Poster #21-70

Probing Biogeochemical Processes in Coastal Ecosystems with High- Resolution/Long-term Dissolved Oxygen Measurements

Ruby Ghosh[1*], Terry Ball[1], Nicholas Fekaris[1], Mike Freeman[1], Reza Loloee[1], Eric Mollon[1], Dean Shooltz[1], Gary Gill[2], Li-Jung Kuo[2], Julia Indivero[2], Nicholas Ward[2, 3]

[1] OptiO2, LLC, Okemos, MI
[2] Marine Sciences Laboratory, Pacific Northwest National Laboratory, Sequim, WA
[3] School of Oceanography, Seattle, WA

Contact: ghosh@optio2.com

BER Program: SBIR
Project: SBIR
Project Website: http://www.optio2.com

Dissolved oxygen (DO) is an indicator for the metabolic state of aquatic ecosystems, representing an integrated signal from the interface of ecosystems. The cycling of carbon and nutrients is intimately linked with DO, making it a powerful parameter for interpreting a wide- range of biogeochemical processes. However, current DO sensor technologies require frequent attention by researchers to ensure proper calibration and data logging. Here we show results from a newly developed optical DO sensor technology by OptiO$_2$, tested in a variety of coastal settings. First, we deployed the OptiO$_2$ sensor in a nearshore marine environment (Sequim Bay, WA), where salinity remains close to full-strength seawater, to test its ability to make in situ salinity corrections. Over a several week-long deployment, the OptiO$_2$ data was in agreement with two commercial units with the added benefit of being able to telemeter data, collect data in high-resolution (1 minute frequency) with reduced power draw, and a small sensor footprint enabling non-traditional deployment approaches. These benefits allowed us to observe real-time changes in DO in Sequim Bay linked to tidal height, with lower DO values observed at low tide. The sensor's small size enabled deployment in a novel benthic flux chamber system, which quantifies the rate of DO drawdown by sediments. Benthic flux chamber results suggest that respiration in Sequim Bay sediments consume considerable amounts of DO, perhaps accounting for decreased DO levels at low tide. We next deployed the system at the mouth of a first-order coastal stream, Beaver Creek, to test performance under dynamic salinity ranges and in belowground environments. The system consisted of a battery/solar powered data collection station that autonomously transmits the DO, temperature, salinity and atmospheric pressure data from multiple sensors over a wireless connection. Beaver Creek is completely fresh during low tide and surface waters experiencing salinities up to 30psu at high tide. Groundwater below the adjacent terrestrial landscape also experiences tidal fluctuations in water level and salinity. We deployed the OptiO$_2$ probes in the river and two settings inaccessible to commercial sensors—in a groundwater well and in a groundwater seep that exchanges water with Beaver Creek. Similar to Sequim Bay, surface water DO was lowest during low tide. However, we speculate that this DO variability in Beaver Creek was largely driven by differences between fresh/saline waters at low/high tide and consumption of O_2 as water moves into and out of the terrestrial landscape.