Horticultural nurseries-based pollution dynamics in canals of South Miami Dade, Florida

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Introduction

The South Miami-Dade agricultural nursery area has a negative impact on surrounding agricultural canals and consequently the Biscayne Bay. Agricultural nurseries are most often used to grow ornamental plants and fruiting trees in above-ground pots, which are sold directly to the consumer or retail outlets. Understanding how much nutrient load the canals receive from agricultural nurseries can lead to better management decisions and consequently more control over non-point source pollution.

Objectives

- Understand the spatial and temporal correlation between nurseries and in-situ NO_X levels.
- Identify the area that contributes the greatest impact to canal pollution
- Explore the spatial distribution of nurseries around canals.
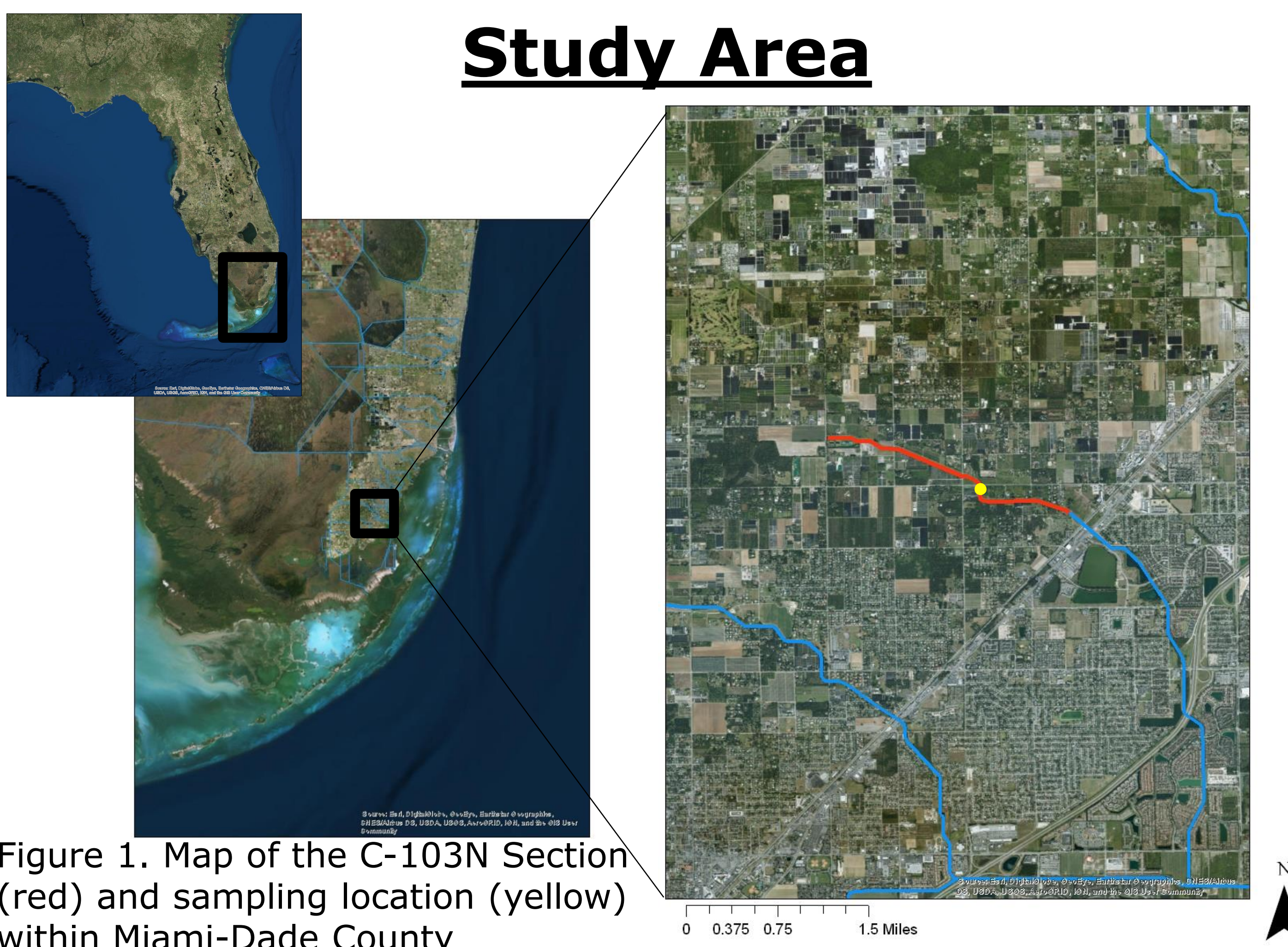
Study Area

Figure 1. Map of the C-103N Section (red) and sampling location (yellow) within Miami-Dade County

The study area is a section of the 103-N canal in South Miami Dade, Florida. This section of the canal is purely rainwater/groundwater/overland flow fed and the outflow gate only opens for a few days per year around the peak rainy season.

Datasets Used

- Monthly in-situ measurements of NO_X in mg/l from Miami-Dade DERM
- Land use data for 2004-2005, 2008-2009, and 2014-2015 from SFWMD
- Canal shapefile from SFWMD

Methodology

- Created 150m, 250m, 500, 1000, and 1500m buffers around the C-103N section.
- Clipped land use with each of the buffer section for each time interval to obtain the percentage of land use dedicated to agricultural nurseries separate from all other agriculture.
- Ran multiple regression models in SPSS for each land use classification per buffer zone's area against in-situ monthly measurements of NO_X.
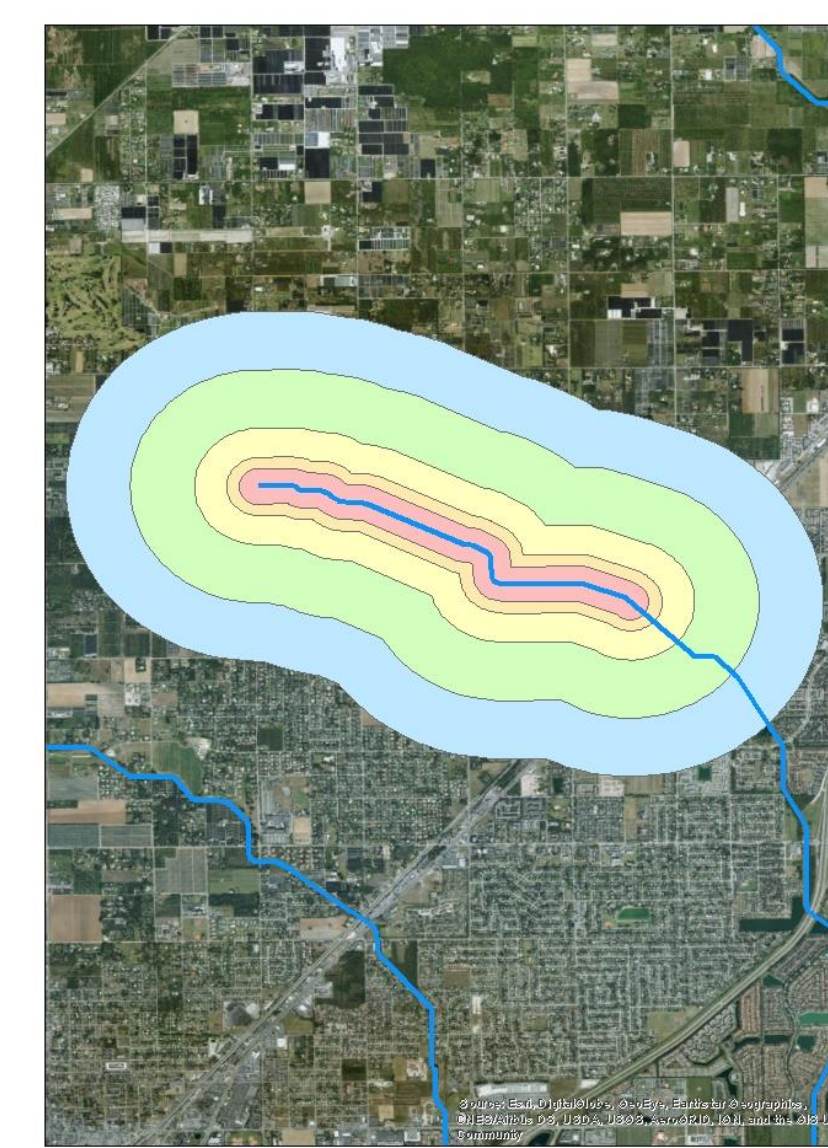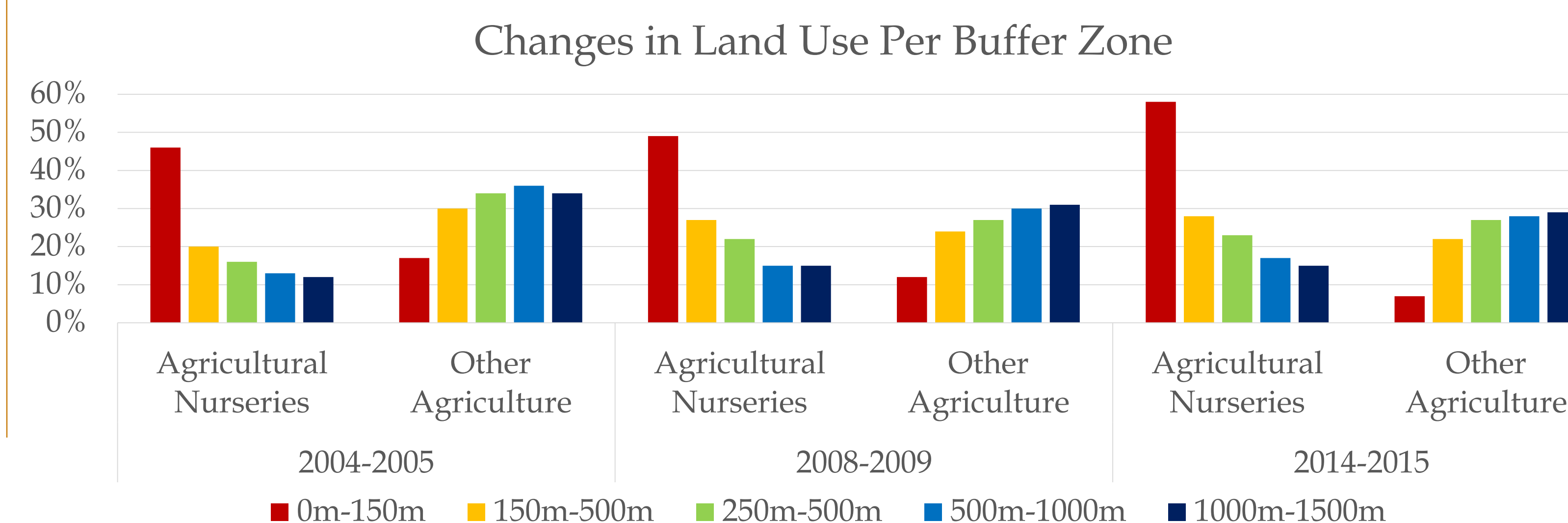

Figure 2. C-103N section with buffers

Results

		Agricultural Nurseries	Other Agriculture
Year-Round	0m-150m	-0.11	3.38**
r^2 = 0.741	150m-500m	3.393**	4.214**
	250m-500m	2.884**	3.665**
	500m-1000m	-2.136**	-1.313**
	1000m-1500m	0.552	1.392**
Wet Season	0m-150m	-0.322	0.532
r^2 = 0.716	150m-500m	4.145**	4.932**
	250m-500m	3.3**	4.041**
	500m-1000m	-2.455**	-1.665**
	1000m-1500m	0.811	1.619*
Dry Season	0m-150m	0.137	1.023**
r^2 = 0.797	150m-500m	2.523*	3.401**
	250m-500m	2.412**	3.25**
	500m-1000m	-1.778**	-0.906
	1000m-1500m	0.251	1.136**

Table 1. Standardized coefficient regression results for NO_X. Symbol denotes P-value (** = <0.01, * = <0.05, none indicates P > 0.05).

Seasonal and Yearly Average Fluxes in NO_X
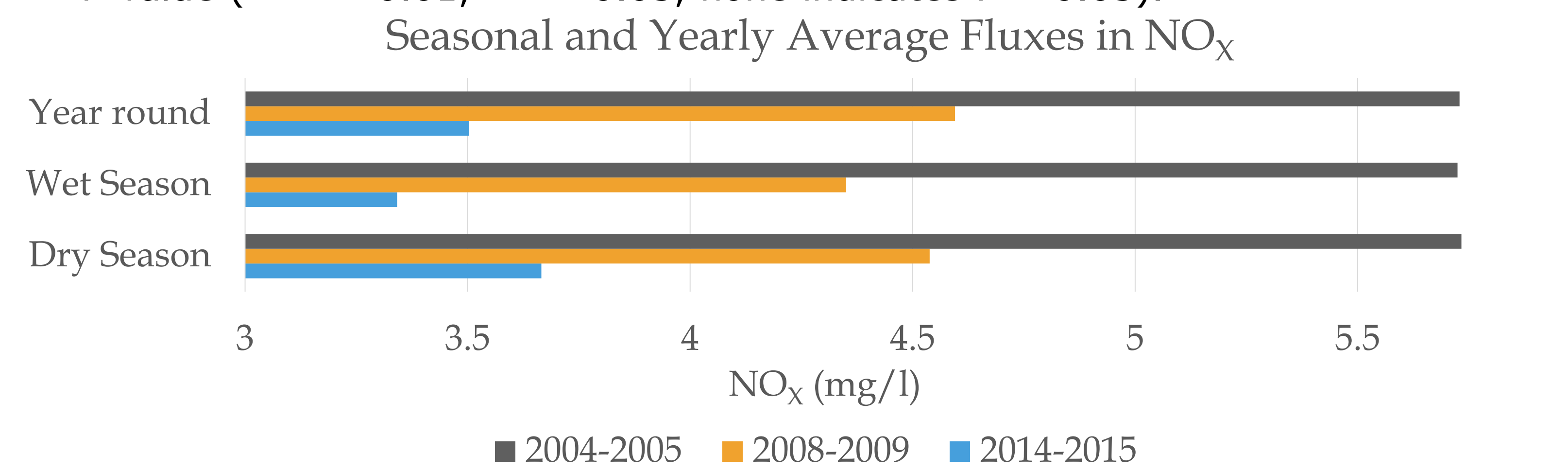
Graph 1. The changes in NO_X per season and updated land use map.

Changes in Land Use Per Buffer Zone

Graph 2. The changes in Agricultural Nurseries and Other Agriculture for each updated land use map.

Discussion

- Nurseries tend to favor land plots nearby canals.
- Other types of agriculture are converting to nurseries.
- Overall impact of nurseries is less than other types of agriculture
- There is minimal seasonal flux in NO_X in any given year, however average NO_X values have significantly decreased over time.
- Areas past 500m showed little to no correlation between agricultural nurseries and NO_X because overland flow likely does not directly reach the canal but instead infiltrates into the soil.
- Areas within 150m showed little significance with agricultural nurseries likely because the smaller area allowed for too much variation, as shown in graph 2.
- The 150m-500m buffer zone showed the highest correlation with both land use classifications.
- Other land use classifications skewed the data, and were removed from the regression model.

Conclusions

- During the wet season, agricultural nurseries have a greater impact on canals. Closer nurseries appear to have a greater impact during this season.
- Little seasonal variability in NO_X further validates impact of land use changes on intervariability of NO_X between time intervals.
- Rainfall seems to have a greater impact in increasing non-point source NO_X from agricultural nurseries rather than other agriculture.
- Areas within 500m of canals should be considered high impact zones as canals feed into the groundwater, impacting drinking water.

Acknowledgments

References

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- Caccia, Valentina G., Boyer, Joseph N. (2005). Spatial Patterning of Water Quality in Biscayne Bay, Florida as a Function of Land Use and Water Management. Marine Pollution Bulletin pg. 1416-1429

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