Spatiotemporal Variability of Water Quality Parameters in the St. Lucie Estuary Basins, Florida

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Background

The loss of natural habitat on watersheds due to increased agricultural lands, coastal urbanization, and other anthropogenic activities has modified the quality, quantity, timing, and distribution of freshwater inputs to coastal environments (Hessen, 1999; Hopkinson & Vallino, 1995). These modifications 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). Natural systems, local communities, and various economic sectors in Florida have been negatively impacted by these conditions. Statistical analyses and visualization of large water quality parameters datasets allow for a better understanding of watershed dynamics and coastal responses. This study shows average values and comparison

Objectives

- Understand the spatial and temporal variation of contaminants on the estuary's watershed, and
- Identify areas of poor water quality on the watershed

Study Area

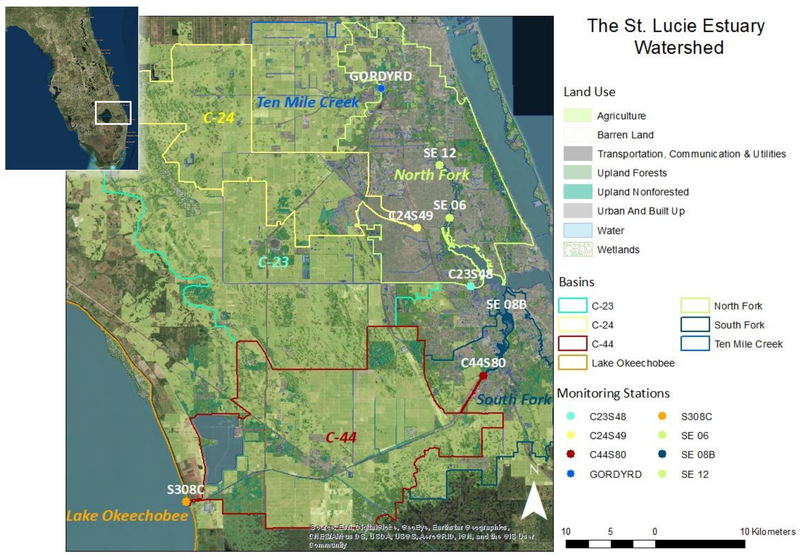

Figure 1 – The St. Lucie Estuary Map and the location of the eight stations and seven basins analyzed

Table 1 – Land Use in acres and percentage of the six basins analyzed in this study and their representative stations in the SLE watershed

Basin	Station	Area (acres)	Agricultural Area (%)	Natural Area (acres)	Natural Area (%)	Urban & Other (acres)	Urban & Other (%)
C-23	C23S48	84, 744	76	23,706	21	3710	3
C-24	C24S49	67,516	81	15,701	19	156	0
C-44	C44S80	78,351	59	37,163	28	17,203	13
Ten Mile Creek	GORDYRD	32,491	82	0	0	7,235	18
North Fork	SE 12 and SE 06	3,968	4	33,129	36	55,041	60
South Fork	SE 08B	20,120	40	18,987	38	11,014	22

Dataset

The DBHYDRO database was used to obtain continuous monthly data for seven selected water quality parameters from 2004 to 2016, in the dry (Dec – May) and wet (Jun – Nov) seasons. The parameters selected were: dissolved oxygen, kjeldahl nitrogen, nitrate + nitrite, pH, phosphate-ortho, phosphate-total, and turbidity.

Methodology

1. Obtained hydrology map of the St Lucie Estuary watershed, locations of monitoring stations, land use map, and continuous time series water quality data from the South Florida Water Management District's (SFWMD) and the Florida Department of Environmental Protection (FL DEP) websites.
2. Gathered water quality parameters from eight monitoring stations form the years 2004 – 2016. Values were checked for error and equipment blanks using Excel.
3. Analyzed the data for variation using Excel and SPSS. A hierarchical dendrogram was produced using Ward's method and Euclidean distance.
4. ArcGIS 10.5 was used to represent results on their respective monitoring stations.

Results

Charts 1 – 6. Average concentrations of nutrients, turbidity, and dissolved oxygen for the wet (Jun – Nov) and dry (Dec – May) seasons of 8 monitoring stations on the St Lucie Estuary watershed from 2004 - 2016.

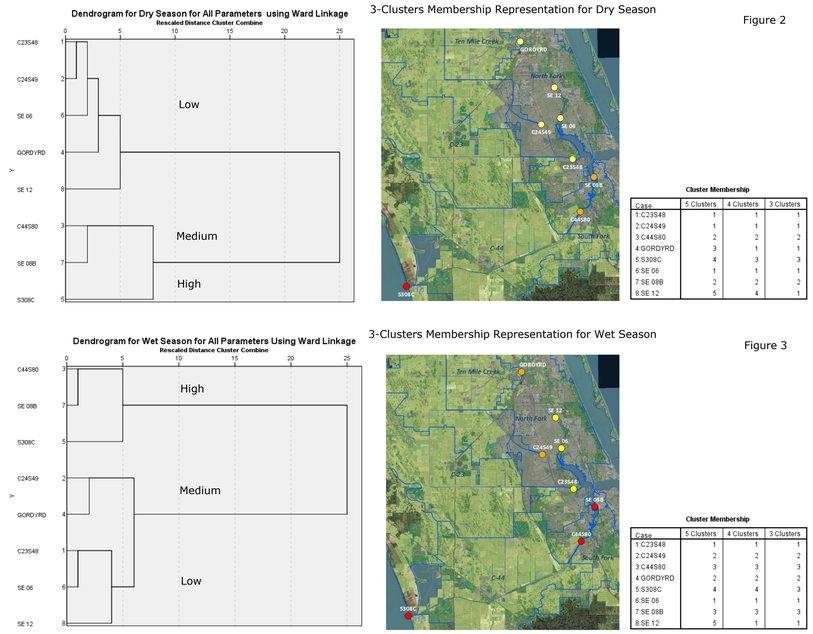

Figure 2

Figure 3

Figures 2 and 3. Cluster analysis of seven water quality parameters (DO, K Nitrogen, NOX, 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

- Lake Okeechobee is an outlier on most water quality parameters. Turbidity levels largely deviate in both seasons. The dry and wet dendrograms identify this station as the third category and the furthest away from the others.
- A seasonal difference is notable in average nutrient concentrations. Phosphorus and kjeldahl nitrogen were found in higher concentrations for the wet Season, which may be due to increased runoff. Differently, NOX and DO were higher in the dry season. Inorganic and readily available nitrogen may be in excess in the dry season due to a decrease in primary productivity and demand for DO may be low, so concentration is higher.
- Both dendrograms differentiate between the stations adjacent to the C-44 canal, which connect the lake. Though all the stations have parameter values that exceed the estuarine recommended standards, the stations that measure lake water deviate more.

References

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