Asthma and the Salton Sea:

Research update

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Take-home:

- **SETTING:**
  - Communities at the Salton Sea suffer from high rates of asthma, attributed to the Salton Sea dust
    - Possible links with other immunologic symptoms (nosebleeds, eczema)

- **STUDIES:**
  - Salton Sea dust triggers lung inflammation in mice; pattern suggests that the cause is a microbial toxin (endotoxin), not an allergen
  - Regional symptom survey plus assays of toxin levels in dust suggests a correlation between asthma and endotoxin levels in dust
  - Hypothesis: Bacteria in Salton Sea produces endotoxin that is pulled into the dust, and into lungs of residents

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Asthma At The Salton Sea

- Based on community input, we began to study the Salton Sea dust and its role in asthma
- Our hypothesis was that it isn't just dry and dusty; something else is driving these high asthma rates
- Families pointed us to three issues: (1) asthma, (2) nosebleeds, and (3) eczema. Are these pieces of the same answer?
- We began with the dust – the Aronson lab set up dust collection sites around the region.

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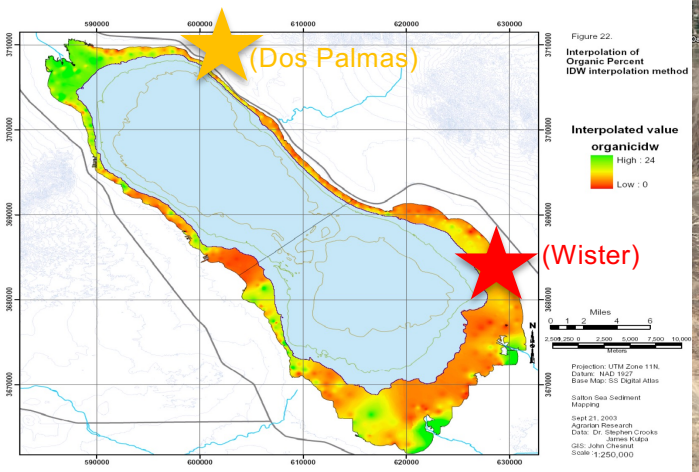
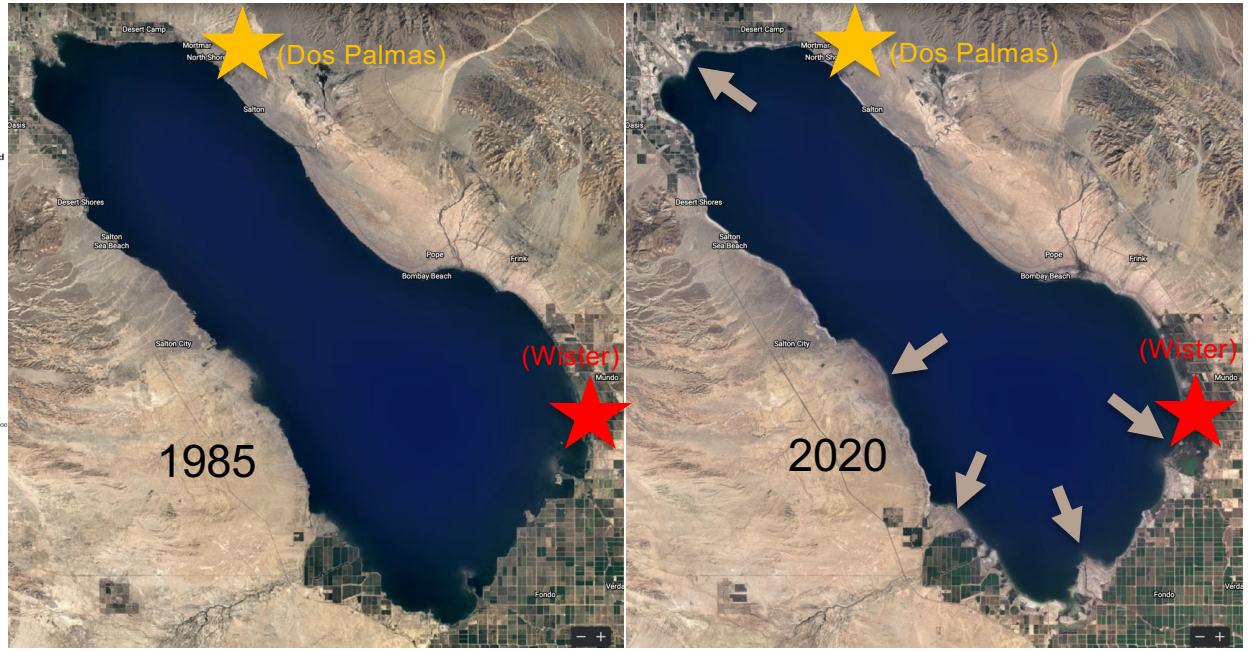
Salton Sea Dusts And Toxicity





- As the drying Salton Sea exposes more lakebed (mainly at the northwest and southeast ends), dust levels increase. Is this dust the cause of lung disease?

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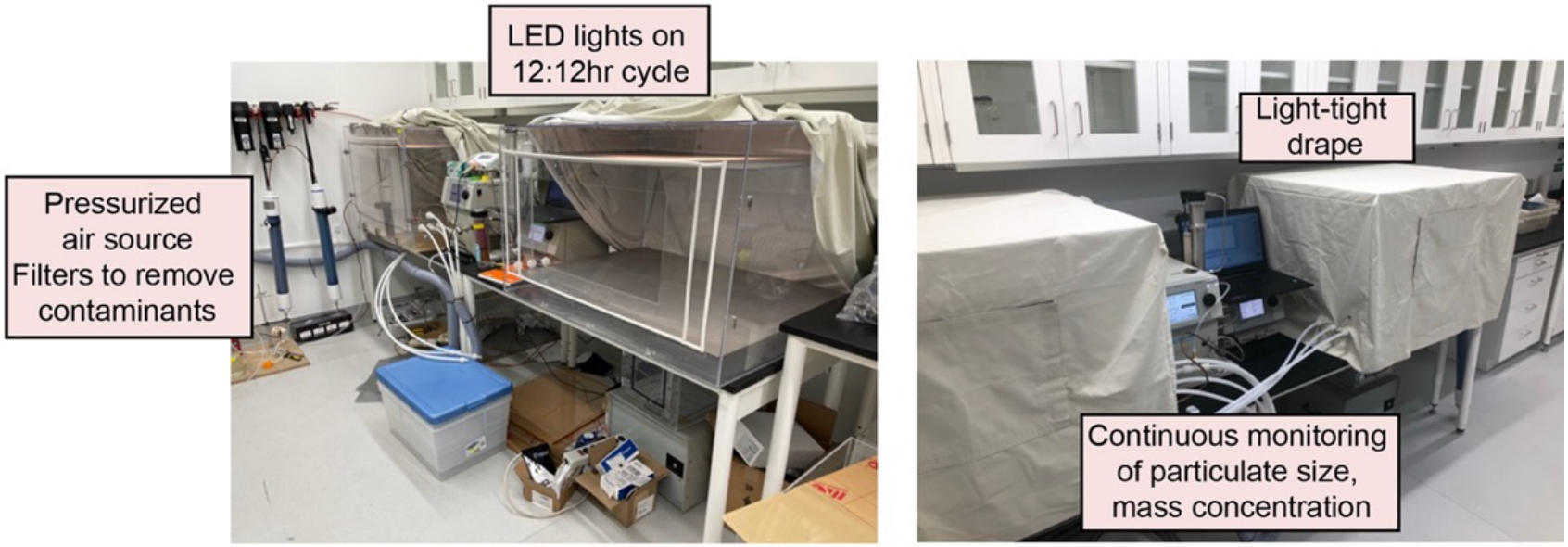
BREATHE *Laboratory*: Environmental Chamber Exposure System



- We exposed mice to the aerosols and tested for toxic or inflammatory effects in lung tissue
- We found that the dust induced inflammation in the lungs of exposed mice, but only dust collected from near Salton Sea

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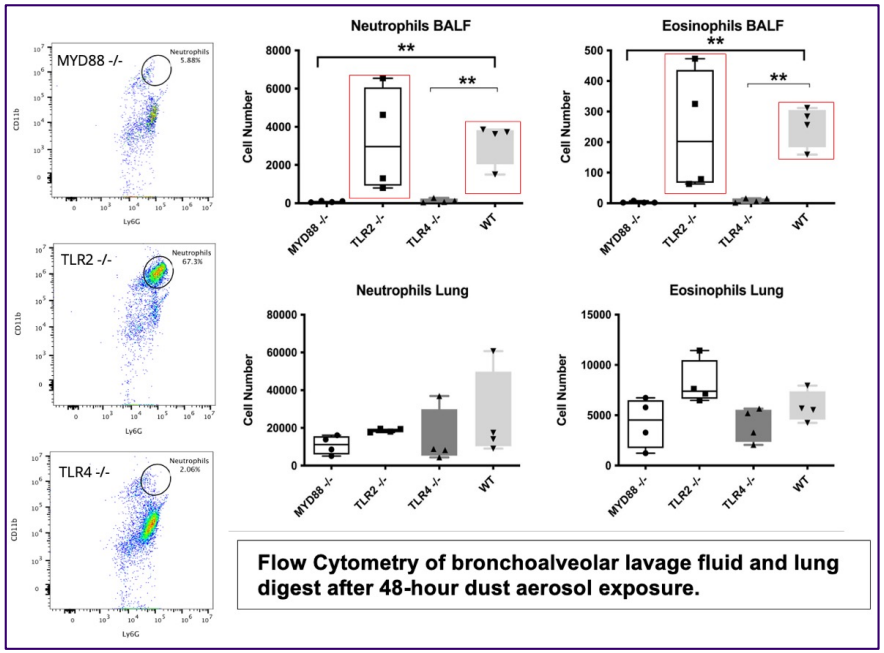
How Does The Dust Cause Disease?

- The lung inflammation in the mice did ***not*** look like usual allergic asthma, and instead looked like a response to bacterial toxin
- We confirmed this in mutant mice that lack the toxin receptor (TLR4ko mice); these mutant mice did not respond to Salton Sea dust at all



(Keziyah Yisrael; Talyssa Topacio, Emma Aronson)

- This supports the hypothesis that the lung inflammation in response to Salton Sea dust is due mainly to bacterial LPS/endotoxin and not an allergen
- Now we have an idea of what could be causing disease, and why it is linked to the Salton Sea; In addition, we can measure levels of this toxin in dust around the region

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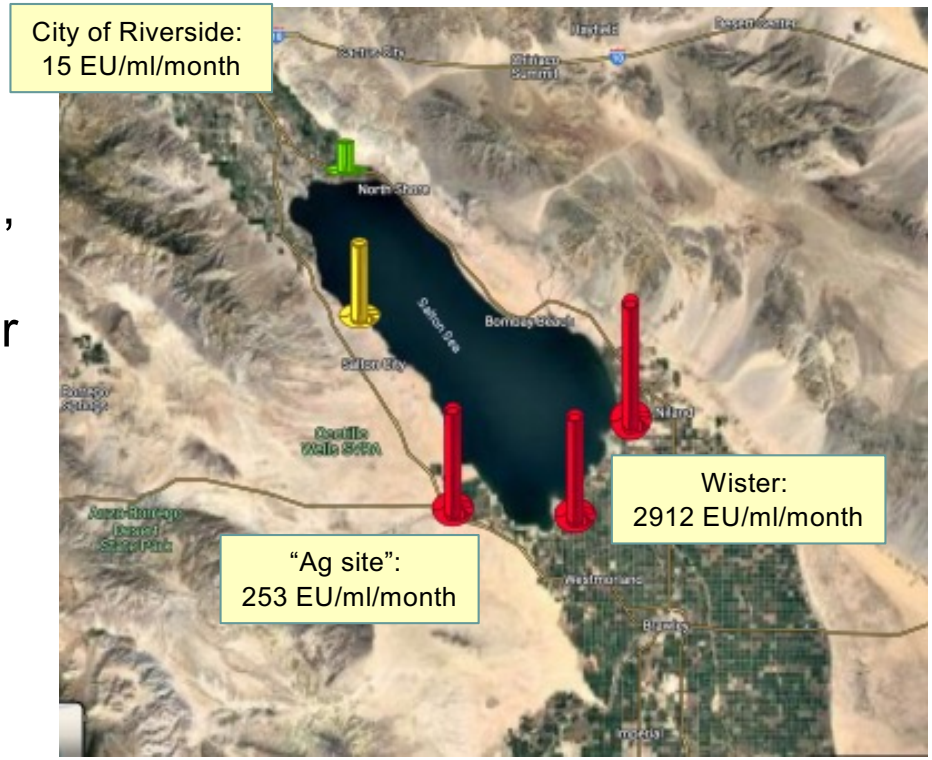
Mapping Microbial Toxin Levels

- We are measuring toxin levels in dust samples in the Salton Sea region, and there appears to be a significant North-South gradient; levels are higher in Imperial Valley (preliminary data in the figure)
- Is the concentration of toxin related to asthma incidence?



(Keziyah Yisrael, Troy Alaama)

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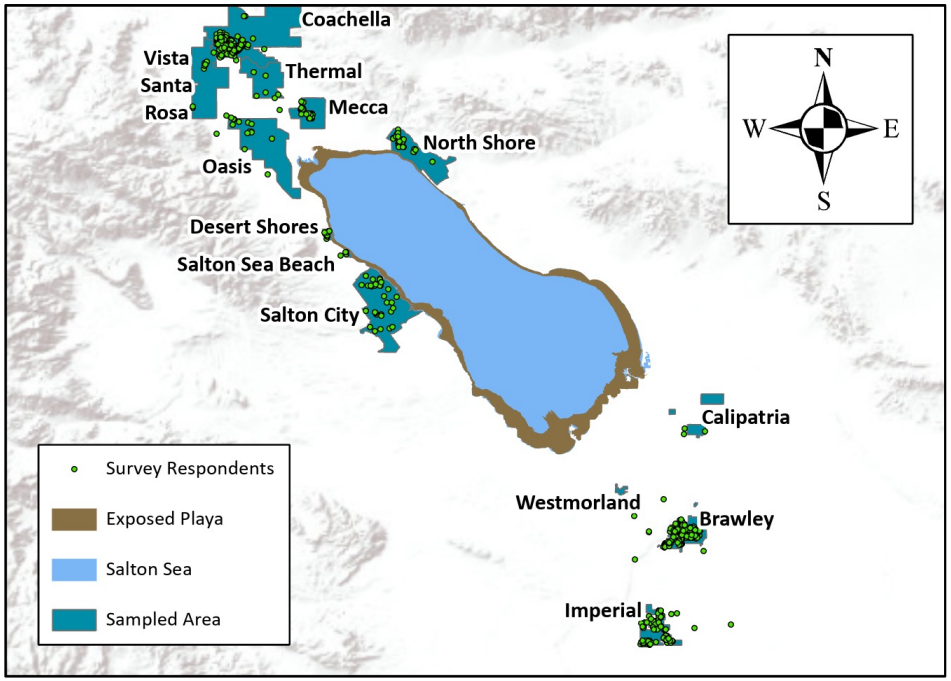
Does Asthma Incidence Match Toxin Levels? Asthma Epidemiology Study

- In collaboration with HARC, we performed a survey of asthma and related symptoms
- Responses were obtained from families with children across the region. (Note map of exposed playa; dust production is higher there.)



(HARC: Chris Morin, Daniel Polk, Casey Leier, Jenna LeComte-Hinely)

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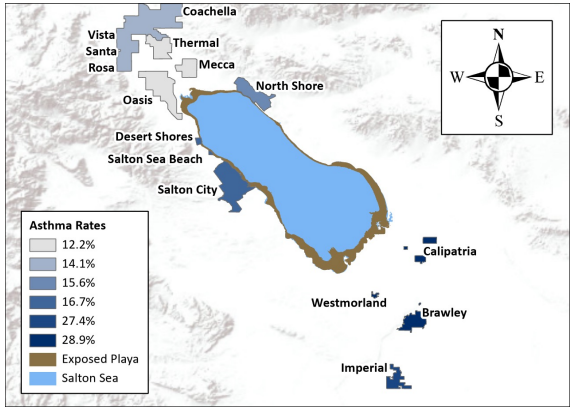
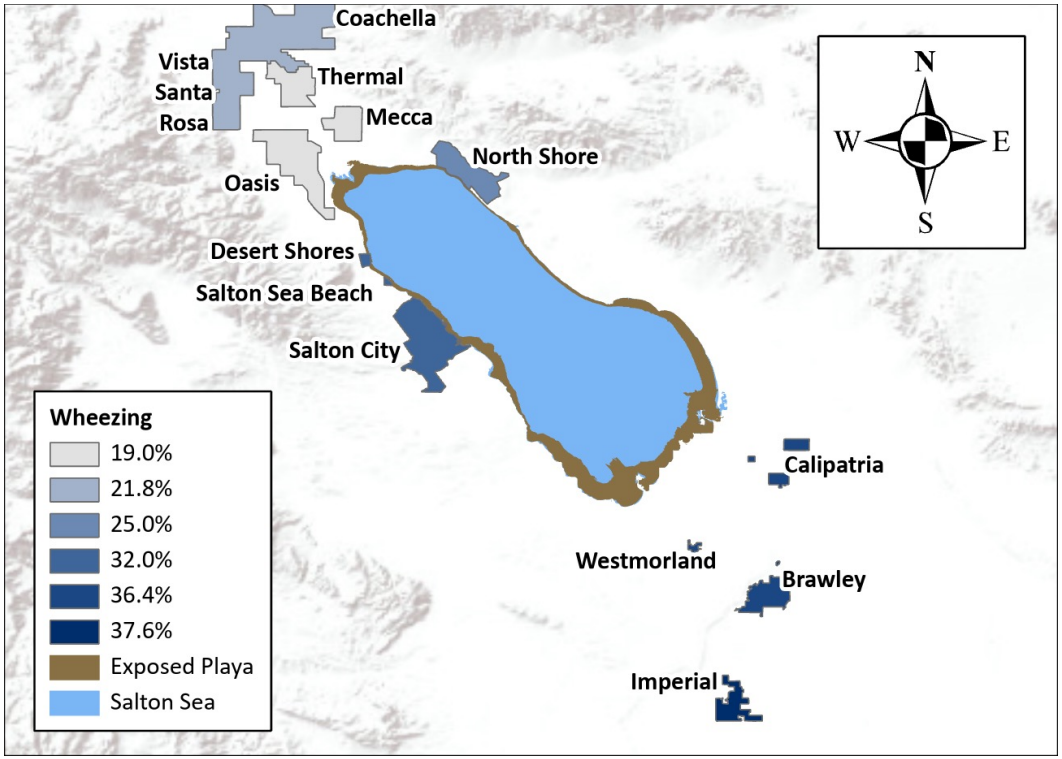
Asthma Rates Show Differences Across The Region

- Asthma diagnoses show a Northwest - Southeast gradient.
- Asthma and related symptom incidence is higher than normal in Coachella Valley (12-19%) but markedly higher in Imperial Valley (>35%).



Diagnosis rates; different from symptoms



(HARC: Chris Morin, Daniel Polk, Casey Leier, Jenna LeComte-Hinely)

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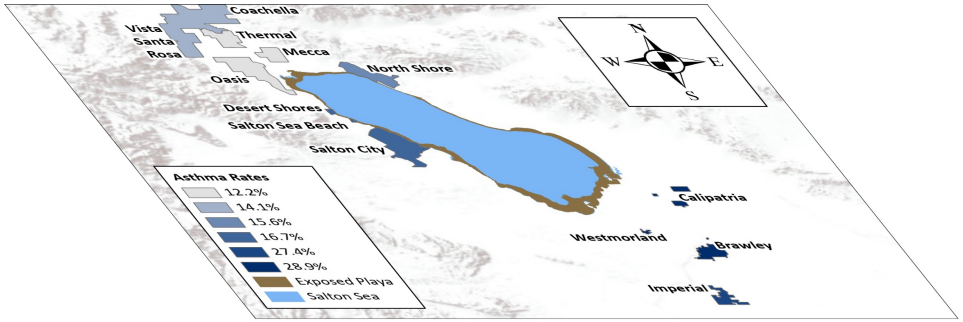
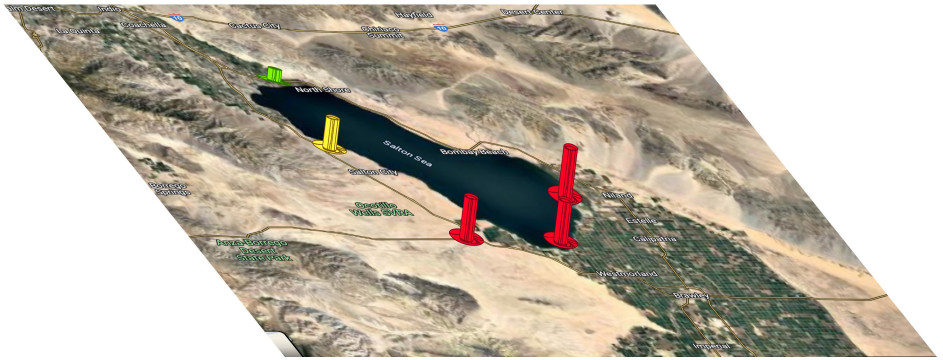
Dust Toxin And Asthma – A Correlation?

- Overlaying the map of toxin levels in dust with the map of asthma incidence shows a rough correlation
- That is, the geographic distribution of bacterial toxin levels in the dust seems to match asthma incidence





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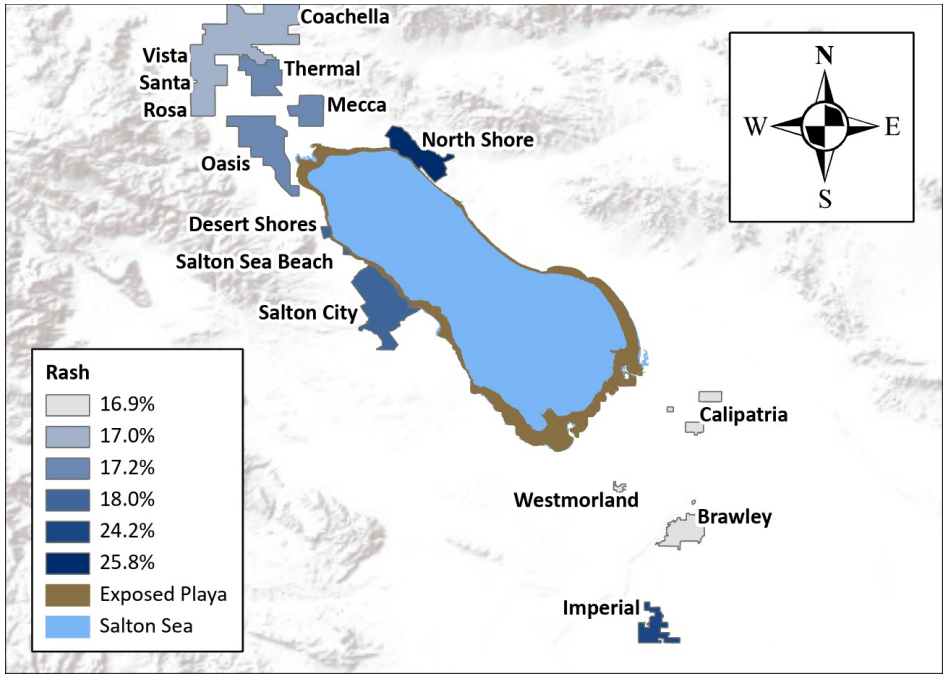
But Endotoxin Levels Might Not Explain Everything

- Families had other health concerns
- Skin rash/eczema can be from immune activity, but its distribution does not match the asthma pattern; it may have a different cause.
- Nosebleeds show a different pattern too – it is more uniform across the region, and might just be related to arid desert air.



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Final comment:

Mice are NOT humans, so while the lab data is suggestive, we still need clinical research data

Funding:
NIMHD/National Institutes for Health
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