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)

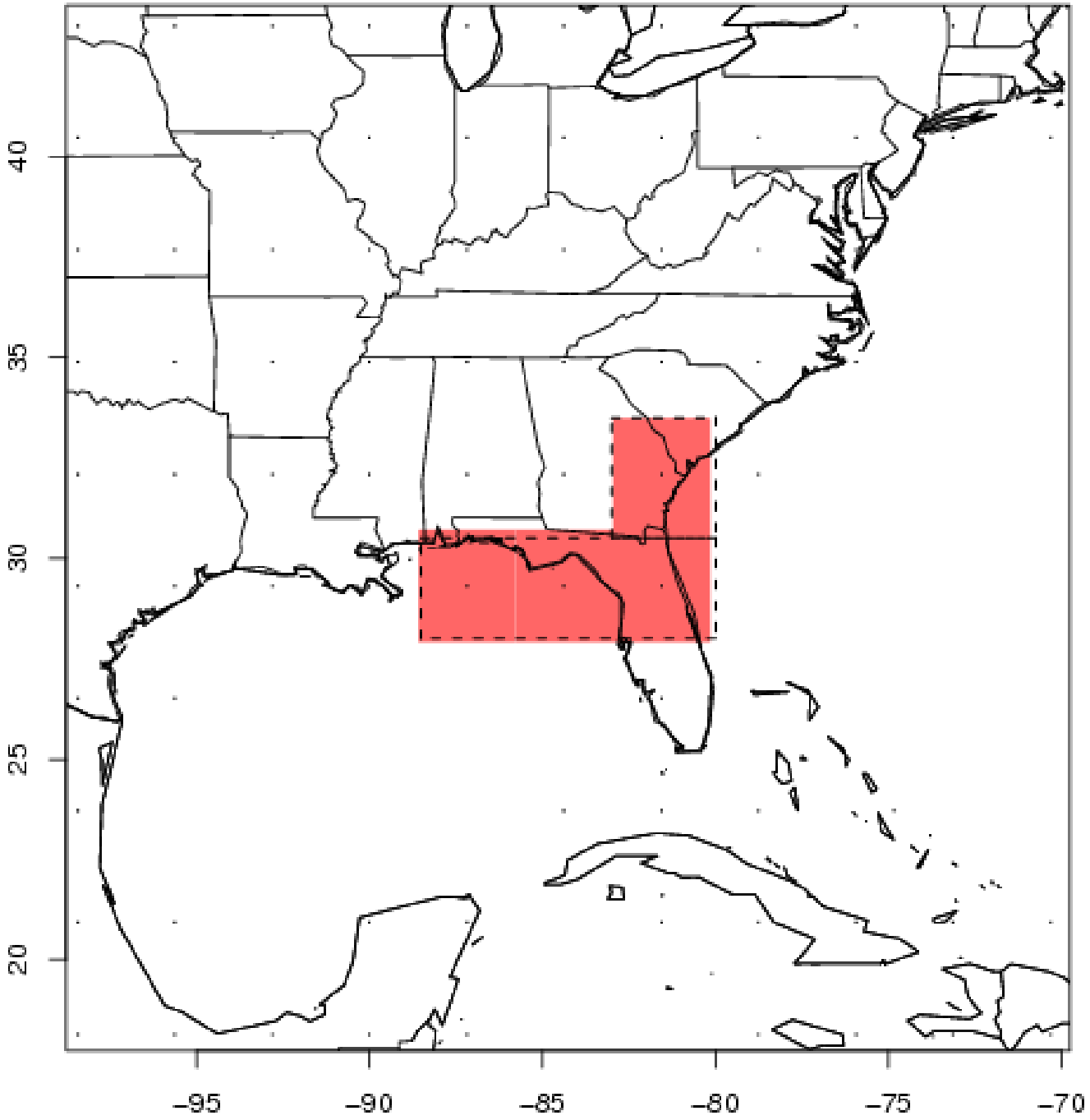
- No ‘best’ GCM
- Too coarse to represent NE Florida
  - Grid cell size -10s to 100s of kilometers
- Temporal scale
  - TS usually days, run for 100s of years
- Coherent results
  - Different teams, parameterizations, boundary data

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

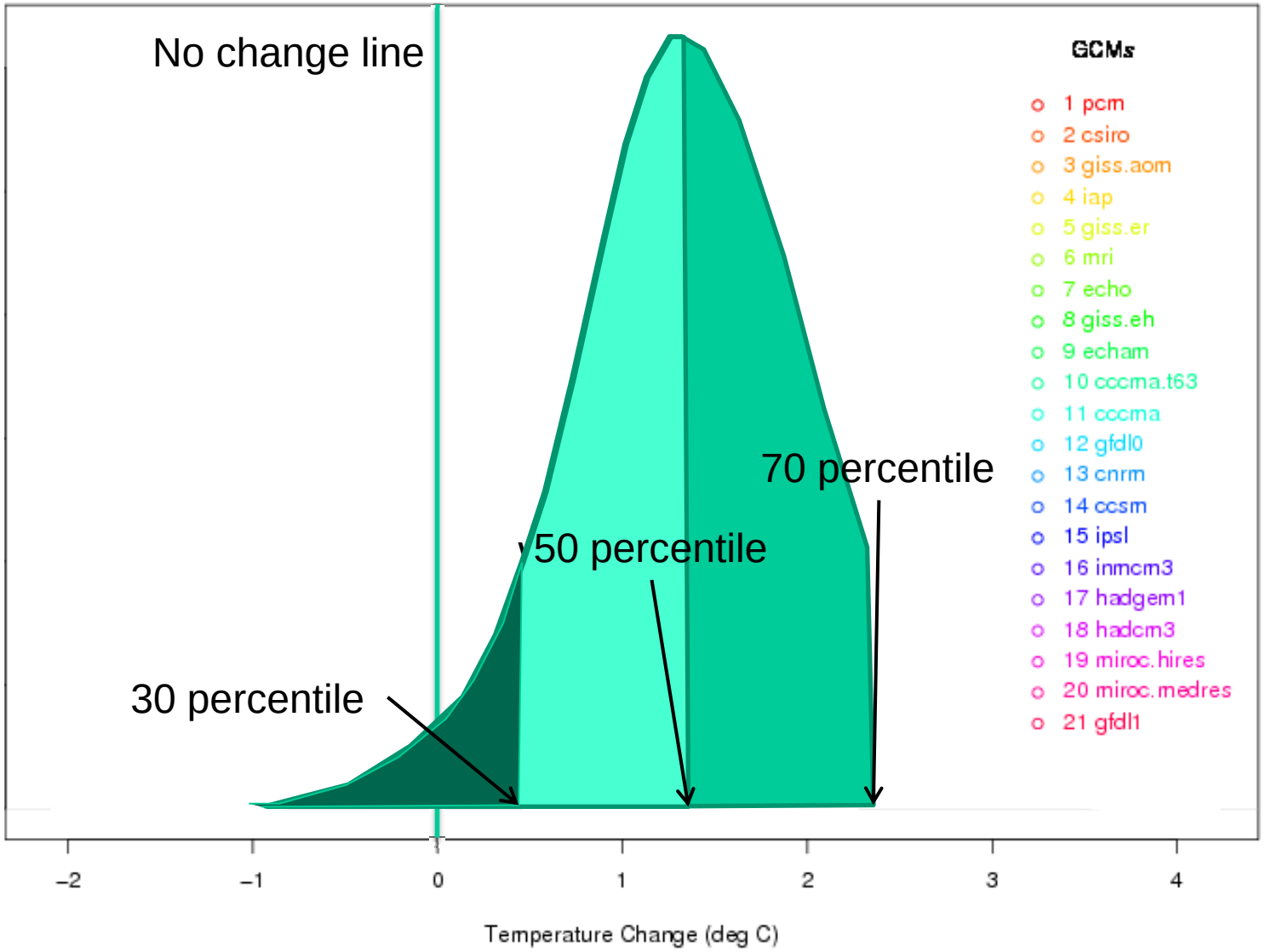
Adapted from: http://www.isse.ucar.edu/climatehealth/doc/Publications.Pg/Puibs.Kovats.Clim.Socio-econ.scenarios.pdf

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

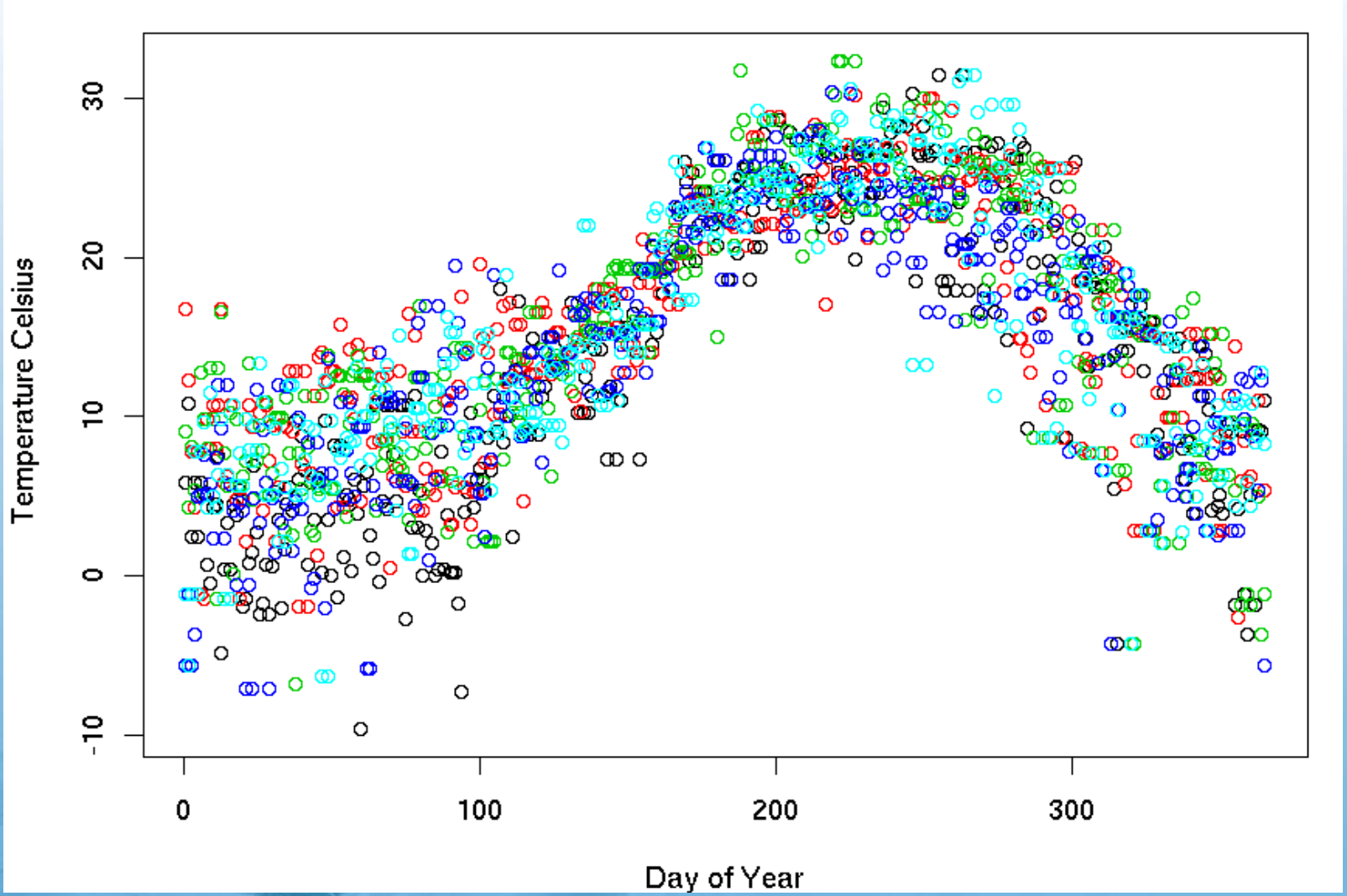
Data Generating Algorithm

- 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

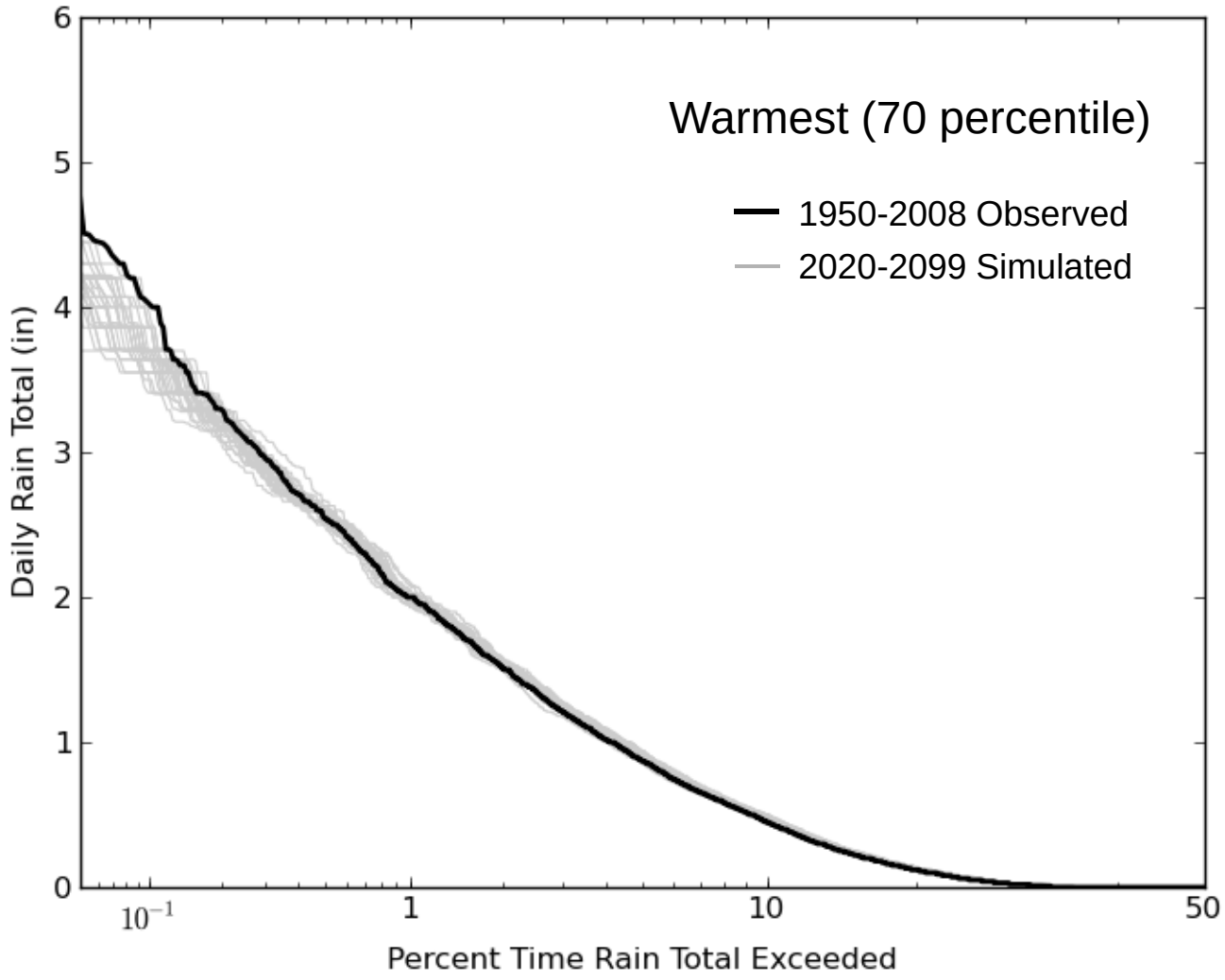
Meteorologic Data Development

- 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

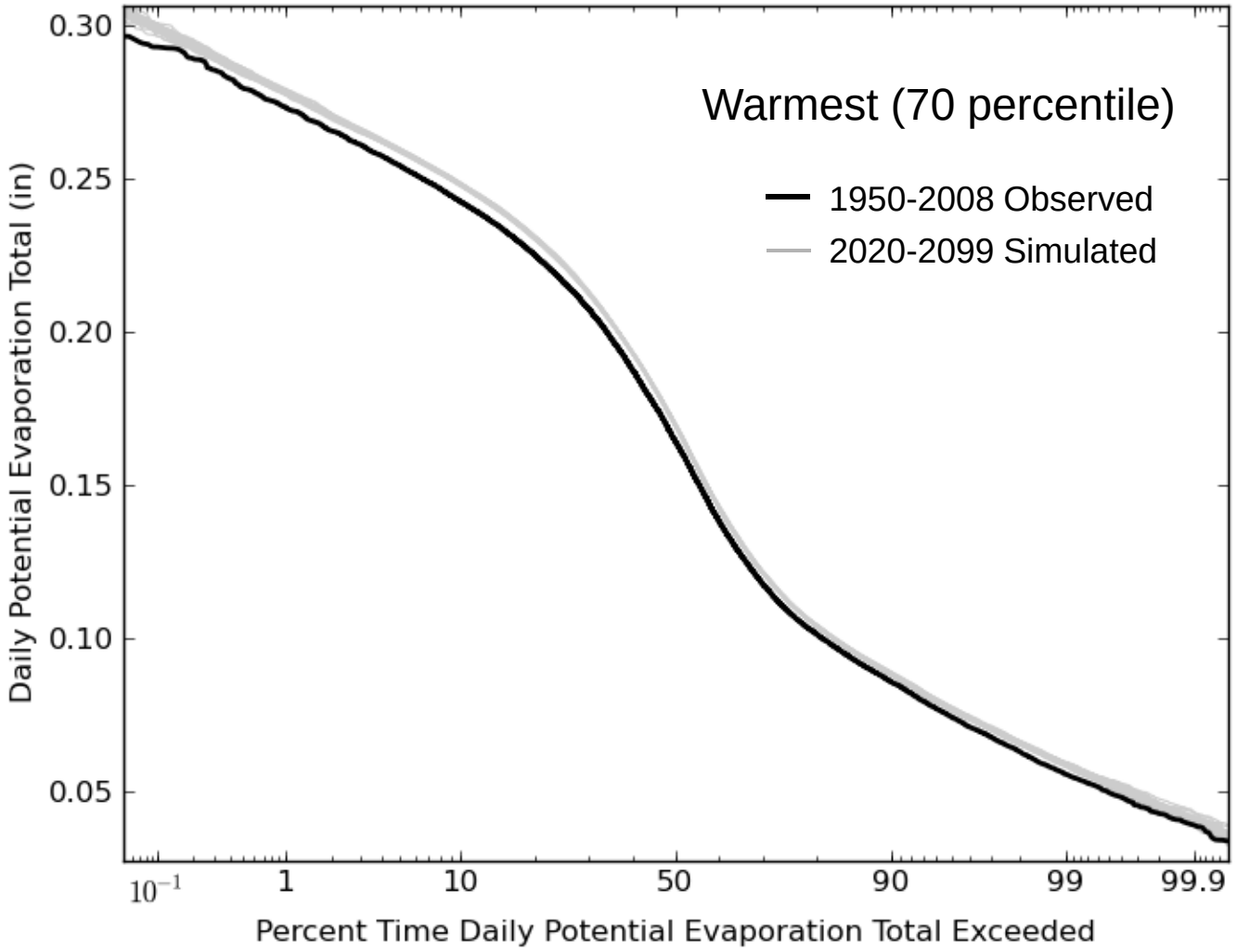
Example of 5 years simulated



Precipitation - Sanford



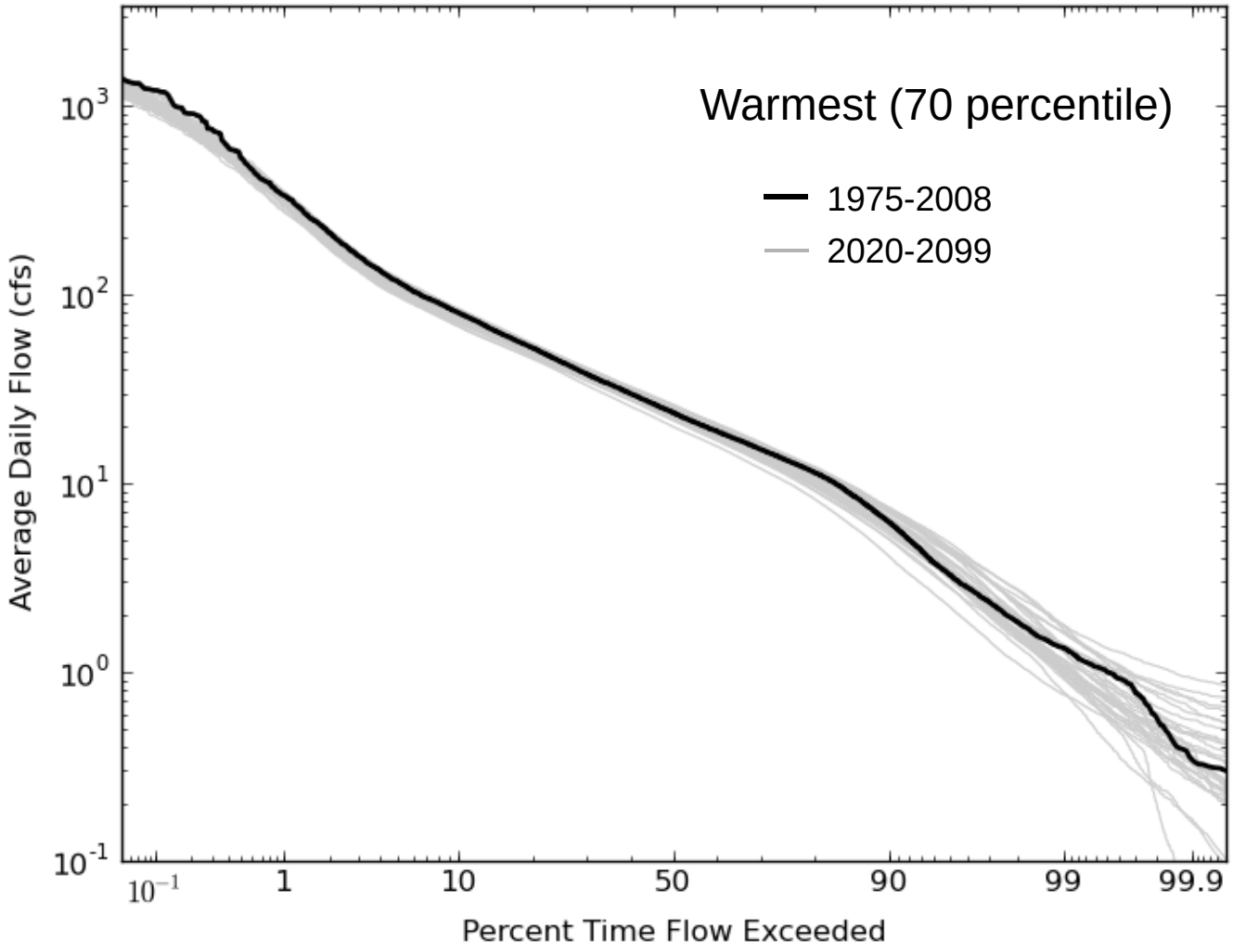
Potential Evaporation - Sanford



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.