

Long-Term Climate Change
Evaluation for the St. Johns River
Water Management District

Water Supply Impact Study

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ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Background

- ❖ Water Supply Impact Study (WSIS)
 - Evaluate 252 MGD surface withdrawal
 - St. Johns and Ocklawaha Rivers NE Florida
 - Hydrology for 90 watersheds
 - Hydrodynamics for Middle and Lower SJR
 - 7 Environmental work groups
 - Peer review by the National Academy of Sciences - National Research Council

Background

- ❖ Water Supply Impact Study (WSIS)
 - Water supply planning horizon – 2030
 - 12 Withdrawal Scenarios
 - Water Added Back to River System
 - Landuse changes
 - Upper St. Johns Basin Rediversion Projects
 - Uncertainty Analysis
 - H&H Models and Biological Uncertainties
 - Channel Dredging and Reuse
 - Climate Change (2100 requested by NRC)
 - Sea Level Rise

Climate Change Project Scope

- ❖ Consultant – (NCAR) National Center for Atmospheric Research
 - High/Med/Low Climate Impact Scenarios
 - Used GCM's data for Scenarios and Probability Density Functions
 - Data analysis - Precipitation/temperature
 - Development of time series for Hydrology
- ❖ District staff
 - Calculate evaporation from temperature
 - Hydrologic evaluation through models

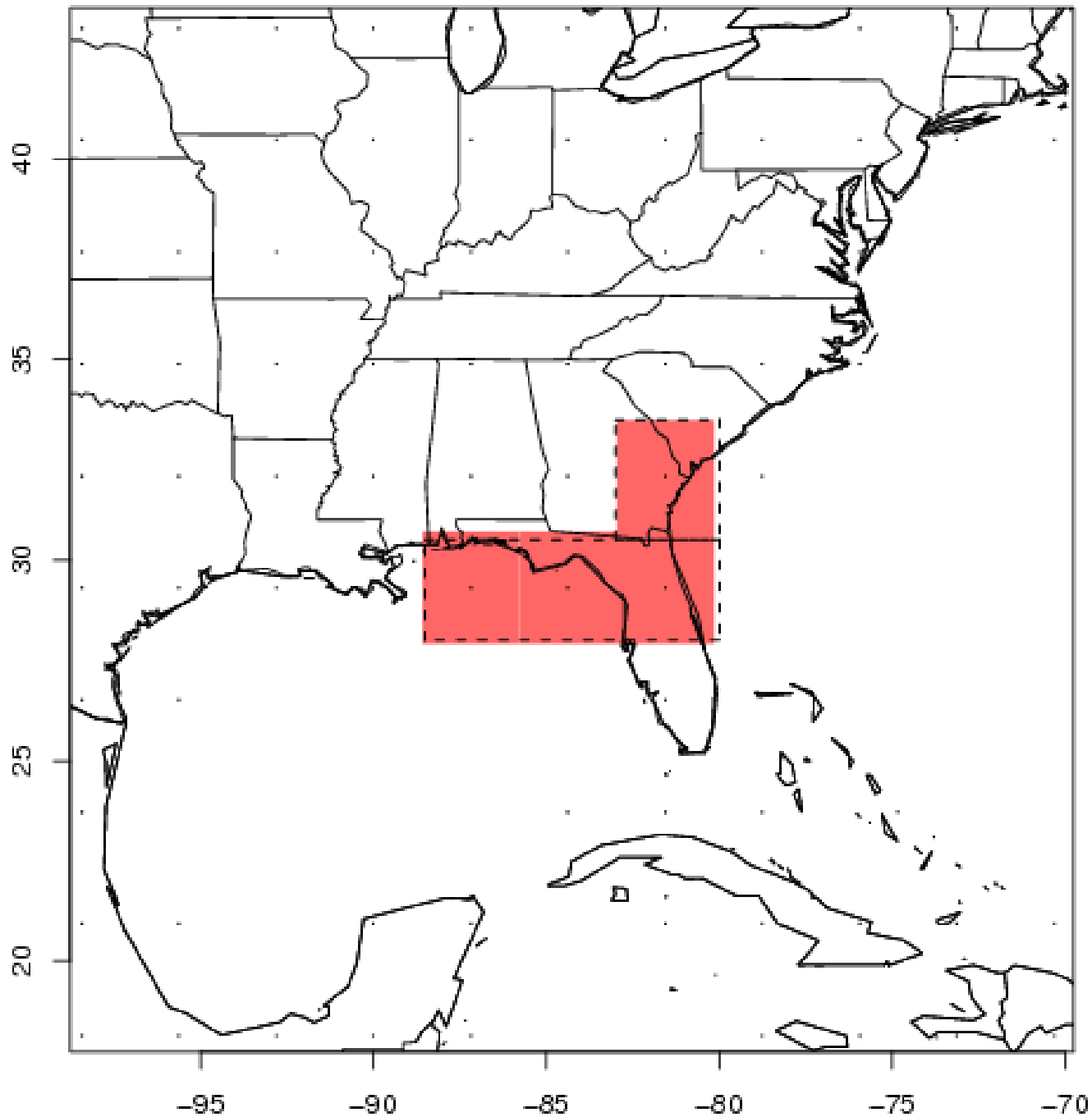
Global Climate Models (GCMs)

- ❖ No 'best' GCM
- ❖ Too coarse to represent NE Florida
 - Grid cell size -10s to 100s of kilometers
- ❖ Temporal scale
 - TS usually days, run for 100s of years
- ❖ Coherent results
 - Different teams, parameterizations, boundary data

Synopsis of GCC Scenarios

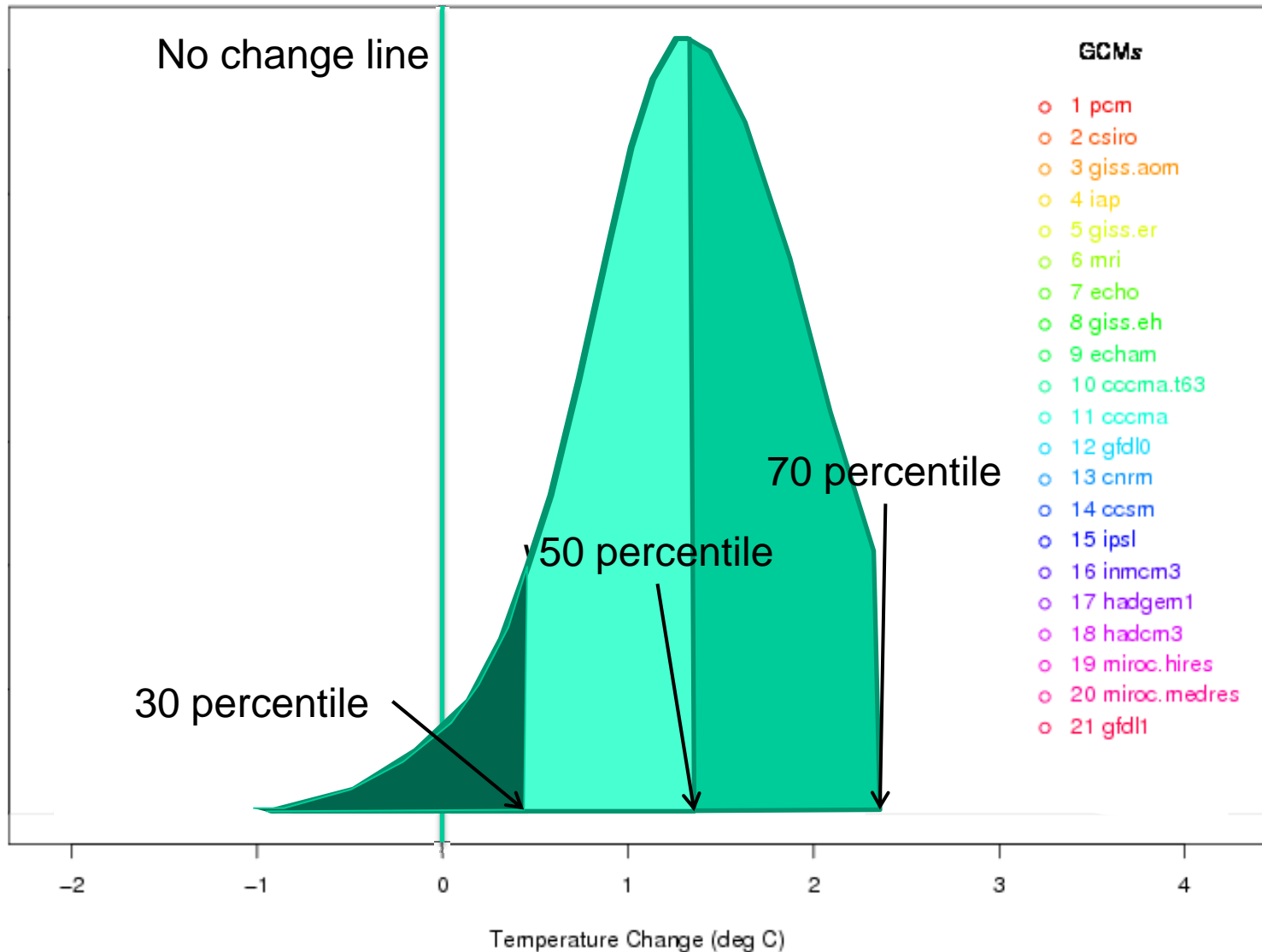
| | A2 | A1B | B1 |
|------------------------------------|---------------------|-------------------|----------------------------|
| Population growth | High ~15 billion | Low ~7 billion | Low ~7 billion |
| GDP growth | Medium | Very high | High |
| Energy use | High | Very high/high | Low |
| Land use changes (1990 to 2100) | Medium-high | Low-medium | High |
| Favored energy | Regional diversity | Balanced sources | Efficient Use of materials |

Bayesian process requires a minimum of 4 cells. Shown to the right are the cells chosen to represent Florida.



Probability Density Function

A1B Scenario, 2040 Average Annual Temperature



NCAR Data Generating Tasks

❖ Source data

- Precipitation and temperature
 - 1950 through 2008 inclusive
 - 49 precipitation stations
 - 23 temperature stations

❖ Method

- List of K-nearest neighbor (K-NN) dates sampled from source data representing 2020 through 2100

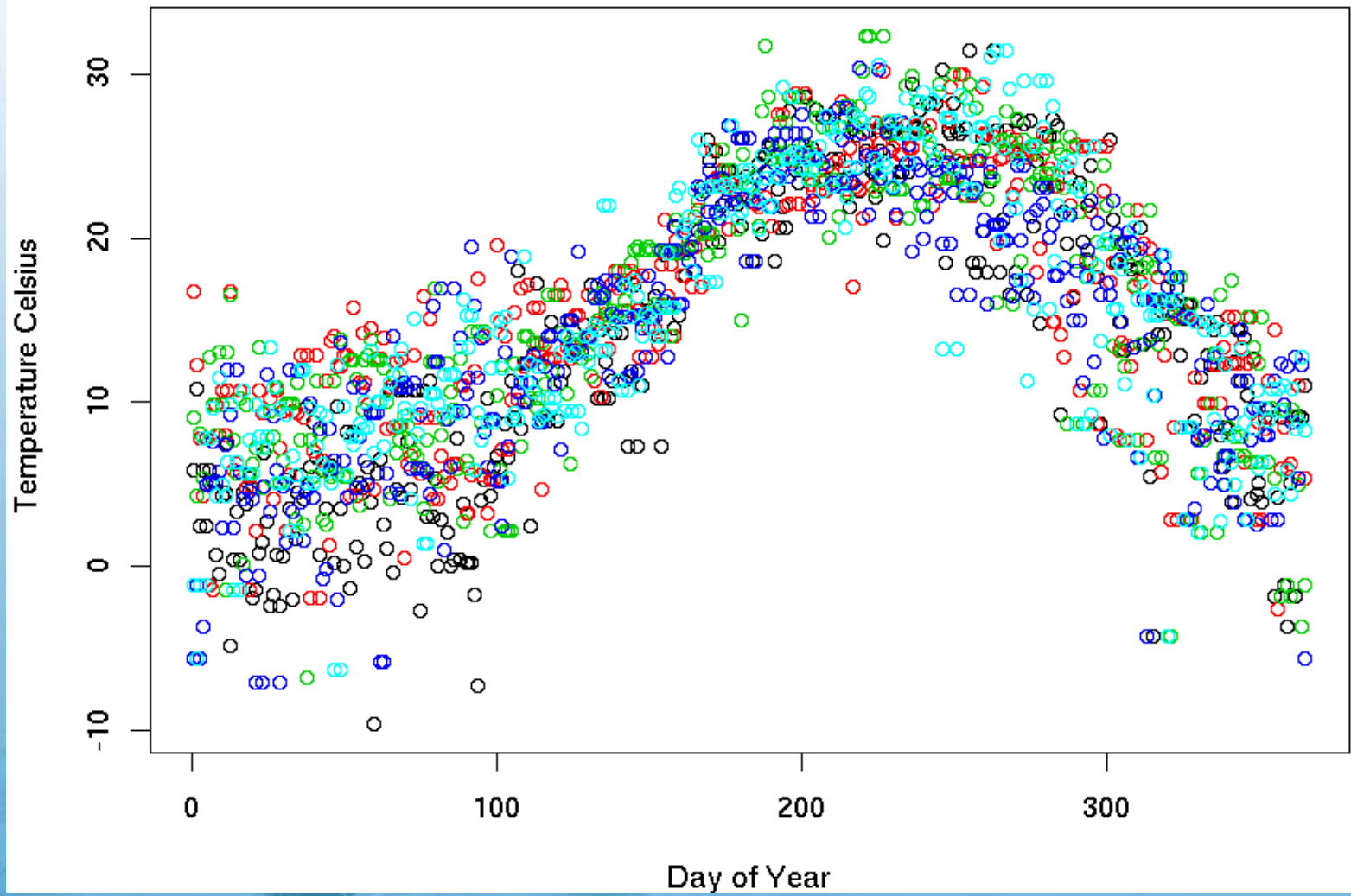
Data Generating Algorithm

- ❖ K-NN = K Nearest Neighbors
- ❖ Resampling technique
- ❖ Generates a sequence of weather data
- ❖ Unbiased selection returns historic stats
- ❖ Biased selection includes GCM results
 - Warmer Weather – dryer conditions , etc.
- ❖ Produces input to Hydrology models

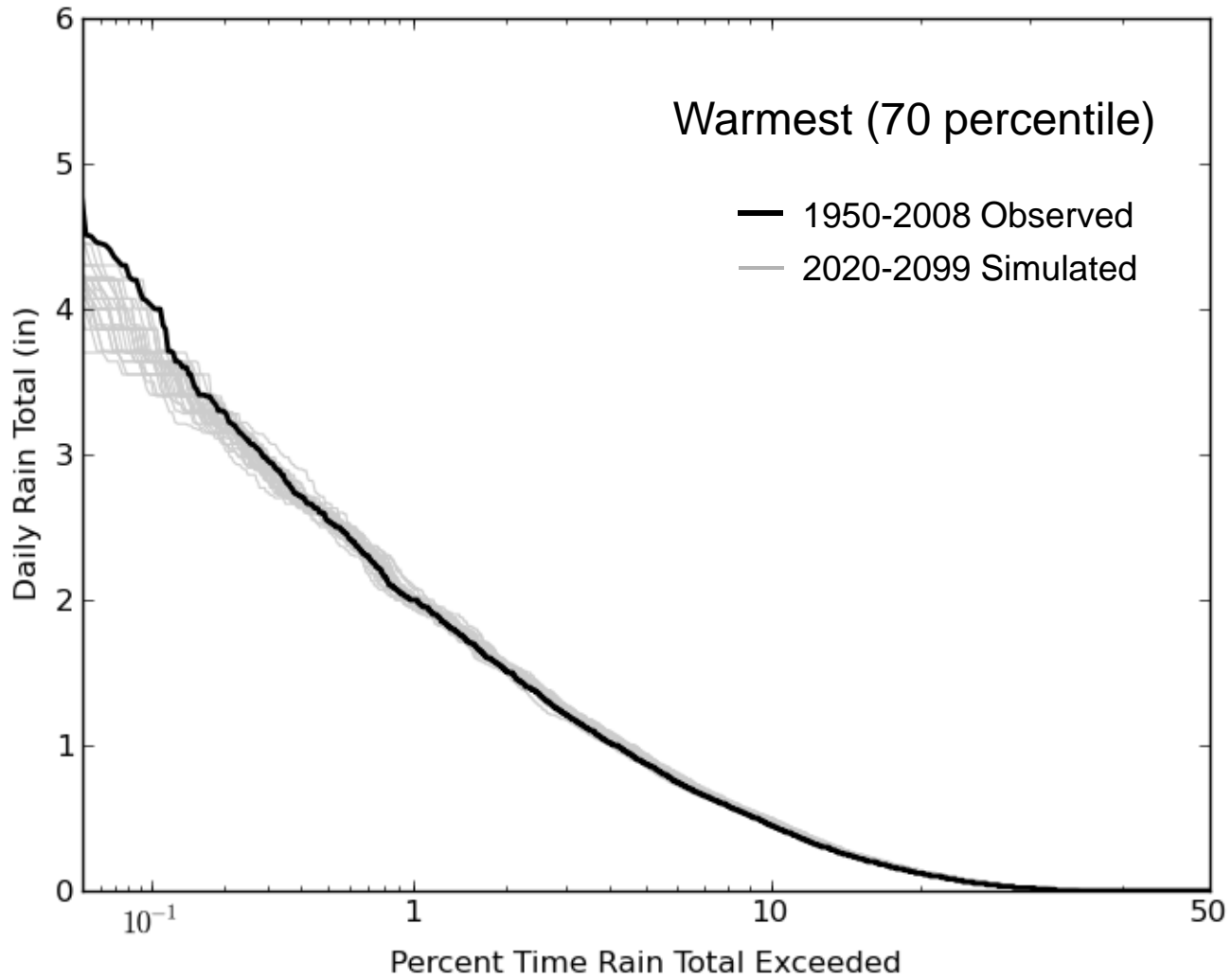
Meteorologic Data Development

- ❖ Thirty KNN ensemble time series for A1B GCM scenario
 - Three Bayesian levels informed from GCMs
 - 30 percentile (cooler)
 - 50 percentile (maximum expectation)
 - 70 percentile (warmer)
 - Forty-nine precipitation stations
 - Twenty evaporation stations
 - Minimum daily temperature
 - Maximum daily temperature

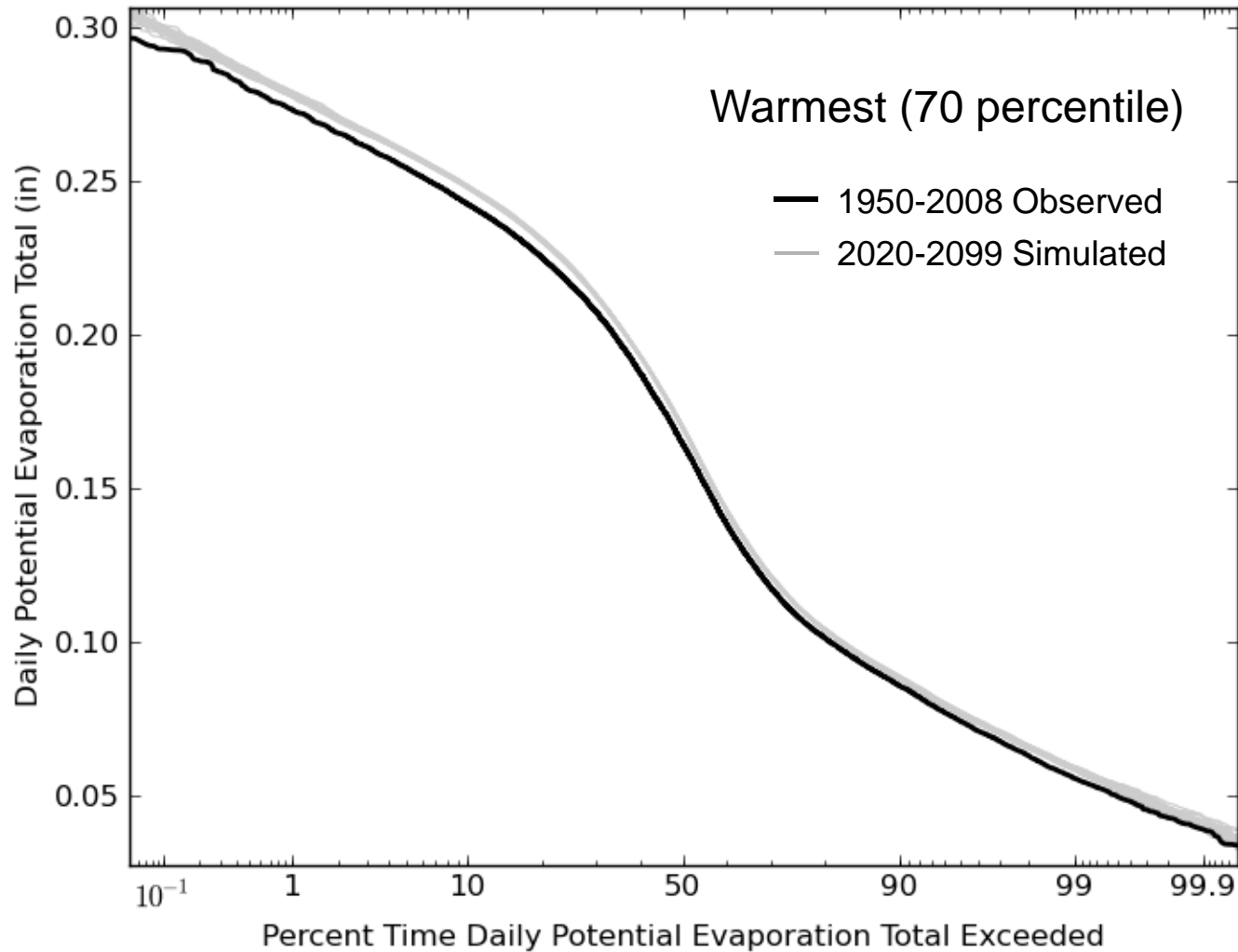
Example of 5 years simulated



Precipitation - Sanford



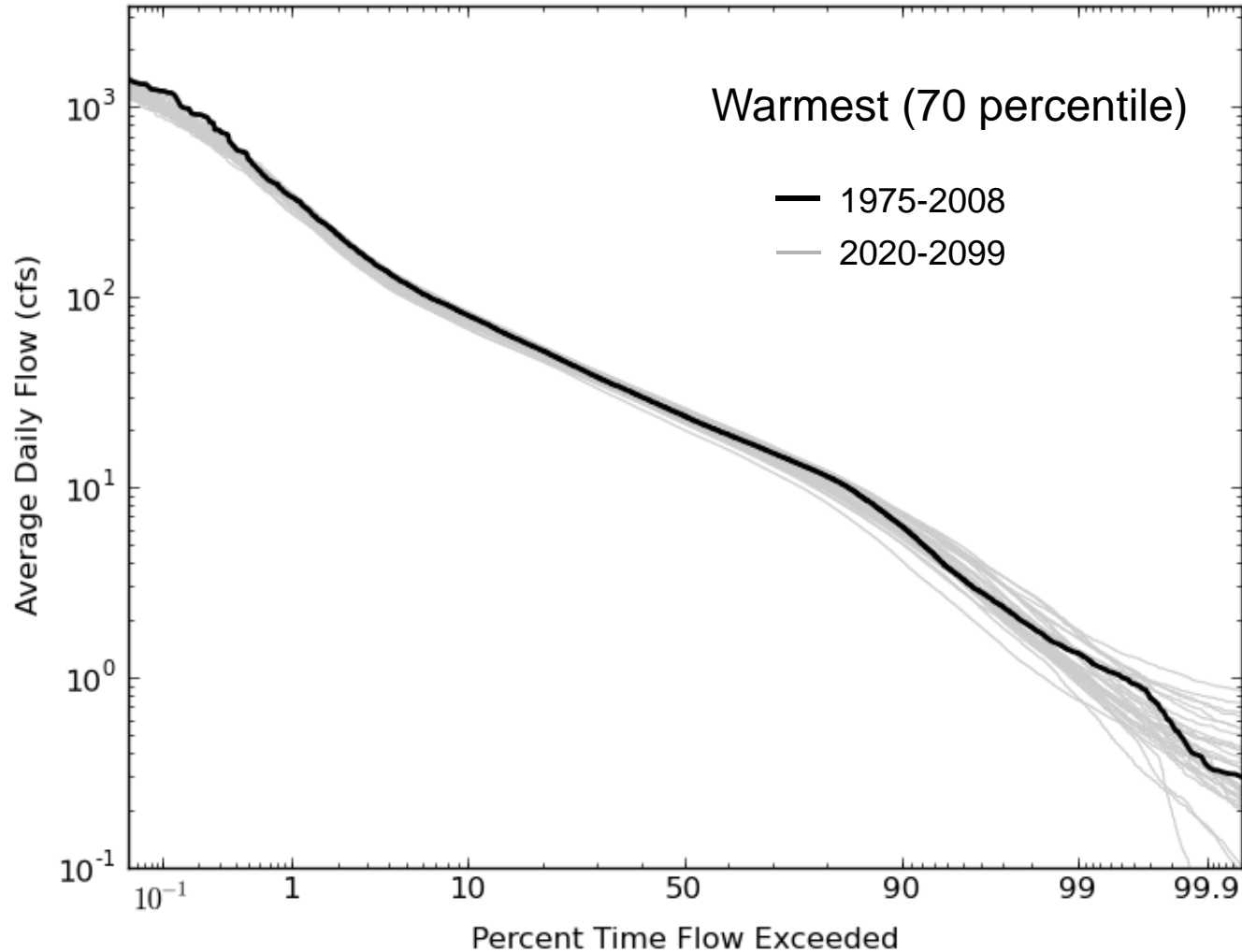
Potential Evaporation - Sanford



Hydrologic Model Application

- ❖ 90 HSPF models (Hydrologic Simulation Program–Fortran)
- ❖ Used District's Beowulf Cluster for 32,000+ model runs
- ❖ Currently Analyzing Results, Drafting Report
- ❖ Presenting to NRC – May 23-25, 2011

MSJ15, Lake Monroe, 1995 Rural



Sea Level Rise

- ❖ The Environmental Fluid Dynamics Code (EFDC) WSIS model was selected for application in the Lower and Middle SJR largely because of the importance of both tidal and sub-tidal ocean effects within these river reaches.

Sea Level Rise

- ❖ Mayport: Long term average (1920-2010) = 2.4mm/yr
- ❖ Recent rate (1995-2010) = 4 mm/yr
- ❖ Rise from Baseline year (1995) to target year (2030) = 14 cm
- ❖ SLR Expected to counter water level reductions due to water withdrawals
- ❖ Accounting for Salt increases in Model

Questions?



1. Project Goals
2. Project Partners
3. Methods
4. Results to Date
5. Lessons Learned
6. Relevance to the PWSU-CWIG Community.