



Salton Sea dust: composition, transport, and health

<https://www.flickr.com/photos/slworking/>

William Porter • University of California, Riverside

Salton Sea Summit • October 17, 2019



Disclaimer: most of the work I will be sharing today is not my own!

Dust Sources in the Salton Sea Basin: A Clear Case of an Anthropogenically Impacted Dust Budget

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BREATHE - A Multidisciplinary Collaborative on Air Quality & Health Research

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](#)

What do we know about what's in Salton Sea dust?

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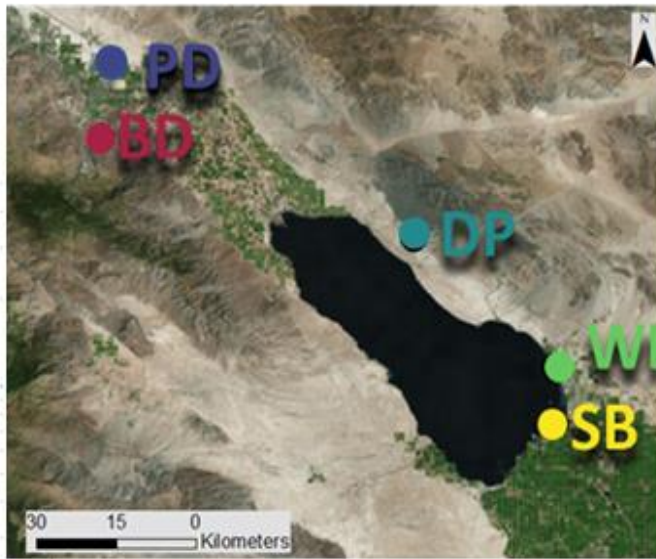
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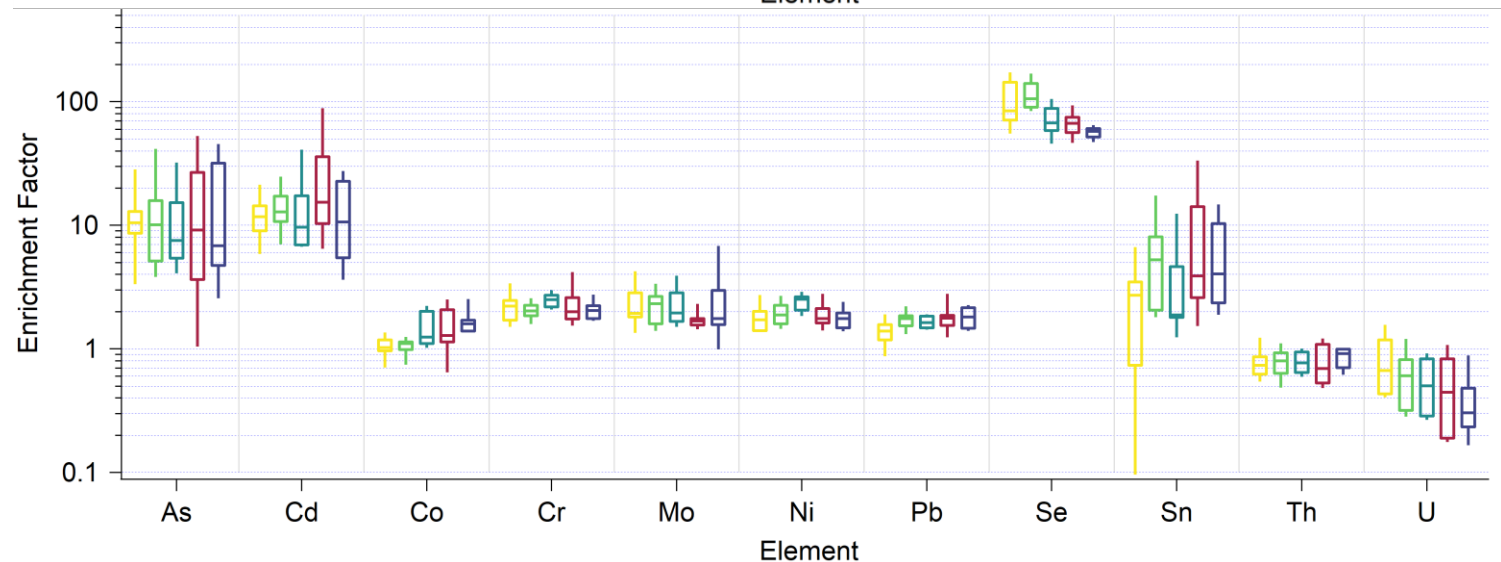
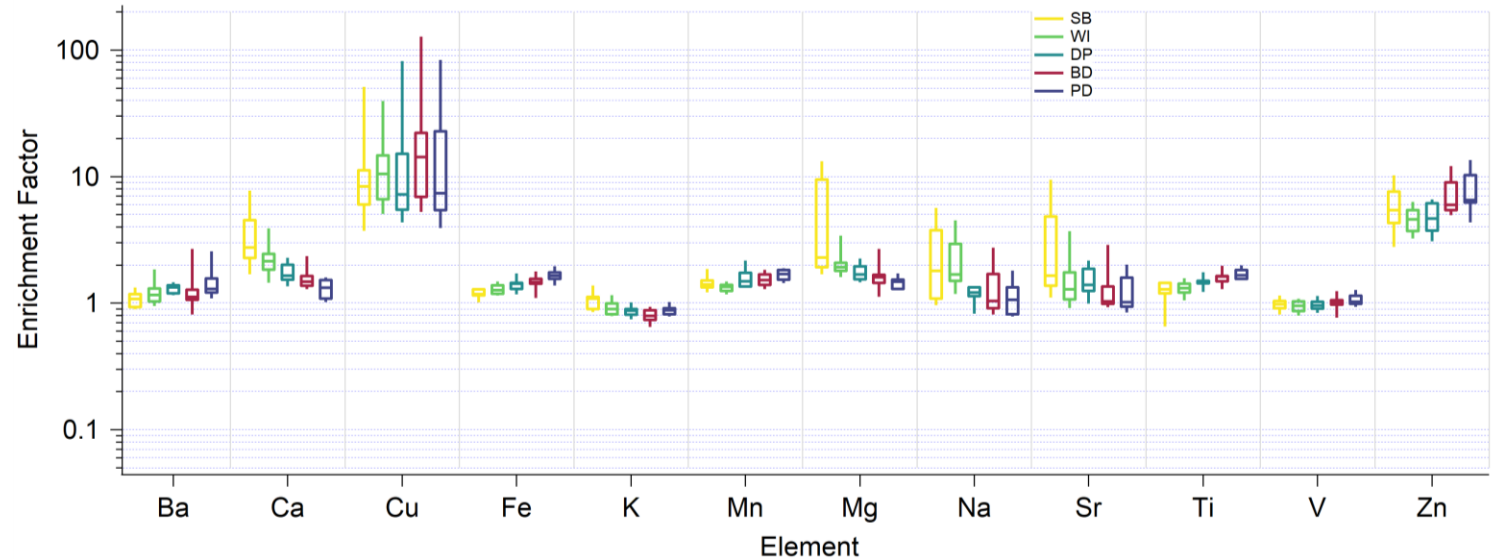


- Monthlyish dust collection from May 2017 to April 2018
- Chemical composition analyzed by month and location (ICP-MS and IC)
- Identified key types using Positive Matrix Factorization (PMF)

Enrichment Factors in dust show natural and human signatures

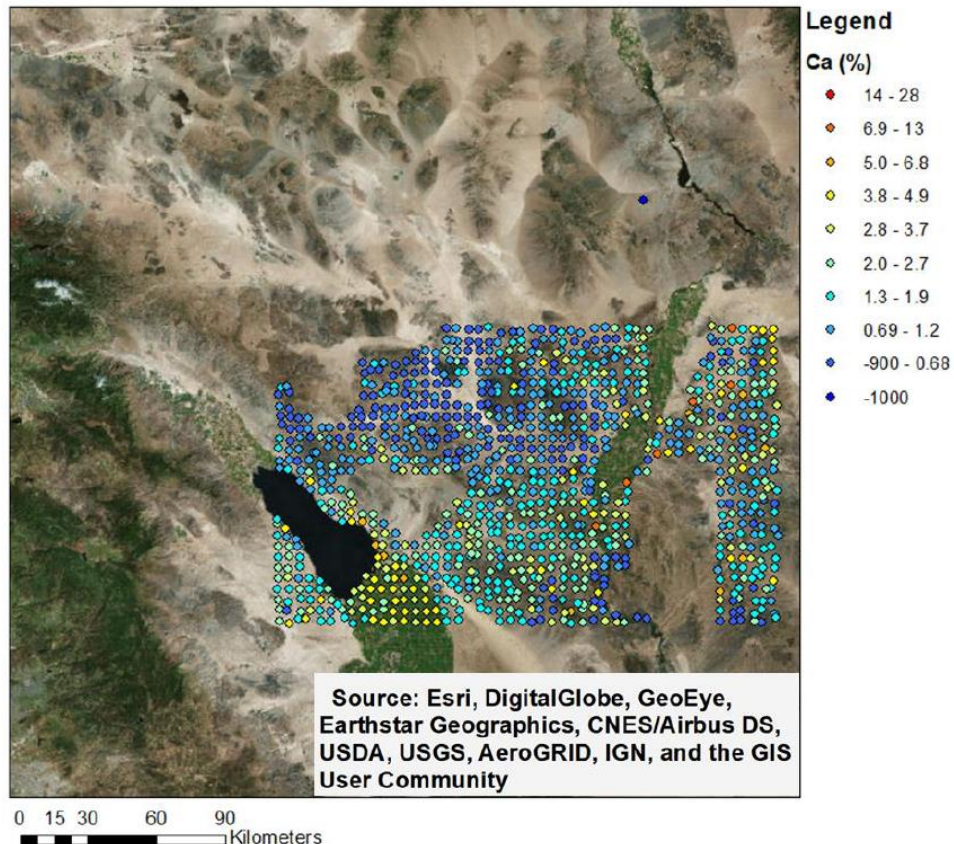


- Enrichment Factor: how much of this element is present, relative to “normal” desert dust?



Soil spatial distributions indicate origins of identified source types

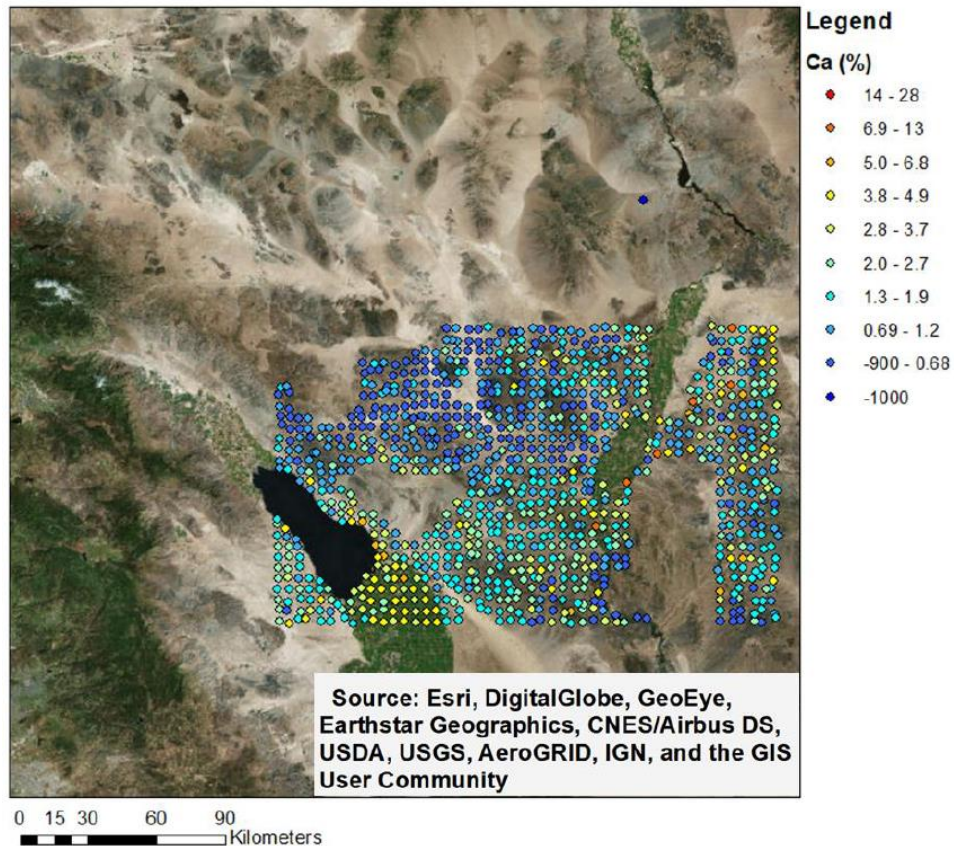
Colorado Alluvium: U, Ca



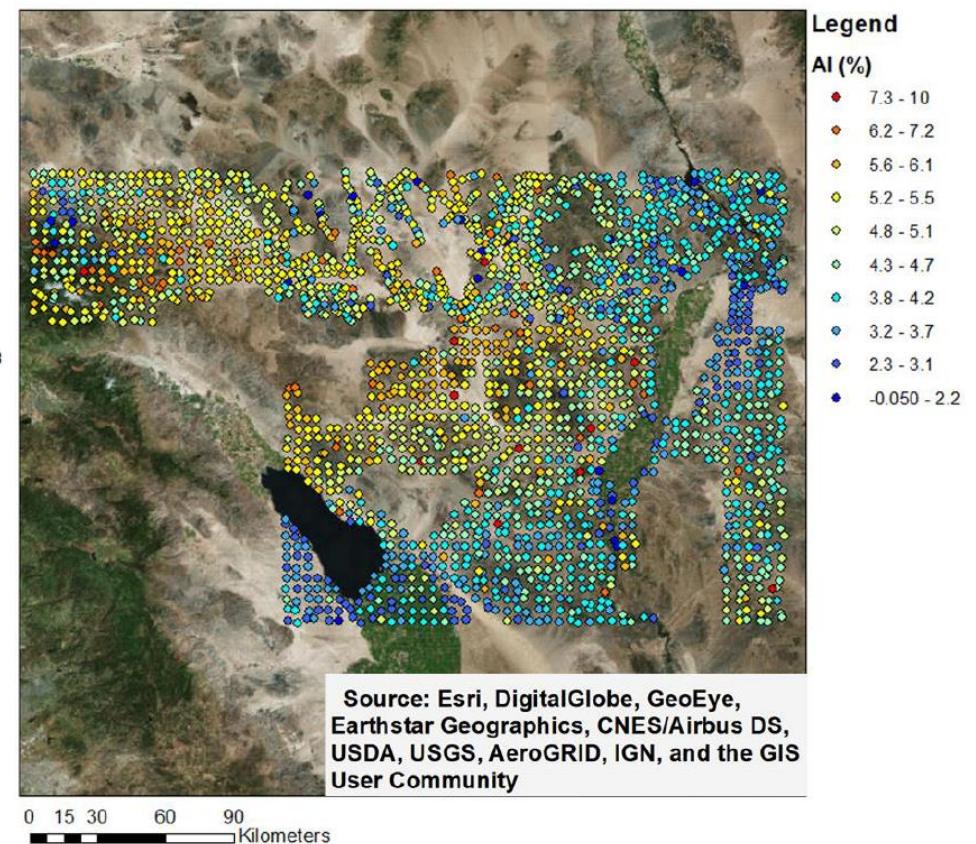
(Source: National Uranium Resource Evaluation: Hydrogeochemical and Stream Sediment Reconnaissance)

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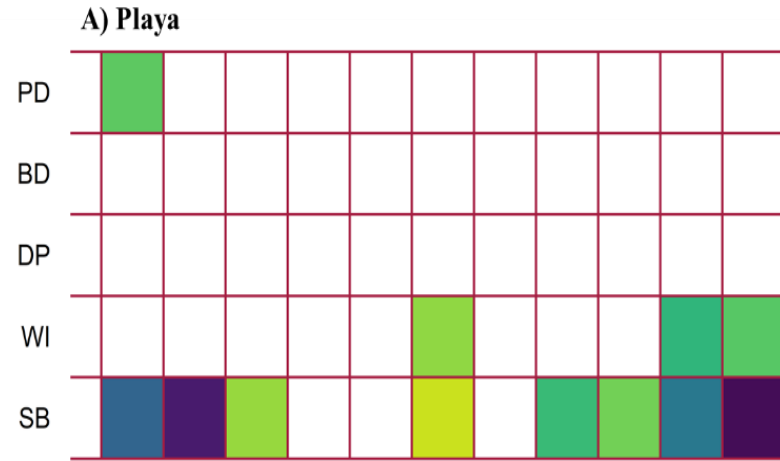


Local Alluvium: Al, Fe, Ti

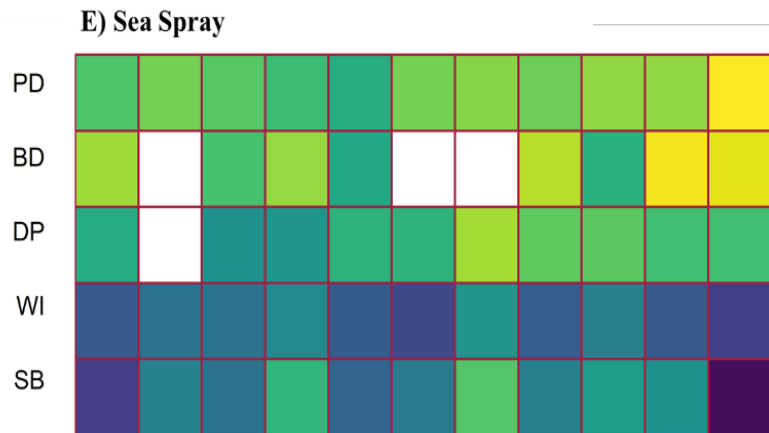
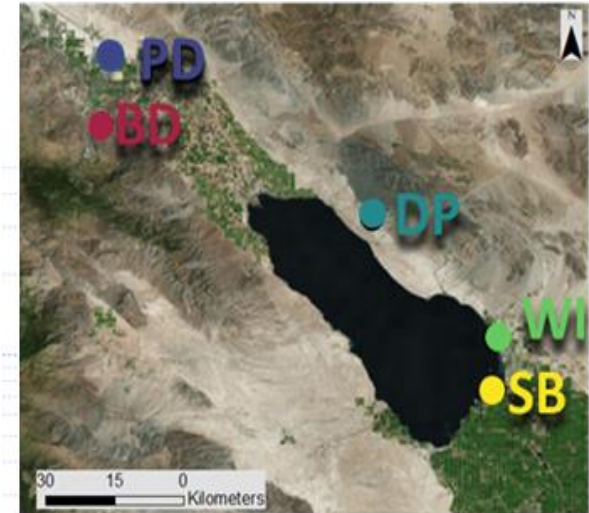
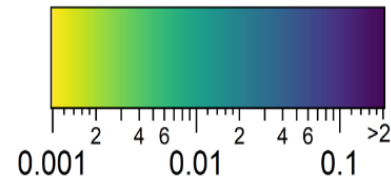


(Source: National Uranium Resource Evaluation: Hydrogeochemical and Stream Sediment Reconnaissance)

Positive Matrix Factorization provides a way to sort out individual sources by their composition fingerprint

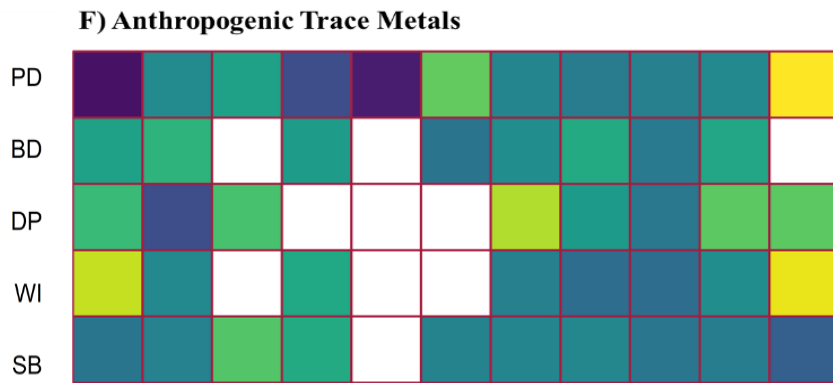


Fraction of Total Observed Factor in Sample

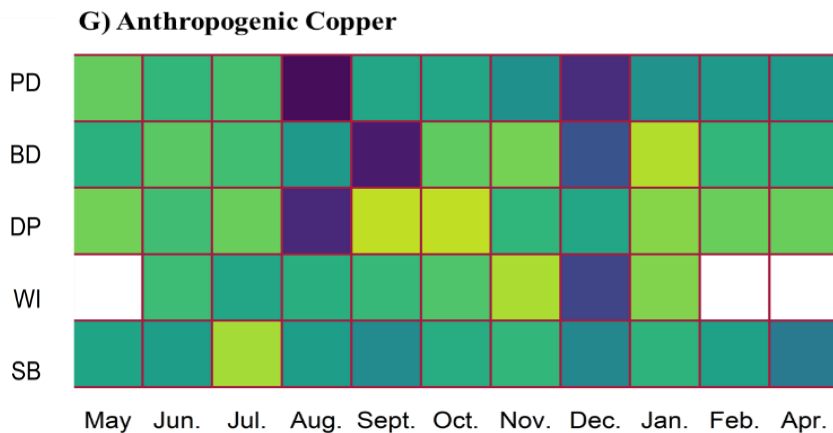
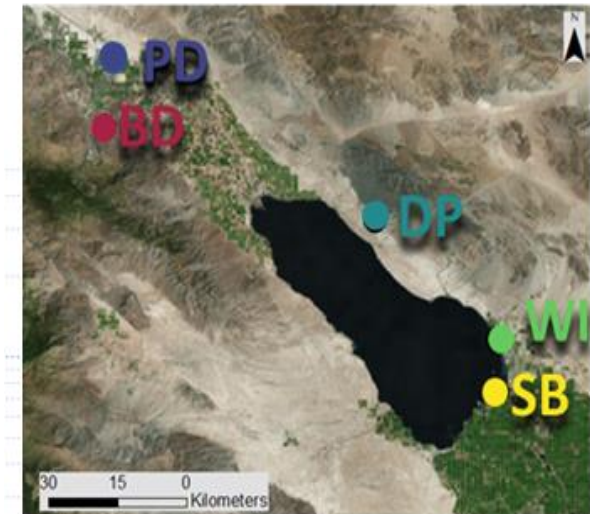
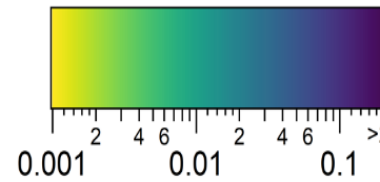


- **Playa:** Mg, SO_4^{2-}
- **Sea Spray:** Na, Cl^- , Se

Direct anthropogenic sources also identified through high concentrations of elements associated with human activity

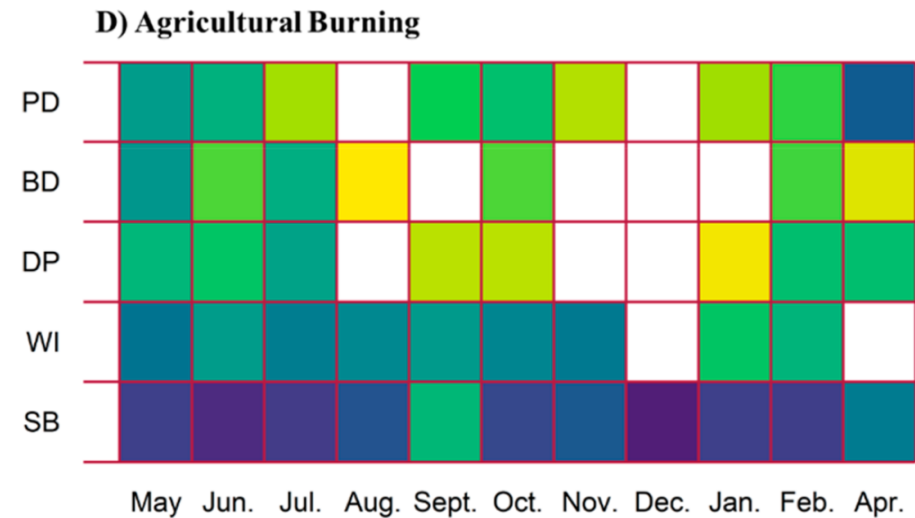


Fraction of Total Observed Factor in Sample

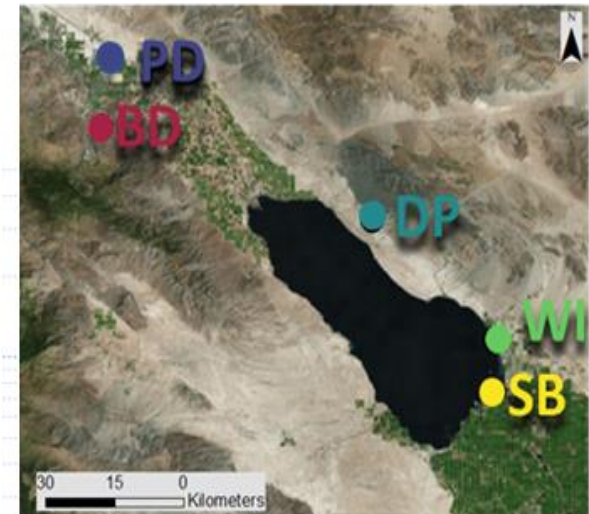
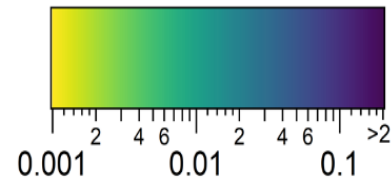


- **Trace Metals:** Sb, As, Zn, Cd, Pb
- **Copper:** Cu

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Fraction of Total Observed Factor in Sample



- **Agricultural Burning: K, PO₄³⁻**

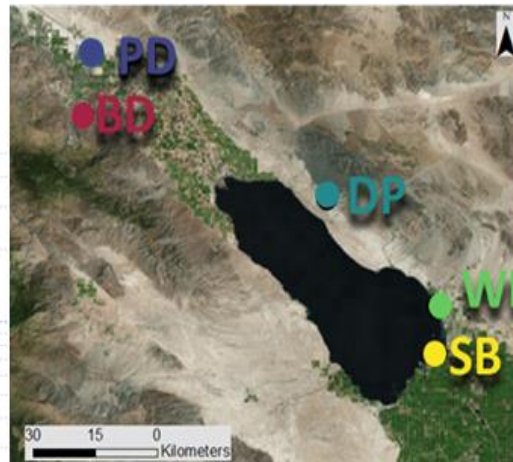
How does human activity influence these sources?

Anthropogenic Copper and Anthropogenic Trace Metals: direct anthropogenic emissions

Colorado Alluvium and Agricultural Burning: agricultural practices

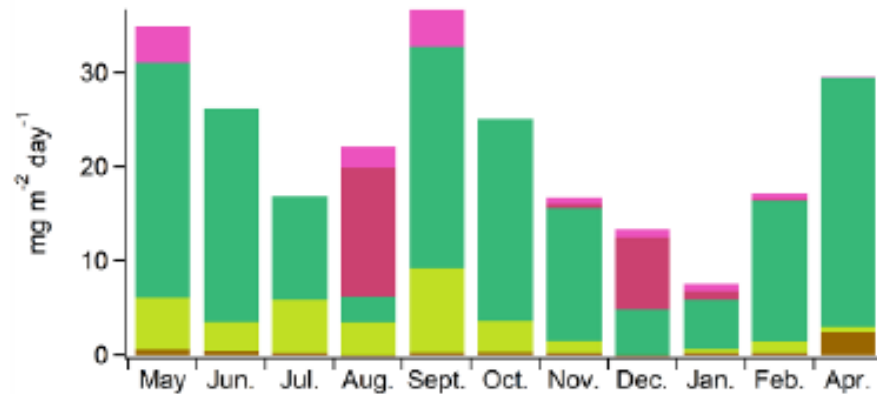
Playa and Sea Spray: water management practices

- Anthropogenic Trace Metals
- Anthropogenic Copper
- Sea Spray
- Playa
- Local Alluvium
- Colorado Alluvium
- Agricultural Burning

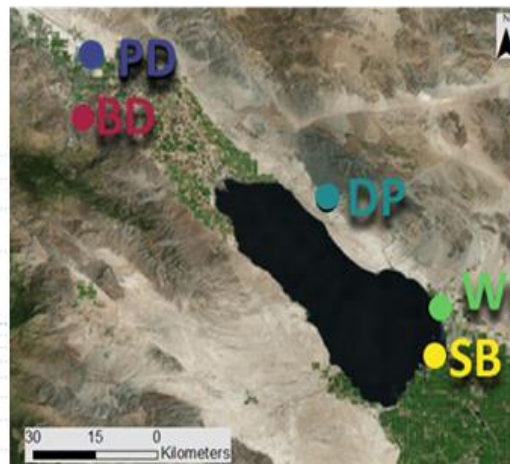


Together, identified sources show patterns in dust composition over space and time

A) Palm Desert

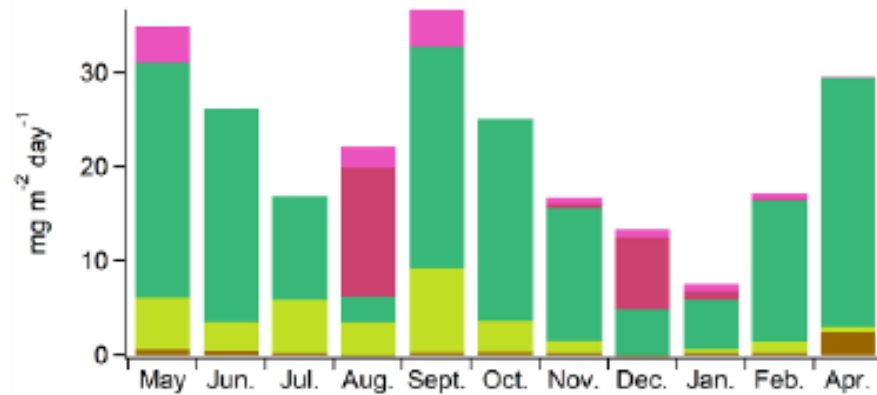


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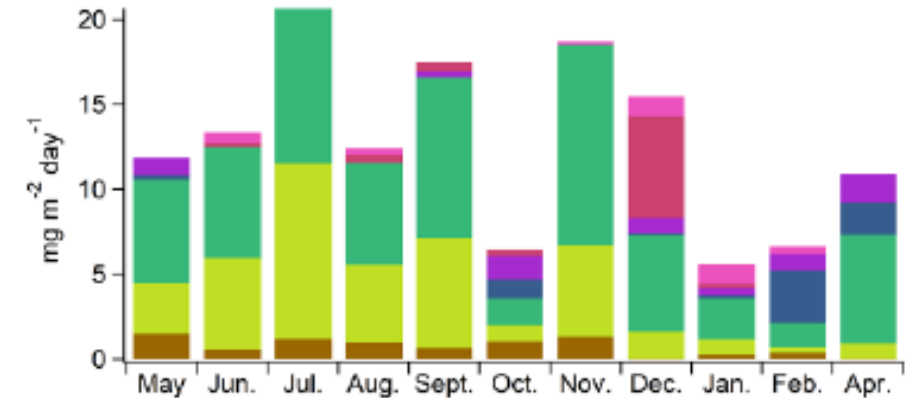


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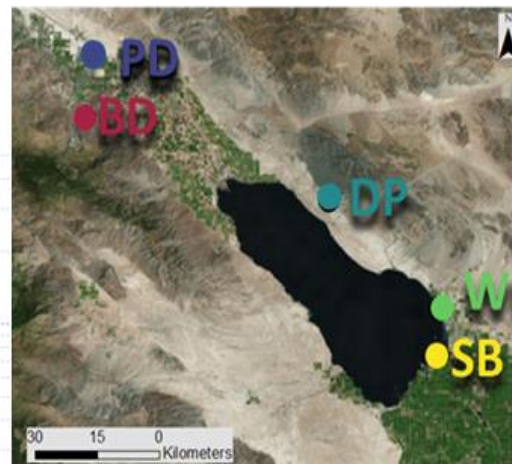
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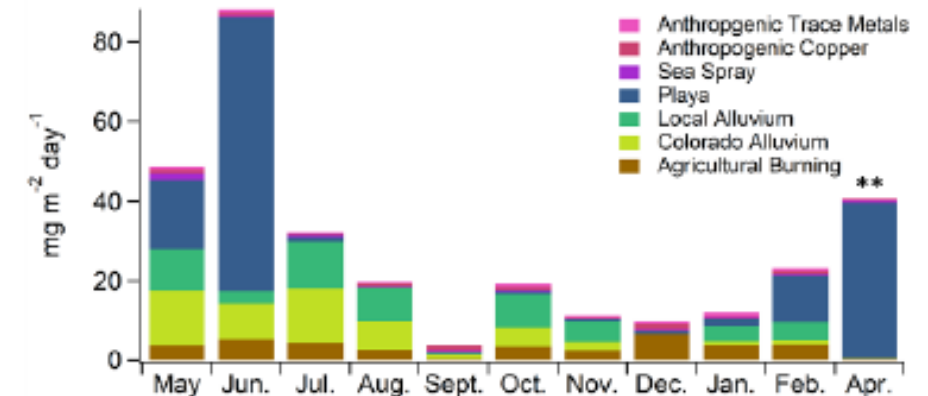
D) Wister



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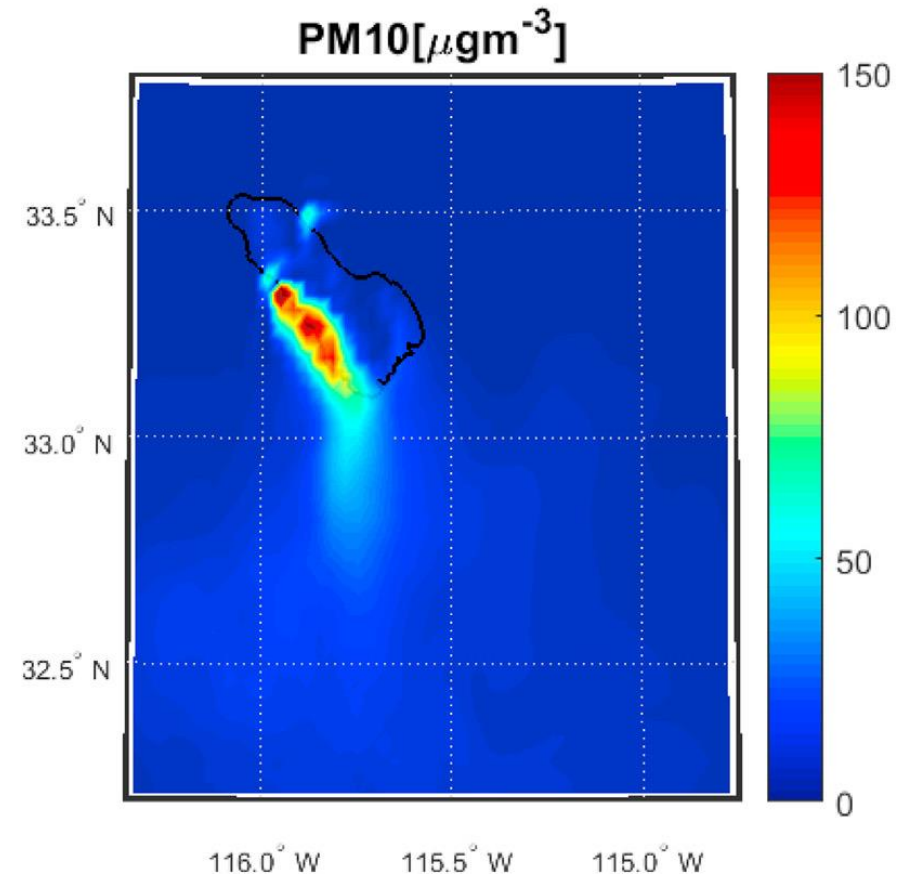
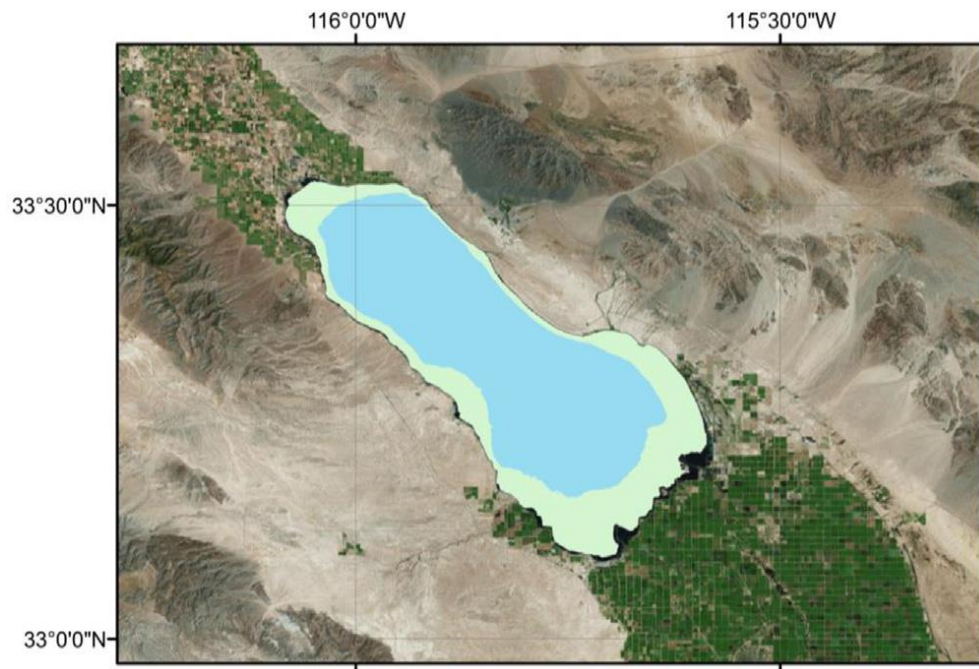


E) Sonny Bono



Playa sources expected to increase with ongoing reduction in Salton Sea water levels

- Preliminary simulations show local dust event concentrations up to 10 times higher in some locations due to increase in playa area by 2030



Parajuli and Zender, 2018

General conclusions

- Able to investigate temporal and regional influence of dust sources
- 7 source types identified
 - Sources strongly influenced by human activity contributed to 55-80% of dust flux
- Playa emissions most intense in spring/early summer, and expected to increase over time
- What does all this mean for **people**?



For detailed questions:
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bahreini@ucr.edu

BREATHE Center at UCR (Bridging Regional Ecology, Aerosolized Toxins, and Health Effects)



**BRIDGING THE GAP
in Air Quality Research**

The BREATHE Center is a multidisciplinary collaborative exploring health effects of toxin exposures from the air we breathe.

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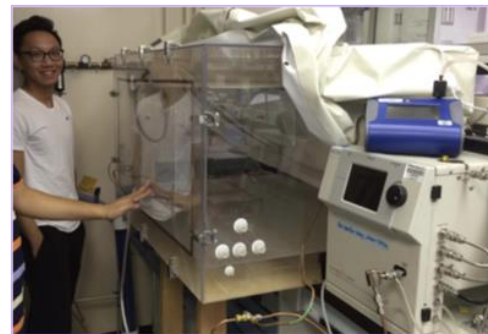
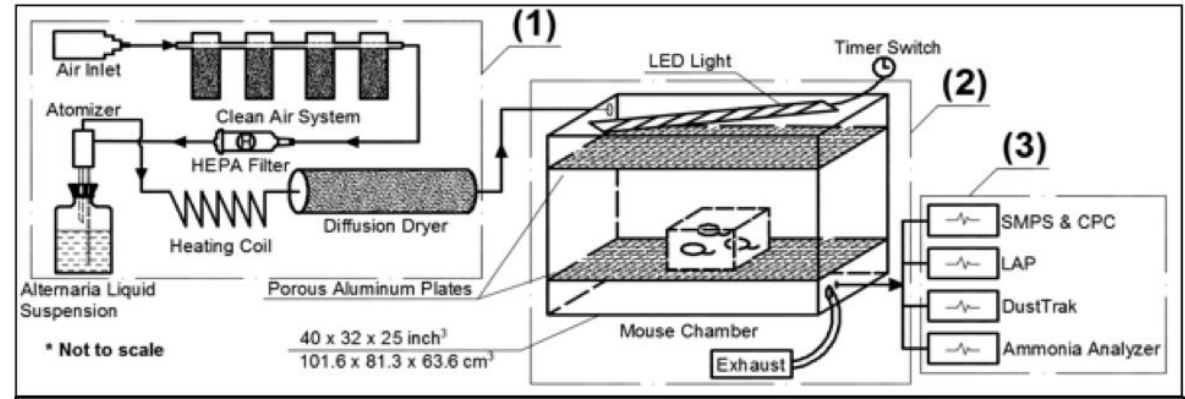
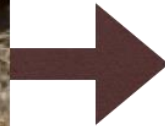
- Interdisciplinary team including epidemiologists, microbiologists, atmospheric scientists, and many others
- Ongoing work on comprehensive health analysis of Salton Sea particulate matter and health impacts

<https://breathe.ucr.edu/>

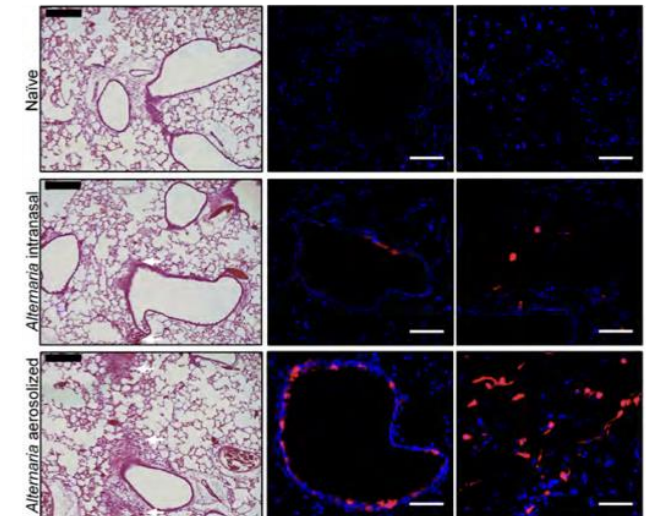
Health impacts of different particle types explored through variety of methods, including mouse chamber exposure studies



Emma Aronson



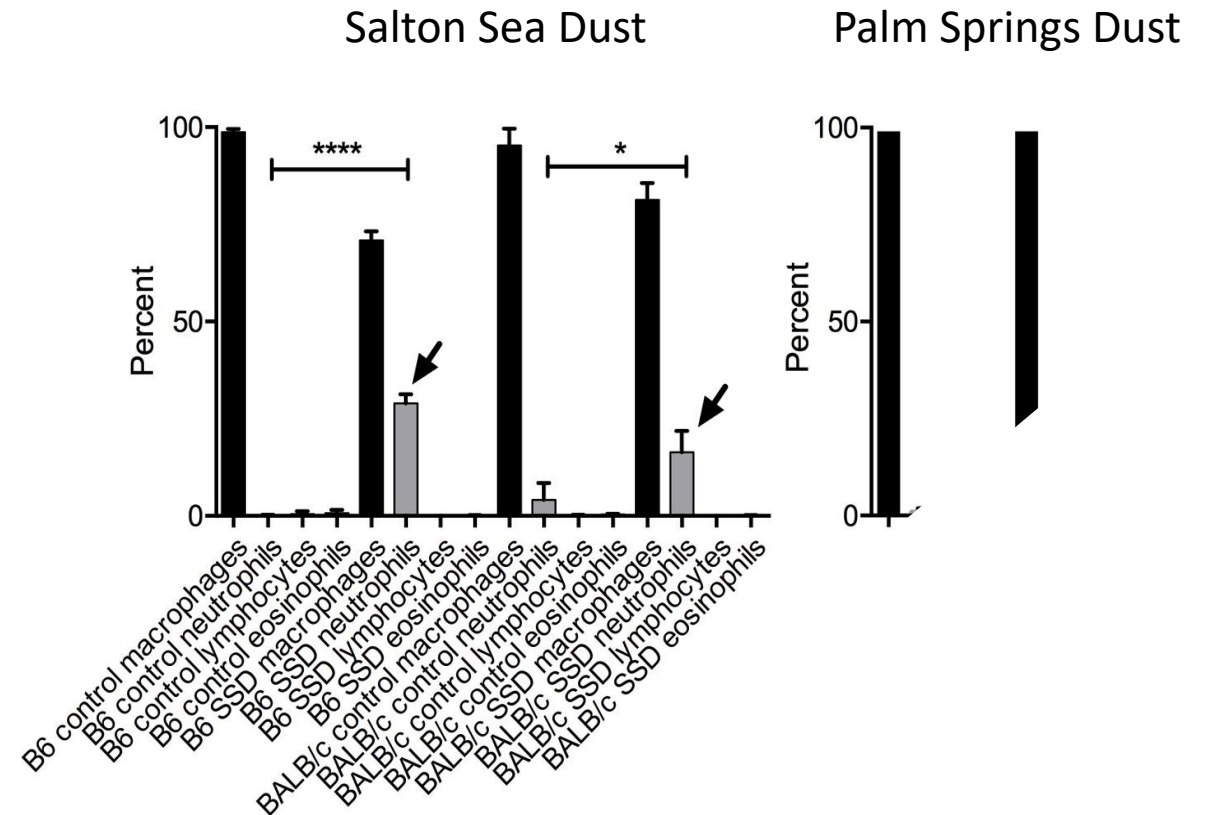
Eric Peng, Cocker Lab



Meera Nair

Preliminary results show unusual inflammatory response to Salton Sea dust

- Neutrophils (identified with arrows to the right) typically associated with health conditions such as bacterial pneumonia
- Extracts from Salton Sea dust induce elevated neutrophil counts while Palm Desert dust does not
- ***So, what is in Salton Sea dust?***



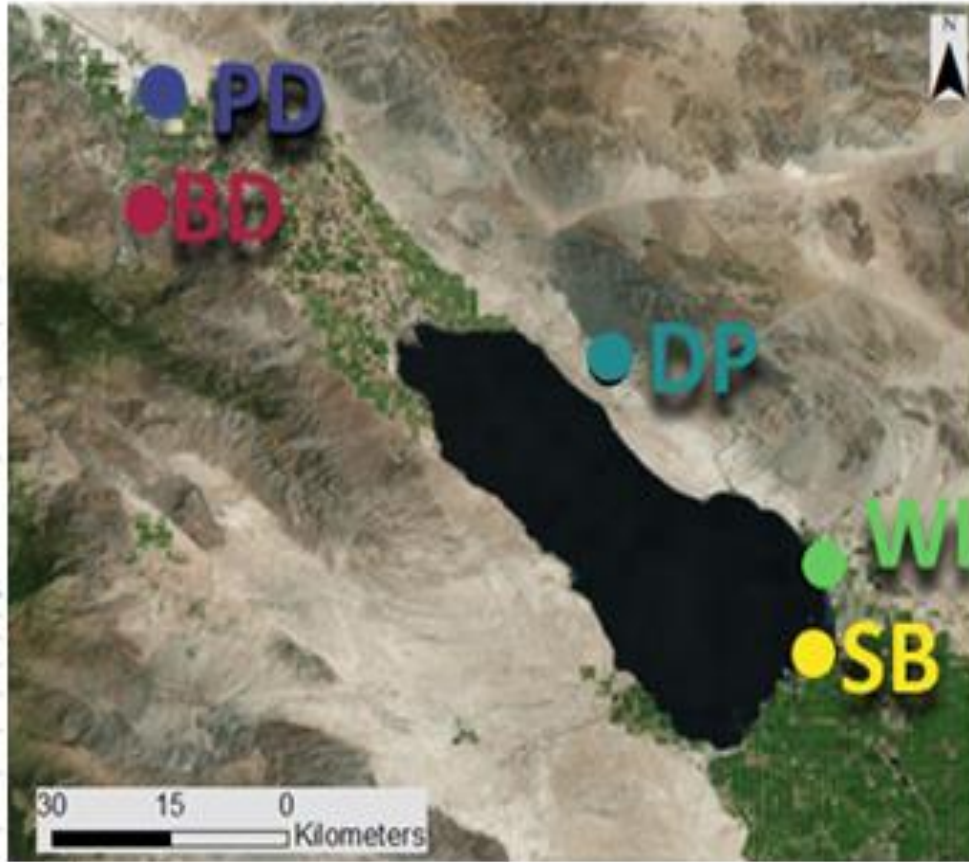
Recently funded NIH center will help explore these, and other concerns as part of focus on health disparities and community-based solutions



- What factors are driving large disparities in childhood asthma and other health conditions?
- How can these disparities be addressed and reduced through collaboration with local community?

<https://news.ucr.edu/articles/2019/08/23/new-center-address-health-disparities-inland-southern-california>

Additional collection sites and methods planned for coming years



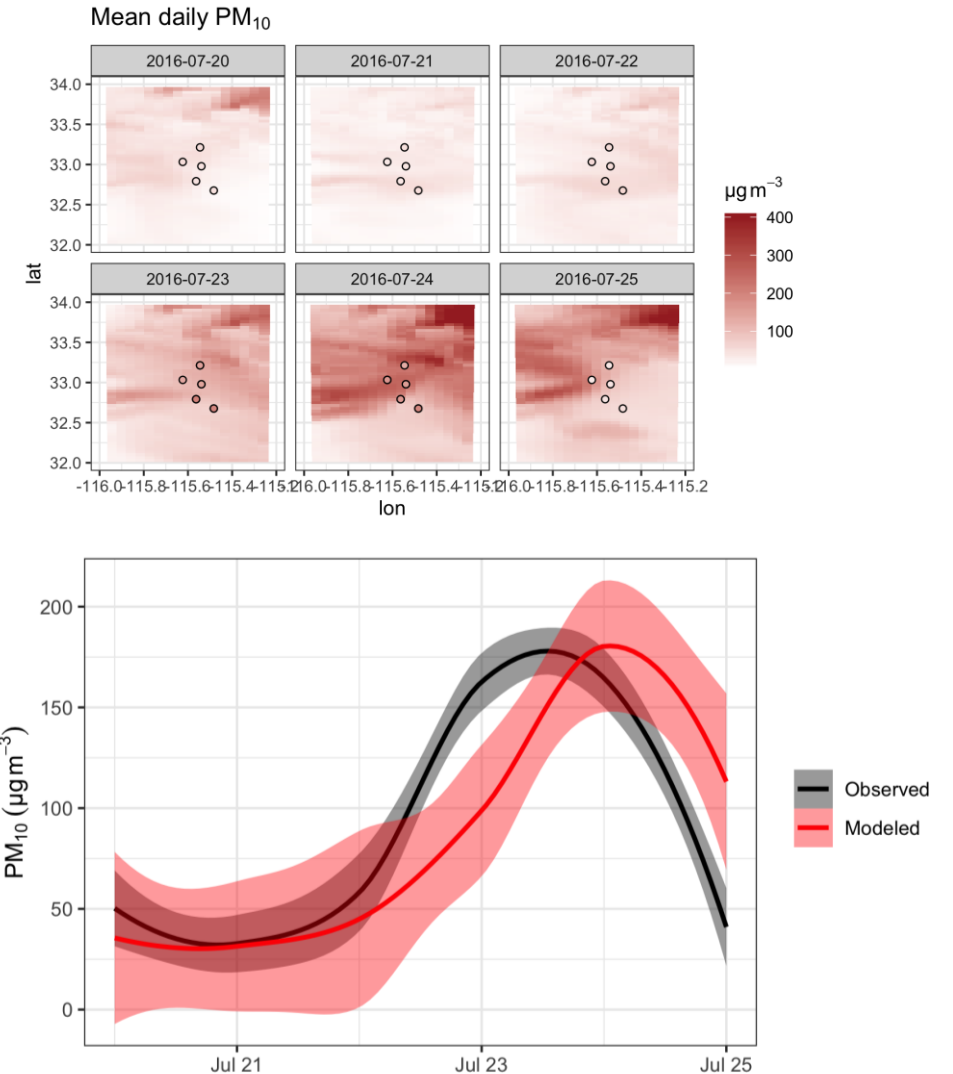
BREATHE Center Director



Dr. David Lo
david.lo@ucr.edu

Transport modeling will provide more resolved estimates of exposure and impacts

- Surface observations inform emissions, which inform exposure estimates
- Increased air sampling provides validation and tuning opportunities
- Knowing dust composition, transport patterns, and health impacts can empower residents and improve regional health



In Summary

- Dust sources in the Salton Sea region show differences both in composition and in health impacts – it's not *just* about total mass!
- Ongoing work will help answer key questions and connect the dots between emissions and illness
- Improving health and reducing health disparities will require a holistic, community-focused approach

