Rylie Hanford

Professor Milia

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Air Pollution and Social Disparities

Air pollution, although having world wide impacts and consequences, disproportionately impacts marginalized urban communities. The result of which leads to exacerbation of health disparities and social inequalities. The following essay seeks to explore exactly how environmental data collection, classification, and visualization are structured to allow biases within these data practices to contribute to environmental injustices within urban communities. Examining case studies such as “Cancer Alley” in Louisiana and tension within data-driven movements, this paper argues that systemic gaps in pollution monitoring alter and obscure the true scale of air contamination in areas that are misrepresented and underprivileged. Such an issue underscores the need of equitable environmental data governance frameworks which involve comprehensive policy alterations that aim to reduce disparities that may be present. Through incorporating vigorous oversight mechanisms, being transparent with data-sharing practices and creating more inclusive decision-making processes these frameworks can work to address the current environmental injustices. In doing so, it can allow for further advocating for policy reforms that can lead to substantive and meaningful change. Additionally, by integrating community feedback loops and leveraging technology to allow for increased accessibility to ensure that all the stakeholders particularly those in underprivileged communities are equitably represented and are able to influence the policies that are impacting their environments.

The Biases within Structures in Environmental Data Collection:

Environmental data collection is a rudimentary process for policy making and raising public awareness and action. However, biases throughout these data-gathering practices often can result in pollution exposure levels being misrepresented within marginalized communities. Kim Fortun in her article on the pushback from data designers and pollution politics, highlights how data gaps are formed due to underfunded monitoring infrastructure, strategic dysregulation, or industry influence, often hiding the full extent to which these environmental hazards can play a disruptive role. “Without data, there can be no critical data design. Critical data design thus depends on continual advocacy for data collection” (Fortun et al, 2). The reduction in pollution data collection, particularly intensified following the financial crisis in 2008, has been justified through restraining measures that have limited the ability of the public space and regulators to be able to track environmental risks effectively.

Additionally, Wohner emphasizes the need of standardization within environmental monitoring frameworks and argues that the inconsistencies within data models often obstruct an accurate assessment of the risks that are present with exposure in different geographical locations. “A data model needs to fulfil a set of requirements that vary from case to case. Generally, the quality of a data model can be evaluated by looking at multiple factors, such as correctness, completeness, integration, simplicity, understandability, flexibility, and implementability (C Wohner et al., 2). For instance the EPA’s air quality monitoring systems are located disproportionately among the wealthier communities, predominantly white neighborhoods. The consequence results in communities of color possessing inadequate coverage of data (Perkins, 2024). A few different reasons for this disproportion result from poor reinforcement of regulatory laws such as the “Clean Air Act requires the EPA to monitor and

regulate major air pollutants" (EPA, 2024). Despite this regulatory program, utilizing monitoring resources and enforcing these programs is often only applied to areas with strong environmental advocacy groups which are composed of predominantly wealthy and white communities. The selectivity of data collection therefore leads to policies that fail to provide an equitable representation for all communities which allows underprivileged communities to lie vulnerable to environmental hazards.

Geographic Disparities: Cancer Alley Case Study:

An evident example of environmental injustice takes place in Louisiana within a predominantly Black region that is surrounded by petrochemical plants called "Cancer Alley". Despite the rate of both cancer and respiratory illnesses being much higher than the average, the air quality monitoring within this area continues to remain insufficient (Sadasivam, 2024). In fact, the EPA has acknowledged that residents of this area face significantly higher health risks due to hazardous air pollutants, yet "has not adequately ensured that federal laws and mandates are enforced in Louisiana, and as such, is failing to protect the air, land, water, and health of Louisiana residents from harms caused by the fossil fuel and petrochemical industry" (Human Rights Watch, 2023). Such inadequate action can often be due to regulatory loopholes that allow the companies responsible for the collection, processing, and analysis of the environmental data to manipulate pollution readings by taking averages of the air quality levels over time instead of capturing the high-exposure moments, therefore skewing the representation of the impacts that these levels have on Cancer Alley residents. The current methods for data collection methods reflect a broader pattern of selective environmental governance that excludes communities of color from policy protection and manipulation. In failing to take action in the interests of these underprivileged communities despite having the knowledge of the damage that these

environmental circumstances are having, it continues to place individuals at risk of facing life endangering diseases and circumstances.

Furthermore, Fortun also mentions how critical data designers work to "push back" against institutionalized environmental abandonment by creating accessible pollution databases and mapping tools. "Critical data designers draw on interpretive skill in finding, linking, visualizing, and circulating available data; they pushback against entrenched ways of thinking about public problems through politically strategic and creative data configurations" (Fortun et al.,1). The ability for data designers to circulate information to the public while also connecting this with further interpretation, allows the unequal distribution of pollution burdens to be placed on the spotlight and therefore encourages these affected communities to vouch their concerns in order to demand effective policy changes and therefore encourage individuals to take action. However, despite this information being circulated, without official recognition and integration into these policy frameworks, these initiatives struggle to produce systemic change to make a difference in these underrepresented communities.

Geographic Disparities Continued: Omaha Nebraska Case Study:

Another example of an area facing extreme amounts of environmental injustice is Omaha Nebraska. Particularly Northern Omaha where the North Omaha coal power plant is located which has been found to have a direct effect of surrounding neighborhoods of color one of which includes "an asthma rate of 20 percent, almost three times the average in Nebraska" (Staff, 2023). Additionally, the "Global Energy Monitor estimates that there have been 14 deaths, and 22 heart attacks that can be directly correlated to the North Omaha Coal Plant" (Staff, 2023). Such devastating losses should be enough to grab the

attention of government officials to understand the personal and environmental impacts that the coal power plant is having. But similar to the situation in Louisiana, the transparency and differential treatment within these communities has been caused by a lack of collaboration amongst government agencies and communities as the lack of action to explore the data that is right in front of them and act on it for the protection of communities is not occurring. In order for there to be collaboration amongst underprivileged communities and government agencies, there first must be "a switch from the mindset of being a gatekeeper of this responsibility to being a conduit for working in partnership with the public. Building in processual transparency and points of clear input for communities, can work against the legacy of distrust in government by environmental justice communities (Dosemagen & Williams, 5). It is the willingness for community members and government officials to be able to have such a relationship that fosters advocacy, transparency and accountability in order to implement change to protect such communities.

Engagement and Citizen Science:

Continuing off the evident consequences that arise from such underrepresented and lack equality within these underrepresented communities, the role of engagement and citizen science is incredibly important. By involving citizens in the gathering, classification, and interpretation of environmental data, it provides an opportunity for citizens within these communities to address and correct these biases.

Citizen science enables local residents to contribute to the data collection process by utilizing tools that require low-technology but high reterms as such tools could include community air quality testing kits and mobile apps that gather information of the air quality in their communities. As illustrated by Jalbert and Kinchy "New mobile devices [are] capable of

capturing sound, images, and GPS locations, the growth of web-based interactive data management platforms, and an expanding set of off-the-shelf sensing components like air and water quality detectors" all of which have had a positive impact on the growth and expansion of citizen science projects. Such efforts could be implemented in these underserved communities to help to capture data that might otherwise be overlooked by official agencies that do not prioritize these areas.

Additionally, not only is raising awareness critical to lessen the injustice of the air pollution within these regions but in increasing engagement it can also influence how data is classified. Often "large-scale classification systems are often invisible, erased by their naturalization into the routines of life. Conflict and multiplicity are often buried beneath layers of obscure representation" (Bowker & Star, 1999). The lack of transparency within the classification of data not only limits the ability for individuals to get involved but also limits the representation that they experience. Classification systems are often created and designed by experts who have the education and context of these systems but are not able to translate this into classification systems that reflect the true circumstances and observations within local communities. The incorporation of local observations and experiences from citizens can help ensure that the classifications by these experts fully encapsulates the real-world experiences that come with living in such heavily polluted regions.

Technical Aspects of Air Pollution Monitoring:

Air pollution monitoring systems contain several technical components that each contribute to the accuracy and overall efficacy of data collection. Such components include:

1. **Sensor Placement and Calibration**: Strategic placement of air quality sensors is critical. It ensures that the data accurately reflects the air quality across different demographic areas including both affluent and underprivileged communities. However, there is frequently a misalignment between where these sensors are placed and where they are most needed. Typically sensors are placed out of logistical convenience or where data monitoring is mandated through regulations which often does not coincide with the areas that are most impacted by the polluted environment. Therefore the misalignment of placement and the intention behind it can often skew the results of data collection and appear as though the air quality is better overall when in reality it is still deficient in more vulnerable areas.

2. **Techniques for Gathering Data:** The techniques used to collect and aggregate air quality data directly impact how levels of pollution are both understood and reported. For example, average air quality over longer time periods might make short-term increases in pollutant levels less visible, which is important when evaluating health implications and risks that have immediate impacts. Underreporting of air quality problems in places that see sporadic but severe pollution episodes may result from this methodological bias. Such bias can lead to inadequate policy measures that fail to address the risks faced by residents in these affected areas in

real time which intensifies the health disparities faced within these communities facing environmental injustice.

3. Data Analysis and Processing: Biases may also be introduced by the algorithms employed to process environmental data. These algorithms may result in generalized policies that fail to sufficiently safeguard all populations if they are not made to take into consideration the differences in environmental conditions among various demographic groups. Without taking into consideration the specifications of the local area, it can both generalize and minimize the results and therefore lead to policies that do not protect underprivileged communities.

Overall, the technical components of air pollution monitoring systems are incredibly important to the broader objective of achieving environmental justice. Each component plays a pivotal role in ensuring that the data collection is actionable, accurate, and representative of the data in its purest form. Addressing such challenges associated with the technical components is critical for developing environmental policies that provide equitable protection to all communities and particularly those who are marginalized and most vulnerable to air pollutants adverse effects.

Policy Implications and Recommendations:

In order to address these inequities of the environmental data and the impact that it has on the policy surrounding air pollution, there are actionable steps to implement towards a safer and more equitable future. One actionable step would be to standardize the collection methods for the data to ensure that the guidelines that are applied around the globe are equal to all. By doing so,

it would increase the reliability of the data and therefore be easy to comprehend how it compares in order to decrease bias and inequitable environmental practices. “While the requirements defined by data standards and interoperability needs are comparatively stable, the requirements defined by research networks might quickly change over the runtime of a project or due to political decisions” (Wohner, 4). In constantly changing the requirements that apply to environmental conditions, it makes it extremely difficult to implement change as the quota to meet is continually changing and often in a disproportionate way. A potential solution for this synthesis of this information is presented by Wohner as a REST-API was built to “expose all information that is available about a site, … allows sharing all available information in a common data format” (Wohner, 8). By working to standardize this data through combining and exposing data, it can be broken down and parsed through much more effectively to create recording formats and remove any restrictions that exist.

Secondly, in order to raise awareness of the disproportionate representation of pollution data, it is critical to enhance transparency to make the information more accessible to the public. Communities must be able to access user-friendly data and platforms to navigate the ability to engage and understand the circumstances that they are living in more easily. Standardizing the practices that are made available to users, allows the perspectives and engagement of communities to multiply. Individuals need to be educated to interpret the data that is made available in order to understand and act on the data that is made available to them. In turn, “user engagement is not only about ‘empowerment’, but about a need to change the way science is produced and operated in society” (Forun et al., 9). By placing user engagement at the core of environmental data governance, standardization will not only become a more standardized comprehensive practice, but it will also reflect the lived experiences of those who are most

impacted by pollution. The intertwining of the two will facilitate systemic improvements in how science is applied to policy making, encouraging all communities, regardless of their socioeconomic status, to be able to access clean air and protections with regard to their environment.

Conclusion:

The organization and representation of environmental data collection plays a critical role in shaping individuals' understanding of air pollution and the impact it has on underprivileged communities. Biased data practices obscure the public's understanding of air pollution and the disproportionate pollution burdens that marginalized communities face. However, standardizing the data collection methods and increasing the transparency of pollution data for the public, it can encourage both engagement and education of these systems to promote a more equitable system to ensure that all communities, regardless of socioeconomic status, are equipped with the proper tools and protection in order to lead a healthier future.

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