Environmental Justice Needs Assessment for Disasters

Assessing the Landscape and Capacity of Organizations & Communities Working Towards Environmental Justice with Potential to Use NASA Earth Observations to Support Equitable Disaster Management and Risk Reduction

 **Synthesis Report**

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# 1. Abstract

Natural disasters pose an increasing risk to communities worldwide. Marginalized populations, in particular, experience compounding vulnerabilities that contribute to unequal burdens of natural hazards as a result of systemic inequality stemming from historical disenfranchisement, disinvestment, and discriminatory policies such as racial redlining. This project connected with community organizations working at the intersection of environmental justice (EJ) and natural disaster management throughout the United States, to assess how NASA DEVELOP can leverage geospatial science to advance EJ efforts. Our team conducted a landscape analysis, which included a literature review, annotated bibliography, and identification of organizations working in EJ and disasters. We engaged EJ organizations in discussions to understand their current resources, challenges, and geospatial needs to inform how DEVELOP and NASA Applied Sciences can support their EJ and disaster work. Findings were compiled in a synthesis report and visualized in an ArcGIS StoryMap to showcase the work of EJ organizations, provide geospatial resources for them to explore, and provide examples of how remote sensing can be utilized in EJ and disasters work. The knowledge gained and end products created support the integration of EJ in future DEVELOP projects, and the expanded use of Earth observations by communities in support of a more just tomorrow.

**Key Terms**

Inequities, vulnerability, hazards, remote sensing, community outreach, landscape analysis, listening tour

# 2. Introduction

***2.1 Background Information***

Natural disasters in the United States have rapidly increased in frequency and severity due to the acceleration of climate change. These disasters vary geographically, from drought and wildfires impacting the Western States to flooding and hurricanes affecting the Gulf Coast. Communities of color, low-income, and linguistically isolated communities, in particular, experience unequal burdens of natural hazards as a result of systemic inequality stemming from historical disenfranchisement, disinvestment, and discriminatory policies such as racial redlining (Flores et al., 2021). The context in which disasters transpire is critical in understanding the impact these events have on these marginalized communities. According to Davies et al. (2018), “natural disasters are not ‘natural’,” but are a culmination of “the social, political, and economic context that makes an environmental hazard become a disaster” (p. 2). To elucidate these dynamics, environmental justice (EJ) research analyzes how multiple factors influence an individual’s experiences and their vulnerability to disasters (Cole and Foster, 2001; Fothergill et al., 1999). Community-level disaster organizations at the cross-section of disasters and EJ arise from areas heavily affected by the intersecting vulnerabilities created by their socioeconomic and environmental conditions. These organizations encounter local issues and recognize the varying risk and susceptibility of marginalized groups highlighted by intersectionality.

With disruptive disasters occurring more frequently, communities have an increasing need to create effective and just strategies for mitigation and response. Marginalized communities have historically been disempowered and excluded from decision-making processes, resulting in policy that fails to meet the specific needs of local communities. This lack of representation contributes to some of the challenges faced by these individuals to prepare for and recover from disasters, and often leaves the groups most vulnerable to disasters unable to access the support needed in the aftermath (Méndez et al., 2020). Oftentimes, crucial support networks of non-mainstream populations are greatly disrupted by disasters, impacting an individual’s ability to cope (Gorman-Murray et al., 2018). Thus, researchers and policymakers must listen to vulnerable communities and learn about the ways they are affected by disasters in order to effectively address community needs (Gorman-Murray et al., 2018; Redsteer et al., 2011). Additionally, they must consider that there can be a general distrust of first responders and relief aid among marginalized communities due to fears of discrimination and a lack of inclusivity in recovery efforts (Méndez et al., 2020. Supporting the work of community organizations that emerge out of disaster-stricken areas is imperative to bridging the gap between policy-level management and the actual needs of at-risk groups.

EJ and disaster research are often studied separately, yet these disciplines are intrinsically intertwined. EJ and disaster research must be linked together to understand and reduce the societal inequalities that lead to environmental injustices (Ryder, 2017). In order to achieve this, large-scale agencies and programs, such as NASA Applied Sciences, have an opportunity to play critical roles in recognizing local diversity and vulnerability issues to forge strong connections with communities and ensure their involvement in disaster-reduction processes (Fothergill et al., 1999). It is also important to consider a citizen-science outlook in the disaster-research process in order to democratize research and directly address community needs for more useful and constructive management (Oyana et al., 2017; Fothergill et al., 1999). By utilizing and incorporating community-based knowledge with spatial data, researchers can identify crucial societal and environmental injustices with a finer level of detail to address community needs during disasters (Wickramathilaka & Liyanage, 2019). Therefore, NASA DEVELOP and NASA Applied Sciences committed to studying EJ and disasters together through projects which listen to the needs voiced by marginalized communities and their local organizations (Figure 1). Our findings will help establish an EJ framework for future DEVELOP projects to promote research that is more inclusive and impactful for the communities most vulnerable to disasters and environmental change.



*Figure 1.* Study area map showing the organizations found during our landscape analysis.

Basemap attribution: ESRI, HERE, Garmin, FAO, NOAA, USGS, EPA.

***2.2 Project Partners & Objectives***

Our project was conducted in partnership with NASA DEVELOP and the NASA Applied Sciences Program to investigate ways both programs could leverage NASA Earth observations and geospatial science to pursue work in EJ and disasters. Our team assessed how DEVELOP could expand its range of partners and projects through supporting EJ organizations’ disaster preparation and relief efforts with remote sensing data and geospatial tools. In connecting with organizations and communities working towards more just disaster response, management, and risk reduction, we also strived to increase awareness of open-source geospatial data, tools, and software trainings available to the general public. The annotated bibliography (Appendix A) and methodology for our outreach, question list, and interview processes will inform frameworks for future EJ and needs assessment projects at DEVELOP. The network of organizations collected throughout the nationwide landscape analysis and displayed in the StoryMap will be used by DEVELOP as a resource for future project partners. The culmination of these end products will serve as a foundation for collaborative disaster-focused EJ work within the NASA Applied Sciences Program.

# 3. Methodology

***3.1 Guiding Principles***

Inspired by the seminal 17 Principles of Environmental Justice (Lee, 1992) created at the first People of Color Environmental Leadership Summit in 1991 and the Jemez Organizing Principles from 1996 (Southwest Network for Environmental and Economic Justice, 1996), our team compiled our own set of EJ-informed principles to guide our work. We emphasized transparency and reciprocity in our relationships with organizations, recognizing the historical and contemporary trauma inflicted by federal institutions on marginalized communities. We were clear about the sources of our data and destination of organizations’ information, as well as ensured that we showed gratitude for their time by sharing a list of resources to learn more about EJ, remote sensing, and geospatial data. Additionally, accessibility was important due to the prevalence of geospatial jargon. We used familiar terminology and provided detailed descriptions and examples to introduce participating organizations to new concepts and help them build their own capacity. Moreover, we were acutely aware of and sensitive to the media included in our presentation and StoryMap in order to be respectful of vulnerable communities and avoid tokenization. While not comprehensive of all our considerations in working with organizations, these guiding principles indicate our great care to foster relationships founded on trust, authenticity, and sustainability.

***3.2 Organization Outreach***

Our team conducted a literature review and landscape analysis to understand current resources, existing research, and gaps relating to data needs at the intersection of EJ, disasters, and geographic information science. Utilizing Google search, peer-reviewed literature, and archived online news articles, we identified organizations working in disasters and EJ with potential for future collaborations with DEVELOP. Due to the geographic factors contributing to natural disasters, we divided the United States into 7 regions (West Coast, Intermountain West, Midwest, Gulf Coast, East Coast, Alaska, Hawai’i). Each team member investigated the regions with which they had the most familiarity and compiled a list of relevant organizations. To contact organizations, our team assigned priority according to the following characteristics: (1) organizations working on both disaster and EJ issues, (2) disaster organizations with an EJ-adjacent focus, and (3) EJ organizations with a disaster-adjacent focus, with (1) being the highest priority. We also noted which phase of disaster they addressed: before (preparation, mitigation), during (response and relief), and/or after (recovery).

Organization outreach followed two pathways (Figure 2). Team members sent emails using a customizable template created through collaboration with DEVELOP’s Virtual Environmental Justice (VEJ) Disasters and Health and Air Quality team. This approach allowed emails to be sent in an efficient manner while simultaneously showing organizations that we were familiar with their work and genuine in our contact.



*Figure 2****.*** Flowchart depicting the outreach methodology process used in the EJ Needs Assessment projects.

The first email served to make an initial connection with an organization, explaining our project and requesting an interview. If an organization indicated interest in being interviewed, we followed up with a second email to confirm a meeting time and send pre-meeting questions. If an organization was uninterested in an interview or had limited availability, we sent a shorter version of our pre-meeting questions in an attempt to gather some information along with a thank you message. If we did not hear back from an organization, we sent one follow up email that contained additional details about our project and explained the connection between SSAI and NASA, as we found that organizations were concerned with our credibility and relationship to NASA when corresponding using SSAI emails. Once an interview was scheduled, we sent a third email containing the NASA Media Release Form and a fourth email with a copy of our planned interview questions.

Within 24–48 hours after the interview, we sent a fifth email thanking the interviewees for their time. This email included the interview transcript to allow organizations to review and approve our notes. We maintained contact throughout the remainder of the term to send out relevant and requested resources, gain consent to include interview quotes in our deliverables, and invite organizations to our final presentation. We also wrote a final ‘goodbye’ email that served as a handoff between our team and Marco Vallejos, the VEJ Node Fellow, so that they could continue our work and pursue collaborative project opportunities on behalf of DEVELOP. EJ principles of transparency, reciprocity, accessibility, sensitivity, and awareness informed every step of our outreach process. Understanding the implications of our position as community outsiders and representatives of a federal agency was critical to creating the foundation for strong partnerships between NASA and communities affected by EJ and disasters.

***3.3 Interview Process***

To uphold our guiding principle of transparency and reciprocity in interviews, we approached organizations carefully and intentionally. To gather advice on best practices, we read literature about community-based participatory research and met with researchers with expertise in EJ, disasters, and environmental psychology: Dr. Sara Grineski and Dr. Tim Collins at the University of Utah Center for Natural and Technological Disasters; Dr. Jennifer Pipitone at the College of Mount Saint Vincent; and Dr. Lori Peek at the University of Colorado Boulder Natural Hazards Center. From these articles and discussions, we collaborated with DEVELOP’s VEJ Health and Air Quality team to establish methodology for conducting an interview and designing questions that would identify needs, challenges, and priorities from contacted organizations. For these interactions, including email communication, we were conscious of linguistic accessibility surrounding geospatial work for organizations who did not have experience in this area. We thus centered diction around familiar terms with the technical term following in parentheticals (e.g., “satellite-sourced data and imagery [remote sensing];” “mapping software [GIS]”).

The pre-interview questions collected qualitative and quantitative data about the organizations’ work in disasters and EJ, as well as their familiarity with remote sensing and GIS. Questions were formatted as short and long answer, multiple choice answer, and Likert scale rating questions (Appendix B). Based on the organizations’ response about their familiarity with these tools, we presented organizations with a specialized set of questions which allowed us to (1) understand the extent of experience and expertise of organizations familiar with the tools, and (2) illustrate the possible applications of remote sensing and GIS for organizations unfamiliar with them. Additionally, our team recognized the varying interests in geospatial applications and DEVELOP, as well as the time constraints often experienced by community organizations, which became particularly evident over the term as organizations were actively responding to disasters and crises. We consequently catered to the organizations’ current capacities with the creation of two sets of interview questions: one short and one long. The short pre-interview questions highlighted key information and allowed us to still understand the basic needs of organizations who were uninterested in or unavailable for an interview. The long pre-interview questions, which were designed for organizations who were available for an interview, provided greater detail of their needs and guided a conversation to better define a potential collaboration with DEVELOP.

Interviews lasted 30 to 60 minutes and covered topics such as environmental concerns and organizational priorities, projects, challenges, goals, needs, and experience with remote sensing and GIS. Questions promoted elaboration on the responses provided in the long pre-interview questions and presented an opportunity for team members and organization representatives to brainstorm possible applications of remote sensing (Appendix C). Organization representatives were sent an external copy of the interview questions two days before the interview to allow them to prepare and confirm our meeting time.

Interviews were conducted in Microsoft Teams and were hosted by two team members: an interviewer and transcriber. The interviewer reviewed responses from the long pre-interview questions and filled in organization-specific details in the internal interview question template. If organizations did not provide responses, the interviewer researched the organization and wrote pre-interview notes within this template to guide the interview. The transcriber recorded the ensuing dialogue on the internal interview question template and was supported by the automated transcription service included in Microsoft Teams.

***3.4 Interview Analysis***

Drawing upon social science analysis literature, our team developed an interview analysis methodology based on applied thematic analysis (Guest et al., 2012). We adapted an exploratory approach in which we derived codes and themes directly from reading our data, as opposed to determining codes via a pre-analysis hypothesis. We sought to identify common themes across our interviews to determine what was most important to our sample of organizations in relation to EJ, disasters, remote sensing, and GIS. After conducting several interviews and reading interview transcripts and supplemental notes, we collaboratively decided on three major thematic categories: priorities, challenges, and geospatial needs. We then developed a set of more specific codes within each category which were defined by common ideas and phrases evident across a sample of four interviews (Table 1). These codes were listed, defined, and assigned colors in a spreadsheet codebook to ensure clarity and consistency across reviewers during analysis.

Table 1

*Thematic categories and codes applied in interview analysis*

|  |  |
| --- | --- |
| **Priorities** | **Description** |
| *Community Involvement* | Engage community members in the planning, execution, and/or any decision-making processes of organizational work; remove barriers which prevent engagement |
| *Holistic Justice* | Address social and/or economic justice alongside EJ; mitigate harms from any source of injustice; work towards dismantling current oppressive systems and practices and/or addressing the lasting consequences from previous oppressive systems and practices |
| *Sustainability* | Center concern about lasting impacts of their work and/or staff workload; consider feasibility of workload, scope, and/or partnership longevity in the present and future |
| *Collaboration/Networking* | Seek opportunities to connect with other organizations and individuals; cultivate and maintain relationships with collaborators/partners; place strong value on sharing knowledge |
| **Challenges** | **Description** |
| *Human Power* | Struggle to engage in and/or pursue the work the organizations would like due to limited staff, volunteers, or energy |
| *Time Constraints* | Struggle to engage in and/or pursue the work the organizations would like due to limited amount of time |
| *Funding for Organizations* | Struggle to engage in and/or pursue the work the organizations would like due to a lack of available funds |
| *Funding through Policy* | Encounter barriers to accessing mainstream funding sources; seek alternative avenues for funding |
| **Geospatial Needs** | **Description** |
| *Data (Access & Usability)* | Lack access to data and/or understanding of its applications |
| *Software (Access & Usability)* | Lack access to software and/or understanding of its applications |
| *Quantifying/Visualizing* | Seek compelling and easily comprehensible visual representations of EJ concerns and/or organizational impact |
| *Changes Over Time* | Seek visual representations and/or data about how community and/or landscape has changed over time, such as before, during, and after a disaster |

Two team members assessed each transcript in effort to promote accurate interpretations and mitigate bias. In addition to color coding the text, we tallied the presence of each code in a table with 1 indicating a code was present, regardless of frequency, and 0 indicating the code was absent. Tallies were then input with the same binary system into a spreadsheet for analysis across interviews. Notably, if one team member marked the presence of a code and the other did not, the code was included as a 1. As interviews progressed and additional themes emerged, new codes were noted, but not applied to all interviews due to time constraints.

# 4. Results & Discussion

***4.1 Outreach Analysis***

Our team identified 82 organizations working in EJ and disasters across the United States (Table 2; Appendix D). Of these 82 organizations, we prioritized contact with 37 of them due to the overt possibilities for remote sensing applications to support or supplement their work. We ultimately received email responses from 19 organizations, gathered pre-interview responses from 11, and scheduled interviews with 10.

Table 2

*Organization Outreach*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Region | Identified | Contacted | Responded | Interviewed |
| Alaska | *3* | *3.7%* | *1* | *2.7%* | *1* | *5.3%* | *1* | *10%* |
| Hawai’i | *2* | *2.4%* | *2* | *5.4%* | *0* | *0%* | *0* | *0%* |
| West Coast | *16* | *19.5%* | *6* | *16.2%* | *3* | *15.8%* | *1* | *10%* |
| Intermountain West | *31* | *37.8%* | *5* | *13.5%* | *3* | *15.8%* | *2* | *20%* |
| Midwest | *6* | *7.3%* | *4* | *10.8%* | *1* | *5.3%* | *0* | *0%* |
| Gulf Coast | *11* | *13.4%* | *7* | *18.9%* | *3* | *15.8%* | *2* | *20%* |
| East Coast | *13* | *15.9%* | *12* | *32.4%* | *8* | *42.1%* | *4* | *40%* |
| Total | *82* | *100%* | *37* | *100%* | *19* | *100%* | *10* | *100%* |

The Intermountain West was the most represented region in our identification phase due to one team member’s intimate familiarity and previous experience working with environmental organizations in the area. Similarly, in our contact phase, the East Coast was most represented due to two team members’ concentrated efforts in the region. The East Coast also contributed significantly to our interview phase, comprising 40% of the organizations interviewed. We were unable to engage with organizations from Hawai’i or the Midwest, despite identifying eight organizations. Moreover, while we were able to work with two organizations from the Gulf Coast, their responses to our emails were, at times, more delayed compared to other regions because of the transpiring Mardi Gras holiday and a tornado that directly hit their communities.

Ultimately, we interviewed with an even spread of organizations across our categories. Forty percent engaged in direct disaster and EJ work, 30% engaged in disaster work with an EJ-adjacent focus, and 30% engaged in EJ work with a disaster-adjacent focus. This distribution reflected the scope of natural disaster events addressed by each organization, as well as their availability to interview. Moreover, the region in which an organization was located, as well as the disaster phase they addressed, informed the type of disasters with which they were concerned and their interview availability due to disaster seasons (Figure 3). As natural disasters are primarily dependent on geography and weather conditions, our interview period coincided with active response to early tornado season, whereas organizations concerned with drought, wildfires, and extreme heat were more focused on preparation. Notably, our project outreach timeline also coincided with Russia’s invasion of Ukraine in late February 2022, to which some of our contacted organizations were responding and were consequently unable to respond or interview.



*Figure 3*.

Chart of Disaster Type and Distribution: 10 interviewed organizations and one organization from the Intermountain West which did not interview, but still provided information.

Furthermore, our team assessed organizations’ familiarity with remote sensing and GIS. Five organizations (50%) indicated that their organization had used either, four (40%) indicated no previous experience, and one (10%) indicated they were unsure. There is one additional data point for this assessment from an organization that declined to interview due to their disinterest in a DEVELOP collaboration but that agreed to respond to our pre-interview questions to support us in our research. This extra organization noted that they have been recipients of external data and visualizations created by remote sensing and GIS, but they have not worked with either themselves.

***4.2 Interview Result Analysis***

Our analysis of code frequency revealed organizations’ priorities, challenges, and geospatial needs as key themes (Table 3). From this thematic analysis, our team found that the highest priority among organizations was involving their communities in their work, with 100% of our interviewed organizations expressing this in their interview. Meanwhile, 90% of the organizations identified holistic justice and sustainability as priorities in their work, and 80% mentioned networking and collaboration, as organizations have the desire to work with other organizations, communities, and like-minded professionals to supplement their work. Additional codes included balancing preparation and response work and building resilience within communities. These priorities offer crucial insights into the missions and future goals of organizations at the intersection of EJ and disaster work. As DEVELOP and NASA Applied Sciences continue to work toward the integration of EJ and geospatial science, recognizing the priorities of organizations as reflections of community goals can help shape future DEVELOP projects and interactions with communities, as well as inform how EJ can be meaningfully implemented as a whole.

Table 3

*Code frequency*

|  |  |  |
| --- | --- | --- |
| Organizational Priorities | Organizational Challenges | Geospatial Needs |
| Code | Frequency | Code | Frequency | Code | Frequency |
| *Community Involvement* | 10 | *Human Power* | 8 | *Data (Access & Usability)* | 9 |
| *Holistic Justice* | 9 | *Time Constraints* | 7 | *Software (Access & Usability)* | 7 |
| *Sustainability* | 9 | *Funding for Organizations* | 9 | *Quantifying/**Visualizing Impact* | 10 |
| *Collaboration/**Networking* | 8 | *Funding through Policy* | 5 | *Changes Over Time* | 8 |
| Additional Codes | Additional Codes | Additional Codes |
| *Balancing Preparation & Response* | *Showing the Feasibility of EJ* | *Community-Led* |
| *Building Resilience* | *Inflexible Agency Structures* | *Collaboration to Build Capacity* |
|  | *Collaborator/Staff Turnover Rates* | *Eventual Independence* |
|  | *Climate Change* | *Interactive Tools* |

The main challenges faced by organizations were funding for their work (90%), human power in the form of staffing and volunteers (80%), and time constraints on projects and community work (70%; Table 3). In addition, 50% of organizations mentioned challenges concerning improved funding plans from federal and outside resources to support community capacity-building and recovery. Our analysis also identified challenges pertaining to geospatial tools and data. In general, organizations shared a high interest in utilizing remote sensing data and geospatial tools to inform and support their work. The main geospatial needs among the ten organizations are quantifying and visualizing their work’s impact (100%), data access and usability (90%), demonstrating changes over time in a particular area (80%), and software access and usability (70%). Additional challenges and geospatial needs included demonstrating the feasibility of EJ through organizational work, inflexibilities in agency structures, collaborator and staff turnover, climate change, and building geospatial capacity in organizations and communities for eventual independence in the process (Table 3). The concern with collaborator and staff turnover especially calls to the importance of sustainability in EJ work and should be a consideration DEVELOP mirrors with the Fellow and project participant turnover processes. It is particularly essential that DEVELOP put in place processes for an apt and seamless transition between Fellows.

Similar to the main priorities identified in our analysis, the challenges and geospatial needs discussed provide an understanding of the work in which disaster and EJ organizations are involved and how these organizations hope to grow and evolve. It is important to recognize and address these limitations in future collaborations with organizations and communities in order to continue a respectful relationship that is sensitive to the particular needs of vulnerable communities. Working to overcome these challenges also supports the involvement of communities in disaster and EJ research for more meaningful management plans and decisions. To foster this, our team provided organizations with a list of resources about EJ, disasters, remote sensing, and collaboration opportunities with DEVELOP. Our StoryMap also offers a more extensive and interactive form of these resources, along with more contextualization about DEVELOP as a program. Overall, the considerations illustrated by our analysis of organizational priorities, challenges, and geospatial needs are important when creating project ideas for future DEVELOP terms to support partners and participants.

***4.3 Limitations***

Throughout this project, our work was limited by both internal and external factors. The response rate from contacted organizations was less than 50%, which could be attributed to a few team-identified possibilities. First, active disaster work likely impacted organizations’ time to read and respond to our emails. Second, some interviewed organizations relayed their hesitancy to respond to our emails with non-NASA email addresses. This sentiment may have been felt by others, too. Third, emails may have been sent directly to spam. Our team attempted to mitigate the latter two challenges by sending a follow up email, though continued caution and spam blockers may have prevailed.

Additionally, our team recognized that organizations may not have had the time or staffing capacity to work with us. Moreover, we were unable to send initial contact emails in Weeks 5 and 6 due to DEVELOP deliverables and other program offerings. The responses from organizations interested in interviews were often slower than anticipated, so our interviews and interview analyses were subsequently delayed. Our team had to be flexible to work with organizations’ valuable time. While we did our best to be considerate of organizations and to express our authenticity, it is important to note that these challenges could have setbacks on future needs assessment projects.

We were able to connect with organizations from across the country, though the diversity of organizations reached was limited. Due to time constraints, team capacity, and the vastness of our study area, our initial list of organizations was by no means exhaustive of all EJ and/or disaster-focused groups in the United States. Future DEVELOP projects should expand upon our findings in order to more accurately represent all regions of the country by engaging with organizations not included in our project. We also would have liked to connect with organizations approaching EJ and disaster work from different perspectives, such as Indigenous organizations and/or tribal governments, but did not feel comfortable doing so given the current structure and timeline of the DEVELOP program. We feel that it would be best to reach out to these groups once EJ projects are more established at DEVELOP or pursue collaborations with NASA Applied Science’s Indigenous Peoples Project.

Our analysis methodology, through which we identified a set of themes and codes from our interview transcripts, also has its limitations. Although most of our organizations shared common themes in needs, challenges, and priorities, there is room for potential error in our analyses. The groups of themes and codes that our team created could over-generalize or over-aggregate information about organizations’ priorities and challenges. For example, due to time constraints, we were unable to distinguish sustainability in organizations’ projects from environmental or community sustainability in our code marking. It is also important to note that codes or themes which went unidentified during an organization’s interview could still be experienced by the organization and the community it serves. These conversations with organizations were preliminary; thus, it is possible that there was information left unsaid during our interviews.

Further, our team decided to not use software, such as NVivo, to generate codes for our thematic analysis using an algorithm. Our team recognized the strength of manually analyzing transcripts with two reviewers, as the context of interviews is important to consider in organizations’ responses and provides a more accurate understanding of the information within transcripts. The transcription service used during interviews was not entirely accurate; therefore, the experience of listening to interviews and using personal notes supplemented context and added meaning to responses. However, we also recognize that this manual analysis of transcripts still has the potential to introduce bias.

Finally, due to time constraints at the end of the term, our team was unable to seek feedback from our contacted organizations to understand their perspective on the success and effectiveness of our project. It would be beneficial for DEVELOP to collect this information to qualitatively and quantitatively evaluate our interactions and outcomes to inform future needs assessment projects.

***4.4 Future Work***

While our project established a solid foundation of EJ at DEVELOP, it is crucial that DEVELOP continues to build upon our work to further advance the integration of EJ into the program. In the immediate future, the VEJ Fellow should maintain contact with our interviewed organizations, share with them our StoryMap as it completes export control, and update them on the DEVELOP project development process (Table 4).

Table 4

*Recommended Priority for Outreach with Interviewed Organizations\**

|  |  |  |
| --- | --- | --- |
| **Highest Priority** | **Medium Priority** | **Lower Priority** |
| Alaska Institute of Justice | All Hands and Hearts | Florida Housing Coalition |
| Depave | Imagine Water Works | Save Our Great Salt Lake |
| NC Climate Justice Collective | SBP |  |
| Valle de Oro National Wildlife Refuge | Seeds of Resistance |  |

\* Organizations are listed in alphabetical order per category. More detailed explanations about these organizations can be found in the partner handoff package provided to NASA DEVELOP and NASA Applied Sciences.

The highest priority organizations were chosen based on their commitment to EJ and potential for a future DEVELOP project. Alaska Institute of Justice is interested in working with NASA Earth observations to supplement their community-based monitoring of coastal ecosystem collapse in Native Alaskan communities. Depave collaborates with historically redlined, marginalized communities to reduce urban heat island through depaving impervious surfaces. NC Climate Justice Collective suggested working with flood extent and hog lagoon data to create a community flood and waste exposure susceptibility map. Valle de Oro National Wildlife Refuge approaches its work with EJ principles ingrained in every action and is interested in visualizing and quantifying their organization’s impact on their community’s well-being and environmental quality, especially as they face multiple disasters.

The medium priority organizations still demonstrated great potential for collaborating with DEVELOP, though had fewer concrete ideas for feasible projects at the time of interview. These organizations would benefit greatly from continued communication and brainstorming with DEVELOP before being moved into the highest priority category. Additionally, All Hands and Hearts and SBP are doing incredibly important disaster work and address EJ issues, but, at the time of the interview, did not have either as strong an EJ focus or have the same level of community involvement as the highest priority organizations. These organizations could be considered for other DEVELOP focus areas, such as Urban Development, Water Resources, and Disasters.

The lower priority organizations are doing important work in their communities, but based on the interview assessments, they may not be the best end-users for a project at this time. Florida Housing Coalition did not have a project idea, but could be a beneficial collaborator or boundary organization. Save Our Great Salt Lake is planning to work on a bill for the 2023 legislative session and is greatly connected to the community of local environmental organizations working to maintain the lake’s health, but do not have a clear idea of what remote sensing data would help them, and as a result defer to alternative organizations who are more knowledgeable in this area. Notably, these recommendations are given with the acknowledgement that these organizations could strengthen their project ideas or programmatic structure in the upcoming future and become better candidates for a DEVELOP collaboration.

Overall, all of the interviewed organizations were enthusiastic about leveraging remote sensing and geospatial data in their work. Specific project ideas based on geospatial needs are included in the full organization list in our team’s handoff package, though not all organizations had concrete ideas. Some organizations, regardless of priority categorization, requested additional support and guidance from DEVELOP to understand the possible applications and brainstorm project ideas together. Engaging in these conversations would allow for the exchange of different types of knowledge and demonstrate DEVELOP’s sincerity in working with organizations to co-create. Our team suggests conducting multi-term EJ and needs assessment projects to ensure meaningful co-collaboration and co-development, and to build these projects upon our guiding principles of transparency, reciprocity, accessibility, sensitivity, and awareness.

Furthermore, DEVELOP could promote the exchange of knowledge with organizations in EJ projects. With community-led structures integral to EJ, it is important to consider the composition of DEVELOP teams. Many organizations noted that their community members were interested in learning more about remote sensing and mapping to build their own capacities. DEVELOP could further invest in these communities by inviting community members to be participants or collaborators in order to ensure the experiences and expertise of the people most affected are included in this space. It could also be helpful for EJ teams to create detailed tutorials or host workshops demonstrating the methodology behind end products.

# 5. Conclusions

Through this project, our team successfully identified ways EJ and geospatial tools could be united to support community-level disaster work and further NASA DEVELOP’s initiative in EJ. Our needs assessment of active EJ and disaster organizations provided significant insights for pursuing more EJ-focused work at DEVELOP and NASA Applied Sciences. These considerations are crucial for creating DEVELOP projects which not only address EJ issues, but also embody EJ in practice. Additionally, they can assist the development of greater sensitivity to and awareness of environmental injustices and the historical, social, and environmental contexts that influence a community’s risk to natural disasters.

EJ requires both time and mindful interactions with communities to build strong and trustworthy relationships. In general, we received positive responses from organizations about working on a DEVELOP project in the future. However, many stressed that meaningful collaborations may require a longer timeline than the one 10-week term and should instead be considered for multi-term projects. Organization leaders noted that it is critical to provide adequate time to understand the unique experiences of communities, provide impactful contributions, and have opportunities to co-create and co-develop. As community outsiders, and especially as a program attached to a federal agency, DEVELOP must be sensitive to how they enter and work within these spaces. Future DEVELOP projects that integrate EJ-principles should establish reciprocal relationships with organizations and emphasize the value in sharing knowledge from non-traditional academic sources. Further, as communities are at the heart of EJ work, it is imperative to listen to their experiences and focus on community-based participatory research. It is important that DEVELOP does not come into communities to “research” and “observe,” but rather to work *with* community members to support their capacity-building and involvement in decision-making. Sustaining respectful engagement with our contacted organizations that can have the most direct impact in communities is an essential step in ensuring that communities and concerns are heard and addressed.

In addition, it is important to acknowledge that the challenges to capacity-building within organizations and communities are often due to insufficient time and resources to dedicate toward finding geospatial data and using software. Yet, many interviewed organizations expressed high interest in utilizing geospatial tools and knowledge to supplement their work. By having access to and skills in remote sensing data and mapping software, organizations can expand ways to quantify and visualize their work, which in turn can be beneficial to strengthening grant writing, informing policy, and supporting community involvement in decision-making and beyond. Organizations were interested in learning more about free software trainings and resources (e.g., ARSET), discussing ideas for integrating remote sensing in their work, and considering collaborations in a DEVELOP project.

As leaders in Earth science, DEVELOP and NASA Applied Sciences have an opportunity to help bring marginalized communities into the landscape of remote sensing and research, especially as climate change impacts intensify. In conducting more EJ-driven work, it is paramount to integrate community knowledge and participation in the research process. Therefore, DEVELOP must continue to maintain and build relationships with organizations and communities. Also, DEVELOP’s work should aim to bridge the gap between EJ and disaster research to support groups in utilizing and making meaningful decisions with remote sensing and other geospatial data. Our project helped build a framework for addressing EJ work at DEVELOP and NASA Applied Sciences, as well as established the beginnings of strong relationships with EJ and disaster organizations for potential partnerships and projects. As DEVELOP and NASA Applied Sciences continue forward, it is crucial to center and practice both co-development and collaboration with organizations and communities, not only in EJ projects, but all future projects.

# 6. Acknowledgments

The VEJ Disasters team would like to thank all the organizations for their impactful work, thoughtful responses, engaging conversations, and enthusiasm about our project. We would also like to thank Dr. Sara Grineski, Dr. Tim Collins, Dr. Jennifer Pipitone, and Dr. Lori Peek for sharing their advice and best practices to help with our outreach, questions, and interviews. We extend our deepest appreciation to our Science Advisor, Lauren Childs-Gleason, our DEVELOP Fellow, Marco Vallejos, and our VEJ Health and Air Quality node-mates for their patience, guidance, and collaboration on this inaugural project dedicated to advancing EJ at DEVELOP and NASA Applied Sciences. Lastly, our team recognizes the countless EJ issues experienced by indigenous peoples and would like to acknowledge the unceded indigenous land where our team members worked: Ute, Eastern Shoshone, and Goshute Lands (Sandy, UT); Oneida and Haudenosaunee Lands (Hamilton, NY); Catawba and Sugaree Lands (Mooresville, NC); and Lands of the Muwekma, Ohlone, and Confederated Villages of Lisjan (Berkeley, CA)

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Aeronautics and Space Administration.

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# 7. Glossary

**Earth observations** – Satellites and sensors that collect information about the Earth’s physical, chemical, and biological systems over space and time

**Environmental Justice (EJ)** – The concept which links social and environmental exploitation and advances movement towards just practices, removal of oppressive structures, and the meaningful involvement of marginalized communities in laws, wellness, and policies linked to the environment and/or public health

**Geographic Information Systems (GIS)** – System or software that utilizes geographic data to map and assess spatial patterns and relationships

**Landscape analysis** – Outline of community needs assessment that provides a framework for addressing these needs

**Marginalized populations** – Groups and communities that experience discrimination and disproportionate burdens due to systemic inequality across social, political, economic, and cultural dimensions

**Remote sensing** – Use of satellite or airborne imagery for gathering information about the Earth without making physical contact with its surface

# 8. References

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Davies, I. P., Haugo, R. D., Robertson, J. C., & Levin, P., S. (2018). The unequal vulnerability of communities of color to wildfire. *PLOS ONE*, *13*(11), 1–15. https://doi.org/10.1371/journal.pone.0205825

Flores, A. B., Collins, T. W., Grineski, S. E., Griego, A. L., Mullen, C., Nadybal, S. M., Renteria, R., Rubio, R., Shaker, Y., & Trego, S. A. (2021) Environmental injustice in the disaster cycle: Hurricane Harvey and the Texas Gulf Coast. *Environmental Justice*, *14*(2). https://doi.org/10.1089/env.2020.0039

Fothergill, A., Maestas, E. G. M., & Darlington, J. D. (1999). Race, ethnicity and disasters in the United States: A review of the literature. *Disasters*, *23*(2), 156–173. https://doi.org/10.1111/1467-7717.00111

Gorman-Murray, A., McKinnon, S., Dominey-Howes, D., Nash, C. J., & Bolton, R. (2018). Listening and learning: Giving voice to trans experiences of disasters. *Gender, Place & Culture, 25*(2), 166–187. https://doi.org/10.1080/0966369X.2017.1334632

Guest, G., MacQueen, K. M., & Namey, E. E. (2012). Applied thematic analysis. *SAGE Publications, Inc.* <https://dx.doi.org/10.4135/9781483384436>

Lee, C. (1992). *Proceedings: The First National People of Color Environmental Leadership Summit.* United Church of Christ Commission for Racial Justice. http://rescarta.ucc.org/jsp/RcWebImageViewer.jsp?doc\_id=32092eb9-294e-4f6e-a880-17b8bbe02d88/OhClUCC0/00000001/00000070&pg\_seq=18&search\_doc=

Méndez, M., Flores-Haro, G., & Zucker, L. (2020). The (in)visible victims of disaster: Understanding the vulnerability of undocumented Latino/a and indigenous immigrants. *Geoforum, 116*, 50–62. <https://doi.org/10.1016/j.geoforum.2020.07.007>

Oyana, T. J. (2017). The use of GIS/GPS and spatial analyses in community-based participatory research. *Handbook of community-based participatory research*,39-57*.* https://books.google.com/books?id=PdsWDgAAQBAJ&lpg=PA39&dq=community%20based%20participatory%20research%20gis&lr&pg=PA39#v=onepage&q=community%20based%20participatory%20research%20gis&f=false

Redsteer, M. H., Kelley, K. B., Francis, H., & Block, D. (2011). Disaster risk assessment case study: Recent drought on the Navajo Nation, USA. *United Nations*, 1–19. https://www.preventionweb.net/english/hyogo/gar/2011/en/bgdocs/Redsteer\_Kelley\_Francis\_&\_Block\_2010.pdf

Ryder, S. S. (2017). A bridge to challenging environmental inequality: Intersectionality, environmental justice, and disaster vulnerability. *Social Thought & Research*, *34*, 85–115. https://www.jstor.org/stable/44807699

*Southwest Network for Environmental and Economic Justice* *[SNEEJ].* (1996). Jemez Principles for Democratic Organizing. <https://www.ejnet.org/ej/jemez.pdf>

Wickramathilaka, A. M. & Liyanage, N. V. (2019). Community Mapping as an Approach to Identify and Mitigate Disaster Risks in an Urban Neighborhood in Sri Lanka. *International Conference on Disaster Risk Management*, 728–732. https://docplayer.net/151332072-Community-mapping-as-an-approach-to-identify-and-mitigate-disaster-risks-in-an-urban-neighborhood-in-sri-lanka.html

# 9. Appendices

# Appendix A: Annotated Bibliography

**Section A1: EJ and Disasters**

Davies, I. P., Haugo, R. D., Robertson, J. C., & Levin, P. S. (2018). The unequal vulnerability of communities of color to wildfire. *PLOS ONE*, *13*(11). https://doi.org/10.1371/journal.pone.0205825

By analyzing over 70,000 census tracts and using a socio-ecological approach to characterize fire vulnerability, Davies et al. found that tracts with majority Black, Hispanic, or Native American groups have a 50% greater vulnerability to wildfire compared to other tracts. They discuss how differences in vulnerability affect magnitude and duration of wildfire-derived impacts, as well as how the context of natural disasters is what pushes environmental hazards to become disasters. This article includes a community vulnerability index, which highlights important components such as hazard potential and adaptive capacity. DEVELOP could utilize this vulnerability index in project proposal planning, but must also recognize the statistics with caution due to the invisibility induced by census tract aggregation, a critique noted by Méndez et al. (2020).

Domínguez, D., & Yeh, C. (2020). Social justice disaster relief, counseling, and advocacy: The case of the Northern California wildfires. *Counselling Psychology Quarterly*, *33*(3), 287–311. https://doi.org/10.1080/09515070.2018.1542593

Through ethnographies from the 2017 wildfires in Northern California, this article discusses the colonial structures ingrained in disaster relief, such as the portrayal of helpless victims and privileged saviors. The authors create an equity-oriented framework for counseling psychologists responding to natural disasters and emphasize collaboration, identification of community strengths, holistic work with impacted communities, multidisciplinary ecological disaster analysis, and long-term support. They outline six major themes, among them exploitation of vulnerable communities, and note that all inequities are compounded by additional physical and psychological disaster-inflicted trauma. While it may not be the most relevant to the technical structure of DEVELOP projects, this article brings forth an important side to disaster relief work and illuminates the need for a holistic approach to disaster recovery which includes mental health advocacy.

Fothergill, A., Maestas, E. G. M., & DeRouen Darlington, J. (1999). Race, ethnicity, and disasters in the United States: A review of the literature. *Disasters*, *23*(2), 156-173. https://doi.org/10.1111/1467-7717.00111

This literature review investigates how different racial and ethnic groups perceive natural disasters based on a survey of existing studies and how these groups have or have not been represented in research efforts. The article uses a very similar framework to this VEJ Disasters Needs Assessment Project for what constitutes a natural disaster and is therefore a very useful jumping off point for learning about how marginalized communities are represented in the sphere of disaster research.

Maldonado, J., & Peterson, K. (2021). Justice-Driven Disaster Recovery: Baseline Data to Support Safe Communities, Healthy Ecosystems, and a Rejuvenated Future. *Natural Hazards Center Quick Response Grant Report Series*, *323*. Natural Hazards Center, University of Colorado Boulder. https://hazards.colorado.edu/quick-response-report/justice-driven-disaster-recovery

This research introduces the compounding effects of disasters and how they expose systemic social and environmental injustices. Historical context and baseline data are provided as to improve master plans and regional economic models that often adversely affect Latinx, Vietnamese, Indigenous, African American, Creole, and other communities of color. Research found within this article can help DEVELOP approach EJ projects in marginalized communities and communities most frequently impacted by disasters.

Méndez, M., Flores-Haro, G., & Zucker, L. (2020). The (in)visible victims of disaster: Understanding the vulnerability of undocumented Latino/a and indigenous immigrants. *Geoforum*, *116*, 50–62. https://doi.org/10.1016/j.geoforum.2020.07.007

Through a case study of the Thomas Fire in Santa Barbara and Ventura, California, the authors examine the special considerations needed to support undocumented Latinx and indigenous immigrants in disasters and how these communities were ultimately excluded in emergency response and recovery efforts. They discuss discrimination, exploitation, economic hardships, linguistic needs, and fears of deportation, as well as the contrast between slow, culminating violence, such as structural and systemic inequalities, and fast-moving disasters. The authors advocate for disaster approaches which center intersectionality, contextual vulnerability, and inclusion in planning. By recognizing this nuanced approach and the varied experiences of marginalized groups in disaster stages, DEVELOP could collaborate with local immigrant rights and Environmental Justice groups to support the most vulnerable. DEVELOP could also use the inductive coding framework outlined in this article and used in the VEJ Disasters Project.

Montgomery, M. C., & Chakraborty, J. (2015). Assessing the environmental justice consequences of flood risk: a case study in Miami, Florida. *Environmental Research Letters*. [https://doi:10.1088/1748-9326/10/9/095010](https://iopscience.iop.org/article/10.1088/1748-9326/10/9/095010)

This case study examines the risks of inland flood risks and coastal flood risks, which the study treated as separate risks, in one of the most diverse and hurricane-prone areas in the world. EJ research has emphasized the need to analyze social inequities in natural disasters. The study examined populations of people based on country of origin. They used the 2010 U.S. Census, community survey estimates, and FEMA flood zones data to analyze inequitable flood risk exposure. Research methods in this article can help identify a methodology and best approach for DEVELOP to create projects in ethnically diverse populations with a focus on recognizing all voices within a community.

Redsteer, M.H., Kelley, K.B., Francis, H. & Block, D. (2010). *Disaster Risk Assessment Case Study: Recent Drought on the Navajo Nation, southwestern United States.* United Nations, International Strategy for Disaster Reduction. https://www.preventionweb.net/english/hyogo/gar/2011/en/what/drought.html

This case study includes the results from 50 interviews with elders from the Navajo Nation and provides qualitative information to supplement the limited and noncontinuous meteorological records in this region. These observations provide general context about climate change and drought, as well as detailed observations about the ways in which these patterns impact culture in the Navajo Nation. Redsteer et al. (2010) draw parallels between the erosion of the physical land and of cultural tradition, and this parallel is imperative for DEVELOP to integrate in its approach to and understanding of EJ.

Ryder, S. S. (2017). A Bridge to Challenging Environmental Inequality: Intersectionality, Environmental Justice, and Disaster Vulnerability. *Social Thought & Research*, *34*, 85–115. <http://www.jstor.org/stable/44807699>

This article provides an interesting perspective on how environmental justice and disaster research are currently treated more as individual research areas and explores how these areas need to be bridged together. Both EJ and disasters have the goal of seeking to understand and reduce societal inequalities that lead to environmental inequalities. A holistic approach to EJ can improve equitable planning, preparedness, response, and recovery efforts in disaster events to ensure experiences of environmental oppression are reduced. This article can help inform DEVELOP of our work in researching disaster and EJ organizations to discover where these areas may intersect.

Wikstrom, K., Miller, T., Campbell, H. E., & Tschudi, M. (2019). Environmental Inequities and Water Policy During a Drought: Burdened Communities, Minority Residents, and Cutback Assignments: Environmental Justice and Water Cutbacks. *Review of Policy Research*, *36*(1), 4–27. <https://doi.org/10.1111/ropr.12301>

After 4 years of drought, California Environmental Protection Agency (CalEPA) issued mandatory water reduction for residents. With previous research uncovering that water cutbacks disproportionately affecting racial and ethnic minorities, Wikstrom et al. utilized CalEnviroScreen, GIS, and regression analysis to identify if this pattern existed in California. Ultimately, they found that the CalEPA order did not increase stress on vulnerable communities, but communities with higher percentages of Hispanics still receive lower water allowances even when controlling for other factors. Wikstrom et al. provide a helpful methodology for working across and combining data types and scales. This article illustrates the need to expand understandings of Environmental Justice (EJ) and recognize drought as an EJ issue, especially in procedural and distributive contexts. It also supports the notion that "environmentally unjust outcomes may result from ingrained institutional factors rather than explicit acts of discrimination” (21), which is similarly important to consider in DEVELOP work.

Secondary Resources:

* Chakraborty, J., Grineski, S. E., & Collins, T. W. (2019). Exploring the environmental justice implications of Hurricane Harvey flooding in Greater Houston, Texas. A*merican Journal of Public Health*, *109*(2), 244-250. https://doi.org/10.2105/AJPH.2018.304846
* Masri, S., Scaduto, E., Jin, Y., & Wu, J. (2021). Disproportionate Impacts of Wildfires among Elderly and Low-Income Communities in California from 2000–2020. *International Journal of Environmental Research and Public Health*, *18*(8), 3921. MDPI AG. http://dx.doi.org/10.3390/ijerph18083921
* Nugent, A. D., Longman, R. J., Trauernicht, C., Lucas, M. P., Diaz, H. F., & Giambelluca, T. W. (2020). Fire and Rain: The Legacy of Hurricane Lane in Hawai’i. *Bulletin of the American Meteorological Society*, *101*(6), 954–967. http://dx.doi.org/10.1175/BAMS-D-19-0104.1

**Section A2: EJ and Geospatial**

Felke, T. (2015). The Use of Geographic Information Systems (GIS) in Conducting a Needs Assessment of Seniors in Collier County. *Advances in Social Work*. https:/doi.org/10.18060/18130

GIS was used to conduct a needs assessment of the senior population in Collier County, Florida. This study successfully established a senior access center by integrating previously obtained qualitative demographic data of the study population with geographic data to identify service locations and public transportation. This article offers important information and insight for integrating geospatial tools and data into needs assessments. DEVELOP, and particularly its future needs assessment projects, can utilize methods and considerations from this study with EJ principles to provide meaningful needs assessments of vulnerable groups. Felke mentions that it is important to consider the GIS capacity of communities involved; therefore, as DEVELOP continues to incorporate EJ and community involvement in its projects, it is important to work closely with the target community and provide access to trainings and tools that can build understanding and capacity of remote sensing and geospatial tools.

Sandifer, P., et al. (2020). Framework for a Community Health Observing System for the Gulf of Mexico Region: Preparing for Future Disasters. *Frontiers in Public Health*, 8. https://doi.org/10.3389/fpubh.2020.578463

Using health indicators, this study set up a baseline disaster-focused health observing system to inform disaster mitigation, preparation, response, and recovery. Sandifer et al. utilized remote sensing data to monitor populations’ exposure to environmental injustices related to disasters. This study offers methods for examining geospatial components of human-environment interactions, pairing ground-based data from communities with remote sensing to create composite exposure data sets. In future DEVELOP projects, these methods and considerations for integrating community-level data with remote sensing imagery can support its EJ initiative.

Secondary Resources:

* Salguero, J., Li, J., Farahmand, A., & Reager, J. T. (2020). Wildfire Trend Analysis over the Contiguous United States Using Remote Sensing Observations. *Remote Sensing*, *12*(16), 2565. MDPI AG. http://dx.doi.org/10.3390/rs12162565
* Wigtil, G., Hammer, R. B., Kline, J. D., Mockrin, M. H., Stewart, S. I., Roper, D., & Radeloff, V. C. (2016). Places where wildfire potential and social vulnerability coincide in the coterminous United States. *International Journal of Wildland Fire*, *25*(8), 896. https://doi.org/10.1071/WF15109

**Section A3: Community-Based Participatory Research**

Oyana, J. (2017). The Use of GIS/GPS and Spatial Analyses in Community-Based Participatory Research. *Handbook of Community Based Participatory Research.* 40-56.

Chapter 4 of Oyana’s Handbook of Community Based Participatory Research provides an overview of Community Based Participatory Research (CBPR) and specific examples of its applications in GIS. This chapter emphasizes the benefits of community inclusion and offers the concept of "citizen science" (especially as mapping technology has become more commonplace and accessible via smartphones). It provides frameworks for integrating CBPR and describes "four levels of participation in Volunteered Geographic Information": crowdsourcing, distributed intelligence, participatory science, and extreme citizen science. Ideas in this paper could be applied to the technical aspects of the DEVELOP project process, especially when utilizing open-source tools such as Google Earth Engine.

Secondary Resources:

* McGregor, D. P., Aluli, N. E., & Alegado, R. A. (2020). *Lessons from Aloha ‘Āina Activism: Visioning and Planning for Our Islands and Communities in the Wake of COVID-19*. Honolulu: University of Hawaiʻi Press and the Center for Biographical Research. <https://scholarspace.manoa.hawaii.edu/bitstream/10125/70201/Lessons%20from%20Aloha%20%CA%BB%C4%80ina%20Activism.pdf>
* Goodyear-Ka‘ōpua, C. Howes, J. K. K. Osorio, & A. Yamashiro (Eds.), *The Value of Hawaiʻi 3: Hulihia, the Turning.* University of Hawai’i Press, 210–218. https://doi.org/10.2307/j.ctv1pncr2m.53

**Section A4: Interview Analysis**

Guest, G., MacQueen, K. M., & Namey, E. E. (2012). *Applied thematic analysis*. SAGE Publications, Inc. <https://dx.doi.org/10.4135/9781483384436>

Guest et al. outline a detailed framework for the systematic and rigorous analysis of qualitative data. It describes methods for data collection and applied thematic analysis, an inductive method that is based on the formation of themes and codes. This methodology is useful for DEVELOP listening tour and needs assessment projects that are based on collecting data through interviews.

Ponto J. (2015). Understanding and Evaluating Survey Research. *Journal of the Advanced Practitioner in Oncology*, *6*(2), 168–171.

This article provides an overview of several methodologies that can be employed in survey research, with descriptions of when each method may or may not be appropriate and how they can each be applied to qualitative social science research. It describes sources of bias and strategies to eliminate it, the statistical basis of sample size considerations, as well as different approaches to data collection. DEVELOP projects that utilize survey research can be supported by this succinct overview of survey benefits, limitations, and approaches.

**Section A5: Miscellaneous**

Lee, C. (2021). Evaluating Environmental Protection Agency’s Definition of Environmental Justice. *Environmental Justice*, *14*(5), 332–337. <https://doi.org/10.1089/env.2021.0007>

A senior policy advisor at the Environmental Protection Agency (EPA) as well as a key figure in many cornerstone events of the Environmental Justice (EJ) movement, Lee proposes a new working definition of EJ to replace the EPA’s current definition which was written over thirty years ago and centers equity, rather than justice. Lee analyzes the diction and scope of the current definition which promotes the equalizing of harm, not removing the instigators of harm and policies that perpetuate harm as EJ advocates. Lee also notes that the EPA’s EJ definition does not recognize disproportionate impacts or push forward meaningful change due to its singular focus on procedural justice. DEVELOP could adhere to this proposed definition, or critically examine their definition of EJ, to push forward justice in their work.

Wilson, S.M. (2009). An Ecologic Framework to Study and Address Environmental Justice and Community Health Issues. *Environmental Justice*, 15-24. <http://doi.org/10.1089/env.2008.0515>

This article addresses environmental justice research while exploring health disparities related to environmental hazards. It includes a multidisciplinary ecologic framework that examines determinants of health and injustices with community zoning, planning, and development. The goal is to approach public and community health in a way that disadvantaged communities can overcome exposure to environmental hazards. This article is relevant to DEVELOP as it is an example of a public health approach to EJ and disasters. Health is a common objective between EJ and disaster organizations and can be used as a focal point to connect these two areas in future DEVELOP projects. The integrated use of GIS and community health surveys are also examined as an effective way to improve community health and resiliency.

# Appendix B: Pre-Interview Questions

Organization Needs

1. What are the top three priorities of your organization? Please list them in order from most important to least important.
2. Which of these disasters is your organization concerned with?
	1. Floods, Wildfires, Earthquakes, Tsunamis, Severe storms, Hurricanes, Drought, Extreme heat, Volcanoes, Landslides/mudslides, Coastal hazards, Tornadoes, Other
3. What stage of disasters does your organization deal with?
	1. Before (disaster prep, mitigation, etc.), During (response), After (recovery), N/A
4. Does your organization address Environmental Justice? If yes, please describe how in a few sentences. If no, write N/A.
5. Has your organization used mapping software and/or satellite imagery before? (Yes/No/Not Sure)

Familiar with GIS and Remote Sensing

1. How has your organization used mapping software (such as GIS (Geographic Information Systems)) or remote sensing (such as satellite imagery) in your work? Please describe in a few sentences.
2. On a scale of 1 to 5, what is your organization’s level of experience with GIS and/or remote sensing? (1 = beginner, 3 = intermediate, 5 = advanced)
3. In your organization’s use of GIS and/or remote sensing, are there things your organization wishes it could do but has been previously limited by?

Unfamiliar with GIS and Remote Sensing

\*(Provided examples from DEVELOP projects: Hawai’i Island Disasters (Fall 2021), Cincinnati and Covington Urban Development II (Summer 2021), and Missouri River Climate II (Spring 2017))\*

1. Knowing these applications, on a scale of 1 to 5, how much interest does your organization have in using mapping software and/or satellite imagery? [1 = low interest, 3 = moderate interest, 5 = high interest]
2. Are there specific applications of mapping and/or satellite imagery that interest your organization? If yes, please explain in a few sentences. If no or not sure, indicate below.
3. If you answered yes to the previous question, are there any obstacles preventing your organization from using these services? Please explain in a few sentences.

Feedback

1. Use this space to write any comments/thoughts which weren’t captured in the above questions. \*(Long answer)\*
2. Would your organization be interested in receiving any of these resources from DEVELOP or its affiliated programs? Mark all that apply.
	1. Educational materials (webinar trainings about GIS, remote sensing, etc.),
	2. Grant resources
	3. Collaborating on a DEVELOP project
	4. Other

# Appendix C: Interview Questions

1. From the pre-interview questions we sent before this call, you mentioned that your top environmental concerns were [CONCERN], [CONCERN], and [CONCERN]. Can you please elaborate on when/where these concerns began and how they shape your organization’s priorities? \*(customized/case based depending on org and their responses to the pre-interview questions)\*

1. We read about some of your organization’s projects on your website and were particularly intrigued by [insert specific project]. What challenges did you face/have you faced while undertaking this work, and what lessons have you learned?

1. After hearing about [insert specific project], where does your organization hope to go next with your work? What are your goals for the future?

1. In your response to the pre-interview questions we sent out earlier, you mentioned that your organization is looking for [type of resource from survey] resources. Can you elaborate on your needs and wants related to those resources? Is there anything else you are looking for help with?

1. In your pre-interview questions, you noted [insert interest] as your interest in using GIS and remote sensing/mapping and satellite imagery \*(change language per org familiarity)\* in your work. You also noted [insert org's idea] as a potential way to incorporate these in.
	1. Do you have any other ideas of how these (geospatial) tools could support your work?
	2. If not, could you speak more about what you listed in the survey? [then after hearing their answer, we could supplement with our ideas and ask if that’s of interest to them]

# Appendix D: Organizations in EJ and Disasters

**Table D1**

*Interviewed EJ and Disasters Organizations*

|  |  |  |
| --- | --- | --- |
| **Organization:** | **Location:** | **Disaster(s):** |
| **Alaska Institute for Justice\*** | Anchorage, AK and Juneau, AK | Floods, severe storms, coastal hazards, usteq (a Yup’ik word meaning catastrophic land collapse caused by thawing permafrost, flooding, and erosion) |
| **Focus:** | **Sector:** |
| Disaster and EJ | Private Sector (Non-Profit)/ NGO  |
| **Organization:** | **Location:** | **Disaster(s):** |
| **All Hands and Hearts** | Mattapoisett, MA | Floods, hurricanes, tornados, wildfires, severe storms, earthquakes, tsunamis, landslides |
| **Focus:** | **Sector:** |
| Disaster and EJ-Adjacent | Private Sector (Non-Profit) |
| **Organization:** | **Location:** | **Disaster(s):** |
| **Depave\*** | Portland, OR | Wildfires, extreme heat, floods, severe storms |
| **Focus:** | **Sector:** |
| EJ and Disaster-Adjacent | Private Sector (Non-Profit) |
| **Organization:** | **Location:** | **Disaster(s):** |
| **Florida Housing Coalition** | Tallahassee, FL | Floods, hurricanes, tornados, wildfires, severe storms |
| **Focus:** | **Sector:** |
| Disaster and EJ | Private Sector (Non-Profit) |
| **Organization:** | **Location:** | **Disaster(s):** |
| **Imagine Water Works** | Arabi, LA | Floods, hurricanes, severe storms, coastal hazards, extreme heat |
| **Focus:** | **Sector:** |
| Disaster and EJ | Private Sector (Non-Profit) |
| **Organization:** | **Location:** | **Disaster(s):** |
| **NC Climate Justice Collective\*** | North Carolina | Floods, hurricanes, severe storms, coastal hazards, tornadoes, wildfires, drought, extreme heat, landslides/mudslides, structural violence |
| **Focus:** | **Sector:** |
| EJ and Disaster | NGO |
| **Organization:** | **Location:** | **Disaster(s):** |
| **Save Our Great Salt Lake** | Salt Lake City, UT | Drought, extreme heat, toxic dust bowl |
| **Focus:** | **Sector:** |
| Disaster and EJ-Adjacent | Private Sector (Non-Profit) |
| **Organization:** | **Location:** | **Disaster(s):** |
| **SBP** | New Orleans, LA | Floods, hurricanes, tornados, wildfires, severe storms |
| **Focus:** | **Sector:** |
| Disaster and EJ-Adjacent | Private Sector (Non-Profit) |
| **Organization:** | **Location:** | **Disaster(s):** |
| **Seeds of Resistance** | Homestead, FL | Floods, hurricanes, severe storms, extreme heat, toxic exposure |
| **Focus:** | **Sector:** |
| EJ and Disaster-Adjacent | Private Sector (Non-Profit) |
| **Organization:** | **Location:** | **Disaster(s):** |
| **Valle de Oro National Wildlife Refuge (U.S. Fish & Wildlife Service)\*** | Albuquerque, NM | Floods, wildfires, drought, extreme heat |
| **Focus:** | **Sector:** |
| EJ and Disaster-Adjacent | Federal Government |

The “\*” indicates organizations which should take highest priority in outreach to explore potential future DEVELOP projects.

**Table D2**

*EJ and Disaster Organizations Which Responded*

|  |  |  |
| --- | --- | --- |
| **Organization:** | **Location:** | **Sector** |
| **Americares** | Stamford, CT | Private Sector (Non-Profit) |
| **Asian Pacific Environmental Network (APEN)** | Bay Area, CA | Private Sector (Non-Profit) |
| **Convoy of Hope** | Springfield, MO | Private Sector (Non-Profit) |
| **Feast Down East** | Burgaw, NC | Private Sector (Non-Profit) |
| **Friends of Great Salt Lake** | Salt Lake City, UT | Private Sector (Non-Profit) |
| **The Fuller Center for Housing** | Americus, GA | Private Sector (Non-Profit) |
| **Latino Community Foundation Wildfire Relief Fund** | Bay Area, CA | Private Sector (Non-Profit) |
| **The Louisiana Environmental Action Network** | Baton Rouge, LA | Private Sector (Non-Profit) |
| **Samaritan’s Purse** | Boone, NC | Private Sector (Non-Profit) |

These organizations responded to our initial emails but were uninterested in collaborations or unable to interview during our 10-week term. They could be contacted again in the future as their future projects could be supported by DEVELOP work, or DEVELOP could focus outreach efforts elsewhere.

**Table D3**

*Contacted EJ and Disaster Organizations Which Didn’t Respond*

|  |  |  |
| --- | --- | --- |
| **Organization:** | **Location:** | **Sector:** |
| **Alternatives for Community and Environment (ACE)** | Roxbery, MA | Private Sector (Non-Profit) |
| **Be Ready Manoa** | Manoa, HI | Private Sector (Non-Profit) |
| **Central Coast Alliance United for a Sustainable Economy (CAUSE)** | Ventura, CA | Private Sector (Non-Profit)/NGO |
| **Craven County Disaster Recovery Alliance** | New Bern, NC | Private Sector (Non-Profit) |
| **Detroiters Working for Environmental Justice** | Detroit, MI | Private Sector (Non-Profit) |
| **Foundation for the Carolinas** | Charlotte, NC | Private Sector (Non-Profit) |
| **Got Green** | Seattle, WA | Private Sector (Non-Profit) |
| **Great Basin Resource Center** | Reno, NV | Private Sector (Non-Profit) |
| **HEAL Utah****(Healthy Environment Alliance of Utah)** | Salt Lake City, UT | Private Sector (Non-Profit) |
| **KAHEA** | Honolulu, HI | Private Sector (Non-Profit) |
| **League of United Latin American Citizens of Iowa – Climate and Environmental Justice Committee** | Iowa | Private Sector (Non-Profit) |
| **Lowlander Center** | Gray, LA | Private Sector (Non-Profit) |
| **North Carolina Inclusive Disaster Recovery Network** | Durham, NC | Private Sector (Non-Profit) |
| **Southern Mutual Help Association, Inc.**  | New Iberia, LA | Private Sector (Non-Profit) |
| **Team Rubicon** | El Segundo, CA | Private Sector (Non-Profit) |
| **Texas-Louisiana Gulf Coast Synod** | Houston, TX | Private Sector (Non-Profit) |
| **UNC Carolina Center for Public Service**  | Chapel Hill, NC | Academic Institution |
| **We the People of Detroit** | Detroit, MI | Private Sector (Non-Profit) |

These organizations did not reply to our initial contacts.