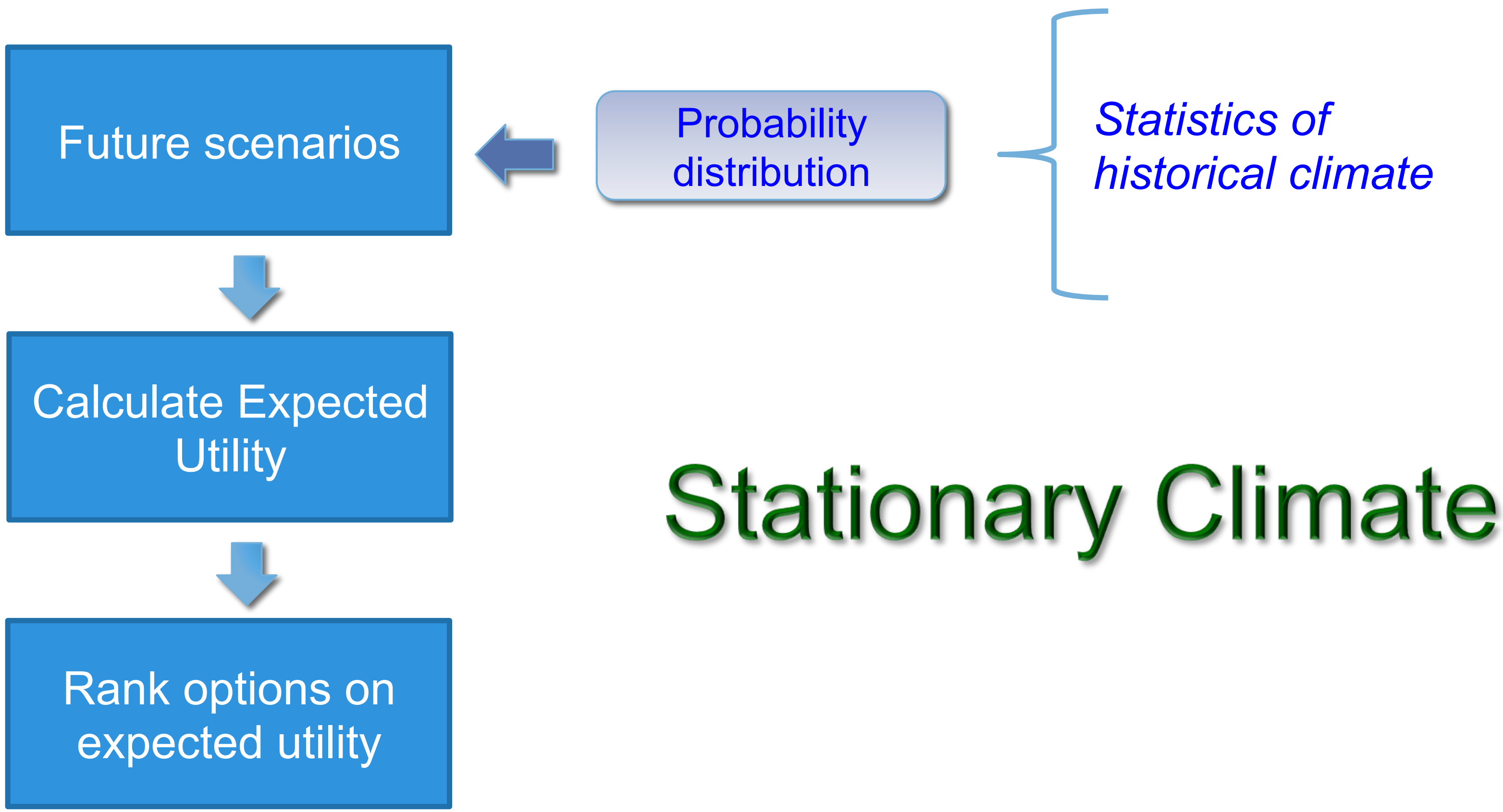
Decision Scaling: Scenario Planning Meets the Stress Test

Casey Brown

Associate Professor of Civil and Environmental Engineering

University of Massachusetts

Traditional Decision Analysis – Maximize Expected Utility



“Predict then Act”

Climate Science Centric – Top Down

Future scenarios

Calculate Impacts

Evaluate Impacts

Statistics of historical climate
or
Climate Change Projections

Which GCM?
Which downscaling method?
Which emissions scenario?
Transient runs?

Climate Change

The impacts could be very bad … or not.

"Predict then ~~Act~~ Repeat"

Premises: Decision Scaling

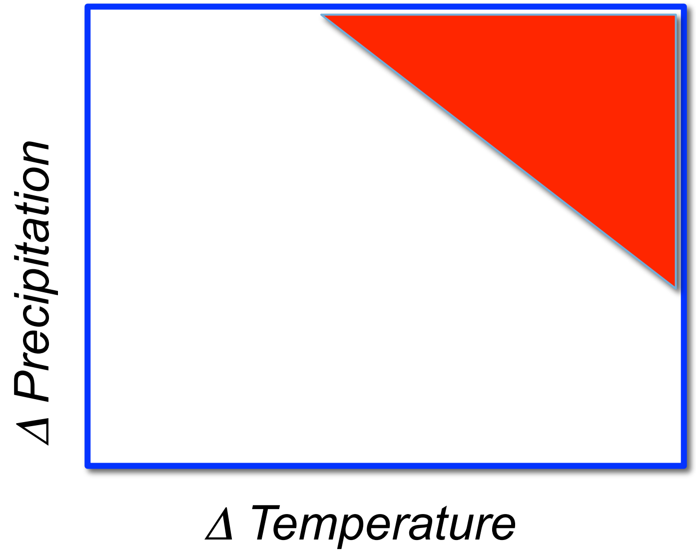
- Stakeholder driven process that is responsive to the factors most relevant to a decision
- Exhaustive exploration of future conditions – “Stress test”
- Ability to identify and select robust strategies
- Key scenarios emerge from the analysis
- Understand sensitivity to climate change (not climate change projetions)

Decision-Scaling

3. Evaluate climate informed risk scenarios

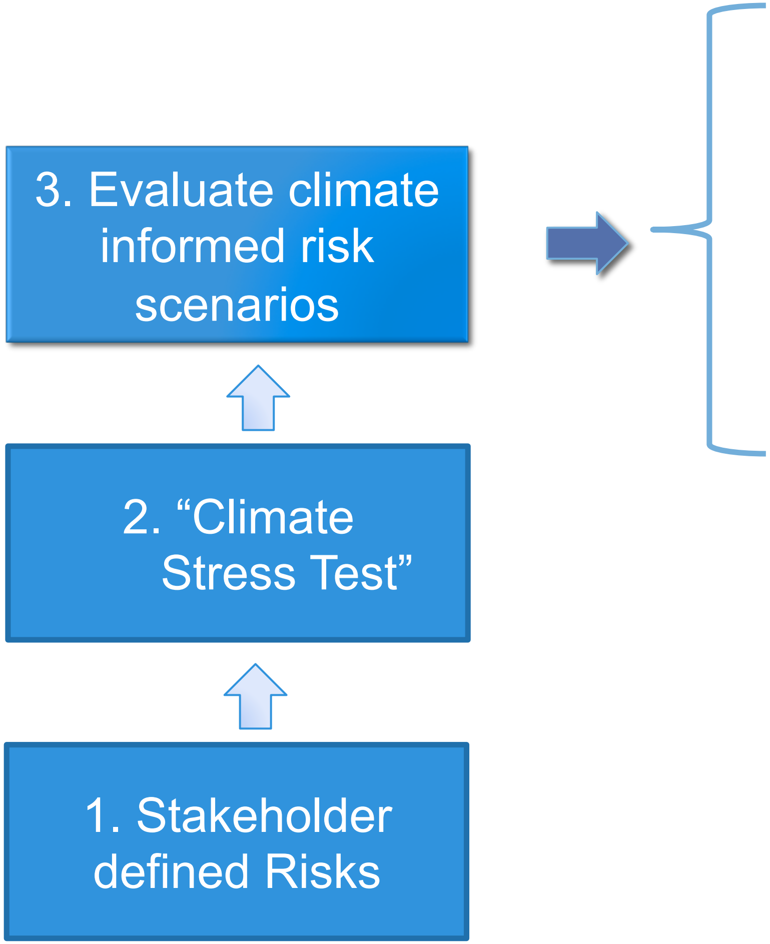
2. "Climate Stress Test"

1. Stakeholder defined Risks



"Climate Charette"
What level of performance is needed?
What are non-climate factors that are also important?
What are current climate/weather effects

Decision-Scaling



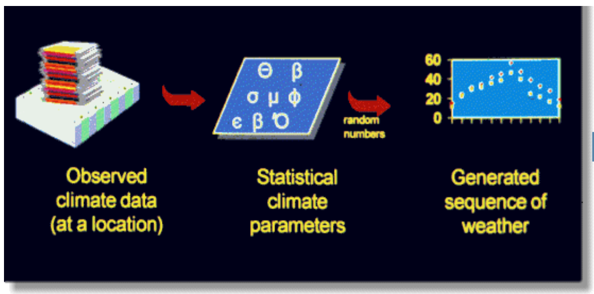
Do projections indicate these conditions are likely?
Are projections credible in simulating these conditions?
How robust is the system?
What are the relative effects of climate and non-climate factors?

Why the "Climate Stress Test"?

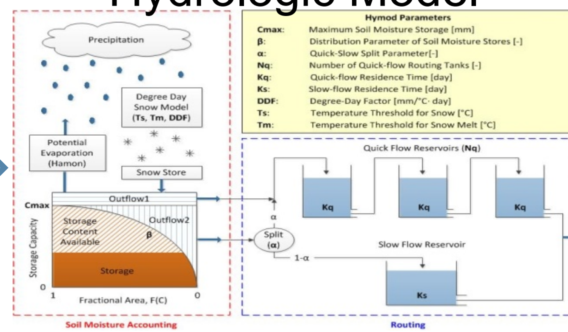
- General Circulation Model (GCM) projections were not designed to evaluate vulnerabilities
- They are inefficient samplers of climate change for vulnerability analysis
- They have biases that may leave climate risks unexposed.
- Requires high stakes prior choices without knowing implications (downscaling approach; emissions)
- Can incorporate nonclimate factors as well

Climate Stress Test

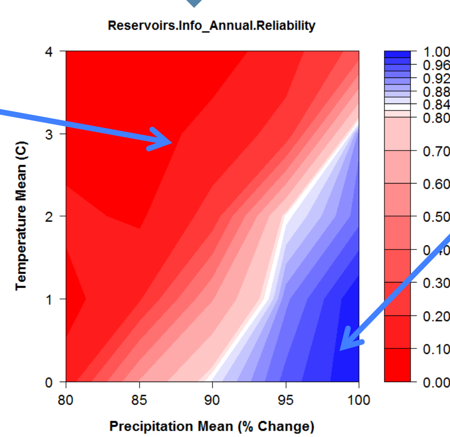
Climate/Weather Generator



Hydrologic Model



Wat. Res. Model



Climate Vulnerability

Robust

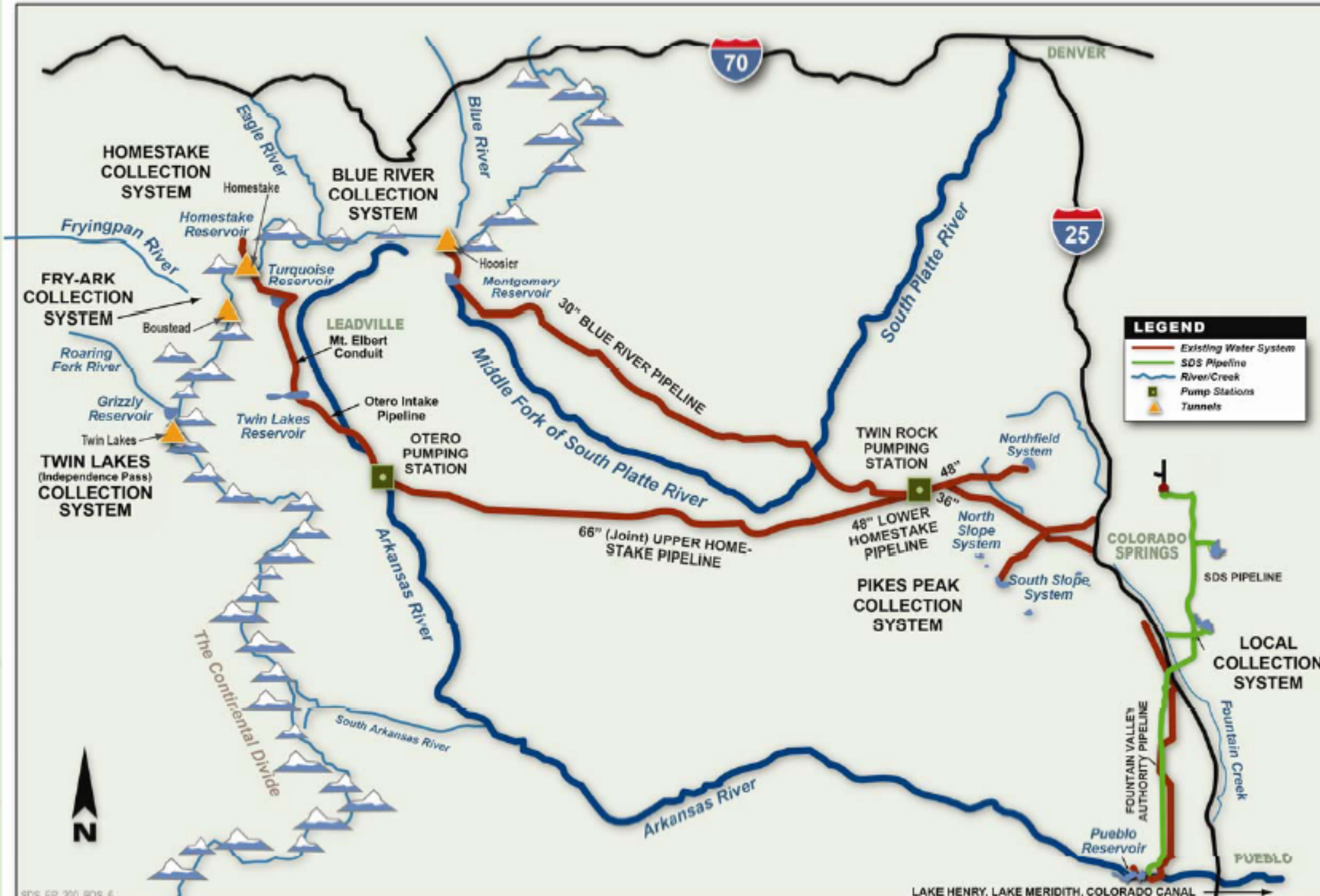
Colorado Springs, Colorado, USA

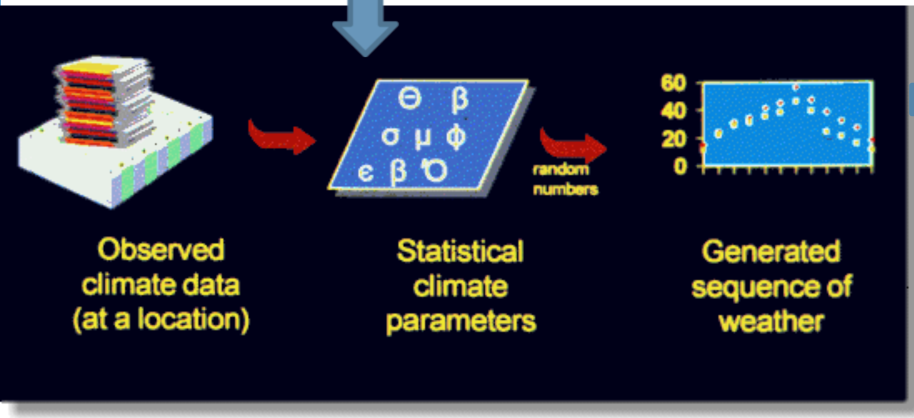
WATER SUPPLY RISK ASSESSMENT

Colorado Springs Utilities
It's how we're all connected

MWH
BUILDING A BET

Colorado Springs' Water Supply System





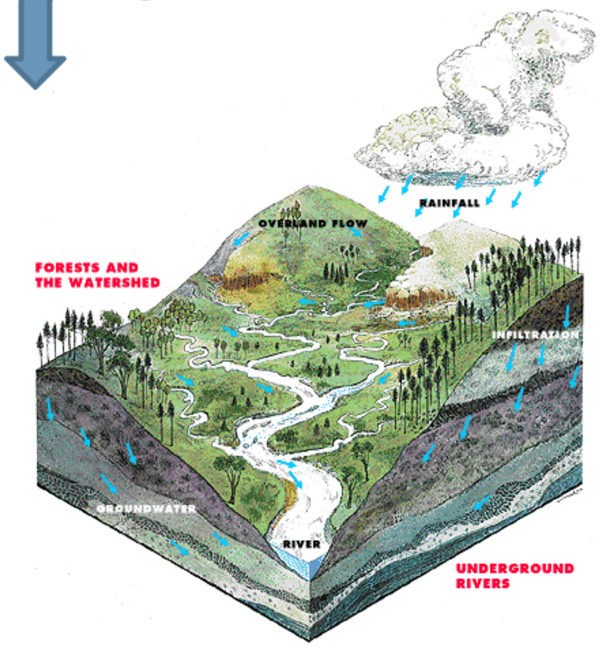
Stochastic Climate Model

Monte Carlo to Sample Uncertainties

-Climate Trends

-Internal Climate Variability

-Hydrologic Model

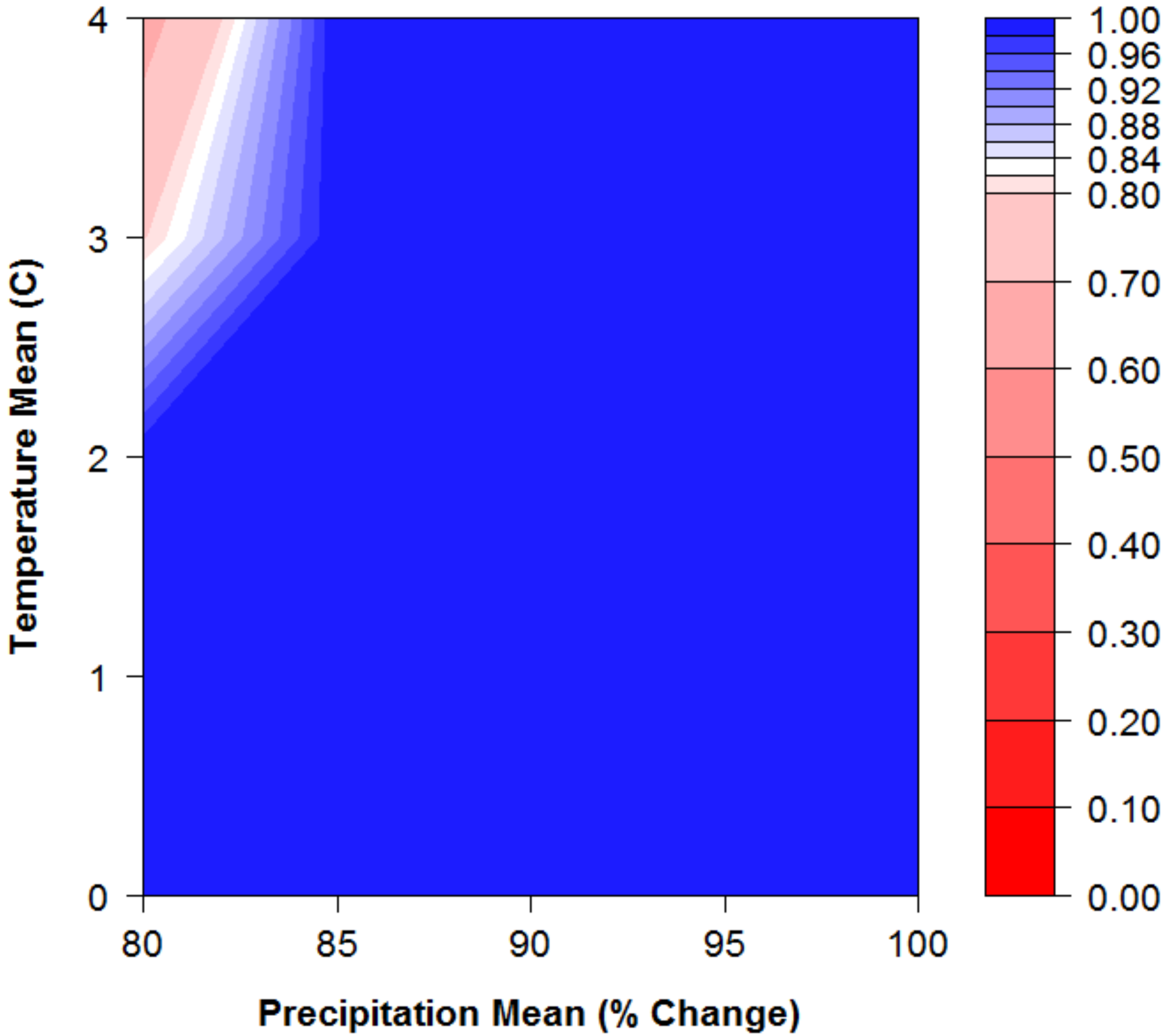


WEAP Hydrologic and Systems Model

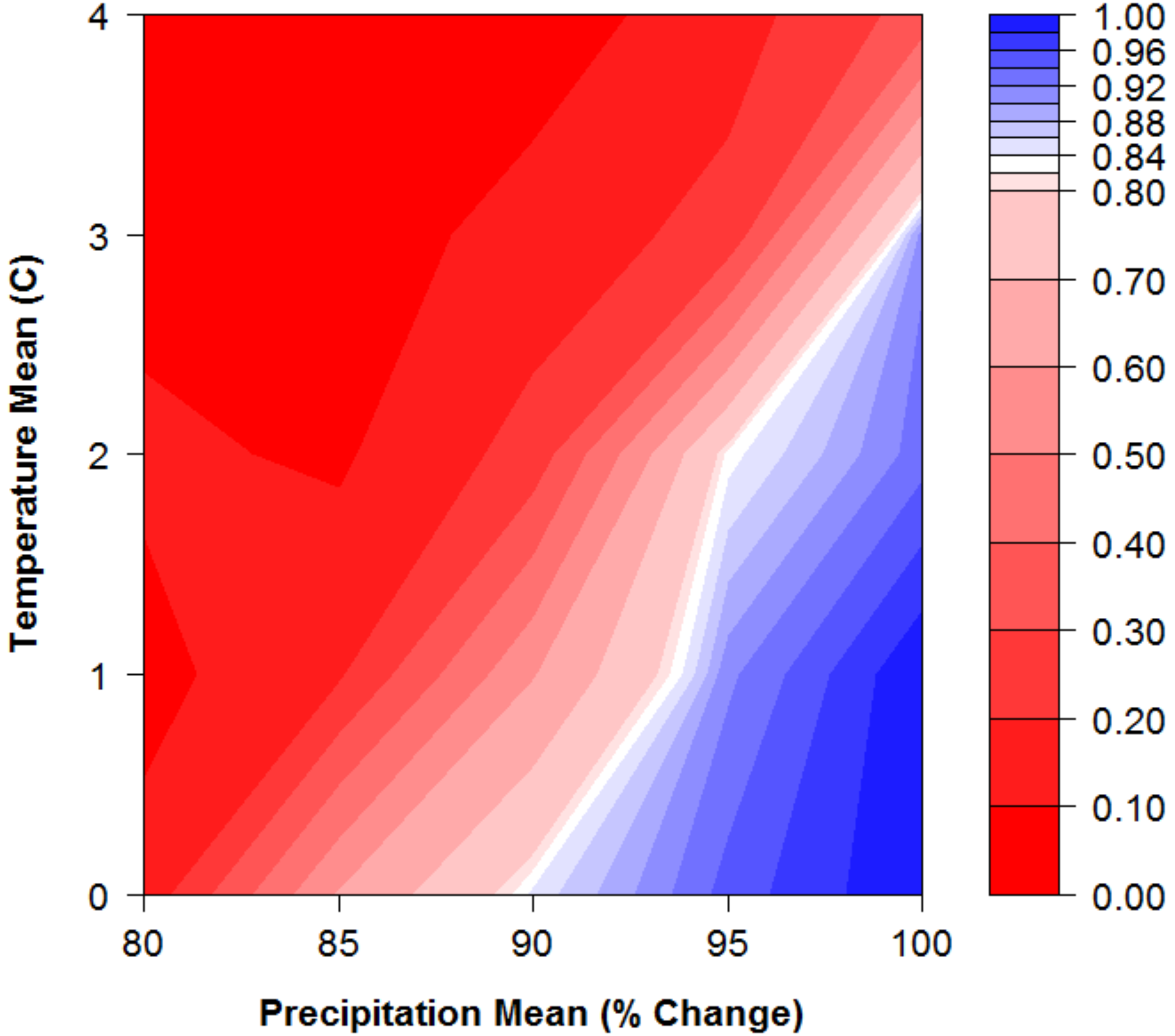
MODSIM Systems Model (All Alternatives)

Performance Metrics

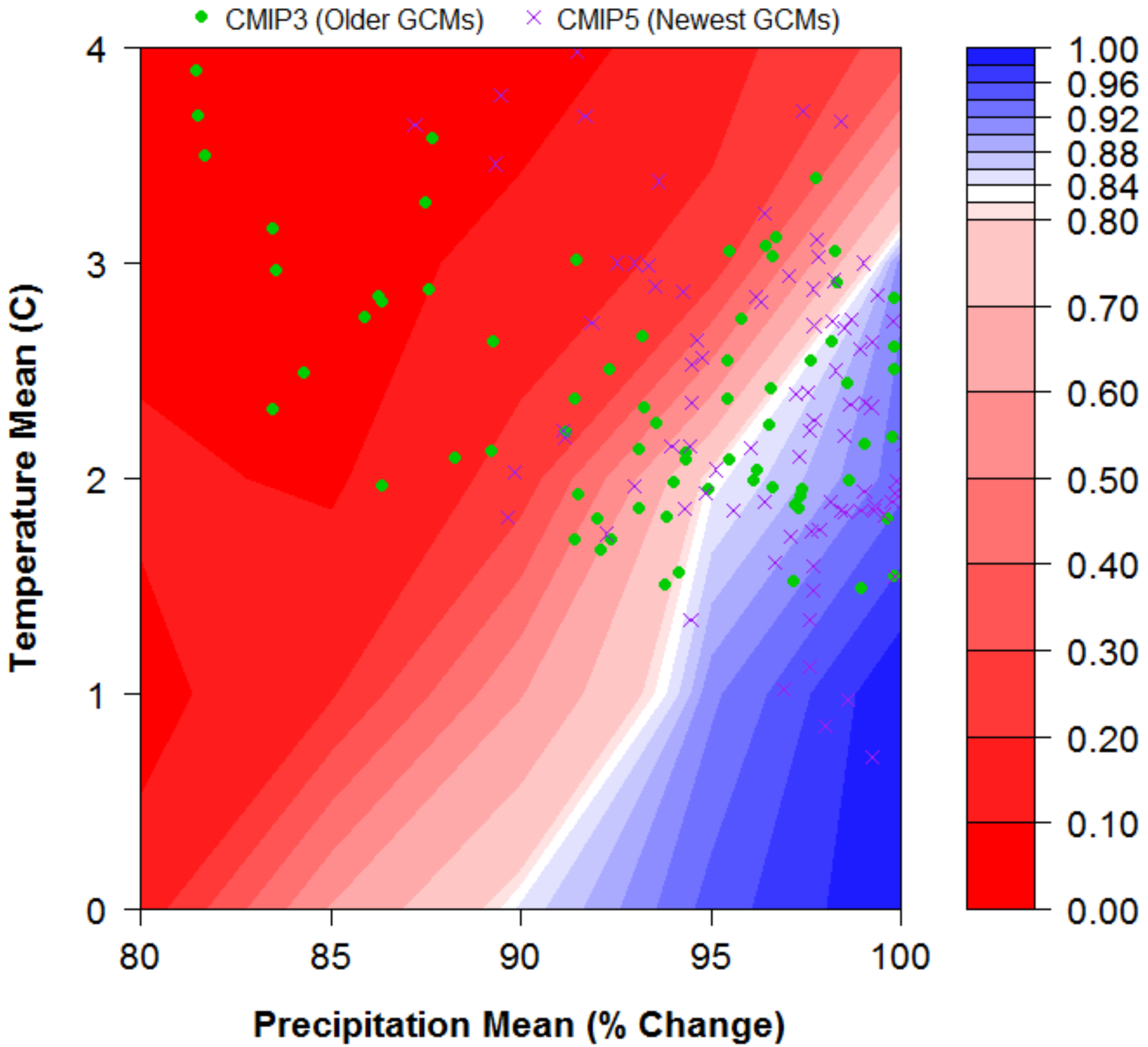
Colorado Springs (USAFA): CURRENT CONDITIONS



Colorado Springs (USAFA): Future Conditions



Colorado Springs (USAFA) Water Assessment



CSprings Risk Scenarios

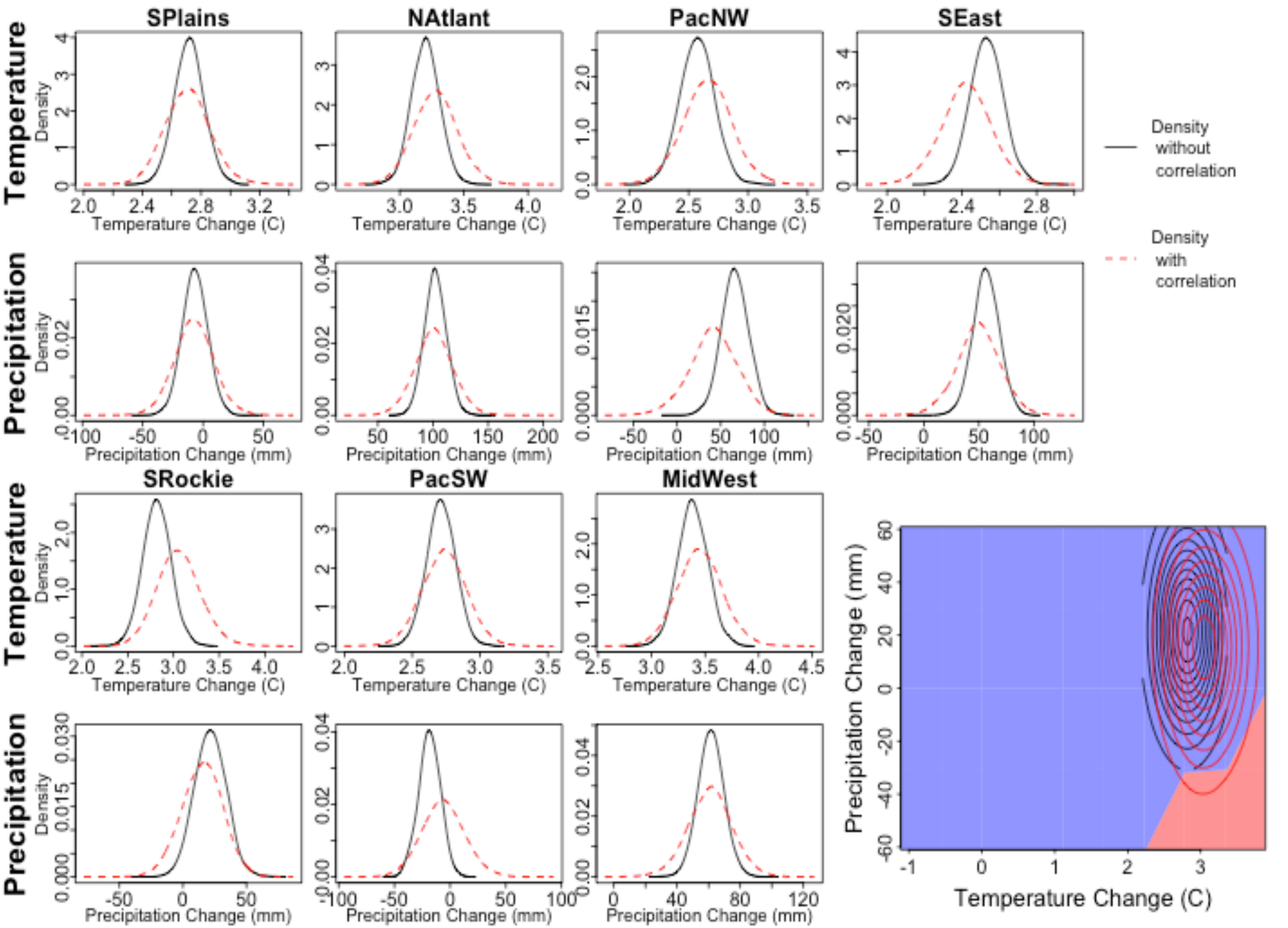
- Present Water Demand: None

- Build out population with current per capita usage:

  - Precipitation reduction of 5%

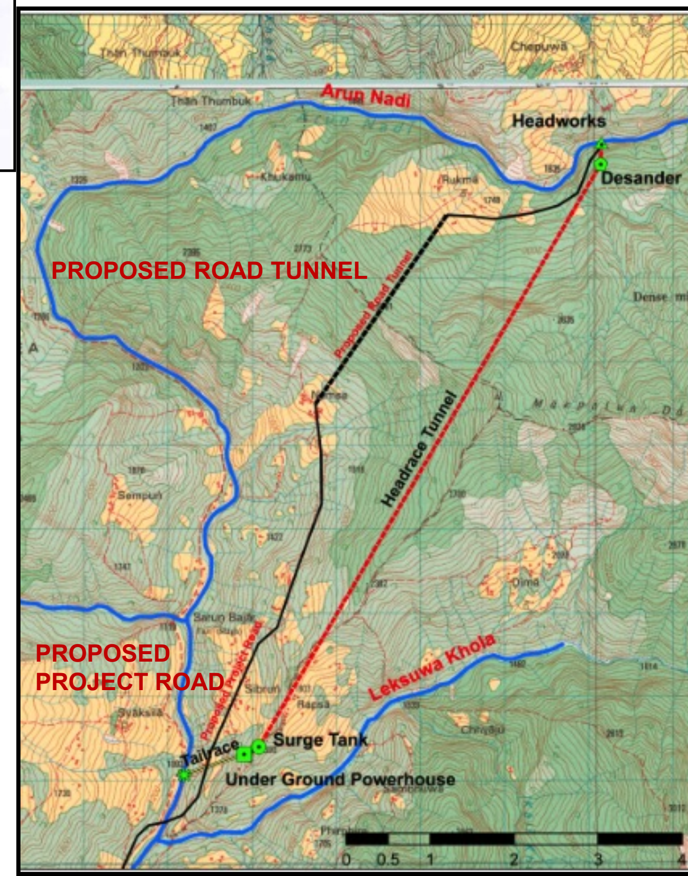
    OR

  - Temperature increase of 2 C

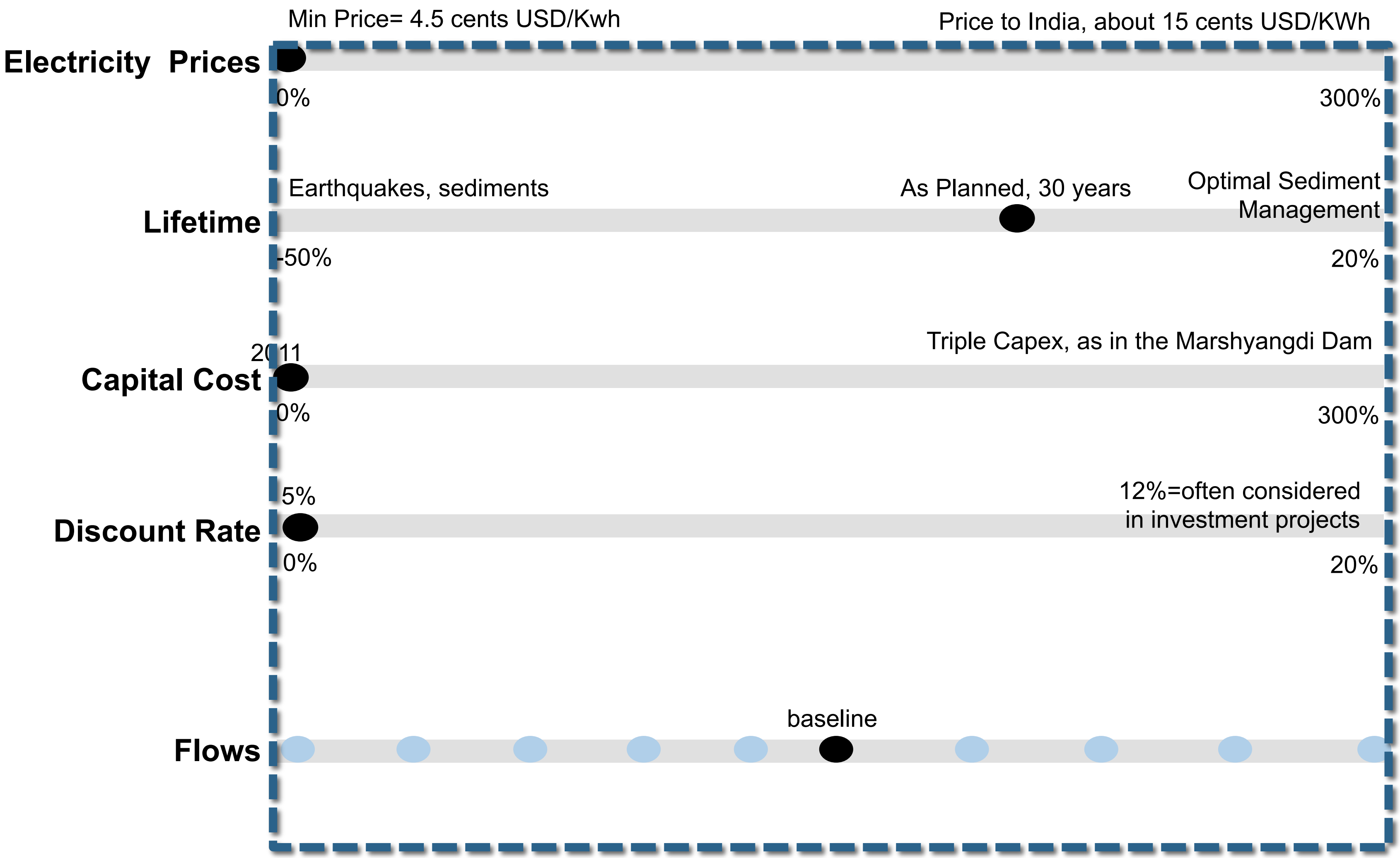


SPlains
NAtlant
PacNW
SEast
Temperature
Precipitation
Density
Temperature Change (C)
Precipitation Change (mm)
Density without correlation
Density with correlation
SRockie
PacSW
MidWest
Precipitation Change (mm)
Temperature Change (C)

Evaluating New Hydropower under Climate and Non-Climate Uncertainties



Incorporating Non-Climate Factors



New Dam Risk Scenarios

335 MW

- **Electricity price** less than 0.079 USD/kwh

AND

- **Capital Costs** double

750MW

- **Electricity price** less than 0.079 USD/kwh

AND

- **Capital Costs** more than 175% of baseline

2000MW

- **Electricity price** less than 0.125 USD/kwh

AND

- **Capital Costs** more than 140% of baseline

In this case, climate change posed no risk to the proposed developments!

Conclusions

- Current approaches to planning not well adapted for use of climate information
  - Climate projections inefficient samplers of future climate; not credible in variables of most interest
  - Scenario Planning explores limited set of futures

- Decision Scaling combines best aspects of Scenario Planning and decision analysis
  - Bottom up approach explores uncertainties of interest to stakeholders
  - Explores many possible futures; scenarios emerge from the analysis
  - Scenarios of interest (problematic or otherwise) can be further investigated and assigned probabilities if needed