How does the Decomp(artmentalzation) Physical Model help move Everglades Restoration Forward?

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National Conference on Ecosystem Restoration

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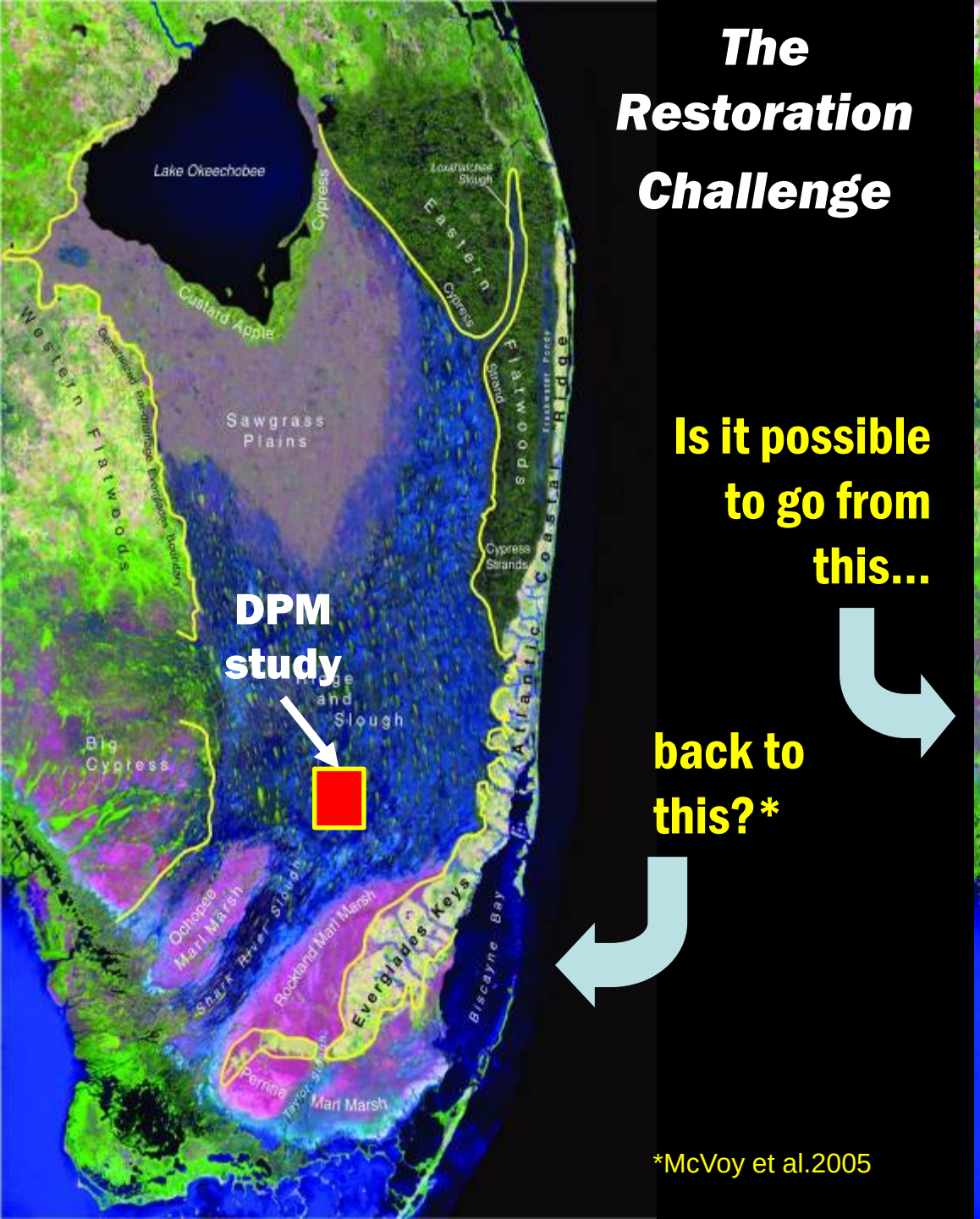
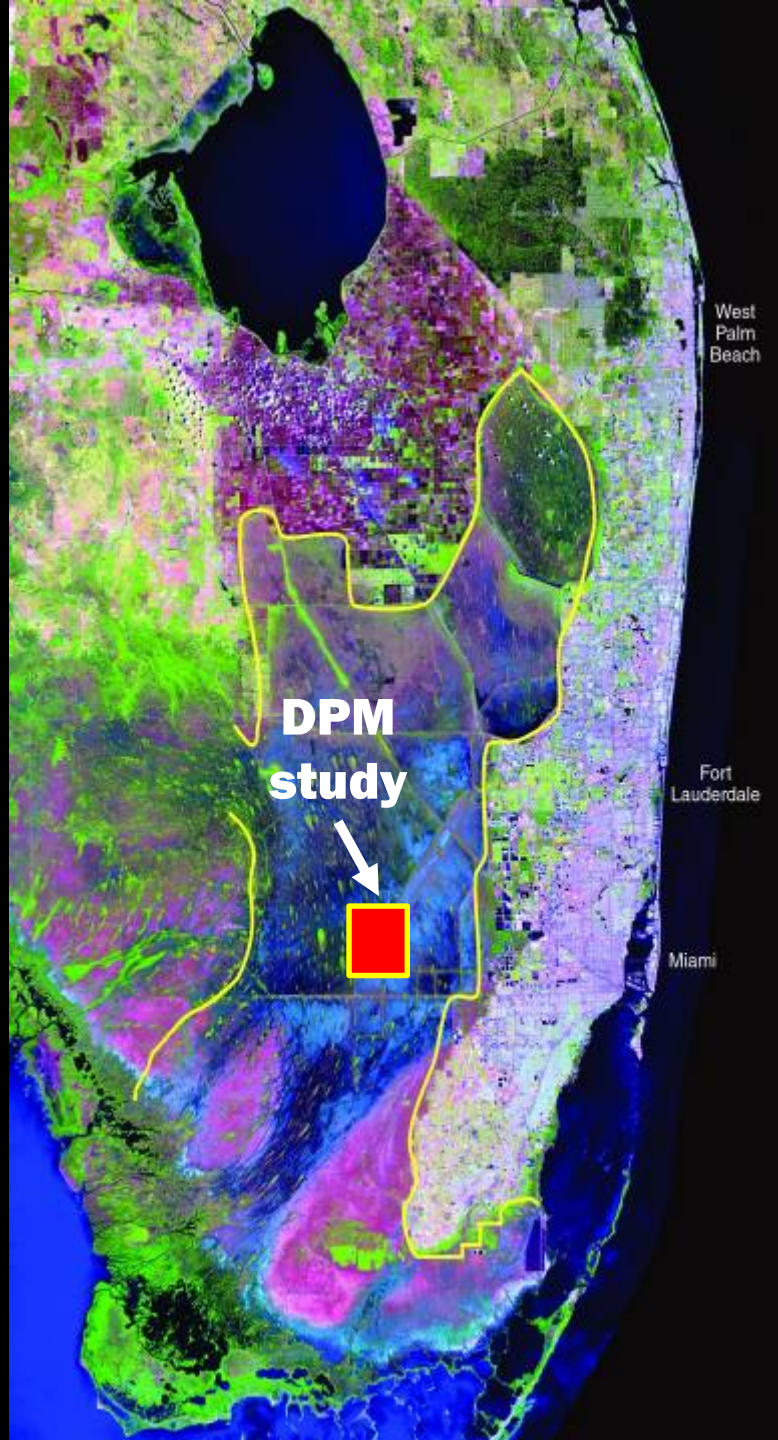
The Restoration Challenge

Is it possible to go from this...

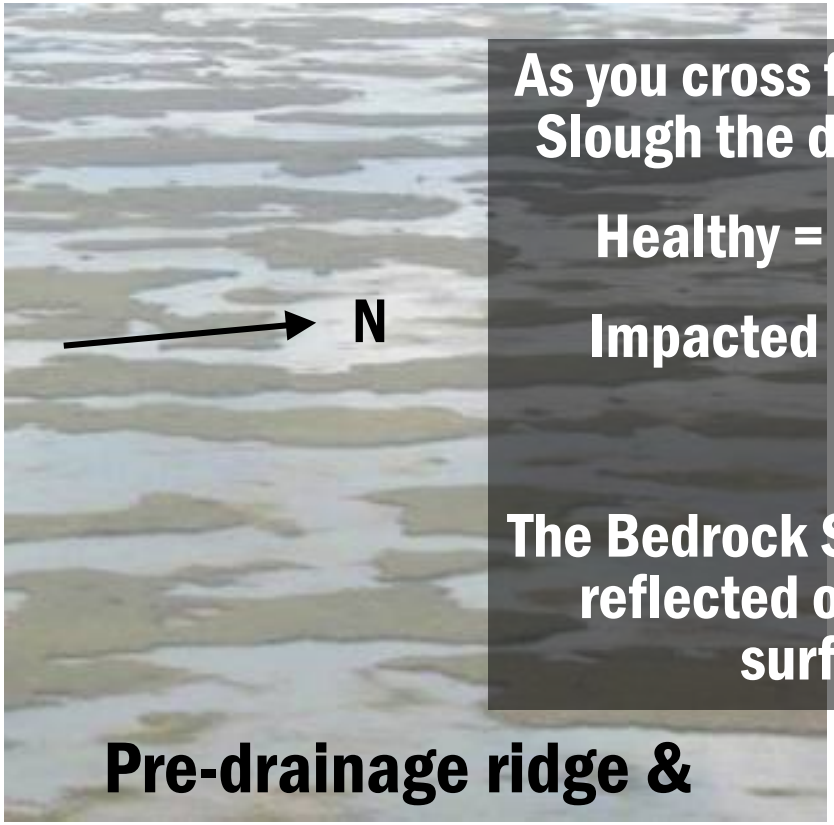
back to this?*





*McVoy et al.2005

Flow …
A Critical Piece of the Restoration Puzzle



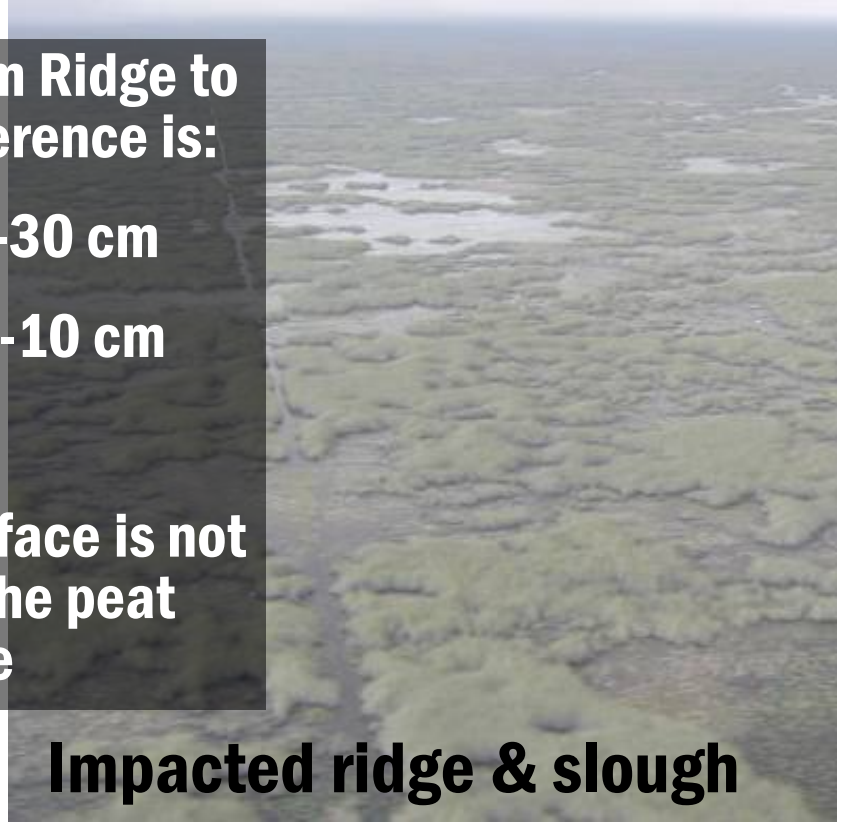
Pre-drainage ridge & slough landscape

As you cross from Ridge to Slough the difference is:

Healthy = 20-30 cm

Impacted = 0-10 cm

The Bedrock Surface is not reflected on the peat surface



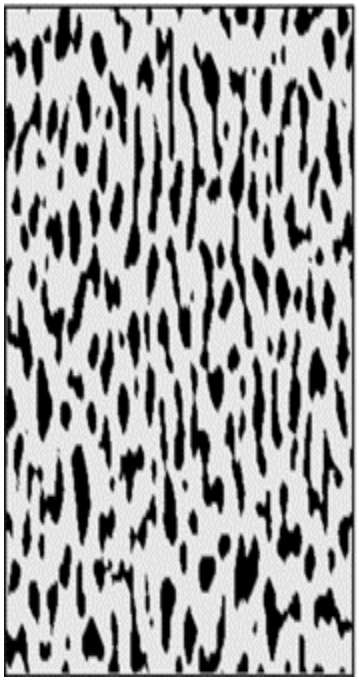
Impacted ridge & slough landscape

Flow …
A Critical Piece of the Restoration Puzzle

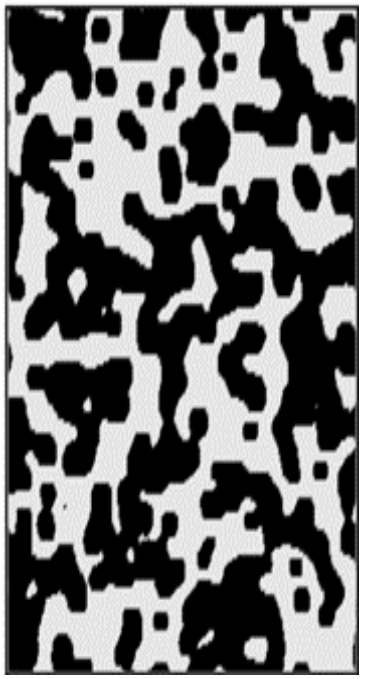
Pre-drainage ridge & slough landscape

Simulated Landscapes

With flow



Without flow

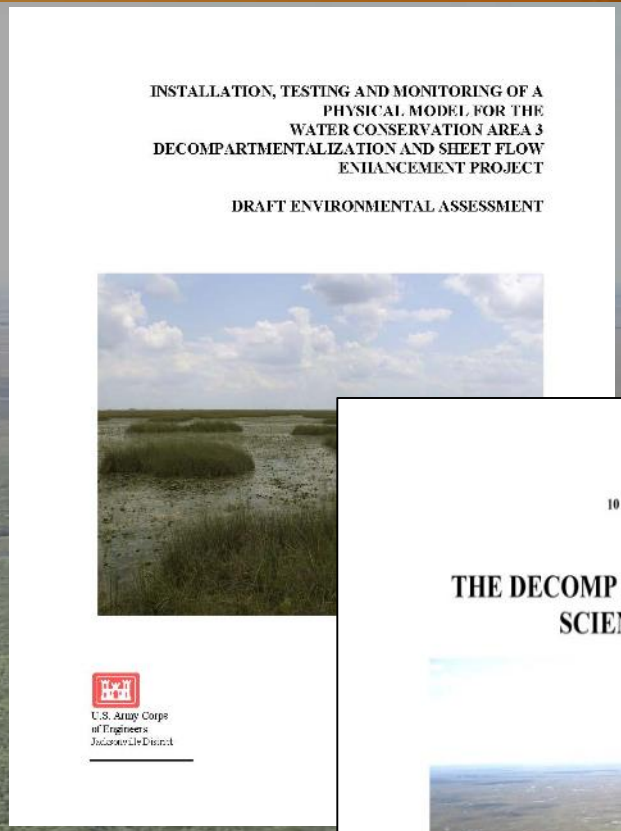


Larsen et al., 2011. Recent and Historic Drivers of Landscape Change in the Everglades Ridge, Slough, and Tree Island Mosaic *Critical Reviews in Environmental Science and Technology,* 41: 6, 344 — 381

The DECOMP Physical Model (DPM)

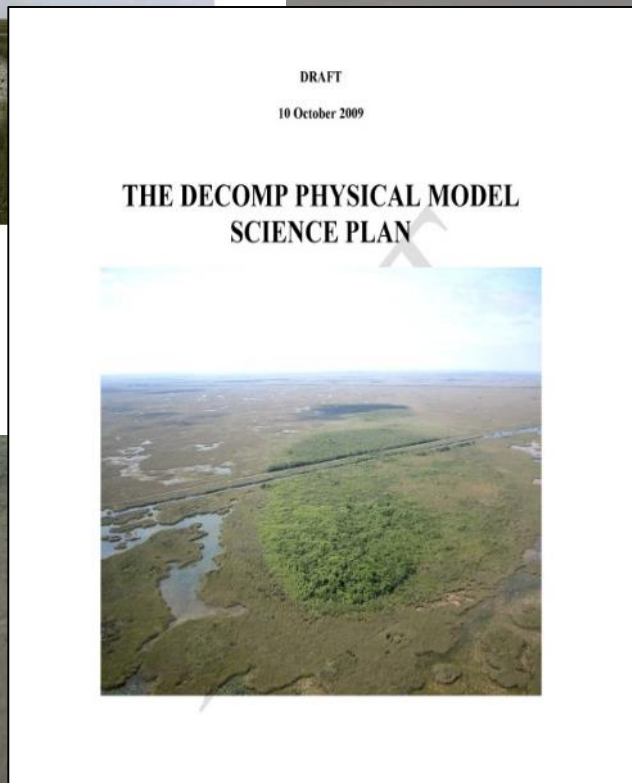
A landscape-scale field experiment to address scientific, hydrologic, and water management uncertainties for DECOMP

1. **Ecological benefits of sheetflow**
2. **Ecological benefits of removing levees and backfilling canals**


INSTALLATION, TESTING AND MONITORING OF A PHYSICAL MODEL FOR THE WATER CONSERVATION AREA 3 DECOMPARTMENTALIZATION AND SHEET FLOW ENHANCEMENT PROJECT

DRAFT ENVIRONMENTAL ASSESSMENT

U.S. Army Corps of Engineers Jacksonville District

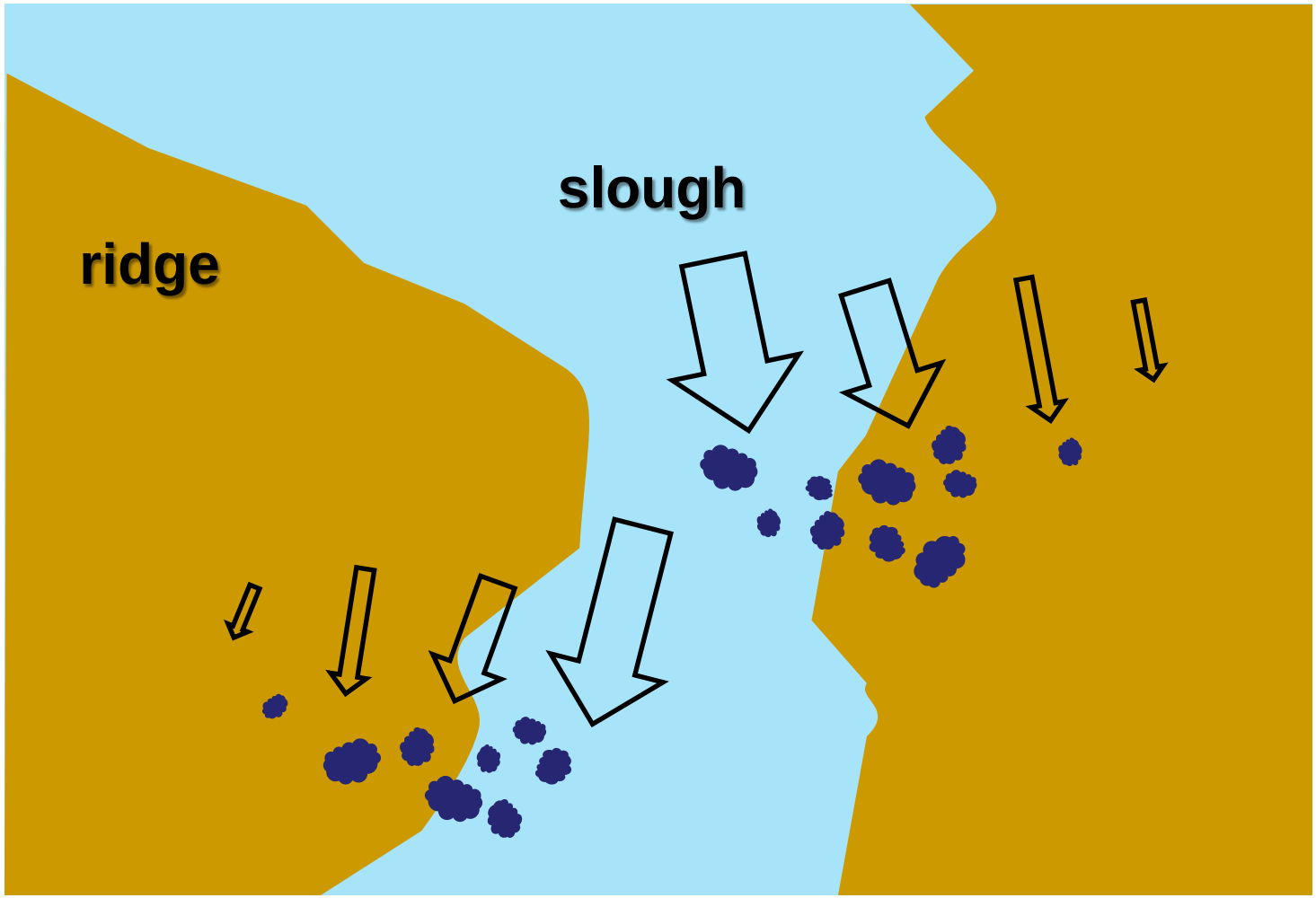

DRAFT

10 October 2009

THE DECOMP PHYSICAL MODEL SCIENCE PLAN

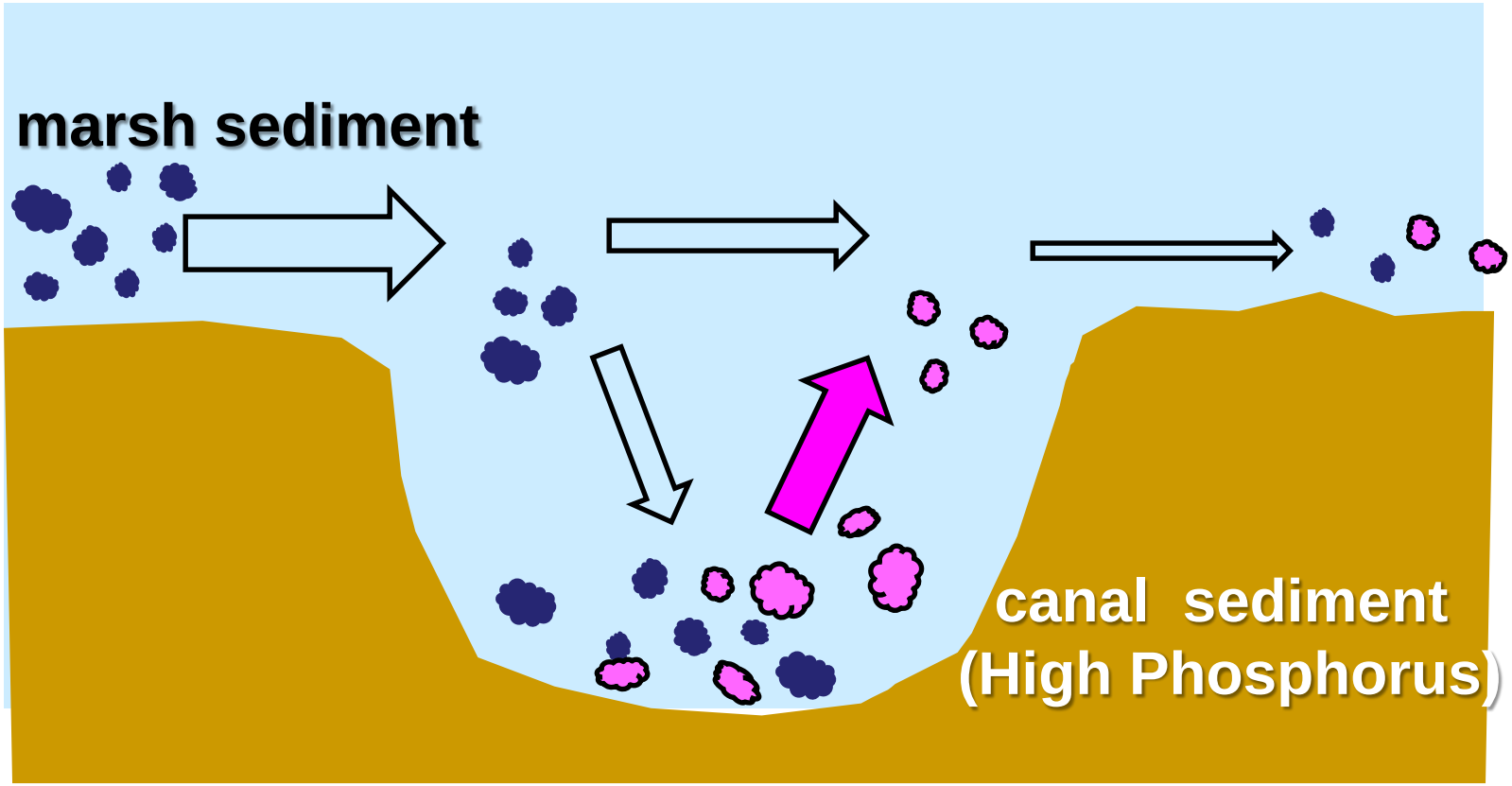
Sheetflow Hypothesis Cluster

- Do deep water sloughs exhibit higher velocities, more sediment transport?
- To what extent does high-flow redistribute sediment (slough to ridge)?

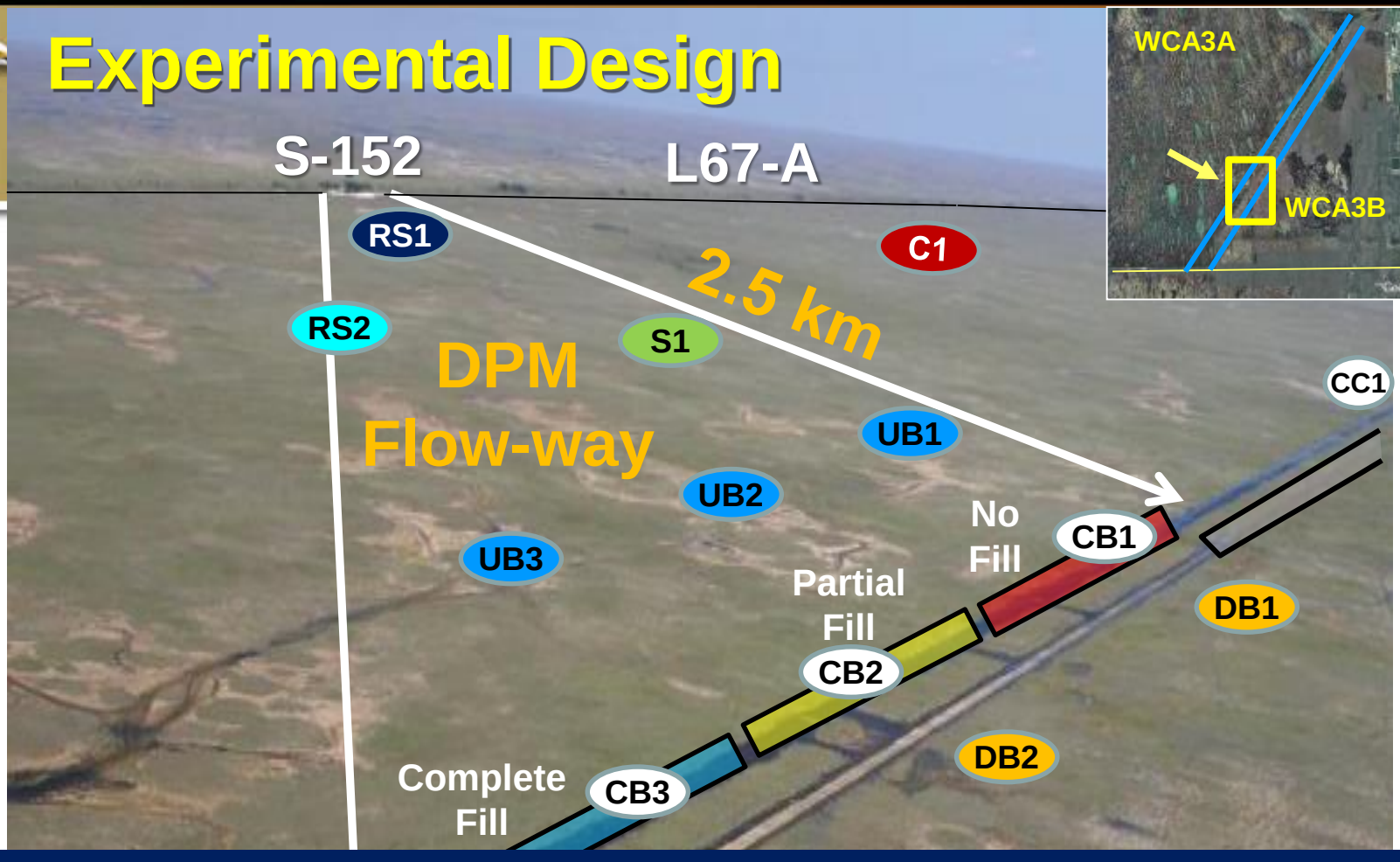


Canal Backfill Hypothesis Cluster

- Does backfilling help maintain natural sediment transport?
- Does backfilling reduce mobilization of canal sediments?
- Does backfilling impact fish populations?



Experimental Design



BACI TIME LINE

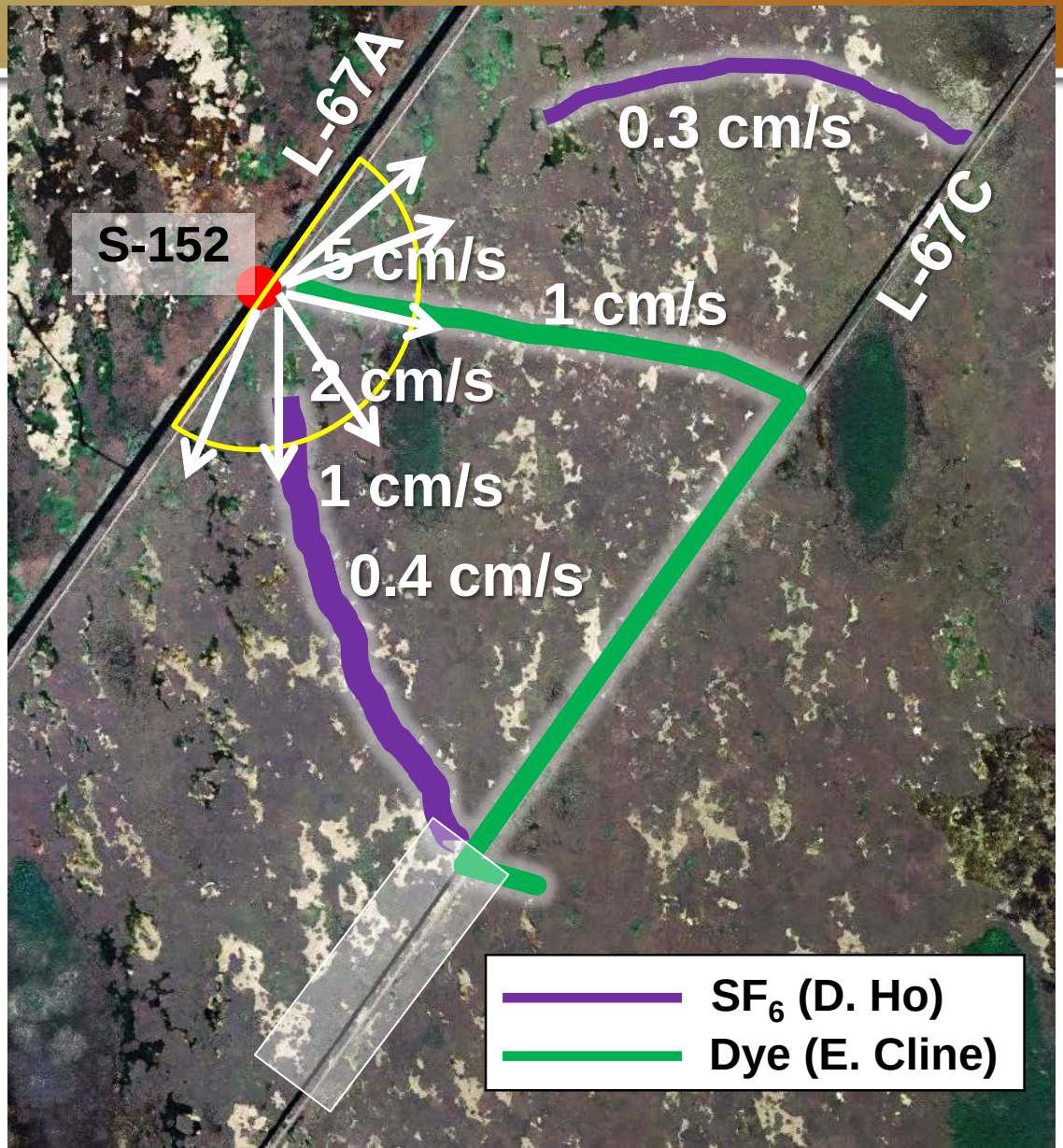
What is Being Measured?

- **Hydrology**
  - Hydraulics of L-67A culverts (head and tail water stages and cfs)
  - Tracer studies (SF6 tracer and dye)
  - A network of sites for stage, water depths, flow direction, and velocity
  - Synoptic mapping of water depth and velocity in conjunction with flow manipulations
  - Vegetation mapping for hydraulic resistance
  - Canal hydraulics

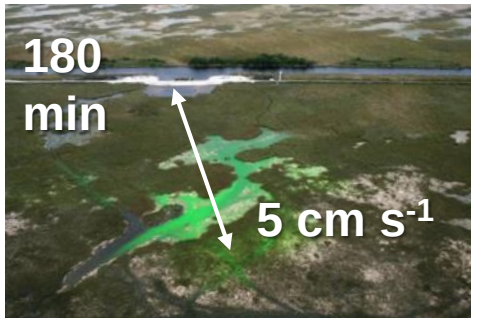
- **Sediment and Nutrient Dyamics**
  - Synoptic mapping of surface water biogeochemistry and sediment erosive properties
  - Resuspension and deposition of natural particles (LISST)
  - Particle transport (Floc tracers, sediment traps, biogeochemical markers)

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

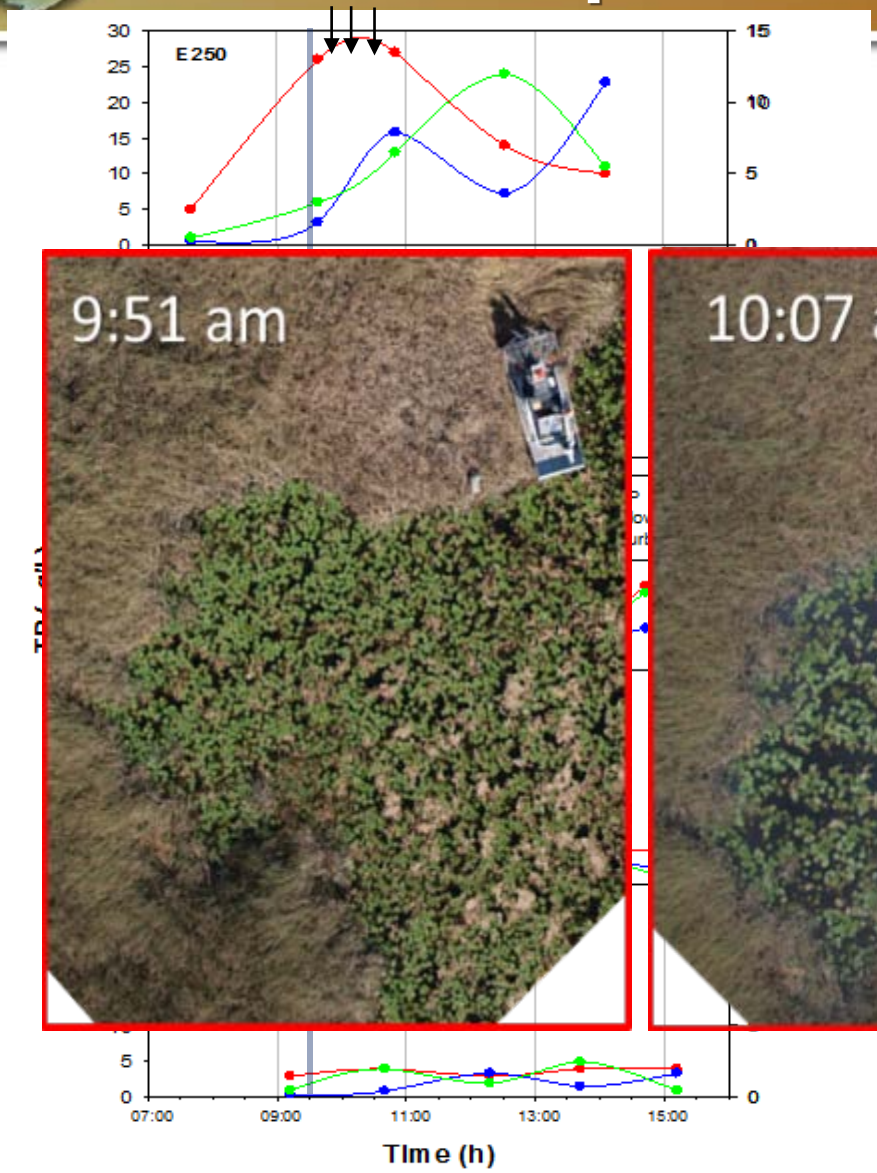
Flow field resolved with water tracers



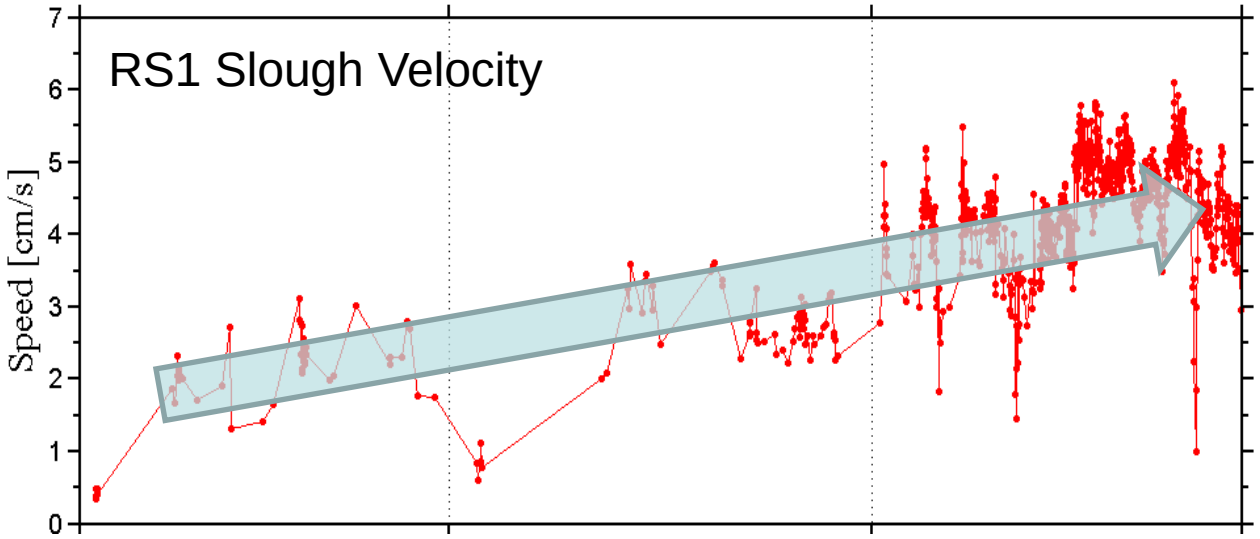
Dye tracer, 2013

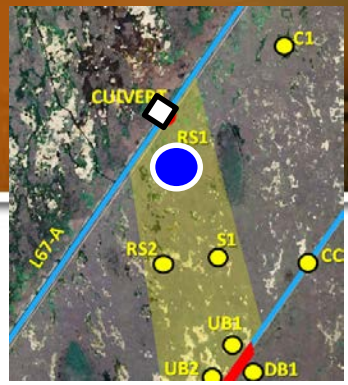


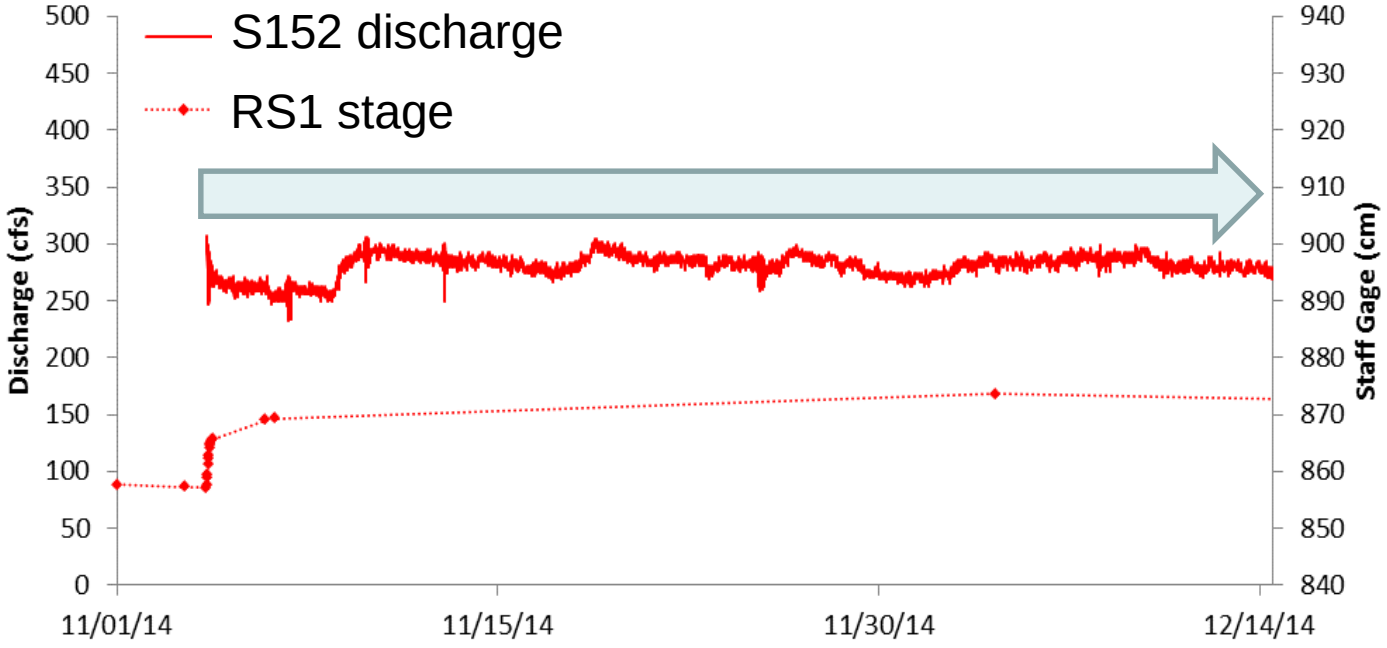
The Initial Pulse - Tracking Sediment and Phosphorus Across the Landscape



S. Newman, E. Tate-Boldt, C. Hansen, Christa Zweig (SFWMD)

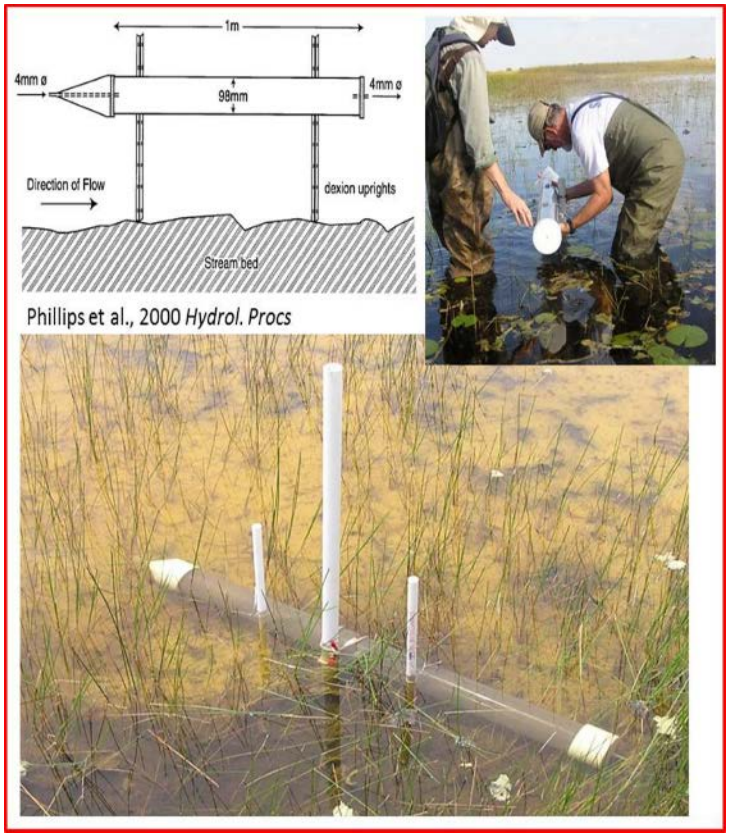




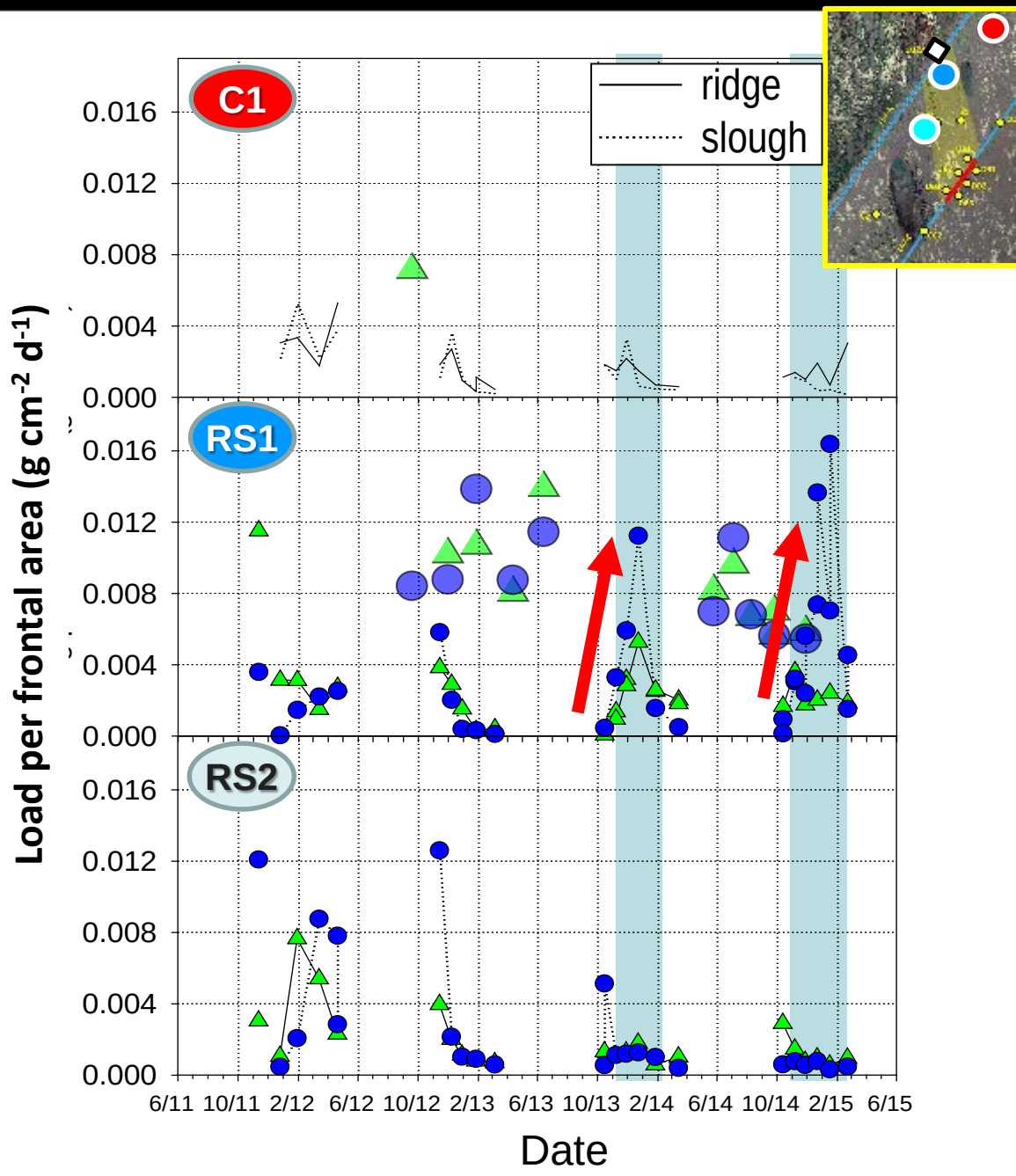


Flow velocities <u>increased</u> with flow duration and despite steady discharge

Data from Harvey, Choi, Dickman (USGS)



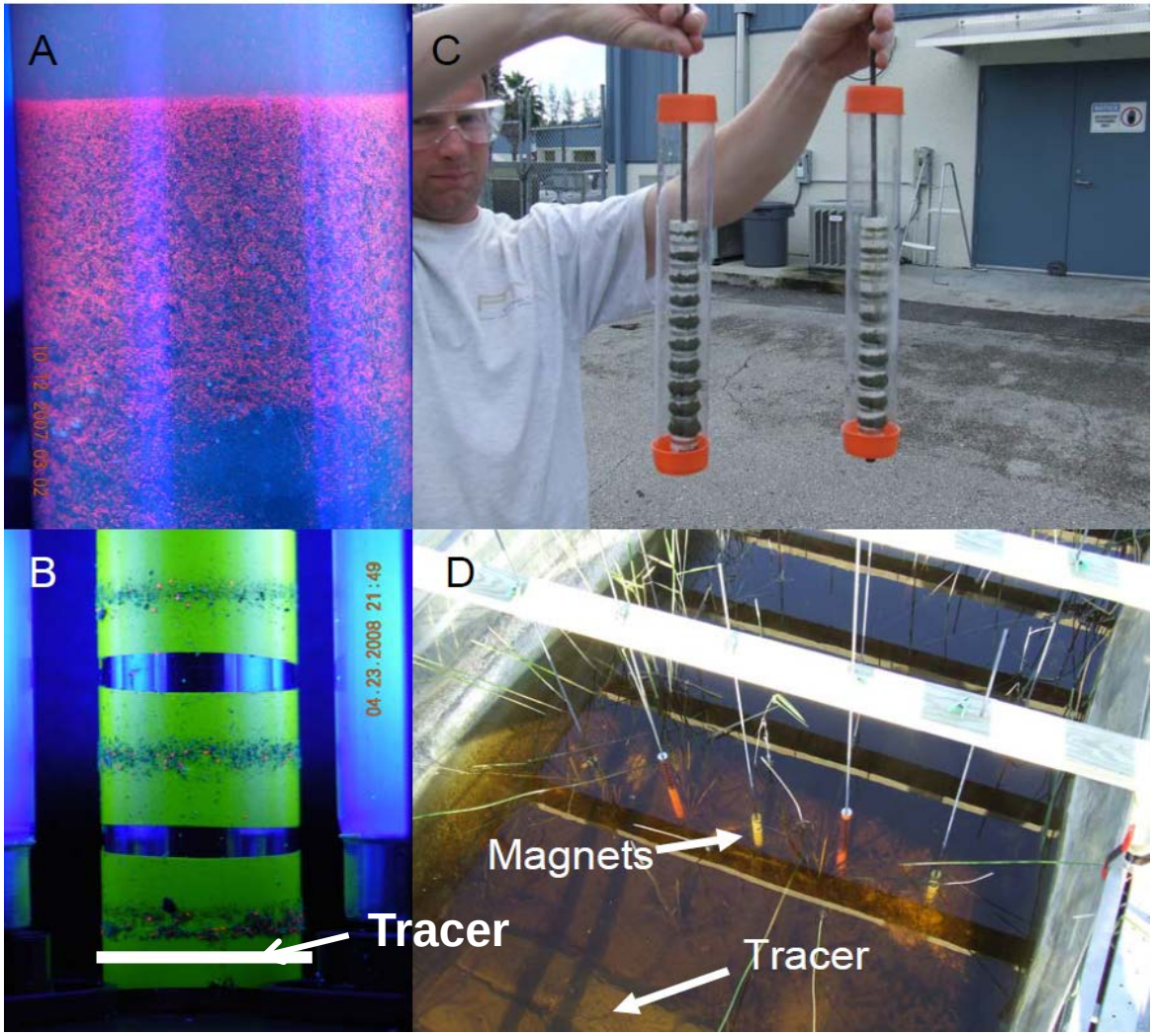
Sediment transport increased with sustained flow



Data from C. Saunders, SFWMD

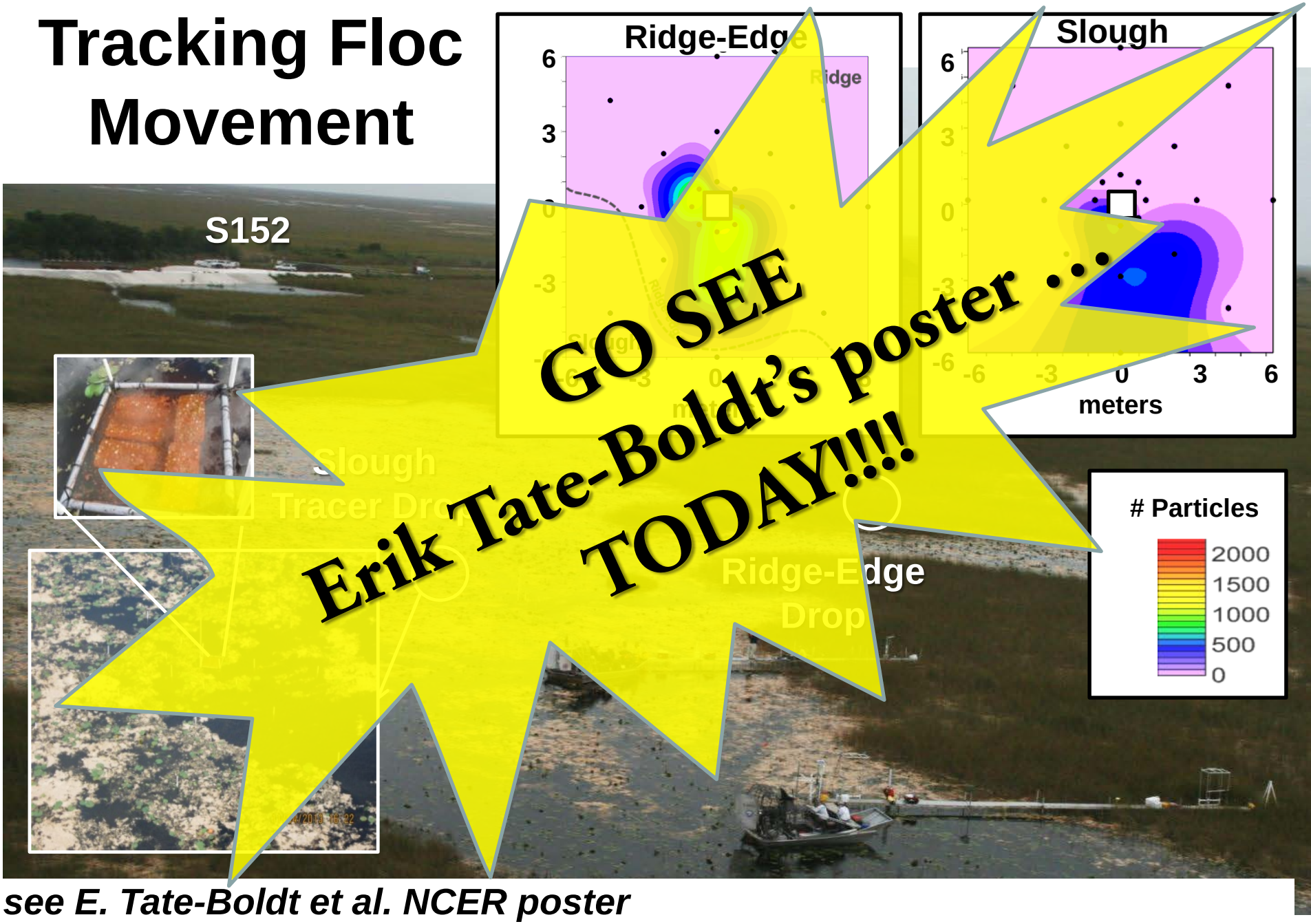
Tracking Floc Movement – Synthetic Tracer

- Physical properties matched to natural Everglades floc
- recaptured using 11 Guass magnets – synoptic surveys and downstream capture
- UV-fluorescent, different colors to track multiple cohorts



E. Tate-Boldt - NCER poster

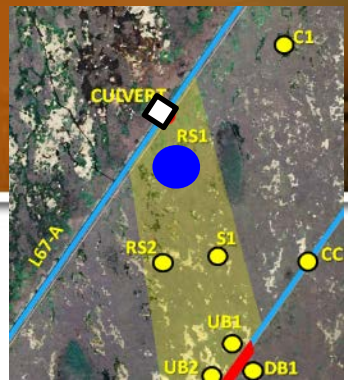
Tracking Floc Movement

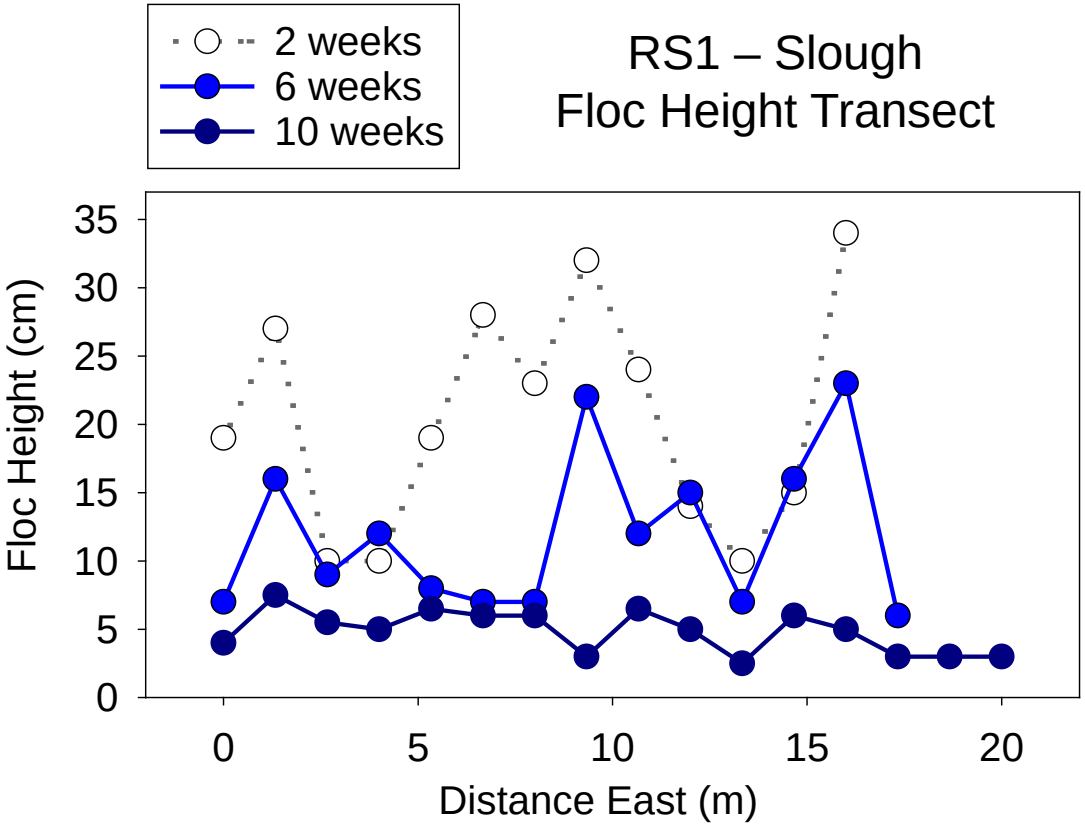


see E. Tate-Boldt et al. NCER poster

Video by C. Saunders - SFWMD

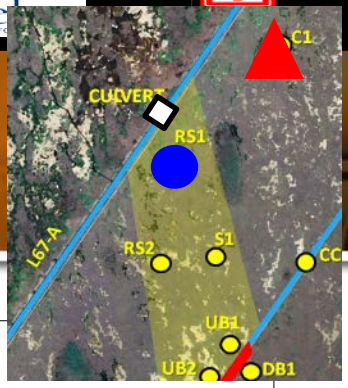
Slough Floc Reduced Under Sustained Flow

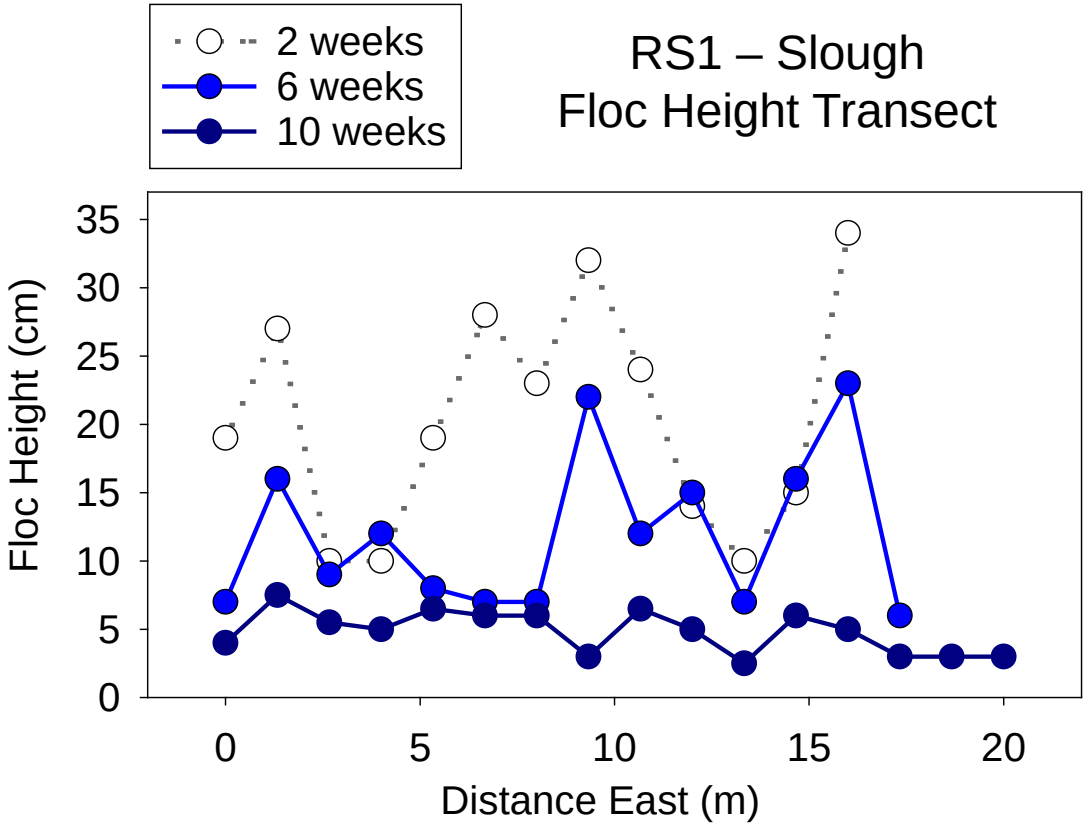


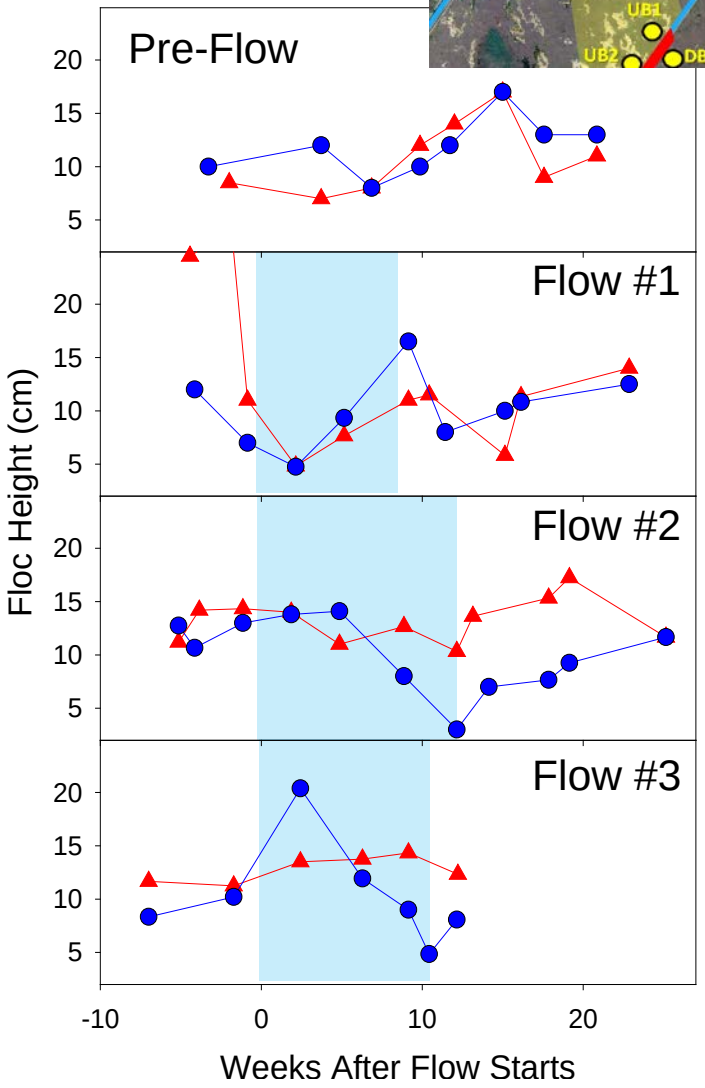


Data from C. Saunders, E. Tate-Boldt, C. Hansen, S. Newman - SFWMD

Slough Floc Reduced Under Sustained Flow





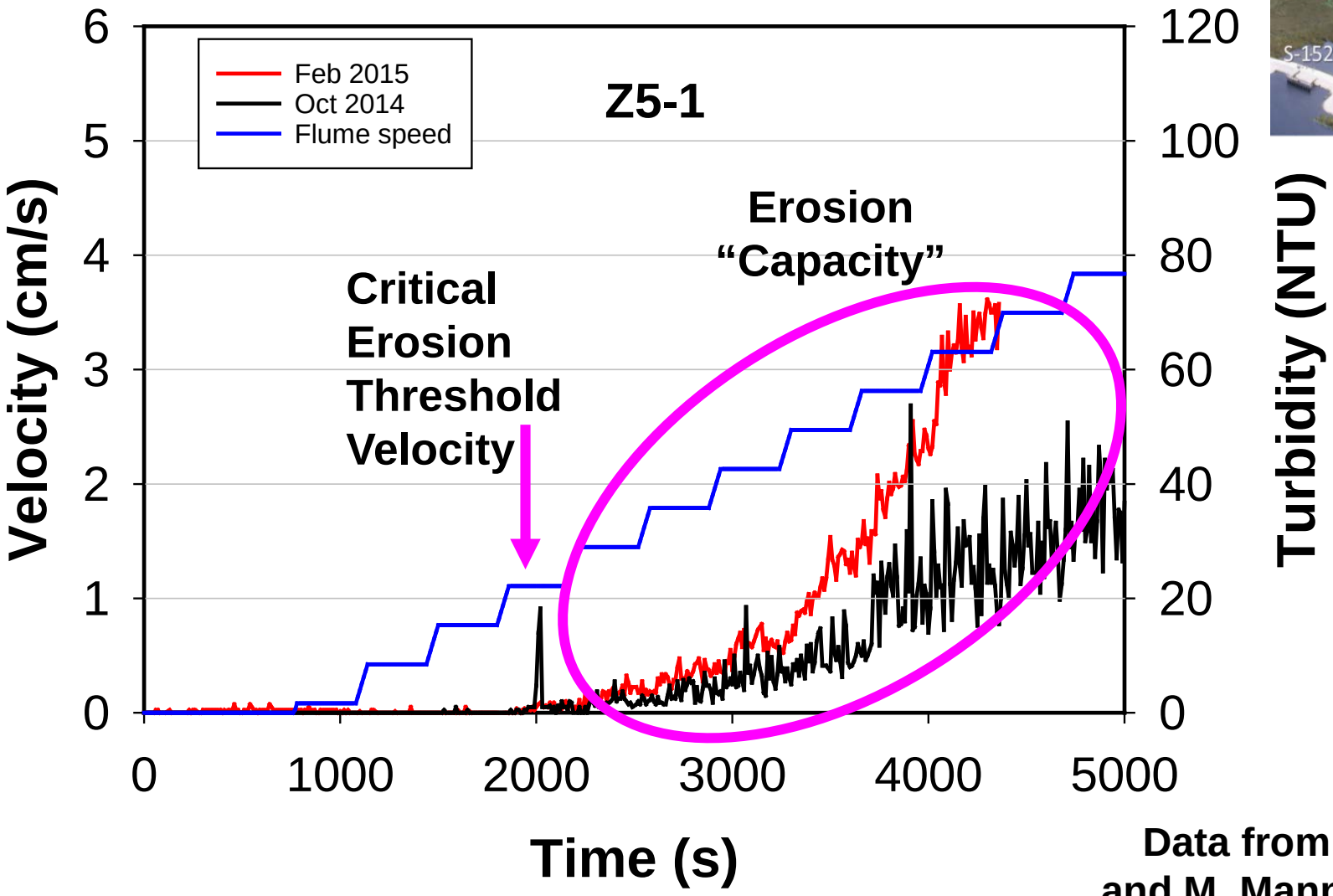


Data from C. Saunders, E. Tate-Boldt, C. Hansen, S. Newman - SFWMD

Measuring Floc Erodibility - Benthic Annular Flume

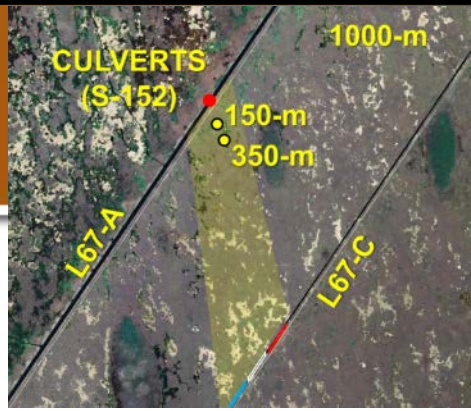
Photos from PARTRAC 2008. (Glasgow, UK)

Floc More Erodible After Sustained High Flow

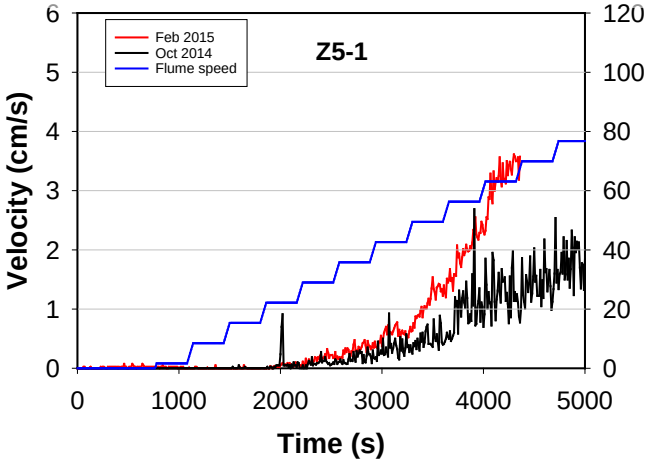


Data from S. Newman and M. Manna (SFWMD)

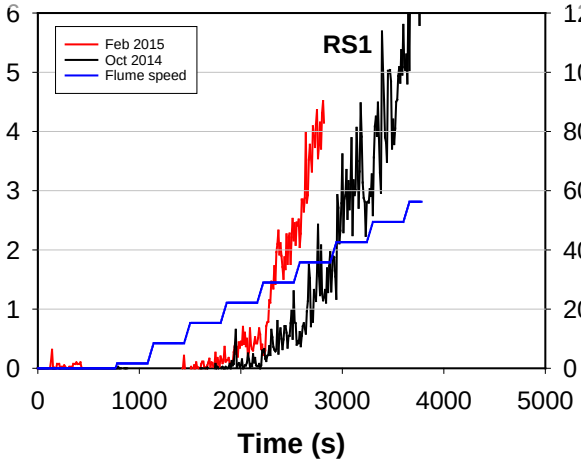
Floc More Erodible After Sustained Flow



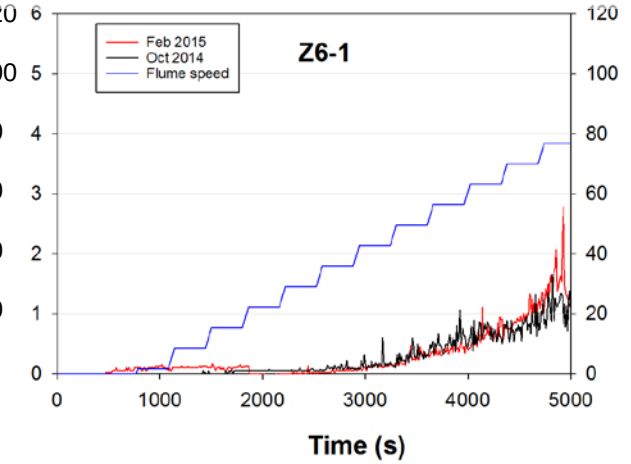
150-m (high)



350-m (high)

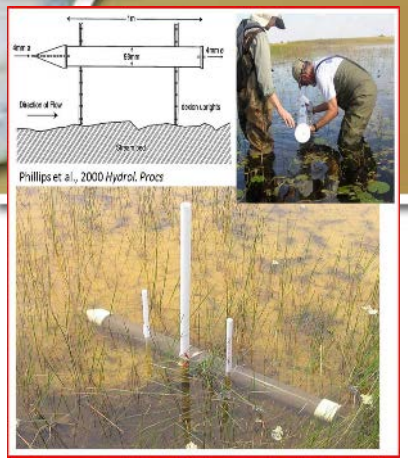


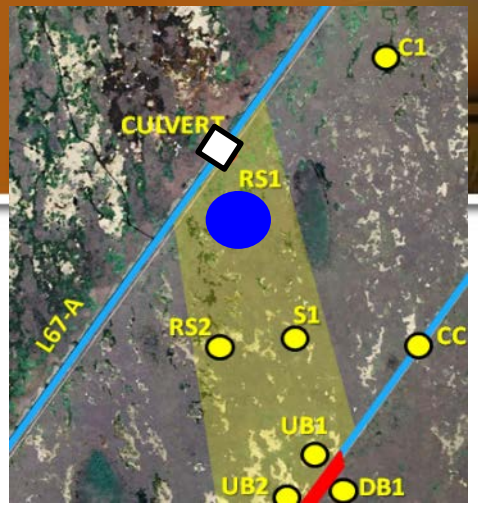
1000-m (Control)

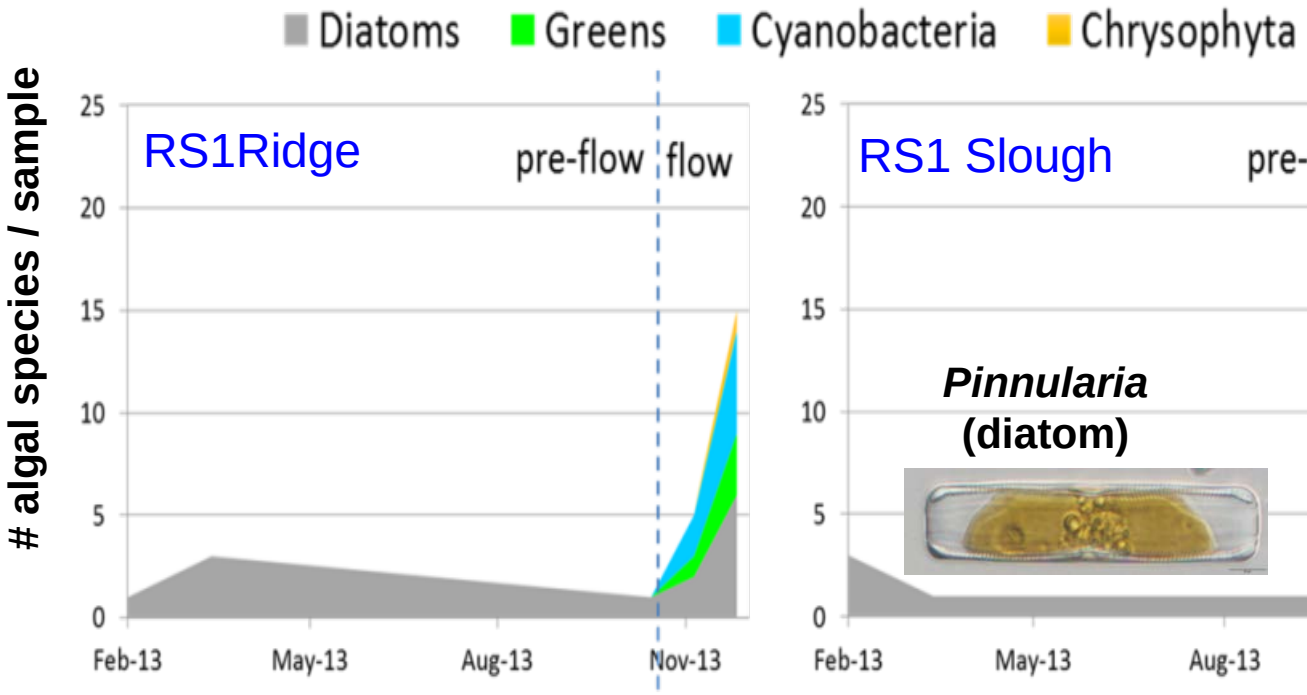


Data from S. Newman and M. Manna (SFWMD) - 2016 SFER

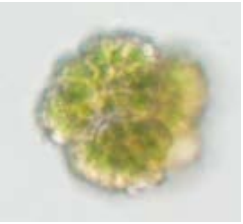
Changes in Algal Taxa of Advected Sediments







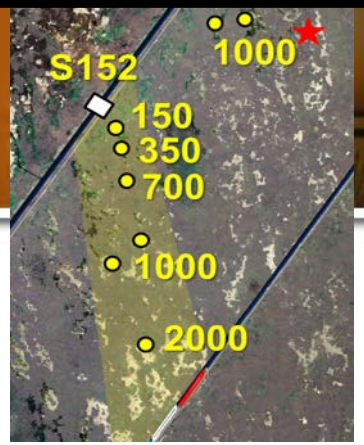
Pinnularia **(diatom)**

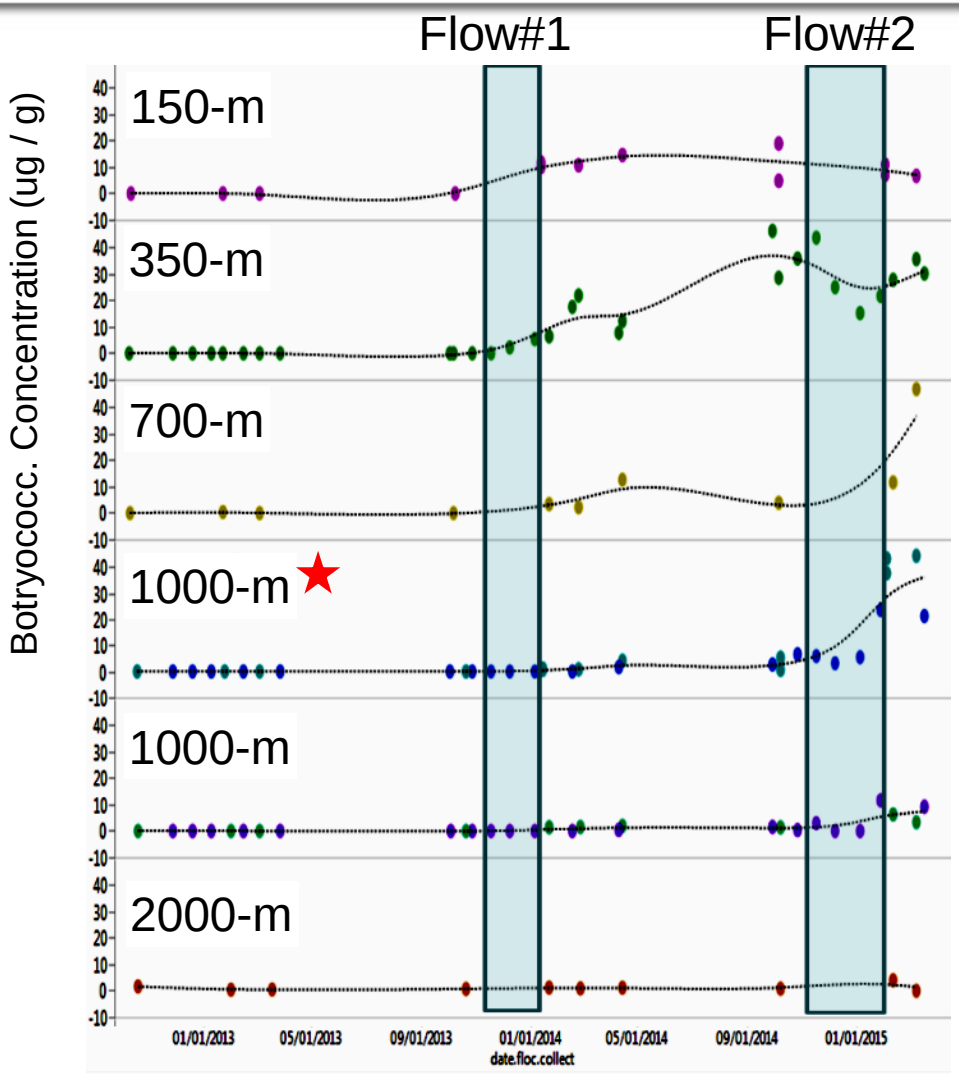


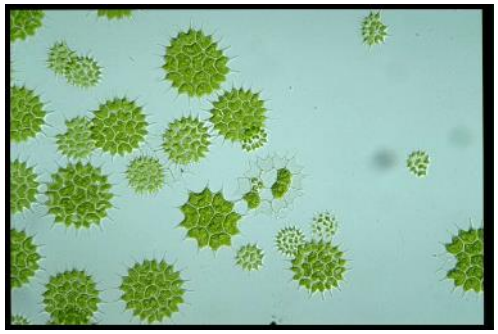
Botryococcus **(green alga)**

Data from B. Rosen (USGS)

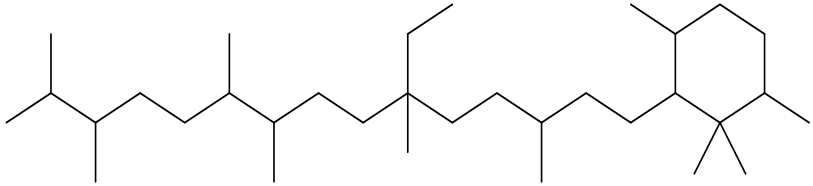
Biochemical Composition of Floc Changes with Flow







Green Algae



Botryococcanes

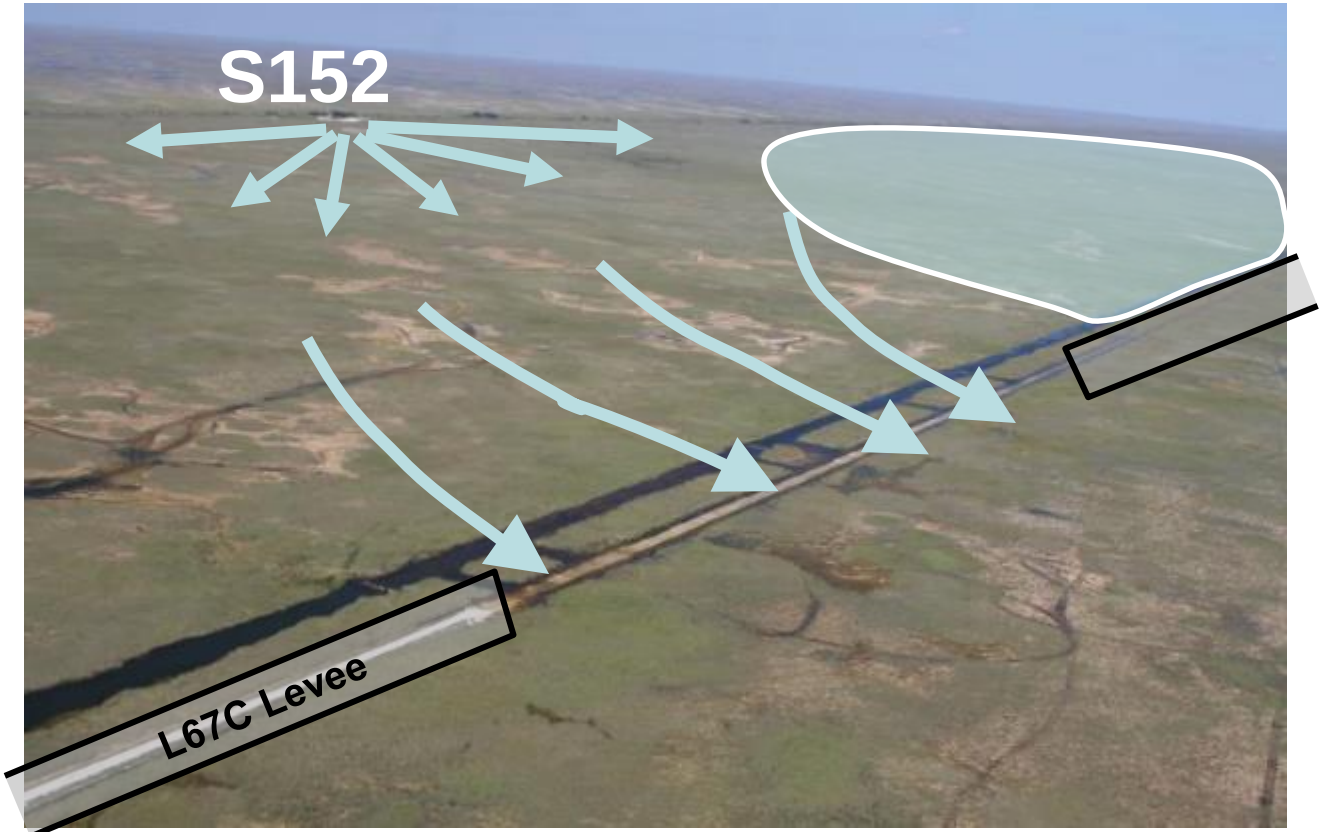
Data from R. Jaffe, P. Regier, D. He (FIU) - 2016 SFER

Restoration and Management Implications – Findings from the Ridge-and-Slough

- Sustained high flows of 8+ weeks effectively "clear sloughs" by self-reinforcing feedbacks → higher velocities, increased transport, reduction in floc
- Short-duration pulse flows increase suspended sediments 10-fold but limited spatial impact.
- High flows triggered mechanisms that rebuild topography – slough velocities sufficient to entrain and redistribute sediments from sloughs into ridges
- Restoration Milestones - After successive flow events, floc chemistry changes are observed farther downstream. Monitoring "fast responding" parameters could set expectations about how landscapes respond to restored flow

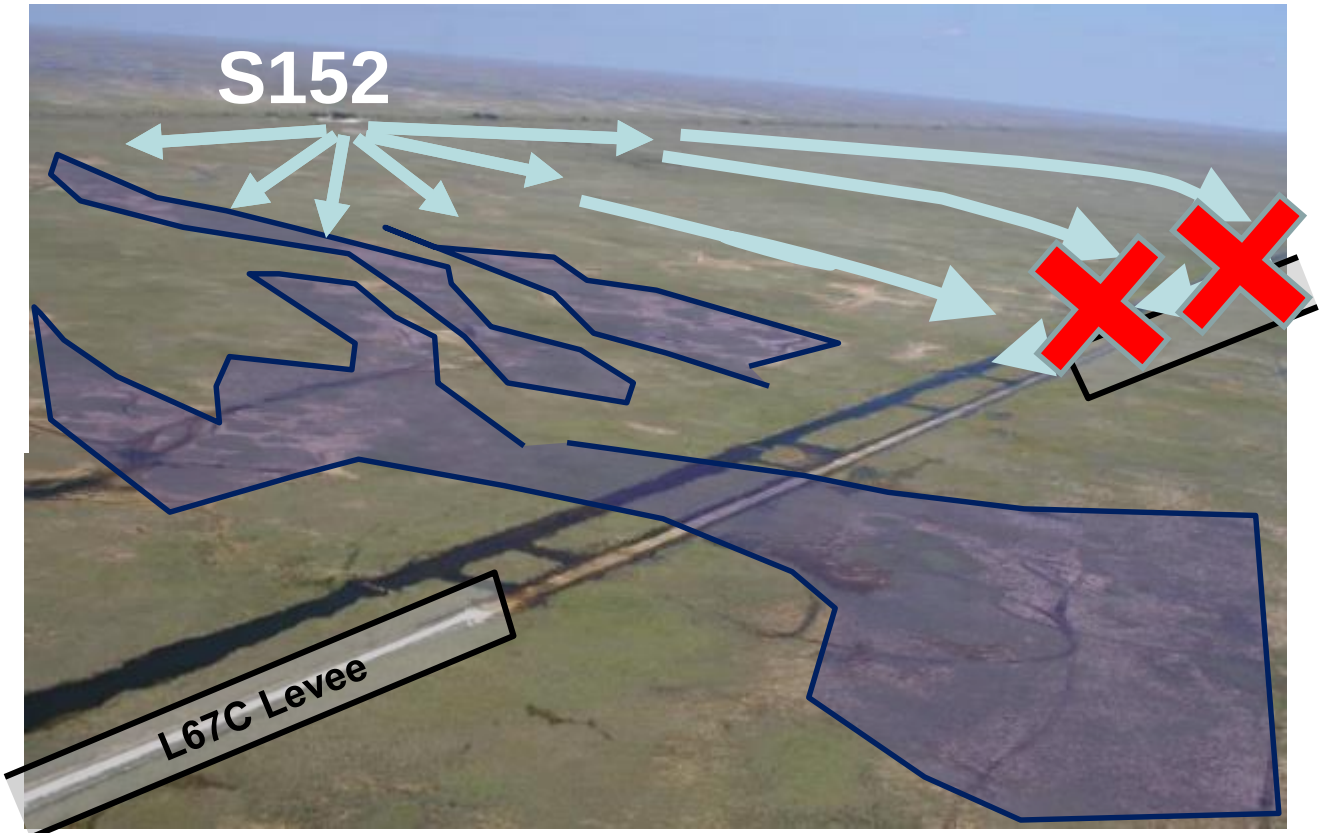
Sheetflow Restoration -The *Big* Picture

- S152 flows move radially and preferentially eastward, diluting sheetflow and sediment transport
- Some water was expected to mound up along the L67C levee, redirecting flow south



Sheetflow Restoration -The *Big* Picture

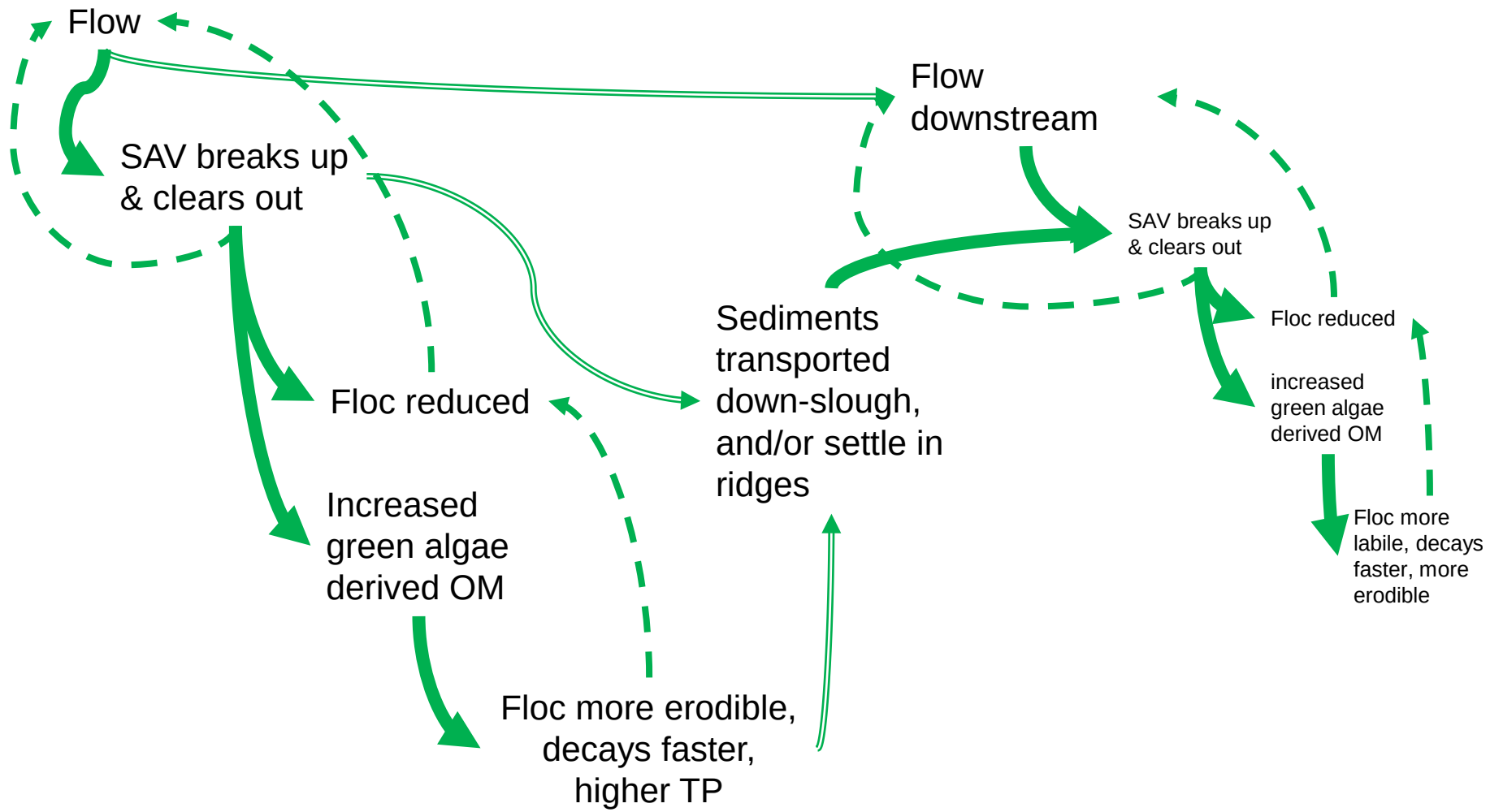
- That water is re-routed by the canal toward the gap, maintaining radial flow … and mobilizing canal sediments
- "Getting the flow direction right" requires 2 fixes
- Importance of doing adaptive management experiments ***in the restoration footprint***



The best time to plant a tree was 20 years ago. The second best time is now.

~Chinese Proverb

Physical & Biogeochemical-mediated responses in sloughs



Sheetflow Restoration -The *Big* Picture

- S152 flows move radially and preferentially eastward, diluting sheetflow and sediment transport
- Some water was expected to mound up along the L67C levee, redirecting flow south

*** **REALITY** ***

- That water is re-routed by the canal toward the gap, maintaining radial flow … and mobilizing canal sediments
- “Getting the flow direction right” requires 2 fixes - active adaptive management (opening up remnant sloughs) and measures to slow canal flows
- Importance of doing adaptive management experiments in the restoration footprint itself