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INFO 4310 - Interactive Information Visualization
16 May 2024

Final Project: "An Out-of-Bounds Anomaly"

https://tammyzhang-1.github.io/hurricanes/

Project Goals, Motivation, and Intended Audience/Use Cases

For our project, we chose to create an interactive news-style data visualization about the 2024 hurricane season and the factors contributing to what will likely be a record-breaking year in both hurricane frequency and intensity. The goal is to be informative and educational through written narrative and data visualization.

Our article focuses on the impact of rising ocean temperatures and La Niña on hurricane development through a scrollable storytelling visualization article, focused on informing/educating through written narrative and data visualizations that emphasize and animate change over time. We incorporated key features of scrollytelling and narrative journalism, taking inspiration from online news outlets such as the New York Times.

We were motivated by our existing knowledge and concern regarding the rapid intensification of severe weather, and were particularly inspired after seeing a NYT article released this past April on hurricane forecasts being exceptional for this year. We were interested in illustrating some of the information in this article, which currently has only a couple of static visualizations, interactively.

The intended audience includes coastal populations of North and Central America that may not have extensive knowledge about meteorology or the increasing impact of climate change on hurricane intensification within their region. We aim for this article to be widely consumable by a large population, inviting to novices through images and visualizations, and supported with straightforward and convincing text/callouts. We imagine this article to be easily shareable and accessible, perhaps being used as a catalyst of discussion on social media platforms or within everyday conversations.

Data

Specific datasets of interest include a National Hurricane Center (NHC) summary report of the annual count of hurricanes, major hurricanes, and named tropical storms in the Atlantic basin, as well as sea surface temperature anomalies (1854-2024) as reconstructed by the National Oceanic and Atmospheric Administration. Oceanic Niño Index (ONI) data from 1950 onwards was acquired from the National Weather Service (NWS) Climate Prediction Center (CPC) and we used intensity categorizations provided

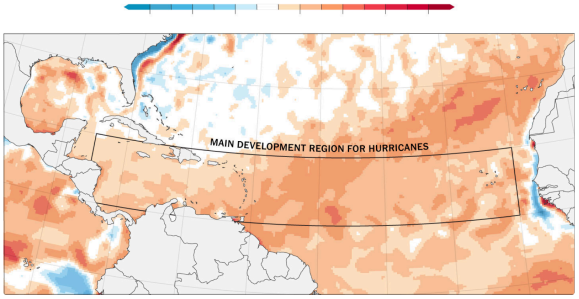
by Jan Null, CCM of Golden Gate Weather Services. Basic country shapefiles were provided by Natural Earth.

The NHC summary report of storm counts was converted to a CSV through a third-party CSV-PDF converter, and the ONI data was manually converted to a CSV. The sea surface temperature data was requested using a wget command to fetch all monthly datasets in NetCDF format, then aggregated, averaged by decade, and cropped to the region of interest using Python's xarray library. A Python script was then run to convert this data into GeoJSON format. Finally, the software QGIS was used to crop Natural Earth's country shapefile to the region of interest, and Mapshaper was used to simplify the resulting GeoJSON as well as convert to TopoJSON.

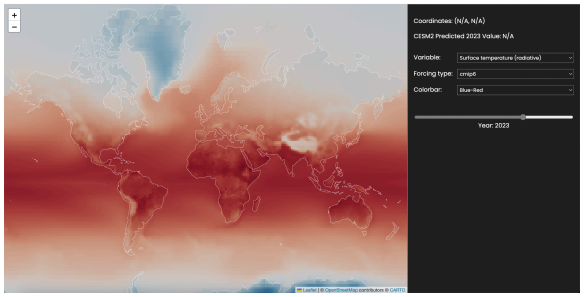
Design Inspirations

Ocean Temperature Visualization:

We aimed to create an animated (through ticks and scrolling) ocean temperature map similar to the following:



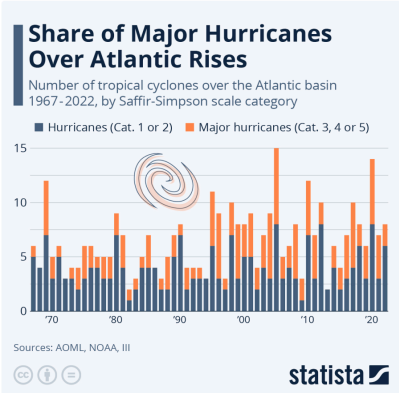
A screenshot of a static NYT visualization



A past personal project using Flask to make a slider for global temperature over time

Tropical Storm/Hurricane Frequency Visualization:

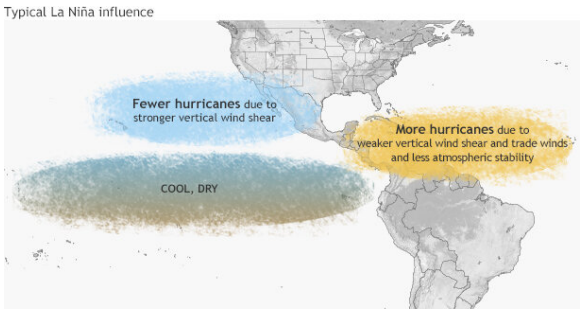
We aimed to create a stacked bar chart that could illustrate the increase of hurricane frequency over time (and in correspondence to rising sea temperatures).



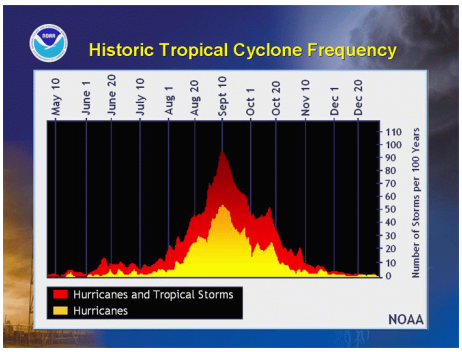
Stacked bar chart from Statista article

La Niña Impact Visualization:

In our narrative, we want to explain La Niña, including what it is and how it impacts the hurricane season, as we assume our audience may not be familiar with the impact of this weather phenomena.



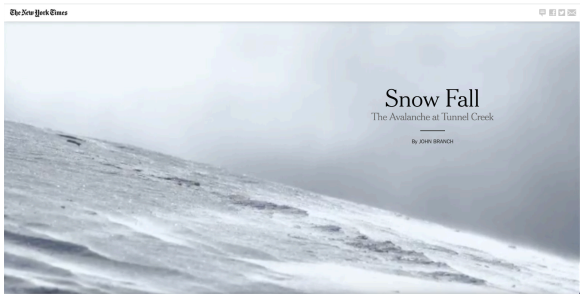
Graphic from [NOAA educational article]



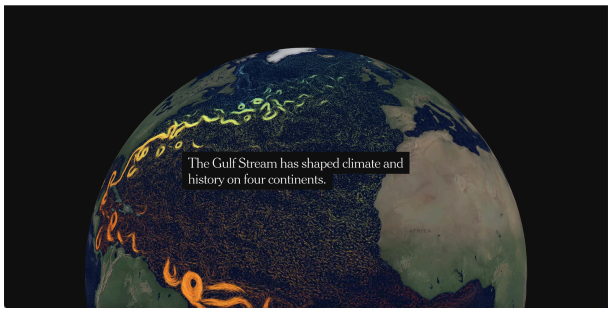
We originally considered creating a layered area chart to compare storm frequency during La Niña vs. El Niño for the east coast, similar to this [NOAA visualization].

Scrolling as Interactivity:

Our project took significant design inspiration from journalistic articles that use scrolling as the main mode of interactivity, guiding an audience through data to tell a story.



[Snow Fall], a Pulitzer Prize-winning article considered one of the web's first "scrollytelling" examples and which [changed NYT's approach to storytelling]



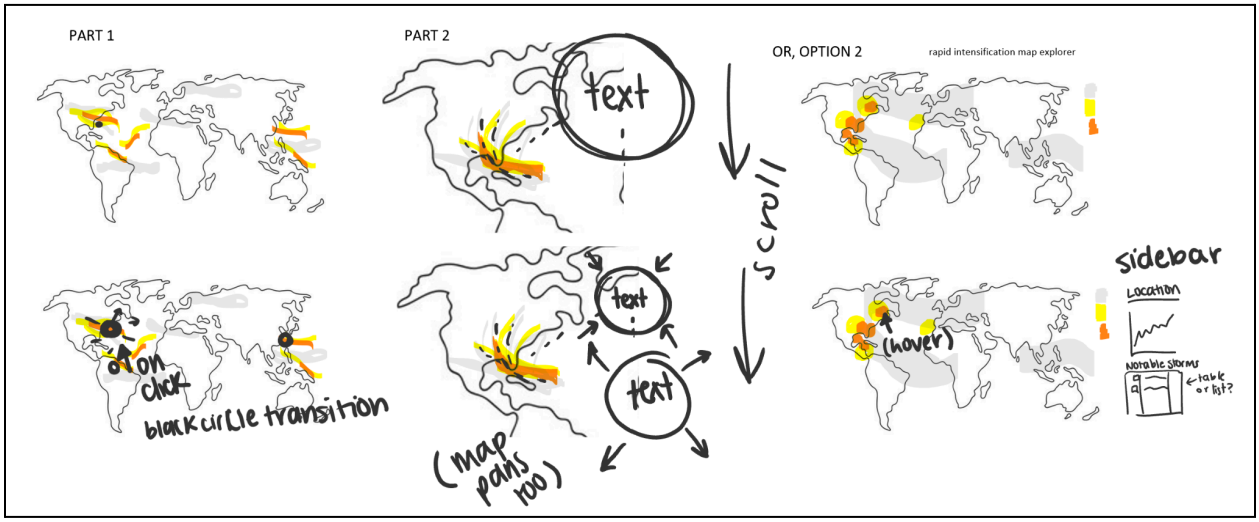
[NYT article] showing scrollable text boxes on top of a geospatial visualization

Design Iterations

Early Sketches:

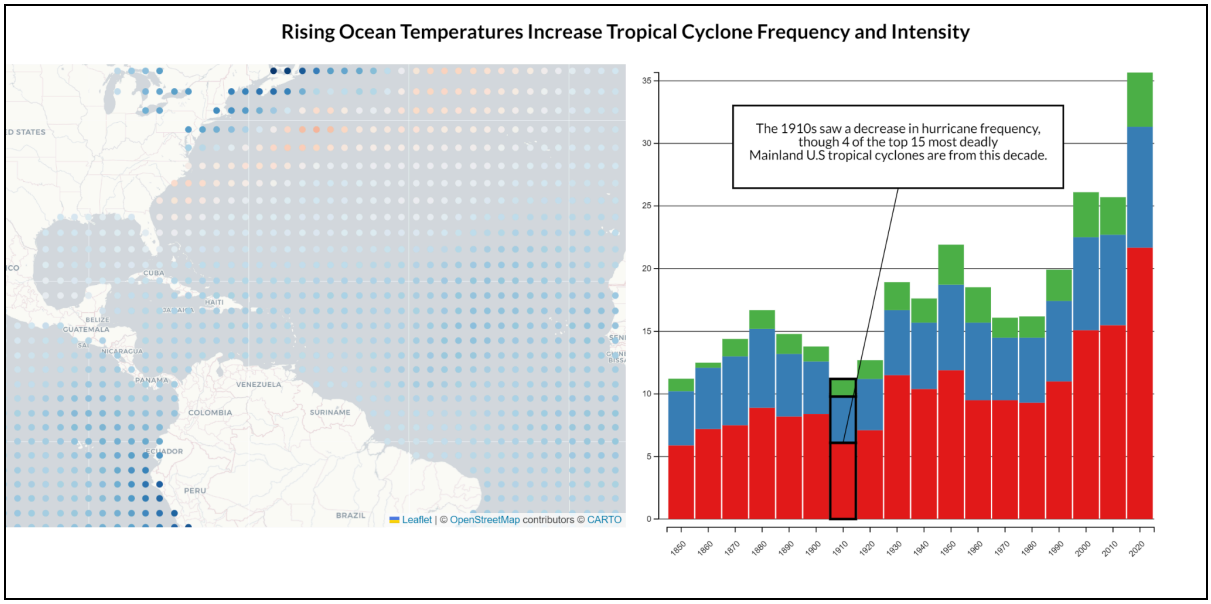
During early brainstorming of this project, we considered highlighting locations with predicted rapid intensification of impacts from tropical cyclones, and allowing the user to explore specific historic hurricanes and their impacts.

In the below sketches, we considered how the map could zoom and display supporting on-click through animated text bubbles. We also considered an interactive map with points that could be hovered over and explored on demand:

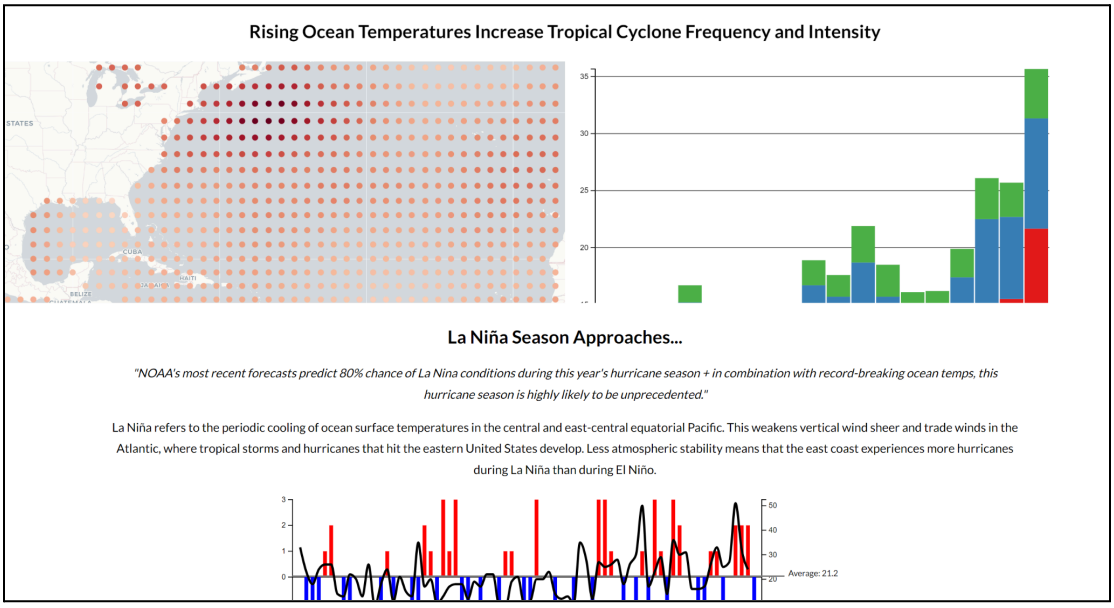


After this point, we created a better idea of our narrative (with a focus on ocean temperatures and La Niña). Below are several iterations of our visualizations that changed during the coding process.

Iteration 1: Our first iteration, shown on 5/6 demo day, showed our prototype ocean temperature map (with circles) and stacked bar chart side by side. Scrolling still functioned as our interaction that ticked both the map and outlined bar of the bar chart, with callout text boxes displayed directly on top of the bar chart. This provided a very clear indication that a callout was being made and had directional lines to direct the reader to the important aspect of the bar chart.

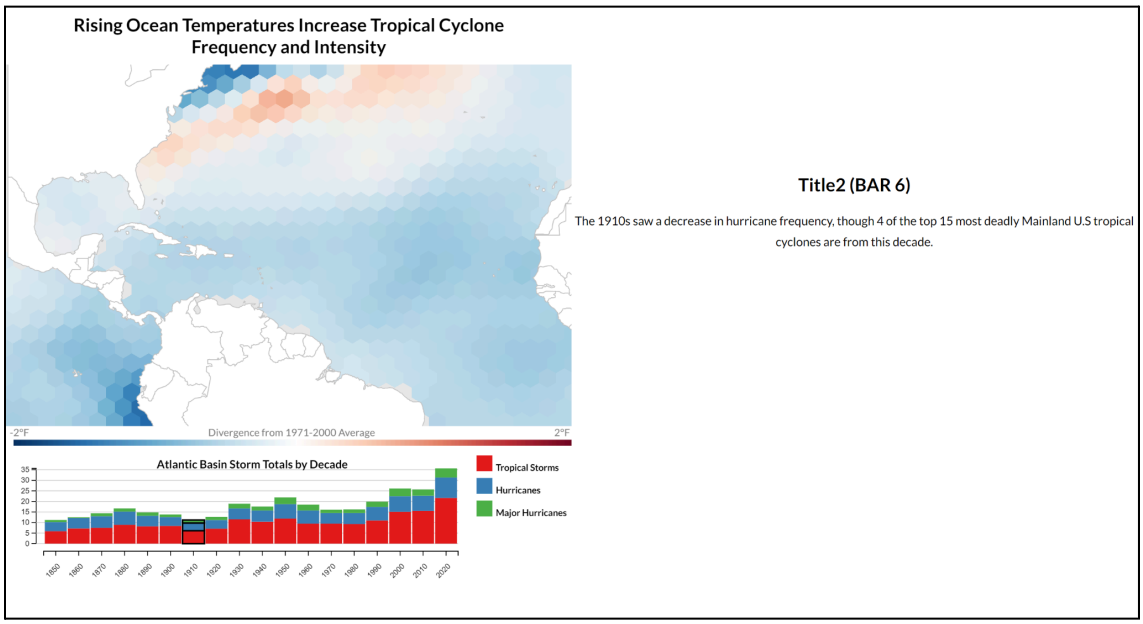


After the user scrolls through the entire timeline of the map and bar chart, scrolling further brings an overlay text that covers the existing visualizations with additional narrative and visualizations.

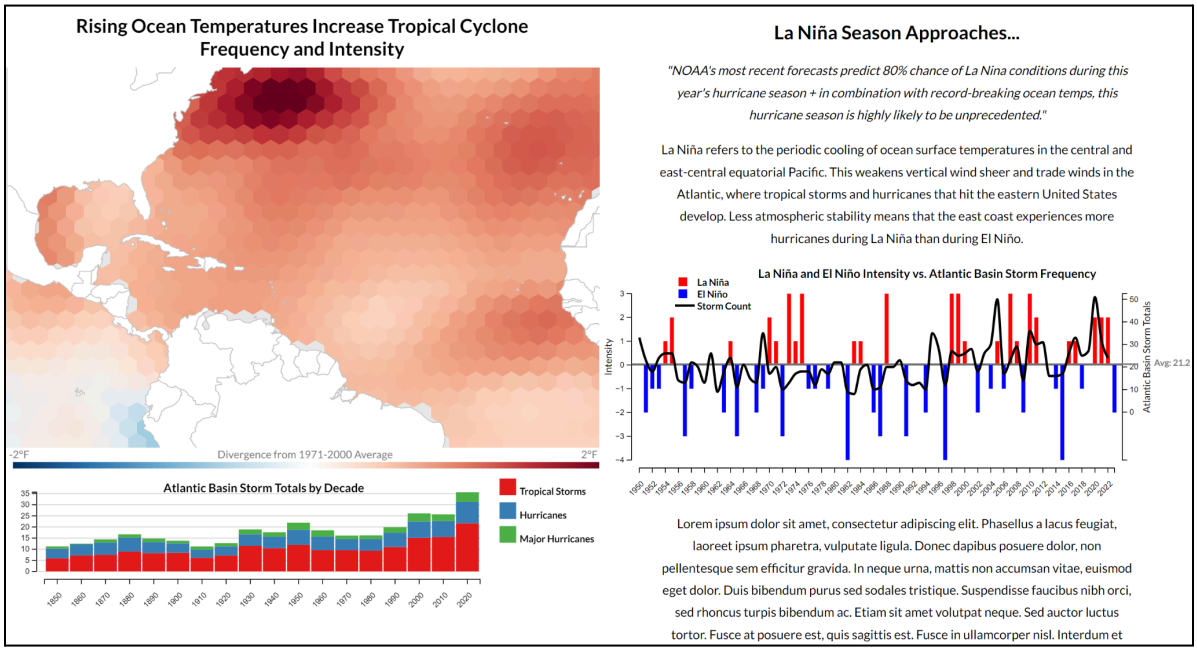


Iteration 2: Our next iteration was to put the map and bar chart on the same side of the screen, allowing for text to scroll exclusively on the right side. This communicated the scrolling-interaction focus of our project more clearly, as previously scrolling was used to tick the visualization's changes, but did not provide any feedback that illustrated the page was scrolling. The text now flies up (and down if reversed) as the user scrolls, and is still synced with the relevant highlighted bars.

At this point we also implemented hexagons (instead of circles) on the map using d3 hexbin and incorporated legends and labels for the bar chart and bar-line chart.



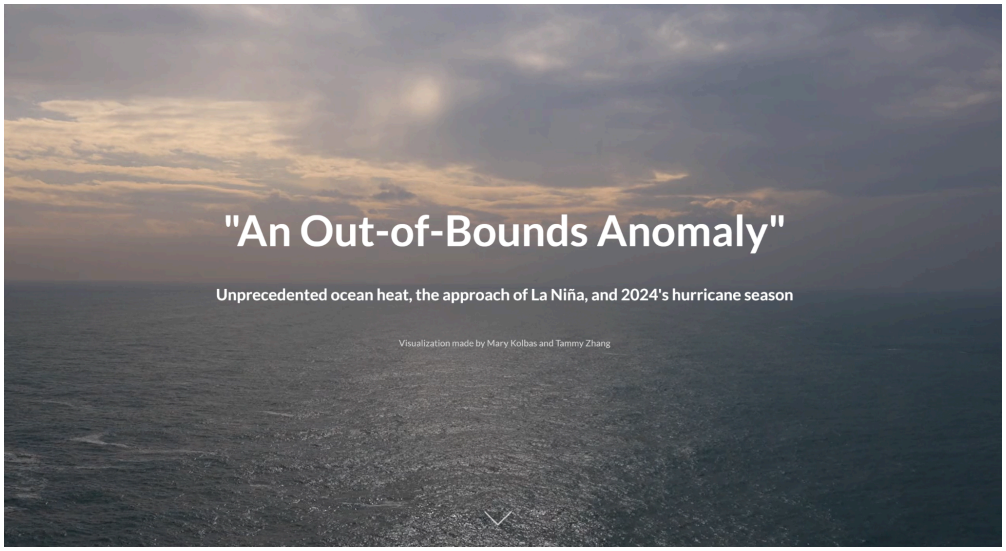
The second section of the narrative about La Niña now follows the text callouts on the right side of the screen and does not cover the existing visualizations.



Final Design

Our final design improves the aesthetics, transitions, and styling of our text and visualizations. This further improves scrollytelling features of our article by resembling more closely the styling of narrative journalism.

Our article now opens with a large hero video, calling back to the header of *Snow Fall*, a groundbreaking scrollable article listed earlier in our sources of inspiration.

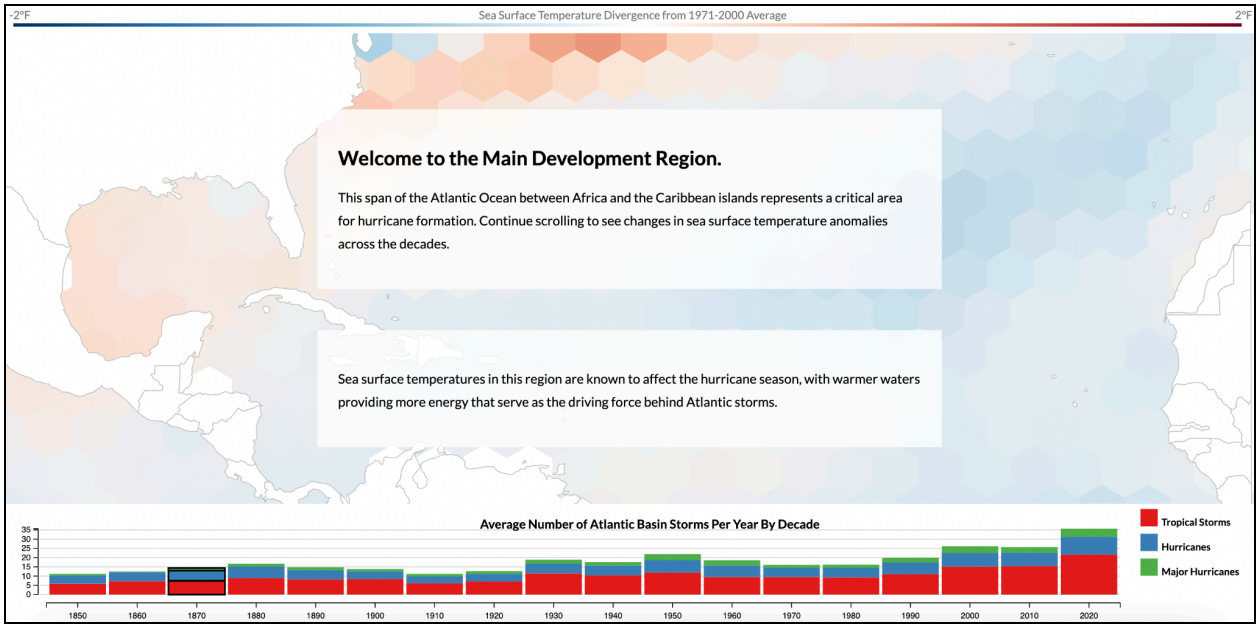


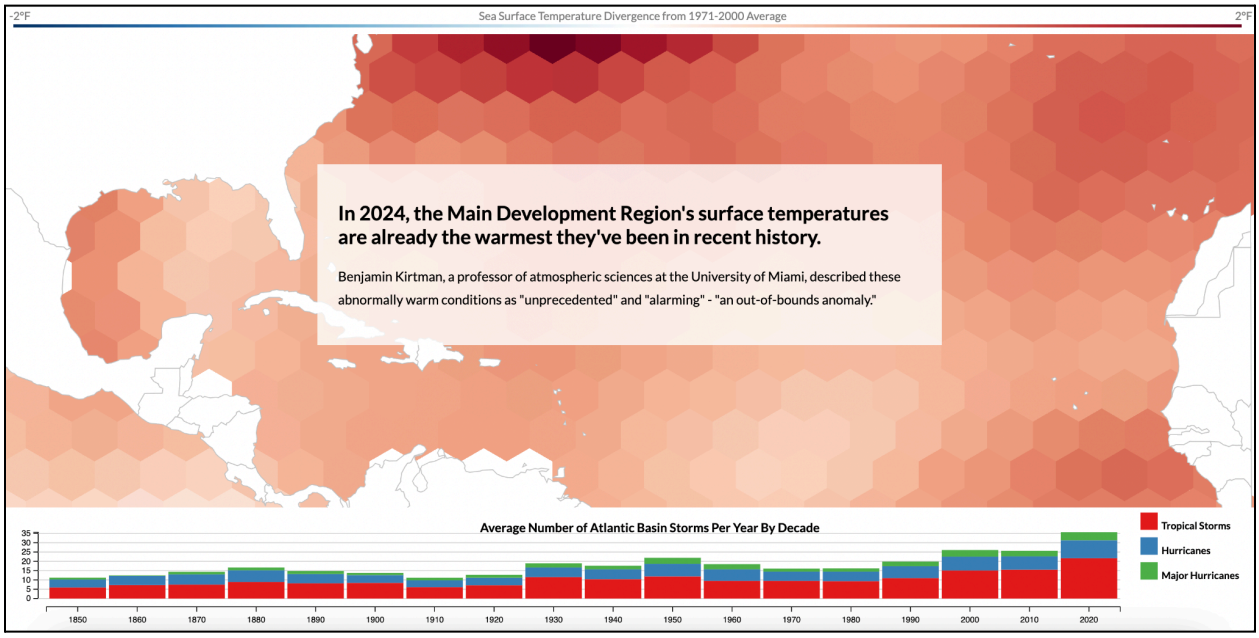
Scrolling down from the video reveals a piece of introductory text; further scrolling fades in our map visualization and initiates the series of scrollable text callouts.

We overlay the text callouts over each other, flying in as the user scrolls in sync with changes in the map and bar chart. This styling choice allows our map to be much larger (now full width/height) and the color changes more dramatic, grabbing the user's attention and setting the scene for such large changes. Like the image on load, part 1 of our visualization encompasses the whole page. All text was changed to be left-aligned since this is the most common practice we observed in journalistic articles online.

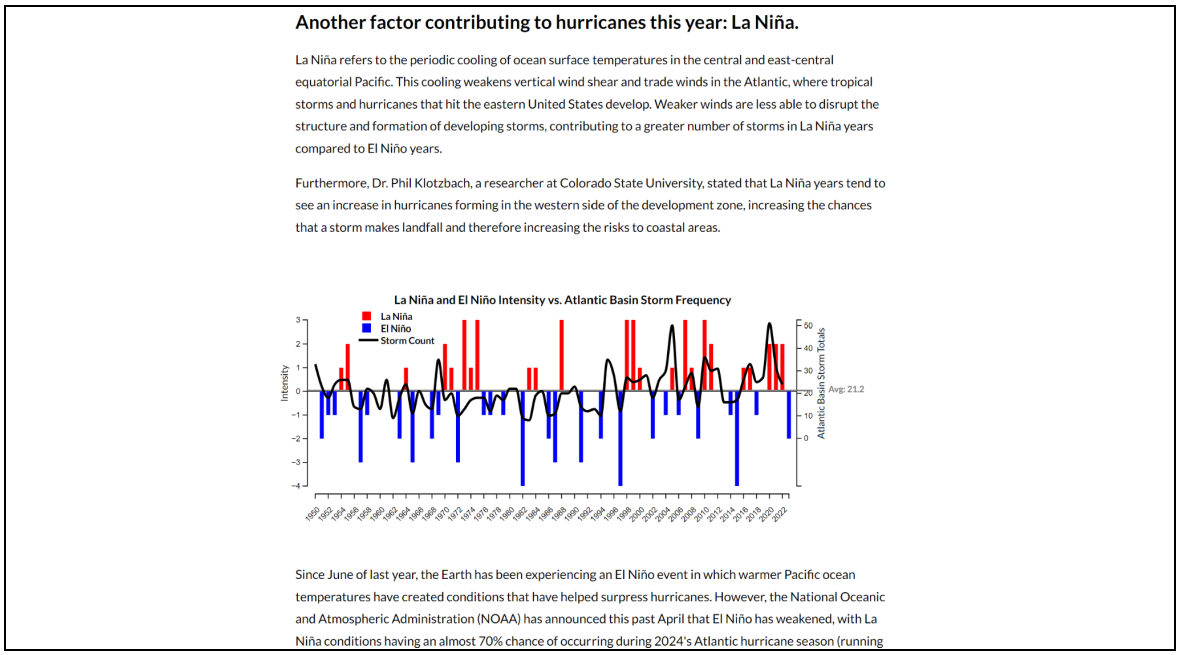
Although the text boxes are translucent and have a fade in and out to avoid blocking the top legend or bar chart as they enter, the text overlay still has tradeoffs, such as covering portions of the map. We believe the dramaticism of the large map and changing colors help support the textual narrative, and the fade in and out of these boxes provides the much-needed seamlessness such that most information is visible.

The visualizations are clear and synced with the text such that the user can stop scrolling and examine the visualizations as supporting evidence of what they are learning about at that point in the article.





In the second half of our article, we transition to a more text-focused, traditional article format. Our bar-line graph provides additional context and acts as supportive evidence for the claims made within the article, giving the reader the autonomy to observe the trends.



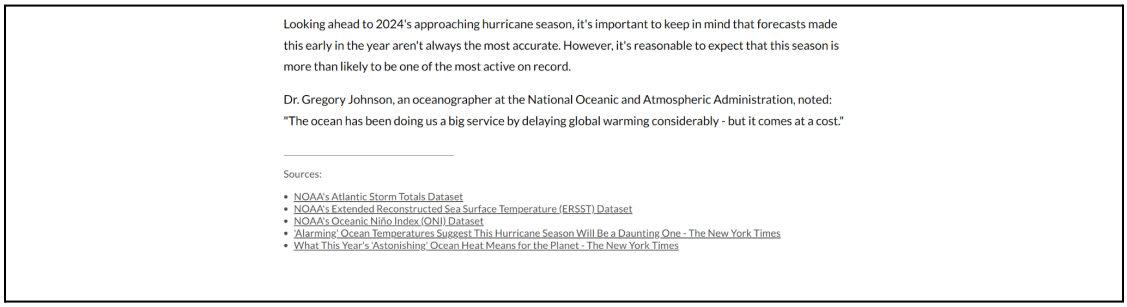
Another factor contributing to hurricanes this year: La Niña.

La Niña refers to the periodic cooling of ocean surface temperatures in the central and east-central equatorial Pacific. This cooling weakens vertical wind shear and trade winds in the Atlantic, where tropical storms and hurricanes that hit the eastern United States develop. Weaker winds are less able to disrupt the structure and formation of developing storms, contributing to a greater number of storms in La Niña years compared to El Niño years.

Furthermore, Dr. Phil Klotzbach, a researcher at Colorado State University, stated that La Niña years tend to see an increase in hurricanes forming in the western side of the development zone, increasing the chances that a storm makes landfall and therefore increasing the risks to coastal areas.

Since June of last year, the Earth has been experiencing an El Niño event in which warmer Pacific ocean temperatures have created conditions that have helped surpress hurricanes. However, the National Oceanic and Atmospheric Administration (NOAA) has announced this past April that El Niño has weakened, with La Niña conditions having an almost 70% chance of occurring during 2024's Atlantic hurricane season (running

Finally, the article ends with a quote and a list of sources, following a common format in online journalistic web pages.



Looking ahead to 2024's approaching hurricane season, it's important to keep in mind that forecasts made this early in the year aren't always the most accurate. However, it's reasonable to expect that this season is more than likely to be one of the most active on record.

Dr. Gregory Johnson, an oceanographer at the National Oceanic and Atmospheric Administration, noted: "The ocean has been doing us a big service by delaying global warming considerably - but it comes at a cost."

Sources:

- NOAA's Atlantic Storm Totals Dataset
- NOAA's Extended Reconstructed Sea Surface Temperature (ERSST) Dataset
- NOAA's Oceanic Niño Index (ONI) Dataset
- 'Alarming' Ocean Temperatures Suggest This Hurricane Season Will Be a Daunting One - The New York Times
- What This Year's 'Astonishing' Ocean Heat Means for the Planet - The New York Times

Contributions

Mary Kolbas: converting NHC and ONI datasets, implementing Atlantic Basin Storm Totals by Decade stacked bar chart, scrolling sync with bar highlights and text annotations, La Niña/El Niño bar-line chart, and final writeup.

Tammy Zhang: acquiring access and preprocessing SST dataset, implementing ocean temperature map with hexagons, syncing ocean temperature map with bar chart ticks, CSS styling and overlaying elements, text/narrative of the article, and final writeup.