Rates of and influences on Phosphorus Flux in the STAs

Long-Term Plan Meeting
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Mike Jerauld, Senior Scientist
DB Environmental, Inc.

Flux chambers at STA-2 Cell 3 mid region
Provisional conceptual model

- Inflow
- Water
- C*
- Diffusion
- Resuspension
- Biota
- Nutrition
- Release
- Avian
- wet/dry deposition
- Outflow
- Underlying soil
- Floc/soil
- Nutrition
- Removal
- Summary
Relevance to STA outflow concentrations

STA-2 Cell 3
average of 26 measurements over 6 years

Juston and DeBusk, 2011. WRR 47:W01511
Relevance to STA outflow concentrations

- Inflow
- Water
- Biota
- Outflow
- Nutrition
- Release
- Diffusion
- Resuspension
- Floc/soil
- Underlying soil
- Wet/dry deposition

Avian

Methods and Experimental Design
Diffusive Flux
Net Flux
Summary
Objective: quantify and apportion net flux rates, and identify controlling variables

- Net flux vs diffusive flux

Working hypotheses
Flux rates affected by:

1. Vegetation
2. Soil characteristics
3. Antecedent loading
### Overview of DBE P Flux Project efforts

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<th>Effort</th>
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<td>Task 4</td>
<td>Data mining analysis of historical DBE data</td>
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<td>• Soils, porewater, and surface water P datasets</td>
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<td>• Modelling of internal P profiles</td>
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<td>Task 7</td>
<td>New P flux field measurements and related analyses</td>
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<td>• P flux chambers</td>
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<td>• Other related variables</td>
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<td>Data integration</td>
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<td>• Discharge P patterns, long-term, monthly-scale</td>
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<td>• Cross-project data integration</td>
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Soil diffusive flux: Peepers
Net flux: in situ flux chambers

- 1.5 m diameter
- Open top, open bottom
- Installed in marsh “in situ”
- Large openings allow exchange with marsh
- Vegetated & unvegetated
Net flux: in situ flux chambers

- Openings sealed during 2-wk monitoring events
- WQ sampled at t = 0, 1, 3, 7 & 14 days

![Graph showing the change in TP (μg/L) over days since chamber closure]
Three “well-performing” flow-ways:
- STA-2 Cell 1
- **STA-2 Cell 3**
- STA-3/4 Flow-way 3

Three regions:
- Inflow
- Mid
- Outflow

Vegetated chambers:
- Net P flux

Unvegetated chambers:
- Net flux, minus macrophyte P cycling

Peepers:
- Flux due to diffusion
Activity to date:

- Advance peeper deployments, Cell 1 (April 2015) & Cell 3 (July 2015)
- Cell 1 chamber event (Sept 2015)
- Lake O. release monitoring (Winter 2015/16)
- Cell 3 “High flow” chamber event (March 2016)
- Cell 3 “Low flow” chamber event (July/Aug 2016)
- Cell 3 “High flow” chamber event (November 2016)
- Cell 3 “Low flow” chamber event (Jan/Feb 2017)

Reporting period:

STA-2 Cell 3 spring, summer & fall chamber monitoring events.
Monitoring event antecedent conditions

STA-2 Cell 3: Phosphorus loading rate

![Graph showing phosphorus loading rate (PLR) from January 2015 to November 2016. The graph includes data points labeled 'Peepers' and 'Chambers.' There is a notable winter pulse in the PLR levels.]
DIFFUSIVE FLUX MEASUREMENTS
Example data set: November 2016: “High Flow”

General observations

- Inflow → outflow trends
- No discernible effect of vegetation (SAV)
- Negligible gradients of DOP.
  SRP key porewater constituent.
- Porewater SRP concentrations at OUT always near or below detection limit.
Consistent, negligible diffusive flux potential at outflow region, even after 17 years of flow-through operation.
CHAMBER RESPONSES
Flux chamber TP

<< Example data set: November 2016: “High Flow”

General observations

- Inflow → outflow gradient
- Increasing TP concentration over closure period (i.e., positive net flux)
- Recent measurement events suggesting vegetation effect at MID and OUT
Example data set: November 2016: “High Flow”

- Rates comparable to previous work in WCA-2A (Fisher and Reddy, 2001)
- Inflow → outflow gradient
- Positive flux rates at outflow
Example data set: November 2016: “High Flow”

General observations

- Rates comparable to previous work in WCA-2A and STAs (Fisher and Reddy, 2001; Newman and Pietro, 2001)
- Net flux >> diff. flux

Not a typo…calculated diffusion rates of 0
Key findings to date

1. So far, no evidence of strong influence of diffusive fluxes on water TP in the outflow region

2. Yet, strong evidence of positive net fluxes in chambers

3. Net flux apparently insensitive to soil P

4. Effect of vegetation and antecedent load on net flux still under investigation

5. Interpretation of flux complicated by apparent rapid P transformations in the water column
Key question going forward

What sources contribute to net flux in STA outflow regions?