standards,” Jacob said.

New estimates of background ozone have changed the way EPA views this problem, a legacy that could affect policy development and implementation for years to come.

“It’s really exciting to see that ACAST’s science and research has implications for policy development,” Jacob said.

Jacob’s ongoing and future research efforts are aimed at determining whether air quality models can predict and mimic high ozone events caused by natural, or background sources.

“I want to hit hard on this because there is an expectation that models can provide an answer, but I think there is only so much that models can do,” he said.

The next generation of satellite instruments may fundamentally change the role of NASA science in air quality management programs.

Jacob is looking ahead to 2018, for a planned launch of a new instrument in geostationary orbit called TEMPO (Tropospheric Emissions Monitoring of Pollution). Where polar-orbiting satellites “see” the earth once a day, geostationary satellites rotate with the earth, so they can monitor the U.S. continuously. This new instrument will measure the evolution of air quality precursors every hour.

“This will totally change the game in terms of using satellites to observe ozone events from background, or anthropogenic sources,” Jacob said. “The work AQAST is doing now will ensure that we hit the ground running when [TEMPO] launches.”

Over the course of a few short years, AQAST has established a lasting legacy of successful collaboration between leading scientific experts and air quality managers.

“This has been a great success and we want this to continue beyond AQAST,” Jacob said.

Like the first astronauts to set foot on the moon, AQAST represents a giant leap for connecting NASA science with air quality management and public health. §



Dr. Joseph Pinto is a research scientist at the EPA's Research Triangle Park in North Carolina. Dr. Pinto has collaborated with AQAST on several studies of background ozone. (Image courtesy of the EPA)

Below: Dr. Jacob has guided AQAST since 2011, spearheading multiple research initiatives and biannual meetings that allow the team to align research initiatives with the most pressing needs in the air quality management community. The meetings now feature nearly a full day of presentations from local, state and federal air quality managers. (Image courtesy of Harvard University)

AQAST Spotlight: Pius Lee

AQAST Brings Satellite Data into Local Orbit

Written by Ben Kaldunski & Tracey Holloway

Satellites orbit the globe several hundred miles above Earth's surface, but NASA's Air Quality Applied Sciences Team (AQAST) is working with air quality managers in Connecticut to bring satellite data down to ground-level.

Pius Lee, an AQAST member and scientist at the National Oceanic and Atmospheric Administration's (NOAA) Air Research Laboratory, has been working with Michael Geigert of Connecticut's Department of Energy and Environmental Protection (DEEP) since 2004. The partnership has provided benefits to both NOAA and DEEP, and has resulted in substantial improvements to the accuracy of NOAA's air quality forecasts.

“Michael's insight as a superb air quality forecaster has been extremely valuable,” Lee said. “He has provided valuable feedback that helped us improve NOAA's national air quality forecasting service.”

Lee explained that Geigert's input has helped NOAA refine the National Air Quality Forecasting System (NAQFS) to account for localized weather and emissions characteristics.

“A decade of good collaboration between NOAA and Connecticut has improved air quality forecasting capabilities for the entire nation, and New England in particular,” Lee said.

In April 2008, elevated ozone concentrations were caused by trees and other vegetation that began sprouting leaves earlier than usual. This “early leafing” produced natural (or biogenic) emissions of chemicals that lead to the formation of ozone.

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“Our model missed high ozone episodes from April 19-22,” Lee said. “The fix was to use more recent monthly data retrieved from the MODIS instrument on NASA’s Terra satellite.”

Data retrieved from MODIS and other NASA satellite instruments has helped NOAA test and tweak the NAQFS, and provide unprecedented monitoring capabilities for state agencies like DEEP.

“We are very interested in identifying emissions from specific sources,” Geigert said. “Satellites allow us to perform almost real-time observations of fine particulates and NO2 from power plants, which will be very important moving forward.”

With the help of Lee and other AQAST members, Geigert and his colleagues at DEEP are evaluating the usefulness of satellite products for developing state implementation plans (SIPs) to comply with federal air quality standards.

“We are trying to set up our own air quality modeling



Michael Geigert of Connecticut’s DEEP has helped NOAA refine national air quality models so they can account for localized phenomenon and emissions sources unique to the northeast. (Image courtesy of the Connecticut DEEP)

Dr. Pius Lee has worked for NOAA’s Air Resources Laboratory where he has collaborated with air quality managers in Connecticut to improve national air quality forecasting capabilities. (Image courtesy of NOAA)



center,” Geigert said. “Initially, it will be used for SIP modeling, but eventually we hope to use it for daily forecasting.”

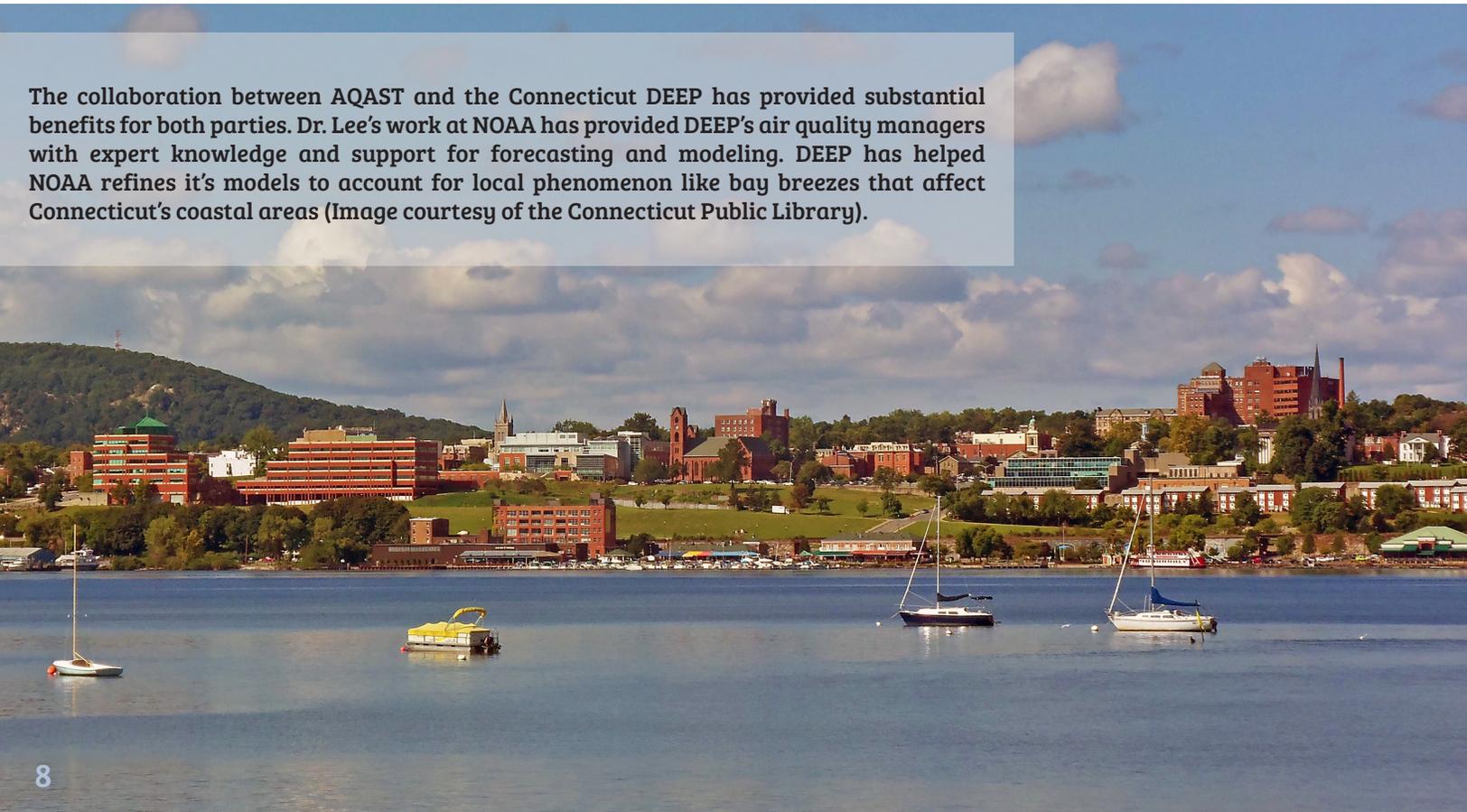
Connecticut has struggled to achieve attainment with federal standards for many years because pollution from New York City and other regions is carried into the state where it affects local air quality. Geigert also identified wood burning stoves as a source of local pollution, particularly during the harsh winter months of 2013-2014. Lee and Geigert see a very promising future for the use of aircraft data and satellite products in coming years.

“One of our future goals is to determine how much pollution comes from different types of sources,” Geigert said.

Satellites could help DEEP and other air quality managers determine how much pollution is caused by emissions from vehicles, or even specific power plants on a real-time basis.

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The collaboration between AQAST and the Connecticut DEEP has provided substantial benefits for both parties. Dr. Lee’s work at NOAA has provided DEEP’s air quality managers with expert knowledge and support for forecasting and modeling. DEEP has helped NOAA refine its models to account for local phenomenon like bay breezes that affect Connecticut’s coastal areas (Image courtesy of the Connecticut Public Library).



“That could be extremely useful for our modeling and forecasting activities,” Geigert said.

Lee said that new multi-channel instruments can provide an entirely new perspective on our current understanding of the atmosphere.

“These are very promising products,” he said.

AQAST’s work with Connecticut provides strong evidence that satellite data can be brought down to Earth, and applied to solve local air quality problems. Bringing high altitude science into the same orbit as accomplished air quality managers is a model for success that AQAST will continue to pursue for years to come.

“I really appreciate Michael’s insight into local meteorological considerations that have greatly improved the NOAA’s modeling capabilities,” Lee said. “Having a dialogue between air quality managers and NOAA has been vital.” §

AQAST Spotlight: Arlene Fiore

U.S. Air Pollution: Domestic or Imported?

Written by Ben Kaldunski & Tracey Holloway

The Environmental Protection Agency (EPA) is charged with keeping air healthy across the U.S., but what happens when air pollution flows in across our borders? Identifying the sources of pollution is a critical step in designing strategies to ensure that our air stays clean.

Of course, airborne chemicals do not pass through customs, or carry import/export labels. Instead, scientists must use advanced computer models of air pollution chemistry and transport combined with detective work to piece together the evidence from the available measurements to determine how other countries are affecting domestic air quality in the U.S. Although our lungs can’t distinguish local from foreign air pollution, it is essential that policy-makers know the difference. Otherwise, air quality managers risk setting unattainable limits, or regulating the wrong sources of emissions.

This issue is particularly significant for ground-level ozone, because the EPA is currently developing a tighter national standard and “background” sources play a major role in the U.S. ground-level ozone budget. Background ozone is defined by EPA as pollution that

Dr. Arlene Fiore’s research has helped EPA improve modeling capabilities to produce more accurate estimates of background ozone. (Image courtesy of Columbia University)



is formed from sources beyond the control of U.S. air quality managers. Major sources of background ozone include global methane emissions, transport from foreign countries and natural sources like wildfires and lightning.

Arlene Fiore, Associate Professor at Columbia University and a member of NASA’s Air Quality Applied Sciences Team (AQAST), is one of the leading experts on the attribution of U.S. air pollution to domestic versus foreign sources.

Although Fiore has been working with the EPA on this important topic for years, her involvement in AQAST has advanced her engagement with air quality managers, especially Pat Dolwick, a scientist in EPA’s Office of Air Quality Planning and Standards, and Gail Tonnesen, a member of EPA’s Air Quality Modeling Group at the agency’s Region 8 office in Denver.

“The work Arlene has done to compare modeling practices has helped us better understand the reasons why model estimates of background ozone can differ,” said Dolwick, who has collaborated with Fiore on research to support federal ozone designations and pollution mitigation plans.

“A high level of background ozone implies that an area cannot attain the federal standards using traditional control methods,” Fiore said. “Unlike particulate pollution, we have no way to identify where an ozone molecule came from.”

This is why scientists need to use models to predict seasonal and geographical variations in background ozone. Fiore’s research team at Columbia uses advanced global models of atmospheric chemistry, which are evaluated against a wide range of measurement data from ground instruments and satellites, to quantify how different sources contribute to U.S. inflow. In particular, she examines how changing regional and global emissions will affect U.S. ozone levels, taking into account climate change and variability over several decades.

“We have leveraged a lot of Arlene’s work in characterizing background ozone,” Dolwick said. “Her work has been incorporated in several of our scientific and technical support documents for the proposed ozone standard revisions.”

EPA is expected to issue new ozone standards in October 2015. The long-term goal of Fiore's efforts is to identify chemical indicators that could serve as "tracers" for background ozone. These tracers could be measured by satellites, or ground-based instruments, instead of relying heavily on imperfect computer models.

Fiore explained that already, satellite measurements of carbon monoxide and nitrogen dioxide (a major ingredient that leads to ozone formation) have helped researchers compare simulations from air quality models against observed conditions.

Gail Tonnesen, from EPA Region 8, said satellite measurements of formaldehyde also hold potential for tracking background ozone.

"It is an evolving process," Tonnesen said. "The current generation of instruments cannot provide the high resolution required to monitor ozone for compliance with the federal standards."

The next generation of ozone monitoring instruments, mounted to geostationary satellites, could provide EPA with a powerful new set of tools for ozone background checks. The Tropospheric Emissions Monitoring of Pollution (TEMPO) instrument, which will be launched into geostationary orbit above North America later this decade, could provide hourly measurements of ozone and other pollutants.

Current satellite instruments, which only pass over the U.S. once per day, can only provide a brief snapshot of pollution.

Below: Dr. Fiore's collaboration with EPA researchers Pat Dolwick and Gail Tonnesen has helped the agency refine air quality models that are used to estimate levels of background ozone in remote areas, such as the Rocky Mountains (shown below). While EPA and state-level air quality managers largely rely on air quality models to quantify background ozone, ACAST research efforts could result in the use of satellite measurements and other remote sensing techniques to provide more accurate and frequent data for a variety of air quality applications. (Image courtesy of the U.S. National Parks Service)

Pat Dolwick, from the Environmental Protection Agency, has worked with Dr. Arlene Fiore on several ACAST research projects. (Image courtesy of the EPA)



"We are trying to extract as much information as possible from existing instruments, while figuring out ways to best utilize the next generation of satellite instruments," Fiore said.

Fiore cites "constant two-way interactions" as essential to succeeding in this type of policy-relevant science.

"I have found it really useful," Fiore said. "I've learned from Pat and Gail how to present research findings in ways that are more digestible to policy makers."

Dolwick also praised the partnership and support provided by collaborations with ACAST.

"We really appreciate the frequency with which they check in with the air quality planning community," Dolwick said.

Tonnesen also cited ACAST's communication and outreach efforts as a major reason for successful collaboration.

"It has been extremely valuable for us to align research initiatives with air quality management needs," he said. §



To learn more about NASA ACAST, visit aqast-media.org and aqast.org, or follow us on Twitter at [@NASA_ACAST](https://twitter.com/NASA_ACAST).

