Comparing Water Column Saturation Profiles of Greenhouse Gases in Constructed and Natural Ponds

Audrey Goeckner, AJ Reisinger, Ashley Smyth, Meredith Holgerson

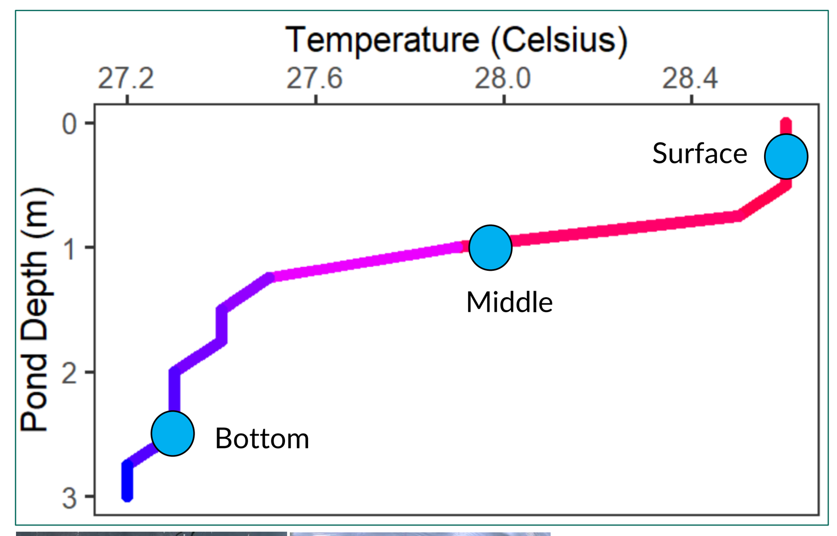
PRESENTER:
Audrey Goeckner
@PondGator
agoeckner@ufl.edu

UF IFAS UNIVERSITY of FLORIDA | Soil & Water SCIENCES | CLUE CENTER FOR LAND USE EFFICIENCY

INTRO: Urban stormwater ponds constructed for flood & pollution mgmt may play a large role in the greenhouse gas (GHG) production of carbon dioxide (CO_2) & methane (CH_4). As the high density of ponds in FL (~74K) grows, we must characterize the concentration & drivers of GHGs

QUESTIONS: **(1)** What biological, chemical, physical, or morphological factors influence the concentration of GHGs? **(2)** Do urban ponds differ biogeochemically (nutrient and GHG cycling) from natural ponds?

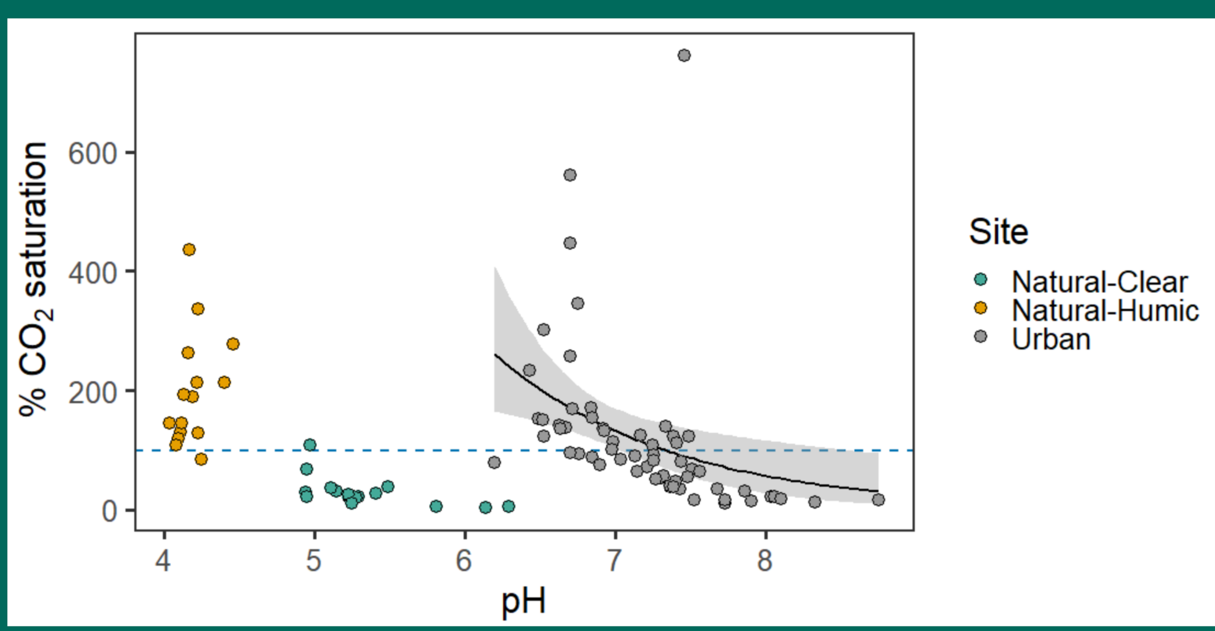
METHODS: 21 sites (15 **urban** + 3 **natural clear** water + 3 **natural humic** water) were sampled in May & Aug. 2021.



Water & gas samples collected from **surface**, **middle** (thermocline) and **bottom** layers of the water column. Sampling depths based on water column stratification (shown left).

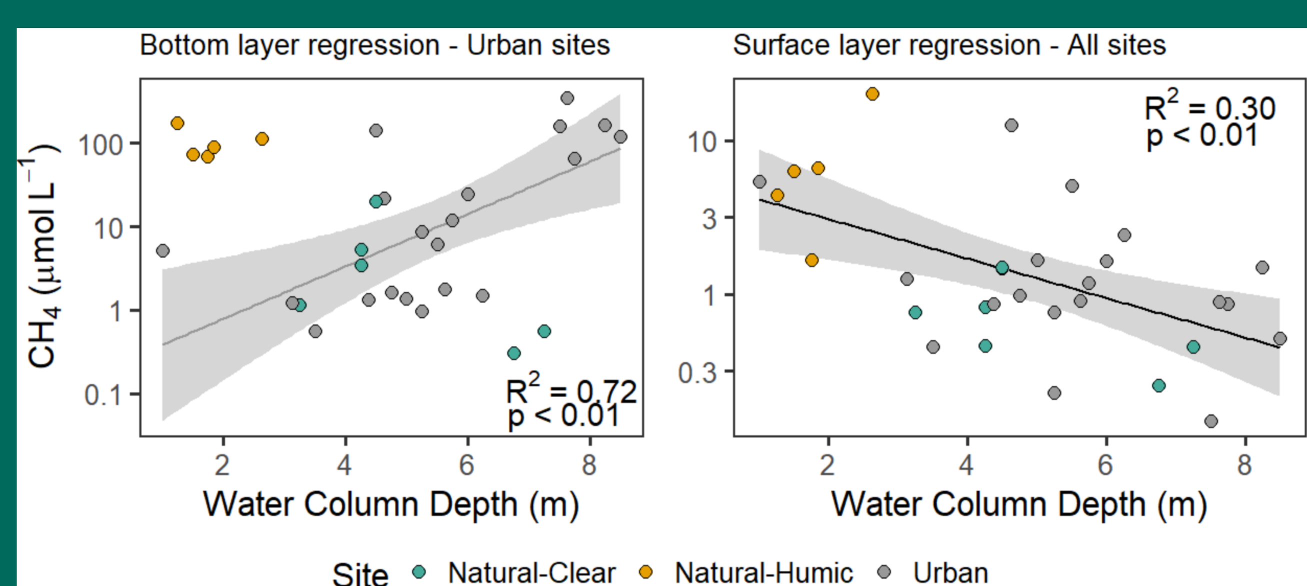
Water analyzed for concentrations of CO_2, CH_4, total nitrogen (TN), dissolved organic carbon (DOC),pH algal biomass (Chl-a), &dissolved O_2

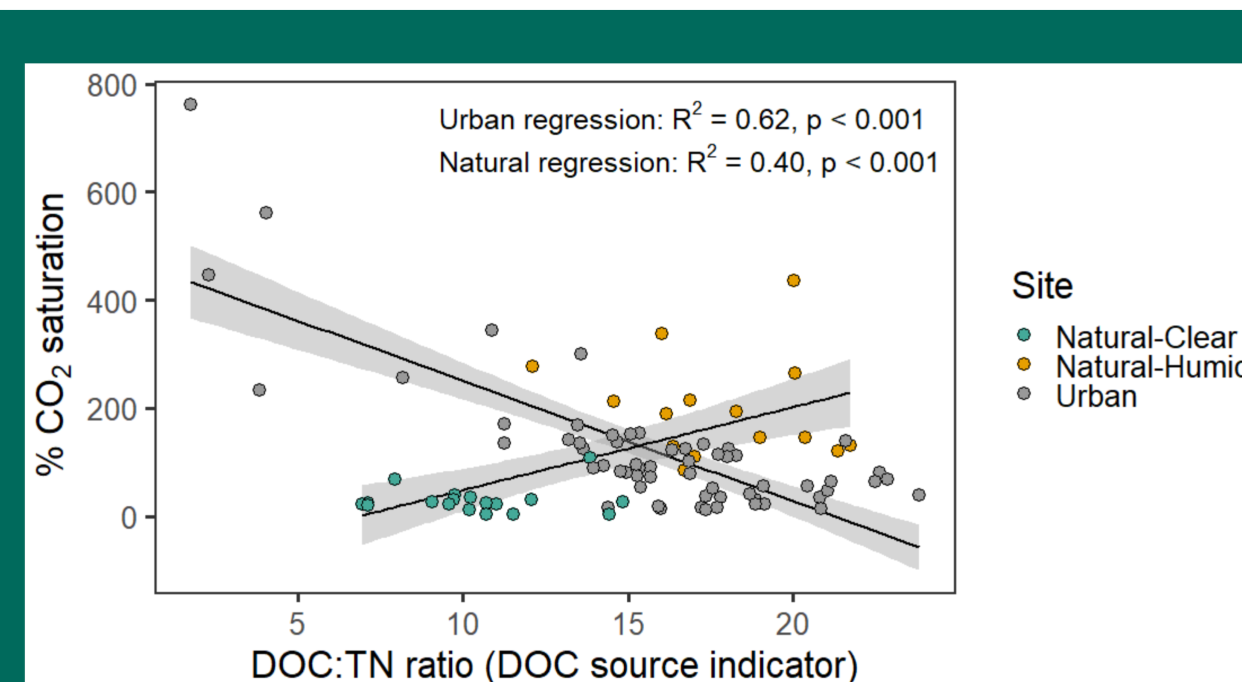
%gas saturation = (measured conc/equilibrium conc)*100



Urban ponds are more alkaline than natural ponds & if high enough can remove free CO_2, an unintentional benefit of urban karst. Natural ponds were more driven by light availability than pH.

Deeper water columns in urban ponds enhance bottom layer CH_4 production but may also enhance CH_4 removal in upper layers, resulting in lower CH_4 emissions.



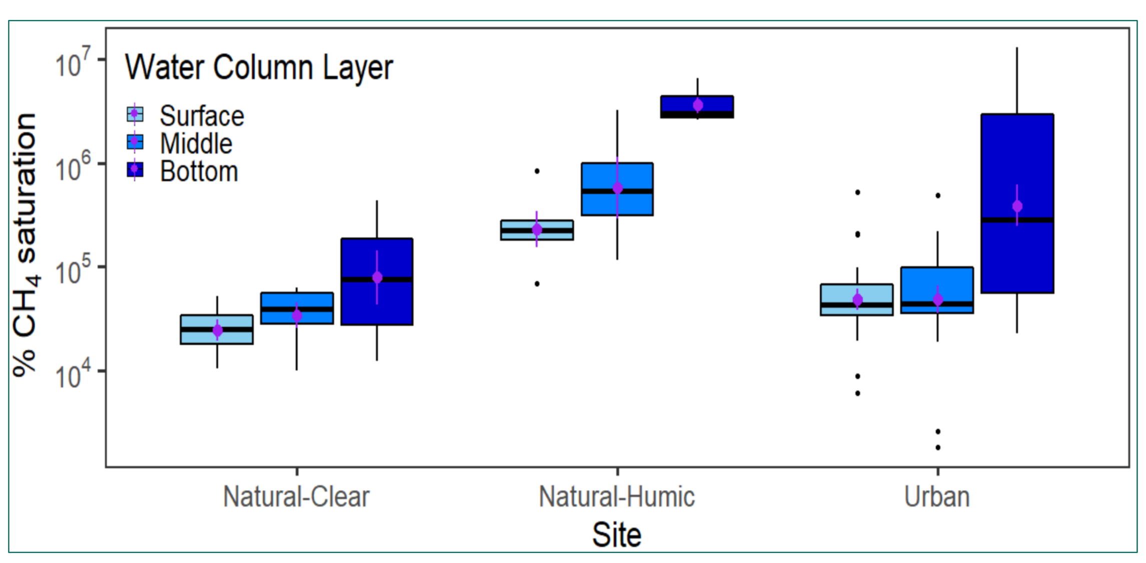


Lower light availability from increasing colored DOC in natural sites favor CO_2 respiration. Urban sites likely increasing in algal-derived DOC indicates enhanced photosynthesis & CO_2 uptake.

RESULTS: **(1)** Natural humic surface layers were on avg 9x & 11x more saturated in CO_2 & CH_4, respectively, than clear sites. Urban values fell in b/w the members.

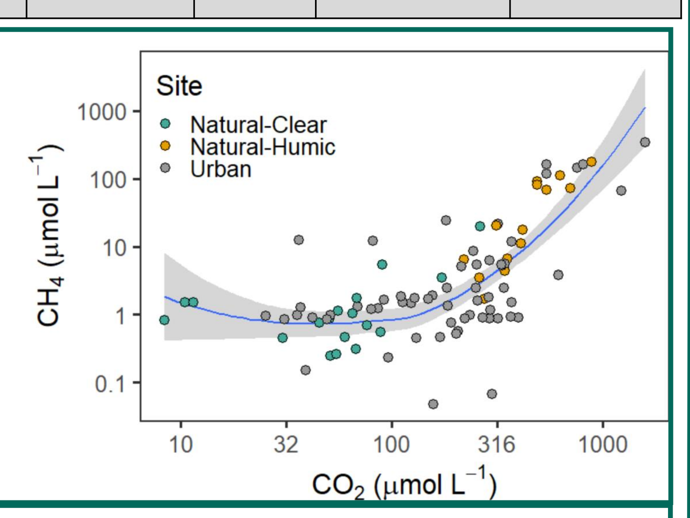
Mean surface layer values shown for concentrations

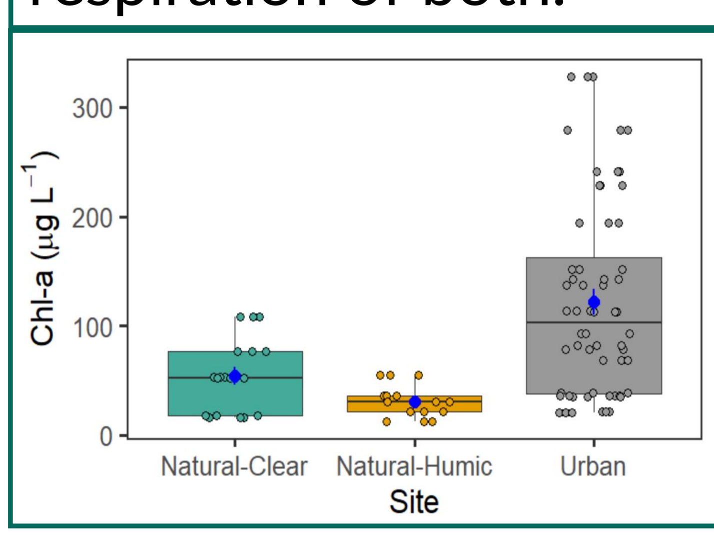
Site	Area (km2) range	Depth (m) range	TN (mg L-1)	DOC (mg L-1)	pH	Surface O_2 (%sat.)	Bottom O_2 (%sat.)
Natural Clear	0.04 to 0.08	3 to 7	0.5	5	5.5	102	68
Natural Humic	0.008 to 0.01	1 to 3	0.9	17	4.2	32	3.6
Urban	0.003 to 0.01	1 to 9	0.6	10	7.4	96	44



(2) Ponds were highly supersaturated, up to 10^7 %, in CH_4 (suggesting net emission) reflecting the large role lakes & urban ponds play in GHGs & climate.

(3) CO_2 & CH_4 were positively correlated, likely due to anaerobic co-respiration of both.





(4) Urban algal biomass was the highest, supporting the GHG & DOC explanation above.

DISCUSSION:

SWPs designed with deeper water columns enhance CH_4 oxidation as gas travels upwards. However, we must investigate if underwater pipes delivering warm runoff (heated on pavement) trigger water column turnover & a mass release of bottom layer CH_4.

SWPs are subject to intense particulate loading from urban karst watersheds. If SWPs react like natural ponds, browning over time (by DOC) may increase respiration & GHG saturation. Alkalinization (by carbonates), may be able to buffer SWP CO_2.

The link between CO_2 & primary production & the high SWP chl-a warrant further review into SWP algal growth management

SCAN ME