



2B Tech's Portable Mercury Monitor: Developing a New Version for Use in the Oil and Gas Industry

SBIR Grant from NIH/NIEHS Will Lead to Explosion-Proof Instrument

2B Tech is working hard to revolutionize the way mercury vapor is measured in air.

Over the past ~2 years, we developed the HERMES Personal Mercury Monitor, the smallest and most accurate mercury instrument on the market today. The hand-held HERMES can operate for 5-8 hours on its lithium-ion battery, or can use line power.

The next step is to make a version of the instrument that is suitable for use in the oil and gas industry, where maintenance workers can be exposed to high levels of mercury during periodic inspections of natural gas compressors and other equipment used to process gas and oil. In this case, not only must the instrument be small and easily operated--it must be explosion proof. Any spark from the internal electronics of an instrument could be disastrous in a work area where hydrocarbon fumes are pervasive.

The research is made possible by a Small Business Innovative Research (SBIR) grant from the National Institutes of Health/National Institute of Environmental Health Sciences (NIH/NIEHS). Phase 1, completed in 2018, led to the [HERMES instrument](#) pictured above and now on our website. Six of these instruments are currently in use on oil platforms in the North Sea. Phase 2 of the SBIR grant was recently awarded to develop the "intrinsically safe" (explosion-proof) version. 2B Tech is working with InHand Electronics (Rockville, Maryland) on the design. It is expected that the design will be complete later this year, and that the new unit will be available sometime in 2020.



The HERMES Personal Mercury Monitor, weighing in at less than a pound, measures mercury in air via UV absorbance at 254 nanometers. A detection limit of 0.2 micrograms Hg per cubic meter is achieved in the 10-second measurement mode.

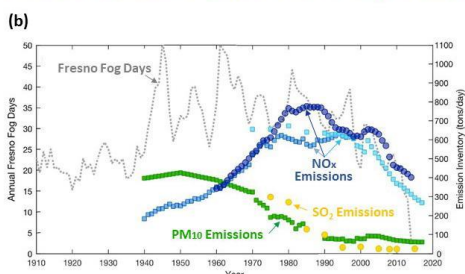
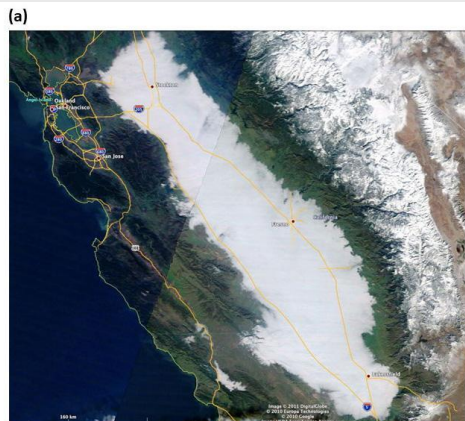
[More Info About the
HERMES Personal Mercury
Monitor](#)

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Air Pollution News

Pollution Progress Helping to Lift the Famed "Tule Fog" in California's Central Valley

New Study Links Fog Declines with Falling NO_x Emissions



(a) The tule fog envelopes the entire Central Valley of California, from north of Stockton to south of Bakersfield, in this NASA image from the MODIS instrument aboard the Terra satellite. The snow-covered Sierra-Nevada mountain range is to the right. (b) Fresno data for number of annual "fog days" (gray line) and pollution emissions (NO_x data in blue correspond best with fog data). [Adapted from Figure 6 in Gray et al., JGR, 2019.]

The "tule fog" is a dense wintertime fog that occurs periodically in the Central Valley of California. Named for a sedge grass in the Valley wetlands, the tule fog helps out agricultural productivity by providing the hours of "winter chill" needed during the cold season dormancy of fruit and nut trees. But it can wreak havoc, too, and is infamous for causing traffic pileups and school closures. It's no ordinary fog--it covers hundreds of miles and is so dense and massive that it looks like snow cover in the satellite image shown here.

The number of "fog days" increased 85 percent from 1930 to 1970 as agricultural development and population grew in the region. But a puzzling decrease of 76 percent occurred from 1980 to 2016, despite continued population and agricultural growth. A [new study](#) by Ellen Gray and colleagues, published in the *Journal of Geophysical Research* in March, looked at 7 decades of meteorological data and 5 decades of air pollution data to find out what has been driving the long-term change in the frequency of the tule fog events.

They found that the decadal trend is best explained by the rise and fall of emissions of nitrogen oxides (NO_x). Before the Clean Air Act regulations enacted in the 1970s, NO_x emissions went up because of increasing agriculture and transportation. In the atmosphere, NO_x reacts with ammonia (largely from agriculture) to form particles of ammonium nitrate,

which are effective "seeds" for the formation of fog droplets. But since the 1980s, NO_x emissions have declined and therefore so have the incidents of the fog. Though weather variability can explain shorter-term variations in fog, the study finds that only the trend in NO_x emissions can explain the long-term rise and then fall in fog frequency.

And thus we have an example of how air quality regulations have led to safer highway travel. :)

[Impact of Air Pollution Controls on Radiation Fog Frequency in the Central Valley of California](#), E. Gray, S. Gilardoni, D. Baldocchi, B.C. McDonald, M.C. Facchini, and A.H. Goldstein (2019), *Journal of Geophysical Research: Atmospheres*, 124, 17 pp.

Case Studies: 2B Tech Monitors Deployed in Major Field Studies

Recently Published: Intercomparison of Ozone Measurements During the California Baseline Ozone Transport Study (CABOTS)

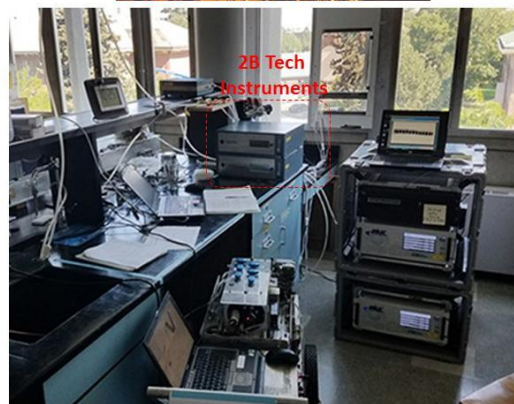
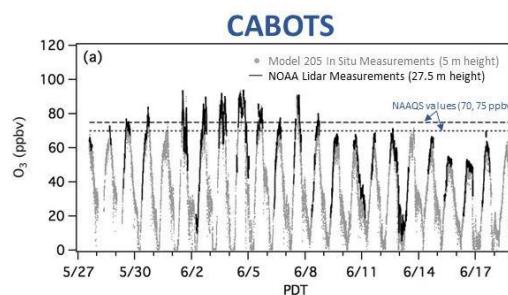
Four different 2B Tech instruments were on the ground and in the air during the 2016 CABOTS study, which was focused on finding out how long-range transport and stratospheric intrusions affect surface ozone concentrations in the San Joaquin Valley of California. It's a critical question for the region, which is one of two extreme ozone non-attainment areas in the U.S. Three Model 205 Dual-Beam Ozone Monitors were put to work, with two of them aboard small aircraft involved in the study, and one at a ground site co-located with NOAA's ozone profiling lidar instrument. A 2B Tech Model 306 Ozone Calibration Source calibrated the measurements made by the modified Model 205 that flew on the NASA Ames Alpha Jet.

A [recent publication](#) by NOAA scientist Andrew Langford and colleagues took a close look at how the lidar, aircraft, and surface ozone measurements compared. The lidar measurements agreed, on average to within 5 parts per billion by volume, with the ozone measured by the 2B Tech monitors on the two aircraft platforms. The lidar agreed well with the co-located Model 205 measurements (top panel of figure), which were adjusted to account for secondary chemistry from nearby traffic emissions.

Happening Now: The Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ) Study

Multiple federal, university, and private industry research groups are teaming up to carry out one of the largest atmospheric measurement projects ever conducted to study the influence of fires and smoke on air quality and climate in the continental U.S. Among them is Bob Yokelson's group at the University of Montana. Yokelson is using two of 2B Technologies' instruments at a ground site in Missoula, Montana. The Model 405 nm NO₂/NO/NO_x Monitor will provide the sensitivity needed for measuring NO_x, and the Model 211 Scrubberless Ozone Monitor will minimize interferences from hydrocarbons expected to be abundant in the atmosphere during the wildfire season. See the [FIREX website's description of the University of Montana's role in the field campaign](#).

[Intercomparison of Lidar, Aircraft, and Surface Ozone Measurements in the San Joaquin Valley during the California Baseline Ozone Transport Study \(CABOTS\)](#), A.O. Langford, R.J. Alvarez II, G. Kirgis, C.J. Senff, D. Caputi, S.A. Conley, I.C. Faloona, L.T. Iraci, J.E. Marrero, M.E. McNamara, J.-M. Ryoo, and E.L. Yates (2019), *Atmospheric Measurement Techniques*, 12, 1889-1904.



(a) Ground measurements of ozone with the 2B Tech Monitor (gray dots) compared with the 27.5-m ozone measurements of the NOAA lidar (black line) during CABOTS. (b) The 2019 FIREX-AQ study will use a 2B Tech Model 211 to measure ozone and a Model 405nm to measure NO_x at a ground site at the University of Montana this summer.

[2B Tech Ambient Ozone Monitors](#)

[Model 405 nm NO₂/NO/NO_x Monitor](#)

Meet Our Director of Educational Outreach **Jessa Ellenburg**

Jessa Ellenburg's love of science and passion for children's education combine to make her a dynamo for the [educational and public outreach program of 2B Technologies](#). If you've ever had the pleasure of talking with Jessa on the phone or at a meeting, you have witnessed this enthusiasm first-hand! For over 10 years, she has worked with 2B Tech President John Birks to start, grow, and evolve the outreach accomplished in the nonprofit Global Ozone (GO3) Project, which puts 2B Tech's air quality instrumentation into the hands of kids and teachers around the globe.



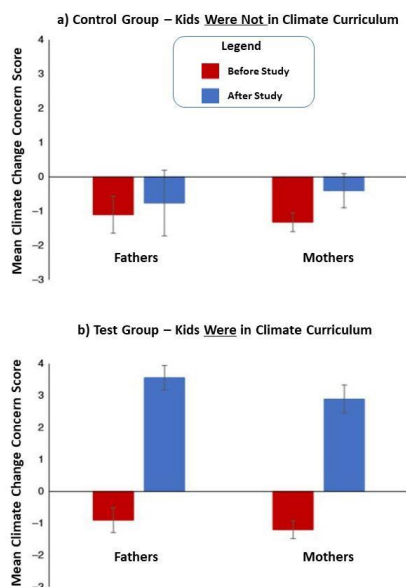
It didn't start out that way. Jessa has a B.S. in Civil Engineering from the University of Colorado, Boulder. For six years, she built suspension bridges (yes, the big ones!) in Tacoma, Washington, and San Francisco. In that work, she did a lot of outreach to young women and minorities, to encourage them to pursue careers in engineering and science. Little did she know that in this part of her work, she was building a bridge for her own career. She began to realize that she had an interest in doing even more outreach. In a case of perfect timing, John and 2B Tech were looking to begin an outreach program. In 2009, the stars aligned and Jessa joined 2B Tech.

Jessa and John built the GO3 Project (a nonprofit) to allow kids to use real scientific instruments and gather meaningful data with ozone monitors stationed at their schools. Google Earth was relatively new at the time, and in the GO3 Project the students used it to map their observations and share them with students around the world. Jessa worked hard to obtain grants so the schools could participate for free. The outreach approach has evolved over the years to use mobile monitors in the [AQTreks](#) program, where the students now make measurements along "Treks" of their own design around their schools and in their communities. Nearly 20,000 students and over 250 schools have participated in the outreach programs Jessa helped to pioneer. It's hard to estimate the ultimate impact on "growing the next generation" of scientists, but several local students wound up working as interns at 2B Tech, and one (Brian Carpenter) became a full time employee as our Product Manager. The newest component of 2B Tech's outreach is [CommunityAQ](#), which extends to the broader public.

Jessa and her husband live in Boulder, where they enjoy raising their two children and going on adventures such as camping, bicycling, and fishing to teach them about all the environmental wonders that Boulder and Colorado have to offer. And of course, we suspect that their scientific curiosity is encouraged along the way!

[2B Tech's Outreach Programs](#)

The Trickle-Up Phenomenon: Kids' Climate Education Reaches Parents



Shifts in climate concerns of parents whose child didn't (top) or did (bottom) participate in a middle school climate curriculum. The climate concern increased significantly for parents in the test group. [Adapted from Figure 2 of Lawson et al., *Nature Climate Change*, 2019.]

Moms and Dads, listen up! Your kids are paying attention in school. And you might find that your views on climate change shift a little bit as a consequence.

A [new study](#) by researchers at North Carolina State University looked at how the climate concerns of children (middle-school age) might be influencing their parents. Of the 292 parents in the study, 199 had children who were receiving a climate change curriculum that involved classroom and field components, a reflective blog post, and community partnerships. The design fostered child/parent interaction. The other 93 parents were in a control group (their children did not participate in the curriculum).

Interviews with parents were conducted at the beginning and end of each of two school years. Comparison of the control group with the test group showed that the climate concerns of the parents shifted significantly for the test group. The views of fathers shifted most significantly (see figure), and daughters had a more persuasive influence than sons. The views of parents who self-identified as conservative or moderate in political ideology were changed the most.

So our kids might be teaching us more than just a new way to do long division... they might also be shifting our perceptions on environmental issues.

[Children Can Foster Climate Change Concern Among Their Parents](#), D.F. Lawson, K.T. Stevenson, M.Nils Peterson, S.J. Carrier, R.L. Strnad, and E. Seekamp (2019), *Nature Climate Change*, 9, 458-462.

See us at these upcoming conferences in 2019!

Conference Name	Conference Dates	Location
International Ozone Association 2019	August 26-29	Atlanta, GA
Gulf Coast Conference	October 15-16	Galveston, TX

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