



# Environmental Justice Mapping Tools:

## Use and Potential in Policy Making to Address Climate Change

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### Executive Summary

**G**eospatial tools can be a powerful ally in the fight for environmental and climate justice. These tools allow users to visualize and explore patterns of environmental and climate hazards, revealing what kinds of communities are (and aren't) at risk from these hazards, and the compounded pollution and climate burdens certain communities face. When they are developed with robust community input, geospatial tools can be powerful advocacy and educational instruments; when incorporated into decision-making, they can also help drive and inform government actions—ensuring spending, policies, and programs benefit everyone more equitably. The purpose of this white paper is to provide policymakers at federal and state levels with guidance on how to improve government decision-making by using these tools. We introduce these tools as crucial resources for anyone interested in furthering environmental and climate justice, discuss how they work, and include best practices for the tools themselves. We conclude with a set of recommendations on how to better integrate these tools into policymaking, drawing insights from action at the state and federal level. Policymakers are giving increasing, and overdue, focus on the racial, environmental, and economic crises plaguing so many communities in our nation—crises compounded by the COVID-19 pandemic and climate change. The effective use of geospatial tools

will help policymakers alleviate historic and ongoing environmental and climate injustices, and invest in healthy, resilient communities for all.

### Mapping Environmental Injustice

**G**eographic information systems (GIS) screening and mapping tools have increasingly become central to the environmental justice movement and environmental justice scholarship. And with good reason: By allowing users to explore the spatial distribution of environmental hazards in relation to populations, these tools can help visualize and quantify the cumulative and disproportionate environmental burdens—and therefore the environmental injustices—certain communities face.<sup>1</sup>

The concept of disproportionate impacts is central to environmental justice (EJ). The Environmental Protection Agency's (EPA) definition of environmental justice requires "fair treatment" of all people, which in turn is defined as no population being "forced to bear a disproportionate share of the negative human health or environmental impacts of pollution or environmental consequences," which can result from things like industrial and commercial operations or the execution of government policies.

# Definitions

## Environmental Justice

For the purposes of this paper, we use EPA's definition: Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. However, we recognize that most EJ scholars include an understanding of systemic racism—including environmental racism and sociohistorical conditions—in understanding why environmental injustices exist. And thus, the need to advance environmental justice requires combatting racism in planning, zoning, and development, as well as the implementation of environmental laws and regulations.

## Climate Equity

This term is frequently used in the international climate context, specifically within the United Nations Framework Convention on Climate Change negotiations, where it relates to country-level discussions about emissions and resource allocations. That is not the definition we are using here.

For the purposes of this paper, and for broader discussions about analyzing climate equity and driving climate solutions with the help of EJSM tools, we define climate equity as: ensuring all people can achieve full and equal access to and the benefits of climate solutions, while not shouldering an unequal burden of climate impacts.

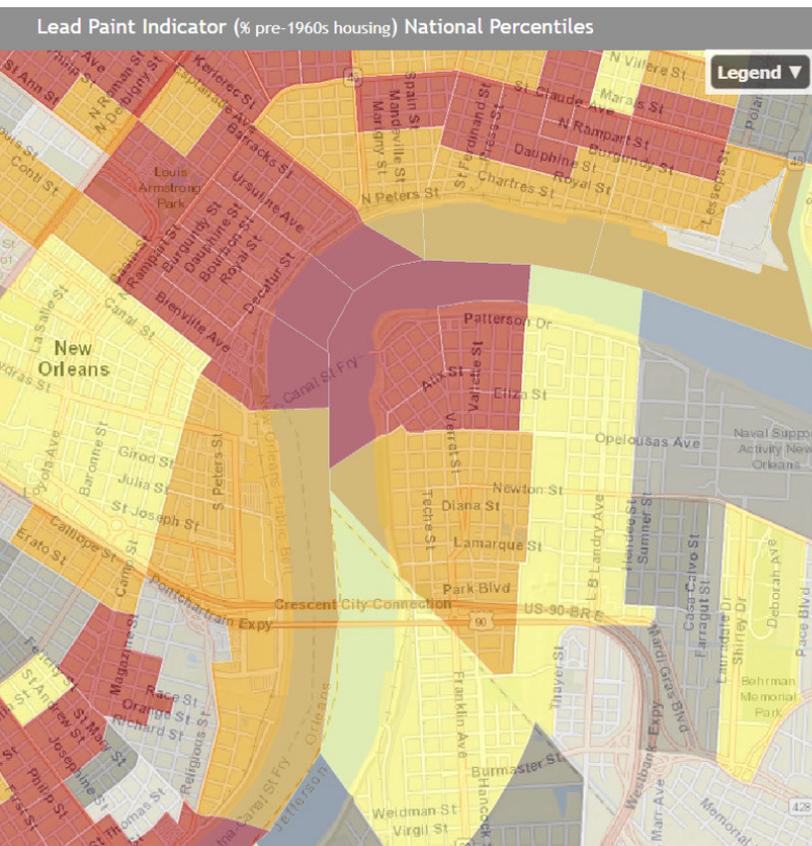
## Environmental Justice Community

A community overburdened by hazards with disproportionate exposure to environmental hazards and increased vulnerability to hazards of concern may be considered an EJ community. These are typically communities that consist of people of color, or low-wealth, tribal, or indigenous groups that potentially experience disproportionate environmental harms, risks, and benefits. This disproportionality can be a result of greater social, economic, or geographic vulnerability to environmental hazards, lack of engagement and participation in environmental decision-making, or other factors. Increased vulnerability may be due to an accumulation of pathogenic (negative) or lack of salutogenic (positive) environmental, health, economic, or social conditions in the community.

EJ communities are defined by locally unwanted land uses (LULUs)—the landfills, or industrial factories, or power plants—that tend to negatively impact the health of a community's environment, along with the physical and mental health of its citizens.<sup>2</sup> With EJ GIS screening and mapping tools (EJSM), we can analyze LULUs in the context of other important socio-economic facets of a community. Mapping these interfaces can show spatial patterns of pollution exposure, along with related disease and health outcomes. The patterns that emerge are, all too often, disproportionate, built by decades of social, economic, and racial discrimination. For example, recent research shows [the linkages between](#) segregation in the form of redlining and the distribution of urban heat islands, with redlined areas up to 12 degrees F warmer than non-redlined areas.<sup>3</sup>

Climate change compounds the burdens EJ communities already face. More frequent and intense heat waves, worsening levels of air pollution, severe flooding from climate-fueled storms—these pressures, and many others, are devastating for any community. But they can be especially pernicious, and nearly impossible to overcome or adapt to, when a community is already experiencing social, economic, and environmental stressors, and when a community has less voice and power in the political process. Climate change has increasingly become a concern for EJ communities, and a part of EJ discourse, scholarship and the greater movement.<sup>4</sup>

GIS tools can also be used to analyze climate impacts, and can play an important role in determining a community's vulnerability to climate change, and in analyzing climate equity. GIS tools can be used to explore patterns of salutogenic, or health-promoting, infrastructure: tree canopy, health care facilities, access to clean transportation, parks and green spaces (and therefore access to wildlife), and grocery stores. These are resources that help make communities more resilient to environmental stressors and climate impacts. Understanding where they are, and aren't, is crucial for understanding climate equity. This work is especially timely, given the disproportionate impacts EJ

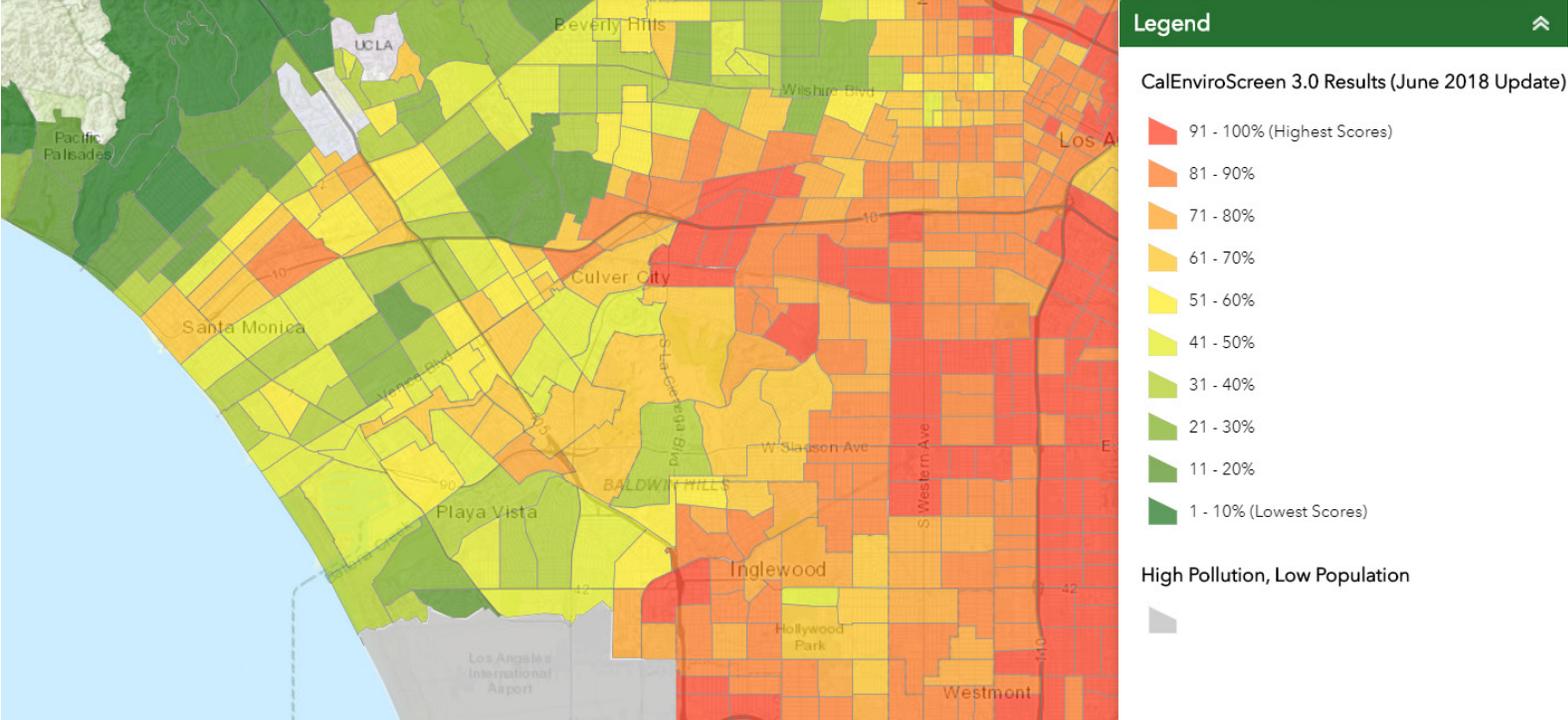


EJSM tools enable users to analyze environmental and demographic indicators in concert, giving a clearer picture of the disproportionate impacts certain communities face. Here, EPA EJSCREEN shows lead paint (on left) and poverty indicators (on right) overlaid on New Orleans. Darker shades indicate areas with more households living below the poverty level and with higher rates of lead paint exposure.

communities are facing from COVID-19, a public health and economic crisis that is compounded by climate change.

GIS is more than just a tool for visualizing disproportionate impacts, however. EJSM tools can and should be part of a strategy to address those impacts.<sup>5</sup> If appropriately integrated into decision-making, EJSM tools can ensure government actions, spending, and programs benefit everyone more equitably. In the sections below, we provide information on how this can be done. First, we provide an overview of key facets of EJSM tools, including best practices for what indicators to include; we follow with a discussion of how to better integrate these tools into policy-making, including a list of specific recommendations. Throughout this paper, we draw many insights from three tools: [EPA's EJSCREEN](#),

California's [CalEnviroScreen](#), and Maryland's [MD EJSCREEN](#). EPA EJSCREEN is a national tool; there are publicly accessible statewide tools in the United States, such as CalEnviroScreen, MD EJSCREEN, and the [Washington Environmental Health Disparities Map](#). EPA EJSCREEN and CalEnviroScreen are widely recognized for their methodology, accessibility (built on interactive, online platforms), and in the case of California, for their explicit integration with policymaking. While MD EJSCREEN is a newer tool, it is similar in structure to both EPA EJSCREEN and CalEnviroScreen, and has similar indicators, functionality, and scoring methodology to CalEnviroScreen. MD EJSCREEN is unique because it will eventually have interoperability with other tools (either created or under development) in the state, including the Maryland Division of Natural Resources' Park Equity Mapper and a Climate Equity and Health tool.



EJSM tools can calculate a quantitative “score” for communities, which can help inform where governments should prioritize investment. Here, we see the EJ score calculated by CalEnviroScreen for east Los Angeles neighborhoods. Higher scores (in red) equate to greater cumulative impacts.

## Indicators and EJ Mapping and Screening

According to EPA’s Office of Environmental Justice, EJ indicators are “data that, when examined together, provide a comprehensive picture of a community’s economic, social, environmental, and health level status or well-being.”<sup>6</sup> Broadly, indicators are classified as environmental or demographic. Environmental indicators tend to describe the physical environment and provide information about community exposure. Examples include air and water quality measurements, traffic density, and groundwater contamination. Demographic indicators provide information about a community’s potential susceptibility to various environmental exposures.<sup>7</sup> Examples include socioeconomic factors such as poverty level or race and ethnicity data, and other key factors that help describe populations, such as educational attainment.<sup>8</sup>

Further delineation of indicators can be helpful. For example, CalEnviroScreen breaks environmental indicators into “exposure,” i.e., indicators based

on measurements of types of pollution that people may come into contact with, and “environmental effects,” i.e., indicators based on the locations of toxic chemical facilities. CalEnviroScreen also divides demographic indicators into “sensitive populations” and “socioeconomic factors.” The former measures the number of people in a community who may be more severely affected by pollution due to their age or health. “Socioeconomic factors” are measures of conditions that increase stress or make healthy living difficult, causing individuals to be more sensitive to a pollutant’s effects.<sup>9</sup> MD EJSCREEN uses a similar approach: sensitive population indicators include low-birth-weight infants and asthma ER discharges, while socioeconomic factors include percentage of population that is non-white or low-income.<sup>10</sup>

Data from indicators are combined in two main ways in current EJSM tools: as EJ indices or an EJ score. EPA EJSCREEN calculates EJ indices, which combine demographic data with a single environmental indicator. As such, each environmental indicator has a different index score. For example, users can calculate an EJ index for superfund proximity for a single census block. CalEnviroScreen calculates an EJ score, which shows

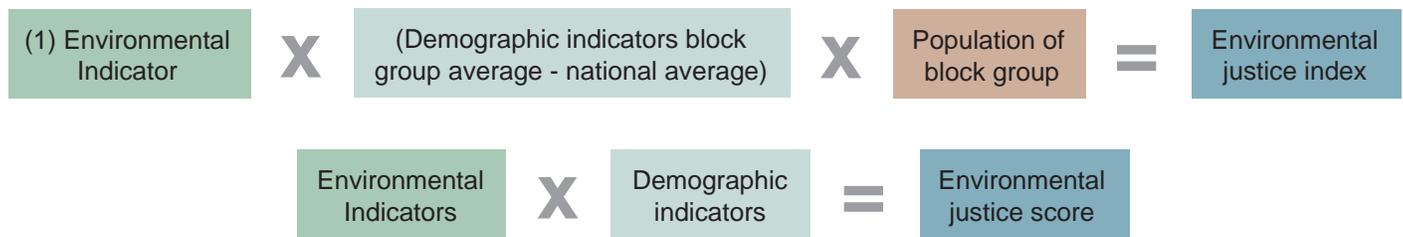


Figure 1. Calculating an EJ index vs. calculating an EJ score.

the cumulative impact of many environmental and demographic indicators, analyzed in combination to produce a single score for each census tract in the state.<sup>11</sup> EJ indices and scores are important facets of EJSM tools, because they allow users to compare different communities, states, and regions, and can help us understand where the greatest cumulative burdens lie. Calculating a quantitative score also helps provide third-party validation for community experiences. Discussing the full extent of how communities can and do use EJSM tools is outside the scope of this paper—but it is important to note that by providing accessible data to verify anecdotal evidence, EJSM tools make it harder to ignore community concerns about safety and quality of life.<sup>12</sup> EJ scores and indices can be further used to help inform decision making and help government agencies prioritize investments and implementation. However, neither metric should be seen as a catch-all for policy making. EJ scores and indices are good technical measurements that can and should be incorporated into policy and evaluation. Policymakers, regulators, planners, and other decisionmakers should view them as additional information to help guide the decision-making process.

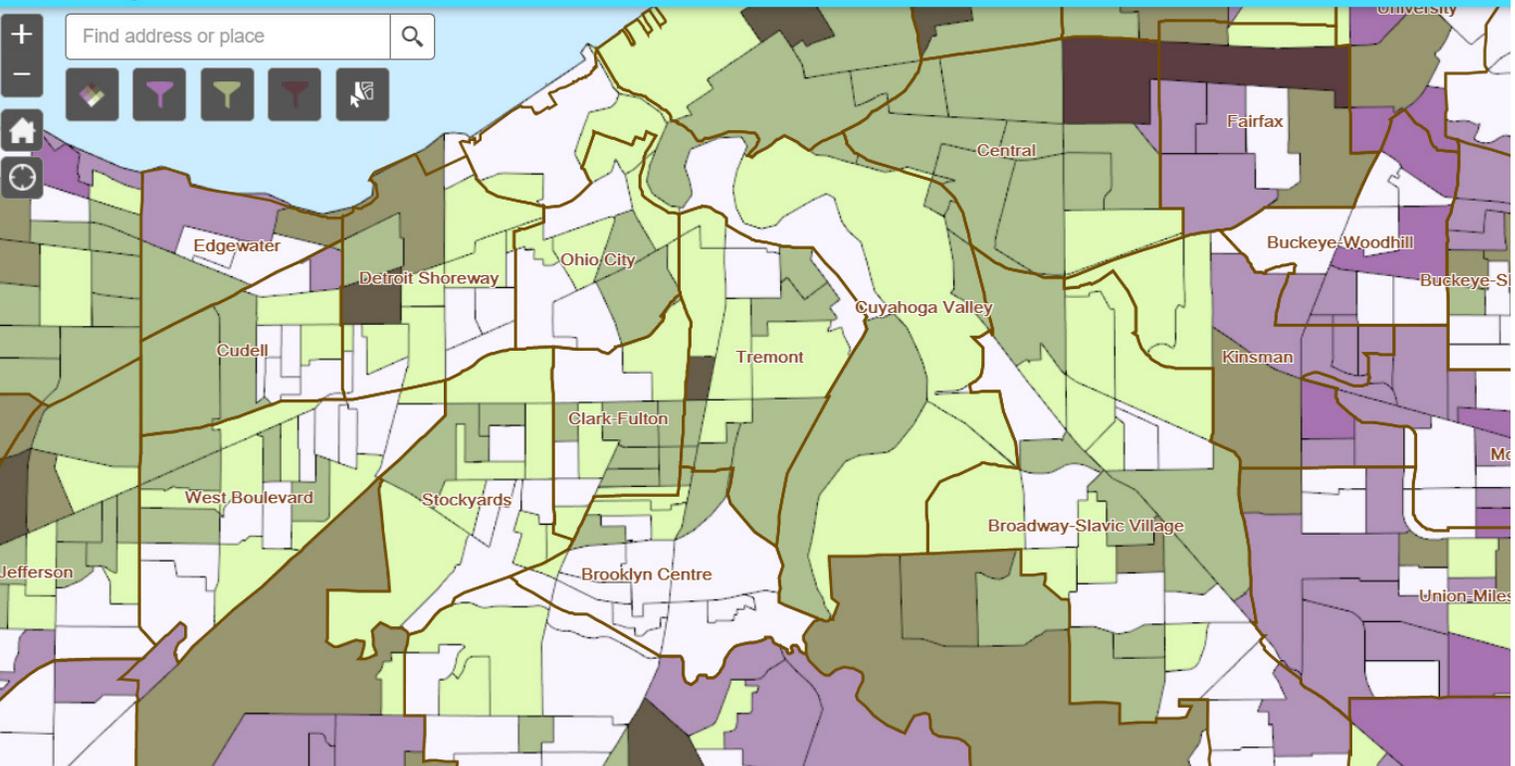
## Best Practices

Regardless of whether EJSM tools use indices or a single score, the indicators included in a given tool are the foundation for showing EJ impacts. Here, we highlight some best practices in determining which indicators to include to enable the fullest picture of climate-associated stressors to communities:

### 1. Indicators in an EJ screening or mapping tool should be selected based on relevance to the communities of the state, region, or locality.

Across EPA EJSCREEN, CalEnviroScreen, and MD EJSCREEN, some environmental indicators are consistently used, including ozone concentration, traffic proximity and volume, proximity to polluted sites that pose a risk to human health and/or the environment, and levels of diesel and fine particulate matter in the air. Demographic indicators used across all three EJSM tools include percentage of population that is non-white, low-income, and linguistically isolated.

EPA EJSCREEN is a national tool; at a state or local level, some indicators may become highly relevant or highly irrelevant, because the factors that illustrate cumulative burdens differ between states. While EPA EJSCREEN provides a good model, the indicators for state or local tools should be selected based on the area they are mapping, and the particular environmental concerns and realities of those communities. Pesticide exposure—a particular concern for Californians, given the state’s robust agriculture industry—is included as an indicator in CalEnviroScreen, but not EPA EJSCREEN. Unlike these two tools, MD EJSCREEN includes indicators on supermarket and small grocery/corner store locations, since access to fresh and nutritious food is a statewide concern, and was of particular interest to stakeholders helping develop the tool (see recommendation 2 below). Moreover, informative data that is impossible to include at a federal level may be available at state or local levels.



*Cuyahoga County's Vulnerability Assessment Map helps identify priority areas for climate adaptation interventions in the northeastern Ohio county, by exploring physical and social factors associated with climate impacts. Here, heat island effect is depicted in olive, and population over age 65 in purple. Darker areas—where both factors are at high rates—are considered more climate vulnerable.*

And, availability of data may differ between states. For example, EPA EJ SCREEN does not use a direct indicator of asthma health complications, but California and Maryland both do.

## 2. Community and stakeholder input should inform what indicators are considered relevant in these screening and mapping tools.

Community input is especially crucial in context of the long and persistent history of disenfranchisement that EJ communities face. A lack of political and economic power restricts the ability of many communities to respond to environmental and climate impacts. The EJ movement is partially concerned with correcting these power imbalances, and active participation by EJ communities themselves is a core component of that work.<sup>13</sup> As such, it's important that communities play a leading role in crafting and executing solutions to the injustices they face, including through robust participation in development of any locally applicable EJSM tool that could inform policy. Community involvement is necessary to ensure these tools are relevant and useful, as those

living in EJ communities are likely to know best which particular indicators reflect challenges and needs.

During the creation of CalEnviroScreen, two of the six principles guiding development were that the tool be “informed by community experience” and based on “thorough public participation.” In developing MD EJSCREEN, feedback was gathered from community members and stakeholders to help determine what environmental, demographic, and health indicators to include.<sup>14</sup>

MD EJSCREEN's development offers a valuable model for gathering community input. Stakeholder meetings and electronic surveys enabled community members to share what indicators they felt were important and worth including. The Washington Environmental Health Disparities Map was also informed by extensive community input, via a series of statewide listening sessions held in partnership with various community-based organizations. The sessions were designed to solicit input from key populations disproportionately impacted by pollution, including indigenous communities, immigrants, and farmworkers.<sup>15</sup>

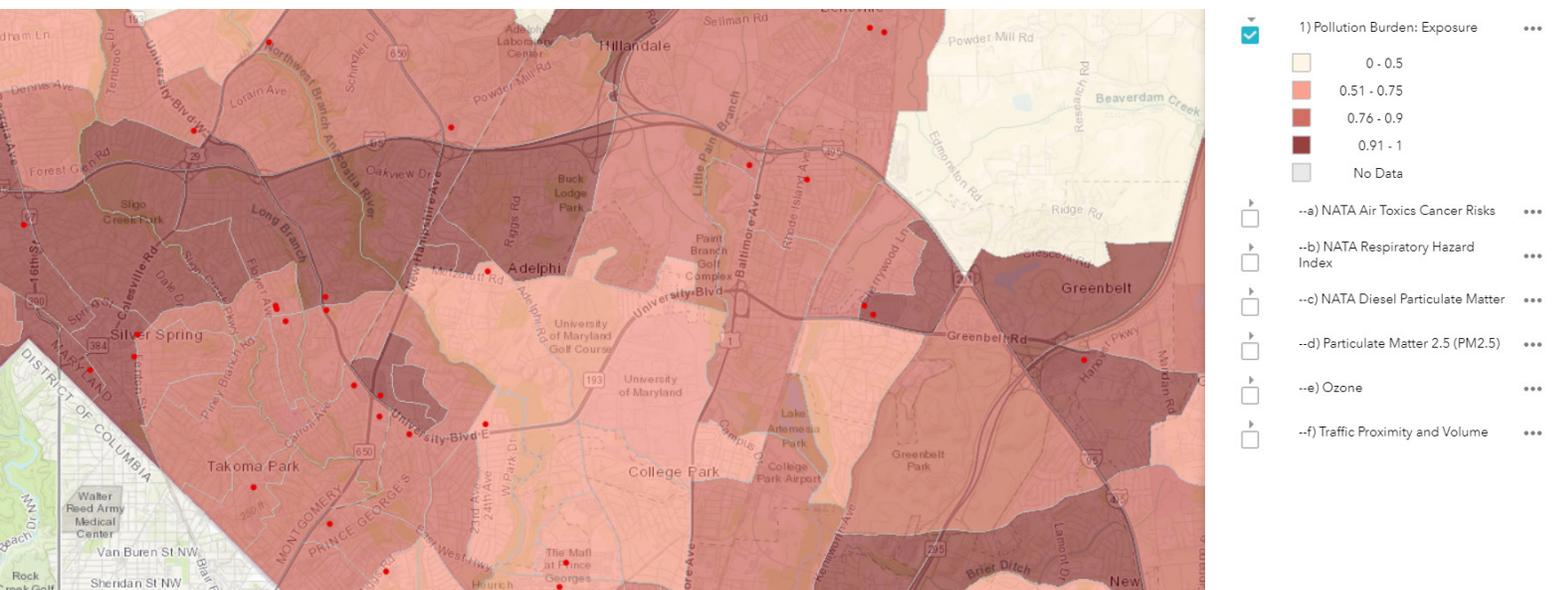
### 3. Include climate indicators in EJSM tools.

Climate vulnerability is determined by a community's exposure and sensitivity to climate risks, and its capacity for coping with those risks.<sup>16</sup> Similar to EJSM tools, climate vulnerability tools can illustrate how demographic and climate-impact related factors combine. For instance, GIS tools can be used to identify where socially vulnerable populations might face risks from rising sea levels.<sup>17</sup>

Some potential indicators that can help predict climate vulnerability include sea-level rise projections; current and future flood risk, wildfire risk, and drought risk; the current and future number of days with extreme heat conditions; percentage of tree canopy cover or green space (and access to that green space); and percentage of land covered by impervious surfaces. Health indicators can also give a more comprehensive picture of community climate vulnerability. Health risks can be worsened due to climate impacts (like asthma) and can complicate an individual's ability to adapt to climate change. For example, chronic illness can make it hard for someone to evacuate during extreme weather or to afford higher electricity costs during summer heat waves. Climate-relevant health indicators include infant mortality,

asthma prevalence, heart disease morbidity, diabetes and cancer rates, hospitalization and emergency department visits for heat stress, and obesity rates. Other important indicators include location of senior and nursing homes, access to transportation, exposure to mosquito-borne or waterborne diseases, and medically underserved areas.

Ohio's Cuyahoga County provides one example of climate vulnerability mapping. The County Planning Commission's [Vulnerability Assessment Map](#) identifies physical and social factors that are associated with climate impacts, such as heat island effect and households without a vehicle. The goal of the map is to help identify areas for climate adaptation interventions based on information about communities that will experience a disproportionate share of climate impacts and with limited adaptive capacity.<sup>18</sup> Seattle's [Climate Challenges Atlas](#), though not an interactive tool, follows a somewhat similar approach, mapping relevant climate impacts (such as warmer oceans and wildland fires) over an equity basemap built with key demographic indicators. The atlas also includes indicators that help confer climate equity, like urban canopy coverage and community assets, including proximity to schools, libraries and regional job centers.<sup>19</sup>



A screenshot of Maryland's MD EJSCREEN tool, showing overall pollution burden in parts of Prince George's and Montgomery counties, which lie right outside of Washington D.C. Darker colors indicate higher pollution exposure. Red dots show the location of supermarkets; an indicator stakeholders requested be included in the tool.

There is considerable overlap between demographic indicators that help predict susceptibility to pollution exposure and vulnerability to climate impacts. For instance, the elderly are more vulnerable to extreme heat, an increasing threat in a changing climate, because older adults have difficulty adjusting to sudden temperature changes, are more likely to have a chronic medical condition, and are more likely to be taking medication that affects the body's ability to cope with heat.<sup>20</sup> The elderly also face greater risks from pollution exposure, due to declines in their immune systems and mobility, and comorbidities that increase the risk of negative health outcomes.<sup>21</sup>

Including indicators that predict climate-vulnerability in EJSM tools, or in integrated EJSM and climate vulnerability mapping tools, can help illustrate a broader web of cumulative impacts. These integrated tools could calculate cumulative impact scores as separate EJ and climate vulnerability scores respectively, in addition to a combined EJ/climate vulnerability score. For instance, researchers at the University of Maryland are working on a climate vulnerability and health tool that will eventually be integrated into MD EJSCREEN, with an option for a combined score. Environmental justice and climate justice are inextricably linked. Connecting EJSM tools to climate impacts can further show which communities face the greatest environmental risks.

## Integrating EJ Mapping Tools into Policymaking

**A**lthough EJSM tools are important in their own right for providing data-driven evidence to back up community voices on EJ issues, it is a missed opportunity when they are not meaningfully incorporated into policy. These tools can and should help drive decision making at the federal and state levels. This has been done successfully before. CalEnviroScreen's development was guided by six principles, including that the tool must be "endorsed and utilized by the government."<sup>22</sup> In 2012, after years of coalition building and debate, then-Governor Jerry Brown signed into law [SB 535](#), which mandates that 25 percent of proceeds

from the state's Greenhouse Gas Reduction Fund benefit disadvantaged communities. CalEnviroScreen, released in 2013, was employed to identify these communities. The tool has since become embedded in other state programs and laws.<sup>23</sup> California's Department of Toxic Substances Control uses it to prioritize inspections and enforcement actions. The state EPA's EJ Enforcement Task Force uses CalEnviroScreen to better integrate EJ considerations into enforcement of environmental laws. And in 2016, [SB 1000](#) was signed into law, mandating that all cities and counties in California identify EJ communities, and address EJ in long-term development planning. The bill specifies CalEnviroScreen as the primary method for identifying EJ communities.<sup>24</sup>

We can draw a few policy-relevant insights from this tool. Explicitly requiring government involvement and endorsement up-front helped ensure CalEnviroScreen was integrated into the work of state agencies and bureaucracies, and helped lay the groundwork for its inclusion in SB 535. The tool has been updated twice (in 2014 and 2017) to ensure data is current, relevant indicators are added, and the tool remains effective and useful for decision-making. A series of public workshops and webinars, plus a public comment period, enabled key stakeholders and Californians to learn about the tool and help guide its development.

Recent action at the federal level suggests ways EPA EJSCREEN may be further supported and integrated into policymaking. The Environmental Justice for All Act ([H.R. 5986/S. 4401](#)), introduced in March 2020 by Rep. Raúl Grijalva (D-AZ) and August 2020 by Sen. Kamala Harris (D-CA), includes a requirement that the Administration offer an EJSM tool, such as EPA EJSCREEN, with nationally consistent environmental and demographic data, plus data on national parks and other federally protected sites. The House Select Committee on the Climate Crisis [staff report](#) recommends that Congress codify EJSCREEN, provide additional funding to EPA to update and improve it (or an equivalent tool), and direct EPA and other federal agencies to use EJSCREEN to establish an "equity screen," to better understand how potential policies or projects might impact EJ communities.<sup>25</sup>

The Climate Equity Act ([S. 4513/H.R. 8019](#)), introduced by Sen. Kamala Harris (D-CA) and Rep. Alexandria Ocasio-Cortez (D-NY) in August 2020, would create a similar screening requirement. The bill establishes a new Climate and Environment Equity Office within the Congressional Budget Office, charged with developing a quantitative and qualitative equity score for legislation with an environmental or climate change nexus. The bill also requires federal agencies to conduct a climate and EJ analysis for any rule expected to have significant impact on EJ communities. Though EPA EJSCREEN or EJSM tools are not explicitly mentioned in the bill, they are well suited to helping determine equity scores and informing climate and EJ analyses.

The recommendations below draw from these state and federal insights. They are a first step towards ensuring that EJSM tools are widely available, widely used, and highly relevant with appropriate consideration to climate change impacts. These tools are not a silver bullet to solve the myriad of complex, interrelated challenges facing EJ communities. But they can, and should, be part of the solution.

## Recommendations

**W**e offer the following set of recommendations for federal and state agencies and governments to effectively integrate geospatial tools in their decision-making processes on environmental justice issues. This list is not meant to be exhaustive.

**1. Ensure EJSM tools are properly funded and maintained.** Reinvest in and expand EPA EJSCREEN, with input from states. EPA does annually update EJSCREEN indicator data, but is not required to do so by law.<sup>26</sup> [S. 3633](#) and [H.R. 6826](#) (both introduced in May 2020 by Sen. Tammy Duckworth (D-IL) and Rep. Donald McEachin (D-VA), respectively) would require the EPA Administrator to annually update and make

publicly available EPA EJSCREEN or an equivalent tool. Additional support and state input would help make the tool more user-friendly, and allow EPA to include additional and timely indicators. This recommendation aligns with a strategy from EPA's EJ 2020 Action Agenda, which states that EPA plans to build on tools like EJSCREEN to help the agency, and the states, tribes and local governments it works with, to direct more EPA enforcement to overburdened communities.<sup>27</sup> Potential funding models for state tools include state or federal agency appropriations for agency EJ offices and direct grants for data collection, tool design and maintenance, and community engagement opportunities (i.e., technical assistance, consultation, outreach, and training related to the tools).

- 2. Mandate that government agency decisions that may affect the environment or climate use EJSM tools.** These decisions could include development and implementation of laws and regulations, evaluating program effectiveness, prioritizing government spending and hazard cleanup, and permitting of industrial facilities. Agencies should use EPA EJSCREEN, as well as state tools where available.
- 3. Incorporate use of existing EJSM tools into legislation that directs funds to EJ communities to improve health and quality of life through better access to salutogenic (health-promoting) infrastructure.**
- 4. Infuse EJSM tools into COVID-19-related response and other stimulus spending, with EPA EJSCREEN as a default tool if more detailed state tools are unavailable.** COVID-19 is disproportionately impacting EJ communities. To maximize the effectiveness of each government dollar spent, and help address the moral failings of systemic racism, we must ensure investments designed to help communities respond and recover from the pandemic are actually going to communities that need it the most.

**5. Ensure community participation in the selection of EJSM indicators, design tools to be user-friendly to a general audience, and provide access to and education about tool use and applications.**

EJSM tools must be relevant and accessible to EJ communities. Workshops, webinars, public comment periods, and collaborations with community-based organizations and grassroots environmental groups are all effective ways to solicit input and to educate.

**6. Include climate and health indicators in EJSM tools, as well as other environmental and demographic data.**

To best capture the cumulative pollution burden, health risks, and adaptive capacity of communities, a robust mix of indicators is recommended.

**7. Require states to develop, maintain, and use their own state-wide EJSM tools to be eligible for federal funding related to the environment or climate, including any federal assistance from EPA.**

This can be a way for states to show compliance under Title VI of the Civil Rights Act, which prohibits recipients of federal financial assistance (including states) from discriminating on the basis of race, color, or national origin. The federal government should provide guidance to states on recommended indicators for inclusion in state EJSM tools, and offer federal technical assistance to states on data collection, cleaning, verification, quality assurance and control, processing, analysis, maintenance, and reporting back to stakeholders of concern.

**8. Federal agencies should use EPA EJSCREEN and/or other EJSM tools when developing or updating their EJ strategies.**

[Executive Order 12898](#) requires all federal agencies to develop an EJ strategy that identifies and addresses agency actions with disproportionately high and adverse environmental and human health impacts.<sup>28</sup> Using EJSM tools, like EPA EJSCREEN, can help agencies meet the directives of E.O. 12898.

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# References

- <sup>1</sup> Driver, A., C. Mehdizadeh, S. Bara-Garcia, C. Bodenreider, J. Lewis, and S. Wilson. 2019. Utilization of the Maryland Environmental Justice Screening Tool: A Bladensburg, Maryland Case Study. *International Journal of Environmental Research and Public Health* 16(3):348.
- <sup>2</sup> Driver et al. 2019.
- <sup>3</sup> Hoffman, J.S., Shandas, V., Pendleton, N. 2020. The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas. *Climate* 8, 12.
- <sup>4</sup> Mohai, P., Pellow, D. and Timmons Roberts, J. 2009. Environmental Justice. *Annual Review of Environment and Resources* 34:1, 405-430; and Shonkoff, S.B., Morello-Frosch, R., Pastor, M., Sadd, J. 2011. The climate gap: environmental health and equity implications of climate change and mitigation policies in California—a review of the literature. *Climatic Change* 109(Suppl 1):S485-S503.
- <sup>5</sup> Lee, C. 2020. A Game Changer in the Making? Lessons from States Advancing Environmental Justice through Mapping and Cumulative Impact Strategies. *Environmental Law Reporter* 50: 10203-10215.
- <sup>6</sup> Office of Environmental Justice (OEJ). 2004. Toolkit for Assessing Potential Allegations of Environmental Injustice. U.S. Environmental Protection Agency. [www.fws.gov/economics/planningnepa/ej-toolkit-epa.pdf](http://www.fws.gov/economics/planningnepa/ej-toolkit-epa.pdf).
- <sup>7</sup> U.S. Environmental Protection Agency (EPA). 2010. Final Guidance on Considering Environmental Justice During the Development of an Action. [www.epa.gov/sites/production/files/2017-09/documents/2017\\_ejscreen\\_technical\\_document.pdf](http://www.epa.gov/sites/production/files/2017-09/documents/2017_ejscreen_technical_document.pdf).
- <sup>8</sup> Kurupparachchi, L., Kumar, A., Franchetti, M. 2017. A Comparison of Major Environmental Justice Screening and Mapping Tools. *Environmental Management and Sustainable Development* 6. 59.
- <sup>9</sup> California Office of Environmental Health Hazard Assessment (OEHHA). 2020. Indicators Overview. [www.oehha.ca.gov/calenviroscreen/indicators](http://www.oehha.ca.gov/calenviroscreen/indicators).
- <sup>10</sup> Driver et al. 2019.
- <sup>11</sup> OEHHA. CalEnviroScreen 3.0 Factsheet. [www.oehha.ca.gov/media/downloads/calenviroscreen/fact-sheet/ces30factsheetfinal.pdf](http://www.oehha.ca.gov/media/downloads/calenviroscreen/fact-sheet/ces30factsheetfinal.pdf).
- <sup>12</sup> Lee. 2020.
- <sup>13</sup> Mohai, P., Pellow, D. and Timmons Roberts, J. 2009. Environmental Justice. *Annual Review of Environment and Resources* 34:1, 405-430; and Rudolph, L., Harrison, C., Buckley, L. and North, S. 2018. Climate Change, Health, and Equity: A Guide for Local Health Departments. Public Health Institute and American Public Health Association. [www.apha.org/topics-and-issues/climate-change/guide](http://www.apha.org/topics-and-issues/climate-change/guide).
- <sup>14</sup> Driver et al. 2019.
- <sup>15</sup> Front and Centered. 2017. 2017 Community Listening Sessions: Pollution, Climate Change, and the Puget Sound. [www.frontandcentered.org/pollution-listening-2017/](http://www.frontandcentered.org/pollution-listening-2017/).
- <sup>16</sup> Gamble, J.L., J. Balbus, M. Berger, K. Bouye, V. Campbell, K. Chief, K. Conlon, A. Crimmins, B. Flanagan, C. Gonzalez-Maddux, E. Hallisey, S. Hutchins, L. Jantarasami, S. Khoury, M. Kiefer, J. Kolling, K. Lynn, A. Manangan, M. McDonald, R. Morello-Frosch, M.H. Redsteer, P. Sheffield, K. Thigpen Tart, J. Watson, K.P. Whyte, and A.F. Wolkin. 2016. Chapter 9: Populations of Concern. The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment. *U.S. Global Change Research Program*. Washington, DC, 247–286.
- <sup>17</sup> Martinich, J., Neumann, J., Ludwig, L. and Jantarasami, L. 2013. Risks of sea level rise to disadvantaged communities in the United States. *Mitigation and Adaptation Strategies for Global Change* 18(2), pp.169-185.
- <sup>18</sup> Cuyahoga County Planning Commission (CCPC). Cuyahoga County Climate Change Vulnerability Map. [www.countyplanning.maps.arcgis.com/apps/webappviewer/index.html?id=7154ce92af264bedbeb4a70c61991e0a](http://www.countyplanning.maps.arcgis.com/apps/webappviewer/index.html?id=7154ce92af264bedbeb4a70c61991e0a).
- <sup>19</sup> Brewer, A., Bouton, W., Martin, T., House, E., Trim H., Wierzbicki, C., Ordonez, J., and Nelson, V. 2017. Seattle Climate Challenges Atlas. Futurewise. [futurewise.org/assets/card\\_images/Futurewise-Climate-Challenges-Atlas-2017.pdf](http://futurewise.org/assets/card_images/Futurewise-Climate-Challenges-Atlas-2017.pdf).
- <sup>20</sup> Centers for Disease Control (CDC). Natural Disasters and Severe Weather: Heat and Older Adults. [www.cdc.gov/disasters/extremeheat/older-adults-heat.html](http://www.cdc.gov/disasters/extremeheat/older-adults-heat.html).
- <sup>21</sup> Carnes, B. A., Staats, D., & Willcox, B. J. 2014. Impact of climate change on elder health. *The journals of gerontology. Series A, Biological sciences and medical sciences* 69(9), 1087–1091.
- <sup>22</sup> Lee. 2020.
- <sup>23</sup> Faust, J., L. August, K. Bangia, V. Galaviz, J. Leichty, S. Prasad. R. Schmitz. A. Slocombe, R. Welling, W. Wieland, and L. Zeise. 2017. CalEnviroScreen 3.0: Update to the California Communities Environmental Health Screening Tool. [www.oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf](http://www.oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf).
- <sup>24</sup> California Environmental Justice Alliance (CEJA) and PlaceWorks. 2017. S.B. 1000 Implementation Toolkit: Planning for Healthy Communities. [www.healthyplacesindex.org/wp-content/uploads/2018/01/2017\\_sb1000\\_implementation\\_toolkit.pdf](http://www.healthyplacesindex.org/wp-content/uploads/2018/01/2017_sb1000_implementation_toolkit.pdf).
- <sup>25</sup> House Select Committee on the Climate Crisis Majority Committee Staff. 2020. Solving the Climate Crisis: The Congressional Action Plan for a Clean Energy Economy and a Healthy, Resilient, and Just America. <https://climatecrisis.house.gov/report>.
- <sup>26</sup> U.S. EPA. EJSCREEN: Environmental Justice Screening and Mapping Tool. [www.epa.gov/ejscreen](http://www.epa.gov/ejscreen).
- <sup>27</sup> U.S. EPA. 2016. EJ 2020 Action Agenda: The U.S. EPA's Environmental Justice Strategic Plan for 2016-2020. [www.epa.gov/environmentaljustice/environmental-justice-2020-action-agenda](http://www.epa.gov/environmentaljustice/environmental-justice-2020-action-agenda).
- <sup>28</sup> U.S. EPA. Summary of Executive Order 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. [www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice](http://www.epa.gov/laws-regulations/summary-executive-order-12898-federal-actions-address-environmental-justice).



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