UNIVERSITY OF CALIFORNIA,
IRVINE

Enacting Environmental Justice: Community Air Monitoring in Late Industrial California

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Anthropology

by

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Dissertation Committee:
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Dedicatoria | Dedication

A la comunidad de Santa Ana,
alcanzando un futuro más justo y respirable

To the community of Santa Ana,
reaching for a more just and breathable future

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2011 **Cox, Kathryn**. 2011. Notes on the Transition: Globalization, (Re)localization, and Ecological Justice. *Development, 54*(2)*:* 265-267.

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Abstract of the Dissertation

Enacting Environmental Justice: Community Air Monitoring in Late Industrial California

by
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With the recent advent of low-cost air sensors and growing use of community science in environmental research, air quality monitoring is newly accessible to researchers outside of government and academia. Low-cost, participatory methods are increasingly used in environmental justice (EJ) advocacy to characterize local air pollution concerns, document environmental inequity, and galvanize campaigns for policy change. This dissertation examines how stakeholders mobilize scientific and moral claims about air pollution, inequality, and justice through these emergent forms of environmental knowledge production. This project is based on over three years of ethnographic fieldwork on community air monitoring (CAM) initiatives across Southern California, including interviews with activists, scientists, policymakers, regulators, and community residents in four counties, as well as sustained collaboration with a CAM project in Santa Ana, California. Each chapter analyzes how air pollution and environmental justice are enacted as matters of public concern through the technologies and practices of community air monitoring, including air quality sensing, mapmaking, community engagement, and science-to-governance pathways. This dissertation shows how CAM practices can both expand and foreclose how environmental justice is conceptualized and addressed, highlighting the risks of reproducing essentialized notions of "disadvantage," "justice," and "community." As environmental justice gains momentum and visibility as a framework for understanding intersecting political, social, and environmental crises, this dissertation documents and theorizes how EJ is defined and mobilized through the work of community air monitoring.

Prologue: Encountering Environmental Injustice in Santa Ana

One May afternoon in 2017, Emma picked her youngest daughter up from school and walked her home to Alamitos Apartments, a two-story apartment complex where she and her husband had lived for over 15 years.[1] As they climbed the staircase to their front door, their neighbor Luisa leaned out her own apartment window.

"Have you seen this?" Luisa asked Emma in Spanish, waiving a yellow flier. "Are they raising the rent?" Emma took the paper, noticing similar yellow notices taped to all the doors along the outdoor hallway of the building. It was printed in English, in dense text on both sides. The top of the page read:

NOTICE OF INTENT TO ISSUE
"PERMIT TO CONSTRUCT AND OPERATE" PURSUANT TO RULE 212

This notice is to inform you that the South Coast Air Quality Management District (SCAQMD) received ten applications for permits to construct and operate a nickel/trivalent chrome plating line, a cleaning line, a stripping line, a packed-bed scrubber control system, two spray booths, an electric drying oven, and brass grinding, polishing, and buffing stations and associated air pollution control systems at a location in your neighborhood. The SCAQMD is the air pollution control agency for all of Orange County and portions of Los Angeles, Riverside, and San Bernardino Counties. Anyone wishing to operate, install or modify equipment must first obtain a permit from the SCAQMD. Rule 212 requires the applicant for certain projects to distribute a public notice prepared by the SCAQMD prior to the issuance of a permit. This notice is being distributed since the project is located within 1,000 feet of Hamilton Elementary School and Johnson Elementary School.

The notice went on to list the name and address of the permit applicant, Apex Industries, a metal-plating company that would be moving into the vacant building just across the railroad tracks behind Alamitos Apartments, a hundred feet from Emma's kitchen window. The letter

[1]Names and identifying characteristics of some people, places, and organizations have been changed to protect participant confidentiality.

detailed the project, associated emissions, and a summary of SCAQMD's analysis of the associated hazards: "Using worst case conditions, our evaluation shows that the chronic and acute health risks are both below our rule's toxic thresholds." It concluded with a note that public comments about the proposed permit should be submitted to the agency within 30 days of the distribution of the notice.

Emma speaks and reads English fluently, but the meaning of the flier's technical language was hard to discern. She translated what she could into Spanish for Luisa, who like Emma and most of their neighbors had immigrated from Mexico to their neighborhood of Los Robles in Santa Ana, California.[2] Concerned about the letter, Emma got in touch with other women in Alamitos Apartments and the public housing complex next door, all of whom had received similar yellow notices on their doors that afternoon. One of their neighbors, Julia, recognized the name of the company – her husband was an employee – and said that the facility had been slated to be built in nearby Tustin, a more affluent city adjacent to Santa Ana. In response to outcry from Tustin residents, they'd moved the project to Santa Ana instead. To Emma, this confirmed her suspicions that this project was a continuation of a long history of powerful interests taking advantage of Santa Ana, and she was skeptical of the letter's assurance that the new factory didn't pose a threat to their health.

Later that week, Emma and Luisa gathered with a small group of other women from the neighborhood in a cheerfully decorated classroom at Hamilton Elementary School, down the block from Alamitos Apartments. They met here frequently, several days a week, as active members of Madres de Hamilton, a parents' group at the school that organized fundraisers, monthly food banks, and the annual school *posada,* a holiday potluck. Clustered in child-sized

[2] In fact, the neighbors would later learn that California law required such a notice to be distributed in Spanish given the neighborhood's high percentage of primarily Spanish-speaking residents.

chairs around small wooden tables, the Madres presented a copy of the flier to Pedro, the director of the community organization Vecinos Unidos (Neighbors United, or Vecinos for short).

Pedro was alarmed by the language on the notice. He had moved to California from Jalisco, Mexico as a teenager, settling in Santa Ana for its strong cultural ties to Mexico and earning a bachelor's and master's from the nearby University of California Irvine (UCI). He'd lived in the neighborhood for over 30 years. He and his wife had raised their now-adult children here, and they had long been active in the Los Robles Neighborhood Association. A decade earlier, he'd helped establish Vecinos Unidos as a non-profit branch of the neighborhood association. Pedro had recently retired from an administrative career at UCI, supporting research and service on Latinx community health in Santa Ana. Since retirement, he remained active in running Vecinos Unidos' health education, nutrition, and *promotora* (community health promoter) programs. Even though Pedro's expertise and passion lay in addressing social determinants of health for the Latinx community, the threat of toxic air pollution in his own neighborhood of Los Robles was news to him.

* * *

Santa Ana is the second most populous city in Orange County, as well as the county seat. Orange County's reputation as a wealthy, conservative, and predominantly white suburb of Los Angeles paints an incomplete picture. The county is one of the most demographically diverse regions in the country: 58% of its 3.1 million residents are people of color, over one third are Latinx, and nearly one fifth are Asian American/Pacific Islander (Muña et al. 2019). The county's marked racial inequities in wealth, income, education, and health have been exacerbated by a regional housing crisis and the COVID-19 pandemic. Until recently, however, environmental inequality has not been considered a prominent public problem (despite, or

perhaps due in part to, decades-long struggles against stark environmental injustices in other parts of the Los Angeles region). For example, Orange County Environmental Justice, the county's first non-profit organization dedicated to EJ issues, was established only in 2017. In recent years, local community-based research on soil lead levels (Masri 2020) and air pollution (Masri 2021, Masri et al. 2022) have begun to pay attention to the disproportionate impact of environmental pollution on low-income residents of color, and California's emphasis on environmental justice in recent legislation have brought these issues to the fore among local policymakers and advocates.

Nestled in the southeast quadrant of Santa Ana, Los Robles is a neighborhood of about 8,000 residents. Many Los Robles residents say they moved to the neighborhood because of its relative affordability in the notoriously costly Southern California housing market, and because they feel at home speaking Spanish with neighbors and at local businesses– over 94% of the neighborhood is Latinx. Single-story homes line its residential streets, with gardens hemmed in by curly wrought iron fences and sturdy citrus and avocado trees. A few larger public housing projects and apartment complexes have tidy courtyards decorated with colorful *papel picado* on holidays, and are often bustling with trucks selling tacos, fresh produce, ice cream, and small household items. Small businesses like grocery stores, Mexican restaurants, and auto-body shops are clustered in a few commercial strip malls on the main streets. The area is corralled by the 5, 405, and 55 Freeways, and lies directly beneath the flight path for John Wayne International Airport. Los Robles is cross-cut by some of the city's busiest thoroughfares, many of which have expansions planned or underway to accommodate the region's growing freight and commuter traffic. Though it is largely out of view from the quieter, tree-lined residential streets, Los Robles also abuts Santa Ana's largest industrial zone, a long corridor dominated by metal-plating and

other manufacturing facilities. A major freight railroad divides the industrial and residential parts of the neighborhood, ferrying consumer goods between Orange County and massive warehouses in the Inland Empire. Since the city displaced the hundreds of people from the region's largest homeless encampment on the Santa Ana River in 2016, a growing number of unhoused people live in makeshift shelters along the tracks.

Los Robles residents speak proudly of their neighborhood's history of community activism and civic engagement. Dolores, a neighbor in her late seventies, keeps a detailed oral history of neighborhood women's organizing to curb gang violence and local government corruption since at least the 1990s. Madres de Hamilton first formed their group in opposition to a proposed 250-bed homeless shelter slated to occupy the lot adjacent to Apex Industries, behind Johnson Elementary School, fearing the lack of supportive services at the shelter would intensify public drug use and violence near the school. In 2009, Vecinos Unidos lobbied the city to establish Los Robles Park, with a soccer pitch, baseball field, playground, community garden, and bike path– a rare oasis of green in the dense residential and industrial zones of Southeast Santa Ana. The park and the adjacent elementary school function as venues for a wide variety of community events, including free summer movie nights, baseball games, and children's performances of Mexican *baile folklórico*. Ms. Alarcón, the Hamilton Elementary School principal, has for years coordinated monthly food pantries for the neighborhood. Emma, Luisa, and other Madres de Hamilton collect donated rice, beans, produce, milk, eggs, and cereal from local organizations and Albertson's grocery store to distribute on the last Saturday of the month (and often more frequently since the start of the COVID-19 pandemic).

Despite this legacy of local organizing, longtime residents say environmental justice (EJ) issues had never figured prominently among Los Robles' concerns before 2017. For example,

even though equitable access to green space is a cornerstone demand of the United States EJ movement, Vecinos Unidos framed its 2009 Los Robles Park campaign as a matter of health equity and community safety rather than EJ: fewer safe spaces to exercise contributed to the high rates of obesity and diabetes in this predominantly low-income Latinx neighborhood, which had fewer green spaces and recreational facilities than any other zip code in Orange County. Today, however, Vecinos Unidos places environmental justice at the center of its organization's mission, and is respected across the city as an EJ leader and the first group to conduct community air monitoring in Orange County. This is a story of how a neighborhood helped surface environmental injustice as a key issue in the Santa Ana landscape.

* * *

After that first meeting with Pedro in the elementary school classroom, Emma and her neighbors got to work. They began sharing stories about pollution concerns near their homes, comparing notes: one neighbor mentioned the whistling steam from one facility that woke her kids up at night, another described the thick black smoke from a factory that made her close her windows in the heat of summer, and a third complained of the suffocating smell emanating from behind the railroad tracks. They debated how best to describe the smell, settling in agreement with a neighbor who observed, "*Huele a cloro quemado"*-- it smells like burnt bleach. In one particularly egregious incident, a mysterious alarm blared from the Apex Industries building for over 48 hours one weekend, keeping the whole apartment complex awake. *"¿A quién se le ocurre poner una fábrica tan cerca a estas casas, a una escuela?"* Luisa asked. "Whose idea was it to put a factory so close to people's homes, to a school?" (Interview, January 29, 2020)

Emma began meticulously documenting the construction and manufacturing process on the Apex Industries lot, posting photos, videos, and textual descriptions to the Facebook pages of

local city council members and to the MySantaAna app on her phone. Pedro and his son went to a sparsely attended public meeting held by the Department of Toxic Substances Control (DTSC), about a cleanup of trichloroethylene, a toxic carcinogen, at a nearby former metal plant now in use as an evangelical church. Vecinos began holding public forums at schools and community centers to inform residents of their environmental concerns. At one, a doctor noted that the neighborhood had the highest rates of pediatric asthma hospitalizations in the area. Neighbors now began to wonder aloud whether their children's asthma could be due to their proximity to the highways and factories.

In 2018, Vecinos Unidos obtained a three-year grant from the California Air Resources Board (CARB) for a community initiative investigating local air pollution. Through the grant, Vecinos convened a resident steering committee made up of adult residents and high school youth – including Emma and many of her neighbors– to learn about environmental health risks in and around Los Robles. They hired Isaac, a community organizer who had grown up in Los Robles and had recently returned after graduating from college, to help coordinate the project. Pedro reached out to colleagues at the University of California, Irvine to form a multidisciplinary advisory committee to provide technical advice, guide research, and obtain funding. From 2018 to 2020, Vecinos Unidos developed a two-year training curriculum for the committee, including topics on community-based research, participatory mapping, developing an advocacy campaign, air pollution health risks, participating in public comment processes, and designing an air monitoring project. In 2021, Vecinos Unidos and the resident steering committees worked with UCI researchers to pilot a community air monitoring study to identify major local pollution sources and to compare air pollution burden in Madison Park to other parts of the city.

That May 2017 encounter with the yellow fliers on Alamitos Apartments began a cascade of events that form the throughline for this dissertation, which explores how environmental justice (EJ) emerges and coalesces as a public problem, catalyzing community science and advocacy. In the chapters that follow, I analyze how Vecinos Unidos and other groups across Southern California leverage air pollution science to name and frame environmental pollution as a matter of racial and social justice, in their own communities and beyond.

* * *

"*[Me involucro] para el bienestar de mis hijas. Para que mis hijas vivan en un mundo mejor, que tengan un futuro mejor que el de nosotros,"* Emma told me one afternoon at her kitchen table, covered in a bright floral oilcloth and her kids' homework. "[I get involved] for my daughters' well being, so that my daughters may live in a better world and have a better future than ours." Looking out her window across the railroad tracks to the Apex Industries building, she added: "But it's not just for them. It's for the community, for all of us who live around here. So that it's not just for my daughter, but for my neighbor's daughter, and for her neighbor's daughter, too.

"Que tengan una vida sana." So that they all may have a healthy life (Interview, January 13, 2020).

Introduction: How to Do Environmental Justice in Late Industrialism

I. Community Air Monitoring in the Birthplace of Smog

On the day before Earth Day in April 2019, I took a half-day's road trip down the 405 and 5 Freeways from my home in Long Beach to southern San Diego. The scenic route was particularly brilliant that spring, with sprays of wildflowers on the coastal hillsides blooming after a rare week of rain in the midst of California's historic drought. The freeway carried me over Orange County's middle-class cities of Westminster and Fountain Valley, through its affluent oceanfront enclaves of Dana Point and San Clemente, and past the defunct San Onofre nuclear power plant and the United States Navy's Camp Pendleton. The Sunday afternoon traffic slowed to a crawl near the beach exits, outlet malls, and United States Border Patrol checkpoints of San Diego County. I opened my car windows, breathing in the mingled scents of car exhaust and ocean air. I spent the night in a small room near the San Diego Bay, waking early Monday morning to travel to San Ysidro, a district immediately north of Tijuana and the US-Mexico border, where I would attend a workshop on how to establish a community air monitoring network.

Small billboards on San Ysidro's concrete buildings featured Spanish-language advertisements for currency exchanges, payday loans, and lunch specials. Citrus trees and hot-pink bougainvilleas spilled over the fences of homes and small businesses. I turned up a steep gravel road to a church parking lot adjacent to the freshly painted community center where the workshop would be held. Folding chairs and tables were arranged in an auditorium with a stage at one end and a basketball hoop at the other. A coffee urn and pastry boxes of *pan dulce* were set up next to a small exhibit of low-cost, DIY air monitors: waterproof metal boxes the size of a large backpack outfitted with an air sensor, a circuit board for storing and transmitting

data, a miniature cooling fan or heater, and a power outlet or solar panel. We were each given a copy of an instructional manual, the *Guidebook for Developing a Community Air Monitoring Network: Steps, Lessons, and Recommendations from the Imperial County Community Air Monitoring Project"* (Wong et al 2018).

The two workshop facilitators were each from organizations that had established community air monitoring (CAM) networks in recent years, one in an urban border community and another in a rural agricultural area. Several additional presenters came from Tracking California, a statewide public/non-profit partnership focused on mobilizing environmental data for public health policy, which had been involved in both CAM initiatives. Through a round of introductions, translated by Spanish/English interpreters through headsets for those who wanted them, I learned that the other workshop attendees came from Tijuana, Calexico, San Diego, Santa Ana, and Los Angeles. They had come to the event due to concerns with air pollution in their neighborhoods from commuter and freight traffic along the US-Mexico border and around the Port of LA; from industrial facilities like oil refineries and metal processing plants; and from agricultural sources like livestock, graineries, crop burning, and erosion. All of us had come to learn how to establish a community air monitoring network, an incipient model of environmental monitoring that one facilitator called "a tool for the underrepresented."

During my time in the field, *community air monitoring* was emerging as a buzzword in academic, government, and activist circles. At conferences, in scientific journals, and even in the California legislature, CAM projects like those highlighted in the workshop were held up as success stories of community engagement, scientific innovation, and government accountability. This workshop marked a turning point in my research, a moment when I recognized that the *community air monitoring project* had coalesced into a coherent and portable model for "how to

do" environmental justice. When I attended the workshop, I was six months into my fieldwork for this dissertation project, which was initially centered around the question of how the concept of environmental justice (EJ) was being operationalized in environmental health science in California. In this community center in San Ysidro, and across California, community air monitoring was surfacing as a tentative answer to that question.

The Los Angeles Air Basin is known as the "birthplace of smog," a toxic consequence of the mid-20th century's explosion of freeways that bulldozed through Black and Latinx neighborhoods and cemented the region's dependence on the automobile (Jacobs and Kelly 2008, Rothstein 2017, Estrada 2005). Southern California is also the birthplace of modern air pollution governance (Haagen-Smit 1970), and the state's pioneering air quality science and progressive environmental policy are lauded as world models (Liévanos 2018). Nevertheless, the limits of existing scientific and regulatory frameworks for air quality management are laid bare by this region's intractable air pollution challenges: cumulative impacts from diverse pollution sources, entrenched racial environmental health disparities, and the intensifying social, economic, and environmental effects of climate change— all of which disproportionately harm low-income communities of color (Cushing et al. 2016). While universal air quality protections have yielded improvements in environmental health overall, most environmental regulation has done little to close this "environmental racism gap," even exacerbating racial and class disparities in exposure to environmental harm (Pulido 2015). Could community air monitoring help address this gap by focusing on pollution in the communities of color that regional air pollution governance had left behind?

By 2017, lawmakers and activists in heavily polluted communities of color in South LA and along the US/Mexico border were beginning to ask this question. Over the course of my

fieldwork between 2018 and 2021, the state of California invested heavily in CAM initiatives in "disadvantaged communities" (DACs), through a legislative mandate to redress racial and economic inequities unaddressed or worsened by the state's existing environmental policies. The enactment of unprecedented environmental justice legislation at the state level created a blueprint for operationalizing EJ through concepts like the "disadvantaged community" (the subject of Chapter 2) and through programs like community-level air monitoring (explored in Chapters 1 and 4). In 2021, the Biden Administration's historic #Justice40 Initiative mandated that at least 40% of benefits from federal agencies' investments in climate and clean energy be delivered to disadvantaged communities, a designation borrowed directly from California EJ policy (Callahan et al. 2021). Pursuant to this executive order, the United States Environmental Protection Agency launched a $50 million program for community air monitoring nationwide, also modeled after California's programs. This dissertation explores how community air monitoring and the designation of disadvantaged communities became the "right tools for the job"[3] in California environmental justice policy-- and what forms of knowledge, imagination, and action are afforded or foreclosed by these tools.

II. What Is Community Air Monitoring?

In their review paper "Citizen Science Terminology Matters: Exploring Key Terms," Eitzel et al. (2017) point out that the rapid growth of so-called "citizen science" in recent decades is characterized by a wide range of terms to describe such projects and their practitioners. (In

[3] My analysis of the relationship between the "tool" of community air monitoring and the "job" of doing environmental justice is informed by STS (Science and Technology Studies) frameworks that emphasize how (scientific) problems are constructed through the articulation of tools and jobs in historically and locally specific ways, and through the practice of work itself (cf. Clarke and Fujimura 1992). In other words, while community air monitoring emerges in part from the goals and demands of the EJ movement in the arenas of advocacy, science, and policymaking, the practice of CAM also shapes how EJ is understood and enacted.

fact, few of my interlocutors described community air monitoring as citizen science, in part due to the fraught meanings of citizenship in immigrant communities.) What terms are used, and how, have significant implications for knowledge production: what does it mean to call citizen science a "tool," a "movement," or a form of "social capacity"? What is the difference between "science," "research," and "monitoring"? This dissertation contributes to this area of inquiry by considering how CAM is re-shaping paradigmatic definitions of air monitoring, of community, and of environmental justice itself.

Community air monitoring is an umbrella term for a wide range of initiatives, where what is meant by "community," "monitoring," and even "air" varies from project to project. The "community" in CAM can refer to a community-based organization or committee that stewards a project, to the neighborhood-level focus of a project using sensors with high spatial resolution, or even to the location of a monitoring system in a so-called "environmental justice community" or "disadvantaged community"-- or none of these. The air quality indicator of interest for most CAM projects is $PM_{2.5}$, or fine particulate matter that is measurable using low-cost, often portable sensors, though some CAM projects focus on other forms of pollution such as metals, gasses, or volatile organic compounds. Monitoring, too, can refer to a wide range of practices: a network of sensors to measure ambient air quality continuously over time, fenceline monitoring of pollution from a particular source, "bucket brigade" sampling to capture data at specific times or locations, personal monitoring using wearable sensors to assess individual exposure, indoor monitoring with low-cost-sensors in homes, or mobile monitoring using sensors installed on or in vehicles (Wong et al. 2018). The methods and practices for storing, transmitting, managing, analyzing, representing, and reporting air quality data also varies depending on the project.

In general, community air monitoring, as other environmental monitoring, is research designed to characterize environmental quality in order to manage it (Biber 2011). It is a set of technologies and protocols for apprehending environmental problems as scientifically measurable, publicly legible, and bureaucratically manageable. Community air monitoring, as I discuss it in this dissertation, includes a diverse array of environmental monitoring projects which tend to share a few common features: they (1) involve air quality sampling using low-cost sensors, (2) conducted at a high spatiotemporal resolution, (3) with the participation or leadership of local advocacy groups, and (4) with the explicit purpose of addressing problems of environmental justice, such as inequitable access to environmental data and disproportionate exposure to environmental vulnerability and harm. I explore the challenges, promises, and implications of each of these features of a typical community air monitoring project through case studies cited throughout this dissertation.

Defining and operationalizing "community air monitoring" as a scalable model of air quality monitoring became a salient question across California in 2018, the same year that I started my fieldwork. In 2017, the California Legislature enacted Assembly Bill 617, one of a suite of unprecedented bills focused on environmental justice passed in that legislative session. AB 617 requires the California Air Resources Board to "develop a statewide air quality monitoring plan, identify disadvantaged communities most impacted by air pollution, and... develop local pollution reduction strategies for and deploy related technology in those communities" (Stratte and Kenline 2018). In 2018, AB 617 established the $500 million dollar Community Air Protection Program (CAPP) through which the California Air Resources Board (CARB) would select ten of the "most impacted communities" statewide. Regional air districts would convene steering committees of residents, EJ advocates, and representatives from local

government, non-profit, and industry to develop community air monitoring plans (CAMPs) that would then inform community emissions reduction plans (CERPs) based on local needs and priorities. Through AB 617, the state air board also created a smaller Community Air Grants program funding "community-based organizations"-- mostly small nonprofits-- to develop technical capacity for their own community air monitoring programs. In other words, in 2018, "community air monitoring" became a legally mandated mode of defining environmental (in)justice in California, with hundreds of millions of dollars in public funding for CAM initiatives across the state disbursed over the coming years.

The San Ysidro workshop signaled to me how AB 617 implementation had amplified community air monitoring from site-specific projects to investigate and advocate for local air quality into a state-wide model for enacting environmental justice. After the workshop, my research came to focus on how this model was defined, translated, adapted, and changed across Southern California sites. Throughout my fieldwork, I followed environmental justice advocates, scientists, regulators, policymakers, and a host of other interlocutors as they worked through the challenges of imagining, designing, and implementing CAM in urban, rural, and suburban neighborhoods from the US-Mexico border to the Port of Los Angeles. I traced how community air monitoring was mobilized to fill in gaps in regulatory data, identify under-regulated sources of pollution, galvanize local EJ advocacy, and inform environmental policy. I observed how CAM was at once heralded as a signature tool of next-generation EJ work, and also critiqued as a costly and toothless strategy that was ill-equipped to challenge the systemic causes of air pollution, environmental inequity, and climate disaster. Endorsed through legislative mandates and well-heeled state programs, I found that community air monitoring practices are tinkered

with and shared among a wide range of stakeholders at regional conferences, public agency meetings, community workshops, and in non-profit reports and scholarly publications.

As a "how-to" for enacting environmental justice in a fraught historical moment, I argue that the practice of community air monitoring offers a window into broader visions of what it means to "do EJ" today, four decades into the United States environmental justice movement. In many ways, CAM draws attention to air pollution at sites and scales that have largely been excluded from the benefits of the mainstream environmental movement, centering these "sacrifice zones"[4] (Lerner 2010) as paradigmatic of racial capitalism rather than as exceptions along the march of progress (Robinson 1983, Pulido 2016a, Pulido 2016b, Pellow 2018, Vergès 2017). At the same time, CAM projects epitomize neoliberal environmental policy, making individuals, NGOs, and the private sector responsible for environmental monitoring in the context of state austerity and mounting political and environmental crises (Harrison 2019, Kimura and Kinchy 2019, Sze 2020). This dissertation tells the story of CAM as a form of science and praxis in the "muddled middle" between these two truths (Fortun and Bernstein 1998), in which a wide range of stakeholders struggle to apprehend a wicked problem that continually exceeds its frame.

III. Collaboration as Object and Method

At the lunch break, I mingled with workshop participants who would become key informants for this project. At the time of the workshop, I had just begun working as an intern at

[4] The term "sacrifice zones" refers to fenceline communities adjacent to sources of toxic pollution and other hazardous land uses, often populated by low-income people of color. Invoked in the environmental justice movement, the term calls attention to the ways that the ongoing pollution of certain people and places is not incidental, but legally and extralegally sanctioned and economically profitable (Lerner 2020, Shaw and Younes 2021). Chapter 3 of this dissertation further explores how racial capitalism shapes the relationship of disposability and value in such sacrifice zones.

Vecinos Unidos, which had just received a grant to establish a community air monitoring program in an industrial corridor in southeast Santa Ana. When I heard about the San Ysidro workshop through an interview with another interlocutor, I passed the invitation along to Pedro, the Executive Director of Vecinos Unidos, and to Isaac, their newly hired community organizer.

Balancing our sandwiches on paper plates, I chatted with Pedro and Isaac about one of the morning workshop sessions, "Planning a Community Air Monitoring Network: Defining your values, goals, and vision." A how-to worksheet offered reflective prompts to help identify a project's goals: *Who will use the data? For what? How good does the data need to be? How much control do you want over data processing, visualization, and communication? How important is it to build organizational and community capacity?* It was clear from the case studies described in these workshops how different answers to these questions would index the need for distinct types of sensing equipment, data management, site selection, program design, and partnerships. From the vantage point of an organization altogether new to community air monitoring and environmental justice work, however, these were chicken-or-egg questions that seemed impossible to answer meaningfully. How could Vecinos Unidos know what sensing equipment they would need when they didn't know what kind of pollution they had in their neighborhood? How could they anticipate who would use data that didn't exist yet? How could they decide how best to process, visualize, and communicate the answers to research questions they hadn't yet articulated? On one hand, community air monitoring was being held up as a solution designed to fit a particular kind of EJ problem, tailored to meet community needs. On the other hand, it was described as a research method for identifying local problems in the first place, from which targeted local solutions might then be developed. Was community air monitoring a means to see the problem, or to solve it?

Hector, a workshop co-facilitator, joined our conversation. He pointed out the features of the air sensors on display, and pulled up an app on his phone to show us the map of the network and its real-time air quality data. Pedro, Isaac, and I peppered him with questions, sometimes nodding in agreement when one of us asked a question the others had also had in mind: Why had they chosen this sensor over other models? How did they decide where to place the sensors? And, harkening back to our frustration from the morning session, how clear had they been on their own goals before launching the project a few years ago? How did they know what they were looking for? Hector patiently answered our queries, offering advice and pointing out ways their concerns, goals, and methods in his rural community were likely different from those in Santa Ana. He introduced us to Álvaro, who had worked on community air monitoring projects in more urban and industrial parts of San Diego that might have more in common with Vecinos' initiative. We exchanged cards and made plans to meet as a group.

As we made our way back to our seats for the afternoon sessions, I reflected on how my questions for Hector and Álvaro were strikingly similar to the questions Pedro and Isaac had asked them. Ethnography is a research modality fundamentally concerned with "how" questions, with characterizing the means, manners, and conditions in which the everyday unfolds. I would learn through the course of fieldwork that community air monitoring, like ethnography, is also largely a matter of asking "how" questions: how to ask old questions in new ways, how to measure intractable problems using novel technologies, how to put new methods into practice, and how to build replicable models from those emplaced practices. As we would learn through the three-year initiative in Santa Ana, doing a community air monitoring project was not a matter of adapting a new technoscientific model for measuring air quality in a local context (*how-to*), but rather a mode of inquiry and experimentation in which networked relationships, knowledge

practices, and sociopolitical visions were continually revised and worked through (*how to?*). As much as we desired the clear-cut imperatives of the how-to manual we were given at the start of the workshop, our pursuits remained squarely in the interrogative tense: *how to do environmental justice?*[5]

Over the next couple of years, both I and my interlocutors at Vecinos Unidos would tack between these moods of "how to" and "how to?," and this iterative grammar would become the basis for our collaboration. While my initial role as an intern was focused on program documentation and grant reporting, and while I had not initially planned for Santa Ana to be a focal field site in my multi-sited research design, my own ethnographic research became intertwined with the organization's efforts to characterize neighborhood air quality and advocate for environmental justice. Through observant participation in Vecinos' CAM project, we all (Pedro, I, and numerous other collaborators) got into the habit of turning obstacles in the project into research questions. For example, the chicken-or-egg impasse we identified at the "how-to" CAM workshop became a "how to?" question that Pedro and I posed to two public health researchers in a combination meeting/interview in a university café: How do we choose a monitor when we don't yet know what pollutants we need to measure?[6]

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[5] In "How to Do Things with Sensors," Jennifer Gabrys examines the proliferation of the instructional how-to guide in citizen science and environmental monitoring, and interrogates "how worlds are made sense-able and actionable through the instructional mode" (2019a). Gabrys argues that how-to guides are replacing the manifesto as a genre for articulating sociopolitical visions in government, NGO, and radical organizing spaces alike, with the "dogmatic proclamations" of the manifesto giving way to a more open-ended, flexible set of practices expressed in the imperative mode of the how-to. My analysis of CAM as a "model" for science in environmental justice work considers how it is made doable, shareable, and even normative while maintaining flexibility and variation in local instances.

[6]The iterative generation of new research questions continued following this meeting, when at Pedro's suggestion I distilled my field notes into another set of queries, which Vecinos Unidos sent to the regional air quality agency: *For each of the 42 facilities in the Los Robles industrial corridor, what specific pollutants are they permitted to emit? How do we obtain the permits? Are there any known pollutants/emission types for these facilities not reflected in the permits? Once a facility is issued a*

In this dissertation, I use the phenomenon of community air monitoring, newly mandated in California through AB 617, as an anchor to focus my ethnographic inquiry into broader phenomena about what environmental justice has come to mean over the last four decades of the environmental justice movement. This project is driven by the following research questions:

(1) How do differently positioned stakeholders in the LA region—including scientists, activists, policymakers, and community residents— envision CAM's potential?

(2) What factors enable or limit CAM's effectiveness for addressing environmental inequity in the region's most pollution-burdened communities?

(3) How do stakeholders make use of air quality data yielded through CAM?

(4) How are these data implicated in political and moral claims about the causes, impacts, and responses to environmental (justice) problems in Southern California?

My fieldwork took place over three and a half years, from 2018 to 2022. During that time, I conducted 38 group and individual interviews with 84 unique interlocutors, including academic and lay scientists, policymakers and staff at regional and state air quality management agencies, environmental justice activists, and other community residents involved in air monitoring initiatives. I conducted participant observation at seven sites in southern California, in Los Angeles, Orange, San Bernardino, San Diego, and Imperial Counties. Across these sites, I collected field notes for over 40 public meetings, events, and protests; three regional conferences on environmental justice and air monitoring; eight "toxic tours" of polluted communities; four

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permit, who tracks actual emissions? How and to whom are those reported? When were each of these 42 facilities first issued permits by AQMD? Were any in operation prior to those permits, and if so for how long? How frequently do companies need to submit for their permits? What information do they share in order to receive a permit? Who decides what pollutants need to be tracked and disclosed? What is on the permits? Are all pollutants listed on the permits? What is the permitting process? If facilities exceed the permitted emissions levels or otherwise violate the terms of the permit, how do SCAQMD and/or other agencies address that violation? (Field Notes, April 2019)

community-wide participatory air sampling events; dozens of Santa Ana community workshops; and over 150 staff and planning meetings with Vecinos Unidos. Additionally, I collected hundreds of documents for analysis, including local, regional, and national media coverage, legal and policy documents, social media posts, advocacy materials, community environmental education tools, and air monitoring guidebooks.

Over time, many of my data collection methods, including site selection and interview questions, were developed in collaboration with Pedro, Isaac, and Vecinos Unidos,[7] as well as numerous other collaborators at UCI.[8] I continued to conduct interviews, attend community meetings, and read about community air monitoring in the neighborhoods surrounding the Ports of Los Angeles and Long Beach, in East LA, Paramount, and Compton, and in San Diego and the Imperial Valley. My interlocutors included staff and board members of regional and state environmental agencies, university researchers, and residents and activists involved in CAM projects and EJ organizing. As I was included in more of Vecinos Unidos' program meetings, I

[7] While this project was not designed using community-based participatory research (CBPR) or participatory action research (PAR) models, the collaborations that emerged from and shaped it are integral to this project. The questions, data, analysis, and arguments articulated in this dissertation were honed through shared labor, and often with a shared vision of what the work could or should be "for." In Chapter 3, I analyze how CBPR and PAR, as well as similar frameworks, can both enable and foreclose collaborative and power-critical modes of academic knowledge production.

[8] Vecinos Unidos had a close partnership with the Research Justice Shop at the UCI Newkirk Center for Science and Society, through which they convened an advisory committee of UCI researchers from across campus, including law, medicine, planning, public health, and social sciences, including myself. This group convened to provide input on the air monitoring initiative, plan and apply for multidisciplinary research grants, and discuss ways to leverage UCI research and financial support for Vecinos' environmental justice and community health programs. In one meeting of the group, while attempting to define the geographic scope of the monitoring project for a grant, members from law, planning, environmental epidemiology, anthropology, and Vecinos offered no fewer than five different technical definitions of the "industrial corridor." While environmental justice is an inherently interdisciplinary problem space requiring many forms of expertise, this disciplinary knowledge is often siloed in ways that stymy EJ research and advocacy. Having such sustained collaboration through which to identify and broach these different forms of expertise is rare in EJ work.

would share what I learned about the successes and challenges of other CAM projects across the region to help inform the design of their project. I also co-designed and facilitated numerous bilingual workshops for the project's resident steering committees on topics including neighborhood mapping, participatory research processes, air monitoring project design, reflective community walks, zoning and land use, and providing public comments. In turn, the practical imperatives of needing to figure out how to implement a community air monitoring project in Los Robles sharpened the analytic focus of my research. The feedback loops between the "how-to" and the "how to?" became a cornerstone of my research methods, and this flexible form of collaboration became an object of study in itself.

IV. Environmental Knowledge Production in Late Industrialism

At the workshop's afternoon break, I refilled my coffee cup and took a walk around the community center to stretch my legs. A installation of photographs hung at the back of the auditorium: a gray-haired man in a citrus orchard, soot-blackened grapefruits hanging from a tree, a dozen hands rolling the fruit over stenciled letters on blank canvas, and a row of these paintings with words printed in the oily residue -- "exposure," "familiar," "la flora," "reduce," "solución." A caption hanging beside the exhibit read:

> *Citizen Artist: Pollution Paintings,* 2018
> Artist: Andrew Sturm
>
> These twelve photographs tell the story of neighborhood activist Señor Guillermo Cornejo and eleven [youth art apprentices]... Señor Cornejo's fruit trees pull soot from the air surrounding the Tijuana/San Ysidro border crossing, where 70,000 cars per day can wait on average thirty minutes to two hours, or more, to cross into the U.S. through the intensified U.S. border security. While idling, cars emit more pollution than when traveling at highway speeds. The U.S. government is currently doing nothing to mitigate the pollution at its source. Residents of San Ysidro already have an 18% higher rate of asthma than the surrounding San Diego County and the health challenges are expected to worsen as southbound security is intensified in the coming months. The words in the paintings come from interviews that the Apprentices conducted with other San Ysidro residents. Twelve unique paintings were created.

Figures A and B: *Photographs from* Citizen Artist: Pollution Paintings*, by Andy Sturm. Used with permission of the artist.*

Figures C and D: *Photographs from* Citizen Artist: Pollution Paintings*, by Andy Sturm. Used with permission of the artist.*

Figure E: *Photograph from* Citizen Artist: Pollution Paintings*, by Andy Sturm. Used with permission of the artist.*

A persistent challenge for apprehending the violence of air pollution is the way it so often disappears from view. Its toxicity is dispersed physically and temporally, distributed on the wind and resting latent in landscapes and bodies.[9] Rob Nixon (2011) points out that this "slow violence"-- "low in instant spectacle but high in long-term effects" (10)-- is a representational crisis as much as it is an environmental one. Citing Aldo Leopold's maxim that "we can only be

[9] Michelle Murphy (2013) uses the term chemical infrastructures to describe how this disappearance is engineered. These infrastructures distribute industrially produced chemicals as "they are produced and consumed, and as they become mobile in the atmosphere, settle into landscapes, travel in water ways, leach from commodities, are regulated (or not) by states, monitored by experts, engineered by industries, absorbed by bodies, metabolized physiologically, and as they bioaccumulate in food changes, break down over time, or persist" (1).

ethical toward what we can see," the slowness and distribution of environmental catastrophe requires devising new representational and narrative forms through which its urgency can be collectively understood and acted upon (Nixon 2011: 14).[10] It is difficult to see air pollution, asthma, cancer, and foreshortened life expectancy in San Ysidro as a violent effect of the increasingly securitized and militarized state, especially in the shadow of the spectacular fast violence of the U.S. border apparatus. In a blog post about the *Citizen Artist: Pollution Paintings* project, artist Andy Sturm writes, "How can we make the invisible, visible? How can we make air pollution tangible? How can we include [our] families, friends and neighbors...as we do this, to spread the word? How can we work in a way that gives [them] ownership and agency in this process and the work that will come after, if they are willing to continue?" (2020). Gathering youth apprentices to listen to Señor Cornejo's stories of pollution at the border, to elicit conversations about air pollution with friends and neighbors, to choose words from those interviews as emblems of the problem, to paint these words onto canvas with the grimy fruit picked from a highway-side orchard-- this is the labor of representing this violence. Drawing diesel from the air onto fruit and paper is a process of recovering the chemical violence of airborne particulate matter from "regimes of imperceptibility" (Murphy 2006) that render it invisible and beyond apprehension.

These regimes of imperceptibility are characteristic not only of air pollution governance but of the current historical epoch in which we, and this dissertation, are situated. Fortun (2012,

[10] Anthropologist Chloe Ahmann writes, "slow violence is a condition that seems to invite incoherence. It takes too long, it's hard to notice, and it casts a wide chasm between effects and the various forces to which we might attribute a cause. But it is, in fact, an object" (2018:164). Ahmann points to how those suffering protracted violence orchestrate their own temporalities of resistance and refusal to punctuate moral claims and demands for accountability. Chapters 1 and 2 of this dissertation explore how activists engaged in community air monitoring attune to different spatial and temporal scales afforded by new sensing technologies to represent the slow violence of air pollution as an urgent concern.

2014) names our present era "late industrialism," a set of historical conditions characterized by degraded industrial infrastructures, climate instability, growing inequality, toxic pollution of bodies and environments, and —despite a cacophonous proliferation of new media and siloed forms of expertise—the exhaustion of existing paradigms for making sense of these problems whose complexity "resists explanation in available terms" (2012: 451). The industrial order is undergirded by a Modern ontology of structural binaries and bounded essentialisms, with rigid distinctions between Culture/Nature, Subject/Object, and Knowledge/Value that "assumes things are what they are intended to be--that they are their essence-- and nothing more" (Fortun 2014: 309, 313). In late industrialism, this essentialist logic is belied by the toxic consequences of industrial systems; the porosity of bodies, objects, and environments is made violently evident through chemical spills, pathogen spillovers, and climate chaos. Nevertheless, the essentialism embedded in our habits of thinking and talking about these problems confounds our collective ability to "see" these violences clearly, to situate them within enmeshed webs of relation, distributed causation, and multiple sites, scales, and histories.[11]

This haunting essentialism generates "discursive gaps" and "discursive risks" that compound other late industrial hazards (Fortun 2012, 2014). Discursive gaps are the gulfs between these problems and the language we have to think about, talk about, or deal with them. Discursive risks are the hazards we face in relying on established yet inadequate idioms anyway (Fortun 2012: 452). In our late industrial moment, many of the concepts that are foundational to environmental science and governance are in profound flux. Increasingly, the meanings, stakes,

[11]Fortun defines *industrial language ideology* as "habits of mind, language, building, and regulation in the industrial order that privilege production, products, property, and boundaries-- in a way that systematically discounts transboundary migration (of toxic chemicals across the fencelines of factories or out of products like carpets, plastic bottles, or electronics) and trespass (into human and other bodies, usually--in biomedicine, for example-- also considered bounded and quite immune to environmental insult)" (2014: 313).

and significance of *community*, *air pollution, government*, and *science*-- as well as of *justice*, *racism*, *capitalism* and *the environment* -- are being questioned widely, publicly, and radically.

This is not new to the environmental justice movement, now over forty years old, which has always been concerned with intersectionality of race, class, gender, migration, and indigenous sovereignty, and with re-defining racial and social justice in environmental terms (Bullard 1990, First National People of Color Environmental Leadership Summit 1991, Schlosberg 2007, Sze 2020, Taylor 2014). In recent years, however, the discourse of environmental justice has expanded vastly in reach and scope, appearing on the platforms of 2020 US presidential candidates and the pages of Instagram influencers, and increasingly invoked in conversations about immigration, homelessness, climate disaster, police violence, and the global pandemic. Environmental justice is particularly resonant as a deeply intersectional framework that links these crises to each other, to long legacies of settler colonialism and racial capitalism, and to a promise of a world otherwise. As Julie Sze points out, however, the expansion of this discourse is not without risk: "Naming problems as environmental racism, inequality, inequity, or injustice has different philosophical and political stakes and distinctly positions the roots and solutions…[Ongoing meaning-making makes EJ continually relevant], but meaning-making and expansion without a clear sense of politics and position is dangerous" (2020: 6).

These discursive gaps and risks are occupational hazards of EJ work. In this dissertation, I show how different stakeholders navigate these discursive risks within the compounding hazards of accelerating global climate change, intensifying racial health disparities, eroding public confidence in scientific and state governance regimes, transformations in participatory knowledge production through citizen science and social media, and growing public investment

in data-based governance-- both before and since the COVID-19 pandemic. Within this context, those engaged in community air monitoring struggle to understand and represent these problems in ways that make their imbrication visible, and to find solutions from within the same structures that produced them in the first place.

As I write this introduction in summer 2021, record-breaking heat, fire, floods, and hurricanes devastate communities on every continent. From where I am sitting in Massachusetts, on the East Coast of the United States, smoke from wildfires in Western Canada have darkened the skies from thousands of miles away. However "slow" the violences of air pollution may seem, it has never been more clear that we are running out of time to deal with them. This urgency creates an impossible double bind (Bateson 1972) for those who are breathlessly grasping for new language but who cannot wait for it to change. In late industrialism, discursive risks are as unavoidable as the air we breathe. For my interlocutors, community air monitoring is a strategy for navigating these double binds. CAM projects, like the pollution paintings, seek to make visible the causes, effects, and stakes of air pollution in new ways so that new idioms for action become available.

V. Enacting Environmental Justice

This project explores how environmental justice is *enacted* -- both encoded into law and policy as well as brought into being through everyday sociomaterial practices (Mol 2002)-- through projects of community air monitoring (CAM) in Southern California, a region where CAM has proliferated in recent years and which is hailed as a global model for the use of participatory, low-cost methods for characterizing air pollution and environmental inequality. Through ethnographic focus on community air monitoring projects in Los Angeles, Orange County, San Diego, and the Imperial Valley, I investigate how multiple stakeholders engage in

the double-binds of "doing" environmental justice at a time of profound discursive, sociopolitical, economic and environmental instability.

The empirical focus of this dissertation is on how environmental justice is fashioned as a legal, scientific, and moral framework for understanding and addressing air pollution in California. The theoretical grounding of this project is also in the growing body of interdisciplinary scholarship known as Environmental Justice Studies (Pulido 1996, Mohai et al. 2009, Pellow 2018). This dissertation thus engages EJ Studies both as a dynamic field of study and a subject of ethnographic research. This research is situated at the cross-section of several major themes in this body of scholarship, including (1) how environmental racism is produced and naturalized through ongoing processes of settler colonialism and racial capitalism (Bullard 1990, 1993; Liboiron 2021; Pellow 2018; Pulido 2016a, 2016b, 2018; Pulido and De Lara 2018; Vergès 2017; Woods 1998; Zimring 2016); (2) how social movements articulate intersecting environmental, racial, economic, and social concerns through dynamic frameworks of environmental justice and environmental racism (Brodkin 2009, Bullard 1990, Cole and Foster 2001, First National People of Color Environmental Leadership Summit 1991, Fortun 2001, Sze 2020, Taylor 2014), (3) how situated technoscientific practices are implicated in elite and counter-knowledges about environmental pollution and injustice (Boudia and Jas 2014, Corburn 2005, Choy 2005, English et al. 2018, Gabrys 2019, Kimura 2016, Kimura and Kinchy 2019, Ottinger 2013a, Ottinger and Cohen 2011, Wylie et al. 2017), and (4) how environmental justice and injustice are defined and operationalized in environmental governance regimes (Baptista 2008; Harrison 2016, 2019; Holifield 2004; Lee 2021; Pulido et al. 2016; Schlosberg 2007).

The following chapters analyze how air pollution and environmental justice are constructed as matters of public concern through the technologies and practices of community air

monitoring, including air quality sensing, mapmaking, community engagement, and science-to-governance pathways. In each chapter, I highlight how these practices that constitute what is broadly defined as "community air monitoring" can both expand and foreclose the ways in which environmental justice is conceptualized and addressed. Although each chapter highlights multiple case studies of community air monitoring projects at sites across the region, the ethnographic focus of this dissertation is Vecinos Unidos' community air monitoring project in southeast Santa Ana.

In Chapter 1, "Sensing Crisis: Shifting the Sites and Scales of Air Quality Monitoring," I argue that community air monitoring projects are part of a nascent paradigm shift in air pollution science that is altering the privileged sites, scales, actors, and pathways of environmental knowledge production– and in doing so, changing how air pollution is conceptualized as a public problem. I situate the recent rise of community science on air pollution within a brief history of air quality monitoring in the United States and argue that the technologies and practices of community air monitoring have emerged as a response to a confluence of crises in air pollution science and environmental governance regimes. Focusing on science and advocacy conducted in California's Imperial Valley, I show how community air monitoring helps enact a shift in what kinds of air pollution matter, and how. By drawing attention to scales of the body, home, and neighborhood (rather than region or air basin), to the experiences of residents (rather than emitters and regulatory bodies), and to the collective and cumulative impacts of pollution (rather than individual emissions sources and types), community air monitoring is helping redefine air pollution as an "environmental justice problem" in environmental science and governance.

In Chapter 2, "Making Air Matter: Enacting Pollution as a Community Concern," I study how air pollution emerged as a public problem at particular moments and locations in Southern

California in the last decade. While much of the discourse about citizen science emphasizes questions of representation– who produces environmental knowledge, and how well that knowledge reflects the world– I turn attention in this chapter to the way community monitoring practices help to construct pollution itself in historical and local context. I explore several CAM case studies in Paramount, Imperial County, and San Diego, all of which helped to inform the implementation of California's AB 617 mandating community air monitoring across the state. Drawing on the philosophical and methodological framework of *enactment*, or how ontologies are "brought into being, sustained, or allowed to wither away in common, day-to-day, sociomaterial practices" (Mol 2002: 6), I show how particular forms of air pollution materialized through situated scientific, legal, social, and political practices in each case. I argue that the practices of community air monitoring are not, fundamentally, about how to "know" air pollution, but rather about how to "do" it– in other words, how the technical work of monitoring brings pollution into being as a collective concern.

In Chapter 3, "Si(gh)ting Disadvantage: Mapping the Environmental Justice Community," I examine how the operationalization of "environmental justice" under California law hinges on the spatial demarcation of "disadvantaged communities" (DACs) through mapping tools like CalEnviroScreen. While the mapping of California's DACs makes visible and manageable environmental justice problems previously unaccounted for in regulatory regimes, locating EJ as a problem of and within these DACs can obscure the global and historical co-production of advantage and disadvantage that exceeds the boundaries of the DAC itself. I analyze how EJ activists across Southern California have advocated for and with the DAC designation, as well as against and beyond it, in order to identify the limitations and possibilities of an EJ framework rooted in a mapped definition of disadvantage. I draw out the multiple

meanings of "the environmental justice community" within the EJ movement, showing how EJ maps have been used both as tools of state control as well as of community self-determination.

In my fourth chapter, "Articulating Air Pollution Knowledges: Reaching for Environmental Justice in Santa Ana," I return to the chicken-or-egg question of "how to do community air monitoring" that my interlocutors and I encountered at the start of this introduction. In late 2020, after many months of learning about pollution, air monitoring, environmental policy, and EJ advocacy in their own community and others', Vecinos Unidos was faced with the task of designing an air monitoring project that would address and advance the neighborhood's vision and goals. In this chapter, I analyze Vecinos Unidos' articulation efforts to align their localized goals, questions, knowledge, and concerns in their own CAM initiative. I discuss in depth a workshop we collaboratively developed to help the Vecinos Unidos EJ steering committee learn from other CAM projects in order to design a neighborhood air monitoring study in Los Robles, drawing together ethnographic insights from several case studies across the region without foreclosing alternative possibilities in Santa Ana. I show how this articulation work is a critical part of environmental knowledge production that reaches beyond available frameworks in order to enact new knowledge forms.

In the conclusion, "Risking Environmental Justice," I call attention to the discursive risk incurred by the expansion of "environmental justice" as a framework for apprehending contemporary social, political, economic, environmental, and public health crises. I situate the contributions of this dissertation within a genealogy of critical environmental justice studies, which has shown how environmental injustice is produced through the exploitation and valorization of racialized difference that makes particular communities expendable and pollutable. I argue that the valorization of "community engagement" in research and

policymaking hinges on an essentialized idea of community that is defined by its devaluation, foreclosing solutions beyond this set of relations. I argue that community air monitoring exemplifies a politics of enactment in the movement for environmental justice, one that refuses essentialized definitions of singular problems or solutions, and instead continually reaches for new articulations.

Across these chapters, this dissertation documents and theorizes how environmental justice is being defined and mobilized in California at a historical moment when it is gaining momentum and visibility as a framework for understanding the intersection of political, economic, environmental, and public health crises. I explore the means through which environmental justice is enacted legally, scientifically, and programmatically through community air monitoring. I show how CAM helps draw the roots and effects of environmental injustice into visibility in new ways, challenging entrenched paradigms of air pollution science and governance. I also call attention to the ways old essentialisms– of "environment," "disadvantage," and "community," –continue to haunt such efforts to enact new forms of environmental knowledge production, risking our ability to conceptualize and address the systemic, historical production of these problems and envision alternative futures. Throughout, I highlight how communities are reaching toward environmental justice through the work of community air monitoring, through and in spite of these risks and double binds.

CHAPTER 1
Sensing Crisis: Shifting the Sites, Scales, and Scope of Air Quality Monitoring

I. Introduction

Report #914: *Arial Spraying of fumes near homes*
Date: *Tuesday June 27, 2017 5:53 AM*
Location: *El Centro CA, 92243 Country Homes*
Category: *Pesticides*
Status: *In Progress*

Description: *On September 26, 2016 while enjoying the afternoon out in our front yard at approximately 4:30pm. A fumigation helicopter commenced his fumigation duties on the field right across the street from my home. Being that it was a windy afternoon, it cause the mist of the sprayed substance to make its way to my home to the point that we all felt the mist in our faces. We immediately ran for cover inside of our home, and closed the windows. I grabbed eye and face protection walked outside and began recording. Shortly after a Chevy truck came to my home, the man inside the truck asked if there was a problem. I explained to him what had happened and expressed my concerns. After a short discussion, we agreed that he would contact me every time they were going to spray. From this incident on, I was contacted via call or text to my cell phone to let me know that they were going to be spraying. I would then close all windows, put wet towels to seal the doors, and turned off the air con or heater if needed. This process would be conducted every time they were going to spray... [On June 15, 2017 at 12:10 am] while my family and I were sleeping... I received a phone call from the above mentioned man of the Chevy truck asking if they could spray the field east to my home. After a 6 minute discussion I agreed. At 1:25 am I received a text message that said that they were going to commenced spraying the field. I then turned off my air conditioner. At 1:53 am I was advised that they were done via text message. The following morning of June 15, 2017. My wife woke up with a severe skin reaction all over her body causing her to go to El Centro Hospital emergency room. Later that day due to*

Figure 1A: *This frame from one of two videos uploaded with the report shows a small airplane flying low over a field, visibly trailing plumes of pesticide droplets. Over the loud whirring of the plane engine and a rooster crowing nearby, a voice narrates the scene: "This is the second time today. Five in the morning, and again in the afternoon… that's how close to our house it is."*

severe discomfort, we went to see a specialist. The doctor advised that it was highly possible that this reaction could have been a result from a chemical exposure. On June 22,2017 my 6 year old son developed the same skin reaction. We then took him to the same specialist that my wife had seen. His diagnoses was the same, a chemical reaction with an addition chronic pulmonary respiratory infection. On June 27, 2017 at approximately 5:30 am. We were awakened by the loud noise of a peculiar airplane flying over our house. We then realized that the crop field west of us was being sprayed. We immediately got up to turn off the air conditioner system and to seal the door gaps. At approximately 5:53 am we began recording. Later the same day at approximately 7:02 pm once again the same crop field west of our house was getting sprayed with moderately strong winds blowing east towards our house... This activities has robed the comfort of my family and has taken an impact to our health. In March 2017 I came down with a episode of Bells Palsy, and now I am questioning if my surroundings had an influence of this condition.

***Administrator Comment:** 07/28/2017: The DTSC Imperial CUPA has forwarded this report to the Ag Commissioner's Office. Response: While this complaint is very thorough and has many very serious concerns, it was also difficult to investigate. We were unable to establish that drift occurred in this case. One thing that I would encourage of anyone reading this, please contact my office as quickly as possible upon an incident involving pesticides and particularly pesticide drift. We can address a complaint before it becomes a pattern and will use our resources to investigate. Please contact the Pesticide Use Enforcement Division of the Agricultural Commissioner's office at 442-265-1500 to report a complaint.*

* * *

Report #914, excerpted above, is one of hundreds archived in the Investigating Violations Affecting Neighborhoods Environmental Justice Monitoring and Reporting Network, or IVAN. The IVAN Network was established in 2008 by Comité Cívico del Valle, a grassroots environmental justice (EJ) organization, to address several glaring gaps in air pollution governance in the Imperial Valley, an arid agricultural region in southeastern California. Report #914 is striking not only in its account of the embodied harm caused by local air pollution, but also as an example of the multiple environmental governance challenges that often compound these hazards. These challenges include how regulatory monitoring fails to capture pollution at fine spatial and temporal scales (like pesticide spray events), little coordination among multiple

organizations and agencies responsible for pollution governance (like the Air District, the Department of Toxic Substances Control, and the Agricultural Commission), and a lack of public transparency and accountability following public reports of pollution concerns (except those archived on the IVAN Network). Created in response to these problems, the IVAN Network creates an infrastructure for documenting, archiving, and mobilizing environmental data in ways that differ from formal, state-run air monitoring. As I explore in this chapter, community air monitoring initiatives like IVAN do more than document gaps in existing governance regimes. In the Imperial Valley, community monitoring works to enact a shift in what kinds of air pollution matter, and how: drawing attention to scales of the body, home, and neighborhood (rather than region or air basin), to the experiences of residents (rather than emitters and regulators), and to the collective and cumulative impacts of pollution (rather than individual emissions sources and types).

This chapter considers community air monitoring (CAM) projects like the IVAN Network as part of a nascent paradigm shift in air pollution monitoring (Snyder et al. 2013) in which the privileged sites, scales, actors, and pathways of environmental knowledge production are changing– and in the process, shifting how air pollution is conceptualized as a public problem. In this chapter, I situate the recent rise of "citizen science" or "community science" on air pollution within a brief history of air quality governance in the United States. I show how the technologies and practices of CAM have emerged as a response to several crises in air pollution science, in particular the role of monitoring in environmental regulation. I argue that CAM is ushering in a new paradigm for understanding air pollution broadly as an "environmental justice problem": as cumulative and variegated in its health impacts, requiring collective action across institutions, populations, and scales.

II. Scientific Paradigm Shifts

Physicist and philosopher Thomas Kuhn first articulated the concept of a paradigm shift in *The Structure of Scientific Revolutions* (1962), characterizing the process by which a prevailing scientific framework is replaced with a new one. Kuhn writes that scientific disciplines cycle through periods of "normal science," in which key theories, values, and technologies of the discipline are mostly fixed and taken for granted, and "revolutions," in which the dominant disciplinary matrix is refuted, challenged, and eventually revised. Normal science is characterized by widespread consensus within a discipline, in which its foundational theories and experimental practices are generally held in common. These shared concepts, values, and practices constitute a scientific paradigm. Within the course of normal science, scientists encounter anomalies for which the dominant paradigm cannot fully account. With the accrual of these anomalies over time, a scientific discipline reaches a state of crisis, catalyzing experimentation with theories and practices beyond the structure of the dominant paradigm. Kuhn calls this activity *extraordinary research:* "the proliferation of competing articulations, the willingness to try anything, the expression of explicit discontent, the recourse to philosophy and to debate over fundamentals" (1962: 91). It is through this extraordinary research that scientific revolutions unfold, eventually ushering in a novel paradigm that comes to replace the old one. A key argument of *The Structure of Scientific Revolutions* is that science does not typically progress through gradual, incremental change, but rather through paradigm shifts that destabilize dominant frameworks as a response to fundamental crises in the discipline.

I argue in this chapter that community air monitoring is a form of extraordinary research extending the science of air quality monitoring beyond the limitations of the current dominant paradigm. Enabled by advances in air sensing technology and citizen science infrastructure, CAM has arisen in response to a confluence of crises in air monitoring– especially its failure to

capture and respond to environmental injustice, or the ways air pollution is experienced unevenly and shaped by race, capital, and power. As a form of extraordinary research, CAM challenges prevailing norms of air pollution science-as-usual, experimenting with new theories and approaches about how best to characterize and govern air pollution. Like all extraordinary research, CAM is heterogeneous, including a wide range of study designs, methods, tools, goals, and practices.

Below, I describe how the prevailing paradigm of air quality monitoring in the United States evolved from early air pollution governance efforts in Los Angeles. Through this history, I highlight key characteristics of "normal science" within this paradigm: it is regional in scale and regulatory in focus. Next, through examples of air pollution in the Imperial Valley, I show how the normal science of regional, regulatory air quality monitoring –even when done "well"– fails to apprehend air pollution problems as experienced by those who live in the valley, and how these failures have come to be characterized as a crisis in the air governance paradigm. I then show how the "extraordinary research" of community air monitoring, using new low-cost air sensing technology and emergent tools from the citizen science movement, has mobilized air pollution data beyond its existing uses within environmental regulatory regimes. I close by arguing that this extraordinary research is already in the process of informing a new paradigm through its focus on environmental justice, driving transformative changes in environmental policy as well as science in and beyond California.

III. The Normal Science of Air Quality Monitoring

The existing paradigm of air quality monitoring is best understood through a history of modern air pollution governance in the United States, which shows how air pollution science and regulatory regimes evolved in tandem in Southern California since World War II. The history of

air pollution control in the Los Angeles region, once widely known as the "Smog Capital of the World," was the first large-scale air pollution control effort in the world, and among the most complex, controversial, and high-profile (Haagen-Smit 1970). The development of air pollution control in Southern California critically shaped the "normal science" of regional, regulatory air quality monitoring that has prevailed in the United States since 1970, and created the blueprint for air quality regulation at state, national, and international levels. This section shows how Southern California's smoggy history informed the existing paradigm of air quality monitoring, which is (1) focused on a regional scale, (2) based on federal and state ambient air quality standards, (3) conducted by environmental regulatory agencies, and (4) reliant on a relatively limited amount of data.

A. The South Coast Air Basin, Smog Capital of the World

The Los Angeles Air Basin, also known as the South Coast Air Basin, is still the smoggiest region in the United State, a bowl of air pollution formed by local geographic and meteorological features as well as histories of speculative capital and settler colonialism. The Santa Monica, San Gabriel, and San Jacinto Mountain Ranges, with peaks up to 10,000 feet above sea level, form a semi-circle around the basin. Daytime wind patterns blow inland from the Pacific ocean, collecting smog in the basin, while weaker nighttime winds disperse some of the pollution offshore. The dry subtropical climate, which averages only a month of rainy days per year, subjects the air basin to continual sunlight, which catalyzes the photochemical reactions of ozone with vehicle and industrial emissions that produce the smog that frequently blankets the region. Despite improvements in air quality in recent decades, the US EPA classifies the South Coast Air Basin as one of only two areas of "extreme nonattainment" for ozone pollution targets in the country; the other is in California's San Joaquin Valley (EPA 2022). Recent research

shows that the air basin's air quality is increasingly dependent on rising temperatures (Nussbaumer and Cohen 2021). These regional challenges are intensifying as an extreme housing crisis pushes commuters farther from their jobs, the warehousing industry booms in response to the rapid growth of online commerce, and climate change exacerbates environmental vulnerability.

Since the 19th century, and as recently as the 1930s, California enjoyed a reputation as a land of healthy air, with boosters and speculators from the oil, real estate, and railroad industries touting its salubrious coastal air as part of their efforts to increase Anglo settlement from the East Coast (Nash 2006). Southern California's oil boom in the 1920s and 1930s accelerated this expansion. It drew mostly white settlers from the South and Midwest, driving the violent displacement of Japanese farmers from oil-rich land and the creation of a racially segregated residential landscape through racial real estate covenants (Cumming 2018, Davis 1990, Nash 2006). By the 1940s, the automobile industry set its sights on Southern California as an untapped market. Borrowing a strategy from 19th century railroad tycoons, the industry spurred the construction of the world's most expansive network of freeways to establish regional dependence on the automobile as the primary form of transportation (Davis 1990, Jacobs and Kelly 2008, Rothstein 2017). As with the oil industry before it (Cumming 2018), the automobile lobby was closely linked to real estate interests (Davis 1990, Jacobs and Kelly 2008). Freeways were strategically built through Black and Latinx neighborhoods to displace residents of color, increase property values, and accelerate the development of suburban real estate (Estrada 2005, Pulido 2000, Rothstein 2017). Even today, the resulting landscape is a densely populated but sprawling expanse of suburban development, laced with freeways swollen with traffic, corralled by mountains and baked by year-round sunshine: a perfect recipe for smog.

B. 1940s: The Birth of Smog, and of Air Quality Control Districts

The first documented attack of eye irritation from air pollution in Los Angeles occurred in 1942, in the midst of World War II, and was attributed at the time to smoke from a wartime rubber factory (Haagen-Smit 1970). When the war ended, however, the pollution persisted. By the mid-1940s, air pollution in the city was ubiquitous (Jacobs and Kelly 2008). Throughout the early 1940s, Angelenos complained of frequent and often severe eye and throat irritation, coining the portmanteau of "smoke" and "fog" to evoke its near-daily presence in the city's air (Haagen-Smit 1970, Nash 2006). Unlike coal-burning regions in other parts of the country, where the source of air pollution was apparent, the provenance of southern California's smog and its mysterious bleach-like smell was harder to pin down (Haagen-Smit 1970). In 1945, in response to the growing smog problem, Los Angeles County appointed a Director of Air Pollution Control and passed some of the state's first air pollution ordinances, including one limiting smoke emissions from any single source (Haagen-Smit 1970: 888).

It soon became clear that county actions alone were insufficient for effective air pollution governance. In the words of Arie Haagen-Smit, an air chemist dubbed "the father of air pollution control": "By 1946, it was plain that air pollution disregarded political boundaries" (Haagen-Smit 1970: 888). Since LA County ordinances had no jurisdiction in the cities within or outside its boundaries, they began to pressure cities in the region to adopt similar ordinances. At the urging of the LA County Counsel, the California legislature passed the Stewart Bill, or the 1946 State Air Pollution Control Act, permitting the creation of air pollution control districts for each county and empowering county supervisors to enforce air regulation (Haagen-Smit 1970). In 1947, the United States Supreme Court chaired by Earl Warren endorsed the nation's first unified smog agency, the LA County Air Pollution Control District (LACAPCD) (Jacobs and

Kelly 2008). Similar county districts were subsequently established in Orange County (1950), San Diego and Riverside (1955) and San Bernardino County (1956) (Haagen-Smit 1970).

C. 1950s- 1960s: The Politicization of Air Pollution

In spite of the LACAPCD's early efforts to address air pollution, the smog problem continued to worsen into the 1950s. Air pollution became a major issue in California's 1954 gubernatorial election after several days of lung-burning smog drew headline coverage that fall (Nash 2006). In 1956, the California Department of Public Health conducted a survey which found that smog factored into California residents' decisions to move to or from Los Angeles (Nash 2006). County air control efforts in the 1950s focused on developing rules, enforced by the sheriff's office, governing emissions at particular sources including petroleum refineries, chemical processing plants, and solid waste incinerators. This created opposition from the chemical and petroleum industries, as well as members of the public who had earlier demanded air pollution control but bristled at receiving tickets for backyard trash burning (Haagen-Smit 1970).

The growing politicization of air pollution was reflected in science as well as policy. Haagen-Smit's groundbreaking research led to findings that Los Angeles smog was different in character from air pollution in East Coast cities, eventually determining that smog resulted from a photochemical oxidation from automobile exhaust and industrial fuel combustion (Haagen-Smit 1950, 1970). In response, petroleum industry interests funded the Stanford Research Institute to discredit and refute this research (Haagen-Smit 1970).

Linking smog to automobiles as the primary source was politically controversial and importantly consequential for air pollution control efforts in general. Since automobiles are mobile sources of pollution, existing strategies to tackle air pollution by regulating

source-specific emissions at the county level were not up to the task. In 1959, California formed the statewide Bureau of Air Sanitation in the California Department of Public Health, setting the first ambient air quality standards in California. The following year, the state established the Motor Vehicle Pollution control Board for mobile sources, enabling statewide pressure on the automobile industry and setting emissions standards and smog test procedures.

D. 1960s - 1970s: Scaling Up Air Pollution Governance

The 1960s and 1970s continued the "scaling up" of air pollution control measures, building on the gradual transfer of authority from county, to state, to federal levels. In 1967, for example, California's Mulford-Carrell Act dissolved the Motor Vehicle Pollution Control Board and established the California Air Resources Board (CARB) with more far reaching powers beyond mobile sources alone (Haagen-Smit 1970). Meanwhile, the indigenous and environmental movements built power nationwide in the 1960s, placing growing pressure on the federal government to take action on environmental pollution. Health effects research began linking air quality to respiratory diseases and cancer (Rothman 2017). A 1969 oil spill ravaged California's coast, one of numerous environmental disasters across the country.

In 1970, the Nixon Administration established the Environmental Protection Agency (EPA), and Congress passed the landmark Clean Air Act. This comprehensive national legislation empowered the EPA to establish National Ambient Air Quality Standards (NAAQS) for hazardous air pollutants from both mobile and stationary sources. It directed states to develop implementation plans (SIPs) in order to achieve these standards by 1975, which in turn led to the development and institutionalization of air monitoring programs in regulatory agencies across the country to measure progress toward air quality benchmarks (EPA 2013).

In 1977, having largely failed to attain NAAQS set by the US EPA, California overhauled its air district system from county-level control to its current system of air basins. The California legislature merged county air districts into larger districts based on air basins, a geographic and meteorological designation that more accurately reflected actual air pollution patterns. The LACAPCD was replaced by the South Coast Air Quality Management District (SCAQMD) to more effectively monitor and attain federal and state ambient air quality standards for the entire South Coast Air Basin. Today, SCAQMD's jurisdiction includes portions of Los Angeles, Riverside and San Bernardino counties and all of Orange County. (It also includes portions of the Salton Sea and Mojave Air Basins in Riverside County).

E. The Current Paradigm of Air Quality Monitoring and its Limits

The brief history above helps to show how the current scientific paradigm of air quality monitoring came to be. This paradigm is focused on the collection of air pollution data primarily by government and industry for regulatory purposes, based on historical and ongoing concerns with ambient regional air quality based on Southern California's 20th century smog problem, and shaped by a variety of political and scientific interests.

Within this current paradigm, state and federal agencies (e.g. CARB and US EPA) establish ambient air quality standards which set limits for specific criteria pollutants (e.g. ozone or nitrogen dioxide). Regional agencies, such as the SCAQMD, are tasked with developing, implementing, and enforcing rules to ensure attainment of these standards for their air basin or region. Compliance monitoring is conducted primarily using expensive, stationary ground sensors dispersed throughout the regional jurisdiction, which are designed to assess regional averages over hours, days, weeks, or months. For example, SCAQMD has ten regulatory monitors dispersed across its five-county jurisdiction, and air quality data collected from these

monitors informs assessment of their compliance with the NAAQS set by the Clean Air Act and state standards set by CARB.

Direct monitoring at pollution sources has long been considered expensive, impractical, or politically contentious since at least the 1970s (Babich 2018). To assess compliance with emissions permits for individual pollution sources, environmental agencies rely largely on self-reported emissions data from companies, which are often outdated, incomplete, or inaccurate (Song 2021, Leven 2018). Even in the case of permit violations, this data is often not available to the general public. Agencies like SCAQMD have a broad enforcement directive, and they do have programs for detecting and enforcing emissions violations for particular sources, but regional-level ambient air quality monitoring remains the main tool for meeting their primary mandate of addressing overall pollution in the air basin.

In other words, the current paradigm of air quality monitoring has been developed by regulatory agencies with a focus on regional problems, and regional solutions. Its primary sensing technologies and methods privilege air quality patterns at a larger spatial and temporal scale, and they focus on attainment of individual pollutants rather than cumulative pollution. Direct monitoring at air pollution sources is not routine or even required, and air quality regulatory agencies nationwide rely largely on emitters' self-reported data and on regional estimates of ambient air quality based on widely dispersed ground monitors to assess compliance. Air pollution data, even when publically accessible, is usually designed for use by government, industry, or research, rather than the general public, through government websites, permit records, and research databases (Snyder 2013).

IV. Sensing Crisis

In recent years, the paradigm of regional regulatory monitoring has increasingly been called into question by scientists, regulators, and environmental justice advocates alike. The privileged tools, models, actors, and applications of the "normal science" of air quality monitoring fail to capture or address many aspects of the problem, especially for people and places most impacted by air pollution. Because of the ways air pollution is concentrated in poor communities and communities of color, the inability of the current paradigm to sense localized, cumulative pollution helps maintain a "regime of imperceptibility" in air pollution governance (Murphy 2006) in which environmental racism has been largely left out of the science of air quality monitoring. Because "what is measured is managed" (and what is unmeasured is not), this has contributed to an "environmental racism gap" (Pulido 2015) in which racial disparities in environmental health have worsened, even as universal environmental quality has improved.

Those in the environmental justice movement and many others affected by environmental injustice have long been aware of the gap between official, regulatory air pollution knowledge and lived experiences of breathing polluted air. Community science and the ability to shape and innovate environmental knowledge infrastructures has long been a cornerstone of environmental justice advocacy (Cohen and Ottinger 2011, Ottinger and Sarantschin 2017). Just within the last decade, however, innovations in air sensing technology have helped to transform the ability of EJ advocates and residents of polluted communities to collect and represent air quality data, drawing attention to the failures of regulatory sensing techniques. In other words, EJ communities have long *sensed a crisis* in the current air monitoring paradigm, but new technologies in air monitoring have helped to bring the current sensing paradigm into a state of crisis within the science of air monitoring, through mounting public recognition of its limitations.

Legal scholar Adam Babich calls the current regulatory air monitoring paradigm an "unfulfilled promise" based on the outdated Clean Air Act-era assumption that "extensive, direct monitoring of industrial emissions and air quality" are "too difficult and expensive to be practical" (2018: 569). While the Clean Air Act grants EPA broad authority to mandate direct emission and air quality monitoring, the agency has historically avoided direct monitoring of sources to avoid the perception of instrumentality by industry interests (Babich 2018: 572). Air monitoring technology has advanced significantly since the 1970s, including through the use of satellite data pioneered by NASA over 20 years ago (Averett 2022). Thus, despite many technological advances in monitoring technology, regulatory monitoring programs continue to rely on estimates based on regional monitors and industry's self-reported facility emissions rather than direct monitoring at the source. In one salient example, SCAQMD conducted a 2017 study of refinery emissions in Wilmington and West Long Beach using cutting-edge optical remote sensing technology, which found that the refinery significantly underestimated its emissions of criteria pollutants, in one case by a factor of hundreds. The refinery had recently undergone an environmental impact assessment to obtain permission for a merger and expansion with a neighboring refinery, but SCAQMD did not allow its own data to be used in the assessment because optical remote sensing was not part of their regulatory monitoring protocol. The merger and expansion went through.

The evolution of air pollution governance since the mid-20th century is often described as a shift from a localized focus on metropolitan smog production to more global concerns with transnational pollution, ozone depletion, and climate change (Fenger 2009). In recent years, however, the proliferation in the applications of Big Data has brought attention to the limitations of higher-level approaches of existing regulatory air quality data, especially for characterizing

and addressing local variation and demographic disparities in exposure to pollution (English et al. 2017, Morawska et al. 2018). For example, studies combining pollution and demographic data sets demonstrate how city and regional air data often fails to capture neighborhood-level differences in pollution, eliding consideration of race and class-based disparities in exposure (Greenfield et al. 2017, Liévanos 2018, Cushing et al. 2016). In many communities, there are too few ground monitors to accurately sense local air quality, and lack of local, direct monitoring is a source of widespread concern and frustration (Averett 2022). For example, the nearest regulatory monitor to the industrial zones in Southeast Santa Ana is located over five miles away in Anaheim. At the same time, regional-scale monitoring is also limited in its ability to address pollution at larger scales and across political borders. Contemporary air pollution challenges demand approaches that are *both* more localized *and* more connected and global.

In addition to developments in high-tech, high-cost monitoring technology such as optical remote sensing, the last decade has also seen rapid advances in low-cost air quality sensors, which has for the first time enabled actors other than regulators or professional scientists to directly measure air quality. With the advent of these low-cost air sensors, the places and actors involved in air monitoring have multiplied, through community-based air monitors and citizen science projects (Calvillo 2018; English et al. 2017; Morawska et al. 2018; Plautz 2018). Where regulators' methods for monitoring and regulating air quality have historically focused on regional monitoring, environmental justice advocates are increasingly arguing for more granular, locally relevant, and community-driven approaches. Low-cost air sensors and attendant transformations in data processing systems have sparked a "revolution" in air pollution monitoring (Morawska et al. 2018) by "democratizing" air monitoring (Plautz 2018). For example, citizen science networks like PurpleAir enroll non-experts in air monitoring, and

highlight discrepancies between regulatory air data at a regional scale and individuals' assessment of their personal exposure to pollution in their homes and neighborhoods (Plautz 2018). Environmental justice advocates and other community groups are using low-cost sensors to contest government air data and push for more equitable regulation (Ottinger 2009, Calvillo 2018, English et al. 2017). Low-cost sensors have also played a role in a broader global shift from source-based to exposure-based air pollution governance (Longhurst et al. 2009), as these sensors can be placed in homes, near schools, and along industrial fence-lines to assess local exposure (Morawska et al. 2018). However, the wide variety and relative novelty of these sensing technologies makes it difficult to maintain and verify data quality across users, locations, sensor types, posing challenges for translating low-cost sensor data for research and policy (Castell et al. 2017, Wyeth 2019).

To summarize, recent developments in monitoring technology, data capacity, and citizen science infrastructure have increasingly exposed the limitations of the current paradigm of air quality monitoring, including (1) its overreliance on data that is unreliable or incomplete, including emissions estimates that are self-reported by industrial sources, (2) its inability to capture pollution occurring on smaller spatial and temporal scales (such as middle-of-the-night refinery flares) due to its regional focus, (3) its related inability to characterize localized inequities in pollution exposure, and (4) a lack of accountability and transparency about air monitoring data and its use in regulatory enforcement. In Kuhn's terms, the growing technological and political capacity to "sense" these failures have placed the system of regional regulatory monitoring that has been in place since the 1970s into a state of crisis. In the next section, I tell the story of community air monitoring efforts in the Imperial Valley that have

helped expose the failures and push the limits of the “normal science” of regional regulatory monitoring in California.

V. Community Air Monitoring as Extraordinary Research

The Imperial Valley's unique geography renders it vulnerable to a confluence of environmental health hazards. Nestled in the northeastern tip of the Sonoran Desert, its intense, dry climate makes it seem like an unlikely hub of water-intensive industrial agriculture, which is responsible for half the county's employment and a large proportion of the United States’ lettuce production. The last trickle of the Colorado River is siphoned off via the All-American Canal into a vast irrigation network, leaving the river dry nearly year round along its final stretch to the Gulf of California. The inland Salton Sea, once fed by this river, has been slowly evaporating since the middle of the 20th century, following its brief mid-century heyday as a tourist destination. As the Sea shrinks, its salt concentration increases, poisoning its fish en masse and provoking blooms of algae in the shallow water. The seabed, or playa, is exposed by the acre, going airborne as it dries into fine-particle dust. This playa dust combines with other air pollutants, including pesticides, fumes from agricultural burns, and emissions from large-scale livestock farms and processing plants. Immediately to the Valley’s south, the US-Mexico border hosts clusters of *maquilas* built to take advantage of Mexico’s laxer regulations in Mexicali, the nearest major city. Long lines of commuter vehicles and diesel freight trucks idle at the checkpoints each day, waiting to cross. The region is surrounded to the east and west by coastal and Sierra mountain ranges, gathering a toxic mix of pesticides, diesel, industrial smog, and playa dust. The mountains channel high winds that whip across the valley periodically, kicking up the pollution in dense clouds. Rates of asthma and other respiratory diseases in the Imperial Valley are some of the highest in the United States.

Many of these air pollution hazards evade characterization through existing monitoring regimes. The Imperial County Air Pollution Control District (ICAPCD) has only a handful of monitors for its 4,482 square mile jurisdiction, providing little neighborhood-level data. Acute pollution events like windstorms, agricultural burns, and pesticide sprays (like the one detailed at the start of the chapter) are often averaged out or dismissed as anomalies in reports of daily, weekly, or monthly air quality averages. Regulatory challenges compound these monitoring limitations. While ambient air quality is governed by the ICAPCD, many common air pollution concerns such as pesticides are governed by the Department of Toxic Substances Control, with little coordination between agencies. Historically, both of these agencies have had little transparency and follow-up on reports from the public about air pollution concerns. This lack of transparency, combined with a widely held sentiment that the agencies are primarily beholden to the interests of corporate agriculture in the valley, has led to wide public distrust of regulatory officials (Interview, January 14, 2020). Within this landscape, a local community organization with a 30 year history in the valley piloted new approaches to rural community air monitoring that has had far-reaching effects on environmental justice policy in California and beyond it.

Originally founded as a farmworker health organization, Comité Cívico del Valle (CCV) turned its attention to air quality because of the widespread respiratory health concerns among its clients and constituents. But the vast, rural landscape bears little resemblance to high-profile pollution hotspots in urban industrial areas, and it took years for air pollution to emerge as a matter of public concern. Even as asthma became a growing public health issue in the valley in the 1990s, CCV did not connect it to air pollution until several years later, in the mid-2000s (Landis 2019). One local activist described having an outdoor picnic lunch with visiting officials from the California Department of Health in 2005:

> And then suddenly these mushroom clouds just start appearing huge, you know, like they like what you see on TV, you know, with atomic bombs and all that. And these people from the Bay Area [said], "What is that? What's happening? I feel like [we're in] a war zone." And I was like, "Really?" What really caught my attention was how surprised, and how amazed, and how disturbed these people from the Bay Area…were at the site of these agricultural burns– you know, these are things that become part of the scenery for us that live here. (Interview, January 2020)

After years of competing with other social services NGOs for limited funding streams focused on Latino community health, the organization under the leadership of Executive Director Luis Olmedo began reframing its mission as a matter of environmental justice. They began building relationships and alliances with environmental groups like the Sierra Club, and visiting EJ activists in other parts of California. Inspired by a bus tour of refineries and pollution sources led by EJ activists in Wilmington, near the Port of Los Angeles, CCV began inviting state officials from CARB and DTSC to visit Imperial Valley. They identified individuals in agencies at the state level who were proactive and willing to work with CCV, sometimes circumventing communication with intractable local agencies. The IVAN network was born in part through these novel collaborations with the state Department of Toxics, and eventually the ICAPCD (Interview, January 14, 2020).

The IVAN network was developed as a web-based tool to simplify the process for reporting environmental concerns and to establish a public archive of these reports. Reports can be made online or by phone, in English or in Spanish, and without submitting any personal information to a government agency — a feature important to many undocumented residents. Once a report is made, an IVAN volunteer (dubbed a "problem-solver") reviews the report, posts it to the database, and forwards it to one or more relevant agencies for follow-up. Unlike government systems for such complaints, IVAN archives all complaints in a public, searchable online database (across my fieldwork in LA, Long Beach, Santa Ana, and Imperial, the lack of

transparency about what happens to reports and not knowing who else has made complaints has come up repeatedly as a frustration for residents and activists). In addition to routing concerns to appropriate channels, IVAN has enabled activists to establish a public record of community complaints like emissions violations, nosebleeds, odors, and flares to pressure agencies for better regulatory enforcement and other changes. An additional six IVAN Networks have since launched across California, including rural areas like Coachella, Fresno, Kern County, and Kings County, as well as urban neighborhoods like Bayview/Hunters Point in San Francisco and Wilmington in Los Angeles.

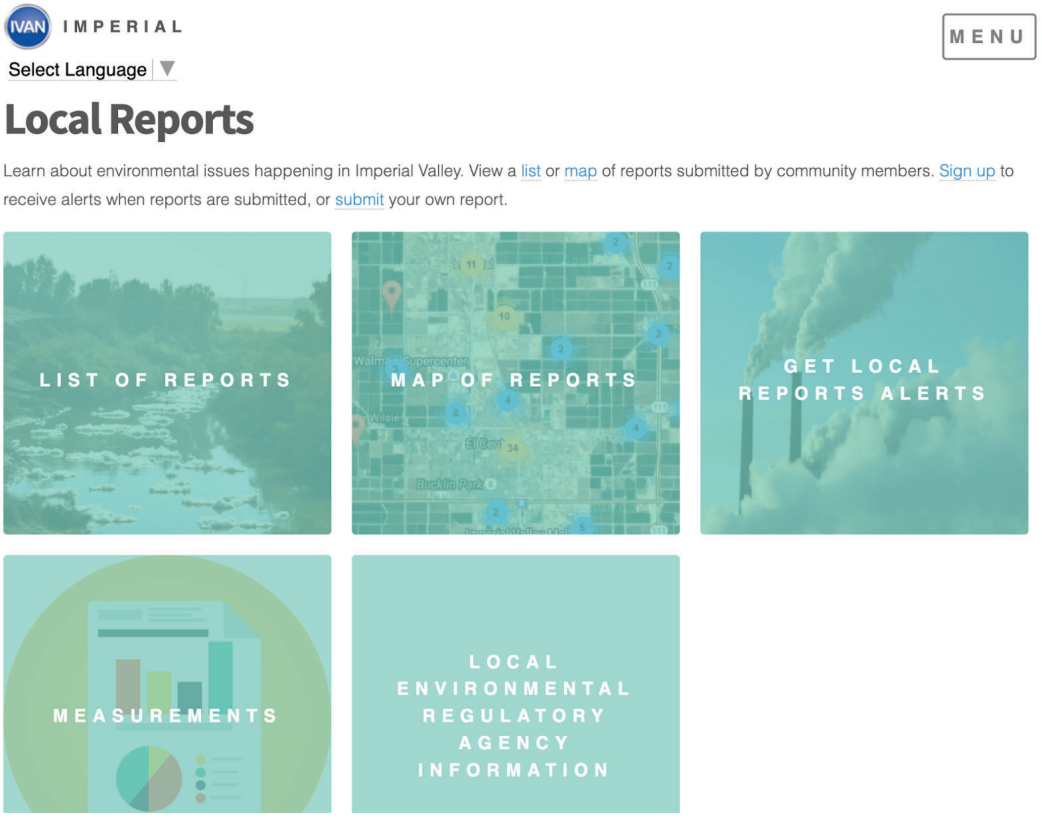

Figure 1B: *The dashboard for Identifying Violations Affecting Neighborhoods (IVAN) allows users to confidentially or publicly report pollution; to view all previous local reports as a list or a map; to sign up for alerts of local reports by text or phone; to see visualizations of average, monthly, and total reports by type; and to access contact information for all local environmental regulatory agencies in one place. All information is available in English and Spanish. Screenshot taken from https://ivan-imperial.org/report/dashboard on February 14, 2022.*

In 2015, Comité Cívico del Valle expanded their community air monitoring efforts to create the Imperial County Community Air Monitoring Network, a network of over 40 low-cost, stationary fine particulate matter ($PM_{2.5}$) sensors distributed throughout the valley, offering more granular data on particulate matter pollution across the region – the largest community-led air network in the world. Through a partnership with academic researchers and state public health programs, CCV assembled community steering committees of local residents and activists to help develop a study design, identify locations for monitoring sites, and oversee data collection and dissemination. Metal shop students at the local high school made the stands for the custom-designed monitors, which included a low-cost sensor, a power source, and a data transmitter. Residents volunteered to host monitors in their backyards and to conduct routine maintenance (English et al. 2017, Landis 2019). Data from the sensors is streamed in near-real time on a GIS map that shows their distribution throughout the valley, overcoming the challenge of temporal delays in air data that made pesticide sprays and ag burns difficult to capture. While sensor companies like PurpleAir also make real-time data from their sensors available publicly

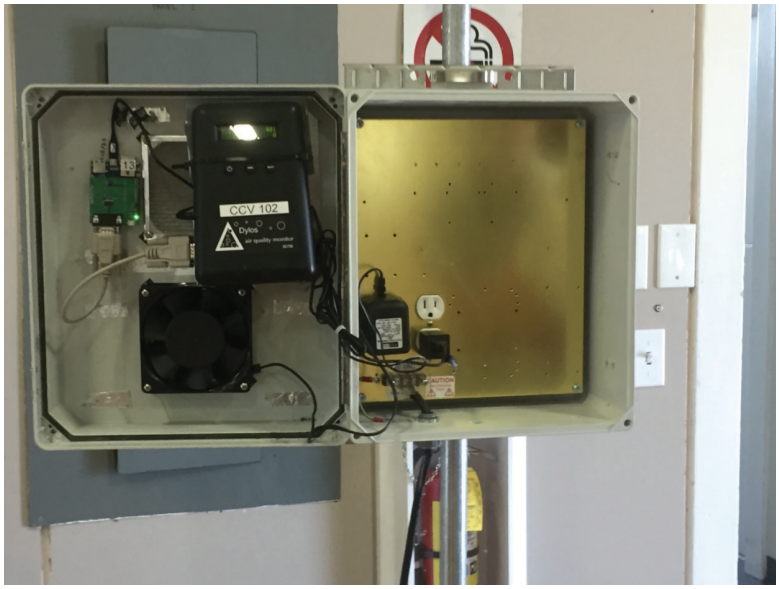

Figure 1C: *A model of one of the Imperial County Community Air Monitoring Network's 40 air monitors. The weatherproof box is held off the ground by a stand made by the local high school's metal shop students, and contains a low-cost Dylos PM 2.5 sensor, a power source, and a small circuit board to transmit the data over WiFi.*

around the world, CCV's data is managed and owned by the organization, allowing them to represent it according to community needs and priorities. For example, they adapted the color scale used by many public agencies and private companies in their visualizations of the Air Quality Index (AQI), but simplified it to make it easier to read and understand.

Through both IVAN and the air monitoring network, Comité Cívico del Valle and its partners adapted citizen science techniques and low-cost sensing technology to conduct air pollution science beyond the dominant air monitoring paradigm. Within the framework of regulatory monitoring, the pesticide spraying described in the report at the start of this chapter would likely not be captured by regulatory data. Even if it took place close to one of the valley's few regulatory monitors, it would register as a brief spike in the average ambient air quality – in Kuhn's terms, an anomaly. Of course, for the family whose home was sprayed with toxic pesticides, this anomalous event is experienced as several sleepless nights, severe skin reactions, a dangerous respiratory infection. Within environmental science and regulatory paradigms, quantitative representations of air quality are valued over embodied experiences of toxic air (Calvillo 2018, Cupples 2019). As forms of extraordinary research, the IVAN reporting network and the $PM_{2.5}$ network created the technical infrastructure for such "anomalies" to accumulate, rendering them quantifiable and legible to scientists and regulators and indexing the failures and limitations of the existing paradigm of regulatory air monitoring, opening alternative pathways for air pollution governance.

Comité Cívico del Valle's environmental monitoring programs received widespread acclaim, cited as models for community air monitoring initiatives in the neighboring Coachella Valley as well as in communities in Delhi and Taiwan. It also gained the attention of state lawmakers, inspiring the state's landmark environmental justice laws passed in 2017, including

AB 398 and AB617. In, the California legislature was debating renewing the 2006 California Global Solutions Act, revising and extending its targets for greenhouse gas emissions reduction from the year 2020 to to the year 2030. Concerned about mounting research that the original 2006 act had done little to address environmental justice issues, even worsening disparities in air pollution exposure (Cushing et al. 2016), environmental justice groups across the state pushed for the inclusion of measures to ensure benefits from the bill for the state's most heavily impacted communities.

Eduardo García, the California State Assemblymember for the Imperial Valley's 56th district, sponsored AB 398, the 2017 update to the state's climate change program that required prioritization of the state's disadvantaged communities. AB 398 was passed in conjunction with AB 617, which requires the California Air Resources Board to "develop a statewide air quality monitoring plan, identify disadvantaged communities most impacted by air pollution, and... develop local pollution reduction strategies for and deploy related technology in those communities" (Stratte and Kenline 2018). In its first year, AB 617 established the $500 million dollar Community Air Protection Program (CAPP) through which the California Air Resources Board (CARB) would select ten of the "most impacted communities" statewide. Regional air districts would convene steering committees of residents, EJ advocates, and representatives from local government, non-profit, and industry to develop community air monitoring plans (CAMPs) that would then inform community emissions reduction plans (CERPs) based on local needs and priorities. AB 617 also created a smaller Community Air Grants program funding "community-based organizations"-- mostly small nonprofits-- to develop technical capacity for their own community air monitoring programs. The law itself, as well as the program CARB

designed to implement it, were directly informed by the Imperial Valley air monitoring project (Interviews, January 14, 2020 and March 3, 2020).

VI. A New Environmental Justice Paradigm?

In a 2013 article in the Journal of Environmental Science and Technology, Snyder et al. hail the arrival of a paradigm shift in air pollution monitoring, ushered in by the invention of low-cost pollution sensors offering high resolution, real time data, enhanced data visualization technology, and wireless infrastructure for storing and disseminating air data. The shift from the "current approach" to the "new paradigm," facilitated by this sensor technology, includes changes in *who* collects the data (formerly governments, industry and researchers, now more communities and individuals), *why* data is collected (for purposes beyond compliance, monitoring, and enforcement), and *how* data is accessed (in formats beyond government websites, permit records, and research databases) (Snyder et al. 2013: 11369). The significance of these technological developments resonates broadly, with low-cost air sensing technology called "revolutionary" (Morawska et al. 2018), enabling a "citizen science explosion" that is driving a "shift in government-centric approach to environmental governance" (Wyeth et al. 2019).

While in agreement with these authors about the significance of the changes underway in the field of air pollution monitoring, this chapter argues for an understanding of this paradigm shift in broader social and historical context, rather than a technocentric narrative. Drawing on Kuhn's conceptualization of how sciences change, I argue that this paradigm shift arises not as a natural consequence of technological innovation, but rather in response to a crisis in the current paradigm – specifically, its failures to apprehend air pollution as a matter of environmental justice. While emergent technologies are facilitating new ways of doing air pollution science, the

practice of community air monitoring emerges from a need to document and mobilize air pollution knowledge considered "anomalous" within the current paradigm.

This distinction, albeit a subtle one, is important for understanding the new paradigm on the horizon. The difference between the current and emergent approaches to air quality monitoring is not just a matter of who, how, and why air quality data is collected. It is, more fundamentally, a broad change in understanding air pollution as an "environmental justice problem." The "extraordinary research" of community air monitoring in the Imperial Valley, as elsewhere, are motivated by failures of existing monitoring science to address air pollution as a toxic effect of social injustice: localized, cumulative, spatially variegated, and embodied as illness in individuals, families, and communities. A shift toward an "environmental justice paradigm" requires a reprioritization of what kinds of air pollution knowledge matter, including a focus on localized pollution, its patterns of distribution, its cumulative effects, and the voices of those most impacted by it. I argue that seeds of this paradigm are already visible in many community air monitoring projects and in the institutionalization of these priorities in new environmental policy such as AB 617.

"It's a big deal for these air districts, it's a big deal for us," said a longtime EJ activist and current CARB employee of AB 617 and the statewide use of community air monitoring. "You have people working in these agencies who are scientists and engineers and they have PhDs and they think they know all the answers. And for them to let go, and to share control with the people who are most at risk… It's a big deal" (Interview, March 3, 2020).

CHAPTER 2
Making Air Matter: Enacting Pollution as a Collective Concern

I. Introduction: Enacting Environmental Public Health

In December 1993, researchers at the Harvard School of Public Health published the results of what would come to be widely known in environmental health sciences as the "Six Cities Study" (Dockery et al. 1993). The prospective cohort study estimated the effects of air pollution on mortality of over 8,000 adults in six United States cities, while controlling for individual risk factors like smoking. The study found strong associations of fine particulate matter ($PM_{2.5}$) with decreased life expectancy, with residents of more polluted cities experiencing a decreased life expectancy of up to 2-3 years (Dockery et al. 1993).

Subsequent research would show that the deleterious effects of air pollution on human health are especially evident in children, whose developing respiratory systems and higher levels of pollution exposure from spending time outdoors render them particularly vulnerable. Higher levels of air pollution are associated with increased rates of preterm birth, infant mortality, pediatric asthma, diminished lung function, and the development of atopic allergies and illnesses (Galizia et al. 1999, Laurent et al. 2016, Peters et al. 1999, Schwartz 2004). The landmark longitudinal Southern California Children's Health study tracked 1,759 school-age children between 1993-2001, and found that those who grew up in highly polluted areas had reduced lung growth and function equivalent to that of children in homes with parents who smoked, with lifelong effects (Gauderman et al. 2004). A 2015 follow-up study showed that, conversely, reductions in air pollution could improve children's health: a comparison of the original cohort to a new group of 863 children in the same area between 2007-2011 found greater lung function growth among the latter group, who grew up when Southern California air quality was much

better (Gauderman et al. 2015). Data from the same study found reduced respiratory symptoms among children during periods of relatively improved air quality (Berhane 2016).

Realizing the links between air pollution and children's health became a bellwether for air pollution as an environmental justice concern, drawing attention to neighborhood-level pollution and its effects on residents' health. Local rates of asthma-related emergency room visits, most of which are pediatric, are used as indicators in CalEnviroScreen and other studies of environmental health inequities, since these reflect both increased exposure to pollution and other forms of vulnerability such as access to effective preventive health care (OEHHA 2021).

Children's increased vulnerability to air pollution-related health problems is reflected in California policy, especially in the recognition of schools and childcare centers as vulnerable land uses. A 2003 law (SB-352) requiring a 500-foot buffer zone between preschools or daycare centers and highly trafficked freeways was one of the first such buffer laws in the country.[12] A new rule issued by the California Department of Pesticide Regulation in 2017 prohibited pesticide application within a quarter mile of public schools and early childcare facilities, also the first statewide rule of its kind in the United States (CADPR 2017). In fact, the yellow notices issued that first alerted the residents of Los Robles to air pollution hazards in their neighborhood were triggered by a state law mandating that air districts alert residents to new pollution-emitting facilities within 1,000 feet of a school.[13] Had the new Apex Industries building not been within this range of both Hamilton and Johnson Elementary Schools, Emma and her neighbors may not have learned about the air pollution hazards posed by this facility and others like it.

The last 30 years have seen tremendous advancements in research on pollution and human health and the emergence of environmental health sciences as a major field of study. In

[12] Notably, however, a 2016 investigation by KPCC found 169 early childhood education centers in Los Angeles located within the 500-foot buffer zone (Fernandes and Mendelson 2016).
[13] This story is told in the Prologue to this dissertation.

the process, this science has redefined what air pollution is and why it matters. In a 2014 interview, the lead author of the Six Cities Study noted that "the 'dirty' communities were all within air pollution standards at the time—they weren't defined as being 'unhealthy' by the Environmental Protection Agency (EPA)—but the Six Cities Study strongly suggested negative health effects in those communities" (Dockery 2014). Through statistical techniques that linked existing air pollution and mortality data, the study transformed what was considered "dirty air." The way that "epistemic objects" like $PM_{2.5}$ materialize through sociomaterial practices including science is helpfully understood through Annemarie Mol's concept of enactment (2002).

In her ethnography *The Body Multiple: Ontology in Medical Practice,* Mol develops an argument for social scientists to wrest materiality from the domain of biomedicine, arguing that medical ethnographers' concern with meaning and representation (to the exclusion of the material) misses the bodies at stake in disease, leaving the "physical reality" of disease "yet again an unmarked category" (2012:11). In order to develop an ethnographic theory of the body's materiality and ontological politics, Mol develops the concept of enactment, or the ways that "ontologies are brought into being, sustained, or allowed to wither away in common, day-to-day, sociomaterial practices" (6). Methodologically, understanding the materiality of the body and disease entails a focus on "events" (20) and "what is done in practice" (13), not (only) on the epistemological perspectives of the actors concerned.

In concert with Mol we can understand "epistemic objects" like air pollution and its effects on human bodies as actively realized, over time, through experiments and other scientific knowledge practices (Fischer 2007:556). Although she draws on poststructuralist theories of construction and materialist notions of production, Mol (2002) argues that we should focus on "enactment" instead of "construction" or "production." "Enactment"—how objects are realized

through practice—joins an epistemic object to the practices that bring it into the world. Rather than just giving objects "contested and accidental" histories (construction), they are given "a complex present…in which their identities are fragmented between sites" (Mol 2002: 43).

The concept of enactment enables ethnographers to move out of the binaries of "knower" (e.g. scientist) and "known" (e.g. air pollution) by "spreading the activity of knowing widely" over many technologies, objects, and habits (Mol 2002:50). In this vein, Jennifer Gabrys has written about how the recent proliferation of sensor technologies has transformed environmental "sensing practices" (2019b). She shows how the knowing of environmental problems is spread widely over "shifting ensembles of multiple humans and more-than-humans, environments and technologies, politics and practices," what she calls emergent "sensing entities" (Gabrys 2019b: 723). These evolving practices of sensing and knowing help collectives attune to environmental problems as inequitably distributed and cumulative. More pointedly, practices like prospective cohort studies, or air sensing, or even breathing itself, actively *enact* air pollution as an object– they "do" pollution as much as they "know" it.

This chapter is about how air pollution is done. It considers how air pollution has emerged as a public problem at particular moments and locations in Southern California in the last two decades. Much of the scholarship about citizen science emphasizes questions of representation– who produces environmental knowledge, and how well that knowledge reflects the world (e.g. English et al 2018, Kimura and Kinchy 2019). In contrast, I turn attention in this chapter to the way community monitoring practices help to realize pollution itself in historical and local context. I explore several CAM case studies in Paramount, Imperial County, and San Diego, all of which helped to inform the implementation of California's AB 617 mandating community air monitoring across the state. Drawing on the philosophical and methodological

framework of enactment, I show how particular forms of air pollution materialized through situated scientific, legal, social, and political practices in each case. I argue that the practices of community air monitoring are not, fundamentally, about how to "know" air pollution, but rather about how to "do" it– in other words, how the technical work of monitoring realizes pollution as a collective concern.

II. Pollution, Multiple

To understand how air pollution comes to matter, we must consider the multiple air pollutions at hand. Through her ontologically-oriented theory and methodology of enactment, Mol finds that there is no single, pre-given thing called "atherosclerosis," nor a single body in which such a disease is to be found: "The objects handled in practice are not the same from one site to another" (2002: 5). Rather, with each of the actors in her ethnography —patients, families, surgeons, internists, pathologists—disease is "done" differently. There are, in truth, multiple bodies and multiple atherosclerosis. Mol's argument thus demonstrates the inherent multiplicity and situatedness of the body, as revealed through a materialist, practice-oriented ethnographic methodology. Likewise, the material concern of air pollution is also multiple, as revealed in the stories below.

A. Making Chromium Pollution in Paramount

In 2013, residents of Paramount, California, a city in Los Angeles County, began noticing a strong metallic odor in the air, sometimes strong enough to taste. Many reported their concerns to the South Coast Air Quality Management District (SCAQMD), but the agency's investigations yielded little information. By 2015, the Exide scandal in the nearby city of Vernon had drawn national and international attention, as environmental justice activists unearthed evidence that a local battery recycling facility had released lead and other hazardous waste that poisoned

thousands of households for over 90 years – and that the agencies responsible for enforcing environmental protections (including SCAQMD) had knowingly allowed the plant to continue operating in violation of its standards for over four decades.[14] Activists and residents in Paramount grew increasingly worried that they had their own Exide in their backyard, and became frustrated by the air district's lack of action. "You can imagine what the community was saying," recalled an SCAQMD staff member. "But we just didn't have the data to do anything about it" (Interview, January 25, 2019).[15]

The South Coast Air Quality Management District (SCAQMD) is a regional agency tasked with ensuring compliance with state and federal ambient air quality standards in the South Coast Air Basin, a region which includes all of Orange County and parts of Los Angeles, Riverside, and San Bernardino Counties. As discussed more in Chapter 1, regional air districts like SCAQMD are the agencies responsible for most air quality monitoring in the United States, and the bulk of their monitoring efforts produce ambient air quality measures for criteria pollutants. To this end, SCAQMD operates ten stationary regulatory monitors across the entire South Coast Air Basin. While designed to assess compliance at a regional level, these monitors often fail to capture localized air pollution. This is more true of certain pollutants than others. For instance, fine particulate matter ($PM_{2.5}$) is dispersed relatively easily through meteorological patterns, so monitoring at higher spatial and temporal resolutions can capture regional $PM_{2.5}$ pollution relatively well. Heavy metals, on the other hand, do not travel as easily and can remain localized, so local metal pollution may not be captured by an air quality monitor even a mile away.

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[14] Community activists' responses to SCAQMD in the wake of the Exide case are also discussed in Chapter 3.

[15] This January 25, 2019 interview with SCAQMD staff was conducted by Wen Ling Tu of National Chengchi University in Taiwan, which I attended.

Things changed in 2016, when SCAQMD obtained a cutting-edge new mobile lab for metals monitoring. In addition to their main stationary monitors for measuring ambient air quality, the district had a "special monitoring team" to conduct field studies in certain situations. Previously, however, metals sampling in the field required building expensive on-site labs and came with a host of logistical and bureaucratic challenges. With the new technology, portable air samplers could collect metals samples to be analyzed on site in a mobile van or returned to the lab at SCAQMD's headquarters for further analysis – one of the few labs in the United States with the capacity for accurate community air sampling of hexavalent chromium (SCAQMD 2017).

"Previously, it was hard to get into the community [for sampling]" said a member of the special monitoring team. "For the monitoring technology, we needed access to power and security, so businesses wouldn't allow us. With new technology, we could just attach it to lampposts, [and] it let us see [what was going on]. In October, we were able to implement [and] deploy new monitors, using meteorology to place more samplers" (Interview, January 25, 2019). On one of their first days using the new field sampling techniques for chromium in Paramount, the special monitoring team was shocked by the results.

"In October [2016], I got the call, what was the value?" recalled one high-ranking SCAQMD official in an interview.

"Twenty-six to 30 [nanograms per cubic meter]," his colleague, a scientist, replied.

"In other words, 500 times higher [a level of hexavalent chromium] than it should have been. My first question was, have you replicated those results?" The team was sure their new equipment was malfunctioning, but repeated tests showed similarly astronomical levels of chromium-6, a toxic carcinogen, as well as elevated levels of nickel, in the neighborhood

(Interview, January 25, 2019). Triangulated data from extensive local sampling eventually traced the chromium-6 pollution to Carlton Forge Works, a metal plating facility. Even after the company, pressured by the air district, took voluntary abatement measures that reduced their emissions of nickel and other metals, chromium-6 levels remained high (SCAQMD 2017).

The special monitoring team eventually determined the problem came from a metal alloy heat treatment process for which there was no existing rule on the books. "A big problem was enforcement access," said a member of the district's legal team. "They didn't have a rule saying what they were doing was wrong, except a nuisance rule… it was definitely a nuisance, so [at first we were] able to enforce it based on that, just on high levels." Another colleague added, "Even though we had nuisance authority, the community was demanding we shut this down. But we didn't have authority. The federal government has authority. We asked EPA to take action, but it was right at the change of administration [from Obama to Trump]. We went to court." The air district succeeded through legal action and subsequent state legislation in obtaining "imminent and substantial endangerment" authority that could apply to such emergency cases in the future. They also undertook a "very long and controversial and contested rulemaking process" to address the enforcement gaps they identified in their sampling, passing new rules governing heat treating and grinding alloys that would apply to all the facilities in their jurisdiction (Interview, February 19, 2020).

In other words, before 2016, the chromium in the air in Paramount was undoubtedly dangerous, but not actionably illegal, or even discernable as "pollution." It took the coordination of a variety of people, technologies, and practices to enact chromium pollution as such: sensing a metallic odor on the air, calling the air district to register a complaint, strapping an air sensor to a lamppost, processing a field sample in mobile van, tracing the chromium leak to a particular

piece of equipment and step in process of metal plating, and writing legislation and regulatory rules to govern that equipment and activity. "Making chromium pollution" is a collective activity involving residents, activists, scientists, lawyers, and bureaucrats.

B. Enacting "Community Air Monitoring" in SCAQMD

SCAQMD staff consider the Paramount case a watershed moment for community air monitoring and their agency's approach to environmental justice issues– not only for its use of novel air sensing technology to address regulatory gaps, but for its engagement of other stakeholders regarding the results. After the initial sampling in October 2016, the team publicly posted the results of their field study within an "unheard of" two days, immediately calling the governor's office, local elected officials, and community groups (Interviews, January 25, 2019 and February 19, 2020). "This is the part nobody had ever done," said an SCAQMD official. "When 9/11 hit, and sampling was going on in NYC, [US] EPA didn't post [air sampling results] for months…What we said was, we're going to post that as quickly as we can… the community becomes more distrustful the longer we take" (Interview, January 25, 2019).

Responding to years of organizing and pressure from activists in Paramount, the air district's efforts to abate the hexavalent chromium disaster included community outreach and cross-agency collaboration that was unprecedented for the SCAQMD. In addition to analyzing and posting monitoring data on their website within days, they began conducting joint inspections with other regulatory agencies and sharing information across organizations. Regarding their monitoring in Paramount, the air district held 25 weekly public conference calls in English and Spanish, over 50 conference calls with other local, county, regional, state, and federal government agencies, and 30 conference calls with elected officials about their investigations. They held five town hall meetings in the community, and overhauled their

processes for providing interpreting/translation and childcare services for residents to be able to participate. Recordings and presentation materials from public calls and meetings were published online, and eventually streamed via Facebook. They expanded their community outreach and public relations staff to multiple full-time positions (SCAQMD 2017; Interview, January 25, 2019).

With the new monitoring and enforcement tools, SCAQMD and other agencies conducted joint inspections at nearly 200 facilities, resulting in nearly 40 Notices of Violation issued to eight facilities and nearly 100 Notices to Comply to another 60 facilities. Abatement efforts and facility improvements resulting from the inspections and new rules reduced levels of chromium-6 and other metals in the neighborhood substantially. In anticipation of additional forms of pollution that are unknown or unaddressed by current regulatory monitoring, a new state law provides the local air district its own authority to enforce pollution that is not covered by existing rules if a facility poses "imminent and substantial endangerment" (SCAQMD 2017).

It was around this time that the air district's "special monitoring" efforts came to be called "community air monitoring" within the agency (Interview, January 25, 2019). The shift is more than semantic. At one level, the term "community air monitoring" references the location of the air sensing activities "in the community." In my interviews and conversations with SCAQMD staff, the terms "community sampling" and "field sampling" were often used interchangeably. Where "field sampling" specifies a distinction between the "controlled" conditions of the laboratory and the "real world" of "the field," "community sampling" connotes a different set of relations in which "the field" is recognized as a social space made up of concerned residents and persistent activists holding the agency to account.

At a second level, the term "community air monitoring" references a change in the protocols and practices through which they agency carries out its sensing practices. In this case, unlike in Chapter 1, CAM does not refer to "citizen-science"-style data collection or the use of low-cost samples. Instead, it indexes the way environmental justice advocates can leverage the availability of new monitoring technologies even within government agencies to transform the procedures for transparency, accountability, and community participation. It also shows how, in turn, increased community access to government monitoring data can create an imperative within regulatory agencies to develop novel enforcement strategies – in this case, a combination of local nuisance laws, expanded emergency authority through legislation, and extensive rulemaking to close regulatory gaps.

"It will be a case study for years to come," said an air district official (Interview, January 25, 2019).

C. Asthma Goes Public in Imperial County and San Ysidro

In *The Body Multiple,* Mol observes that "In hospital practice, thickened vessel walls do not *underlay* legs that hurt. They come, instead, *after* them" (2002: 37). In a world of multiple atherosclerosis, a disease is enacted first by a patient's pain, which may bring them to the hospital. Later, under a microscope, a physician may enact another atherosclerosis as they observe the thickened intima of the patient's artery walls. For many residents of "environmental justice communities," children's asthma is an embodied manifestation of air pollution that precedes the problematization of air pollution itself. "Breath has sentinel qualities," write Alison Kenner and Chloe Ahmann, "it can signal trouble in the air" (2020).

In Imperial County, air pollution emerged as a concern for the community health organization Comité Cívico del Valle (CCV) because of high rates of asthma and respiratory

disease among the farmworker families they served, where pediatric asthma rates are as high as 20% (CCV 2020). As CCV's environmental justice programs developed, including the Identifying Violations Affecting Neighborhoods Reporting Network (IVAN) and the community air monitoring network,[16] asthma care figured prominently into their understanding of the problem and approach to its solution. CCV founded Respira Sano (Breathe Healthy), an asthma education and clinical intervention program serving families throughout the Imperial Valley. Asthma education and care work includes helping children and their caregivers prevent and manage severe symptoms by avoiding asthma triggers, such as outdoor activity on days with poor air quality. As part of their efforts to increase transparency and community awareness of air quality, CCV worked with local schools to implement a school flag program. Each day, students or staff of participating schools raise a bright triangular flag whose color corresponds to that day's EPA Air Quality Index as reported by the air district, ranging from Good (green), Moderate (yellow), Unhealthy for Sensitive Groups (orange), or Unhealthy for Everyone (red) (US EPA 2022, CCV 2020).[17]

Schools became important partners in the implementation of Imperial County Community Air Monitoring Network, a network of 40 $PM_{2.5}$ monitors distributed across the valley to characterize local air quality. The welding shop class at one high school constructed the metal posts and boxes in which the custom monitors were installed. Since air monitors require regular maintenance, WiFi, security, and a central location in proximity to sensitive land uses, school campuses were often ideal sites for the air monitors themselves. While many school flag

[16] These programs are described in detail in Chapter 1.

[17] The EPA AQI includes a fifth, purple category for extremely poor air quality, which CCV opted to drop from their own color code both to simplify their messaging and because, from a precautionary perspective, any air quality over the threshold for the red category was harmful enough to be considered extreme (Interview, April 2019).

programs still use the official AQI to choose their daily flag color, some teachers opt to use the air quality indicated by CCV's own network or their on-campus air monitors.

To the east of Imperial County, community air monitoring programs in San Diego have also implemented school-based programs in the San Ysidro School District along the smoggy US-Mexico border, where asthma rates are 18% higher than the county as a whole (Chen Ryan et al. 2017). By 2017, EJ advocates engaged in CAM initiatives in Imperial, San Ysidro, and other California communities had successfully pressured the state to designate funds from the California Climate Investments program to reduce emissions in disadvantaged communities.[18] A local school board member had participated in the resident steering committee for a community air monitoring study run by Casa Familiar, so as a program staff member narrated, "[The San Ysidro School Board] really understood the value of how we wanted to connect [CAM] to community investments for emissions reductions" (Interview, February 2020). The school district obtained funding from the California Air Resources Board as well as the IQAir Foundation (IQAir is a private air sensor manufacturer) to assess and upgrade the heating, air conditioning, and ventilation systems of all seven San Ysidro schools. In January 2020, the San Ysidro School District also adopted a resolution to convert their entire fleet of school buses to zero emissions vehicles (Interview, February 29, 2020).

In her ethnography of asthma care, Alison Kenner shows how schools act as important nodes of asthma "carescapes" through which individuals and communities navigate the challenges of disordered breathing in increasingly unbreathable conditions (2018). School teachers, nurses, and coaches are routinely enrolled in the distributed work of asthma care. In spite of this, schools are not often thought of as environmental actors. As environmental justice advocacy and mounting public health research help to situate personal, embodied experiences of

[18] This program is described in Chapter 3.

asthma within the collective and structural concerns of air pollution, schools are also increasingly enrolled in the broader work of air pollution governance, becoming important partners for air quality monitoring and related interventions.

In contrast to the Southern California Children's Health Study described in this chapter's introduction, which enacted children's asthma as an entity resulting from dirty air, these examples from Imperial County and San Ysidro point to a different ontology of asthma and air pollution. Like the thickened intima that *follows* the patient's pain, $PM_{2.5}$ pollution follows asthma in these sites. The networked relations and practices of making asthma matter as a public concern – bringing asthma screening and education into schools, raising colored flags on the flagpole before the first bell, calling students in from recess on a smoggy day– are part of what enact air pollution in these places.

D. Sensing the Border in the Air

In January 2020, I visited the border fence between Calexico, California and Mexicali, Baja California on a Toxic Tour led by Comité Cívico del Valle for visiting officials from the California Air Resources Board. Calexico's historical downtown has large buildings that shade tiled sidewalks, filled with storefronts advertising currency exchanges, notary services, and sales on clothing and pharmacy goods. The bus stopped near a 19th century Spanish colonial-style building with painted tiles, which the guide pointed out as the oldest immigration building on the US-Mexico border. We deboarded the bus to look at the border fence sitting a few yards behind it, made of 50-foot-tall, vertical slats strung with multiple coils of barbed wire. From a closer vantage point, I could see through the slats to baskets, plastic sandals, and woven blankets for sale hung by vendors on the Mexico side. Most of the large group took pictures many feet back

from the imposing structure, keeping close to the bus, until some CCV staff encouraged them to get closer if they wanted.

A border patrol car parked down the road approached, and the agent inside rolled down his window. A CCV staff member walked up to the truck in a confident stride and leaned over to speak to him. After a moment, she waved us over to the truck and the agent got out. “Where are you all from?,” he asked. A CARB board member deferentially explained they were from the state air board and we're here to learn about air pollution challenges in the area. The agent said “Air pollution… that’s a big issue here. Some improvement would be really appreciated. Right now it's nice, but in the summer with the heat and the pollen...” he trailed off. He explained that the expansion of the port of entry at Calexico/ Mexicali had improved the long lines of traffic, but that it still took an average of 80 minutes to wait, “with the AC cranked.”

“I have a motorcycle,” he added, “so I get through in two to three minutes.”

Apparently deciding the group of state bureaucrats was not a threat, the border patrol agent’s tone of voice changed to the rehearsed-sounding cadence of a tour guide: “Right now you’re at the oldest section of the fence, the newer fence which you’ll probably see is down there. It’s taller, which is a blessing for us. It’s much safer. A taller fence, it’s more difficult for criminals to climb, and more difficult for them to attack us. Otherwise, we get rocks thrown at us every day. As you know, that constitutes an assault, so we are being assaulted daily. Most law enforcement officers might get assaulted once or twice in their whole careers — for us, we are under assault every day.” Looking around at us, he said sardonically, “I guess that’s a type of air pollution, right? It falls from the sky” (Field Notes, January 15, 2020).

As the bus pulled out of the parking lot on its way to the next Toxic Tour site, I chatted with my seatmate, Jim, a local activist who had grown up in the Imperial Valley and now served

on the community steering committee for its AB 617 work. He said that many of the farmworkers who cultivate the valley's fields of lettuce, melons, and broccoli live in Mexicali, where the cost of living is much lower. In the intensive winter season, between December and February, farmworkers leave home at one or two in the morning to avoid traffic and start work across the border before dawn (Field Notes, January 15, 2020).

Air pollution is prominently visible in Imperial, but it is only one of many ways the border materializes there, along with the navigation of long lines of traffic, the movement of people, money, and goods back and forth every day, the heavy presence of border police and residents' resistance to their presence. Here, air pollution is enacted through the routine practices of coordinating, maintaining, and traversing a national border.

The border figures prominently in the enactment of air pollution in San Ysidro, too. Like Comité Cívico del Valle and Vecinos Unidos, Casa Familiar did not start out as an organization concerned with air pollution. As a community development organization based in San Ysidro, their mission focused on providing a range of social services including education programs and affordable housing. Their environmental justice work began around 2003, during the post-September 11th expansion and militarization of the US-Mexico border apparatus overseen by the newly established Department of Homeland Security. As in many border communities, daily life for residents of San Ysidro is lived across the border, which many locals cross daily for work, family, and shopping. In the couple of years since 9/11, the wait times on the northbound road had doubled, resulting in long lines of idling cars puffing exhaust into local neighborhoods around the clock (Interview, February 29, 2020).

"The federal government, after 9/11, passed a mandate…that it was going to further secure the border with Mexico, and it wanted to augment the capacity of all border crossing

stations. And suddenly San Ysidro was identified as one of those stations that needed urgently to be basically rebuilt," recalled a longtime Casa Familiar staff member (Interview, February 29, 2020). When Casa Familiar looked at the plans for the border checkpoint renovation– which would make it the largest federal facility in the United States – they saw they included a massive expansion of the freeway connecting San Diego and Tijuana. The four southbound lanes would increase to 16, and the 22 northbound lanes would increase to 30.

Deeply concerned about the impact of the freeway expansion on daily life along the border, Casa Familiar obtained a grant to assess the city's urban plan and slated border facility renovation, including its environmental impact. In an attempt to obtain baseline air quality data, they learned from the San Diego County Air Pollution Control District that the nearest monitor was sited in Otay Mesa, ten miles away from San Ysidro. Casa Familiar teamed up with researchers at San Diego State University to data on traffic-related pollution. One early study involved pedestrians carrying air monitors in backpacks back and forth across the border, confirming their hypothesis that longer wait times at checkpoint corresponded to worse local air quality (Interview, February 29, 2020). In 2016, Casa Familiar began a partnership with San Diego State University, the University of Washington, and CalEPA to establish a local air monitoring network. They placed 13 community air monitors monitoring five contaminants, and in 2017 launched a website with real-time local air data. This initiative, including a collaboration with CCV and other EJ groups, helped inform the development of CalEnviroScreen and the passing of AB 617.

For Casa Familiar in San Ysidro, air pollution materializes through a community's concern with the violences and disruptions to everyday life posed by the increased securitization

of the border after September 11, 2001. Air pollution is a problem enacted through the sensing practices of the organization's efforts to confront the hazards of the border security apparatus.

E. Territorializing Air Pollution in Old Town/National City

Around the same time that Casa Familiar developed its community air monitoring in San Ysidro, another CAM project was taking place just 15 miles north, near the Port of San Diego. The local Environmental Health Coalition (EHC) led the Toxic Free Neighborhood Campaign in the neighborhood of Old Town National City (OTNC), in which a number of heavy industrial uses sit alongside schools and homes. The campaign included a community-based participatory research project combining a variety of methods–including air sampling, secondary data analysis, GIS mapping, survey research,and legal and policy analysis– and leveraged the organizing and participation of neighborhood *promotoras de salud* (lay health promoters). As a part of this study, air sensor measurements taken by coalition members helped document the gaping disparities in air quality between the predominantly low-income and Latino OTNC neighborhood and a control site at City Hall (Takvorian et al. 2008, Minkler et al. 2010). The campaign resulted in several groundbreaking policy outcomes: (1) a landmark 2006 amortization ordinance passed by the city council to phase out polluters, (2) a 2008 plan for creating an industrial park outside the city to relocate polluters and mitigate their environmental impacts, (3) the conversion of a ten-acre brownfield in OTNC into a large affordable housing project with restored marshland and recreational green space, (4) and the 2009 inclusion of a Health and Environmental Justice Element the the City Council's General Plan,[19] and (5) the 2010 adoption

[19] This was the first municipality in California to include an EJ element in its General Plan, and would serve as a model for the 2017 State Bill 1000 mandating the inclusion of EJ in all General Plans for cities and counties in California going forward.

of the Westside (Old Town) Specific Plan to relocate industrial businesses out of the neighborhood (Minkler et al. 2010: 804-805).

"Land use planning is one of the bigger historical legacy items that we have to deal with today. Land use authority is something that is very, very difficult to tackle," commented a longtime San Diego EJ activist (Interview, February 29, 2020). Because air quality monitoring and other modes of environmental governance have historically been the purview of environmental agencies, efforts to address local air pollution issues have typically focused on permitting processes and regulatory enforcement. With the implementation of AB 617 across California, numerous communities across the state have turned to land use as a crucial site for environmental justice policy, an issue which implicates local and county governments and a broad range of stakeholders.

In Chapter 1 of this dissertation, I showed how the paradigm of air pollution governance that emerged in the 20th century has figured air pollution– regional, ambient air pollution to be exact–as a matter to be managed by regulatory agencies. Municipal governance of air pollution is firmly circumscribed by city zoning policy: typically, cities will issue permits to any industrial facility so long as it holds the proper permits required by relevant environmental agencies, as long as it is located in a zone of the city designated for industrial land use. In EHC's campaign in Old Town/National City, the coordination of a variety of sensing practices (e.g. advocacy, policy analysis, community research, and local air monitoring) helped enact a new air pollution object, one firmly emplaced in the city's land use policy. This territorialized air pollution object evinces how land use policy itself participates in its enactment, opening up new paths for addressing air pollution via city policy rather than environmental regulation alone.

III. Conclusion: Why Multiple Ontologies of Air Pollution Matter

My argument in this chapter and in this dissertation is not that we should understand community air monitoring practices as socially, historically, and geographically situated – though, of course, they are. Nor am I arguing that community air monitoring helps to apprehend a "truer" understanding of air pollution than the knowledge practices that preceded it – though, perhaps, it may. Rather, I am arguing that what comes to "count" as air pollution hinges on the orchestration of many tools, techniques, and actions within particular sites and conditions, and that knowledge about the air is "not…a matter of reference, but one of manipulation" (Mol 2002: 5). Mol writes,

> "This book does not try to show that *the social* is larger than we took it to be while *the technical* is smaller. Instead, it suggests that technicalities themselves, in their most intimate details, are technically underdetermined. They depend on social matters: practicalities, contingencies, power plays, traditions. Thus, technicalities should not be left to professionals alone. They affect us all, for they involve our way of living. But this does not mean that they are not also technicalities" (Mol 2002: 171).

The rise of community air monitoring over the last several years shows what happens when technicalities are no longer left to professionals alone. Attending to the technicalities of doing air pollution helps environmental justice advocates re-make air as a situated, community problem. The case studies above, as well as others I explore in this dissertation, show what happens when the tools and activities of knowing the air are spread more widely, across a broader range of actors, sites, and contexts: air pollution is made multiple.

Understanding the ontology of air pollution as multiple can help us move through some of the impasses in the scholarship of environmental citizen science, much of which is concerned with matters of accuracy, validation, and representation of environmental knowledge (Kimura and Kinchy 2019). For example, citizen science is hailed for its potential to finally include

"community voices" in environmental science, but the legitimacy of the data produced by advocacy groups is often suspect and inherently "political" (Kimura 2016, Kimura and Kinchy 2019, Ottinger 2009). Challenges of validation and quality control for data from low-cost air sensors are considered major barriers for the use of citizen science data to inform and enforce regulatory standards (English et al. 2018, Wyeth et al. 2019).

These dilemmas are without a doubt important, and worth working through. Sometimes, however, these questions about how best to *know* air pollution impede understanding of how air pollution is actively *materialized*, and thus why and how it *matters.* Sometimes, it is a matter of industrial manufacturing. Sometimes, it is a matter of public participation in an agency's regulatory process. Sometimes, it is a matter of children's health. Sometimes, it is a matter of border policing. Sometimes, it is a matter of city planning. Always, it is all of these at once. How air pollution is addressed depends on what kind of a problem air pollution is understood to be. Mistaking ontological differences for epistemological ones can mire well-intentioned people in the task of how best to know the problem, when the more pressing question is *what is to be done.* In this chapter and throughout this dissertation, I show how air pollution and many, many ways of addressing it are mutually enacted through practices like community air monitoring.

CHAPTER 3
Si(gh)ting Disadvantage: Mapping the Environmental Justice Community

I. Introduction

One weekday morning in August 2020, on the seventh day of a record-breaking heatwave singeing Southern California, I sought out the shade of a tree near the playground of Los Robles Park in southeast Santa Ana. Though it was only nine o'clock, the heat was already stark, and the unusually humid air was hard to breathe through my cloth face mask. As I rummaged in my backpack for my notebook and pen, I heard Pedro call out "Good morning!" from across the park, dressed for the weather in a broad straw hat. I walked over to meet him, where we were soon joined by Issac, Vecinos Unidos' community organizer, and Diego, the president of the local neighborhood association and an active participant in Vecinos Unidos' community air monitoring efforts. We joked about the heat and that it was good to see each other in three dimensions after months of Zoom meetings during the COVID-19 pandemic.

The occasion for this in-person gathering, Vecinos' first since the start of the pandemic in March, was to take a group of city officials and urban planners on a walking tour of the Los Robles neighborhood. The tour was Vecinos' latest appeal to the city to include more robust environmental justice policies in their upcoming update to the Santa Ana General Plan, including targeted protections for and outreach to residents of the city's "disadvantaged communities," or DACs as they are called in California environmental policy. Los Robles is a DAC, as are the adjacent neighborhoods to the north and south, all designated by the state as such due to their high pollution burden and social indicators of environmental health vulnerability.[20] Vecinos

[20] California State Bill 1000, passed in 2017, requires all cities and counties containing at least one DAC to incorporate environmental justice into their general plans. As one of the first municipalities to update their General Plan since the implementation of SB 1000, it was uncertain how Santa Ana would interpret the new requirements.

Unidos hoped today's "toxic tour" would help convince the city's leadership to delay the timeline for approving the new plan, so their organization and others could have time to analyze the draft updates and coalesce around demands for more stringent environmental justice protections for neighborhoods like Los Robles. They also demanded more transparency and active outreach to the city's DACs specifically regarding environmental justice policy, arguing that the communities most impacted by environmental pollution had the most to gain and to lose from the updated General Plan.

A few members of the city council and planning commission arrived, enthusiastically bumping elbows in lieu of handshakes. Once greetings, introductions, and quips about the heat had been exchanged, Diego welcomed the group to the neighborhood. "Thank you for being here. We wanted to invite you to where we live so you can understand what these issues mean to us. We know you have been working on the General Plan update for a few years now, but there are implications of this plan on our community for many more years to come. As we walk around, you will see the cumulative effects of pollution, not only from multiple sources, but from the many decades this environmental justice issue has been going on."

At that, Pedro abruptly interjected. "Well, you [Diego] say the environmental justice issue has been going on a long time, but in a sense it is a new issue...You know, people don't know this is going on. I have lived in the neighborhood 30 years, and no one brought it to my attention. It was serendipity that I learned about it."

Diego nodded in agreement, adding for the visitors, "I live by the railroad tracks— we will go past them today. Both of my sons have asthma and allergies. And this neighborhood has the highest childhood asthma rates in the city, but I never realized that that is affected by the built

environment… So we welcome you on the community's behalf, and if you find that we are pushy or aggressive, I hope you will understand why."

"You mean passionate," Pedro corrected him, laughing lightly. "We're passionate."

* * *

The toxic tour of Los Robles with Vecinos Unidos and the city officials surfaced questions that arose again and again throughout my research: What *is* a "disadvantaged community"? How is it recognized and made recognizable, both by those who live within it and those who do not? What is at stake in this recognition? This chapter explores how the "disadvantaged community" designation emerged recently in California as a technical response to a longstanding challenge in the environmental justice movement: operationalizing the vast and visionary moral framework of "environmental justice" (EJ) to address a deeply complex array of social, economic, and environmental problems through the bureaucratic register of state environmental policy.

In this chapter, I analyze the technologies and practices through which California demarcates communities as disadvantaged in order to articulate EJ as a legally definable, scientifically measurable, and bureaucratically manageable matter of state concern. I show how this designation of disadvantaged communities is profoundly consequential for numerous state policies and programs, for human and environmental wellbeing, and, I argue, for our collective conceptualization of how environmental injustice is produced across time and space. Because this demarcation of disadvantage is, by necessity and by design, a process of defining the limits of environmental justice, this chapter also examines the limitations of the DAC framework for apprehending the complexity of the problems it is designed to address. In order to do so, I analyze how EJ activists in three southern California communities have advocated *for* and *with*

the DAC designation, as well as *against* and *beyond* it, in their work to align state interventions with their broader visions for social and environmental justice. Building on these activists' claims, I argue below that while the mapping of California's DACs makes visible and governable some EJ issues previously unaccounted for in regulatory regimes, it frames EJ too narrowly as spatially bound and geographically (rather than historically) determined. Put another way, locating EJ as a problem of and within these DACs can obscure the historical and global co-production of advantage and disadvantage through systemic processes that exceed the boundaries of the DAC.

Returning to the opening question of "What *is* a disadvantaged community?," I aim in this chapter to reorient the commonsense understanding of DACs as particular, discrete locations characterized by unambiguous evidence of environmental injustice and the absence, presumably, of the "advantages" of communities elsewhere. Instead, I suggest we conceptualize the DAC more flexibly, as a designation that operates in multiple registers at once. While DACs can indeed name actual places and people and their material concerns of environmental vulnerability and hazard, DACs are also a way of seeing and representing "environmental justice" itself. In their comments welcoming city officials to Los Robles, Pedro and Diego allude to both the discursive and material significance of emplacing environmental disadvantage in their neighborhood. Their exchange begs the question: How is it that environmental (in)justice can be both a longstanding neighborhood concern and a "new issue" for Los Robles.

II. "We Only Recently Became an EJ Community"

The neighborhood tour with the city officials was the first time I heard Pedro expressly describe environmental justice as a "new" issue for Los Robles, but it wouldn't be the last. Throughout that summer and fall, it would come to be a refrain whenever I heard him introduce

the community air monitoring project to someone new, be it academic scientists, Santa Ana residents, other local community organizations, or representatives from government agencies. When describing the neighborhood, its environmental challenges, and Vecinos Unidos' project, Pedro would begin by saying, "Air pollution isn't new to southeast Santa Ana, [but] we're new to air pollution." In one instance, on a call to the California Attorney General's Office requesting their support of Vecinos Unidos' campaign with the City, Pedro put it even more pointedly: *"We only recently became an EJ community*."

The term "environmental justice community," or more often "EJ community," has been widely used in environmental justice advocacy and policy circles since the 1980s (Harrison 2019, Liévanos 2018). It circulates broadly among EJ advocates, academics, and bureaucrats alike, who use it to refer to heavily polluted and implicitly racialized places and the people who live there (typically, low-income and non-white). Defining and operationalizing the concepts of environmental justice and environmental racism in science and policy is wickedly complex and often contested (Maantay 2002; Harrison 2019; Schlosberg 2007, 2013). The term "EJ community" is ubiquitous in part because its lack of specificity circumvents these fraught debates while still indexing a commonly understood array of intersecting environmental and social exposures, vulnerabilities, and concerns, and it can be used flexibly and non-pejoratively to describe actual or hypothetical geographic or demographic referents.

Early on in my fieldwork, after noticing an air district employee mention Los Angeles' "EJ communities" several times, I asked her how the term was defined. She laughed— the question was a familiar one— and explained that while the agency didn't have a single working definition of the term, it was generally used to describe low-income communities of color with a disproportionate burden of the region's environmental pollution. By contrast, however, Pedro's

assertion that Los Robles "only recently became an EJ community" calls into question the idea that what constitutes an EJ community is taken for granted and commonly understood. After all, this recent "becoming" was not brought about by new environmental hazards or demographic shifts in the neighborhood. The characteristics of Los Robles that are typically evoked by the term "EJ community"— its proximity to heavy industry, high levels of pollution from multiple sources, high rates of asthma and other environmental health problems, a predominantly Latinx and low-income population— are longstanding. Pedro's framing of environmental justice as a nascent issue underscores that what constitutes an EJ community in practice is more complicated than the sum of the characteristics the term seems to index. How, then, does an EJ community come to be understood as such?

In Pedro's telling of the moment when Los Robles "became" an EJ community, it all started with a map. A few weeks after Emma and her neighbors found the notice on their doors informing them of the metal plating facility being built behind their apartments,[21] the South Coast Air Quality Management District (AQMD) sent a letter to the neighborhood's city council representative in response to a query he had made on Vecinos Unidos' behalf. At the council member's request, AQMD's letter included a map of other industrial facilities in the area holding permits with the regulatory agency. The map shows the numbers one through 42 scattered over an aerial view of the neighborhood, clustered near familiar landmarks like Hamilton and Johnson Elementary Schools and Los Robles Park. A key lists the 42 companies, for each numbered site, holding permits with the agency allowing them to legally emit air pollutants regulated by state or national agencies. For Vecinos Unidos, the numbers on the map brought new significance to several of the neighborhood's nondescript warehouses and windowless industrial facilities as sources of unknown hazard. This map prompted their realization that they live alongside a major

[21] I tell this story in more detail in the prologue to this dissertation.

industrial corridor, though it would be over a year before the residents came to know the full geographic extent and number of facilities in the industrial zone on Santa Ana's Eastside.

"Environmental justice, it was something that was not on our radar," Pedro said at a community meeting in the fall of 2020, narrating the origin story of the air monitoring project. "We gathered some information, and [from the map] we learned that these companies, actually they're all around us. They're all around us."

Figure 3A: *South Coast AQMD sent this map in a December 2017 letter to then-city council member (now Mayor of Santa Ana) Vicente Sarmiento, in response to his request on behalf of Vecinos Unidos for a map of SCAQMD-permitted facilities in the area. (The parts of the city zoned as industrial in fact extend to the north, south, and east of these boundaries.) The numbered sites outlined in red hold air pollution permits with the agency. Los Robles and other residential neighborhoods are located immediately west of the industrial area.*

III. Si(gh)ting the Environmental Justice Community

Mapping practices have played a central role in the United States environmental justice movement since its inception. Where mainstream environmentalism in the United States in the 1950s and 1960s brought public attention to the dangers of pollution, the social and spatial differentiation of these threats were not widely acknowledged (Maantay 2002). In the late 1970s

and 1980s, the environmental justice movement emerged in resistance to the discriminatory siting of hazardous land uses in socially marginalized communities (Bullard 1990). The early work of this social movement motivated the landmark 1987 study by the United Church of Christ's Commission for Racial Justice, "Toxic Wastes and Race in the United States: A National Report on the Racial and Socio-Economic Characteristics of Communities with Hazardous Waste Sites." This groundbreaking study mapped the locations of hazardous waste facilities across the United States, presenting them alongside indicators like the race, ethnicity, and income of the populations in the nearest ZIP codes to the waste facilities (United Church of Christ 1987). One of the first widespread spatial analyses to combine environmental and demographic indicators—and the first to do so in southern California— the United Church of Christ study maps showed irrefutable statistical and spatial correspondence between the locations of hazardous waste facilities and non-white populations (Bullard 1990, Maantay 2002, Pulido 2000). In 1992, environmental and civil rights advocate Reverend Benjamin Chavis contextualized these findings as manifestations of what he coined as systemic "environmental racism:" the exclusion of people of color from environmental movements, science, and policy, unequal enforcement of environmental protections, and disparate environmental health burdens borne by racial minorities (Liévanos 2018).

Throughout the 1980s and 1990s, early environmental justice research— much of it in geography, or commissioned by non-profit or government agencies— was concerned primarily with "proving" the existence of environmental racism (e.g. Boer et al 1997), through mapping the locations of environmental hazards and measuring statistical relationships between the siting of pollution sources and demographic characteristics of nearby populations (Holifield et al 2010, Maantay 2002). These maps were the evidentiary basis on which the growing EJ movement

staked its claims of environmental racism and calls for environmental justice protections, resulting in the passing of the first federal EJ legislation under the Clinton Administration (Liévanos 2018). These EJ claims also resonated across scholarly disciplines, enabling historians and social scientists to attribute environmental disparities to the enduring legacies of residential segregation. Spatial and demographic analyses of environmental health also bolstered public health scientists' critiques of environmental risk assessment frameworks that focused on single chemical exposures while ignoring social determinants of health, driving the emergent study of "cumulative impacts": "the multiplicity of chemical exposures and effects that people and places experience, and the relationship between those experiences and pre-existing biological, physiological, and social conditions of a human settlement" (Solomon et al 2016, Liévanos 2018). Maps of environmental injustice thus drew together a number of interlocking concerns previously excluded from dominant frameworks in environmental science and policy--namely, the disparities in exposure, vulnerability, and legal protections for people of color and low income, and the ways these social, environmental, and biological conditions cumulatively shape risk and harm.

Maps are thus crucial technologies not only for describing differential environmental risk, but for problematizing environmental justice altogether— that is, for articulating it as a distinct set of concerns about the racialized distribution of environmental hazards and the historical and ongoing role of race and racism in producing environmental harm. Through the cartographic *siting* of environmental and demographic indicators, "environmental justice" is *sighted*, or brought into visibility as a collective concern— in the case of Los Robles as in the broader history of the environmental justice movement, environmental health science, and US environmental policy. In other words, mapping technologies are an important way that

environmental justice is enacted, or brought into being through practice (Mol 2002). The "EJ community" as a site is not given in the order of things by virtue of its demographic and environmental characteristics; rather, it is made visible and knowable in context and praxis.

Although many of my interlocutors speak of EJ communities as if they are speaking about the same (sorts of) places, I aim in this chapter to understand the EJ community as a category and site that is always multiple, requiring translation, coordination, and negotiation across contexts and among the many actors who engage with it. Understanding the EJ community as multiple helps explain how Southeast Santa Ana might have already been an EJ community for decades when it first "became" one in late 2017. As Mol points out, conceptualizing [the EJ community] as multiple also demands asking how it is political and moral, and thus how it might be "done well" (2002: 7). How, then, are environmental justice communities "done" in practice, and what might it mean to "do them well?"[22]

"Doing" environmental justice—operationalizing environmental justice principles in scientific and legal practice—has long been a challenge for EJ advocates and their counterparts in science and government. Both scientific expertise and state protections are crucially consequential for environmental justice struggles, but these are often uneasy alliances (Checker 2007, Cohen and Ottinger 2011, Harrison 2019). Environmental science is by nature

[22] Fujimura (1987) defines "doable problems" in scientific research as those that can be aligned across "experiment, lab, and social world." Coordination across these levels requires articulation work, which is facilitated through modularity and standardization. Making environmental justice research "doable" is peculiarly challenging in that it requires alignment across multiple scientific disciplines, legal frameworks, political jurisdictions, and social domains, as well as with the materiality of environmental pollution and experiences of those who live with it. Mapping is a crucial practice in the articulation of environmental justice, making exceedingly complex and plurally understood problems commensurable through the modularity of the "environmental justice community." In mapping the EJ community — siting it and sighting it — environmental justice becomes a "doable problem" that can be spatially demarcated, statistically measured, and bureaucratically managed. Mapping the "EJ community" as both a category and a site thus helps to articulate environmental justice across the domains of advocacy work, scientific research, and governance.

interdisciplinary and frequently controversial (Checker 2007, Fortun 2012, Singer 2016). Within dominant arrangements of modern industrial power and expertise, science and engineering are typically aligned with the interests of elite polluters (Cohen and Ottinger 2011, Singer 2016). Even where alliances between technoscience and environmental justice movements emerge, these are often frustrated by the reality that "accepted modes of scientific practice" are often ill-equipped to showing the impacts of chemical exposures and health, and hostile to "lay" or "local knowledge" (Cohen and Ottinger 2011: 6-7).[23] While environmental pollutants may be implicated in a wide range of health problems, it is difficult to definitively attribute specific health concerns to particular environmental conditions (Singer 2016, Little 2014, Harrison 2019).

The relationship of environmental justice advocacy and state power is similarly fraught. The goals of the environmental justice movement in the United States are often closely dependent on state environmental protections, and building relationships with government actors has been a key strategy for much successful environmental justice advocacy (Pellow 2018, Harrison 2019). United States environmental agencies have a long history of discriminatory enforcement of environmental laws that disproportionately harm the poor and people of color (Konisky and Schario 2010, Pulido 2015). The heavy influence of elite polluters and industrial interests in policy-making and governance impede effective responses to environmental health risk, even when confirmed by extensive scientific research (Singer 2016).

Moreover, as many scholars have pointed out, US environmental policy was never *designed* to address environmental inequity. Harrison (2019) demonstrates that "Environmental

[23] Ottinger and Cohen point out that the environmental justice movement (and environmental science) are shaped by two historical transformations that accompanied 20th century industrialization: 1) "the rise of an expert class" and 2) the creation of "a modern industrial system that relies on science and technology to generate wealth" (2011: 5). This context produces the paradox described in Beck's *risk society* (1992), where "only science and technology can provide solutions to the problems created by science and technology" -- including environmental devastation (Cohen and Ottinger 2011: 5-6).

regulatory agencies' progress is measured in utilitarian, aggregated measures (e.g. changes in the number of expected deaths from air pollution nationwide)" (9), a theme echoed in my interviews with the air district staff: "As the local Air Quality Management District, we have a very clear objective: our objective is to measure the Clean Air standards… And so you have this challenge where the local community [says], 'We want you to come to our community to clean up our community.' And so it's taken a very different mindset, in terms of, we know what the problems are, right? But we don't know what the problems are from a community perspective" (Interview, August 25, 2019).

Even where environmental agencies have developed on EJ policies and programs, these have overwhelmingly focused on increasing community outreach and participation, to the exclusion of other EJ goals (Baptista 2008, Harrison 2019, Lee 2021). Some EJ practitioners attribute this in part to the difficulty of defining and operationalizing EJ concepts like "disproportionate impacts," leading well-intentioned agency actors to focus instead on more tangible concerns of community engagement (Lee 2021). In summary, while environmental justice advocacy is inextricably connected to scientific expertise and state power, the double-binds produced by powerful interests, conflicting knowledge regimes, and profoundly complex science make "doing EJ well" peculiarly challenging for advocates working across sectors.

Maps can help to mediate this morass of challenges to make environmental justice a "doable problem"—measurable, legible, governable, and aligned across activism, science, and government. In doing so, mapping practices actively enact what environmental (in)justice "is," or how it is made visible, tangible, and knowable. Attention to the techniques through which the "environmental justice community" is brought into being can thus help illuminate how

environmental justice itself is conceptualized, problematized, and intervened upon— as well as what is left "out of sight/site." The remainder of this chapter examines how environmental justice is done in practice in California through the enactment of "disadvantaged communities," or DACs, in state mapping projects. How do particular places come to be designated as DACs in California? What kinds of analyses and interventions does the category and site of the DAC allow and disallow? What is at stake in framing the problem of environmental justice as geographically determined and spatially bound?

IV. Doing Disadvantage in California

Where early environmental justice maps aimed to prove the existence of environmental racism through the spatial and statistical correlation of race, income, and pollution, EJ mapping projects today are largely concerned with operationalizing legal definitions of environmental justice for the technical purposes of policy implementation and programmatic decisionmaking (Lee 2021). Maps like the 1987 United Church of Christ study helped buttress advocates' successful efforts to incorporate EJ priorities into legislative, executive, and bureaucratic mandates, and by the late 1990s numerous environmental agencies at federal, state, and local or regional levels had developed working definitions of environmental justice. The first legal definition of environmental justice in the United States appeared in Executive Order 12898, signed by President Clinton in 1994, requiring all federal agencies to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Bullard 2000). In 1999, the California legislature defined EJ as "the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of

environmental laws and policies" (Liévanos 2012). Of course, having defined environmental justice for legal and policy purposes, environmental agencies then faced the hardly-straightforward task of "doing" EJ in practice, operationalizing slippery concepts of fairness, equity, and justice in ways that were at once responsive to pressures from EJ advocates, legitimized through scientific research, and legible within agencies' institutional mandates and policy frameworks. To help align these legal definitions with their programmatic agendas, agencies turned back to the keystone articulatory tool of the environmental justice movement: the EJ map.

California has become a prominent leader both nationally and globally in next-generation environmental justice mapping for policy implementation (Liévanos 2018, Lee 2021). These emergent EJ mapping tools are characterized by their focus on spatial modeling of "cumulative impacts" (social, biological, and environmental) and by their use by government agencies as environmental justice screening tools to systematically identify "environmental justice communities." Where first generation EJ maps focused on demographic indicators, these new mapping tools spatially array several indicators that research has shown to contribute to cumulative impacts (Lee 2021). In fact, the first of these maps, the Environmental Justice Screening Method (EJSM), was developed by environmental public health researchers in the South Coast Air Basin (a region including Los Angeles and Orange Counties), who worked with EJ advocates to identify key factors of concern (Sadd et al 2011). The development of these new maps has been enabled by recent advances in geographic information system (GIS) capabilities as well as the more widespread availability of demographic and environmental data. These shifts have made possible the integration of multiple large and diverse datasets in GIS tools, overcoming a longstanding challenge for EJ mappers stymied by data quality and integration

issues (Liévanos 2018, Maantay 2002). Specifically, more robust datasets enable researchers to quantify the discrete factors contributing to environmental public health, which, once quantified, can be placed on a map using GIS, making it newly possible to visualize the spatial distribution of impacts, hazards and vulnerabilities (Lee 2021). Finally, California's position at the leading edge of EJ mapping is also in large part a result of its precedent-setting policies on environmental justice and climate change, which have necessitated operational definitions of EJ terms like "disadvantage" and "cumulative impacts" recently enshrined in state law (CalEPA 2017, Eng et al. 2018, Liévanos 2018, Stratte and Kenline 2018).

California-based science and policymaking have thus played a prominent role in elaborating the concept of cumulative impacts (e.g. English et al 2013, Sadd et al 2014, Solomon et al. 2016). Responding to demands from California EJ advocates who envisioned the "cumulative impacts" concept as crucial to assessing and addressing disproportionate environmental impacts, the California Environmental Protection Agency established the very first working definition of the concept in US environmental policy at any level of government in 2005 (Alexeeff et al 2010, Eng et al. 2018, Liévanos 2018, Lee 2021): "Cumulative impacts means exposures, public health or environmental effects from the combined emissions and discharges in a geographic area, including environmental pollution from all sources, whether single or multi-media, routinely, accidentally, or otherwise released. Impacts will take into account sensitive populations and socio-economic factors, where applicable and to the extent data are available" (Alexeeff et al 2012: 648). As this definition gained traction in environmental policy and programs, California has developed in the last decade multiple prominent cumulative impact mapping tools, many of which preceded and informed the national mapping tool released by the US EPA in 2015 (Liévanos 2018, Sadd et al 2014). California's mapping tools include the

Cumulative Environmental Hazard Inequality Index (CEHII), the aforementioned Environmental Justice Screening Method (EJSM), the Climate Change Vulnerability Screening Method (CCVSM), the Cumulative Environmental Vulnerability Assessment (CEVA), and the California Community Environmental Health Screening Tool (CalEnviroScreen). Of these, CalEnviroScreen is the only one with statewide coverage, and is by far the most politically and economically consequential: it is the only cumulative impact tool in the United States that directly informs laws, funding, and programs at the state level (Eng et al. 2018, Liévanos 2018). It has also provided the model for US EPA's nationwide EJSCREEN, as well as similar tools being developed in at least nine states and two municipalities (Lee 2021).

Among similar mapping tools, CalEnviroScreen is unique in its significant role in shaping California's changing legal and bureaucratic conceptualizations of environmental justice. First released in April 2017, the history of CalEnviroScreen is rooted in an older piece of legislation: California's landmark Assembly Bill 32 (AB 32), better known as the Global Warming Solutions Act of 2006. AB 32 established a statewide carbon auction program, the first of its kind in the United States and still one of the largest such programs in the world . Carbon auctions, also known as cap-and-trade programs, place legal limits on carbon emissions but allow polluters to buy permits to exceed these limits through the auctioning of carbon offsets, or measures designed to "offset" the impact of additional carbon pollution through investment in environmental projects. An oil refinery in Norway might purchase a voucher to exceed regulatory limits on carbon emission, the proceeds from which could be used to fund a carbon sequestration project in Brazil that, in theory, effectively cancels the marginal impact of the Norwegian company's excessive emissions. The Global Warming Solutions Act was in name and in concept emblematic of an emergent environmental discourse focused on climate change (then

more commonly termed global warming) as a planetary concern calling for action at a planetary scale, in order to achieve the rapid reduction of worldwide carbon emissions and slow the exponential rise in global temperature.

In some of the most pollution-burdened places, targeting carbon pollution at this massive scale came at the expense of air quality equity. Many cap-and-trade programs, including California's, have been successful in achieving their aims of reducing *overall* carbon emissions, but they have been critiqued by environmental justice advocates around the world for their exacerbation of environmental disparities along lines of race, wealth, and political power. Among other critiques,[24] these arguments point out that market-based programs like carbon auctions allow the wealthiest and most powerful polluters to buy their way out of environmental regulations, in effect amounting to a deregulation of carbon limits that overwhelmingly impacts communities already overburdened by pollution (English et al. 2013, London et al. 2008, London et al 2013, Sze et al. 2009). Moreover, industrial carbon emissions are often associated with toxic co-pollutants including benzene and other carcinogens, and carbon trading systems can increase exposure to these co-pollutants in the most heavily polluted communities. The anticipated detrimental effects of California's carbon auction market on environmental inequity were eventually borne out in studies evaluating the statewide impact of AB 32: reductions in universal carbon emissions at the state level were achieved through carbon trading that effectively

[24] In practice, carbon trading is riddled with problems. Many of California's cap-and-trade dollars are invested in its forest offset program– the largest government-regulated program of its kind– which ostensibly preserves forest from logging and destruction to offset pollution elsewhere. Forest offset programs have been critiqued on numerous grounds, including that the reductions are canceled out by increased logging elsewhere or that credits are used to protect forests that were never in danger of logging in the first place. Among the most concerning and sobering analyses are those showing that developers inflate the impact of some forest offsets by exploiting regional averages of carbon savings in a kind of ecological gerrymandering (Song and Temple 2021). One recent study shows that California's forest offset program creates between 20 to 39 million "ghost credits" that do not achieve real carbon savings– equal to the annual emissions of up to 8.5 million cars (CITE).

increased pollution for low-income communities of color and widened environmental health disparities (Cushing et al 2012, English et al 2013).

Bolstered by these alarming findings, environmental justice advocates across the state lobbied for statewide legislation that would ensure that proceeds from California's cap-and-trade program would be used to mitigate these gaping disparities through environmental investments in the state's most environmentally impacted communities (Eng et al. 2018). In 2012, the state legislature established the Greenhouse Gas Reduction Fund (AB 1532), now called California Climate Investments (CCI). That same year, State Bill 535 (SB 535) established a requirement that a minimum of 25% of the proceeds from this fund benefit California's "disadvantaged communities," encoding this term in state law for the first time.[25] (A subsequent 2016 law would further require that 25% of CCI investments be *located* in DACs [AB 1550]). The legislature tasked CalEPA with identifying these DACs, so the agency's Office of Environmental Health Hazard Assessment (OEHHA) set to work developing a tool that would reflect cutting-edge cumulative impacts research and EJ screening methods: the California Community Environmental Health Screening Tool, or CalEnviroScreen. In April 2017, CalEPA published the state's first list of DACs for the specific purpose of targeting California Climate Investments funds according to SB 535.

In this way, CalEPA created an operational definition of disadvantaged communities under SB 535: a DAC is any census tract in "the top 25% scoring areas from CalEnviroScreen along with other areas with high amounts of pollution and low populations" (CalEPA 2017). CalEnviroScreen scores are calculated through a multiplicative framework based on previous

[25] As of 2019, over three billion dollars from this fund have been allocated to benefit disadvantaged communities. Illinois and New York have since passed similar bills to allocate 25% and 40% of funding from state renewable energy programs to disadvantaged communities (Lee 2021).

cumulative impacts models (Liévanos 2018), wherein indicators of *pollution burden* (including *environmental exposures* and *environmental effects*) are multiplied by indicators of *population characteristics* (including *sensitive populations* and *socioeconomic factors*) in order to yield an overall score (see Figure 3B):

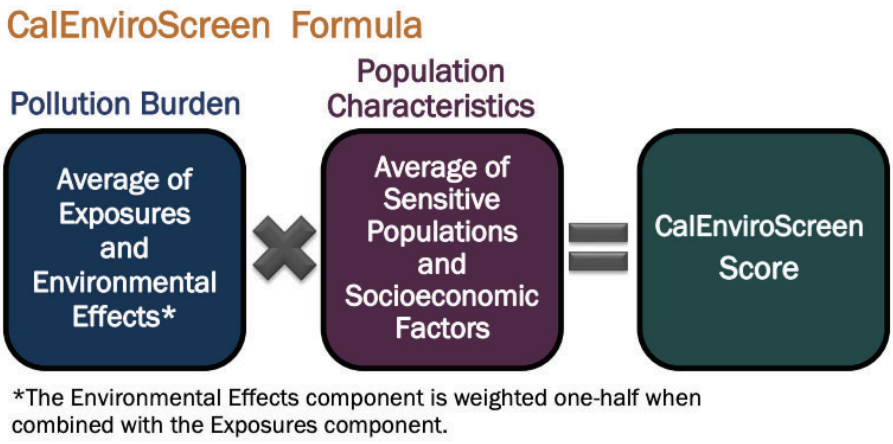


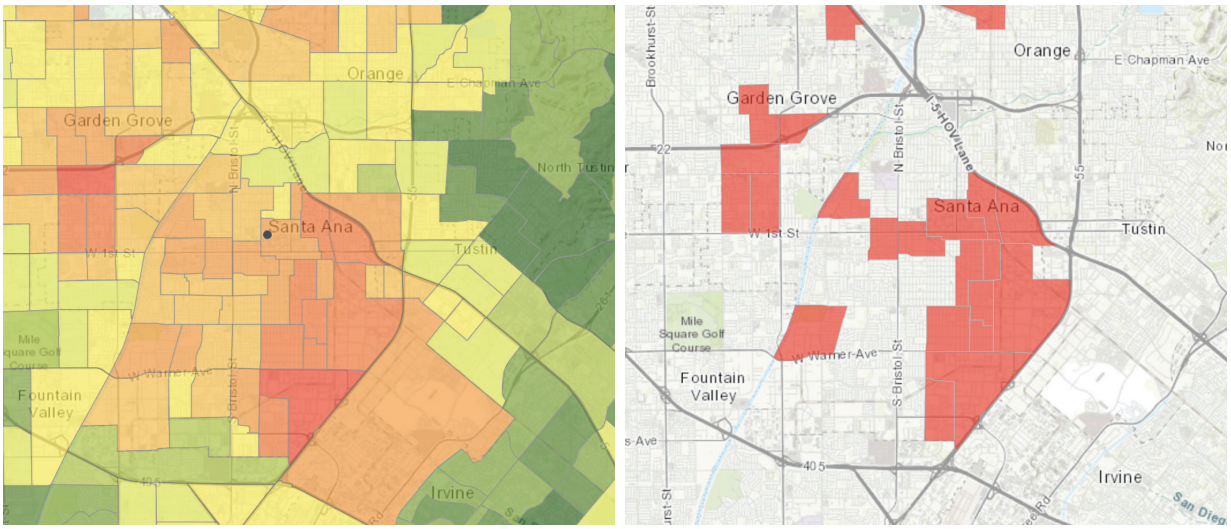
Figure 3B: *CalEnviroScreen Formula (OEHHA 2019)*

Each of these four indicators are themselves based on aggregations of numerous and diverse data sets. For instance, "environmental exposures" includes pollution data on several criteria pollutants, types of sources, and media to indicate local contact with pollution, including ozone, particulate matter, pesticide use, traffic, drinking water contamination, and toxic releases from facilities. "Environmental effects" data on a range of environmental conditions caused by pollution, including solid and hazardous waste facilities, cleanup sites, groundwater threats, and polluted water bodies. "Sensitive populations," defined as "populations with biological traits that may magnify the effects of pollution exposures," is an indicator based on local incidence of asthma, cardiovascular disease, and low birth-weight infants. Finally, "socioeconomic factors," or "community characteristics that result in increased vulnerability to pollution," include characteristics of poverty, unemployment, educational attainment, linguistic isolation, and

housing-burdened low-income neighborhoods. Environmental threats (*exposure* and *effects*) are averaged to yield a *pollution burden* score; similarly, biological and social vulnerabilities (*sensitive populations* and *socioeconomic factors*) are averaged to yield a *population characteristics* score. The CalEnviroScreen score for any given census tract is the product of its pollution burden multiplied by its population characteristics. In other words, higher indicators in any of these categories -- pollution exposure, environmental effects, or biological or social vulnerabilities--magnify the overall score to determine the tract's classification as a DAC.

CalEnviroScreen has thus helped remake the "EJ community" into the "disadvantaged community" through both discursive and technical means.[26] By building the EJ movement's concept of cumulative impacts into a novel, spatialized definition of "disadvantage," CalEnviroScreen enacts a new notion of "community" as a geographically bounded and scientifically identifiable territory that is defined through comparison to other areas. This territorialization of quantified environmental disadvantage has already had widespread implications: while CalEnviroScreen was originally developed for Greenhouse Gas Reductions Funds pursuant to SB 535, its definition of disadvantaged communities has been used in at least ten statewide programs spanning eight California agencies, as well as local initiatives in the cities of Los Angeles and San Diego (Eng et al. 2018). Legislative initiatives and agency directives now mandate targeted investments and programming related to issues like affordable housing, energy infrastructure, and transportation in communities designated as DACs.

[26] In her 2013 book *Mark My Words: Native Women Mapping Our Nations,* Mishuana Goeman argues that the discursive and technical powers of state mapping projects have always been inextricable. Mapping has historically been both a discourse representing a colonial imaginary, and a technopolitical instrument for deploying imperial power: "Maps exert political control by manipulating the representation of space into a language of normativity" (Goeman 2013: 18).



Figures 3C and 3D: *The map on the left shows the CalEnviroScreen 3.0 scores for Santa Ana and the surrounding areas (as of February 11 2021), where dark orange and red indicate areas with higher scores and green indicates areas with lower scores. The map on the right shows the census tracts scoring in the top 25% in California, designated as disadvantaged communities pursuant to SB 535 and SB 1000.*

The widespread adoption of the "disadvantaged community" as a policy tool for addressing issues of equity, even beyond environmental agencies, is a direct result of the nascent technical capacity to quantify, spatialize, and compare environmental (in)justice across locations using maps like CalEnviroScreen. By defining disadvantage spatially, by census tracts, rather than according to any singular environmental indicator or demographic threshold, CalEnviroScreen made the disadvantaged community articulable across agencies, jurisdictions, and policy contexts. Where the EJ community was previously the purview of environmental agencies alone--where it was usually imagined as a public to be managed and engaged with as a matter of compliance with federal statutes (Lee 2021, Harrison 2019)-- CalEnviroScreen made the EJ community into a territory, objectively locatable and normatively defined, that the state can visualize and act upon through a wide range of legal and policy techniques.

Two of the most novel and significant legal applications of CalEnviroScreen are in Senate Bill 1000 and Assembly Bill 617, passed by the California legislature in 2016 and 2017

respectively (Eng et al. 2018, Stratte and Kenline 2018).[27] SB 1000 requires that counties and municipalities which include one or more disadvantaged communities to add to their general plan “objectives and policies to reduce the unique or compounded health risks in disadvantaged communities,” “promote civil engagement in the public decisionmaking process,” and “prioritize improvements and programs that address the needs of disadvantaged communities" (Leyva 2016). AB 617 requires the California Air Resources Board to “develop a statewide air quality monitoring plan, identify disadvantaged communities most impacted by air pollution, and... develop local pollution reduction strategies for and deploy related technology in those communities" (Stratte and Kenline 2018). In its first year, AB 617 established the $500 million dollar Community Air Protection Program (CAPP) through which the California Air Resources Board (CARB) would select ten of the “most impacted communities” statewide. Regional air districts would convene steering committees of residents, EJ advocates, and representatives from local government, non-profit, and industry to develop community air monitoring plans (CAMPs) that would then inform community emissions reduction plans (CERPs) based on local needs and priorities. AB 617 also created a smaller Community Air Grants program funding “community-based organizations”-- mostly small nonprofits-- to develop technical capacity for their own community air monitoring programs.

In other words, both SB 1000 and AB 617 require the identification of DACs as a condition of carrying out other environmental justice goals, making the spatialization of the

[27] These laws both define the term “disadvantaged community” as an area defined by CalEPA pursuant to section 39711 of the Health and Safety Code as “(1) Areas disproportionately affected by environmental pollution and other hazards that can lead to negative public health effects, exposure, or environmental degradation” and “(2) Areas with concentrations of people that are of low income, high unemployment, low levels of homeownership, high rent burden, sensitive populations, or low levels of educational attainment.” The laws do not directly require the use of CalEnviroScreen to identify these DACs, but in practice the mapping tool has been used to designate DACs for the purposes of implementing these and other laws (Eng et al. 2018).

environmental justice community integral to the state conceptualization of EJ. In the following section, I analyze how environmental justice advocates in some Southern California leverage and critique the implications of the DAC designation in the implementation of SB 1000 and AB 617 for their own advocacy goals.

V. Living With(in) the DAC: Advocating With, Against, and Beyond the Map

The capacity to distill a complex array of social and environmental factors into indicators that can be located on a map has made environmental justice newly definable in state law, manageable across government agencies and jurisdictions, and legible to numerous publics. They also, as Charles Lee points out, "[put] the information in front of the analysts and decisionmakers in a form they cannot ignore" (2021: 10213). In other words, tools like CalEnviroScreen have helped make environmental justice into what John Dewey (1927) calls a "public problem," a matter of shared concern around which publics can form and mobilize for democratic action. This framing of the problem of EJ as one of spatialized, disproportionate impacts is a hard-won success resulting from decades of environmental justice organizing and advocacy, across California, the United States, and the globe. It moves the state, among other actors, to recognize the failures of universal environmental regulation and the particular vulnerabilities of the places and populations most impacted by the interlocking problems of pollution, environmental degradation, poverty, and systemic racism. As with any conceptual framework, however, the mapped disadvantaged community operates through abstraction and essentialization. It is made significant as much by what it makes visible as by what it leaves out.

Many of the residents and activists involved in the community air monitoring projects I studied engage productively with the concept of the DAC as both problematically narrow and politically potent. As a mode of "strategic essentialism" (Spivak 1990), the DAC enables the

legal and regulatory discourse to register racialized inequity as an environmental matter. At the same time, the DAC discourse brackets environmental injustice both spatially and temporally within the presentist and geographically bounded features represented on maps like CalEnviroScreen. Where maps engage in the "abstraction of land and bodies into territories and citizens" (Goeman 2013: 32), the environmental justice movement has always been rooted in the materiality of land and bodies, in the struggle to live and breathe in place. For those working to make their communities more breathable, *living in* the DAC means contending with the double-binds of this framework -- *living with* the implications of the DAC designation by leveraging it in their engagement with state environmental agencies and/or by pushing against its limitations.

These are not mutually exclusive positions; I observed the same people and groups working with, for, against, and beyond the DAC framework at various moments in my fieldwork, often within the same conversation or meeting. The vignettes that follow illustrate how some of my interlocutors engage the framework of the disadvantaged community as they articulate their own visions of an environmentally just future in their engagements with state EJ programs: by leveraging the DAC designation in making claims to the state for funding and other demands in Santa Ana, by refusing the designation as distracting and ahistorical in East LA, and by pushing beyond the geographical and rhetorical limits of the DAC and the framing of disproportionality in the Imperial Valley.

A. Becoming Disadvantaged in Santa Ana

AB 617 was signed into law in July of 2017, just a few months after Los Robles residents first became concerned with the industrial emissions in their neighborhood that spring. Vecinos Unidos responded to a call for applications to the newly implemented Community Air Protection

Program (CAPP), through which air districts and the state air board would select disadvantaged communities for comprehensive local air monitoring.

Santa Ana was not selected as a site. A representative from the air district explained to Pedro that Santa Ana did meet some of the selection criteria for the program's Year 1 communities, such as disproportionate levels of pollution compared to nearby areas, and the proximity of schools to air pollution sources (the southeast Santa Ana industrial corridor abuts several elementary schools and surrounds the city's largest high school). Santa Ana was lacking in other CAPP selection criteria, however, including robust existing local air pollution data and a record of past community plans and programs addressing air pollution issues. At the time, there was little local air pollution data in the city. The nearest regulatory air monitor was located near Disneyland Resort in Anaheim, nearly 20 miles northwest of Los Robles. Even PurpleAir, the largest network of low-cost air sensors in the world, had no sensors sited within Santa Ana before Vecinos Unidos' air monitoring program. Moreover, there was not a single organization in all of Orange County focused on environmental justice; the first to do so, Orange County Environmental Justice, would not be established until 2018.

The air district representative suggested Vecinos Unidos apply for a grant through the Community Air Grants program, a smaller set of funds also established by AB 617 for community-based organizations to conduct their own air monitoring project. A grant like this would enable Vecinos Unidos to become competitive for the CAPP in future years, developing local data to demonstrate the disproportionate impact of air pollution on the neighborhood and establishing a record of community projects addressing air pollution. Vecinos Unidos applied, citing in the application the proximity of the 42 industrial facilities to homes and schools and Los Robles' high CalEnviroScreen score -- lack of local air data notwithstanding. In late 2017,

Vecinos Unidos received a Community Air Grant funding three years of organizing, research, and education, establishing resident steering committees who would be trained to oversee the design and pilot implementation of air monitoring along the industrial corridor.

As Vecinos Unidos would learn, becoming an EJ community doesn't just happen– it takes work.[28] Through the course of the grant period, Vecinos Unidos and the residents of Los Robles hosted several toxic tours and community forums on environmental justice, recruited and trained over 30 youth and adults for the steering committees, and conducted workshops on developing advocacy campaigns, participatory neighborhood mapping, engaging in the public comment process, and designing an air monitoring project. They built relationships with neighborhood associations throughout Santa Ana, co-founded a coalition of new and emerging local non-profits concerned with environmental justice, and convened a multidisciplinary panel of technical advisors at UCI, with whom they went on to collaborate on several other environmental health grants. They began the first community air monitoring network in Orange County, setting up a dozen stationary monitors and coordinating mobile air sampling throughout Santa Ana and surrounding cities. Vecinos Unidos and the steering committees also helped spearhead a city-wide campaign to incorporate environmental justice concerns into Santa Ana's General Plan Update, as required by the new provisions enacted in SB 1000. By arguing that the city had not conducted adequate outreach to Santa Ana's 21 disadvantaged communities (according to SB

[28] In *Being Nuclear* (2012), a history of uranium and the nuclear industry in Africa, Gabrielle Hecht argues that *nuclearity* is an unsettled and contested technopolitical category, where the qualities that make a particular place "nuclear" are unstable and context-specific. "Nuclearity is not so much an essential property of things as it is a property distributed among things," Hecht argues, and whether it is used as a tool of "empowerment or disempowerment" depends on its distribution (2012:14). "Being nuclear" is not merely a matter of the existence of uranium or of mineworkers' exposure to radon. Rather, particular places, objects, and industries become nuclear (or not) through a variety of processes including the production of scientific data on exposure, the political development of nuclear governance systems, and the social recognition of the property of nuclearity. "Nuclearity," Hecht observes, "requires work" (2012:320).

535 and SB 1000 definitions, which are based on CalEnviroScreen), they and the rest of the nascent Plan del Pueblo (the People's Plan) coalition succeeded in delaying the approval of the General Plan Update, sending the planning commission back to the drawing board to conduct robust community engagement and redesign the environmental justice components of the plan.

Los Robles residents and organizers thus leveraged their new status as a DAC according to the technical definitions of CalEnviroScreen to gain AB 617 funding for community organizing, education, training, and environmental monitoring, and to demand a seat at the table in Santa Ana's city planning process. Adriana Petryna's concept of biological citizenship (2002) describes how claims of rights and benefits are made on biological bases such as disease or disability. The DAC designation, can similarly enable those living within such a disadvantaged community to make demands on the state according to their disproportionate environmental exposures and vulnerabilities.

B. Dehistoricizing Disadvantage in East Los Angeles

In January 2019, I attended a community meeting for East Los Angeles/ Boyle Heights/ West Commerce, which had been selected for the first year of the Community Air Protection Program. The meeting was hosted by the South Coast Air Quality Management District and was held in the gymnasium of an East Los Angeles community center, its concrete walls decorated with cheerful fliers for health fairs and evening Zumba classes. Toward one end of the room, air district staff were recognizable by their blue polo shirts emblazoned with the agency's logo. The other people around the table--representatives from community groups, industry, and local government selected by the air district--were members of the steering committee tasked with overseeing the design and implementation of the community air monitoring program.

The meeting began with a presentation from the air district of a draft proposal for the air monitoring project. Following the presentation, the meeting facilitator invited comments from the steering committee.

Helen, a resident of the Boyle Heights neighborhood and a well-known local activist, spoke into the table microphone, "Let me tell you why I'm here… Even though we've had a troubled relationship with AQMD in the past, mainly regarding the Exide fiasco... I am hoping to join the steering committee to effect change. Unfortunately [based on] what I see here, I don't see necessarily where we can effect change… We already know the pollution is there."

The "Exide fiasco" refers to the notorious case in which Exide Technologies' battery recycling plant in nearby Vernon, California, caused dangerous levels of lead pollution in over 10,000 homes across a nearly two-mile radius, in an area populated overwhelmingly by low-income, immigrant, Latinx residents. For thirty-seven years, state agencies had allowed Exide to operate the plant under temporary permits, despite the company's continuous violation of state standards for hazardous waste disposal. The air district itself had found Exide exceeding maximum emissions of lead and arsenic since at least 2008, but did not shut it down or consistently share its findings with other permitting agencies. In 2015, after over three decades of pollution violations, Exide finally shut its doors in the face of threats of federal criminal charges. To date, the cleanup of thousands of contaminated homes remains incomplete.[29]

"We want to work with you," Helen continued, "but we want to fight these polluters killing our communities. The pollution with Exide has made my whole family sick… When you

[29] Geographer Laura Pulido argues that Exide's decades-long regulatory noncompliance exemplifies the role of white supremacy in the production of environmental racism: Exide was fully aware of the impacts of its actions, but knowingly and deliberately prioritized the company's financial wellbeing (which overwhelmingly benefits white shareholders) over the health and lives of people of color (2015: 813).

put the monitors up, we already know you're going to get pollution, [but] we want serious enforcement. [Otherwise] you're kind of like a security guard walking around with a flashlight." As Helen sat back in her seat, an air district staff member turned to face her and responded, **"**I think our agency has evolved a lot since Exide…We're much more than a security guard with a flashlight."

Alex, a fellow activist seated next to Helen who had also helped lead the campaign for the Exide cleanup, leaned in to add his concerns about the air monitoring project. "Many of us were opposed to AB 617 before it was even drafted… Our biggest concern was that as opposed to advancing on the issues that are well known by those of us that breathe them every day… instead we would be given, to be quite frank, bullshit monitoring… That would be done over a period of time, and then recommendations would be given that would even be weaker than [what] we've been talking about for years… We all know–you guys know, the state already knows–where the issues lie, and where the opportunities are. What's really happened is the solutions aren't politically feasible."

As I scribbled notes from across the room, I was reminded of an interview with a researcher involved in an early project (prior to AB 617) targeting monitoring in the air district's "environmental justice communities." In Boyle Heights, setting up local air monitors led regulators to identify many small, often locally-owned businesses like auto repair shops that were not previously registered with the city or relevant environmental agencies. "We went in to set up [air pollution] monitors, but we ended up having to give a lot of citations because so many of the businesses weren't on the books," the staff member said. I would encounter similar stories throughout my fieldwork about how efforts to increase enforcement in communities with multiple sources of pollution resulted in crackdowns on the politically feasible, low-hanging fruit

of small polluters instead of on larger, well-heeled facilities responsible for the bulk of local emissions. In a neighborhood like Boyle Heights, which has been the site of high-profile struggles against gentrification in recent years, the use of air monitoring to seek out and fine local businesses already risking displacement while a corporation like Exide poisoned families for decades added insult to injury.

As important as the concept of cumulative impacts has been for apprehending the compounded environmental health risks faced by communities like Boyle Heights, this pattern illustrates how, in practice, the focus on identifying "multiple sources" can flatten analyses of the primary sources of pollution and broader dynamics, including gentrification, that influence community wellbeing. Helen and Alex gave voice to the risks and limitations of a program that makes the future detection of pollution, rather than accountability for past and ongoing harm, the starting point for action on environmental justice. By making DACs into sites where "cumulative impacts" need to be identified and monitored, and where pollution is something that needs to be detected before it can be addressed, the Community Air Protection Program elides consideration of the historical conditions that have produced disadvantage in the first place, as well as past struggles to name and challenge environmental racism and to negotiate on environmental regulation and enforcement.

C. Thinking Beyond the DAC in the Imperial Valley

"That right there is the busiest McDonalds in the United States," Jim said, leaning toward me and raising his voice to carry over the noise of our tour bus rattling down Highway 111. In January of 2020, I visited another community selected for California's first cohort of the Community Air Protection Program. Calexico/El Centro/Heber are three municipalities clustered in the south of Imperial County, a vast rural area east of San Diego. As the first year of the CAPP

program drew to a close, El Centro would be hosting the first meeting of the California Air Resources Board outside of the Sacramento headquarters in the agency's history, as the board convened to approve the Community Emissions Reduction Plan based on the community air monitoring conducted in the community over that year. On the morning of the meeting, I rode in a tour bus with the visiting board members and a number of local hosts, making stops at pollution sources including a geothermal plant, a cattle feedlot, a cement factory, and a border facility. I had the good fortune to sit next to Jim, a lifelong resident of El Centro, director of the valley's Chicano Heritage Center, and a knowledgeable and captivating storyteller.

As in East LA, Imperial County residents' air quality concerns had long been neglected by state and local agencies and excluded from existing regulatory frameworks. Rather than seeing community air monitoring as a resource-intensive project that replicates ample existing data while glossing over well-known problems, residents and activists in the valley pioneered community air monitoring as a crucial tool for environmental justice. In 2013, local community health organization Comité Cívico del Valle partnered with researchers at Tracking California (formerly the California Environmental Health Tracking Program) and the University of Washington to establish a community air monitoring network of 40 low-cost sensors sited throughout the Imperial Valley. It was the first network of its size and kind in the world.[30] The monitoring project was instrumental in making the region visible as a disadvantaged community burdened by numerous environmental health concerns, albeit different ones than those in industrial areas and urban centers. The Imperial County Community Air Monitoring Network has served as a model for community air monitoring projects across California and around the country, and directly informed the implementation of AB 617 including the development of the Community Air Protection Program.

[30] I tell the story of the Imperial County Community Air Monitoring Network in Chapter 1.

What Jim pointed out as the busiest McDonalds in the United States is just down the road from one of the country's most lucrative Walmarts, in terms of annual sales. The booming business is due to their location in Calexico, within a few miles of the US-Mexico border, where they cater to customers from both sides traveling across for work, shopping, and family. Calexico is a town of only 40,000 residents, but it swells to thousands more each day with visitors from the Mexican city of Mexicali (population 1.1 million), separated from its US sister by a 50-foot barbed-wire fence. As the bus rumbles down the highway toward the border, John points out the license plates of the cars in the lane beside the bus.

"See that?" he says, "That's a Mexican license plate. But look at these others--most of them are California… Yet when our district says we're not in attainment, they blame it all on Mexico, which is out of their hands. But these cars are mostly from California, and the trucks are mostly from the US, or at least they are moving goods for US based populations. All that industry on the other side caters to the US. To say the whole thing is Mexico doing it is not accurate… you have to consider the consumer markets of these multinational corporations, they are not just from one side of the border or the other" (Conversation, January 15, 2020).

Jim's point offers a different, though related, critique of CAPP than that put forward by Helen and Alex in the January 2019 meeting: even for disadvantaged communities for which community air monitoring is seen as an important tool rather than a costly distraction, "local" air pollution often has extra-local causes. The DAC's disadvantage is produced through processes and systems extending beyond its geographic borders. The massive Community Air Monitoring Plan implemented in the area through the Community Air Protection Program had found that diesel pollution from freight traffic accounted for the largest proportion of local emissions by far, despite the area's numerous other pollution sources. This is a pattern for rural DACs: San

Bernardino/Muscoy, another year 1 CAPP community, has been transformed by the ecommerce boom as distribution centers for Amazon and other major online retailers proliferate on former ranchland, drawing thousands of trucks that ferry goods to and from the ports, railyards, and consumers' doorsteps.

I interviewed Ignacio, a longtime EJ activist in the Imperial Valley, about how his perspective on environmental justice issues had shifted over the course of his years in advocacy. He responded by describing the tension between the growing movements against global climate change and local EJ concerns. "A lot of times people in disadvantaged communities, what we call environmental justice communities, the priorities are what's happening to them right there, right now, around them," Ignacio said, tapping his forefinger on the table between us for emphasis. He had traveled recently to an urban environmental justice community outside of Imperial County, where he had attended a community meeting in a neighborhood along a refinery fenceline. He relayed how a resident there had suggested moving refineries, incinerators, and other polluting facilities outside of their city to "less populated areas," as a facilitator took notes on large sheets of sticky paper.

"Now that person didn't have bad intentions, yeah?" Ignacio said. "But it's just [they] just clearly didn't understand the fact that no, everybody deserves to have clean air… Maybe the conversation should be this transition to [a] clean energy economy. Don't just move the pollution around." Ignacio, whose work had played a pivotal role in cumulative impacts research and the development of the DAC framework, also expressed anxiety about how the focus on local priorities could obscure how communities are interconnected and limit a broader vision of environmental justice. "I'm not saying minimize [local priorities], because it's important to reduce emissions, reduce pollution, reduce risk, but not at the expense of communities. And if

you're not at the table, somebody else may not understand your community, because they haven't had the same experience." A pivotal moment in his own thinking, he said, came a few years prior at a regional environmental justice conference hosted annually in Imperial County. A speaker at the conference had questioned fundamentally the framing of EJ as a problem of "disproportionate impacts"-- a framing that, through maps like CalEnviroScreen and legislation like AB 617 and SB 1000, was gaining traction in environmental policy and popular discourse. Ignacio explained,

> "We make the common mistake of saying that we are getting disproportionately affected or impacted. And we've said it wrong all along. That's giving sort of permission that we somehow are deserving of some portion of the pollution, right? … Because it's true. Why is it that we're always claiming a disproportionate impact? What proportion of that impact is it really that we're seeking, when we're really seeking to have no impact? Right? And that has also, I think, helped us in a way how we communicate with government and how we articulate expectations. As we grow in knowledge and capacity as an organization working on environmental justice, we grow in our ability to better message and better articulate our vision, and our expectations for our community." (Interview, January 14, 2020)

As John and Ignacio both explained, the concentration of pollution in low-income communities of color is a symptom of broader economic and political systems that are inherently polluting. While concepts like disproportionate impacts, tools like CalEnviroScreen, and frameworks like the DAC can help to identify the environmental risk and harm experienced unevenly across landscapes and populations, they do not, on their own, diagnose the problem. A too-narrow focus on the DAC as the site within which environmental injustice occurs misses how these risks and harms are produced elsewhere, and how disadvantaged communities exist in interrelation with other communities near and far.

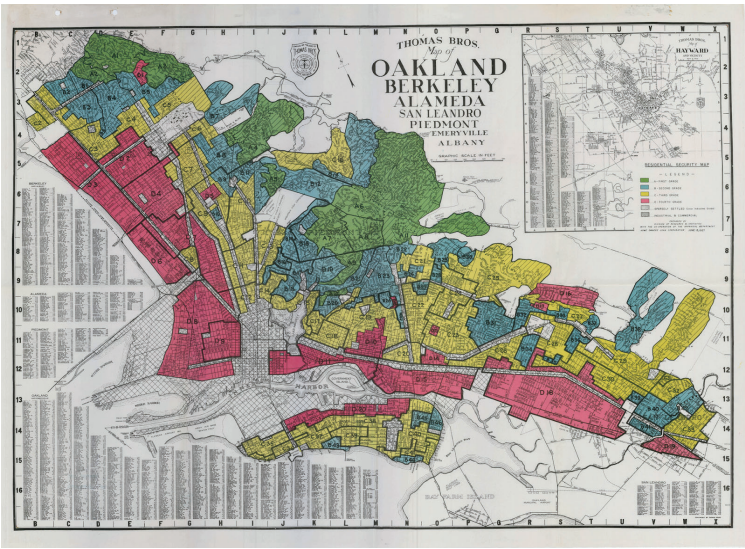
VI. Conclusion

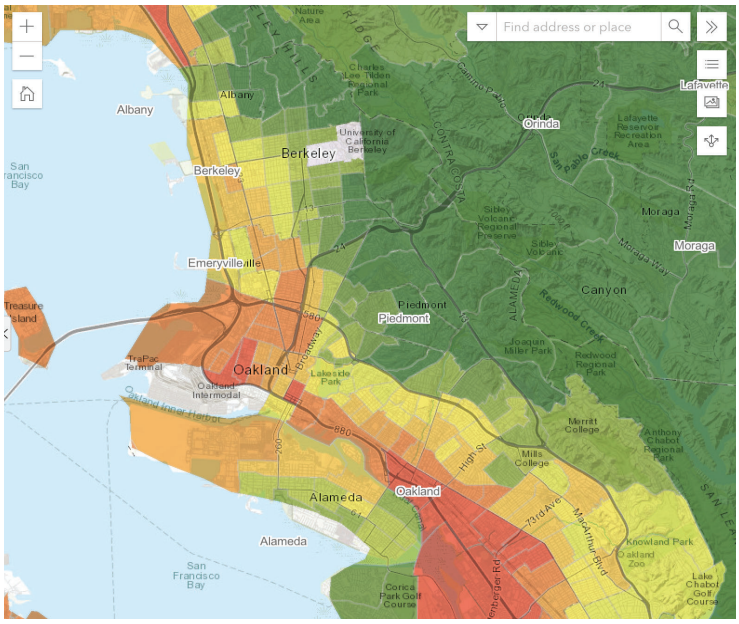
Through the aggregation and spatial mapping of multiple impacts and vulnerabilities, CalEnviroScreen and the EJ screening maps it informed have helped advance a goal that has long eluded advocates, scientists, and decisionmakers. Charles Lee, the principal author of the 1987 Toxic Wastes and Race in the United States report and Senior Policy Advisor for Environmental Justice in the Biden Administration's EPA, wrote in March 2021:

> "After more than 25 years, the practice of environmental justice within government agencies has finally evolved the science and policy tools to confront a conundrum that has plagued it since President William J. Clinton issued Executive Order No. 12898 in 1994. What lies at the heart of this transformative development? It is the ability to define, articulate, visualize, and apply the concept of disproportionate environmental and/or public health impacts (disproportionate impacts) based on empirical data in the context of programmatic decisionmaking." (Lee 2021:10207)

The operationalization of formerly undefined or slippery concepts like disproportionate impacts through these maps enabled new forms of government action on environmental justice by enabling the presentation of information in "objective (based on empirical evidence), comparable (quantitative), and visualizable (mapped) terms" (Lee 2021:10213). Put another way, these maps are politically compelling because they translate the embodied experience of racialized environmental violence into the language of the state.

Over the last couple of years, I have seen the same juxtaposition of two images circulated in a half dozen journal articles, news reports, and conference papers: a recent CalEnviroScreen map of Oakland, California published alongside an 85-year-old redlining map of the same area. The two images are remarkably similar. The tracts mapped in yellow ("definitely declining") or red ("hazardous" to mortgage lenders) by the Home Owners Loan Corporation (HOLC) in 1937, largely on the basis of residents' race, are also colored in red or orange in CalEnviroScreen



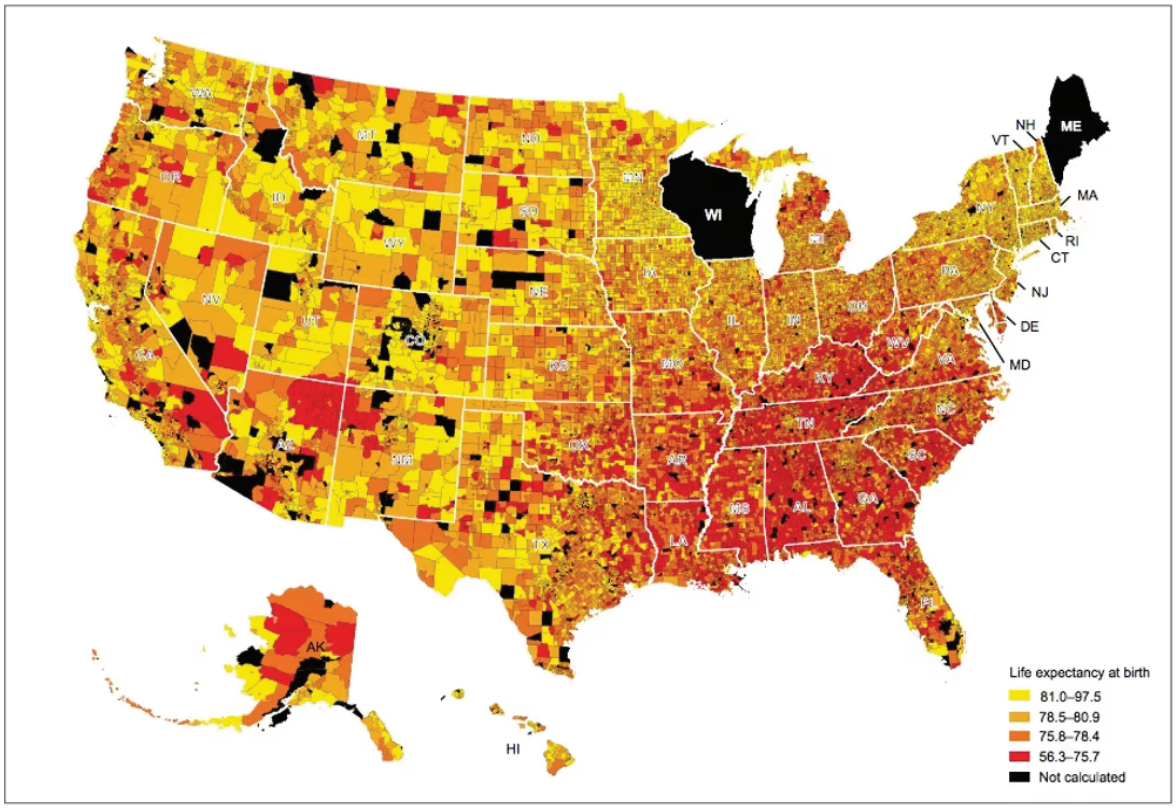


Figures 3E and 3F: *A 1937 redlining map of the East Bay by the Home Owners Loan Association (public domain, scanned image courtesy of the University of Richmond's Mapping Inequality Project) resembles a 2021 CalEnviroScreen 4.0 map of the same area.*

today. A 2022 landmark study found that historical redlining is associated with present-day air pollution in U.S. cities (Lane et al. 2022). Read together, maps like these can help make visible the longue durée of racial violence, underscoring the inextricability of economic discrimination, environmental racism, and health inequality.

The way that place mediates the relationship of race, hazard, and harm is critically important, but may also be easily misconstrued. In 2018, the National Center for Health Statistics published first-of-its-kind data on life expectancy at the scale of census tracts. The summary report found that "the strongest predictor of life expectancy in the United States is zip code" (Arias et al. 2018). The map produced by this NCHS study is a stark visualization of racism as geographer

Ruth Wilson Gilmore defines it: “the state-sanctioned and/or legal production and exploitation of group-differentiated vulnerabilities to premature death, in distinct yet densely connected geographies” (2007: 261). Indeed, environmental justice pioneer Robert Bullard frequently cites this NCHS finding to draw connections among historical racism, escalating climate disasters, and the unevenly felt ravages of COVID-19 (e.g. Bullard 2017, 2021).



NOTE: Census tracts from Maine and Wisconsin were excluded.
SOURCE: NCHS, National Vital Statistics Systems, Mortality.

Figure 3G: *United States map of life expectancy at birth by census tract, 2010–2015. NCHS, National Vital Statistics Systems, Mortality.*

While discursively powerful, the "zip code effect" framing is risky when it is decontextualized.[31] News coverage of the 2018 NCHS study lead with headlines like "Your Zip Code Might Determine How Long You Live – and the Difference Could Be Decades" (Ducharme and Wolfson 2019) and "Being Born in the Wrong Zip Code Could Shorten Your Life" (Owens-Young 2018). David Harvey warns against conceptualizations of spatial forms or locations as before or outside of social process: "To write of 'the power of place', as if places…posses causal powers, is to engage in the grossest of fetishims; unless, that is, we confine ourselves rigorously to the definition of place as a social process" (Harvey 1973: 21). The relationship of zip code to life expectancy (Figure 2G), or of Oakland's 1937 redlining map (Figure 2E) to its 2021 CalEnviroScreen map (Figure 2F), ought not to be interpreted as evidence of the "power of place." To read in these maps that communities of color are at risk because they live in hazardous places dangerously misses the point. Rather, I argue that we ought to keep in mind Goeman's reminder that "[t]he material reality of inequities and hierarchies result from the mapping process of naming and symbolically defining and enframing land" (2013: 23). The HOLC's redlining maps and CalEnviroScreen are not just similar because they reflect ongoing processes of spatialized racism at different points in time; they are alike because they do similar kinds of discursive work. HOLC's maps, like CalEnviroScreen, are maps of risk, racializing places and people as hazardous.[32] Without a rigorous reading and application of

[31] I discuss Kim Fortun's (2012, 2014) concepts of discursive gaps and risks as characteristic of late industrialism in the introduction to this dissertation.

[32] Historian Daniel Cumming documents the use of redlining maps in Southern California's oil boom, showing how "the mapping of the underground–the location and volume of subterranean oil fields, in particular– was a crucial technique in underwriting urban apartheid" (2018: 85). This history illustrates the centrality of the construction of environmental resources and hazards to the production of racial segregation.

CalEnviroScreen, it too risks reproducing racialized hazard rather than enabling its interrogation and interruption.

With this in mind, I argue that environmental policy that hinges on defining "the most impacted communities" rests on an essentialized understanding of "community" that too narrowly fixes the unfolding of environmental injustice in both (1) temporal and (2) spatial scales. First, there is a risky presentism embedded in CalEnviroScreen's indicators of environmental conditions (e.g. ozone exposures, impaired water-bodies) and population characteristics (asthma rates, linguistic isolation). Uncareful interpretations of CalEnviroScreen may read these features as effects or outcomes of place-based dangers (evidence of the "power of place") rather than indicators of ongoing historical processes that continue to produce risk and meaning about people and places in the present.

Second, we ought to be wary of implicit claims that the DAC is "where environmental injustice happens," which can obscure the production of this disadvantage at other scales. In her pivotal critique of dominant definitions of environmental racism in law and geography, Laura Pulido (2000) points out that these definitions rest on narrow, normative understandings of racism characterized in part by an uncritical approach to scale. To paraphrase Pulido's analysis of how white privilege (2000) and white supremacy (2015) are crucial components of environmental racism, any meaningful characterization of the "disadvantaged community" must include an analysis of how its production is predicated on the generation and maintenance of "advantage" elsewhere.

How, then, ought we to read CalEnviroScreen and maps like it instead? I argue that there is promise in using these maps to understand *how,* rather than *where,* environmental injustice is enacted. In summer of 2020, in the heat of the pandemic, the Vecinos Unidos resident steering

committee gathered in a Zoom call for the first time since their in-person meetings had been suspended in March. The meeting was called to launch the campaign for more robust environmental justice policy in the city's General Plan, which I described in the vignette at the start of this chapter. The city had published an informational flier on SB 1000 and EJ in the General Plan, featuring a map of the City's 17 disadvantaged communities but offering little information about how the plan would address environmental injustice for and in these areas. While planning the steering committee meeting with Pedro and Issac, we discussed how best to explain a) the significance of the flier from the city, b) what a city's General Plan is, and c) how it might be related to the committee's air pollution concerns. We settled on a slideshow with two maps, back to back: the image from the flier of Santa Ana's DACs (Figure 2H), and the land use map in its current plan (Figure 2I). We facilitated a discussion about the maps in which residents observed that the city's DACs were largely clustered in areas where industrial and residential zones met. This led to discussion of how zoning and land use can affect exposure to pollution, and how a city plan might be designed to support healthier neighborhoods: through establishing industrial buffer zones, for example, or by creating more green spaces throughout the city.

Juxtaposing the DAC map circulated by the city with the land use map enabled a collective, critical reading of how maps are used as governance technologies that shape the spatiality of environmental (in)justice locally. As the General Plan Update campaign grew and evolved, Pedro and Issac used images of various maps flexibly and fluently in presentations to other neighborhood associations, community organizations, city council members, and other potential allies. Over time, they invoked maps of Santa Ana (e.g. Figures 2A, 2C, 2D, 2H, and 2I) not only to claim Los Robles' status as an "environmental justice community" or DAC but to

illustrate the roots and causes of environmental injustice in their city, and to propose policy solutions by redrawing parts of the map.

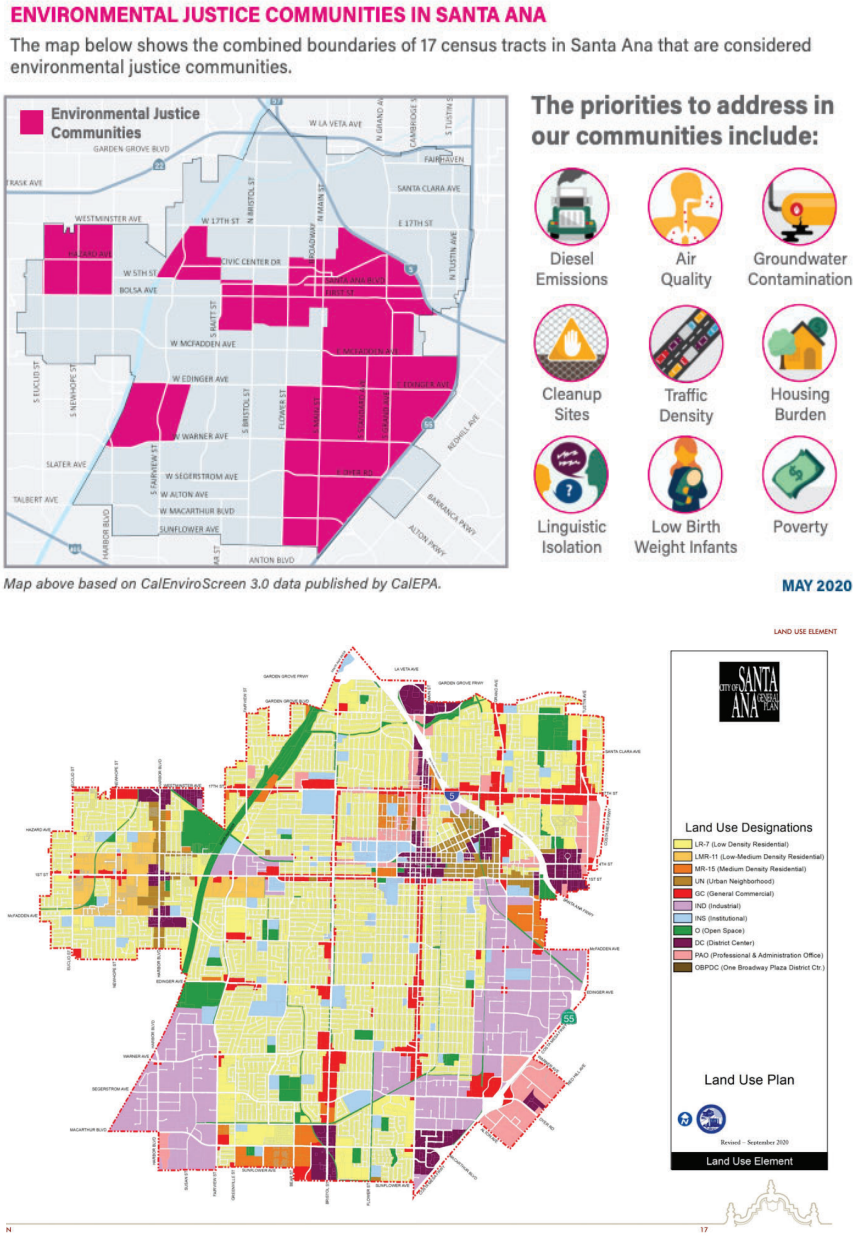


***Figure 3H** (above): Image from a flier circulated in May 2020 by the City of Santa Ana about SB 1000 and environmental justice in the General Plan Update, showing the city's "disadvantaged communities" as determined by CalEnviroScreen 3.0.*

***Figure 3I** (below): Zoning map from the Land Use Element of the City of Santa Ana's current General Plan, adopted February 1998.*

Vecinos' Unidos evolving use of maps in their EJ advocacy illustrates the political malleability of maps as discursive tools. Goeman (2013) writes that despite cartography's violent histories, maps are not always tools of colonialism and state control; they are also media for narratives of self-determination and resistance. Although the "environmental justice community" is operationalized as the "disadvantaged community" through California law and maps like CalEnviroScreen, the "environmental justice community" is an expansive concept whose multiple meanings are not totally defined by its legal equivalent, the DAC. It is notable that unlike "disadvantaged community," "EJ community" is, in many contexts, an emic term, coined and used by residents and advocates to describe not only the harm and risk they experience, but also the relational politics of EJ work.[33] When Pedro describes Los Robles' "becoming" an EJ community, he refers not only to its designation as a DAC, but also to the cultivation of shared and emplaced knowledge and care about pollution, health, justice, and wellbeing in the neighborhood.

Maps are implicated in both of these kinds of becoming. In early 2019, at one of Vecinos Unidos' first public community forums on air pollution and environmental justice in Santa Ana, they conducted a participatory mapping exercise for those in attendance. At long tables at a community center in Los Robles, residents gathered around sheets of colorful adhesive flags along and printed copies of the map of the industrial corridor (Figure 2A). Neighbors took turns sticking flags on the sites they frequented regularly–a friend's home, a child's school, a grocery

[33] In her essay "Nature as Community: The Convergence of Environment and Social Justice," ethnographer Giovanna Di Chiro calls attention to the relationality embedded in definitions of nature, environment, and community in Latinx environmental justice organizing in South Los Angeles: "Ideas of nature, for environmental justice groups, are therefore tied closely to ideas of community, history, ethnic identity, and cultural survival, which include relationships to the land that express particular ways of life. The place– geographic, cultural, and emotional– where humans and environment converge is embodied in the ideas and practices of 'community'" (1998:318).

store, a clinic– diagramming the social relations of place alongside the map of the 42 permitted facilities. The environmental justice movement is often described as the movement to bring mainstream environmentalism home to the places people "live, work, play, and pray," resisting constructions of nature and wilderness as "elsewhere" and connecting concerns of environmental hazards with racial and social justice (Taylor 2014). Looking together at the colorful maps they had created, those at the meeting began to see the environmental justice community of Los Robles take shape: it all started with a map.

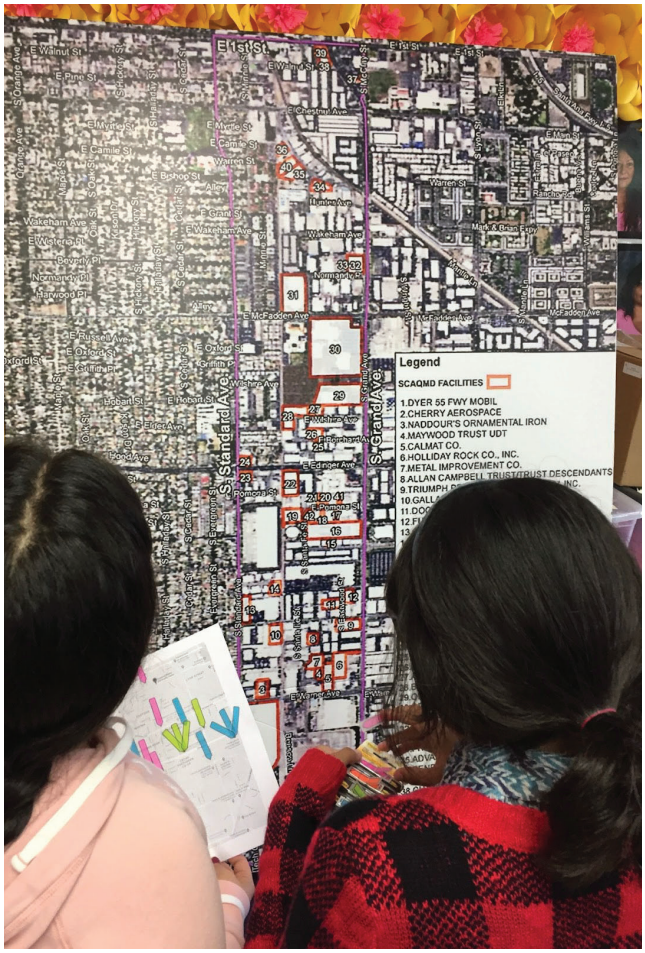


Figure 3J: *Los Robles residents take part in a participatory mapping exercise diagramming the places they "live, work, play, and pray" on a map of southeast Santa Ana's industrial corridor.*

CHAPTER 4
Articulating Air Pollution Knowledges: Reaching for Environmental Justice in Santa Ana

I. Introduction

Luisa and Mayte were breathing heavily as they approached the Hamilton Elementary School courtyard. Mayte fanned herself with the front of her t-shirt pinched between her fingers, the sweatshirt she had worn that morning tied around her waist. Luisa wiped her brow as she removed the AtmoTube Pro air sensor and its lanyard from her neck, placing them on the check-in table in front of me. "*¿Cómo les fue?"* I asked eagerly. "How'd it go?"

They gave each other a sidelong glance over their face masks and laughed goodnaturedly. The walk was longer and harder than they'd expected, they said. The California winter sun had grown hot by midmorning. "We walked all the way to the 5! We need to tell the next shift to bring an extra water bottle." I mentioned to them that Doña Martinez, one of the eldest of the Vecinos Unidos resident volunteers, had signed up for the same route with her son. "We need to split up the routes," Mayte said, "It's way too long." Luisa sighed, exhausted, in agreement.

Vecinos Unidos had been planning the air monitoring project over email and Zoom for months during the pandemic lockdown. Finally out from behind our computers, I was struck by the physicality of the data collection itself. As one of the few volunteers with a car, I drove to some of the farther-flung data collection points during my own shift that afternoon, wondering how Doña Martinez and the other pedestrian volunteers were faring.

That first field sampling day of the air monitoring project took place in February 2021, as a winter surge in COVID-19 cases that had swept across Santa Ana finally began to ebb. Vecinos dubbed the event a "Toxic Tour," involving dozens of volunteers carrying air sensors by foot, bicycle, and car in designated routes through the Los Robles industrial corridor and the greater

Santa Ana area. Pedro, Isaac, and I arrived early at Hamilton Elementary School to set up before the first shift, timed to collect air quality data during rush hour traffic. Our nervous excitement abated the pre-dawn cold as we set up the check-in station, a long folding table in the school's front courtyard, with water bottles, face masks, sanitizing wipes, and reflective vests for those walking and biking. Volunteers queued up, masked and six feet apart, to receive an AtmoTube Pro (a cell phone-sized air sensor worn on a lanyard and synced to a smartphone app), a portable GPS device, and packets in English and Spanish of data collection forms, sensor instructions, and individualized maps for their assigned routes.

After a hectic first hour directing volunteers and troubleshooting technical issues, the bustle at the check-in table slowed. The first shift was on their way. Those on foot would walk in pairs along designated routes in southeast Santa Ana, along familiar neighborhood sidewalks, past industrial facilities, and across highway overpasses, the sensors collecting air quality data on fine particulate matter ($PM_{2.5}$) and volatile organic compounds (VOCs) continuously. The few resident volunteers with access to cars or bikes would travel to designated sites across the city and its surrounds, stopping for 5-10 minutes at a time to collect data at each point. Isaac and I took turns waiting at the check-in table for volunteers to return, helping them sync and send their sensor data via the AtmoTube smartphone app, and sanitizing each device for the next shift.

Most of the volunteer data collectors were the 30 members of the Vecinos Unidos environmental justice steering committee, a mix of high school-aged youth and adult residents of the neighborhood who had been meeting regularly for the past two years for training on air pollution, environmental justice, community monitoring, and advocacy campaigns. Over the last several months, they had worked with Vecinos Unidos staff and UC Irvine researchers to help plan the monitoring project, articulating their concerns and research priorities and providing

feedback on the study design. Each steering committee received an annual stipend for their participation.

For subsequent field sampling days, we strived to recruit additional volunteers from Santa Ana and UCI to help break up the routes and distribute the labor of data collection more widely. We always planned for last-minute no-shows and other contingencies but the most reliable and consistent participants by far were the resident steering committee members – arriving early and staying late, taking shifts between their work and childcare schedules, walking miles across the city to try to document what kind of air they were breathing.

II. Community Knowledge in/as Practice

Months later, as I helped Vecinos Unidos apply for funding to continue the air monitoring, the fleshy details of those field sampling days disappeared from my written descriptions of the Toxic Tours, filtered through the banal language of the grant application: *Community residents participate in all stages of the research, from development of study aims to data collection… Toxic Tours leverage citizen science and community knowledge to identify potential air pollution hot spots.* Requests for proposals from government environmental agencies increasingly require "community engagement" in "environmental justice communities" as a requisite for funding projects. The strain on eyes of hours on Zoom calls, the ache of feet during a long walk on hot pavement, the heavy breathing through face masks on a highway overpass, the wiping of sweat from a palm before handling the sensitive air sensor – these embodied labors of community knowledge production fade from view.

The *work* of "citizen science" and "community-engaged research" is very rarely talked about as such. Within the progressive discourse of community engagement in academic research,

community development, and environmental policymaking, "community knowledge" is typically conceptualized as a static entity, a local resource that lends ineffable value, authority, and legitimacy through its emplaced expertise. Gwen Ottinger points out how the idea of local knowledge as static impedes procedural justice, or "the ability of people affected by decisions to participate in making them, [which] is widely recognized as an important aspect of environmental justice" (2013: 250). For instance, even when relevant data is not actively suppressed by industry or other powerful actors, the knowledge people need to meaningfully participate in decision making may not exist at the time a decision is made. Drawing on an STS-informed understanding of knowledge as dynamic, changing, and developed through practice, Ottinger argues that "procedural justice should include proactive knowledge production to fill in knowledge gaps, and ongoing opportunities for communities to consent to the presence of hazards as local knowledge emerges and scientific knowledge changes" (2013: 251).

At the outset of Vecinos Unidos' air monitoring project, Pedro and I often mused that we wished for some sort of flowchart to show us which kinds of air sensors, study designs, and environmental data could be used for different kinds of environmental justice advocacy. What did we need to know in order to proceed with identifying and accomplishing the community's goals? As we learned about and from other CAM projects in the region, including those discussed in Chapters 1 and 2, we often turned up more questions than answers: We had learned, for example, that the data from most low-cost air sensors wasn't legally suitable for regulatory purposes, but what kinds of data were? We had also learned that different sensors would be needed to detect different types of pollutants, but what types and sources of pollution ought Vecinos Unidos to prioritize in their study? We were beginning to appreciate that different

communities across California were using community air quality data in widely varying ways, but how could we find out what kind of data would be relevant and useful in Los Robles?

There were no straightforward answers to the questions Vecinos faced in designing their community air monitoring project, but over the course of the project and of my fieldwork, partial ones began to emerge. In meetings and focus groups with the steering committees, residents enumerated their environmental concerns in the neighborhood and began to express their visions for change. Through interviews with environmental justice activists, regulatory agency staff, and environmental scientists across southern California, I learned about the challenges and successes of specific community air monitoring projects in the region. As the first communities selected for the AB 617 Community Air Protection Program concluded a year's worth of local air monitoring, I observed more about how insights from this monitoring were informing EJ policy and programs across the state. As the Vecinos Unidos-UCI Collaborative continued to meet, the shared conversations with medical and public health researchers, environmental lawyers, and social scientists helped us envision how different forms of research could support Vecinos Unidos' work. I imagined how we might draw these ethnographic insights together in a way that could make these "puzzle pieces" visible to steering committee members without taking for granted what visions or conclusions they formed.

In this chapter, I analyze Vecinos Unidos' articulation efforts to align their localized goals, questions, knowledge, and concerns in their own CAM initiative. I discuss in depth a workshop we collaboratively developed to help the Vecinos Unidos EJ steering committee learn from other CAM projects in order to design a neighborhood air monitoring study in Los Robles, drawing together ethnographic insights from several case studies across the region without foreclosing alternative possibilities in Santa Ana. While monitoring data has historically been

used to inform and enforce environmental regulation, this chapter documents the potential for CAM projects to multiply governance pathways for air monitoring within and beyond regulatory regimes, expanding the ways air pollution science is leveraged for environmental justice.

III. Staging Encounters

When Vecinos Unidos first obtained a California Air Resources Board grant in 2017, the work plan for training the resident steering committee included several planned site visits to tour other community air monitoring projects in the region. Some of the most notable CAM projects in the state were in two communities within a few hours' drive south of Santa Ana, in San Diego and in Imperial County.[34] While close enough for a weekend day trip, the routes to these border communities from Orange County are studded with U.S. Customs and Border Protection checkpoints. Because many of the steering committee members are undocumented, the group could not travel safely to visit the other projects in person. Pedro, Isaac, and I began devising another solution.

We decided to host a "Community Air Monitoring 101" workshop as part of the environmental justice training program for the steering committee members. In collaboration with Brenna Biggs, a then a UCI Chemistry PhD student also involved with Vecinos Unidos, we developed the idea of a problem-based learning centered around different scenarios, each designed to highlight some of the neighborhood's air pollution and environmental justice concerns. Each of the three workshop scenarios would be based on one or more case studies of CAM initiatives at my other southern California field sites. I wrote the three scenarios so that each describes a different (if overlapping) problem space that could index the need for different

[34] I describe these community air monitoring projects in Chapters 1 and 2.

air sensing technologies and potential interventions[35]. I then adapted the details of each scenario to be locally relevant to southeast Santa Ana, including real neighborhoods, schools, housing developments, and polluting facilities (though these have been replaced with pseudonyms in this chapter). The details of each scenario, especially residents' concerns, are also drawn from ethnographic data, such as interviews with neighborhood residents as well as conversations at steering committee meetings.

Once I had sketched the scenarios, Brenna and I worked together to write the "clues" for each group. Each clue was a piece of information relevant to the given scenario that could help inform the characterization of the problem (such as a photo of a factory with a faulty vent), indicate the need for particular research approach (such as a permit with a list of pollutants), or suggest a possible intervention (such as a brochure for a school flag program in another community). Most of the clues were information that I or others Vecinos Unidos had found or gathered over the course of the project so far, and that had helped us form a better understanding of the challenges in Los Robles and possible ways forward for the project. By curating these findings into discrete "clues" presented to each group, we created a simplified representation of the messy work of answering the chicken-or-egg question of how to design a community air monitoring workshop. Importantly, the scenarios, clues, and worksheet were still open-ended and

[35] The three workshop scenarios below illustrate a range of examples of how community air monitoring techniques might be used to characterize or address air pollution as an environmental justice concern in Santa Ana. While the details of each scenario are specific to Santa Ana, they are drawn from what I learned from three important CAM case studies in other parts of Southern California: in Paramount, Imperial County, and San Diego, which I explored in detail in Chapter 2. I selected these three case studies to work with because they varied significantly from each other in several regards, including the sensing technology used, their study design and rationale, the types of actors involved in the monitoring, and the policy outcomes resulting from the projects. This "maximum variation" strategy of case study selection is beneficial for maximizing the utility of information provided to the workshop participants from a small number of cases where "concrete, context-dependent knowledge is more valuable than [theoretical knowledge]" (Flyvbjerg 2006: 230, 241).

nonlinear, allowing for a number of possible study designs and interventions, and intended primarily to provoke discussion among workshop attendees.

The design logic of the workshop was inspired by Kim Fortun's techniques for "ethnography in late industrialism." Fortun describes ethnography as an experimental system that can be designed in such a way to help discern how the past inhabits the present without overdetermining potential futures: "to bring forth a future anterior that is not calculable from what we now know, a future that surprises" (2012: 450). One such ethnographic technique is that of "staging encounters" among interlocutors for creative "worrying through": "The goal is not to give everyone a chance to voice his or her perspective, rearticulating what they think and see. The goal is to create a space of creativity, where something surprising, something new to all emerges" (Fortun 2012: 454). To avoid the re-articulation of rehearsed perspectives, I included the experiences of the Vecinos Unidos committee members in the scenarios themselves, so that these could work as points of departure rather than conclusion. I then "staged encounters" with other CAM projects by juxtaposing these scenarios with ethnographic artifacts that indexed various forms of expertise without overdetermining the relevance of these artifacts or conclusions about what ought to be done with them.

The three following subsections each explore these "staged encounters," including the "clues" that accompanied each of the three workshop scenarios.

* * *

One September evening in 2020,[36] we called into a Zoom meeting to host the workshop on how to design a community air monitoring project. One by one, familiar names and faces appeared on the screen, as Emma, Luisa, Julia, Mayte, and the rest of the committee joined the call, chiming in with greetings and asking after each other's health. Isaac welcomed the group to the call, and Pedro introduced Brenna.

After a brief presentation, the steering committee split into three breakout rooms, with Isaac, Pedro, and I each facilitating a group. Each breakout group would discuss a hypothetical but ethnographically-informed scenario detailing a particular local air pollution concern in Southeast Santa Ana: (1) suspected emissions violations from a nearby industrial facility, (2) high rates of childhood asthma in the neighborhood, and (3) the proximity of industry to homes and schools. Each scenario included several "clues," or artifacts for group members to discuss, such as a neighborhood map, an index of chemical exposure thresholds, or a list comparing different low-cost air sensors. After reading their given scenario and accompanying clues, each group used a worksheet (Figure 4A) to sketch a plan for a community air monitoring project by identifying key priorities, defining a research question or goal, and brainstorming resources needed to execute the project.

[36] We had originally planned an in-person version of this "Community Air Monitoring 101" workshop for March of 2020, but postponed it at the last minute amid rising concerns about COVID-19. Santa Ana had been hit hard by the pandemic, especially in its first year. Between March 2020 and March 2021, the City of Santa Ana reported 44,276 cases and 779 deaths– nearly 18% of both infections and deaths in all of Orange County due to COVID-19 (Orange County Health Care Agency, March 2021). Vecinos Unidos' response to the crisis included establishing food and rental assistance programs, vaccination outreach and administration, launching an adult health promoter (*promotora)* program, developing a COVID-19 youth education curriculum, efforts to measure the impact of the pandemic in this community, and partnering with the school district, local media, and UC Irvine to host COVID-19 virtual town halls. The resident steering committee for the CAM project had resumed meetings via Zoom over the summer of 2020, but this was the first time we had met collectively about the planned air monitoring study in over six months.

Plan comunitario del monitoreo del aire
Community Air Monitoring Plan

1. En este escenario, ¿cuáles son las **principales preocupaciones** sobre la calidad del aire? ¿Cuáles de estas preocupaciones se pueden medir através del monitoreo comunitario del aire? *(Recuerden las Tres E's: Emisiones, Exposición, y Efectos en la salud. El monitoreo comunitario del aire no puede medir directamente los efectos en la salud.)*

According to your scenario, what are your main **air pollution concerns**? Which of these will you try to measure through community air monitoring? (*Remember the Three E's: **Emissions**, **Exposure**, and Health **Effects**. Community air monitoring cannot directly measure health effects.*

2. En este escenario, ¿cuál es su **objetivo principal** para este proyecto? *(Recuerda: Las metas pueden incluir (1) crear conciencia sobre la contaminación del aire, (2) abogar para que el gobierno haga cumplir a las industrias con las leyes ambientales, y/o (3) luchar por cambios en las leyes o políticas ambientales.)*

According to your scenario, what is the **main goal** for your community air monitoring project? *(Remember: Goals can include raising community awareness, pushing for better enforcement of existing environmental regulations, or advocating for change of environmental policy.)*

3. ¿Qué **recursos** necesitarán para lograr estas metas a través del proyecto de monitoreo comunitario del aire?

What **resources** will you need to accomplish these goals through your community air monitoring project?

A. **Equipaje/Equipment:** ¿Qué tipo de sensores requieren? ¿Dónde se instalarán? / What type of air sensor(s) will you need? Where in the community will you set them up?
B. **Community expertise/ Conocimiento de la comunidad:** ¿Qué conocimiento y experiencia tienen miembros de su comunidad que pueden contribuir a este proyecto? What knowledge and experience do members of your community have to contribute to this project?
C. **Outside expertise/ Conocimiento externo:** ¿Qué tipos de conocimiento necesitarán para ejecutar este proyecto? ¿De dónde o de quién lo podrían buscar? / What kinds of outside knowledge and experience will you need? Where or from whom can you get this?
D. **Labor y mantenimiento/ labor and maintenance:** ¿Qué tipo de trabajo se requiere para montar y mantener este proyecto? / What kind of work will be required to install and maintain this project?
E. **Capacitación/ Training:** ¿Qué tipo de capacitación necesitará su grupo para llevar este proyecto a cabo? / What will your group need to learn in order to carry this out?
F. **Financiación/ Funding:** ¿Cuánto espera que cueste este proyecto? / What do you expect this project to cost?

Figure 4A: *Worksheet for designing a community air monitoring plan from a workshop for the Vecinos Unidos resident steering committees in September 2020*

A. Scenario 1

You are a resident of Alamitos Apartments. You love your neighborhood because it is close to schools and shops, you and your neighbors look out for each other, and many people are active in their community. You've gotten to know many of your neighbors by advocating for the City to create a new park at the corner of Green Street and Santa Ana Avenue, and you often get together to share meals or childcare.

One day while talking to your friends in Vecinos Unidos, you share complaints about the noise and emissions that sometimes come from the industrial facility next door to you, Graystone Manufacturing. One neighbor says she has seen foamy green water run through the gutter between her home and Graystone. Another neighbor who has lived in Alamitos Apartments for a long time says that several years ago there were even concerns that the facility was causing a cluster of leukemia cases among students at Johnson Elementary School across the street.

You and your neighbors are worried that Graystone could be causing pollution in your neighborhood that is dangerous to your family, neighbors, and kids at the school. You even wonder if they are breaking the law.

Using the clues below, decide as a group how you could use community air monitoring to find out if Graystone is violating environmental health standards.

* * *

1. Wanting to learn more about Graystone Manufacturing, you take a walk around the neighborhood and then search for the address on Google Earth. What other buildings are nearby? What did you notice on your walk that you couldn't see on the map, and vice-versa?

2. Wanting to learn more about Graystone, you go to their website to find out more about what they do. You learn that they specialize in putting chrome (metal) and plastic plating on industrial equipment. What kinds of emissions do you think this facility would produce?
3. While walking past Graystone one day, you take a picture of the vents on top of the building (Figure 4B). To find out what they are, you show the photo to Brenna, a UC Irvine student who studies air chemistry and works with Vecinos Unidos. Brenna explains that these vents probably belong to Graystone's "scrubbers," which are supposed to prevent metal particles from entering the air. In this picture, it looks like the scrubbers are not covering the vents, which could mean that metals are not being blocked by the filter and will exit through these vents into the air.

Figure 4B: *Photograph of vents on top of a metal plating facility in Southeast Santa Ana*

4. You decide to look up Graystone Manufacturing on the website of South Coast Air Quality Management District (SCAQMD). SCAQMD is the government agency in charge of issuing permits for industries that produce air pollution, and their permits are listed online. This table is an excerpt from a long list of permits that Graystone Manufacturing, Inc. has applied for and been given (Figure 4C). What do you notice about the information in **bold font**?

Permit Number	Issue Date	Permit Status	Equipment
X40256	12/30/2016	ACTIVE	TANK **CHROME PLATING** HEXAVALENT
X40257	12/30/2016	ACTIVE	TANKS, **NICKEL PLATING**
X40258	12/30/2016	ACTIVE	TANKS, **NICKEL PLATING**
X40259	12/30/2016	ACTIVE	SCRUBBER, **PARTICULATES** VENTING
X40260	12/30/2016	ACTIVE	SCRUBBER, **PARTICULATES** VENTING
X40265	12/30/2016	ACTIVE	SCRUBBER, **PARTICULATES** VENTING
X40266	12/30/2016	ACTIVE	MESH PADS, **TOXIC GAS** STREAM
X40267	12/30/2016	ACTIVE	SCRUBBER, **PARTICULATES** VENTING
X40268	5/19/2017	ACTIVE	TANK, **CHROME PLATING**
X40270	2/9/2019	ACTIVE	TANK, **CHROME** - STRIPPING

Figure 4C: *Modified list of SCAQMD permit data for a southeast Santa Ana metal plating facility*

5. After reviewing the information from the other clues, you notice specific pollutants that are part of the manufacturing process at Graystone. You are curious whether these pollutants are safe for humans to be breathing in, especially if they were to exit the scrubbers and enter the air surrounding Graystone. You look up the metals from the permit list on the Centers for Disease Control and Prevention (CDC) website to see if they are toxic to humans. This table (Figure 4D) is an excerpt of what you found on the CDC website.

Compound	If Inhaled
Chrome and Chromium *(cromo)*	● Chromium compounds are respiratory tract irritants and can cause pulmonary sensitization. ● Chronic inhalation of Cr(VI) compounds increases the risk of lung, nasal, and sinus cancer.
Nickel *(níquel)*	● Chronic bronchitis, reduced lung function, nasal sinus, and lung cancer have occured in people who have breathed dust containing certain nickel compounds while working in nickel refineries or nickel processing plants. These require extremely high concentrations of nickel. ● People can become sensitized and have asthma attacks, but this is rare.

Figure 4D: *Health effects of chromium and nickel, from Centers of Disease Control Agency for Toxic Substances and Disease Registry (https://www.atsdr.cdc.gov/)*

6. You learn from a CUAL community forum that government agencies set maximum limits for different types of pollution to protect human health, including the California Occupational Safety and Health Administration (Cal/OSHA) (Figure 4E). If a compound's concentration is more than the limit, the industry could get in trouble.

Standard Organization	Compound	Limit
Cal/OSHA	Chromium (VI)/ cromo	**Average 0.005 mg/m³** during 8-hour period **0.005 mg/m³** de promedio cada 8 horas
Cal/OSHA	Nickel metal/ níquel	**Average 0.5 mg/m³** during 8-hour period **0.5 mg/m³** de promedio cada 8 horas

Figure 4E: *Permissible exposure limits for chromium and nickel, established by the California Division of Occupational Safety and Health (Cal/OSHA) (https://www.dir.ca.gov/)*

7. Upon learning that chromium and nickel can be bad for your health, you do some research on the website of Cal/OSHA, and take note of the legal limits for emissions of these metals. What kind of air monitoring would you do to find out if Graystone is exceeding these limits? You get in touch with environmental justice community organizations in other cities about what sensors might be good for community air monitoring. You learn that there are several options, and that choosing a sensor will depend on the type of emissions you want to measure, and what your goals of measuring the emissions are, and what resources you have (Figure 4F). In this scenario, which of these sensor(s) would you choose for your community air monitoring plan?

Sensor	Photo/ Foto	Compound/ Químicos	Pros / Lo bueno	Cons/ Lo malo
Purple Air II		$PM_{1.0}$ $PM_{2.5}$ PM_{10}	• Automatic data uploads / Sube los datos automáticamente • Cheap ($200)/ Bajo costo ($200) • Samples every minute / Mide el aire cada minuto • Low maintenance / Fácil de mantenerse	• Only measures PM (doesn't indicate chemical makeup)/ • Solo mide la concentración de partículas (no indica el tipo)
CairPol Cairsens		NO_2 CO Ozone NH_3 H_2S NMVOC formaldehyde SO_2 PM	• Samples every minute / Mide el aire cada minuto • Wearable/ pueden llevarse con si mismo • Mide más tipos de químicos	• High maintenance/ difícil de mantenerse • Need to recharge battery/ Necesita cargar la batería • Manual data upload/ Hay que subir los datos manualmente • More expensive ($500)/ Más costoso ($500)
ICS-3000		Metals	• Precise measurement • Toma mediciones muy precisas	• Need a lab/ Requiere un laboratorio • Very expensive ($20,000) / Muy costoso ($20,000)

Figure 4F: *Table comparing features of air quality sensors, compiled by Brenna Biggs*

B. Scenario 2

You and your family live in the Oakview neighborhood. You love your neighborhood because it is close to your children's school and to the restaurant where you work. You and your neighbors look out for each other, and many people are active in their community.

Two of your three children have asthma. Sometimes it has even caused them to miss school, soccer, and rehearsals for baile folclórico. When your second child was diagnosed, your doctor explained that asthma can run in families, but it seems like many of your neighbors have asthma, too.

When you get involved in Vecinos Unidos, you learn that asthma can also be caused by air pollution. You wonder if air pollution in your neighborhood could be causing your children's and neighbors' illness.

Using the clues below, decide as a group how you could use community air monitoring to find out if your community is exposed to air pollution that could be affecting your health. (Since community air monitoring on its own can't show the cause of your children's asthma, you decide to find out if they are being exposed to the kind of air pollution that can affect their condition.)

* * *

1. During the pandemic, you and your family have been going on walks with masks on to get exercise where there is more ventilation. Lately, however, the smoke from the recent wildfires has made it hard for your kids to go out. You've started to check the air quality data in the morning to know if it is safe to go for a walk. You search for your zip code on AirNow.gov and learn that today's air quality is considered "Moderate." You also learn that the main type of air pollution in your area today is called "$PM_{2.5}$" (Figure 4G).

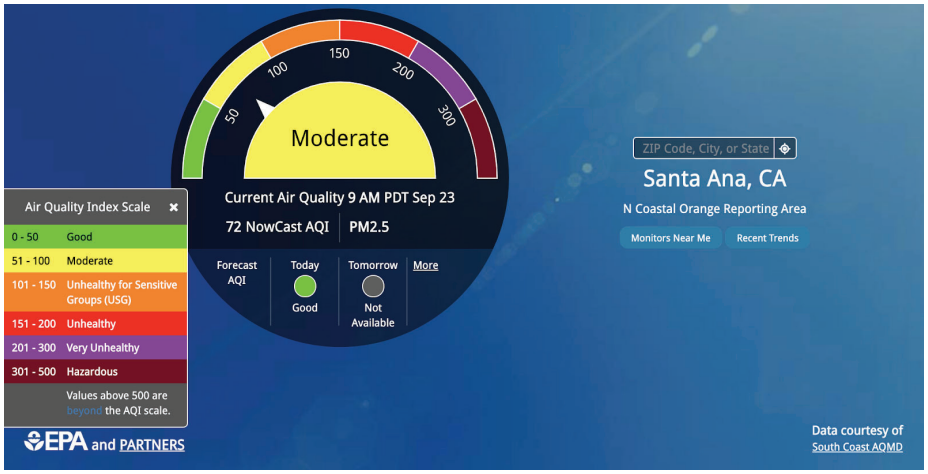


Figure 4G: *Screenshot from AirNow.gov showing SCAQMD ambient air quality near Santa Ana on September 2, 2021*

2. To learn more about $PM_{2.5}$, you do some research on the website of the Environmental Protection Agency (EPA). You learn that $PM_{2.5}$ refers to tiny particles in the air that measure 2.5 microns. (In Figure 4H), the little pink balls represent particles of this size compared to a single human hair and fine beach sand.) Because they are so small, these particles can enter your body and cause health problems including asthma.

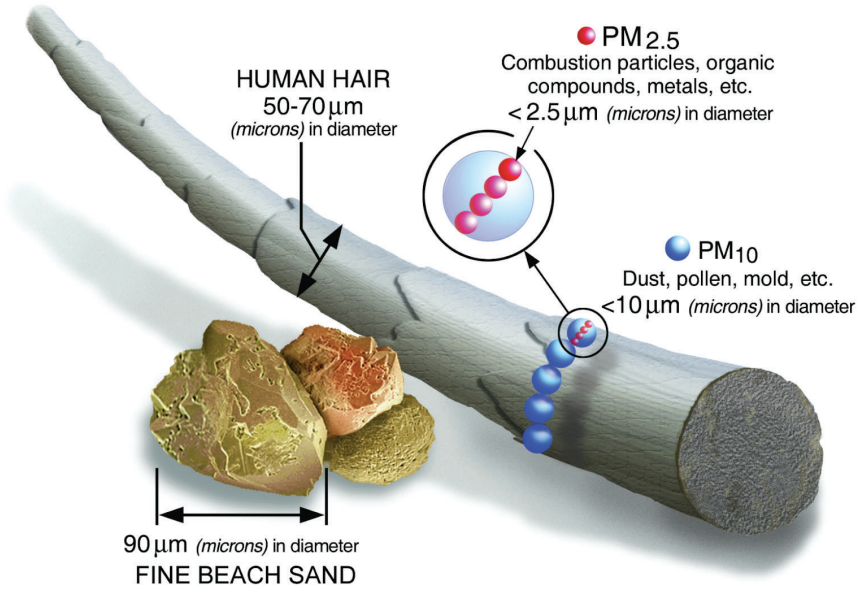


Figure 4H: *Size comparison of particulate matter particles, from the US Environmental Protection Agency website (https://www.epa.gov/pm-pollution/particulate-matter-pm-basics)*

3. You remember a community health workshop you attended last year at the elementary school, where you learned that children who live in your zip code have to go to the emergency room for asthma attacks much more often than children in other parts of Orange County. Now that you've learned about the connection between $PM_{2.5}$ and asthma, you begin to wonder: Could this be because there is more $PM_{2.5}$ pollution in this part of Santa Ana?

4. At a CUAL workshop, you learn that there is a network of air monitors made by a company called PurpleAir that measures $PM_{2.5}$ at local sites all over the world. You visit the map at purpleair.com, but it looks like there are no monitors in your neighborhood or in Santa Ana in general (Figure 4I). You also remember learning at a community forum in your neighborhood that the nearest government monitoring station is all the way in Anaheim! How could you find out if there is a lot of $PM_{2.5}$ pollution in Los Robles?

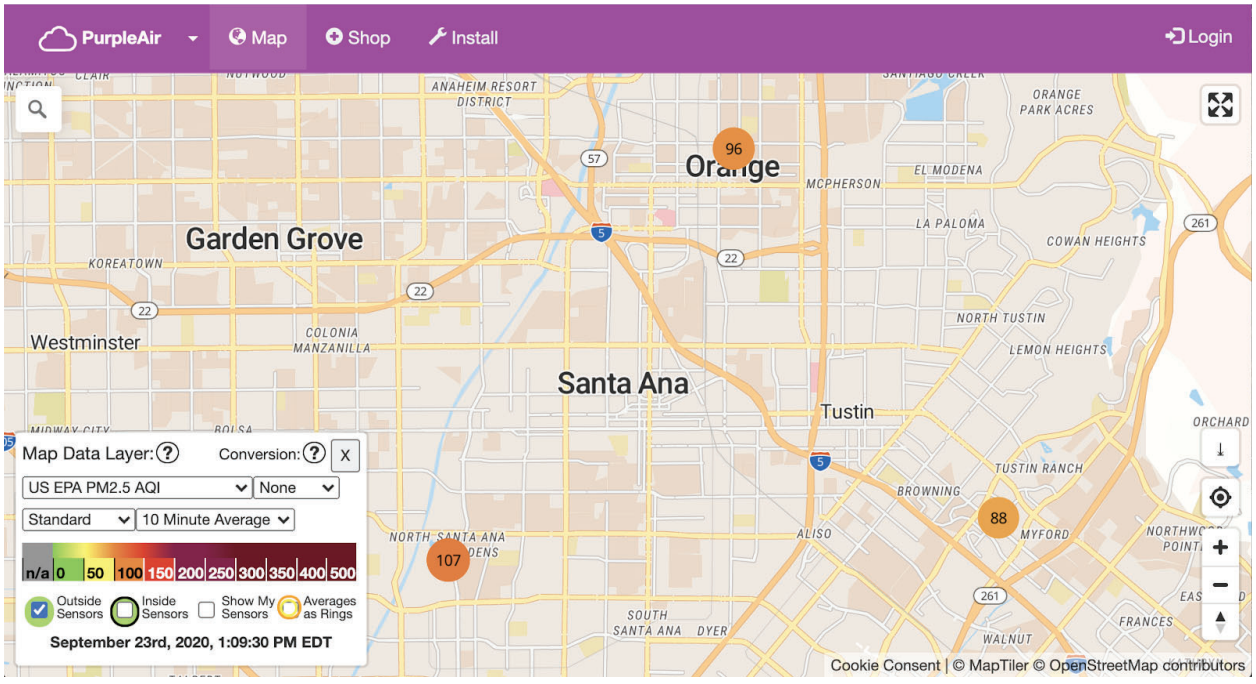


Figure 4I: *PurpleAir.com map of Purple Air $PM_{2.5}$ sensors in Central Orange County, showing only one in Santa Ana. Screenshot taken September 23, 2020.*

5. One day on Facebook, you read a story about how Comité Cívico del Valle, a community organization in Imperial County, started a community air monitoring network in their region (Figure 4J). They set up monitors at local schools, and every day the youth at the schools raise a colored flag to help children, parents, teachers, and the community know what the air quality is and help them make decisions about outdoor activities. You and other CUAL members decide to get in touch with Comité Cívico del Valle to learn if you could set up a similar program in Santa Ana, and what kind of sensors you should use. You learn that there are several options, and that choosing a sensor will depend on the type of emissions you want to measure, and what your goals of measuring the emissions are, and what resources you have (Figure 4F). In this scenario, which of these sensor(s) would you choose for your community air monitoring plan?

Figure 4J: *Screenshot of the website for Respira Sano, the Imperial Valley Asthma Education Program. Taken September 20, 2020 (https://www.respirasano.org/school-flag-program)*

C. Scenario 3

You are an Eastside High School student living in Los Robles. You love your neighborhood and have lived here your whole life, attending the Vecinos Unidos Summer Science Academy, volunteering at food drives at your elementary school, and going to community events, dance performances, and baseball games.

One day a couple years ago your family received a notice that a new metal-plating facility called Apex Industries would be moving to the neighborhood, right next to your apartment and right between Hamilton and Johnson Elementary Schools. When you try to find out more about it, you learn that there are 42 other companies that emit air pollutants within less than two miles of your home.

You think it's unjust that so many dangerous polluters can operate so close to homes and schools, putting you and your community at risk. As a member of Vecinos Unidos, you think this is an important environmental justice issue and you want to advocate for change in Santa Ana to make your community cleaner, healthier, and safer.

Using the clues below, decide as a group how you could use community air monitoring to show the City of Santa Ana that city policy is putting your community at risk.

* * *

1. When you and your neighbors first learned about a new polluter moving in next door, you decided to get organized. You contact your city councilmember, Vince Sarmiento, who writes a letter to the South Coast Air Quality Management District (SCAQMD) to find out more about air pollution issues in your area. SCAQMD is the regional government agency in charge of issuing permits for industries that produce air pollution. SCAQMD sends Sarmiento a map of the 42 permitted facilities in this section of Santa Ana (Figure 4K). You didn't know there were so many! You begin to wonder what the effects of so many polluting facilities might have on your community.

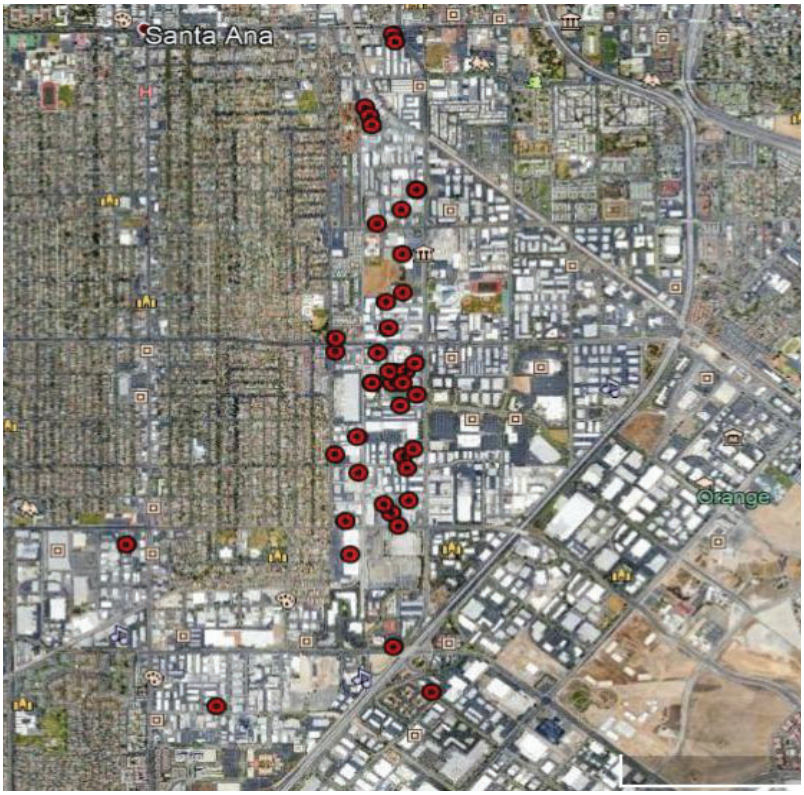


Figure 4K: *Map of air-district permitted facilities in industrial corridor in southeast Santa Ana, provided to Vecinos Unidos by SCAQMD*

2. First of all, you decide to find out what types of air pollutants might be in your community. With the help of some UC Irvine students, you look up information about each permit for each facility on the SCAQMD map. Although the information on the permits is incomplete, you make a list of all the pollutants that you can find (Figure 4L).

Gasses		Particles and Metals Partículas y metales		Other Toxic Compounds Otros compuestos tóxicos	
Compound/ Químico	**# Facilities Reported/ # de Industrias**	**Compound/ Químico**	**# Facilities Reported/ # de Industrias**	**Compound/ Químico**	**# Facilities Reported/ # de Industrias**
VOCs	5	Ammonia	6	Naphthalene	3
Nitrogen Oxides	6	Cadmium	1	PAHs, total	3
Carbon Monoxide	6	Chromium (VI)	2	1,4-Dioxane	1
Benzene	5	Arsenic	1		
Formaldehyde	6	Nickel	2		
Sulfur Oxides	4	Lead (inorganic)	1		
Reactive Organic Gasses	2	Particulate Matter	5		
Ethylene Oxide	1	Total Suspended Particulates	2		

Figure 4L: *Table of air pollutant types emitted from 42 SCAQMD permitted facilities in southeast Santa Ana, compiled by Cristobal de la Cruz and Brenna Biggs*

3. At a community forum with representatives from the City and SCAQMD, you ask the officials why so many polluters are allowed in your community. The air district explains that they issue permits on an individual basis, so they can't deny one facility just because there are other companies in the area. On the other hand, the City Planner explains that they allow any facility as long as it has an SCAQMD permit and follows the rules in the General Plan. Frustrated, you look up the zoning map for the General Plan (Figure 4M). What do you notice about your neighborhood?

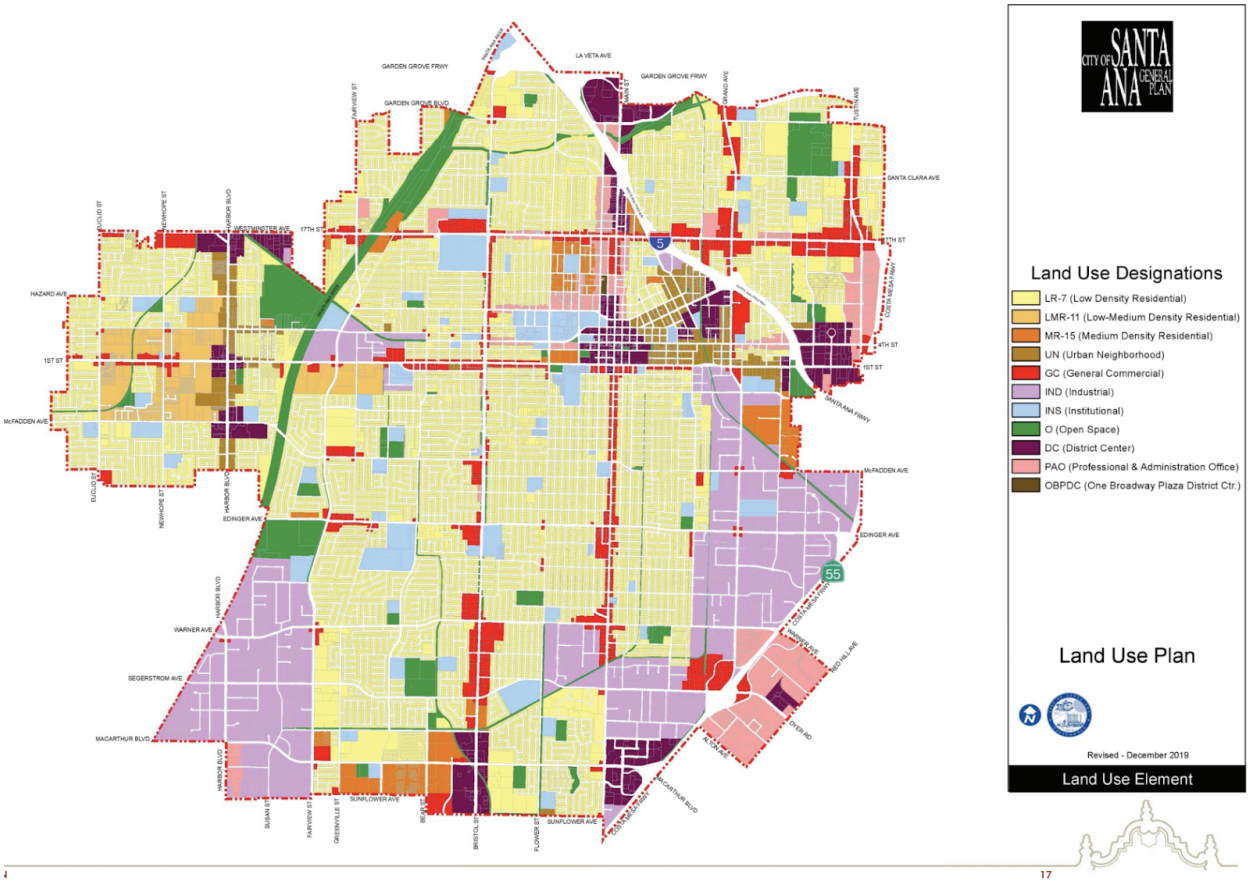


Figure 4M: *Zoning map from the Land Use Element of the City of Santa Ana's current General Plan, adopted February 1998*

4. A few months later, during the COVID-19 pandemic, the city suddenly announces that they will soon publish and approve the new General Plan. You and your neighbors know this is an important opportunity to show the city that they must protect your community and advance environmental justice. How might you use community air monitoring to support your advocacy efforts with the city? You get in touch with environmental justice community organizations in other cities about what sensors might be good for community air monitoring. You learn that there are several options, and that choosing a sensor will depend on the type of emissions you want to measure, and what your goals of measuring the emissions are, and what resources you have (Figure 4F). In this scenario, which of these sensor(s) would you choose for your community air monitoring plan?

IV. Articulating Air Monitoring in Place

As we learned throughout the course of planning the Vecinos Unidos community air monitoring project, the "work" of community air monitoring includes the labor of realizing the "local knowledge" needed to carry out the air sensing itself. This knowledge is not pre-existing, but enacted through a variety of knowledge practices including negotiations with the air district and local officials, walks through the neighborhood, conversations with other residents, and myriad other activities. Calls for "community engagement" in research and policymaking processes often implicitly imagine that such engagement will reveal local knowledge that will yield more accurate, effective, or locally relevant information or results. As Mol puts it, however, "[t]he ethnographic study of practices does not search for knowledge in subjects who have it in their minds and may talk about it. Instead, it locates knowledge primarily in activities, events, buildings, instruments, and so on" (2002:32).

This kind of knowledge-in-practice requires continuous articulation work. There is no straightforward teleology of knowledge-to-practice or theory-to-application. As Kim Fortun (2012) points out, the conditions of late industrialism redouble the need for articulated knowledges and flexible practices for enacting them. Despite a hope at the outset of the Vecinos Unidos project that gathering data about the air pollution problem in Los Robles would point to a promising solution, the enactment of environmental justice as a public concern in Santa Ana has not been straightforward. Vecinos Unidos' community air monitoring efforts have not followed a teleological "science-to-governance" pathway, in which the scientific method produces findings that in turn inform policy solutions. In this section, I describe some of Vecinos Unidos' articulation efforts to align their localized goals, questions, knowledge, and concerns in their own CAM work.

When Vecinos Unidos first received the California Air Resources Board (CARB) grant to establish a community air monitoring project, Pedro reached out to his former colleagues at UCI to form a technical advisory group. In 2018, working with the university's Research Justice Shop, which facilitates team science and community-research collaboration, they established the Vecinos Unidos- UCI Collaborative, a roundtable of Vecinos Unidos staff and researchers from medicine, law, public health, urban planning, and anthropology. Importantly, this group was created not to oversee the work of the grant, but to generate a range of strategies for dealing with emergent environmental justice concerns in Los Robles.

These cross-disciplinary conversations brought to the fore diverse approaches to studying the problem – or, more accurately, enacting it. A pediatric pulmonologist hoped to use personal monitors to measure Santa Ana children's exposure to $PM_{2.5}$. A medical student devised a project to study links between industrial proximity, asthma prevalence, and academic outcomes for Santa

Ana students. An environmental epidemiologist weighed the merits of various air sampling strategies for identifying local hot spots. Fellows and students at the law school considered the significance of the recently-passed California EJ legislation and Santa Ana's upcoming update to their General Plan. One researcher's contacts at SCAQMD wanted to establish PurpleAir sensors in Santa Ana for a NASA study comparing satellite air quality data with low-cost sensor data on the ground. Pedro worried about toxic threats from sites like a long-shuttered metal plating plant that was now the subject of a Department of Toxic Substances Control cleanup. Meanwhile, Los Robles residents raised their worries about odors, noise pollution, litter, the rise of homeless residents in the area, and the spectral threat of unknown air pollution by industrial facilities they'd only recently learned were there.

At first, it often felt we were talking at cross-purposes, that our conceptions of the problem were too different to be commensurable. Over time, themes that emerged from the conversations included the need to collect local ambient air quality data, given the absence of any air monitors in Santa Ana, a desire to investigate potentially hazardous emissions sources, and a goal to document the distribution of pollution burden in the city to demonstrate that it was borne unjustly by its most disadvantaged residents and connected to local land use patterns. These goals are overlapping, not discrete, and did not come from a systematic analysis of stakeholder concerns or from a consensus by residents and researchers. They are an articulation of community worries and goals, policy opportunities, forms of expertise, examples from other projects, and technical resources available to the group.

The community air monitoring project that Vecinos Unidos and its technical partners designed reflected this articulation. The aims of the study were three-fold:

"(1) to characterize air pollution near the industrial corridor in Santa Ana; (2) to identify potential air pollution hotspots and emissions sources using both mapping techniques and local community knowledge; and (3) to characterize and compare air pollution within socially vulnerable areas versus those measured in less vulnerable communities within and outside of Santa Ana, so as to evaluate the potential of environmental inequities" (Masri et al. 2022)

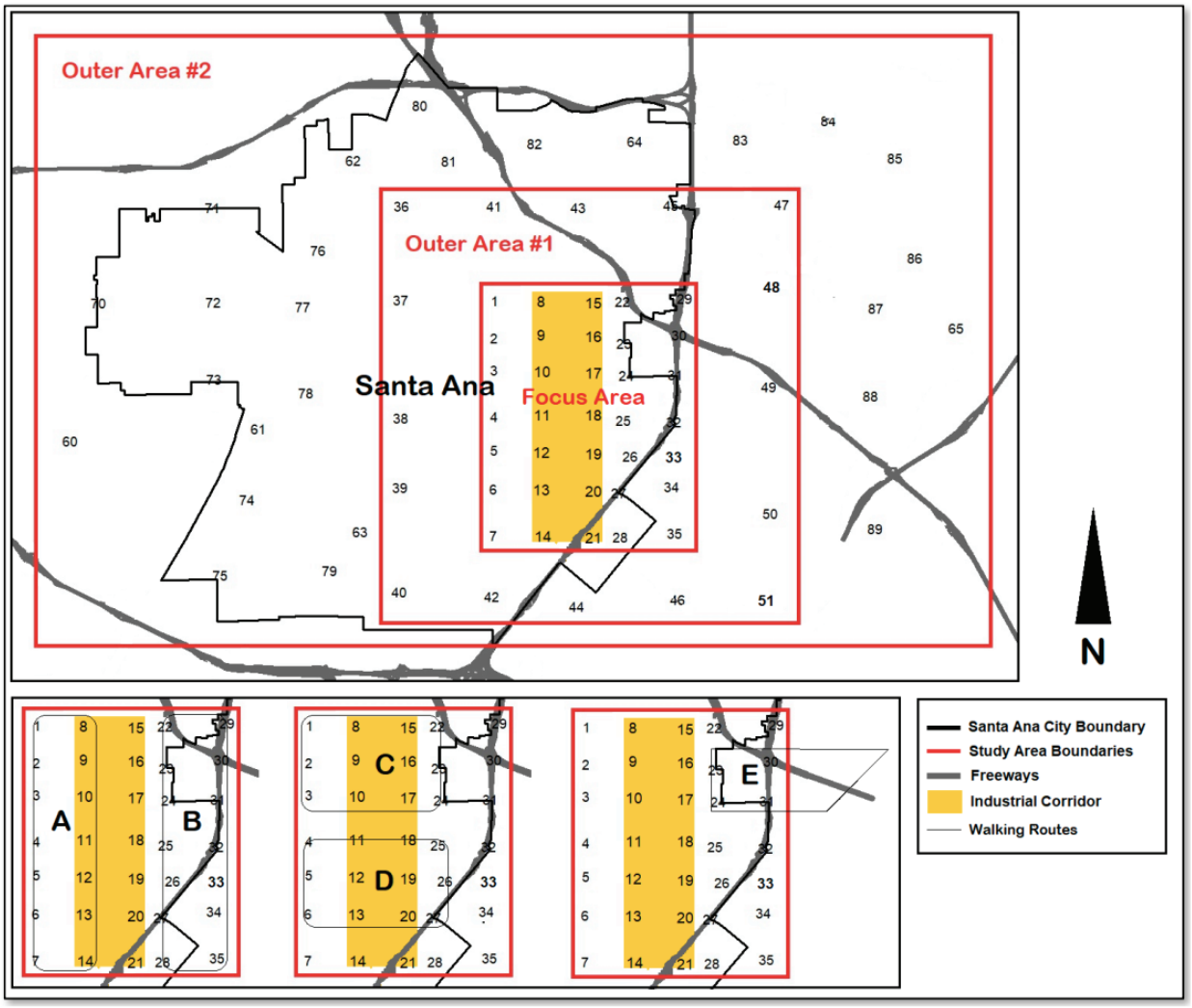


Figure 4N: *Map depicting walking routes along industrial corridor (A-D) and the freeways (E), as well as numbered regional sampling sites (Masri et al. 2022)*

Data collection for the project included two complementary sampling strategies over four Toxic Tour sampling days between February and April 2021 (Figure 4N). In one, participants would follow five walking routes alongside the industrial corridor and

adjacent freeways with wearable AtmoTube Pro $PM_{2.5}$ sensors, in order to detect air pollution hotspots. In the second, samples were collected at specific sites distributed across the city and its surrounding area to enable a comparison of air quality across the study region. The combination of these two methods was critical, as one of the most salient findings from the study arose through the articulation of the two. While there were no consistently significant differences in $PM_{2.5}$ measurements between the focus area and outer area or between different walking routes, "EJ communities consistently demonstrated a greater frequency of high-$PM_{2.5}$ outliers relative to non-EJ communities over the four sampling days" (Masri et al 2022:15). This finding suggests further investigation of local air pollution sources and the causes of these emissions as an important next step.

The articulation of environmental knowledge practices in Santa Ana has taken other lines of flight, too. An organizer for a metal workers union saw a flier seeking volunteers for a Toxic Tour day, and reached out to Vecinos Unidos for help with a campaign to form a union at a metal plating facility in the neighborhood. In addition to complaints about low wages and wage discrimination, workers at the plant had voiced health and safety concerns about the fumes they inhaled at work. With AtmoTubes borrowed from Vecinos Unidos, they secretly collected samples on the job. They found $PM_{2.5}$ concentrations from indoor samples were, on average, seven times higher than outdoor samples. One employee's personal exposure over the three-day study was nearly double that average, occasionally exceeding the sensor's maximum detection ability (Masri 2021). Personal air quality monitoring helped articulate a link between environmental and worker health concerns in the workers' campaign.

V. Environmental Justice Knowledges and Their Politics of Scale

On a cloudy winter day in 2020, I met Isaac and two young members of the Vecinos Unidos resident steering committee, Ben and Lucas, at a house on a quiet cul-de-sac near Hamilton Elementary School. The house belonged to Amalia, another steering committee member, who had agreed to install a PurpleAir $PM_{2.5}$ monitor at her home. PurpleAir monitors are relatively low-cost and user-friendly, though unlike the portable AtmoTube Pro sensors, they are stationary. Amalia showed us into her backyard, her neighbor's chatty toddler hoisted on her hip. Isaac, Ben and Lucas walked around the house to identify the best location for the monitor: away from trees, chimneys, outdoor grills, and kitchen exhaust, and within reach of a power source and reliable WiFi. Finally settling on a spot on the side of the house above a bedroom window, they affixed the monitor to a wrought iron bar, passing cords to Amalia as she stood inside.

Figure 4O: *Vecinos Unidos steering committee members reach up high to install a PurpleAir monitor on a house in Santa Ana*

Vecinos had opted not to use PurpleAir monitors for their main air study (described above), but had recently received a dozen free devices as part of their participation in a research project led by SCAQMD and NASA. The aim of this research was to use local $PM_{2.5}$ data from the openly available PurpleAir network to validate satellite air quality data, enabling its potential to be used for applications including more accurate regulatory monitoring in the future. The air district and NASA researchers were eager to partner with Vecinos Unidos, because Santa Ana represented a substantial gap in the PurpleAir network. Although low-cost sensors are often hailed for their promise for "disadvantaged communities," such communities are grossly underrepresented in low-cost monitoring networks overall (deSouza and Kinney 2021).[37]

The need for neighborhood knowledge to both "ground-truth" and "scale up" air knowledge from outer space points to a paradox at the heart of much environmental knowledge production: while environmental problems manifest in locally specific ways, they are produced through multiscalar and multi-sited dynamics that also require apprehension. As I have documented in this dissertation, the environmental justice movement has highlighted the failures of universal approaches to environmental governance. At the same time, the unfolding climate catastrophe violently shows how collective action across borders and scales is needed more urgently than ever.

Tim Choy analyzes the uses of particularism and universalism in environmental knowledge production (2005, 2011, 2012). Whereas the former seeks to encompass

[37] Vecinos Unidos' experiences finding places to host the PurpleAir monitors illustrated several challenges for remedying this problem. Despite a 30-strong resident steering committee of enthusiastic volunteers, they had had difficulty finding sites for all the monitors. For one, most of the committee members were renters whose landlords prohibited the installation. The apartments nearest to Apex Industries, as well as the ones near Graystone, were mostly public housing, where installation would have required negotiating a bureaucratic mess of permissions from local and state government. As a result, the handful of homes with access to power, WiFi, and the landlord's permission were on some of the neighborhood's more affluent streets, farther north and west from the industrial corridor.

particularities within a coherent master narrative, the latter refuses to be subsumed. Both, Choy points out, seek solid analytic ground through resorting to a singular "one" – an all-encompassing "one" of the universal or the specific, irreducible "one" of the local (2012:12)--both of which are insufficient. Furthermore, Choy notes that both of these positions are routinely and self-consciously deployed in the arena of environmental politics, where "the local" no longer represents a "counter-knowledge" to the hegemonic discourse of universalism, as the logics of the local have already been thoroughly internalized and rehearsed:

> "[T]he critique of universalism is as dead as universalism itself; it no longer speaks to the configuration of power but instead finds itself echoing the state. More mildly put, an indictment of universalism in expert venues is helpful but not sufficient for the critical analysis of expert politics. That critique–and its valorization of specificity–has already been internalized in those arenas" (Choy 2005: 16)

The production of counter-knowledges in environmental politics thus requires articulation across sites, scales, social domains, practices, experiences, and modes of expertise (Choy 2004), orienting to the "relations that co-implicate us at different points as 'breathers'"(Choy 2012:12).

Speaking to the challenge in anticolonial sciences of how to acknowledge the emplacement and particularism of all knowledge production, which includes a refusal of universalism and an investment in place-based methods, Max Liboiron poses the question, "How do we make a nonuniversal science trustworthy and useful in more than one place?" (2021: 152). Generalization without universality is possible, Liboiron argues, with a rethinking of scientific validity as a matter of good relations. What relations validate our knowledge? To whom is our knowledge accountable? Liboiron proposes that "researchers attempt to move their findings toward that which is not yet imagined, not yet in practice, not yet in sight" (2021:154).

The creation of knowledges toward environmental justice is a matter of enactment of problems-in-place, cross-site and cross-scale articulation, cultivation of "relational validity" (Liboiron 2021), and of reaching for knowledges-yet-to-be. In this chapter, I have tried to tell the story of how communities of breathers (Choy 2012) in Santa Ana are reaching for environmental justice through articulated practices of community air monitoring. This story is not yet finished.

Conclusion: Risking Environmental Justice

"Every day, we learn more. This issue of environmental justice just keeps getting bigger."
– Isaac, Vecinos Unidos Community Organizer, February 2022

This dissertation has analyzed the politics of knowledge production for, within, and about the environmental justice movement in late industrial Southern California, asking these questions: How does EJ work expose the limits of dominant environmental governance and knowledge paradigms, pushing beyond them (Chapter 1)? Where and how are EJ and its objects of concern enacted in practice (Chapter 2)? What forms of knowledge and politics are enabled and foreclosed through the institutionalization of EJ concepts like "disadvantaged," "cumulative impacts," and "community" (Chapter 3)? How do EJ activists articulate new knowledges for the future, through and in spite of the many double-binds they work within (Chapter 4)?

Versions of these questions are as old as the environmental justice movement itself. EJ advocates have long recognized the need for technoscientific expertise that helped produce environmental justice problems in the first place (Checker 2007; Fortun 2012, 2014; Ottinger 2009, 2013a; Ottinger and Cohen 2011). The coining of terms like "environmental racism" and "environmental justice" are metadiscursive moves aimed at reframing dominant paradigms for understanding race, the environment, nature, and space (Bullard 1993, Cole and Foster 2001, First National People of Color Environmental Leadership Summit 1991). While these themes form long-running throughlines in EJ scholarship, the frameworks for theorizing the relationship of race, space, power, and environmental harms and hazards has changed dynamically over the last three decades, and particularly in recent years. This dissertation is situated in and aims to contribute to these latest turns in EJ scholarship, highlighting how community air monitoring emerged and gained increasing coherence as EJ strategy and evidence.

I. First- and Second-Generation Environmental Justice Scholarship

The "first generation" of research on environmental racism—much of it in geography, or commissioned by non-profit or government agencies—was concerned primarily with "proving" the existence of environmental racism (e.g. Boer et al 1997), through (a) mapping the locations of environmental hazards and (b) measuring statistical relationships between the siting of pollution sources and the spatial location of people of color (Holifield et al 2010). Moreover, much of this early environmental racism research was concerned with evaluating the evidence of "intentional" discrimination in the siting of environmental hazards (e.g. Been 1993, Boone and Modarres 1999). Pulido (2000) pointed out that the over-emphasis on the siting of hazards as the primary mechanism of environmental racism operates on a limited conception of racism that is severed from larger political economic processes. For example, Baden and Coursey (1997) provide six consequential scenarios explaining a community's proximity to toxic sites, distinguishing, for instance, between a situation in which people of color move into an area known to be dangerous and one in which a hazardous facility is sited in an area where people of color live. In this framework, where racism operates only through intentional discriminatory siting, only the latter scenario evinces environmental racism. By contrast, Bullard's (1996) early definition of environmental racism underscored that any discriminatory outcome is racist, regardless of the intentionality of the mechanism by which it is produced, due to the racist nature of the economy and society. Bullard's early definition of environmental racism as "any policy, practice, or directive that differentially affects or disadvantages (whether intended or unintended) individuals, groups, or communities based on race or color" underscored this point (1996: 497).

As social science research on the intersections of race, class, and pollution proliferated, some academics and activists adopted the term "environmental equity" instead of environmental

racism, as it could include other racial and economic disparities. Others argued this term depoliticized the problem by suggesting that the problem was with the allocation of environmental danger rather than with the underlying economic system (Heiman 1996), thus muting the antiracist foundations of environmental justice movements (Pulido 2000).

Eventually, the term "environmental justice" was more widely embraced by activists, researchers, and policymakers alike (Pulido 2000, Bullard 2000 [1990]).The 1994 Executive Order 12898 on environmental justice —required all federal agencies to "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Clinton 1994). These documents, in effect, helped cement the durability of this term by institutionalizing it in national and state policy discourse. Ironically, though activists initially proposed the term "environmental justice" as a more politicized conception of the problem, the proliferation of its uses and meanings across multiple arenas makes it difficult to use with any conceptual or political specificity. Early critiques like Bullard's and Pulido's drew upon social science theories of racism as systemic and institutionalized to problematize the narrow conceptualization of environmental racism as it was being taken up in public policy and environmental health research. By the late 1990s, with growing controversy about the discursive definitions of environmental racism and environmental justice, more critical approaches to environmental racism research emerged, spanning disciplines like geography, sociology, anthropology, and urban planning.

This "second generation" of interdisciplinary environmental racism research worked to expand the concepts of environmental justice and environmental racism to situate them within

broader social structures and political economic systems. Holifield et al (2010) identify two main strains of this critical environmental racism research in the early 2000s. The more prominent within anthropology was political ecology, which took a neo-Marxian approach to the examination of environmental inequality in urban settings. These scholars emphasized how capitalist modes of production, resource extraction, and labor exploitation produce environmental racism (Biersack and Greenberg 2006, Swyngedouw and Heynen 2003). Another school built upon Robert Bullard's and Laura Pulido's groundbreaking work, utilizing sociological theories of race and racism to understand how they work to constitute environmental inequality. Scholarship in this vein drew heavily on Omi and Winant's (2015 [1987]) theory of racial formation (Hanafi 2017), and especially the concepts of racialization (Brahinsky et al 2014) and racial projects (Park and Pellow 2004, Teelucksingh 2007) to show how hazards and polluted spaces are racialized through political-economic and scientific projects that produce, measure, and manage environmental inequality.

Nearly three decades since "environmental justice" was first encoded in United States law through Executive Order 12898, EJ is being written into major legislation across multiple states and in many government agencies (Lee 2021). Simultaneously, the failures of the state to address historical and ongoing environmental racism are glaringly apparent (Harrison 2019, Pulido 2016). Environmental justice has entered mainstream political discourse in the United States, through the lead pollution crisis in Flint, Michigan, Indigenous-led resistance against the Dakota Access Pipeline, and the gutting of federal environmental protections during the Trump administration (Dillon et al. 2018, Sze 2020). Environmental (in)justice is increasingly invoked as a framework for naming the root causes and intersections of the accelerating social, economic, environmental, political, and public health disasters of our time, including the COVID-19

pandemic, rising fascist power, a global refugee crisis, spectacular military and police violence, entrenchment of corporate power, unprecedented wealth inequality, and the early effects of catastrophic climate change. Environmental justice resonates as a call to action in this "moment of danger" (Sze 2020).

II. Expanding Environmental Justice

Expansions of "environmental justice" that draw in and connect with more and more issues and structural problems are important and promising, creating the space in which the events narrated and analyzed in this dissertation took place. But these expansions also carry enormous discursive risk. In recent years, scholars have called for an articulation of "Critical Environmental Justice Studies" (Pellow 2018) that can address the limitations of earlier generations of scholarship in the field, restore its radical potential, and attune to the ways "EJ" is increasingly invoked in ways that risk retrenching its harms (Pellow 2018, Pulido and De Lara 2018, Sze 2020). Critical Environmental Justice Studies situates EJ within robust theorizations of the historical and ongoing dynamics of racial capitalism and settler colonialism (e.g. Liboiron 2021; Pulido 2016a, 2016b; Vergès 2017),[38] extending intersectional analyses of how multiple social categories of difference (e.g. race, class, gender, sexuality, species) produce inequality (Pellow 2018), a more explicit focus on the role of the state in perpetuating environmental racism

[38] Vergès (2017) for instance, points out that the so-called "Anthropocene" might more appropriately be termed the "racialcapitalocene" to index the specific political, cultural, and economic roots of our global ecological crisis, as well as the profound inequality in its effects. The theory of racial capitalism challenges capitalist and industrial ideologies that render human injury and environmental harm "externalities" to the ultimately desirable processes of industrial growth and capital accumulation. Instead, damage to the environment and human health must be conceived as integral to the production of difference and inequality that drives and sustains capitalism.

and violence (Pulido 2016a, Harrison 2019),[39] and what David Naguib Pellow calls "the largely unexamined question of expendability" (2018: 14).

Examining expendability requires moving away from a discussion of how only particular localized, *places* are made expendable (e.g. "fenceline communities" and "sacrifice zones"), and toward a theorization of how entire *populations* are made disposable, pollutable, and "marked for erasure and early death" (Pellow 2018: 17). This is rooted in theorizations from Black feminist geography and Ethnic Studies of how racial capitalism produces value through the creation and exploitation of racial difference, and how the disposability of certain people and places is integral to the surplus that allows for the production of this value (Gilmore 2007, Hong 2012, Pulido 2016a, Pulido and De Lara 2018, Vora 2015).[40] This kind of critical analysis helps us attune to

[39] Pulido (2016a) argues that racial capitalism is also crucial for addressing the "environmental racism gap"— that is, the under-addressed issue of how racial environmental inequality persists despite state environmental protections—and for recognizing environmental racism as a form of state-sanctioned racial violence, given industrial capital's legal impunity when it comes to issues of environmental racism. Pulido calls on researchers to develop research agendas that interrogate (a) how polluters operationalize the devaluation of nonwhite bodies, (b) how the state, like capital, relies on the production of racialized difference and elides the problem of environmental racism, and (c) how institutionalized and technocratic environmental justice frameworks serve capital at the expense of so-called "environmental justice communities."

[40]Anthropologist and historian Cedric Robinson first articulated the concept of racial capitalism in his seminal book *Black Marxism: The Making of the Black Radical Tradition* (1983). Robinson's far-reaching historical research challenged commonsense historiographies of capitalism, racism, socialism, and Marxist theory. In *Black Marxism,* Robinson argues that racism is not only thoroughly imbricated in modern capitalism, but was in fact essential to capitalism's historical development. He argues that the construction of European civilization, long before the advent of capitalism, hinged fundamentally on the social production of racialized antagonistic differences . Robinson locates the roots of this racialism—defined as "the legitimation and corroboration of social organization as natural by reference to the racial components of its elements" (1983: 2)— in feudal Europe, challenging mainstream histories that trace the origins of contemporary racism to colonial contact with Africa and Enlightenment theories of race. Robinson coins the term racial capitalism to denote "the development, organization, and expansion of capitalist society [in] essentially racial directions" and the permeation of the broader social structures emergent from capitalism (1983: 2). Capitalism has always hinged on the production of racial difference for the acquisition and exploitation of capitalist means of production—land, labor, and capital—through genocide, dispossession, enclosure, slavery, colonialism, and empire.

the discursive gaps and risks that emerge when "environmental justice" is divorced from understandings of how it is produced and valorized through racial capitalism.

Within the problem space of this dissertation, this kind of discursive risk is apparent in the expanding discourse of "community knowledge" as a concept and practice in environmental research and policymaking, in which the participation of marginalized publics is increasingly mandated as both a means and an end of socially just governance and knowledge production. As "community knowledge" comes to be valued in air pollution governance in California, a critical EJ scholarship approach interrogates the relationship between the elite valorization of subjugated knowledges and the disposability of the people that produce them. I argue that the ubiquitous invocation of concepts like "environmental justice" and the "disadvantaged community" incurs discursive risk by reifying essentialized conceptualizations of "community" in ways that enable their ongoing devaluation. While this risk is a condition of late industrialism, and these double binds cannot be avoided, these conditions demand a rigorously accountable engagement with "community knowledge" that is rooted in awareness of the conditions of its production and committed to enacting a more breathable alternative.

III. A Politics of Enactment

In an open letter titled "Suspending Damage: A Letter to Communities," Eve Tuck calls for a moratorium on "damage-centered research" – "research that operates, even benevolently, from a theory of change that establishes harm or injury in order to achieve reparation" (2009: 413). This mode of inquiry is so ubiquitous, Tuck argues, that it has become the "default" theory of change within the social sciences: looking to histories of colonization, exploitation, and subjugation to explain contemporary problems like poverty, pollution, and poor health. Tuck calls into question the effectiveness of this approach, which puts researchers and communities in

the position of litigating their own oppression, with little to show for it. As decades of progressive academic research about and alongside the environmental justice movement are moving concepts like "cumulative impacts" and "disadvantaged communities" into the language of policy and the state, we risk the trap of "damage-centered research" if the interventions begin and end with refining definitions of the problem.

Four years since the implementation of AB 617 began, the ambitious program costing $1 billion so far has yielded little impact on air quality in the state's disadvantaged communities while demanding hours of time, effort, and input from community advocates (Becker 2022, Behles et al. 2021, Sadasivam 2021). Environmental justice advocates across California are increasingly skeptical that it will, since there is no recourse if the measures developed through the ambitious local air monitoring initiatives do not yield actual emissions reductions (Sadasivam 2021). A May 2021 report by the California Environmental Justice Alliance is titled bluntly, "Lessons From California's Emissions Reduction Plans: AB 617's Flawed Implementation Must Not be Repeated" (Behles et al. 2021). Community air monitoring in air pollution science and governance may represent a new paradigm for characterizing the problem through local focus and community representation, but it does not in itself resolve the concern at hand. To paraphrase Tuck and Yang (writing about decolonization) (2012), clean air is not a metaphor.

As the stories I relate in this dissertation show, the solutions do not follow logically from a definition of the problem, and the "problem" of environmental injustice is not reducible to a singular definition outside of particular histories, places, and social relations. All of the paths available are compromised and ridden with double-binds. What I have aimed to draw out in this dissertation are the ways that community air monitoring practices enact partial ways through this mess, albeit in risky ways. Community air monitoring arises from and evinces the exhausted

paradigm of state-led air pollution governance of the last 80 years. It has radically localized air pollution monitoring and knowledge, making environmental injustice visible in new ways, and in new places. It also risks over-localizing environmental injustice, dropping recognition of extra-local and structural drivers. It invites enunciation from new actors and standpoints through its enactment of different kinds of data and novel social formations. It also risks reducing environmental justice to procedural concerns of community participation and engagement. It is being pursued as a model to be replicated across sites, yet it must be conceptualized and designed anew in each place. It requires continual learning, articulation, realignment, and creative coalition-building.

A politics of enactment, in which we see both the problems and solutions as particular articulations that materialize in context and place, can help us think and work outside the essentialisms that haunt this problem space. There is no singular "community," no singular "monitoring," no singular "air." There is no singular "environment," and certainly no singular "justice." There is no one existing solution, only the many that are yet-to-be-enacted– only just, for now, out of reach.

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