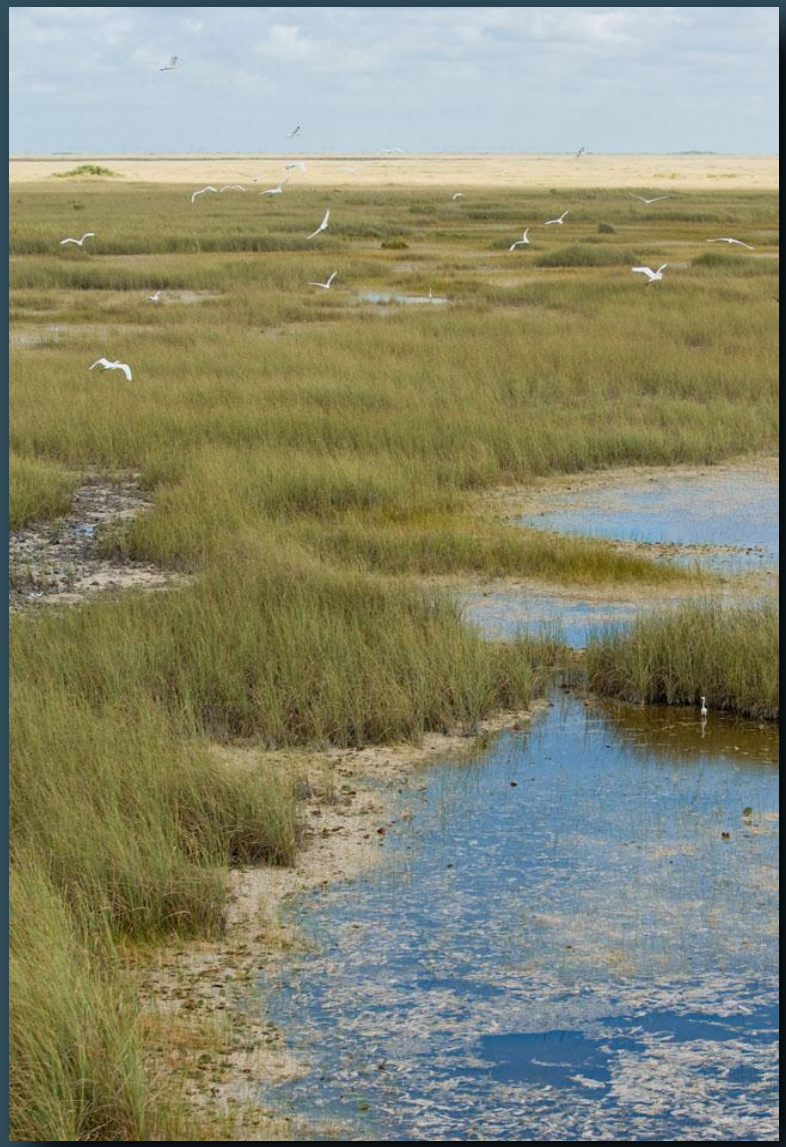


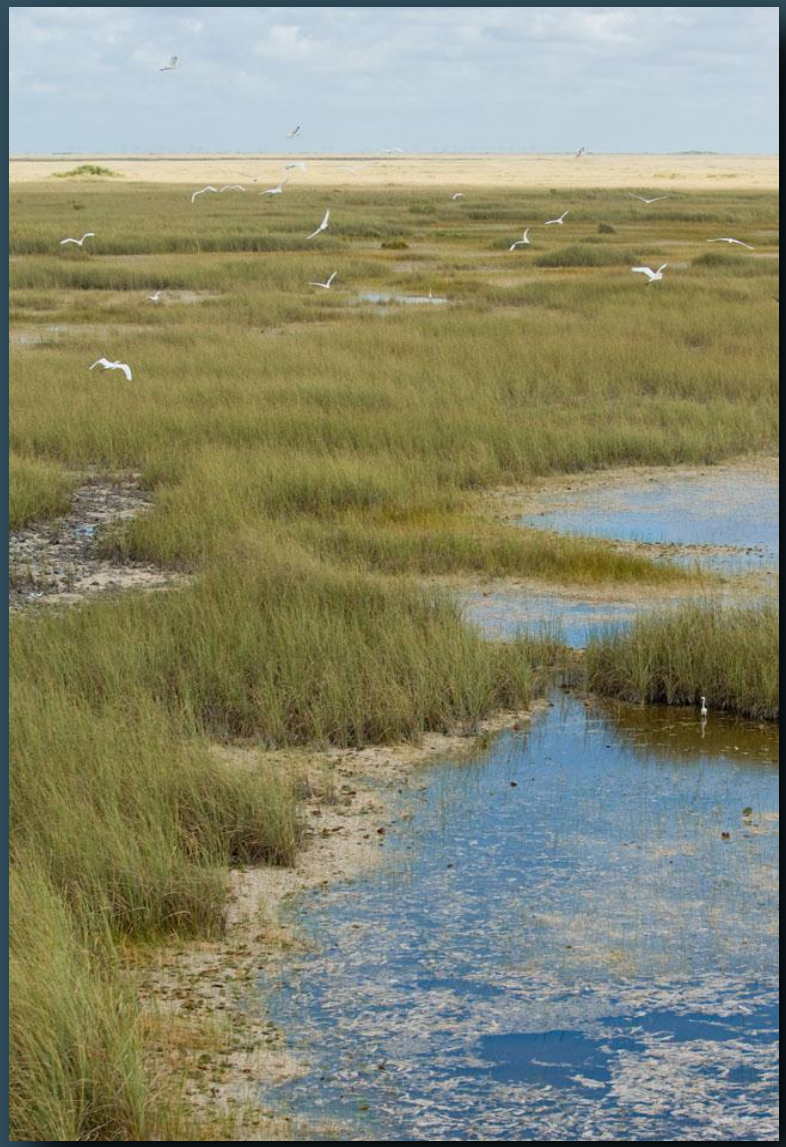
Application of Adaptive Management for Wetland Restoration

An Overview of a Large-Scale Everglades Physical Model

Fred Sklar, Ph.D
Director
Everglades Systems Assessment

International Wetlands Conference (INTECOL)
June 3-8, 2012

sfwmd.gov



The CERP is constructing the largest AM project in USACOE history!

The Decomp Physical Model (DPM) is a $10 M ecohydrology experiment that took 6 years to design and approve.

DPM Science Team (USGS, SFWMD, FIU, UH, COE):

Colin Saunders; Sue Newman, Scot Hagerthey; Laurel Larson; Jud Harvey; Sue Wilcox; David Ho; Vic Engel; Joel Trexler; Barry Rosen; Tamela Kinsey; Ronnie Best; Steve Baisden

International Wetlands Conference (INTECOL)
June 3-8, 2012

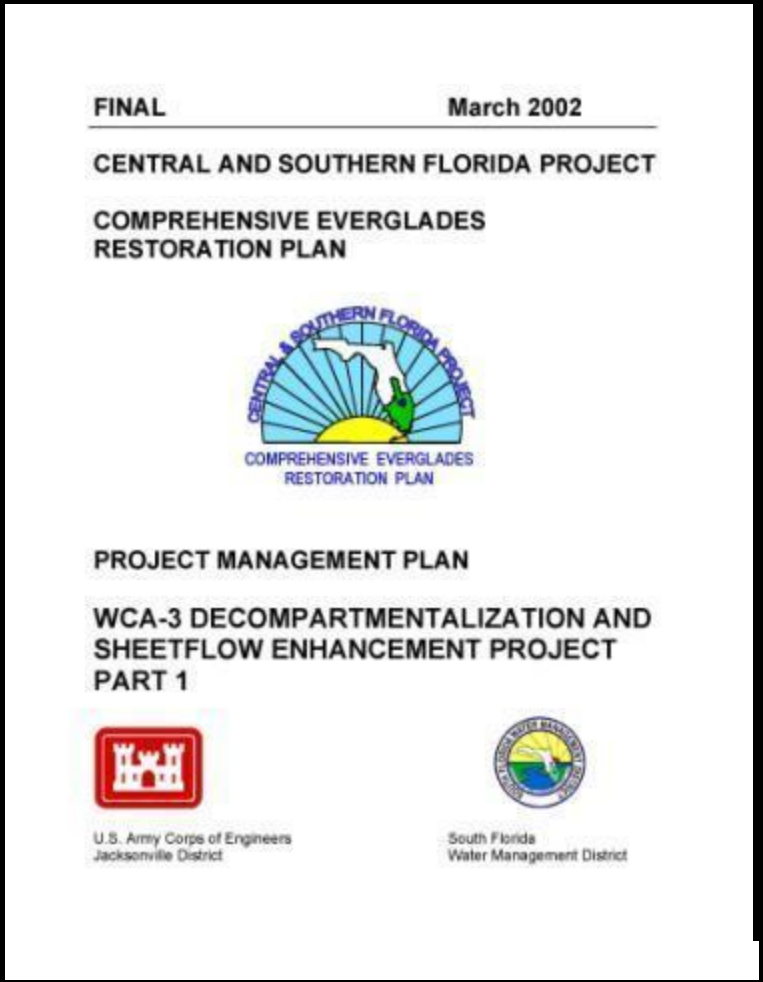
What is Adaptive Management? (Holling, Gunderson and Light)

- It is a scientific, systematic approach for finding answers to ecosystem management questions.
- It can be implemented at any point within the planning, design, construction and operation of a restoration project.
- It is "learning by doing" - it involves the scientific analysis of natural resources and environmental impacts of large-scale restoration or management plans, designs, constructions, and operations.
- It is an organized and inclusive means for identifying and addressing key uncertainties (often an alternative to numerical models), allowing managers to move forward in the face of inadequate knowledge.
- It is a directive of Section 601(h)(3) of WRDA 2000.

What is Adaptive Management NOT? (Sklar)

- It is not a guarantee or the solution for all problems. Some problems are intractable or beyond the scope of an ecosystem management project.
- It is not justification to stall or cancel a project. Projects need not be put on hold to implement A.M.
- It is not a phased implementation and it is not irrevocable (A.M. projects are designed to be reversible).
- It does not mean choosing a management plan and "adapting as you go" through a process of "trial and error."
- It is not necessarily a more expensive approach for designing, implementing, or managing a restoration project. It is less expensive because it increases the probability of success and decreases the threat of litigation.

3.1 Statement of Project Scope


FINAL March 2002

CENTRAL AND SOUTHERN FLORIDA PROJECT

COMPREHENSIVE EVERGLADES RESTORATION PLAN

COMPREHENSIVE EVERGLADES RESTORATION PLAN

PROJECT MANAGEMENT PLAN

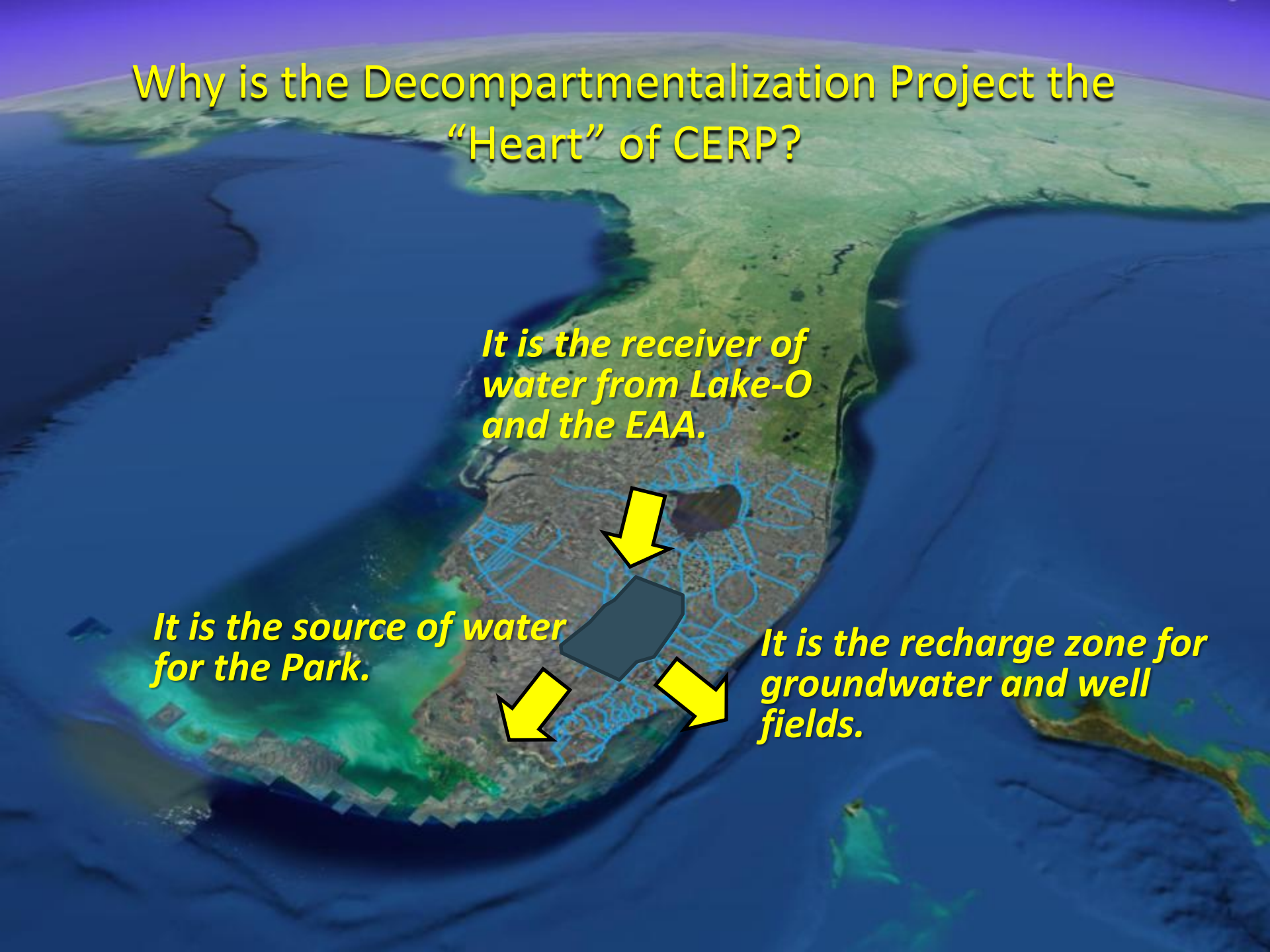
WCA-3 DECOMPARTMENTALIZATION AND SHEETFLOW ENHANCEMENT PROJECT PART 1

U.S. Army Corps of Engineers
Jacksonville District

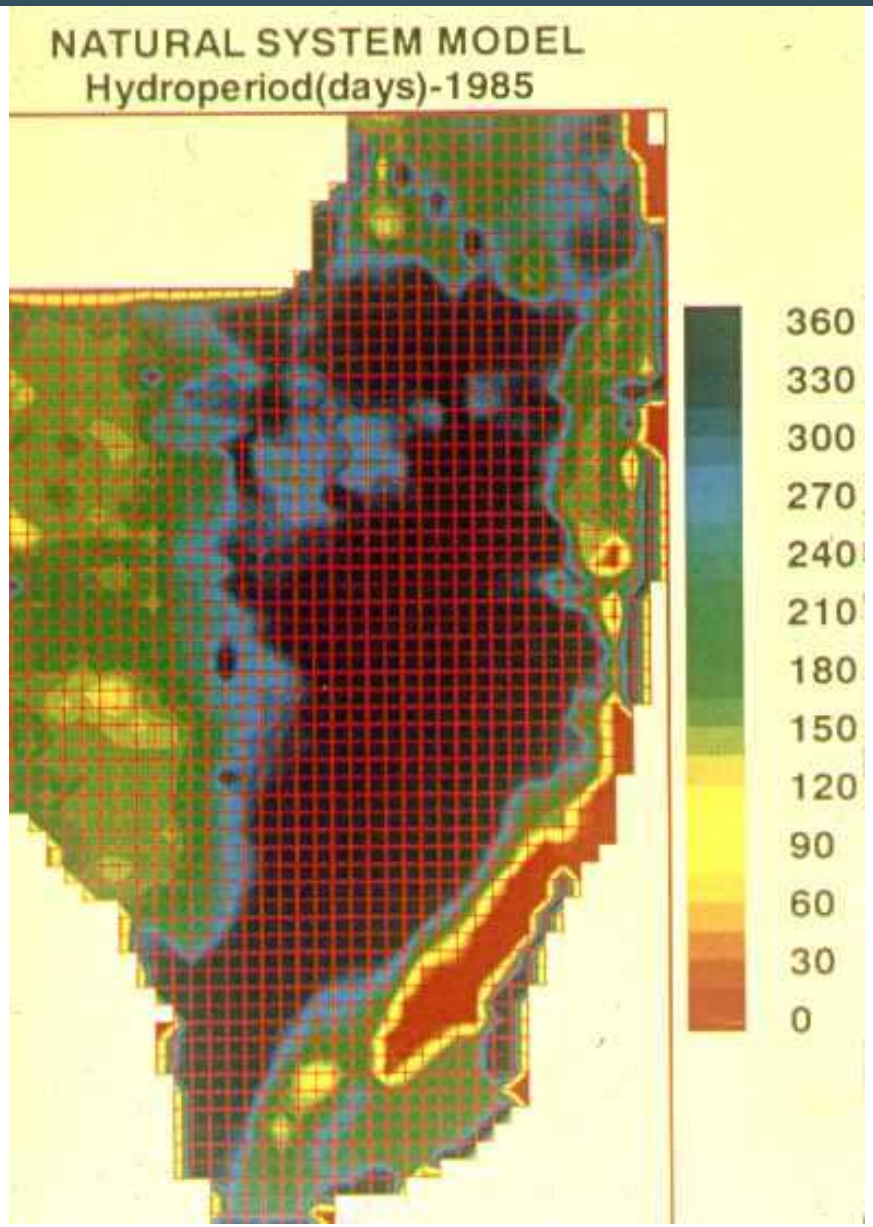
South Florida
Water Management District

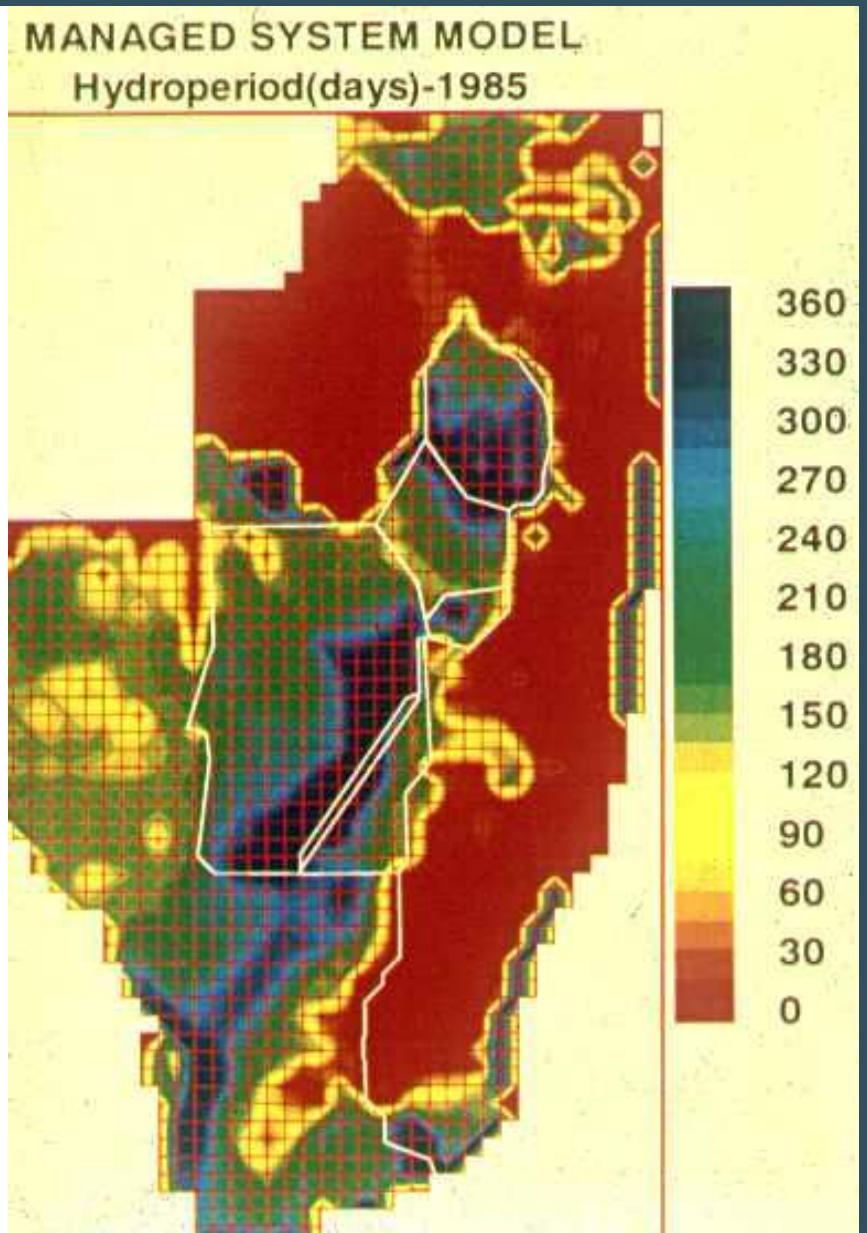
The purpose of the WCA-3 Decompartmentalization and Sheetflow Enhancement Project, is to restore natural landscape patterns, and native flora and fauna in WCA-3 and Everglades National Park by removing barriers to Sheetflow in order to restore natural hydroperiods, flow, and water depths, and reestablish ecological connectivity.

Why is the Decompartmentalization Project the "Heart" of CERP?



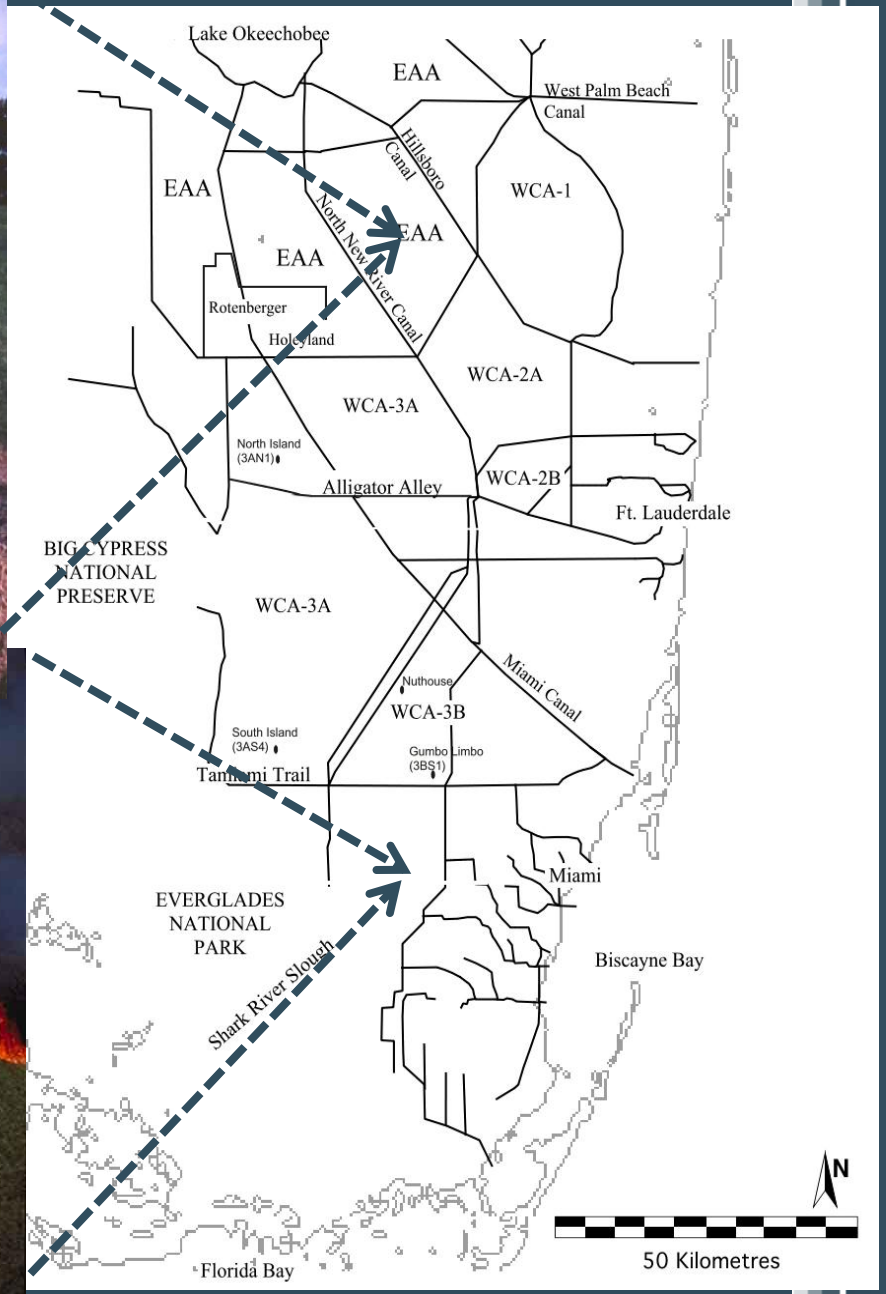
Duration of flooding (hydroperiod) in the Greater Everglades, currently (right) and under pre-drainage conditions (left) for an average year.





Peat oxidation has removed almost 2 meters of soil.

(Dr. Len Scinto as a young man)



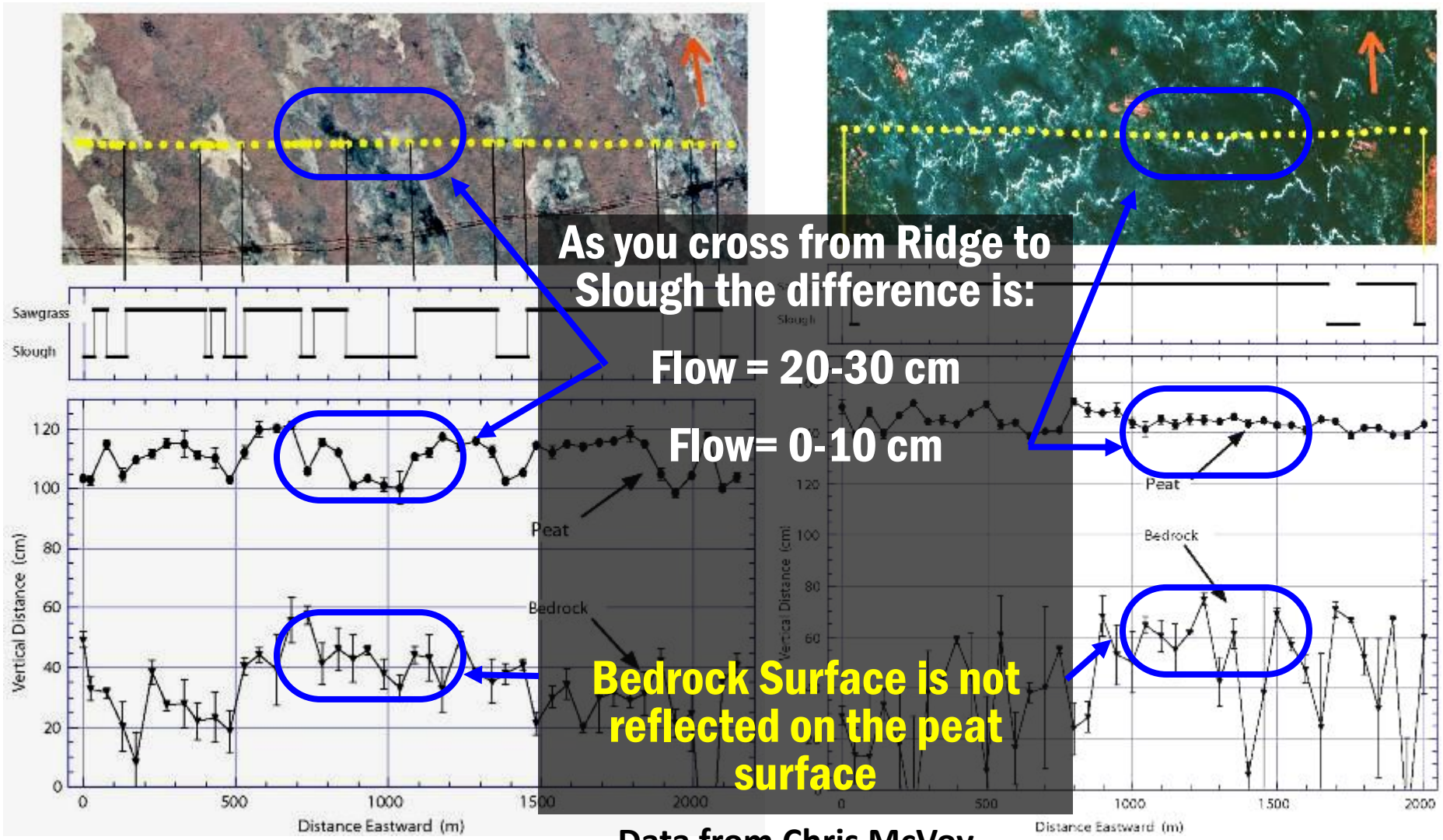
Hydroperiods in the Everglades are Short and Flow Velocities are Small

The marsh can not create soil fast enough to keep up with peat oxidation. Wetlands that get too dry are like couch potatoes – they lose healthy structure.

The Flow Hypothesis: The Everglades is on the Verge of Structural Collapse

With Flow

Without Flow



As you cross from Ridge to Slough the difference is:

Flow = 20-30 cm

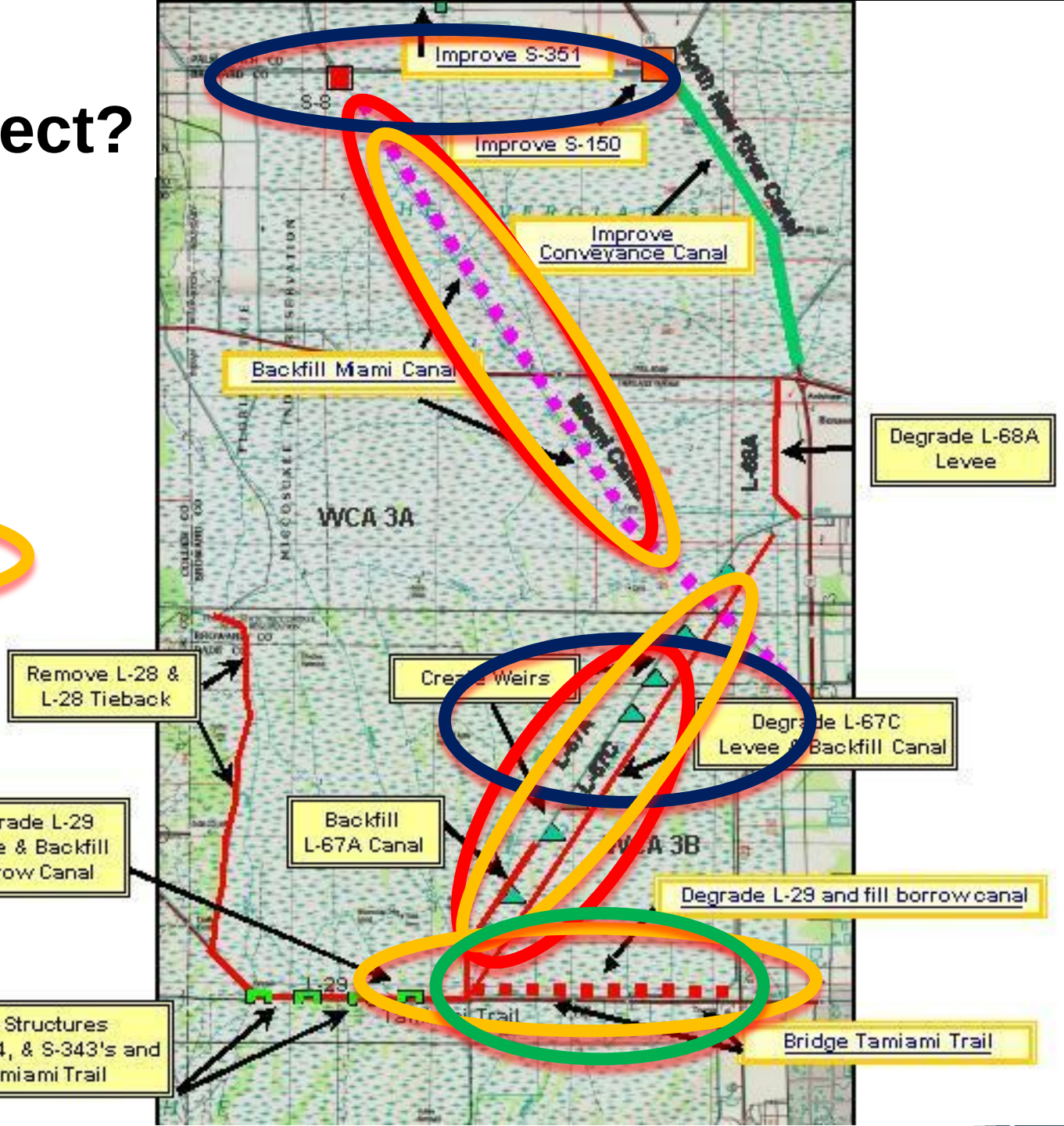
Flow= 0-10 cm

Bedrock Surface is not reflected on the peat surface

Data from Chris McVoy

What is the Decomp Project?

- Backfilling
- Increasing conveyance capacity
- Degrading levees
- Raising & bridging

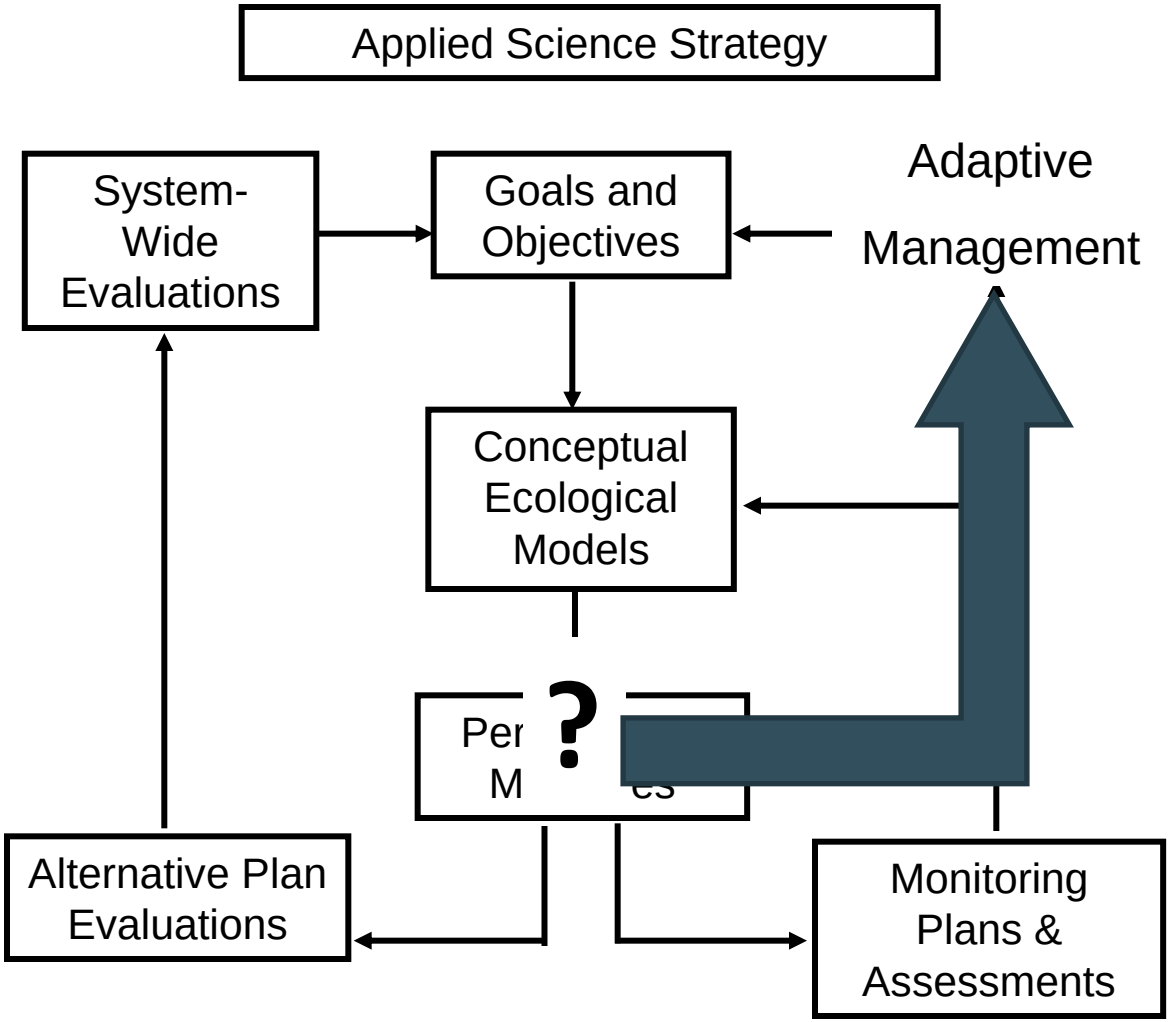


Scientific Uncertainties of DECOMP

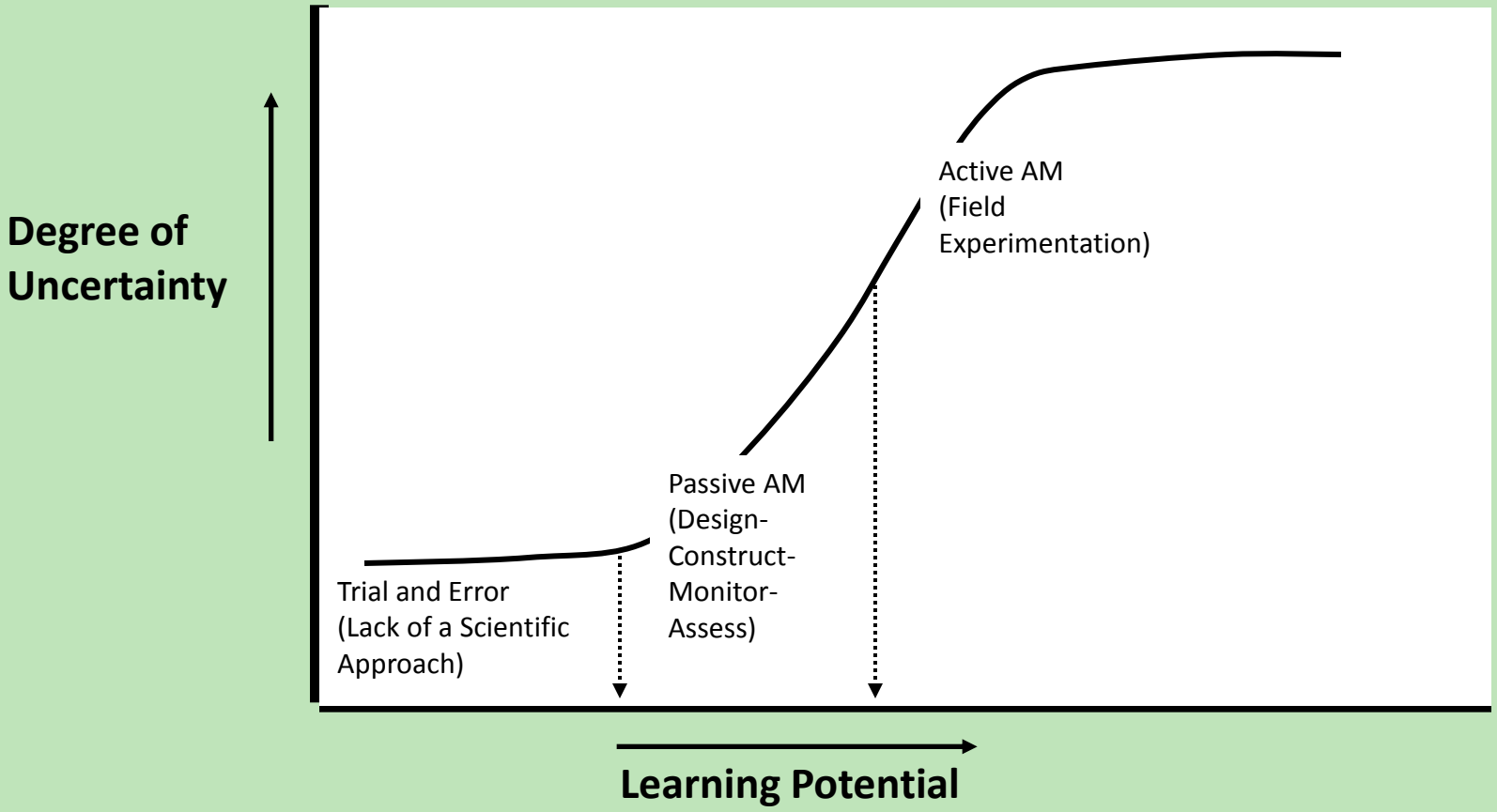
1. Ecological effects of levee modifications
2. Effects of partial versus extensive backfilling of canals
3. Water depth and hydroperiod tolerance of tree islands
4. Quantification of benefits of sheetflow
5. Assessment of seepage
6. Calibration of hydrologic models

The Adaptive Management Process

Reduce Uncertainty & Incorporate New Information



Passive and Active AM



Active AM involves actual field testing and experimentation addressing high levels of uncertainty.

The Physical Model: Purpose

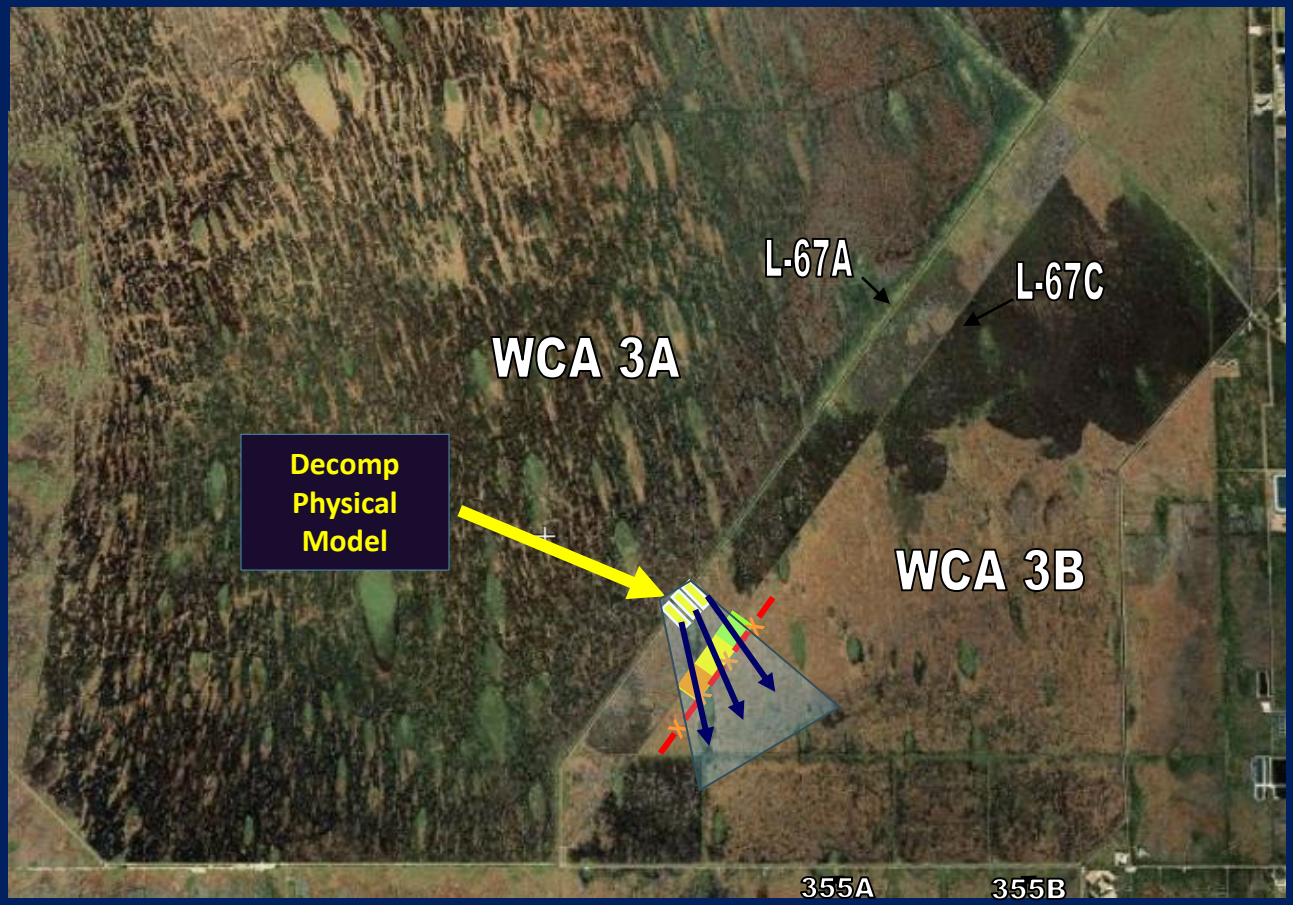
- Address uncertainty and constraints in Everglades restoration.
- Refine our understanding of ecological benefits and support the selection of alternative plans.
- Modify evaluation performance measures.
- Obtain a better scientific understanding of how "pristine" and "impacted" regions of the ecosystem will respond to hydrologic restoration

Scientific Uncertainties Addressed by the DPM

1. Ecological effects of levee modifications
2. Effects of partial versus extensive backfilling of canals
3. ~~Water depth and hydroperiod tolerance of tree islands~~
4. Quantification of benefits of sheetflow
5. ~~Assessment of seepage~~
6. Calibration of hydrologic models

DECOMP Physical Model (DPM)

- The DPM will address uncertainties associated with hydrology, canal backfilling, sediment transport, and ridge & slough restoration
- DPM will finish construction of eight gated culverts (750 cfs) on L-67A in November 2012
- 3,000 ft of levee will be removed
- There are three canal "treatments"



BACI Design

Temporary Gated Culverts

No Backfill

Partial Backfill

Complete Backfill

Sheetflow

Levee Degrade

DPM Science Plan Components

L-67A
750 cfs

Ecological Benefits of Sheet flow

L-67C Degraded Levee (3000')

L-67C Canal Backfill (1000' per treatment)

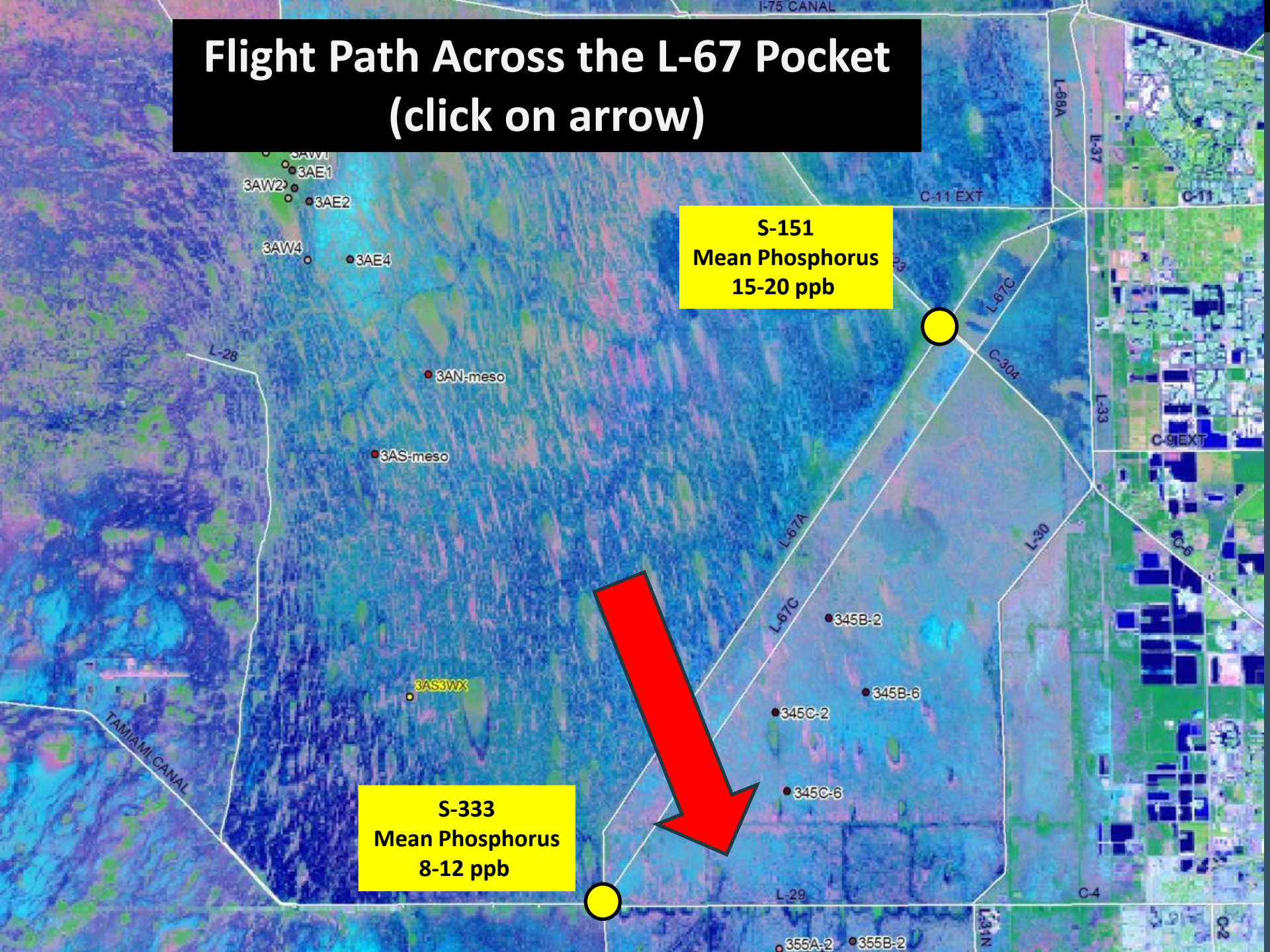
Canal Backfilling Options

What is Being Measured?

- **Hydrology (Laurel Larsen, Jud Harvey, David Ho)**
  - A network of sites for stage, water depths, flow direction, and velocity
  - Hydraulics of new S-152 culverts (head and tail water stages and cfs)
  - Synoptic mapping of water depth and velocity in conjunction with flow manipulations
  - Vegetation mapping for hydraulic resistance
  - Tracer studies (SF6 tracer and dye)
  - Canal hydraulics

- **Physical Transport (Colin Saunders, Laurel Larsen, Sue Newman)**
  - Synoptic mapping of surface water biogeochemistry and sediment erosive properties
  - Resuspension and deposition of natural particles
  - Particle transport (Floc tracers, sediment traps, biogeochemical markers)

- **Biological (Joel Trexler, Sue Newman)**
  - Environmental monitoring (dissolved oxygen, pH, temperature, specific conductivity)
  - Fauna characterization (native and exotic) and movement
  - Vegetation structure


Flight Path Across the L-67 Pocket
(click on arrow)
S-151
Mean Phosphorus
15-20 ppb
S-333
Mean Phosphorus
8-12 ppb
I-75 CANAL
3AE1
3AW2
3AE2
3AW4
3AE4
3AN-meso
3AS-meso
3AS3WX
L-28
L-68A
L-37
C-11 EXT
C-11
L-67C
C-304
L-33
C-9EXT
L-67A
L-30
C-6
345B-2
345B-6
345C-2
345C-6
TAMIAMI CANAL
L-29
C-4
L-31N
C-2
355A-2
355B-2

Pre-construction SF6 (gas) Tracer Does Not Follow Ridge-Slough Directionality

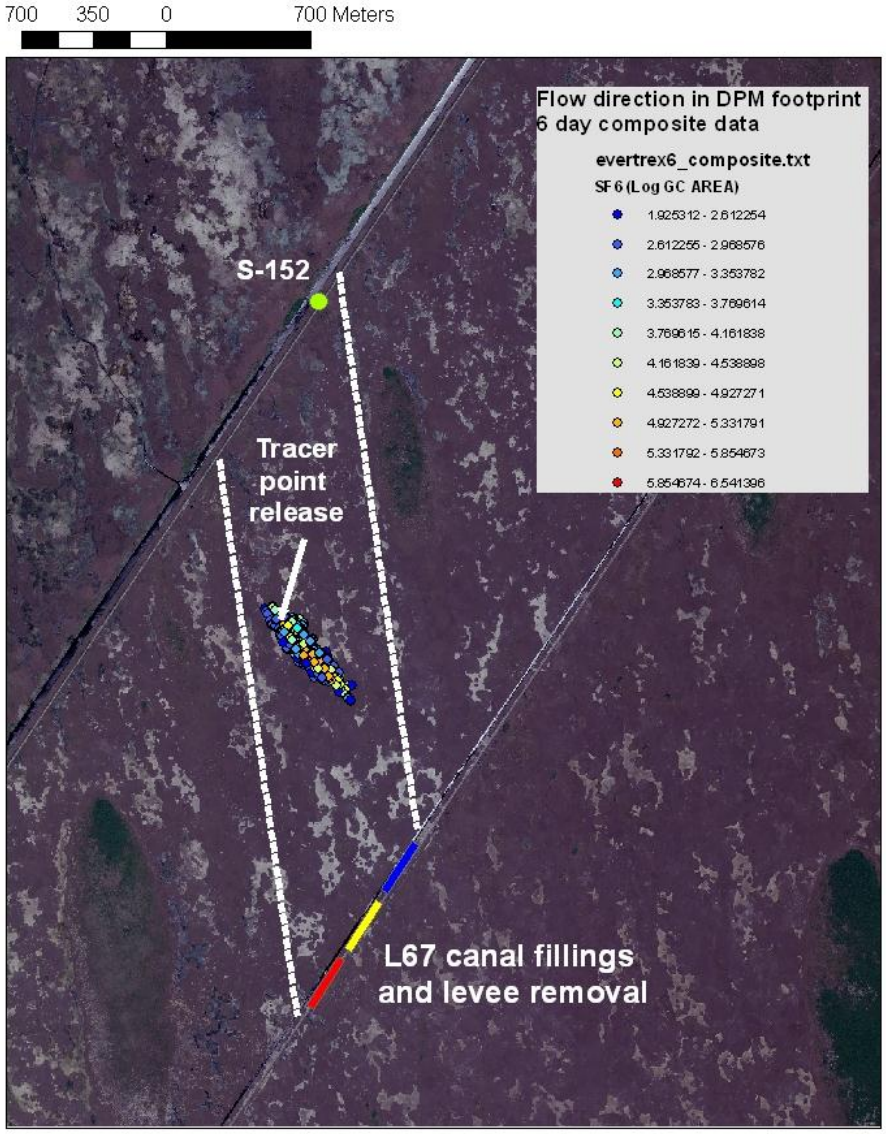


Figure 1. Surface water tracer release and recovery in the DPM footprint over a period of 5 days (Oct 8-12, 2009). 5L of the tracer was released and mixed by hand in the middle of a remnant slough on October 7th. Flow direction is southeast.

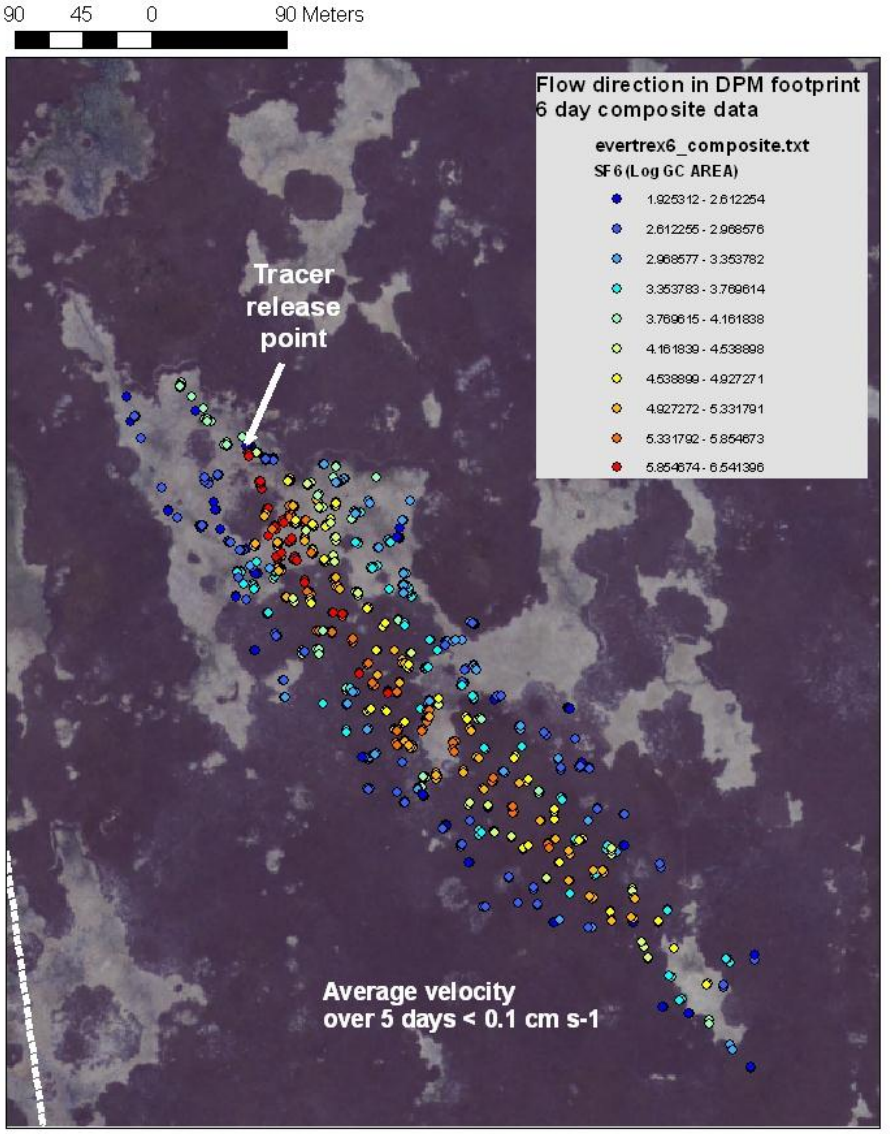


Figure 1. Surface water tracer release and recovery in the DPM footprint over a period of 5 days (Oct 8-12, 2009). 5L of the tracer was released and mixed by hand in the middle of a remnant slough on October 7th. Flow direction is southeast. Highest tracer amounts shown in red, lowest in blue.

Ho and Engel unpublished data

DPM-related presentations to see at INTECOL

- **Barry Rosen ---** Wednesday at 11:20 – Session: Everglades Nutrients and Water Quality. *Cyanobacteria Species from Florida Everglades Floc .*
- **Laurel Larsen ---** Wednesday at 2:20 – Session: Self-organized Landscapes. *Sediment redistribution and accretion feedbacks.*
- **Ann Hijuelos** --- Wednesday at 4:40 – Session: Wildlife, Exotics & Restoration. *Fish Use of Canals as Dry-Season Refuges.*
- **Jud Harvey ---** Thursday at 1:40 -- Session: The Role of Flow and Hydrologic Connectivity in Floodplains and Wetlands. *Revealing the influence of flow dynamics and flood pulses.*
- **Colin Saunders (Katherine Skalak) ---** Thursday at 3:40 -- Session: The Role of Flow and Hydrologic Connectivity in Floodplains and Wetlands. *A physical model of flow reconnection.*
- **David Ho ---** Thursday at 4:00 -- Session: The Role of Flow and Hydrologic Connectivity in Floodplains and Wetlands. *Resolving km-scale flow patterns using SF6 tracer.*

DPM-related posters to see at INTECOL

- Jay Choi – Connectivity of Everglades Landscapes (CEL): a Tool for Relating Changing Flow Conditions to Functional Quality of Everglades Landscapes (#240)
- Laurel Larsen – Hydrologic Connectivity as a Window into Fluvial Landscape Pattern Origin, Degradation, and Restoration (#241)
- Geoff Sinclair – Assessing the Role of Mobile Organic in a Free- Flowing Everglades Sediments (#242)
- Michael Bush – Movement and Activity Patterns of Fishes in a Dynamic Landscape poster (#257)

Conclusion - The DPM is needed because:

1) The goals and targets of Decomp are constrained by a poor understanding of the mechanisms that restore and maintain a healthy Everglades landscape. It is "active" AM and deals with numerous uncertainties.

"Problems cannot be solved at the same level of awareness that created them". (Albert Einstein, 1879-1955)

2) It is not clear how WCA-3B will respond to a new hydrology. DPM moves restoration forward "incrementally" because it is within the footprint of the Decomp project.

"Prudence is an old maid courted by incapacity". (William Blake, 1757-1827)

Thank you for your attention