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A comparison of nitrate measurements with advanced optical sensor technology and traditional grab sampling in two large rivers under different flow and water quality conditions

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Nitrogen, especially nitrate nitrogen, has been implicated as the main cause for eutrophication of rivers, lakes, reservoirs and coastal waters around the world. Traditionally, determination of nitrate content in the surface waterbodies is accomplished by manually collecting water samples for laboratory analysis (a.k.a. grab sample method). In recent years, effort has been made to implement real-time field monitoring of nitrate with optical sensor technologies, and a few studies have reported promising results in characterizing high-resolution variation of riverine nitrate. While good agreement between real-time and grab sample measurements of nitrate was found based on limited data, two questions arise: 1) Do measurements of composite grab samples that are collected mostly from riverbanks differ from real-time measurements that are recorded normally from a submerged sensor in river centers or deeper waters? And 2) how do the measurements from the two methods compare under varying flow and ambient water quality conditions, such as high flow vs low flow, low temperature vs high temperature, and oxygen-depleted vs well-oxygenated waters? Real-time nitrate monitoring offers a great advantage in providing continuous water quality measurements. However, the method is costly and requires frequent maintenance, and its application will remain largely limited in the foreseeable future. As the grab sample method will continue to be the world's most used in-situ approach, the answers to the above questions will be helpful in improving our current field sampling design and technology. In this presentation, we will show comparison of real-time and grab sample measurements of nitrate in the lower reach of two large rivers - the Mississippi and Atchafalaya Rivers. The data were collected independently during the period from 2014 to 2016, therefore covered a wide spectrum of river hydrological and ambient water quality conditions. The presentation will focus on ways to understand potential causes for measurement discrepancies and ways to integrate high- and low-resolution measurement data for cost-effective and accurate nitrate transport and transformation analysis.