Water Quality Variability in the St. Lucie Estuary River Watershed, Florida

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Background

- Modifications to the land and the hydrology of coastal watersheds for human activities have been linked to increased eutrophication, loss of submerged macrophytes, declines in fish and shellfish stocks, and extensive phytoplankton and toxic bacteria blooms among others (Buzzelli et al., 2013; Hessen, 1999; Hopkinson & Vallino, 1995).
- Coastal ecosystems, local communities, and economic sectors in Florida have been negatively impacted by these conditions.
- We need to bridge our knowledge gap on the links between land use, watershed dynamics, and coastal responses in order to maintain coastal water quality at optimal levels.

Objectives

- Understand the spatial and temporal variation of contaminants on a coastal watershed
- Visualize nutrient species partitioning
- Identify areas of poor water quality on the watershed

Study Area

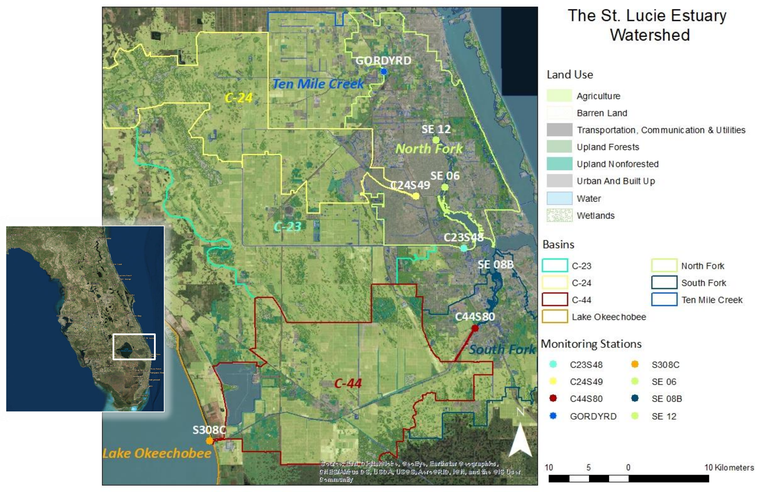


Figure 1 – The St. Lucie Estuary Map and the location of the eight stations and seven basins analyzed

Table 1 – The basins and their corresponding stations from where in situ data were gathered and analyzed. Land use area and percentages were gathered from the publicly available St. Lucie River Watershed Restoration Plan of 2012.

Basins	Stations	Area (acres)	Agricultural Area (%)	Natural Area (%)	Urban & Other (%)
C-23	C23S48	84, 744	76	21	3
C-24	C24S49	67,516	81	19	0
C-44	C44S80	78,351	59	28	13
Ten Mile Creek	GORDYRD	32,491	82	0	18
North Fork	SE 12 and SE 06	3,968	4	36	60
South Fork	SE 08B	20,120	40	38	22
Lake Okeechobee	S308	467,200	N/A	N/A	N/A

Dataset

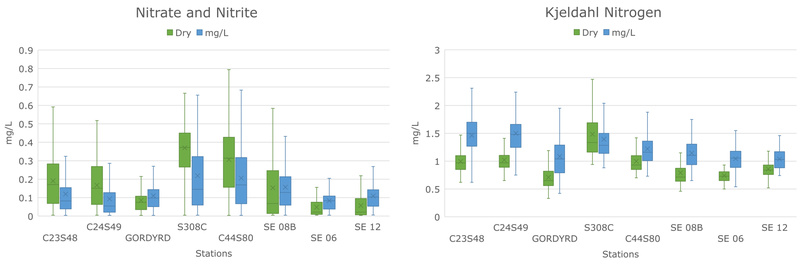
- South Florida Water Management District (DBHYDRO) and FL Department of Environmental Protection databases.
- Continuous monthly data of seven water quality parameters from 2004 to 2016, in the dry (Dec – May) and wet (Jun – Nov) seasons.
- Parameters: dissolved oxygen, kjeldahl nitrogen, nitrate + nitrite, pH, orthophosphate, total phosphorus, and turbidity.

Methodology

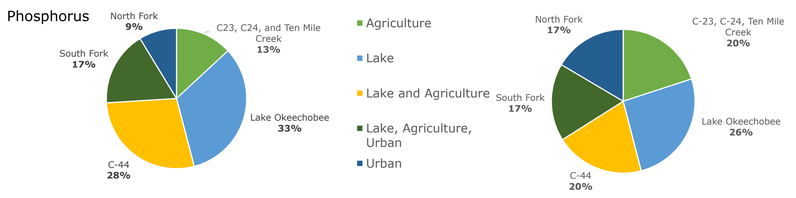
1. Obtained hydrology layer, land use map, and water quality data
2. Checked for error and equipment blanks using Excel.
3. Analyzed the data for spatial and temporal variations using Excel and SPSS.
4. The hierarchical dendrogram was produced using Ward's method and Euclidean distance.
5. ArcGIS 10.5 was used to represent results on their respective monitoring stations.

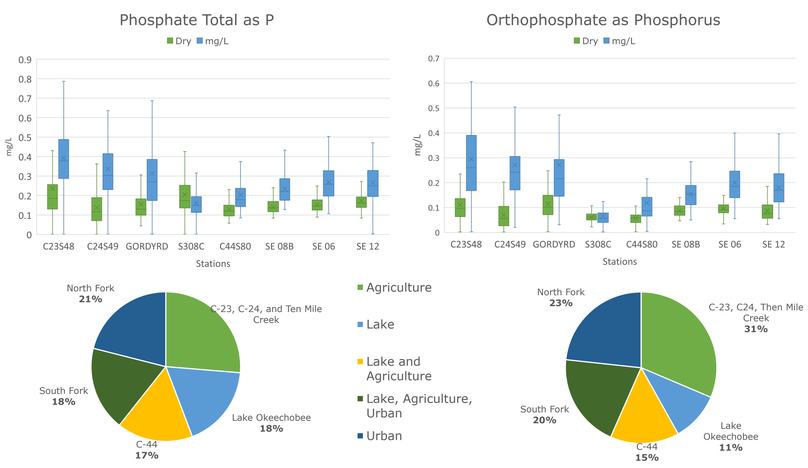
Results

Nitrogen



Phosphorus





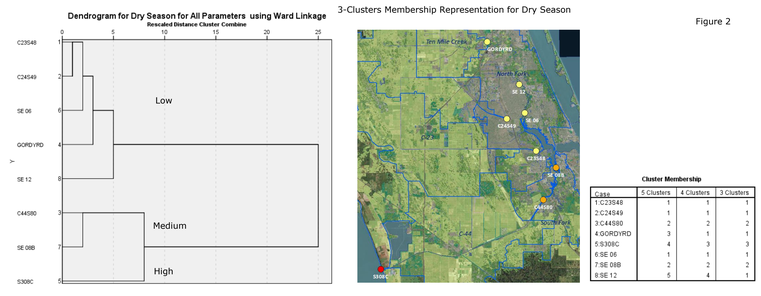


Figure 2

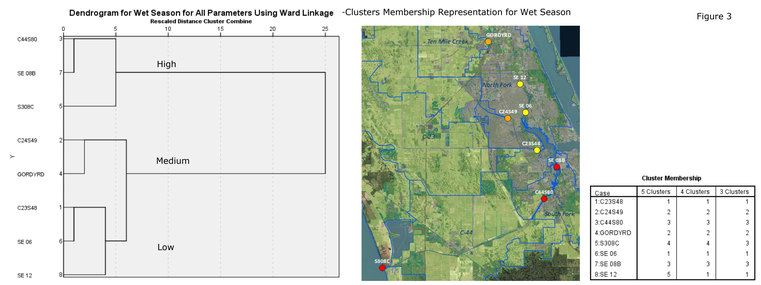


Figure 3

Figures 2 and 3. Cluster analysis of seven water quality parameters (DO, K Nitrogen, Nitrate+Nitrite, Phosphate Total, Phosphate Ortho, pH, and Turbidity) for the wet (Jun – Nov) and dry (Dec – May) seasons of 8 monitoring stations. Yellow represents stations in cluster 1, which are related as they are the least polluted. The orange represent cluster 2, which have medium pollution. The red represents the stations with highest pollution. The resulting 3 cluster memberships are spatially and seasonally represented on the maps.

Discussion and Conclusions

- A seasonal difference is notable in average nutrient concentrations.
- Both P species and kjeldahl nitrogen were found in higher concentrations during the wet season in almost all stations, which may be due to increased runoff. Nitrate + nitrite concentrations were higher in the dry season in 5/7 stations might be due to changes in aquatic autotrophs.
- Lake Okeechobee seems to have a larger percent nitrogen input than P when compared to other sources.
- Turbidity, DO, and nutrients data in the dendrograms differentiate between the stations adjacent to the C-44 that connect the lake in the wet season better than the dry season. Though all the stations have parameter values that exceed the estuarine recommended standards, the stations that measure lake water deviate clearly.
- Further analysis on the speciation of nutrients in relation to land use and the seasonal variation of parameters is needed.

References

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Acknowledgments

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