Final Report to American Red Cross
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Executive Summary

The American Red Cross (ARC) organization has and continues to provide tools and services concerning emergency assistance, disaster relief, and disaster preparedness. This project aims to produce tools that will unequivocally communicate the link between the services and tools the ARC organization provides. Specifically, this project uses three (3) different but linked web map products to show the link between climate change and the ARC organization's humanitarian services within the USA. Below is a summary of each of the three web map products:

1. Product 1 is a web application created through ArcGIS Online that reveals information to aid ARC in decision making. First, the application identifies how socially vulnerable areas (counties) in the United States (US) are to emergencies or natural disasters based on 15 social factors. Second, the application identifies areas in the US exposed to Hurricanes and the potential sea-level rise (storm surge) associated with them. Viewers of the map can work to understand what resources may need to be allocated to specific communities or regions to prepare, respond, and recover from hurricanes and related disasters based on recent exposure to storms, sea-level rise, and social vulnerability to disasters.

2. Product 2 is a web map built with Mapbox GL JS. The purpose of this product is to aid in project coordination and provide users quantitative information regarding ARC's disaster relief response to past hurricane events. This product is meant to bridge the gap between Products 1 and 3 by moving beyond raw datasets toward quantitative analyses while still refraining from adding a contextual, narrative element. The goal of this product is to allow the public to see where ARC is working and how they are addressing emergency and long-term recovery needs for individuals and families they serve.

3. Product 3 is in the form of an ArcGIS Story Map. The purpose of this product is to highlight recent efforts of the ARC pertaining to disaster relief following hurricanes in the Gulf Coast region. This allows viewers to create connections between the ARC and small communities, as interviews with residents, ARC volunteers, and local news stories are incorporated. Maps included in this product describe storm trends over the past 50 years, major hurricanes in 2020, and locations of ARC's on-the-ground relief work.

4. Product 4 is a sample survey using Survey123, showing just one possible way the American Red Cross can integrate spatial data into their surveys and mobile data collection. The product includes a link to the sample survey and a more detailed description of possible uses of the product.

The paragraphs below give detailed descriptions of the project, data, and prototypes.

Introduction

The American Red Cross relies on a plethora of web-based products to disseminate information concerning disaster mitigation, response, and recovery. Individually, these products serve their purpose, but showing the synergy between these products can show more information. This project seeks to show such synergy by presenting 4 web-based products, which communicate the link between hurricanes, vulnerable areas, relief efforts, and mobile data collection (survey) services the ARC provides in the USA. Users can access these products through an interactive web product, which presents an Overview, Product 1, Product 2, Product 3, Product 4, and Summary. A detailed explanation of the four products is presented in the executive summary of this report. The fonts and font colors of the headings and text of the website and web products were chosen are in line with the **corporate colors of ARC**. This report has 4 main sections: Executive Summary, Introduction, Considerations on surveys/mobile data collection, and Summary. Please refer to each of these sections of this report for a vivid explanation of this project's objectives, data, and products.

Prototypes and Data

Product 1

The prototype created for Product 1 was through ArcGIS Online's Web App Builder. This format was utilized for the product to aid in decision-making because it allows ARC and the users of the tool to examine the spatial extent of the US and have control of which layers they can see. This web app allows the user to explore areas that could need assistance due to exposure to Hurricanes and related tropical events in the US, particularly in the country's southeastern part. The map helps determine where assistance or resource allocation should go based on two major aspects that the web map shows, the social vulnerability to natural disasters and exposure to the disaster.

Social vulnerability is shown in the map through the social vulnerability of US Counties layer. This layer reveals the Social Vulnerability of a US County as a percentile ranking from 0 to 100, with 0 being least vulnerable to 100 being most vulnerable. This data helps reveal which areas of the US contain populations vulnerable to disasters based on a combination of various demographic information that comes from four themes. These four themes are socioeconomic status, household composition & disability, minority status & language, and housing type & transportation. Additional county layers provide the vulnerability that each US County has to each of the four themes, also presented as percentiles. Suppose the user wants to see the percentile of social vulnerability and the percentiles for the other four themes for a specific county. In that case, they can just click on the county for a popup to appear with relevant information. This information

not only reveals how vulnerable US counties are to disaster, but it also reveals what aspects make each county socially vulnerable to them, which would be helpful for ARC to determine what resources would be needed for a specific county. For instance, if minority status & language has a high percentile value, that would reveal to ARC that translators would likely be needed. Suppose housing type & transportation has a higher percentile. In that case, this could indicate that many individuals have mobile housing and a lack of transportation, so a shelter to use during a storm or disaster that's easily accessible would likely be needed. With this map, users also can filter the county data, which means users can look at counties that have a certain level of social vulnerability, have a certain level of vulnerability, located within a particular state, or any combination of the three. Examining this data shows that many of the more socially vulnerable US Counties are located in the Southeastern part of the country, where most Hurricanes and Tropical Storms pass through, which is essential to recognize to help those dealing with disasters properly.

The exposure data is presented as Hurricane tracks from 2020 and sea-level rise (SLR). These data show how much of a threat Hurricanes and related storms are to communities in combination with the social vulnerability data. The hurricane data is categorized by strength (miles per hour), and each one-foot increment categorizes SLR. For the SLR data, the user has the option of turning on and off each layer to see which areas are projected to be inundated at a certain level of SLR or storm surge. The combination of exposure and social vulnerability data will help ARC see which areas have the greatest risk of getting hit by a hurricane or related-storm, being inundated by water through storm surge, and not having the appropriate resources to prepare, respond, and recover from the event.

Using this format for Product 1 to aid in decision-making presents many advantages. First, while often a feature with online mapping, the transparency option allows the user to see through them, have a general area where SLR impacts counties, and see how socially vulnerable a county is. Also, the layer list in the web app allows the user to control which layers they can turn off and on, so if the user only wants to look at one aspect of the map, they have the option to do so. As mentioned previously, the user can filter data out with the filter feature that the web app provides to look specifically at counties that may be of interest to them when observing the map. However, while relatively minor, there are some disadvantages to this tool. One, there was no option to create a slider for the SLR data, which would allow a user to more easily see increases or decreases in SLR without having to go to the layer list to check and uncheck each layer. However, the tool is overall already pretty user-friendly. Also, if ARC wishes to edit or update this map, they need to ensure that they have an AGOL account, which costs money to obtain. Overall the tools offered through this web app are very user-friendly and can be helpful in decision-making, the biggest issue will be the access to edit and

update data, which will need to be done at some point as these data will not remain consistent.

Product 2

The prototype for Product 2 is an interactive web map of past ARC hurricane relief projects. This prototype was created using **Mapbox GL JS**, a **JavaScript library** that uses WebGL and Mapbox functionality in tandem to display interactive web maps with vector tiles and custom Mapbox styles. Mapbox was chosen to create this particular product because it can be used to produced clean and attractive web maps with interactive content, particularly useful capabilities for a public-facing map. The ability to customize the basemap and corresponding feature icons is additionally advantageous to ARC if they planned to expand the purpose of this map to include all of their disaster relief work across the United States, from wildfires to floods to hurricanes. All Mapbox products begin with a free tier that would allow ARC to explore the potential of web maps for branding and communicating their work. Beyond free use, Mapbox scales the price of usage based on volume of traffic to a site meaning that the price would increase the more the map is shared and viewed. Despite the cost, Mapbox understands the impact of their platform and exercises generosity with partner organizations.

The Javascript used to build the web map makes use of a Mapbox Impact tool called **Sheet Mapper**, which utilizes the set of functions within **csv2geojson** to parse a Google Sheet or CSV file to derive a GeoJSON FeatureCollection object for use in a web map. The workflow makes use of latitude and longitude fields in the rows of a Google Sheet or CSV file to generate spatial data. Sheet Mapper is a blueprint for organizations that would like to map data from a CSV or Google Sheet to display shelters, events, offices, and more, and was chosen specifically for this reason. As a large non-governmental organization focused on on-the-ground work and direct assistance, ARC may not have the technical capacity for more complex spatial data collection beyond the creation of a spreadsheet. Furthermore, the use of a Google Sheet to generate and manage this data means that the data can be shared within the organization and widely contributed to.

The last tool the product makes use of is the **JQuery JavaScript library** which adds functionality and interactiveity to the map through pop-ups. This way when a user clicks on a hurricane point, they receive information about the particular work ARC conducted in the area in response to the disaster. The addition of the pop-up further allows ARC to add a link to their page with more in depth information about their disaster response and relief work. This channels traffic toward the ARC site, where the public may be more inclined to donate after seeing a demonstration of what their money would go toward.

The intention of this prototype is display where ARC is working on **hurricane relief projects** throughout the United States in a manner that emphasizes the priorities of the organization - namely, helping as many individuals as possible through disaster relief. By displaying information about amount of people help, dollars raised and spent, and relief items distributed, the maps turns data collected by the organization into a short blurb for the public to explore and consume. In this manner, the web map converts internal organizational data into simple point data with corresponding pop-ups for use by donors, decisionmakers, and the public. The overall benefit of these tools working in tandem is that once set up, ARC need only edit the Google Sheet with new data as they generate and receive it in order to update the map. Instead of having to create a new GeoJSON file every time more data points are added, Sheet Mapper performs the critical step of generating spatial data with little trouble and maintenance needed. Drawbacks include difficulty in changing the structure or function of the web map without knowledge of HTML, CSS, or JavaScript as well as the need to pay Mapbox for widespread sharing and viewing of the map.

The data is sourced from the American Red Cross's **Hurricane Relief** website under the heading Recent Hurricane and Typhoon Relief Efforts. In this section of the webpage, there are links to pages with information about the assistance ARC has provided in the wake of a particular hurricane. Linked out from these pages are PDF documents giving long-term updates (six months, one year, or two years typically) that include numbers of people helped and resources distributed. These documents were manually searched for information regarding meals and snacks served, relief items distributed, overnight shelter stays provided, households given financial assistance, and amount of overall financial assistance given to affected households. These data were collected in **this Google Sheet**, that links to the above web map. The data can additionally be found viewed and downloaded from GitHub **here**.

While the data are real, their collection into this Google Sheet was performed specifically to demonstrate how this information can be used with spatial data to increase transparency for the organization. The GeoJSON generated from the Google Sheet using csv2geojson is a file with point data of where each hurricane first made landfall in the United States. To properly realize the prototype, ARC employees would need to input the name and year of the hurricane as well as the latitude and longitude. The location in plain English, link to the ARC site, and additional information are used to build the pop-up. The layout of the spreadsheet is meant to be as simple as possible, so that users could easily enter new data points as well as their corresponding features. It is clear that ARC tracks and maintains information on its disaster relief for reporting purposes; this tool would be a way to collate and repurpose this information. The advantages of using a Google Sheet are primarily the ease of use and conversion into a GeoJSON. The limitations lie in the inability for point data to capture the swath of area

affected by a hurricane, especially when a relief response must span all the way from the Caribbean to the United States.

<u>*Product 3*</u>

This prototype was created using ArcGIS Online Story Maps. We chose to utilize this format to "tell a story" about where the ARC is working and what they are doing because it allows for interactive web maps to be integrated into a narrative format, as well as different forms of media. In creating the web maps for this product, a hurricane track dataset (lines) created by NOAA was added through ArcOnline's Living Atlas, which is a collection of ready-to-use geographic datasets provided by ESRI. This dataset was utilized in the first map, depicting the spatial distribution, frequency, and severity of hurricanes in 1950 and 2020, visualized using a swipe-map format for easy comparison. The hurricane tracks were also used in the second map to highlight the hurricanes of interest in the narrative- Laura, Sally, and Delta. The third spatial element within this product is in the form of a map tour. This allows for a chronological depiction of the hurricanes, the location of their landfalls, and where the ARC was stationed (point data). Map tours also have a panel for media, where interviews and news stories about each storm and the ARC involvement are provided. The scrolling text panel also allows for key information to be highlighted with each new location within the map tour.

There are many advantages to using ArcGIS Story Maps for narrative geospatial products. First of all, they are highly customizable; essentially all elements of the map symbology and web page design can be altered by the user. For the purposes of this story map, a customized theme was created for the story map page in order to incorporate the ARC color scheme. Furthermore, the interface for creating story maps is very user friendly and intuitive. There are some disadvantages to using this story map platform. First of all, an ArcOnline account is required to make a product, which does cost money unless provided through an institution. Furthermore, a point system is used in order to perform certain geospatial techniques or use certain datasets, which is tied to the level of account you purchase. Lastly, ArcOnline does not have all of the capabilities of ArcGIS Desktop, which limits the level of geospatial analysis the user can utilize. In general, it is a strong tool for walking through a narrative with map and media elements, however it is not the most accessible option.

<u>*Product 4*</u>

Surveys are a valuable tool for disaster mitigation, response, and recovery. A survey with spatial features can be particularly helpful for the American Red Cross. By introducing this geographic element, decision-makers can better understand where there is the most need and administer aid more efficiently. ArcGIS Survey 123 is a relatively easy way to create surveys for the general public and for mobile data collection. More information on the application can be found <u>here</u> These surveys can be crafted for different audience

levels. The interface is very user-friendly, which can also help create surveys quickly for faster response times to disasters. These surveys can also be embedded within an already existing website or be sent out directly using a simple link.

There is also a spatial data collection aspect of this application, which can be applied to data collection by ARC team members. Because Survey 123 is associated with ArcGIS, data can be easily viewed within other ESRI software. In the sample survey below, you can see that you can drop pins to collect spatial data. For even more spatial data collection options, a **GeoForm**, another ESRI tool, could also be used.

Below is a sample survey created using Survey 123, showing some of the features that are available and giving examples of how the questions could be used by both internal data collection and surveys for the general public.

Summary
The four products featured on this web page present a few potential ways to employ web mapping applications for the improvement of the American Red Cross's disaster mitigation, response, and recovery work across the United States.

Product 1 presented an ArcGIS Online web application that displayed publicly-available data in a clear way. This product not only is a useful tool for presenting spatial data, but it communicates the importance of climate change in natural disaster preparedness and response. This is an incredibly versatile tool, with lots of different options available for different presentation styles, options to interact and filter the data, and many different widgets to visualize the information in new ways like charts, graphs, and pop-ups.

Product 2 uses a different web mapping tool, Mapbox GL JS, to present a possible tool for coordination during a project. The ARC can use a web map like this to track current projects, in this case hurricane relief projects. The value of using a product like this is that it is both a clear, visual way of sharing information across a team or network, and it is easy to collaborate. This means that a map like this can be continuously updated by team members using the Google Sheet. Using a service like Github to share and host the code can further the ease of updating the map and staying on top of current projects.

Product 3 uses a ArcGIS StoryMap to tell a clear story about one of the ARC projects. Another amazing tool from ESRI that allows a client to design and tell their own stories. The options to incorporate your own branding, include spatial data, videos, images, and much more provide ample opportunity for the ARC to share the great work that has been done across the nation.

Product 4 uses another ESRI product, Survey123 to show how versatile surveys can be. This product includes a sample survey to give the client a taste of possible routes the survey could take. Surveys can help an organization gather valuable information from the public or gather data in the field.

Furthermore, this website is itself another example of an open-source option for sharing and displaying information. The site was created using Github Pages, which can be an easy way to bring together a website quickly to share information before, during, and after a disaster.

These four products are all just examples of the many ways that web mapping tools can be employed within the American Red Cross. This team focused on how climate change and the ARC's disaster mitigation efforts are linked, using these products to tell the story in a visual medium. However, these tools can be applied to any number of projects or goals. We encourage the American Red Cross to consider web mapping and the products highlighted on this site for better coordination, management, and visualization of their projects.