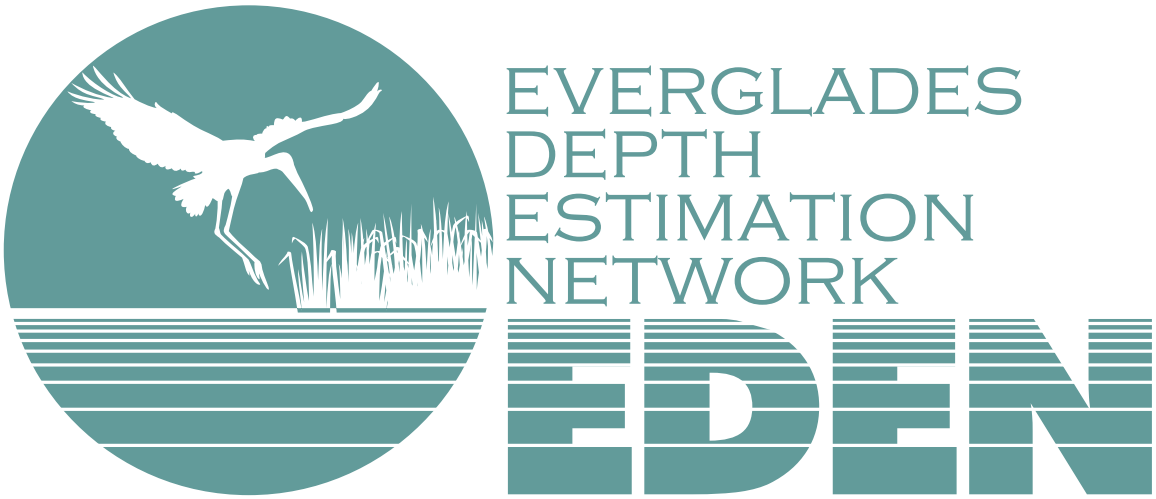
Summary of

FY06 Annual Status Report

For Everglades Depth Estimation Network (EDEN): South Florida Surface Water Monitoring Network for Support of MAP Projects (MAP Activity Number 3.5.4.1)



Produced November 21, 2006

This summary version of the FY06 Annual Progress Report for EDEN is posted to the EDEN website (http://sofia.usgs.gov/eden). For a CD of the complete progress report, contact Pamela Telis, patelis@usgs.gov .

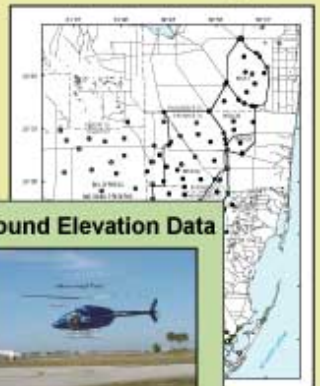
Submitted to: Elmar Kurzbach, Project Manager
USACE, Jacksonville District

Submitted by: Pamela Telis, Project Leader
USGS, Jacksonville, FL

November 2, 2006

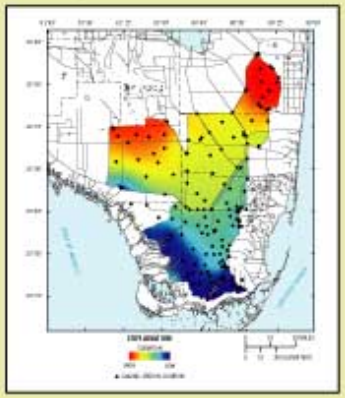
Everglades Depth Estimation Network (EDEN) Project Overview

EDEN Interagency Network of Water-Level Gages

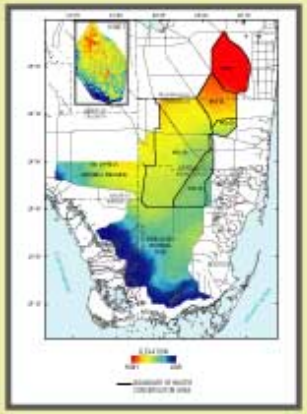


Ground Elevation Data

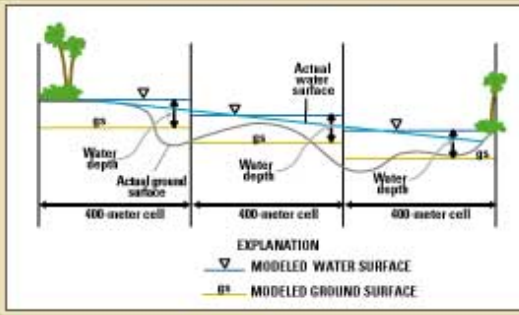
Daily Water Surface Model



Ground Elevation Model

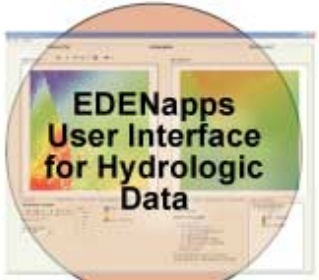


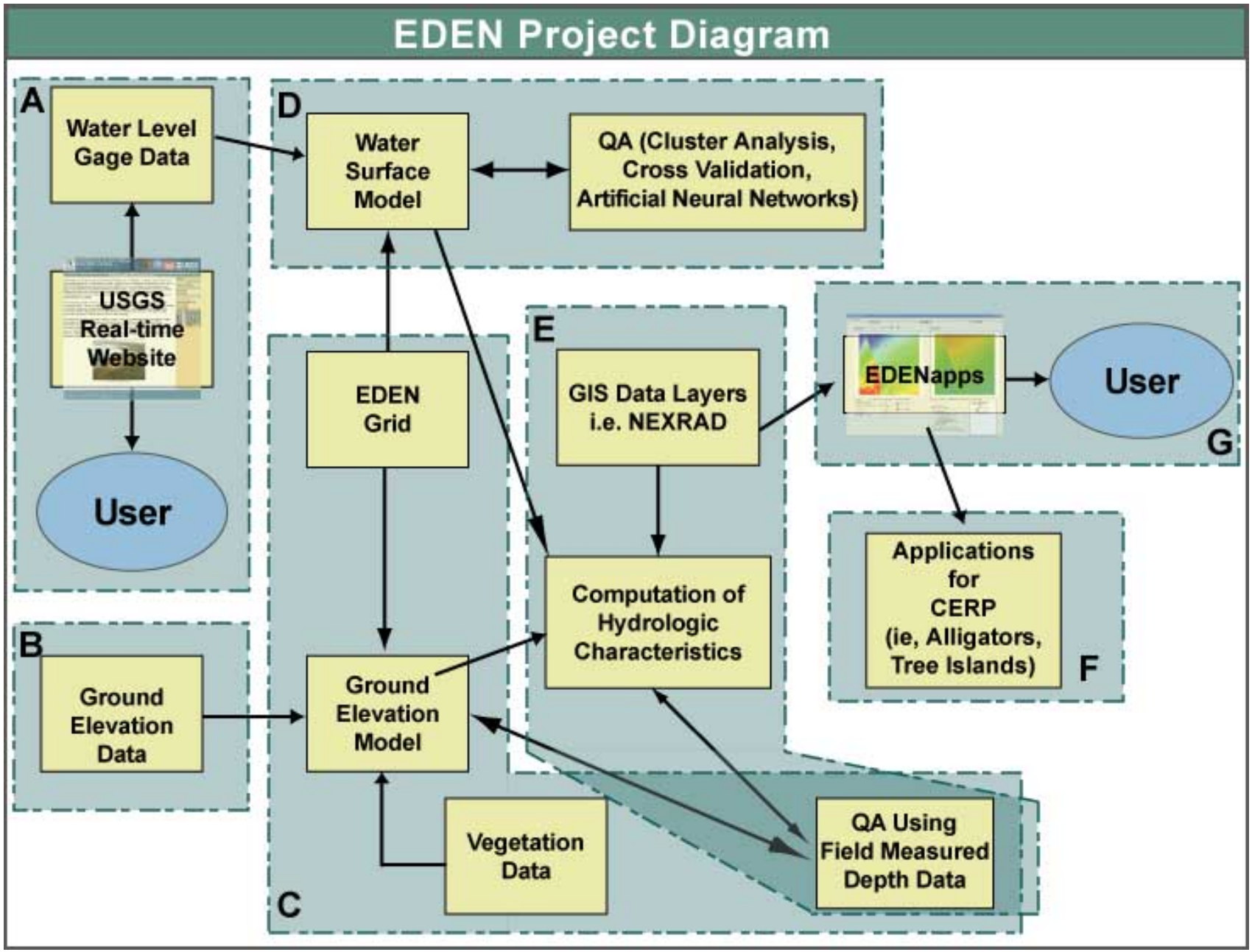
Computation of Water Depth



Website of Real-Time Water-Level Data

EDENapps User Interface for Hydrologic Data




EDEN Project Diagram
A
Water Level Gage Data
USGS Real-time Website
User
D
Water Surface Model
QA (Cluster Analysis, Cross Validation, Artificial Neural Networks)
E
EDEN Grid
GIS Data Layers i.e. NEXRAD
EDENapps
User
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Applications for CERP (ie, Alligators, Tree Islands)
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Ground Elevation Data
Computation of Hydrologic Characteristics
Ground Elevation Model
Vegetation Data
QA Using Field Measured Depth Data
C

Introduction

The Everglades Depth Estimation Network (EDEN) is an integrated network of real-time water-level monitoring, ground-elevation modeling, and water-surface modeling that provides scientists and managers with current (1999-present), on-line water-depth information for the entire freshwater portion of the greater Everglades. Presented on a 400-square-meter grid spacing, EDEN offers a consistent and documented dataset that can be used by scientists and managers, to: (1) guide large-scale field operations, (2) integrate hydrologic and ecological responses, and (3) support biological and ecological assessments that measure ecosystem responses to the implementation of the Comprehensive Everglades Restoration Plan (CERP) (U.S. Army Corps of Engineers, 1999). The target users are biologists and ecologists examining trophic level responses to hydrodynamic changes in the Everglades.

The RECOVER Monitoring and Assessment Plan (MAP) project entitled "South Florida Surface Water Hydrologic Network for Support of MAP Projects" and now referred to simply as EDEN was initiated on March 28, 2005 to support hypotheses in the MAP section 3.5, South Florida Hydrology Monitoring Network Module and MAP Section 3.1, Greater Everglades Wetlands Module.

Purpose and Organization of Annual Report

The purpose of the annual progress report is to document work and products completed in FY06. Many of the products completed in FY06 were a culmination of work effort from the project start in FY2004.

Each section of the report begins with a section summary page **(presented in the summary version without the complete section text and figures)** which provides an overview of what was completed by project component. Potential future direction is documented in a brief discussion under Future Work Considerations. Since this is a summary of the FY06 Annual Progress Report, only a list of the contents of each section is provided.

Because EDEN has many component pieces, two flow diagrams show the relationships, data flow, and feedback among the project components (see diagrams attached). These diagrams at various levels of complexity offer the reader a less detailed or more detailed understanding of these interconnections. On the EDEN project diagram, the report sections are identified by a letter A through G, which corresponds to sections of the report.

EDEN Website

The information from EDEN is readily available to scientists, engineers and water-resource managers through a website that integrates the real-time monitoring data and model results. The purpose of the website (EDENweb) is to integrate EDEN monitoring

and modeling data and provide “one-stop shopping” for data with consistent data format and documentation. EDENweb can be accessed at http://sofia.usgs.gov/eden .

EDEN water level data is accessed through an interactive map showing the location of gaging stations in the network, and provides “clickable” access to gage data on a near real-time basis (generally with 24 hours). EDENweb also provides station information, such as station descriptions, measured ground elevation, and vegetation in the vicinity of the gaging station.

In addition, ground elevation data used to create the ground surface digital elevation model (DEM) are available at the South Florida Information Access (SOFIA) website (http://sofia.usgs.gov) and linked from the EDENwebsite.

The daily water surface maps, water depth maps and other derived data map layers will be posted to the EDENweb in early FY07. Because EDENapps requires user-specific coordination, initially it will be made available only to the Greater Everglades Module investigators. If the beta-testing on multiple computers by multiple users is successful and funding is available to support distribution and support of the application, EDENapps may be made downloadable from the website or via CD to serve a larger community of users.

EDEN Publications

Conrads, P.A. and Roehl, E.A., 2006. Estimating water depths using artificial neural networks. Hydroinformatics 2006, edited by Philippe Gourbesville, Jean Cunge, Vincent Guinot, Shie-Yui Liong, Vol. 3, p. 1643-1650.

Fujisaki, I. and L.G. Pearlstine, (In Review). Validation of water depth surface models using an equivalence test. *Environmental Modeling and Assessment*.

Fujisaki, I., L.G. Pearlstine, and K.G. Rice, (In Final Preparation). Validity and use of hydrologic models in wildlife research. *Wetlands*.

Jones, John W. and Susan D. Price, 2006 (In Press). Conceptual design of the Everglades Depth Estimation Network (EDEN) grid. U.S. Geological Survey Open File Report.

Jones, John W. and Susan D. Price, 2006 (In Press). Initial Everglades Depth Estimation Network (EDEN) digital elevation model research and development. U.S. Geological Survey Open File Report.

Palaseanu. M. and L.G. Pearlstine, (In Review). Estimation of water surface elevations for the Everglades, Florida. *Computers and Geosciences*.

Telis, P. A., 2006. The Everglades Depth Estimation Network (EDEN) for support of ecological and biological assessments. U.S. Geological Survey Fact-Sheet 2006-3087, 4 p.

Project Team

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Funding

Funding for EDEN has been provided by the USACE under the RECOVER MAP and by the USGS Greater Everglades Priority Ecosystems Science.

SUMMARY OF SECTION A

REAL-TIME AND HISTORIC WATER LEVEL DATA AND FIELD-MEASURED WATER DEPTH DATA

Technical Lead: Roy Sonenshein, USGS (sunshine@usgs.gov)

Brief description of completed EDEN task(s):

- Integrated real-time data from 179 existing gaging stations operated by four agencies.
- Compiled values for over 200 water level gaging stations to convert data from NGVD 29 to NAVD 88.
- Constructed and operated 23 water level gages to fill gaps in the existing network throughout the greater Everglades.
- Compiled historical hourly water level data from the period October 1, 1999 to September 30, 2005 for over 200 gaging stations.
- Compiled about 60,000 field-measurements of water depth and vegetation data by 13 scientists covering the period 1996 to 2004.
- Documented data management of EDEN water level data; acquisition, storage, and access.

Future work considerations:

- Include coastal (tidal) gages in EDEN network.
- Manage EDENweb and NWIS data base to maintain real-time water level data access.

Listing of contents in full report:

SUMMARY OF SECTION B

GROUND ELEVATION DATA

Technical Lead: Greg Desmond, USGS (gdesmond@usgs.gov)

Brief description of completed EDEN task(s):

- Used all existing high accuracy elevation data (HAED) to develop the EDEN ground surface DEM.

Future work considerations:

- Acquire newly sampled HAED data for improved DEM development.

Listing of contents in full report:

SUMMARY OF SECTION C

GROUND ELEVATION MODEL

Technical Lead: Dr. John Jones, USGS (jwjones@ usgs.gov)

Brief description of completed EDEN task(s):

- Developed the EDEN grid, 400m by 400m cells for EDEN area, and populated the grid database for cell location, ground elevation, and land cover.
- Evaluated numerous surfacing techniques and spatial segmentation approaches for each Water Conservation Area, Everglades National Park and Big Cypress National Preserve. Techniques used for evaluation of each area's model included random data withholding ("jack-knifing") and cross-validation.
- Applied the geostatistical approach called "kriging", to create an individual DEM for each Water Conservation Area, Everglades National Park, and Big Cypress National Preserve using currently available high accuracy elevation data (HAED). Combined the individual models to create a single ground elevation DEM, referred to as EDEN_DEMv2.

Future work considerations:

- Relationships between topography and land cover types might be used to synthesize higher-resolution elevation models. Experiment with HAED segmentation and remote sensing data to develop pseudo-topography. A primary challenge will be the proper segmentation of land cover and HAED to derive meaningful local-area land cover-elevation relationships.

Listing of contents in full report:

SECTION D

WATER SURFACE MODEL

Technical Lead: Dr. Leonard Pearlstine, UF (pearlstn@ufl.edu)

Brief description of completed EDEN task(s):

- Spatially continuous interpolation of water surface across the EDEN area was generated for daily median values from January 2000 to May 2006.
- The continuous water surface was predicted on the EDEN grid at 400m by 400m spacing.
- Radial basis function (RBF) multiquadric interpolation performed superior to other interpolation methods and negotiated better border conditions such as canals and levees than other methods. RBF multiquadric was used for the final water surface development.
- Several methods were used to test and validate the water surface model; cross validation, use of artificial neural networks, and cluster analysis.

Future work considerations:

- Document use of TIME model for water surface/water depth data in coastal areas.
- Refine surfacing with evaluations of localized effects from rainfall, canal and levee influences, improved understanding of conditions and limitations of gage operation of each of the individual gages, and improved datum corrections.
- Provide analyses to aid optimal siting of new gages as opportunities arise.
- Refine automation routines for water surface layer development and use to analyze large datasets for improved estimates of confidence in EDEN results and for reparameterizing the water surface model.
- Create daily water surface data layers for new water level data.
- Continue validation of model using cluster analysis and hind-casting techniques.
- Compute an additional daily map layer, water surface confidence.

Listing of contents in full report:

SUMMARY OF SECTION E

COMPUTATION OF HYDROLOGIC CHARACTERISTICS

Technical Lead: Dr. Leonard Pearlstine, UF (pearlstn@ufl.edu)

Brief description of completed EDEN task(s):

- Water depth map layers were computed from the difference between the water surface elevation and the ground surface elevation and stored daily for the EDEN area from January 2000 to May 2006.
- Other derived data, or map layers, including rate of water depth change, mean water depth, water depth deviation and water surface slope are computed on-demand for specific areas and time periods as requested by users via EDENapps.
- Water depth results were validated from comparison of the modeled water depths to field-measured water depth measurements.
- NEXRAD rainfall data has been obtained from SFWMD and arrangements are pending for regular transfer of these data for EDEN use.

Future work considerations:

- Compute an additional map layer, days since last dry down, daily for the period January 2000 to May 2006.
- Create daily water depth map layers and other derived data for new data.
- Investigate use of NEXRAD data to improve water surface model results.
- Integrate with field-measured water depth data collection methodologies to improve sampling for calibration of DEM and validation of water depth maps.

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SUMMARY OF SECTION F

EDEN APPLICATIONS

Technical Lead: Dr. Leonard Pearlstine, UF (pearlstn@ufl.edu)

Brief description of completed EDEN task(s):

- Three programs (DailyMedianServer, EDENServer, and EDENapps) were developed to automate the process of creating and accessing the EDEN surfaces and map layers.
    - DailyMedianServer collects raw station gage data and formats it for use by EDENServer.
    - EDENServer interpolates a continuous water level surface and water depth from the data and stores the results.
    - EDENapps is the means by which the user communicates with an external server to obtain water surface maps, water depth maps, and days since last dry down maps, confidence maps, and metadata and it is the medium by which users will view and analyze this data.
- Data management for EDEN results is documented.
- EDENapps User's Manual is developed and beta testing is complete.

Future work considerations:

- Provide user support and training for EDENapps
- Coordinate with CERPZone staff to integrate some or all of EDEN results to CERPZone or an alternative interactive web-based application.
- Integrate GIS data, i.e. water quality data and NEXRAD, into EDENapps

Listing of contents in full report:

SUMMARY OF SECTION G

APPLICATIONS FOR CERP

Technical Lead: Leonard Pearlstine, UF (pearlstn@ufl.edu)

Brief description of completed EDEN task(s):

- Two applications of EDEN data for CERP-related activities have been tested:
  - The relationship between alligator body condition and water depth was explored by Drs. Ken Rice (USGS) and Ikuko Fujasaki (UF).
  - Tree island flooding relationships to adjacent sloughs were explored by Mary Ann Furedi (FAU), Dr. John Volin (FAU), Carlos Coronado-Molina (SFWMD) and Dr. Fred Sklar (SFWMD).
- The complete set of EDEN historic water level and water depth data has been delivered to four investigators:
  - Work by Dale Gawlik (FAU) for wading bird studies.
  - Work by Peter Fredrick (UF) for wood stork investigations.
  - Work by John Volin (FAU) for tree island and physiological ecology of exotic plant species investigations.
  - Work by Ken Rice (USGS) for alligator and amphibian habitat relations.

Future work considerations:

- Support RECOVER scientists with hydrologic data and analysis for development of System Status Reports.
- Integrate EDEN with ongoing ecological modeling through the JEM lab at UF and CERP IMC activities.

Listing of contents in full report: