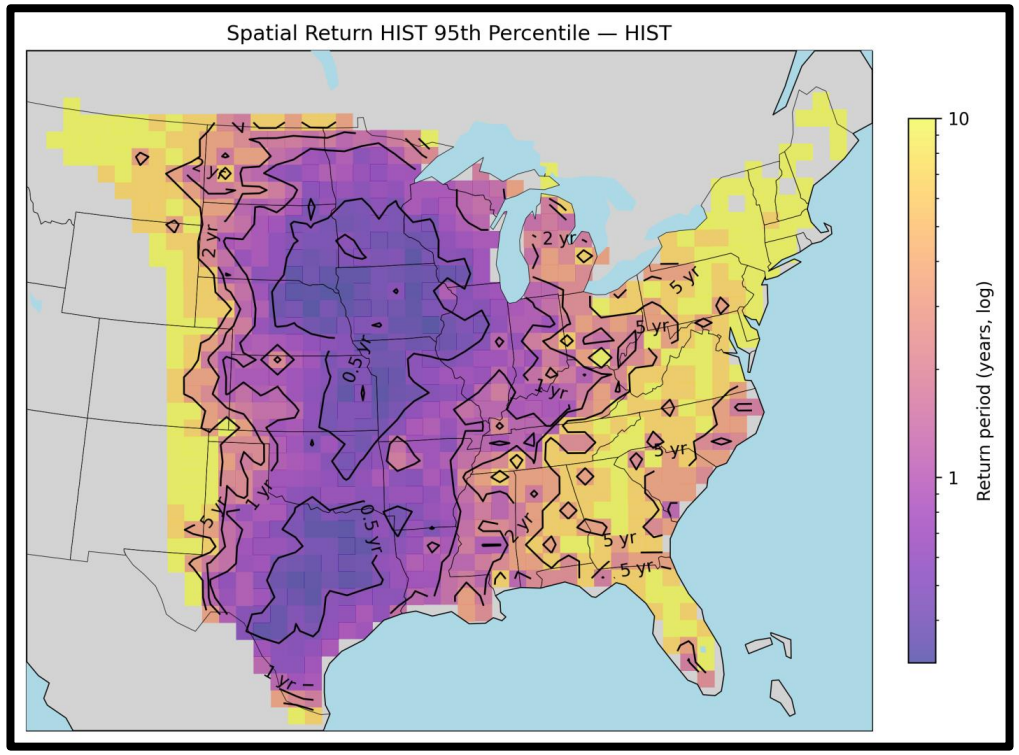
Evolution of High-Loss SCS Events in the U.S.



Lead PI: Caitlin M. Roufa[1]

Collaborators: Walker Ashley[1], Victor Gensini[1], Alex Haberlie[1]

[1] Northern Illinois University

Northern Illinois University

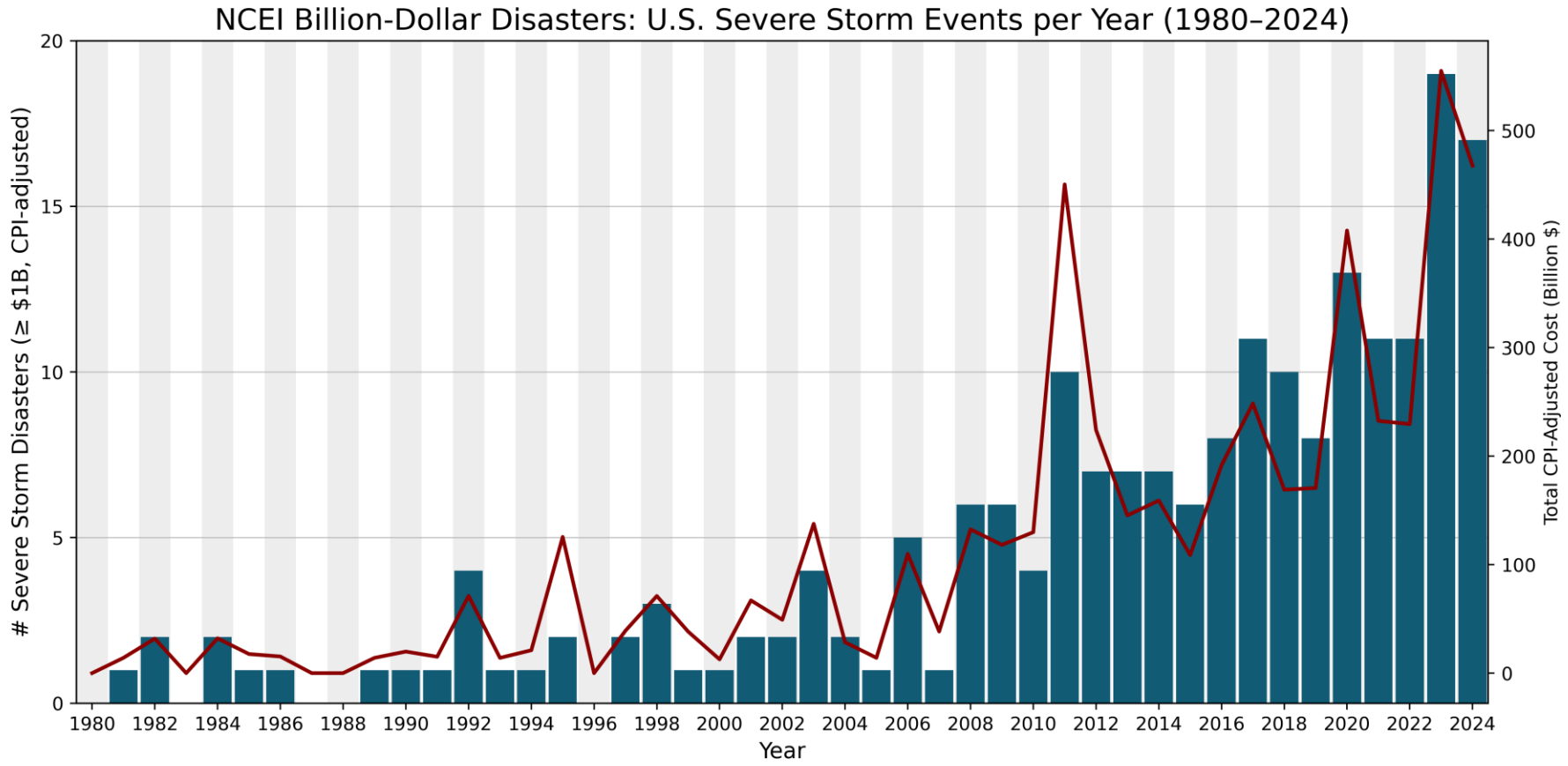
WISCONSIN UNIVERSITY OF WISCONSIN–MADISON

CIRCS

NOAA

NSF

Need and Relevance



Northern Illinois University

WISCONSIN

CIRCS

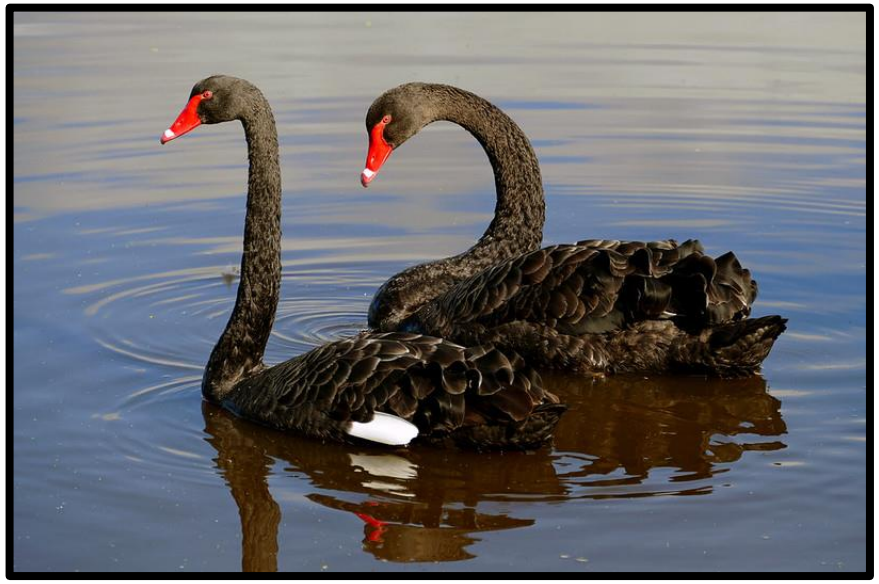
NOAA

NSF

Need and Relevance

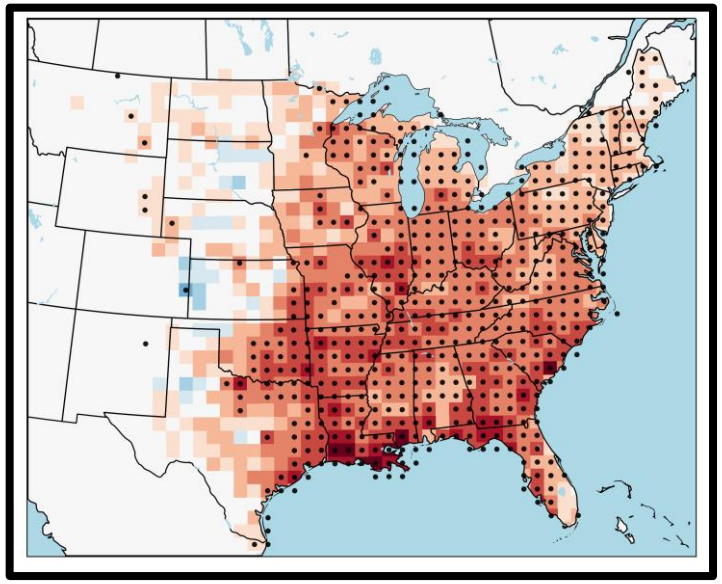
Problem

How are the most extreme SCS outbreak events changing in the U.S.?



Gap

We need to quantify the evolution of high-loss SCS outbreaks.



Solution

Create SCS outbreak risk surfaces for historical and future periods.

Northern Illinois University
WISCONSIN
CIRCS
NOAA
NSF

Project Vision

This project will improve understanding of the changing risk of high-loss severe convective storm (SCS) events in the U.S. by quantifying projected seasonal and annual trends in SCS outbreak frequency, variability, and spatial extent between the historical period and mid-century.

Northern Illinois University
WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON
CIRCS
NOAA
NSF

Alignment with CIRCS Research Pillars

Risk

Creation of risk surfaces for high-loss SCS outbreak events.

Variability and Change

Quantifies climate-driven trends in the frequency, variability, spatial extent, and return period of catastrophic convective storm events.

Societal Impacts

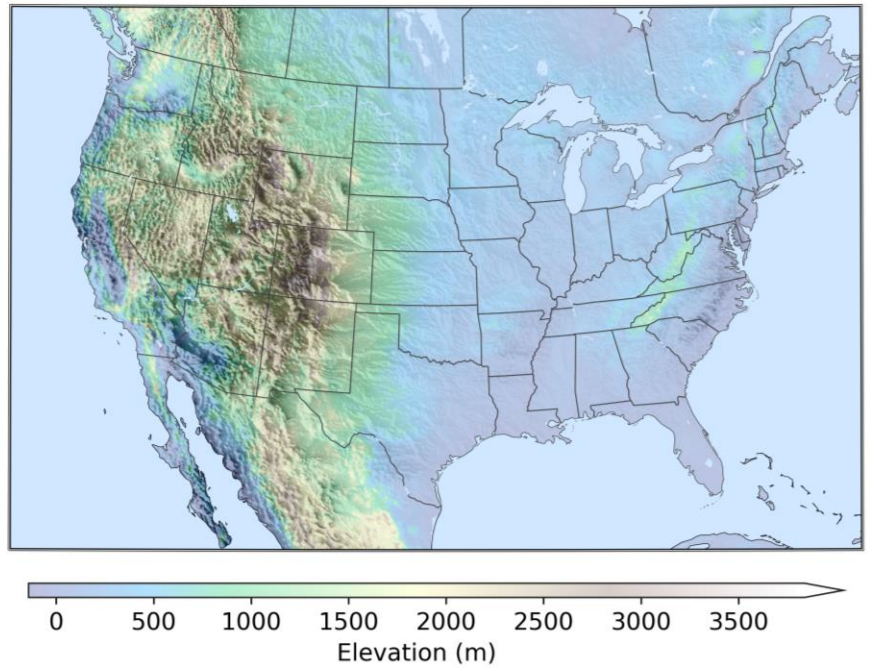
Identifies regions where high-loss hazard potential is projected to increase most.

Northern Illinois University
WISCONSIN
CIRCS

Approach: WRF-BCC

- Generated by **Gensini et al. 2023**
- **Convection-permitting, dynamically downscaled RCM simulation**
- WRF-ARW v4.1.2
- GCM Input from CESM
- Bias-corrected with ERA-Interim Reanalysis
- CONUS domain
- 3.75 km horizontal grid
- 51 vertical levels

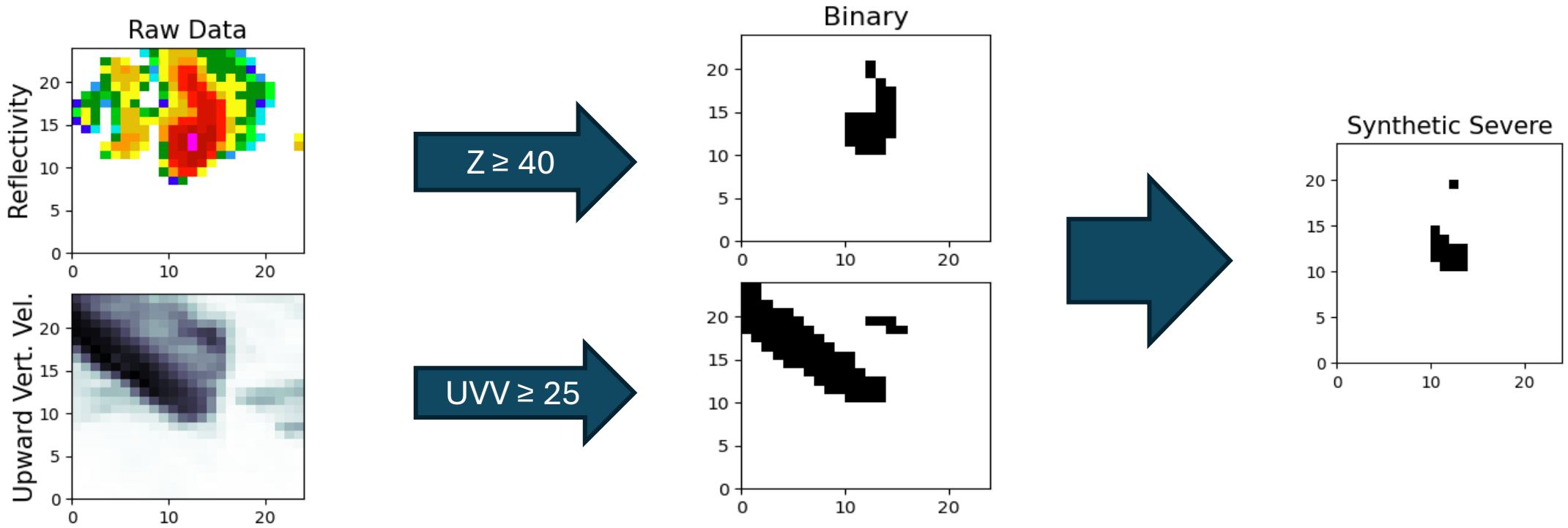
HIST	1990 – 2005
MID	2040 –2055 RCP 4.5 RCP 8.5
END	2085 –2100 RCP 4.5 RCP 8.5



Northern Illinois University
WISCONSIN
CIRCS
NOAA
NSF

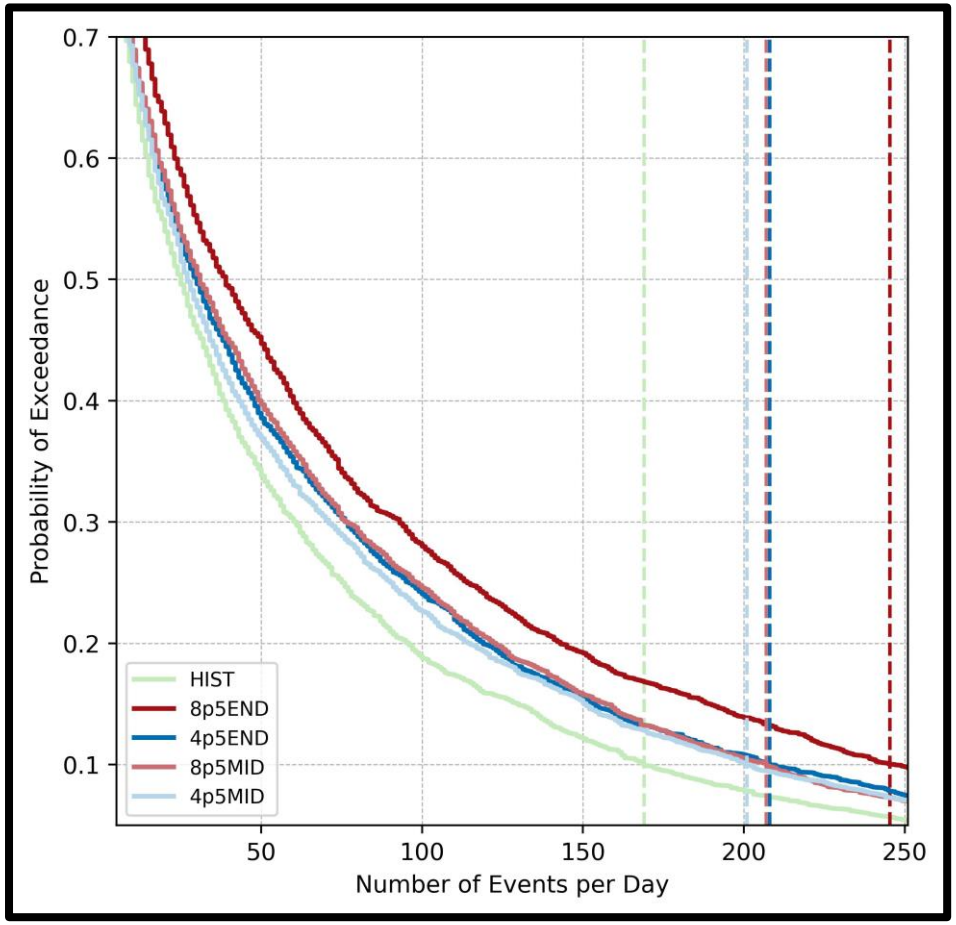
Approach

1. Select SCS proxy in WRF-BCC output (Roufa et al. In Review)



Approach

2. ID percentile thresholds of our SCS proxy in WRF-BCC HIST in alignment with historical high-loss events



Calculate tail end (e.g., 90th, 95th percentile) events per day in HIST

→

Compare RCM pct output with historical outbreak characteristics

Northern Illinois University

WISCONSIN

CIRCS

NOAA

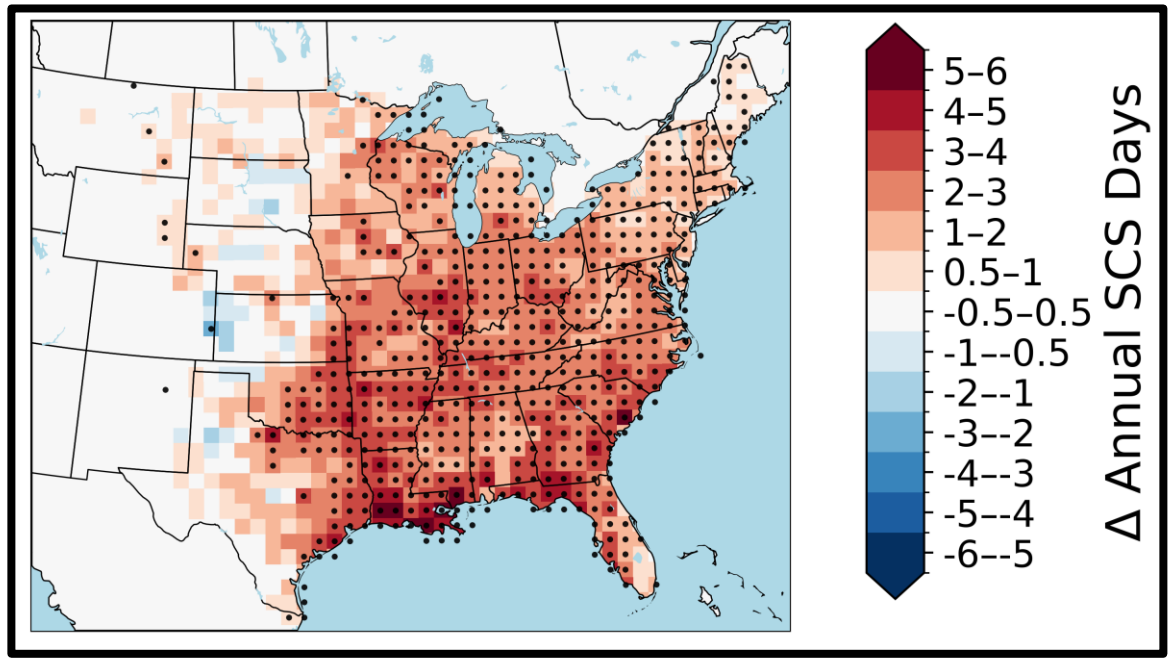
NSF

Approach

3. Apply percentile thresholds to mid-century WRF-BCC output and assess trends in extreme SCS between periods

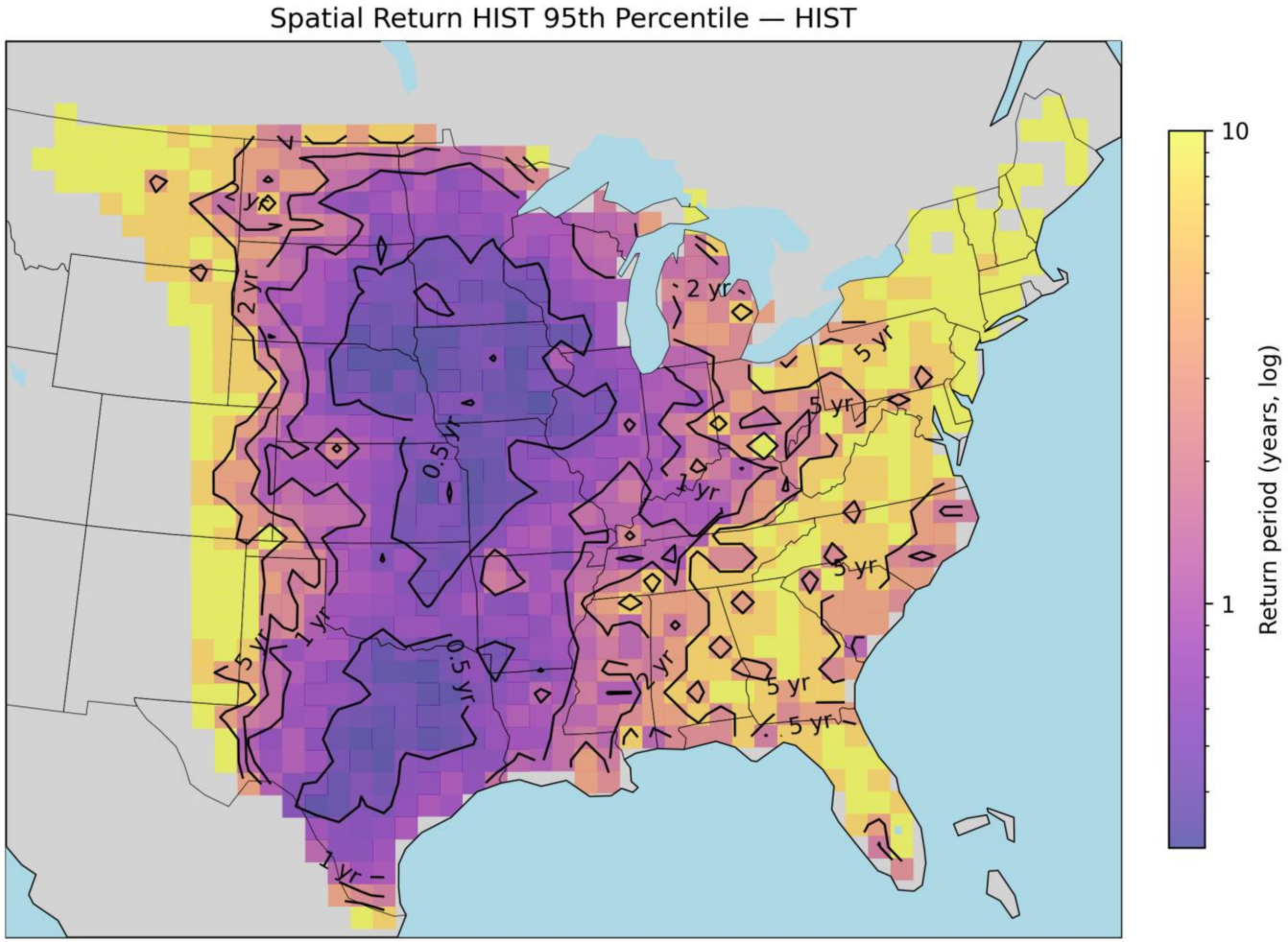
Define outbreak days in MID4.5 and 8.5 using HIST percentile thresholds

Assess frequency, variability, and spatial extent changes between HIST and MID4.5 and 8.5



Northern Illinois University
WISCONSIN
CIRCS
NOAA
NSF

Expected Outcomes and Deliverables



Outbreak Risk Surfaces

Catalog of annual and seasonal mean gridded spatial figures of changing extreme SCS events.

Outbreak Dataset

Gridded data of seasonal and annual frequency, variability, trends, and return periods for historical and mid-century extreme SCS's.

Northern Illinois University
WISCONSIN
CIRCS
NOAA
NSF

Impact

Actionable hazard information

Gridded, loss-aligned risk surfaces for historical and mid-century periods that members can directly intersect with exposure data to assess outbreak risk on multiple planning horizons.

Research Advancement

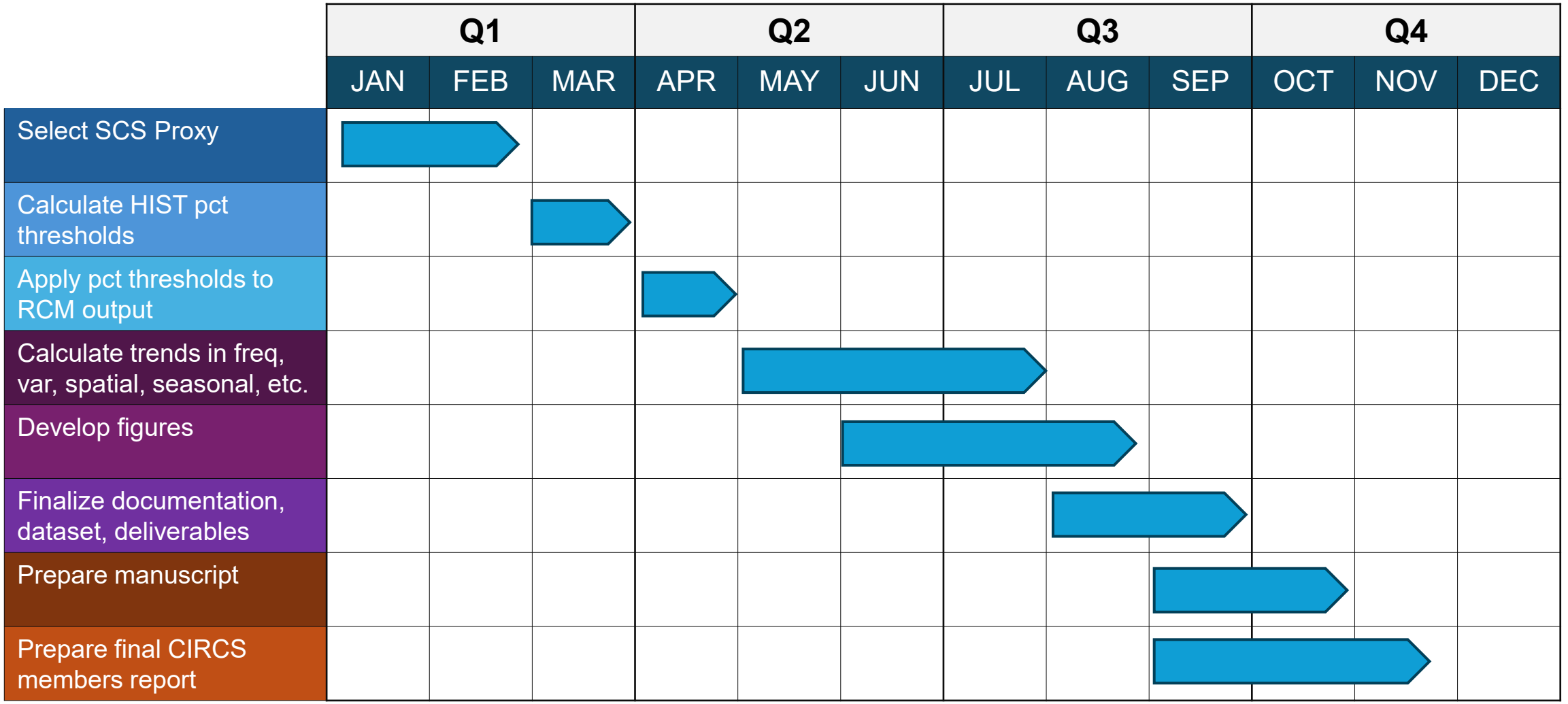
Establishes a reproducible framework for translating climate model projections into loss-relevant severe weather hazard products.

Synergy with CIRCS Research

Potential collaboration with other projects (Haberlie, Lang, Strader, etc.) to broaden research outcomes for CIRCS members.

Northern Illinois University
WISCONSIN
CIRCS

Project Timeline



Northern Illinois University
WISCONSIN
CIRCS

Project Budget

Personnel: $85k

Materials and Supplies: $20k

- Compute time
- Data Storage and Egress

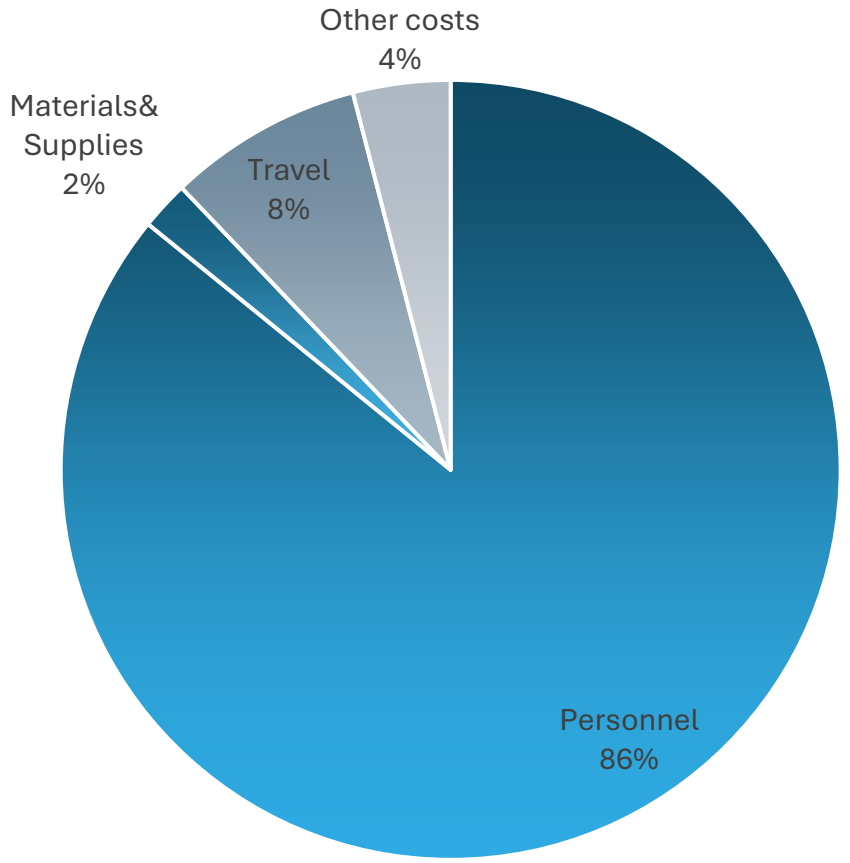
Travel: $8k

- Conference presentations (AMS SLS 2026, AMS Annual 2027)

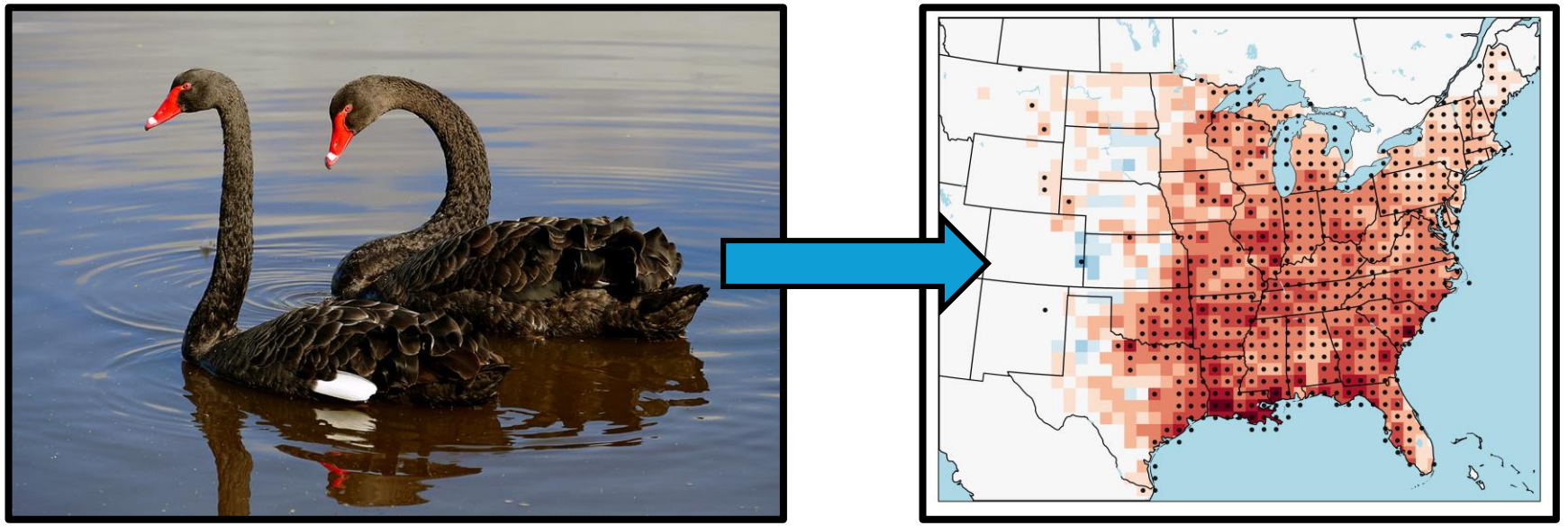
Other: $4k

- Open access publication fees

Total: $117,000



Evolution of High-Loss SCS Events in the U.S.



This project will deliver seasonal and annual risk surfaces for high-loss SCS events in historical and mid-century periods for U.S. regions, providing understanding of the evolution of these events for risk assessment at multiple planning timelines.

Northern Illinois University
WISCONSIN
CIRCS
NOAA
NSF