DRAFT: Estuary Tipping Point Analysis - PCA Analysis

Part I: Caloosahatchee River Estuary

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Data

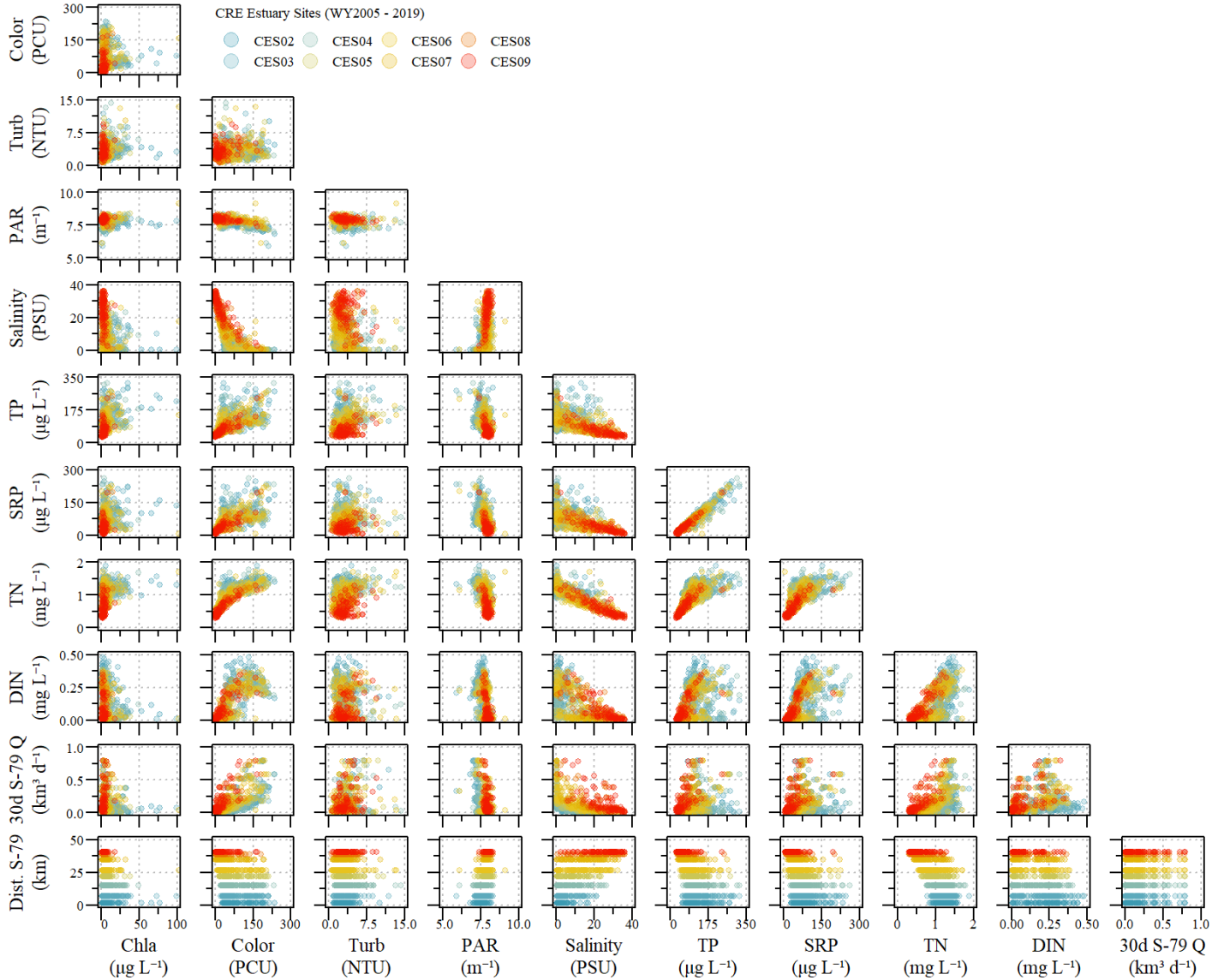
- Water quality and hydrologic data were retrieved from the South Florida Water Management District (SFWMD) online database (DBHYDRO).
- S-79 and Caloosahatchee River Esturay (CRE) monitoring network.
- Period of Record: May 1, 2004 - April 30, 2019 (WY2005 - 2019).
- Data were screened for fatal qualifers and reversals (i.e. SRP > TP).
- Data reported as less than method detection limit (MDL) were assigned one-half the MDL.

Statistical Analysis

- Principal Component Analysis using `rda(... scale = T)` in `R`.
- Analyses performed in R (Ver 3.6.1)

The Data

- Daily grab samples from CES02 - CES09
    - Chlorophyll-a (chla)
    - Color
    - Turbidity (turb)
    - Photosynthetic Active Radiation (PAR)
    - Salinity (Sal)
    - Total Phosphorus (TP)
    - Soluable Reactive Phosphorus (SRP)
    - Total Nitrogen (TN)
    - Dissolved Inorangic Nitrogen (DIN)
- S-79, 30-Day rolling total discharge
- Distance downstream from S-79



Pairwise comparison of parameters by station. One sample excluded, (Chl-*a* = 265 µg L^{-1} CES03; 2012-01-10)

Measure of Sampling Adequacy (MSA)

Parameter	MSA
Chla	0.53
Color	0.90
Turb	0.28
PAR	0.82
Sal	0.83
TP	0.58
SRP	0.58
TN	0.78
DIN	0.72
q.30d	0.66
Dist_km	0.72

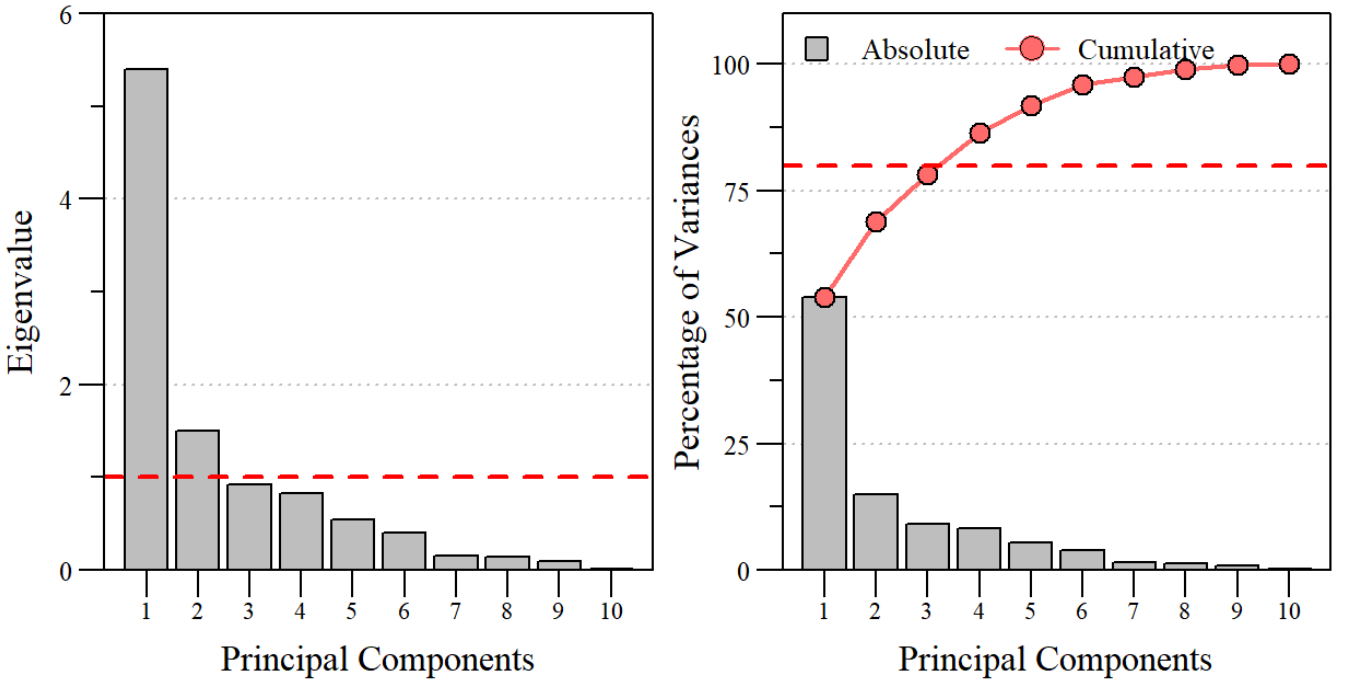
* $KMOS(...)$ in the $REdaS$ package

† MSA & KMO threshold of 0.5 for data suitability

Kaiser-Meyer-Olkin Statistics (KMOS)

- KMO-Criterion: 0.70
- If Turbidity is excluded KMO-Criterion: 0.72

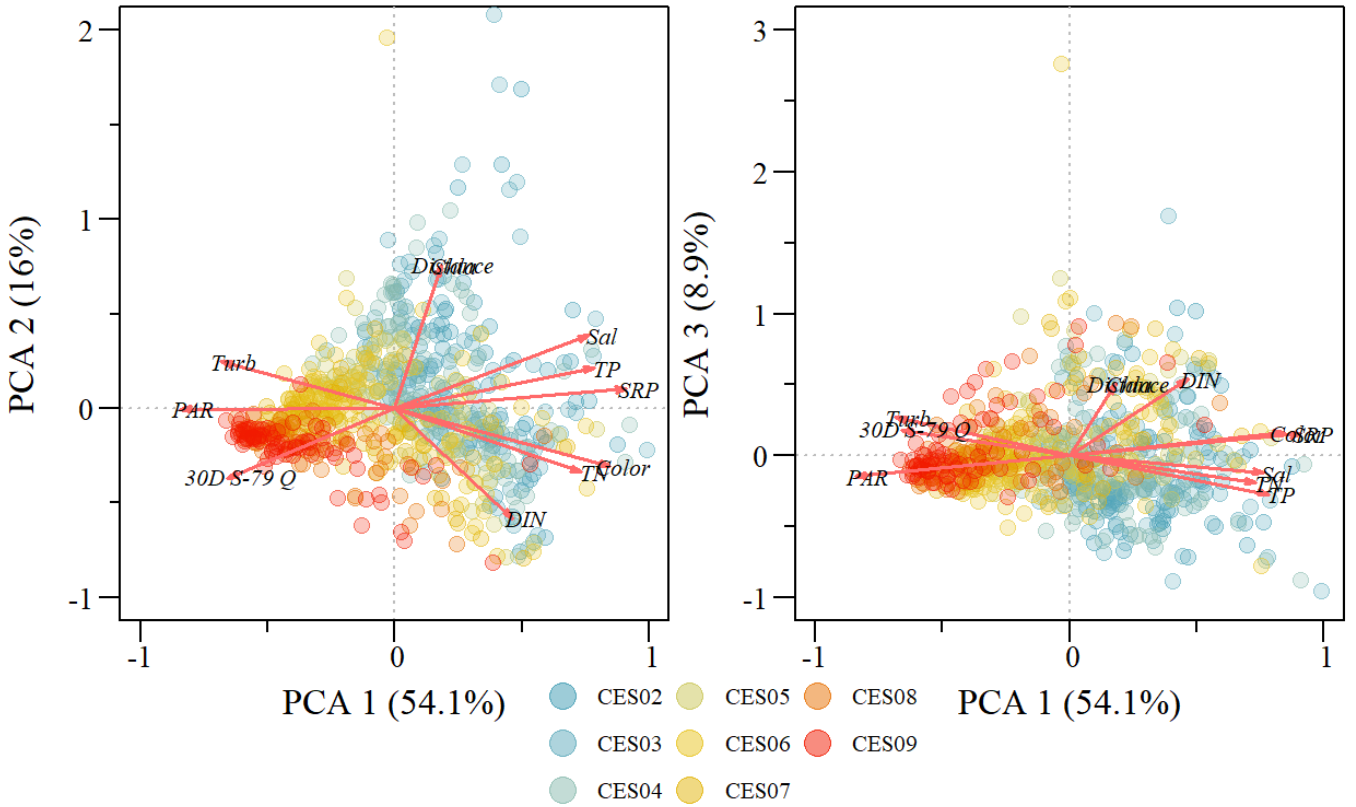
PCA Scree Plot



Left: Scree plot of eigenvalues for each prinicipal component with the Kaiser threshold identified. Right: Scree plot of the variance and cumulative variance for each priniciple component.

- The first three components account for 79% of the cumulative variance.

PCA Biplot



Biplot comparing PCA 1, 2 and 3.

Next

- Compare parameters at the site level (i.e. PCA for CES02, 03, etc.)
- Evalute nitrogen species (NO_x, NH_4, TON, etc.) in the multi-dimensional space
- Explore Non-metric multidimensional scaling (NMDS) analysis
    - Similar to PCA with some unique differences.
    - Both dimensionality reduction / pairwise comparison techniques

Project analysis, information and presentation can be found at
https://github.com/SwampThingPaul/EstuaryTip