Restoring Sheetflow in a Ridge-Slough-Canal-and-Levee landscape - A Synthesis of Tracers, Traps and Transport

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** With contributing authors*

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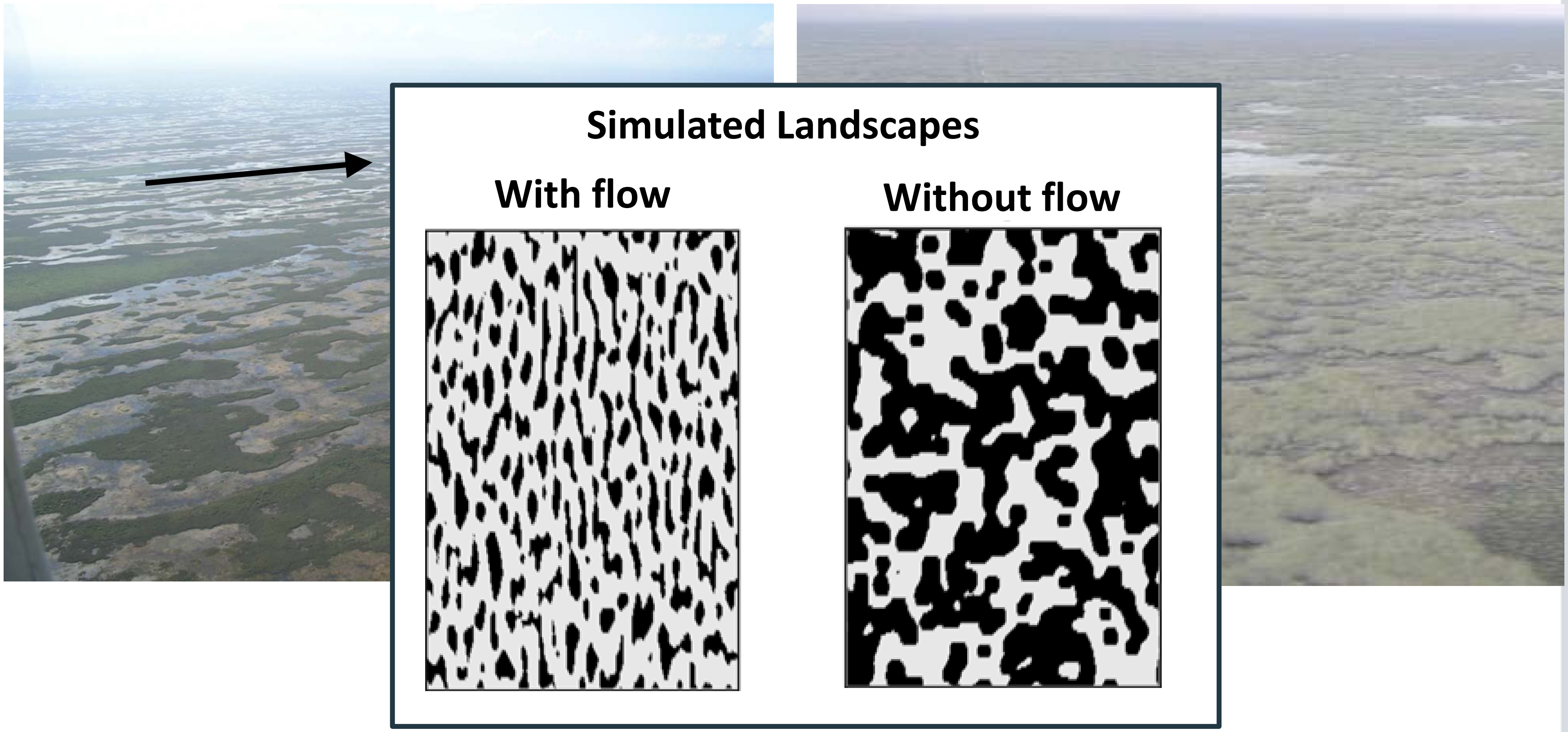
Flow – A Critical Piece of the Restoration Puzzle

Landscape Patterned by Flow **Degraded Landscape with no Flow**

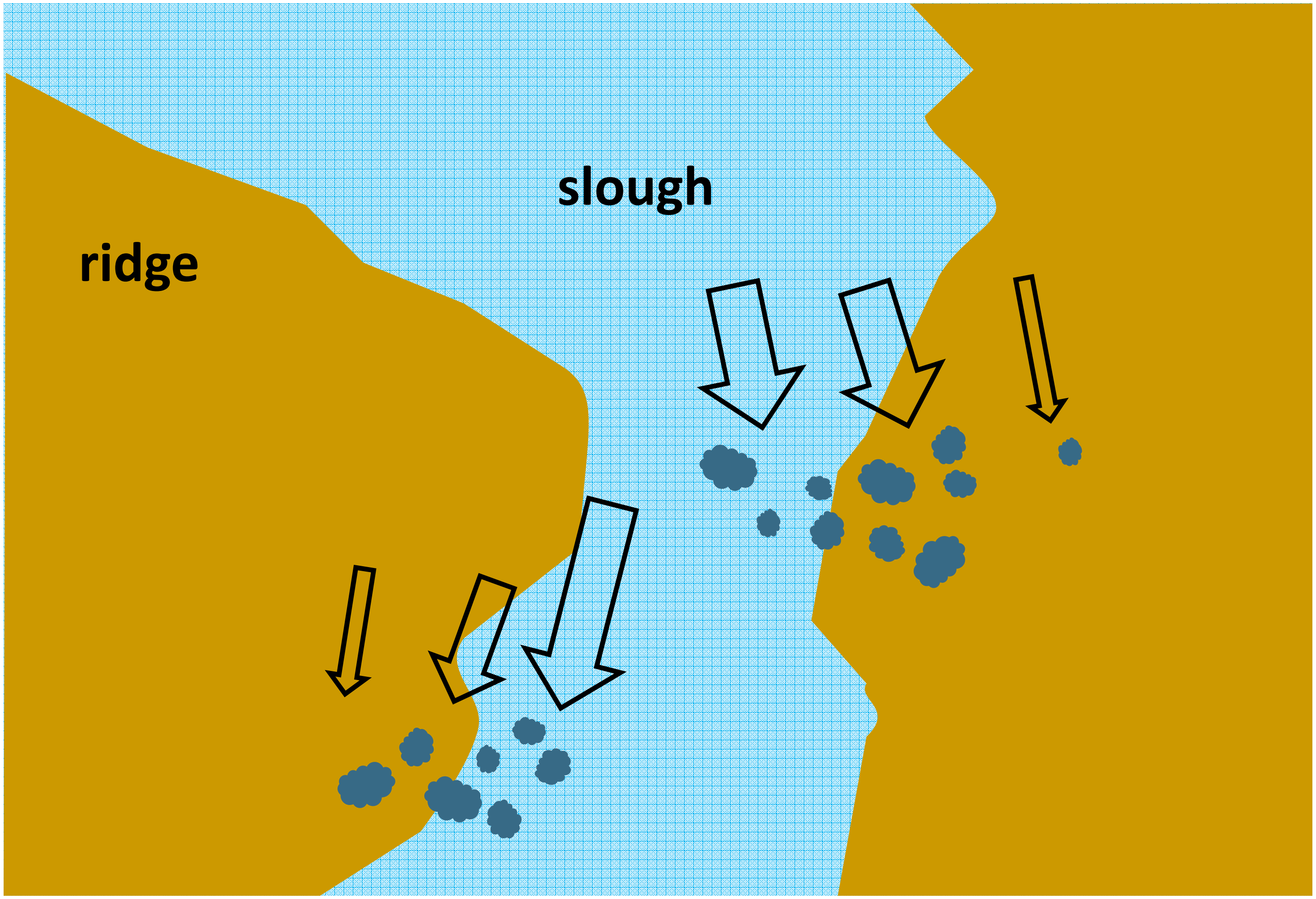


Larsen et al., 2011. Recent and Historic Drivers of Landscape Change in the Everglades Ridge, Slough, and Tree Island Mosaic *Critical Reviews in Environmental Science and Technology,* 41: 6, 344 — 381

Sheetflow Hypothesis Cluster

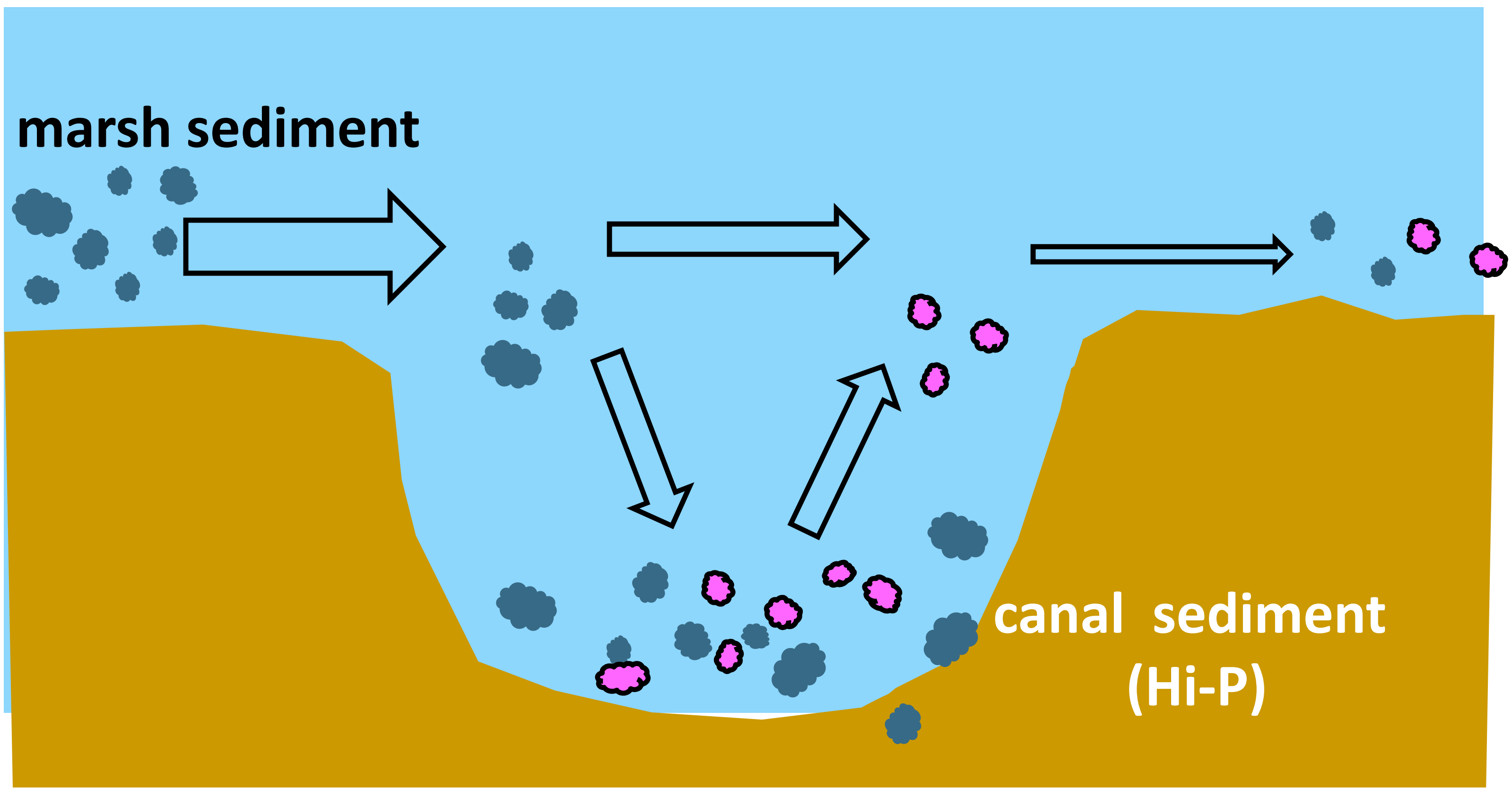
Deep water sloughs exhibit higher velocities, more sediment transport

High-flow redistributes sediment from sloughs into ridges

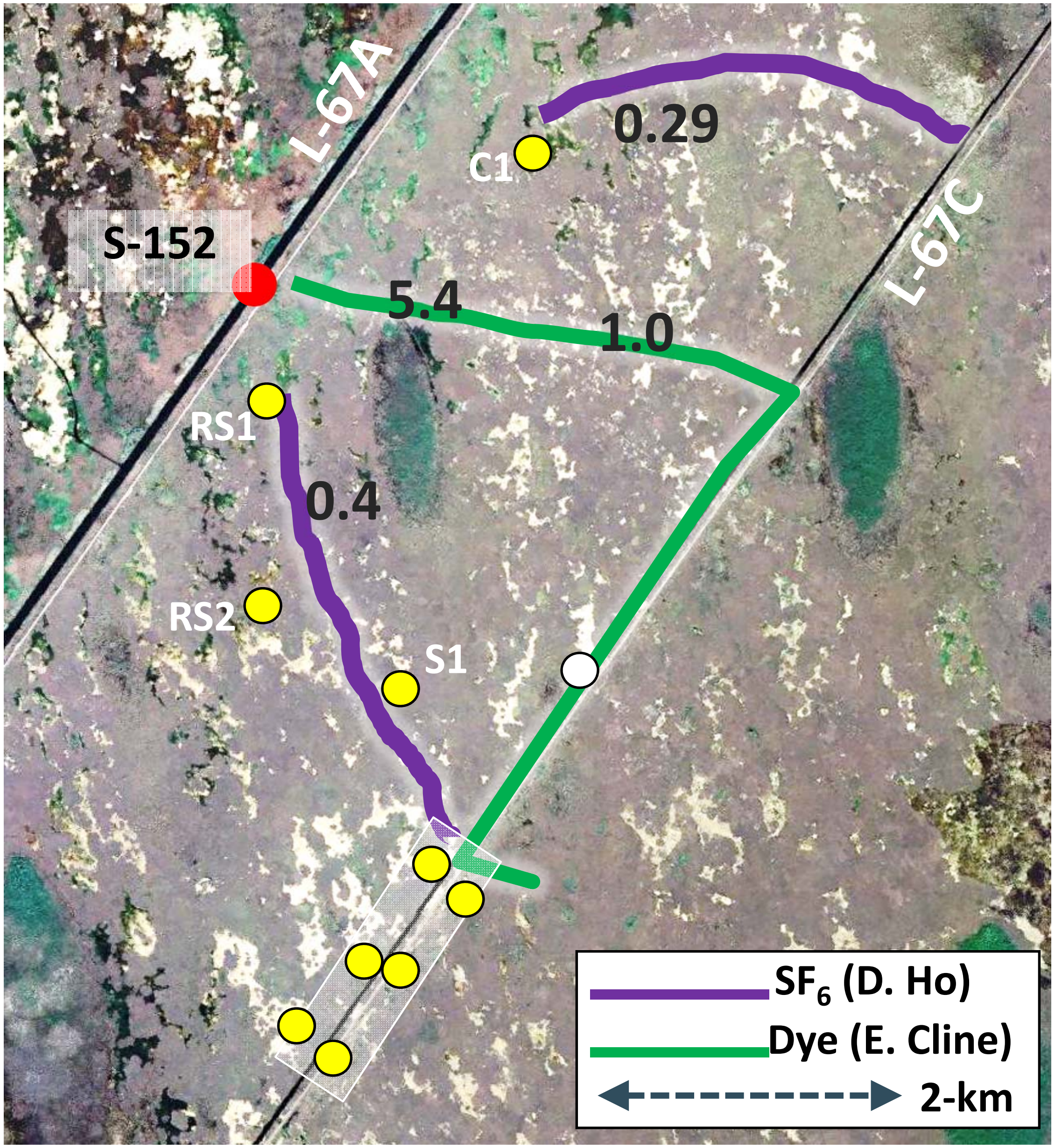


Canal Backfill Hypothesis Cluster

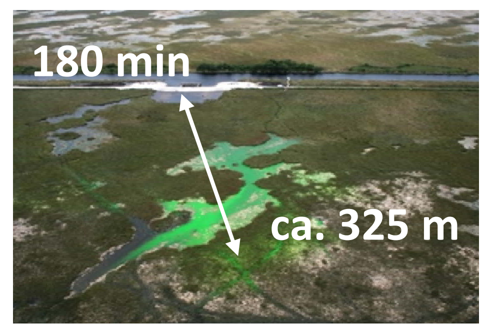
Is canal backfilling needed to maintain sediment transport?
Does backfilling prevent downstream nutrient loading



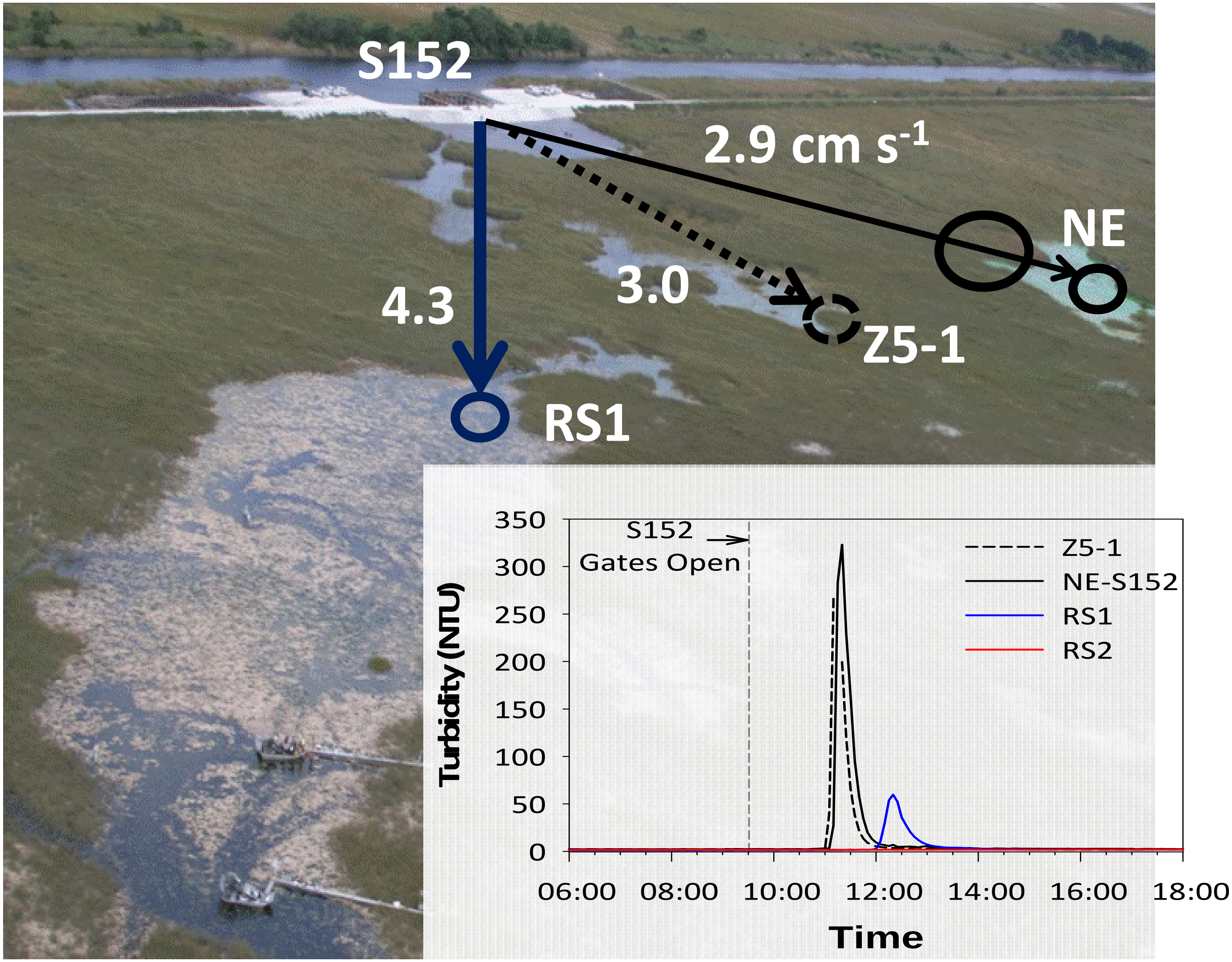
Results –Velocities (cm s^{-1}) at the Landscape-Level



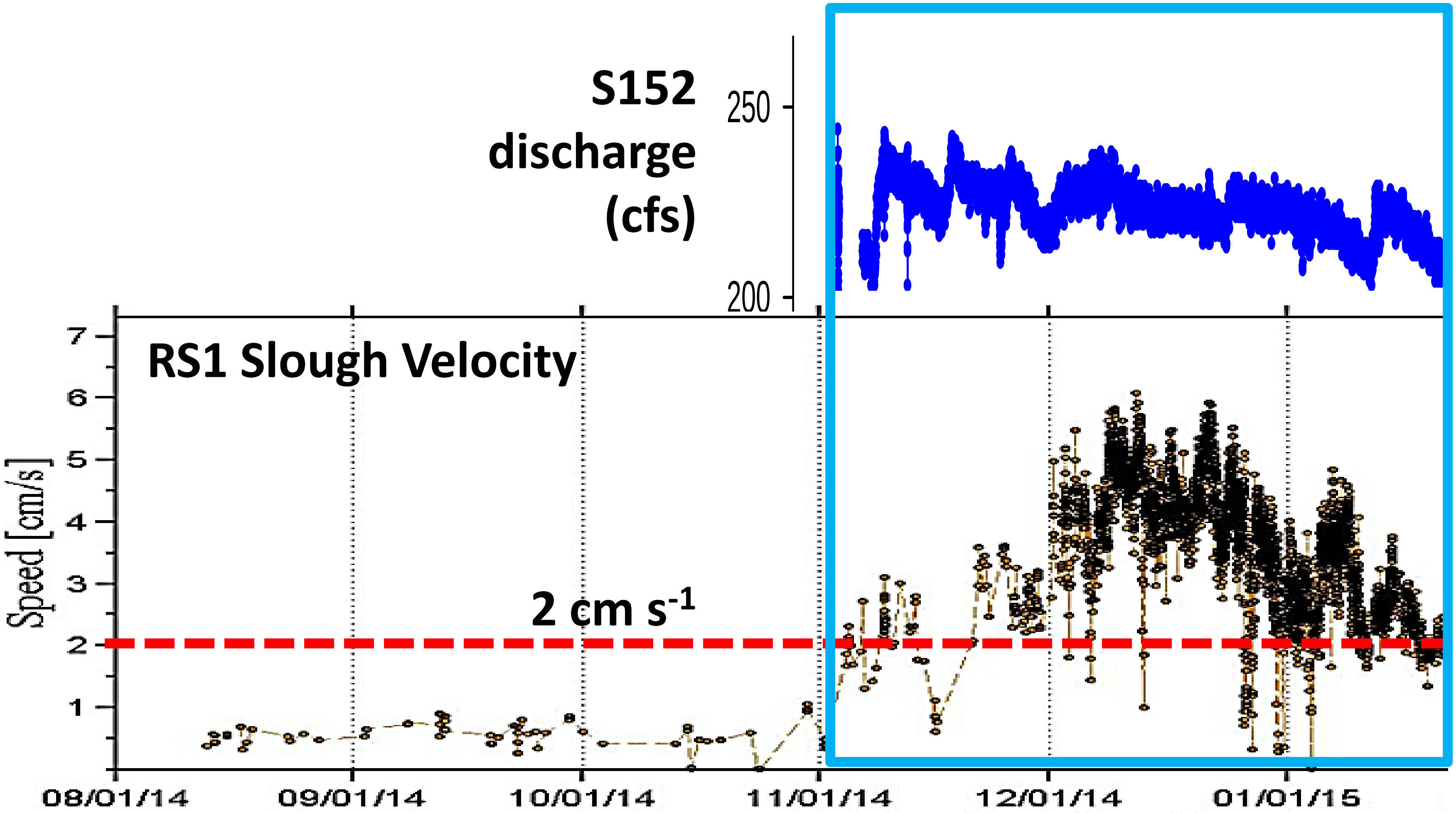
Dye tracer at S-S152



Results –Velocities (cm s^{-1}) at the Landscape-Level



RS1 Slough Velocity vs S-152 discharge Nov 2014-Jan2015



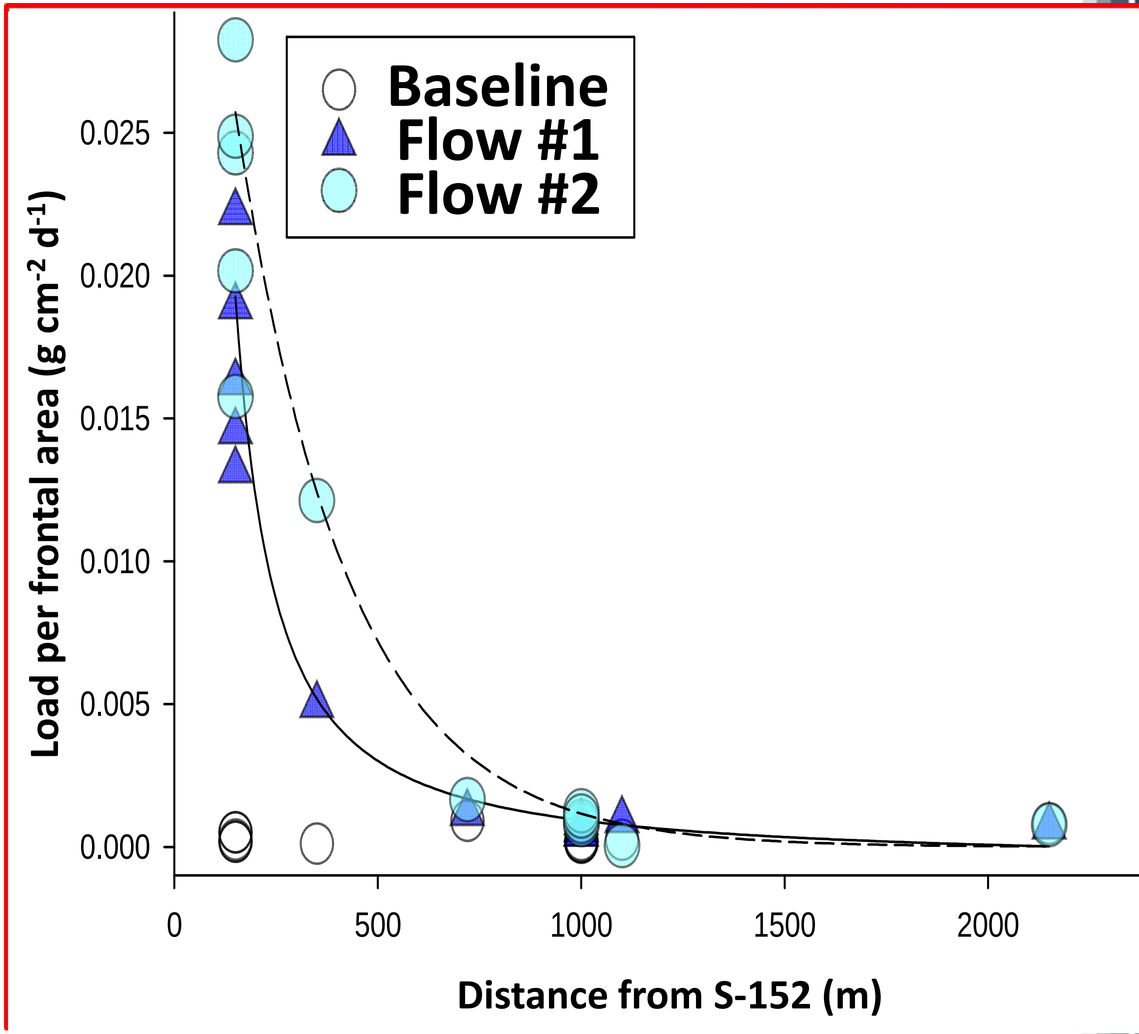
Data from Jud Harvey, Jay Choi and Mark Dickman, USGS

Monitoring Sediment Movement in the DPM

• Transport – TSS, Velocity	- J. Harvey, L. Larsen
• Sediment Entrainment	- L. Larsen, S. Newman
• **Horizontal Traps**	**- C. Saunders, C. Coronado-Molina**
• **Vertical Traps**	**- C. Coronado-Molina**
• **Synthetic Tracer**	**- E. Tate-Boldt**
• **Organic Biomarkers**	**- R. Jaffé**
• **Chemistry**	**- SFWMD, USGS**

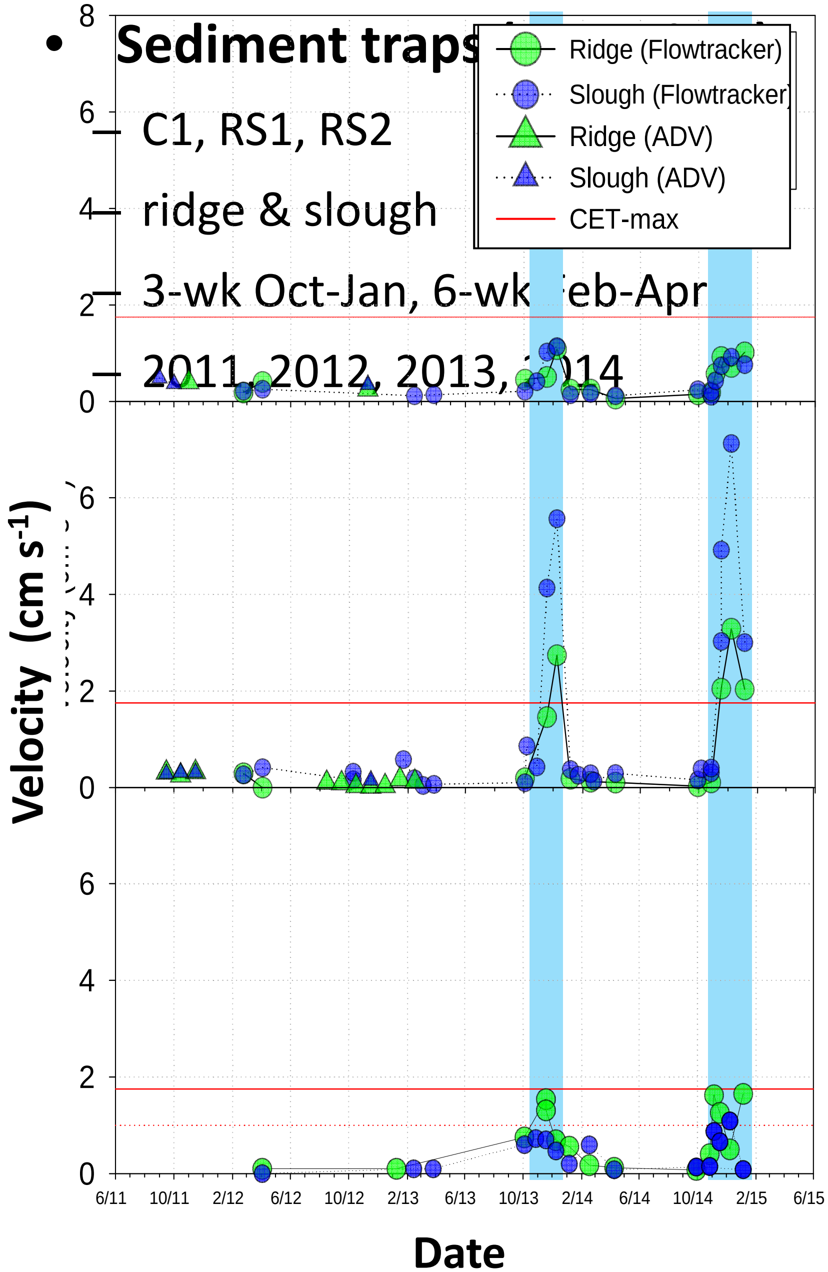
Flow Effects on Ridge-and-Slough Sediment Transport – Horizontal Traps

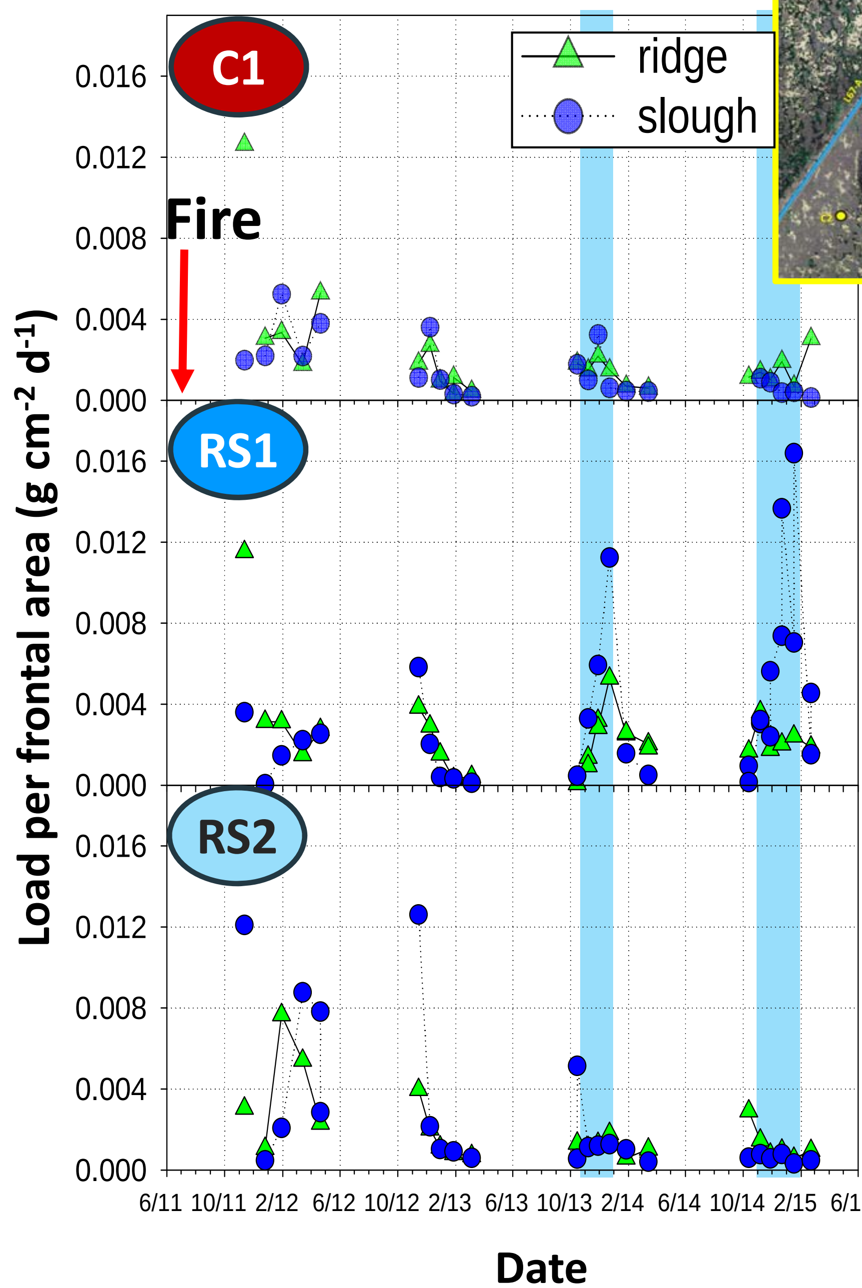
- **Sediment traps**
  - adapted from Phillips et al., 2000 *Hydrol Procs.*
  - Mid-water column, parallel to flow
  - Deployed at spatial sites
  - Nov-Jan 2012, 2013, 2014

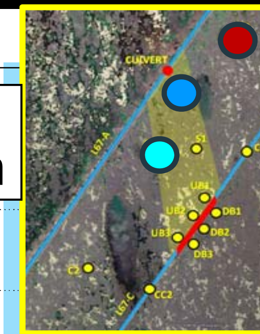


Data from C. Saunders, SFWMD

- **Sediment traps**
  - C1, RS1, RS2
  - ridge & slough
  - 3-wk Oct-Jan, 6-wk Feb-Apr
  - 2011, 2012, 2013, 2014



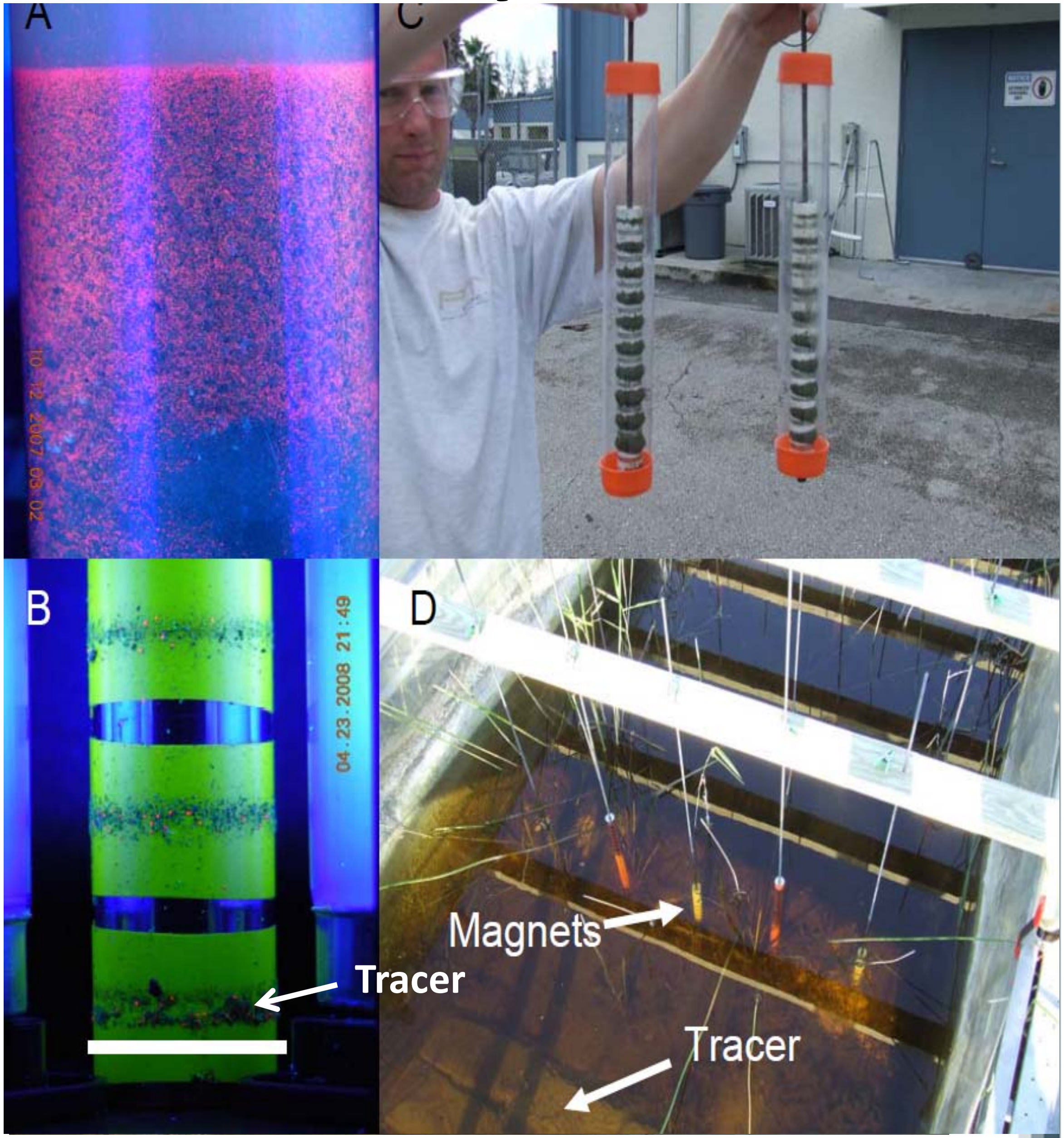




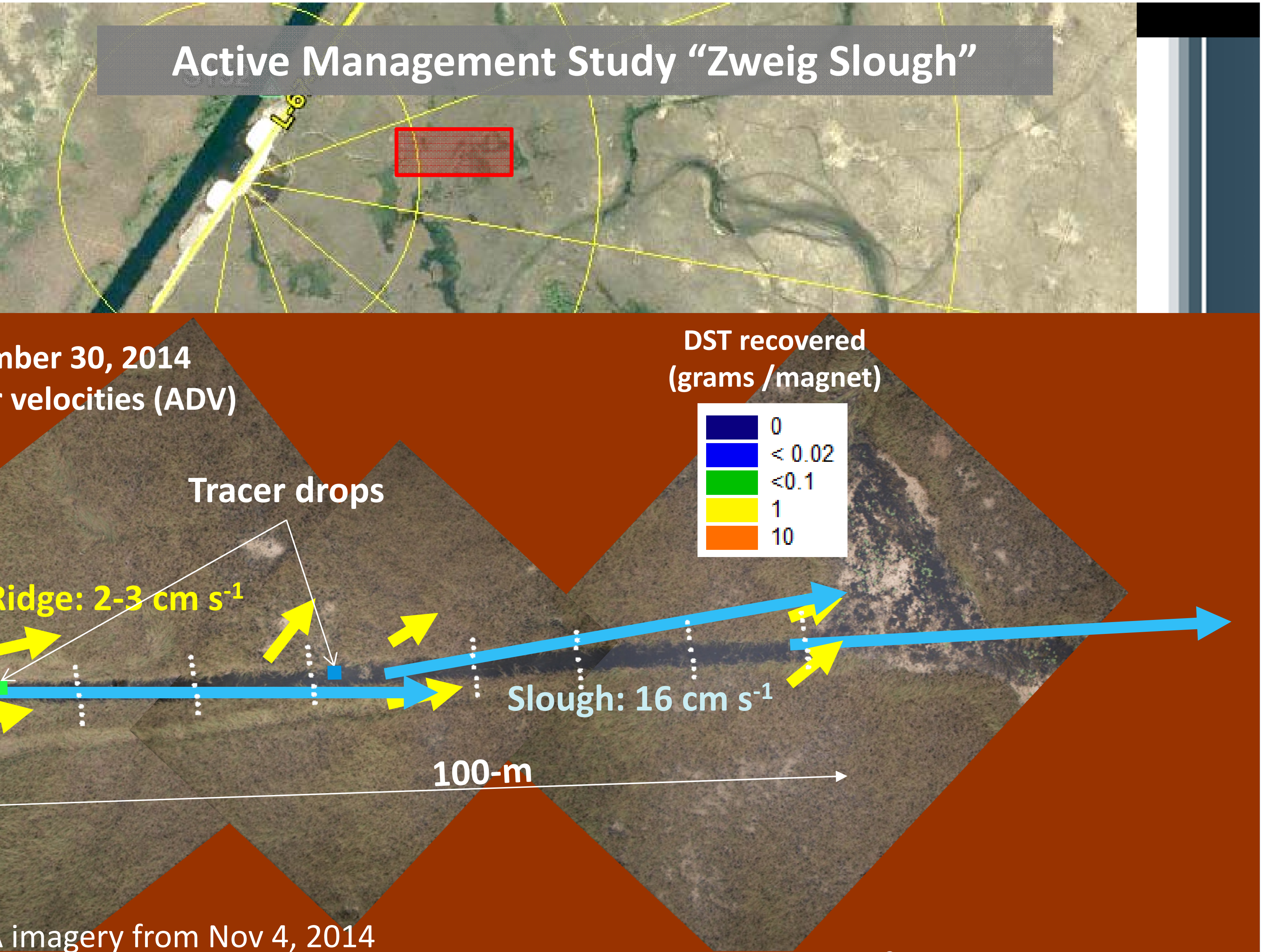
Data from C. Saunders, SFWMD

Tracking Floc Movement –Synthetic Tracer

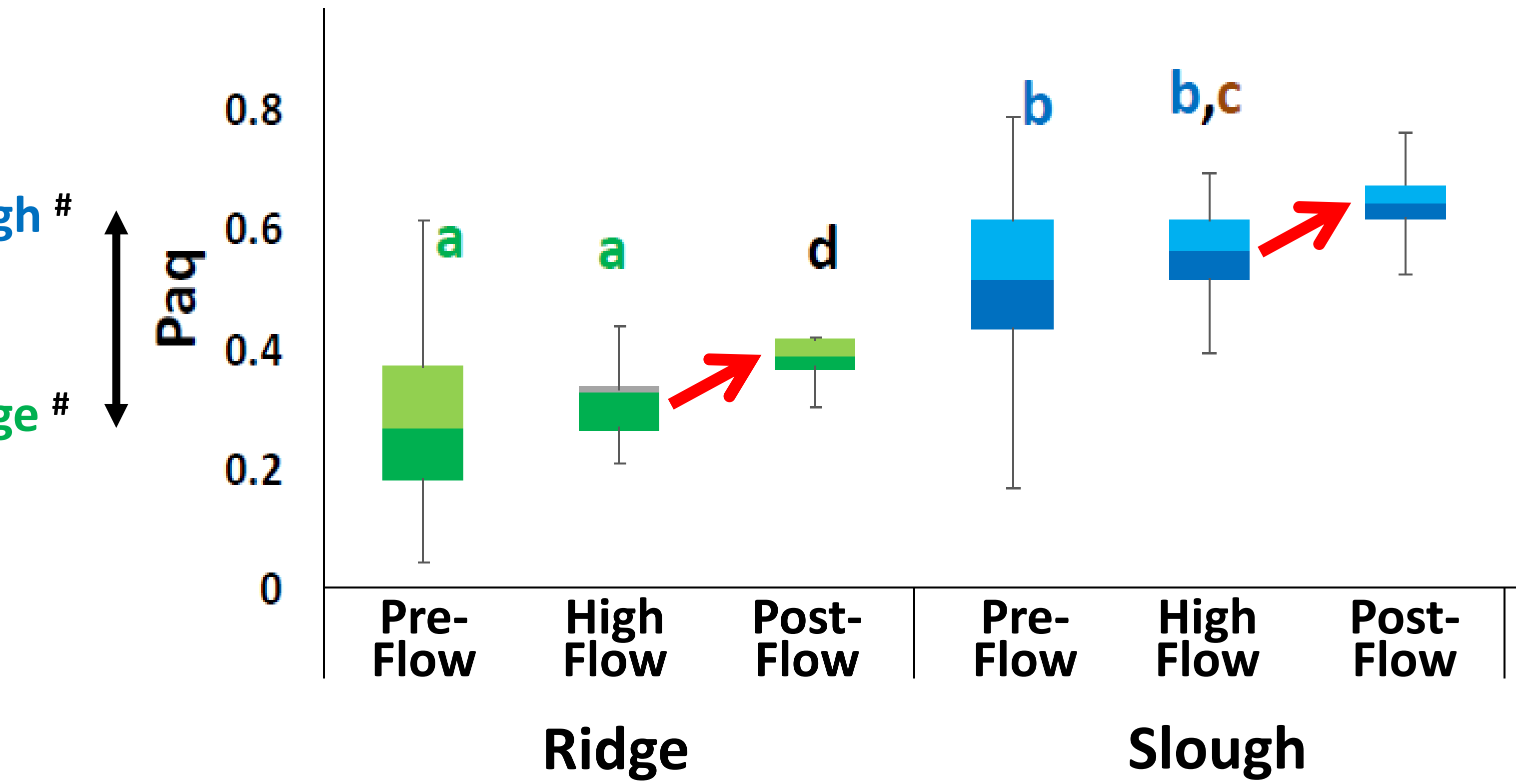
- Physical properties matched to natural Everglades floc
- 25kg frozen blocks deployed at upstream locations
- recaptured using 11 Guass magnets
- UV-fluorescent, different colors to track multiple cohorts
- Synoptic surveys & downstream capture



see E. Tate-Boldt et al. GEER presentation


Active Management Study “Zweig Slough”
mber 30, 2014
r velocities (ADV)
DST recovered
(grams /magnet)
0
< 0.02
<0.1
1
10
Tracer drops
Ridge: 2-3 cm s-1
Slough: 16 cm s-1
100-m
imagery from Nov 4, 2014

Natural Tracers:
Organic Biomarkers in Floc



P. Reiger et al. GEER poster

Data from R. Jaffé, FIU

Summary – 1. Flow Effects on Sediment Transport in the Ridge & Slough

o deep water sloughs exhibit faster velocities, more transport? Is edYiment preferentially redistributed from sloughs to ridges?

- ✓ Achieved velocities high enough to erode sediments
- ✓ Water did not follow the historic flowpath
- ✓ Flow velocities increased with flow duration
- ✓ Sediments transported preferentially in sloughs
- ✓ Sediment from sloughs can get deposited on ridges
- ✓ Active management might be required along with flow

Summary – 1. Transport Synthesis

mplications for building topography

Baseline ridge accumulation (max) = 300 g m^{-2} yr^{-1}

Slough transport = ~5,000 to 100,000 g m^{-1} yr^{-1}

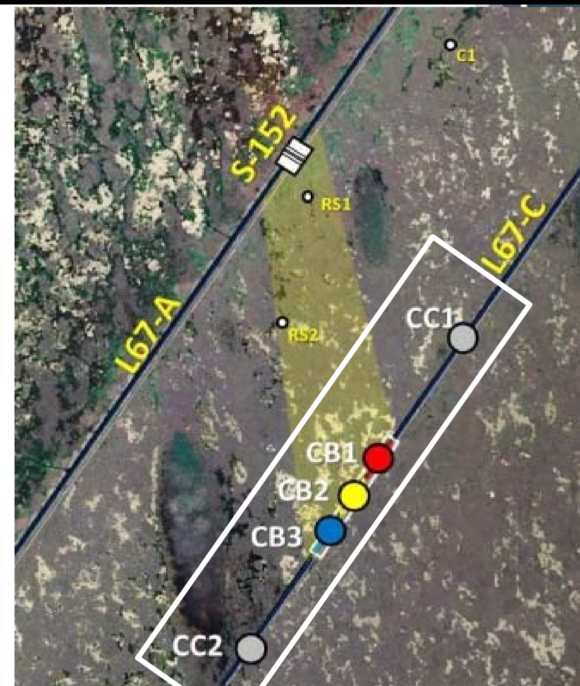
Assuming

- 120 high flow days per year
- 10% settles in the ridges, 75% decomposes
- Bulk density 0.15 g cm^{-3}

Ridge accretion increases 1.2-17 cm $decade^{-1}$

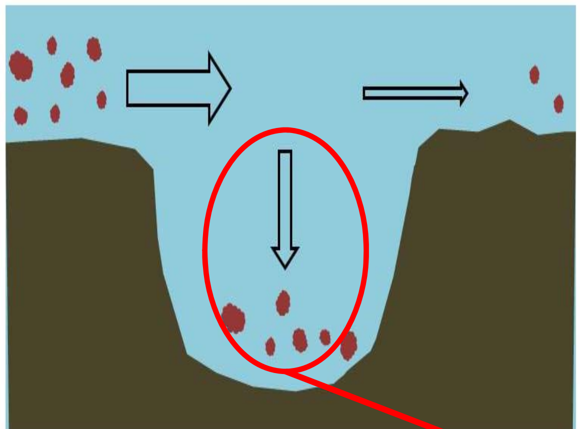
60-800% increase vs average ridge accretion

'art 2. Is the Canal a Sediment
k or Source? Role of Backfilling?



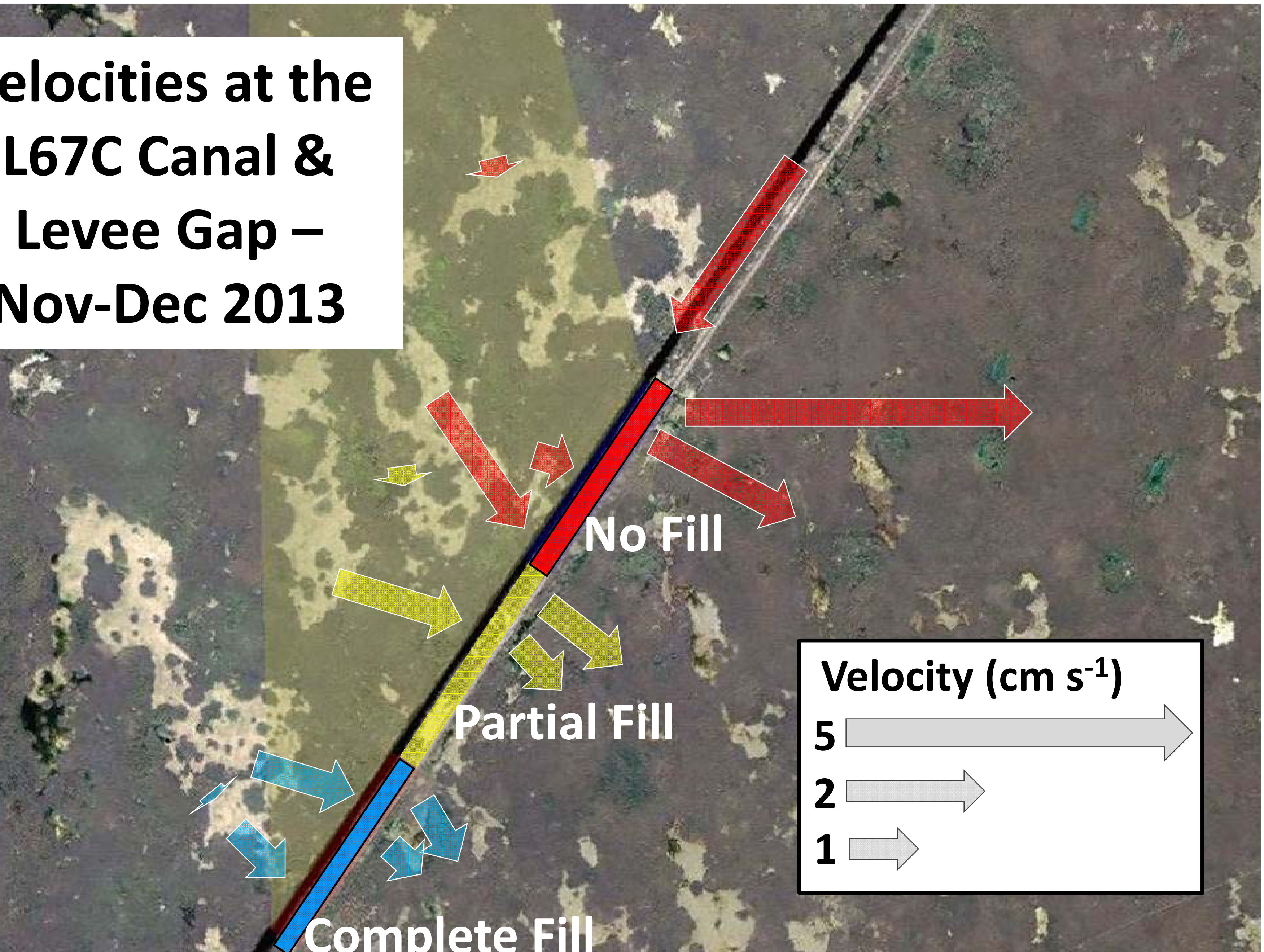
tical sediment traps

- 4”-dia PVC (Len:inlet >5)
- Anchored to bottom, kept upright with floats
- 5 canal sites, 3-6 wk deployments



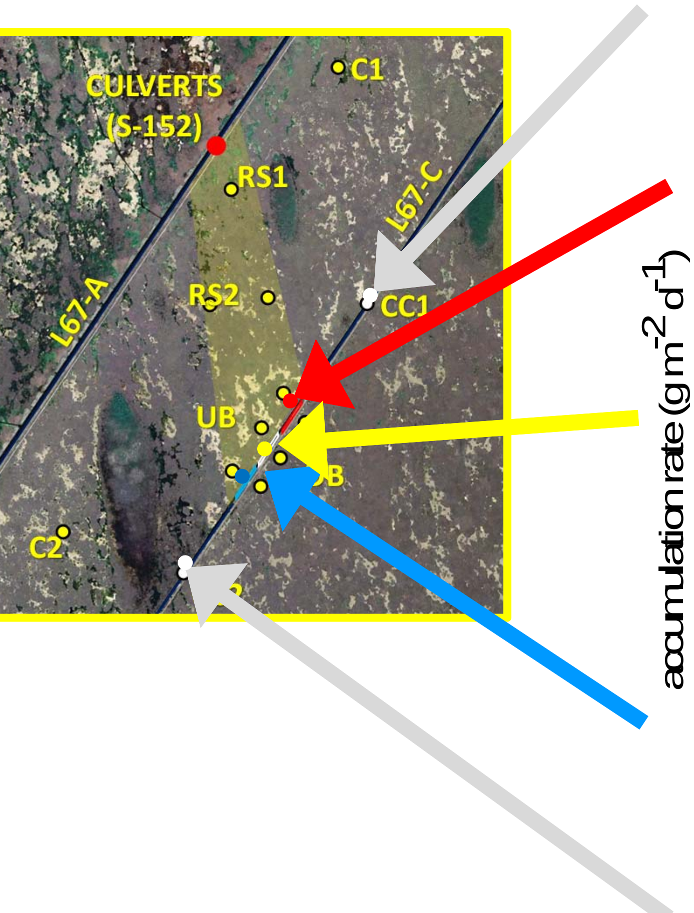
t processing

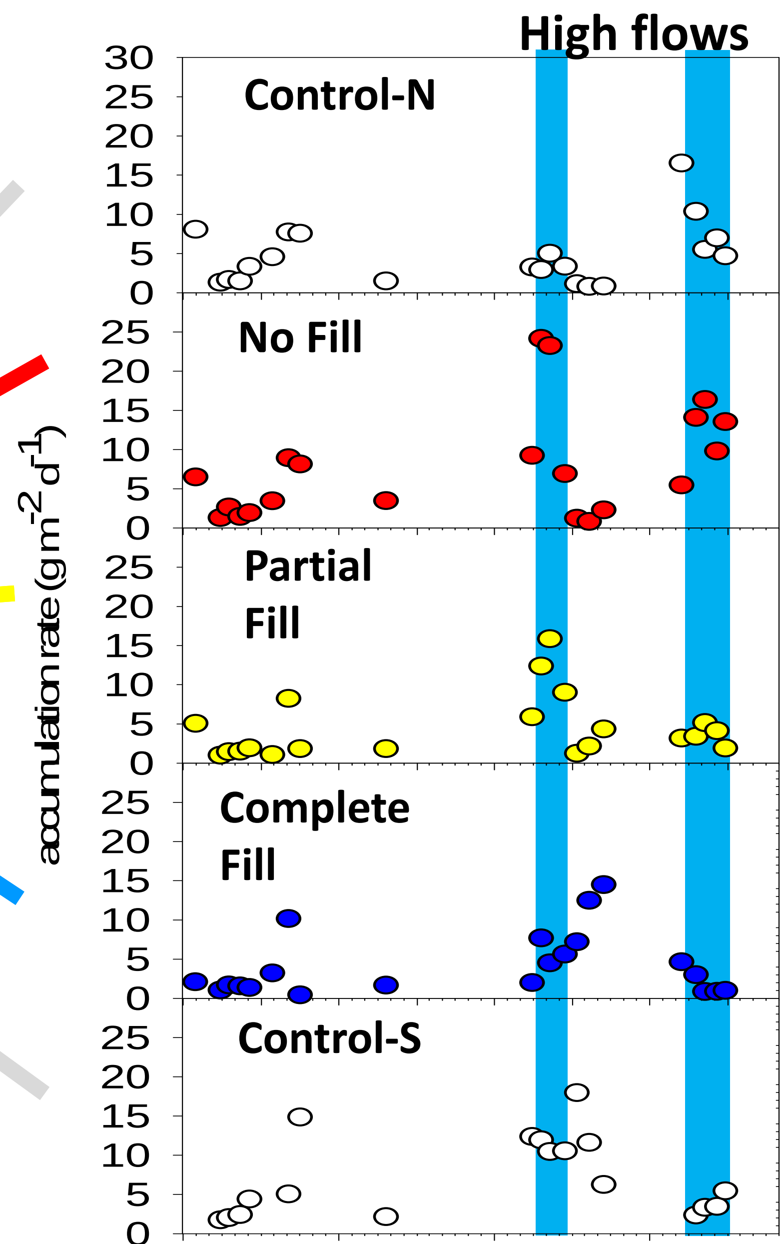
- Fine (<1-mm) sediments collected in Imhoff funnels
- Dry wt to determine mass accumulation, density, chemistry (LOI, TCNP)
- Molecular biomarker analysis on frozen



elocities at the
L67C Canal &
Levee Gap –
Nov-Dec 2013
No Fill
Partial Fill
Complete Fill
Velocity (cm s-1)
5
2
1

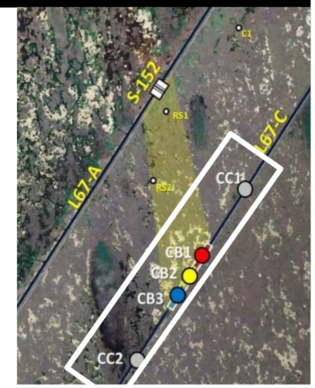
Canal Sediment Accumulation



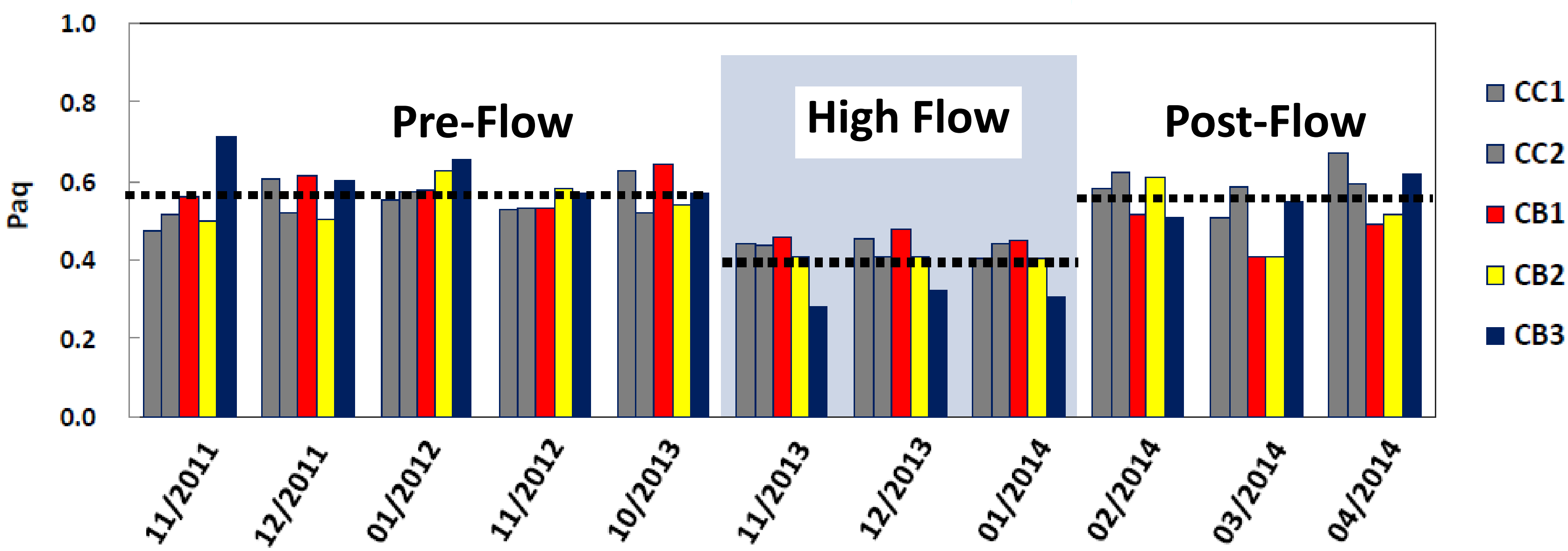


n from
ronado-Molina

Canal sediment dynamics: Molecular Organic Biomarkers

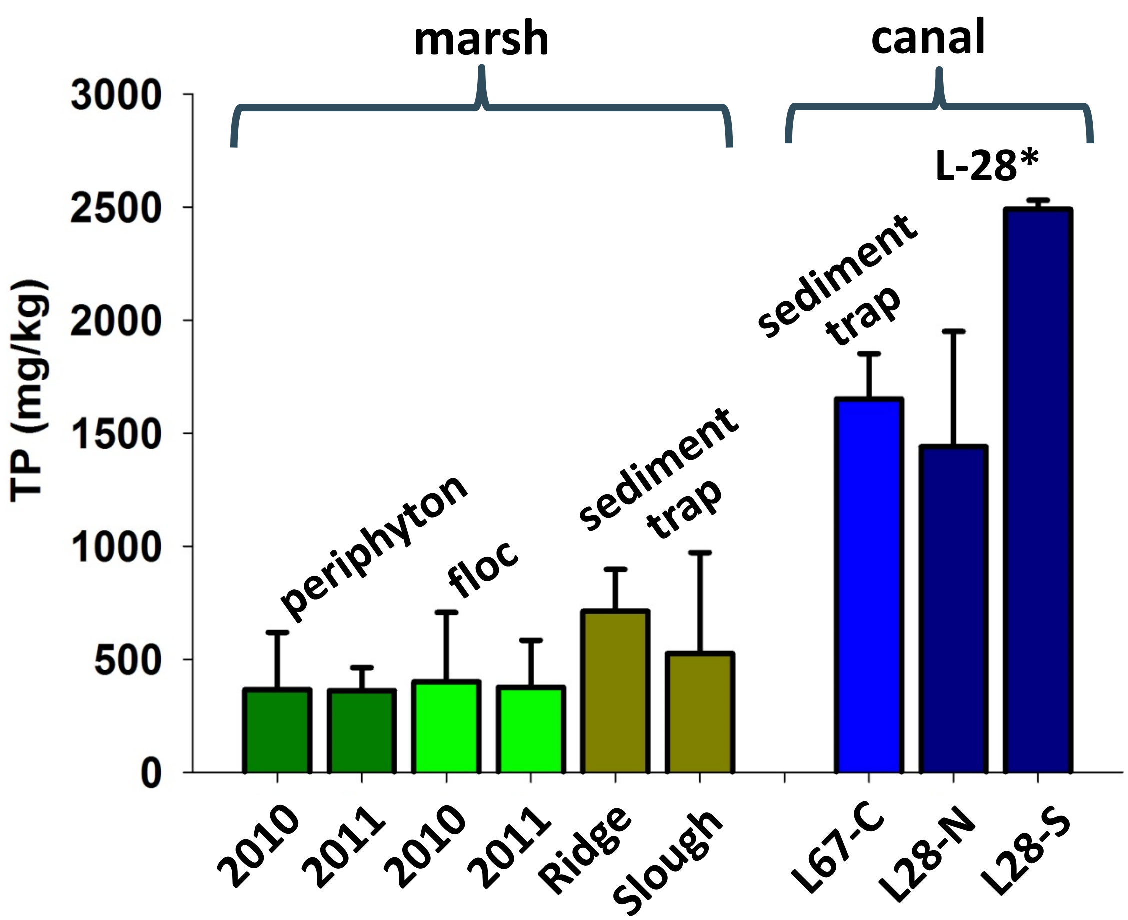


Canal Sediment Traps - **Paq**



Sediment Phosphorus and Sources: Marsh vs Canal

- osphorus ntent highest in nal sediments
- ggests canal cumulating a cal source of diment
- nals a potential urce of P



Data from L. Larson (UCB), C. Coronado-Molina & C. Saunders (SFWMD)

ummary – 2. Effects of Flow & Backfilling on Canal Sediment Dynamics

Is backfilling of canals needed for ecological restoration?

- ✓ No-Fill – higher accumulation, but higher inflows
- ✓ Partial & Complete Fill - still recovering from construction
- ✓ Flow affected all canal sites - mobilizing canal sediments?
- ✓ Implications for nutrient dynamics in canal and downstream

….*analyses are ongoing*

cknowledgements...

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Marks, Ingar Hansen, Deinna Nicholson, Paul Julian, Mike Ross, Pablo
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ESTIONS?

ical Model of Flow Reconnection
eve Ecological Restoration in the Everglades

. Saunders, DPM Science Team Lead