Confirming a plant-mediated "biological tide" in a arid land constructed treatment wetland (maybe submit to Ecol. Applications)

Introduction

- CTWs & urban sustainability; turquoise infrastructure; arid land CTWs as potentially unique
- The "biological tide" first identified with a whole-system water budget of T.R. (Sanchez et al. 2015); links to N uptake efficiency of the CTW.
- Objective of this paper: Verify the ET-based water budget calculations by measuring actual water flow into the marsh; literature from other dye/tracer studies in marshes to measure water flow. Note that the scale of measurements (whole system vs. small) and scale of expected/ actual velocities is important here.
- Approach: methodological comparison (brief) and why a dye study was used here; low velocities limit methodological options. Also pull in literature on marsh flume studies and the importance of a flume to this research. Brief overview of our approach.

Methods

- Briefly overview the ET-based water budget approach, citing Sanchez et al. (2015); explanation of why dye studies were done in July. Importance of good estimates of marsh water volume; wrack volume as an unknown and how we measured/estimated this (Dakota's work).
- Briefly overview plant biomass measurements and importance of this to the "biol. tide", citing Weller et al. (2015). B/c T.R. is being dominated by Typha we did our experiments in Typha marsh.
- Summer 2014 pilot dye study results and importance to refining approach used in Summer 2015). The need to constrict flow b/c of low velocities and high dispersion + diffusion/advection ratio; best time step to collect samples.
- Experimental set-up: 1) location of flume & experiment; 2) flume dimensions & design specs; 3) sampling locations and time intervals + duration; 4) ran 2 experiments--one started in the AM and 1 started in the PM: 5) defend use of Rhodamine vs. Fluorescene or a dissolved conservative tracer.
- Lab analyses: 1) sample prep: sample and standard dilutions; analyses done immediately; 2) type of fluorometer, wavelength chosen for analysis, calibration curves.
- Data analysis: 1) baseline/background fluorescence accounted for; 2) highest velocity (breakthrough curve and first peak) and average velocity (area under curve); 3) estimates of dispersion and diffusion rates; 4) comparison/ contrast of AM vs. PM start times; 5) resolve multiple velocity estimates from different sampling points.
- Actual comparison of Sanchez et al. (2015) estimates to dye study velocity measurements.

Results

- Advection measurements from both AM and PM experiments; includes maximum and average velocities and combination of measurements from different sampling points into a single whole-system velocity estimate; precision of values.
- Estimates of rates of dispersion and diffusion; comparison of these rates with rates of advection; confirmation of directional water flow into the marsh.
- Present full 4 years of biomass, ET, & water budget data; spin in better estimates of marsh water volume by discussing Dakota's wrack volume estimates; refined water budget-based residence times; make the jump from advection measurements to marsh water residence times and comparison to estimates from Sanchez et al. (2015).

Discussion

- Are low-magnitude velocity measurements made with dye studies in marshes robust? Bring in precision/error measurements here.
- Discuss our advection vs. diffusion + dispersion findings; look in literature for other studies that have measured these in either field or wet lab/flume settings.
- Compare our flow rates with those from the literature for other CTWs and other marshes in general; Compare our ET rates with those from the literature for other CTWs and other marshes in general;
- Consider making an estimate of likely winter advection/flow rates based on the ET-based water residence time data.
- Consider modeling different plant composition scenarios and how each affects flow rates and water residence times.

Conclusions

- Link findings to N uptake and the whole system N budget.
- Future directions: modeling work to scale up advection measurements to the whole system; use model to play design scenario games to possibly optimize arid land CTW efficiency.
- Inform better CTW designs for arid land cities