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ECNS 460

Final Analysis for a Product - Shiny App for Florida Storms

Goal

As our challenge, we chose to create a shiny app that tracks storms in Florida. We chose this topic as Hurricane Milton had devastated Florida recently. We set out to develop an app that enables users to easily access instances of hurricanes within Florida counties. We developed the app using the Shiny App package in R. This allowed us to utilize other R functions to develop the features within the Shiny App to create a user friendly experience.

Intended Audience

One of the most important factors in choosing where to live, open a business, or continue to live is safety and security. Extreme weather events pose significant risk to homes and businesses. Therefore understanding the risk of these extreme weather events is key to making informed decisions for potential homebuyers, homeowners, and business owners. This app could be a valuable tool for three groups to assess the risk associated with extreme weather events. Given Florida is a state with a large population and experiences the most hurricanes in the US, we made this product specific to the Florida market.

Why this Product Matters

According to the National Climate Agency intensity of storms in the North Atlantic is increasing (Walsh). The intensity of storms play a massive role in the damage a storm inflicts upon the affected area. With the increasing intensity of storms, homebuyers, homeowners, and other stakeholders in areas vulnerable to extreme weather events are deeply concerned about the risks these events pose to their property, safety, and way of life. For the average person, interpreting complex climate models and forecasts can be difficult to realize in a real world context. An easier way to understand the risk associated with extreme weather events is to understand the history of these events within the area you are interested in. However, combing through articles and data about an area's history of extreme weather events can be a time consuming task. Our app streamlines this process to allow for its users to be able to simply select their county in

Florida and view the history of these extreme weather events since 2000. This app will allow for these groups to make informed decisions regarding where to live or whether measures should be taken to mitigate risk associated with extreme weather events.

Methods and Scientific Choices

The main data source used to build our Shiny App is weather station data from the National Oceanic and Atmospheric Administration (NOAA). This dataset included many variables giving characteristics of the storm at the observation, the longitude and latitude, date, and time of the storm. The second data source utilized was a spatial data set of Florida counties. This source was used to categorize the storm observations into Florida counties. The NOAA dataset was very messy when initially downloaded. The data cleaning process consisted of separating variables that were combined, renaming variables into tidy format, removing unnecessary characters within observations, and removing variables that were relating to storm characteristics that the everyday person would not be able to interpret. The storm names were also not attached to each observation, instead a row would consist of NA values except for storm name and storm type, all rows following this observation would be of said storm. To fix this we used the fill function to add the storm name and storm type to the rows containing data giving characteristics of the storm. The visualization process that was pertinent to our project consisted of utilizing the tmap package to visualize Florida counties, storm observations and storm paths; Figure 1 shows Florida counties, Figure 2 shows Florida counties with storm observations and their wind speed overlaid, and Figure 3 shows Florida counties with a generated storm path overlaid. Figures 1 and 2 have data for 2000 to 2024, and Figure 3 is specific to 2020 to 2024, as the figure became too congested when considering more years.

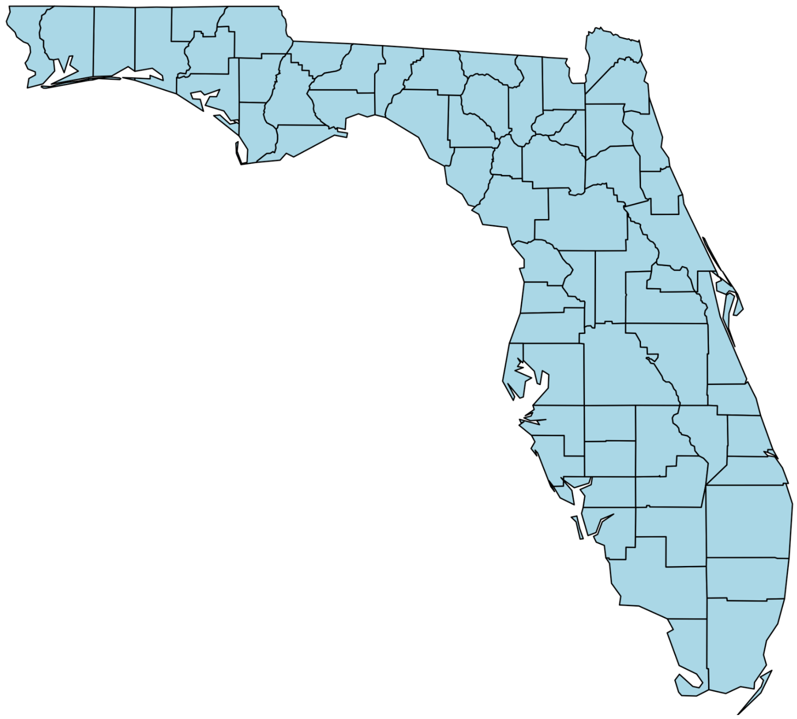

Figure 1: Map of Florida Counties

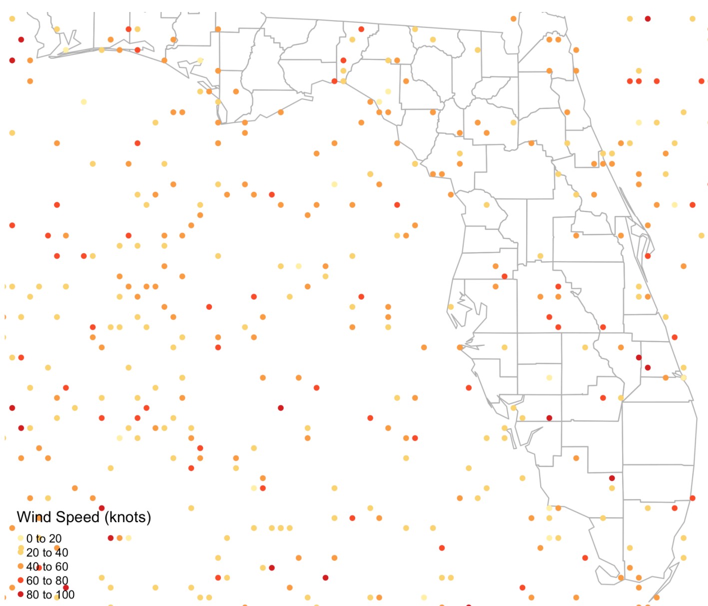

Figure 2: Map of Florida Counties with Storm Observations Overlaid, Color Gradient Represents Wind Speed(Knots).

Figure 3: Florida Counties with Generated Storm Paths Overlaid

Given that we have not worked with Shiny App in class, it took a little research to understand its functionality and syntax. From our research, we found that you must create a user interface (ui) and a server function. First, the ui is what the customer interacts with. In our case, it is where the user selects what Florida County they would like to look at. The ui is also where the layout of the app is constructed. We opted to have the customer interact on the left side of the page, and have the results populate on the right side of the page. Creating the server function turned out to be significantly more complex than creating the ui. To create this function, we had to specify inputs and the outputs. The outputs in our case were a map, a data table, and a text field, all of which were to be based on the user input county. The map was rendered using tmap, and it visually highlights the selected county and plots the storm location as red bubbles. Simultaneously, the data table is created using the DT package. This table shows the information about the filtered storms. If there were no recorded hurricanes in the input county, the table displays a text message indicating this. We also chose to utilize the renderUI function to display a link to hurricane damage mitigation resources if the input county has had hurricanes. This is meant to encourage those in affected counties to explore protective strategies. Overall, the server function serves to ensure outputs are generated dynamically for the selected county.

Final Product

We created a Shiny App that allows the user to select a county in Florida and the app provides storm observations in the selected county since 2000. It is important to note that only recorded observations are displayed, i.e. if a storm passed through a county, but a weather station did not record an observation, it will not display in the app. Also, if a storm was recorded over the ocean, it was not in a county, so it will not be displayed. This is a potential gap, but we can only rely on the data that was recorded at the weather stations. When a county is selected, the storm names, the observation date, the observation time, the wind speed at the time of observation, the pressure at the time of observation, and the storm type (hurricane, tropical storm, tropical depression, etc.), and a link to a FEMA site for potential ways to mitigate hurricane damage to homes is displayed. The storm observation sites can be seen as red dots displayed on the map. An example of this can be seen in Figure 4. There are some counties where there were no storm observations, and in these cases, the map of Florida with the county highlighted is the only thing displayed. An example of this can be found in Figure 5.

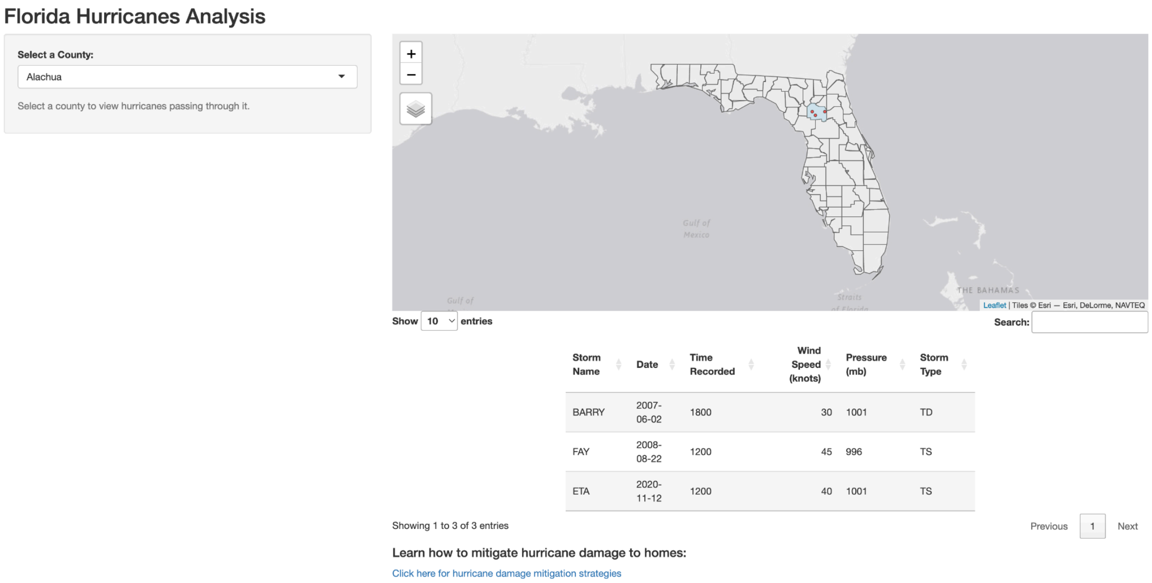

Figure 4: Storms displayed for Alachua County, Florida.

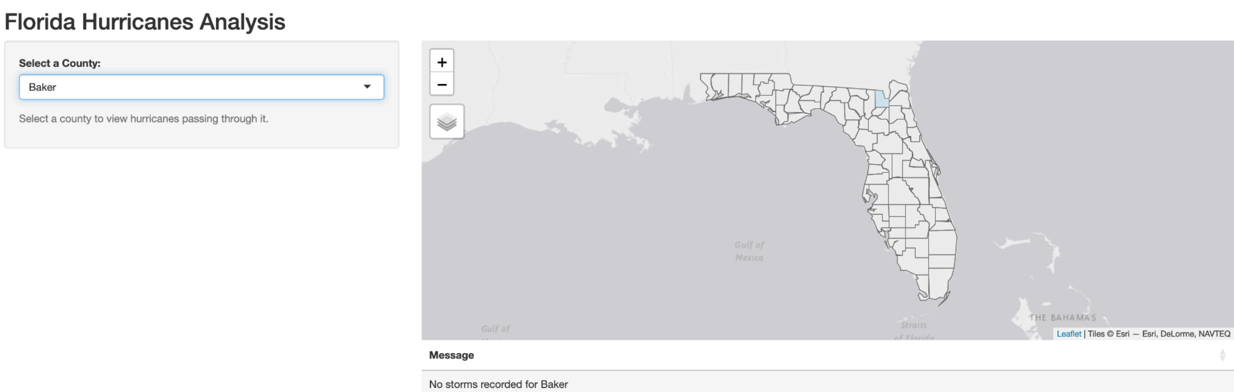

Figure 5: An example where there were no recorded storms: Baker County, Florida.

Conclusion

To conclude, we created a Shiny App to look at storms by county since 2000 in Florida. This app can be used for people in Florida, or anyone interested in moving to Florida. The app allows the user to select what county they want to observe. There are some limitations, as some storm observations were made when the storm was over the ocean - so these observations will not be displayed as they are not in a county. Another limitation is that a storm may go through a county without there being an observation recorded, such as can be seen in Figure 3. The challenge we accomplished was building a Shiny App, and we utilized many of the tools from this semester to get to the end result, such as data cleaning, tidying data, and data visualization. A short term improvement we could make would be to include information on damages inflicted by these storms through the renderUI function. A larger scale improvement may consist of including easily interpretable climate forecasts to enhance the users understanding of the risks posed by extreme weather events. Another large scale improvement would be to obtain more specific spatial data. This could include flood zones, storm surge susceptible areas, and community infrastructure designed to mitigate damages from storms.

AI Disclosure

We did use ChatGPT at points during our product creation. We attempted to code everything on our own in R, but we ran into multiple errors along the way. We utilized ChatGPT to understand what these errors meant, and we also used it to help solve and navigate the errors we encountered. We encountered some errors during the visualization stage (graph and plot creation), but the majority of the use of AI was to navigate errors when creating the Shiny App. Specifically, we used it most when running into errors during the server function creation.

Sources

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