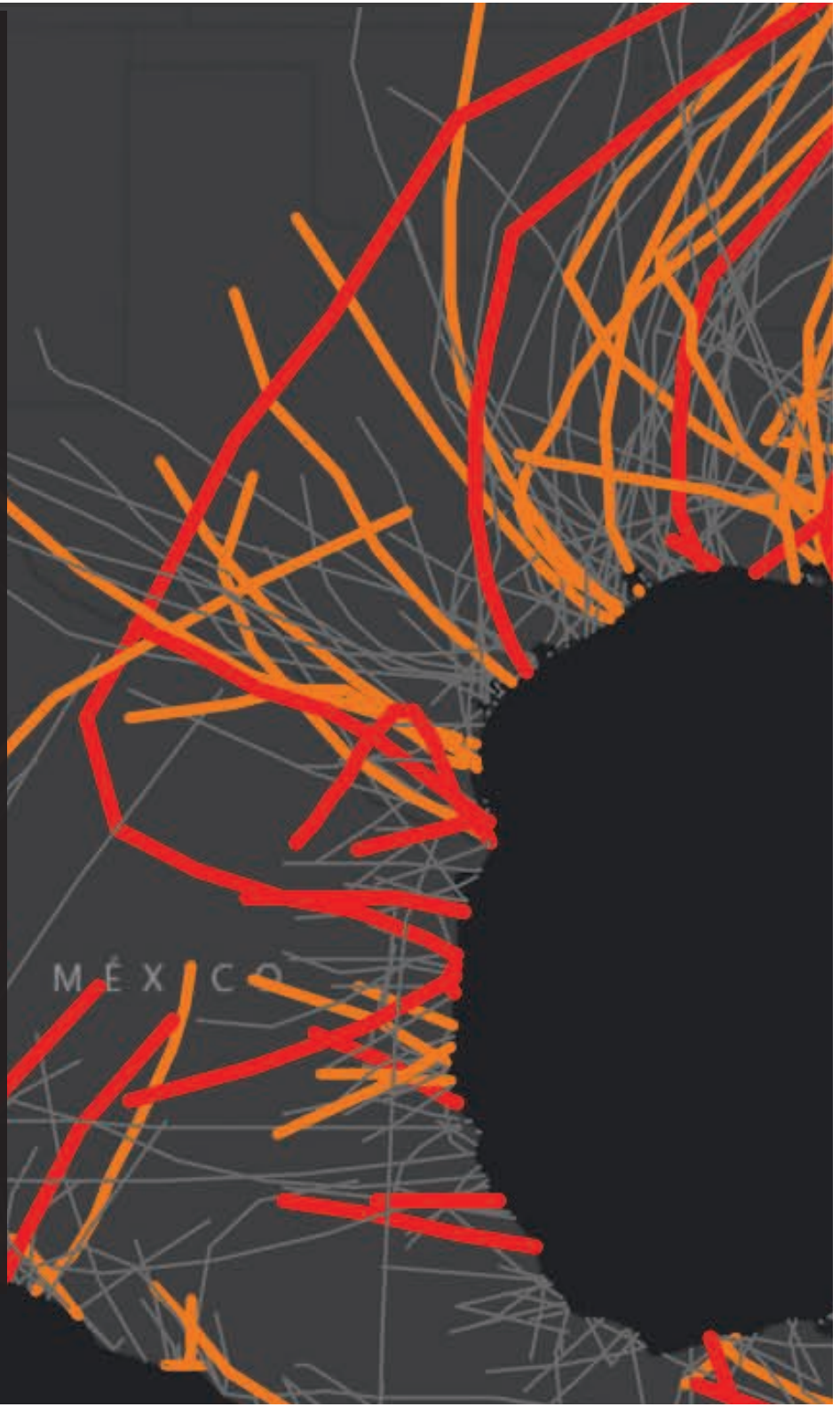
JUPYTER™ NOTEBOOK ANALYSIS

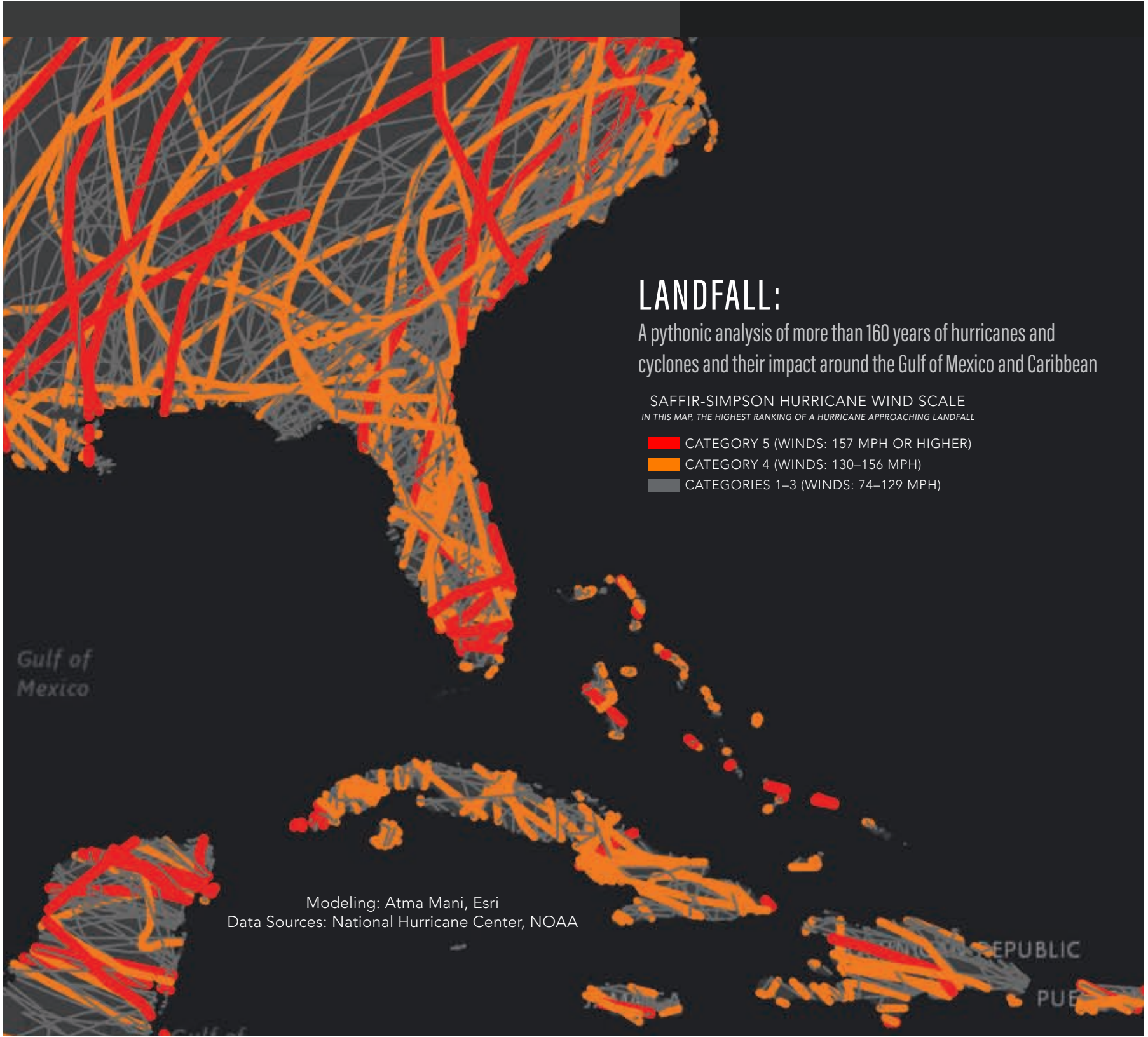
The National Hurricane Center has collected meteorological data about hurricanes and cyclones across this planet from the past 160+ years. Esri recently analyzed this massive collection of datasets based on hurricane severity indicators, such as wind speed, atmospheric pressure, track duration, track length inland, and category over time (seasons). The analysis revealed that the total number of hurricanes is decreasing globally since 1970 across all basins. While the number of hurricanes shows a reducing trend, their severity is increasing, with hurricane wind speed, track duration, and category designation correlating positively and with atmospheric pressure correlating negatively against seasons. The research found a reduction in the number of milder, Category 1 and 2 hurricanes and an increase in the number of severe, Category 4 and 5 hurricanes. This map shows a detail of the worldwide hurricane landfall tracks analysis within the geographic region of the Gulf of Mexico and the Caribbean.

By analyzing the datasets as a time series, Esri observed a sinusoidal seasonality trend indicating that the peaks between hurricane events in the Northern Hemisphere and cyclones in the Southern Hemisphere were offset by about six months, matching the time when summer occurs in these hemispheres. One difference is that hurricanes over the Indian basin occur throughout the year because they are influenced by a monsoon phenomenon.

When Esri overlaid the hurricane tracks over coastlines, the trend showed that most hurricanes make landfall. Once they do, most of them travel less than 100 miles inland. Using spatial density analysis on the landfall locations, Esri found that repeat landfall of hurricanes affects the Atlantic coast along North and South Carolina in the United States, the states of Odisha and West Bengal in India, several areas on China's east coast, the southern tip of Japan, and most of the Philippines. By using GeoEnrichment, the process of adding demographic and lifestyle data to maps, we get a sense of how hurricane landfalls may impact people and places, although more research is needed.

Massive datasets such as the one used in this study don't typically fit within the computational memory of a scientist's laptop or workstation and are quite common in climate studies. To solve a problem of this scale, Esri used distributed and delayed analysis tools with ArcGIS API for Python to wrangle and aggregate the data. The analysis was performed entirely in Python on ArcGIS Notebooks, a hosted Jupyter Notebook environment that provides access to datasets and tools from Esri and many analytical libraries available in the scientific Python ecosystem.




LANDFALL:
A pythonic analysis of more than 160 years of hurricanes and cyclones and their impact around the Gulf of Mexico and Caribbean
SAFFIR-SIMPSON HURRICANE WIND SCALE
IN THIS MAP, THE HIGHEST RANKING OF A HURRICANE APPROACHING LANDFALL
CATEGORY 5 (WINDS: 157 MPH OR HIGHER)
CATEGORY 4 (WINDS: 130–156 MPH)
CATEGORIES 1–3 (WINDS: 74–129 MPH)
Gulf of Mexico
Modeling: Atma Mani, Esri
Data Sources: National Hurricane Center, NOAA