Colorado Vulnerabilities to Flood, Drought, and Wildfire

Under a Changing Climate

A statewide pilot study to quantify and communicate the economic impacts of Colorado's three key hazards into the future

COLORADO
Colorado Water Conservation Board
Department of Natural Resources

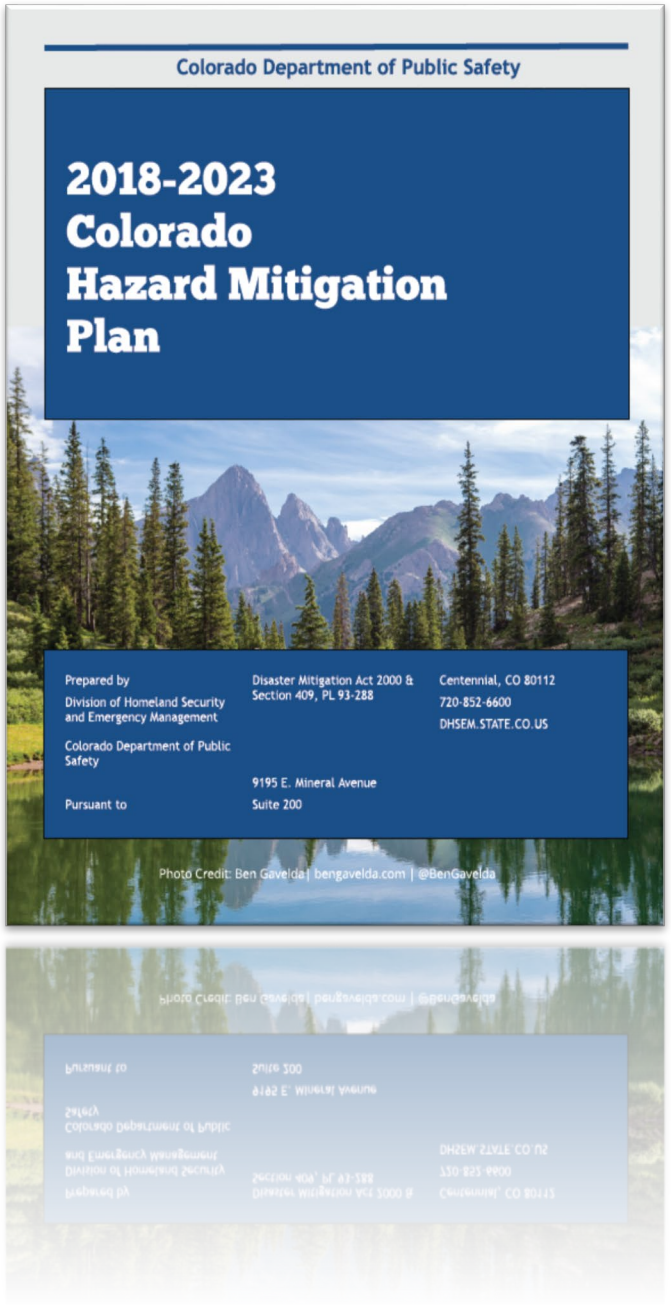
COLORADO
Department of Local Affairs

COLORADO
Division of Homeland Security & Emergency Management
Department of Public Safety

Lynker

Introduction

- **Nov 2018** — Colorado Enhanced State Hazard Mitigation Plan
- **Mar 2019** — Element H of the E-SHMP Scope of Work
- **Aug 2019** — Hazard Vulnerability Study Contracted
- **Mar 2020** — Hazard Vulnerability Study Deadline



Project Steering Questions

1. What is Colorado's **current** vulnerability to flood, drought, and wildfire?

   *Vulnerability = physical and **economic losses** across key sectors*

2. What is Colorado's **future** (2050) vulnerability to flood, drought, and wildfire based on projected population growth and new development?

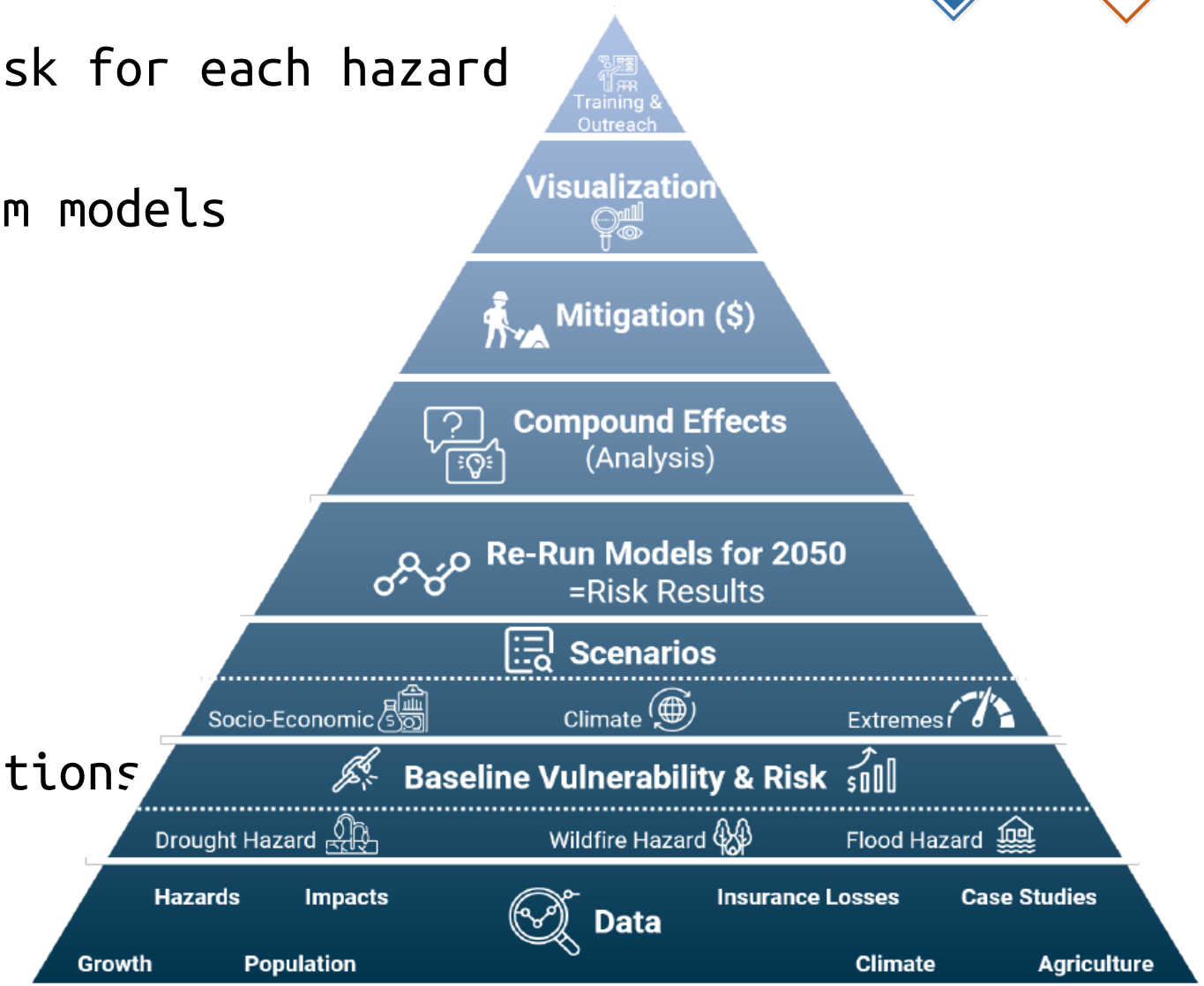
3. How does climate change affect Colorado's projected 2050 vulnerability to flood, drought, and wildfire?

4. What are the projected impacts of these climate hazards on local economies?

5. What are the cost savings of targeted resilience actions on current and future vulnerabilities?

General Approach

1. Build conceptual models of risk for each hazard
2. Gather relevant data to inform models
3. Quantify baseline risks
4. **Develop future scenarios**
5. Quantify future risk
6. Identify future resilience actions
7. Build visualization tool



Hazards

Flood

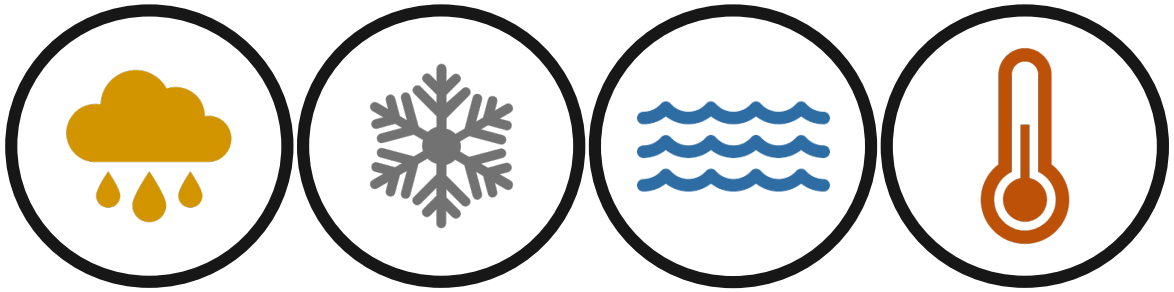
Drought

Wildfire

Scenarios

Climate

- Baseline (Current/Historic)
- Median 2050
- More Severe 2050



Hazard-specific variables

Socioeconomic

- Baseline (Current/Historic)
- Low growth 2050
- Business as usual 2050
- High Growth 2050

Vulnerability Sectors

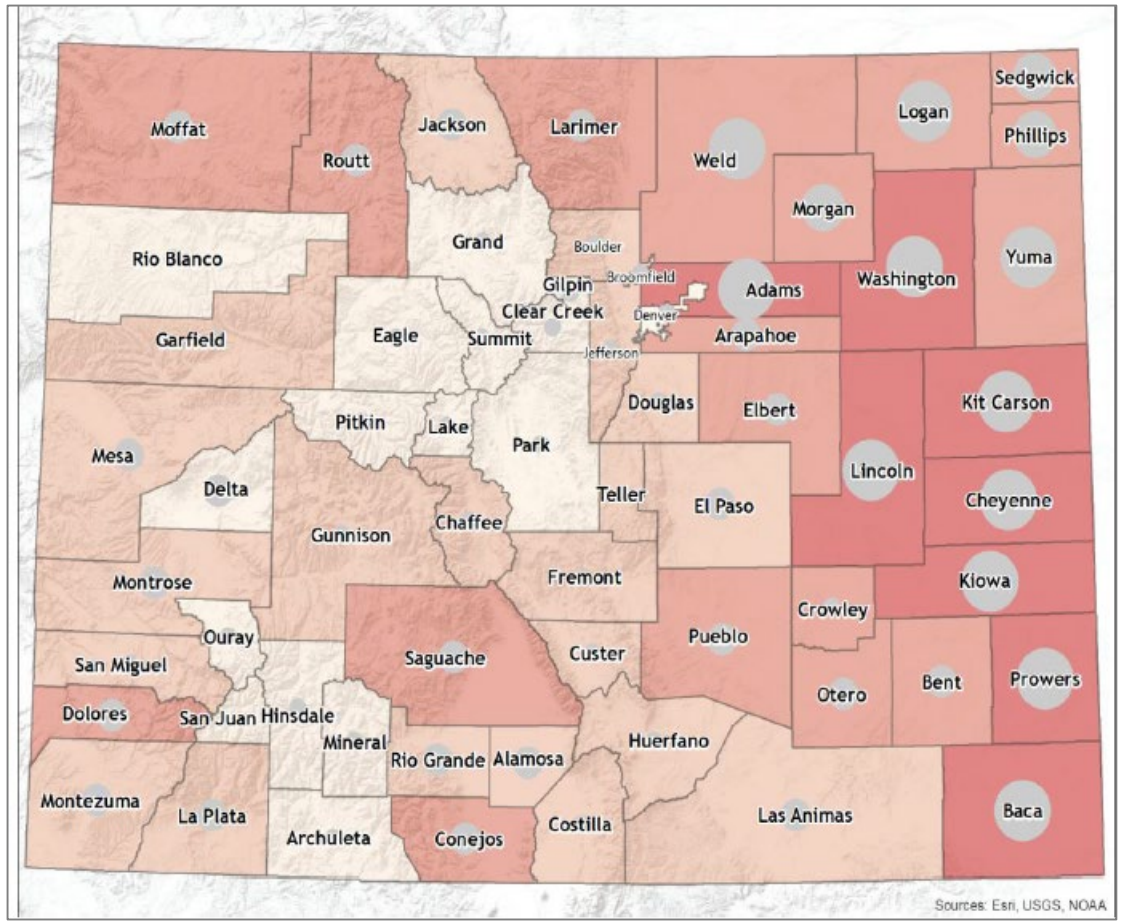
Statewide Quantitative Assessment

Qualitative

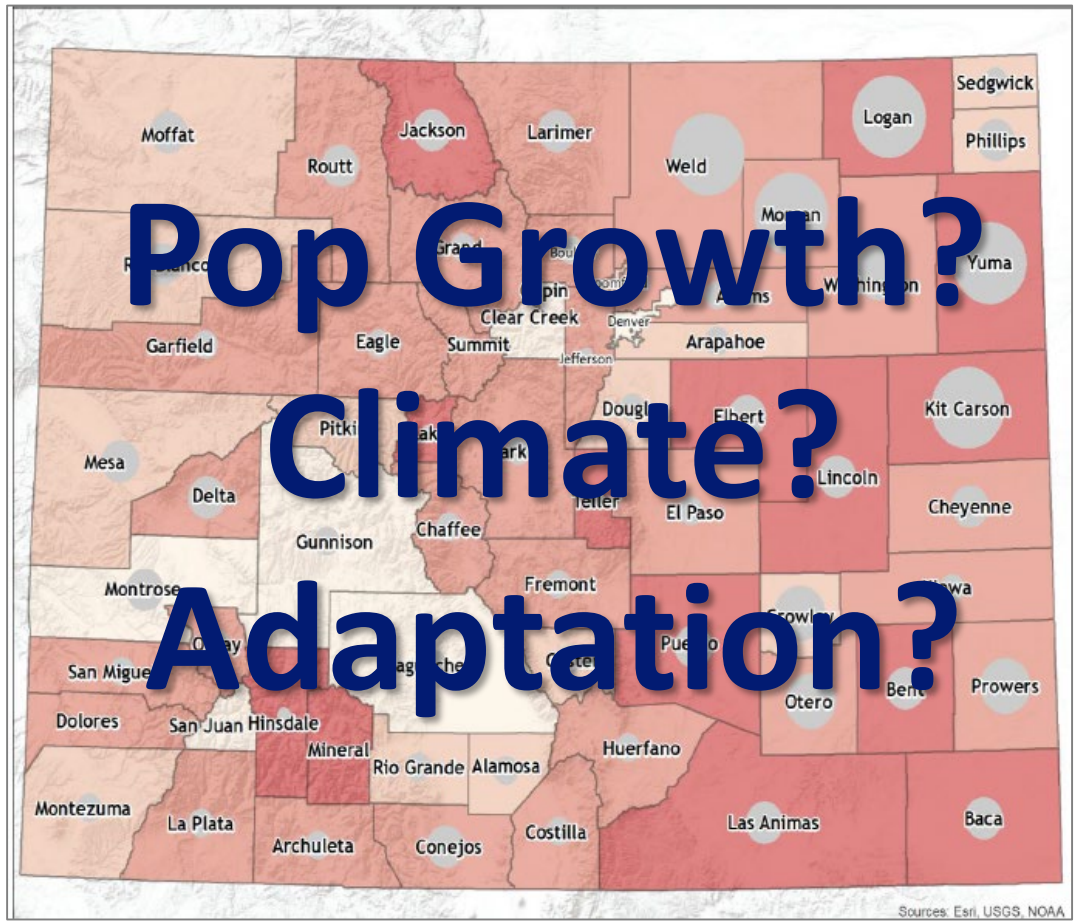
Project Goals & Limitations

Visualize Results

Expected Annual Damages ($)



Baseline (Current)



Pop Growth?
Climate?
Adaptation?

2050 Scenario

Intended Audience

Legislators

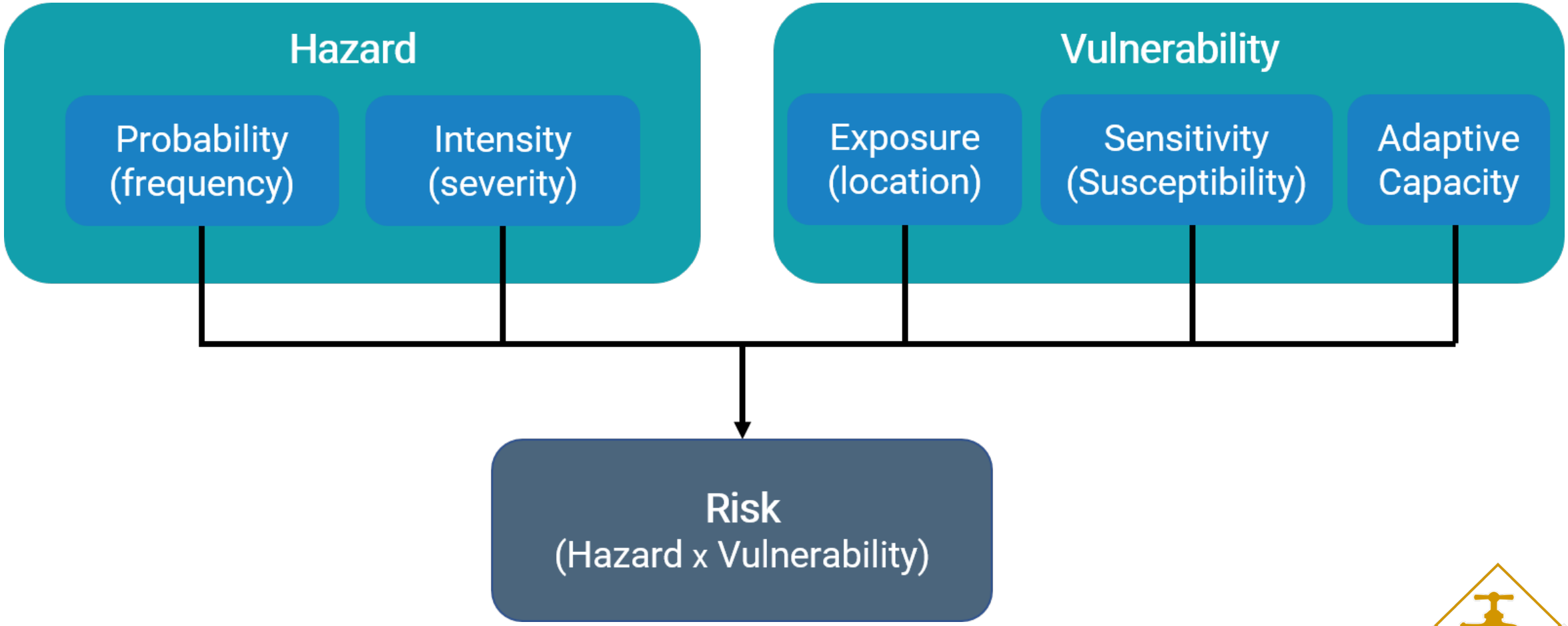
Planners

CWCB Basin Roundtables

General Public

Industry Representatives

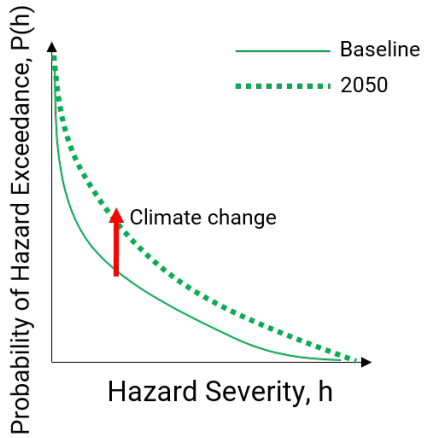
What is Risk?


Hazard
Probability (frequency)
Intensity (severity)
Vulnerability
Exposure (location)
Sensitivity (Susceptibility)
Adaptive Capacity
Risk
(Hazard x Vulnerability)

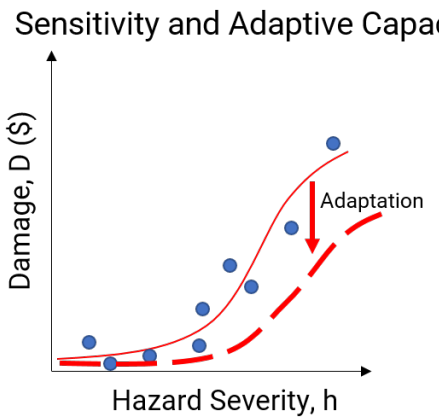
Quantifying Future Damages

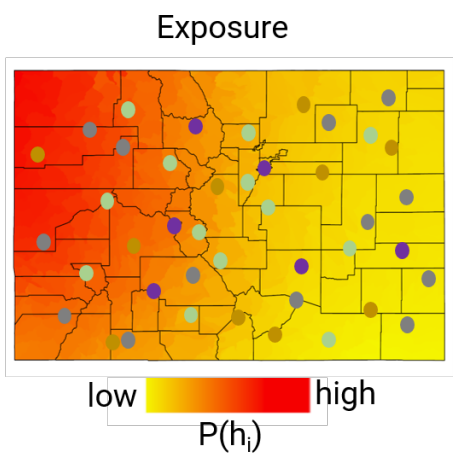
1. Probability-Severity Relationship
2. Damage-Severity Relationship
3. Damage-Probability Relationship

Hazard

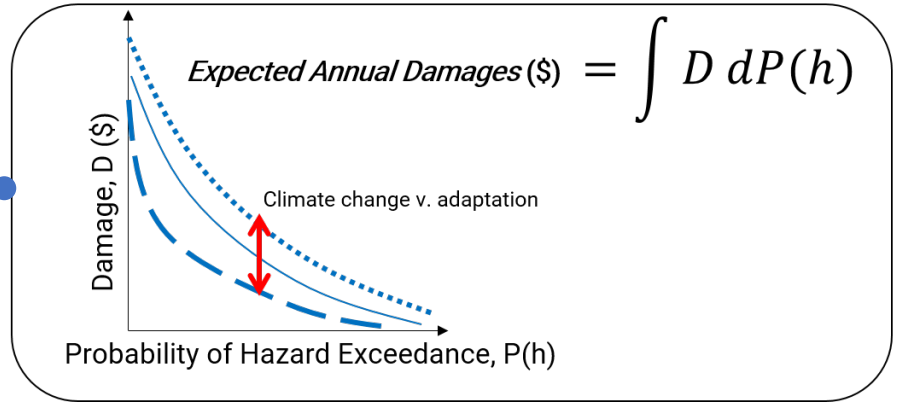


Vulnerability





Risk

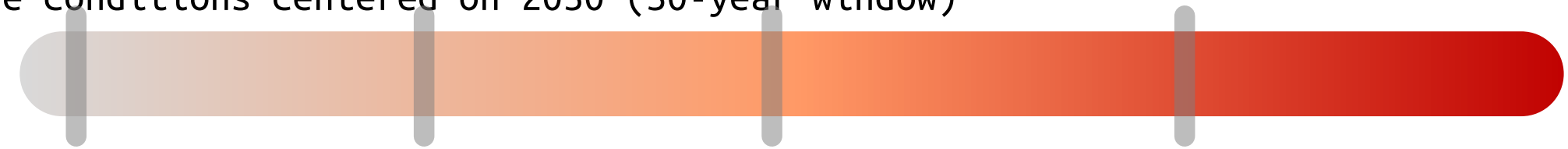


Climate Scenarios

CO Water Plan Definitions:

- "Hot & Dry": 75th percentile CIR and 25th percentile flow (more severe)
- "between 20th century observed and hot and dry": 50th percentile CIR and flow
- "1.5˚C statewide warming": *Not in CWP (is this a useful scenario?)*
  - This is the 1.5°C Paris Agreement goal (1.5°C above pre-industrial levels)

Future conditions centered on 2050 (30-year window)



Baseline	+1.5C Warming	2050 Moderate	2050 More Severe
Historical/Current conditions	*"PCA"*	*"50th Percentile"*	*"75th Percentile"*

Socioeconomic (Population) Scenarios

CO Water Plan Definitions:

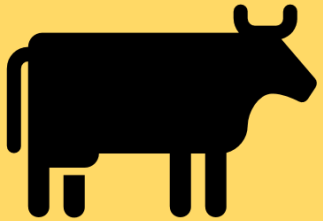
- "Baseline/Current" – 2015 values
- "Business as Usual Scenario" – Official CDO Growth Projection
- "Weak Economy Scenario" – Less Population Growth
- "Hot Growth Scenario" – Greater Population Growth

Baseline	2050 Low Growth	2050 Moderate Growth	2050 High Growth
Historical/Current conditions	*"Weak Economy"*	*"Business As Usual"*	*"Hot Growth"*

Drought: Modeling Approach

Agricultural drought severity

Crop production



Pasture health

Feed cost

Snowpack duration

User-days

River flows

User-days

Drought: Modeling Approach

Palmer Drought Severity Index - agricultural drought

Agricultural drought severity

Crop production

Palmer Drought Severity Index

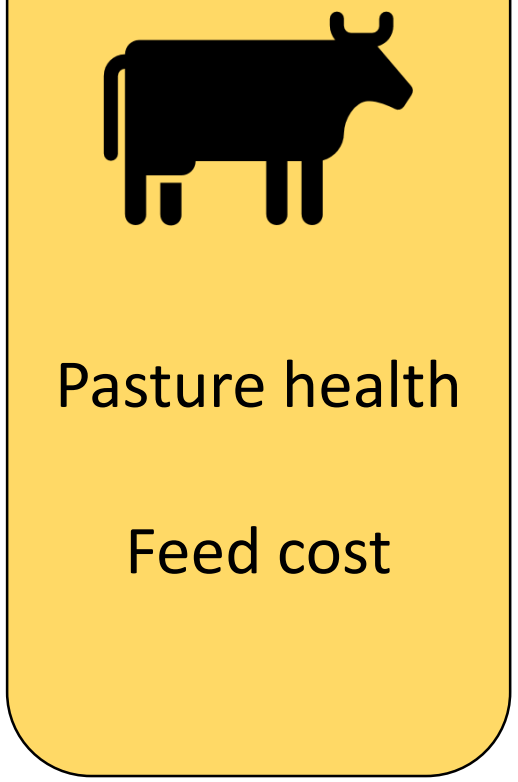
- PDSI = *f*(Temperature, Precipitation)
- Approximates soil water deficit (relative)
- Specific method: self-calibrated PDSI

Drought: Modeling Approach

Livestock modeling – a difficult problem

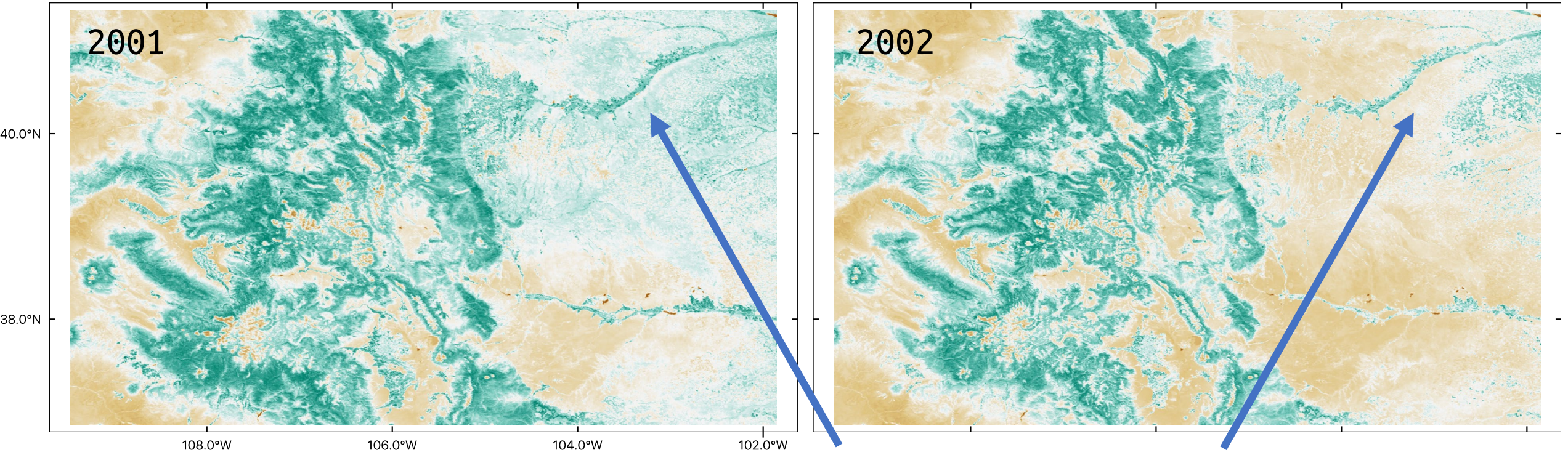
- The livestock industry expresses a complex response to drought
  - Move/sell herd
  - Cull herd

- Impacts are lagged, long-lasting, and difficult to separate from other macroeconomic trends



Drought: Modeling Approach

A first-order approach:
Greenness → Pasture Health → Feed Costs



Large-scale decline in Apr-Oct pasture/grassland greenness from 2001 to 2002

Drought: Modeling Approach

Snowpack duration – An indicator of snow drought

Snowpack duration

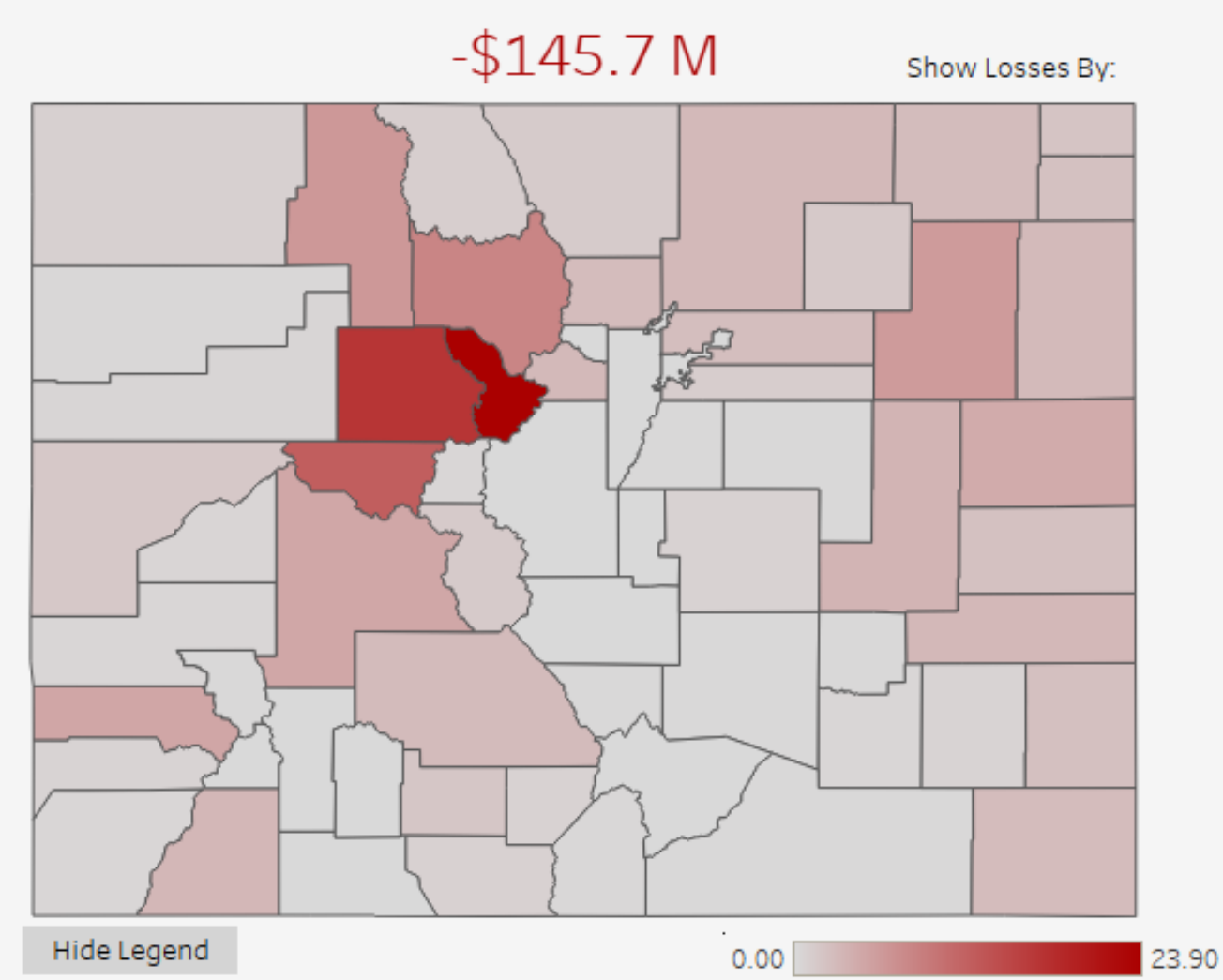
User-days

Snowpack Duration

- Duration SWE > 100mm
- Simulated using a simple temperature-index snow model (SNOW17)
- Forced with temperature and precipitation data

Drought: Statewide Results

Baseline Damages: Crops & Winter Recreation



Questions & Discussion

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