TIME PERIOD ADDRESSED BY REPORT: 06/01/2012 – 5/30/2013

SECTORAL APPLICATIONS RESEARCH PROGRAM (SARP) – PROJECT ANNUAL REPORT

PROJECT TITLE: Collaborative Development of Public Water Supply Utility Relevant Climate Information for Improved Operations and Planning

INVESTIGATORS:

Principal Investigator: Wendy D. Graham, Director UF Water Institute, Water Institute, PO Box 116601, University of Florida, Gainesville, Florida 32611-6601. Ph- 352-392-5893 x 2113, email: wgraham@ufl.edu, http://waterinstitute.ufl.edu

Co-Investigators:
Keith Ingram, Coordinator, Southeast Climate Consortium, University of Florida, Department of Agricultural and Biological Engineering, 283 Frazier Rogers Hall, PO Box 110570 Gainesville, FL 32611, 352-392-1864 ext. 283, email: ktingram@ufl.edu

Tracy Irani, Director, Center for Public Issues Education in Agriculture and Natural Resources, University of Florida, AEC Department 121E Bryant Hall University of Florida GNV, FL 32611, Ph-352-273-2588, email: Irani@ufl.edu

Vasu Misra, Assistant Professor of Meteorology, Florida State University, 1017 Academic Way, Tallahassee, FL, 32306, Ph-850-644-2814, email: vmisra@fsu.edu

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TIME PERIOD ADDRESSED BY REPORT: 6/01/2012 – 5/30/2013 **(YEAR 2)**

I. PRELIMINARY MATERIALS

A. Research project objective.

To increase the regional relevance and usability of climate and sea level rise data and tools for the specific needs of water suppliers and resources managers in Florida. The project will (1) develop a collaborative Working Group comprised of public water suppliers, water resource managers, climate scientists, and hydrologic scientists focused on understanding how climate variability/change and sea level rise may impact planning and operations of Florida's public water supply utilities, (2) Identify the appropriate spatio-temporal scales, climatic indices, and events that drive utilities' decisions, and evaluate the practical applicability of current climate tools at these scales through synthesis of nationally available General Circulation Model (GCM) simulations and statistically and dynamically downscaled GCM data products for the region, and (3) Identify appropriate entry points for climate data and model predictions in Working Group members' models and decision making processes and evaluate the usefulness of these data for minimizing current and future risks associated with climate variability/climate change and sea level rise.

B. Stakeholders and decision makers

Florida Public Water Supply Utilities

- Alison Adams, Tampa Bay Water
- Nancy Gallinaro, Palm Beach County, Water Utilities Department
- Kevin Morris, Peace River Manasota Regional Water Supply Authority
- David Richardson, Gainesville Regional Utilities
- Robert Teegarden, Orlando Utilities Commission
- Douglas Yoder, Miami-Dade Water and Sewer Department
- Fran Henderson, Broward County

Florida Water Management Districts

- Jayantha Obeysekera, South Florida Water Management District
- Michael Cullum, St Johns River Water Management District
- Ken Herd, Southwest Water Management District

Florida State Climatologist

- David Zierden, SouthEast Climate Consortium

C. Approach

Our basic approach centers on building a Working Group (learning network) that operates as a social learning and collaboration platform and promotes shared knowledge, data, models and decision-making tools relevant to climate impacts and water supply planning. The working group and key beneficiaries are public water suppliers, local governments, water resource managers, climate scientists and hydrologic scientists engaged with planning and operations of Florida's public water supply utilities. While the immediate focus of the Working Group is on Florida public water supply utilities, the Working Group process and the Working Group products will be transferable and useful nationwide. The project will provide feedback to the national climate science community on additional research needed to improve the utility of local- to regional-scale climate simulations/predictions for water resource based on applications.

The working group is collaboratively defining and exploring the most important issues faced by water utilities at a range of planning and management timescales, possible impacts of climate variability/change and sea level rise on these issues, and the relevant spatio-temporal scales at which climate-related information is needed to assess risks of potential impacts. Furthermore, the group is identifying sources of climate data that may provide the desired information and processing the data into a format consistent with Working Group needs.

To date the group has evaluated the skill of seasonal precipitation and temperature forecasts for the region, and the ability of nationally available reanalysis products and GCM retrospective simulations (CMIP3) to reproduce historic climatology in Florida at utility-relevant space-time scales using both dynamic and statistical downscaling techniques. We have also evaluated the potential for incorporation this seasonal, reanalysis and retrospective climate information into a selected hydrologic models to enable risk assessment and adaptation/mitigation planning. All Working Group members participate in these assessments in order to gain experience and build capacity for their own future applications. Over the next year we will evaluate alternative methods for generating future downscaled regional climate scenarios for use in water resource applications.

D. Matching funds/activities

All working group members from the Public Water Supply Utilities, Water Management Districts and local governments provide in-kind support through paying their own travel costs to quarterly project meetings and staff time to attend the meetings and conduct project specific activities between quarterly meetings.

Funds from Tampa Bay Water are being used to fund an additional Ph. D. student who is working on this project (Stipend and tuition approximately $33, 700 per year). Funds from the South East Climate Consortium base grant (approximately $23,500 per year) are being used to partially fund a post doc on the project.

E. Partners

- Southeast Climate Consortium (SECC)
- UF/IFAS Center for Public Issues Education
- Florida Climate Institute
- Florida State Climatologist
- Tampa Bay Water
- Palm Beach County Water Utilities
- Peace River Manasota Regional Water Supply Authority
- Gainesville Regional Utilities
- Orlando Utilities Commission
- Broward County
- Miami-Dade Water and Sewer Department
- South West Florida Water Management District
- South Florida Water Management District
- St Johns River Water Management District

II. ACCOMPLISHMENTS

A. Project timeline and tasks accomplished

Project accomplishments are reported here by objectives and tasks in the work plan.

Objective 1: Develop a collaborative Working Group

Group Building and Workshops - The NOAA-SARP project this year has significantly contributed to building the learning community of the Florida Water and Climate Alliance. The active group of stakeholders is working on technical issues, identifying communication issues and potential entry points for use of climate science in the water supply utilities planning and operations. Group identity is forming (originally referred to as the "Public Water Supply Utilities Climate Impacts Working Group- PWSU-CIWG," the group recently adopted the name the Florida Water and Climate Alliance - FloridaWCA). Eight workshops have been conducted since the initiation of the "working group." The workshops during this reporting period have provided a venue to share interests, technical project results, new science presentations, and explore how the information can best be used by water resource managers and utility operators. Discussions continue to inform the project's technical research activities at both seasonal scale and long term climate timeframes, and informational needs for sea level rise. In workshops over the next year, we will increase the focus on the application of the information in the user contexts for decision making, and communicating climate science to policy & decision makers, while continuing to share technical information. Average attendance at the workshops remains high, averaging over 20 participants with a strong core of actively engaged participants.

Knowledge Management System (KMS) – In response to a major interest expressed early in the group building process for a common base for communication and information, the project participants have contributed to development of a web-based, searchable knowledge management system. KMS subcommittee and development activities were an important part of each of the workshop agendas this reporting period. The full design and soft roll out of the KMS has been completed this reporting period.

Progress to date includes 1) completing and analyzing results from a needs assessment, 2) assembling a sub-committee to oversee the development process, 3) reviewing and testing the functionality of multiple platforms for construction, 4) drafting documents to guide the design of the website, 5) identifying hosting and domain name (Floridawca.org), 6) implementing a participatory activity in Workshop 7 for refining relevant information categories, and 7) establishing a site management and review committee to focus on both usability, and sustainability of the KMS. The new website http://floridawca.org is in process of replacing the preliminary static website that was initially established to support the working group.

Objective 2: Identify the appropriate spatio-temporal scales, climatic indices, and events that drive utilities' decisions, and evaluate the practical applicability of current climate tools at these scales

a) Identify appropriate spatio-temporal scales

Through workshop activities water resource managers and utility operators have emphasized that predictions (rainfall, temperatures, extreme events and sea level change) are needed at space, time and event scales relevant to operations (3-12 months), permitting (20 years) and capital planning (20-50 years). Three technical teams were established, which developed 'research roadmaps" and activities focused on 1) **Seasonal Scale Forecasts** (to develop and robustly diagnose seasonal precipitation and temperature forecasts for all 4 seasons), 2) **Long-term Climate Scenarios** (to develop common reanalysis, retrospective and future climate scenarios for use in Florida, and 3) **Sea-level Rise/Change** (initially focused on improving access to existing information).

b) Evaluate output of existing Seasonal Scale Forecasts -

1. **Task:** Evaluate the ability of the Florida Climate Institute-Florida State University Seasonal Hindcast at 50km (FISH50) to provide skillful probabilistic seasonal prediction of temperature and precipitation over the SouthEastern United States (SEUS).
   Results: The FISH50 forecasts were 1) initialized in June and integrated through November of each year and 2) initialized in December and integrated through May of the following year for each year from 1982-2001. Each of the seasonal climate forecasts had 6 ensemble members. These ensemble members were produced with same boundary condition but with varying initial atmospheric conditions. For the winter and spring season, the FISH50 overestimated aerial average rainfall by nearly 23% over the watersheds in this study. However FISH50 displayed a good discriminating skill in predicting quartile categories of winter and spring rainfall. Thus FISH50 is able to deliver probabilistic seasonal prediction of temperature and precipitation that could be potentially exploited for operational water management. However the lead time of the seasonal forecast is zero, i.e., the June-August seasonal forecast is released in beginning of June, which would give very short time to take adaptive measures based on the forecast.

2. **Task:** Evaluate whether the FISH50 seasonal precipitation and temperature forecasts show statistically significant skill for predicting hydrology at seasonal timescales over 28 watersheds in the SEUS. These watersheds were selected from the Model Parameter Estimation Experiment (MOPEX) for their minimal intervention by water management. The FISH50 seasonal climate retrospective forecasts were used to forecast streamflow based on three calibrated rainfall-runoff models. Each of the hydrological models was carefully initialized by forcing them with observed rainfall for several years before the start of the seasonal forecast. The hydrological models were forced with rainfall from FISH50, quantile-based bias corrected FISH50 rainfall (FISH50_BC), and resampled historical rainfall observations based on matching observed analogues of forecasted quartile rainfall anomalies (FISH50_Resamp).

Results: Direct utilization of output from the climate model (FISH50) results in huge biases in predicted streamflow. This issue is significantly reduced with bias correction (FISH50_BC) or by FISH50_Resamp. On a discouraging note we found that the deterministic skill of retrospective streamflow prediction, as measured by the normalized root mean square error, is poor compared to the climatological forecast irrespective of how FISH50 (e.g. FISH50_BC, FISH50_Resamp) is used to force the hydrological models. This is largely because the elasticity of rainfall on streamflow is large for these SEUS watersheds, which therefore produces disproportionate response in streamflow to errors in rainfall. These results reiterate the point that the predictability of rainfall variability in the SEUS in summer and fall seasons is difficult and therefore their application in hydrological studies challenging. However our analysis of probabilistic skill from the same suite of retrospective prediction experiments reveal that over the majority of the 28 watersheds in the SEUS, significantly higher skill than climatological forecast of streamflow can be harvested for at least the dry seasonal anomalies, while for the wet seasonal anomalies they continue to be poor.

3. Although we suggested the option to consider the NMME set of seasonal hindcasts in the initial roadmap, we have not specifically used NMME for this project (we do address this in a separately funded NOAA SARP project). We requested daily data but have not yet received data at that level. Some slides were shown on comparing FISH50 with NMME.

c) Evaluate output of Long term Climate Scenarios

1. Task: Assessment of Historical Trends for Temperature and Precipitation to determine if the recent observations of rainfall and temperature show any significant changes indicative of climate change. (Jayantha Obeysekera)

Results: A comprehensive collection of climate metrics was investigated to study historical trends in both averages and extremes of precipitation and temperature in Florida. The data investigated consisted of long-term records (1892–2008) of precipitation and raw (unadjusted) temperature at 32 stations distributed throughout the state. To evaluate trends in climate metrics, an iterative pre-whitening method was used, which aims to separate positive autocorrelation from trend present in time series. Results showed a general decrease in wet season precipitation, most evident for the month of May and possibly tied to a delayed onset of the wet season. In contrast, there seemed to be an increase in the number of wet days during the dry season, especially during November through January. Results showed that the number of dog days (above 26.7 _C) during the year and during the wet season has increased at many locations. For the post-1950 period, a widespread decrease in the daily temperature range (DTR) is observed mainly because of increased daily minimum temperature (Tmin). Although we did not attempt to formally attribute these trends to natural versus anthropogenic causes, we found that the urban heat island effect is at least partially responsible for the increase in Tmin and its corresponding decrease in DTR at urbanized stations compared with nearby rural stations.

2. Task: Comparison of the Maurer et al (http://www.engr.scu.edu/~emaurer/data.shtml#Gridded_ObsPr), NLDAS2 (http://mirador.gsfc.nasa.gov/) , CPC (ftp://ftp.cdc.noaa.gov/Datasets/cpc_us_precip/), and PRISM (http://prism.oregonstate.edu) gridded historical climate datasets over the state of Florida to determine which is most appropriate for use to evaluate and bias-correct climate models.

Results: The four data sets report different parameters at different spatial resolutions (4km to 24km) and different temporal resolutions (hourly to monthly). When aggregated to a common space and time scale all methods give comparable results with high correlation coefficients and low root mean square errors, particularly at the monthly time scale and outside of the summer months (JJAS). The most comprehensive data set is NLDAS2 which provides precipitation, air pressure, vapor pressure , temperature, wind speed , and solar radiation at an hourly timestep over an1/8 degree (~12km) grid from 1979 to present. PRISM is the longest data set (1890-2011) but only provides precipitation, maximum temperature, minimum temperature and dew point temperature on a monthly basis over a 4km grid. The conclusion of this analysis was that any of these gridded data sets could be used depending on the application of the results, but that NLDAS2 has the advantages that it provides the full suite of parameters required to estimate evapotranspiration, is available at a sub-daily timestep and is kept up to date by a US federal government agency.

3. **Task**: Evaluate the feasibility of using dynamically-downscaled, bias-corrected reanalysis data (i.e. regional reanalysis data) to predict hydrologic behavior in the Tampa Bay Region of West Central Florida.

Results: Four different sets of global reanalysis data (NCEP/NCAR-R1, NCEP-DOE-R2, ERA40, and 20CR) that were previously downscaled using two RCMs (MM5, Hwang et al, 2011; and RSM, Stefanova et al. (2012) and DiNapoli and Misra 2012) were obtained, bias-corrected on a daily basis using the CDF-mapping approach, and used to drive an integrated hydrologic model (INTB) that was previously calibrated and verified for the Tampa Bay region.

All raw dynamically-downscaled reanalysis datasets accurately estimated the annual cycle of daily maximum and minimum temperature, except the NCEP/NCAR R1-MM5 data which consistently underestimated daily maximum temperature. All raw regional reanalysis precipitation data significantly overestimated precipitation, particularly for the dry season. Bias-correction using the CDF-mapping approach effectively removed biases in the temporal mean and standard deviation of both the daily precipitation and temperature predictions. Biases in the mean monthly and mean annual precipitation totals were removed by CDF-mapping on a daily basis, but the standard deviation of the monthly and annual precipitation totals were not accurately reproduced. Furthermore inaccuracies in actual daily precipitation time series aggregated into monthly and annual rainfall total time series that showed significant and temporally persistent errors.

Precipitation timing errors produced by regional reanalysis data were propagated and enhanced by non-linear streamflow generation, groundwater flow and storage processes in the hydrologic model and produced significant errors in both actual and mean daily, monthly and annual streamflow and groundwater level predictions. These results show that improvement in large-scale reanalysis products and regional climate models may be required before dynamically downscaled bias-corrected reanalysis data can be used as a surrogate for observational data in hydrologic model applications for low-relief, rainfall driven systems.

4. **Task**: Evaluate the ability of four statistical downscaling methods (BCSD (Wood et al 2002), SDBC (Abatzoglou and Brown, 2011), BCCA (Maurer et al. 2010) and BCSA (Hwang, 2011)) combined with 4 CMIP3 GCM retrospective predictions (BCCR-BCM 2.0, CCSM, CGCM 3.1, and GFDL-CM 2.0) to generate accurate precipitation and temperature fields over Florida at the time (daily) and space (12km) scales of interest to the working group.

Results: Spatial and temporal statistics, transition probabilities, wet/dry spell lengths, spatial correlation indices, and variograms for wet (June through September) and dry (October through May) seasons were calculated for each method. Results showed that (1) BCCA underestimated mean climatology of daily precipitation while the BCSD, SDBC and BCSA methods accurately reproduced it, (2) the BCSD and BCCA methods underestimated temporal variability because of the interpolation and regression schemes used for downscaling and thus, did not reproduce daily precipitation standard deviations, transition probabilities or wet/dry spell lengths as well as the SDBC and BCSA methods, and (3) the BCSD, BCCA and SDBC methods underestimated spatial variability in precipitation resulting in under-prediction of spatial variance and over-prediction of spatial correlation, whereas the BCSA method accurately reproduces observed spatial statistics for both the wet and dry seasons. These results underscore the need to carefully select a downscaling method that reproduces all precipitation characteristics important for the hydrologic system under consideration if local hydrologic impacts of climate variability and change are going to be accurately predicted. For low-relief, rainfall-dominated watersheds in Florida, where reproducing small-scale spatiotemporal precipitation variability is important, the BCSA method is recommended for use over the BCSD, BCCA, or SDBC methods.

5. **Task:** Evaluate whether statistically-downscaled retrospective GCM predictions are able to accurately reproduce retrospective hydrologic behavior in the Tampa Bay Region of West Central Florida.

   Results: Three statistical downscaling methods: 1) bias-correction and spatial disaggregation at daily time scale (BCSDdaily), 2) a modified version of BCSD which reverses the order of spatial disaggregation and bias-correction (SDBC), and 3) the bias-correction and stochastic analog method (BCSA) to downscale General Circulation Model retrospective daily precipitation outputs to the sub-basin scale for the Tampa Bay Region in Florida. The downscaled datasets were then used in an integrated hydrologic model to examine the streamflow response to each climate input dataset.

   Results showed that the BCSD_daily method consistently underestimated mean streamflow because the highly spatially-correlated low volume precipitation fields produced by this method resulted in an overestimation of evapotranspiration. The SDBC method overestimated the standard deviation of daily streamflow in the wet season and the magnitude and frequency of high streamflow events because of highly spatially-correlated high volume precipitation fields. BCSA showed better performance than the other methods in reproducing spatiotemporal variability of daily precipitation and streamflow characteristics. This study demonstrated that differences in statistical downscaling techniques propagate into significant differences in streamflow predictions, and underscores the need to carefully select a downscaling method that reproduces precipitation characteristics important for the hydrologic system under consideration.

d) Improve access to Sea Level Rise/Change information:

1. **Task:** Improved access to information already available:

   Results: During the past year we created a list of websites and collected recent publications with region relevant information on sea level change. This list of websites and links to publications were shared with other members of the Alliance and posted on the website. The next steps toward achieving this goal include: conducting a review of websites identified and making publications available through the knowledge management system.

2. **Task:** Catalog current projects on sea level change; 3) Develop and implement plan on how best to move from science to policy and action ; 4)Investigate the role of governance structures related to responses to sea level change

   Results: There has not been any work on these goals during the past year, largely because members of the task force were working principally on the National Climate Assessment. We anticipate that the National Climate Assessment and related reports will provide much of the information needed in the region relative to sea level change that will be needed to accomplish these goals.

Objective 3: Identify appropriate entry points for climate data and model predictions in Working Group members' models and decision making processes

Through workshop meetings only one of the group member's existing models (Tampa Bay Water's Integrated Hydrologic Model, IHM) has been identified as appropriate for incorporating the dynamically and statistically downscaled climate data for predictions and decision making. This model has been used to evaluate hydrologic predictions from both dynamically and statistically downscaled reanalysis and retrospective climate data (see results reported under Objective 2c Tasks 1 and 3 above). Over the next year IHM will be used to predict potential future hydrologic implications of climate change using dynamically and statistically downscaled future CMIP3 predictions.

In addition, the 28 watersheds in MOPEX experiment described above include two of interest to the working group: the Lower St Johns River basin and the Peace River basin. Thus the group has also evaluated seasonal GCM-scale climate forecasts for these river basins (see results reported under Objective 2b Task 3 above)

B. Application of your findings to inform decision making

Several partner utilities are using models and climate data in their operational plans, and others are not. Preliminary results of both seasonal and long term scale data and model runs have been shared at workshops and shown that regional actionable information is difficult with no one best answer. Utilities are diverse and face different challenges and abilities to implement specific modeling options. We will need to better understand Utilities decision making processes to target a range of possibilities in their decision making. During future workshops, we will strive to articulate and explore varying decision contexts, and developing cases for discussion addressing smaller utilities.

C. Planned methods to transfer the information and lessons learned from this project

Participants have reported sharing information in their own organizations, as well as making presentations to their contacts. Several new members of the group mention that they are joining the group based on presentations that they have heard in various venues.

In addition, the participants are actively seeking collaborative project opportunities to build on lessons learned and have submitted 2 proposals this reporting period. As the group continues its work, more participants active in local government and planning are becoming interested and involved providing avenues for outreach. The following responses to a recent question provides some evidence of the sharing the benefits of the varying organizations and individuals engagement with the FloridaWCA. - *Have you been able to share the benefits of participating in this group with others at your institution or within your professional/social environment?*

- "Although my first workshop, I see benefits of this group via our participation in Seven50 - SE Florida Prosperity Plan, seven counties /50 years. " http://seven50.org/
- "Yes, too numerous to describe most recent – NOAA article and future video"
- "Have shared presentations and information with staff and others in organization"
- "Yes, contacts for research collaborations and opportunities for workshop/conference presentations"
- "Yes, discussed meetings with colleagues, students and mentors"
- "Yes, shared concepts and lessons other utilities have learned or initiatives they are working on spark ideas"
- "Yes, we discuss the importance of translating knowledge into useable information for less informed audiences." "We are very interested in climate change and the potential impacts. However, based on the current level of predictability of what may happen and when, it is hard for us to make specific plans or to develop specific strategies to deal with climate change. We are continuing to stay engaged with FWCA and monitor the progress of client science."

Website, newsletters, poster and oral presentations have provided opportunities to share project information to date. We will continue to develop these opportunities as well as broaden the outreach through our developing KMS. One idea is to develop a tool that promotes the KMS itself and encourages members to contribute and/or curate submissions. Since we don't have a one size fits all approach, the value of a KMS is that it is a go to repository of best science available for our context that decision makers could consult, or have their technical experts consult.

D. Significant deviations from proposed workplan

None

E. Completed publications, white papers, or reports (with internet links if possible).

1) Websites

- http://floridawca.org
- http://waterinstitute.ufl.edu/WorkingGroups/PWSU-CIWG.html
- http://waterinstitute.ufl.edu/research/projects_detail.asp?TA=Water+and+Climate&Contract=79361

2) Publications

- Asefa, T. and A. Adams, 2013, Reducing Bias-Corrected Precipitation Projection Uncertainties: A Bayesian-Based Indicator-Weighting Approach, Reg. Environ Change, Springer-Verdag Berlin Heidelberg, (doi:10.1007/s10113-013-0431-9)
- Bastola, S., 2013, Hydrologic impacts of future climate change on Southeast US watersheds, Reg. Environ Change, Springer-Verdag Berlin Heidelberg (doi:10.1007/s10113-013-0454-2
- Satish Bastola, V. Misra, and H.Li (2013) Seasonal hydrological forecasts for watersheds over the Southeastern United States for boreal summer and fall seasons (Submitted to Earth Interactions)
- Bolson, J., C. Martinez, N. Breuer, P. Srivastava, P. Knox, 2013, Climate information use among southeast US water managers: beyond barriers and toward opportunities, Reg. Environ Change, Springer-Verdag Berlin Heidelberg, DOI 10.1007/s10113-013-0463-1
- Hwang, S., W. Graham, J. Hernández, C. Martinez, J. Jones, and A. Adams, Quantitative Spatiotemporal evaluation of dynamically downscaled MM5 precipitation predictions over the Tampa Bay region, Florida, Journal of Hydrometeorology, 12, 1447–1464, doi: 10.1175/2011JHM1309.1, 2011.
- Hwang, S., W. Graham, A. Adams, and J. Guerink, Assessment of the utility of dynamically-downscaled regional reanalysis data to predict streamflow in west central Florida using an integrated hydrologic model, Regional Environmental Change, doi: 10.1007/s10113-013-0406-x, 2013.
- Hwang, S., and W. Graham, Development and comparative evaluation of a stochastic analog method to downscale daily GCM precipitation, Hydrol. Earth Syst. Sci. Discuss., 10, 2141–2181, doi:10.5194/hessd-10-2141-2013.
- Hwang, S., W. Graham, J. Guerink, and A. Adams, Hydrologic implications of errors in bias-corrected regional reanalysis data for west-central Florida, Journal of Hydrology, in review, **2013.**
- Hwang, S., and W. Graham, Hydrologic importance of spatiotemporal variability in statistically downscaled daily GCM precipitation predictions, Journal of the American Water Resources Association, in review, 2013.
- Misra, V.; S.M. DiNapoli, S. Bastola, 2013 Dynamic downscaling of the twentieth-century reanalysis over the southeastern United States, Reg. Environ Change, Springer-Verdag Berlin Heidelberg, (doi:10.1007/s10113-012-0372-8

- Obeysekera, J., Validating climate models for computing evapotranspiration in hydrologic studies: how relevant are climate model simulations over Florida?, Reg. Environ Change, Springer-Verdag Berlin Heidelberg, (doi:10.1007/s10113-013-0411-0)

3) Workshop Reports
- Workshop 7 – http://floridawca.org/node/320
- Workshop 8 - http://floridawca.org/node/321

There were two workshops during this reporting period. The related information including agenda, summary report, and presentations are available on the Floridawca.org website. In addition, information on all other workshop and working group documents are available at the Floridawca.org website.

4) Outreach – Presentations, Media, Information
- Climate Prediction Applications Workshop – APRIL, 2013 UTAH (Lisette Staal)
- Seminar, Agricultural Education and Communications Department, UF (Wendy Graham)
- Orlando Sentinel newspaper article
- Featured project in NOAA CPO Fact Sheet
- Article/Video - Tampa Bay Water's innovative use of climate science in utility operations decision-making is highlighted in the feature article of NOAA's ClimateWatch magazine: Florida's Fragile Oasis. http://www.climatewatch.noaa.gov/article/2012/floridas-fragile-oasis
- UF Center Public Issues Education, Blog (Wendy Graham)
- Presentation about project to Rotary Club & USF & Everglades climate meeting"

III. GRAPHICS: PLEASE INCLUDE THE FOLLOWING GRAPHICS AS SEPARATE ATTACHMENTS TO YOUR REPORT

They appear at the end of this document and are attached to the report as separate documents.

□Photo /Slide 1: Introduction to the Florida Water and Climate Alliance

□Photo/ Slide 2: FloridaWCA timeline reflecting workshops and activities to date.

IV. WEBSITE ADDRESS FOR FURTHER INFORMATION
- http://waterinstitute.ufl.edu/WorkingGroups/PWSU-CIWG.html
- http://FloridaWCA.org

V. ADDITIONAL RELEVANT INFORMATION NOT COVERED UNDER THE ABOVE CATEGORIES

NA

VI. REFERENCES

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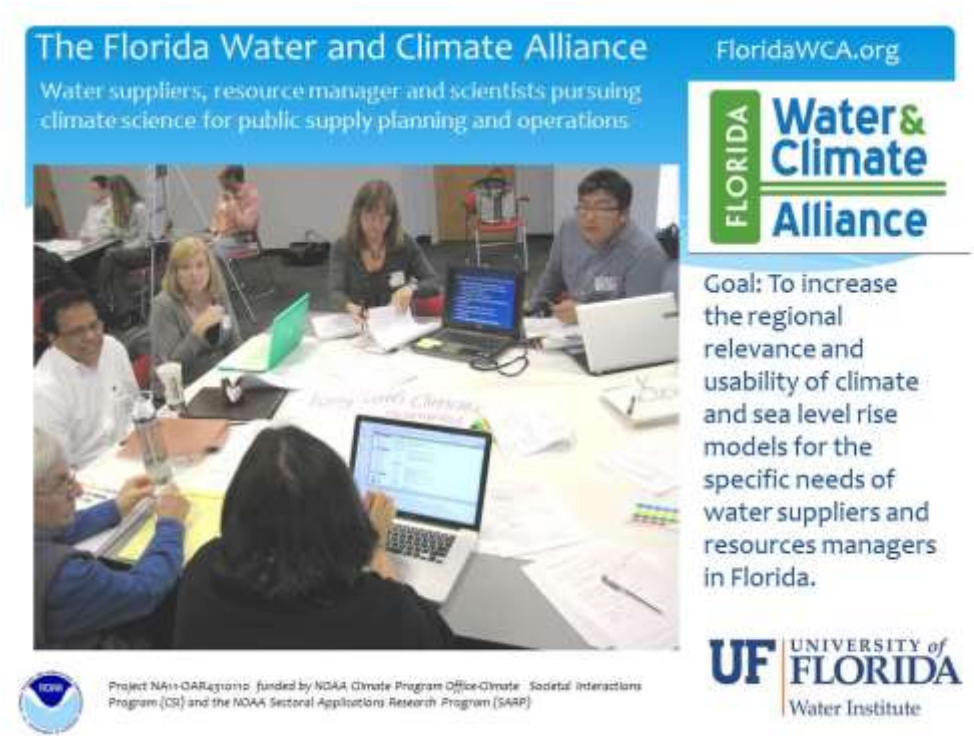
Slide 1: Introduction to the Florida Water and Climate Alliance



Slide 2: FloridaWCA timeline reflecting the 8 workshops and activities to date.