Winter 2023 Newsletter

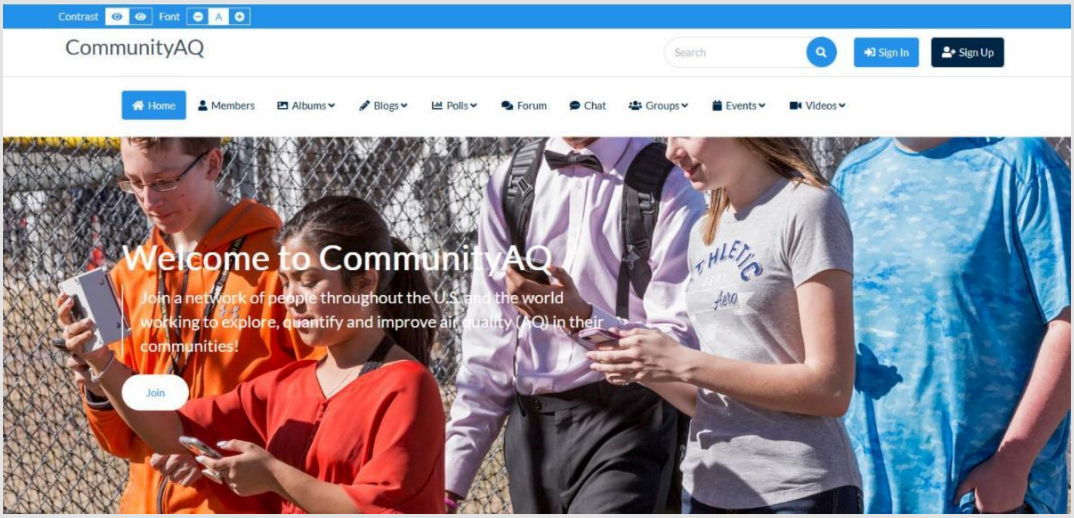
2B Technologies

2B Buzz

Spotlight

Join Our New Social Network for Community Air Monitoring!

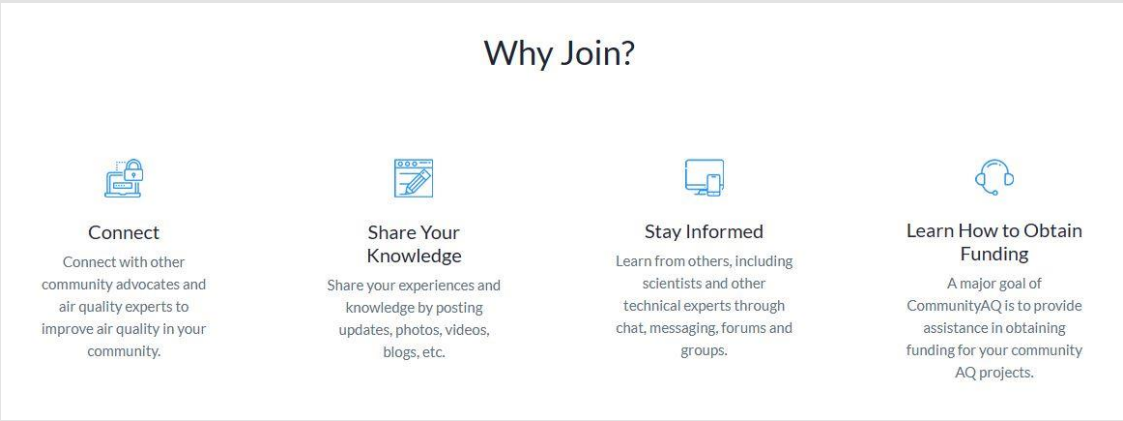
We have launched a new social network similar to Facebook but for people involved in community air monitoring. Please have a look and join: **https://communityAQ.com**



The goal is to provide a place where community members can share their knowledge and experiences in the use of instruments and sensors for measuring air pollutants in their communities.

A major focus early on is to help environmental justice communities and Native American communities apply for grants from the EPA that are funded by the Inflation Reduction Act (IRA).

We invite you to join!



CommunityAQ Social Network

Air Pollution News

Raising a More Climate-Friendly Cow

Feed Additive Reduces Methane Emissions

Enough about gas stoves. Let's talk about cows.

Cows enter into the discussion of climate and also considerations of air quality. That's because they are emitters of methane, a powerful greenhouse gas that also contributes to the formation of ozone pollution.

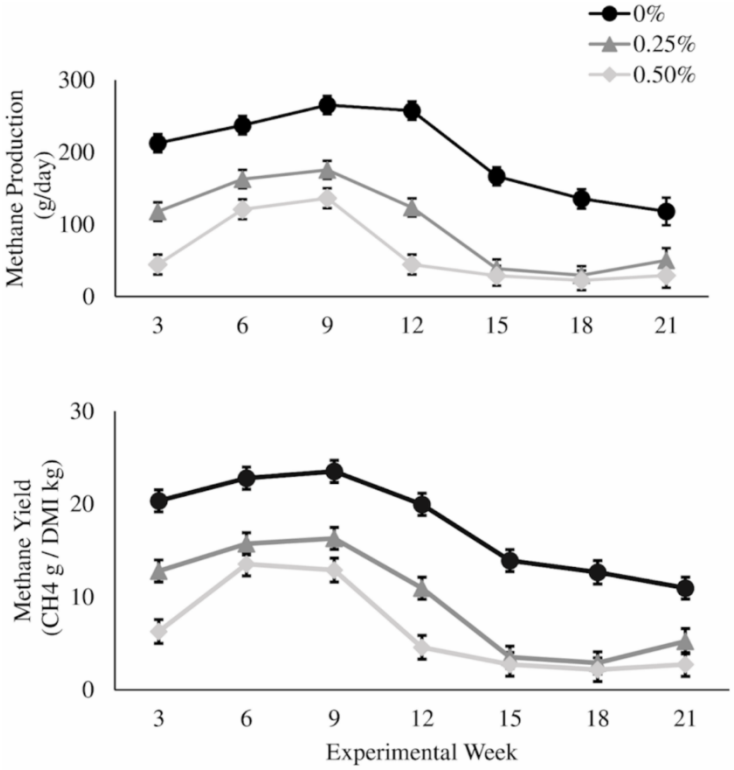
Figure credit: Dairy Global.

So how do cows make methane? There's no delicate way to put it: Cow burps and flatulence put out methane, which forms in the cow's stomach through a process called enteric fermentation. Amazingly, 70% of the agricultural emissions of cows and other grazing animals is due to this process. And livestock produce most of the human-induced emissions of methane. When expressed as "CO_2-equivalents," global emissions from livestock production contribute 15% of total anthropogenic greenhouse gas emissions.

Working on reducing these emissions could make a dent in the climate problem, so a lot of research has gone into how to alter the cows' diet to minimize methane emissions. Several studies have shown promising ways of doing that, but the supplements tested have also been costly and had side effect of reducing the meat quality. A recent study has shown that there's a straightforward way to reduce the methane emissions of cows without these factors that affect the ranchers' bottom line: put a little seaweed into their feed!

Adding either a half- or quarter-percent of seaweed to the feed reduced methane significantly, with the low treatment (0.25% or about 50 grams seaweed) giving about a 50% reduction and the high treatment (0.50% or ~90 grams seaweed) giving around 70% reduction. And the effects were immediate and persisted throughout the study, as shown in the figure above. In addition, the overall feed efficiency was increased (i.e., a lower feed cost per unit weight gain).

Bottom line, the authors note that "These feed cost reductions in combination with significantly reduced CH_4 emissions have a potential to transform beef production into a more economically and environmentally sustainable red meat industry." The next steps would include developing the infrastructure for producing a high quality seaweed product in both oceanic and land-based systems.



Trends in the methane production and methane yield over the 21-week study. Steers were fed 3 different diets during the course of the study, per typical feedlot practices, which contributes to the temporal features of the data. Figure 3 from Roque et al., 2021.

Red Seaweed (*Asparagopsis taxiformis*) Supplementation Reduces Enteric Methane by Over 80 Percent in Beef Steers, B.M. Roque, M. Venegas, R.D. Kinley, R. de Nys, T.L. Duarte, X. Yang and E. Kebreab, *PLOS ONE* (2021) **16** (3), e0247820.

Link to PLOS ONE Paper

Case Study: 2B Tech's Model 205, 405, and BCP

Measuring the Physiological Effects of Air Pollution

The Human Body Is an Air Pollution Detector

Our instruments went out for a spin when researchers at the University of Texas loaded up the back of a hatchback for a study of the physiological effects of air pollution. The study was published in 2022 in the journal *Sensors*.

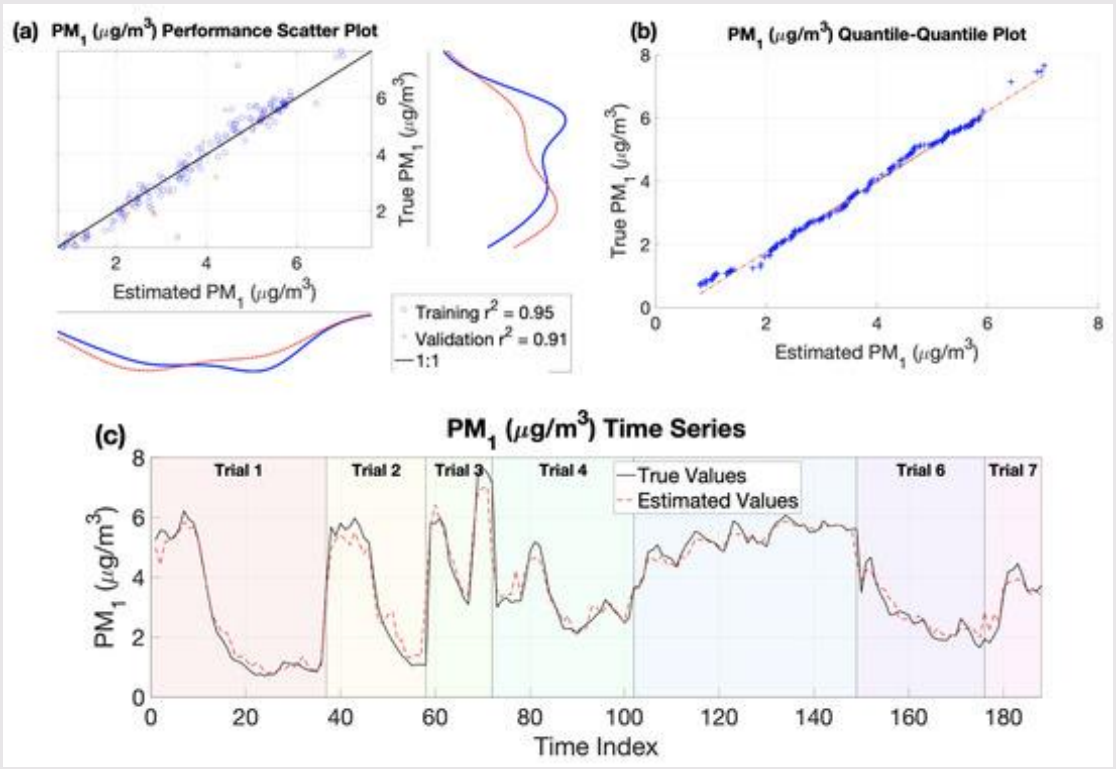
Included were 3 instruments from 2B Tech to measure O_3, NO_2, NO, and black carbon. Other instruments measured particulate matter (PM), CO_2, water vapor, and meteorological parameters. A bicyclist was outfitted with biometric sensors as the hatchback followed and gathered air quality data.

Researchers developed empirical machine learning models to investigate the interaction between environmental variables (in this paper, particulate matter concentrations) and physiological parameters of the bicyclist. Those biometric parameters included body temperature, galvanic skin response, heart rate variability, blood oxygen saturation, eye pupil measurements, and others. The top nine important biometric values were used in the model development.

Figure Credit, Modified from Figure 4 of Talebi et al., 2022.

A tantalizing finding from the study: the biometric measurements themselves were in some cases good "detectors" of PM. The relationship was particularly strong (r2=0.91) at smaller sizes of PM (see figure below for PM1 results).

The researchers suggest that the smaller particles might be more accurately predicted because they are more well mixed in the atmosphere, so that the values measured by the instruments in the follow-vehicle are more representative of the concentrations experienced by the bicyclist ahead. In addition, the smaller particles penetrate the respiratory system more deeply and therefore may have a greater effect on physiology. They plan to investigate the other environmental variables that were collected (ozone, black carbon, NOx) to better understand the interactions of air quality with the human body.



Measured atmospheric values of PM1 versus the values that were modeled using 9 biometric indicators from sensors on the bicyclist. Figure 5 of Talebi et al., 2022.

Decoding Physical and Cognitive Impacts of Particulate Matter Concentrations at Ultra-Fine Scales, S. Talebi, D.J. Lary, L.O.H. Wijeratne, B. Fernando, T. Lary, M. Lary, J. Sadler, A. Sridhar, J. Warzak, A. Aker and Y. Zhang, *Sensors* (2022), 22, 11, 4240.

Link to Sensors Paper

Link to 2B Tech Instruments

Employee Spotlight

Sheldon Hackler: Building Our 2B Tech Instruments

Meet Our Manufacturing Assistant

If you've purchased one of our instruments in the last year, there's a good chance it was built by Sheldon Hackler.

Sheldon is a member of our production team that builds the ~800 instruments we ship each year. He works on almost everything we make, ranging from our largest and most complex instrument (the AQSync) to the smallest (the Personal Ozone Monitor, POM). His repertoire is always expanding and now includes the Models 106L, 202, 205, 306, 714, and AQLite.

Sheldon joined 2B Tech in November 2021. His prior jobs were in the food service industry, but he was eager to get back to the kinds of hands-on work he did growing up. He assisted his dad with woodworking and his grandfather with construction. Sheldon enjoys the high-tech version of building that he's doing now with 2B Tech. He especially likes work that requires great attention to detail, such as making the wire assemblies that go into the optical benches of our instruments.

Sheldon lives in Longmont just a few miles from 2B Tech. His roommates include 2 cats, Onyx and Beetlejuice. In his spare time, Sheldon feeds his creative side by being the Game Master for tabletop role-playing games such as Dungeons & Dragons. His group of 6 includes members who now live in Arizona, so at times they meet online for the ongoing adventure they're creating. Sheldon comes up with the bare-bones storylines for the games, and the players take it from there. It's an activity that also feeds into Sheldon's love for detailed work. He paints the miniatures that are a part of the gameplay. The examples here give you a good idea of the Sheldon's patience and skill.