

Revisions to the Everglades Depth Estimation Network (EDEN) Surface-water Model

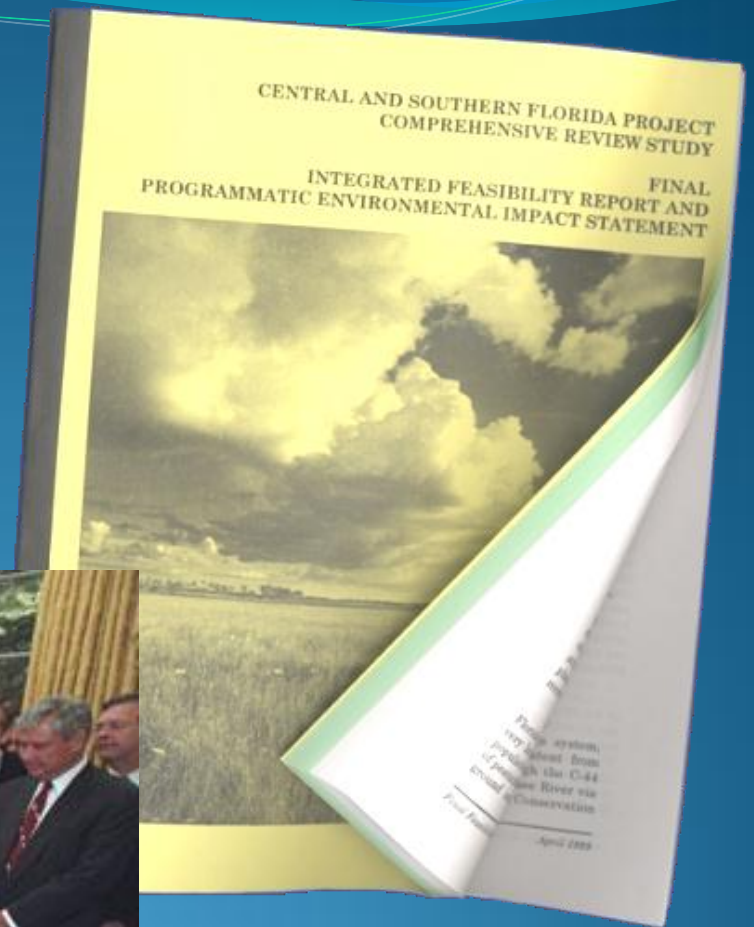
INTECOL/GEER 2012 Conference

Pamela A. Telis (USGS) and Zhixiao Xie (FAU)

June 2012



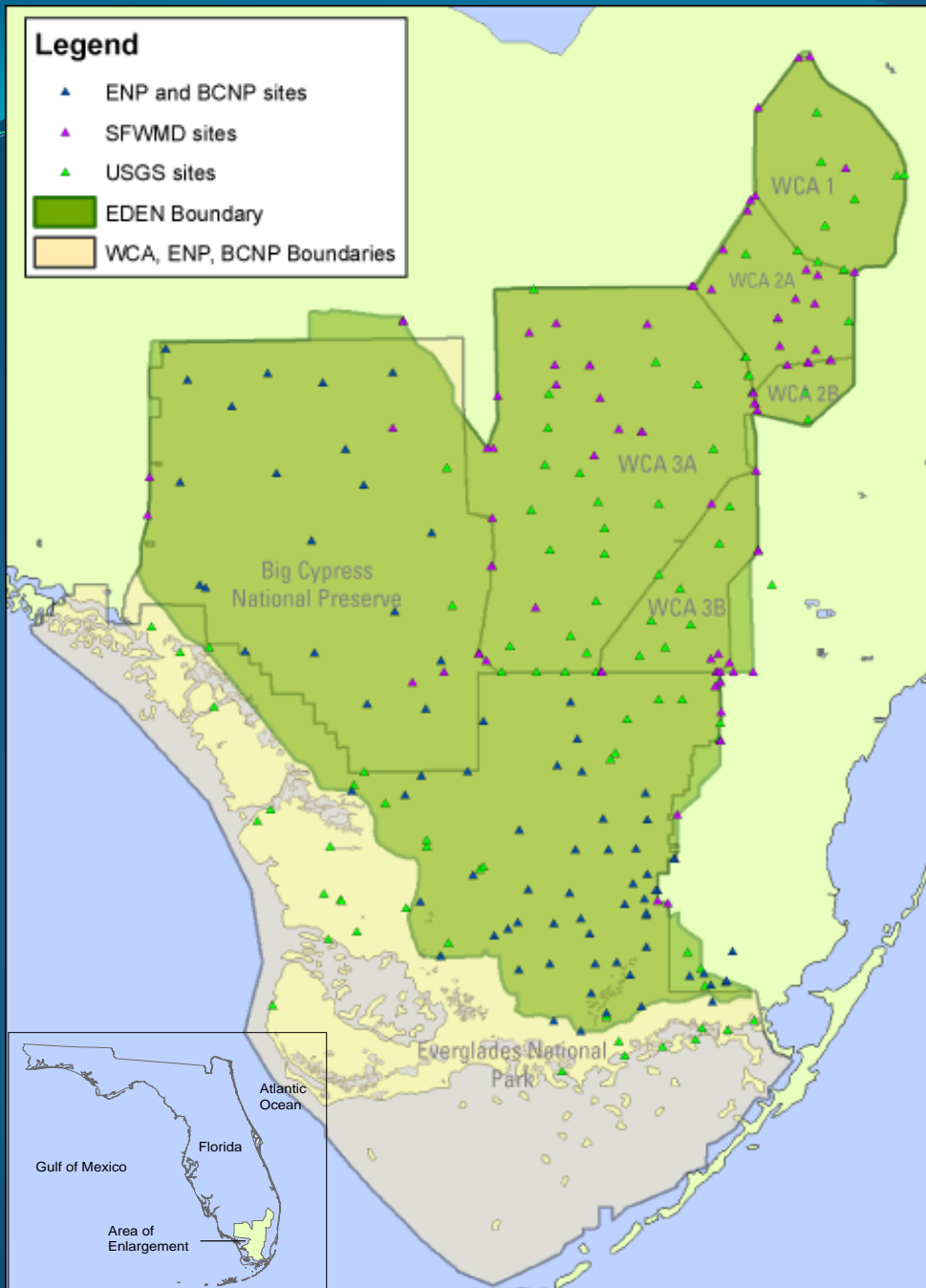
CERP signed into law December 2000



EDEN Objectives

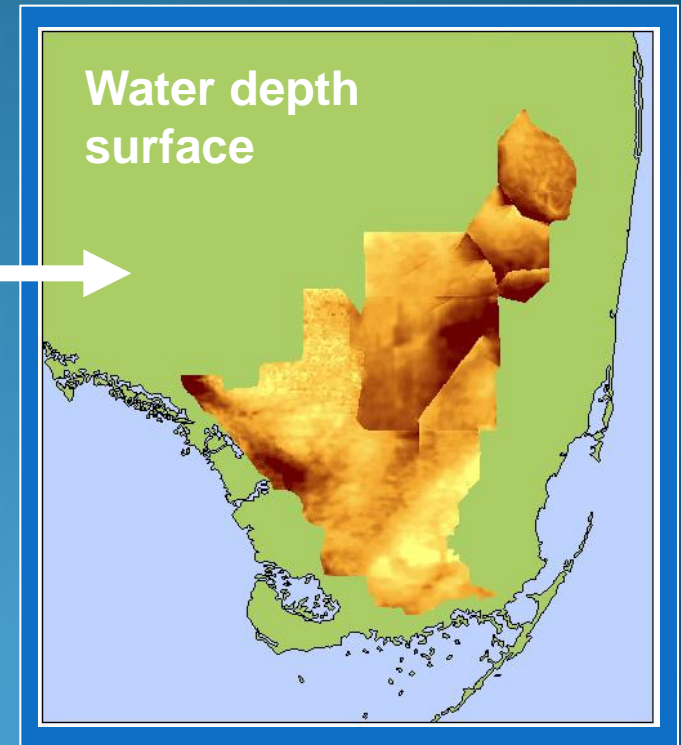
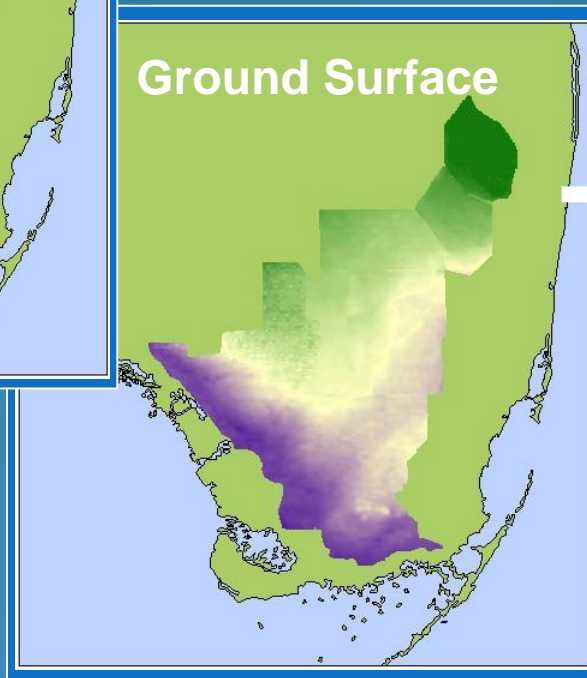
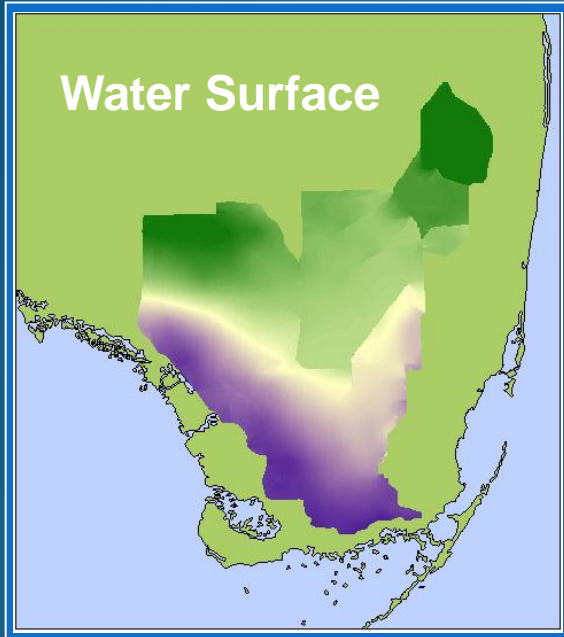
- Data to examine trophic- and landscape-level responses to the hydrodynamic changes in the Everglades
- Daily water surfaces from 1991-current for 400m by 400m grid
- Hydrometeorologic data
 - Water depth
 - Water-surface slope
 - Hydroperiod
 - Rainfall and evapotranspiration
- Ground elevation model, 400m by 400m grid

EDEN network of water-level gages



EDEN's daily surfaces

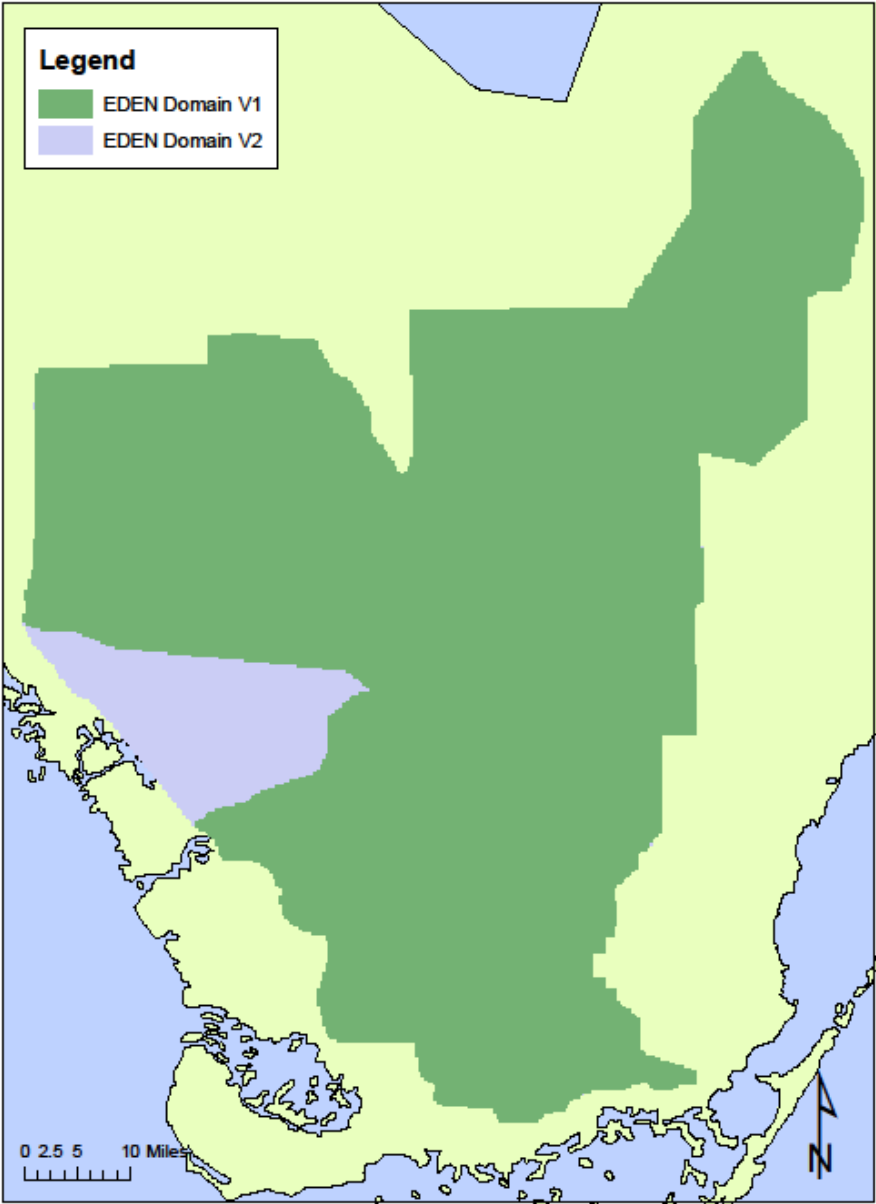
Water Surface – Ground Surface =
Water Depth



Time to revise the V1 SW model?

- Feed back from users
- Updated technology
- More knowledge of the system and gage network
- Longer PORs for gages → revise hindcasted datasets for gages
- Network of benchmarks gave independent water-level data

Model domain expanded

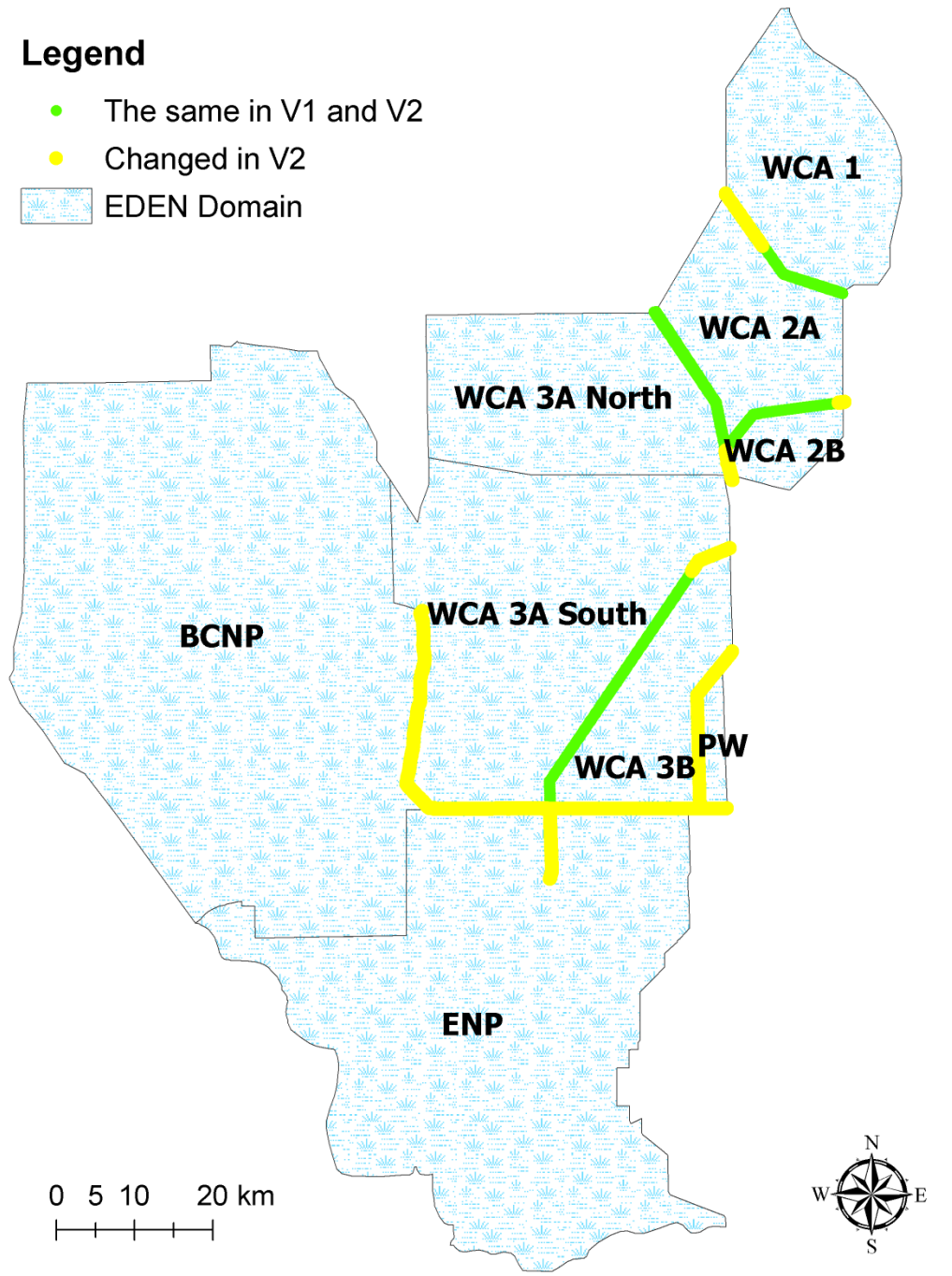


Legend

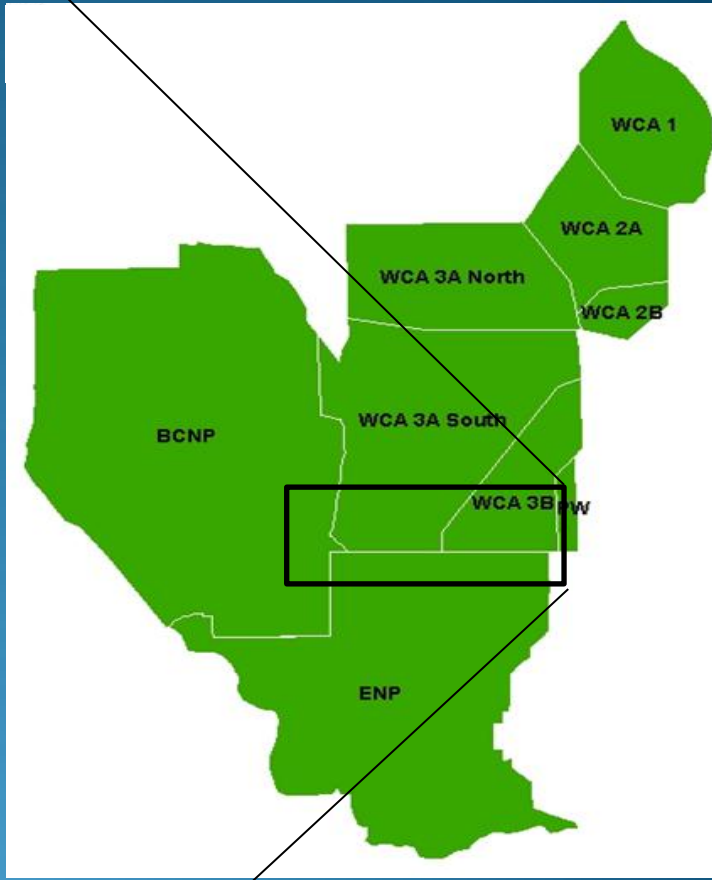
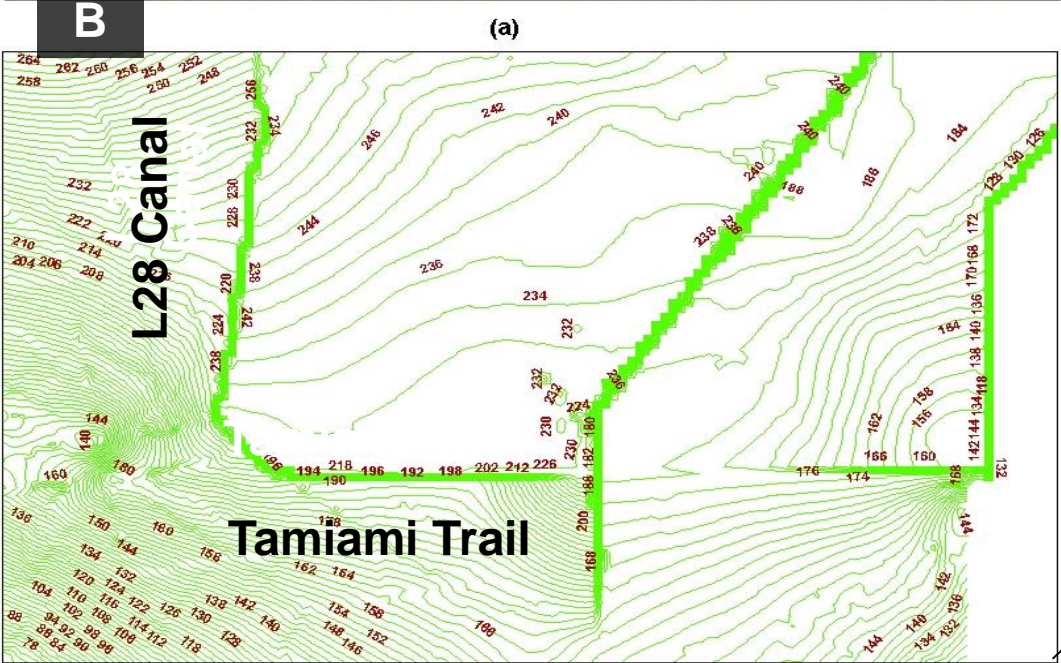
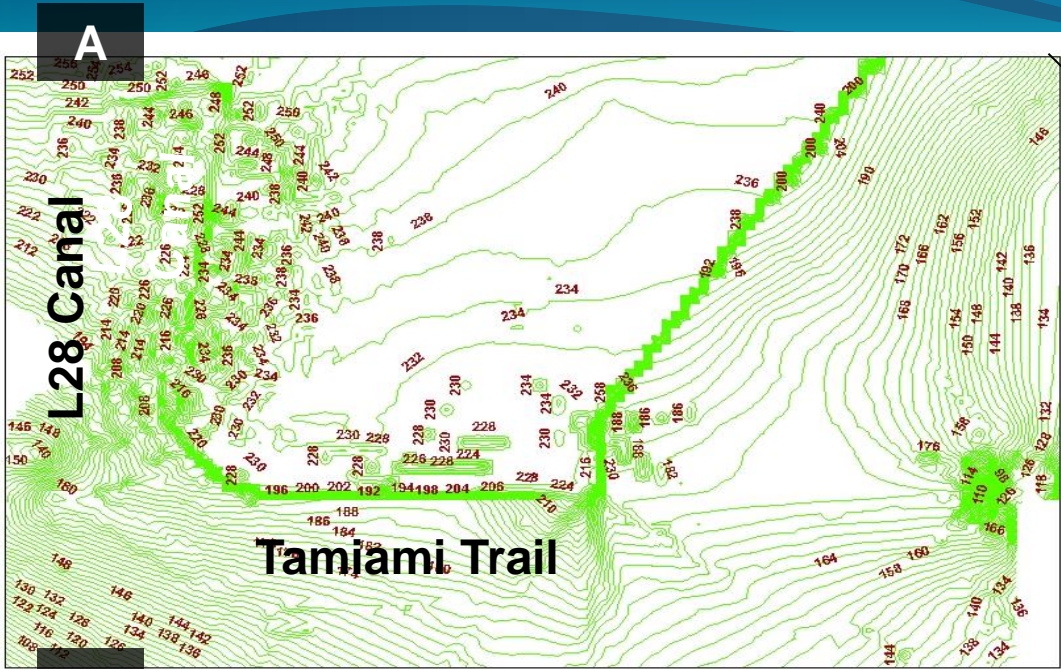
● The same in V1 and V2

● Changed in V2

EDEN Domain



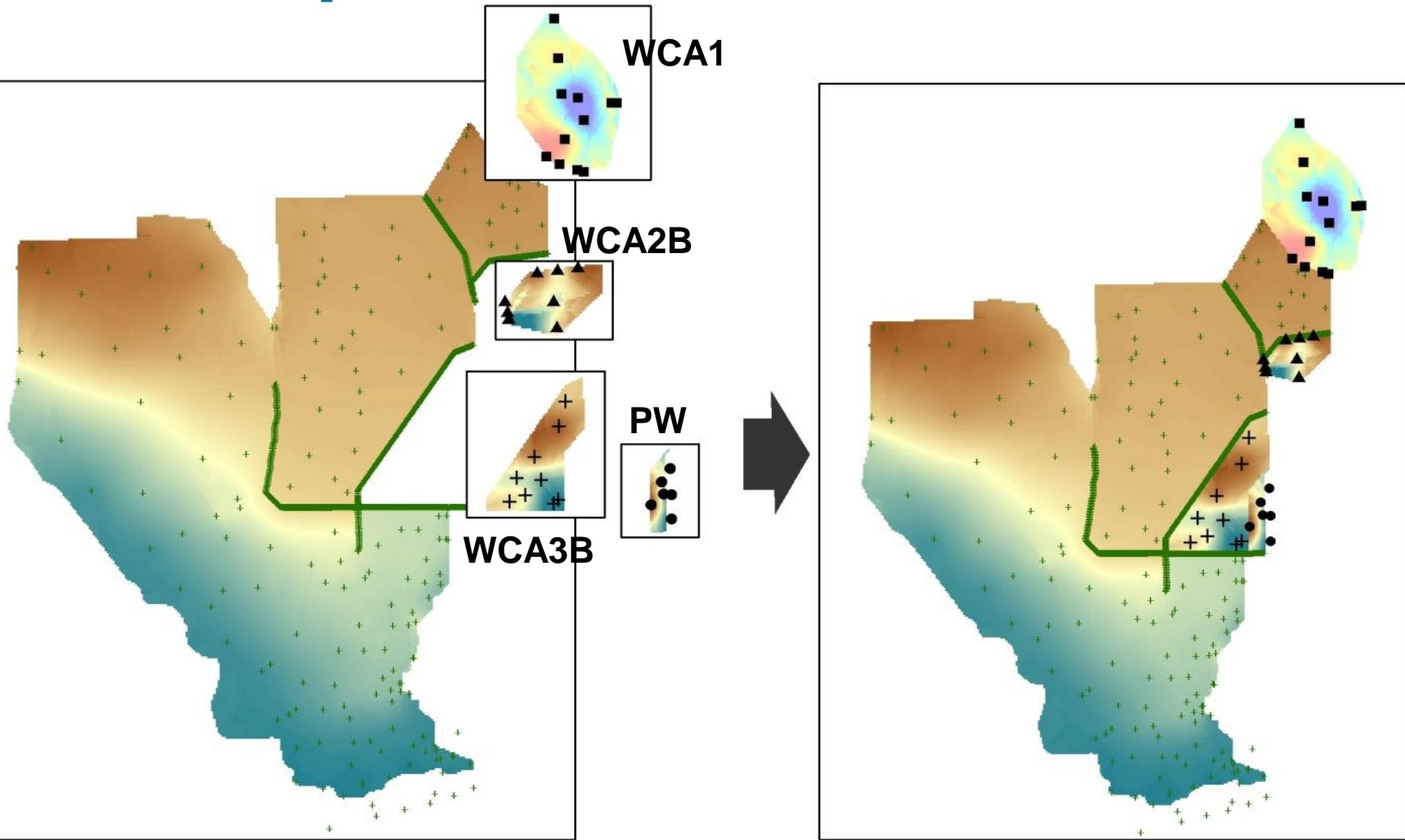
Canal files revised



A = V1 model

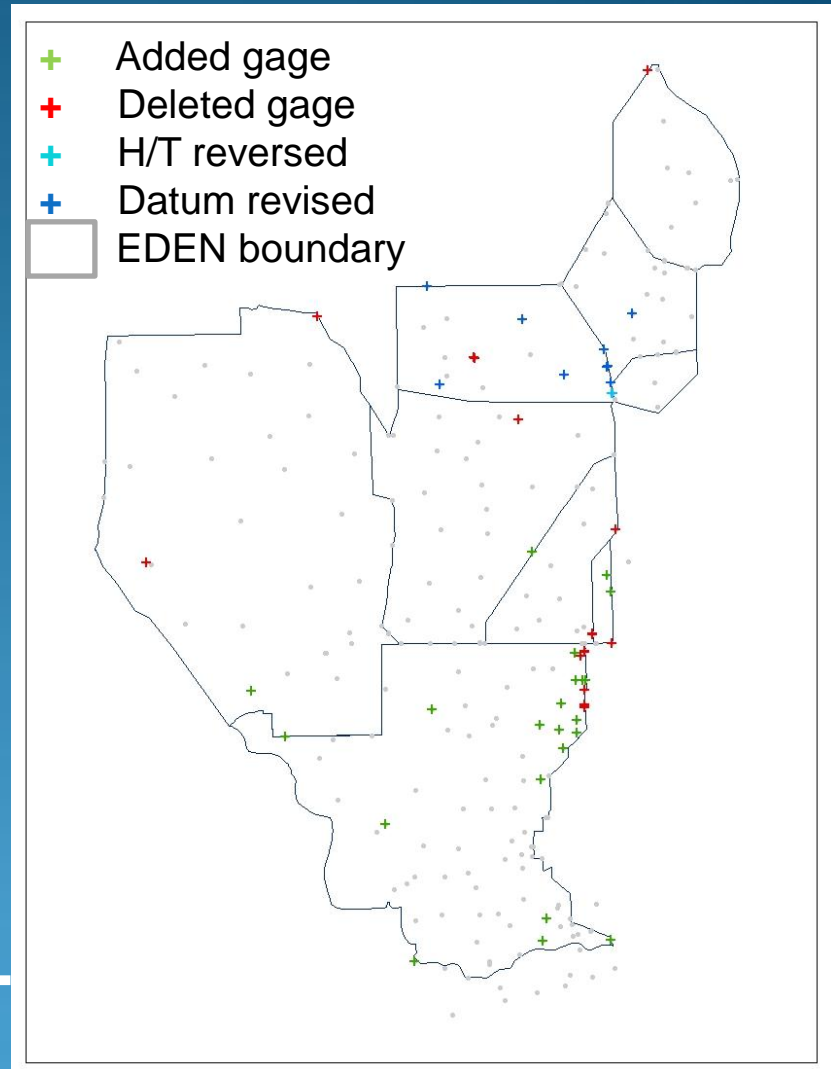
B = V2 model

Development of sub-area models

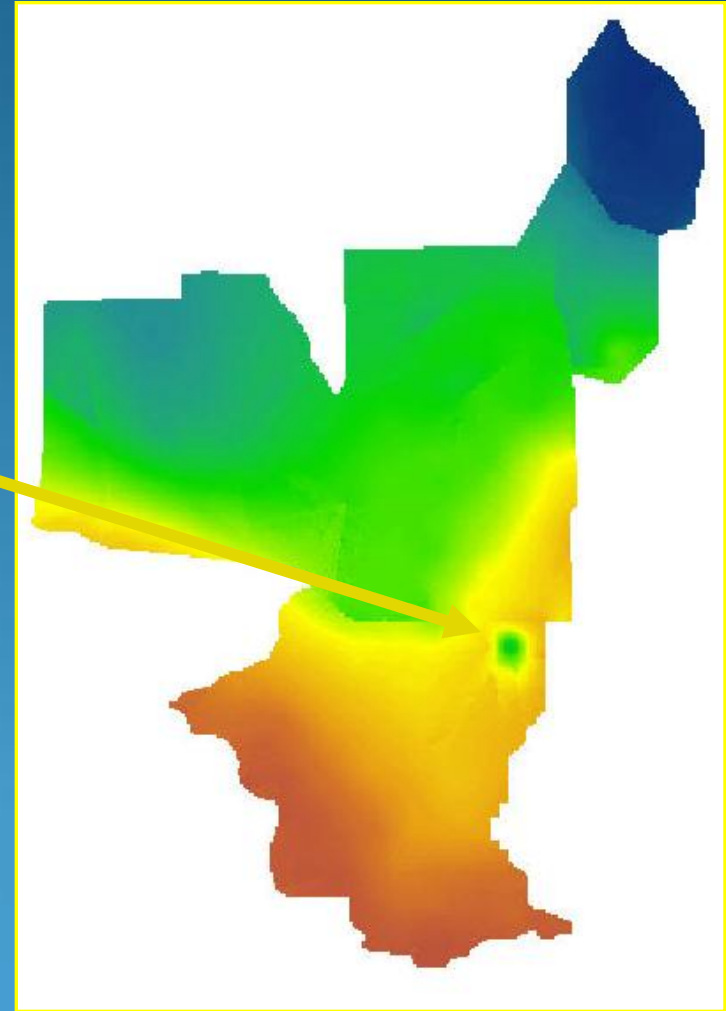
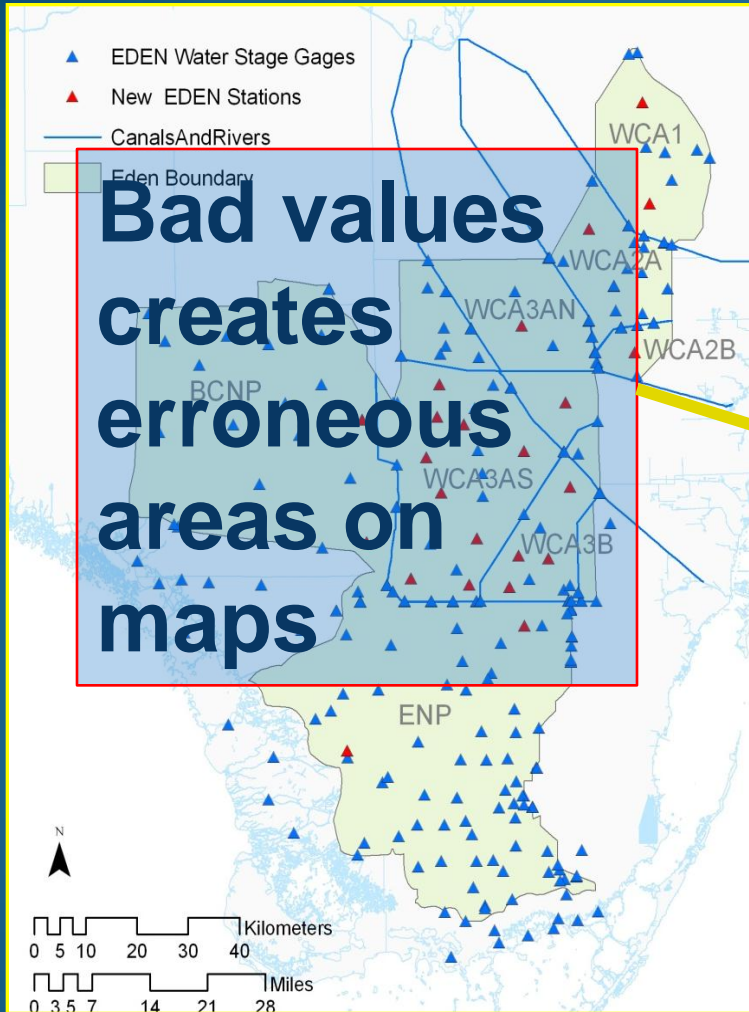


Updated gage data

- Added 23 gages
- Deleted 22 gages
- Reversed S142H & T
- Revised vertical datum conversions for 11 gages

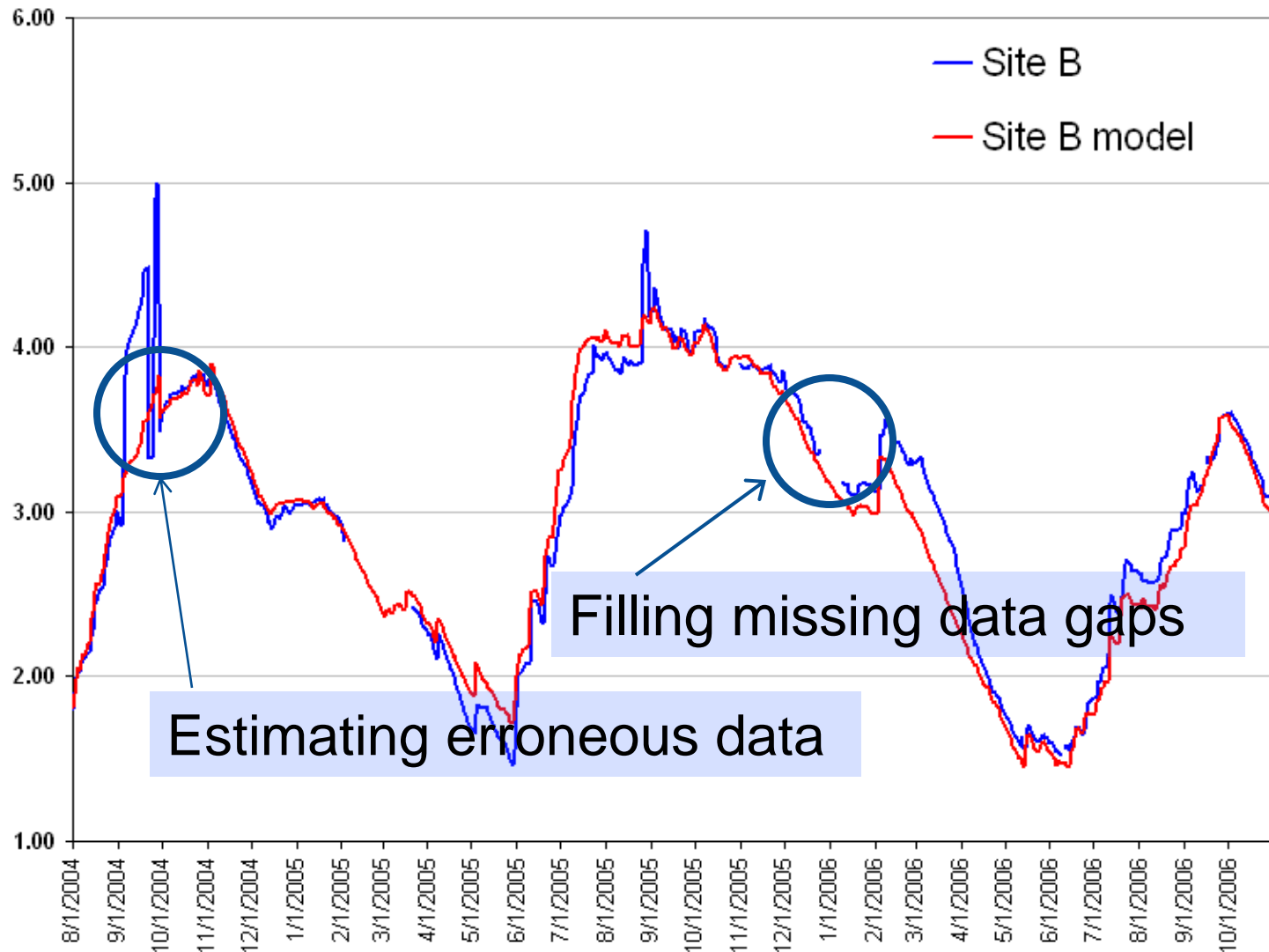


EDEN water surface map for a sample day



ADAM (Automated Data Assurance and Management)

Gage Height, in feet



File Home Insert Page Layout Formulas Data Review View

Clipboard Font Alignment Number Styles Cells Editing

Calibri 11 Bold Italic Underline Wrap Text Merge & Center

Number \$ % .00 .00 Conditional Formatting Cell Styles

Insert Delete Format Sort & Find & Filter Select

AA5

B C D E F G H I J K L M N O P Q R S

Review Site Selection

Station Name	Site_no	DD_nu	Step through Sites
Rev Site Any Flt: 2A300_WCA2_MSH	261446080243000	1	◀ ▶
Rev Site Flt 1: 251433080265000	251433080265000	1	◀ ▶
Rev Site - All: 3A9_WCA3_MSH	260722080385200	1	◀ ▶

Other Sites Selection

Sim Site: 3A12_WCA3_MSH	261008080403300	1	◀ ▶
Other Site: EDEN5_WCA3_MSH	260725080451001	1	◀ ▶

Graph Options

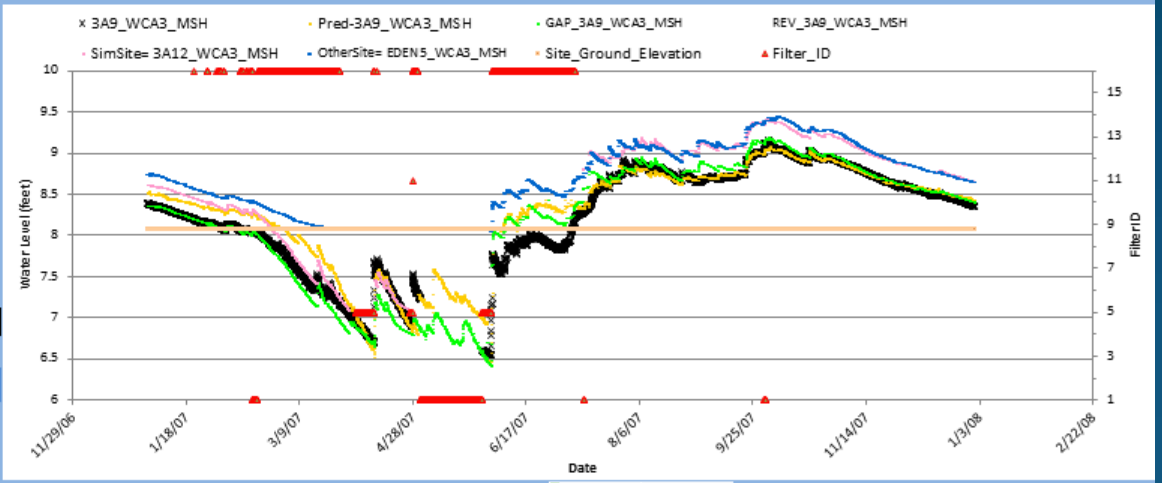
Min StartDate	Selected StartDate	EndDate	Selected EndDate
1/1/2007	1/1/2007	12/31/2007	12/31/20

Reset X Reset Y

Set Y Y1Min 6 Y1Max 10

Select To Show / Clear From Graph:

Pred PCA Gnd. Elev.
 Pred GAP Sim Site Run Review Complete
 Reviewed Other Site



About Control Review Tab Review Chart Current TroubleList Filter Adjustments SiteList Graph Data RegSelectionData PCData RegressionData

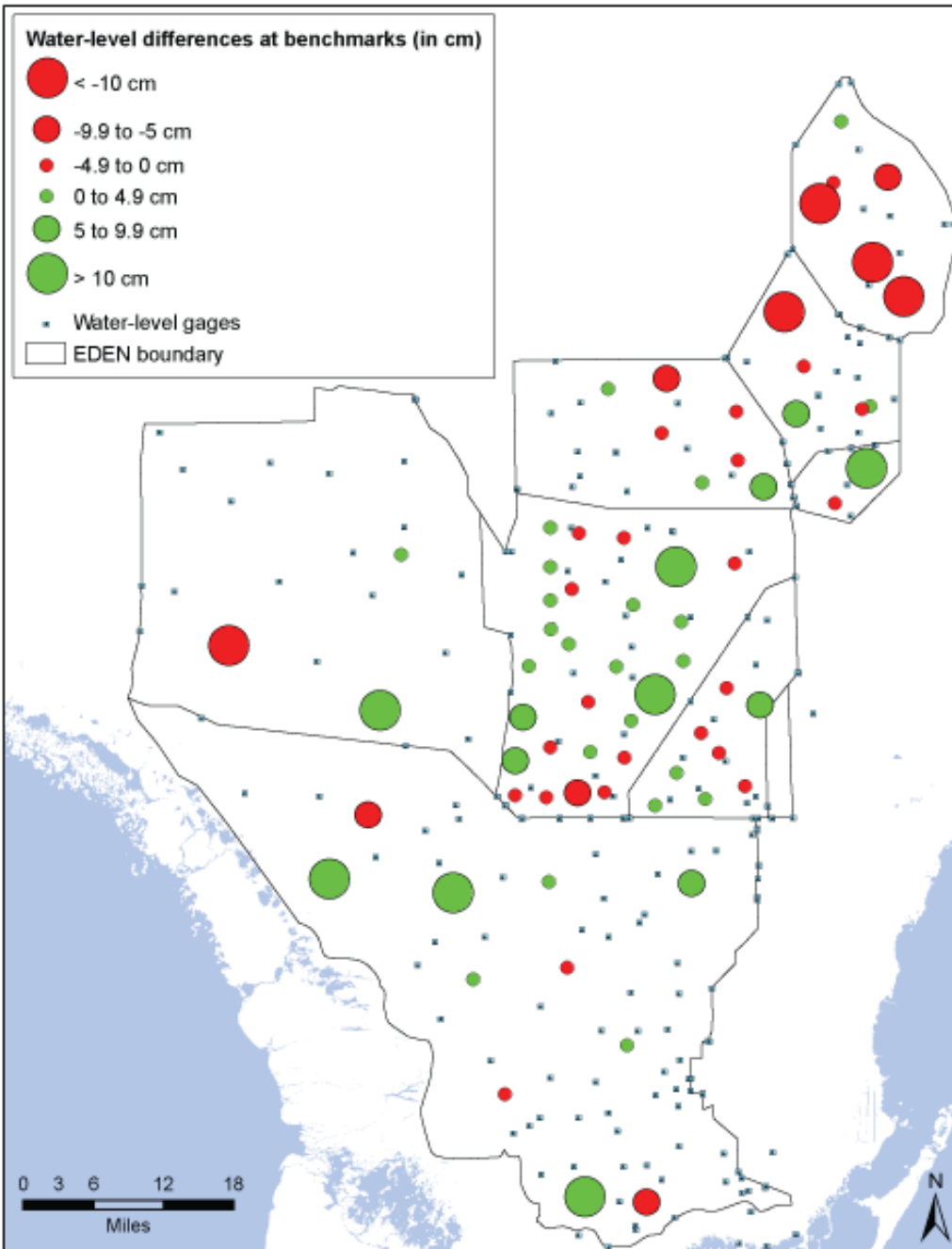
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B C D E F G H I J K L M AA AB AC AD AE

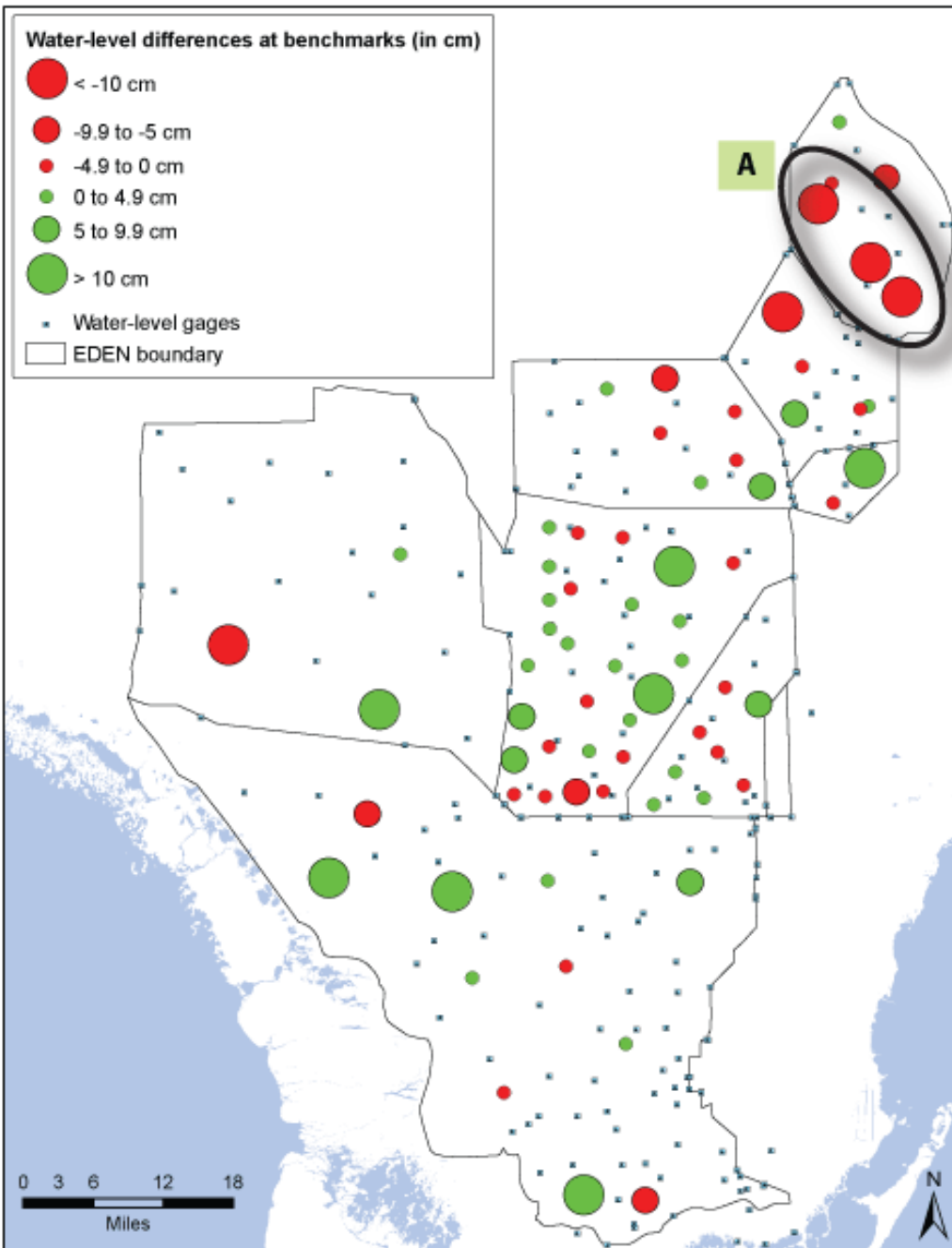
Concatenated Name	RecordCount	For All Values Use														
3A9_WCA3_MSH	8760	Recommended Rev	FilterID	GapFillSite	Countb	Pred_dif	GAP dif	Man dif	Data for Selected							
date_tm	ActualValu	FilteredValu	PredValu	GapFillPre	datum_chanc	RevValue	Suggested Va	Manual Ent	Recommended Rev	FilterID	GapFillSite	Countb	Pred_dif	GAP dif	Man dif	
1/1/2007 0:00	8.39	8.39	8.51	8.36	0.00	8.39		✓	Keep Prior Review	0	3A12_WCA3_MSH	-	0.12	-0.03	-	
1/1/2007 1:00	8.39	8.39	8.51	8.36	0.00	8.39		✓	Keep Prior Review	0	3A12_WCA3_MSH	-	0.12	-0.03	-	
1/1/2007 2:00	8.39	8.39	8.51	8.36	0.00	8.39		✓	Keep Prior Review	0	3A12_WCA3_MSH	-	0.12	-0.03	-	
1/1/2007 3:00	8.39	8.39	8.51	8.36	0.00	8.39		✓	Keep Prior Review	0	3A12_WCA3_MSH	-	0.12	-0.03	-	
1/1/2007 4:00	8.39	8.39	8.51	8.36	0.00	8.39		✓	Keep Prior Review	0	3A12_WCA3_MSH	-	0.12	-0.03	-	
1/1/2007 5:00	8.39	8.39	8.51	8.36	0.00	8.39		✓	Keep Prior Review	0	3A12_WCA3_MSH	6	0.12	-0.03	-	
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Validation of V2 model

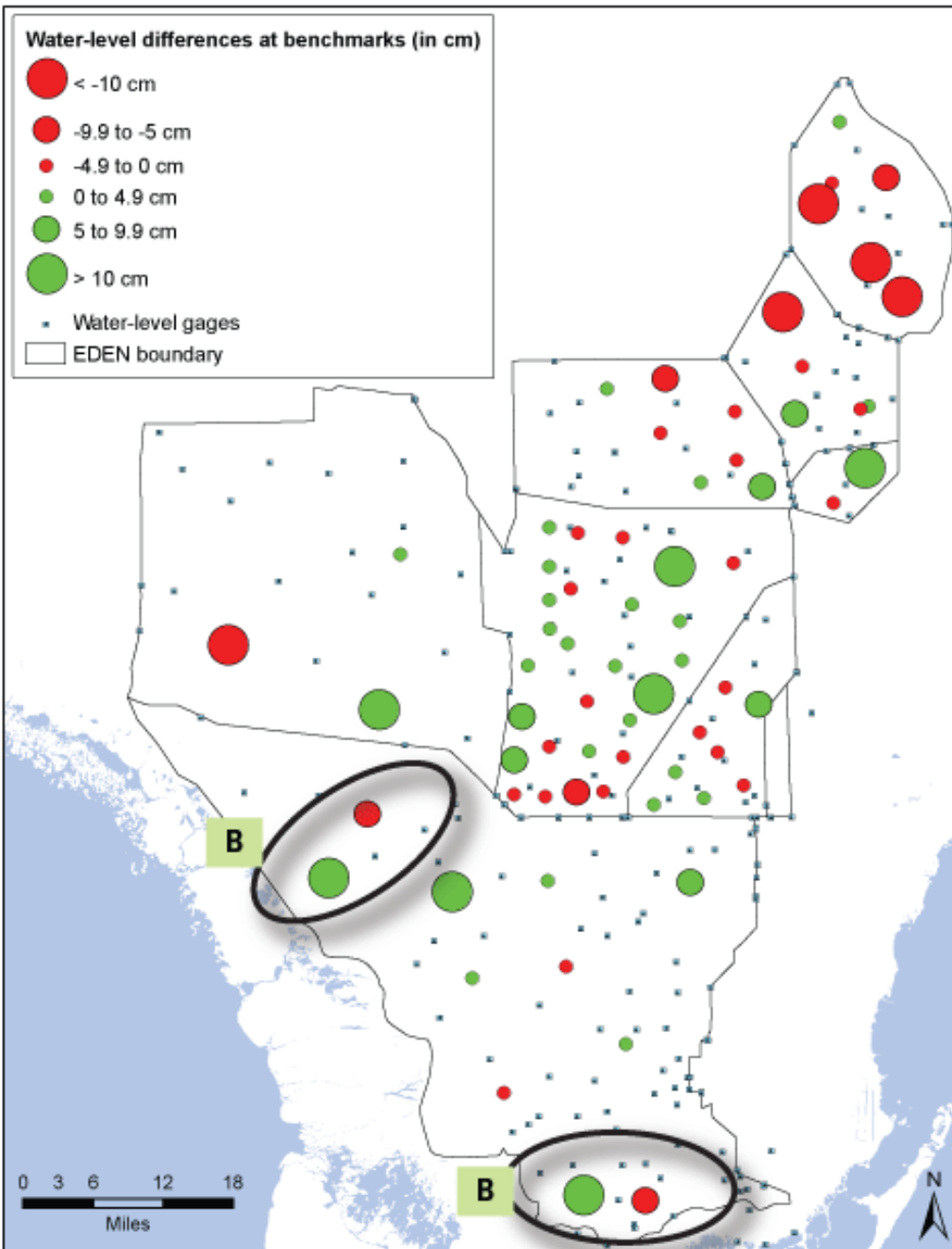
- Model error analysis
- Compared with benchmark measurements
- Comparison of difference maps (V2-V1)
- Evaluation of contour maps



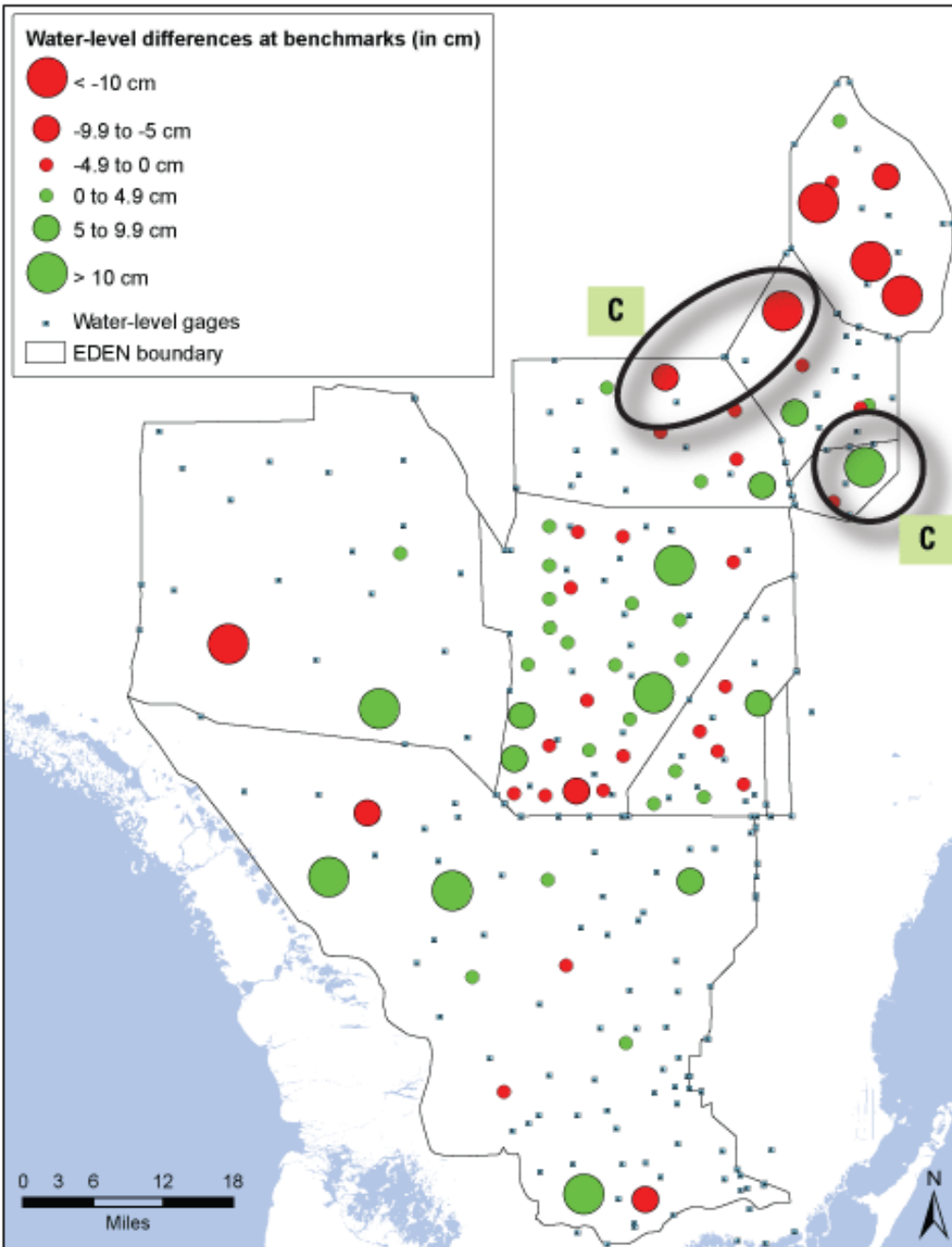
**Circle size
represents the
water-level
differences
(modeled
minus
measured)**



Area A in western WCA1

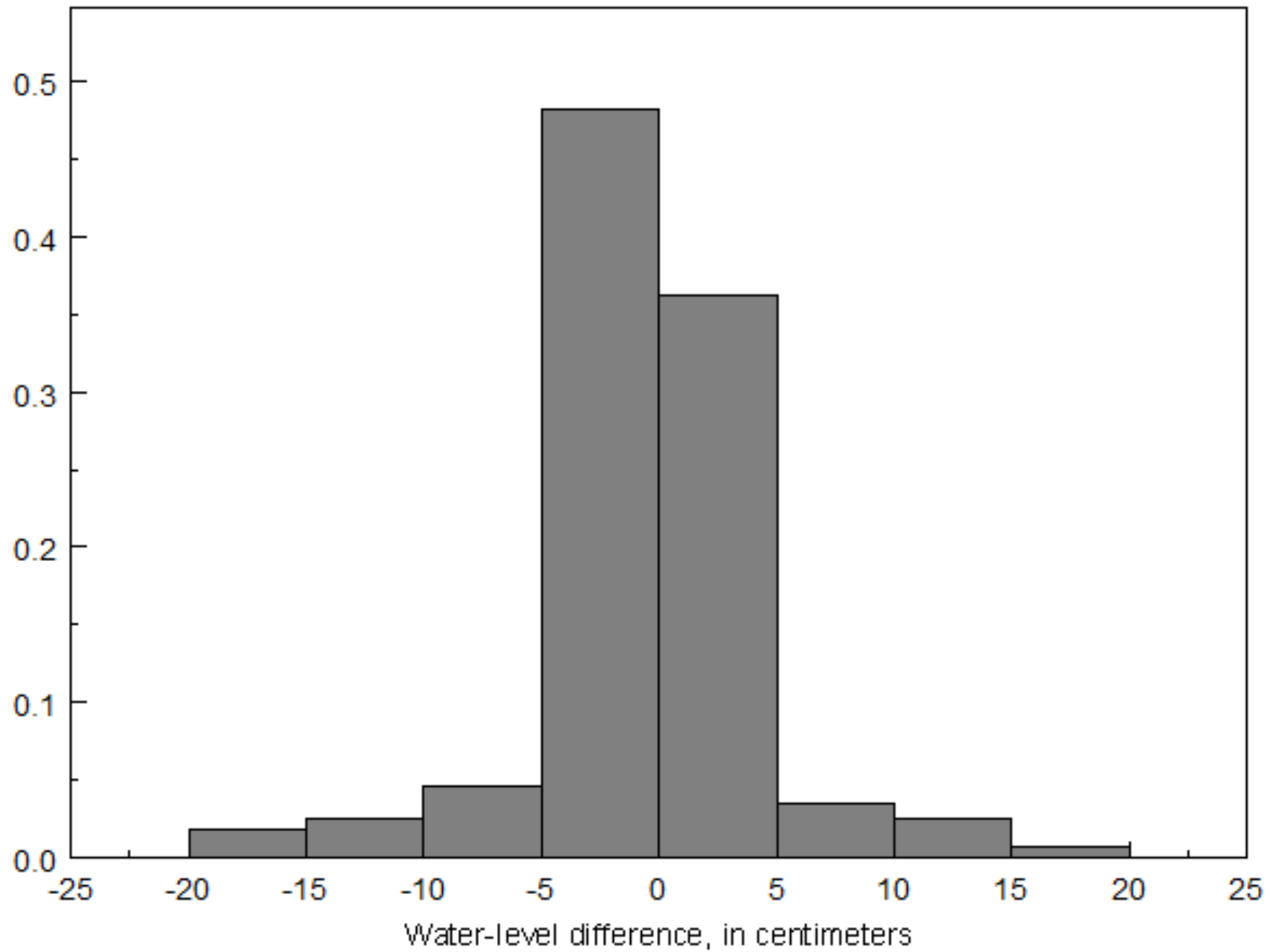


Areas B within tidal influence



**Areas C near
boundaries**

Frequency





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



Water Surfaces

In October of 2011, the EDEN project released a new version (Version 2, V2) of the EDEN Water Surface Model. This version replaces the last version (Version 1, V1) of the EDEN model. As part of this upgrade, most (4/1/00-6/30/11) EDEN water surfaces were recreated, new data was processed (1991-1999), and several new map datasets are now available (see below).

[Download the new \(V2\) EDEN Water Surface files](#)

- [What are EDEN water-surface files?](#)
- [What area is covered by the EDEN water-surface model domain and how is it gridded?](#)
- [What files are available?](#)
- [What has changed between V1 and V2?](#)
- [Are there maps showing what has changed between V1 and V2?](#)
- [What are the differences between real-time, provisional, and final surfaces?](#)
- [How good is the data for a given day?](#)
- [How are water surfaces created?](#)

What are EDEN water surface files?

Spatially continuous interpolation of water surface across the greater Everglades is generated for daily median values of the [water-level gages for the EDEN network](#) beginning January 1, 1991. Surfaces are recorded as elevation in centimeters relative to North American Vertical Datum of 1988 (NAVD 88). [More information on how water surfaces are created is available](#) below.

The list of gages used to generate the daily water surface changes over time because gages are discontinued, new gages are constructed, or gages are added or removed from the EDEN network. The daily median output files provide users with the list of gages used for each day's water-level surface.

What area is covered by the EDEN water-surface model domain and how is it gridded?

The EDEN surface-water model domain includes Water Conservation Areas 1, 2, and 3, Pennsuco Wetlands and the freshwater portions of Big Cypress National Preserve (BCNP) and Everglades National Park (ENP). Version 2 (V2) of the model added the northwest corner of ENP and southern portion of BCNP.

The EDEN domain is gridded into 400 x 400 meter cells that in total are referred to as the "EDEN grid" and which allow for analysis of subsets of the grid and GIS analysis of other data layers over the EDEN domain, such as ground elevation data, rainfall data, and water depth computation. [Learn more about the EDEN Grid.](#)

What files are available?

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Ground Elevation (DEM)

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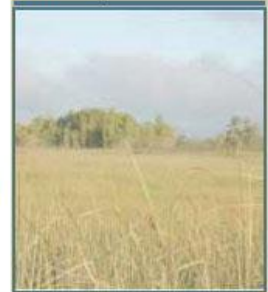
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EDEN's Time Machine

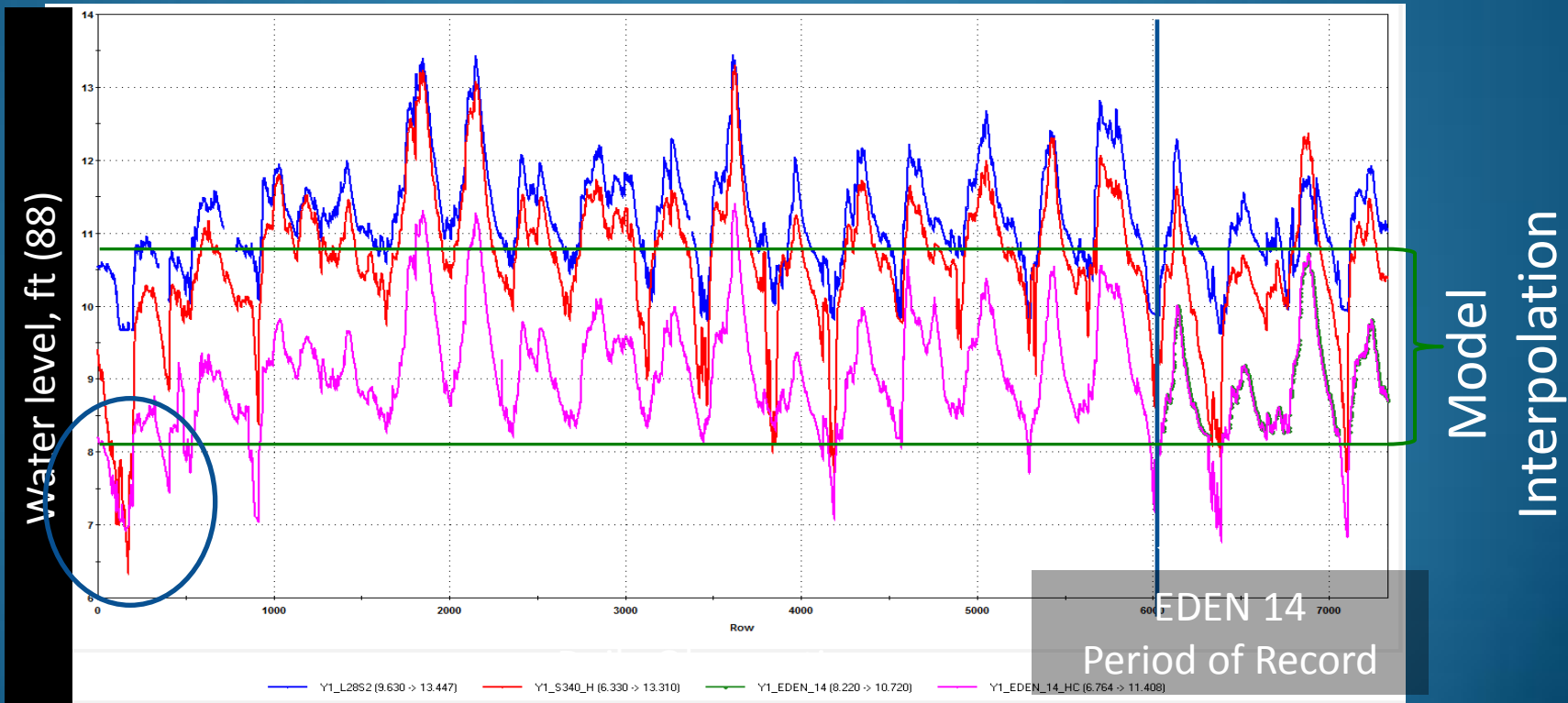
- **Users requested EDEN surfaces back to 1990**
- **65 gages operational back to 1990**
- **Paul Conrad's hindcasting approaches**
 - **Simple linear regression (~ 155 gages)**
 - **With nearby gages**
 - **Artificial neural network models (~ 20 gages)**
 - **For cluster groups**

Hindcast example: EDEN14

EDEN 14 (green)

EDEN 14 Hindcast (magenta)

L28S2 and S340_H (blue and red)





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



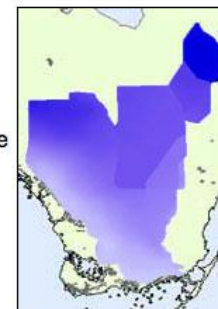
Download Water Surfaces Data

Data for modeled EDEN water surfaces are available in two different formats:

- [NetCDF](#)
- [GeoTiff](#)

A daily median file (two files prior to 5/14/12) provides users with a list of gages and data used to generate the day's water-level surface. Metadata for the water-level surfaces is also provided.

- [daily median output file](#)
- [metadata \(for water surfaces\)](#)



NetCDF Files:

NetCDF (Network Common Data Form) is a set of freely-distributed software libraries and machine-independent binary data formats that support the creation, access, and sharing of large array-oriented scientific data. This format replaces the bulky file structure and difficult file management of ESRI GRIDS for EDEN data. It also allows EDEN applications to run on computers without ArcGIS installations.

Each file contains 3 months (one quarter-year) of daily datasets. For example, the data for every day in 2002 will be stored in 4 files: 2002_q1.nc, 2002_q2.nc, 2002_q3.nc, and 2002_q4.nc. In addition, each zip file contains a [readme file which contains brief information about release notes](#) related to this data release.

NetCDF Files

File naming conventions:

- **v#** = version of surface water model (v1 or v2),
- **r#** = release of surface (r1 or r2),
- **prov** = provisional,
- **rt** = real-time

New: You may download a year's worth of data all at once. Simply click the link below for each year. Because of file size limits, the most you can download at one time is a year. If you need to download several year's worth of data at once, please contact Heather Henkel (hhenkel@usgs.gov) and other arrangements can be made.

Date	1/1 - 3/31	4/1 - 6/30	7/1 - 9/30	10/1 - 12/31
1990-1999	data available on a separate page			
2000 (zip, 69 MB)	2000 Q1 (zip, 18 MB) v2prov, December 2011	2000 Q2 (zip, 18 MB) v2r1, October 2011	2000 Q3 (zip, 18 MB) v2r1, October 2011	2000 Q4 (zip, 18 MB) v2r1, October 2011
2001	2001 Q1 (zip, 18 MB)	2001 Q2 (zip, 18 MB)	2001 Q3 (zip, 18 MB)	2001 Q4 (zip, 18 MB)

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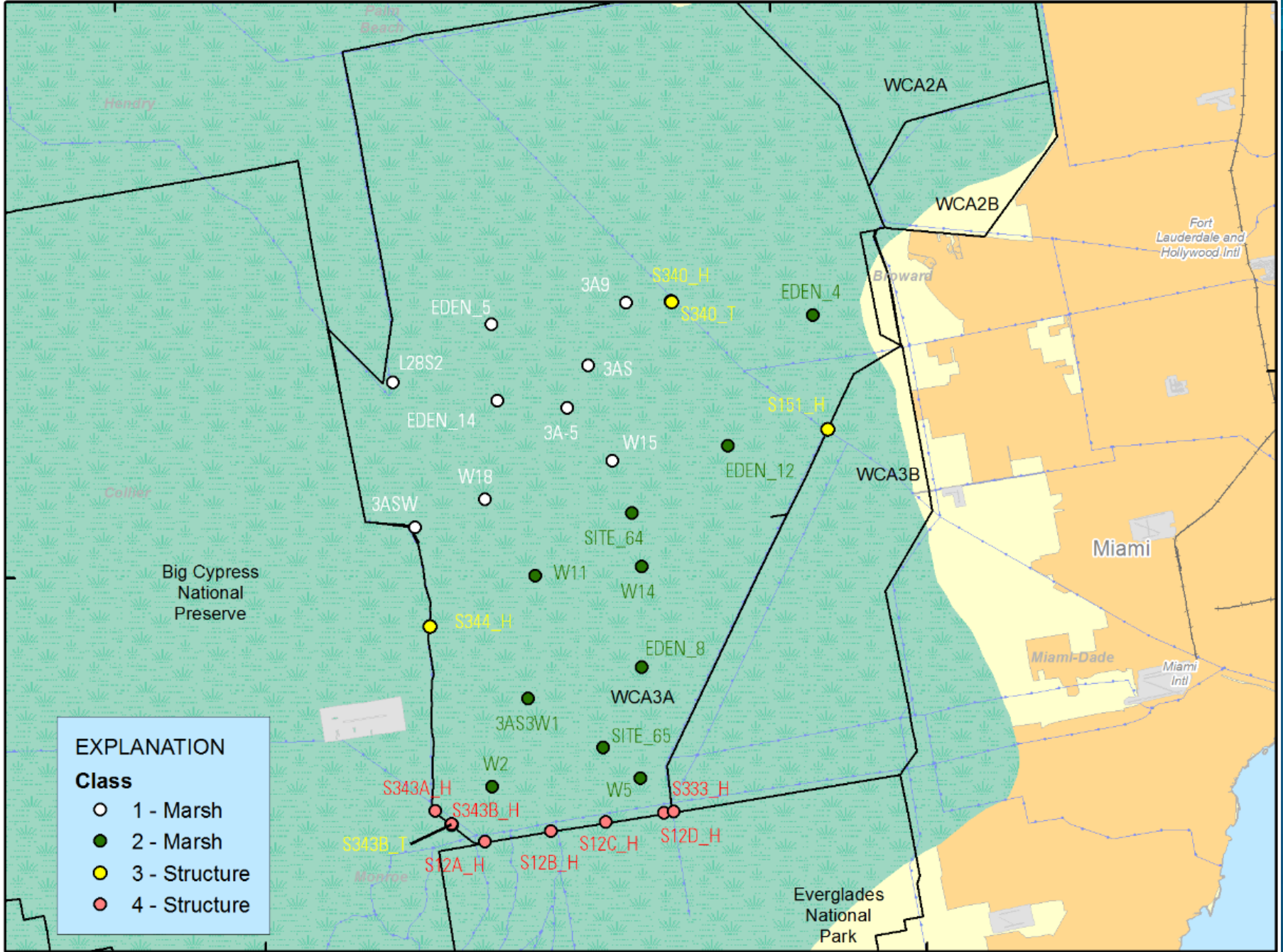
Contacts



EDEN-Syn Application

(pilot effort)

- **EDEN daily water-surface maps for hypothetical hydrologic conditions**
- **Requires synthetic input hydrographs at EDEN gages**
- **Must reproduce the dynamic relations between gages**

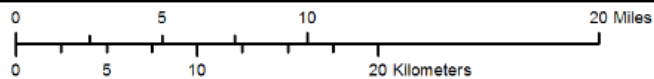


EXPLANATION

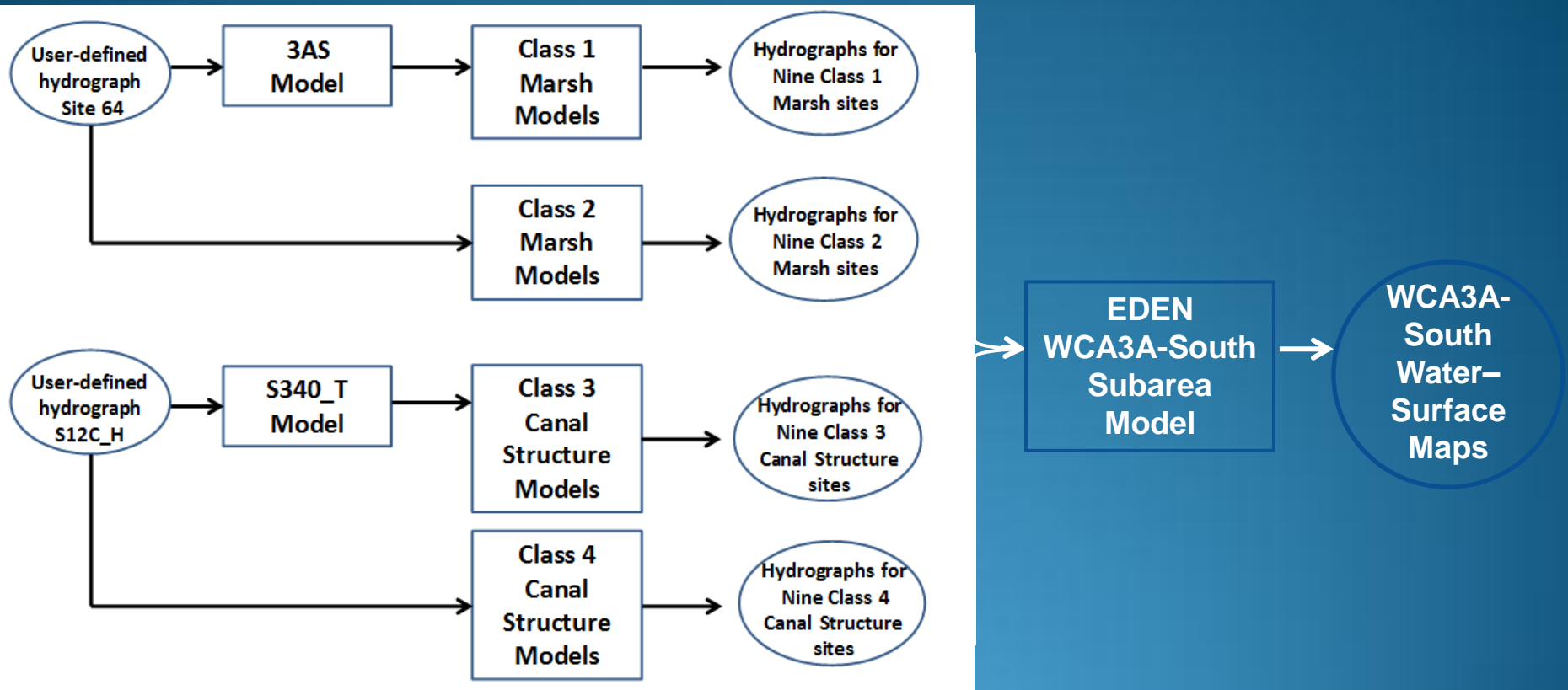
Class

- 1 - Marsh
- 2 - Marsh
- 3 - Structure
- 4 - Structure

Base From ESRI® Data & Maps, 2008



Data Generation for EDEN-Syn



User Settings: Index Sites for WCA3-South

% Historical: %
 Percentile: Percentile
 Ft: ft

A

- % Historical - Entire Period
- Percentile - Entire Period
- Constant - Entire Period

View Duration Hydrograph

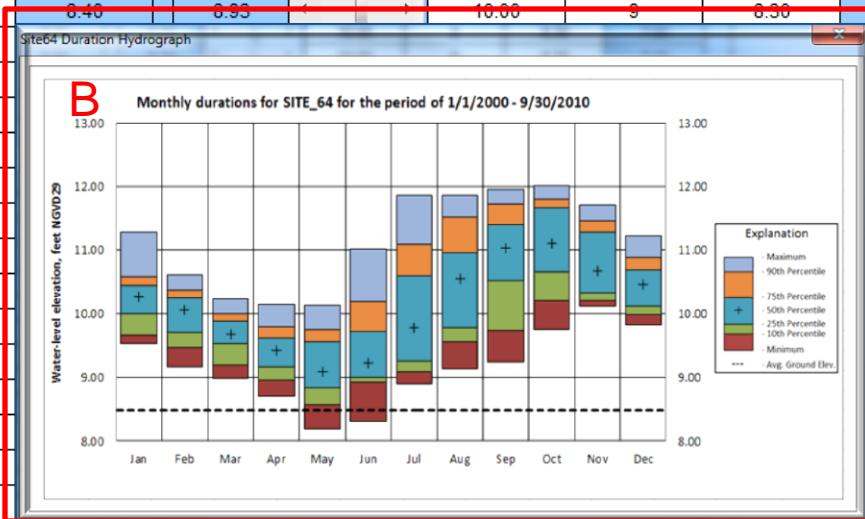
% Historical: %
 Percentile: Percentile
 Ft: ft

View Duration Hydrograph

Site_64

S12C_H

Date	Hist. Value	User Setpoint	% Historical	Percentile	Constant	User Value
Jan-01	9.68	<input type="text"/>	10.00	20	9.50	8.71
Feb-01	9.34	<input type="text"/>	10.00	20	9.50	8.40
Mar-01	9.11	<input type="text"/>	10.00	20	9.50	8.30
Apr-01	8.96	<input type="text"/>	10.00	20	9.50	8.30
May-01	8.64	<input type="text"/>	10.00	20	9.50	8.30
Jun-01	9.08	<input type="text"/>	10.00	20	9.50	8.30
Jul-01	9.38	<input type="text"/>	10.00	20	9.50	8.30
Aug-01	10.39	<input type="text"/>	10.00	20	9.50	8.30
Sep-01	10.50	<input type="text"/>	10.00	20	9.50	8.30
Oct-01	11.15	<input type="text"/>	10.00	20	9.50	8.30
Nov-01	11.23	<input type="text"/>	10.00	20	9.50	8.30
Dec-01	10.76	<input type="text"/>	10.00	20	9.50	8.30
Jan-02	10.54	<input type="text"/>	10.00	20	9.50	8.30
Feb-02	10.31	<input type="text"/>	10.00	20	9.50	8.30
Mar-02	9.90	<input type="text"/>	10.00	20	9.50	8.30
Apr-02	9.37	<input type="text"/>	10.00	20	9.50	8.30
May-02	8.94	<input type="text"/>	10.00	20	9.50	8.04
Jun-02	9.49	<input type="text"/>	10.00	20	9.50	8.54
Jul-02	10.70	<input type="text"/>	10.00	20	9.50	9.63
Aug-02	11.16	<input type="text"/>	10.00	20	9.50	10.04
Sep-02	11.09	<input type="text"/>	10.00	20	9.50	9.98
Oct-02	10.79	<input type="text"/>	10.00	20	9.50	9.71



**EDEN Synthetic Hydrograph
Application (EDEN-Syn)
takes us from
“What was” to “what if”**


Everglades Depth Estimation Network (EDEN) - Opera

http://sofia.usgs.gov/eden/index.php

Search with Google



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






Providing real-time hydrologic tools for biological and ecological assessments for adaptive management

What's New @ EDEN

- [January Rainfall Data](#)
- [2010 Q4 provisional data released](#)
- [NWIS WaterAlert web page](#)
- [Google Earth/Map KML file for EDEN Gages](#)
- [Water Depth Measurements web page](#)
- [December Rainfall Data](#)
- [2010 Q3 provisional data released](#)
- [2010 Q2 provisional data released](#)
- [2009 Evapotranspiration Data](#)
- [WY09 Final Surfaces Released](#)
- [Benchmarks Network website](#)
- [May and April Rainfall Data](#)
- [2010 Repl...](#)
- [2009 Repl...](#)
- [Real-view](#)
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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.

For more information:



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

Station Information	
Station Name:	EDEN_12
Operating Agency:	USGS
USGS NWIS Agency Code:	USGS
USGS NWIS ID:	2600420803
Latitude (DMS) NAD83:	26°00'42"
Longitude (DMS) NAD83:	-80°35'17"
UTM Easting Zone 17N (meters NAD83):	541222.6
UTM Northing Zone 17N (meters NAD83):	2877040.8
Location Area:	Water Conserve Area 3A
Real-time data (daily):	Yes



Data Links	
(Please note: the links below marked by this icon  will take you off of the EDEN website.)	
[Information about these links]	
Water Level Data:	Recent Hourly  Recent Daily 
Salinity Data:	(no salinity data available)
Hindcast data	
Evapotranspiration Data	
Rainfall Data	
Station Location Map	
Other Database Links	

**EDENweb
directs users
to real-time
gage data**

Water Surfaces - Everglades Depth Estimation Network (EDEN) - Opera

http://sofia.usgs.gov/eden/models/watersurfacemod.php

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

Water Surfaces

For More Information: [*Spatially Continuous Interpolation of Water Stage and Water Depths Using the Everglades Depth Estimation Network \(EDEN\), University of Florida, IFAS, CIR 1521.](#)

Spatially continuous interpolation of water surface across the greater Everglades is generated for daily median values of the [water level gages for the EDEN network](#) beginning January 1, 2000. Surfaces are recorded as elevation in centimeters relative to North American Vertical Datum of 1988 (NAVD 88). [More information on how water surfaces are created is available below.](#)

The list of gages used to generate the daily water surface changes over time because gages are discontinued, new gages are constructed, or gages are added or removed, for other reasons, from the EDEN network. The daily median output files provide users with the list of gages used for each day's water level surface.

Real-Time, Provisional, and Final Surfaces

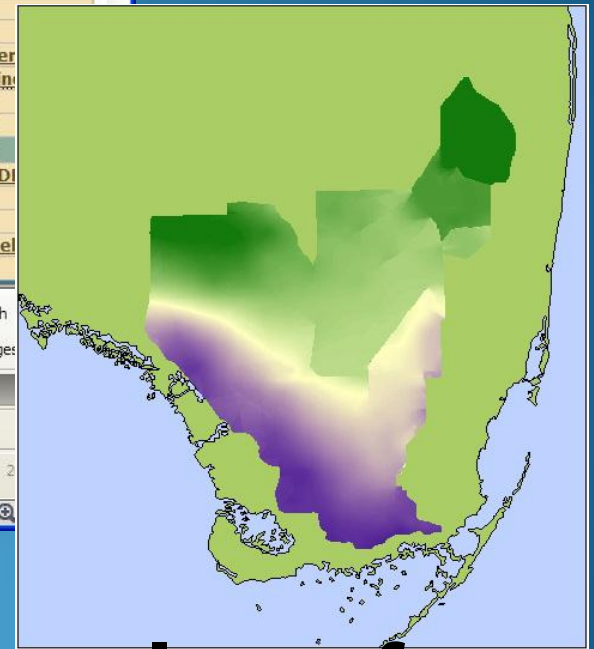
The EDEN project uses a specific notation to indicate the quality of the data being provided. Each file contains either real-time, provisional, or final data:

- **Real-time** EDEN water-level surfaces are created daily using real-time water-level data that are relayed by satellite or other telemetry and have received little or no review from the operating agency. A threshold comparison program eliminates daily values that appear erroneous (i.e., extremely high or low, extremely different from the previous day). Subsequent reviews and edits of the data may result in significant revisions to the data.
- **Provisional** EDEN water-level surfaces are created quarterly using water-level data that have received some review and edits by the operating agency. For some agencies, the review is near final while for others, the review is preliminary.
- **Final** EDEN water-level surfaces are created annually using final approved data from the operating agencies. The 'release' notation is used only when the surface has been reprocessed.

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Fit to Width
Show Images
100%
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Update Ready



Download daily water-level surfaces

EDEN Tools (REVISED)

The image displays the EDEN software interface, which is used for managing and visualizing depth estimation network data. The main window, "EDEN Data Viewer", shows a map of the United Kingdom with a crosshair indicating the current location. The coordinates are set to UTM, NAD83, with a northing of 2833533.93 and an easting of 529186.40. The date is set to October 1, 2007. The map shows water depth in cm and days since dry.

The "EDEN xyLocator" window is used to specify the grid folder, points file, and output units. The grid folder is set to D:\EDEN\edenapps\Data, and the points file is D:\EDEN\edenapps\Tools\xyLocator\EDEN-te. The output units are set to cm. The date range is from January 1, 2000, to December 31, 2007. The series to export are DEM, stage, depth, and days since dry.

The "EDEN Depth&DaysSinceDry" window is used to specify the grid folder, export folder path, and series to export. The grid folder is D:\EDEN_Apps\Data, and the export folder path is D:\EDEN_Apps\Data. The series to export are depth and days since dry. The quarters to export are all available quarters, and the date range is from 2000, q1 to 2002, q4.

The "EDEN Transect Plotter" window shows a cross-section plot of water depth (cm, NAVD88) versus distance (m). The plot shows a stage line (blue) and a DEM line (red). The date is set to 8/3/2006. The plot includes various site markers and a legend for the stage and DEM lines. The plot also shows the date control and animation control options.

Newsletter – Everglades Depth Estimation Network (EDEN)
 http://sofia.usgs.gov/eden/newsletter.php

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

EDEN Newsletter

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 Last updated: April 19, 2012 09:59 AM(HSH)

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EDEN Project Team

Member	Location	Responsibility
Pamela Telis	USGS FL WSC	Project leader
Heather Henkel	USGS FL St. Pete	Water-level surfacing; GIS, database, and web work
Bryan McCloskey	USGS FL St. Pete	Water-level surfacing; database and web work, meteorological data
Paul Conrads	USGS SC WSC	Hindcasting data/Gapfilling
Matthew Petkewich	USGS SC WSC	Water-level data QA; processing; and Gapfilling
Nate Matthews	USGS SC WSC	Water-level data QA
Carlton Wood	USGS SC WSC	Water-level data QA
Brian Reece/ Joe Vrabel	USGS TX WSC (2010-2012)	Programming of scripts to process data
Zhixiao Xie/ Zhongwei Liu	Florida Atlantic University	Surface-model V2 revisions



EVERGLADES
DEPTH
ESTIMATION
NETWORK

EDEN

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