Communicating Climate Change to Communities: A GIS-based Framework to Support Local Decision-Making

By: Kaitlyn Goode, MGIS, Penn State

Capstone Advisor: Brandi Robinson, Penn State

Agenda


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Introduction & Background

- The way we are communicating climate change is changing
- The path to climate resiliency has shifted towards local governments and communities
- Climate change resiliency in local communities lies within their ability of understanding the impacts of climate change on a local level

Supporting Local Actions

- We need to support local community driven frameworks to address and create achievable climate solutions
- Local Climate Action Plans
  - Pennsylvania has developed a Local Climate Action Plan Program
  - 53 cities, townships, boroughs, counties, and regional organizations in Pennsylvania have created their own plans

Local Climate Action Program

Having state and local governments lead by example on climate action is a key component of mitigating climate change in Pennsylvania and one of the strategies recommended in the Pennsylvania Climate Action Plan.

The DEP Local Climate Action Program provides free technical and personnel assistance to local governments that want to reduce greenhouse gas emissions and address climate change.

PA DEP (2022)

Local Climate Action Plans in Allegheny County

Municipalities in Allegheny County with Local Climate Action Plans

- Carnegie
- City of Pittsburgh
- Etna
- Forest Hills
- Millvale & Millvale EcoDistrict Plan
- Munhall

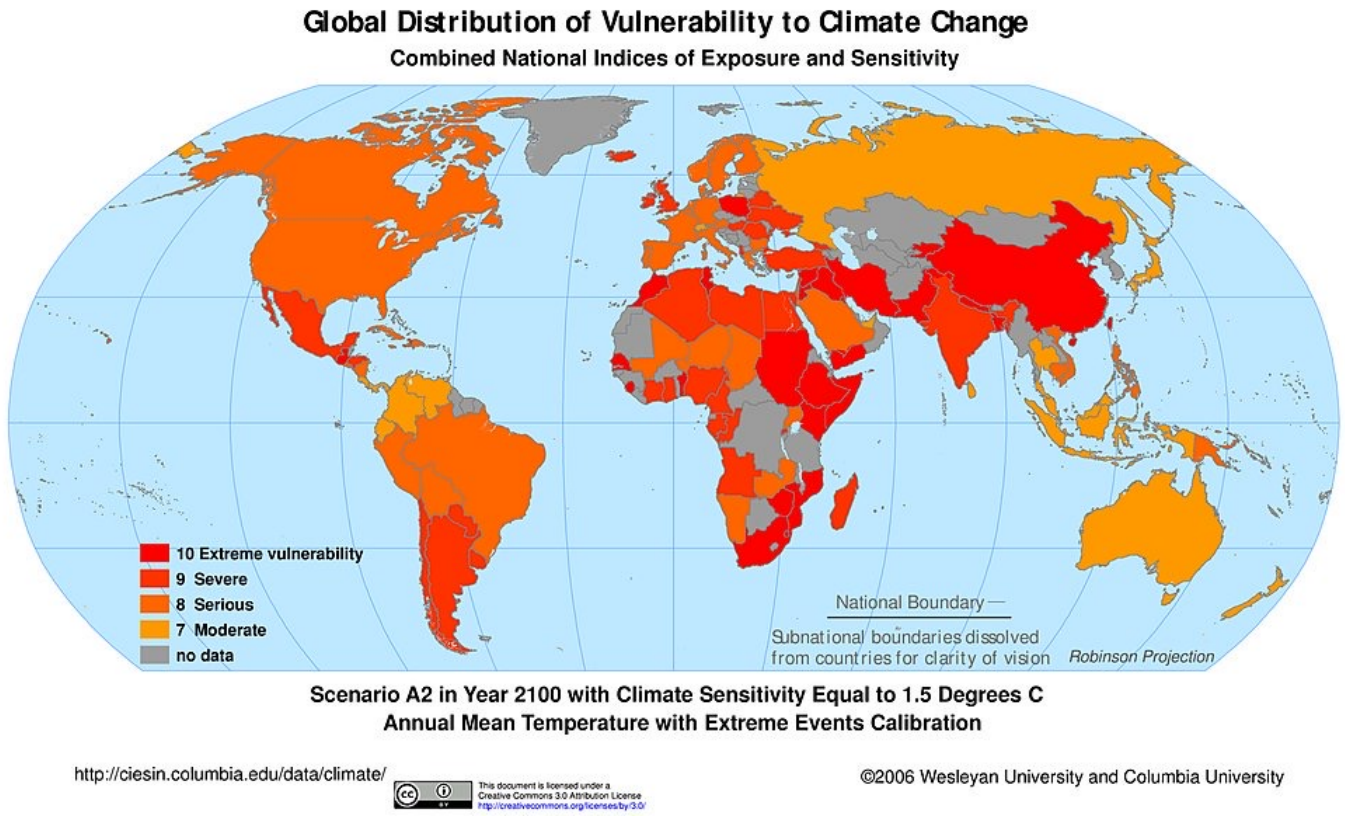
Communities in Allegheny County with Local Climate Action Plans

- University of Pittsburgh
- The Congress of Neighboring Communities (CONNECT) Climate Action Plan
- The Sustainability Initiative at Carnegie Mellon University

Local Plans in Allegheny County That Help Build Climate Resiliency

- Plan for a Healthier Allegheny 2023 -2027
- Allegheny County Sustainability Report 2022

Utilizing GIS for Local Decision Making



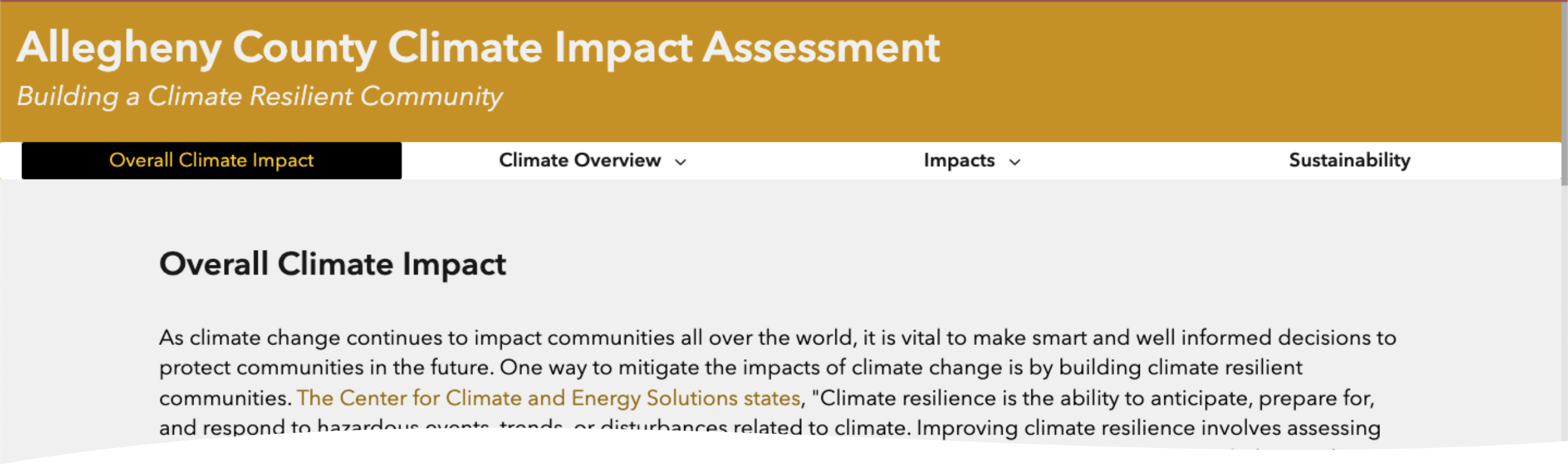
- GIS is extremely helpful tool for decision making
- Due to the geographic nature of climate change, maps are an important piece of visual representations of climate change (Fish, 2020b).
- However, we need more localized community climate change maps

Communicating Climate Change with the Community in Mind

- Create personal connections to climate change through individual interests and shared values
- Storytelling is an effective medium to create personal connections
- Storytelling allows scientists to effectively communicate data using visualizations and narratives (Cote, 2021)
- Use user engagement tools to better evaluate community members and local decision makers

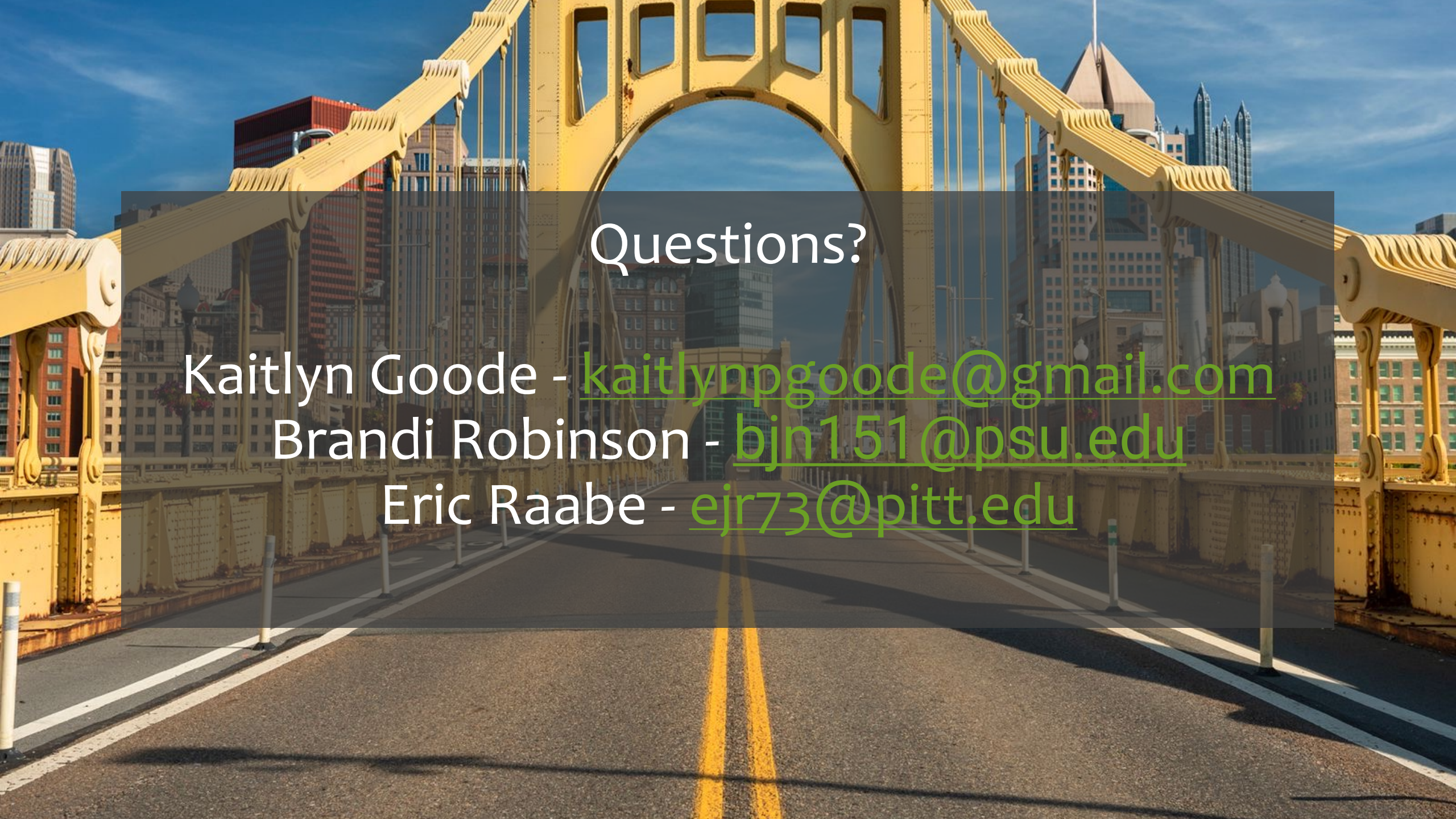
Project Objectives

- Address climate change data and the perception of climate data from a local community aspect.
- Investigate how climate change data is distributed, communicated, and displayed to the community using GIS tools and products.
- Conduct a risk and vulnerability assessment using ArcGIS to identify the most vulnerable communities in Allegheny County.
- Use ArcGIS Experience Builder to create a Web App to communicate findings with local decision-makers and local communities



Web App

- Used ArcGIS Experience Builder
- Includes interactive maps, supplemental information, and informative links to climate resiliency information
- Discusses climate impacts for air quality, land vulnerability, and social vulnerability
- Discusses sustainability initiatives already occurring in Allegheny County



Questions?

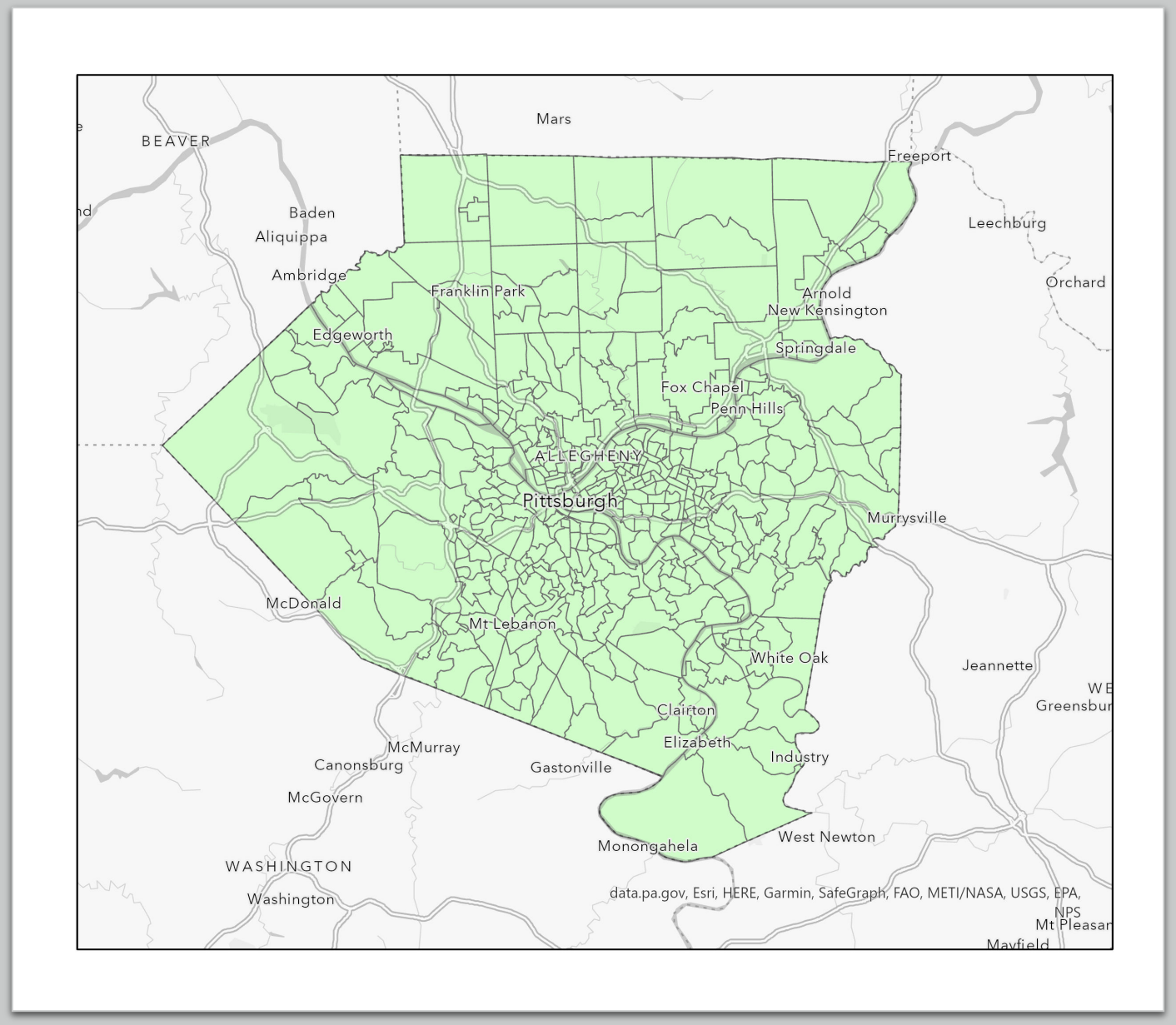
Kaitlyn Goode - kaitlynpgoode@gmail.com
Brandi Robinson - bjn151@psu.edu
Eric Raabe - ejr73@pitt.edu

Additional Slides & Information

Methodology

Identify the Community

- Study Area: Allegheny County, Pennsylvania
- Largest City: Pittsburgh, PA
- Area: 745 sq mi (1,930 km2)
- Population: 1,250,578 (2020)
- Known for: Heavy Industry (specifically Steel), Technology, Medicine, and Home of Multiple Universities



Developing Climate Indices

- Need to identify:
  - Local Climate Action Goals
  - Potential Hazards & Vulnerabilities
  - Risk Areas of Concern
  - Sustainability Efforts

*Equation found via IPCC (2022) and Weis et. al (2016)

Local Climate Action Goals

Public health	Saving Money and Promoting Jobs	Enhance Resource Security	Foster Social Equality
• Reduction in disease and air pollutants • Increase in Public Safety • Trees and green infrastructure	• Energy Savings • Increase in property values by creating green spaces and energy savings • More clean industry jobs	• Preserves natural spaces • Protects our waters • Reduces dependencies	• Reduces energy burdens • Expanding transit to target disconnected communities • Changing zoning to provide greater opportunities

Identifying Potential Hazards

Areas of Concern for this Study

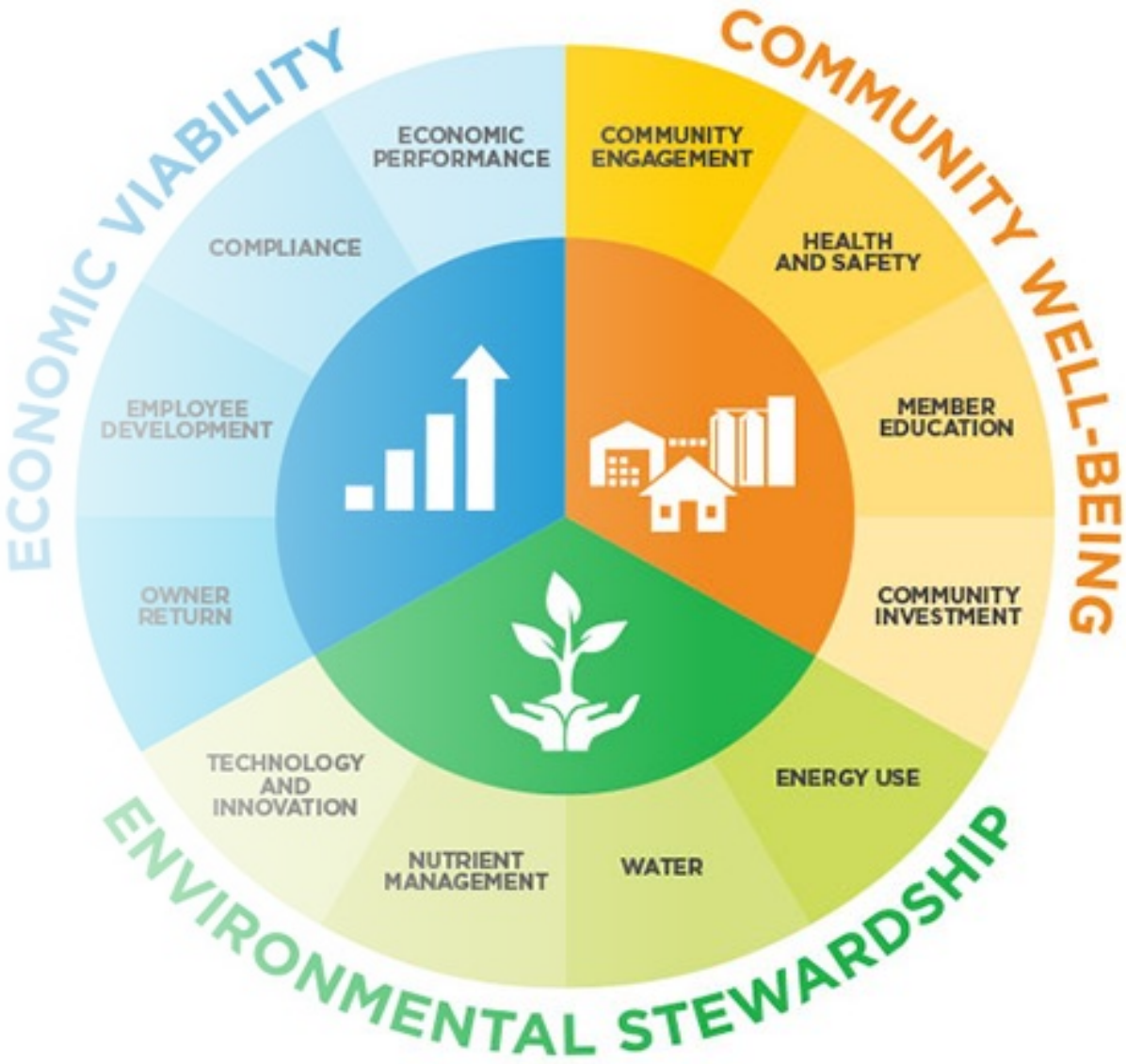
- Air Quality
- Flooding
- Landslide
- Heat Health
- Social Vulnerability
- Land Use

Potential Hazard	Level of Risk*	Level of Community Concern***
Air Quality	High	High
Cold Wave	High	Medium
Drought**	Medium	Medium
Flooding	High	High
Heat Wave	Medium	High
Ice Storm	Low	Low
Landslide	High	High
Lightning	Low	Low
Strong Wind	Medium	Low
Tornado	High	Low
Water and Stormwater	High	High
Winter Weather	Medium	Medium

Note: *Level of Risk determined from The National Risks Index for Allegheny County
**Drought level determined from U.S. Drought Monitor
***Level of Community Concern was determined based upon Local Climate Action Plans in Allegheny County

Sustainability Assessment

- Identifies positive climate resiliency actions already being done in the community
- Identify efforts from local community's climate action plans
- We will look at positive sustainability efforts:
  - Green Infrastructure
  - Greenways
  - Community Gardens



Data Used for Maps

Name Of Data	Source	File Format
2020 Green House Gas Emissions from Large Facilities	EPA Flight	CSV
Allegheny County Census Tracts 2016	Western PA Regional Data Center	Shapefile
Allegheny County Greenways	Western PA Regional Data Center	Shapefile
Allegheny County Land Cover Areas	Western PA Regional Data Center: Allegheny County – GIS Open Data	Shapefile
Allegheny County Municipal Boundaries	Western PA Regional Data Center: Allegheny County – GIS Open Data	Shapefile
Community Gardens	Grow Pittsburgh	CSV
Environmental Justice Areas (2015)	PA DEP GIS Portal	Shapefile
Green Infrastructure	3 Rivers Wet Weather	Shapefile
Heat Health Census Tracts	ArcGIS Living Atlas Created by: mgilbert_climatesolutions	Shapefile
Landslide Pomeroy	Allegheny County - GIS Open Data	Shapefile
National Risk Index Census Tracts	ArcGIS Living Atlas Created by: FEMA_NationalRiskIndex	Shapefile
Particulate Matter 2.5 (2011)	Western PA Regional Data Center	Shapefile
USA Flood Hazard Areas	ArcGIS Living Atlas Created by: Esri_Landscape 2	Shapefile

Calculating Indices

- For each climate variable, we determined the risk level on a scale from 1 (low risk) to 5 (high risk)
- Risk levels were determined based upon several factors relating to the potential hazard and previous local impacts.
- Example for Land Use:

Land Use	Risk Level
Water	4
Transportation	2
Forest, Grasslands, Agriculture	1
Residential	2
Commercial, Malls	3
Industrial, Strip Mine	5
Non-Vegetative	3

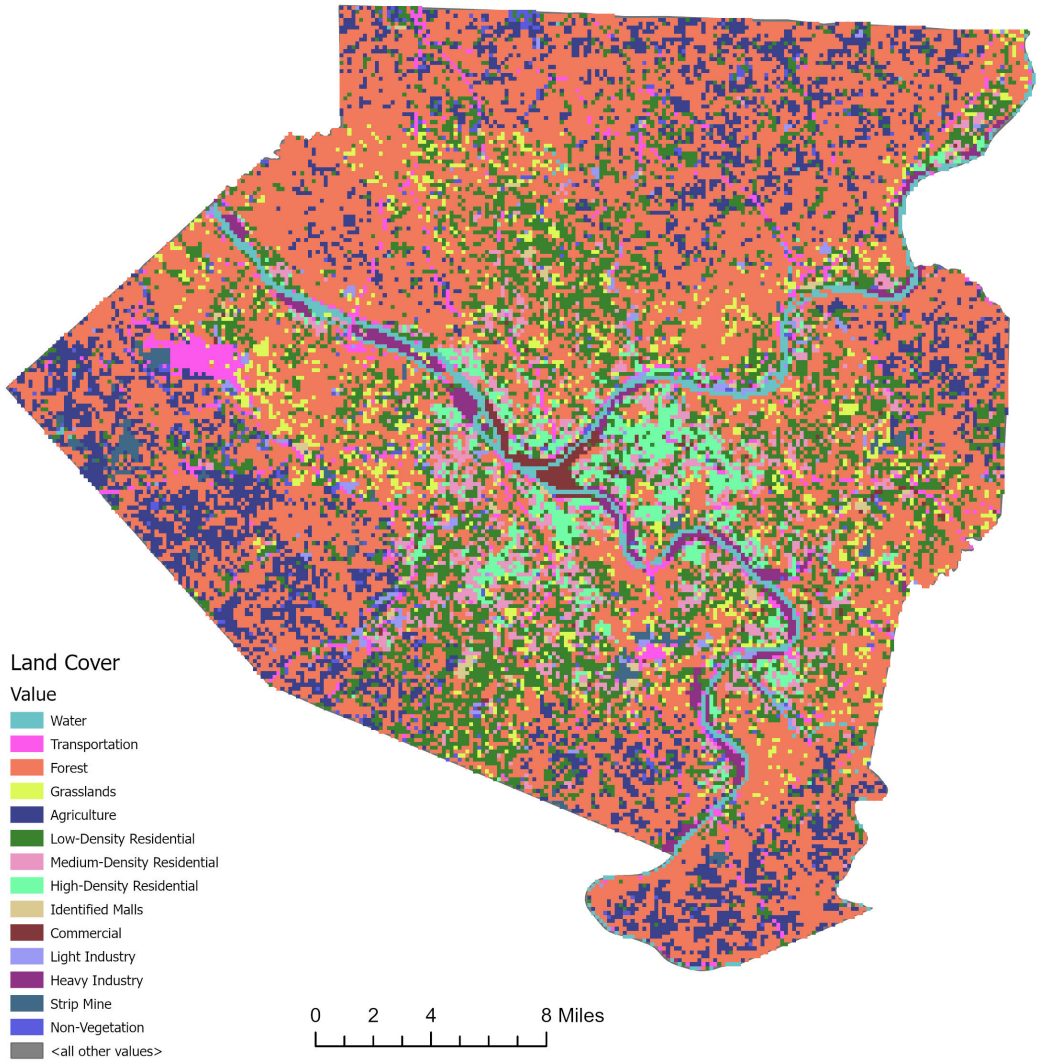
- Reclassify each variable based upon the determined risk level

- For individual risk analysis: Use Summarize Within to find the standard deviation of the risk level.
  - The higher the standard deviation, the higher the risk.
  - The lower the standard deviation, the lower the risk.

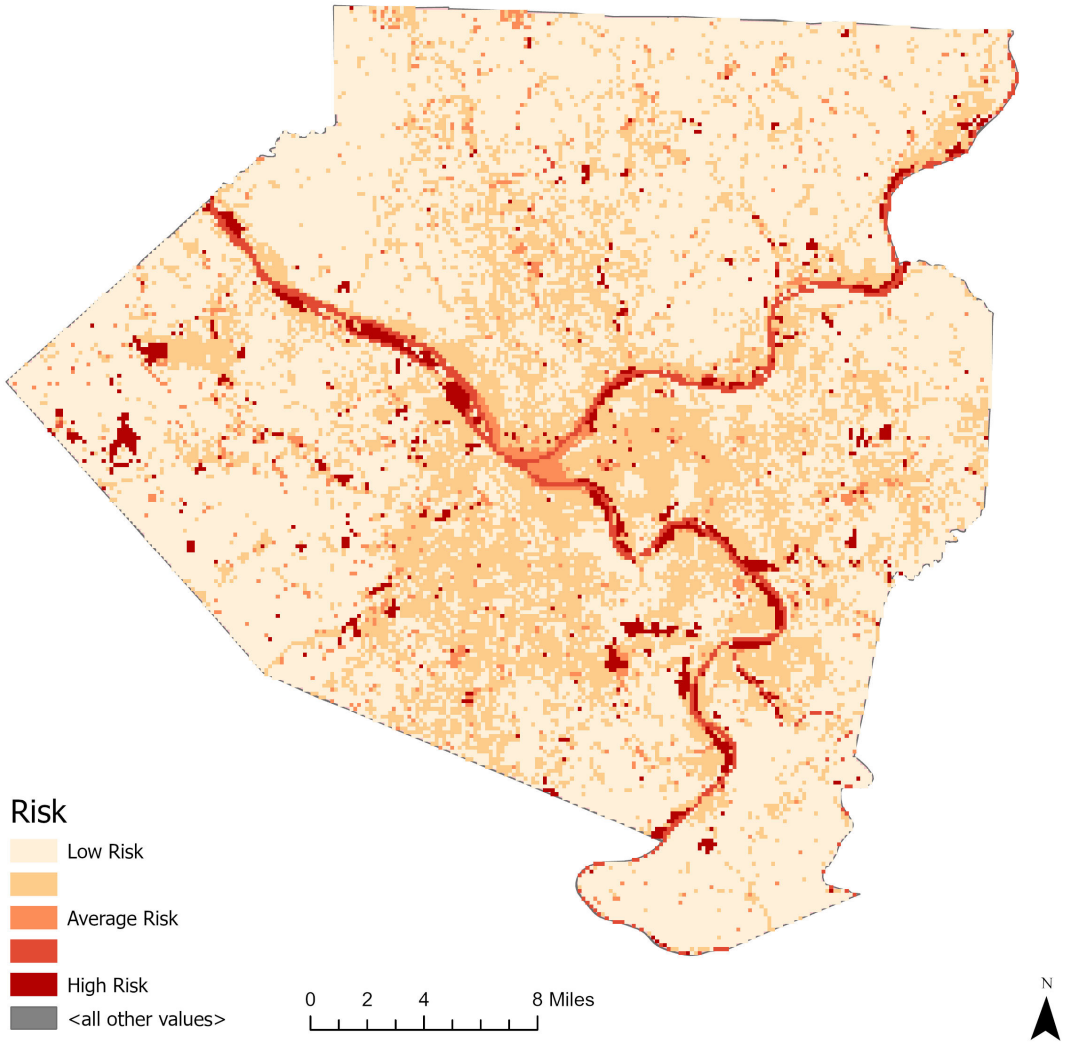
- Once all of the variables have been individually analyzed based of risk level, then we will use map algebra or raster calculator to add all of the variables together.

Type	Grid Code	New Value
Water	1	4
Transportation	2	2
Forest	3	1
Grasslands	4	1
Agriculture	5	1
Low-Density Residential	6	2
Medium-Density Residential	7	2
High-Density Residential	8	2
Identified Malls	9	3
Commercial	10	3
Light Industry	11	5
Heavy Industrial	12	5
Strip Mine	13	5
Non-Veg	14	3

Land Cover Type

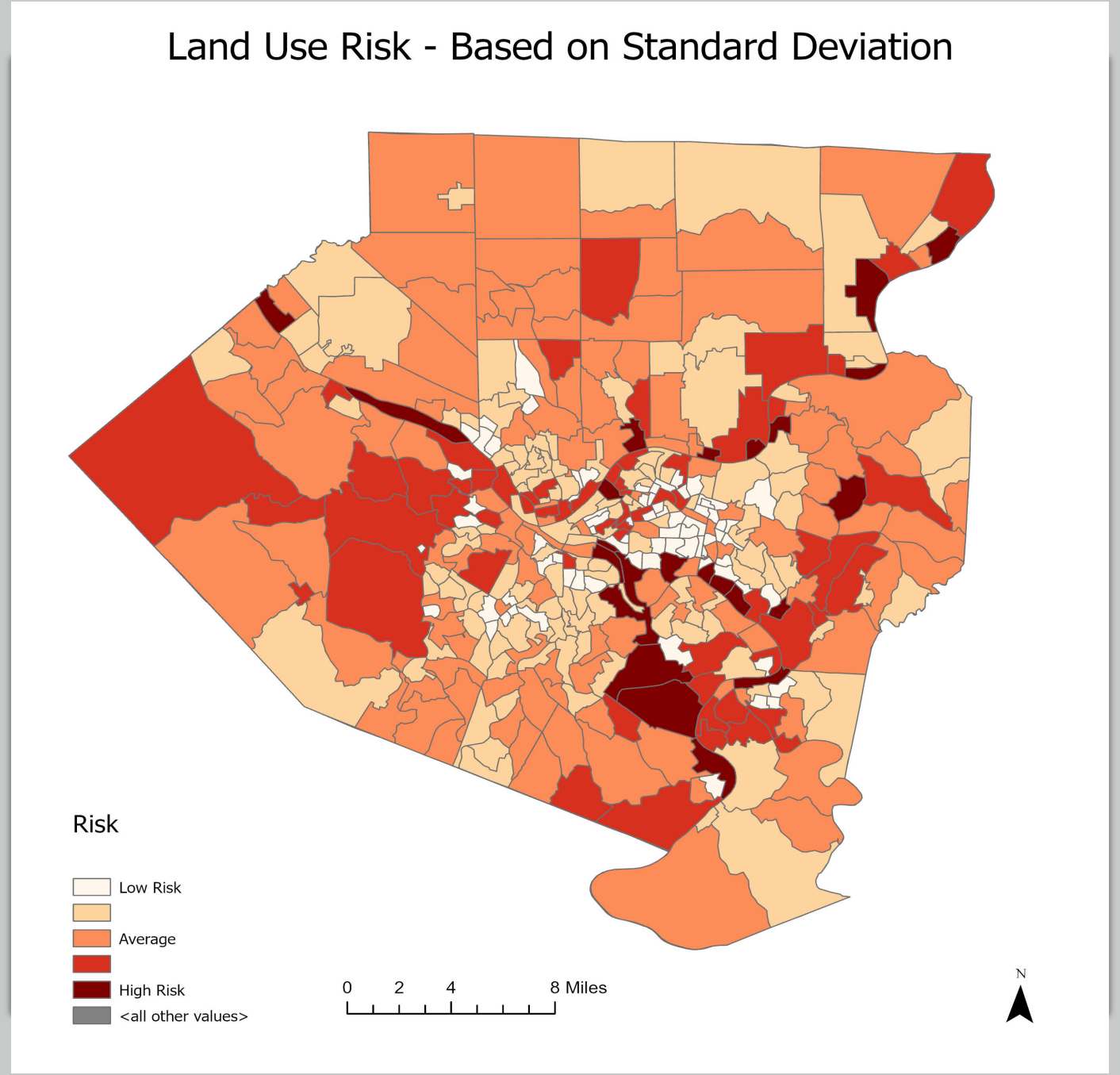


Land Use Risk - Based on Reclassifying



Results

- Individualized maps of each risk variable
- Combined map displaying the risk level from low to high for the census tracts and municipality in Allegheny County
- Most risk levels determined via standard deviation



Additional Map Data

Air Quality

- Large Industrial Emitters
- Particulate Matter 2.5

Environmental Justice Areas

Sustainability

- Green Infrastructure
- Greenways
- Community Gardens

References

CHS. (2022). [Infographic]. Retrieved from https://www.chsinc.com/about-chs/sustainability

CONNECT Infrastructure & Utilities Coordination Working Group. (2022). *CONNECT Climate Action Plan* (Resolution 22-05). Retrieved from https://www.connect.pitt.edu/sites/default/files/connect_climate_action_plan_final_6.5.22_1.pdf

Fish, C. S. (2020b). Cartographic content analysis of compelling climate change communication. *Cartography and Geographic Information Science*, *47*(6), 492-507. Doi:10.1080/15230406.2020.1774421

Evangelo-Giamou, A. (2021, June 15). [Photograph]. Retrieved from https://www.travelandleisure.com/travel-guide/pittsburgh

Hayhoe, K. (2021). Saving us: A climate scientist's case for hope and healing in a divided world. New York, NY: Simon & Schuster.

Huntley, R. (2020). How to talk about climate change in a way that makes a difference. Crows Nest, Australia: Allen & Unwin.

IPCC, & Center for International Earth Science Information Network at Columbia Univeristy. (2022). [Map]. Retrieved from https://sedac.ciesin.columbia.edu/data/collection/ipcc/maps/gallery/search

IPCC, 2022: Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K.Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

Klenotic, D., & PA DEP. (2021, November 17). [Graphic]. Retrieved from https://www.dep.pa.gov/OurCommonWealth/pages/Article.aspx?post=72

NOAA NCEI. (2021, April 15). *Two side-by-side maps of the contiguous United States depict the change in U.S. annual mean temperatures (in degrees; left map) and precipitation totals (% change; right map) between the new set of Climate Normals, 1991-2020* [Map]. Retrieved from https://www.noaa.gov/media-release/noaa-1991-2020-us-climate-normals-update-april-20

References Cont.

NOAA. (2021, August 13). *A collage of typical climate and weather-related events: floods, heatwaves, drought, hurricanes, wildfires and loss of glacial ice* [Photograph]. Retrieved from https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts

Peach, S. (2020, May 1). [Cartoon]. Retrieved from https://yaleclimateconnections.org/2020/05/what-can-i-realistically-do-about-climate-change/

Pennsylvania Department of Environmental Protection. (2021). Pennsylvania Climate Action Plan. Retrieved from https://www.dep.pa.gov/Citizens/climate/Pages/PA-Climate-Action-Plan.aspx

Pennsylvania Department of Environmental Protection. (2022). Local climate action plan. Retrieved August 28, 2022, from https://www.dep.pa.gov/Citizens/climate/Pages/Local-Climate-Action.aspx

Policy Opinions Politiques. (2022, February 9). [Graphic]. Retrieved from https://policyoptions.irpp.org/magazines/february-2022/embracing-the-unknown-cost-of-climate-change/

Shepard, C. C., Agostini, V. N., Gilmer, B., Allen, T., Stone, J., Brooks, W., & Beck, M. W. (2011). Assessing future risk: Quantifying the effects of sea level rise on storm surge risk for the southern shores of Long Island, New York. Natural Hazards, 60(2), 727-745.doi:10.1007/s11069-011-0046-8

Weis, S. W., Agostini, V. N., Roth, L. M., Gilmer, B., Schill, S. R., Knowles, J. E., & Blyther, R. (2016). Assessing vulnerability: An integrated approach for mapping adaptive capacity, sensitivity, and exposure. Climatic Change, 136(3-4), 615-629. doi:10.1007/s10584-016-1642-0