

2. Vulnerability Assessment

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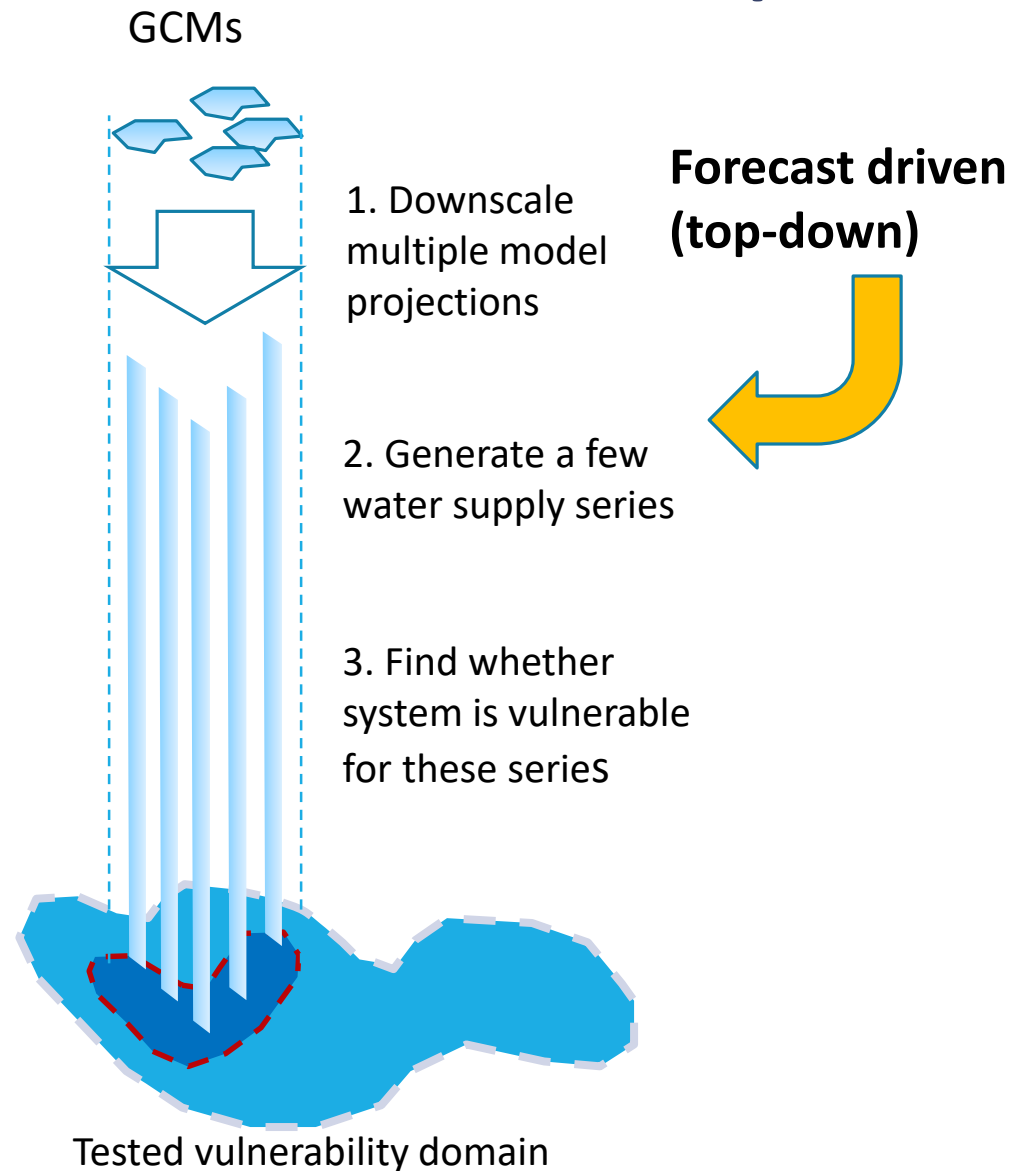
JOINTISZA PROJECT

Strengthening cooperation between river basin management planning and flood risk prevention to enhance the status of waters of the Tisza River Basin

**WP6 Activity 6.4 Pilot on climate change induced specific water quantity issues
Shared Vision Planning Pilot Methodology and Stakeholders workshop**

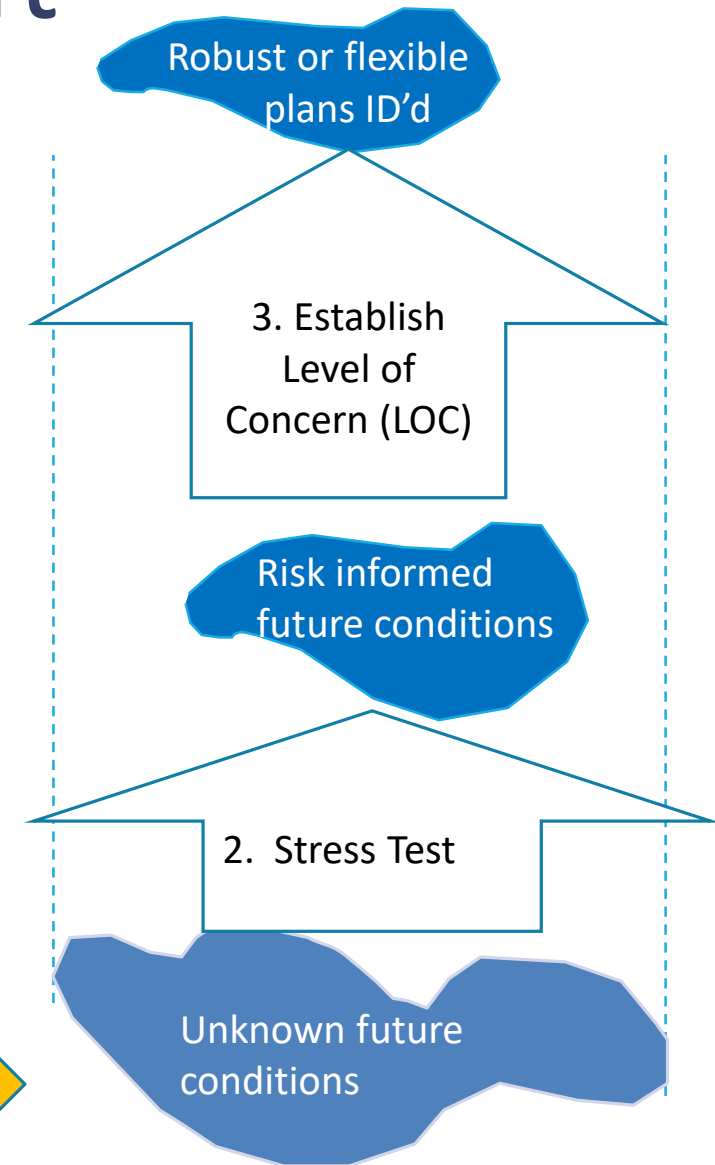
26-27 October 2017, Szolnok, Hungary

The paradigm shift



Performance driven (bottom-up)

1. Establish Decision Context with Stakeholders and SMEs



Stress Test Flow

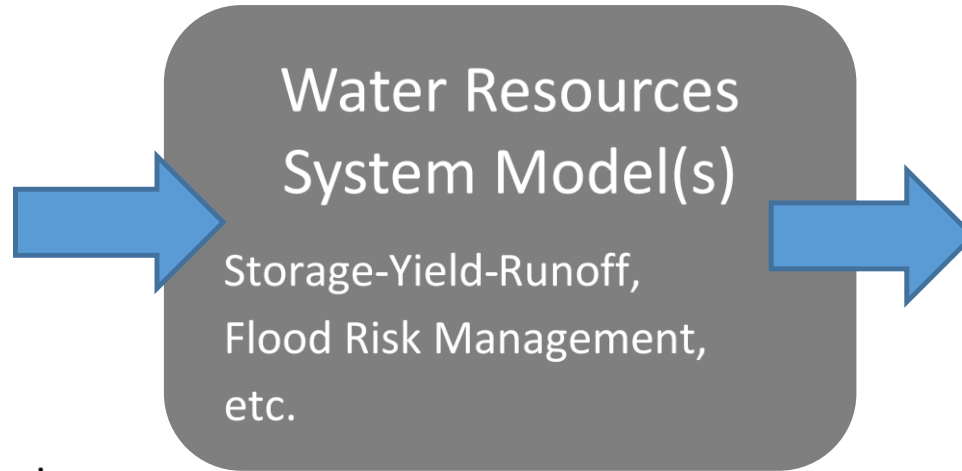
External Drivers

Hydrologic Drivers

Precipitation
Temperature
Streamflow

Other Drivers

Landuse
Upstream withdrawals
Return flows
Demand



Performance Metrics

Flood damages
Water supply reliability
Hydropower production
Water quality

Economic benefits
Economic losses
Cost-Benefits

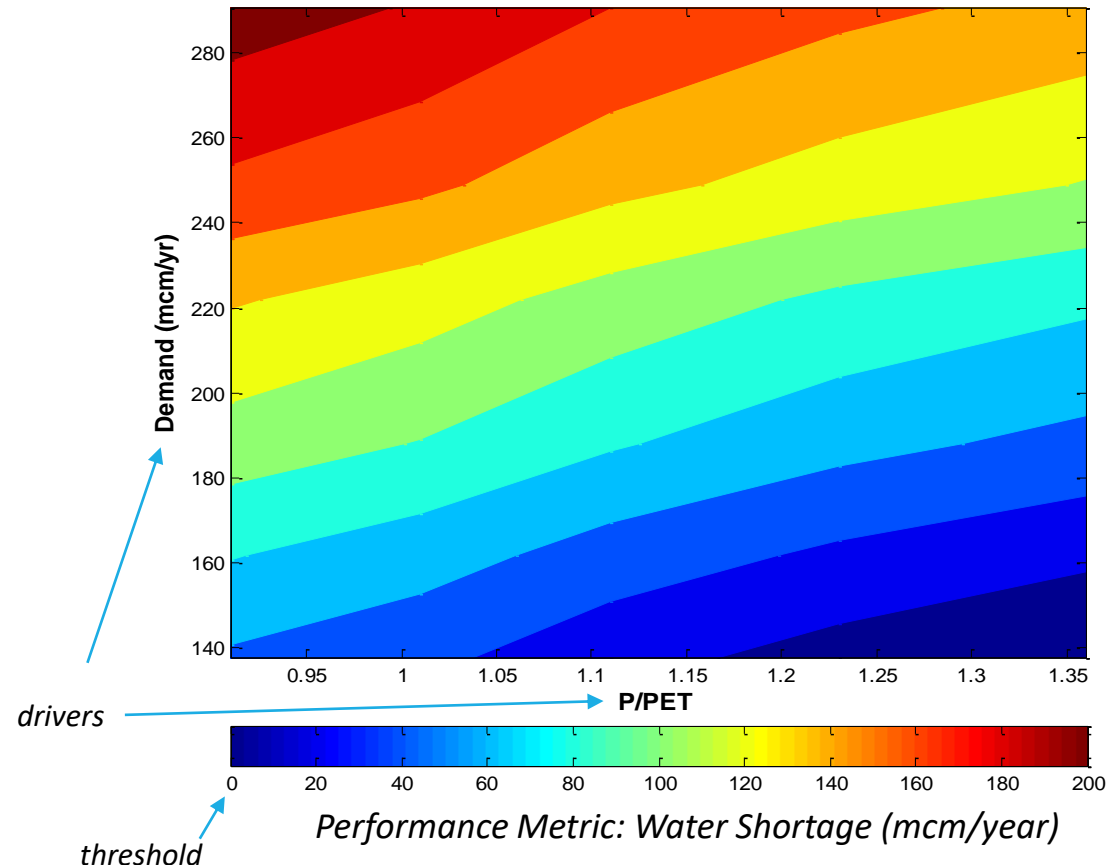
External drivers adjusted to determine impact on performance

Introduction to Vulnerability Assessment

Goal: assess vulnerability of system to climate change in order to place problem in decision matrix quadrant

Objectives

1. Identify system **drivers** (i.e., climate metrics)
2. Perform stress test: run simulation model for range of values for each driver until system passes **performance metric threshold**
3. Analyze performance response to drivers (Stress Test Output)

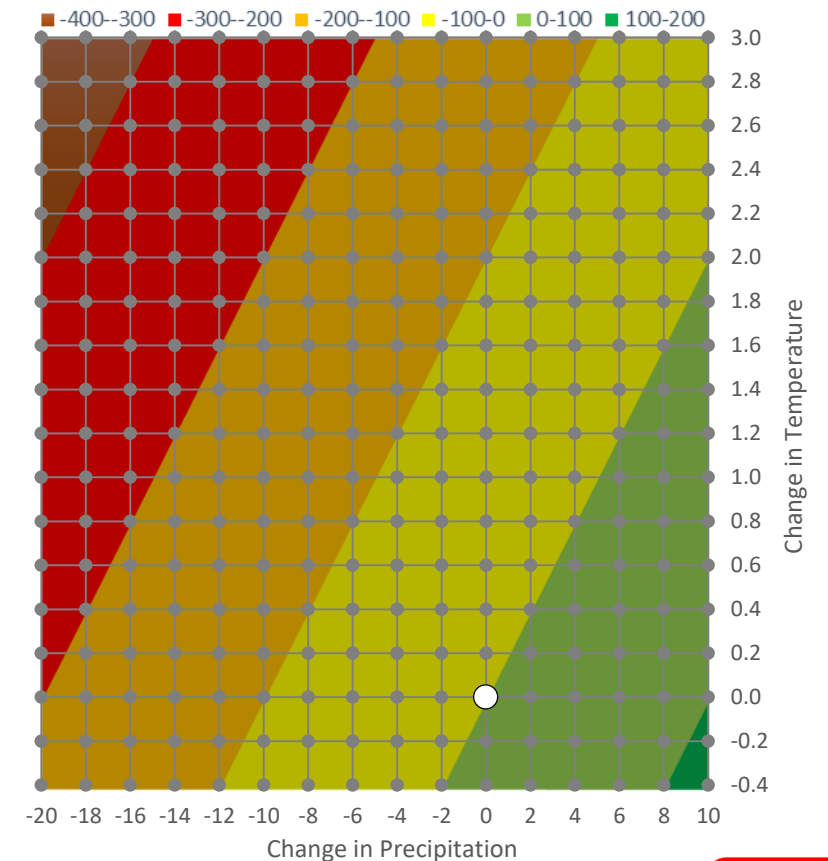


Stress Test for Climate Risk

1. Start with a Baseline Climate
2. Develop a Full Suite of Climate Scenarios
3. Model Performance Under Those Scenarios
4. Evaluate **Climate Risk**

Note: Stress test is an iterative process: adjust drivers and evaluate changes in performance for failure

Performance Contour Graph



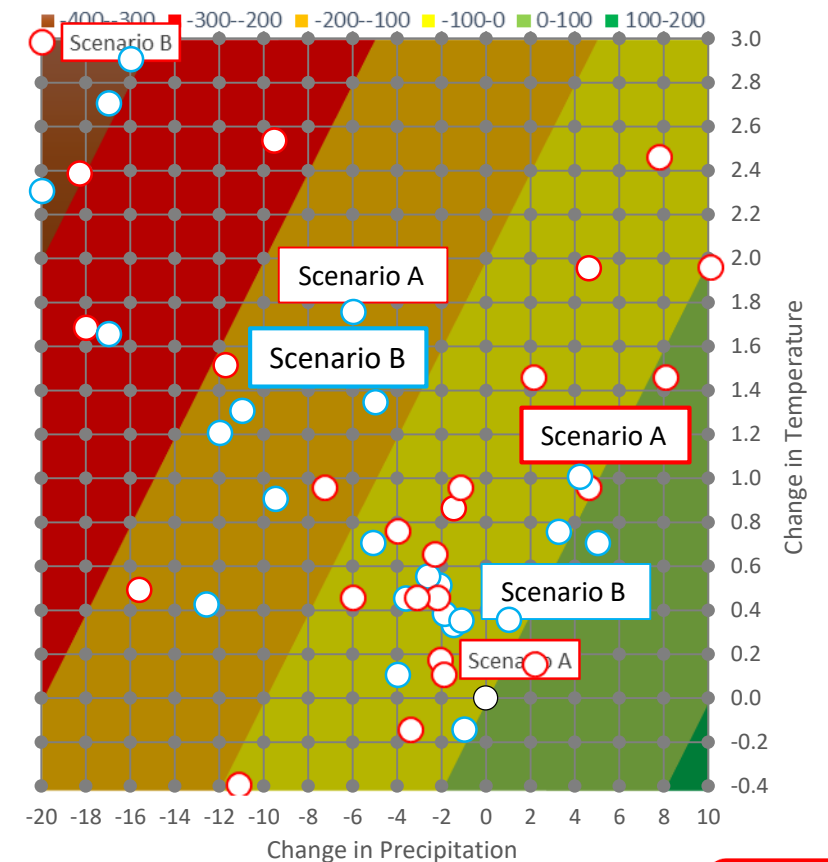
Evaluate Climate Risk

Risk = Likelihood x Consequence

Thought Experiment

- Which is more likely? **Scenario A**
- Which is more likely? **Scenario B**
- Which is more consequential? **Scenario B**

Performance Contour Graph



Categorizing Risk

Considerations

- Is the threshold well defined?
- How severe are the consequences?
- Are the scenarios within the bounds of our current climate variability?
- Speed of change versus adaptation?

Climate Risk Matrix

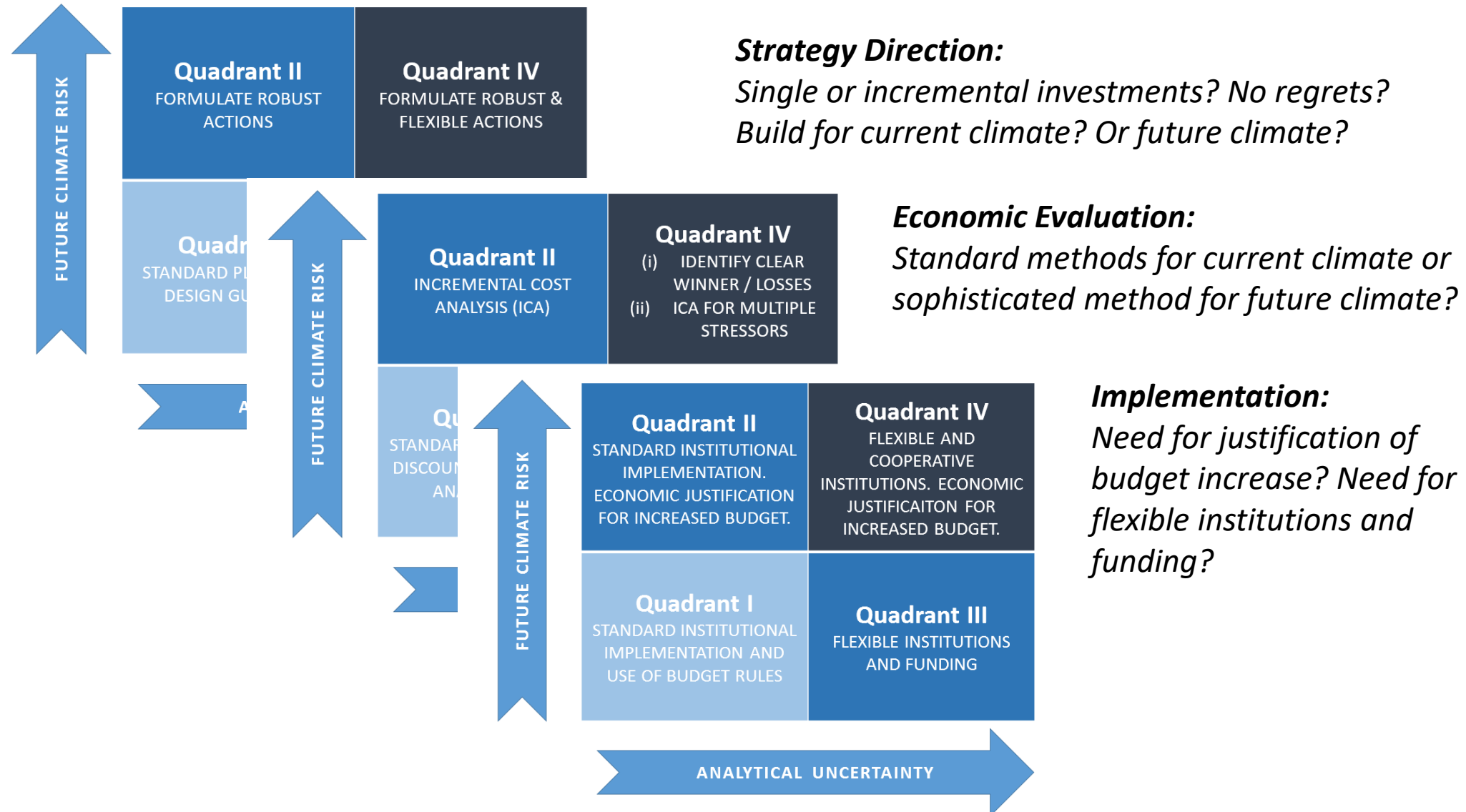
Consequence of Exceeding Threshold	Likelihood Climate Conditions Exceed Threshold		
	Low		High
	Low	High	High
High	Medium Risk	Medium-High Risk	High Risk
Medium	Low-Medium Risk	Medium Risk	Medium-High Risk
Low	Low Risk	Low-Medium Risk	Medium Risk

Analytical Uncertainty

- Based on:
 - Evidence
 - Agreement/Disagreement between data sources
- Provides indication of potential error
- Depends on:
 - Range of data sources
 - Range of climate scenarios?
 - Quality
 - Quality of data?
 - Quality of model?
 - Accuracy
 - Accuracy of baseline climate data?
 - Accuracy of climate scenarios?
 - Driver Analyzed
 - Ex. Flood peaks – annual vs. monthly – annual higher level of certainty
- Risk aversion or risk appetite of stakeholders and decision makers



Linking Stress Test to Decision Matrices



Vulnerability Assessment Exercise

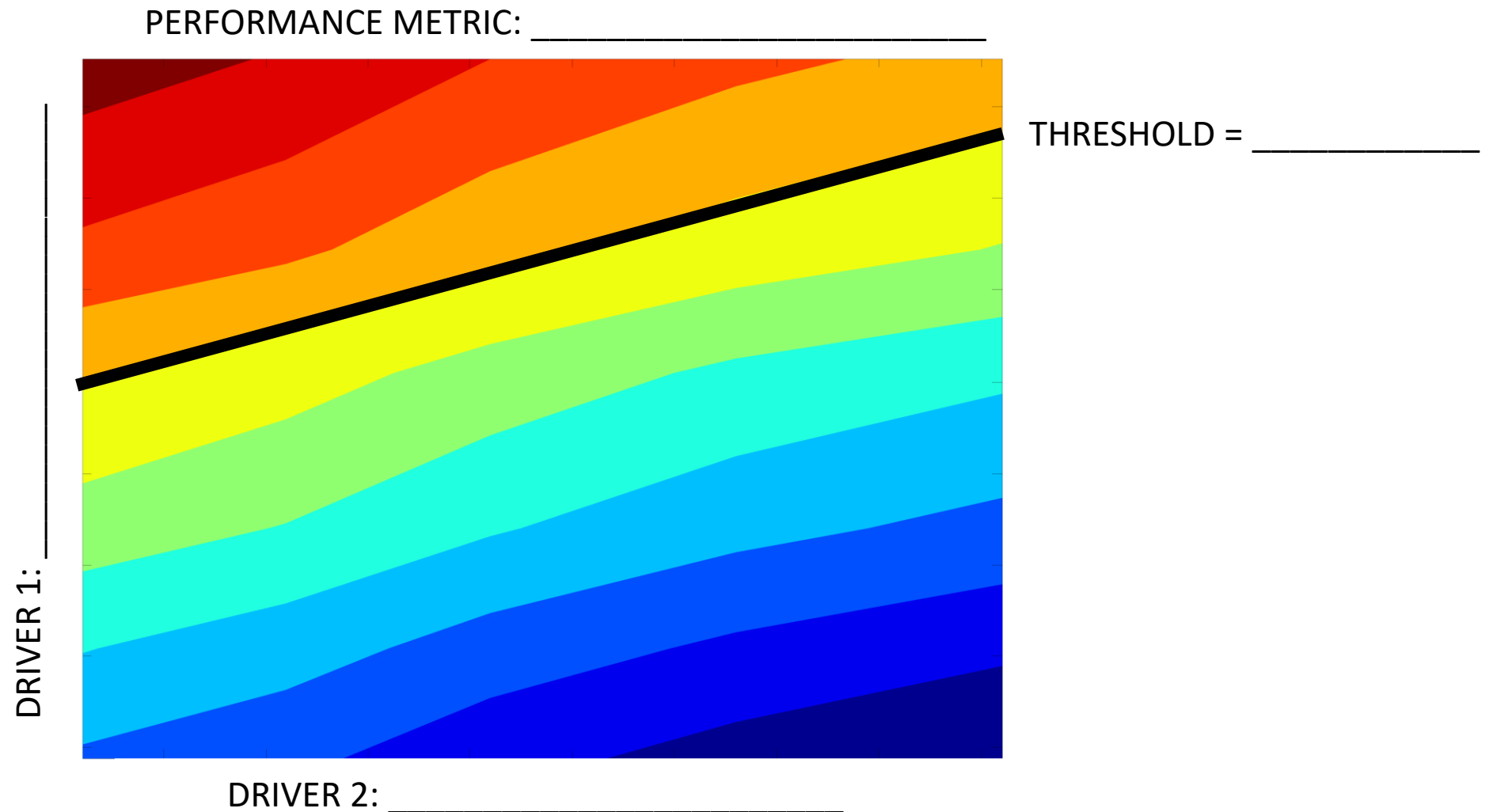
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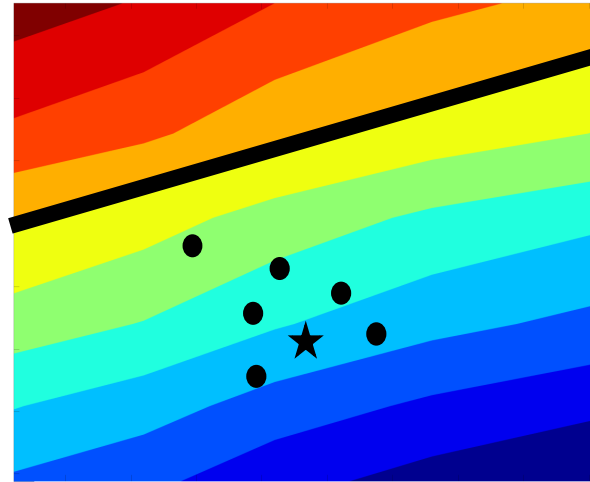
Identify System Drivers (climate or non-climate)



Evaluate climate risk (likelihood x consequences)

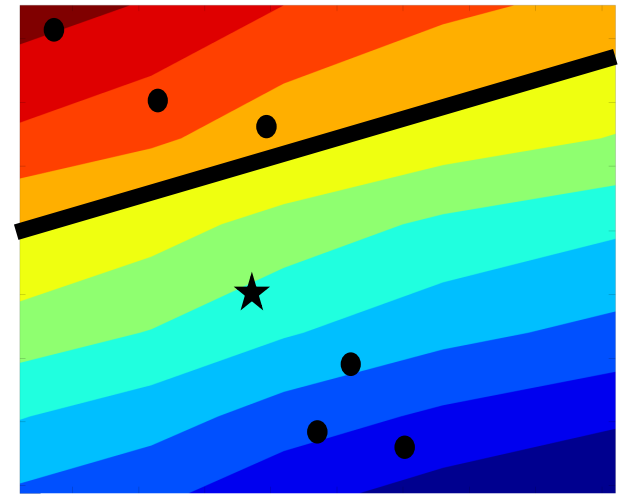
- Is observed data already in a vulnerable state?
- Is observed data trending to a vulnerable state?
- Does projected data suggest we are heading towards a vulnerable state?

Example 1



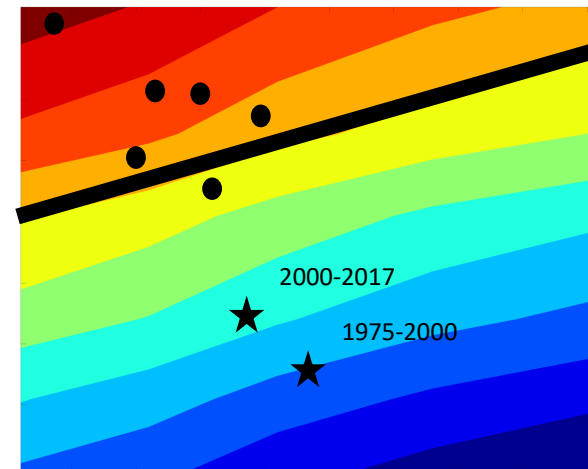
★ Observed 1950-2017
● Projections

Example 2



★ Observed 1950-2017
● Projections

Example 3

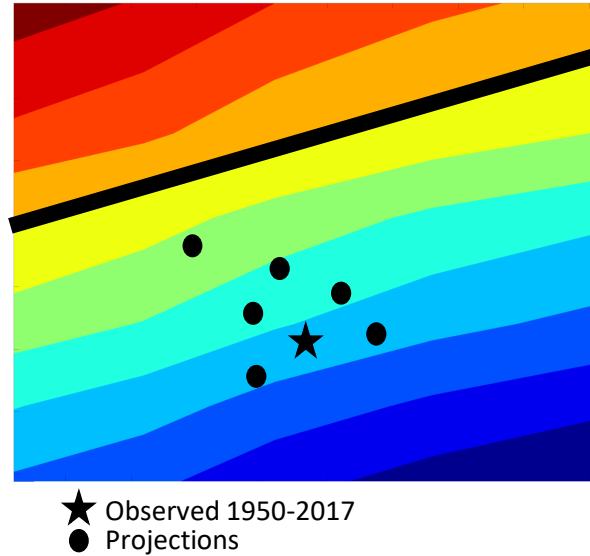


★ Observed 1950-2017
● Projections

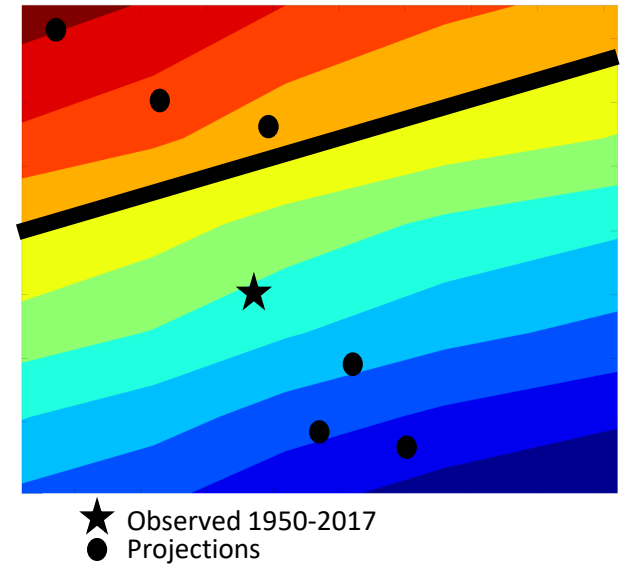
Evaluate analytical uncertainty

- How much data are available?
 - Observed?
 - Projected?
- Are data in agreement with each other?
- Are there known issues with quality of GCM projections for this metric or geographic region?

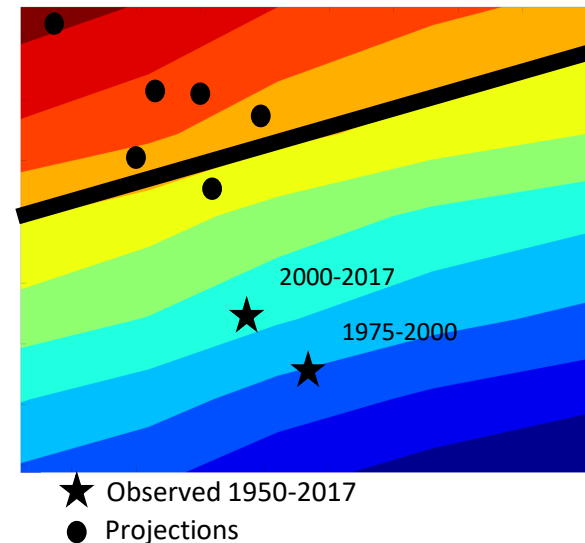
Example 1



Example 2



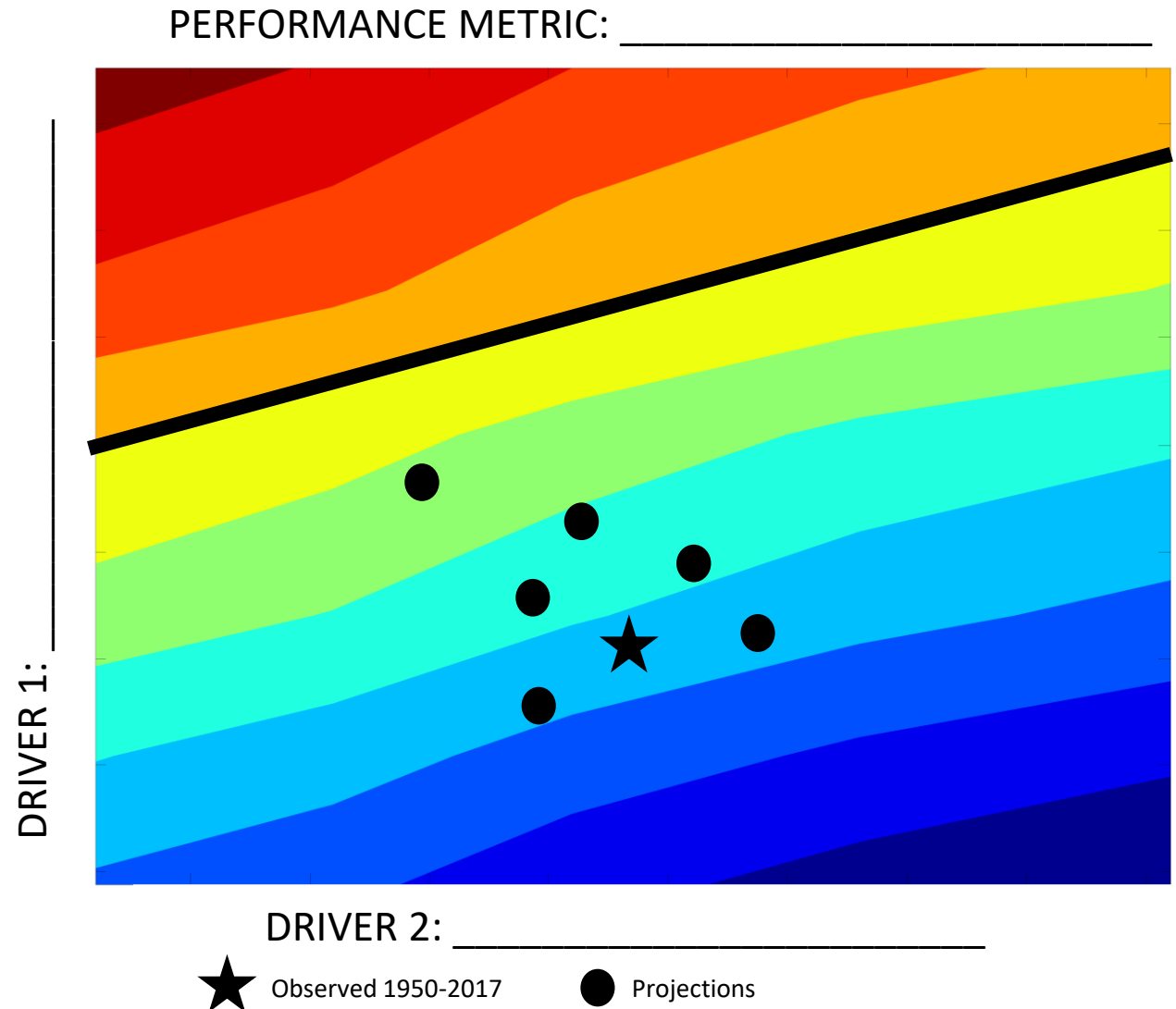
Example 3



Evaluate climate risk: Example 1

- Is observed data already in a vulnerable state?
 - No
- Is observed data trending to a vulnerable state?
 - No
- Does projected data suggest we are heading towards a vulnerable state?
 - Some are lower, some are higher

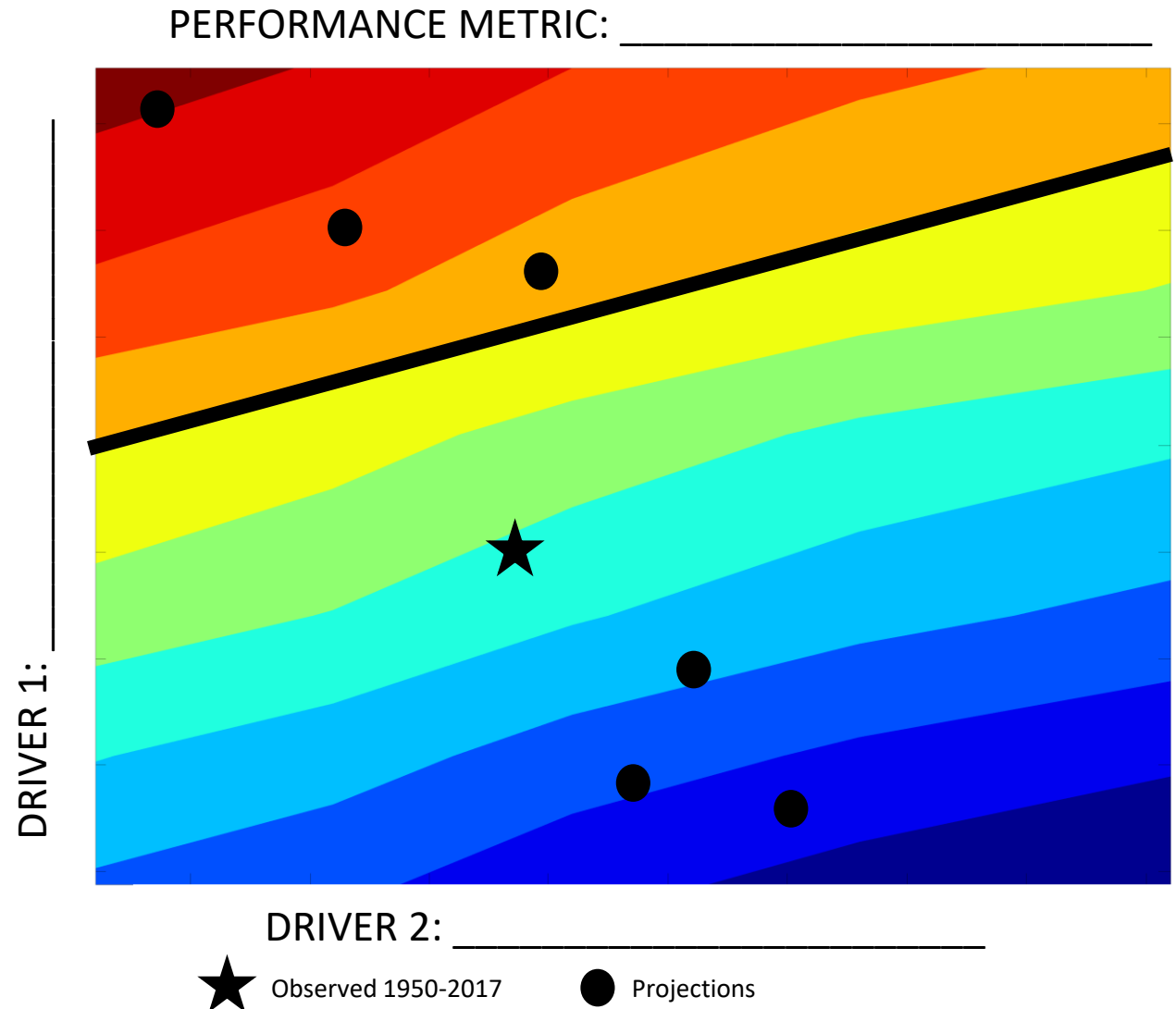
Climate Risk: LOW



Evaluate climate risk: Example 2

- Is observed data already in a vulnerable state?
 - No
- Is observed data trending to a vulnerable state?
 - No
- Does projected data suggest we are heading towards a vulnerable state?
 - Some Yes, Some No

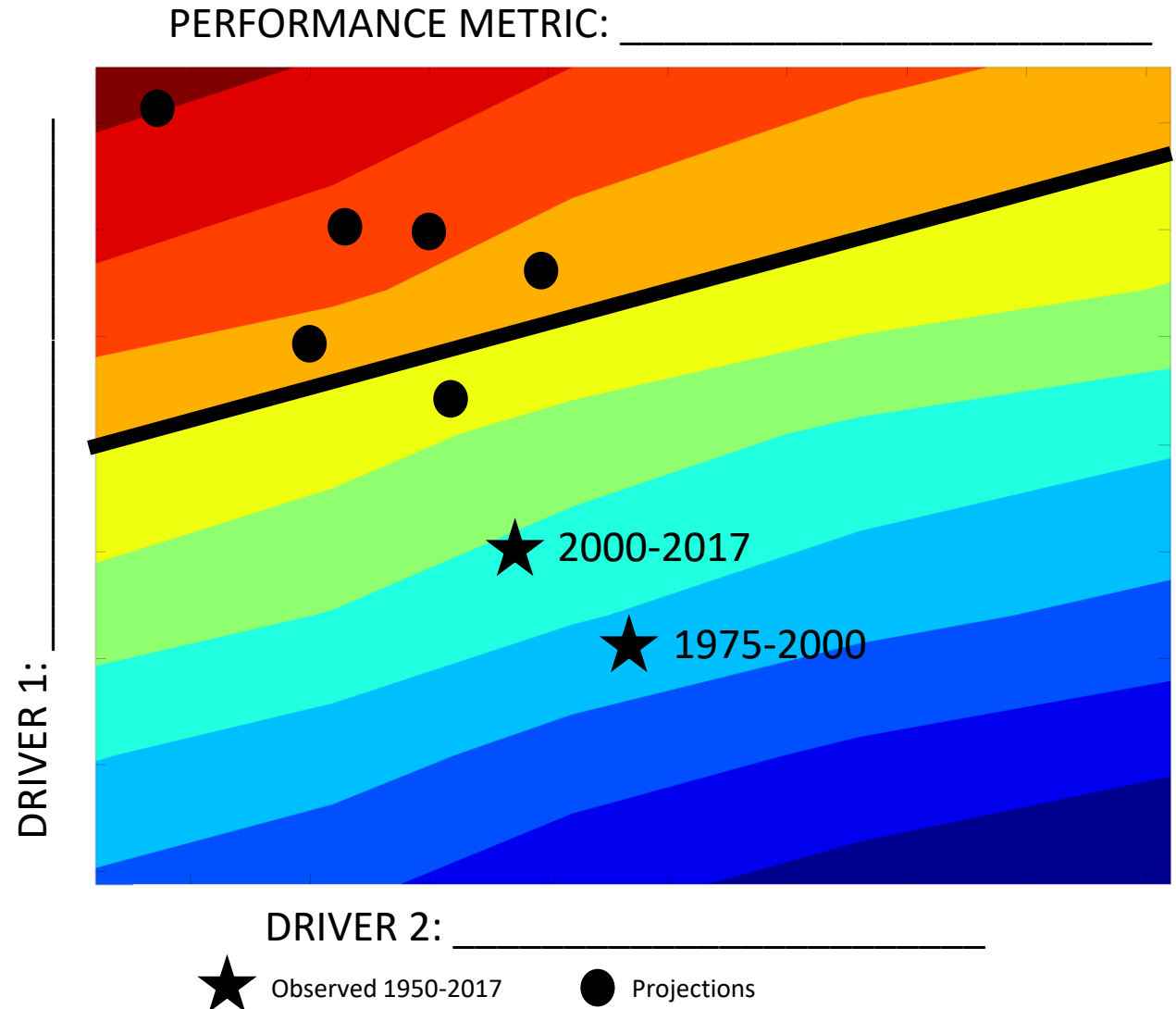
Climate Risk: Medium



Evaluate climate risk: Example 3

- Is observed data already in a vulnerable state?
 - No
- Is observed data trending to a vulnerable state?
 - Yes
- Does projected data suggest we are heading towards a vulnerable state?
 - Yes

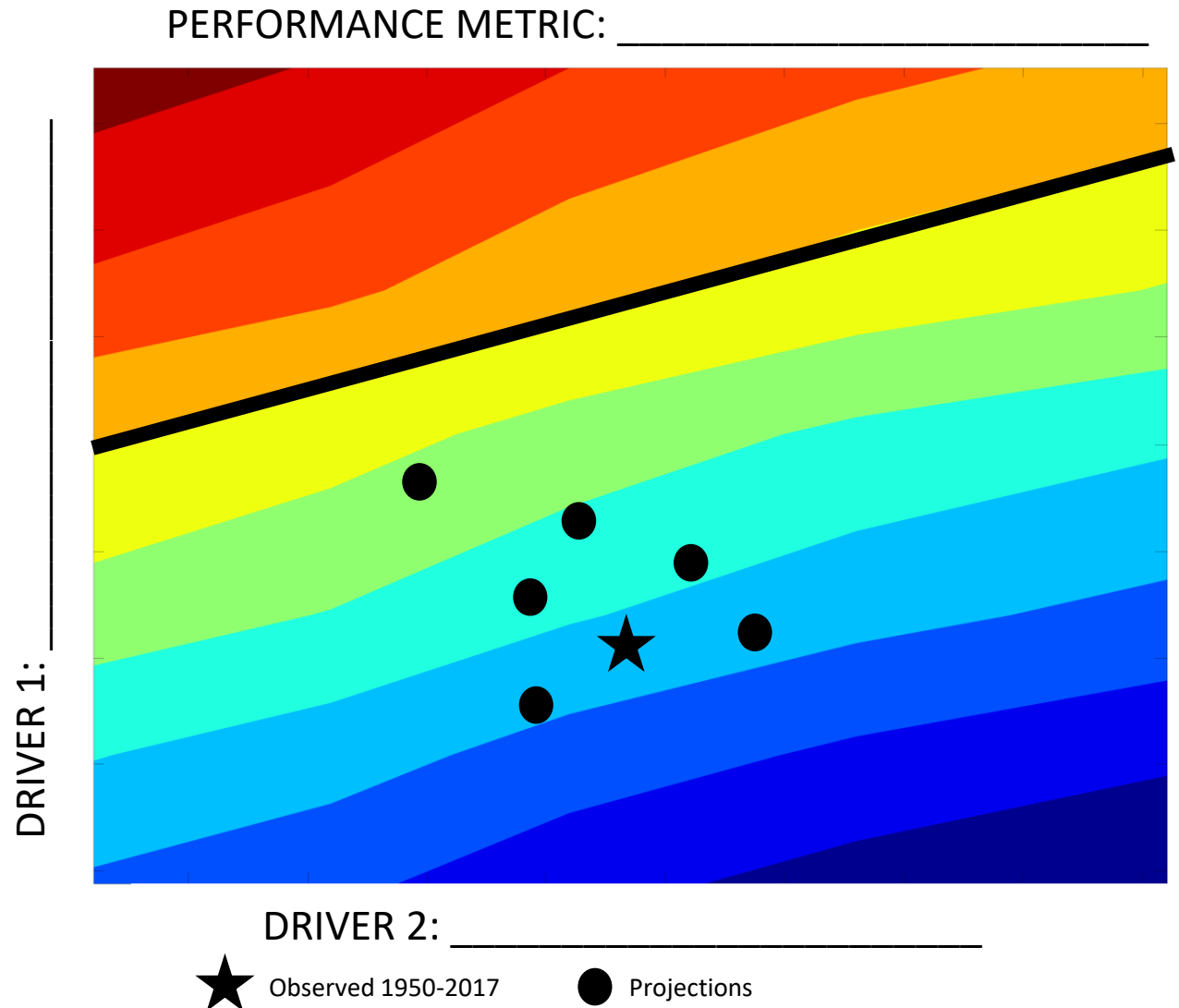
Climate Risk: High



Evaluate Analytical Uncertainty: Example 1

- How much data are available?
 - Observed? **Yes**
 - Projected? **Yes**
- Are data in agreement with each other? **Yes**
- Are there known issues with quality of GCM projections for this metric or geographic region? **No**

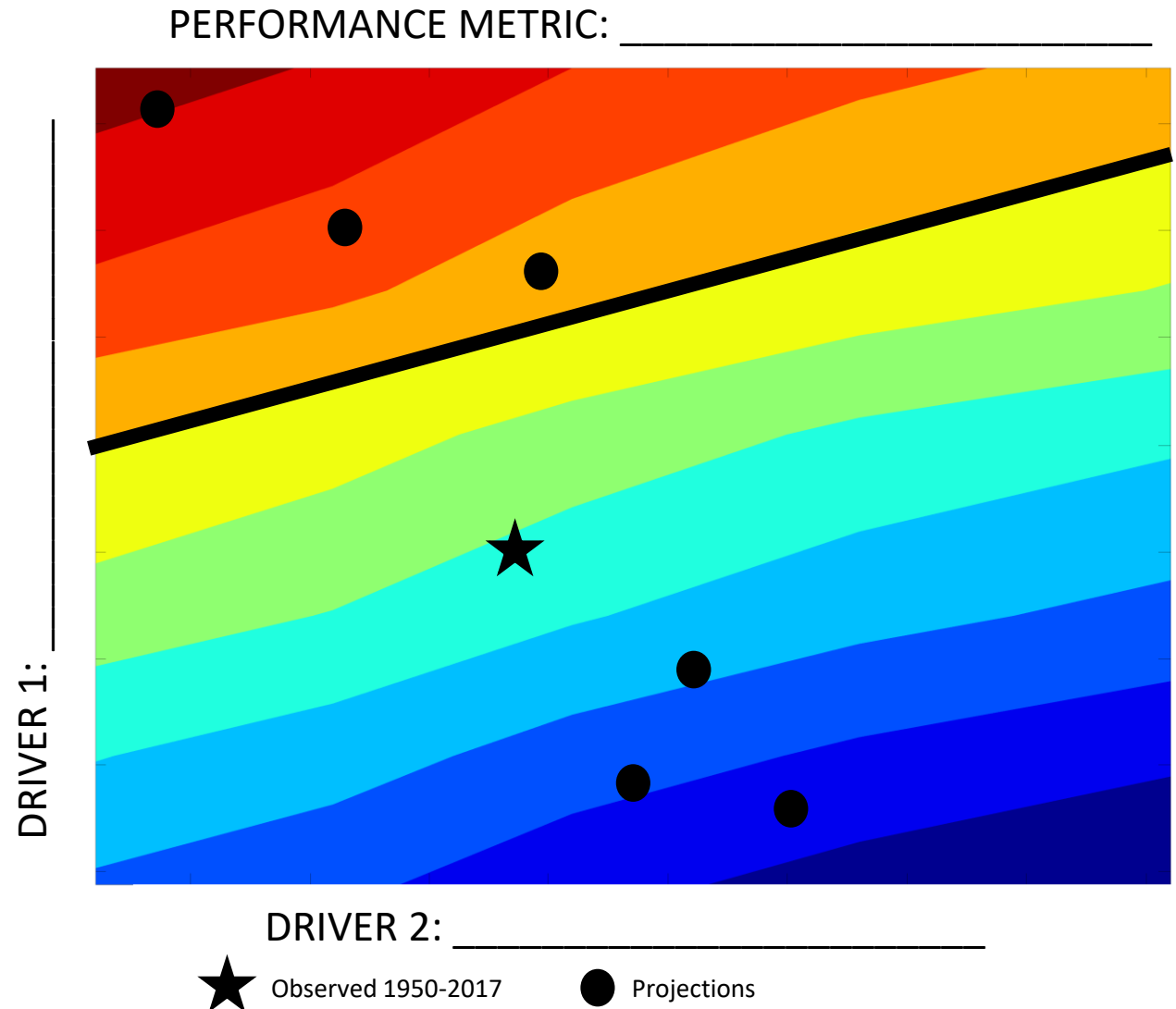
Analytical Uncertainty: Low



Evaluate Analytical Uncertainty: Example 2

- How much data are available?
 - Observed? **Yes**
 - Projected? **Yes**
- Are data in agreement with each other? **No**
- Are there known issues with quality of GCM projections for this metric or geographic region? **No**

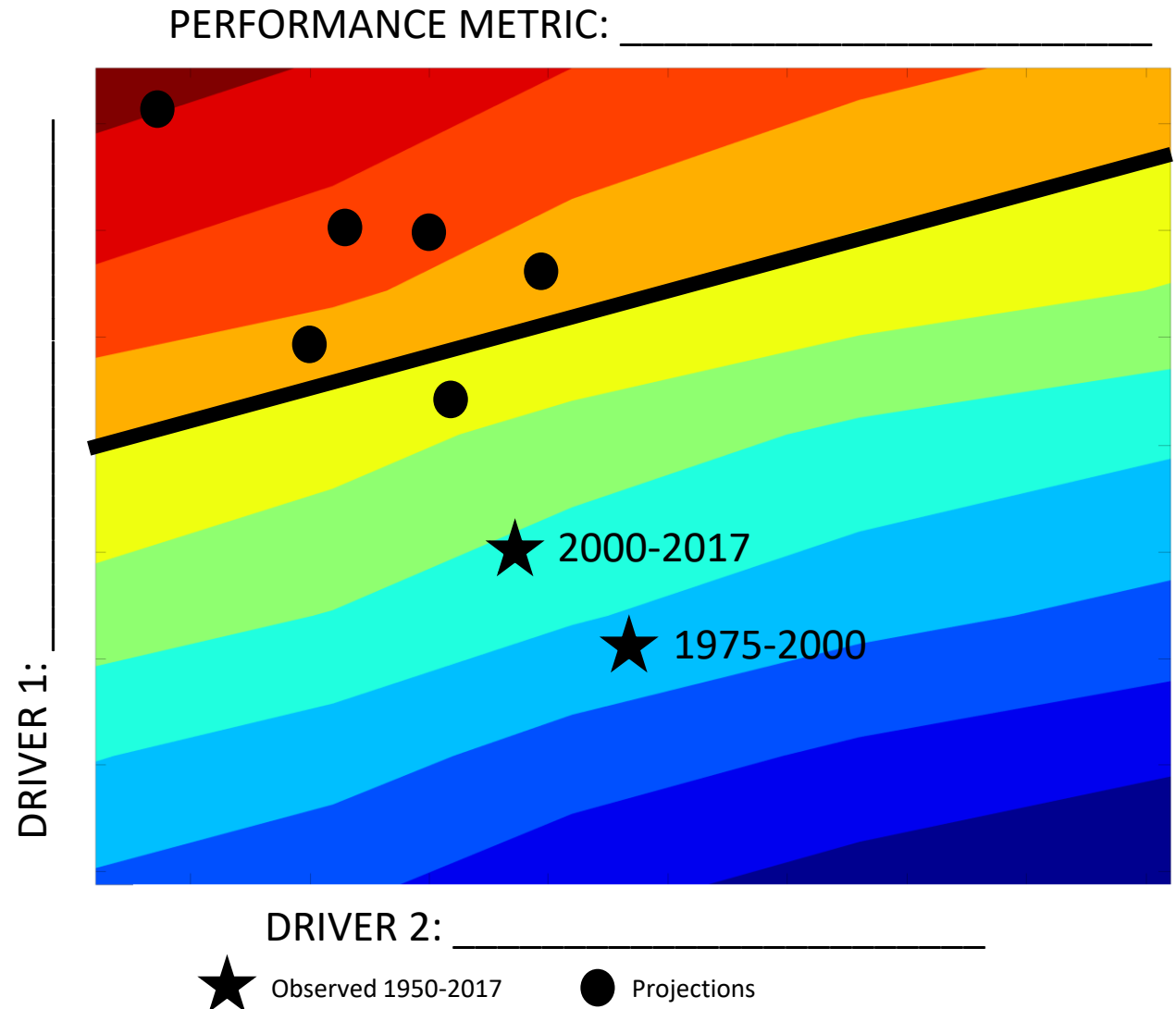
Analytical Uncertainty: High



Evaluate analytical uncertainty: Example 3

- How much data are available?
 - Observed? **Yes**
 - Projected? **Yes**
- Are data in agreement with each other? **Yes**
- Are there known issues with quality of GCM projections for this metric or geographic region? **No**

Analytical Uncertainty: Low



Notes for Analytical Uncertainty

- It is also possible to bring in theory into the analysis when projections are unavailable.
 - Therefore, a lack of projections does not always result in High Analytical Uncertainty.
- These are simplified examples.
 - This part of the analysis is subjective and might require discussion among stakeholders and decision makers if a clear evaluation is not possible.

End Goal: Identify Quadrant for Problem

