# Introducing Students to Hazard Mitigation using ArcGIS Pro® and the FEMA National Risk Index

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## BACKGROUND

The **purpose** of this poster is to demonstrate how mitigation is introduced to cadets in an introductory Emergency Management course at the US Coast Guard Academy (USCGA). This assignment is designed for undergraduate students to explore nationwide **trends in risk from natural hazards**, apply **knowledge of mitigation tools**, and **sharpen analytical skills in the context of emergency management**.

In December 2020, the Federal Emergency Management Agency (FEMA) produced a geospatial dataset (shapefile) for use by states and counties to evaluate risk from natural hazards across the United States (Zuzak et al. 2023). The purpose of making this data available was to help communities design effective mitigation programs based on natural hazards posing the greatest risk.
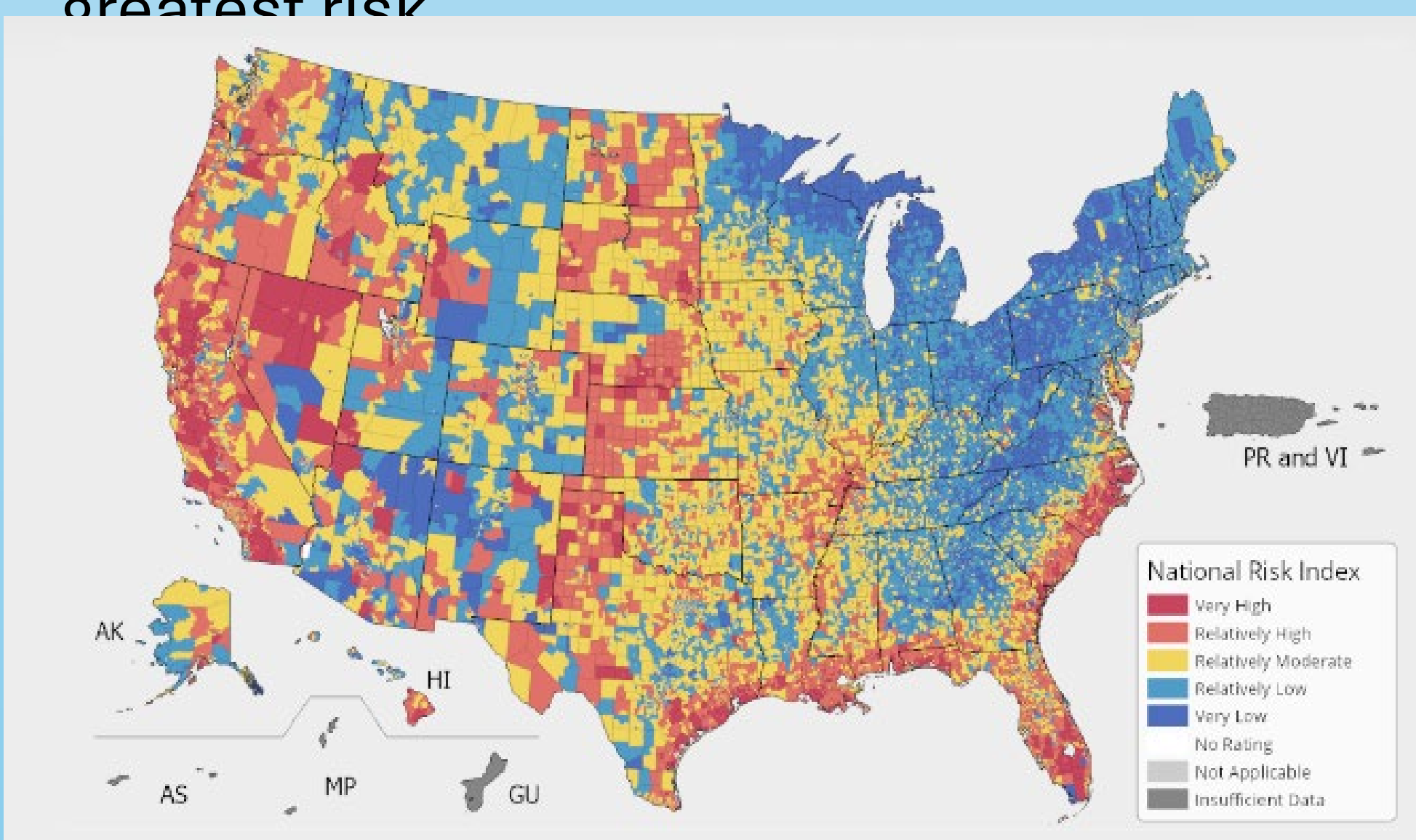
This activity was developed for an undergraduate course in Emergency Management in Spring 2021. It has been completed by over 100 cadets since then.


Fig. 1 FEMA National Risk Index by county (FEMA 2024).

## METHODS

This project was used in a part of the Emergency Management course about mitigation. It centers upon the FEMA Five Mission Areas and Core Capabilities described in the National Preparedness Goal (FEMA 2015). Initially students were shown how to conduct a hazard, vulnerability, and risk analysis. Then two class periods were spent on the concepts of mitigation and mitigation tools. To link these concepts, students were introduced to the National Risk Index and given five days to develop an individual quad chart.

After uploading National Risk Index data into ArcGIS Pro v.3.3.1 (Esri 2024), students explored the distribution of risk posed by natural hazards across the United States. For a state of their choice, each student:
- Determined which three factors contribute most to the risk equation in their chosen state on a county-by-county basis.
- Calculated the # people exposed to very high or relatively high risk.
- Made recommendations for hazard mitigation activities within their state, supported by geospatial evidence from the National Risk Index.

Students chose mitigation measures from the Federal Emergency Management Agency's Mitigation Ideas (2013) (FEMA 2013).
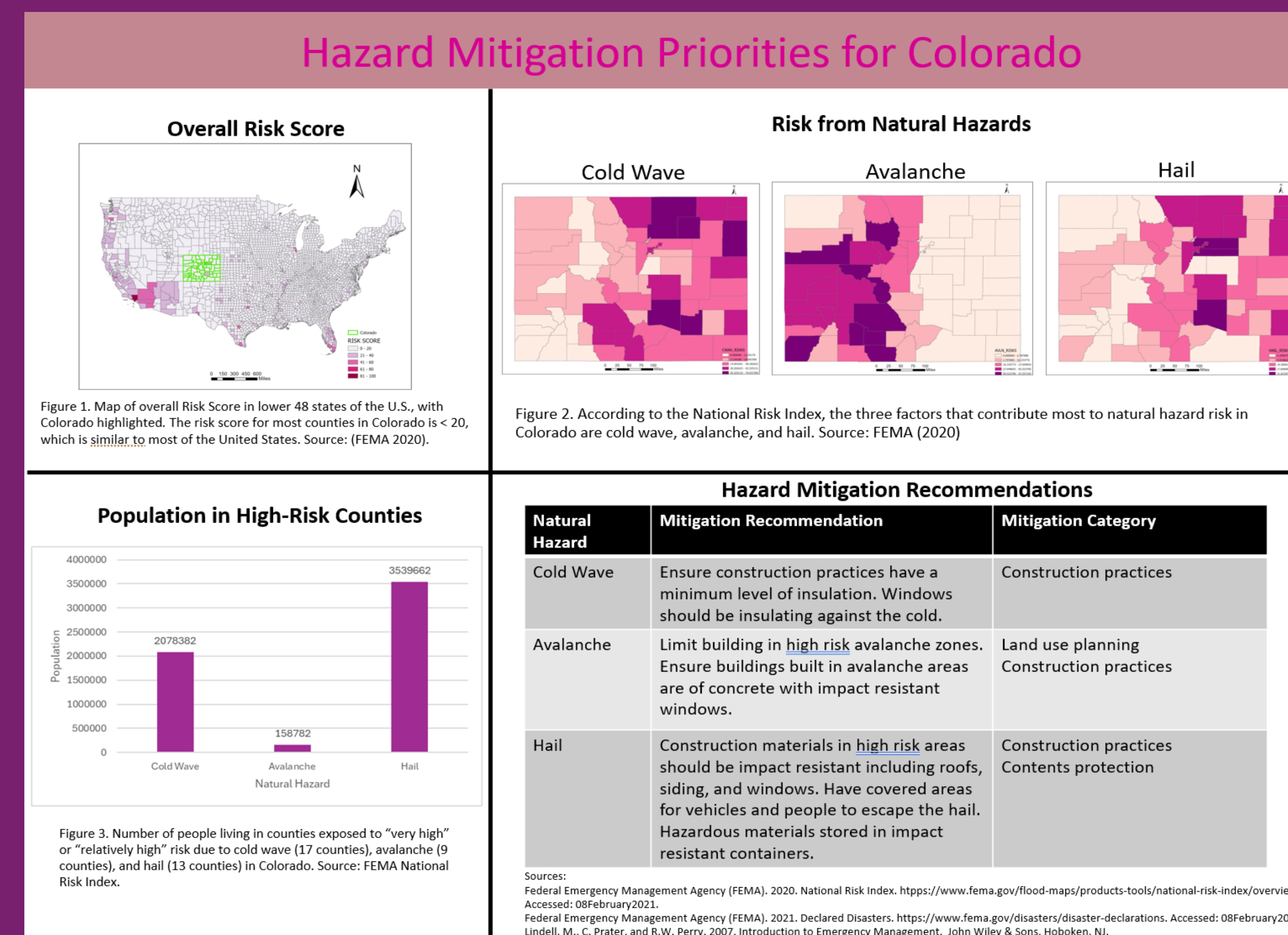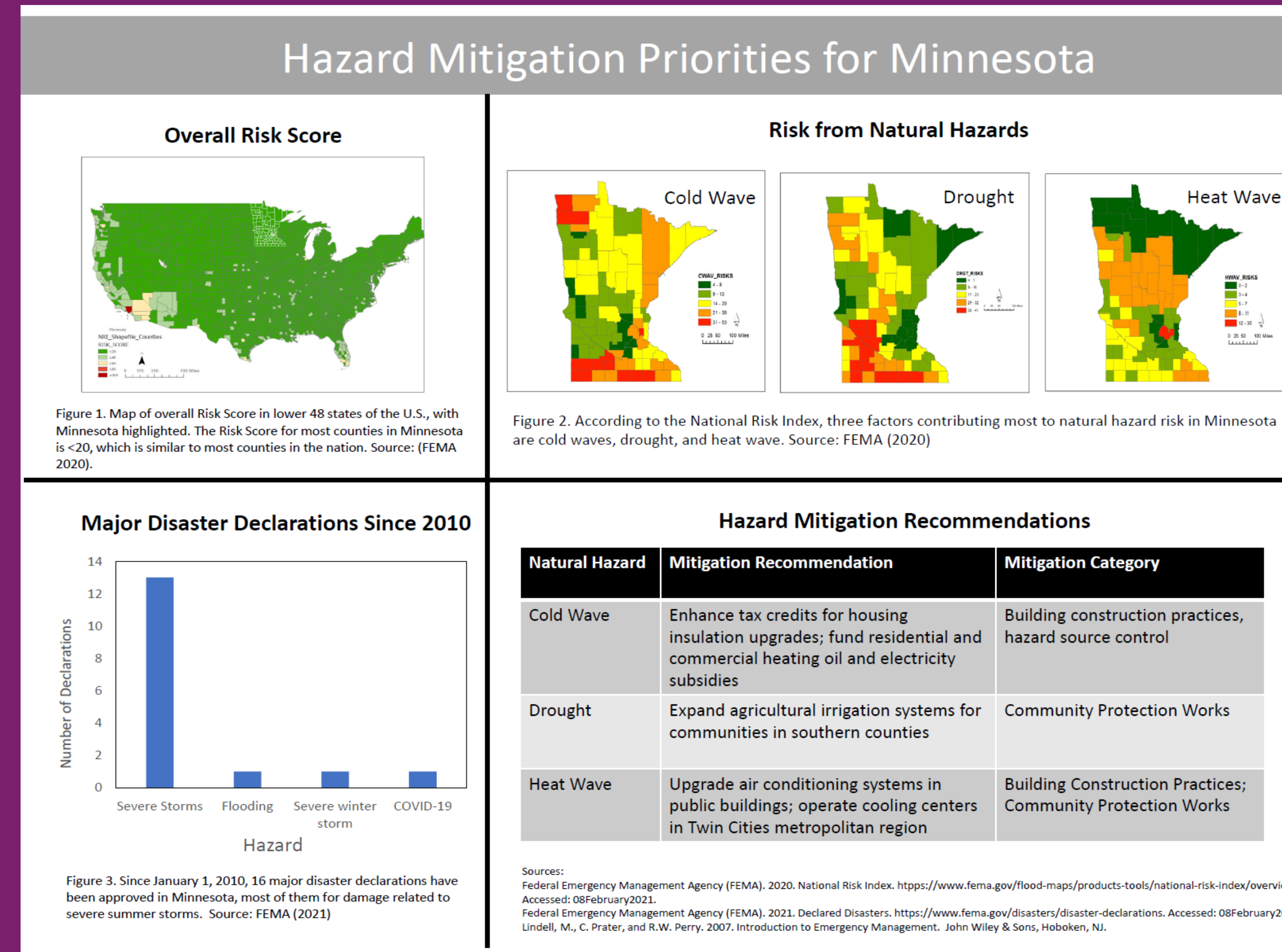
## QUAD CHART EXAMPLES


Fig. 2 Examples of quad charts identifying the top three highest risks for Minnesota and Colorado, and hazard mitigation recommendations.

## LEARNING OBJECTIVES

- Explore nationwide trends in risk from natural hazards.
- Apply knowledge of hazard mitigation tools.
- Apply geospatial analytical techniques in the context of emergency management.

## LEARNING OUTCOMES

Students without extensive knowledge of ArcGIS Pro (Esri 2024) were able to follow the instructions and complete the assignment to develop their quad chart with minimal assistance.

Classroom learning was reinforced through this project by requiring critical thinking to determine the mitigation measures to recommend based on the risks identified.

Students positively responded to being able to recommend mitigation measures based on risks derived from real world data.

Viewing student submissions together provided an interesting and informative picture of how risk changes by geography across the United States, and how associated mitigation measures must change to address the identified risks.

## RECOMMENDATIONS

Recommendations for future assignments include :
- Shortening the amount of time allowed to students to complete the assignment. Most cadets were able complete the assignment within two class periods and therefore will shorten the period assignment from five days to three.

- To expand the assignment, we recommend requiring students to determine if the hazard mitigation recommendations have been implemented in their chosen state.

## REFERENCES

Esri (2024). ArcGIS Pro: Release 3.3.1. Redlands, CA: Environmental Systems Research Institute; FEMA (2013) Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards. Available Mitigation Ideas (fema.gov); FEMA (2015) National Preparedness Goal. Available: https://www.fema.gov/emergency-managers/national-preparedness/goal; FEMA (2024) National Risk Index map. Available https://hazards.fema.gov/nri/map. Zuzak, C., E. Goodenough, C. Stanton, M. Mowrer, A. Sheehan, B. Roberts, P. McGuire, and J. Rozelle. 2023. National Risk Index Technical Documentation. Federal Emergency Management Agency, Washington, DC