Title: Spatial dynamics of biogeochemical processes in the St. Louis River freshwater estuary

Authors: Joel C. Hoffman, John R. Kelly, Greg P Peterson, Anne M. Cotter

Abstract: In the Great Lakes, river-lake transition zones within freshwater estuaries are hydrologically and biogeochemically dynamic areas that regulate nutrient and energy fluxes between rivers and Great Lakes. The goal of our study was to characterize the biogeochemical properties of the river-lake transition zone in the St. Louis River and understand how physical mixing influences spatial variation in nutrients and organic matter across the estuary. Differences along the transition zone were described using a conservative mixing model that is based on the geochemical gradient that arises from river and lake water mixing. Stable isotope gradients that arise from the mixing of river and lake water were used to identify nutrient and organic matter sources. We found that the upstream displacement of the transition zone varied with tributary discharge. Principal components analysis revealed that variability in nutrients and particulate organic matter along the transition zone was strongly influenced by physical mixing of river and lake water. Nutrient and organic matter sources to the estuary reflected anthropogenic activity within the watershed. Deviations from conservative mixing revealed sources of nutrients and phytoplankton within the mixing zone, as well as regions that serve as an organic matter sink. The conservative tracer approach was thus a powerful tool to diagnose biogeochemical processes in the river-lake transition zone.