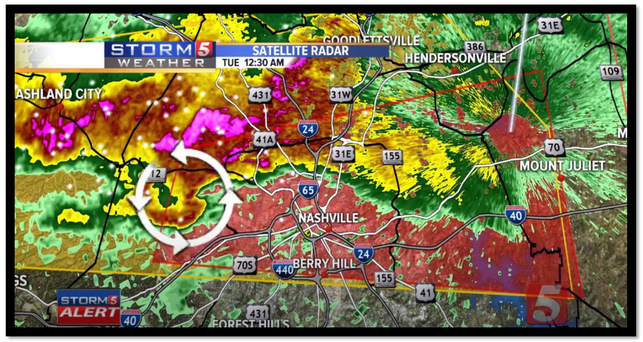
Effects of Urban Environments on Supercell Thunderstorms

Emily Barbini[1], R Chase Green[1], Dr. Chenghao Wang[1,2]

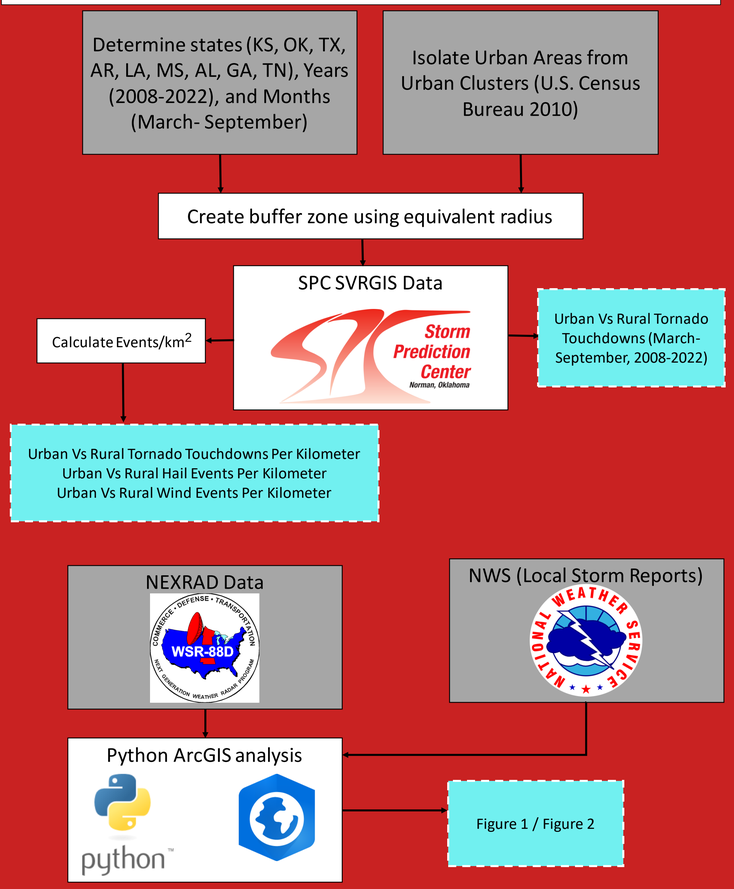
[1]School of Meteorology, The University of Oklahoma; [2]Department of Geography and Environmental Sustainability, The University of Oklahoma

Introduction:



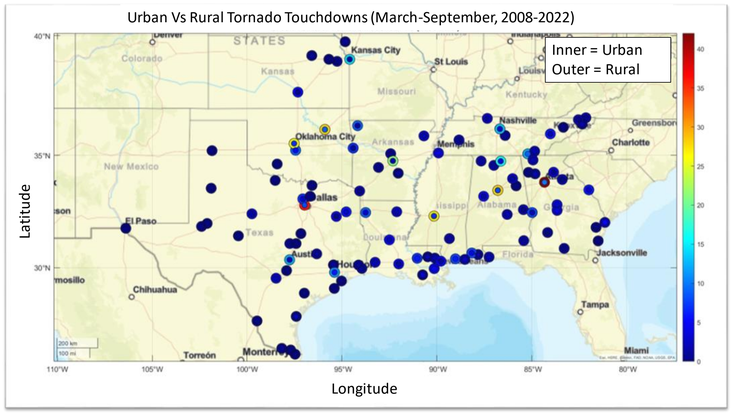
- As cities continue to expand, the impact these urbanized areas have on severe weather needs to be better understood.
- The following variables could have an impact on supercell development:
  - Urban Heat Island
  - Surface Roughness
  - Aerosols

Objective: Identify connections between supercell intensification and urban boundaries.



Data:

- 28.02% of total Tornado touchdowns occurred in urban zones
- 49.33% of total Hail reports occurred in urban zones
- 47.97% of total Wind reports occurred in urban zones



Results and Conclusion:

For all three events types(Tornado, Hail, Wind), the total number of events in rural areas was greater than the total number of events in urban areas. However, when looking at density of events by looking at Events per Kilometer, we found that urban areas had a higher density of events per square kilometer for all three event types.

In Figure 1's case, we looked at the Oklahoma City, OK Supercell, on May 10, 2010. Our analysis showed an increase in dBz values and increase in local storm reports as the supercell progressed into the OKC metro area. The supercell also increased in area and developed a hook echo signature as it entered left our rural defined zone and entered the urban zone.

In Figure 2's case, we looked at the Nashville, TN supercell that occurred on March 2-3rd, 2020. The case is very similar to that of Oklahoma City's. The only difference is that the Nashville Supercell was already well defined, but it still strengthened once it entered the urban zone.

From our analysis, we can confidently conclude that a connection between supercell strength and urban zones exists. This connection suggests that as a storm moves into an urbanized area, it will increase in strength and intensity. Our Hypothesis is that this is caused by a combination of the Urban heat island effect, increase in aerosols, and surface roughness due to man-made structures. For future study, we wish to test this hypothesis through expanding our sample size and avenues of research such as modeling supercells entering urban zone in idealized conditions.

Figure 1- *Analysis of the 5/10/2010 Oklahoma City supercell*

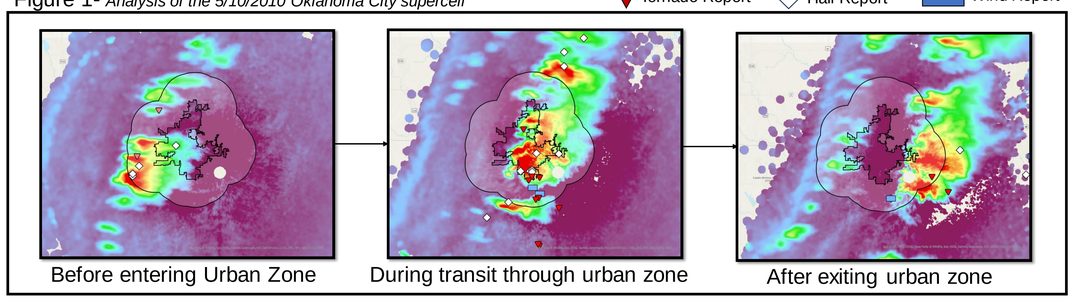
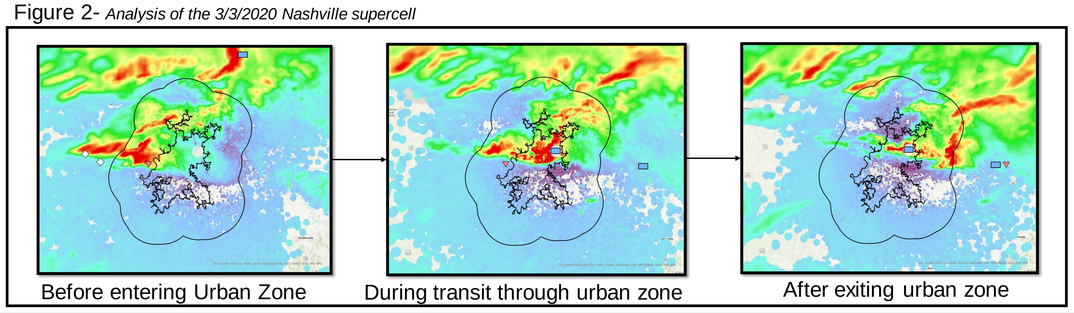
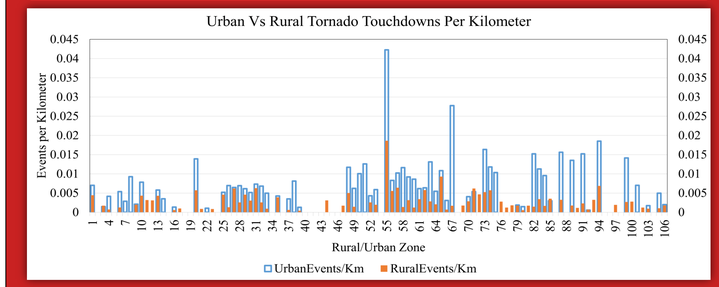


Figure 2- *Analysis of the 3/3/2020 Nashville supercell*



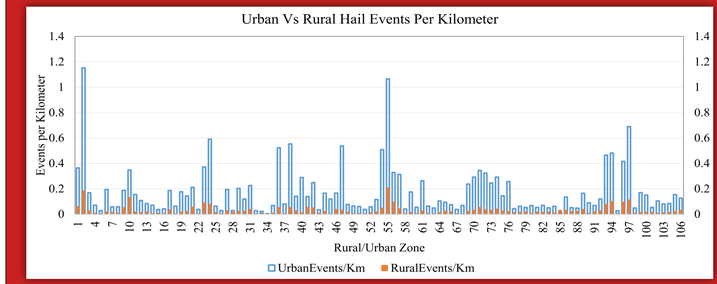
Tornado Report Density

- Tornado Touchdowns are 238.84% more dense in Urban areas.



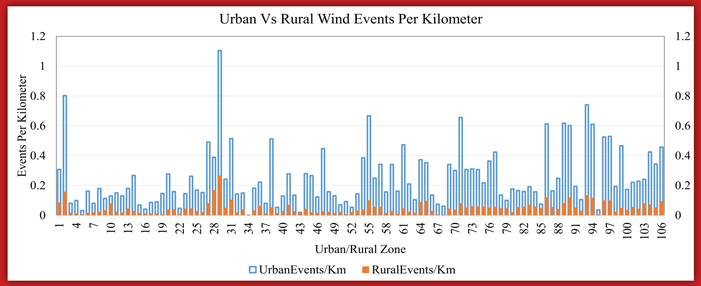
Hail Report Density

- Hail Events are 578.74% more dense in Urban areas.



Wind Report Density

- Wind Events are 545.02% more dense in Urban areas.



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