
## BREATHE: Bridging Regional Ecology, Aerosolized Toxins, & Health Effects

**Welcome to the 4th Annual BREATHE Spring Workshop!** The BREATHE Center at the University of California, Riverside School of Medicine is a multidisciplinary collaborative for studies Bridging Regional Ecology, Aerosolized Toxins, and Health Effects. Research efforts among our collaborative include regional climate modeling, culture and policy studies on air quality and health, environmental justice and health disparities, and the health impacts of aerosolized particles including dusts, soil microbes, allergenic pollens from invasive species, and pollutants.
Our main partners in this work include faculty in the Center for Conservation Biology (CCB), the College of Engineering Center for Environmental Research and Technology (CE-CERT), and Biomedical Sciences in the School of Medicine.
Affiliated faculty include researchers in the Bourns College of Engineering (BCOE), the College of Natural and Agricultural Sciences (CNAS), the College of Humanities, Arts, and Social Sciences (CHASS), the School of Public Policy (SPP), and the School of Medicine (SOM). We also have affiliations with the Science and Technology Studies group in the UCR Center for Ideas and Society, and Health Assessment and Research for Communities (HARC).

---

We have come quite a way from our origins as a cluster proposal! We now have recently completed our cluster hiring, with a few more hires than originally approved. Several collaborations are now in progress; two papers from these collaborations already published, and more are already in the works. We were asked to testify before the State Assembly Water, Parks and Wildlife Committee regarding the Salton Sea Management Plan. Several grant applications have been submitted for research originating in BREATHE projects; we're learning from some and optimistic about the prospects of others. Meanwhile, the scope of our ongoing research projects is expanding. One major focus has been on the Coachella Valley as a living laboratory. There are studies on transport of aerosol particulates, the Salton Sea as an unstable ecosystem, and of course, the health impacts, especially in the context of health and socioeconomic disparities.

## A sampling of ongoing BREATHE-associated research projects:

- Small environmental chamber: The lab of Professor of Biomedical Sciences David Lo and CE-CERT built a small environmental chamber to do long term exposure studies in models of inflammation. Initial studies in collaboration with Assistant Professor Meera Nair's and Professor Monica Carson's labs have been on the effects of chronic exposure to allergens.
    - In studies supported by the NIMHD-sponsored U54 Center for Health Disparities Research (healthdisparities.ucr.edu), the environmental chamber is being used to study the effects of Salton Sea aerosols on models of lung inflammation.
- The lab of Assistant Professor of Plant Pathology and Microbiology Emma L. Aronson is looking at material from particle collectors in the Coachella Valley to identify microbes and other material in aerosol particulates. The lab has also submitted proposals to study the effects of inhaled particulates on the lung microbial ecology.

---

## BREATHE Affiliates:

- UCR School of Medicine (SOM)
- College of Engineering Center for Environmental Engineering and Technology (CE -CERT)
- Center for Conservation Biology (CCB)
- Environmental Dynamics and GeoEcology (EDGE)

David Lo, SOM
Michael Allen, CCB
Emma Aronson, CCB
Roya Bahreini, Environmental Sciences
Kelley Barsanti, CE -CERT
Monica Carson, SOM
David Cocker, CE -CERT
Mona Eskandari, Mechanical Engineering
Marilyn Fogel, EDGE
Sydney Glassman Microbiology and Plant Pathology
Erica Heinrich, SOM
Cesunica Ivey, CE -CERT
Georgios Karavalakis, CE -CERT
Philipp Nicolas Lehmann, History
Ying -Hsuan Lin, Environmental Sciences
Keith Kiyake, Ethnic Studies
Meera Nair, SOM
Tara Nordgren, SOM
William Porter, Environmental Sciences

We like to express our sincerest gratitude for attending our 4th annual workshop!

**- The BREATHE committee**

thank you see you next year!!!

UC RIVERSIDE | BREATHE

# 4th Annual BREATHE Spring Workshop

## Tuesday, May 18th, 2021
## 9am-12pm

## Agenda

| | |
|---|---|
| 9:00 - 9:15AM | **Welcome and Land Acknowledgment**<br>David Lo, M.D., Ph.D.<br>BREATHE Director<br>University of California, Riverside |
| | **Faculty Research Talks**<br>(Session Moderator, David Lo, M.D., Ph.D.) |
| 9:15 - 9:30AM | *"A Community Science approach to forecast increases in PM10 from the shrinking shoreline at the Salton Sea"*<br>Ryan Sinclair, *Ph.D., Associate Professor, School of Public Health, LLU* |
| 9:30 - 9:45AM | *"Significant climate benefits from near-term climate forcer mitigation in spite of aerosol reductions"*<br>Robert Allen, *Ph.D., Associate Professor of Earth Sciences, UCR* |
| 9:45 - 10:00AM | *"Microbial communities of the Salton Sea, exposed playa, and surrounding dust"*<br>Emma Aronson, *Ph.D., Associate Professor, Microbiology & Plant Pathology, UCR* |
| 10:00 - 10:15AM | *"Geochemical Patterns in Salton Sea Mud: Controls and Implications for Potential Toxic Dust Contributions"*<br>Tim Lyons, *Ph.D. Distinguished Professor of Biogeochemistry in the Department of Earth and Planetary Sciences* |
| 10:15 - 10:25AM | **BREAK** |

UC RIVERSIDE

UC RIVERSIDE | BREATHE

**Abstract Talks**
(Session Moderator, Will Porter, Ph.D.)

10:25 - 10:32AM
*"Ambient measurements of peroxy radicals"*
Jingsong Zhang, *Ph.D. Professor, Department of Chemistry, UCR*

10:32 - 10:39AM
*"Exposure to Hog Dust Extract induces airway inflammation and increases intestinal permeability in mice"*
Melisa Crawford, *Ph.D., Postdoc, SOM Division of Biomedical Sciences, UCR*

10:39 - 10:46AM
*"Aerosolized Salton Sea water induces a pulmonary response distinct from allergic inflammation in mice"*
Trevor Biddle, *Graduate Student, SOM Division of Biomedical Sciences, UCR*

10:46 - 10:53AM
*"WAREHOUSES, POLLUTION, AND SOCIAL DISPARITIES: An analytical view of the logistics industry's impacts on environmental justice communities across Southern California"*
Ivette Torres, Academic Researcher, CE-CERT, UCR

10:53 - 11:00AM
*"Nanosensor Arrays for Real-Time Monitoring of Air Contaminants"*
Ashok Mulchandani, Ph.D., Distinguished Professor, Chemical and Environmental Engineering, UCR

**Keynote Talks**
(Session moderator, Will Porter, Ph. D.)

11:00 - 11:20AM
*"Eastern Coachella Valley AB 617 Community Emission Reduction Plan (CERP) – Plan Development and Implementation"*
Keynote Speaker: Pedro Piqueras, Ph.D., Air Quality Specialist

11:20 - 11:40AM
*"Eastern Coachella Valley AB 617 Community Air Monitoring Plan (CAMP) – Dust Characterization and Source Apportionment"*
Keynote Speaker: Mohammad Sowlat, Ph.D., Air Quality Specialist

11:40 - 12:00PM
**South Coast AQMD and Faculty panel discussion**
(Panel moderator, Will Porter, Ph.D.)



see you next year!!!

Faculty Research talk abstracts: The 4th Annual BREATHE Spring Workshop

**1. "A Community Science approach to forecast increases in PM10 from the shrinking shoreline at the Salton Sea"**

**RYAN SINCLAIR (**1), Josileade Gaio (1), and Will Porter (2)

1) School of Public Health, Loma Linda University, Loma Linda, CA
2) Department of Environmental Sciences, College of Natural & Agricultural Sciences, University of California, Riverside, CA

This presentation will discuss the Community Science process that used Balloon Mapping as a collaborative tool to collect aerial photographs of a shoreline transect near the community of North Shore, CA. The Balloon Mapping process uses tethered weather balloons with cameras that take photographs over a period of 1 hour as the balloon is walked down the shoreline. The process is collaborative and requires several people to inflate the balloon and pull it along a transect to map the shoreline and make environmental observations along the way. The images were collected over two years and were later used to forecast future shoreline positions and potential PM10 air quality enhancements from the exposed playa. Images from 2019 and 2020 are combined with additional satellite images of the shoreline beginning in 2002 and analyzed with the DSAS (Digital Shoreline Analysis System) in ArcGIS desktop. The DSAS described a new land area that was used as an input to the WRF-Chem, a regional chemical transport model. The WRF-Chem predicted increases in emissive PM10 particulates from the newly exposed playa, discovered through the DSAS model. These model projections illustrate the potential human health impact from water management policies.

**2. "Significant climate benefits from near-term climate forcer mitigation in spite of aerosol reductions"**

**ROBERT J ALLEN** (1), Larry W Horowitz (2), Vaishali Naik (2), Naga Oshima (3), Fiona M O'Connor (4), Steven Turnock (4), Sungbo Shim (5), Philippe Le Sager (6), Twan van Noije (6), Kostas Tsigaridis (7), Susanne E Bauer (7), Lori T Sentman (2), Jasmin G John (2), Conor Broderick (2,8), Makoto Deushi (3), Gerd A Folberth (4), Shinichiro Fujimori (9,10,11) and William J Collins (12)

1) Department of Earth and Planetary Sciences, University of California Riverside, Riverside, CA, United States of America
2) DOC/NOAA/OAR/Geophysical Fluid Dynamics Laboratory, Biogeochemistry, Atmospheric Chemistry, and Ecology Division, Princeton, NJ, United States of America
3) Meteorological Research Institute, Japan Meteorological Agency, Tsukuba, Ibaraki, Japan
4) Met Office Hadley Centre, Exeter, United Kingdom

5) National Institute of Meteorological Sciences, Seogwipo-si, Jeju-do, Republic of Korea
6) Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands
7) Center for Climate Systems Research, Columbia University, NASA Goddard Institute for Space Studies, New York, NY, United States of America
8) Macalester College, St. Paul, MN, United States of America
9) Department of Environmental Engineering, Kyoto University, C1-3 361, Kyotodaigaku Katsura, Nishikyoku, Kyoto, Japan
10) Center for Social and Environmental Systems Research, National Institute for Environmental Studies (NIES), 16-2 Onogawa, Tsukuba, Ibaraki, Japan
11) International Institute for Applied System Analysis (IIASA), Schlossplatz 1, Laxenburg, Austria
12) Department of Meteorology, University of Reading, Reading, United Kingdom

Near-term climate forcers (NTCFs), including aerosols and chemically reactive gases such as tropospheric ozone and methane, offer a potential way to mitigate climate change and improve air quality—so called ‘win-win’ mitigation policies. Prior studies support improved air quality under NTCF mitigation, but with conflicting climate impacts that range from a significant reduction in the rate of global warming to only a modest impact. Here, we use state-of-the-art chemistry-climate model simulations conducted as part of the Aerosol and Chemistry Model Intercomparison Project (AerChemMIP) to quantify the 21st-century impact of NTCF reductions, using a realistic future emission scenario with a consistent air quality policy. Non-methane NTCF (NMNTCF; aerosols and ozone precursors) mitigation improves air quality, but leads to significant increases in global mean precipitation of 1.3% by mid-century and 1.4% by end-of-the-century, and corresponding surface warming of 0.23 and 0.21 K. NTCF (all-NTCF; including methane) mitigation further improves air quality, with larger reductions of up to 45% for ozone pollution, while offsetting half of the wetting by mid-century (0.7% increase) and all the wetting by end-of-the-century (non-significant 0.1% increase) and leading to surface cooling of −0.15 K by mid-century and −0.50 K by end-of-the-century. This suggests that methane mitigation offsets warming induced from reductions in NMNTCFs, while also leading to net improvements in air quality.

**3. "Microbial communities of the Salton Sea, exposed playa, and surrounding dust"**

**EMMA ARONSON (**1), Hannah Freund (1), Talyssa Topacio (1), Mark Swenson (1), Jon Botthoff (2), Mia Maltz (3), and David Lo (3)

1) Department of Microbiology and Plant Pathology, Department of Environmental Sciences, College of Natural & Agricultural Sciences, University of California, Riverside, CA
2) Center for Conservation Biology, University of California, Riverside, CA
3) Division of Biomedical Sciences, School of Medicine, University of California, Riverside, CA

Although the Salton Sea was once a thriving destination for humans and wildlife, it has now degraded to the point of ecosystem collapse. Increases in local dust emissions introduce aeolian microorganisms, along with contaminants and minerals into the atmosphere, detrimentally impacting inhabitants of the region. Proliferation of certain microbial groups in regions of the Sea may have a disproportionate impact on local ecological systems. Yet, little is known about how the biogeochemical processes of this drying lakebed influence microbial community composition and dispersal. Changing conditions and accelerated desiccation likely influence both the geographic distribution and functional capacity of microbial groups associated with the Sea. To elucidate how these microorganisms contribute, and adapt, to the Sea's volatile conditions, we synthesize information regarding three niche-specific microbiomes: the Sea, playa, and aeolian microbiomes. We highlight modern molecular techniques, such as metagenomics, coupled with physical science methodologies, including transport modeling, to predict how the drying lakebed will affect microbial processes. We argue that an explicit consideration of microbial groups within this system will provide vital information about the distribution and functional roles of ecologically pertinent microbial groups. Furthermore, we can begin to examine the implications of these microbial groups on ecosystem stability, conservation, and public health.

**4. "Geochemical Patterns in Salton Sea Mud: Controls and Implications for Potential Toxic Dust Contributions"**

**TIMOTHY LYONS**, Caroline Hung

1) Department of Earth and Planetary Sciences, College of Natural & Agricultural Sciences, University of California, Riverside, CA

Each summer the deeper waters of the Salton Sea lose their oxygen and accumulate hydrogen sulfide through the activities of bacteria. These waters are concentrated in the central portions of the basin. Notably, such waters are able to enrich the underlying sediment in metals far beyond the concentrations observed on the lake margin. These metals, while beneficial at low levels, can become health hazards when elevated. Many of these sediments are already concentrated beyond acceptable levels and will continue to enrich under current plans for lake management. Critically, these muds and their metals will be exposed to the atmosphere following the planned dramatic reduction of lake level and will become widely distributed as dust throughout the region. Signatures of lakebed muds are already observed in dust in the surrounding areas and will increase dramatically as the shoreline continues to recede. In other words, if current water policy is continued, there will be more dust, and that dust will be more toxic.

Short talk abstracts: The 4th Annual BREATHE Spring Workshop

## 1. "Ambient measurements of peroxy radicals"

**JINGSONG ZHANG**

1) Department of Chemistry, University of California, Riverside, CA

The peroxy radical chemical amplification (PERCA) method is combined with cavity ring-down spectroscopy (CRDS) to measure atmospheric peroxy radicals HO2 and RO2. HO2 and RO2 are converted to NO2 via reactions with NO, with subsequent reactions to recycle most of the OH and RO coproducts back to HO2 by reactions with CO and O2 and amplify the level of NO2. The amplified NO2 is then monitored by CRDS, a sensitive absorption technique. The PERCA-CRDS method is calibrated with a HO2 radical source, showing an amplification factor of ~ 180. The peroxy radical detection sensitivity by PERCA-CRDS is ~ 4pptv/10s. Ambient measurements of the peroxy radicals are carried out at Riverside, California to demonstrate the PERCA-CRDS method.

## 2. "Exposure to Hog Dust Extract induces airway inflammation and increases intestinal permeability in mice"

**MELI'SA CRAWFORD,** Arzu Ulu**,** Tara M Nordgren, Declan McCole

1) Division of Biomedical Sciences, School of Medicine, University of California, Riverside, CA

Agricultural enterprises, such as concentrated animal feeding operations (CAFOs), are responsible for the production of 10% of global greenhouse gases and harmful environmental pollutants including hydrogen sulfide, ammonia and particulate matter. Seasonal farmworkers, especially swine farmers, are frequently exposed to organic dust that is pro-inflammatory in the lung and are thus at greater risk of developing pneumonia, asthma and other respiratory conditions. In addition to respiratory disease, these air pollutants are directly associated with altered gastrointestinal (GI) physiology and the development of GI diseases. Therefore, the aim of the current study was to identify mechanisms by which extracts of dusts derived from hog CAFOs (HDE) can disrupt intestinal homeostasis. Caco-2 BBE monolayers were seeded at 0.5x106cells/well in a Transwell system and exposed to a single dose of either 0.25%, 0.5%, 0.75%, 1% or 5% HDE. A decreasing trend was seen in monolayer integrity, determined by transepithelial electrical resistance (TEER), at 24-and 48-hours following treatment with 5% HDE (Two-Way ANOVA, p=0.1824 and p=0.2017, respectively, n=3). Moreover, 8-week-old male or female C57BL/6 mice (n=12) were intranasally exposed to saline (n=6) or 12.5% HDE (n=6) for 3 weeks. Bronchoalveolar lavage fluid from

HDE-treated mice showed no changes in macrophage cell numbers (unpaired t-test, p=0.2993), but exhibited elevated total cell and neutrophil levels (unpaired t-test, p=0.0027 and p=0.0061, respectively) in comparison to saline controls. Furthermore, no significant differences were seen among the colon lengths of HDE-treated mice (8.32± 0.13cm SEM) to that of saline controls (9.2 ± 0.67cm SEM). Additionally, HDE increased permeability to FITC-dextran 4kDA and rhodamine B-dextran 70kDA (unpaired t-test, p<0.001). Moreover, histological changes observed by hematoxylin and eosin staining indicated epithelial cell loss and minimal-mild inflammation in the proximal and distal colon of HDE-treated mice. Together, these findings suggest that airway exposure to CAFOs dusts promotes airway inflammation and can access the gastrointestinal tract to increase regulated and/or unrestricted intestinal permeability, possibly due to intestinal epithelial cell damage. Further identification of mechanistic interactions between the respiratory and gastrointestinal systems is imperative to understand the complex physiological consequences of chronic exposure to organic dusts derived from CAFOs on the gut-lung axis.

**3. “Aerosolized Salton Sea water induces a pulmonary response distinct from allergic inflammation in mice**”

**TREVOR BIDDLE**

1) Division of Biomedical Sciences, School of Medicine, University of California, Riverside, CA

Asthma is a severe health issue in the communities surrounding the Salton Sea. However, the role of the Salton Sea in pulmonary health is understudied. To investigate the potential role of the Salton Sea, we exposed mice to aerosolized Salton Sea water for 7 days and assessed tissue responses, including cellular infiltration and gene expression changes. Aerosolized Salton Sea water failed to induce neutrophil and eosinophil recruitment to the bronchioalveolar lavage or the lung. However, it did induce a consistent change in gene expression suggestive of an inflammatory response.

**4. “WAREHOUSES, POLLUTION, AND SOCIAL DISPARITIES: An analytical view of the logistics industry’s impacts on environmental justice communities across Southern California”**

**IVETTE TORRES (**1,2,3,4), Professor Dan Klooster and his Environmental Studies 277 students (3)

1) Center for Environmental Research & Technology, University of California, Riverside
2) Peoples Collective for Environmental Justice
3) Environmental Studies, University of Redlands, CA
4) Sierra Club, My Generation Campaign

In collaboration with the University of Redlands, the People's Collective for Environmental Justice (PC4EJ), and Sierra Club, My Generation used a collection of data to analyze the 3,321 warehouses above 100,000 sq.ft that fall in the South Coast Air Basin, which covers Los Angeles, Orange, Riverside, and San Bernardino counties. The regional board responsible for regulating air quality in Southern California—the South Coast Air Quality Management District (SCAQMD)—is considering adopting an Indirect Source Rule for warehouses in an attempt to address the air quality and health impacts associated with the goods movement industry. While warehouses do not produce pollution directly, the mobile sources of pollution they attract (the most notable of these sources being diesel trucks) contribute to the region's high levels of smog and ozone that have consequential impacts on the respiratory health of Southern California residents.

As the warehouse and logistics industry continues to grow and net exponential profits at record rates, more warehouse projects are being approved and constructed in low-income communities of color and serving as a massive source of pollution by attracting thousands of polluting truck trips daily. Diesel trucks emit dangerous levels of nitrogen oxides and particulate matter that cause devastating health impacts including asthma, chronic obstructive pulmonary disease (COPD), cancer, and premature death. As a result, physicians consider these pollution-burdened areas 'diesel death zones.' Using data sources from the SCAQMD and the California Office of Environmental Health Hazard Assessment's CalEnviroScreen 3.0 tool, the following data sets were analyzed: warehouse location to a toxic facility (such as gas and oil facilities), warehouse location to e-commerce sales for 2020, warehouse location to schools, warehouse locations to traffic, and warehouse locations to a variety of other demographic variables.

It is important to note that maps with the aforementioned variables were not publicly available or accessible. Until now, no industry, research institution, or agency found it necessary to map warehouse locations with vital correlations to socio-economic demographics. It has been clear to many community members, advocates, and many others in the clean air and environmental justice movement that the growth of the logistics industry in Southern California correlates with health, economic, and racial disparities.

These maps will serve to demonstrate the severity of our region's air pollution woes and raise the urgency for important policies such as the Indirect Source Rule, the Advanced Clean Fleet rule, and other air quality management and community emissions reduction plans that will work to clean our air, create sustainable freight and goods movement, and protect public health.

**5. “Nanosensor Arrays for Real-Time Monitoring of Air Contaminants”**

**ASHOK MULCHANDANI**

1) Department of Chemical and Environmental Engineering, University of California, Riverside, CA

In this presentation, I will present our research on development of nanosensors based on one-dimensional and two-dimensional pristine and functionalized nanomaterials for real-time monitoring of contaminants such as ammonia, NOx and volatile organic carbons, in air.