Nutrient Storages in the Everglades Stormwater Treatment Areas

18th April

GEER 2017

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RATIONAL

Understand wetland biogeochemical processes that regulate phosphorus (P) removal efficiency and dictate long-term stabilization of P in Everglades STAs

Key Question
• Can internal loading of P to the water column be reduced or controlled, especially in the lower reaches of the treatment trains?

Objectives
• Determine existing nutrient (P) storages in STA soils
• Compare the differences in soil nutrient storages between emergent and submerged vegetation
Emergent Aquatic Vegetation (EAV)

U = Uptake
T = Transfer
D = Decomposition and leaching
A = Accretion
Pr = Precipitation

Submerged Aquatic Vegetation (SAV)

*RAS = Recently Accreted Soil
Two treatment flow ways (cells) in STA-2

- **Cell 1 (EAV)** → Treatment area = 744 ha
- **Cell 3 (SAV)** → Treatment area = 930 ha
SAMPLING AND ANALYSIS

- Floc – comprised of unconsolidated material
- RAS – determined based on color and texture
- Pre-STA – layer representing antecedent soils (before STAs began operations)
- Bulk density (BD) and nutrient (P, C & N) concentrations
- Nutrient storages were calculated for each layer

\[
\text{Soil nutrient storage} \left( \frac{g}{m^2} \right) = \frac{\text{Nutrient conc.} \left( \frac{mg}{Kg} \right) \times \text{BD} \left( \frac{g}{cc} \right) \times \text{depth (cm)}}{100}
\]

RAS = Recently Accreted Soil
SPATIAL TRENDS – Bulk Density

Higher bulk density in SAV than EAV cells, in all soil sections
SPATIAL TRENDS – Phosphorus in Floc

TP (mg kg$^{-1}$)  P mass storage (g m$^{-2}$)

Avg. depth (cm) – EAV- 7.7 and SAV- 10.7
SPATIAL TRENDS – Phosphorus in RAS

Cell 3
SAV

Cell 1
EAV

Cell 3
SAV

Cell 1
EAV

TP (mg kg\(^{-1}\))

P mass storage (g m\(^{-2}\))

Avg. depth (cm) – EAV- 2.5 and SAV- 3.0
SPATIAL TRENDS – Phosphorus in pre-STA soils

Cell 3
SAV

Cell 1
EAV

Cell 3
SAV

Cell 1
EAV

TP (mg kg\(^{-1}\))

Pre STA

TP (mg kg\(^{-1}\))

0 - 250
251 - 500
501 - 750
751 - 1000
1001 - 1500
1501 - 3000

P mass storage (g m\(^{-2}\))

(g m\(^{-2}\))

< 2
2 - 3
3 - 4
4 - 5
> 5

Avg. depth (cm) – EAV- 19.1 and SAV- 16.4
### SOIL NUTRIENT STORAGES

<table>
<thead>
<tr>
<th>STA-2</th>
<th>Type</th>
<th>Depth</th>
<th>P</th>
<th>N</th>
<th>C</th>
<th>S</th>
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<tbody>
<tr>
<td>Cell-1</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>EAV</td>
<td>Floc</td>
<td>7.7 ± 0.4</td>
<td>2 ± 0.1</td>
<td>38 ± 2</td>
<td>487 ± 28</td>
<td>13 ± 1</td>
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<tr>
<td>RAS</td>
<td>2.5 ± 0.2</td>
<td>1.7 ± 0.2</td>
<td>47 ± 3</td>
<td>680 ± 50</td>
<td>20 ± 2</td>
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<tr>
<td>Pre-STA</td>
<td>19.1 ± 0.3</td>
<td>6.1 ± 0.3</td>
<td>787 ± 28</td>
<td>12641 ± 433</td>
<td>225 ± 10</td>
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<tr>
<td>Cell-3</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAV</td>
<td>Floc</td>
<td>10.7 ± 0.5</td>
<td>8.5 ± 0.8</td>
<td>124 ± 9</td>
<td>2313 ± 161</td>
<td>44 ± 3.6</td>
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<tr>
<td>RAS</td>
<td>3 ± 0.2</td>
<td>3.3 ± 0.3</td>
<td>78 ± 8</td>
<td>1452 ± 134</td>
<td>30 ± 3</td>
<td></td>
</tr>
<tr>
<td>Pre-STA</td>
<td>16.4 ± 0.7</td>
<td>17.5 ± 2</td>
<td>1128 ± 42</td>
<td>18098 ± 735</td>
<td>278 ± 14</td>
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</table>

Phosphorus storage in vegetation biomass

- EAV ~ 3 - 4 g P m\(^{-2}\)
- SAV ~ 0.5 – 1.5 g m\(^{-2}\)
VEGETATION INDUCED DIFFERENCES

**Floc**

- Floc-EAV
- Floc-SAV

**RAS**

- RAS-EAV
- RAS-SAV

**Pre-STA**

- Pre-STA-EAV
- Pre-STA-SAV

Images of EAV and SAV Floc samples.
DIFFERENCES – Phosphorus forms

**Floc**

\[ y = 0.19x + 9.49 \]

\[ R^2 = 0.83 \]

\[ y = 0.73x - 153.98 \]

\[ R^2 = 0.97 \]

**RAS**

\[ y = 0.19x + 9.49 \]

\[ R^2 = 0.83 \]
VEGETATION DIFFERENCES—Phosphorus forms

Organic P

\[ y = 0.81x - 9.49 \]
\[ R^2 = 0.99 \]

Sampling transect

Cell 1 EAV

Cell 3 SAV

RAS

Floc
SUMMARY

• Significant P enrichment in floc near inflows with concentrations diminishing towards outflows

• Floc P enrichment in EAV (Cell 1) was greater & spatially extensive compared to SAV (Cell 3)

• Nutrient (P, C, N, S) storages were typically higher in SAV (Cell 3) in comparison to EAV (Cell 1)

• SAV floc had higher percentage of TP as inorganic P (up to 55%) in comparison to EAV floc (20%)

• EAV floc had higher percentage of TP as organic P (up to 80%) in comparison to SAV floc (30-35%)
THANK YOU!!!

This study is funded by a research grant from the South Florida Water Management District (SFWMD). The SFWMD Lab and the Wetland Biogeochemistry Lab, UF are acknowledged for their analytical services.