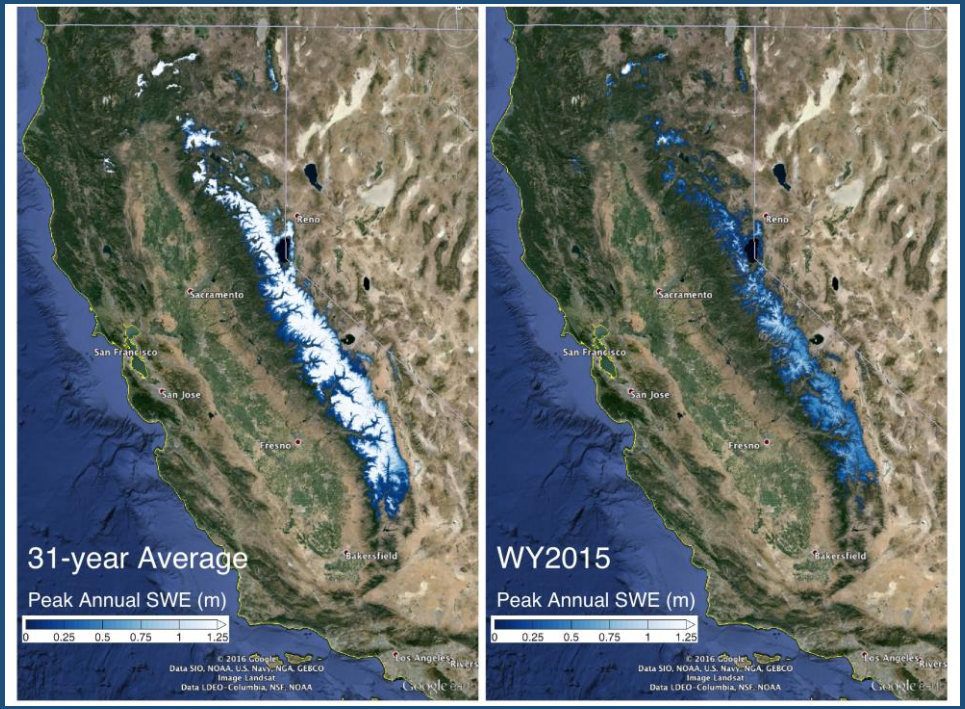
Bottom Up Climate Change Vulnerability Assessment: California's Water System



NATIONAL ACADEMY OF SCIENCES

Making Climate Assessments Work: Learning from California and Other Subnational Assessment Efforts

August 14-15, 2018

Collaborative project between

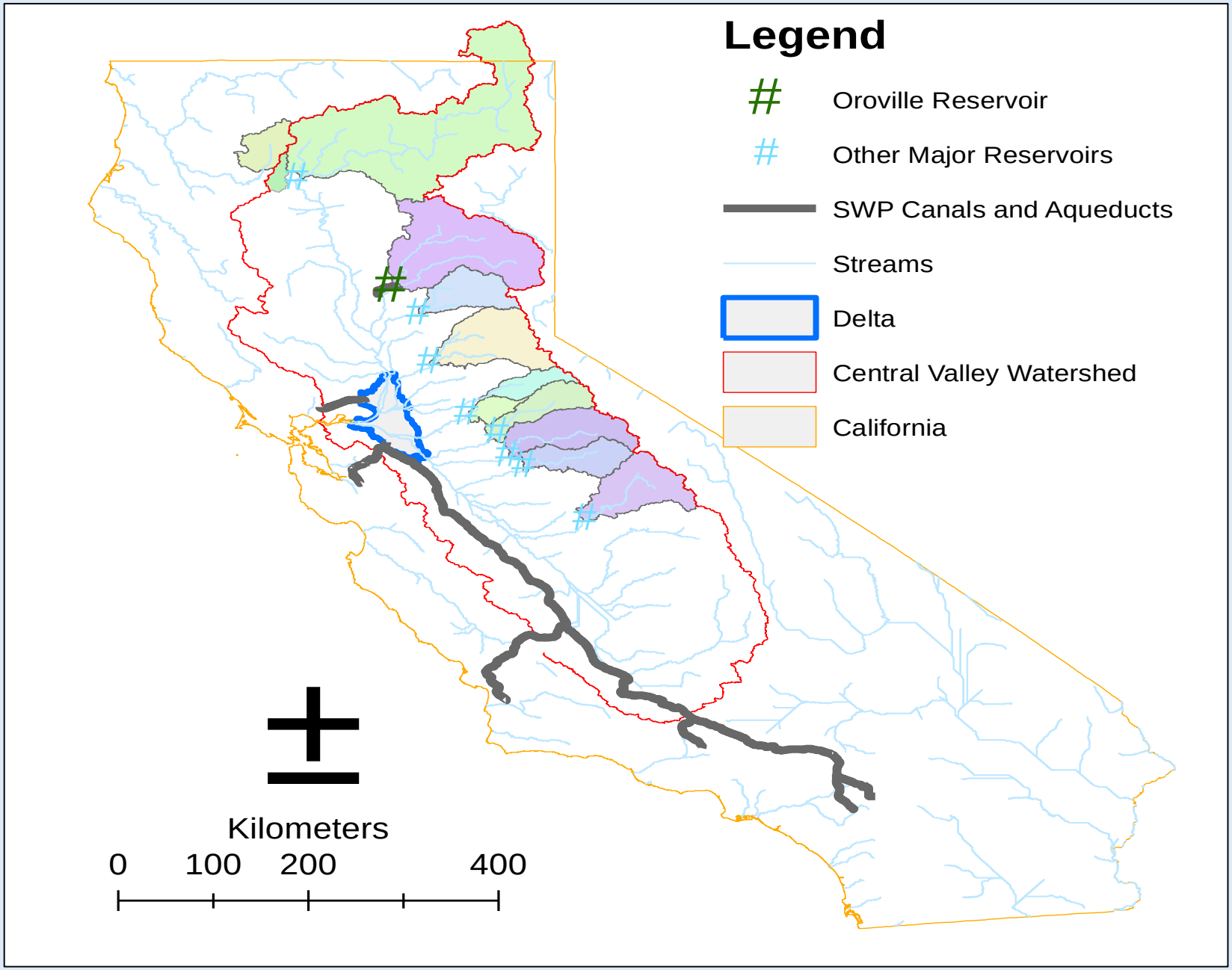
- California Department of Water Resources

- University of Massachusetts-Amherst Hydrosystems Research Group
  - Dr. Casey Brown
  - Dr. Patrick Ray (now at University of Cincinnati)
  - Dr. Sungwook Wu

Publication: "Climate Change Risks Faced by the California Department of Water Resources" Schwarz et al. 2018. California 4th Climate Change Assessment

- Handling Climate Change Uncertainly by Using Our Tools Differently

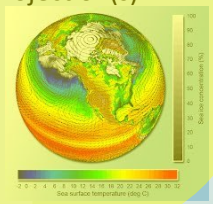
- A Model for Co-Development of Science to Inform Policy


Legend
Oroville Reservoir
Other Major Reservoirs
SWP Canals and Aqueducts
Streams
Delta
Central Valley Watershed
California
Kilometers
0
100
200
400

Where should we start?

Top Down/ Scenario Analysis

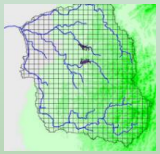
Climate Model Projection(s)



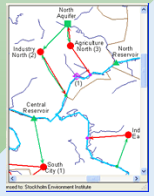
Largest Source of Uncertainty

Downscaling

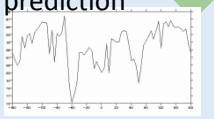
Rainfall-runoff Models and calibrations

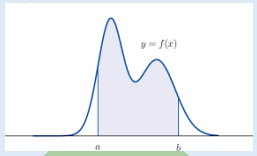


Operations and Planning Models



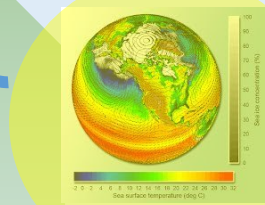
System performance prediction

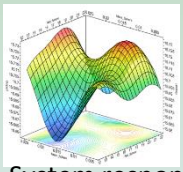




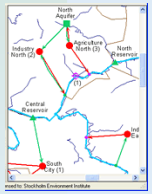
System performance prediction

Climate Model Ensemble





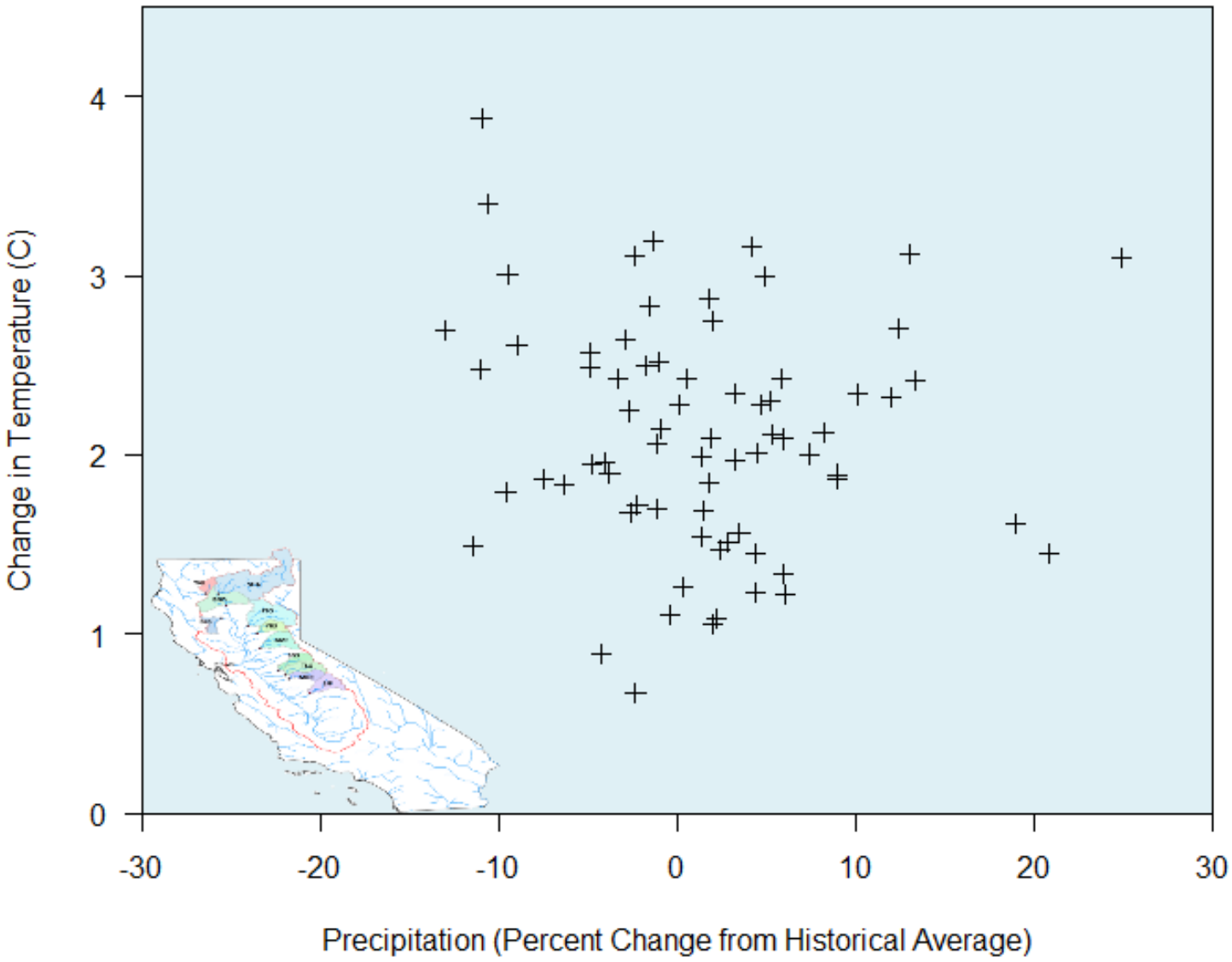
System response surface

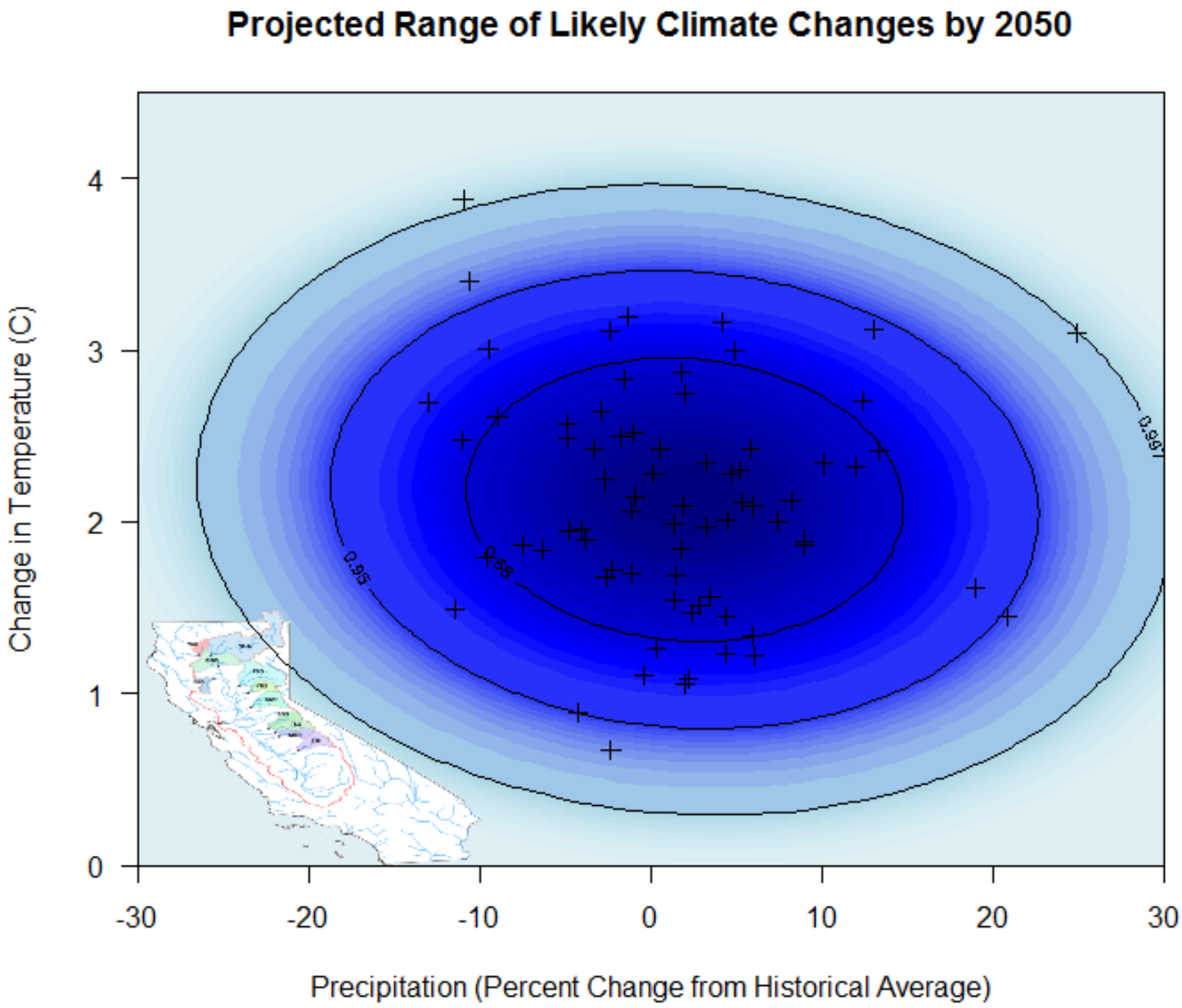


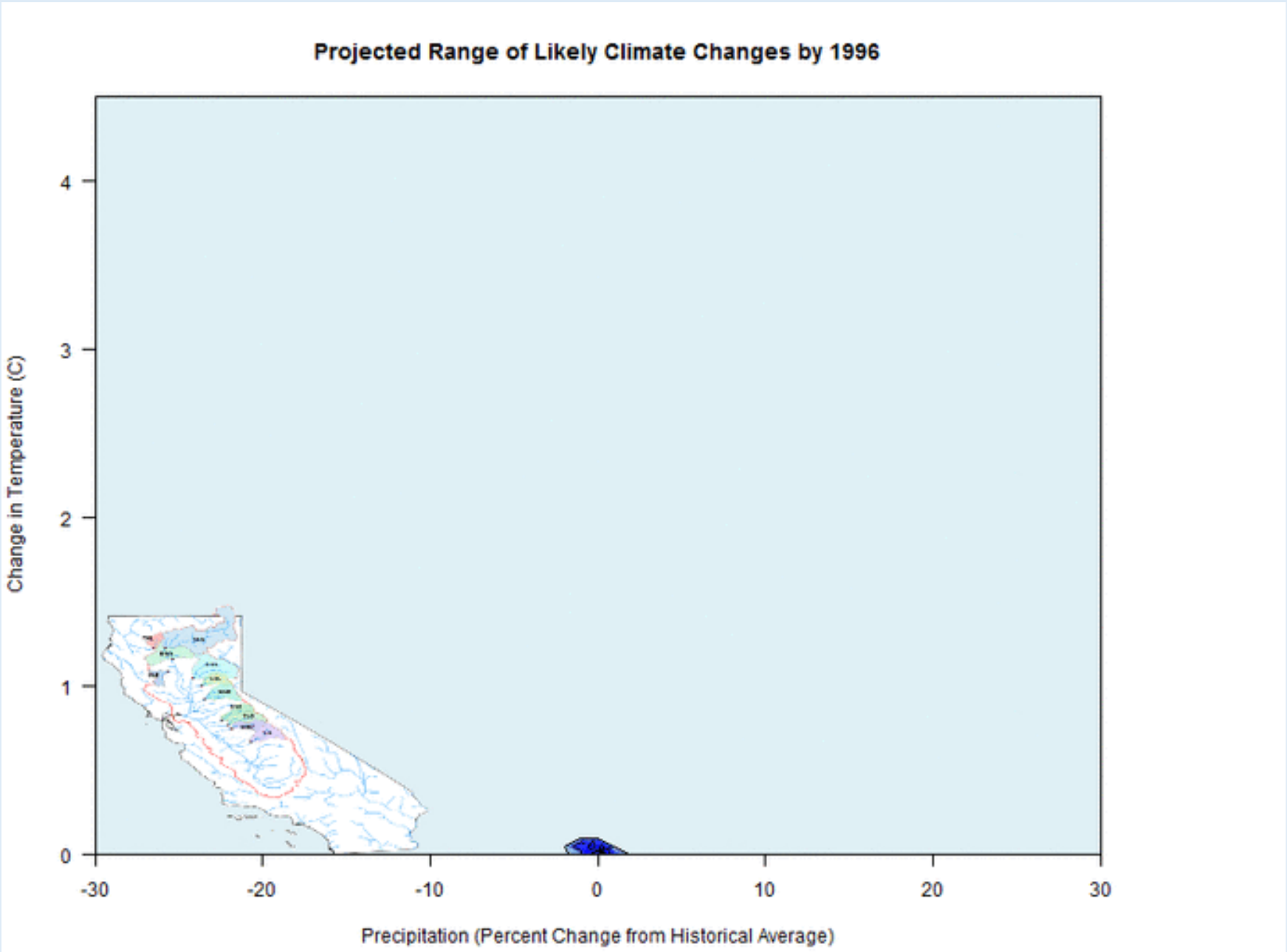
Operations and Planning Models

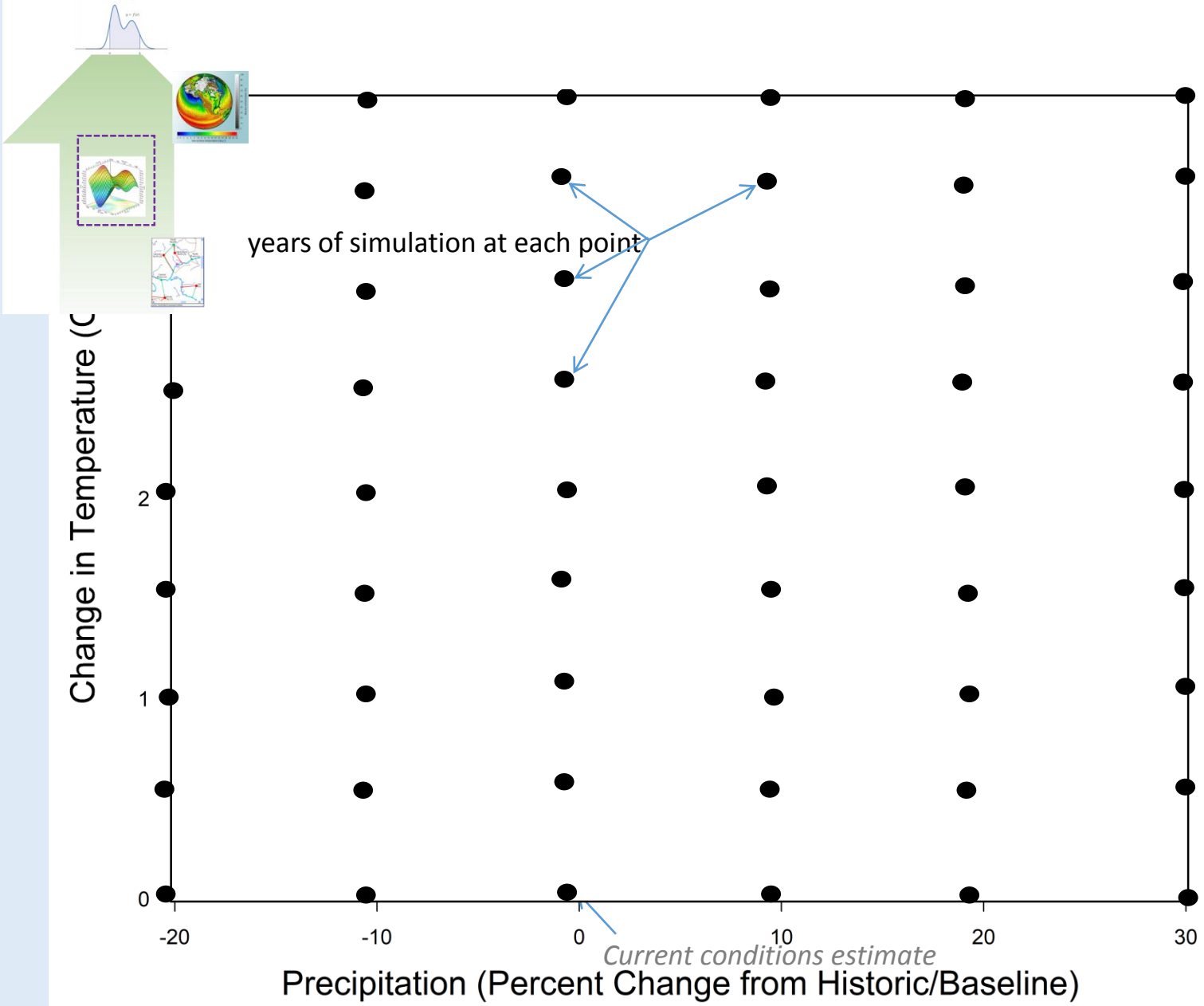
Bottom Up/ System Analysis

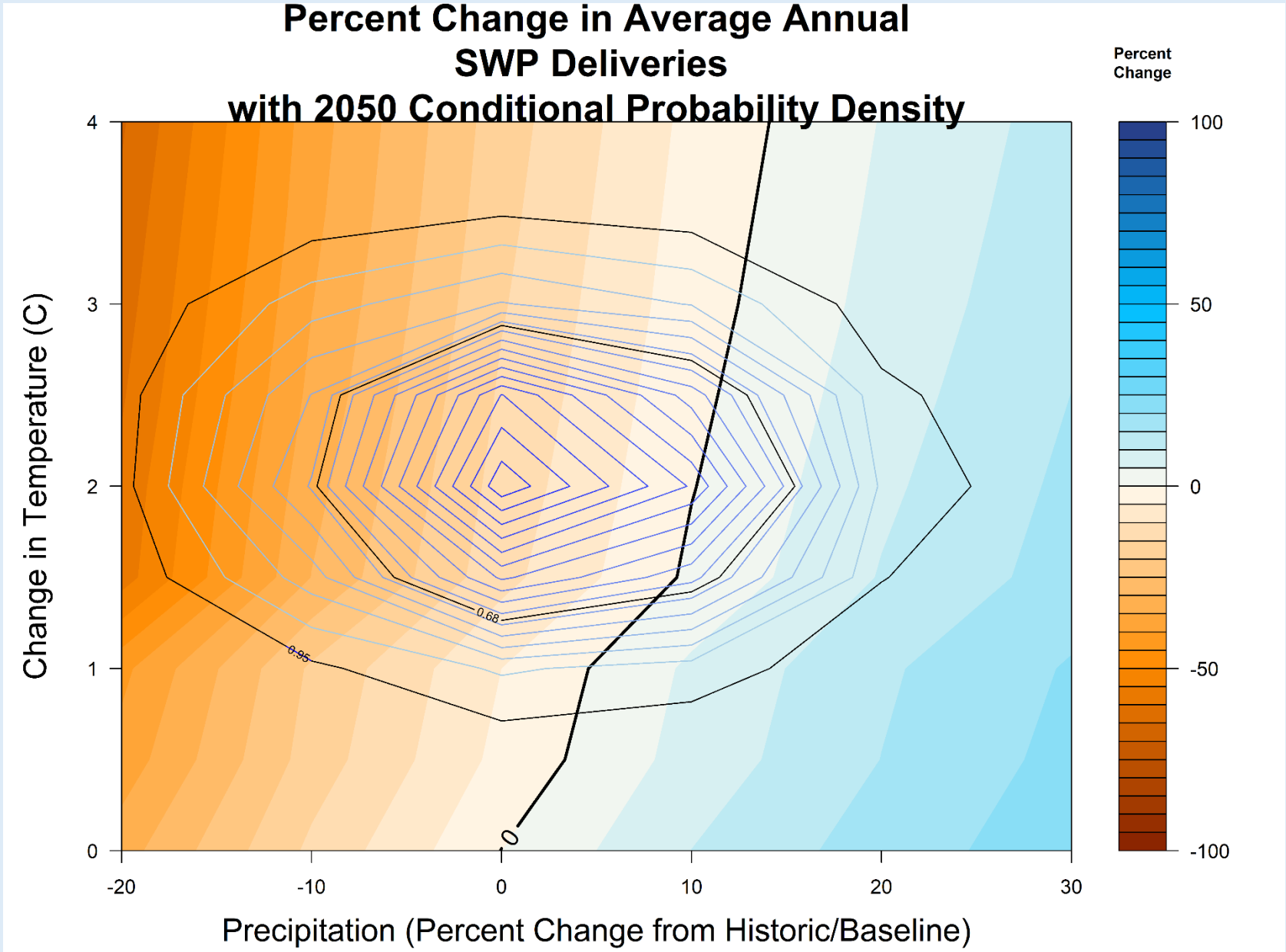
Projected Range of Likely Climate Changes by 2050




Projected Range of Likely Climate Changes by 2050
Change in Temperature (C)
Precipitation (Percent Change from Historical Average)
0
1
2
3
4
-30
-20
-10
0
10
20
30
0.95
0.68
0.997

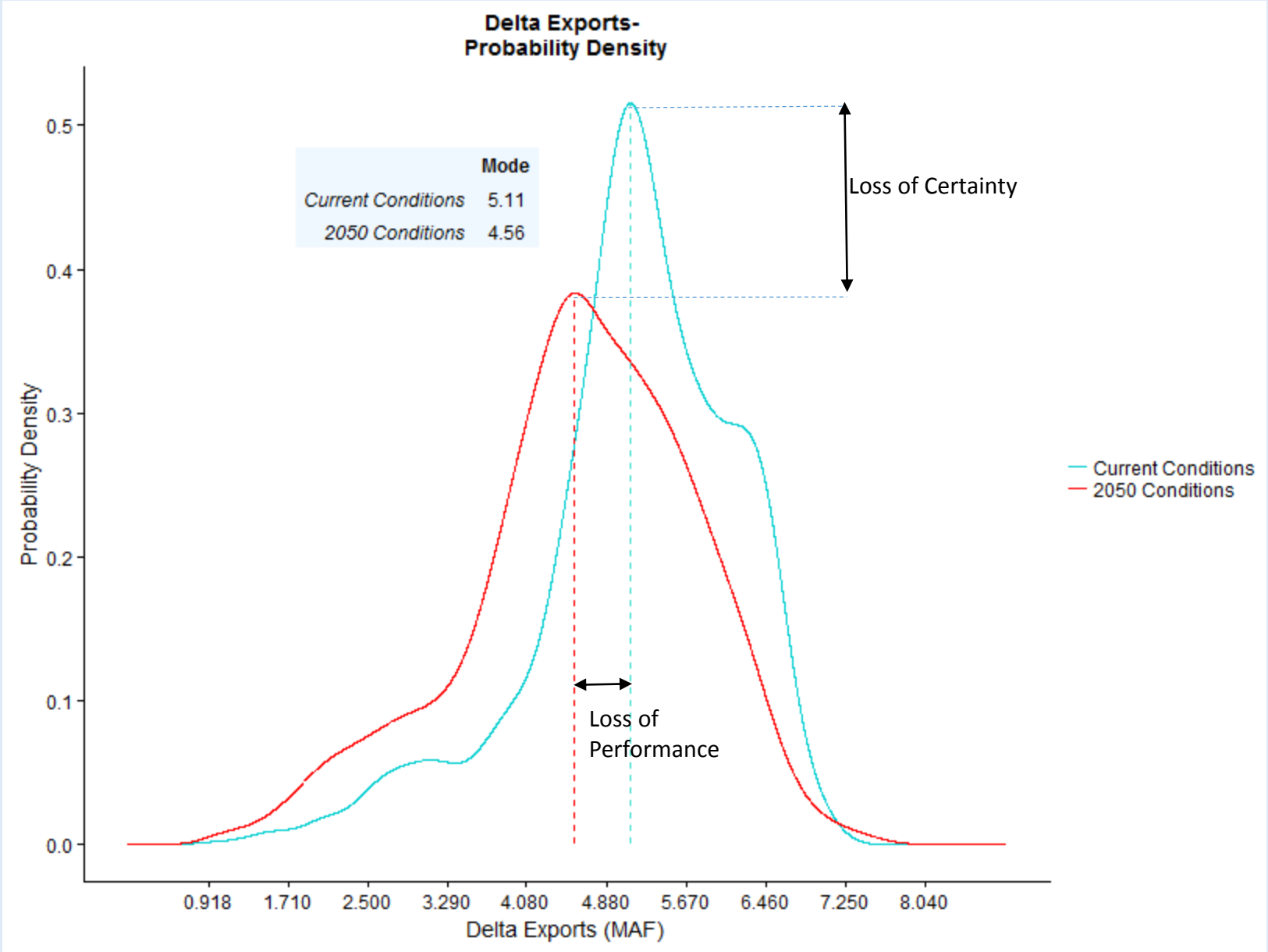

Projected Range of Likely Climate Changes by 1996
Change in Temperature (C)
0
1
2
3
4
-30
-20
-10
0
10
20
30
Precipitation (Percent Change from Historical Average)

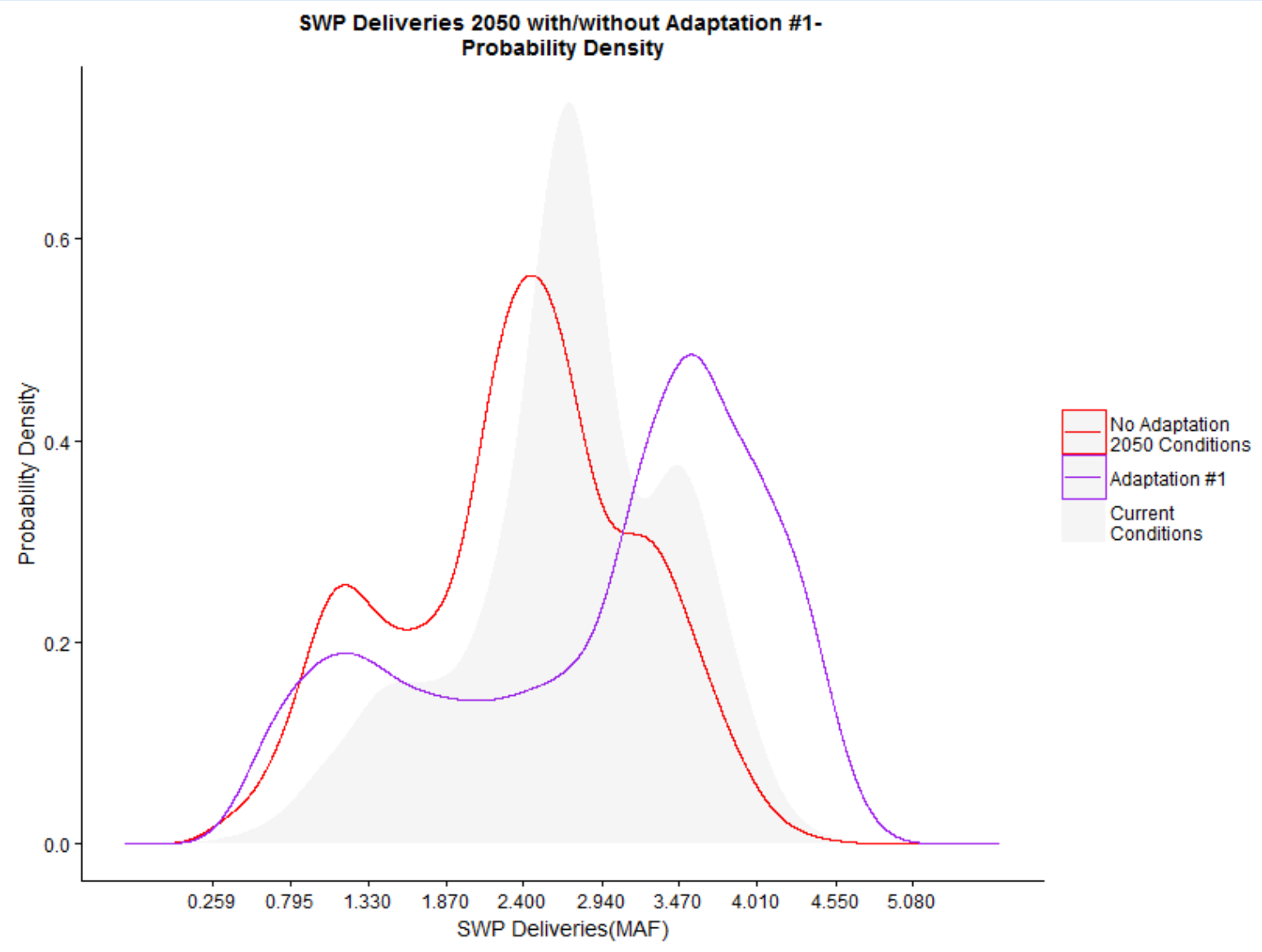

years of simulation at each point
Change in Temperature (C
0
1
2
-20
-10
0
10
20
30
Current conditions estimate
Precipitation (Percent Change from Historic/Baseline)


Percent Change in Average Annual
SWP Deliveries
with 2050 Conditional Probability Density
Percent
Change
100
50
0
-50
-100
Change in Temperature (C)
0
1
2
3
4
-20
-10
0
10
20
30
Precipitation (Percent Change from Historic/Baseline)
0.68
0.95
0

Performance Metric	GCM-Based Probability that Mid-Century Performance will be inferior to Current Performance
North-of-Delta Storage	
Total NOD April Storage	65%
Total NOD Carryover Storage	95%
Shasta Carryover Storage	97%
Oroville Carryover Storage	95%
Folsom Carryover Storage	99%
Trinity Carryover Storage	87%
Net Delta Outflow	
Winter	63%
Spring	65%
Summer	21%
Fall	40%
Annual Delta Exports	93%

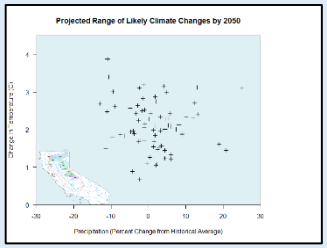
Source: Pre-publication CCC4A, "Climate Change Risks Faced by the California Department of Water Resources" Schwarz et al. 2018


Delta Exports-
Probability Density
Mode
Current Conditions 5.11
2050 Conditions 4.56
Loss of Certainty
Loss of
Performance
Current Conditions
2050 Conditions
Probability Density
0.0
0.1
0.2
0.3
0.4
0.5
0.918
1.710
2.500
3.290
4.080
4.880
5.670
6.460
7.250
8.040
Delta Exports (MAF)

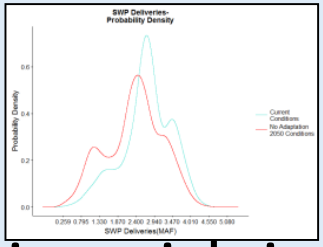

SWP Deliveries 2050 with/without Adaptation #1-
Probability Density
Probability Density
0.0
0.2
0.4
0.6
0.259
0.795
1.330
1.870
2.400
2.940
3.470
4.010
4.550
5.080
SWP Deliveries(MAF)
No Adaptation 2050 Conditions
Adaptation #1
Current Conditions

Advantages of This Approach

- Greater exploration of climate change uncertainty



- Uncertainty is explicit



- Probabilistic results fit within a risk-informed decision making framework

Building Co-production of Science Partnerships

- Mutual benefit: Each party has to see that the other side is bringing something they don't have
- Both parties need to have "heavy lifters"
- Create positions within government that have the time to work with academic community and authority to influence policy
- Regular communication

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