Screening for Justice

Proactive Spatial Approaches to Environmental Disparities

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Whether it's proximity to mobile and stationary emission sources, poor ambient air quality, or the relationship between air toxics and student demographics at the school site, researchers studying issues of environmental justice in California have generally found consistent evidence of significant disparities in exposure by racial and socioeconomic factors (including indicators like income, rates of home ownership, and linguistic isolation), even after controlling for land use and other explanatory factors.[1–3]

But while documentation of disparities is important, determining ways to ameliorate inequality in the environmental "riskscape" is a key next challenge for researchers and policy-makers. Can new spatial screening methods help decision-makers take a proactive, rather than reactive, approach to promoting environmental justice? Can areas that are over-burdened with environmental hazards and are socially vulnerable be identified so that they might be targeted for regulatory and policy efforts to improve environmental conditions and protect community health?

This is the basic logic behind the Environmental Justice Screening Method (EJSM), developed with the support of the California Air Resources Board (CARB). The EJSM uses roughly 30 health, environmental, climate, and social vulnerability measures

to score neighborhoods on three different dimensions: (1) proximity to hazards, (2) exposure to air pollution, and (3) social and health vulnerability. These three scores are then added together in order to determine "cumulative impacts." The result is an easy-to-understand visual representation of which communities might require special consideration, such as targeted regulatory protection from further siting of emission sources, more compensatory resources, and additional participatory outreach.

The Mechanics of Mapping

A detailed description of the EJSM methodology is offered elsewhere.[4] In brief, the first step entails developing a detailed land use map layer that indicates where people live, go to school, or secure health care. In the case described here, that data came from the six-county Southern California Association of Governments (SCAG), although it was supplemented with other information on the locations of schools, health care, and day care facilities.

We focused on those particular land uses and eliminated industrial areas, so that the resulting maps emphasized the people affected by facilities rather than the facilities themselves. For example, if few people live near a hazardous facility, the location may be less worrisome from a public health perspective; conversely, more populated areas near hazards would be of public health concern. We thus focused on residential land use but also tracked schools, day care centers, senior residential facilities, health care facilities, and urban parks and playgrounds because these are land uses where air pollution sensitive populations (very young, elderly, and people with respiratory disease) spend much of their day.

We intersected each of these (often parcel-level) land uses with 2000 U.S. Census block shapes, the finest level at which demographic data were available; each resulting "polygon" was thus tagged with both a land use characterization and information about the census block. For each of the polygons, we then calculated the proximity of nearby hazards such as chrome platers, rail lines, and other land uses considered worrisome by both CARB regulators and residents.

How to count the hazards? Since proximity matters, we used a "wedding cake" approach in which land uses that were located closer to the polygons were more heavily weighted that those further away. Each polygon received a hazard score (with additional weight given if the polygon was also hosting a sensitive land use, such as a school) and we then weighted up to census tracts using the population in each polygon (as derived from the

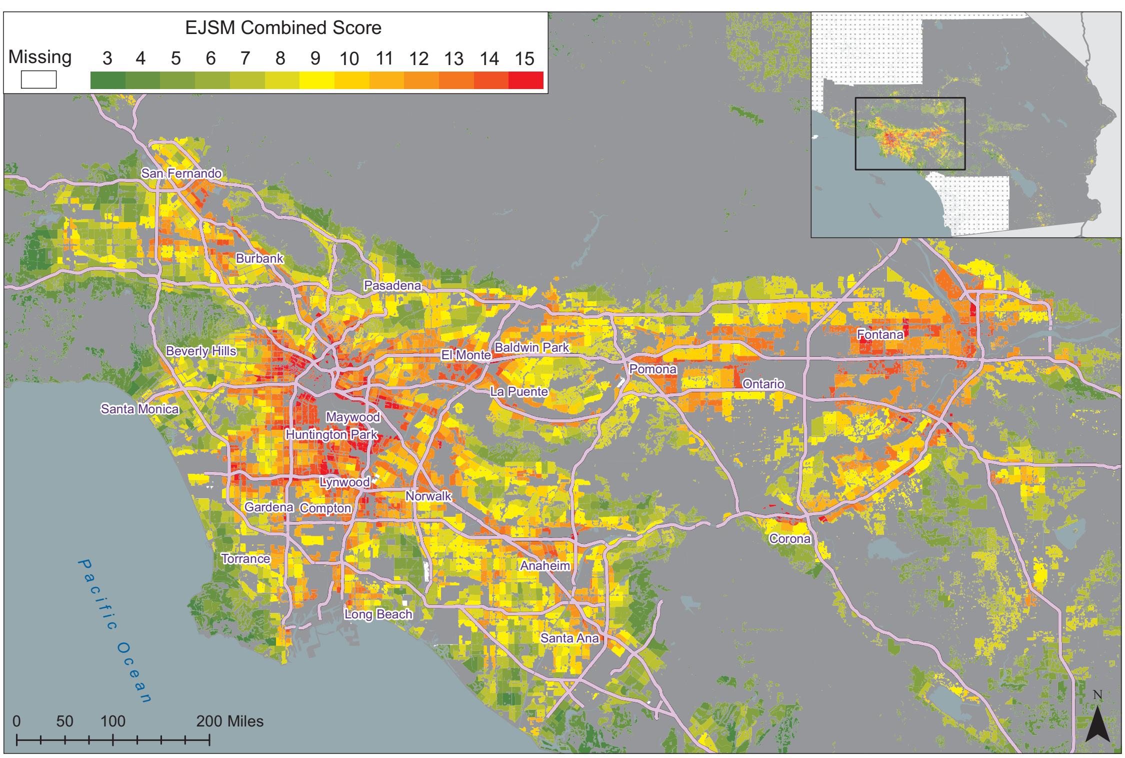

Figure 1. Environmental Justice Screening Method (EJSM) Scores for Southern California.

Notes: As noted in text, scores range from 3 to 15, with higher scores indicating closer proximity to hazards, higher levels of exposure, and a higher degree of social vulnerability.

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census block information). The census tracts in the Southern California region were then ranked from one to five, with five reserved for those tracts with the highest hazard count.

This hazard proximity metric is actually the most complex aspect of the EJSM. It is also a vital one because community members are often concerned about proximity not simply for direct health reasons, but also for reasons of visual blight and noise pollution. It was scored up at the tract level because this was the finest spatial unit at which the other data layers were available and we did not want to create a sense of false precision.

For the air quality and estimated health risk measures, we simply ranked the census tracts within a region from one to five based on the quintile distributions of five tract-level measures: a toxic score from the U.S. Environmental Protection Agency's (EPA) Risk-Screening Environmental Indicators (RSEI) Model, cancer and respiratory risk estimates calculated from EPA's National Air Toxics Assessment (applying California cancer and respiratory toxicity values for pollutants, such as diesel), and ambient concentration estimates from CARB for particulate matter ($PM_{2.5}$) and ozone.

For the social vulnerability measures, we ranked the tracts from one to five based on variables (mostly taken from the U.S. Census) such as percent of households living below poverty, percent people of color, age, home ownership rate, housing values, educational attainment, linguistic isolation, birth outcomes, and voting rates.

Making the Maps

With the three dimensions of cumulative impact ranked from one to five, we added up to get an overall ranking of regional census tracts from three to fifteen; one could choose another weighting scheme but this was a simple first approach. The resulting map is shown below and there are three things worth highlighting.

First, while we do not have the space to show them, the maps for proximity, air pollution, and social vulnerability do show different patterns: For example, the proximity maps show red "hot spots" in tracts that are near large industrial uses and the air pollution maps reflect traffic impacts and the wind patterns that send pollution and its health risk eastward to the Inland Empire.

Second, the distribution of scores from three to fifteen actually follows a normal distribution–which is what one expects from an analysis that identifies extremes—and that is the case in other California regions that we have also scored. Both the differently patterned maps and these results provide additional confidence in the approach.

Third, and perhaps most important, the maps shine a spotlight beyond the places where residents are already raising concerns. Near the port, around Pacoima, and close to the small cities near the industrial facilities in Vernon, there are vibrant community-based environmental justice organizations raising concerns about disparity. However the EJSM captures not just those locales that have been the center of environmental advocacy, but also places like El Monte and Pomona where community organizing has not caught on but agency attention may be nonetheless warranted.

Mapping Futures

Since we completed and published our first article about the EJSM, we have updated the underlying databases, added a metric for traffic counts, completed coverage for the Bay Area, San Diego, and the Central Valley, and collaborated with others to develop layers that account for climate vulnerability, pesticide use and the quality of drinking water.[5] Indeed, part of the reason why this is called a method rather than a tool is exactly because it can be adapted and modified.

A family of other screening tools has emerged, including an approach devised by colleagues at the University of California, Davis,[6,7] and the California EnviroScreen being developed by California's Office of Environmental Health Hazard Assessment (see http://oehha.ca.gov/ej/ces042313.html). Each approach uses somewhat different metrics and scoring strategies, but all employ the same basic strategy: score small areas and utilize the results to change policy.

The EJSM, for example, has been used to promote a "Clean Up, Green Up" campaign in the City of Los Angeles that will target environmentally overburdened and socially vulnerable communities and provide special assistance to prevent new siting and help businesses convert to safer processes.[8] The basic approaches of the EJSM and EnviroScreen are also being promoted as ways to determine how to allocate auction dollars from California's cap-and-trade to "environmental justice" communities.

One important feature of the EJSM and the other evolving screening approaches is the degree of community participation. In our case, we hosted meetings to secure community input and also had community members engage in hands-on data collection to validate some of the secondary databases. After all, a main goal of these screening approaches is to protect disadvantaged publics and one of the best ways of doing that is through full inclusion of those communities in the development of these valuable decision-making tools that can inform policy-making and regulatory processes. **em**

References

1. Pastor, Jr., M.; Sadd, J.L.; Morello-Frosch, R. Who's Minding the Kids? Pollution, Public Schools, and Environmental Justice in Los Angeles; *Social Science Quarterly* **2002**, *83*, 263-280.
2. Morello-Frosch, R.; Pastor, M.; Sadd, J. Environmental Justice and Southern California's "Riskscape": The Distribution of Air Toxics Exposures and Health Risks among Diverse Communities; *Urban Affairs Review* **2001**, *36*, 551-578.
3. Sadd, J.L.; Pastor, M.; Boer, J.T.; Snyder, L.D. "Every Breath You Take... ": The Demographics of Toxic Air Releases in Southern California; *Economic Development Quarterly* **1999**, *13*, 107-123.
4. Sadd, J.; Pastor, M.; Morello-Frosch, R.; Scoggins, J.; Jesdale, B. M. Playing It Safe: Assessing Cumulative Impact and Social Vulnerability through an Environmental Justice Screening Method in the South Coast Air Basin, California; *Int. J. Environ. Res. Public Health* **2011**, *8*, 1441-1459.
5. English, P.; Richardson, M.; Morello-Frosch, R.; Pastor, M.; Sadd, J.L.; King, G.; Jesdale, B.M.; Jerrett, M. Racial and Income Disparities in Relation to a Proposed Climate Change Vulnerability Screening Method for California; *Int. J. Climate Change: Impacts and Responses* **2013**, *4*, 1-18.
6. Huang, G.; London, J.K. Cumulative Environmental Vulnerability and Environmental Justice in California's San Joaquin Valley; *Int. J. Environ. Res. Public Health* **2012**, *9*, 1593-1608.
7. London, J.; Huang, G.; Zagofsky, T. *Land of Risk, Land of Opportunity: Cumulative Environmental Vulnerabilities in California's San Joaquin Valley*; UC Davis Center for Regional Change: Davis, CA, 2011.
8. Los Angeles Collaborative for Environmental Health and Justice. *Hidden Hazards: A Call to Action for Healthy, Livable Communities*; Liberty Hill Foundation: Los Angeles, CA, 2010.