

CALIFORNIA DEPARTMENT OF WATER RESOURCES

Moving Toward Adaptation

2021 IRWM Roundtable



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November 16th, 2021

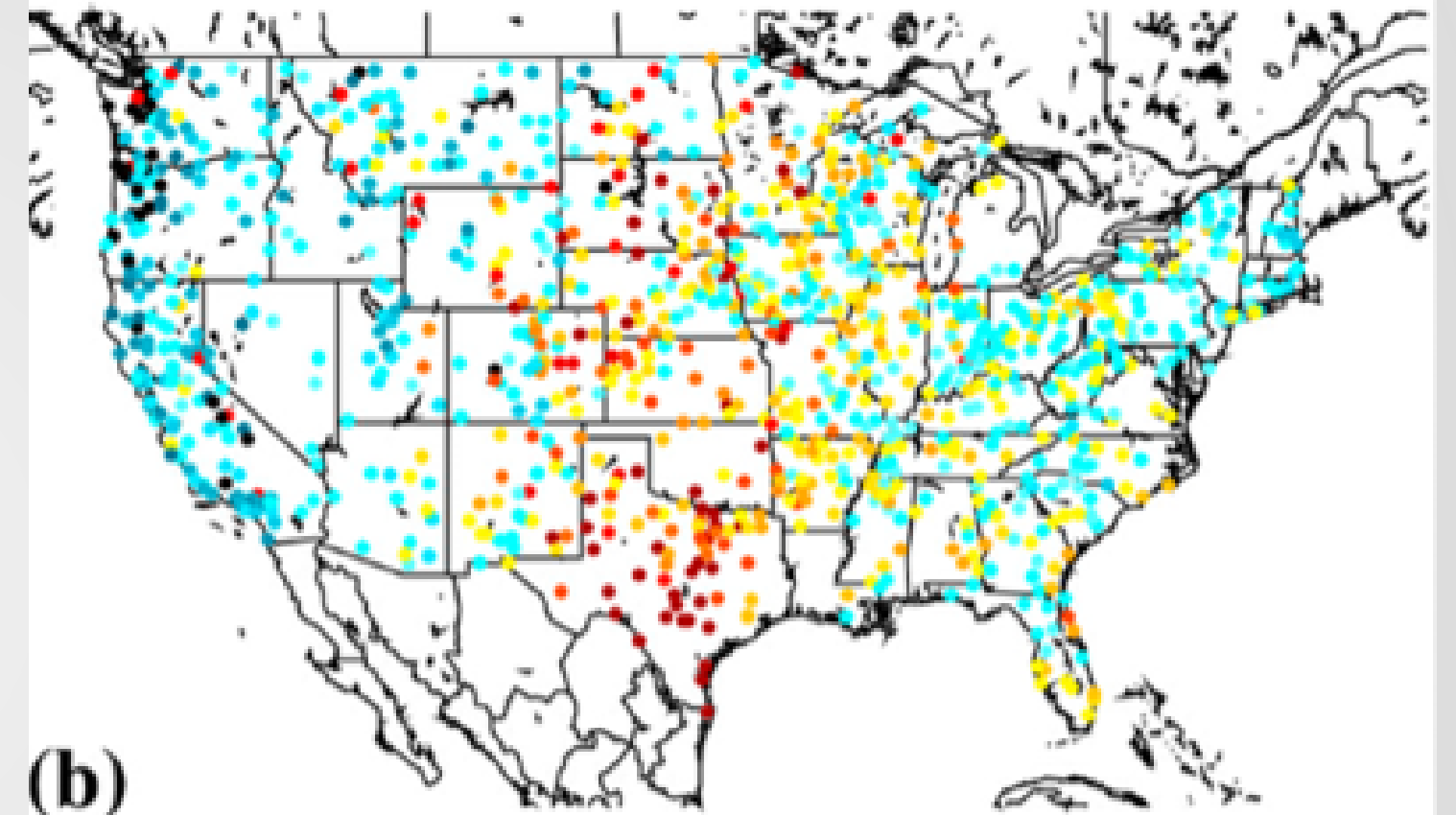
SOME CONTEXT

Climate Change Stressors in California

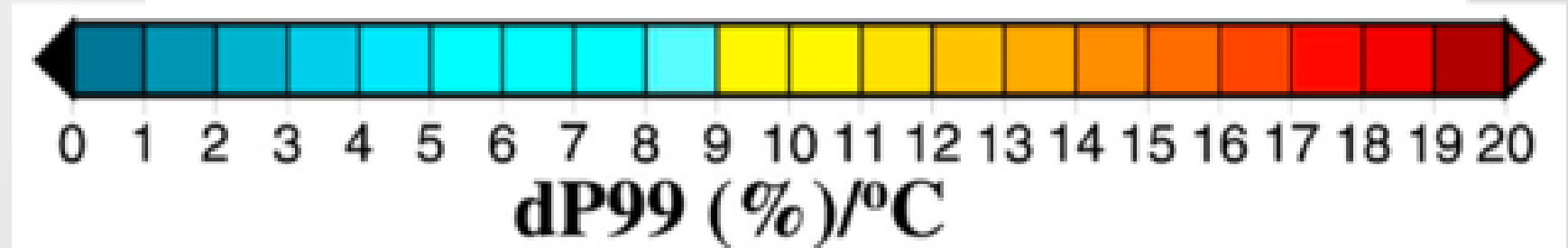
Understood changes

- Increase of temperature
 - 4.4 – 5.8°F (2.4 – 3.2°C) by mid-century¹
- Change in precipitation pattern
 - +3.9%°F (+7%/°C) for daily precipitation above the 99% Prob.²
 - Intra-annual variability may increase substantially^{3,4}
- Sea level rise
 - Median: 0.9ft by mid-century⁵
 - H++: 2.7ft by mid-century⁵

Winter



(b)



Mishra et al (2012), Relationship between hourly extreme precipitation and local air temperature in the United States

¹California's Fourth Climate Change Assessment: Statewide Summary Report (2018)

²Fischer et al (2017), Observed heavy precipitation increase confirms theory and early models

³Dettinger et al (2016), Climate Change and the Delta

⁴Swain et al (2018), Increasing precipitation volatility in twenty-first-century California

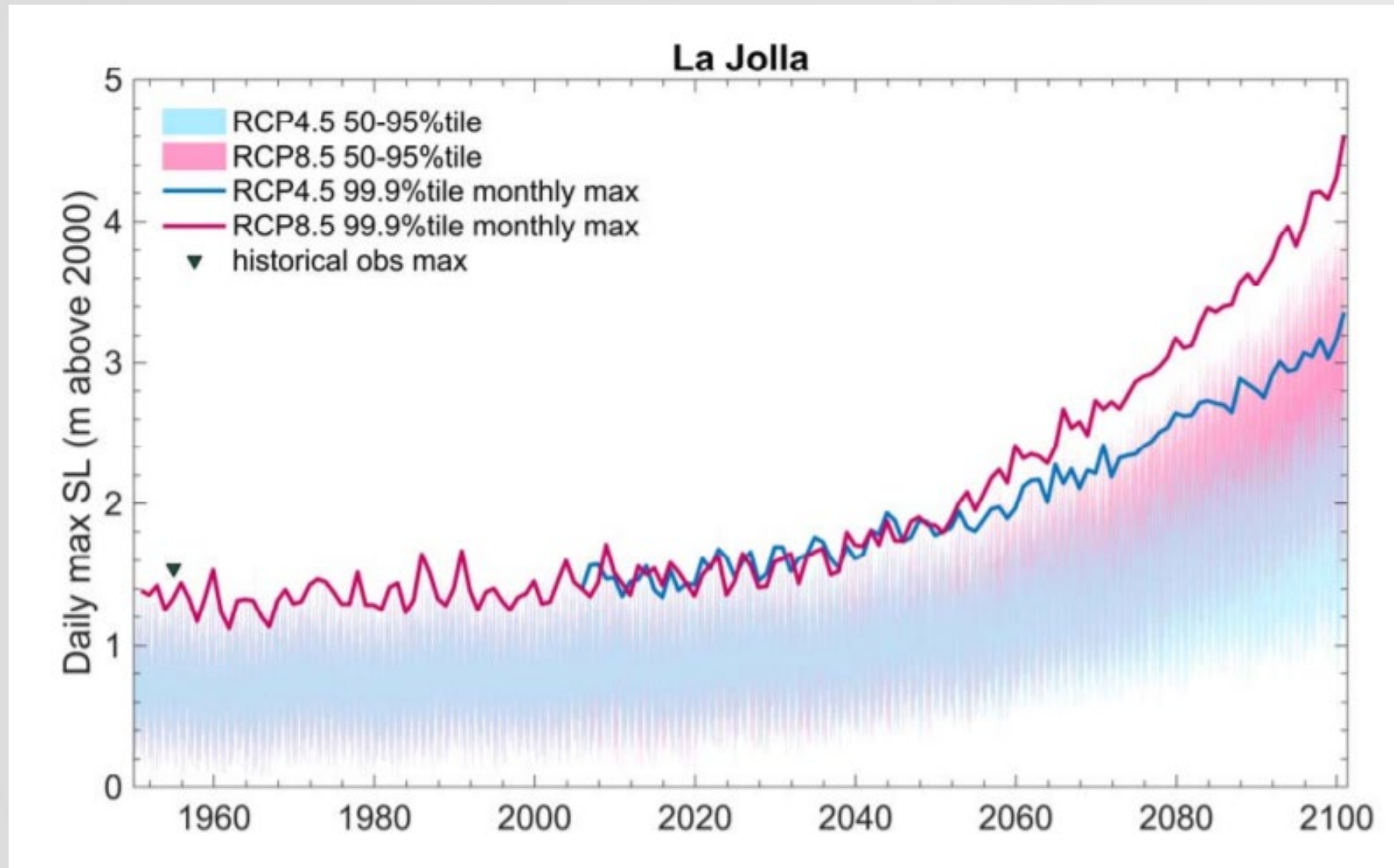
⁵State of California Sea-Level Rise Guidance, 2018 Update



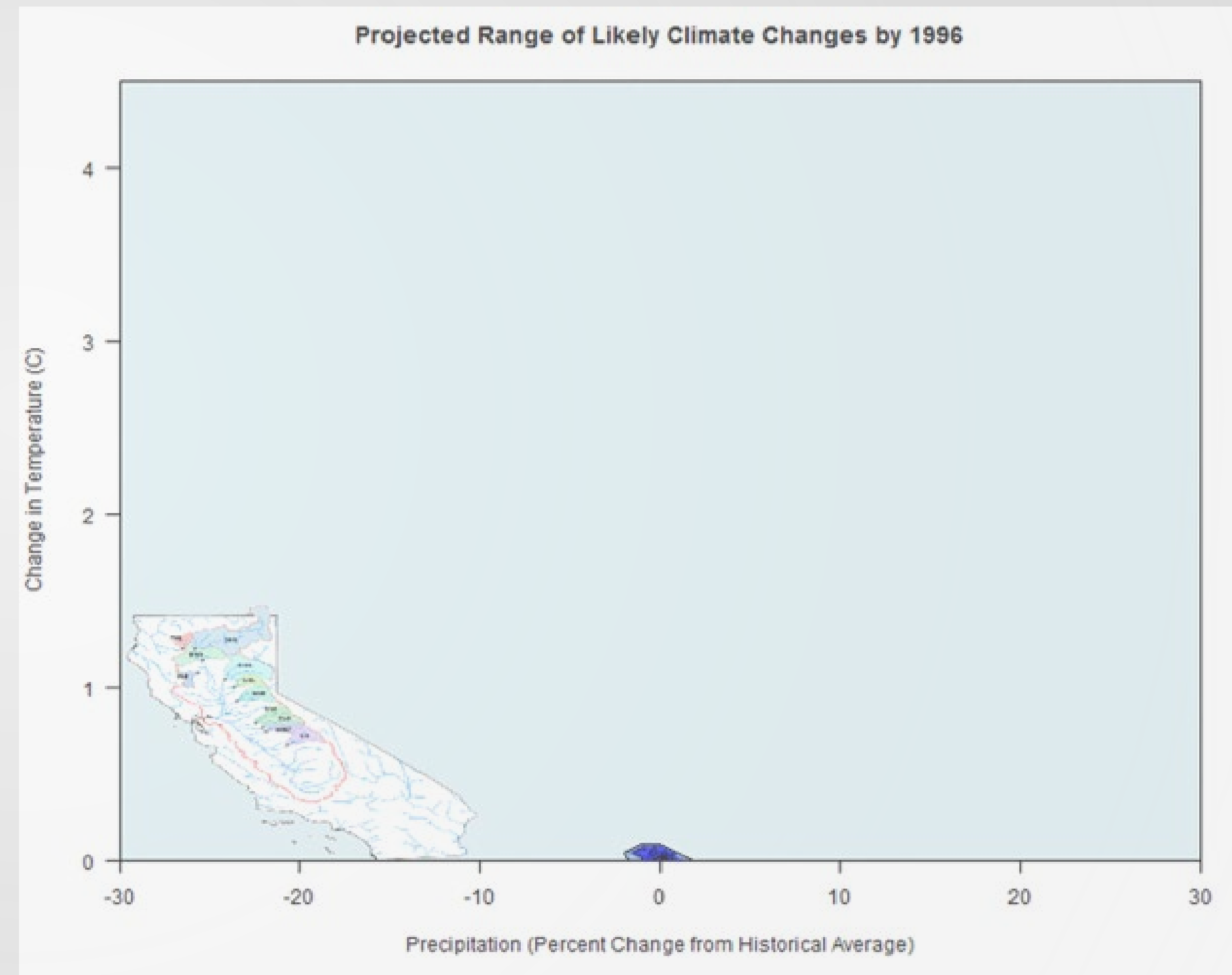
The Challenge: Climate Change Uncertainties

Precipitation and Temperature

Sea Level Rise



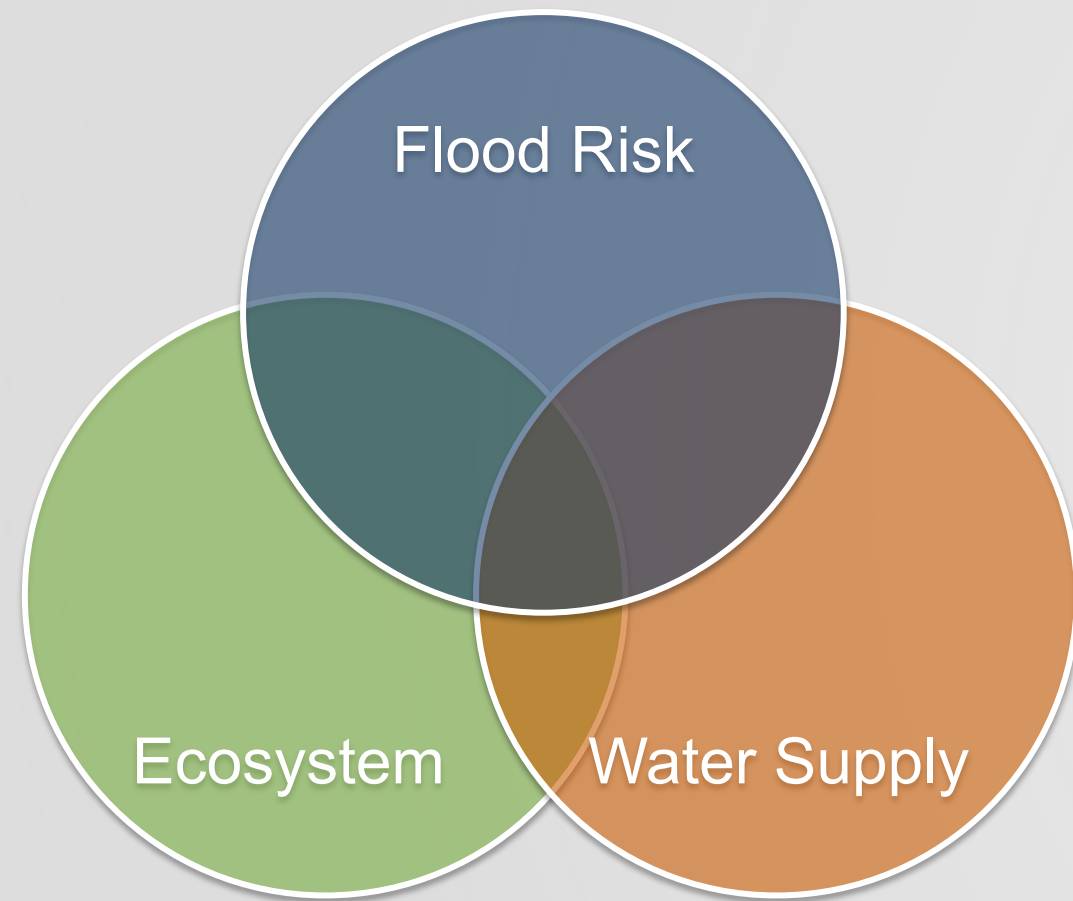
Pierce et al (2018), Climate, Drought, and Sea Level Rise Scenarios for California's Fourth Climate Change Assessment



DWR (2019), Decision Scaling Evaluation of Climate Change Driven Hydrologic Risk to the State Water Project



Important Considerations Toward Adaptation



1. Institutional Anticipation
2. Adaptation Strategies
3. Innovation



INSTITUTIONAL ANTICIPATION

DWR Climate Action Plan

A Comprehensive Response to Climate Change

Phase I: Greenhouse Gas Emissions Reduction Plan

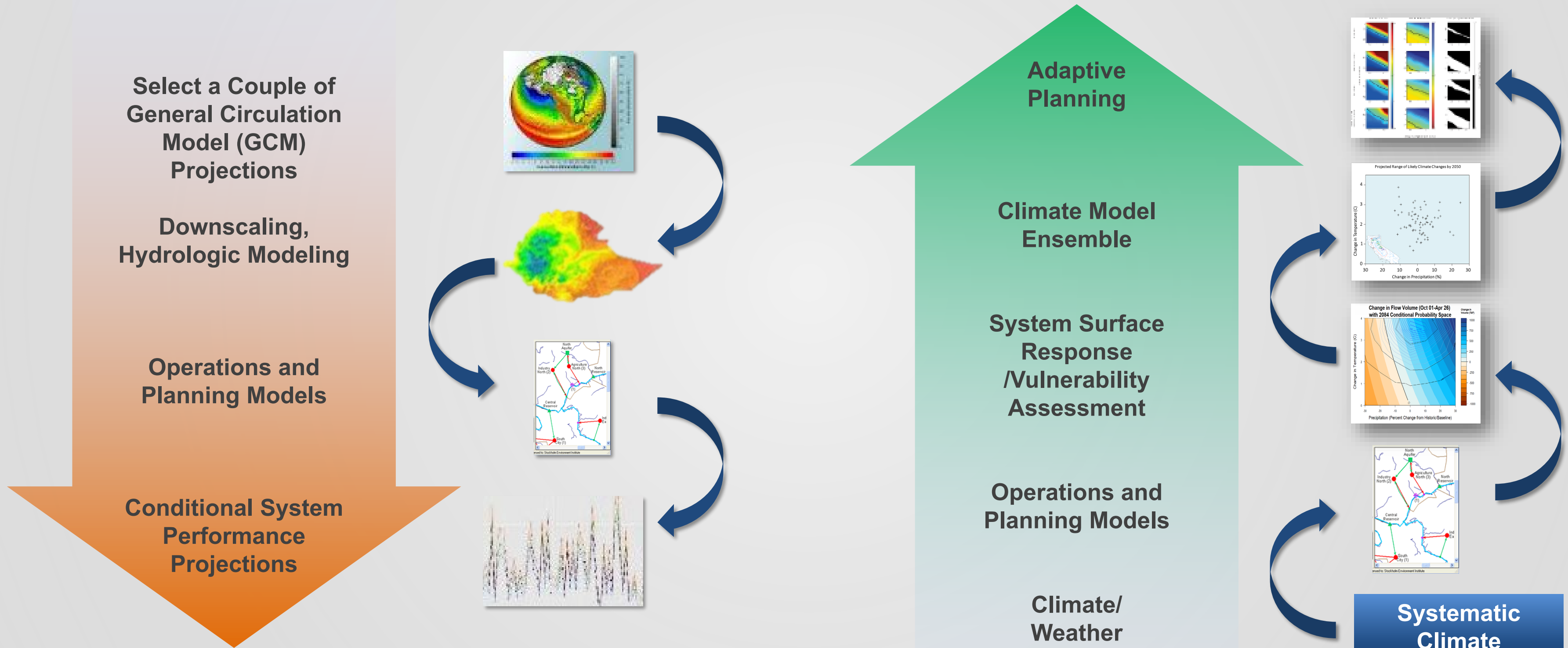
Phase II: Consistent, high quality climate change analysis across all DWR programs

Phase III: Vulnerability Assessment and Adaptation Plan



Downscaling or Top-Down Approach

Bottom Up or Decision-Scaling Approach

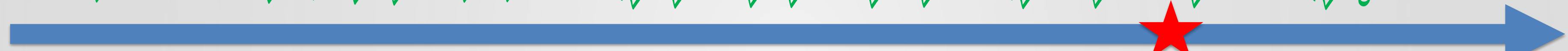




Climate Change Analysis



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2006 SWP/CVP Impacts Report

2009 CWP

2009 SWP/CVP Impacts Report
2009 SWP Delivery Reliability Report
2009 Delta Risk Management Study

2010 Monterey Plus Final EIR
2010 Management Response Status Report

2013 CWP Update
2013 BDCP

2016 Final Water Fix EIR/EIS
2016 WSIP used for SGMA

2017 CVFPP Update
2018 CWP Update

2019 -2020 ITP and DCR

2020 SGMA Extreme Scenario

2021 Delta Conveyance

2022 CVFPP Update & Conservation Strategy

2012 CVFPP

2018 SWP Vulnerability Assessment

SWP Subsidence Program
Flood-MAR – Merced Study

Tuolumne Pilot Study

2023 CWP Update
San Joaquin-wide Climate /Watershed Studies

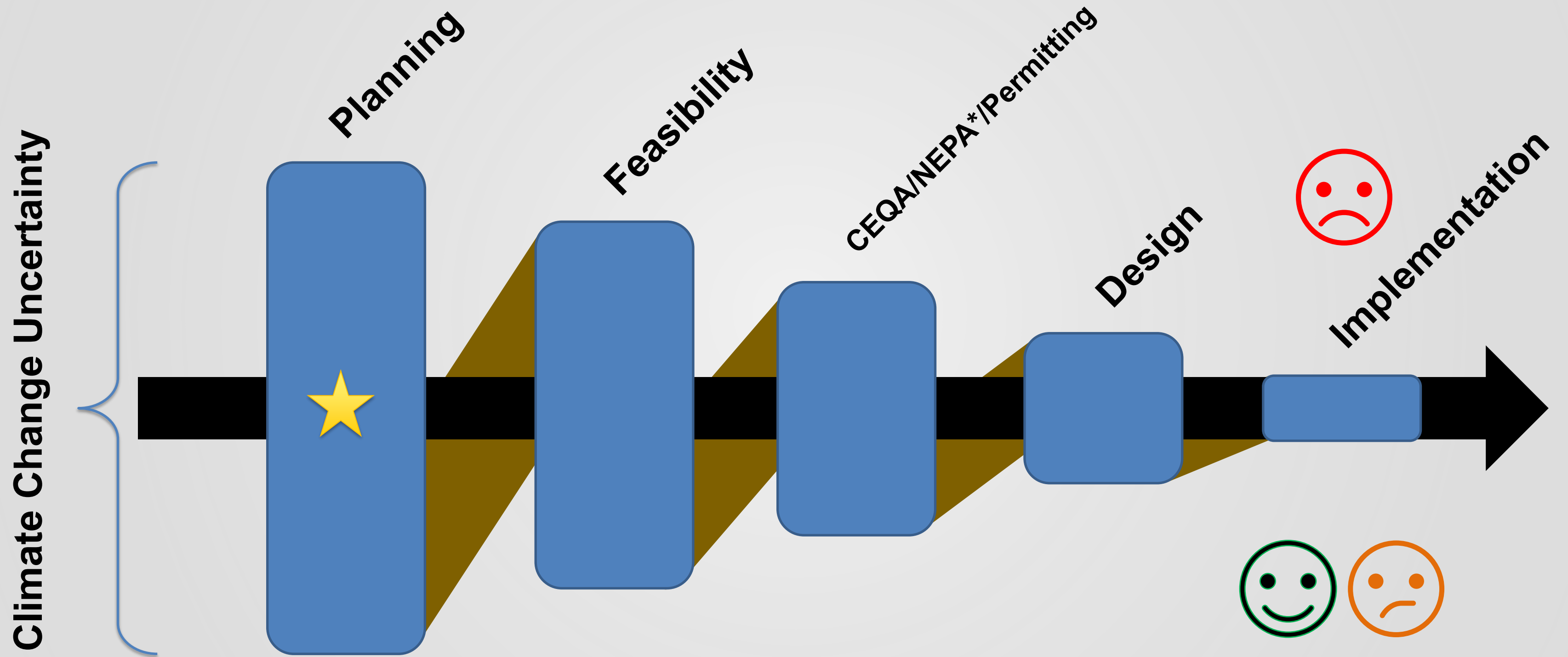


Today

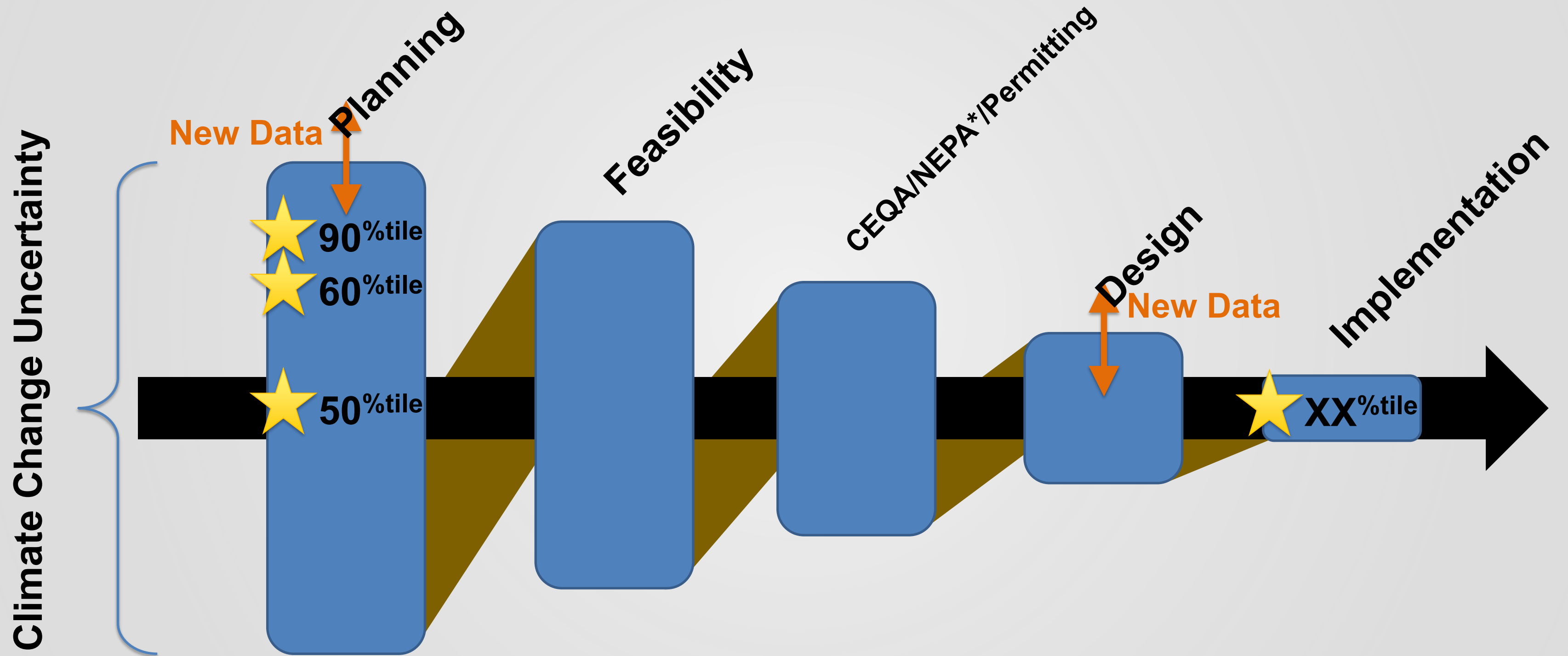
Top-Down/Downscaling Analysis

Bottom-up/Decision Scaling Analysis

From Planning to Implementation



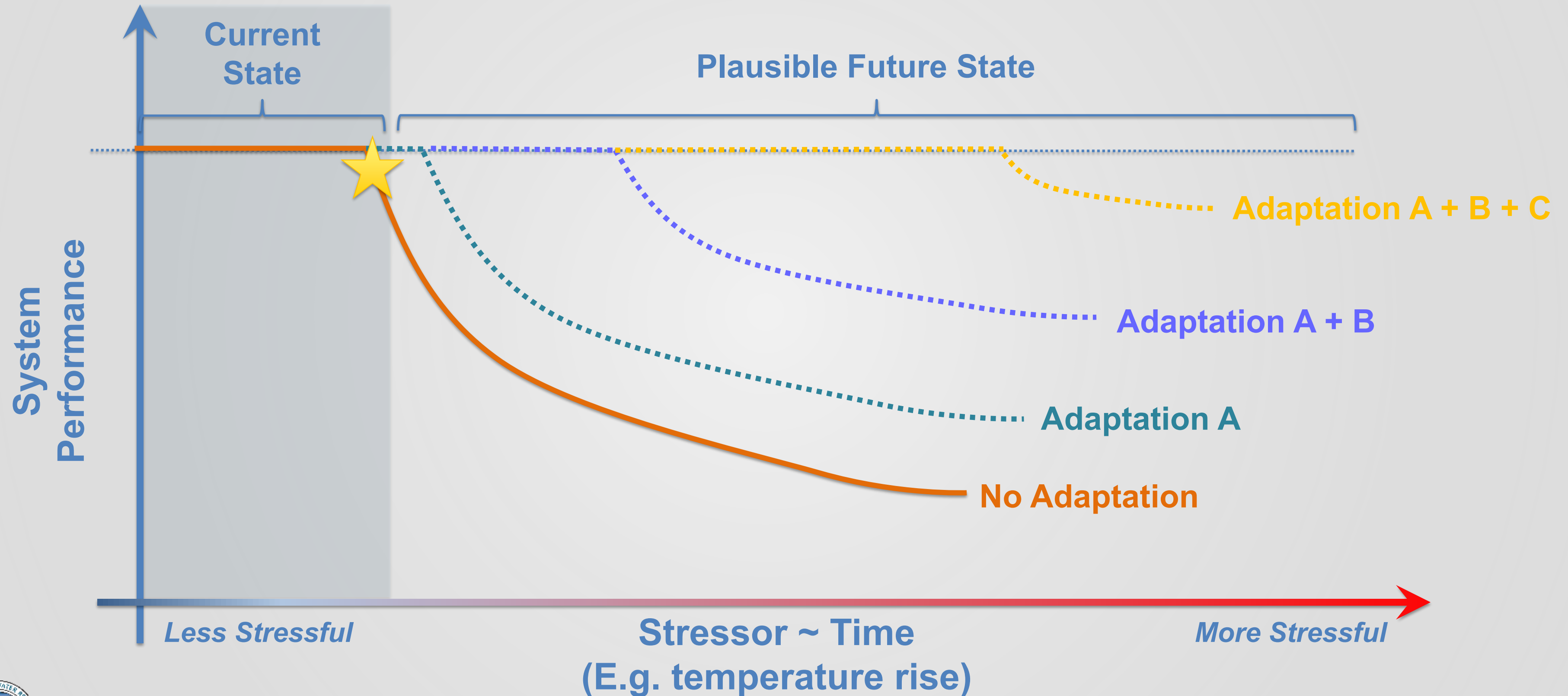
From Planning to Implementation



The background of the slide features a large, faint watermark of the University of Twente logo, which includes a circular emblem with a mountain range and the text 'UNIVERSITY OF TWENTE'.

ADAPTATION STRATEGIES

Adaptation





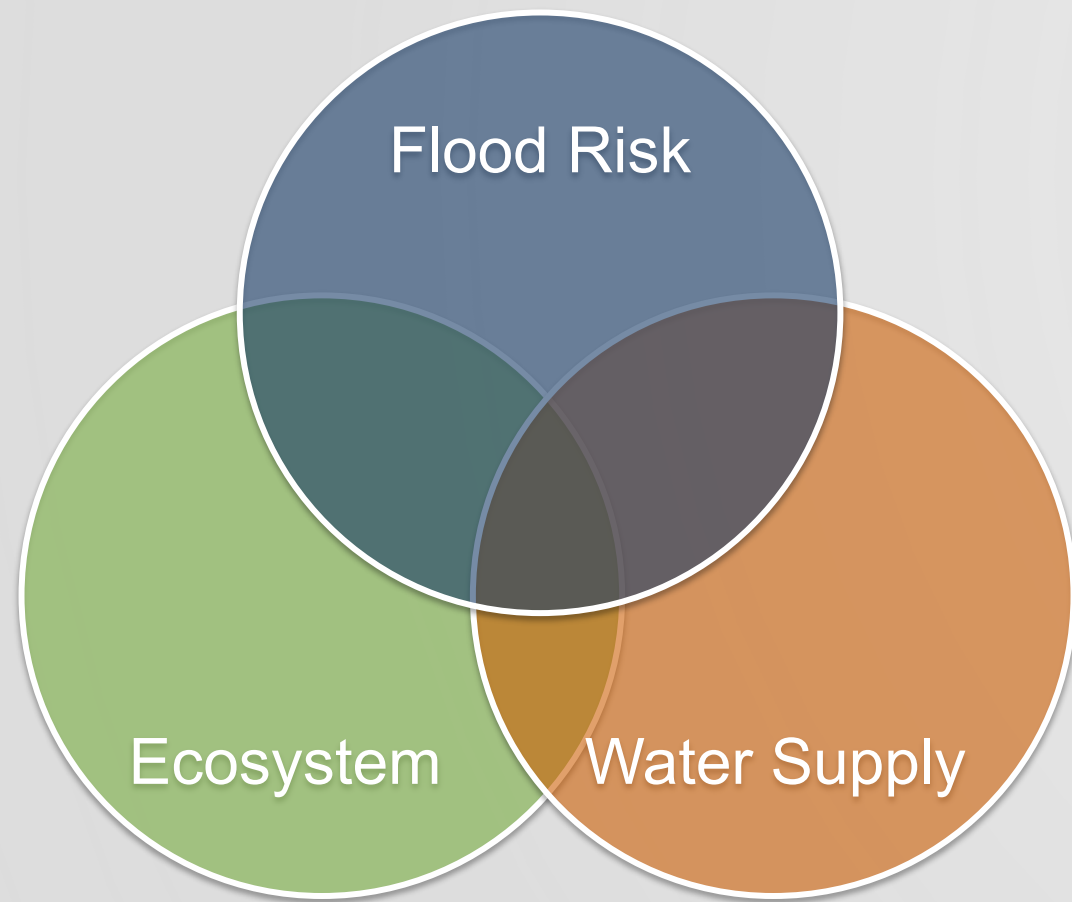
Source: Jose Luis Roca / AF



Source: Reuters



Source: DWR

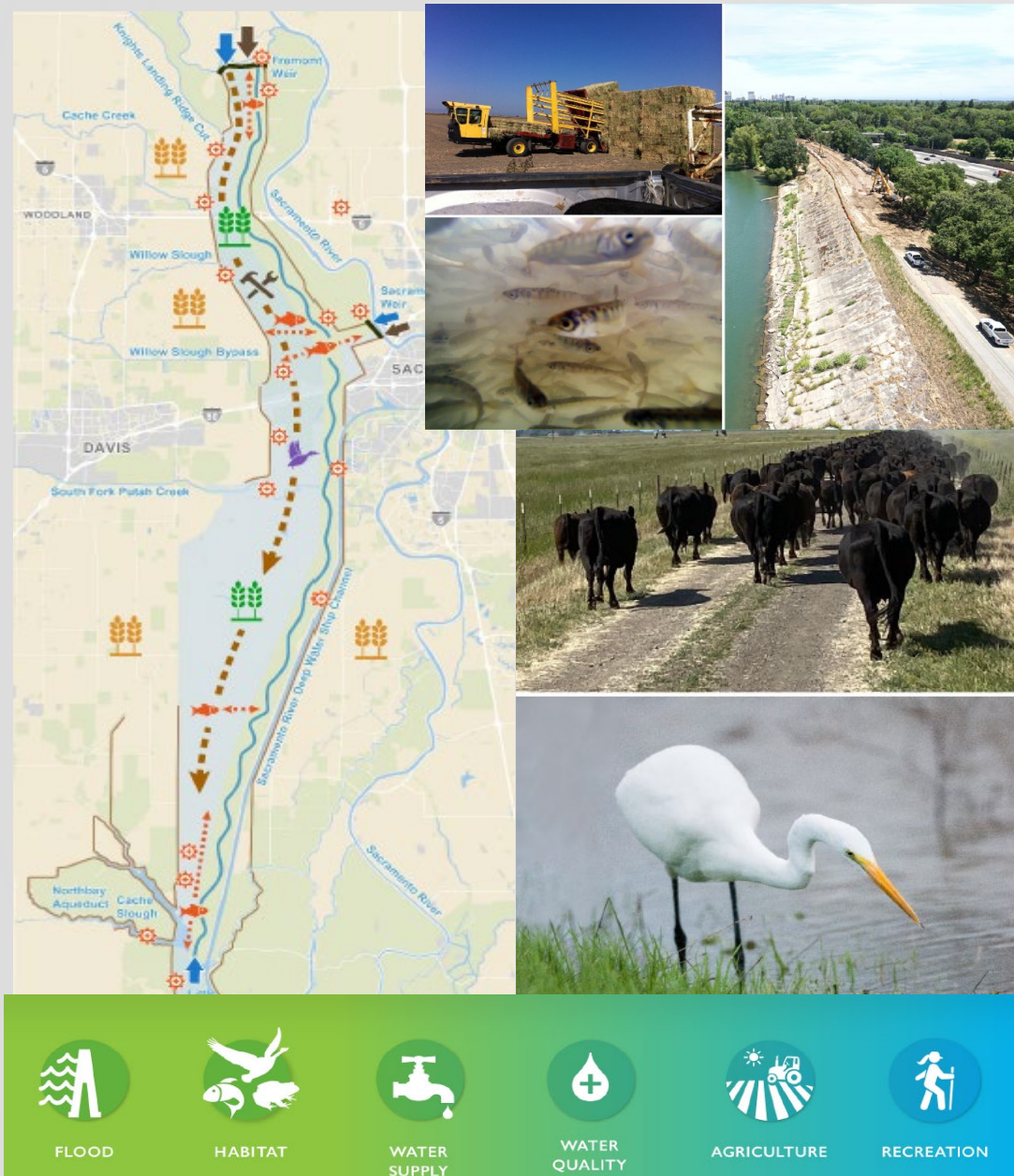


- Each water sectors – flood, water supply and ecosystem – are vulnerable to climate change
- Sectors vulnerabilities are often interconnected
- A need for multi-sector adaptation strategies

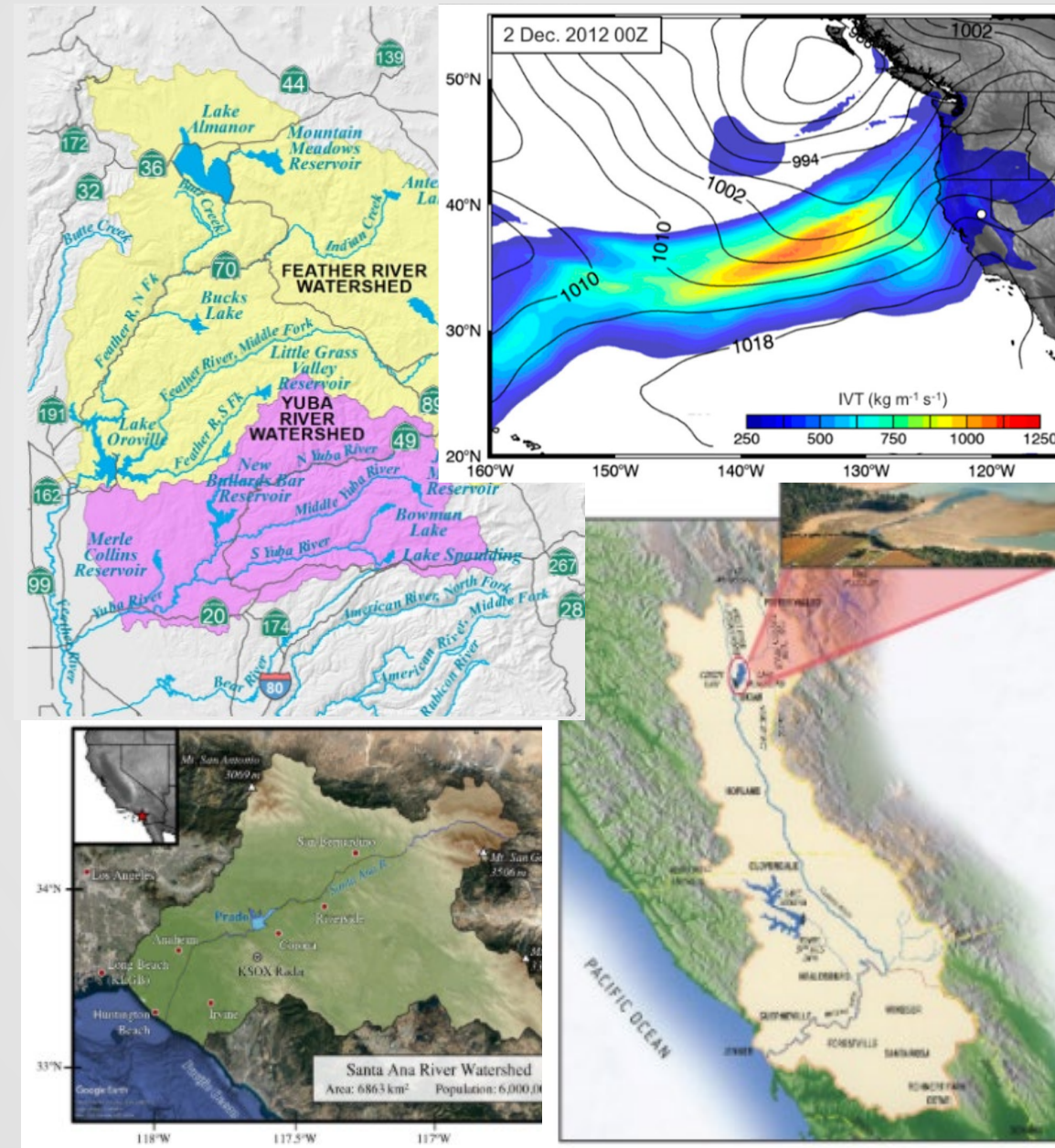


Multi-Sector Adaptation Strategies

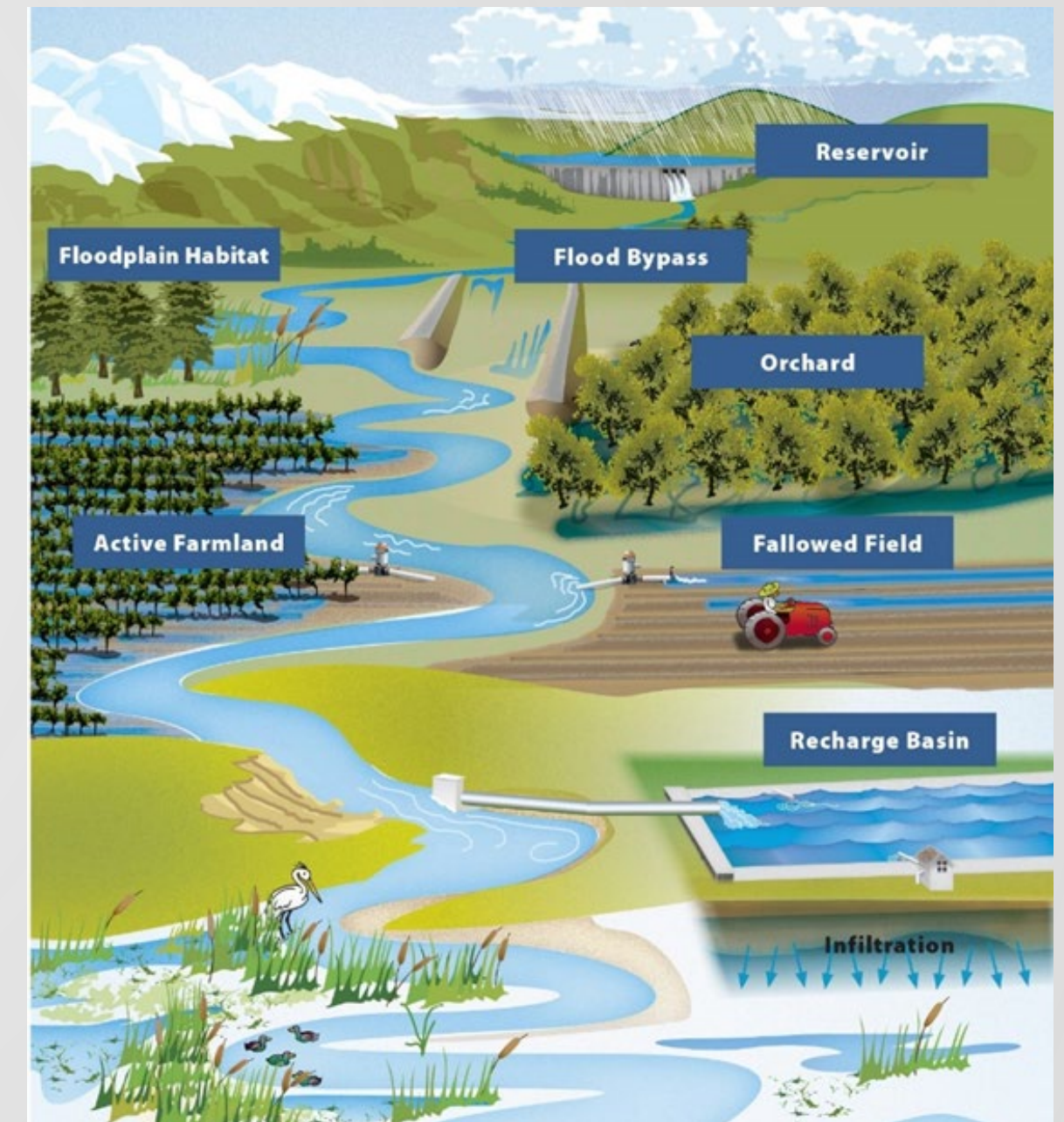
Multi-Benefit Bypass Improvements



Forecast Inform Reservoir Operation



Flood-Managed Aquifer Recharge (MAR)



INNOVATION

Watershed Vulnerability and Adaptation Planning Studies

Merced River Basin Flood-MAR Reconnaissance Study

Tuolumne River Watershed Vulnerability Assessment and Adaptive Planning Study

What?

Use Decision Scaling, applied in two phases:

- 1) Climate change vulnerability assessment of the water resources systems and
- 2) Adaptative planning evaluates the effectiveness of adaptation strategies

How?

Stress test watershed water supply, flood, and ecosystem performance under a range of climatic precipitation and temperature perturbations using:

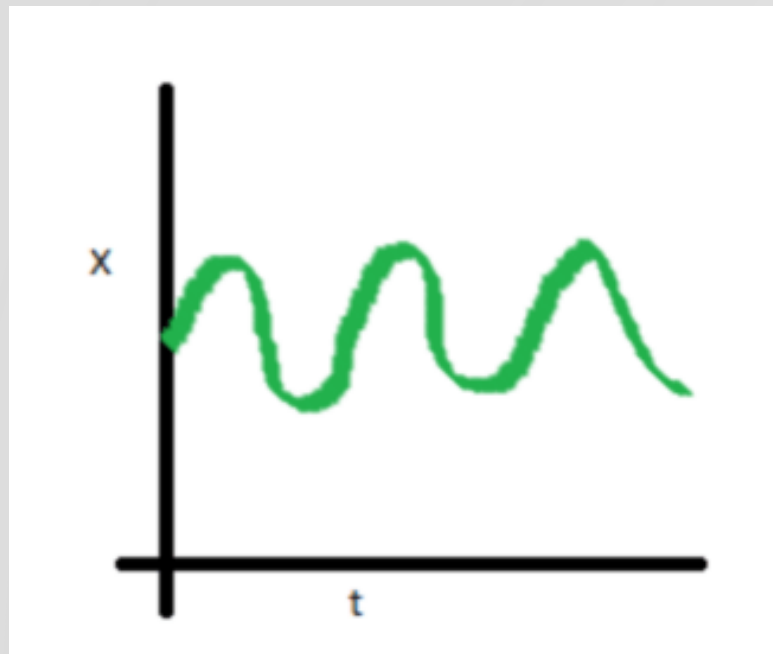
- Paleo-climatic reconstructions of historic hydrology
- An innovative stochastic weather generator

Why?

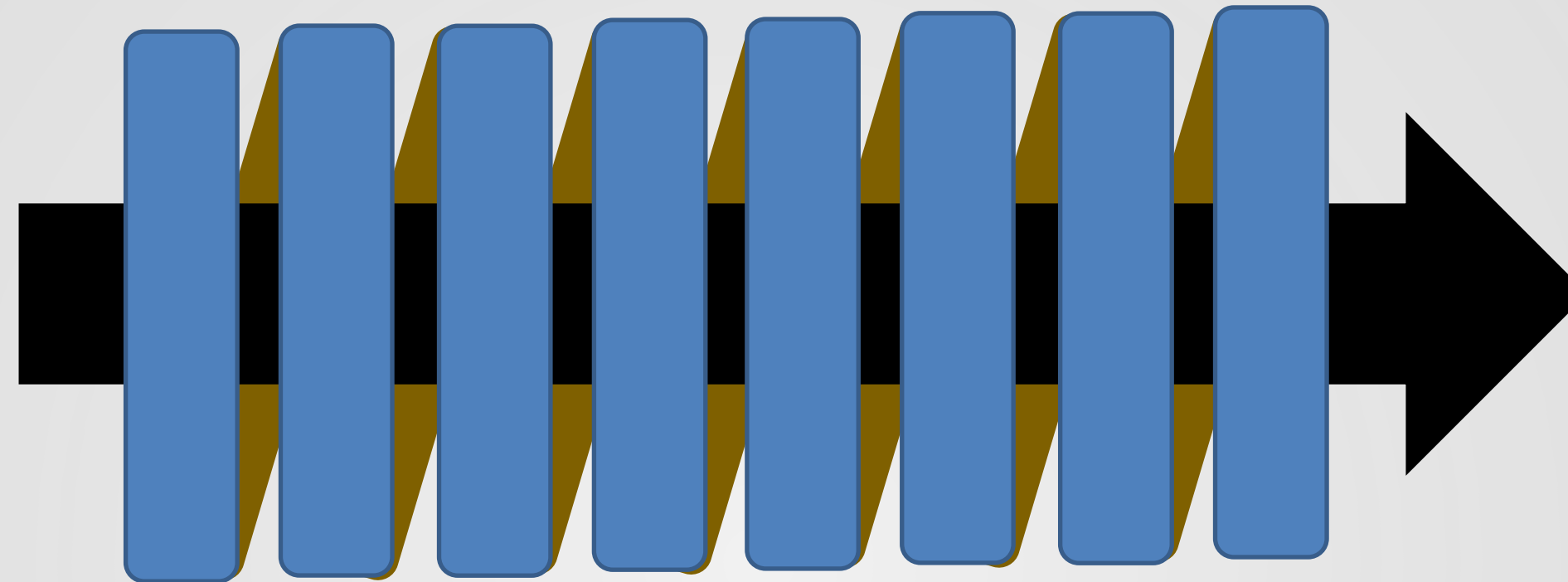
- Demonstrate application of watershed-scale integrated analytical toolset
- Improve understanding of climate change vulnerabilities, using risk-based reporting of results
- Demonstrate advantages of planning and managing across water sectors at the watershed scale
- Provide a proof-of-concept study, applying and testing Flood-MAR implementation concepts
- Improve understanding of the effects of atmospheric rivers connected to climate change



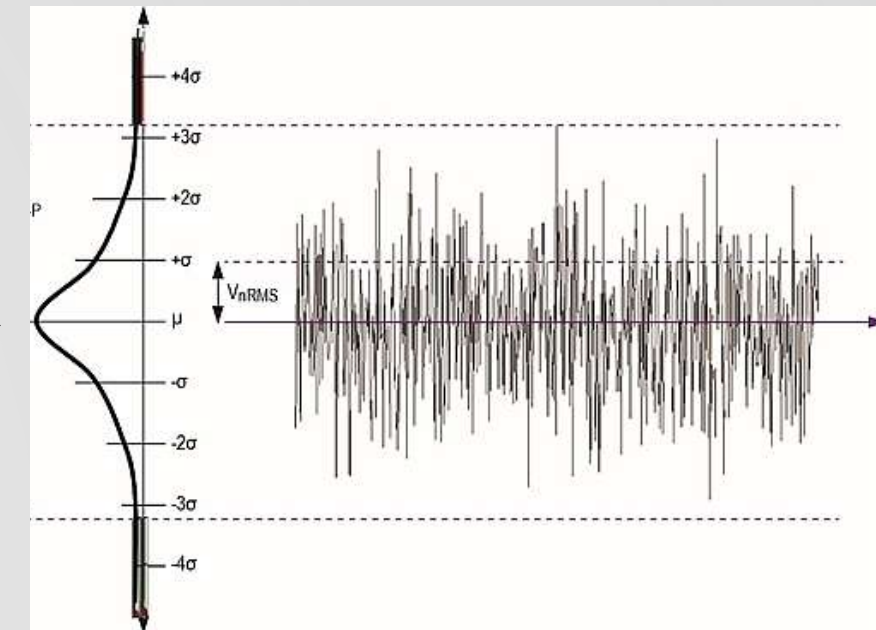
Weather Generator & Perturbations



Observed or historical time series of weather

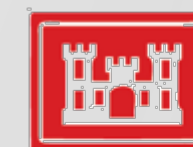


- Dendrochronology Module
- Annual Module
- Seasonal Module
- Daily Module



Many simulated time series of weather data

- Precipitation change driven by temperature increase
- Investigating weather regimes changes



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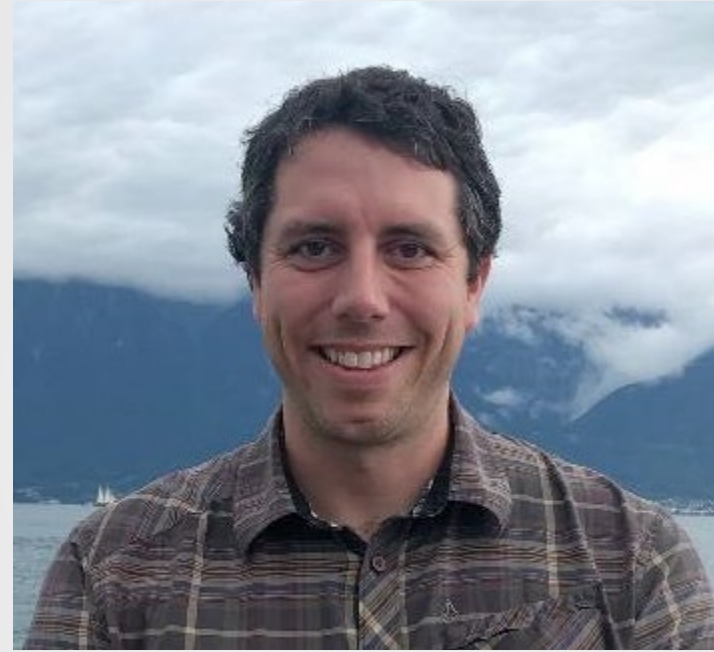
CONCLUSION

Path Toward Adaptation

1. Institution Anticipation: Recognize the need to act to what and when
2. Adaptation Strategies: Collaborate to form multi-water sector strategies
3. Innovation: Stay connected to the research community



Thank You



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