Fall 2019 Newsletter

2B Technologies

2B Buzz

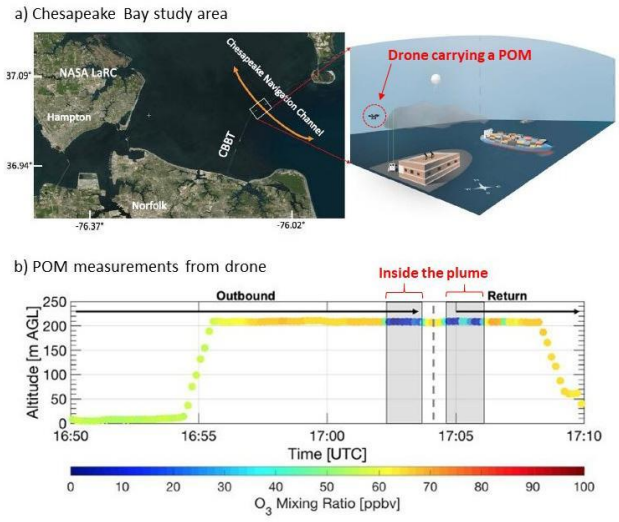
Case Study

What Happens to Ozone Inside a Ship Plume?

2B Tech's POM Flies on Drone through a Freighter's Plume in Chesapeake Bay

2B Tech instruments were on the ground and aboard a small Unmanned Aerial System (sUAS) during a multi-faceted study of air chemistry/air quality in Chesapeake Bay near Hampton, Virginia. The Ozone Water Land Environmental Transition Study (OWLETS) campaign was led by NASA Langley in July-August 2017. Researchers made measurements over land and water with the aim of characterizing air quality in a coastal boundary region, Chesapeake Bay being the largest and most productive estuary in the U.S. Such areas are seeing large increases in population, and now more than 40% of the U.S. population lives within 100 miles of a coast. Changes are also happening offshore, as maritime shipping has quadrupled in the last 50 years, ships have increased in size, and associated emissions have risen. An estimated 15% of global anthropogenic NO_x emissions (and 9% of SO_x emissions) are emitted by sea-going vessels.

Guillaume Gronoff et al. report simultaneous measurements of a plume from a large freighter that passed a few hundred meters from an observing base deployed offshore along the Chesapeake Bay Bridge Tunnel. At the observing base, a 2B Tech Model 202 Ozone Monitor and several 2B Tech Personal Ozone Monitors (POMs) measured ozone, along with a Pandora spectrometer system (and a second Pandora system that measured NO_2). Ozonesondes were launched, and a POM flew aboard the drone. Over land at nearby NASA Langley, a tropospheric ozone lidar rounded out the measurement ensemble.



a) Study area in the Chesapeake Bay, showing the offshore measurement base near the shipping lane. b) Ozone as measured by the 2B Tech POM aboard a drone as it traversed the plume of a large freighter. [Adapted from Figures 1 and 5 of Gronoff et al., 2019.]

The ship plume led to a distinct change in air composition, captured most vividly by the drone's POM, which flew right through the plume twice, on outbound and inbound passes. Shown in the bottom panel of the figure, ozone was severely depleted in the plume as the ship's NO_x emissions "titrated" the ozone ($NO + O_3 \rightarrow NO_2 + O_2$). The other instruments in OWLETS also observed the event, and measurements confirmed that the ozone loss agreed quantitatively with the associated NO_2 increase. The plume stayed aloft likely due to its higher temperature, and ground measurements did not record an ozone decrease.

The authors note that the synergistic sampling approach used in their study has the potential to validate and verify satellite measurements of air quality and atmospheric composition, especially emissions arising from combustion point-sources such as ocean-going vessels as were studied here, and other sources such as fires, power plants and incinerators.

A Method for Quantifying Near Range Point Source Induced O3 Titration Events using Co-located Lidar and Pandora Measurements, G. Gronoff, J. Robinson, T. Berkoff, R. Swap, B. Farris, J. Schroeder, H.S. Halliday, T. Knepp, E. Spinei, W. Carrion, E.E. Adcock, Z. Johns, D. Allen and M. Pippin, *Atmospheric Environment*, **204**, 43-52, 2019.

Link to the Paper

2B Tech's Personal Ozone Monitor (POM)

Air Pollution News

Ozone and Corn Don't Mix Well

New Study Shows Two of the Most Common Varieties Are Most Sensitive to Ozone

In the free-air concentration enrichment experiment, ozone is delivered to a planted field by an octagon of pipes (right), with delivery points and amounts along the pipe adjusted based on wind speed and direction. [Photo at right from Figure 1 of Choquette et al., 2019.]

The earliest interest of ozone-science pioneer Arie Jan Haagen-Smit in ozone pollution stemmed from its damaging effect on crops in the Los Angeles area. Now, in the world's most polluted places such as in China and India and even in the Midwest U.S., high ozone is causing as much loss to corn crops as droughts, floods, pests, or diseases--decreasing yields by as much as 10 percent. In the U.S., that translates to annual losses of over $7 billion. It's an important issue tied to future food security, both in the U.S. and globally.

Crop scientists at the University of Illinois at Urbana-Champaign, the University of Florida, and the US Department of Agriculture have published the results of a two-year study of how different varieties of corn respond to elevated ozone pollution. They used the free-air concentration enrichment (FACE) approach to conduct field exposures of different parent varieties of corn. The FACE approach delivers a target ozone dose via an octagon of pipes that release the ozone at different points based on wind direction and wind speed, with little to no alteration of other aspects of the real-world growing environment used by farmers. The goal is to identify varieties that are most resistant to the photosynthetic decreases and premature ageing caused by excessive ozone exposure. Ozone can also degrade the ability of a plant leaf's stomata to close, causing the plant to lose water more rapidly and affecting the plant's ability to tolerate drought conditions. Though a lot of work has been done to find ozone-resistant varieties of other crops, little is known about corn.

Nicole Choquette and colleagues studied 45 hybrids of 10 different parent varieties of corn. Ozone stress caused different physiological responses among the parent varieties, and two of the most common varieties were especially sensitive. As research continues to pin down the genetic causes of the differences, the hope is that breeders will be able to identify the best choices for a future of increasing pollution and changing climate.

Uncovering Hidden Genetic Variation in Photosynthesis of Field-Grown Maize under Ozone Pollution, N.E. Choquette, F. Ogut, T.M. Wertin, C.M. Montes, C.A. Sorgini, A. M. Morse, P.J. Brown, A.D.B. Leakey, L.M. McIntyre and E.A. Ainsworth, *Global Change Biology*, doi: 10.1111/gcb.14794, 2019.

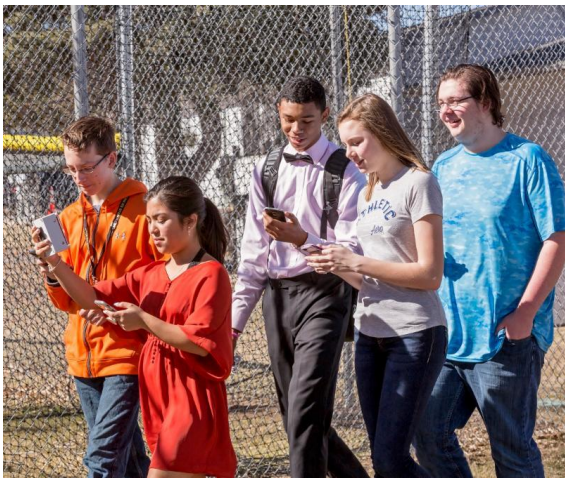
Link to Paper

2B Tech Authors a New Publication

Bringing Air Quality Science to Students and the Public: The 2B Tech Story

A new publication chronicles the extensive efforts of 2B Technologies over the past 10 years to put air quality instrumentation in the hands of students and the public.

The work has fulfilled a lifelong passion of 2B Tech President John Birks for science education. Starting with stationary ozone monitors in schools in the GO3 Project, and now with mobile monitoring of multiple pollutants in the AQTreks program, more than 20,000 students have been engaged worldwide. The programs have capitalized on new and emerging technologies in instrumentation and data communications to enable data sharing and uploading on the web and on mobile phones, the latter as shown in the photo here. 2B Tech Vice President Craig Williford has led the team that developed the instrumentation and data sharing methods.



Students in Colorado use their phones to view air quality data gathered by a 2B Tech Personal Air Monitor (PAM), shown at far left.

It was finally time to tell the story in a peer-reviewed publication! 2B Tech's Director of Educational Outreach, Jessa Ellenburg, led the authoring of the paper published this month in *Atmospheric Environment: X*. Some of the highlights discussed in the paper:

- The instrumentation made available for stationary ozone measurements in the GO3 Project is research-grade, and as a result the data gathered has been of sufficient quality to be useful to scientists.
- The sensor package used in the AQTreks project has proven to be highly engaging for students, enabling them to see and share data using their mobile phones as they measure multiple air pollutants along "Treks" of their own design.
- Seeing and sharing their data on the web make the data come alive for students.

The handheld Personal Air Monitors (PAMs) used in AQTreks are available for rental, making it more economical for schools and communities to participate. Contact us for more information about bringing this to your area.

Global Ozone (GO3) Project and AQTreks: Use of Evolving Technologies by Students and Citizen Scientists to Monitor Air Pollutants, J.A. Ellenburg, C.J. Williford, S.L. Rodriguez, P.C. Andersen, A.A. Turnipseed, C.A. Ennis, K.A. Basman, J.M. Hatz, J.C. Prince, D.H. Meyers, D.J. Kopala, M.J. Samon, K.J. Jaspers, B.J. Lanham, B.J. Carpenter and J.W. Birks, *Atmospheric Environment: X*, **4**, 100048, 2019.

Link to the Paper

2B Tech's Outreach Programs

Meet Our Repair Specialist
Ryan Murphy

If it's broken... give it to Ryan Murphy, 2B Tech's Repair Specialist. Whether it's a 2B Tech ozone monitor, a car, or vintage electronics, Ryan will have it running again in no time.

A self-proclaimed tinkerer and problem solver, Ryan is the perfect man for the job of Repair Specialist at 2B Technologies. For nearly 9 years, he's been responsible for maintaining 2B Tech's entire fleet of ozone monitors (nearly 5000 total sold). Over the years, he's repaired all manner of issues with customers' ozone monitors... including ones that inhaled water instead of air, others that have come in with mysterious unidentified debris, and those that have had less dramatic measurement adventures that just need the regular cleaning and refurbishment service. He enjoys the challenge of getting the instrument up and running again, including some that have been in service for over 15 years. Ryan's experience with "what goes wrong" often leads him to make suggestions that result in improvements to 2B Tech's manufacturing and reduce the occurrence of repair issues.

Before coming to 2B Tech, Ryan honed his diagnostic skills for over 10 years in the auto industry, where he was ASE-certified in automotive repair. He grew up in the Boston area and moved to Colorado in middle school. In his time off, he enjoys doing the same kind of thing that he does on the job-- getting broken things to work again. He's usually repairing things at his home in Frederick, Colorado; restoring old cars; and the like. Other interests include camping, paintball, and (timely right now!) Halloween. Handing out candy is much too tame for Ryan, though. This year he's planning to set up an elaborate outdoor haunted house, and hide inside his home and listen for the screams in the yard. (No doubt he'll be doing this while also repairing something that's broken.)

2B Tech Website

Get Quote

Our Team

Newsletter Archive

Helpful Downloads

2B Technologies

2100 Central Avenue, Suite 105| Boulder, Colorado USA
303-273-0559 | sales@twobtech.com