CWP 2009 WEAP
Hydrologic Region Model
- Irrigation Calibration and Key Results -

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SWAN Meeting

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WEAP HR Model Estimates Future Irrigation Demand Using Soil Moisture Model

- Agricultural Sector
  - Irrigation demand by 20 crops
- Outdoor Urban Demand
  - Single-family houses
  - Multi-family houses
  - Commercial sector
  - Public sector
- Monthly time-step
- Each irrigation demand node covers an entire hydrologic region

Key Factors

- **Area under irrigation by crop type**
  - Estimated independently – related to population growth projections
- **Soil and crop parameterizations**
  - Tuned over calibration period (1998 – 2005)
- **Monthly climate signal** (T, P, and RH)
  - Downscaled climate data
  - Averaged over land-use class by hydrologic region

Irrigation Demand Calibrated Using Recent Historical Data

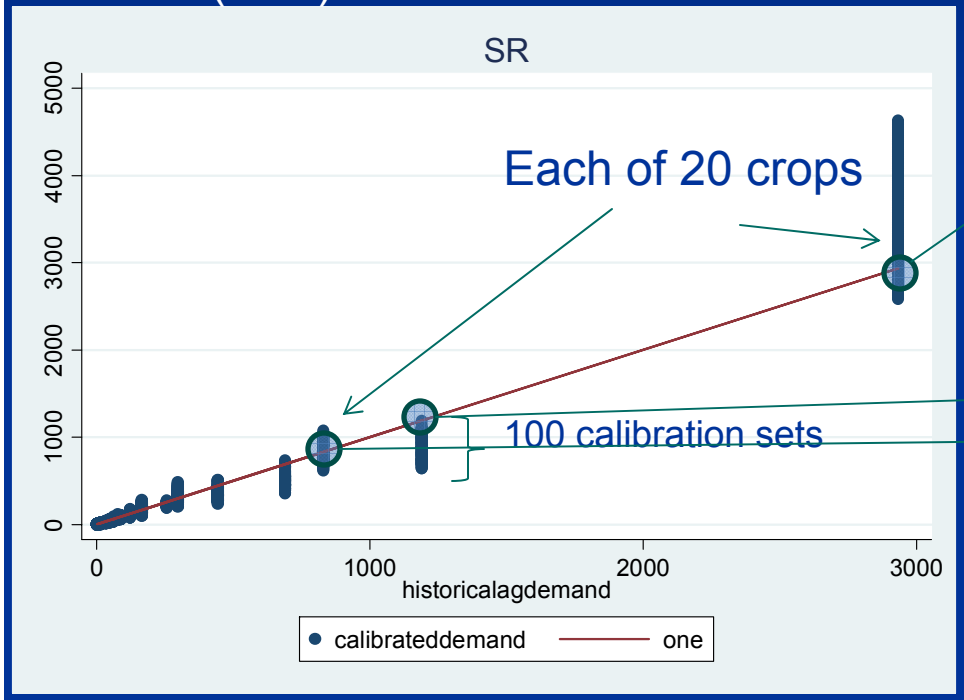
- Water Plan "Portfolio Analysis" data
  - Urban outdoor (SF, MF, Commercial, Public)
    - 1998, 2000, and 2001
  - Agriculture (20 crop-type)
    - 1998 – 2005
- Calibration independent for each HR and crop-type (for Ag)

Systematic and Automated Calibration Procedure Utilized for HR Analysis

1. Defined ranges of values for calibration parameters
   - Soil water capacity
   - Root zone conductivity
   - Lower and upper irrigation thresholds
2. Exploratory modeling software defined and evaluated 100-point Latin hypercube sample over calibration parameter set
3. Selected calibration set that minimizes average demand for calibration period

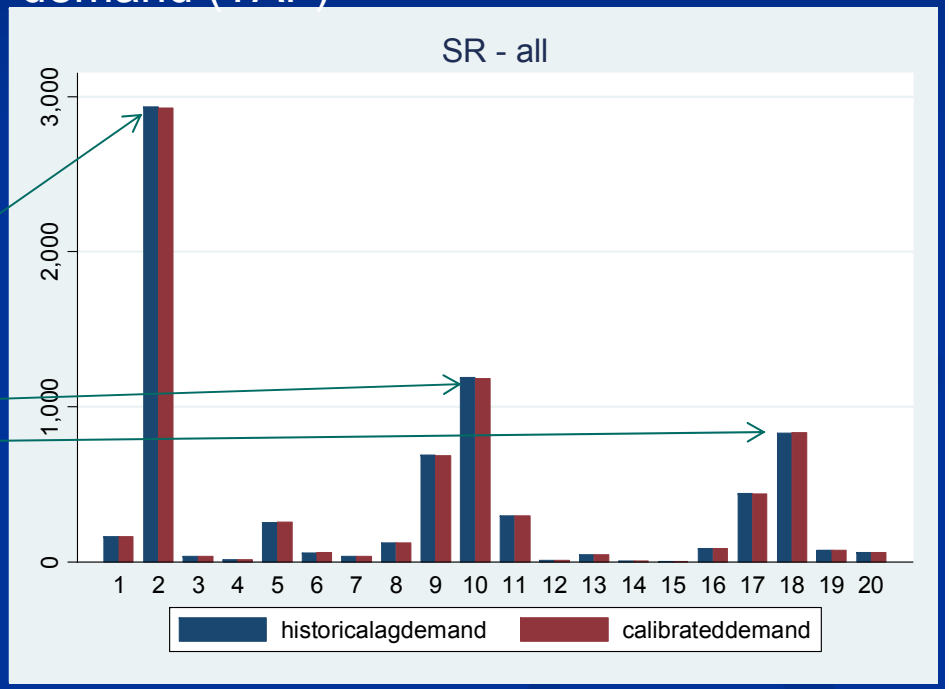
Agricultural Irrigation Calibration Results for Sacramento River HR

Calibrated average annual demand (TAF)



Historic average annual demand (TAF)

Average annual demand (TAF)

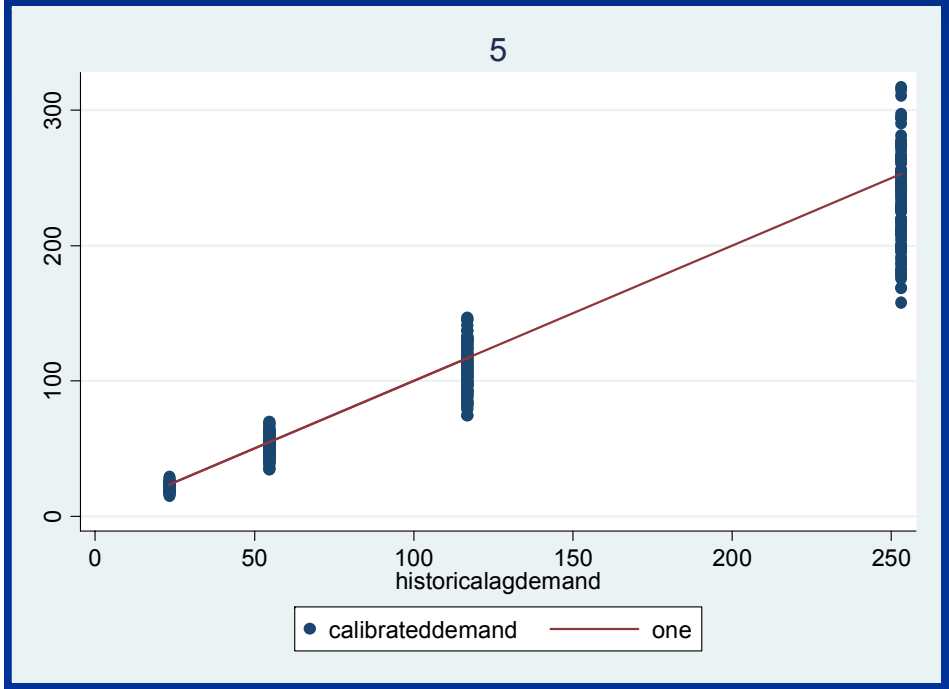


Crop number

1998-2005

Urban Outdoor Irrigation Calibration Results for Sacramento River HR

Calibrated average annual demand (TAF)



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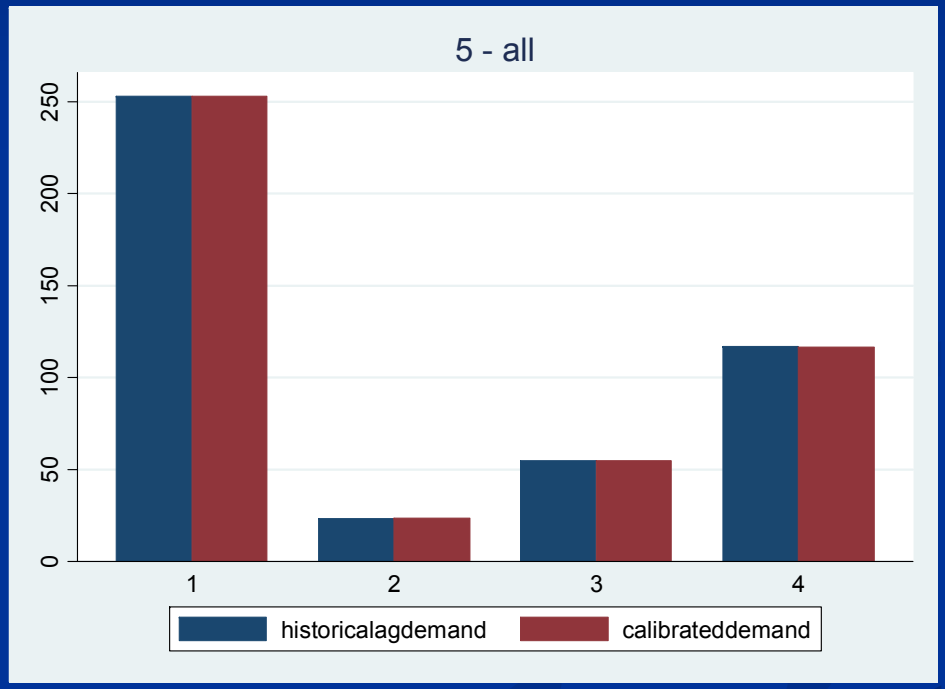


SF MF Commercial Public

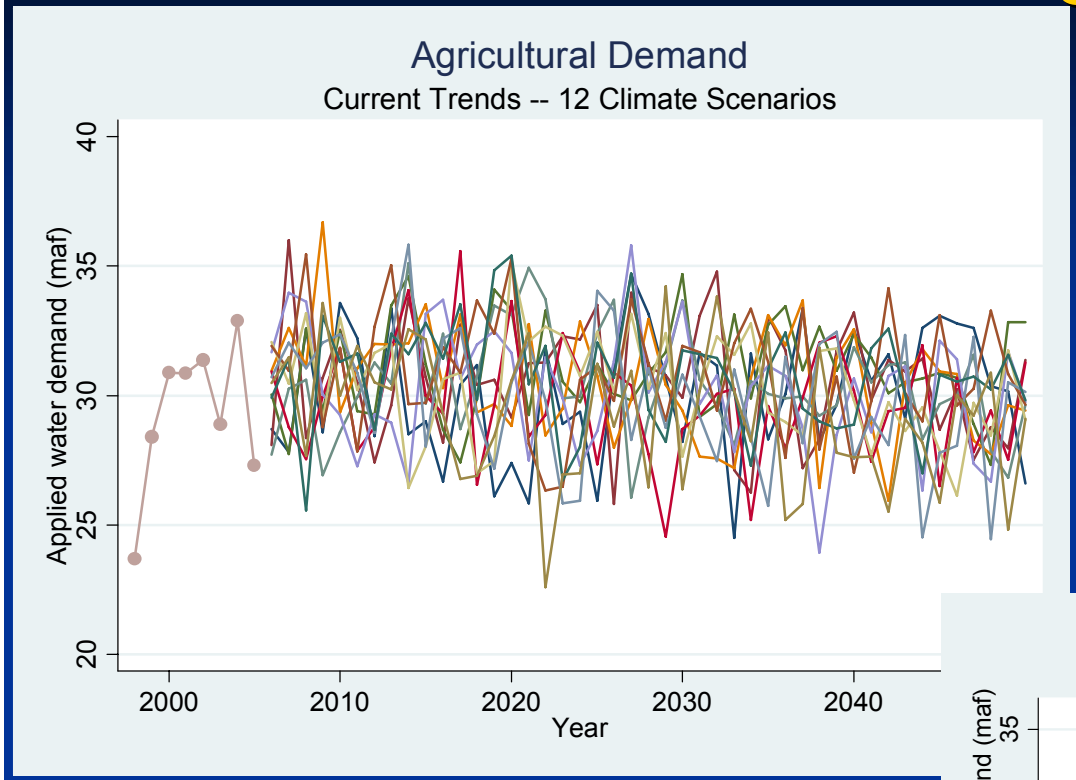
1998, 2000, 2001

Scenario Analysis Procedure

- Evaluated scenarios reflecting plausible future conditions
  - 12 sequences of climate (6 models, 2 global emissions scenarios)
  - 3+ land-use scenarios consistent with Narrative Scenarios
    - Current Trends
    - Blueprint Growth
    - Expansive Growth
    - (Constant Demand Drivers)
- Three sectors
  - Urban (indoor direct use & outdoor irrigation)
  - Agricultural (irrigation)
  - Environment (unmet demand)
- Projections from 2005 – 2050 by Hydrologic Region

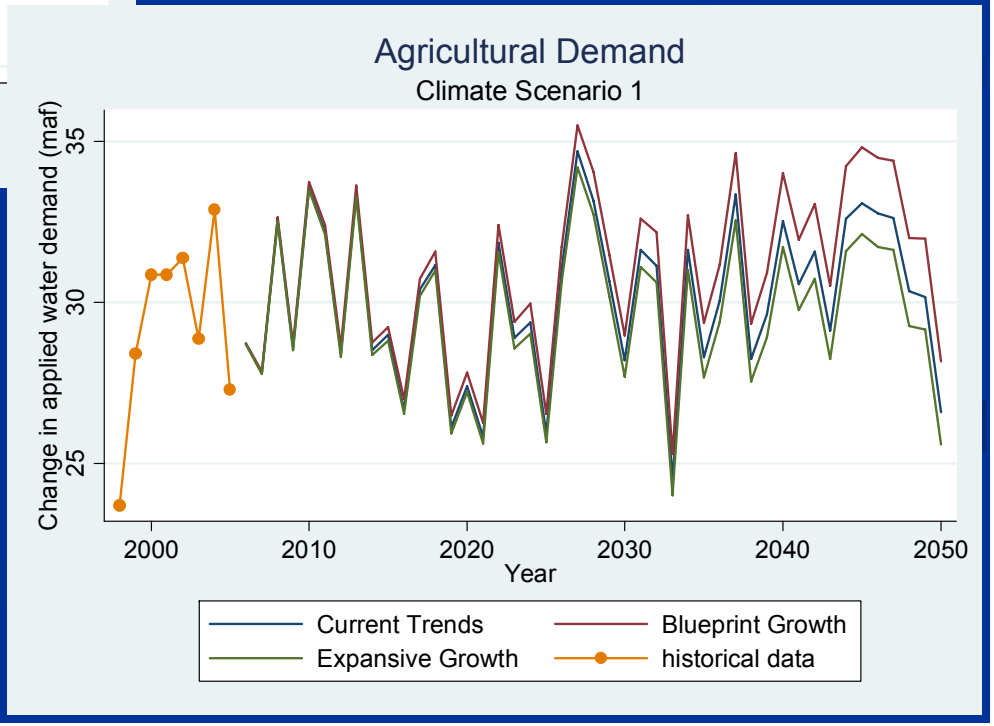
Results are preliminary and subject to change

Statewide Results – Agricultural Sector



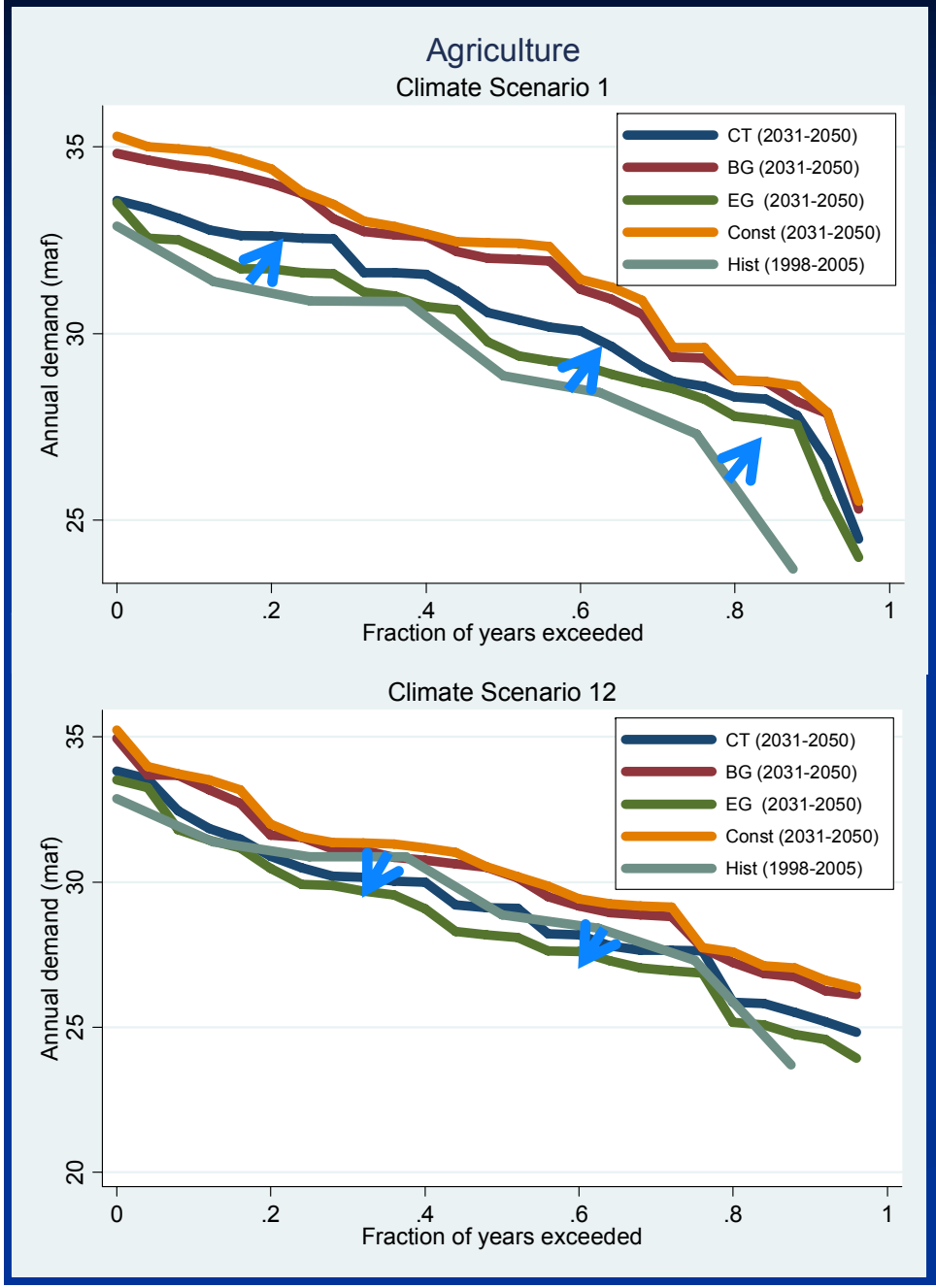
12 Climate Scenarios
Single land use scenario

Single Climate Scenario
Three land use Scenarios



Preliminary – for discussion only

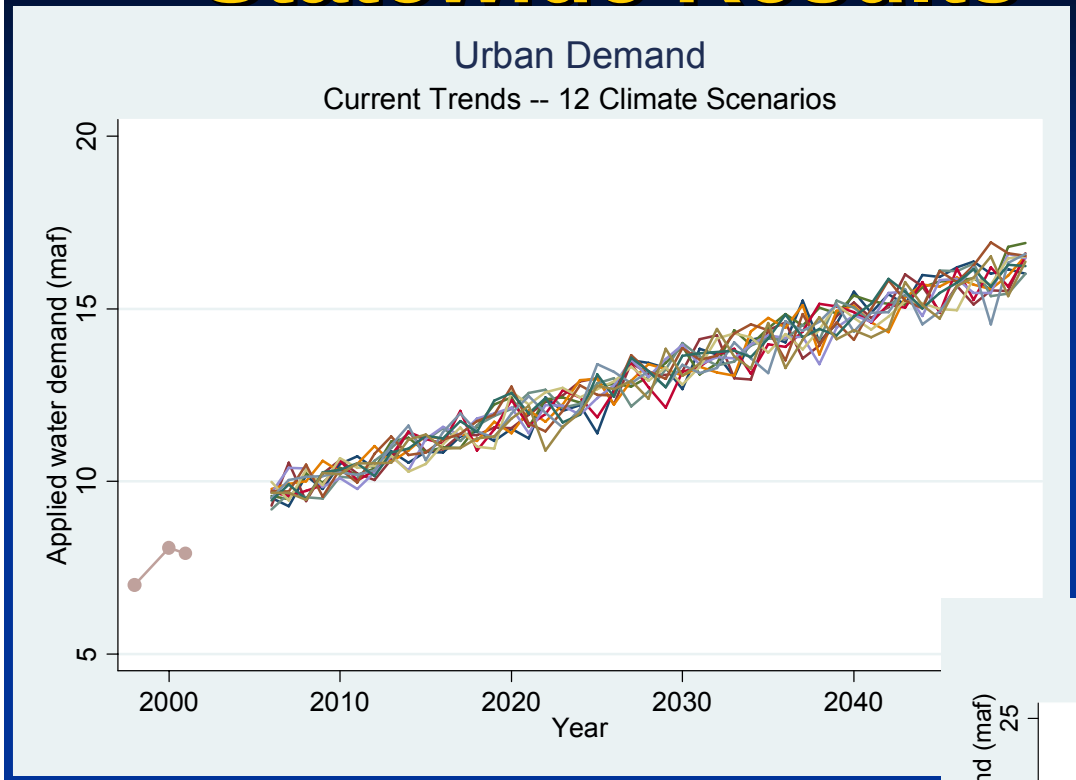
Climate Scenarios Change Agricultural Demand Regimes



Under scenario 1, significant demand increases under all land-use scenarios in later years.

Under scenario 12, declines in demand under Extensive Growth Scenario.

Statewide Results – Urban Sector



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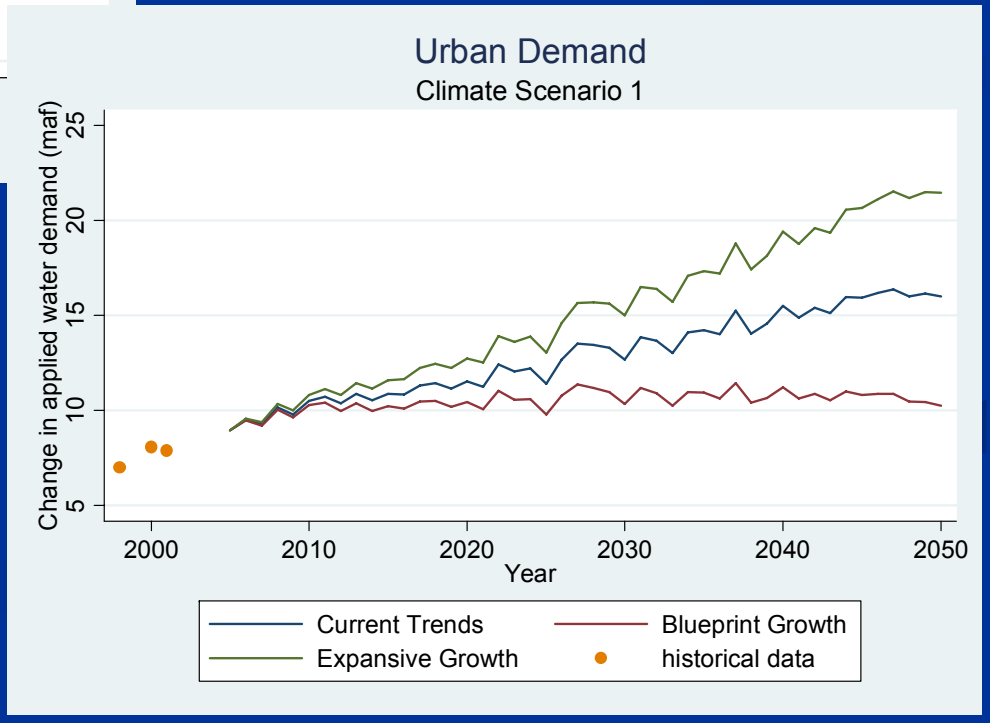

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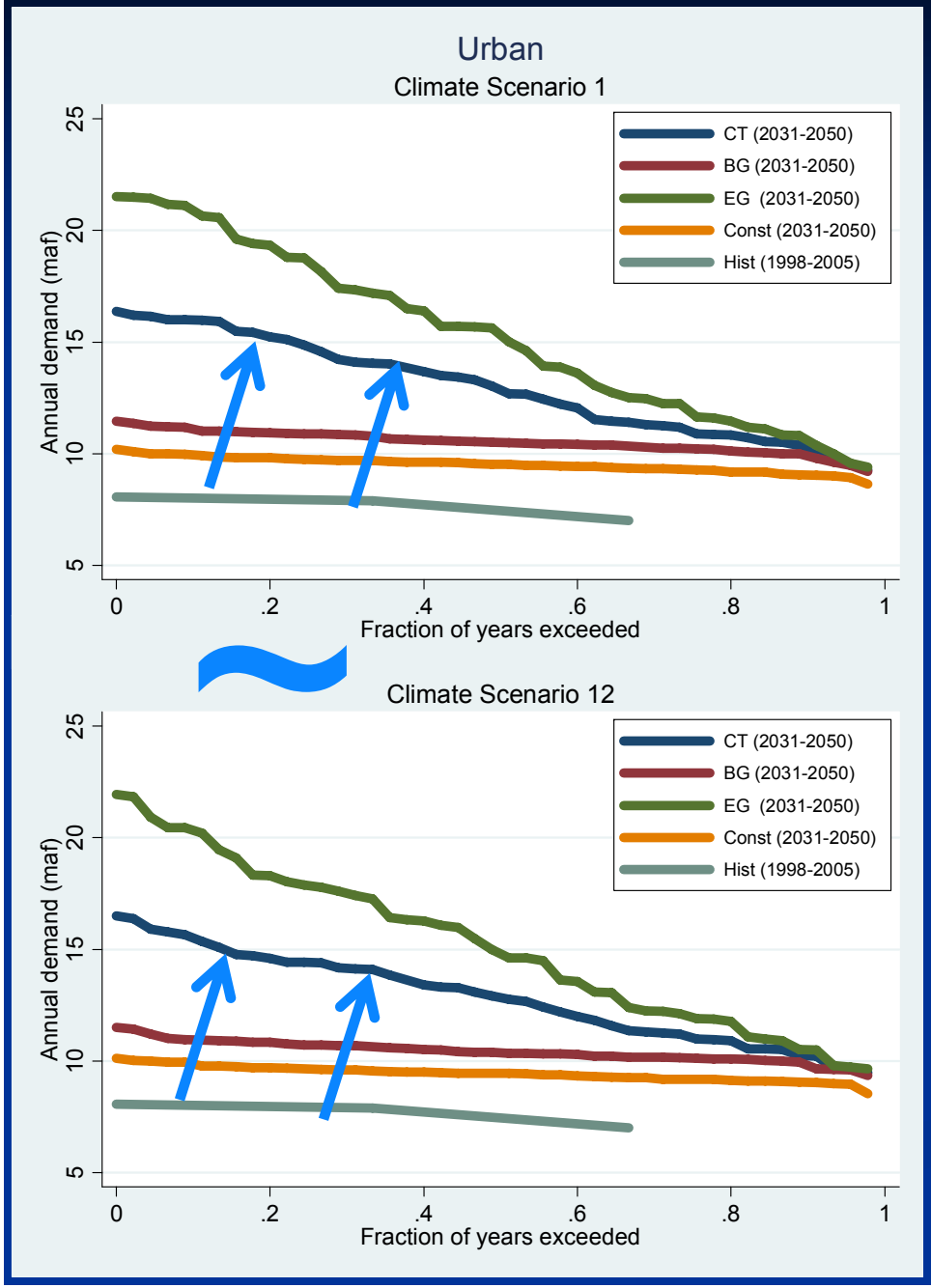
Climate Scenarios Have Small Effect Relative to Land Use Trends for Urban Demand

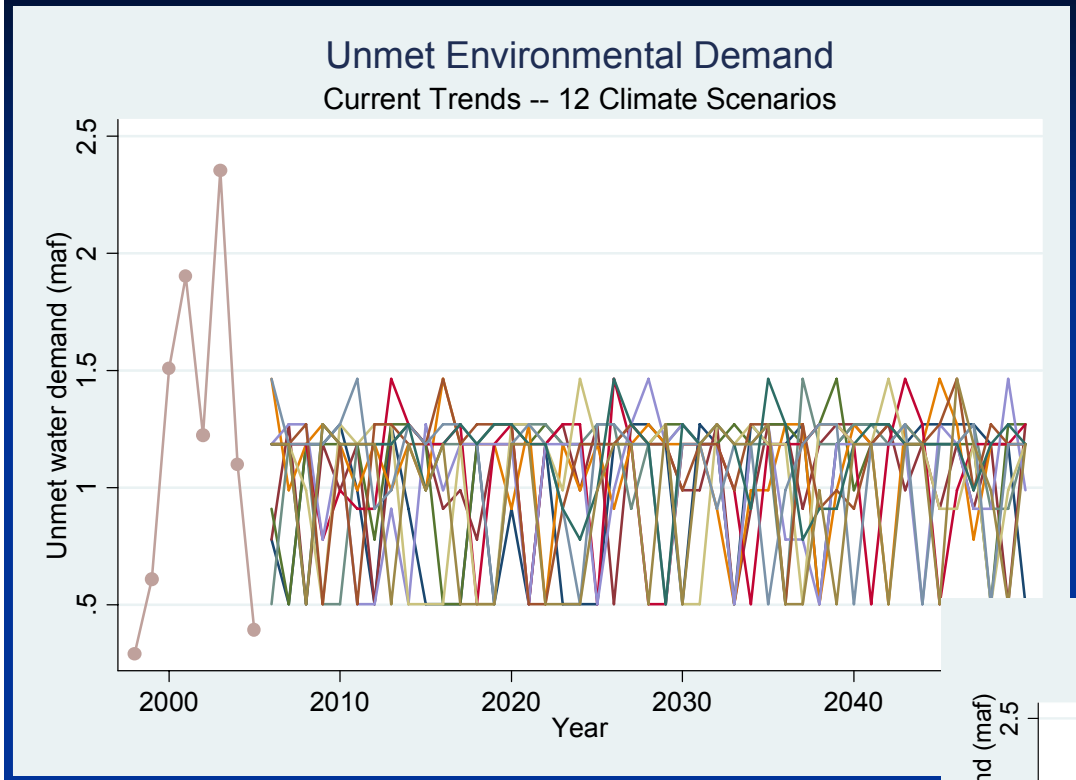


Significant demand increases due to land-use scenarios.

Little difference between climate scenarios

Preliminary – for discussion only

Statewide Results – Unmet Environmental Demand



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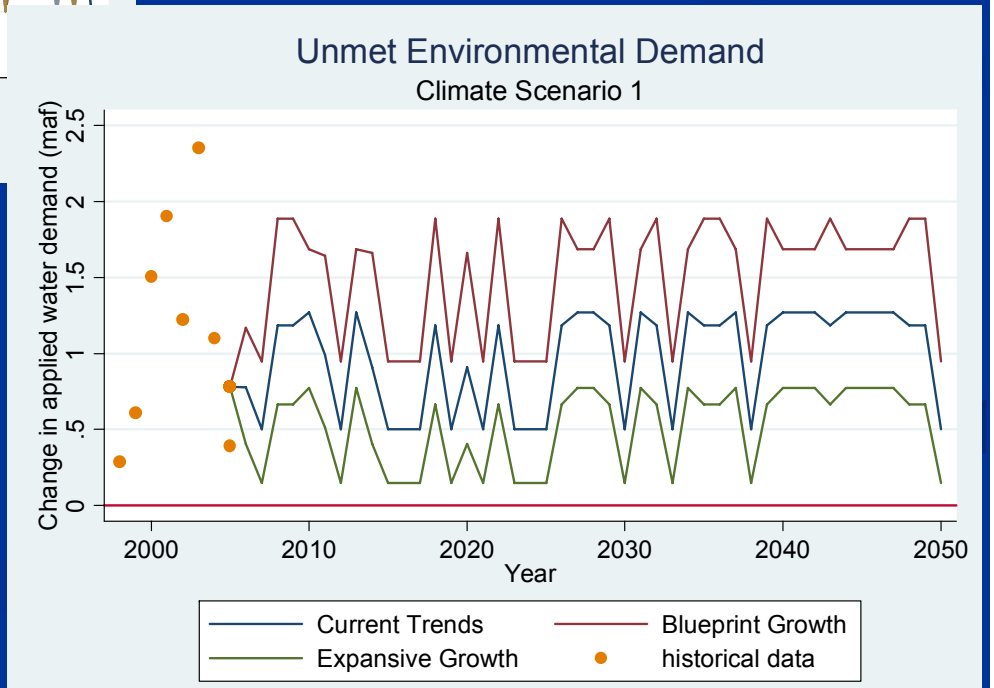
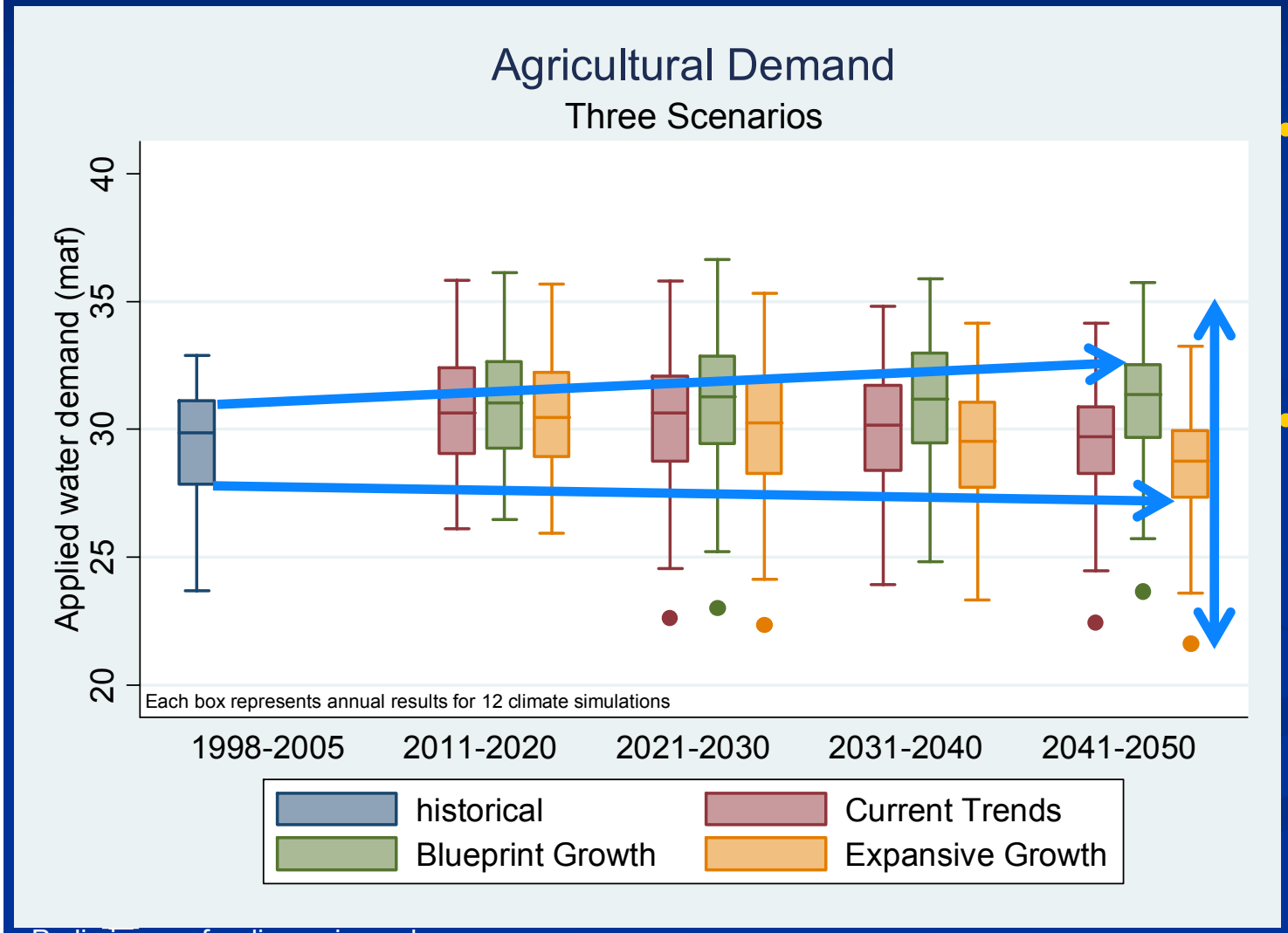
Single land use scenario

Single Climate Scenario
Three land use Scenarios



Preliminary – for discussion only

Box Plots Summarize Changes Over Time For the 12 Climate Scenarios



- Modest changes in demand across land-use scenarios
- Climate change and natural variability overwhelms land-use effects

Preliminary – for discussion only

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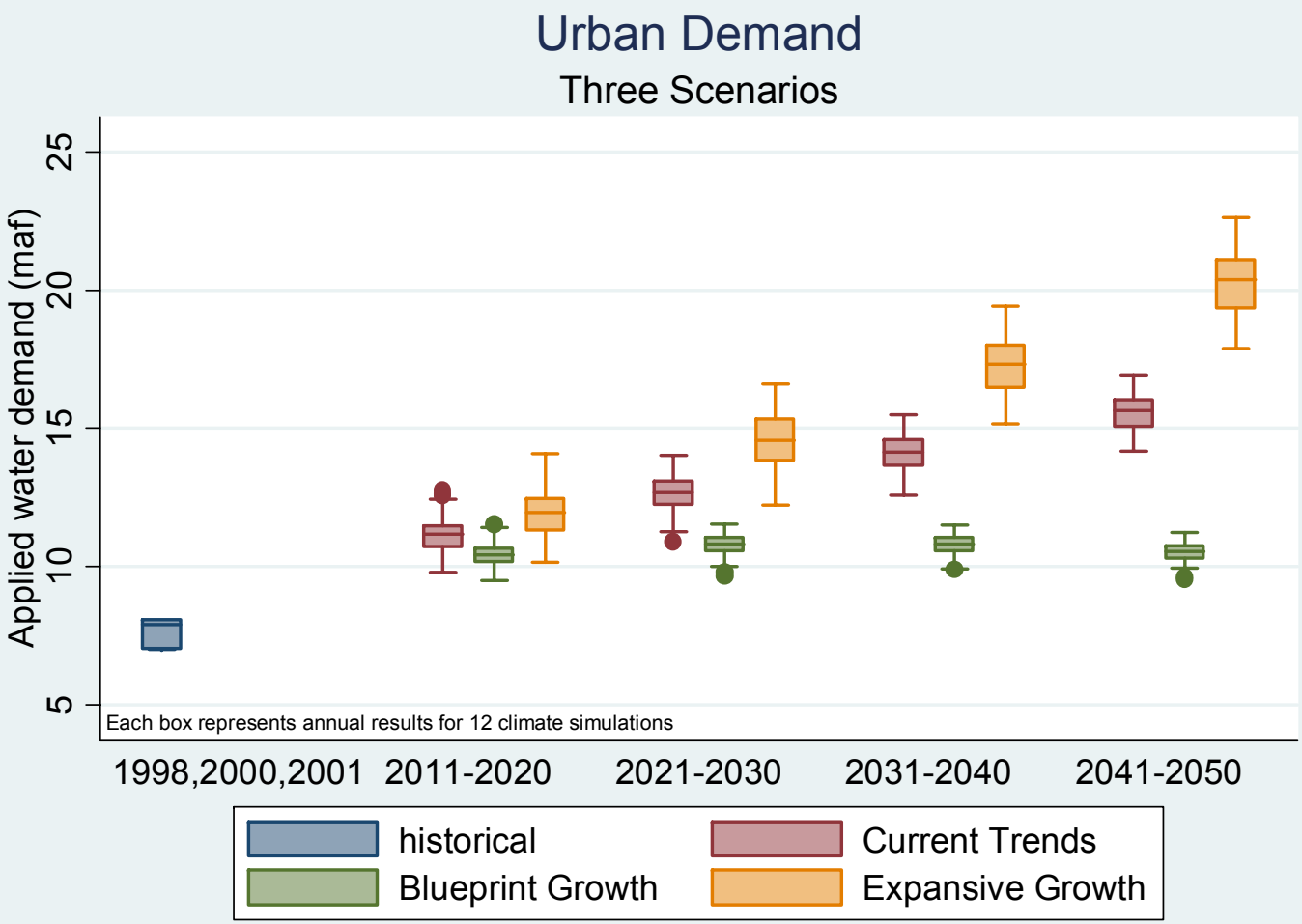

- **Significant changes in demand across land-use scenarios**
- **Climate change and natural variability has small comparative effect**
- **Climate change impacts grow with more urban growth**

Preliminary – for discussion only

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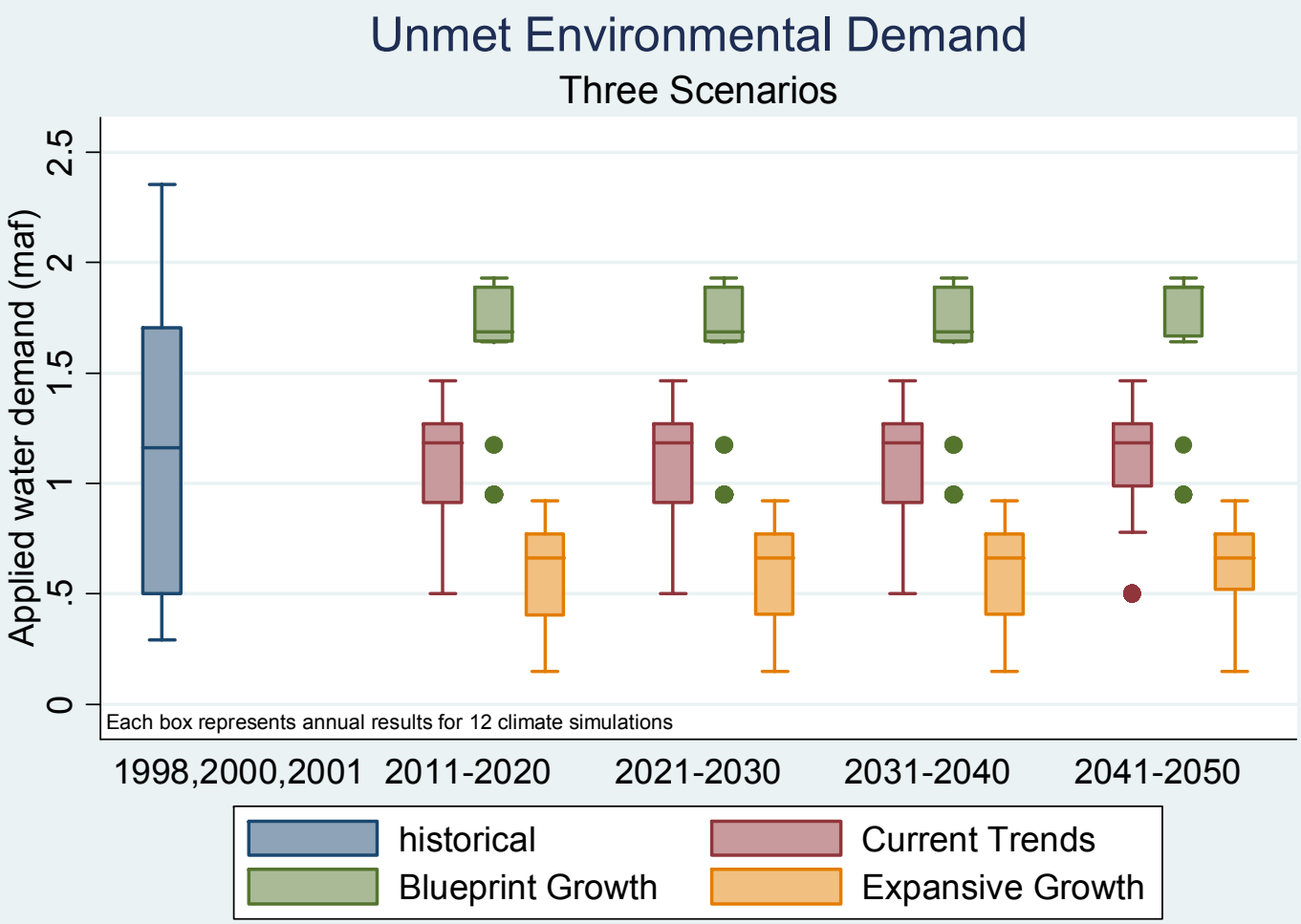

- **Unmet demand constant through the simulation**
- **Higher for Blueprint Growth**
- **Lower for Expansive Growth**
- **Lower variability than historical**

Summary of Median Statewide Results

	1998-2005	2011-2020	2021-2030	2031-2040	2040-2050
			Current Trends		
Agriculture	29.9	30.7	30.6	30.2	29.7
Urban	7.9	11.2	12.7	14.1	15.6
Unmet Environ.	1.2	1.2	1.2	1.2	1.2
Urban + Agriculture	37.8	41.8	43.3	44.3	45.4
			Blueprint Growth		
Agriculture	29.9	31.0	31.3	31.2	31.4
Urban	7.9	10.4	10.8	10.8	10.5
Unmet Environ.	1.2	1.7	1.7	1.7	1.9
Urban + Agriculture	37.8	41.4	42.1	42.0	41.9
			Extensive Growth		
Agriculture	29.9	30.5	30.2	29.5	28.7
Urban	7.9	11.9	14.6	17.3	20.4
Unmet Environ.	1.2	0.7	0.7	0.7	0.7
Urban + Agriculture	37.8	42.4	44.8	46.8	49.1

Results by Hydrologic Region Still Under Review

Key Issues for Discussion and Follow-up

- Agricultural land use projections
  - Sources for improved projections
  - Consideration of price and other agricultural water use parameters
- Industrial demand use approach
  - Move to industrial process base
- Other missed climate impacts on water demand
  - Yield effects
  - Crop mix
- Unmet environmental water use