Introduction

Based on data analyzed from death certificates by the CDC, 8,081 deaths from extreme heat exposure were recorded in the United States from 1999-2010. Within these years, from 2003-2008, Harris County, Texas had the second highest number of heat-related deaths in Texas, with a total of 41 deaths, according to the Texas Department of State Health Services.

For a highly developed urban area with substantial infrastructure, the number of deaths recorded in this time period is alarming. Our research aims to highlight communities more vulnerable to extreme heat and rising temperatures within the highly populated Houston metro area. This project is a multidisciplinary research project, involving students with Meteorology, GIS, Computer Science and Public Health backgrounds.

Methodology

When analyzing meteorological data we used several different indices of heat:

- Humidex Index - developed in Canada, uses temperature in Celsius and dew point in Kelvin to give a number of perceived heat.
- Heat Index - developed in the United States, uses temperature in Fahrenheit and relative humidity to calculate a "feels-like" temperature.

We then used several different sources of data, including observed/reanalysis and climate modeling, to give a wide overview of heat within Harris County during the summer months.

- CMIP6 model output (2015-2020) was used in calculating the Humidex.
  - Temperature was modeled using RCM 8 assumptions.
  - Highest daily temperature was averaged over each month.
  - Assumption made that dewpoint would not vary much over the area, and used one constant point in order to solve resolution errors.

- NARR (North American Regional Reanalysis) & ERA5 (a global reanalysis) data was used in calculating the Heat Index.
  - ERA5 data is averaged at 1000 hPa over each month using hourly data at times 0Z, 6Z, 12Z & 18Z each day.
  - NARR data was averaged at 1000 hPa over each month using average daily temperature and relative humidity.

- Temporal analysis was conducted June-September 2019 to compare the two indices and evaluate the modeled CMIP6 data.

Results

<table>
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<tr>
<th>CMIP6 Average Highest Daily Humidex</th>
<th>CMIP6 Number of days with a Humidex value &gt; 46</th>
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Daymet 1-km Summertime Max Temperature June 1st - Sept 30th 2017-2018

Houston Humidex (CMIP6) and Heat Index (NARR, June - September 2019)

Conclusions & Future Work

Conclusions

- The Humidex shows that throughout the summer, the Houston Metro area consistently reaches values that are associated with "great discomfort".
- The Heat Index values across the Houston Metro area were all above 80 degrees F, providing potentially dangerous conditions continuously.
- Heat Index showed an increase of values from 2009-2019.
- The comparison between modeled Humidex and observed Heat Index showed relatively similar trends throughout June-September 2019.
- Coastal communities tend to experience less heat than urban and rural communities.
- Across all types of modeling, we can see that the most extreme heat days are more likely to be in July and August, as June is consistently cooler.
- Knowing the warmest parts of the city is not enough to determine which communities are most in danger on hot days. Determining other factors such as: whether the area is a residential or commercial area; the age of the people living there; the predominant socioeconomic status of the population; and the general health trends of the area, are vital to accurately perceiving how susceptible people are to extreme heat.

Future Work

- Use ArcGIS to map socioeconomic and health data as well as areas of greenspace and urban sprawl.
- Combine data to create an index that highlights vulnerable communities.
- The ultimate goal is to help inform local authorities and communities so they can be more prepared and knowledgeable about specific concerns they face in their community due to extreme heat.

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