

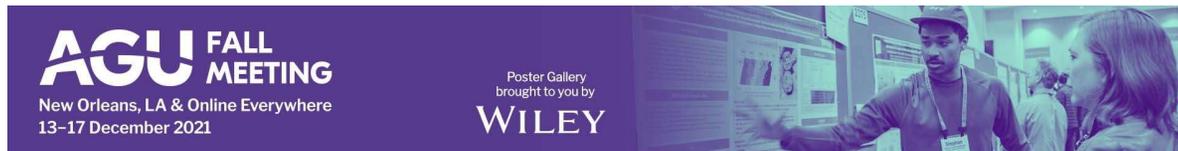
Methodological Challenges in Assessing Environmental Burdens and Benefits



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PRESENTED AT:



BACKGROUND

There is an urgent need to address inequity across multiple dimensions, including socio-economic, health, education, and especially climate and environmental justice (EO 14878, SCR 17).

Second generation Environmental Justice screening tools (Lee, 2020), such as EPA's EJScreen combine environmental burdens, socio-economic disadvantages, and health vulnerabilities to create a more comprehensive and nuanced picture of the cumulative burden faced by communities.

However, there is a need for states and local jurisdictions to develop their own EJ assessment framework as burdens and strengths as well as parameters to be considered in an EJ assessment are likely to differ from state to state.

Given this need for nuanced, local, assessments, many jurisdictions, notably California, Minnesota, and New Jersey, have developed state specific EJ screening tools. (see Konisky et al for a comparison of 19 EJ screening tools.)

Within this context, we wanted to assess the methodological challenges in developing a state-level environmental burden assessment framework for Oregon. We describe here the lessons learned from our effort at developing an environmental burden assessment tool that explored a small set of socio-demographic and environmental burdens.

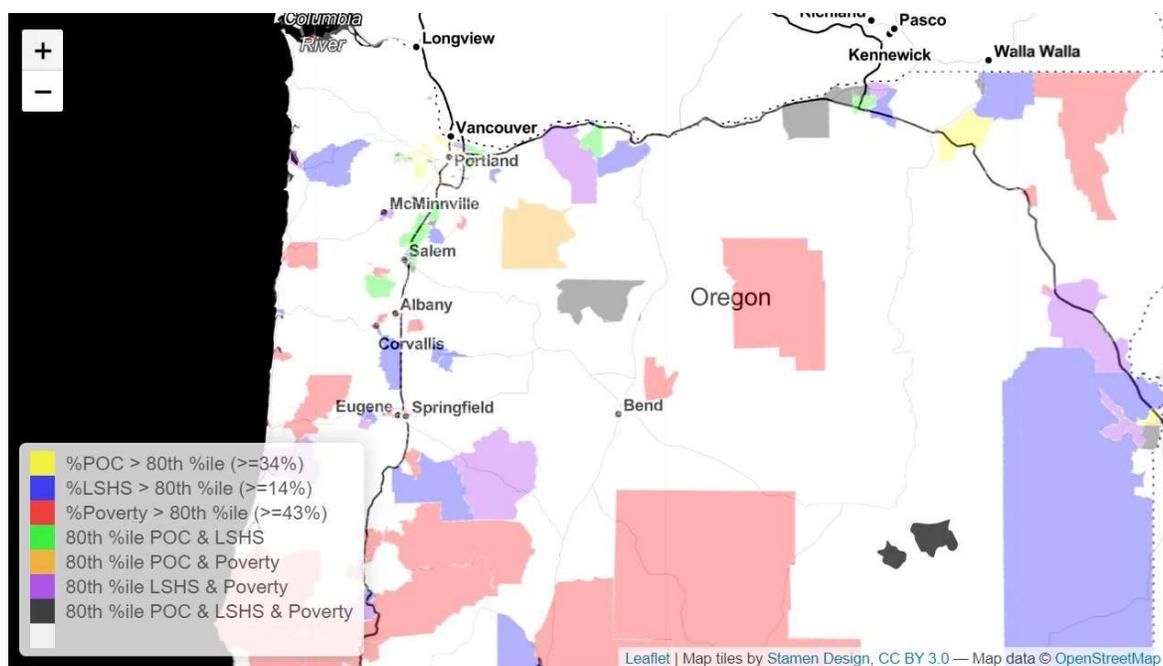
We set out with three goals:

- How to identify the most relevant environmental burdens?
- How to identifying the appropriate spatiotemporal scale for each burden?
- How to aggregate environmental burdens into a single indicator?

As we met and discussed our datasets and goals it became apparent that more fundamental work was needed prior to addressing the goals we laid out initially. Our discussions frequently returned to questions of (1) how to define environmental justice communities and vulnerable populations, and (2) how to meaningfully compare population vulnerability to environmental burden, so that we could understand and see disparities in the distribution of environmental burdens among the different communities of Oregon. We decided to shift our goals to incorporate this need, and so the primary goal of this poster became a data visualization goal: provide a visual framework to aid with comparisons of population vulnerability and environmental burdens and to identify areas with relatively high cumulative impacts.

A final goal that we identified over the course of our discussions was something of a meta-goal: we hope that our experience and learnings from this exercise can provide helpful guidance to our agency as it continues to work towards meaningful environmental justice engagement work with the communities of Oregon.

APPROACH



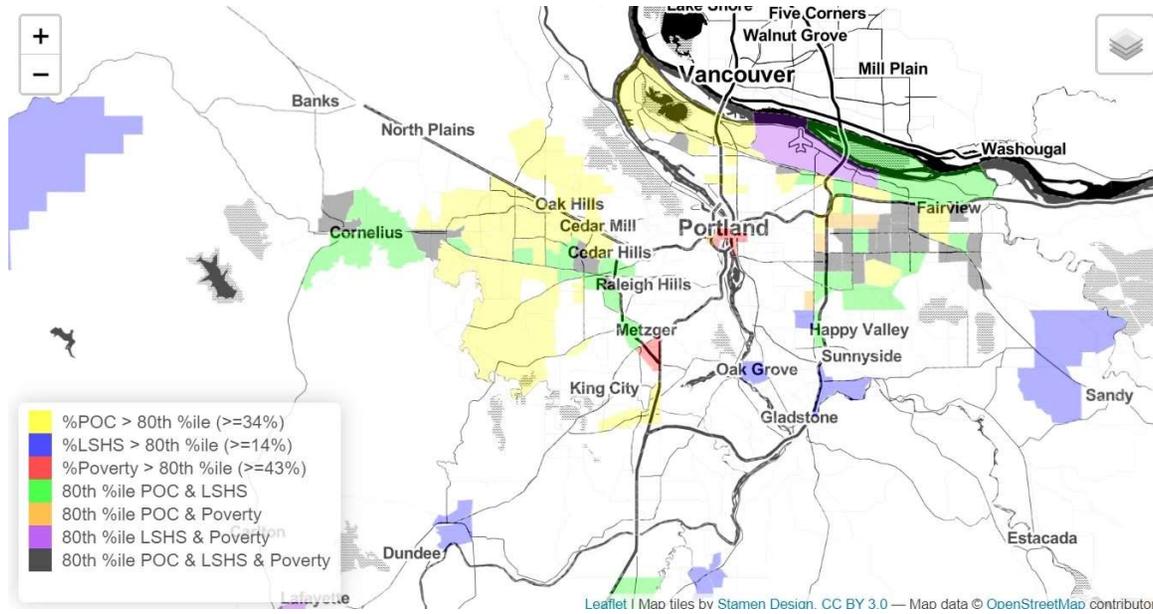
We decided to use the term population vulnerability rather than environmental justice community because we felt that the latter designation conveyed a sense of community buyin that is beyond the scope of this study.

To address our goal of visualizing population vulnerability, we chose the following three variables to compare, at census tract resolution:

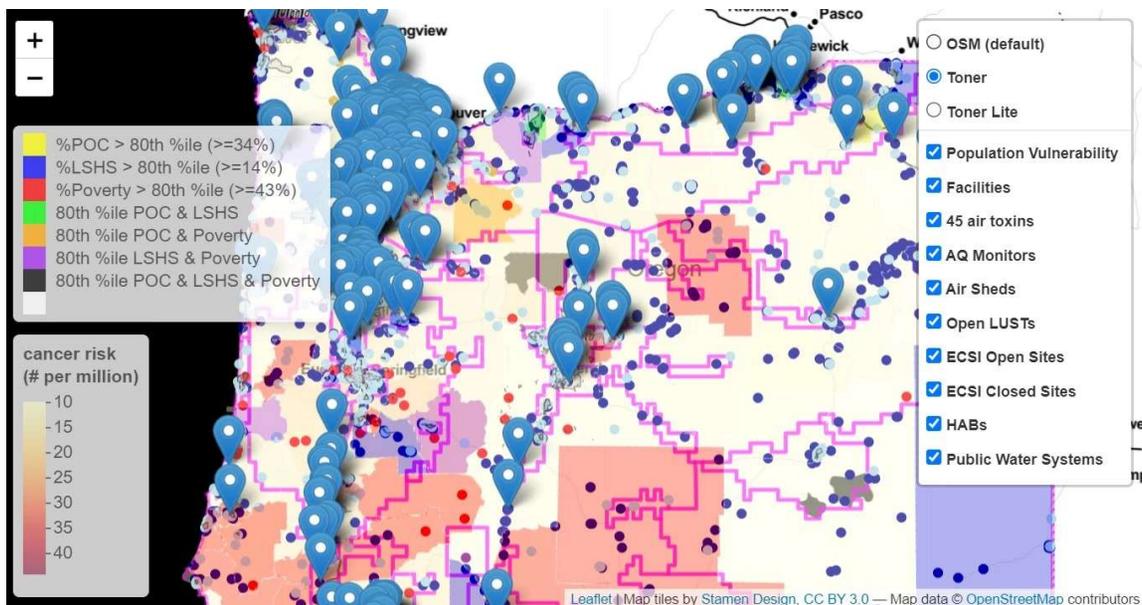
1. Percent People of Color (%POC)
2. Percent Population with Less than High School Education (%LSHS)
3. Percent Population Less than 2 times the federal poverty line (%Poverty)

We chose these variables because they were included in EPA's EJScreen tool, and we felt that they captured a spectrum of vulnerability characteristics that would identify vulnerable populations in both urban and rural settings. They are also among the characteristics included in the White House's Justice40 guidance for identifying disadvantaged communities. To aid in visualization, we chose a color scheme that created 7 categories: primary colors represent census tracts that are above the 80th percentile for either %POC (yellow), %LSHS (blue), or %Poverty (red). Secondary colors were used to identify census tracts above the 80th percentile for 2 variables- green was used for tracts above the 80th percentile for both %POC and

%LSHS, orange was used for tracts above the 80th percentile for both %POC and %Poverty, and purple was used for tracts above the 80th percentile for both %LSHS and %Poverty. For tracts that were above the 80th percentile for all 3 variables, black was used as the fill color.



ENVIRONMENTAL BURDEN



Link: <https://rstudioconnect.deq.state.or.us/content/9044ba43-3ca4-4e80-81d6-ca01fdd698ef>
 (https://rstudioconnect.deq.state.or.us/content/9044ba43-3ca4-4e80-81d6-ca01fdd698ef) (takes a few seconds to fully load)

Layer Index

Air

Air toxics facilities: Top 5 Toxic Air Contaminants (TACs) from each facility that reported TAC emissions to Cleaner Air Oregon in 2016.

Risk-based air toxics: Emissions data from air toxics facilities layer divided by Risk-based Concentrations (RBCs), which normalizes the emissions and provides a risk score for the scenarios for which RBCs exist for each TAC, for each facility.

45 air toxins: This layer shows excess cancer risk per million and the popups indicate the drivers of that risk by toxin and source sector.

AQ Monitors: Existing particulate matter 2.5 (PM 2.5) air quality monitor locations.

Air Sheds: Outline of PM2.5 representativeness polygons, the areas around each monitor where PM2.5 concentration changes are similar to those recorded at a given monitor.

Land

Open LUSTs: Short for Leaking Underground Storage Tanks (LUSTs), this layer shows the LUSTs that have not yet been cleaned up.

ECSI Open Sites: Current Environmental Cleanup Sites (ECSI).

ECSI Closed Sites: Closed environmental cleanup sites.

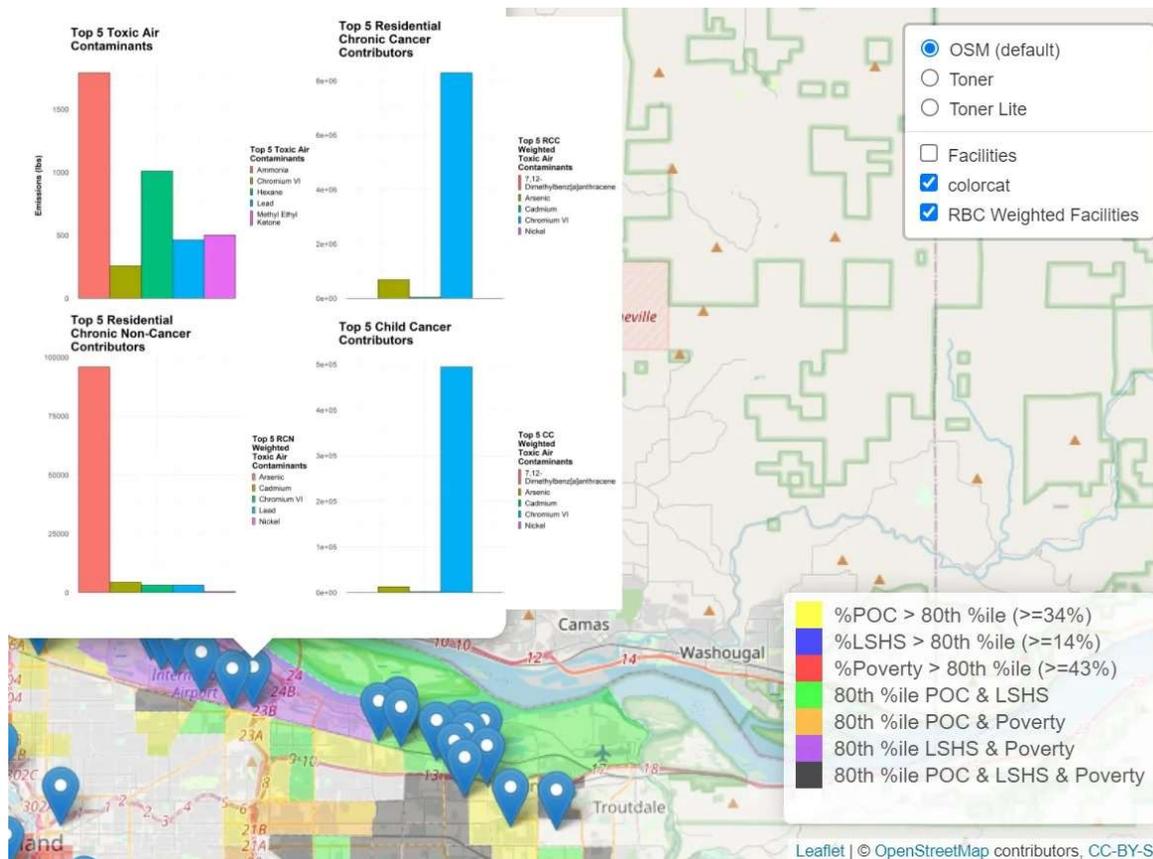
Water

HABs: Harmful Algal Blooms (HABs), this layer shows all water bodies that the Oregon Health Authority has issued a Harmful Algal Bloom Advisory for since 2004. (Link to OHA info: <https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/RECREATION/HARMFULALGAE/BLOOMS/Pages/index.aspx>)

PWS Service Areas: This layer shows the service areas of public water systems (PWSs) in Oregon.

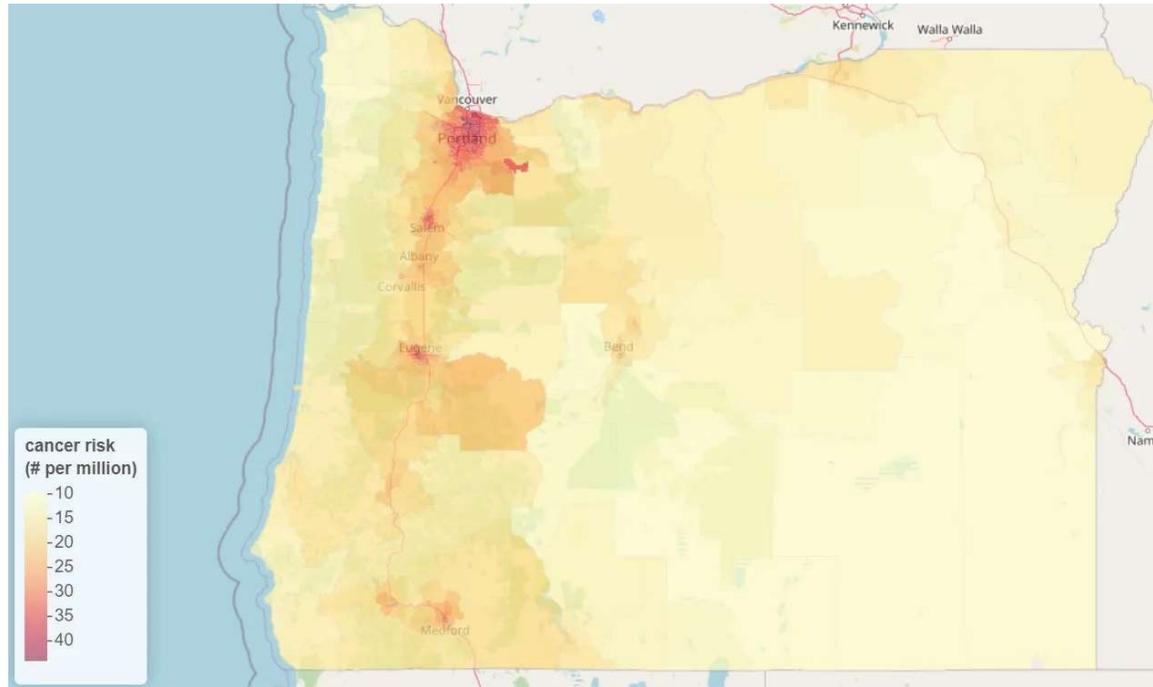
Air Layer Discussion and Challenges

Air Toxics Facilities

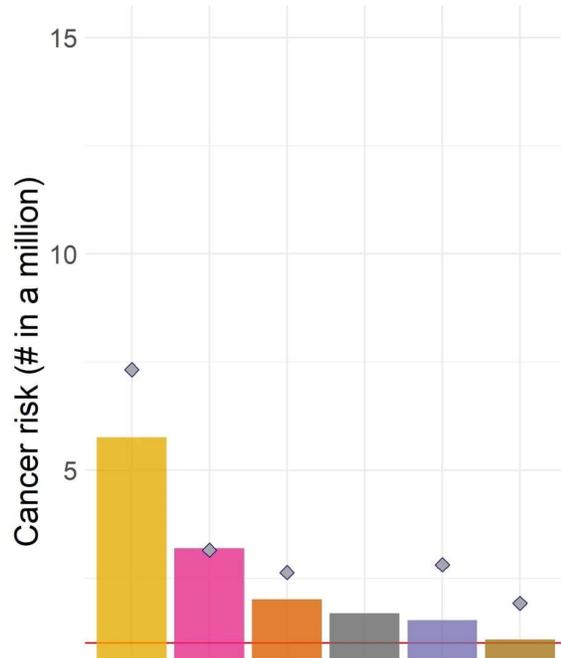


Combining the population vulnerability layer with the Toxic Air Contaminant (TAC) facility emissions data provides a helpful visualization tool for seeing the disparities in potential air toxics exposure. This can help our agency identify communities to reach out to for enhanced engagement around air toxics issues and possibly be a tool for assessing permitting decisions in the future in cases where clusters of air toxics emissions create areas with high cumulative exposure risks. Currently DEQ does not assess cumulative air toxics exposure risk, that is, risk that combines the relative risk score from facilities within short distances of one another. One limitation of the current Risk-based air toxics layer is that it does not incorporate modeling inputs like stack height. Facility data could be updated as CAO continues to perform risk assessments to reflect the actual risk values based on those assessments, but this could be a valuable tool to keep the public apprised of CAO's data findings in the meantime.

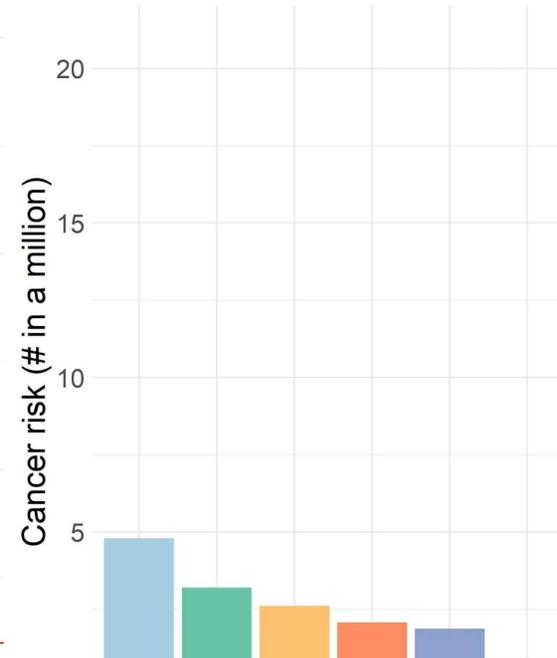
Air Toxins and Cancer Risk

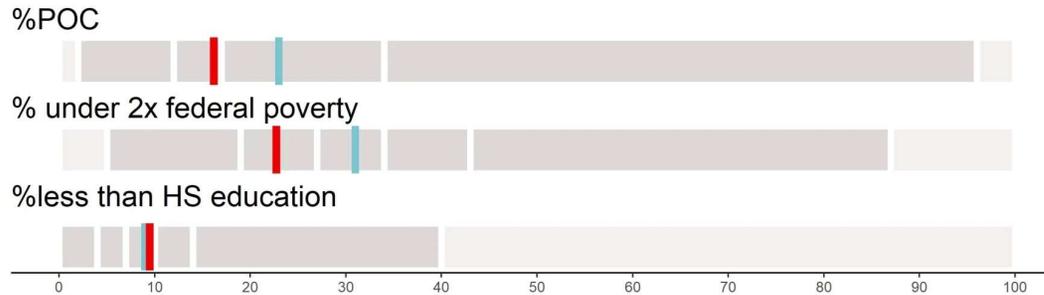
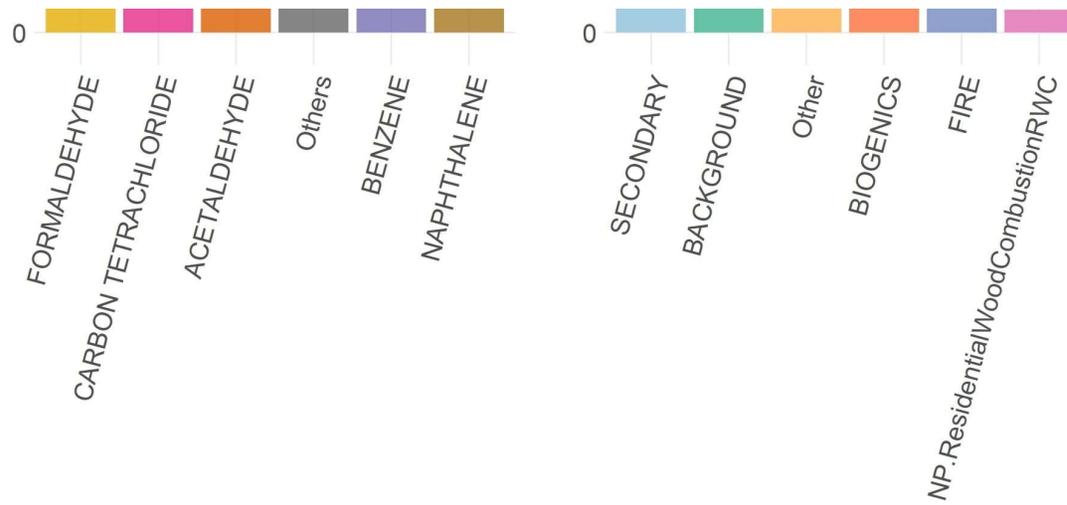


Top 5 Air Toxins contributing to cancer risk in tract



Top 5 sectors contributing to cancer risk in tract

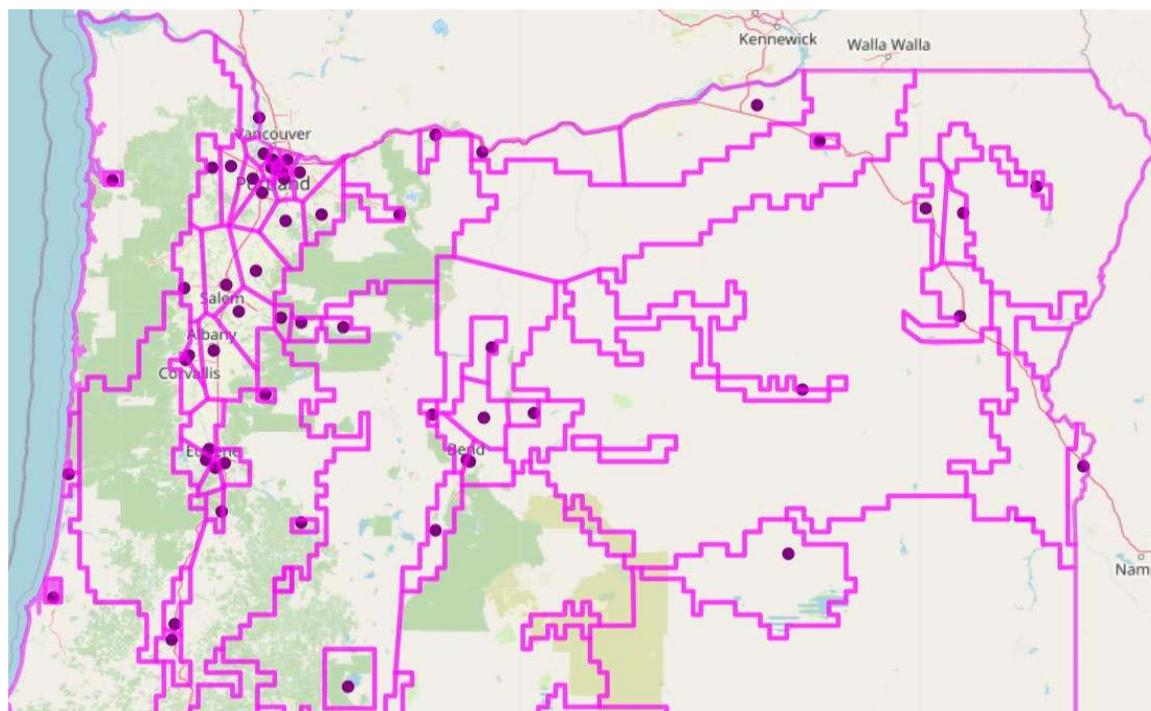




This figure shows in red (top) the percent of the tract population that identify as POC, (middle) the percent of the tract population below 2x the federal poverty level, (bottom) the percent of the tract population with less than a high school education. Blue lines indicate the average percentages across all census tracts; white lines are quantile markers.

This layer shows that the main drivers for cancer risk from air toxins are formaldehyde and diesel PM, and the risk is highest in the urban interstate I5 corridor. Formaldehyde is driven primarily from secondary formation, biogenics and wildfire, and diesel PM comes from urban construction as well as road travel. The basis for this layer is a modeling study that considered 45 air toxins. There were several limitations to this study. It is difficult to validate the model for all 45 chemicals due to the cost and time needed for monitoring. It is also limited by the lack of Toxic Reference Values (TRVs) and emission factors for the chemicals considered. The state of Oregon considers ~635 substances to be TACs, and EPA considers 187 substances to be Hazardous Air Pollutants (HAPs), but TRVs do not exist for all of those listed substances. Also the TRVs that do exist can differ by state- California for instance has a Diesel PM TRV that is ~30 times more conservative than Oregon's, while EPA doesn't have a Diesel PM TRV.

AQ Monitors and Air Sheds

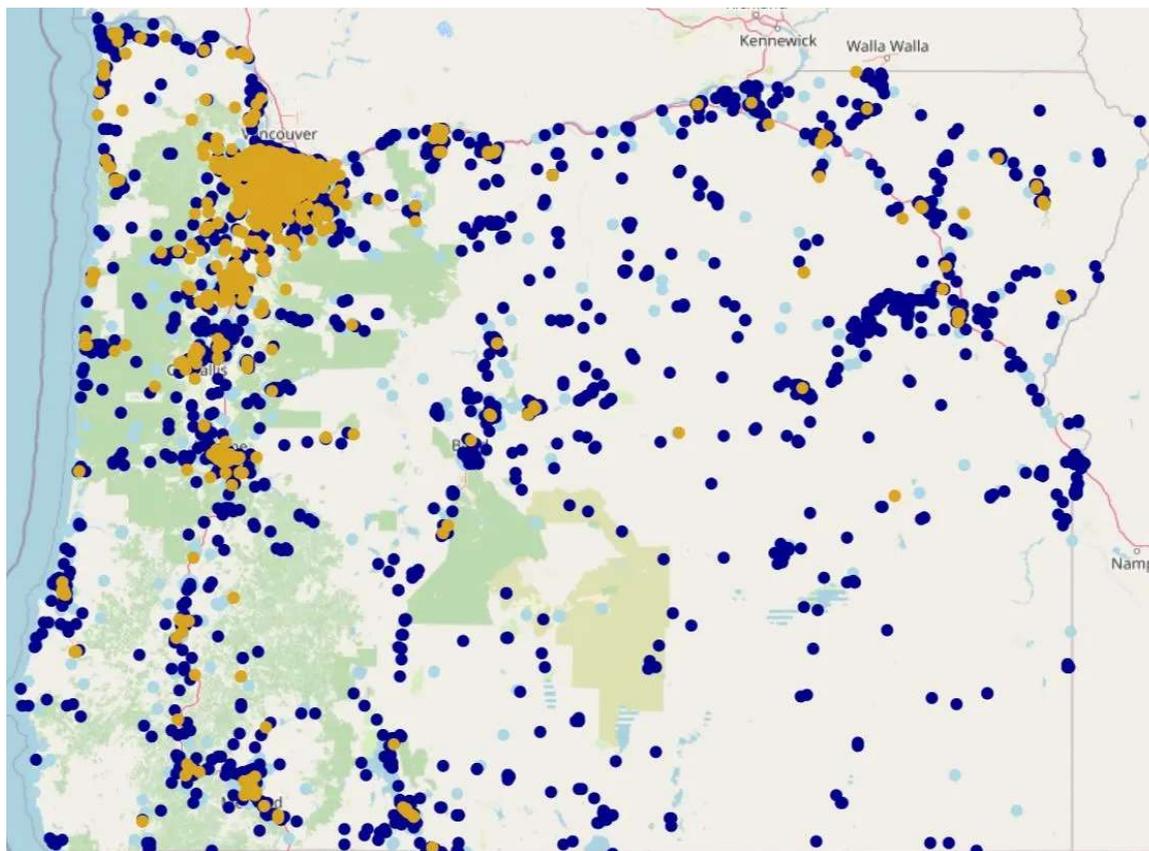


The polygons will enable DEQ to incorporate the 5-day PM_{2.5} forecasting framework used by WA and ID. Additionally, these polygons will be used as the basis of interpolating PM_{2.5} values, which will provide OHA with a framework to better understand the health impacts of wildfire smoke. Monitoring network expansion and siting needs may be another potential area of use.

The forecasting airsheds that we identified reflect annual and daily averaged particulate matter concentrations. Hour-to-hour or day-to-day variability may not be captured well in some instances. However, over longer time scales, we anticipate these forecasting airsheds to be represented by the monitor. Additional analysis is needed to verify these forecasting airsheds for daily forecasting, including error bounds.

Land Layer Discussion and Challenges

ECSI Open (dark blue), Closed (light blue), and LUST (goldenrod) Layers



The Environmental Cleanup Sites (ECSI) and Leaking Underground Storage Tanks (LUST) exhibit challenges of differing spatial and temporal scale. Sites in ECSI reflect the voluntary nature of the program and areas of high real-estate transaction may be overrepresented. On the other hand, a leaking underground storage site must be reported.

The voluntary nature of some programs, and the limited resources of program staff, reveal a need to further assess and address barriers to program participation.

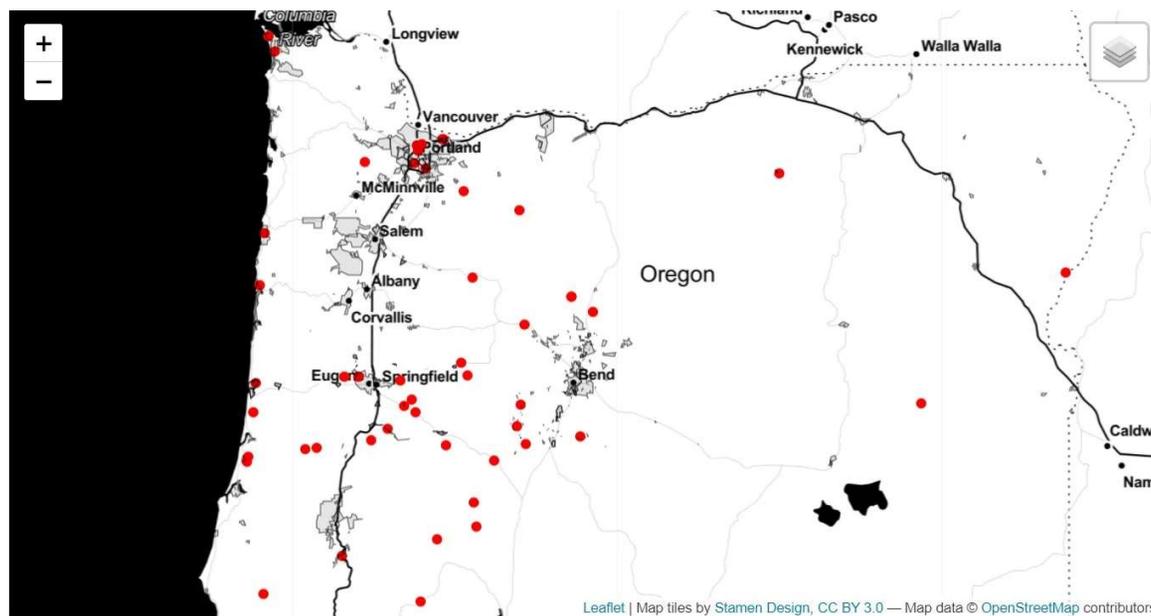
Both the ECSI and LUST databases include sites where cleanup has been completed and sites where cleanup is on-going or further investigation is needed. This presents the challenge of which sites to include in an analysis- do we focus only on currently active sites, or do we want to capture an environmental burden over the last 10 years?

Comparing risk across sites is also difficult as the toxicity of contaminants and the media they were released into vary greatly. For example, a site with contaminated sediment resulting in contaminated fish has a greater reach of impact than a site with only soil contamination within the property's boundaries. While some programs have a systematic way to prioritize and rank cleanup sites, many sites enter the program directly and do not receive a priority score.

Lastly, the data are collected for site-specific analysis and risk based decision making. This data is not always in a form that is readily comparable to other sites or integrated into a state-wide database.

Water Layer Discussion and Challenges

HABs and PWS Service Areas



The HABs layer presents a difficult challenge because proximity is not necessarily a determinant of exposure. HABs can present an acute exposure risk to people from hundreds of miles away visiting a lake for a weekend getaway. HABs are often ephemeral, making it challenging to predict and determine exposure risk.

There are also challenges and limitations associated with using the public water system (PWS) service areas layer for environmental burden analysis. The quality of service area location data is variable because the source of each polygon of data is different. In some cases, the service area boundaries were accurately mapped, in others the service area was estimated to match city limits or a different jurisdictional boundary. Additionally, not all service areas have been mapped. Of the mapped PWS service areas, there is a variety of PWS types, some serving dozens of people and some tens of thousands, some groundwater based and some surface water based, some serving residential population and some serving offices or schools. This diversity puts these systems at risk from groundwater contamination and drought as well as algal blooms and infrastructural failure. The variety of risks to this resource make clear the need for strong monitoring systems to protect it, and for identifying communities that have been historically underserved or discriminated against in ways that increased the health risks to those communities to eliminate any such inequities that persist.

OVERARCHING CHALLENGES

There are a variety of technical and operational challenges of assessing and communicating environmental burdens and benefits, and all require additional allocation of resources and funding. Though there has been a renewed focus on environmental justice including directives from the legislature (SR 17) they are not enough if there is no funding allocated to prioritize the research. The goal of this research is not to tell communities what they are, but rather to inform them what the data shows and receive input on what they, as residents of those areas, see as their biggest burdens.

As staff we have begun to outline the work to describe environmental burdens, several technical and operational questions regarding data quality, data visualization, and community input have arisen. These are described in more detail below.

- Community engagement: A tool created for the public, and with potential impact for the allocation of resources to the public, needs public input. Outreach strategies, whether new or revised, need to be put into action to ensure there is a process for educating the public and gathering feedback to guide the process.
- Inclusion/exclusion criteria: There are no standards (or criteria) for deciding which data layers to include in an environmental burden assessment. It is very important that this incorporate community feedback and provide confidence that the data being used shows the complete picture. There is also a need to analyze what data layers would be the most helpful, or which data layers add new information vs. information already captured by other data layers.
- Data quality: There are currently no data quality standards in place for data sets to be incorporated to a total environmental burden assessment. Data completeness and the limitations of each data layer are important for interpreting any results.
- Data visualization: When visualizing data, it is always important to keep the audience in mind. Public feedback will be helpful to ensure that the data visualization has enough contextual information for viewers to understand the main point and assumptions underlying the data and conclusions.
- Capturing data variability: different data sets have different spatial and temporal scale and resolution, and different chemicals have health impacts on different scales. For example, some data sets are available state-wide based on satellite data, demographic variables are available by census tract or census block group, and some environmental data are available based on voluntary monitoring, reporting, or program participation. This information, and how to compare datasets or combine them into one index score, will also need to be considered, addressed, and defined during this data analysis.

Next Steps: As next steps; we will continue to lay the groundwork for the environmental burden analysis, communicate with other partners about available data, and work to outline a strategy to fund the analysis and tool development.

SUMMARY AND CONCLUSIONS

Our work underscores the magnitude of challenges associated with accurately assessing and conveying information that combines population vulnerability data with environmental pollution burden data. The difficulty of selecting an appropriate approach stands out as a particular challenge to our agency and other environmental agencies interested in incorporating equitability or environmental justice into their work. With so much existing research and absent a definitive roadmap on how to incorporate environmental justice into their work, members of environmental agencies run the risk of choosing arbitrary metrics and thresholds and labeling entire communities "environmental justice communities", or "disadvantaged communities" without sufficient consideration of what those designations mean and without discussions with the target communities to gain input into such designations. This exercise has highlighted the need for visualization tools, such as the ones displayed in this poster, to facilitate conversations with communities that may have characteristics that enhance their risk of environmental pollution burdens. We succeeded in identifying relevant environmental pollution burdens and identifying the appropriate spatiotemporal scales for each burden. However, we were not able to aggregate environmental pollution burdens into a single indicator, opting instead to focus on displaying the environmental pollution burden datasets alongside sociodemographic data that we used as a proxy for population vulnerability. We did this to see if any trends or surprising results emerged when plotting different environmental burden datasets superimposed onto a map with communities possessing high population vulnerability.

Several overarching trends emerged when displaying the overlapping maps. Urban areas have more census tracts with high population vulnerability than rural areas. The largest cluster of high population vulnerability tracts lies in the state's urban center of Portland. The environmental pollution burden layers, particularly the air pollution layers and to a lesser extent the land layers, appear to have their effects concentrated in the Portland region. Water pollution layers pose additional challenges having to do with the difficulty of aligning the location of the pollution with the location of the people who primarily bear the burden, since the effects of burdens like Harmful Algal Blooms are not necessarily related to proximity. Exposure path differences of this nature therefore complicate efforts to incorporate population vulnerability considerations into environmental burden considerations through the type of overlay approach we have employed.

We also developed several recommendations for advancing our work on matching environmental pollution burdens with vulnerable populations through the collaborative conversations and efforts throughout this process. As the discussion of challenges associated with each of these layers has shown, each environmental burden shown presents plenty of unique challenges to consider and contend with before even factoring in population vulnerability. In order to incorporate environmental justice considerations into our work at DEQ, and at other environmental agencies, population vulnerability must be better defined and protocols and procedures for assessing it and incorporating it into a more holistic consideration of environmental burden must be developed. Our hope is that the visualization tools we have developed as part of this project will contribute to the eventual development of an Oregon specific Environmental Justice screening tool.

ABSTRACT

As our world warms and our extreme weather intensifies there is a renewed societal urgency in addressing environmental equity and justice disparities, which may worsen as we cross planetary boundaries and encounter the social upheaval arising in the wake of the resultant environmental stressors. To prevent this from happening, we must work to redress existing disparities. Environmental justice (EJ) screening tools are a critical component in assessing disparities in environmental burdens. Lee (2020) distinguishes between first generation tools- which look solely at demographic indicators- and second generation tools, which combine environmental burdens, socio-economic disadvantages, and health vulnerabilities to create a more comprehensive and nuanced picture of the cumulative stressors faced by communities.

Oregon DEQ aims to develop indicators of environmental burden and benefit that will become part of the second-generation EJ assessment tool currently being designed for the state. Doing so will require the resolution of a number of methodological challenges in assessing environmental burden. We focus on describing and developing approaches of addressing methodological challenges related to:

- (i) Identifying the relevant environmental burdens: how do we assess the distribution of pollution impacts on the public and the environment and ensure our assessment incorporates ecosystem health and dynamics, and what environmental datasets are most essential for quantifying environmental burden to our communities and environment;
- (ii) Identifying the appropriate spatiotemporal scale for each environmental burden and ensuring that our models and interpolations of socio-economic and environmental datasets reflect reality; and
- (iii) Developing methodologies and guidance on aggregating all environmental burdens into a single indicator to deliver an understandable and accurate cumulative impact assessment to guide our future work and to inform Oregonians.

As a precursor to this work we will complete an equity analysis on our monitoring networks. Incorporating our findings will enable us to develop a robust foundation for assessing environmental burdens and benefits in Oregon that can be used by multiple stakeholders.