# An interactive web-based GIS system for the space-time visualization of groundwater quality from private wells

Presenter: Yu Lan, Ph.D. student

Co-authors & Corresponding Author: Eric Delmelle (Eric.Delmelle@uncc.edu)

Department of Geography & Earth Sciences

The University of North Carolina at Charlotte, Charlotte, U.S.

AutoCarto 2020
WhereNext

# Introduction

- The importance of private wells

- The importance of quality of drinking water

- The variation of the quality of ground water

- The related health risk

- The need of environment health agencies
  - educate well users
  - support decision-making with information on the spatial and temporal variation of contaminants

# Study Area
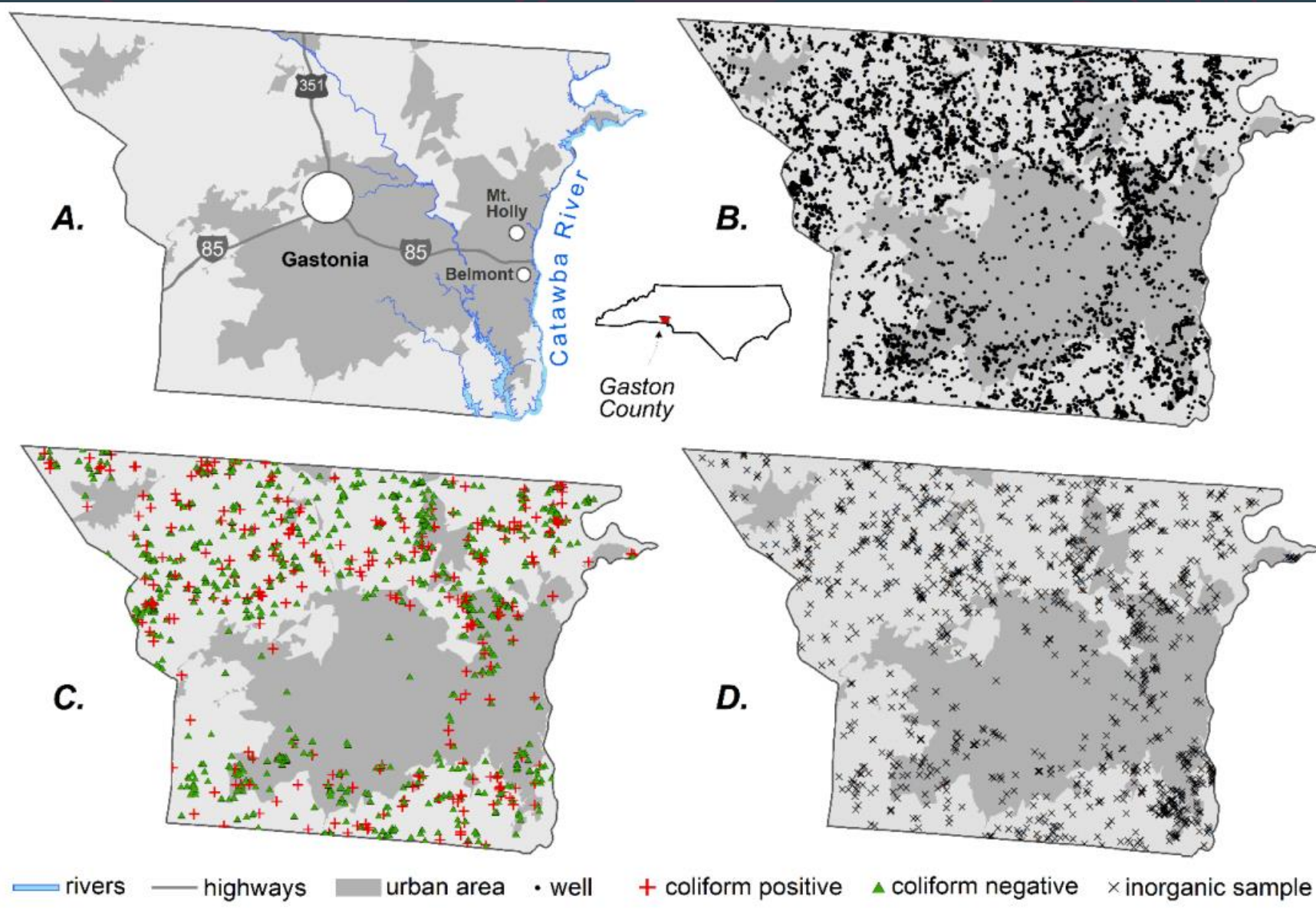


- A: Gaston County;
- B: spatial distribution of geocoded wells;
- C: presence of total coliform;
- D: historical data on inorganic contaminants 2012-2017.

rivers — highways — urban area · well + coliform positive ▲ coliform negative × inorganic sample

# A Web-based Spatial Decision Support System for Monitoring the Risk of Water Contamination in Private Wells

the previous research
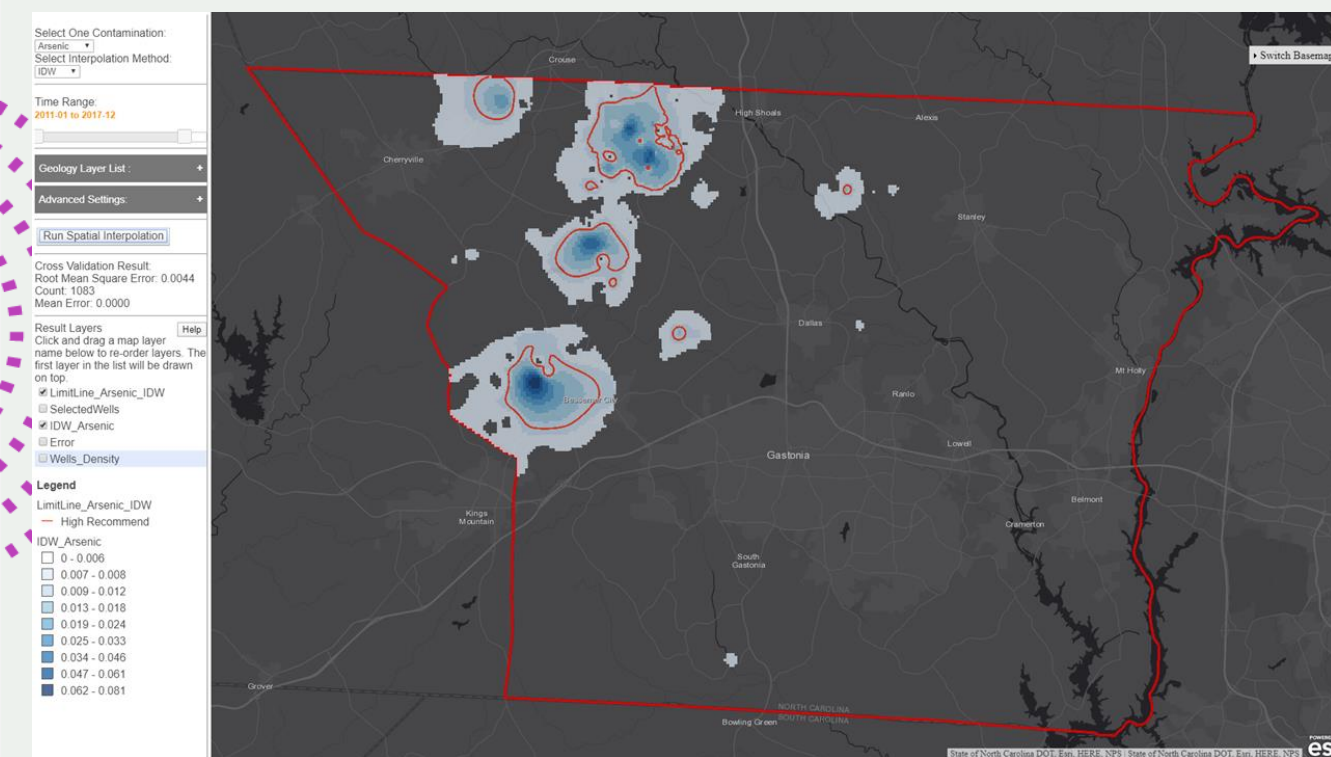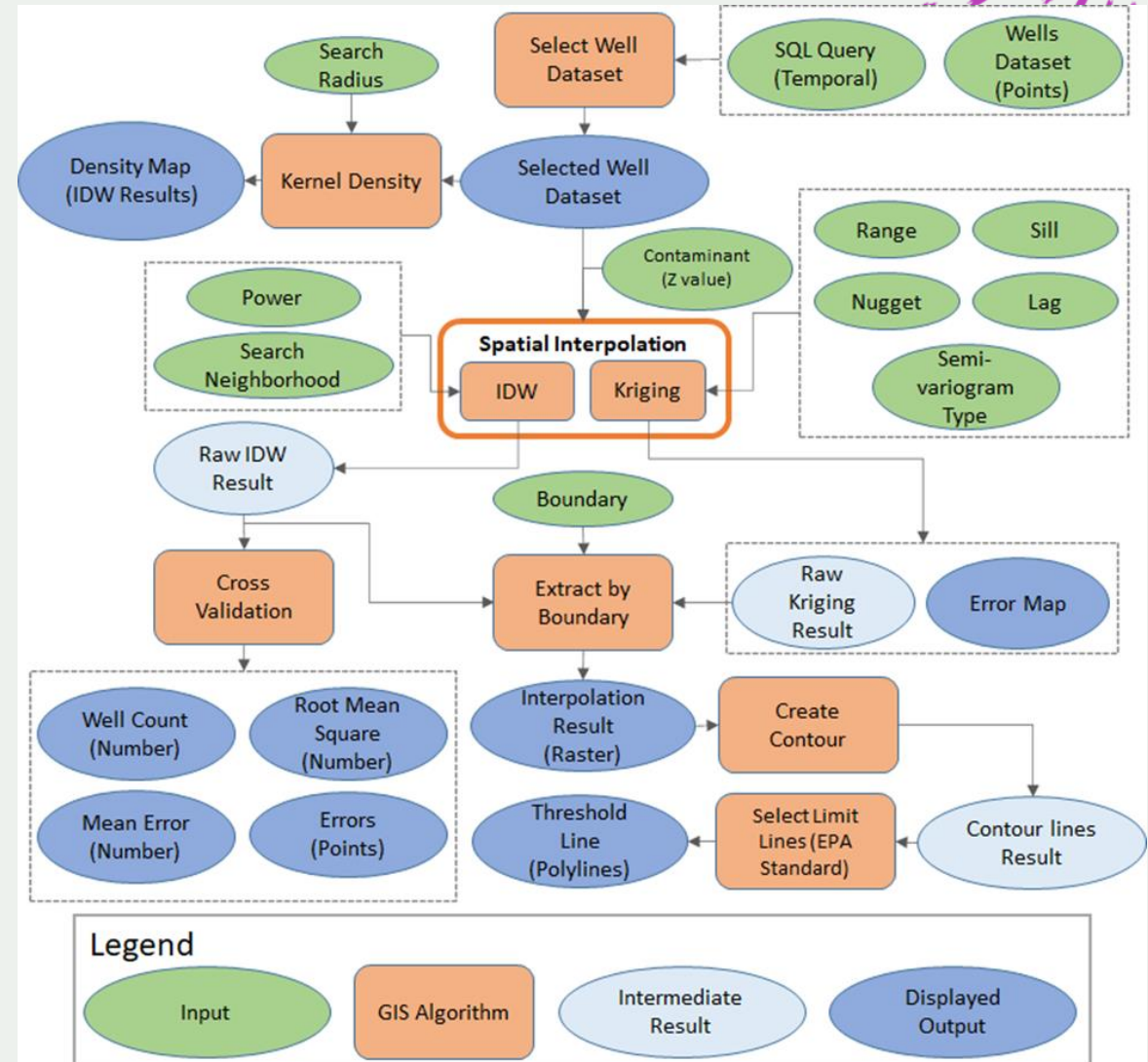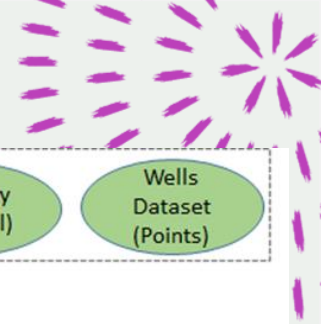
# How to identify the transition of threshold lines in both spatial temporal extent?

1,235 private wells from 2011 to 2017

# Animated Map

- Seven threshold lines for yearly interval

- Animated threshold lines in time sequence

- Highlight the current stamp and the first past stamp
  - o other past stamps are dark colored

- The interactive timeline to indicate the current stamp

- Generated threshold lines
  - o web feature service (WFS)
  - o ArcGIS JavaScript API 4.14.
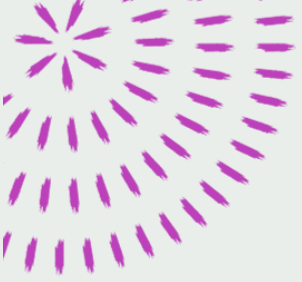
# Animated Map
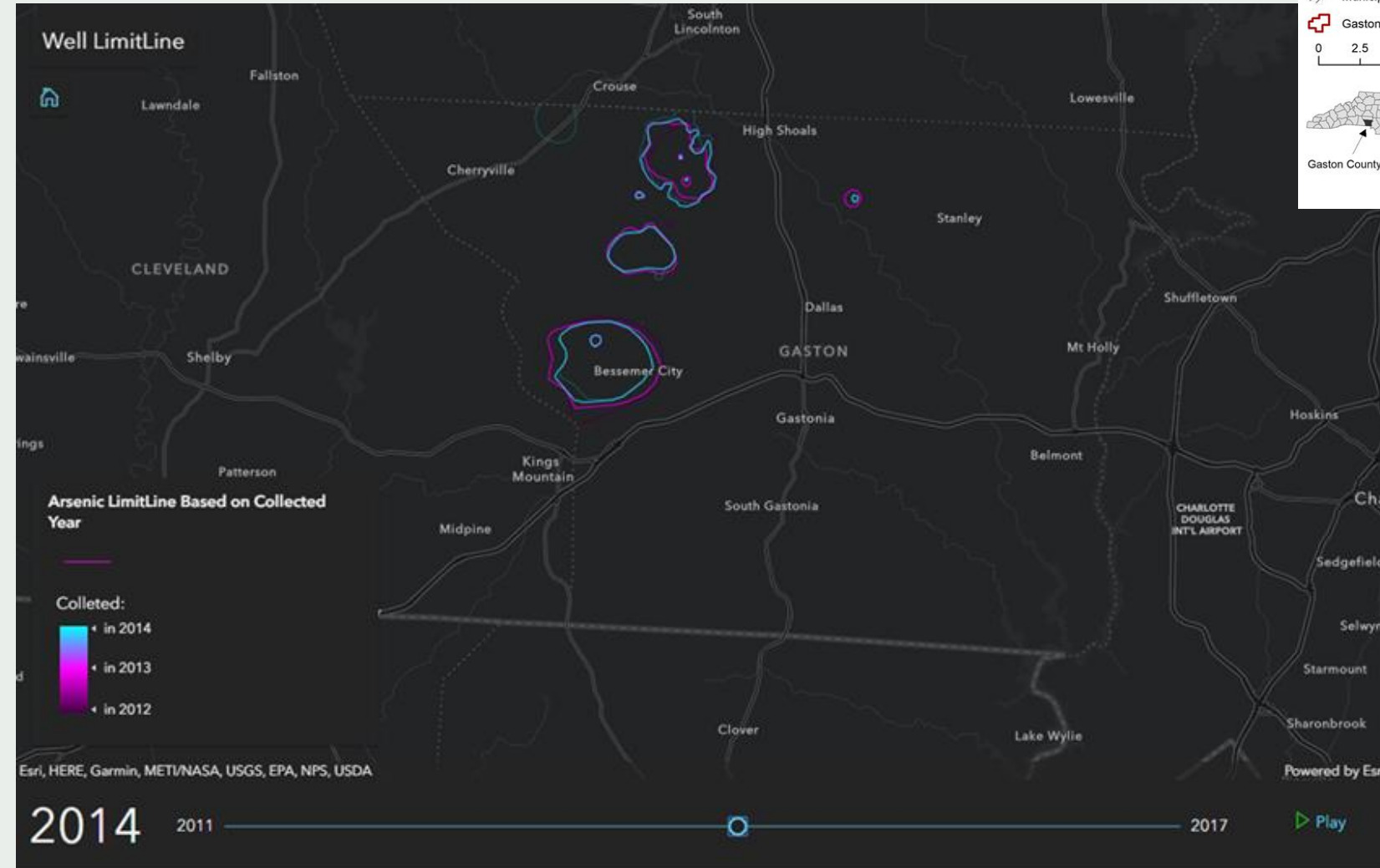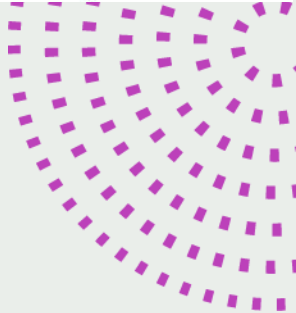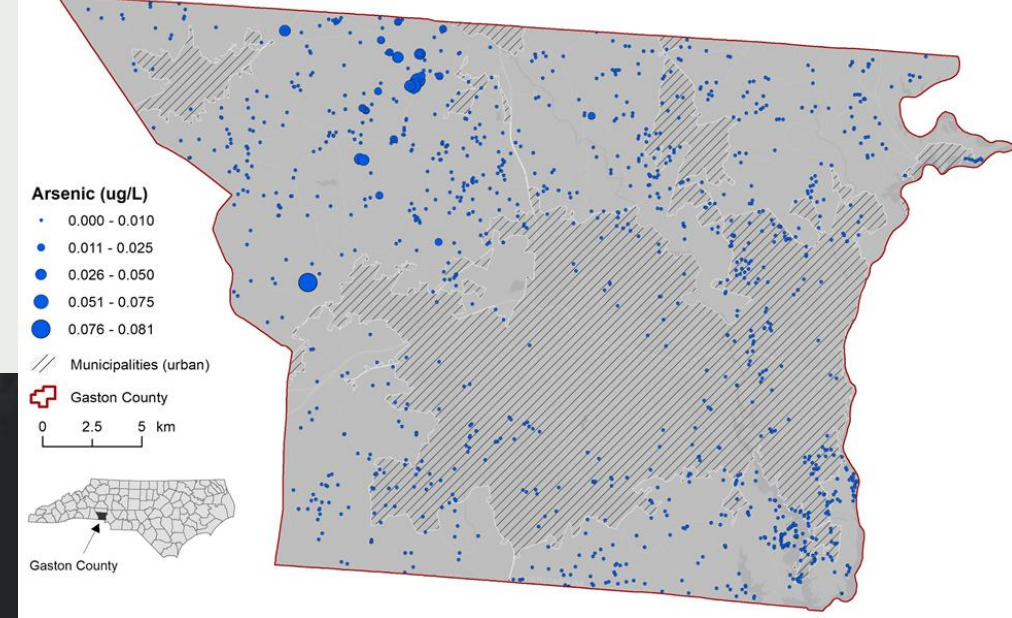
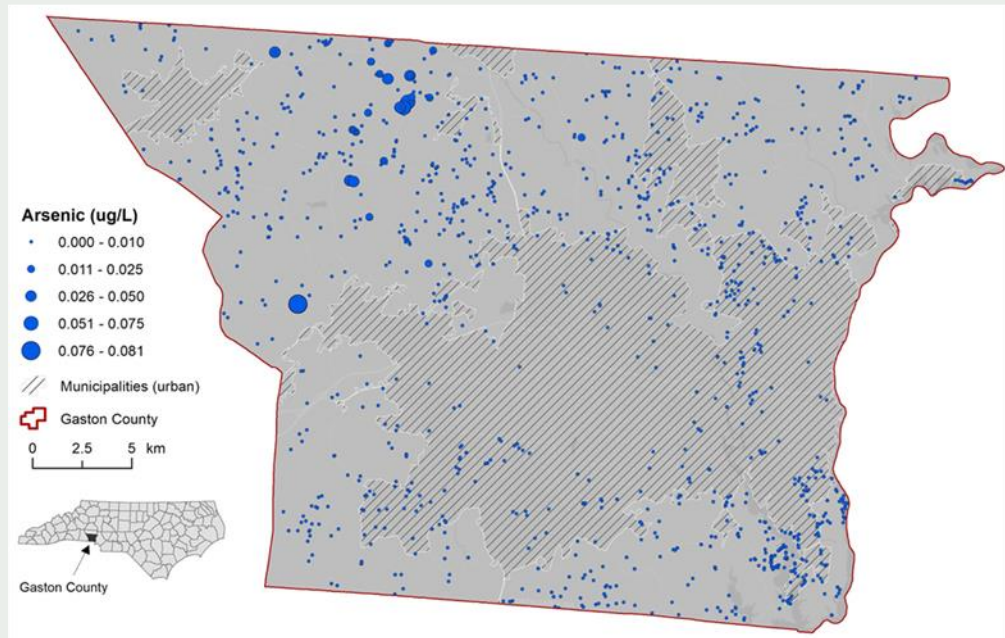# Space-time cube

- Threshold lines
- A space-time cube
  - above certain height of the
  - the temporal axis
  - the maximum boundary of the change extend
- The planar and vertical on the 3D map
- Relative location of each threshold line
- Interaction including rotating, panning, and zooming
- Layers
  - be published as web scene
  - ArcGIS JavaScript API 4.14 for the interface

# Space-time Cube
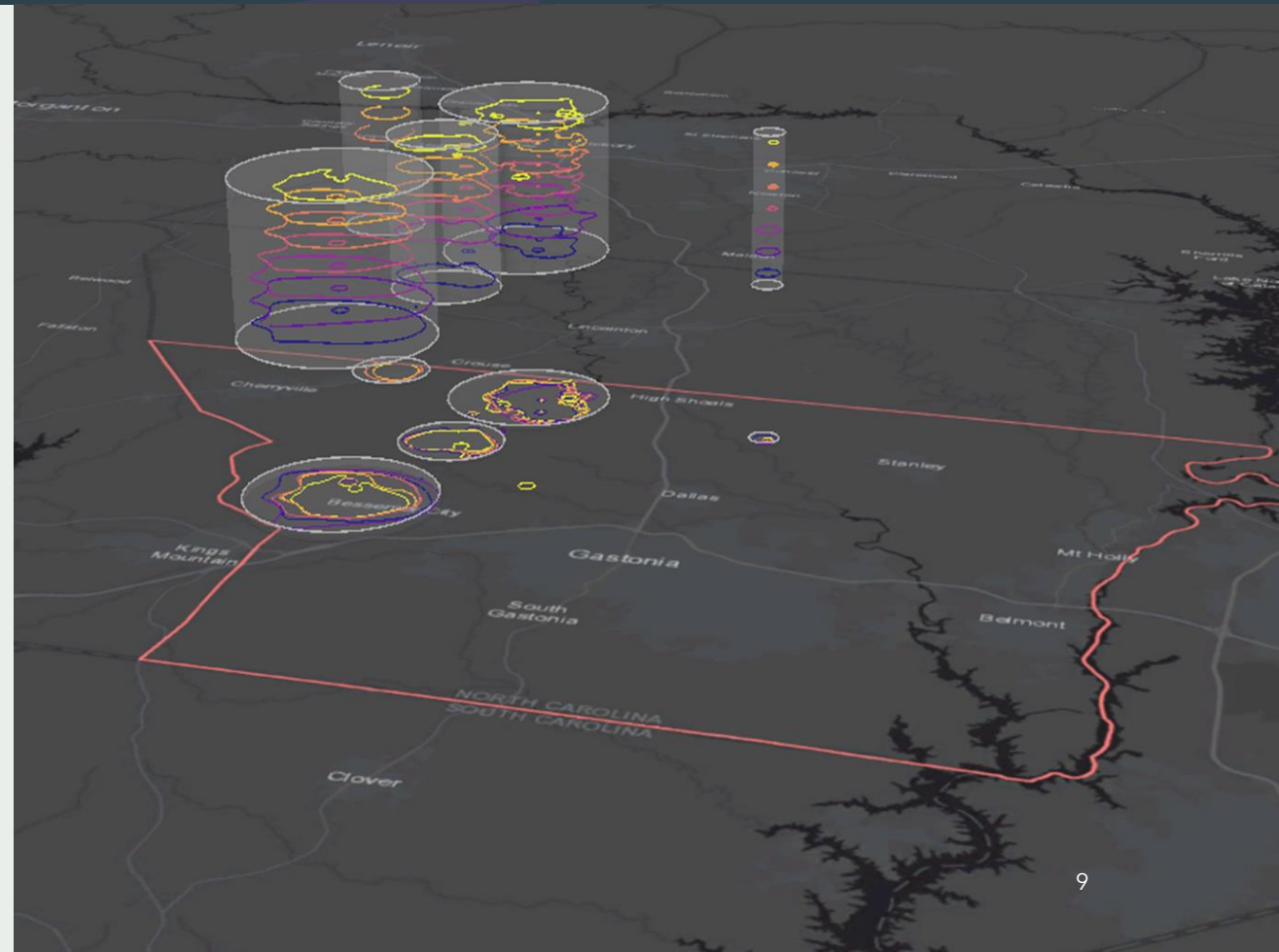
# Discussion and Conclusion

Our web-based interactive space-time visualization of groundwater quality is accessible and straightforward for wells owners to monitor the contamination status around their wells.

This visualization also can be applied to educate public other environment health concerns, such as air pollution.

The future study could implement web processing service to allow generate real-time threshold lines with new updating data from environment health agencies or well owners themselves.

# References

- Bach, Dragicevic, Archambault, Hurter, & Carpendale. (2014). A review of temporal data visualizations based on space-time cube operations.

- Desjardins, Hohl, Griffith, & Delmelle. (2019). A space–time parallel framework for fine-scale visualization of pollen levels across the Eastern United States. Cartography and Geographic Information Science, 46(5), 428-440.

- Dübel, Röhlig, Schumann, & Trapp. (2014). 2D and 3D presentation of spatial data: A systematic review. Paper presented at the 2014 IEEE VIS International Workshop on 3DVis (3DVis).

- Ilägcrstrand. (1970). What about people in regional science? Paper presented at the Papers of the Regional Science Association.

- Lee, Bhang, & Park. (2010). Effective visualization for the spatiotemporal trend analysis of the water quality in the Nakdong River of Korea. Ecological Informatics, 5(4), 281-292.

- Lu, & Fang. (2015). Examining personal air pollution exposure, intake, and health danger zone using time geography and 3D geovisualization. ISPRS International Journal of Geo-Information, 4(1), 32-46.

- Smith, Hopenhayn-Rich, Bates, Goeden, Hertz-Picciotto, Duggan, . . . Smith. (1992). Cancer risks from arsenic in drinking water. Environmental health perspectives, 97, 259-267.

- Tominski, Schulze-Wollgast, & Schumann. (2005). 3d information visualization for time dependent data on maps. Paper presented at the Ninth International Conference on Information Visualisation (IV'05).

- Lan, Y., Tang, W., Dye, S., & Delmelle, E. (2020). A web-based spatial decision support system for monitoring the risk of water contamination in private wells. Annals of GIS, 26(3), 293-309.

# Questions?

Thank you!