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Developing a geospatial product to assess climate change vulnerability in USFWS Region 3

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USGS Mission

- provide reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

- provide the scientific information needed by managers, decision makers, and the public to protect, enhance, and restore the ecosystems in the Upper Mississippi River Basin, the Midwest, and worldwide.

Project: Vulnerability assessment and adaptation planning for projected changes in water quality and quantity for protected areas in the Upper Mississippi Watershed

Goal: pilot an approach that will allow FWS offices in the Midwest to begin working towards increasing our local and regional ability to address climate change

Objectives

- Assess vulnerability of protected lands to projected climate and land use changes at sub-watershed and parcel-level scales
- Develop adaptation strategies for mitigating impacts to focal resources

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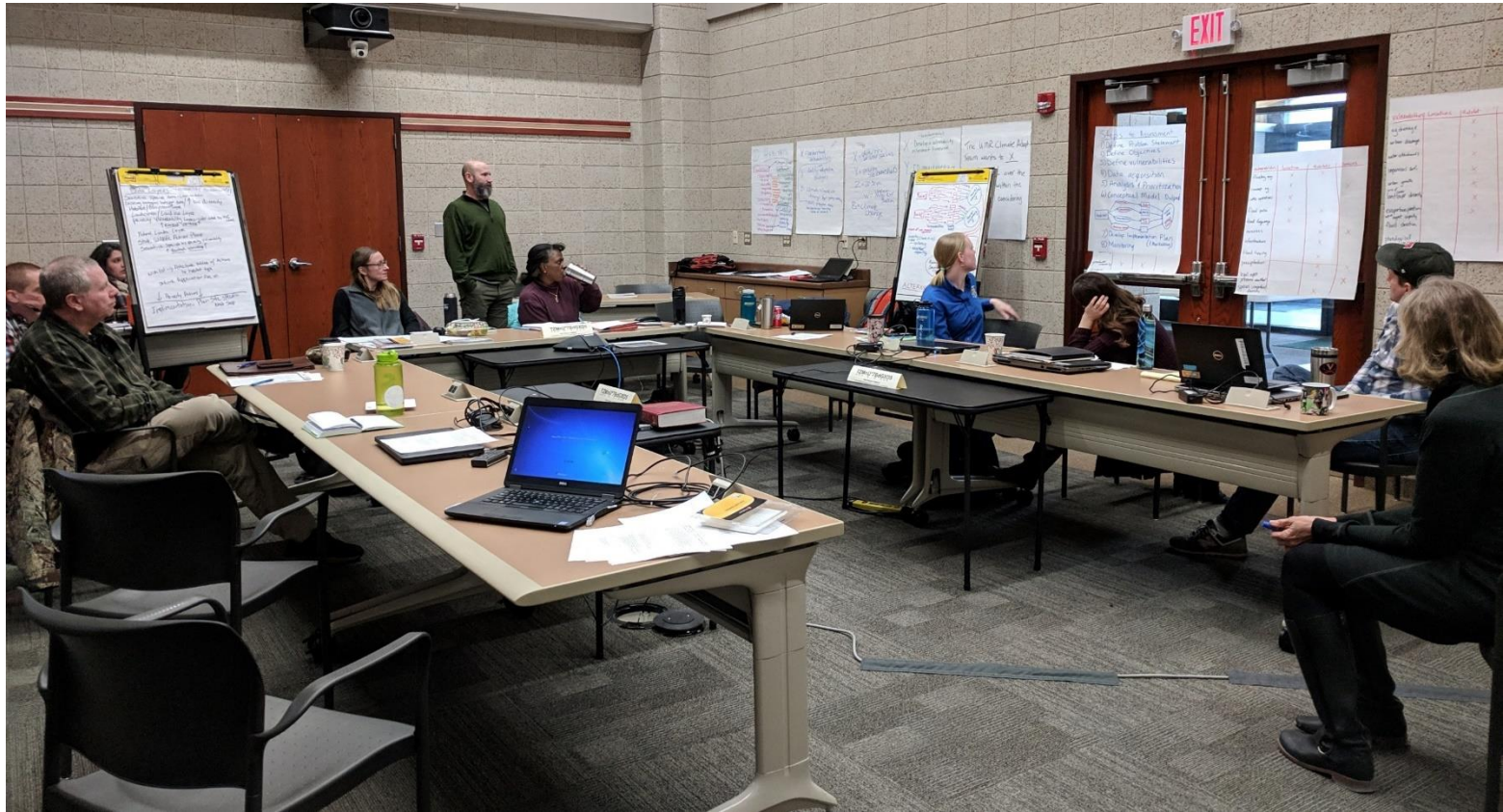
Workshop

- March 5th & 6th, 2019
- Managers and researchers working at species, habitat, refuge, and landscape levels



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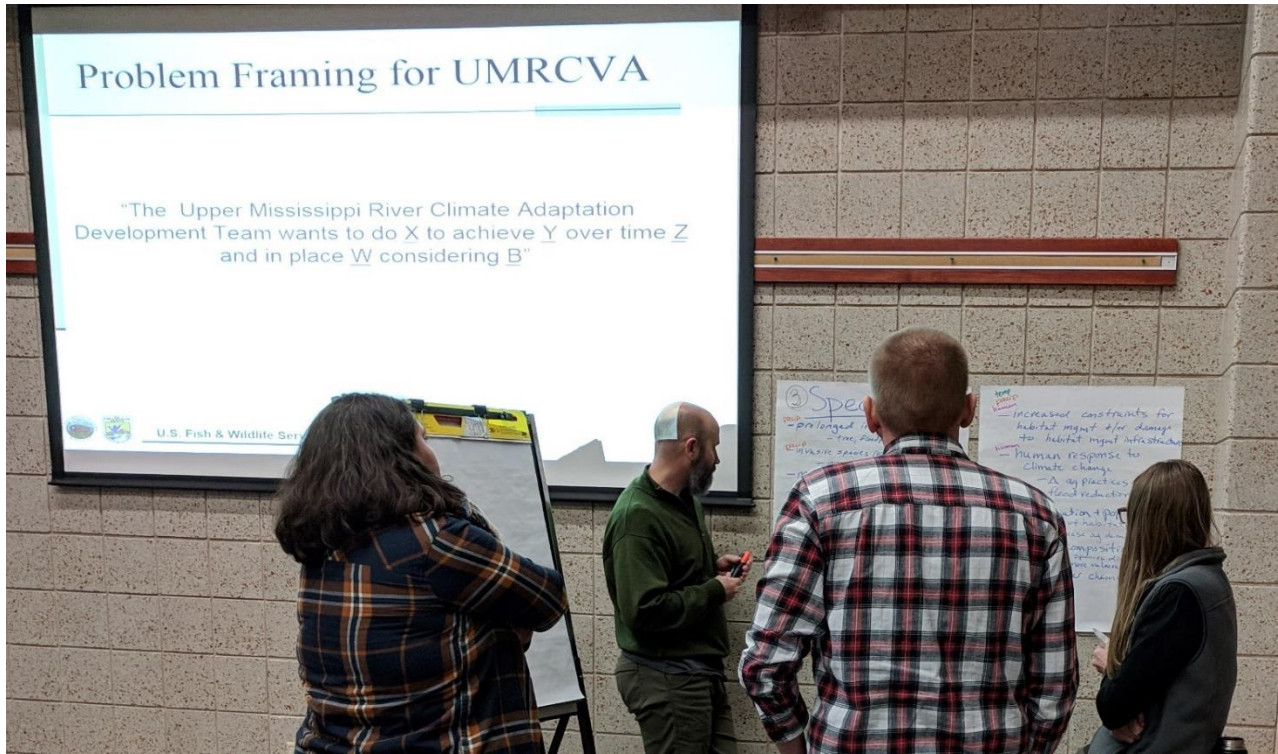
Problem Statement

- The UMR Climate Adaptation Team wants to **develop a vulnerability assessment framework** to identify areas and **prioritizing** these **areas** for the purpose of **developing adaptation strategies**…



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Study Area

- Upper Mississippi River Basin
- USFWS Region 3

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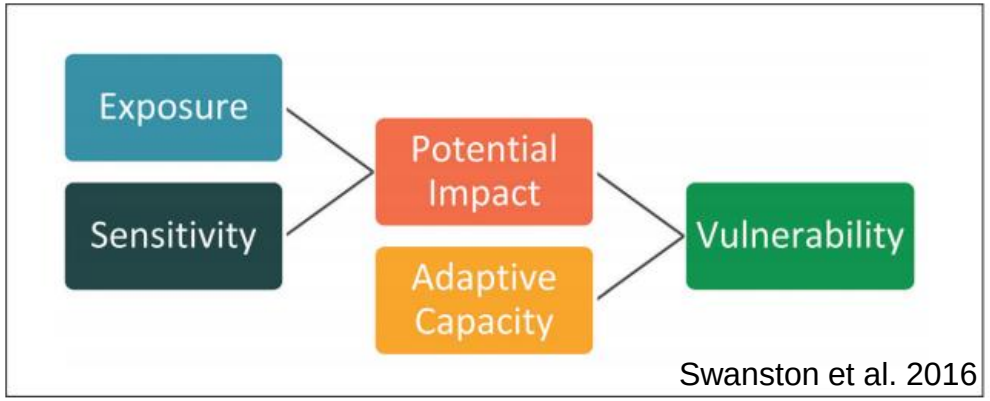
Process for developing vulnerability assessment

- Provides an understanding of the potential impacts of climate change on identified focal resource (i.e., species, habitats)
  - Exposure – expected/projected magnitude and rate of environmental change
  - Sensitivity – considers resource's tolerance to environmental change
  - Adaptive capacity – ability of resource to cope with environmental change



Swanston et al. 2016

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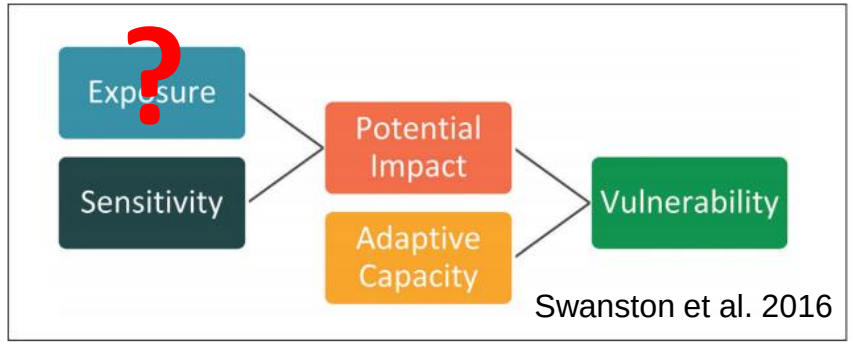
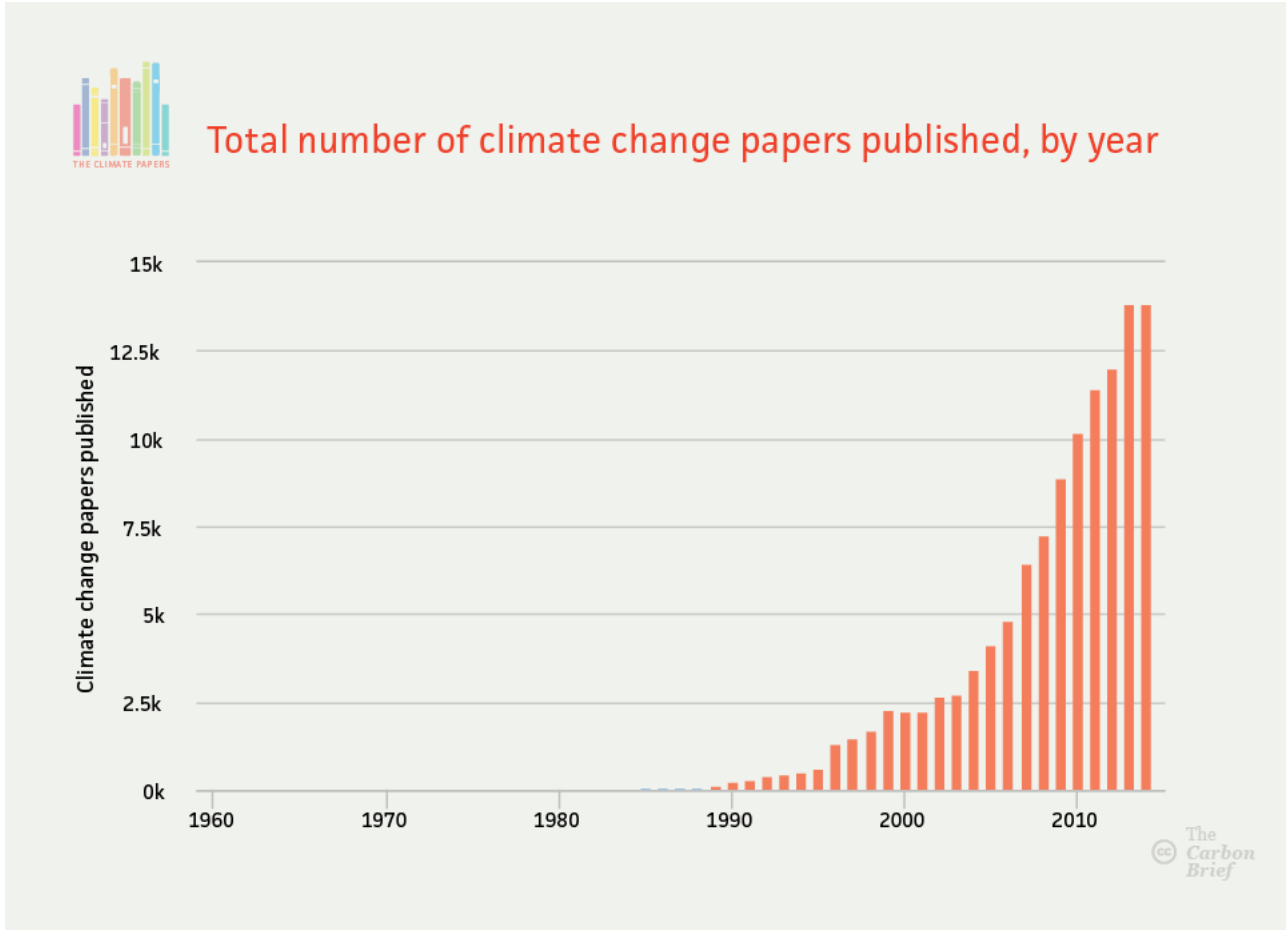
“The Practitioners Dilemma”



- Google Scholar: “climate change”
  - 2.3 Million Results
- Google Scholar: "climate change" Midwest “United States“
  - 67,000 Results



carbonbrief.org

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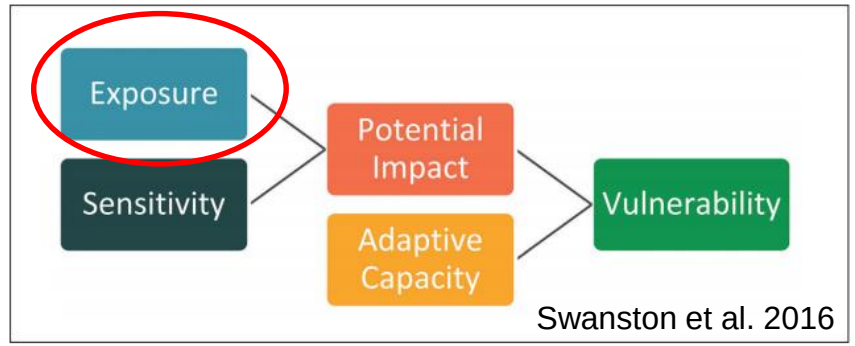
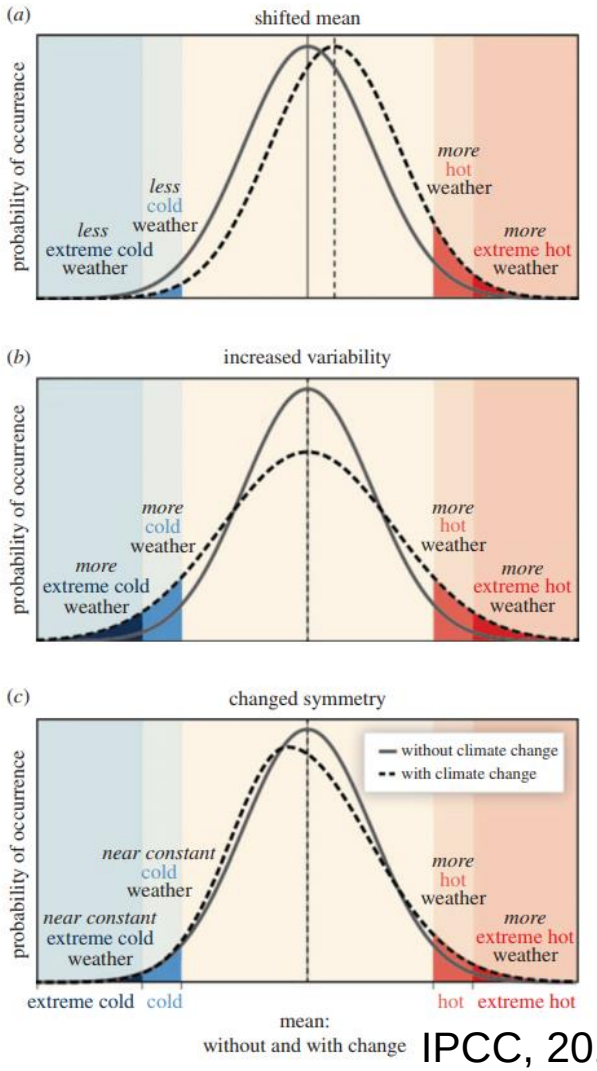
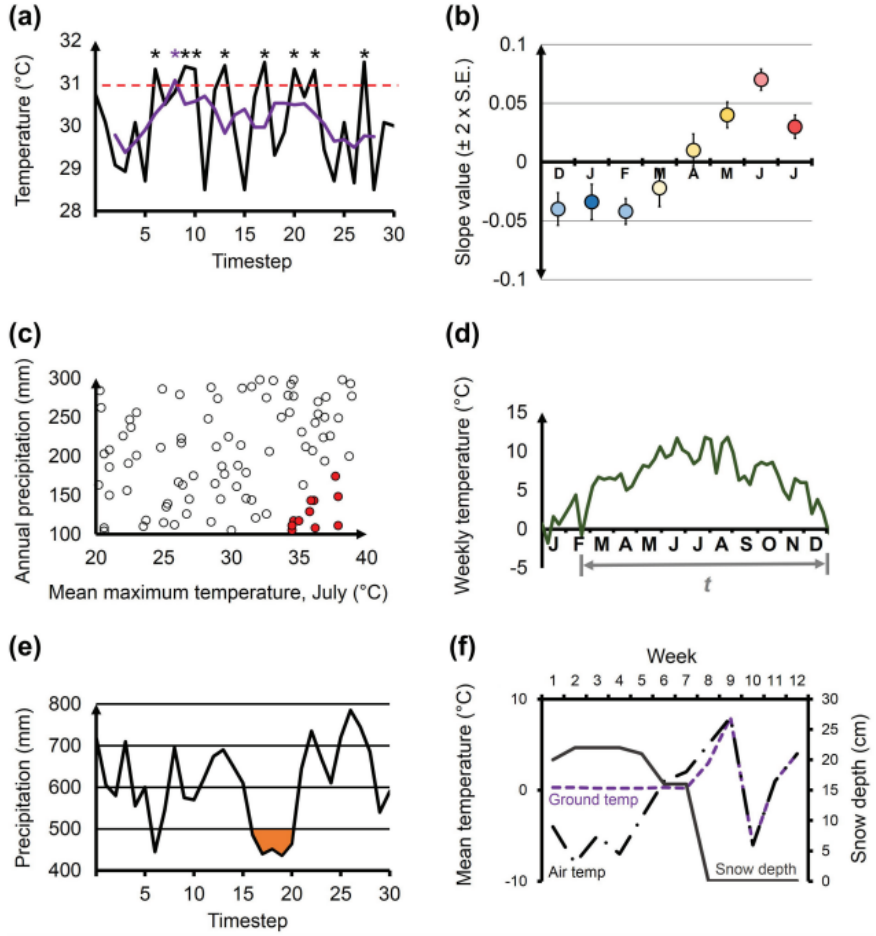
Ecological Relevance



Swanston et al. 2016



IPCC, 2012



Suggitt et al. 2017

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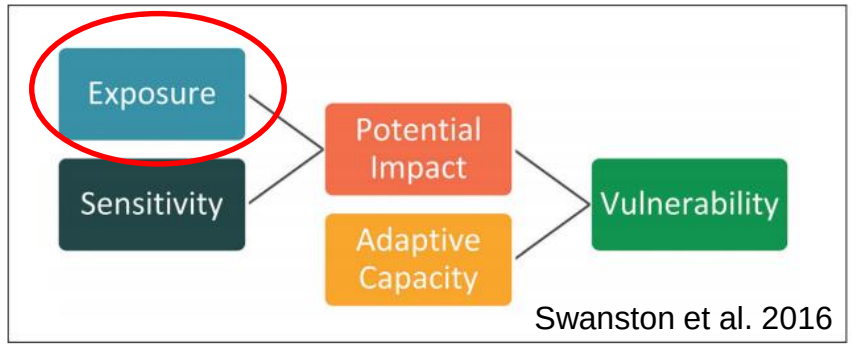
Preliminary Key Exposures



Swanston et al. 2016

- Temperature
  - Seasonal Averages
  - Growing Season Start/Length
  - Water Temp
  - Annual Avg. Temp
  - *False spring, snow depth/snow melt*
- Precipitation
  - Flood Frequency
  - Drought
  - Seasonality
  - Length of Inundation
  - Nutrients & Sediments
- Land-Use/Land-Cover
  - Agriculture
  - Developed
  - Infrastructure
  - Wetlands
  - Nutrients & Sediment

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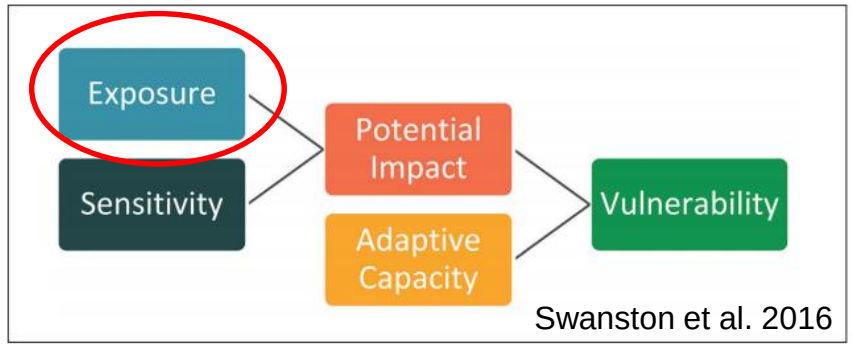
Compile Data



Swanston et al. 2016

- Temperature
  - Climate Models
- Precipitation
  - Climate Models
  - Hydro Models
    - HAWQS
    - SWAT
- Land-Use/Land-Cover
  - FORE-SCE

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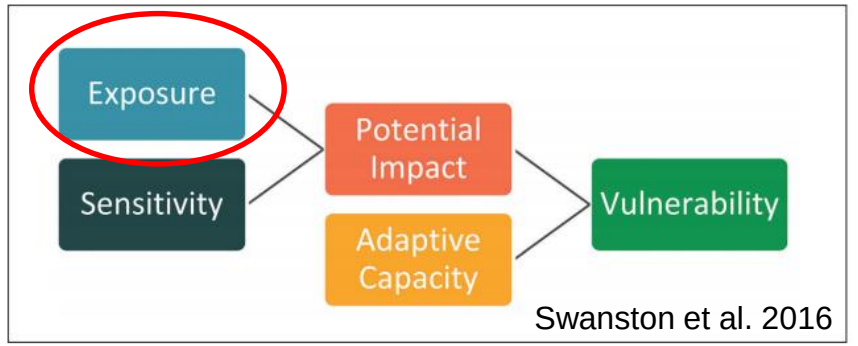
Standardize Different Data Sources



Swanston et al. 2016

- Timeframe
  - Historic 1986-2005
  - Mid Century 2040-2059
- Pathway/Scenarios
  - 4.5 (SRES B1)
  - 8.5 (SRES A2)

SWAT Soil & Water Assessment Tool

HAWQS Hydrologic and Water Quality System
A National Watershed and Water Quality Assessment Tool

CanESM2, CCSM4, GISS-E2-R, HadGEM2-ES, MIROC5

Ecological Applications, 24(5), 2014, pp. 1015–1036

Spatially explicit modeling of 1992–2100 land cover and forest stand age for the conterminous United States

Terry L. Sohl,[1,6] Kristi L. Sayler,[1] Michelle A. Bouchard,[2] Ryan R. Reker,[2] Aaron M. Friesz,[3] Stacie L. Bennett,[4] Benjamin M. Sleeter,[5] Rachel R. Sleeter,[5] Tamara Wilson,[5] Chris Soulard,[5] Michelle Knuppe,[1] and Travis Van Hofwegen[4]

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Spatial Scale

- HUC 8 – 364 watersheds in FWS Region 3

- HUC 10 – 1155 watersheds in Upper Mississippi River Basin

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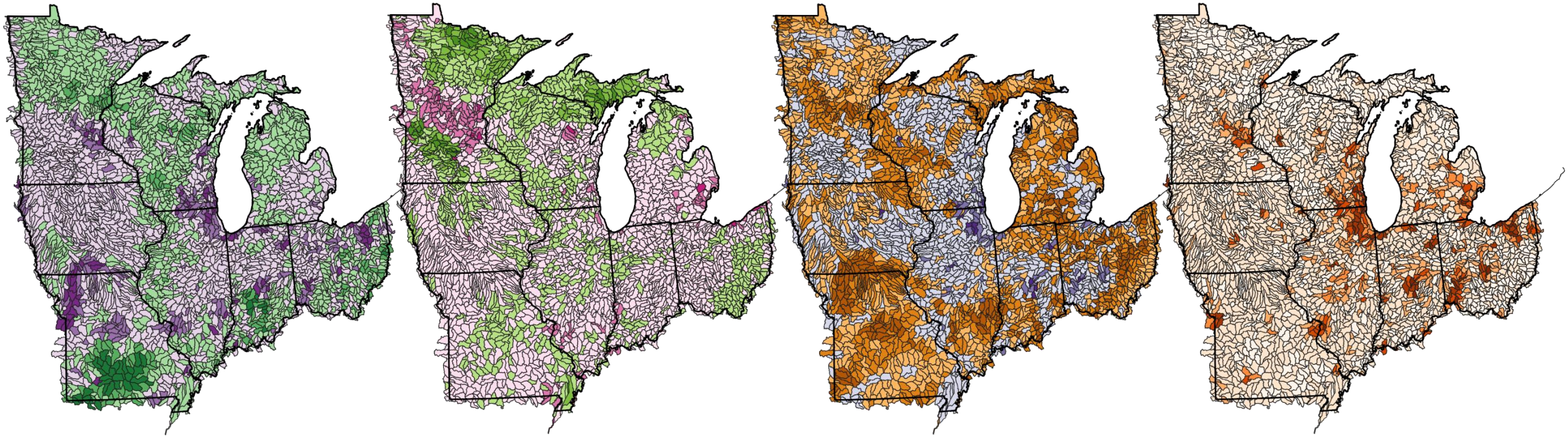
Create Layers



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Standardize Variables

- To create a composite index

- Because of different units, for example:
  - Temperature (degrees)
  - Precipitation (mm)
  - Flow (m^3/s)
  - Land Use (%)
  - Concentration (mg/L)

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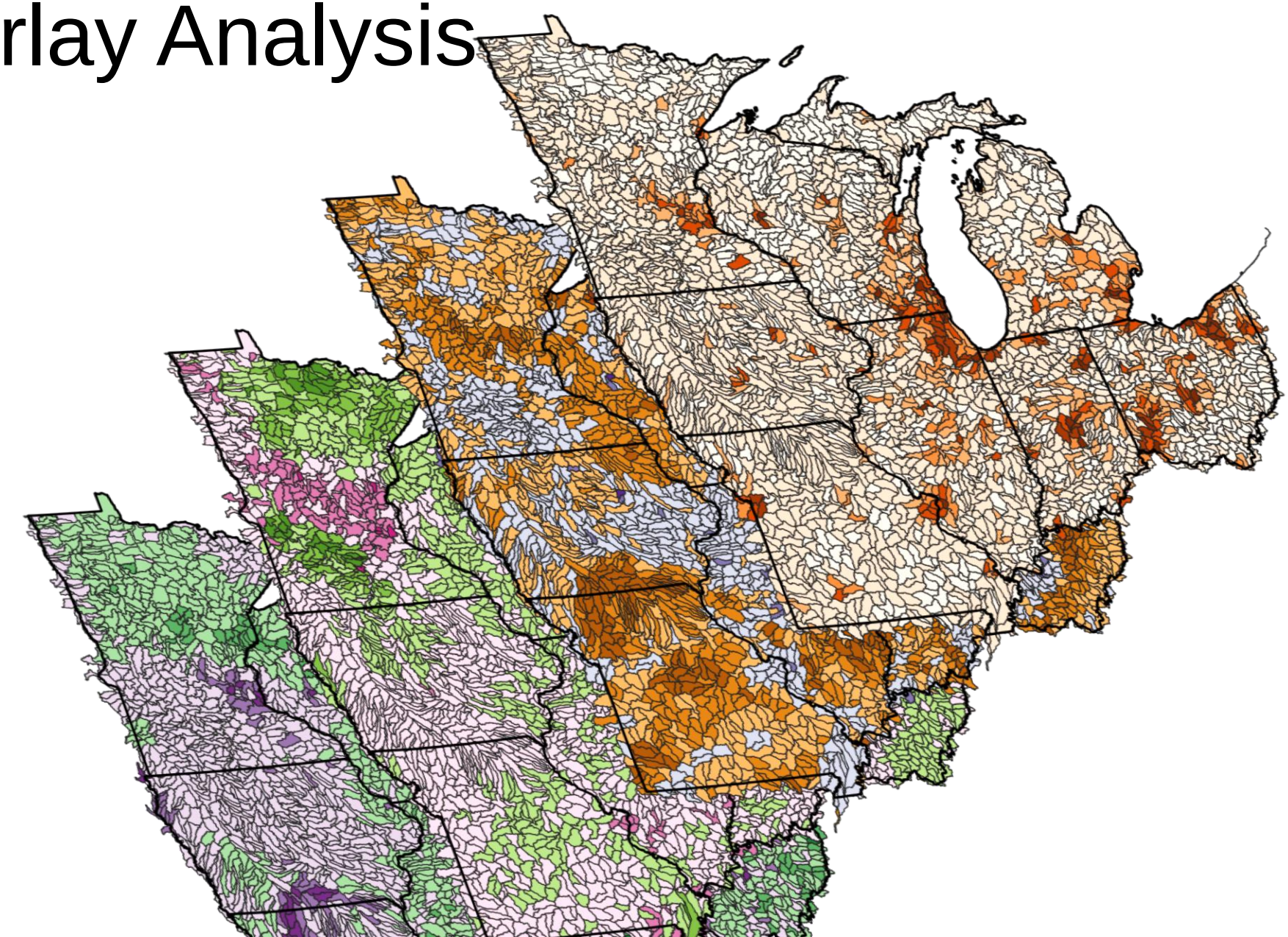
Overlay Analysis



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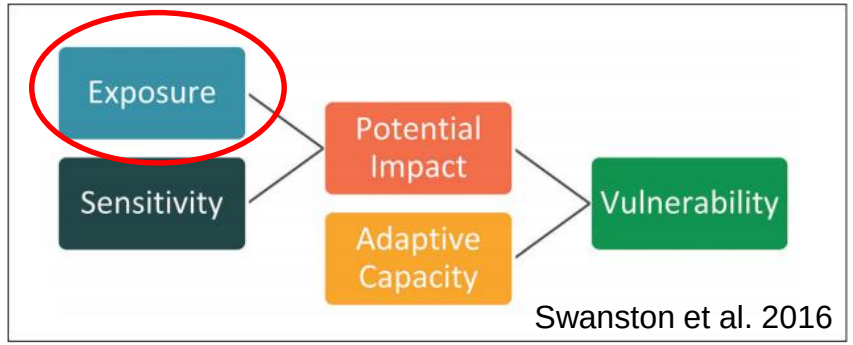
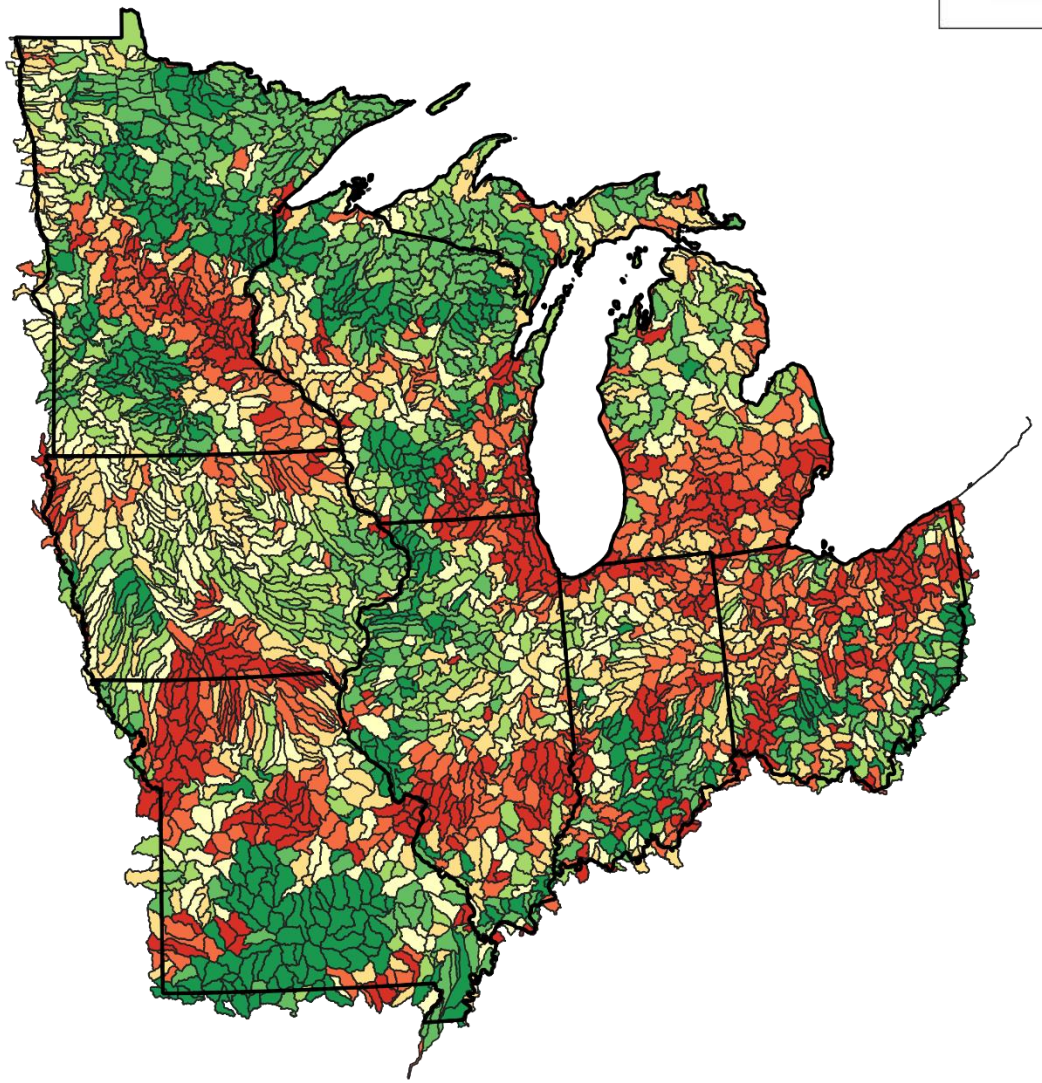
Identify Hotspots



Swanston et al. 2016



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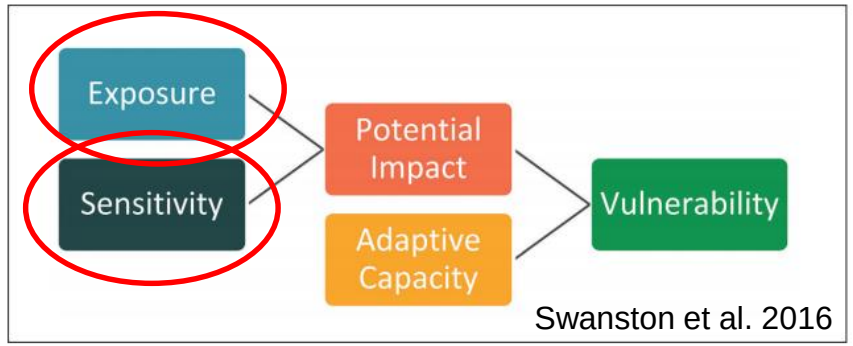
Identify Sensitivities



Swanston et al. 2016

- Perform literature review
- Query refuge managers

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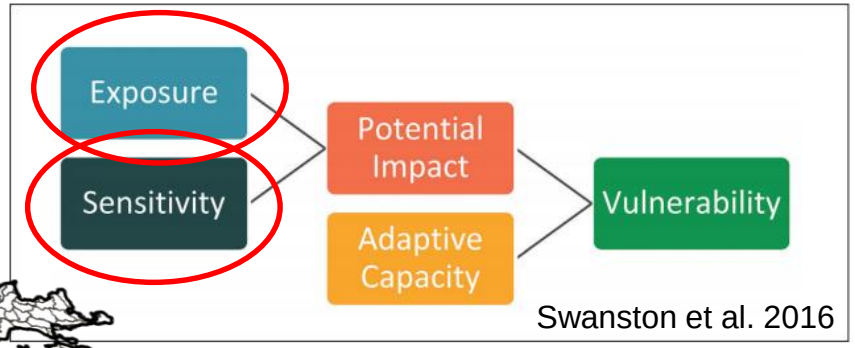
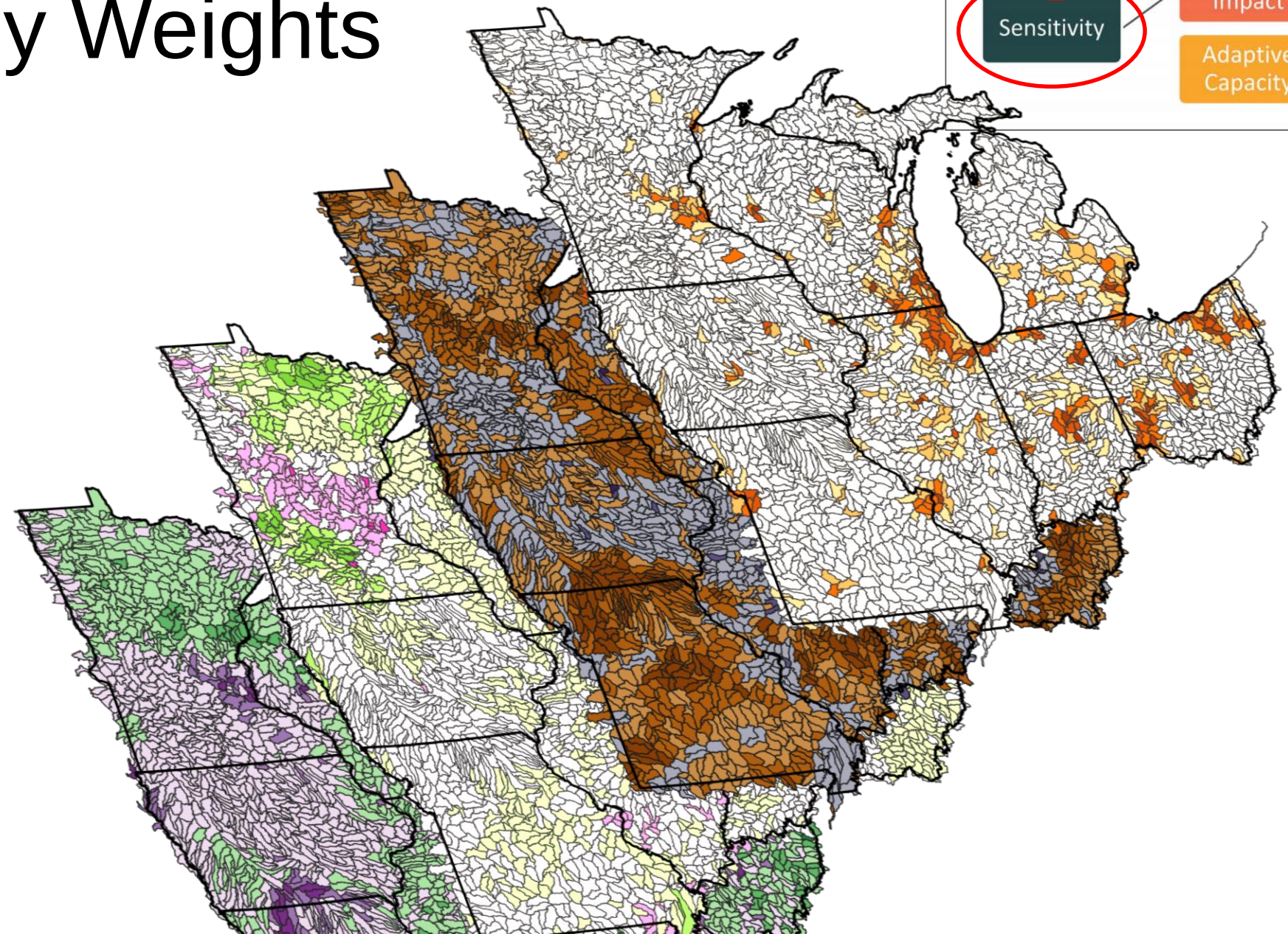
Apply Weights



Swanston et al. 2016



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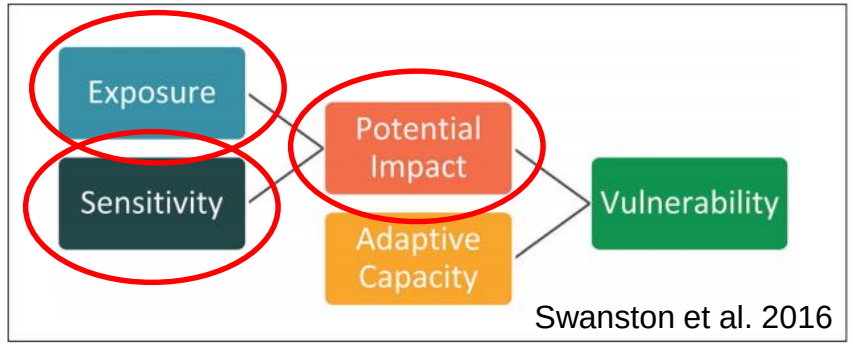
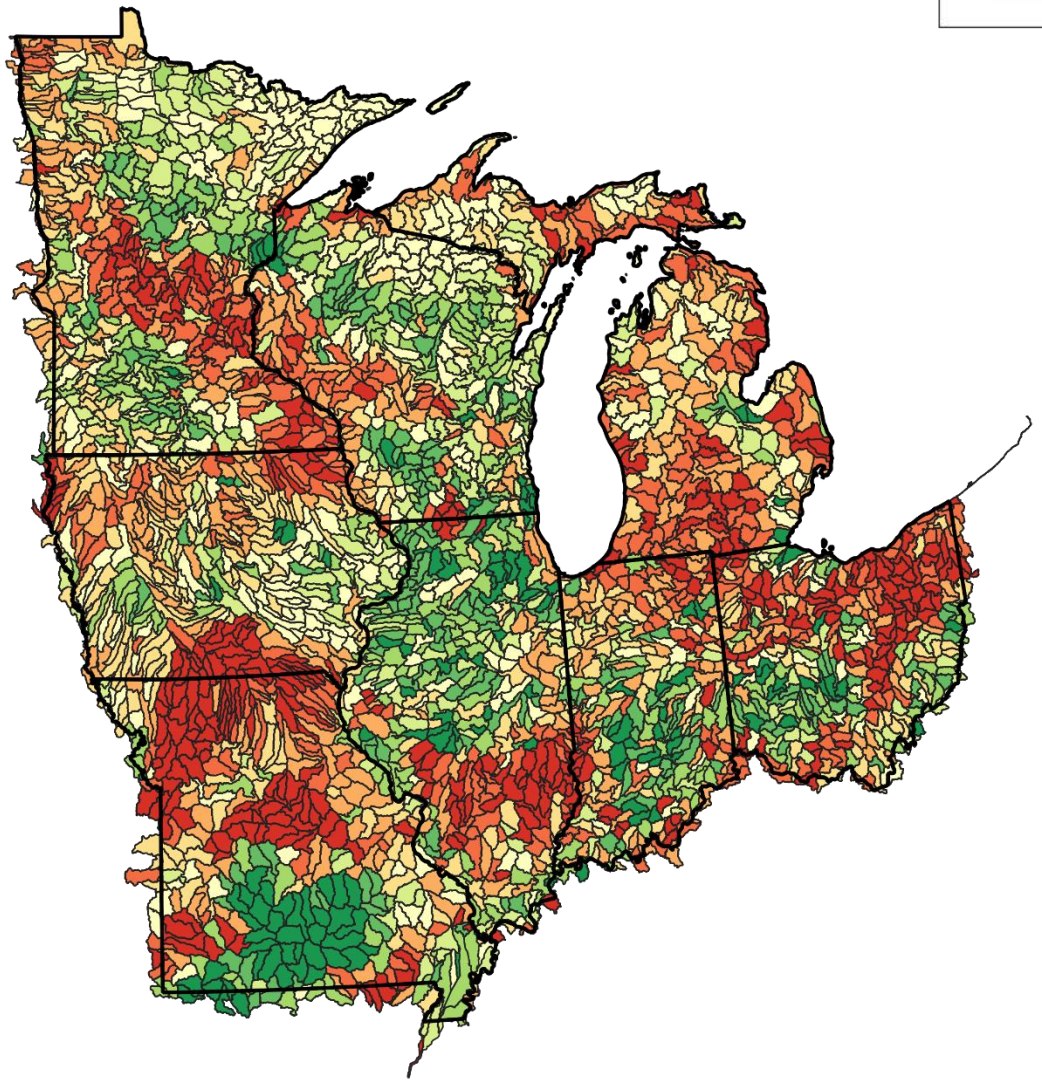
Potential Impacts



Swanston et al. 2016



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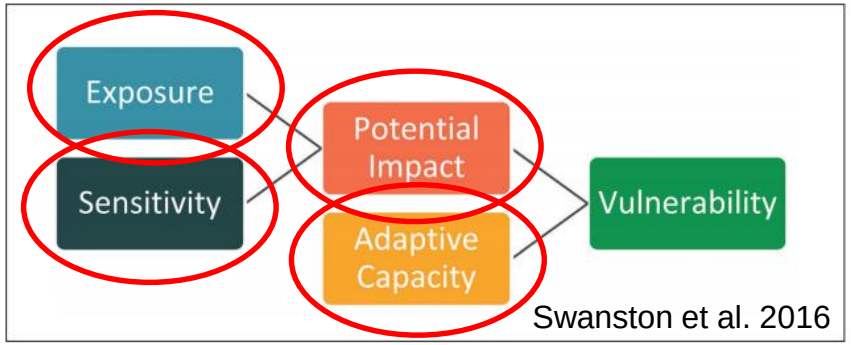
Build in Adaptive Capacity



Swanston et al. 2016

- Landscape Metrics

- Possibly
  - StreamCat
  - Index of Watershed Integrity
  - FishTails
  - TNC Resilience Mapping

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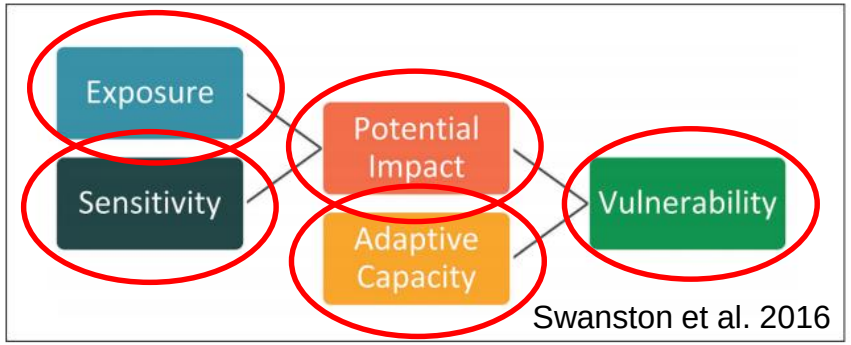
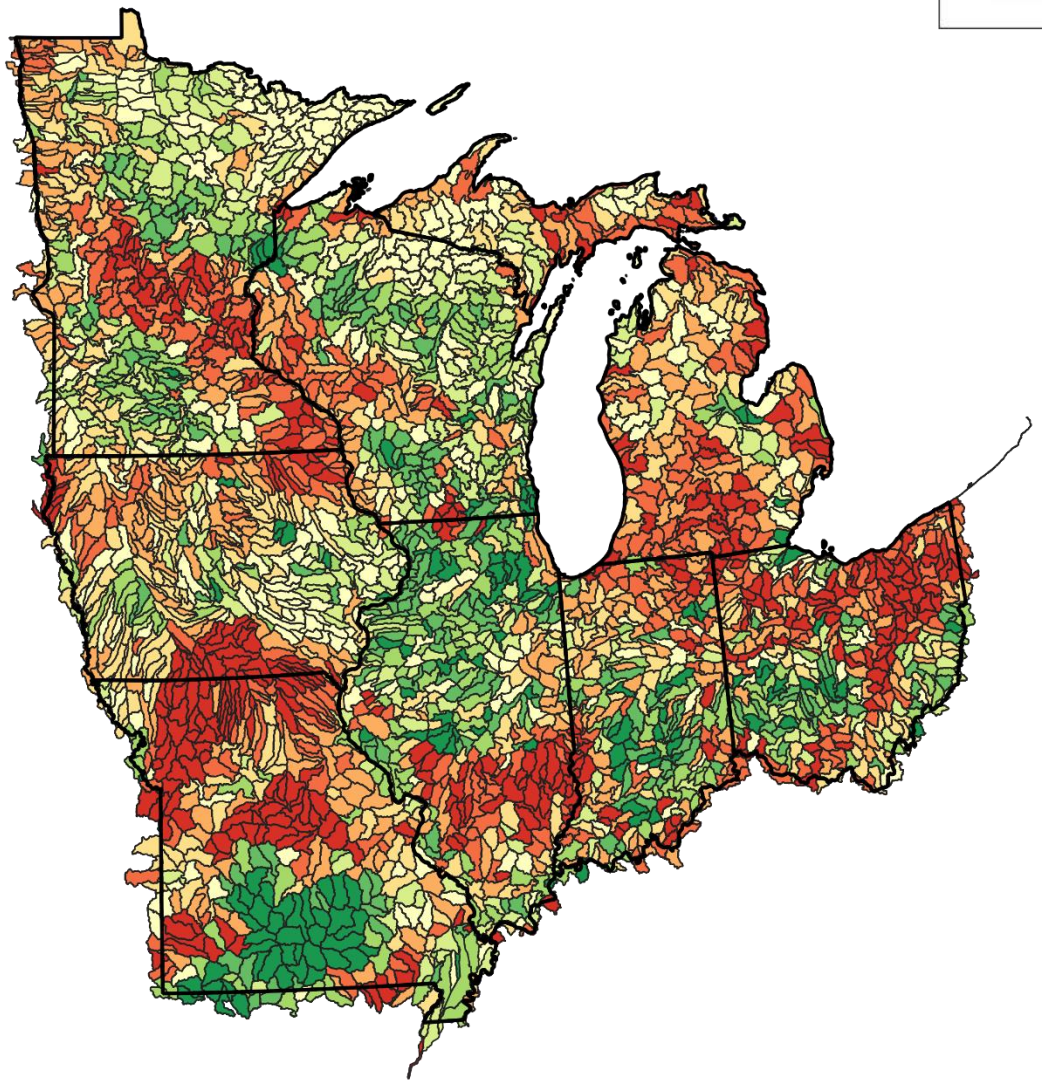
Geospatial Vulnerability Product



Swanston et al. 2016



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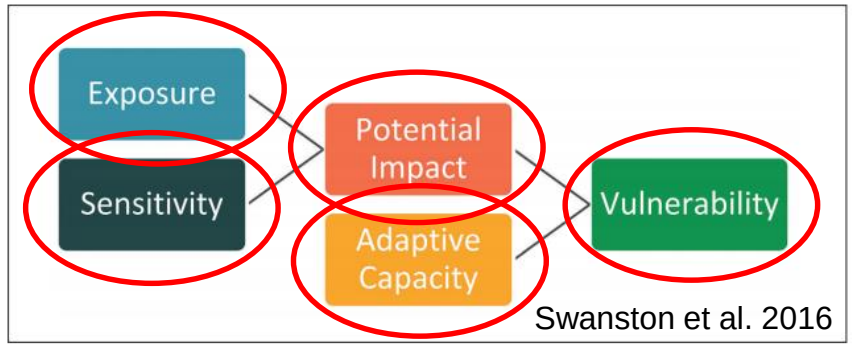
Next Steps



Swanston et al. 2016

- Rank watersheds
- Identify refuges in vulnerable areas

- Work with vulnerable refuges on performing refuge scale vulnerability assessments and develop adaptation strategies

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