WATER QUALITY TREND ANALYSIS FOR THE CHARLOTTE HARBOR ESTUARY IN SOUTHWEST FLORIDA, 2000–2021

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This study investigates water quality dynamics in the Charlotte Harbor estuary in southwest Florida between 2000 and 2021, including nitrogen, phosphorus, chlorophyll-a, oxygen, carbon, and physical parameters within the upper 1 m of the water column. Data were collected by the Coastal Charlotte Harbor Monitoring Network (CCHMN) following a spatially stratified random sampling design that divides the estuary into 13 segments of relatively homogeneous habitat and water quality conditions. For each water quality parameter at each segment, we fit a generalized additive model (GAM) to the available data, estimated annual mean values (with 95% confidence intervals), and estimated trends in the means over a sliding 5-year window using a linear mixed effects model that accounts for uncertainty in the mean estimates. For nitrogen, phosphorus, and chlorophyll-a parameters, we estimated trends over the 5-year period 2017–2021 and the 10-year period 2012–2021 and interpreted these results in the context of thresholds based on segment-specific regulatory criteria. Annual mean concentrations of total nitrogen at most segments increased between 2012–2021 and appear to have more recently stabilized at levels near or above regulatory criteria. In contrast, annual mean concentrations of total phosphorus were typically below regulatory criteria in 2021, with some notable exceptions, and trend directions varied across the estuary between 2012–2021 and 2017–2021. Annual mean chlorophyll-a concentrations were below regulatory criteria in 2021 and showed either downward trends or no significant trends between 2012–2021 and 2017–2021. Our analysis identified nitrogen as an important pollutant of concern throughout the Charlotte Harbor estuary, corroborating earlier studies suggesting that the achievement of restoration goals will require nutrient source and transport controls throughout the highly developed watershed.

PRESENTER BIO: Dr. Miles Medina is an environmental scientist specializing in water quality dynamics, trends, and drivers throughout Florida. Last year, he founded a private consulting firm, ECCO Scientific, to develop actionable, data-driven insights that inform management interventions for cleaner water and ecological restoration.