

## **Status Report**

**Period Covered:** October 1, 2010 through September 30, 2011

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

**Agency:** U.S. Geological Survey (USGS)

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

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This annual report for 2011 summarizes the major accomplishments, lists deliverables and reports, and outlines the work plan for 2012 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 9/30/2010 (using V2 surface-water model)
  - Provisional for 10/1/2010 through 6/30/2011 (using V2 surface-water model)
  - Real-time for 7/1/2011 through current
- Additionally, all surfaces 1/1/2000 through 6/30/11 have been recreated using our **new expanded and improved EDEN surface water interpolation model (V2 model)**
  - Real-time surfaces using V2 model to go online during the first quarter of FY2012.
- Completed development of the **EDEN surface-water model (V2)**. Revisions include:
  - Model platform changes – Python and the ESRI ArcGIS9.3.1 Geoprocessing package replaces Winbatch and ESRI ArcGIS ArcMap 9.1 and creates a more efficient model that is easier to run and update.
  - Expansion of the EDEN domain – The model domain is expanded to include the remainder of Big Cypress National Preserve and Everglades National Park along the southwest coast of Florida.
  - Development of subarea models for selected basins – Subarea models developed for WCA1, WCA2B, WCA3B and Pennsuco Wetlands better represent the hydrology of these basins. These surfaces are then merged to the full domain model for the final daily water surface.

- Changes to canal files - The canal files in the V2 full domain model are used the same way as in the V1 model. In the V2 model, several canal files were updated, added, or deleted to better represent the hydraulic conditions near canals.
- Updated water-level gage data – Water-level gage data for the V2 model is updated by adding, deleting and revising gage data based on new information about the gage network.
- Model validation -- The model was assessed with benchmark data, surface contour and expert comments which confirmed its improved performance.
- See figure 1.

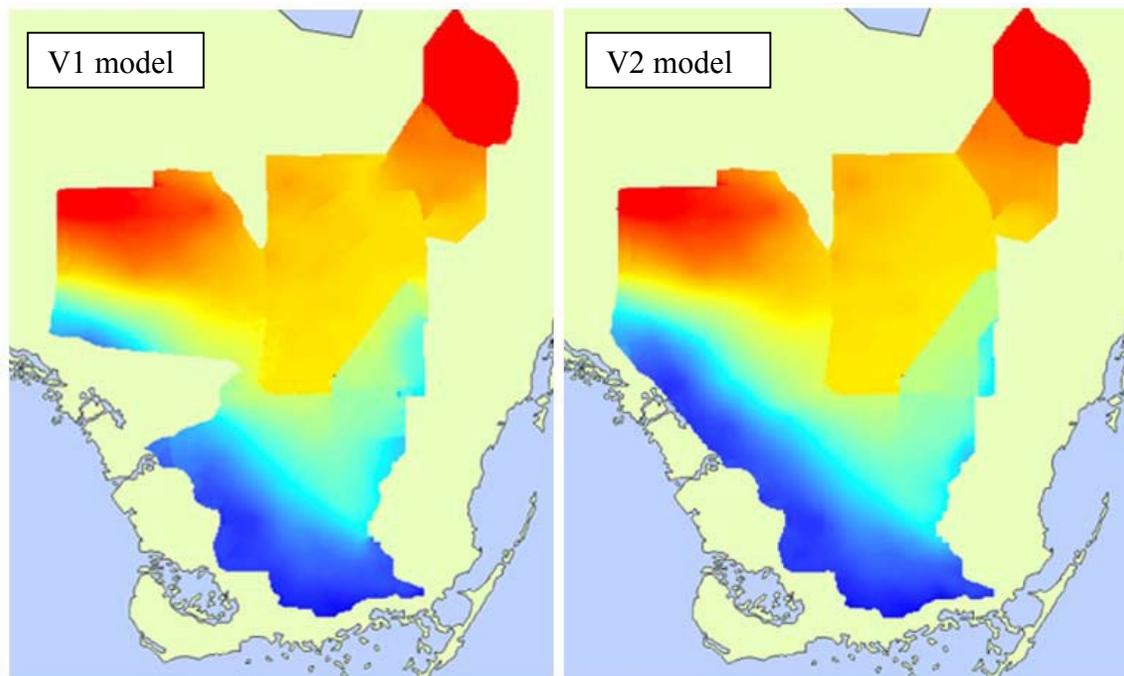


Figure 1. Example of daily water-level surfaces created by V1 EDEN surface-water model and V2 EDEN surface-water model (note change in model domain)

- The **ADAM (Automated Data Assurance and Management)** software developed in FY2011 is making data review and processing much more efficient.
  - ADAM is being used for quarterly and annual data processing to find and fill data gaps and problem data.
  - ADAM was used to review the historic 10-year data set (2000-2009) and to find and fill data gaps and problem data.
  - ADAM will be used for real-time data processing.
  - See figure 2.

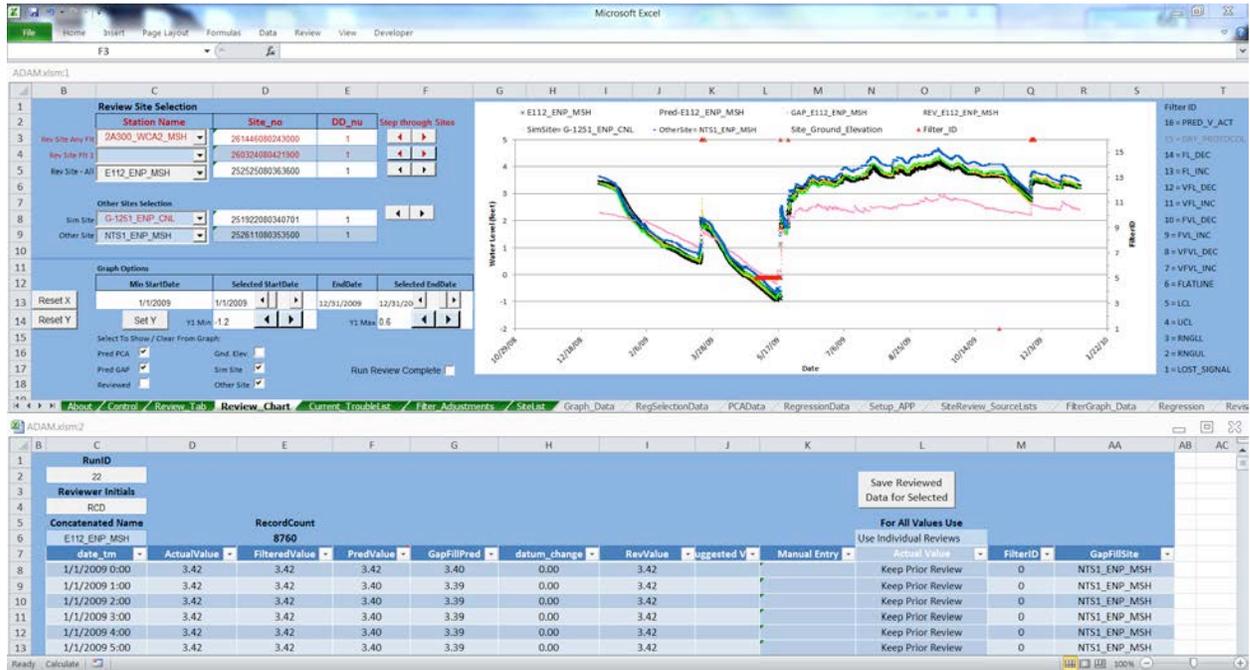


Figure 2. Example of ADAM software screen for a single gage that is reviewed, gap filled, and stored.

- Developed independent **EDEN database** that will supplement the USGS NWIS database for expanded EDEN capabilities. This database was necessitated by ADAM software datasets and confidence index computations and allows storage of ADAM estimated data.
  - New GAPFILL equations were derived based on new period-of-record data.
- Developed a **confidence index (CI) maps** for the EDEN model water-level surfaces to account for differences in reliability of the model based on distance from gages, canals, and model boundaries, and known cross validation errors of the model.
  - Final testing of the CI and website modifications will be completed in November 2011 when daily CI surfaces will be posted for all daily water-level surfaces.
  - See figure 3.



Figure 3. Example of a daily confidence index map for a given day; green shows areas of high confidence, yellow shows areas of medium confidence, red shows areas of low confidence, and grey shows areas that are dry.

- Provided **support to several RECOVER principal investigators** and agencies representatives for EDEN data.
  - For example, met with Snail Kite researchers to discuss their need for water-level data that synthesizes extreme-case conditions for use in their models. In FY2012, we hope to develop datasets that can be used by these and other researchers.
  - The member list for the EDEN newsletter is 124 and includes participants from federal government agencies (such as DOI, ENP, USGS, FWS, EPA), State agencies (such as SFWMD, FDEP), many local and other universities and several international affiliations.

## II. SUPPORT FROM OTHER PROGRAMS AND FUNDING SOURCES

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), Bryan McCloskey (USGS-St. Pete), and Matt Petkewich (USGS-SC). Additionally, PES provides some funds for Pamela Telis (USGS-Jacksonville) in her role as project coordinator and liaison with the USACE.

- RECOVER funds and USGS Greater Everglades PES funds -- **Hindcasting** the EDEN stations in the freshwater portion of the Everglades for the period 1990 - 1999 was completed in FY 2011.
  - Various approaches for hindcasting the stations data have been applied including linear regression and artificial neural network models.
  - Estimates of period of missing record prior to 2000 have been adjusted by applying “shifts” to the estimates. The application of shifts is analogous to the procedure for computing continuous stage and water-quality records.
  - The example below (fig. 4) shows the benefit of applying the shift. The model for estimating Site 76 using site SRS1 has an  $R^2$  of 0.84 indicating that the model captures 84 percent of the variability in the water levels of Site 76. The statistic indicates a satisfactory model and is an indication of the model’s ability to capture the overall trend of the data. The trend is not an absolute prediction of the value at a particular time. In the example below, the difference at the beginning and end of the 8-day estimation of missing data is 0.48 and 0.49 ft, respectively. The 8-day estimate is adjusted by these difference is generate a more accurate absolute prediction of the missing record.
  - The generation of the 252 hindcasted EDEN records back to 1990, including the filling and shifting of the missing record of stations established in 1990 or before, has been more time consuming than anticipated.
  - These datasets will be used to create daily water-level surfaces using the V2 EDEN surface-water model for the period 1990-1999.
  - See fig. 5 for an example of hindcasted data for a gage based on data from a nearby gage.

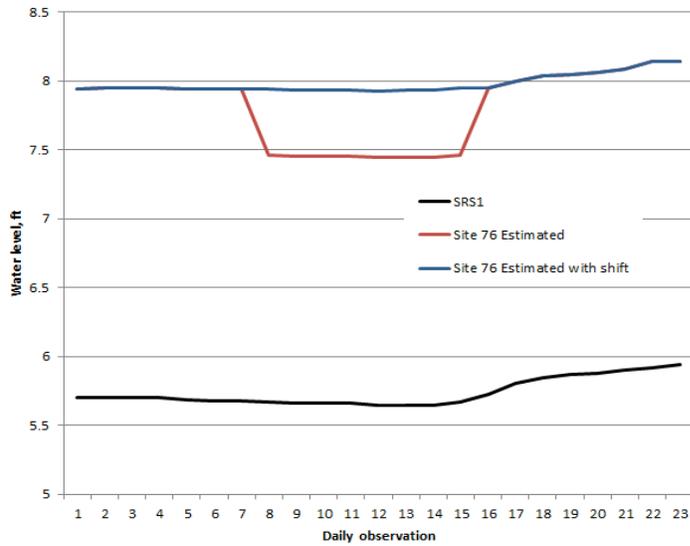


Figure 4. Example of the application of a “shift” to adjust and estimate water level to a more accurate prediction of the actual water level.

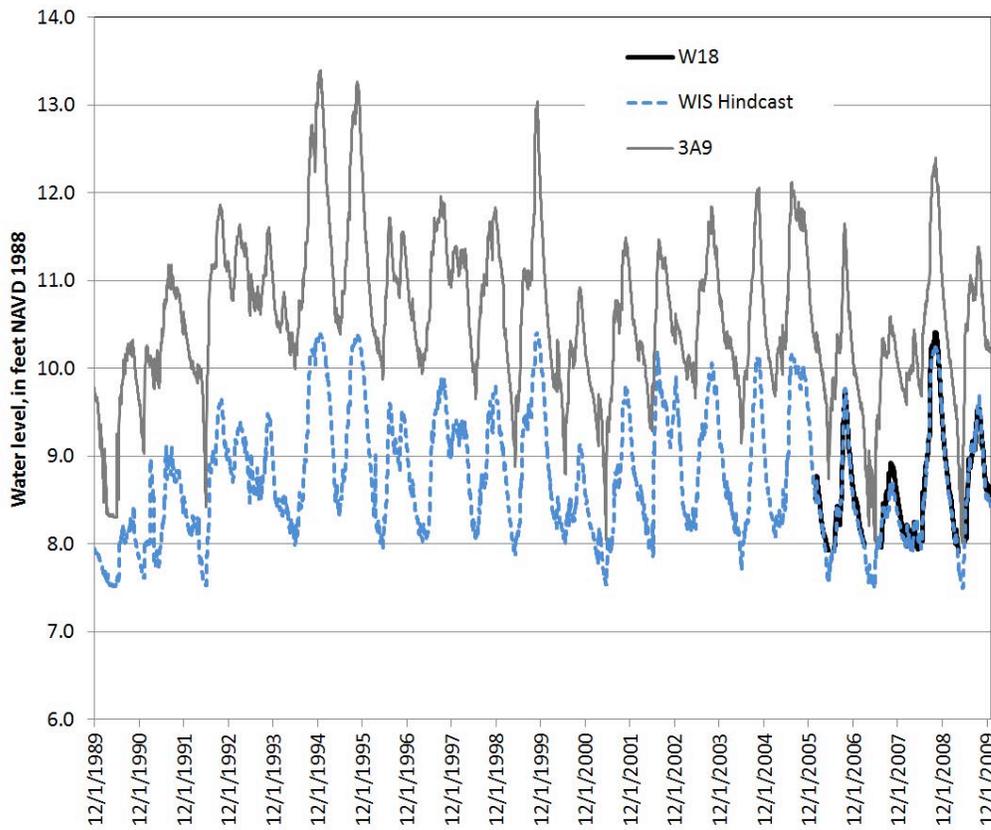


Figure 5. Example of hindcasted data is shown for site W18 in Water Conservation Area 3A South. The measured data for site W18 starts in January 2006. An empirical model was developed to estimate the daily water level back to January 1990. Site 3A9, a site near W18 with measured data dating back before 1990, is shown for comparison.

- Greater Everglades PES funds -- The **EDENapps tools** continue to offer EDEN users capabilities such as data viewing, data retrieval, and data access and manipulation. Expansion of the EDEN datasets and increased digital requirements require that the EDENapps tools be upgraded to 64-bit processing. To take advantage of the work funded by other PES funds, the National Wetlands Research Center (NWRC) in Lafayette, LA is working with EDEN to improve capabilities of the existing tools and provide access to the new datasets, such as the confidence index maps.
- Greater Everglades PES funds -- **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 August 2011 and ET data available for 1995 to 2010.
- Greater Everglades PES funds – Initiated development of a prototype Web application for the display of current conditions and the change in conditions for coastal water-level data described as **Coastal EDEN**.

### III. SIGNIFICANT MEETINGS/WORKSHOPS/CONFERENCES

- National Conference on Ecosystem Restoration (Baltimore, MD)
  - POSTER - **The South Florida Information Access (SOFIA) System and Everglades Depth Estimation Network (EDEN): Providing Support for Everglades Restoration**; Heather Henkel
- USGS National Surface Water Conference (Tampa, FL)

The EDEN Team conducted an EDEN session to highlight the work by EDEN and relevance for other large gage network efforts:

- PRESENTATION – **Everglades Depth Estimation Network (EDEN): Providing Hydrologic Data for the Restoration of the Everglades**; Pamela Telis
- PRESENTATION – **Everglades Depth Estimation Network (EDEN) Data Management Cycle: From Data Input to Analysis of Confidence Index Maps**; Heather Henkel and Bryan McCloskey
- PRESENTATION - **Hindcasting Water-Surface Elevations for Water Conservation Area 3A South**; Paul Conrads, Zhixiao Xie, and Bryan McCloskey
- PRESENTATION - **Water-Level Record Extension of the Everglades Depth Estimation Network**; Paul A. Conrads, Bryan J. McCloskey, and Andrew M. O'Reilly
- PRESENTATION - **Using Inferential Sensors for Quality Control of Water-level Data for the Everglades Depth Estimation Network**

- (EDEN);** Matthew D. Petkewich, Paul A. Conrads, and Ruby C. Daamen (Advanced Data Mining International)
- **POSTER - Automation of the Estimation of Missing Water-Level Data for the Everglades Depth Estimation Network (EDEN);** Matthew D. Petkewich, Paul A. Conrads, and Brian D. Reece
  - **POSTER- The Everglades Depth Estimation Network (EDEN) for Support of Biological and Ecological Assessment;** Pamela A. Telis
  - **POSTER – Rainfall and Potential Evapotranspiration Data for Everglades Depth Estimation Network (EDEN);** Bryan McCloskey
  - **POSTER – Hindcasting Water-Surface Elevation for Water Conservation Area 3A South;** Paul Conrads
  - **POSTER – Conceptual Components for the Coastal Everglades Depth Estimation Network (Coastal EDEN);** Heather Henkel
  - UNESCO seminars
    - **The South Florida Information Access (SOFIA) System and Everglades Depth Estimation Network (EDEN);** Heather Henkel
  - 2011 South Carolina Water Resources Conference (Columbia, SC)
    - **POSTER -- Automation of the Estimation of Missing Water-Level Data for the Everglades Depth Estimation Network (EDEN);** Matthew D. Petkewich, Paul A. Conrads, and Brian D. Reece
    - **PRESENTATION - Development of Inferential Sensors for Real-Time Quality Control of Water-Level Data for the Everglades Depth Estimation Network;** Ruby Daamen (Advanced Data Mining International)
  - 2011 USGS Eastern Region (Chider) Data Conference (Pittsburgh, PA)
    - **Using Inferential Sensors for Quality Control of Water-level Data for the Everglades Depth Estimation Network (EDEN);** Paul Conrads, Matt Petkewich, and Ruby Daamen

#### **IV. ADMINISTRATIVE (Contractual and Budgetary)**

- The EDEN project was fully funded in FY11 under the USGS IA# 28 under the MOA between USGS and USACE.
- Florida Atlantic University (FAU, Zhixiao Xie, Zhongwei Liu) was funded by the EDEN project through a CESU agreement in FY11 for:
  - Revision/documentation of the EDEN surface water interpolation program.

## V. FY11 DELIVERABLES/REPORTS

- EDENweb has been updated throughout the year to provide data, metadata, and documentation to MAP PIs and others.
- Quarterly Reports have been submitted on time to the RECOVER MAP coordinators.

## VI. FY12 WORKPLAN

This plan includes work elements funded from both RECOVER MAP and USGS GEPES:

- Data management and daily water-surface creation
  - Create and post daily water surfaces on schedule
  - Use ADAM for data gap filling and EDEN database for data storage
  - Use V2 surface-water model for creation of all surfaces
  - Create and post daily confidence index maps for surfaces
  - Use confidence index maps to test impacts of less dense network of gages
- Complete creation of hindcasted water-level surfaces for the period 1990 – 1999
- Continue to work with agencies that are monitoring water levels and develop a plan for creating EDEN daily surfaces with fewer surface-water gages as funding cuts reduce the network.
- Implement webpage for EDEN oligohaline zone (Coastal EDEN)
- Document all the new work via USGS series reports and journal articles
- Participate in GEER2012 and present recent EDEN improvements and results
- Collaborate with National Wetlands Research Center for revisions to several of the EDENapps tools
- Provide hydrologic analyses and results for 2012 System Status Report to Congress.

## VII. ANTICIPATED NEEDS AND ISSUES

- The significant impact of funding cuts for South Florida monitoring will be the reduction in the gage network by all operating agencies. As the water-level gage network becomes less dense, the confidence of the modeled water surface is reduced. In some areas, a less dense network will have less impact than in areas where the hydrology is more complex. Pamela Telis will work with the operating agencies over the next few months to attempt to coordinate loss of gages to reduce the impacts on the EDEN surfaces.

## VIII. FUNDING STATUS

- As of 9/30/11, all of the FY11 funding under USGS IA #28 has been expended or obligated. Invoices will be electronically submitted to the USACE within the next few months.
- USGS Priority Ecosystem Science (PES) funding in FY2011 was approximately \$400,000 to multiple principal investigators in support for EDEN research efforts. This level of support is expected to be continued in FY2012 with a potential 10% cut.