EPA SCIENCE MATTERS 2018




EPA's mission of protecting human and environmental health starts with science. In laboratories, research centers, and field sites across the country, EPA researchers are conducting the science that provides a foundation upon which to make decisions at the Agency. EPA researchers are also lending their expertise to states, tribes, and communities to provide the information, technical support, and innovative tools that will protect them from the environmental issues they are facing.

EPA's Science Matters newsletter highlights these efforts. Read about how EPA researchers are assisting communities dealing with wildfires, reducing children's lead exposure, using innovative methods to evaluate chemicals, and more in a few of the articles published in 2018.

For more stories about EPA research go to:
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Understanding PFAS in the Environment

Per- and polyfluoroalkyl substances (PFAS) are a group of synthetic chemicals that have been in use since the 1940s. PFAS are found in a wide array of consumer and industrial products. PFAS manufacturing and processing facilities, facilities using PFAS in production of other products, airports, and military installations are some of the contributors of PFAS releases into the air, soil, and water.

Due to their widespread use and persistence in the environment, most people in the United States have been exposed to PFAS. There is evidence that continued exposure above specific levels to certain PFAS may lead to adverse health. EPA will continue to partner with other federal agencies, states, tribes, and local communities to protect human health and, where necessary and appropriate, to limit human exposure to potentially harmful levels of PFAS in the environment.

As part of this effort, EPA scientists and engineers are working on some specific projects to help communities make informed decision about PFAS in their environment.

EPA Researchers Use Innovative Approach to Find PFAS in the Environment

The traditional approach to testing a sample for chemicals--called targeted analysis--is time consuming, labor intensive, and researchers must know what chemicals they are looking for.

Using a new approach, called non-target analysis, researchers do not have to know what specific chemical they are looking for in a sample. With high resolution mass spectrometry (HRMS), a more sensitive analysis, researchers can identify many of the chemicals present in a sample. The HRMS measures the accurate mass of molecules and can find chemicals that were previously unknown.

In 2018, Researchers from EPA and NC State University used the non-targeted approach to understand the impact of industrial discharges in the Cape Fear River in North Carolina. Researchers took sequential samples at locations along the river at specific distances from each other. They then compared what new chemicals occurred downstream relative to an industrial discharge source upstream. When researchers found new chemicals in a downstream sample, they used HRMS to figure out the chemical formula and proposed chemical structure of what they found. Using HRMS they identified many PFAS, including GenX, in the Cape Fear River. The researchers coordinated with the EPA regional office, the state, and industry to reduce PFAS in the watershed.

Non-targeted analysis is proving to be useful in other communities as well. EPA researchers are currently using this approach to help communities in New Hampshire and New Jersey determine the impact of PFAS exposure.

For many chemicals, especially PFAS, there is little known about how they move through the environment. With this new non-targeted approach, researchers can pinpoint what chemicals are in a sample and at what concentrations, as well as how they flow through a river, or move through the air or in soil. This innovative approach is important to states, tribes, and local communities to protect their health and the health of the environment.

EPA Toxicologists Focus Innovative Research on PFAS Compounds

EPA researchers note that one of the biggest challenges in understanding potential hazards of exposure to PFAS is the lack of toxicity information.

Toxicity and kinetic information shows how a chemical affects an organism and how the chemical moves through the organism—from being absorbed, to being distributed and metabolized, and finally to being eliminated. Scientists need this information to develop toxicity values for the chemicals which help determine what levels of exposure are generally safe for public health, and to help communities communicate to residents about any potential risks related to exposure.

EPA researchers partnered with researchers at the National Toxicology Program to develop a tiered testing approach to quickly generate toxicity and kinetic information for approximately 75 PFAS compounds. These compounds were selected to represent the whole of PFAS 'chemical space', based on occurrence in the environment, diversity of chemical structures, and suitability for high-throughput testing based on volatility and solubility of the compounds. High throughput testing gives researchers the ability to rapidly screen chemicals to generate toxicity and kinetic data for chemicals that have little to no existing data.

"The first phase of this testing casts a broad net for potential health effects," said EPA toxicologist Dr. Reeder Sams. "This phase of research includes a range of high-throughput in vitro [cell-based and cell-free, biochemical assays] tests that cover a range of health endpoints such as immunotoxicity or neurodevelopmental toxicity. It also includes tests that show estimates of absorption, distribution, metabolism, and clearance within an organism."

He adds, "These tests will help determine if there is concern for a given compound and then we can decide which PFAS will need additional testing and what type of testing we need."

Once the first tier of testing is complete, the data generated will be used to inform risk assessment efforts, develop predictive models for PFAS with limited or no existing data, and help prioritize which PFAS should go on to a second phase of testing.

The second tier involves in vivo testing. These tests will focus on the PFAS that have the greatest potential for toxicity based on existing data, data generated through the tier one testing, and exposure information. This information will give EPA and partners the ability to estimate how potent the compounds are and will be used to inform future decisions on the risk of PFAS in the environment.

EPA Toxicologists Use Innovative Assessment Methods to Develop Draft Toxicity Values

In 2018, EPA released draft reference doses (RfDs) for perfluorobutane sulfonic acid (PFBS) and GenX chemicals for public comment. These reference doses, developed by EPA's Office of Research and Development and Office of Water, are an estimate of the amount of a chemical a person can ingest daily over a lifetime (chronic RfD) or less (subchronic RfD) that is unlikely to lead to adverse health effects. Their release marked significant progress towards completing one of four action items set during the 2018 PFAS National Leadership Summit.

To complete draft assessments in a rigorous and transparent manner consistent with the latest innovations in toxicology assessment, the PFBS assessment team, led by EPA researchers Beth Owens and Jason Lambert, relied on EPA's growing use of systematic review methods to review the scientific literature in a targeted, efficient, and unbiased way. Both assessment teams also engaged heavily with program offices, states, and other federal agencies to expedite the review processes.

The final assessments can be combined with specific exposure information to help characterize the potential public health risks associated with exposure to these chemicals.

EPA Scientists Develop New Methods to Evaluate Chemicals

EPA scientists are developing and evaluating new methods to evaluate chemicals for potential health effects. These methods are fast, cost effective, and reduce our reliance on traditional methods which use laboratory animals.

There are thousands of chemicals currently in use and hundreds of new chemicals are introduced into the market each year. Under different federal statutes, EPA makes a broad range of decisions to protect public health and the environment from unintended consequences of using chemicals.

EPA's ENTACT Study Breaks New Ground with Non-Targeted Research

EPA scientists are leading a multi-phase project to evaluate the ability of non-targeted analysis laboratory methods to consistently and correctly identify unknown chemicals in samples. EPA's Non-Targeted Analysis Collaborative Trial (ENTACT) was formed in 2015 and includes nearly 30 academic, government, and industry groups. Non-targeted analysis involves analyzing water, soil and other types of samples to identify unknown chemicals that may be present, without having a preconceived idea of what chemicals may be in the samples.

"One of our main goals is to figure out what scientists are doing with non-targeted analysis as a group at large, particularly which chemicals we correctly identify and why," says Elin Ulrich, an EPA scientist who co-leads ENTACT with EPA's Jon Sobus.

To conduct the study, the ENTACT team used about 1,200 chemical substances from EPA's ToxCast library to make 10 liquid mixtures containing 100-400 compounds each. Three types of samples were also used in the study: house dust, human serum (a component of blood), and silicone wristbands. The samples were each spiked with one of the 10 liquid mixtures.

These different types of samples were then sent to approximately 25 labs where workers were instructed to use their own non-targeted lab methods to analyze the samples, and to report back to EPA what chemicals they believed were in the samples

As the labs send back their findings, EPA scientists unveil the chemicals present in each sample so that participants can evaluate what they correctly or incorrectly identified, or didn't detect.

"ENTACT is not focused on which lab had the most matches," says Sobus. "It's about determining which non-targeted analysis methods work best so that everyone's research improves."

Developing Organs On-a-Chip: Chemical Safety Research Collaborators Provide Research Review

EPA's ability to meet its mission of protecting public health and the environment depends on credible and timely assessments of hazards and risks posed by chemicals. To understand the effects of chemical exposures, risk assessors must understand how chemicals impact human systems, including complex tissues and organs. Unfortunately, there are huge data gaps in this area, and current testing methods are costly and time-consuming.

To fill these data gaps, EPA is developing predictive toxicology tools called Organotypic Culture Models (OCMs). OCMs are 3-D, in vitro (lab-based) cell culture constructs. Sometimes referred to as "Organs on-a-Chip," these new testing approaches will be a faster and less costly method for predicting the effects of chemicals on human biology. In addition, OCMs have the potential to reduce and eventually replace vertebrate animal testing, one of the traditional testing methods.

EPA Science to Achieve Results (STAR) research grants were awarded to four universities to develop OCMs in close collaboration with EPA scientists. When integrated with in silico (computer) models and other relevant information, human cell-based OCM technologies currently under development will help simulate how a chemical exposure might affect human tissues. OCMs can serve as predictive toxicology tools to inform decision-making associated with chemical compounds, mixtures, and emerging contaminants.

These grants are now in their fourth year of funding and have shown considerable progress. Grantee projects focus on the development of OCMs that can provide data on the effects of chemicals on systems relevant to development and reproduction, as well as endocrine systems, organ-specific toxicology, and disease. OCMs show promise toward providing relevant platforms for toxicological assessments that can be run in a reproducible, medium to high-throughput manner, allowing for the quick assessment of many chemicals.

The continued development of robust 3-D models of organs' and tissues' responses to chemical compounds is critical to informing EPA's chemical safety research and advancing science aimed at protecting public health and the environment.

New Testing Method for Lead and Arsenic in Contaminated Soil Saves Money and Protects Public Health

EPA recently validated an innovative new technology to guide the cleanup of soils contaminated with arsenic and lead. The new laboratory method, based on a "virtual stomach" that mimics human digestion, estimates the bioavailability of arsenic and lead in soils quickly and inexpensively relative to animal models. This method will increase the accuracy of Human Health Risk Assessments, potentially reducing remediation costs.

EPA researcher Karen Bradham uses a "virtual stomach" that mimics human digestion to determine if arsenic and lead in contaminated soils are bioavailable.

The method lowers bioavailability assessment costs by enabling simultaneous assessments for both arsenic and lead at contaminated sites. It has been used successfully by EPA Regional offices to develop clean-up strategies across the U.S., saving millions of taxpayer dollars in clean-up costs, and interest in the method is growing internationally.

EPA scientist Karen Bradham, Ph.D., along with Clay Nelson and Drs. David Thomas and Kirk Scheckel have been working on a bioavailability method that simulates how the human digestive system absorbs arsenic and lead in soil. "Bioavailability" refers to the amount of a substance that is absorbed by the body's gastrointestinal system following exposure.

EPA validated the method after it was shown to meet rigorous regulatory acceptance criteria. This means that States and public health risk assessors can use the method during cleanups at EPA Superfund sites and other locations with arsenic and lead contamination issues. In addition to protecting public health, the bioavailability method improves the accuracy of human health risk assessments.

The newly-validated method is sometimes called the "artificial stomach" because it mimics the human gastric system, but in fact, it doesn't look like a stomach at all. It is a clear box that sits on a counter and contains small capped, plastic bottles. Each bottle holds one gram of soil in a clear amino acid solution, with a low pH of 1.5. Researchers flip a switch and the bottles begin rotating end over end in an incubator heated to 98-degress F, matching a person's average body temperature. These conditions are carefully selected to mimic the digestion conditions of the human stomach. After a one-hour extraction period, the amount of lead or arsenic from the soil sample that is solubilized in the artificial stomach is measured to determine the bioavailable fraction of the toxic metal.

"Not all arsenic and lead present in soil are able to be absorbed into humans or animals and can cause harm," Bradham explains. "Certain forms of arsenic and lead are not bioavailable, meaning they are not fully absorbed by the human body" says Bradham.

Many years of work have started to pay off. Previously, if a site contained lead or arsenic in its soil and posed a potential risk, the remedy would be to remove the contaminated soil. Moving this much dirt is expensive. While disposal costs vary, they may account for up-to half of the total remediation costs.

Scientists and public health officials can now use the artificial stomach method to determine if arsenic and lead in contaminated soils are bioavailable and remove those specific sections of soil. For example, researchers evaluated arsenic-contaminated soil samples from a site using this method and found that only about half the arsenic was bioavailable. Based on this example, only about 90 acres of soil would need to be removed as opposed to the 117 acres that would have been slated for removal using chemical analysis for total metals only. Those chemical analyses are based on measurements of total arsenic levels instead of that which is truly problematic for human exposure. The potential cost savings of the above example: $9 million.

The work of Bradham and her team of EPA researchers continues to progress, both in the U.S. and abroad. The scientists are currently testing how adding soil amendments to soils allows the elements to bind with lead and arsenic, potentially causing them to pass through the human gastric system unabsorbed. These remediation technologies are in the early stages but are exciting developments for the field of public health.

This research is having an international impact. Researchers around the world are now using this validated method to test the bioavailability of soils. Bradham has trained scientists on using the method in Taiwan. Scientists in Australia, the United Kingdom, and Canada are also using this method.

Bradham explained what she ultimately hopes for the bioavailability method as developments continue worldwide. "We need to keep sharing this method with researchers so they can implement it at contaminated sites to protect human health while saving millions of dollars in clean-up costs and reducing volumes of hazardous material."

EPA Researchers use AI to Mimic Human Behaviors that Could Affect our Exposure to Chemicals

Where and how we spend our time – like eating breakfast around the table at home or riding a bike on the commute from work – plays a major role in the types of chemicals we're exposed to each day.

For EPA scientists, understanding exposure to chemicals is an important consideration in how they assess risks to human health. One piece of data required for studying human exposure is a record of an individual's daily activities, including where they're spending their time. Traditionally, researchers have relied on surveying people about their daily activities but collecting enough data this way can be a challenge. Surveys also can't capture information that people aren't aware of (like consumer products being used by people nearby) or information that's too time-consuming to report (like the amounts of all consumer products used in a given day).

EPA researchers have proposed an alternative to relying on human activity surveys by creating a method that models human behaviors using artificial intelligence (AI). Their new method incorporates an "agent-based model" into a "needs-based" AI program, which allows scientists to mimic human decision-making for behaviors that might affect our exposure to chemicals. The AI program can simulate the behaviors over extended periods of time, making the framework and models based on it able to generate human behavior data suitable for use in exposure assessments.

EPA researcher Namdi Brandon says it's important to consider human behavior over time because chemical exposure can have a snowball effect, slowly accumulating across days or weeks.

"When someone is exposed to a chemical from a consumer product on a given day, it's possible that a fraction of the chemical might remain in their body for the following days," Brandon says. "Meanwhile, there may be exposures to the same or other chemicals during the same time, causing the chemicals in their body to accumulate over time to possibly hazardous levels."

EPA's model currently addresses four exposure-related behaviors – sleeping, eating, commuting and working – but doesn't account for more complex actions, like raising children or unscheduled group activities. Though, Brandon believes the framework could be extended to include new behaviors or interactions.

"We could improve the model to have multiple agents within a household," he says. "With multi-agent households, we could have agent-to-agent interactions, in which one agent may do an activity that may affect the needs of the other agent such as: child rearing and communal responsibilities like cleaning, food preparation, yard work, etc."

Beyond modeling exposure to chemicals, this research has many possible applications.

"Because this method allows us to simulate people's daily routines in and outside of their homes, scientists can use the human behavior patterns generated by the model to better understand human exposure to both indoor and outdoor air pollutants," Brandon notes.

Likewise, Brandon suggests the method could be used to better understand exposures related to residential water use. "By simulating behaviors related to water use – like bathing, using the faucets for cleaning, drinking or cooking – we may be able to obtain more detailed estimates of exposure due to use of residential water sources," he says.

Reducing Children's Lead Exposure in Omaha, Nebraska

For over 125 years, the American Smelting and Refining Company operated a lead refinery in Omaha, Nebraska, only a few blocks west of the Missouri River. Large amounts of lead were emitted into the air, contaminating the surrounding neighborhoods. Between 1998 and December 2015, EPA sampled more than 40,000 residences in the area, and found that about thirty-three percent of the properties had soil in their yards with lead above the cleanup level.

EPA's Region 7, which encompasses a four-state area including Nebraska, has been working for years to clean up the neighborhoods surrounding the old lead smelter, which is now a Superfund site. A Superfund site is any land in the United States that has been contaminated by hazardous waste and identified by EPA as a candidate for cleanup because it poses a risk to human health and/or the environment. At this particular Superfund site, over 95% of properties with soil found to have lead above the cleanup level have been remediated. This means that the soil has been removed and replaced with new, clean soil. With the cleanup nearing completion, EPA wanted to ensure that the soil remediation was leading to decreasing blood lead levels in the children that lived in the affected neighborhoods and determine whether further remediation was needed.

Lead is particularly dangerous to children because their growing bodies absorb more lead than adults. Lead has been shown to have negative impacts on children's developing brains and nervous systems. Babies and young children can have higher lead exposure because they often put their hands and other objects into their mouths which can be covered with lead from dust or soil.

Through a collaboration with the Douglas County Health Department, EPA researchers Drs. Ellen Kirrane and James Brown accessed blood lead level data that had been collected from thousands of children living in residences within and bordering the most impacted 27-square mile area in Omaha. EPA combined this data with data on lead in soil and dust inside local homes. Through some analysis, EPA linked the datasets together to create a complete picture of lead exposure in local children, down to the level of exposure that occurred in each home. EPA completed a preliminary analysis of the data, which found that blood-lead levels in local children had dramatically decreased over time.

However, EPA's work is not done. There are many factors that may have influenced the drop in blood lead levels. For example, blood lead levels in children have dramatically decreased due to changes like the phase out of lead in gasoline. EPA is now working to tease out the effect of soil remediation on the blood lead level decrease by doing a direct comparison of levels of lead in the soil before and after remediation.

Omaha, Nebraska

EPA researcher Ellen Kirrane is overseeing work on a report that will document the "lessons learned" about evaluating the efficacy of remediation using these types of environmental and blood lead surveillance data.

"This will enable us to share our experiences and methods for collecting and analyzing these data so other communities can benefit from similar evaluations," says Kirrane.

"Our experience using the Omaha data has helped us better appreciate the extent to which surveillance data can be used to evaluate models such as the EPA's Integrated Exposure Uptake and Biokinetic (IEUBK) model for lead in children and understand data types essential to model evaluations," said EPA researcher James Brown.

The IEUBK model is used to estimate the probability of exceeding specified blood lead levels given that lead exposure can occur through multiple pathways. Increasing the accuracy of the model at low blood lead levels that are now commonly seen is very important, as health effects can occur even at very low levels of lead exposure.

What EPA is learning in Omaha has the potential to help protect children across the country in areas where not as much data is available.

In addition to protecting public health in Omaha, this research could potentially focus scarce resources on the most important sources of lead exposure in other communities.

Gene Gunn in EPA Region 7 says, "This work will help determine whether additional residential soil cleanup actions will be a cost-effective way to further reduce blood lead levels in young children in Omaha and other lead sites across the country. In Omaha alone, it can cost more than $300 million dollars to achieve lower soil lead levels in yards."

This work is another example of how EPA's collaboration with state and local health officials can contribute to a better understanding of Superfund site impacts and decision making that leads to healthier communities.

Advancing Sensor Technology to Monitor Wildfires

EPA recognizes the need for compact and field-deployable sensor technology to measure air pollutants emitted during wildfires. Rugged but reliable and easy-to-use sensor systems can significantly increase data on air quality conditions during a wildfire or prescribed fire. Data from these small sensors complement measurements obtained from more complex regulatory-grade monitors that are stationary or not easily transported.

EPA and other federal agency partners are responding to the need for more monitoring capabilities during wildland fires through two research projects. These projects build upon EPA's expertise in developing emissions and ambient monitoring systems that integrate sensor technologies, as well as field evaluation of commercially available sensors under ambient conditions.

Wildland Fire Sensor Challenge

EPA and five other federal agencies issued an international Wildland Fire Sensors Challenge to encourage sensor developers and researchers to develop new and innovative air sensor monitoring technologies to measure air pollutants from smoke during wildland fires. The competition required monitors to be portable and low maintenance, measure a wide range of pollution levels, and report real-time data continuously and wirelessly to a central data-receiving station.

"Our goal for the Challenge was to encourage innovative technology designs that are easy to use and operate as a wireless sensor network and that can be used to assess air quality conditions close to the fire as well as in downwind communities," says Gayle Hagler, an EPA researcher who helped coordinate the Challenge. "The target user is the Air Resource Advisor who is responsible for developing public health communications about air quality conditions and could benefit from expanded air monitoring technology options."

The winners of the Challenge were announced in September 2018. The first-place winners of the challenge are Jason Gu and Bryan Tomko of SenSevere/Sensit Technologies in Pittsburgh, Pennsylvania, who used their experience designing gas detection and measurement instruments for manufacturing operations to develop an air sensor prototype for wildland fires.

In Bellevue, Washington, Scott Waller and Andrew Smallridge of Thiingy LLC in earned second place, and Honorable Mention went to Javier Fernandez of Kunak Technologies in Pamplona, Spain.

"The winners of the Wildland Fire Sensors Challenge have demonstrated incredible ingenuity using miniaturized technology to develop continuous real-time monitoring systems that are accurate and portable," says Alan Vette, Acting Director of the Air and Energy National Research Program at EPA. "This challenge has responded to the need for innovative systems for use during wildland fires to alert the public about health threats from high levels of smoke."

Sensor Testing in the Field During Wildfires

In another project, EPA researchers collaborated with the United States Forest Service and other partners to evaluate the performance of fine particle pollution (PM2.5) sensors already commercially available for their ability to operate under real-world wildfire conditions. EPA researchers put the sensors into portable units, evaluated their performance compared to reference monitors in the Research Triangle Park, NC, and tested them in the field at three fires in the western U.S. during the 2018 wildfire season.

"The goal was to identify emerging air sensor technology that can enhance efforts to monitor air quality during a wildfire event and to provide guidelines for communities and government agencies on the use of these sensors," says Amara Holder, EPA researcher and principal investigator.

The sensor packages were designed to operate for up to a two-week period with minimal maintenance and without access to power. Using data from the study, researchers will develop a performance evaluation report that can be used by states, tribes, communities, and public health officials to learn more about the potential application of sensors for wildfire smoke monitoring.

EPA researcher Amara Holder holds up one of the sensors tested in the field during wildfires.

These and other air monitoring projects are helping to advance the next generation of sensor technology systems for wildland fire applications to protect public health.

Tracking Emissions Using New Fenceline Monitoring Technology

Over the past five years, EPA researchers have been developing new cost-effective approaches to measuring air pollutants at the fenceline or in communities near industrial facilities to help identify air pollution that may drift across property lines. The benefits include reduced operational expenses for companies and improved air quality. The research is being conducted in collaboration with industry, states, and communities.

EPA scientist Ingrid George holds an SPod, a fenceline monitoring system developed by EPA that can identify air pollution plumes from leaks or other fugitive emissions at the perimeter of industrial facilities.

Companies can manage air pollutants that are emitted from smokestacks or tailpipes using existing measurement and control technologies. In contrast, "fugitive emissions" escape from some industrial processes or equipment leaks in facilities such as refineries, chemical plants, and energy production operations. The fugitive pollutants are difficult to identify, measure, and track, and can include many different volatile organic compounds (VOCs).

For neighborhoods and communities living close to industry, emissions may be a concern to health and wellbeing. The release of VOCs can lead to ozone formation, and many of the compounds are hazardous air pollutants that can contribute to harmful health effects. One measurement technology developed by EPA that has shown promise is called the SPod, a solar-powered sensor system that is portable, lower-cost, and can be placed at a facility's fenceline. The instrument detects and locates plumes of air pollutants, including VOCs, that are being emitted.

"The SPod is a simple sensor," says Eben Thoma, lead investigator at EPA. "Its job is to protect the fenceline by detecting whether VOC emissions are present and providing wind and concentration data to help identify the source and speed repair of emissions if required."

The SPod is an open-source design that has been shown in field studies to provide useful emission detection information. EPA has shared the design with dozens of interested early-adopters to encourage improvements and commercialization.

Three early SPod-like prototypes that have been developed by outside parties are being evaluated by Thoma and his colleagues at EPA's research laboratories in Research Triangle Park, NC. The devices are being compared to the Agency's research SPod, as well as more sophisticated and expensive measurement instruments.

In Louisville, Kentucky, EPA is working with local industry, the Louisville Air Pollution Control District, and other partners in a field study to evaluate the SPod and other technologies in a community called Rubbertown. The community has faced challenges related to the control of ozone and other pollutants.

Researchers are also in the early stage of testing a new portable version of the SPod that can be used on a truck or moved around inside an industrial facility. Taking the SPod concept another step forward, EPA researcher Ingrid George is developing the VOC Emissions Tracker (VET), an emission measurement system that can be easily deployed in the field to help detect VOC emissions and locate their sources.

The VET combines three advanced VOC measurement technologies:

- the SPod to detect and locate VOC plumes,
- a miniaturized, field-deployable automated gas chromatograph used to monitor a specific VOC pollutant of concern,
- and a canister triggering system that can collect whole air samples when a plume has been detected.

The samples can be sent to the lab for analysis for a wide range of VOCs, to further identify their sources.

For a pilot study in Dallas, Texas, the VET has been customized to measure xylene, a VOC, to assist EPA and Texas with determining the source or sources that may be contributing to elevated levels of the pollutant in the city. Xylene contributes to the formation of ozone and is a hazardous air pollutant. In 2018, the VET tracker was deployed in Dallas for its first field demonstration.

The new emissions measurement technology being developed and tested at EPA is providing solutions to complex air quality problems that exist in some parts of the country.

EPA Scientists Collaborate with States to Protect Long Island Sound Air Quality

Expansive views of land across water, gulls cawing, water lapping on the rocks: this is Long Island Sound. Despite its proximity to New York City and other major urban areas, a diverse array of aquatic and terrestrial ecosystems dot this narrow land that stretches out toward the Atlantic Ocean.

The unique geography of Long Island Sound presents an interesting challenge for scientists. For example, the cooler surrounding waters trap regional air pollutants above the water. As temperatures rise, the breeze pulls this pollution inland. This leads to high ground-level ozone concentrations along the shorelines of New York, Connecticut, and Rhode Island. Although ozone levels have decreased in recent years, they still persistently exceed National Ambient Air Quality Standards (NAAQS).

In 2018, EPA scientists collaborated in a multi-agency field study to better understand the complex interaction of emissions, chemistry, and meteorological factors contributing to these high ozone levels along the Long Island Sound shorelines. The Long Island Sound Tropospheric Ozone Study (LISTOS) included researchers from state and federal agencies and academia with expertise in collecting aircraft-, satellite- and ground-based air quality measurements.

As part of the study, EPA scientists used a variety of advanced instruments at sites surrounding Long Island Sound to measure compounds such as nitrogen dioxide, formaldehyde, and carbon monoxide, which react in the atmosphere in the presence of sunlight to form ozone. Other compounds, including carbon dioxide, sulfur dioxide, and particulate matter, are being measured to better understand emission sources.

“As our instruments continue to advance, EPA is learning more about ozone formation near the ground and aloft,” says Jim

EPA’s David Williams and Luke Valin at the U.S. Fish and Wildlife Service Outer Island, CT site. David is installing a spectrometer and the large white instrument is a ceilometer.

Szykman, who led EPA's work on the project. "Ultimately this enables states to have a better sense of how to most effectively protect people and the environment from harmful ozone levels."

By using various instruments to measure ozone precursors on both the ground and in the atmosphere, researchers can determine the height at which precursors are mixing and the ease at which pollutants might move across a region.

In addition to EPA's ground and satellite work, University of Maryland and NASA flew aircraft fitted with instruments that measure nitrogen dioxide and formaldehyde in the atmosphere. University of Maryland flew its aircraft over the study area when there was a high-ozone episode during the research months, and NASA used its aircraft throughout the summer to gather data to better understand ozone formation and nitrogen dioxide emissions.

"Air pollution in the New York City area and over Long Island Sound is complex and dynamic on a daily basis," said Dr. Paul Miller, Chief Scientist at the Northeast States for Coordinated Air Use Management, organizer of the study. "The LISTOS effort is helping address a difficult public health problem that affects over 20 million people living in the region."

The study provided valuable data and resources to state air quality managers as they develop strategies to control ozone pollution and reduce and eliminate NAAQS non-attainment areas.

EPA Researchers Partner with WaterStep to Deliver Clean Water During Emergencies

Following a disaster like a hurricane, water systems can become flooded and unable to provide safe drinking water to communities. EPA researchers recognized the need for portable water treatment systems that can quickly and cost-effectively provide safe drinking water to affected communities following a disaster.

EPA researchers partnered with WaterStep to develop a modular, mobile water treatment system known as the Water on Wheel - Emergency Mobile Drinking Water Treatment System, or the WOW cart. EPA's role in the partnership with WaterStep was to provide technical assistance, environmental sampling and analysis, and logistical support. Researchers also provided expertise to expand the mobile unit's capability with drinking water treatment and disinfection research, including granular activated carbon (GAC) and UV disinfection best practices. WaterStep designed the mobile treatment cart and provided the engineering and fabrication. The result, the WOW cart, was designed and prototypes were built.

Within days of the devastating impacts of Hurricane Maria on Puerto Rico's drinking water systems, WaterStep rapidly deployed 78 Mini Water Treatment Units (Mini), which are smaller versions of the WOW cart, with the help of the National Puerto Rico Leadership Council Education Fund. Each Mini includes everything needed for quick assembly and operation and can deliver safe drinking water within 30 minutes of set-up. Each of these Minis has a solar panel and a chlorine generator, and can provide up to 10,000 gallons of drinking water each day.

This EPA partnership with WaterStep helped provide clean drinking water in the aftermath of the devastating impacts from hurricanes in Puerto Rico. This technology can also be used in communities where there is any kind of water contamination. Public-private partnerships like this one bring EPA researchers and experts in academia and industry together to help communities solve real environmental challenges.

From Brownfield to Breadbasket: Health Impact Assessments Help Communities Make Healthy Decisions

The Former Chesapeake Supply is a vacant and once contaminated property, or brownfield, located in downtown Dover, Delaware. As part of a revitalization effort in the area, local and state officials are contemplating what to do with the property now that it is safe to use again. Because of an interest in increasing food access in and around Dover, they are considering using the site for food production, specifically aquaponics. Aquaponics is a type of farming that grows fish and plants together in an integrated system. EPA staff agreed to help Dover and Delaware officials make decisions about the former brownfield by conducting a rapid Health Impact Assessment (HIA).

An HIA is an approach for identifying how a proposed policy or project might impact the health of a community and how those impacts might affect citizens. It systematically applies scientific data, analytical methods, and input from stakeholders to develop recommendations for how to maximize positive health impacts and minimize negative health impacts. The goal is to help inform decision makers, members of the affected community, and stakeholders about any health-related issues that could result from implementing, or not implementing, a given plan. A rapid HIA is a shortened form of the approach that uses a smaller amount of primary research and stakeholder engagement.

EPA used a rapid HIA to help decision-makers explore ways a brownfield revitalization project might yield broader community benefits and meet other community goals. The Dover rapid HIA evaluated how the proposed project would influence five factors that affect health:

1. Access to fresh and affordable food.
2. Employment opportunities.
3. Brownfield and urban revitalization.
4. Crime and perceived safety.
5. Household and community economics.

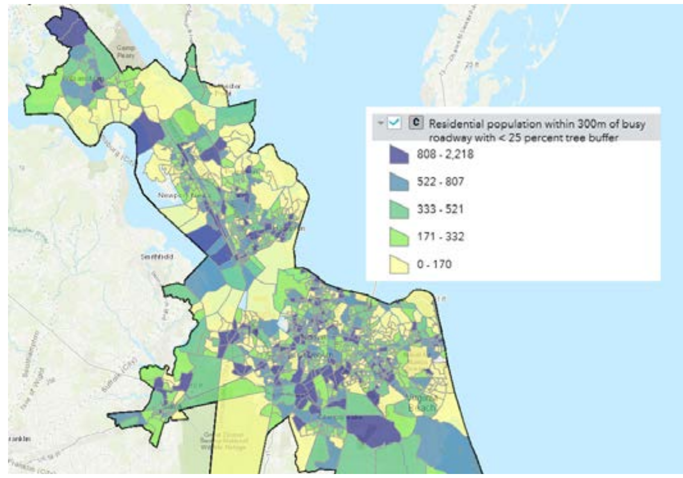
The HIA team evaluated how the proposed project might affect these health factors by examining the conditions in and around the Dover brownfield site. For example, the team looked at statistics such as crime rates in the area and considered factors such as the locations of local grocery stores.

The team also reviewed literature to qualitatively evaluate how the five factors might be affected if the proposed project was executed. Through this approach, the team summarized potential health benefits of using brownfield sites to address food access issues in urban environments. They also demonstrated that brownfield sites could be suitable for agriculture with the use of alternative farming methods, such as hydroponics and aquaponics.

The HIA team presented multiple recommendations to the city and other decision-makers which address each of the five health factors evaluated. These recommendations might also be applicable to future projects in the Dover area and other urban environments across the United States. Now that these recommendations have been given, the community can make decisions on addressing them.

EPA's EnviroAtlas Publishes Data on Six New Urban Areas, Including Baltimore and Chicago

All communities rely on clean air, clean water, green space, and other natural amenities for their economic sustainability and quality of life. Often referred to as "ecosystem services," these functions provide many societal benefits, but aren't always fully understood or considered in local decision-making. EPA's EnviroAtlas tool aims to change that by using maps and data to help communities understand the relationship between nature, health, well-being and the economy.



Example of EnviroAtlas map for Virginia Beach with demographic data overlaid.

EnviroAtlas is an interactive web-based tool that combines maps, analysis tools, fact sheets, and downloadable data to inform state and local policy and planning decisions. The tool already had fine-scale data and maps for 18 U.S. urban areas, and added six more in 2018. The new areas include Baltimore, Md., Chicago, Il., New Haven, Conn., Virginia Beach, Va., Birmingham, Ala., and Brownsville, Texas, which cover 430 cities and towns not previously featured in EnviroAtlas.

The tool shows data at two main scales: national and urbanized community areas. The national component of EnviroAtlas summarizes data for the 48 mainland U.S. states, while the community-component includes additional fine-scale data for 24 exurban to fully urbanized areas, including the six recent additions.

These urban areas include 950 U.S. cities and towns ranging in population from 1,500 to 9.2 million, selected based on environmental and human health data availability, population size, geography and regional interest.

EPA scientist Laura Jackson said the newest areas have a diverse user base who are eager to apply the data to existing community projects. The availability of existing landcover data was also a strong factor in the selection, particularly for Baltimore, Virginia Beach, and Chicago.

The EnviroAtlas team is continuing to develop their suite of 100+ data layers for additional communities, with three planned for completion later this year.

Community-scale data from EnviroAtlas can be used by community leaders and citizens to inform decisions on urban planning, transportation, children's health, green infrastructure, parks and more. Jackson admits she's especially partial to the tool's high-resolution "heat maps" and spatially explicit data layers that show data down to the home, school, and workplace levels.

"The data shows details like how much tree cover is along the sidewalk area of your local street network, how much green space and pavement are within a ¼ kilometer of any point on the map, and how far any point is from the nearest park entrance," she noted.

Data with that much detail can help users evaluate very localized conditions, like the potential for heat stress, and opportunities for physical activity, social interaction, and engagement with nature. In addition to EnviroAtlas' fine-scale data, the tool features fact sheets specific to each community, and an "Eco-Health Relationship Browser" which shows how green infrastructure's ecosystem services have been linked to more than 30 specific aspects of public health, including cardiovascular disease, obesity, ADHD, and depression. "EnviroAtlas was designed to help communities better use ecosystem services for public good," Jackson said.

Questions about any of these stories?
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