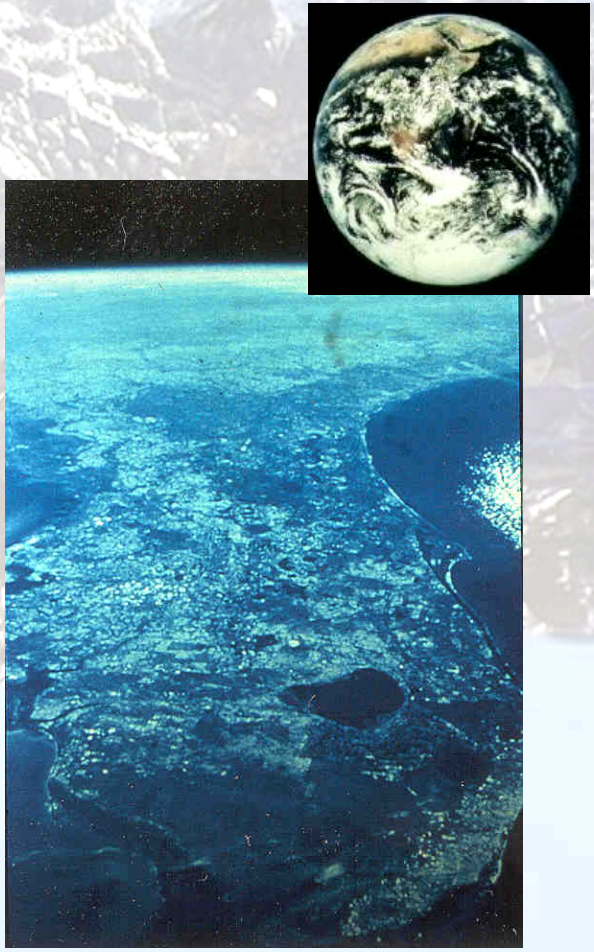
The Florida Water and Climate Alliance:

A Collaborative Working Group for the Development of Climate Predictions for Improved Water Management



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The Florida Water and Climate Alliance

Initially funded by NOAA Climate Program Office: CSI and SARP
Now funded by local partners.

Goal: To increase the regional relevance and usability of climate and sea level rise models for the specific needs of water suppliers and resources managers in Florida.

Project Activities

- Develop a **collaborative Working Group** comprised of public water suppliers, water resource managers, climate scientists, and hydrologic scientists
- Evaluate the practical applicability of current climate data/models predictions at **utility relevant space-time scales**
- Evaluate the usefulness of these data/models for **minimizing current and future public water supply risks** associated with climate variability/climate change and/or sea level rise

Academic Partners: UF Water Institute; Southeast Climate Consortium; UF Center for Public Issues Education; FSU COAPS; U Miami RSMAS
Public Utilities: Miami-Dade County; Broward County; Palm Beach County; Peace River Manasota Regional Water Supply Authority; Tampa Bay Water; Orlando Utilities Commission; Gainesville Regional Utilities
Water Management Districts: SFWMD, SWFWMD; SJRWMD

Develop a collaborative working group

Actionable climate science -
Data/models/tools relevant to water supply operations and management

Domain

Learning together

Community

Practice

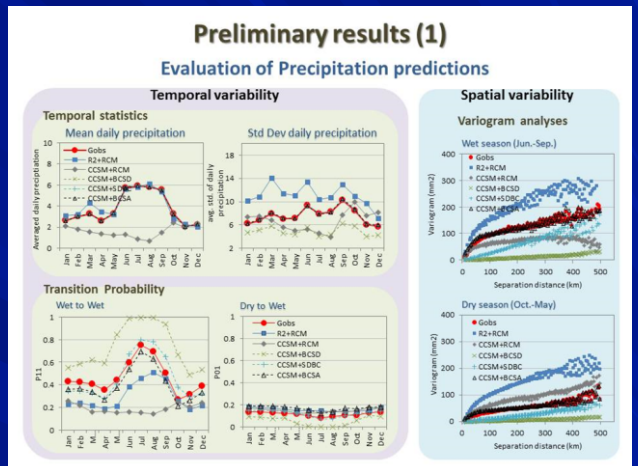
Public water suppliers, resource managers, climate, social and hydrologic scientists, local planners

Workshops, projects, research, website, reports, emails, personal communication, outreach

Based on: Wenger, Communities of Practice, May 2009

Evaluate applicability and usefulness of climate models for water supply operations & planning

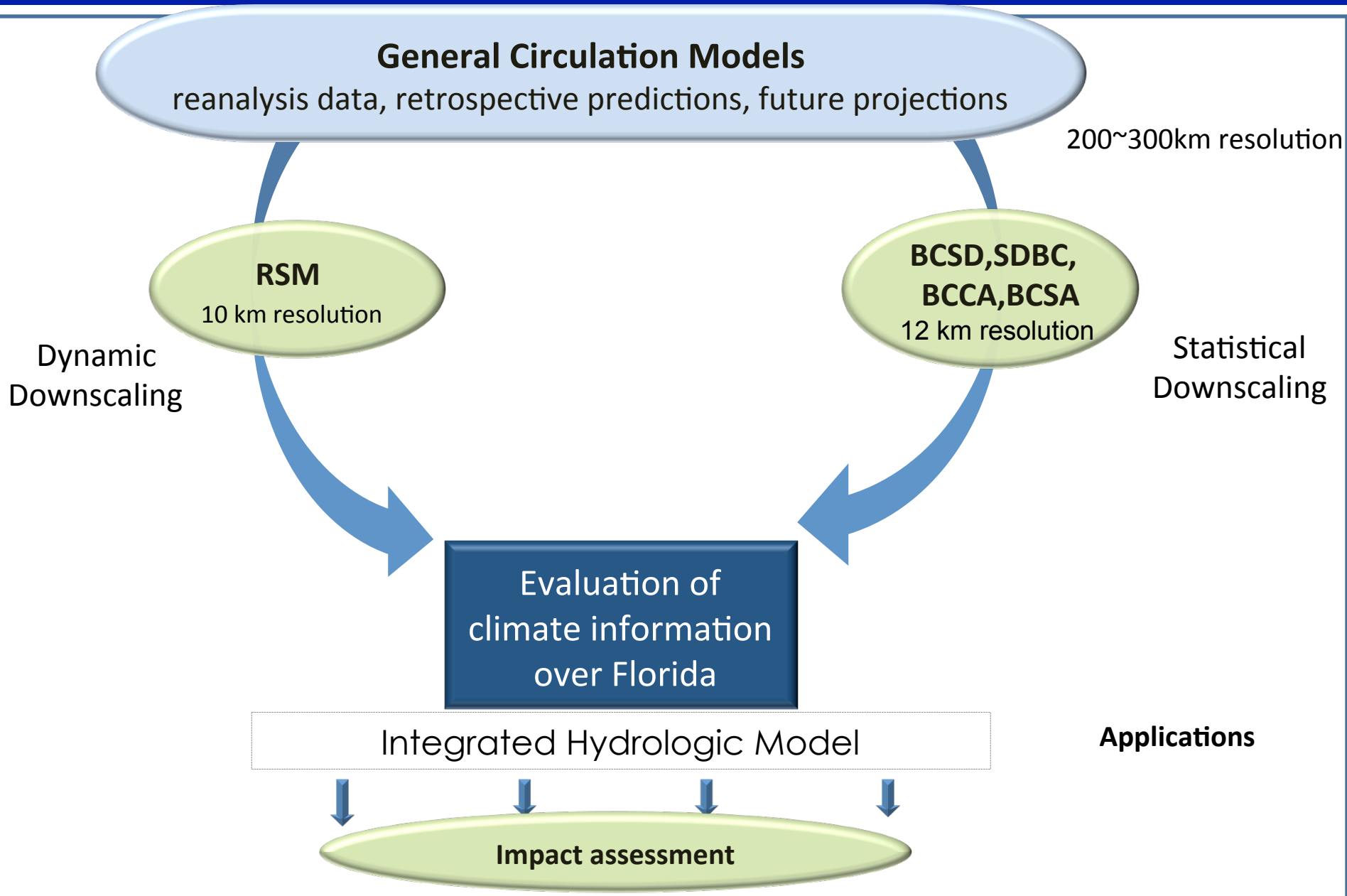
- **SEASONAL PREDICTIONS–** Diagnose skill of NMME seasonal precipitation and temperature forecasts and their utility for forecasting seasonal streamflow in Florida
- **LONG TERM CLIMATE PROJECTIONS–** Evaluate ability of reanalysis data and retrospective GCM output to reproduce current climate and hydrologic patterns, and implications of future GCM projections on climate and hydrologic patterns
- **SEA LEVEL RISE** – Evaluate salt water intrusion and coastal flooding risks for a suite of sea level rise predictions



Tampa Bay Water Project Objectives

- Evaluate the ability of GCM retrospective predictions to reproduce observed temperature, precipitation and reference evapotranspiration in the Tampa Bay region
- Evaluate the ability of downscaled retrospective GCM predictions to reproduce historic hydrologic behavior when used with Tampa Bay Water's Integrated hydrologic model
- Evaluate changes in hydrologic behavior that result from GCM future projections
- Evaluate impact of future climate scenarios on future water supply availability in the Tampa Bay region

Long-term Climate Projection Analysis Framework



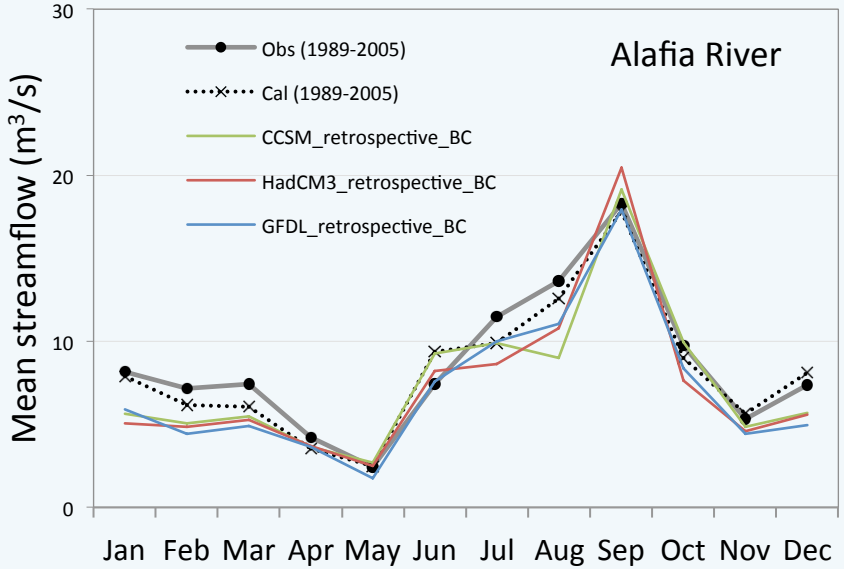
Phase 1: Hydrologic Implications of Dynamically Downscaled Climate Predictions

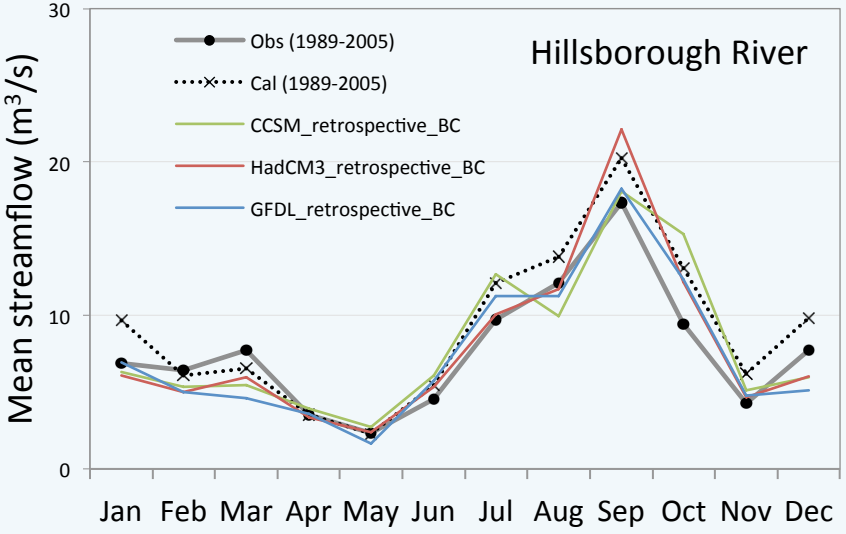
- What we did
  - Used dynamically-downscaled bias corrected retrospective and future climate projections (CMIP3) to evaluate potential impacts of future climate change on hydrology in the Tampa Bay region
- Why we did it
  - Want to understand implications of future changes in temperature and precipitation over Tampa Bay region on long term water supply planning
- What we found…

Validation of the Downscaled Retrospective GCM Output for Streamflow Prediction

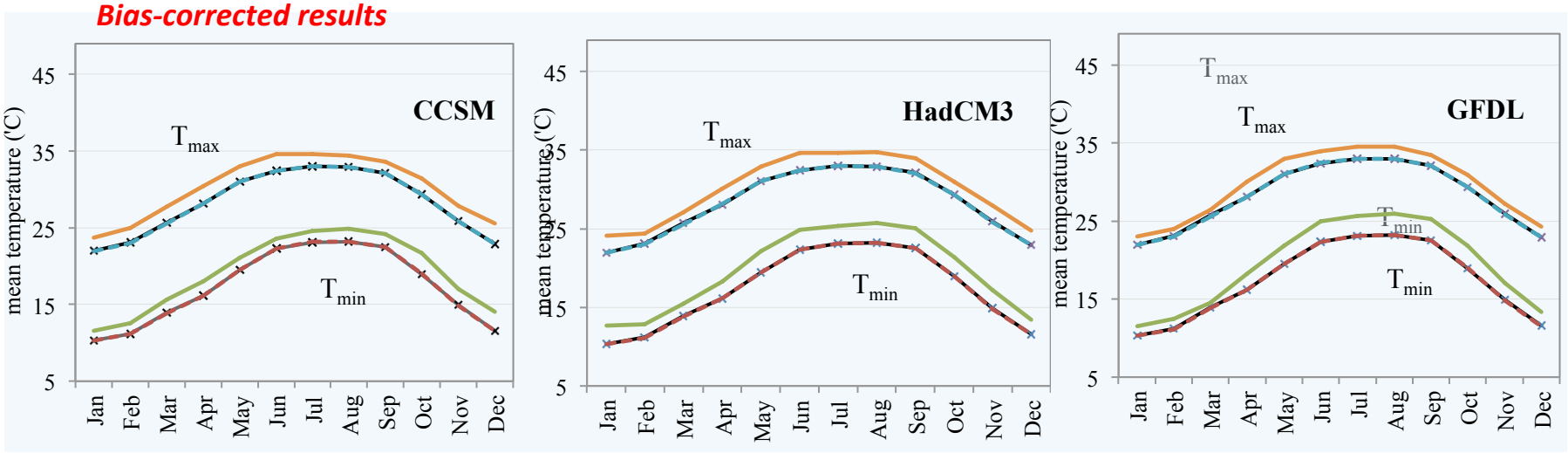
Key Finding

Historic Streamflow seasonal cycles preserved using retrospective GCM predictions





Temperature – Dynamic Downscaling Climate Modeling Results



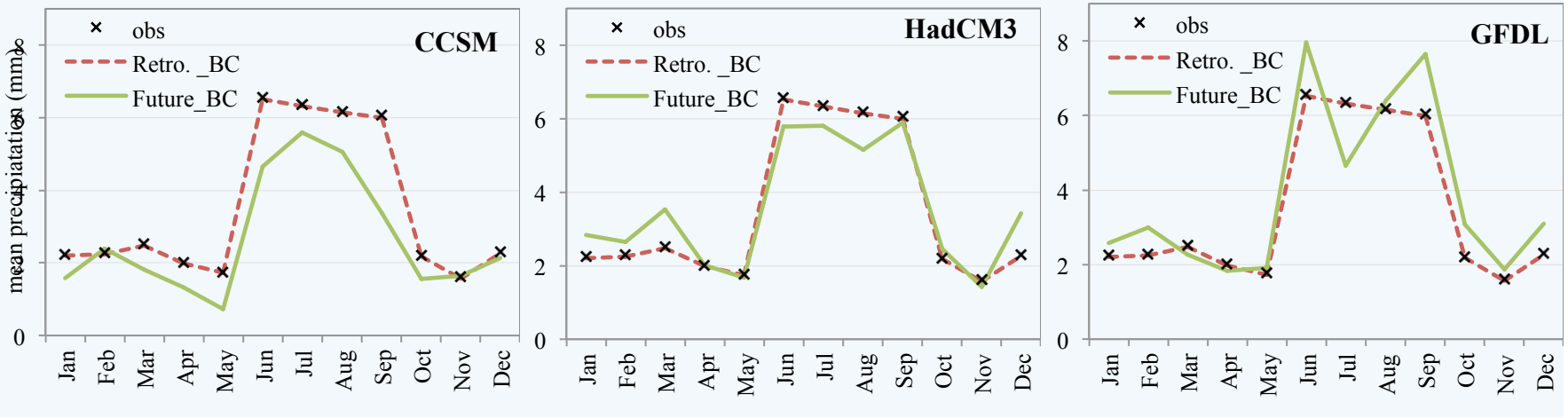
Key Findings:

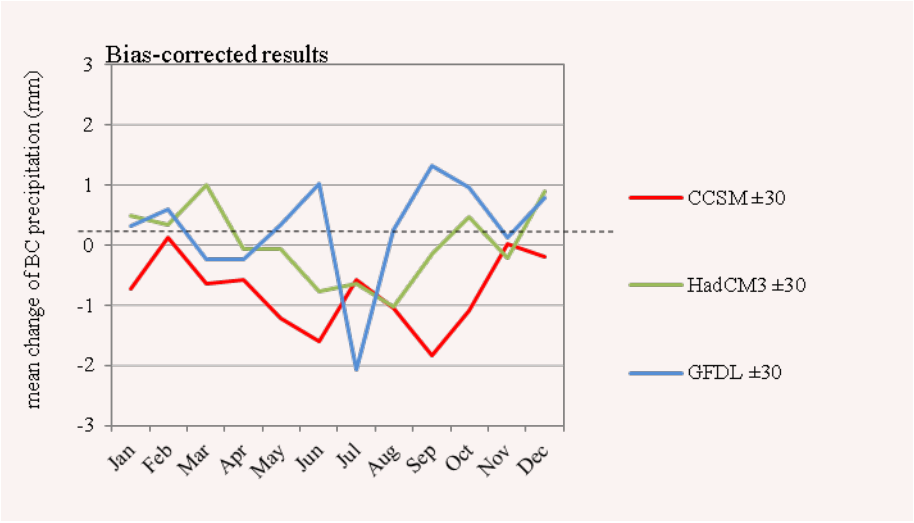
1. Global Climate Models reproduce seasonal cycles of observed mean monthly temperatures

2. Global Climate Models predict about 1 to 3 degree C increase in average monthly Temperature for the future period 2039-2070

Precipitation – Dynamic Downscaling Climate Model Results

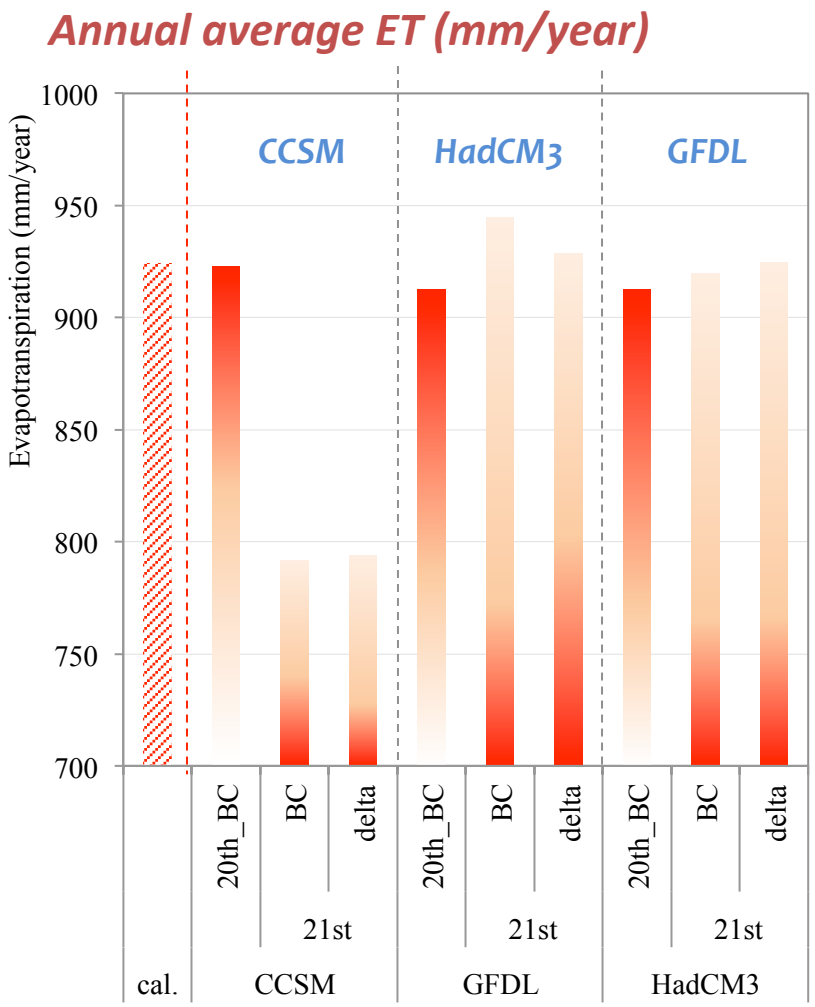
Bias-corrected results

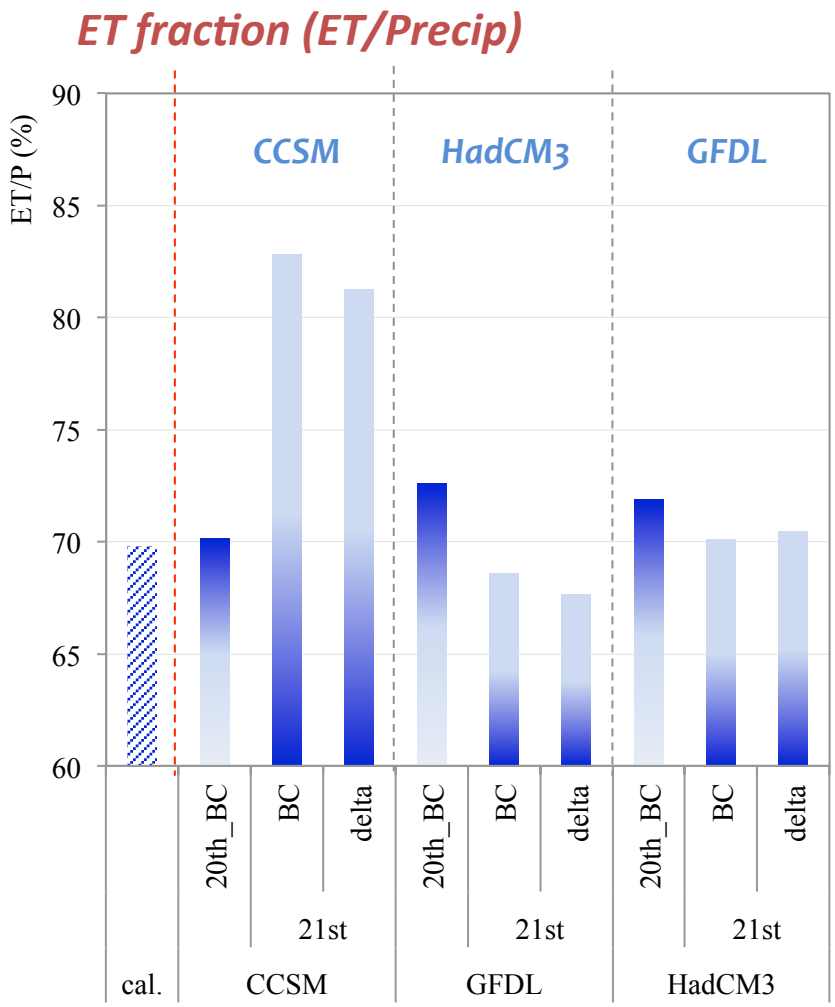




Future projections for rainfall vary considerably in the summer rainy season

Evapotranspiration – Hydrologic Modeling Results





IHM predicts lower actual ET, but higher ET/P ratios for low rainfall scenario (CCSM)… system becomes water rather than energy limited

Future Predictions of Streamflow
(Alafia River station)

CCSM

Very low river flow predictions

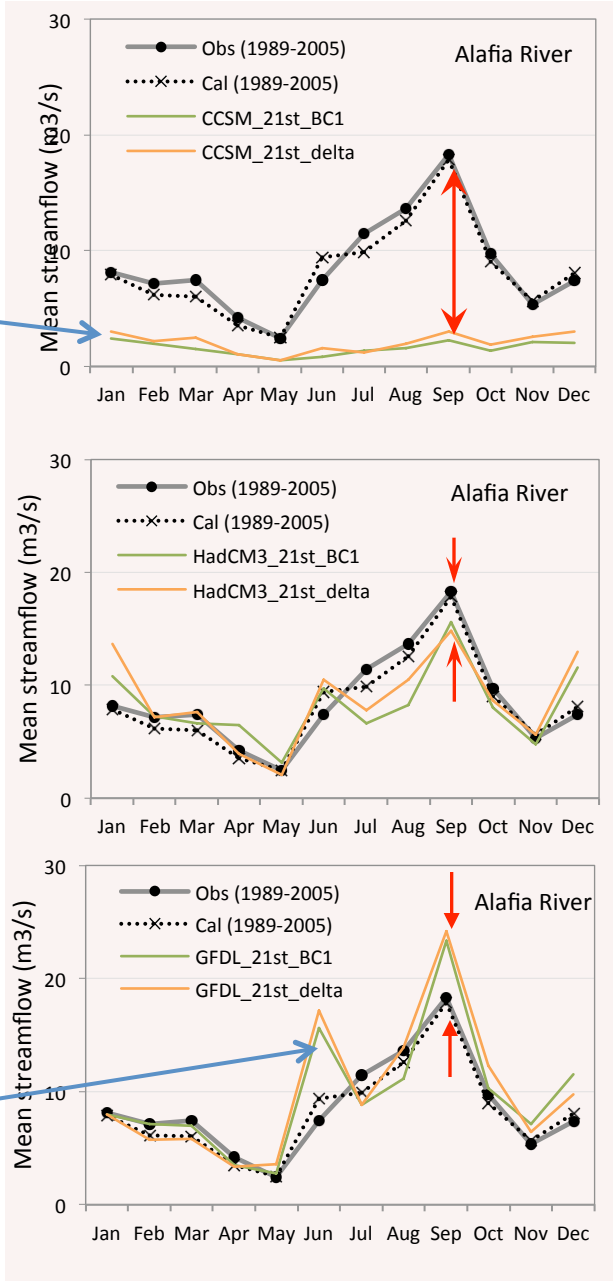
HadCM3

About the same as today

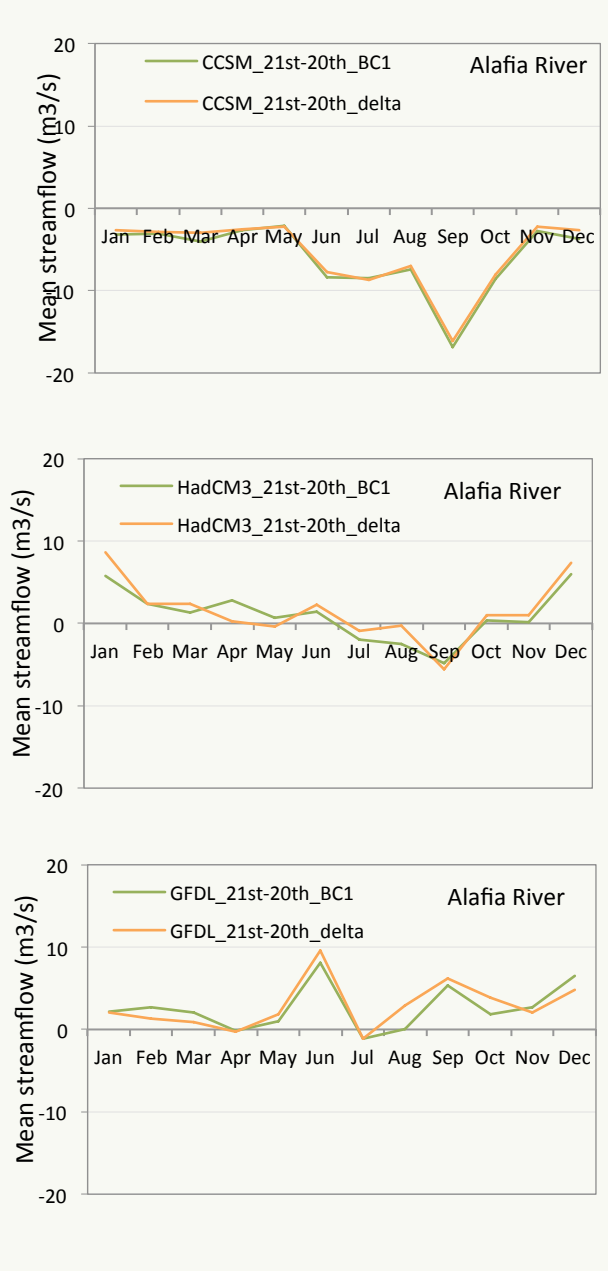
GFDL

Higher late spring and summer flows

Future simulations



Streamflow Change (Future-retro.)



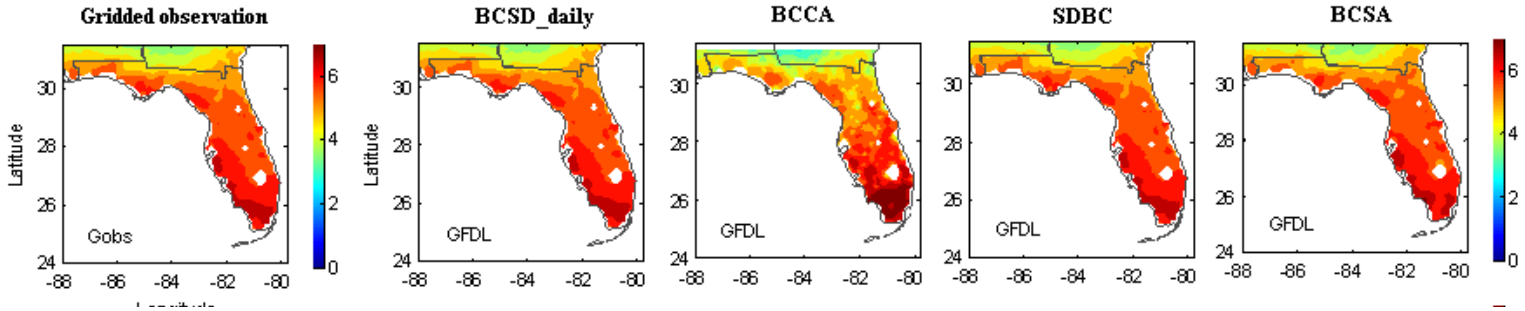
Phase 2: Hydrologic Implications of Statistically Downscaled Climate Predictions

- Statistically downscale CMIP5 retrospective and future predictions for 10-15 GCMs and 3 RCP trajectories
- Quantify the uncertainty in future temperature, precipitation and reference ET projections for the Tampa Bay Region among the GCMs and RCPs
- Estimate agricultural and urban irrigation demand projections for retrospective vs future climate in the Tampa Bay Region
- Evaluate potential impacts of climate change on future water supply availability in the Tampa Bay region

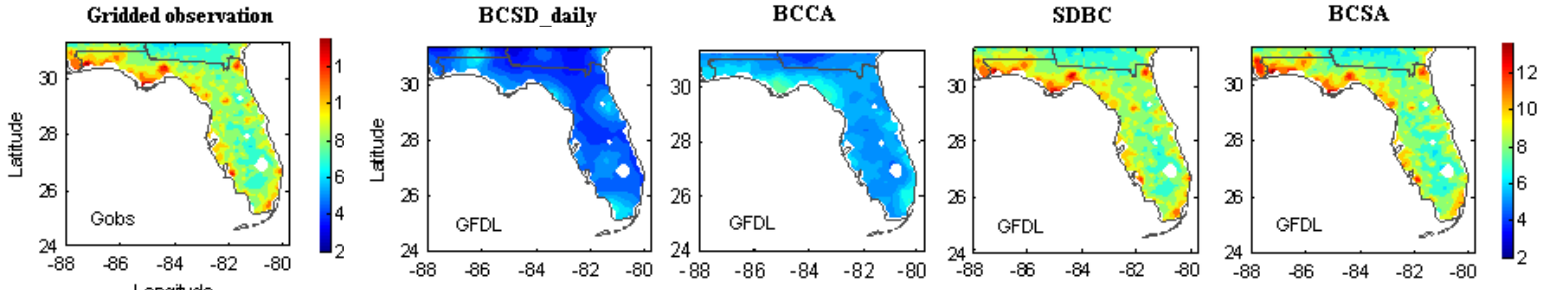
Step 1: Comparison of Statistical Downscaling Methods

- What we did
  - Developed a new statistical downscaling method (BCSA) and compared it to existing methods (BCSD, SDBC, BCCA)
- Why we did it
  - Existing statistical downscaling methods did not reproduce spatiotemporal rainfall characteristics in Florida very well
- What we found…
  - Choice of statistical downscaling method matters in Florida.

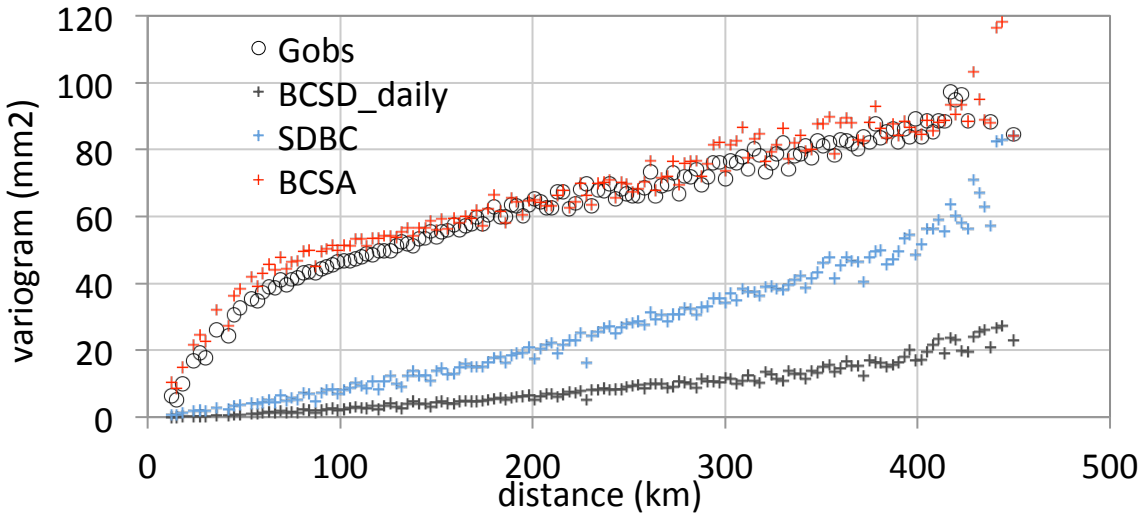
Wet season average daily rainfall



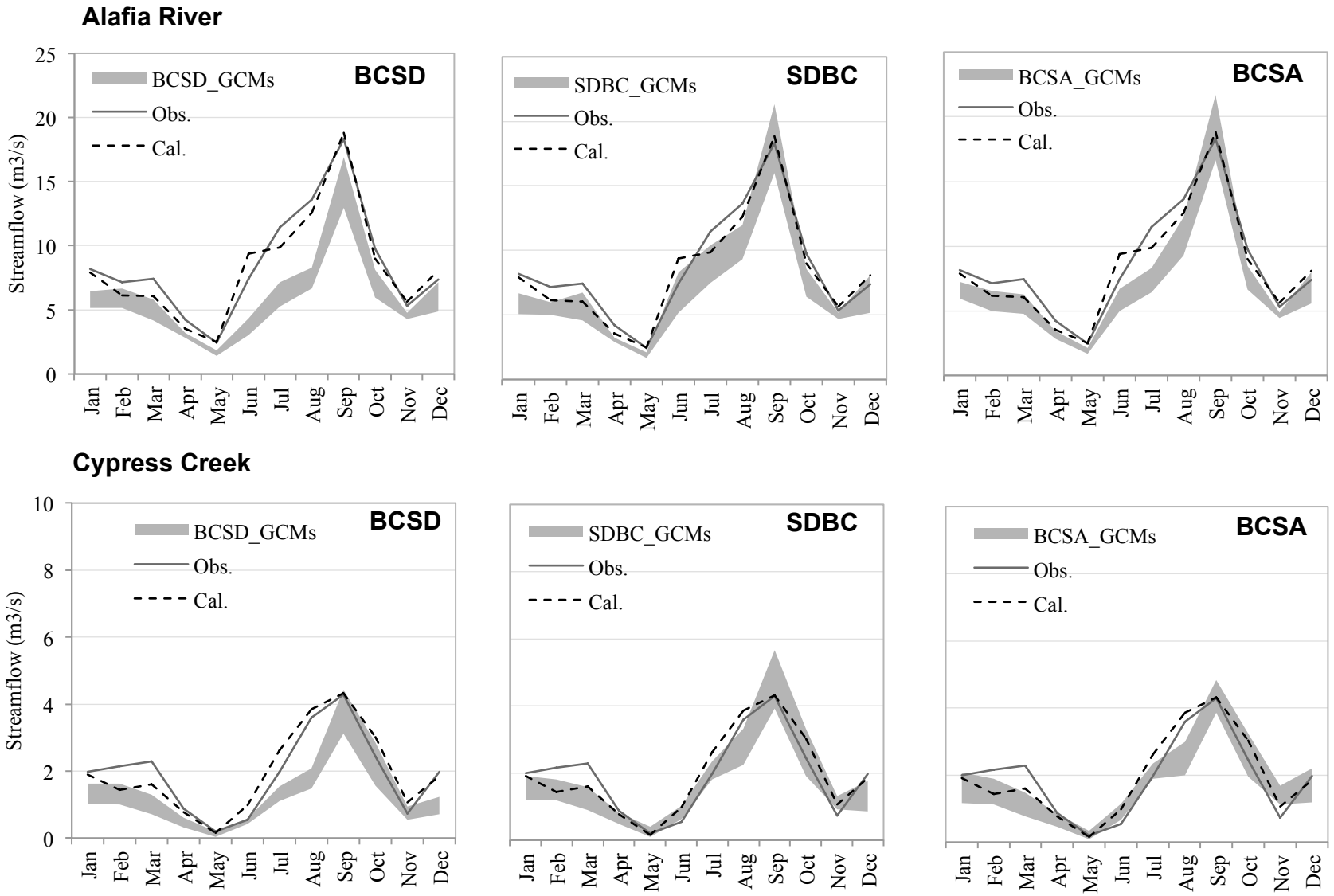
Wet season standard deviation of daily rainfall



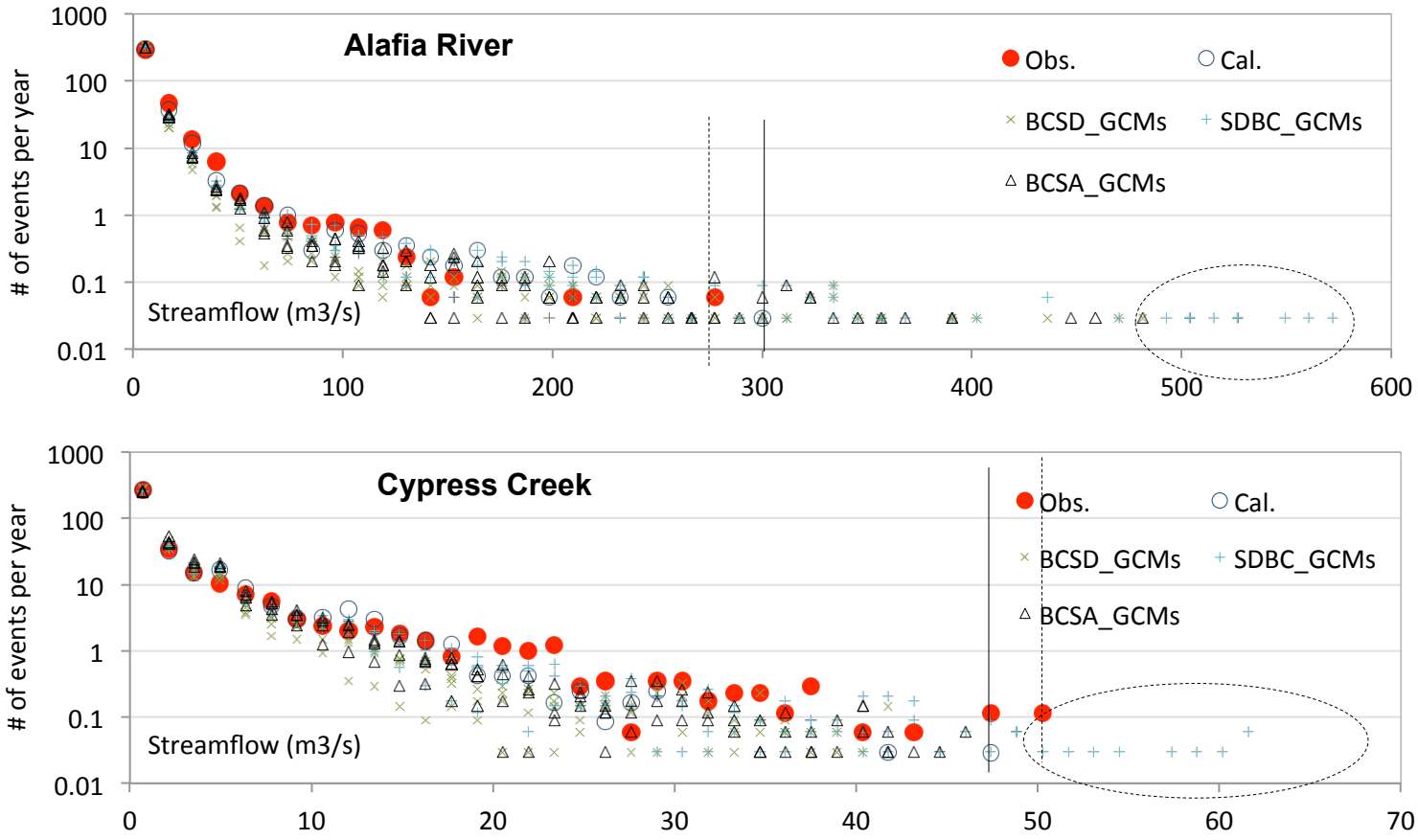
Wet season spatial correlation structure



Monthly average streamflow



Frequency of daily streamflow events

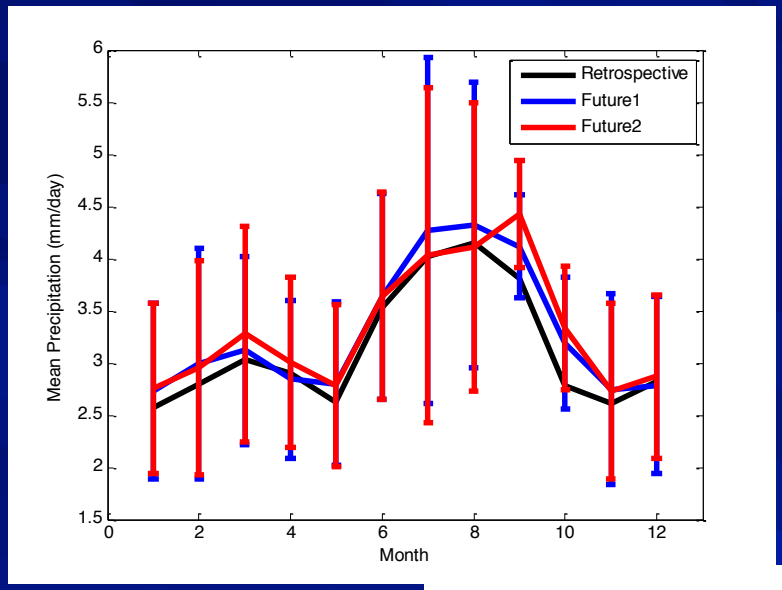


Step 2: Evaluate uncertainty of CMIP5 P, T and ET_0 projections

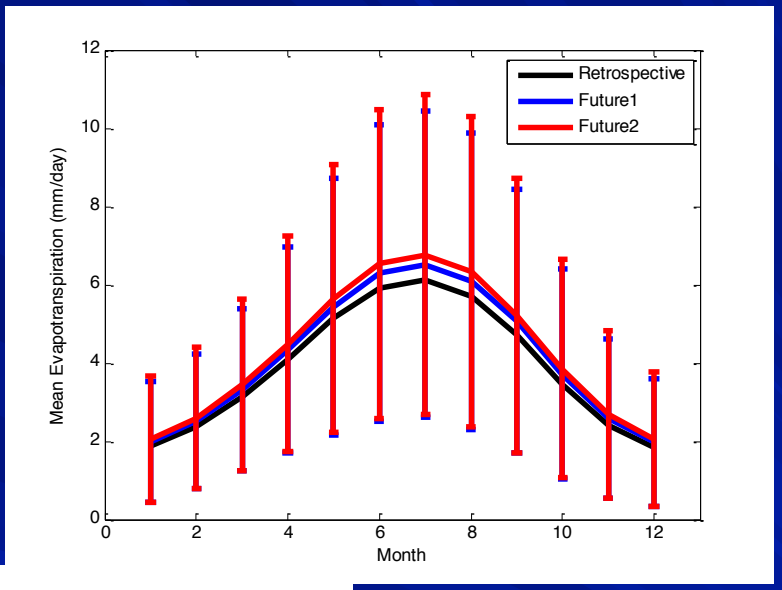
- What we did
  - Evaluated uncertainty in P, T, and ET_0 projections using Global Sensitivity Analysis and Monte Carlo Filtering
- Why we did it
  - To develop an appropriate ensemble of GCMs, ET methods and RCP trajectories for evaluating future climate change
- What we found
  - Choice of ET method matters!
  - Evaluate impacts of future projections over an ensemble of GCMs and a variety of ET methods and RCP trajectories

CMIP5: Mean and Std Dev of Projected Monthly Averages

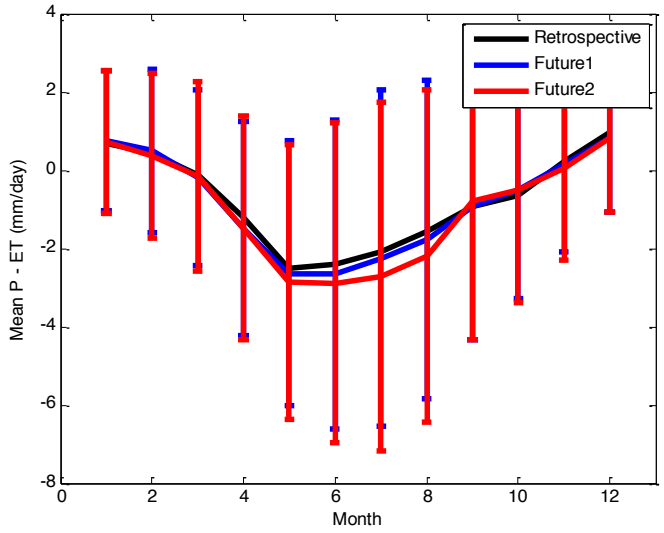
P



ET_0

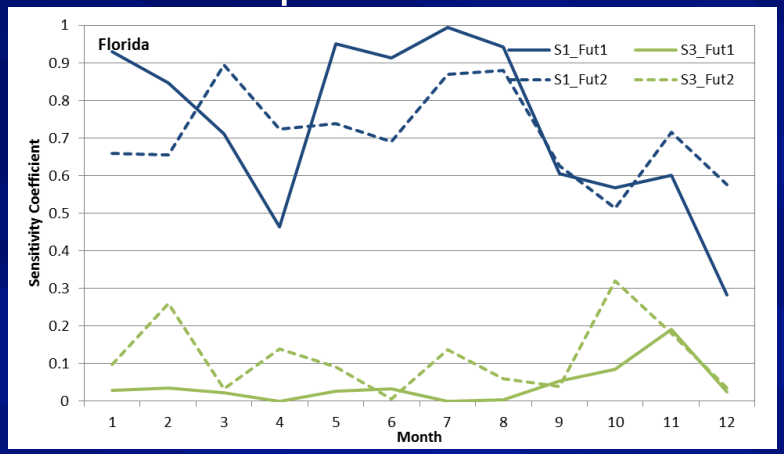


$P\text{-}ET_0$

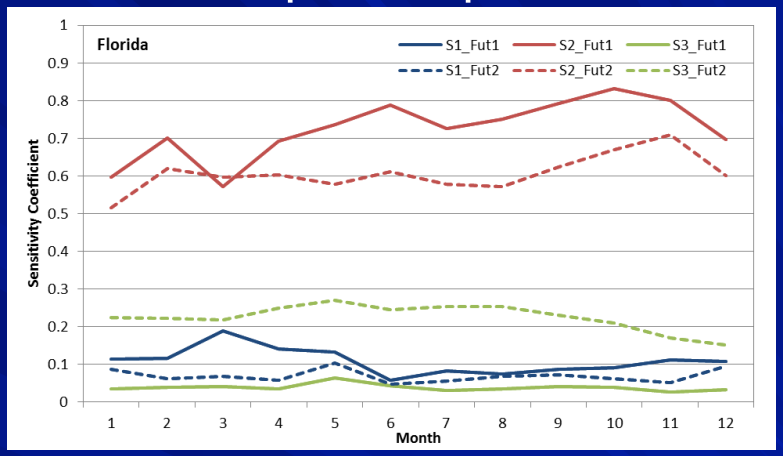


Drivers of Uncertainty

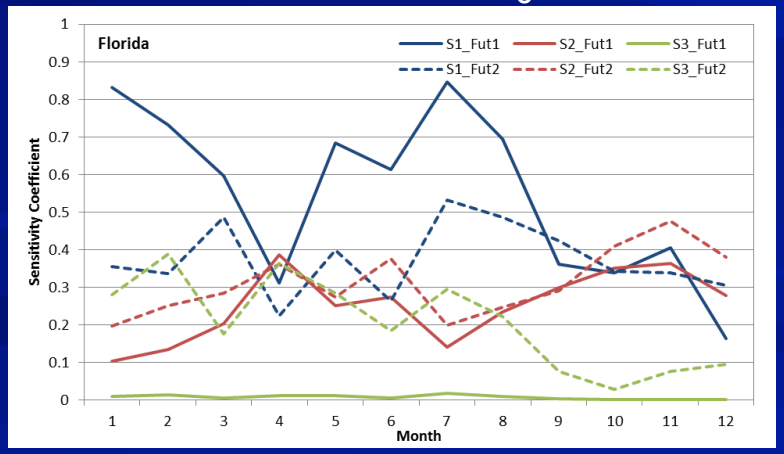
Precipitation



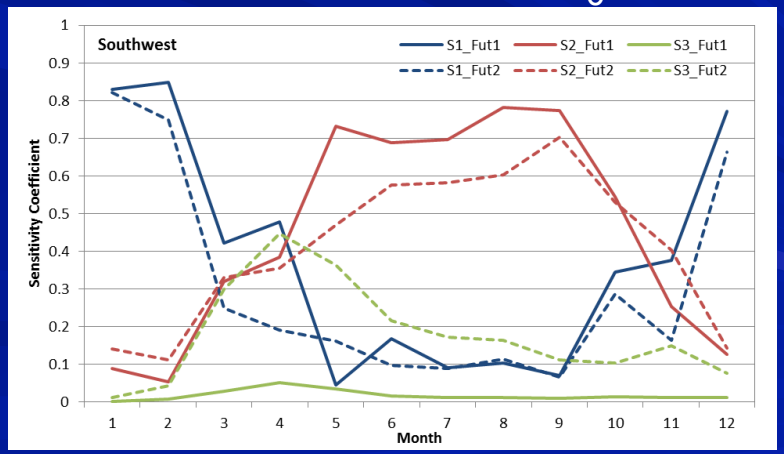
Evapotranspiration



Florida P-ET_0



SouthWest P-ET_0



Blue: uncertainty due to GCM, Green: uncertainty due to RCP scenario, Red: uncertainty due to ET_0 method. Solid line 2030-2060, Dashed line 2070-2100

2070-2100 Change in Annual P-ET_0 by ET method (averaged over GCMs and RCPs)

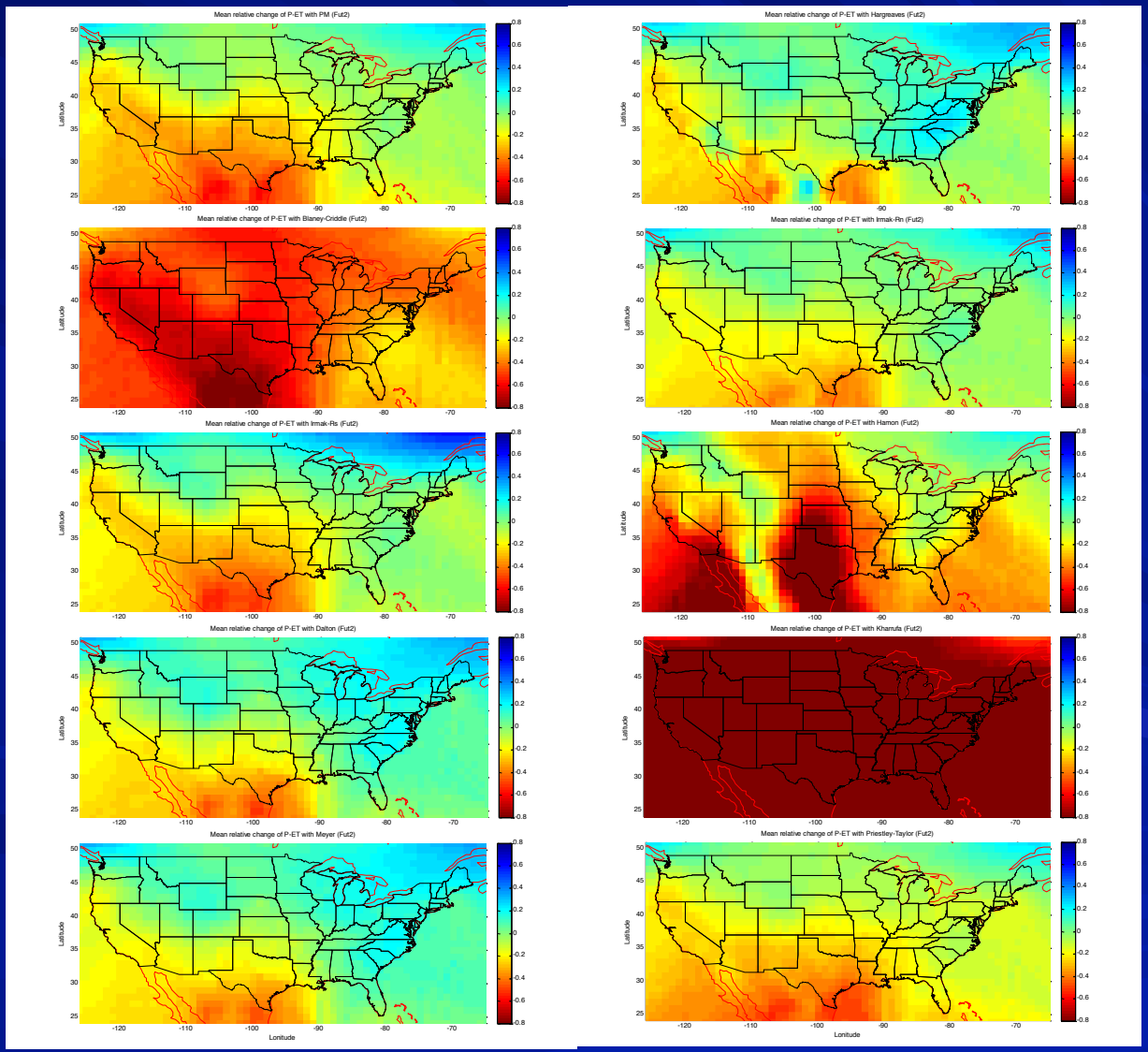
Penman-Monteith

Blaney-Criddle

Irmak- Rs

Dalton

Meyer



Hargreaves

Irmak- Rn

Hamon

Kharrufa (PET)

Priestly Taylor (PET)

Current Work

- Estimate agricultural and urban irrigation demand projections for retrospective vs future climate for a variety of ET methods in the Tampa Bay Region
- Develop future population, land use and water use scenarios for the Tampa Bay Region
- Evaluate future impacts of population, land use, water use and climate change on future water supply and water demand in the Tampa Bay region

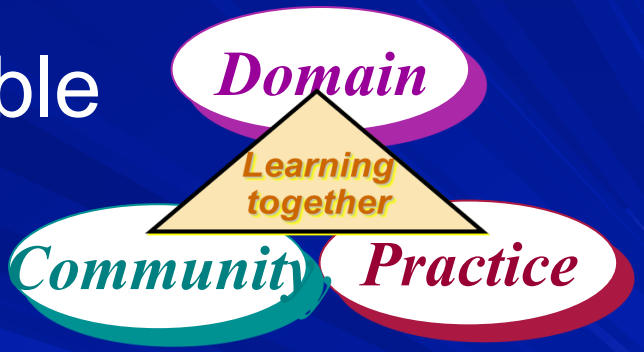
Group Learning to Date

- Choice of downscaling technique matters for water supply planning in Florida
- Choice of ET method matters for hydrologic model predictions
- Precipitation and ET differences propagate nonlinearly through hydrologic system
- Must have local/regional hydrologic models to understand changes in hydrology due to climate
- Regional actionable information is difficult!

Community Building Lessons

Participants → Engagement → Outcomes → Process

- Support a Shared Interest
  - Useable climate information at locally relevant space and time scales
  - Passion and real need for the information
- Get the "right" people at the table
  - Energized core group and internal leadership
  - Different stakeholders engaged
  - Outreach to new participants



- Manage Diversity, Enhance Communication
  - Value diversity of individuals and institutions
  - Use variety of activities to challenges and opportunities
  - Respect evolving agendas and learning/communication styles

Community Building Lessons

Participants → Engagement → Outcomes → Process

- Provide Rigorous Science
  - Reliable predictive tools and evaluate practical applicability
  - Forecast skill: can we trust the climate information?
  - "Frame" the science for various publics
- Understand User Perspective and Context
  - Consider organizational context to understand how climate information adds value to decision making
  - Sharing case studies about the systems of others contributes to understanding how decisions are made
- Ensure Sustainability
  - Provide added value- balance goals to keep people interested
  - Build Identity/ownership
  - Get individual & institutional commitment for time and funding


Questions…. Comments?