

Status Report

Period Covered: October 1, 2009 through September 30, 2010

Project: South Florida Surface Water Monitoring Network for Support of MAP Projects

Agency: U.S. Geological Survey (USGS)

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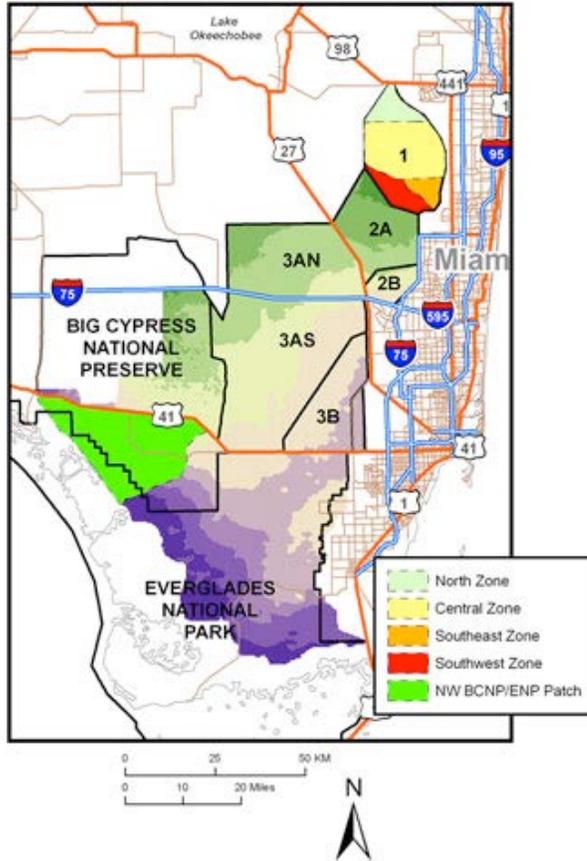
USACE Point of Contact: David Tipple, 904-232-1375, Gretchen Ehlinger, 904-232-1682

Agreement: USGS IA#28 under MOA between USGS and USACE

This annual report for 2010 summarizes the major accomplishments, lists of deliverables, and outlines the work plan for 2011 for the EDEN project. The EDEN's primary deliverable and product continues to be the EDENweb (<http://sofia.usgs.gov/eden>); the project website that provides all data, results, documentation, and other project information for EDEN users.

I. MAJOR ACCOMPLISHMENTS

- Real-time, provisional, and final EDEN surfaces are being produced and posted to EDENweb on schedule. Surfaces currently posted on the EDENweb include:
 - Final for 1/1/2000 through 9/30/09
 - Provisional for 10/1/09 through 6/30/10
 - Real-time for 7/1/10 through current
- Expanded and improved EDEN surface water interpolation model
 - Improved water level datasets with datum corrections and gapfilling techniques
 - Added area south of Big Cypress Natural Preserve
 - Dry protocols for gage data were tested
 - Several canal files revisions were made and tested
 - Tested revisions with water level data from new benchmark network
 - Started development of subarea models for potential improvements of results and for scenario testing using model
 - Model to be finalized and documented in first quarter 2011
- Continued to improve quality and efficiency of data management
 - Improved communication and response time with agencies for addressing problems with water-level data
 - Improved scripts that load, test, and verify data sets in NWIS database
 - GAPFILL program now processed in a SQL server for improved computing capabilities and efficiency of processing
 - Began testing the inferential sensor tool for daily data processing.
- EDEN digital elevation model for ground surface revised and expanded in 2009 was documented with metadata and posted to EDENweb for users



The shaded polygons represent the areas of the EDEN study area for which new digital elevation models have been developed: WCA1 (4 new models), the northwest corner of ENP/southern portion of BCNP.

- Revisions to EDENapps completed, including:
 - Easier and consistent loading of datasets
 - Improved color ramps
 - Standardization of terms and techniques across tools
 - Crashing problems were identified and fixed
- Rainfall and evapotranspiration (ET) data continue to be updated regularly for the EDEN gage network and posted to the EDENweb. Currently, rainfall data available for 2002 to 2010 and ET data available for 1995 to 2009.
- Database and webpage created for benchmark (BM) network installed by USACE at EDEN direction
 - BM network used to test/verify new EDEN surface-water model
 - First network of BMs in Everglades marsh away from water-level gages

Benchmarks Network - Everglades Depth Estimation Network (EDEN) - Opera

<http://sofia.usgs.gov/eden/benchmarks/>

Everglades Depth Estimation Network (EDEN) for Support of Biological and Ecological Assessments

Network of Benchmarks Used to Evaluate and Verify the EDEN Surface-Water Model

An alphabetical listing of benchmarks is available below. Instructions for using the map are below.

A network of benchmarks is being established in the marshes of the greater Everglades and surveyed to North American Vertical Datum of 1988 in 2009-2010 to test, validate, and improve the Everglades Depth Estimation Network (EDEN) surface-water interpolation model that creates daily water-level surfaces for the Everglades. Twenty-four benchmarks were installed and surveyed in 2009 and 7 additional benchmarks are proposed for installation and survey in 2010. When these benchmarks are combined with the 31 benchmarks established by the Florida Department of Environmental Protection in 2006, the network of 62 benchmarks (2nd order or better) provide a geographically broad distribution of points of known elevation and measured water levels independent of the existing water-level gage network.

SFWMD Benchmarks
USACE Benchmarks

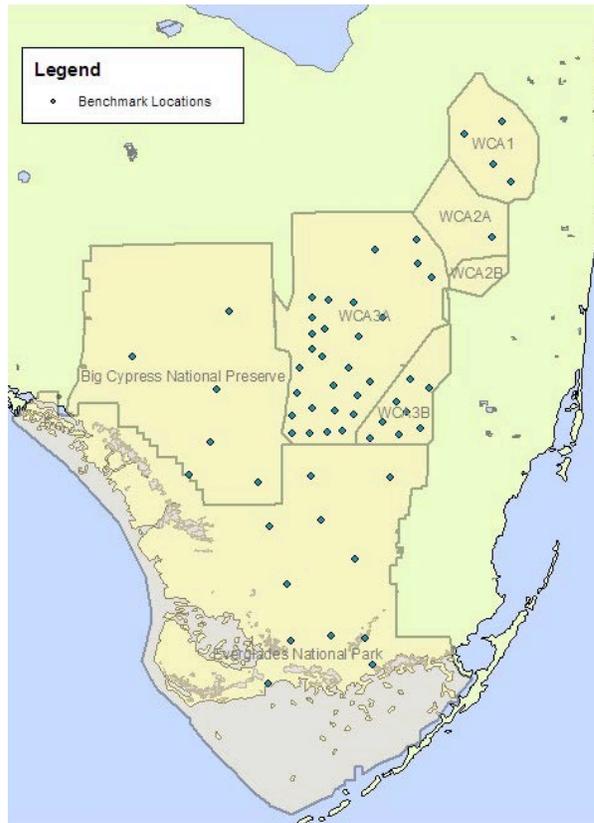
This map requires enabled JavaScript to view; if you cannot fully access the information on this map, please view the [benchmark listing below](#) or contact [Heather Henkel](#).

To use map: place mouse cursor over markers to view benchmark information. Use the + and - buttons in the upper-right corner to zoom in or out. You can double-click on the map to zoom in. Clicking and holding the mouse button, and then dragging, will allow you to pan in any direction.

References to non-US Department of the Interior (DOI) products do not constitute an endorsement by the DOI. By viewing the Google Maps API on this web site the user agrees to these [TERMS](#) of Service set forth by Google.

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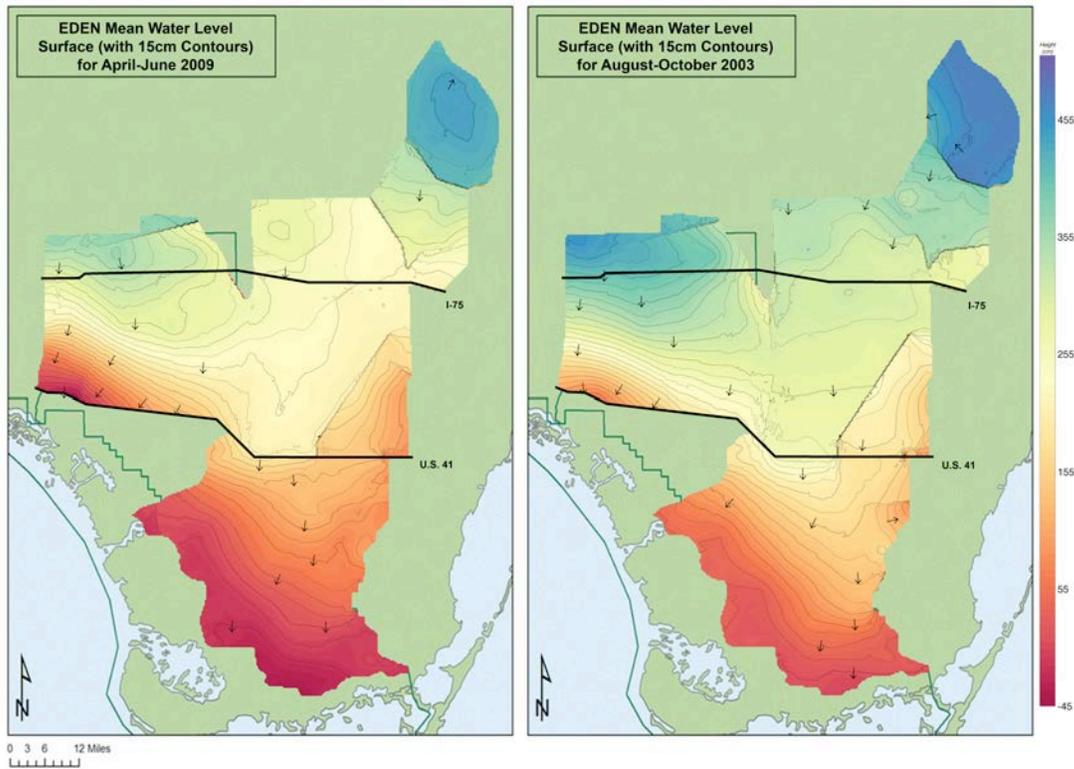


Map showing location of benchmarks

- Compilation of a data library of TIME model input for 10/1/06 through 9/30/09. This data set will allow running of the TIME (now called the BISECT model) for ENP for use in the coastal EDEN analyses planned in 2011.
- Support to numerous RECOVER-funded and other Everglades Investigators (examples below):
 - Joel Trexler, FIU – developed spreadsheet format of selected water depth data for assessment of fish datasets:

FishID	Date Y	X	Region	grid	grid_ID	depth
5M	2009-06-29	2804176.58688271	542675.761333922	Taylor Slough		
63233	60230	5.97843991888667	60231	4.32938957214355		
60232	3.18228912353516	60233	3.72451972961426			
60234	3.89661979675293	60235	4.00788961486816			
60236	-3.89912986755371	60237	-7.62955893383789			
60603	9.15440948856934	60604	8.46632957458496			
60605	6.86033058166504	60606	5.89984016418457			
60607	4.04240836818742	60608	3.50523948669434			
60609	4.21553993225098	60610	2.91596831188965			
60611	2.51948928833008	60612	4.20720180482832			
60613	-4.52374839782715	60614	5.84296989440918			
60977	18.0609493255615	60978	13.8910182844238			
60979	10.9351596832275	60980	9.09770011981855			
60981	6.35131872998047	60982	5.80244064331055			
60983	3.90237998962482	60984	3.06785811291584			
60985	2.91716957892285	60986	2.62456893928988			
60987	1.99783897399902	60988	0.913679122924885			
60989	4.56373977661133	60990	6.94528007587324			
61352	22.6985961836682	61353	17.8655662536621			
61354	17.3698492850171	61355	12.7521895275879			
61356	10.2622989545898	61357	8.00716972351874			
61358	7.33502006530762	61359	6.14581871832715			

- Vic Engel, ENP – Three-month mean water level surfaces for 2009 SSR:



- EDEN Newsletter currently has 120 subscribers and is used to notify users of updates or additions to the EDEN website.

II. SIGNIFICANT MEETINGS/WORKSHOPS/CONFERENCES

- The EDEN team participated in GEER 2010 with 5 posters and 2 oral presentations (All posters are posted on EDENweb):
 - Higer, A., Conrads, P., Henkel, H., Telis, P., and McCloskey, B., Conceptual Components for the Coastal Everglades Depth Estimation Network (Coastal EDEN), GEER2010.
 - Roehl, E., Daamen, R., and Conrads, P., Development of Inferential Sensors for Real-time Quality Control of Water-level Data for the EDEN Network, GEER2010.
 - Conrads, P., Xie, Z., McCloskey, B., Hindcasting Water-Surface Elevations for Water Conservation Area 3A , GEER2010.
 - Petkewich, M., Conrads, P., and Reece, B., Automation of the Estimation of Missing Water-Level Data for the Everglades Depth Estimation Network (EDEN), GEER2010.
 - Telis, P., McCloskey, B., and Xie, Z., Using a Network of Benchmarks to Evaluate and Verify the EDEN Surface-Water Model, GEER2010.
 - Xie, Z., Liu, Z., Pearlstine, L., Sonenshein, R., Conrads, P., Henkel, H., and Telis, P., Revision and Assessment of Water-Surface Modeling of the Everglades Depth Estimation Network (EDEN), GEER2010.
 - Xie, Z., Liu, Z., Jones, J., Higer, A., Telis, P., and Conrads, P., Revisions to the EDEN Ground-Surface Digital Elevation Model and Water Surface Model in the Water Conservation Area 1, GEER2010.
- UNESCO seminars
 - Bryan McCloskey (presenter), The South Florida Information Access (SOFIA) System and Everglades Depth Estimation Network (EDEN), June 8, 2010, Davie, FL
- Community for Data Integration Workshop
 - Conrads, P., Xie, Z., McCloskey, B., Hindcasting Water-Surface Elevations for Water Conservation Area 3A.
 - Henkel, H. and McCloskey, B., Everglades Depth Estimation Network (EDEN): How the Right Mix of Scripts, Programs and Databases Can Create Better Maps, Data, and Tools.
 - Higer, A., Conrads, P., Henkel, H., Telis, P., and McCloskey, B., Conceptual Components for the Coastal Everglades Depth Estimation Network (Coastal EDEN).
- Other conferences
 - 3rd USGS Modeling Conference -- Revision and Assessment of Water-Surface Modeling of the Everglades Depth Estimation Network (EDEN).
 - 2010 South Carolina Water Resources Conference -- New approved paper will be presented in October -- Daamen, R.C., Roehl, E.A., and Conrads, P.C., 2010, Development of Inferential Sensors for Real-time Quality Control of Water-level Data for the Everglades Depth Estimation Network, : *Proceedings of the 2010 South Carolina Water Resources Conference*, held October 13-14, 2010, at the Columbia Metropolitan Convention Center.

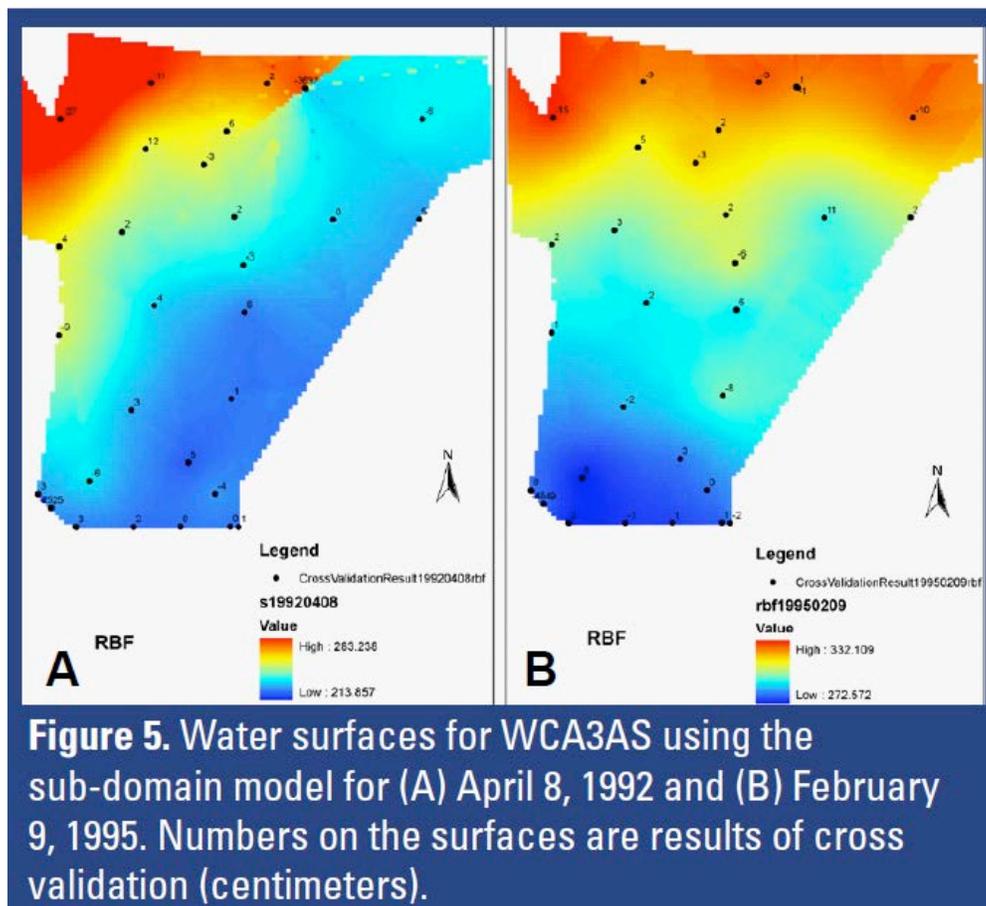
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III. ADMINISTRATIVE (Contractual and Budgetary)

- The previous agreement, USGS IA#12 under MOA between USGS and USACE, ended 3/31/10. A final report delivered on 3/18/10 documented all deliverables for that agreement.
- A new agreement, USGS IA# 28 under the MOA between USGS and USACE, started 4/1/10 for the period 4/1/10 through 3/31/15.
- University of Florida (UF, Aaron Higer) and Florida Atlantic University (FAU, Zhixiao Xie, Zhongwei Liu) were funded by the EDEN project through a CESU agreement in FY10 for:
 - Revision/documentation of the EDEN surface water interpolation program
 - Compilation of TIME datasets for the period 2007-2009.

IV. SUPPORT FROM OTHER PROGRAMS AND FUNDING SOURCES

- The RECOVER Evaluation Team funded (\$125,000 in FY2010) the compilation of data for creation of hindcasted water level data and generation of EDEN surfaces prior to 2000 back to 1990 for the EDEN domain. Effort to be completed 3/31/11. Figure below shows preliminary results for WCA3A-South.



- Greater Everglades PES funds continue to support the EDEN project by funding efforts by Paul Conrads (USGS-SC), John Jones (USGS-Reston), Heather Henkel (USGS-St. Pete), and Bryan McCloskey (USGS-St. Pete). Additionally, PES provides some funds for Pamela Telis (USGS-Jacksonville) in her role as project coordinator and liaison with the USACE.
- ARRA (economic stimulus) funding (June 2009 through Sept 2010) supported an effort by Advanced Data Mining (ADM), LLC to address data quality issues by developing an intelligent software application to automate the validation and correction of data, in the case of EDEN, prior to creation of the daily water level surfaces. Additionally, the ARRA funding partially supported the CESU agreement with Florida Atlantic University to improve the surface water interpolation program based on the improved datasets based on ADM's effort. The final report for this effort is due 9/30/10.
- USACE funding paid to install and survey a network of benchmarks throughout the Everglades, collect water level data at this network (during wet season 2009, dry season 2010, and wet season 2010), install continuous water level recorders at benchmarks in Everglades National Park, survey elevations to NAVD88 datum at 8 water level gages in Everglades National Park, and collect ground elevation data at 12 water level gages. The EDEN project used these data to improve the quality of the EDEN daily water level surfaces.

V. FY10 DELIVERABLES/REPORTS

- EDENweb has been updated throughout the year to provide data, metadata, and documentation to MAP PIs and others.
- Report (partially funded by USGS PES funds):
 - Xie, Z., Liu, Z., Jones, J., Higer, A., and Telis, P., Landscape Unit Based Digital Elevation Model Development in the Freshwater Wetlands of Southeastern Florida, submitted to the Journal of Applied Geology, September 2010.
- For the 2009 System Status Report, EDEN provided hydroperiod maps and mean monthly water depth data to assist with hydrologic assessments of component areas of the Everglades and for understanding the total system hydrology. Then in July 2010, the SSR review team asked that EDEN prepare additional maps that show contours of the water surface elevation and flow directions through the EDEN domain during wet and dry conditions. See example above.

VI. FY11 WORKPLAN

- Data management and daily water surface creation
 - Create and post daily water surfaces on schedule
 - Implement automated data assurance and estimation program
 - Use new datum surveys at gages to revise water level data
 - Add new gages if appropriate
 - Implement rules for handling 'dry' data at gages and in EDEN surfaces

- Complete revision of surface-water model
- Use water level data at benchmarks to evaluate/improve EDEN surfaces
- Post benchmark data to the EDENweb
- Fully test, document and use the newly revised surface model for EDEN surfacing
 - Develop confidence layers for surfaces
 - Pilot additional surfaces, such as slope, rainfall, ET
- Continue to enhance the EDENweb to provide users with data and information that is user-friendly and easily accessible
- Complete effort to hindcast water-level data and create of water surfaces prior to 2000
- Implement webpage for EDEN oligohaline zone (coastal EDEN)
- Update rainfall and evapotranspiration data on schedule
- Participate in NCER2011
- Consider collaboration with National Wetlands Research Center for revisions to EDENapps
- Conduct hydrologic assessments for RECOVER
- Continue to document EDEN protocols, research, and data analyses

VII. ANTICIPATED NEEDS OR ISSUES

- The needs/issues reported in the 2009 Annual Report are still relevant and of concern to the EDEN project team. See bullets below.
- Because the water level data at gages is the foundation of the EDEN surface water interpolation program, the quality of gage data is critical to the resultant EDEN daily water surfaces. Gage data used for EDEN surfaces comes from multiple agencies with varying protocols, schedules, and levels of review. It is a highly ambitious goal to receive hourly data from 230 gages daily (approximately 5520 data values). Even if only 1% (rarely this low) of these data appear bad or are missing, 55 values per day or 5000 values per quarter must be identified and resolved. Monitoring, reviewing, editing (when necessary) and estimating missing and bad data has taken more personnel time than expected. Users see the results as EDEN products when, in fact, they are the result of many others' work outside of EDEN. It has been a serious challenge for me as the project chief to balance sufficient data quality with adequate results and appropriate use of funds.
- EDEN staff continues to be concerned that datum surveys and water level data is not as accurate as necessary to produce a high-quality interpolated water-level surface. Independent data sets at gages may look adequate but when surfaced together can show discontinuities and shifts not seen when viewing water level data gage by gage. Continued investigation of data and files suggests that gage data may still have datum inaccuracies. New funding in 2011 may be available to run new datum surveys to the newest standards for many gages in the Everglades. Any significant changes to the water level dataset might require another round of reparameterizing of the surface water model.

VIII. FUNDING STATUS

- As of 9/30/10, \$327,548 of the \$392,548 FY10 funding under the new agreement has been expended or obligated. The remaining \$60K for the hindcasting effort will be expended by 3/31/11 as per the agreement.
- ARRA (economic stimulus) funding (\$200,000) was received 6/29/09 and is fully expended as of 9/30/10.
- USGS Priority Ecosystem Science (PES) funding in FY2010 was approximately \$400,000 to multiple principal investigators in support for EDEN research efforts. This level of support is expected to be continued in FY2011.