Global Vulnerability to Weather Hazards

Introduction

Climate Change has the potential to amplify the frequency, as well as the destructive potential., of weather hazards. Increasing atmospheric heat and ocean surface temperatures make room for extreme events, and though the number of reported deaths for global weather disasters has steadily declined since roughly 1920, the number of reported disasters has climbed for over a century. There have been drastic improvements in weather data, both in abundance and ability, making it difficult to pinpoint climate change's influence on the matter. In this project, I analyze flood, earthquake, hurricane, and drought data since 1980 to determine the location of populations most vulnerable to weather hazards, as well the areas that are increasingly becoming exposed to them.

Methods

As shown in the "Data Layers" graphic, I created aggregate vulnerability scores based on multiple raster layers. No two data sets come from the same source, thus the information provided varies widely between sets. For hurricanes, I created a density map showing areas that experience events at high-speeds. For flooding, I used severity scores provided in the data table. The earthquake density map is populated with magnitude ratings, and the drought density is populated by count. I tried to factor in social aspects that can contribute to vulnerability as well. I'm more concerned about vulnerable land when there is a high-density of people living on it, so I rasterized a polygon layer with population density by province, reclassified it, and included it in my aggregate raster calculation. Also included was a reclassified raster measuring distance to the nearest road. The three-dimensional layers were created in ArcScene by assigning a raster cell's value to a z-coordinate.

Most of my data sets contained information dating back roughly 40 years, which allowed me to analyze trends over time. I created space time cubes and produced emerging hotspot and local outlier maps for earthquake, drought, flooding, and hurricane events, though the outlier analysis did not

Results

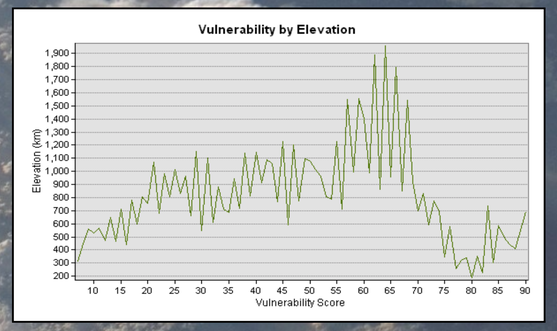
As indicated on the vulnerability score map, Taiwan and Fujian are the most vulnerable provinces in the world based on my methods. This was found by calculating the mean value of raster cells within a province polygon with zonal statistics. The value of the cells correlate to the density of high0force weather events in the area.

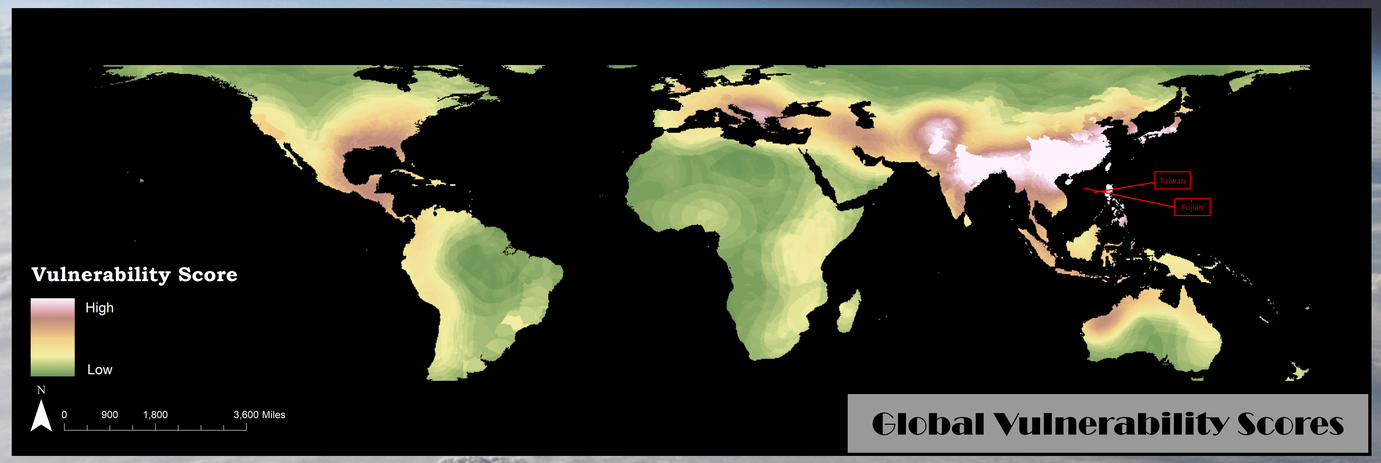
Emerging hotspot analysis indicates areas of weather hazard intensification, with no area in the world experiencing significant declines in exposure to harsh weather. There is a significant increase in flood severity in south and southeastern Asia. Much of India and the surrounding south Asian areas are expectedly consecutive hot spots, however there area a significant number of cells indicating new hot spots along the western coast, and intensifying hot spots along the eastern coast. There is emerging coastal flooding along India and parts of South Africa, the U.S, and areas of drought are emerging around Egypt and Japan.

Using zonal statistics, I found that much of the most vulnerable land is at low elevations, which is logical with flooding severity as one of my raster layers.

Conclusions

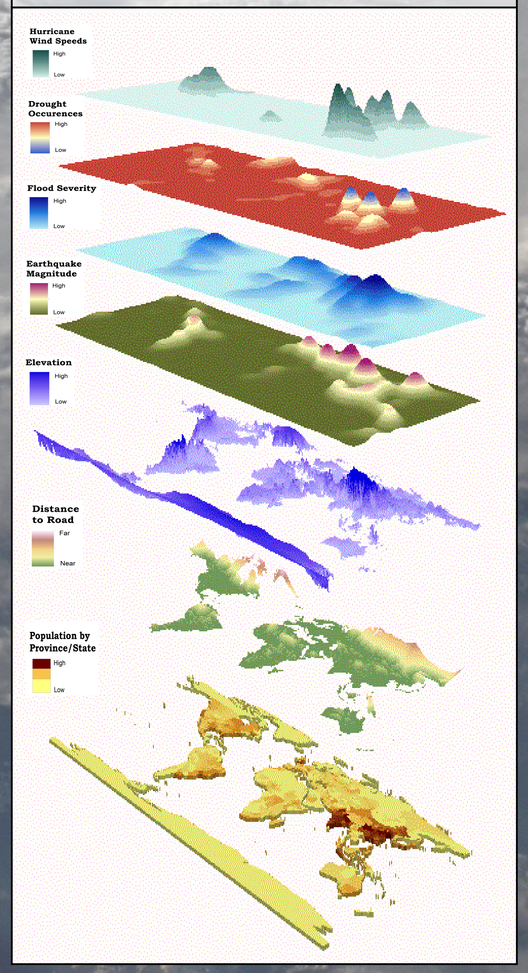
I have not come across a map like the one I made for aggregate vulnerability. Vulnerability is a very difficult thing to measure, particularly at this scale. It is hard to know with certainty if weather hazard intensity is changing, or if its the methodologies used for classifying them that is changing. Nevertheless, what is clear is that some of the most vulnerable land is also the most populated. Much of the land is bordered by ocean, and with low elevations, it will be some of the most severely affected land as sea level rise continues.



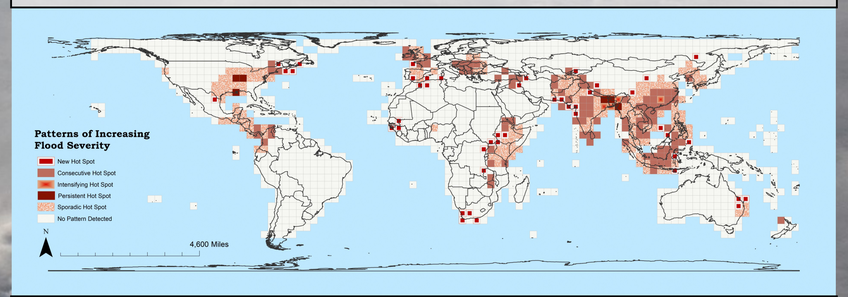


Global Vulnerability Scores

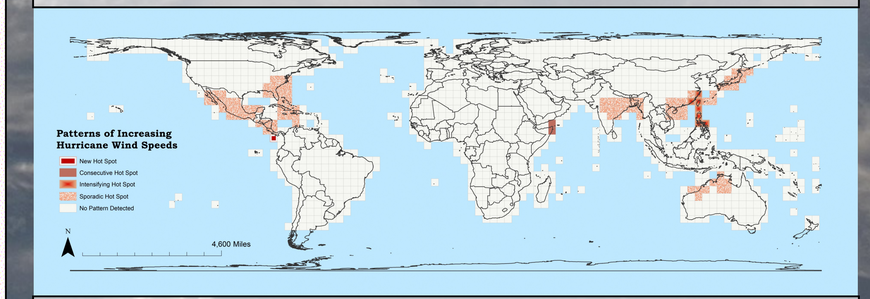
Data Layers



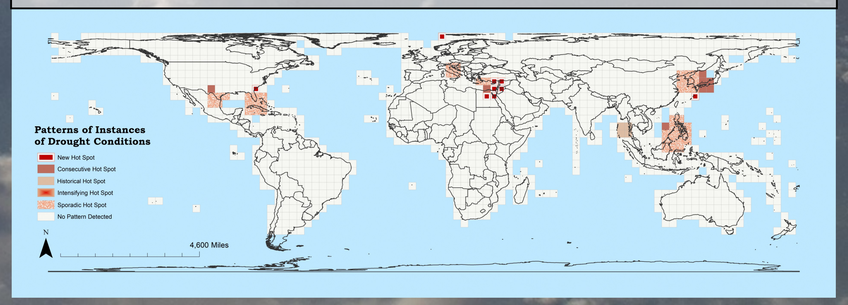
Emerging Hotspots: Increasing Flood Severity



Emerging Hotspots: Increasing Hurricane Wind Speeds



Emerging Hotspots: Drought Conditions



Tufts

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5/7/2019 (Spring Semester)
GIS 102: Advanced GIS
Projection: Cylindrical Equal Area
Coordinate System: GCS_WGS_1984
Data Sources: Dartmouth Flood Observatory, UN Office for the Coordination Of Human Health, NOAA, M: Drive