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DEVELOPMENT OF AUTONOMOUS CHEMICAL SENSORS FOR OCEAN CARBON CYCLE RESEARCH AND MONITORING

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The oceans, especially the coastal oceans, are characterized by large spatial and temporal biogeochemical gradients. Ships only provide brief glimpses of this variability and research and monitoring would more ideally be conducted using autonomous sensors deployed on unmanned platforms such as moorings, autonomous profilers, drifters, and gliders. More and more chemical sensors are being developed that are suitable for this task. Sensors that can quantify CO_2-related parameters such pH, partial pressure of CO_2 (pCO_2), total alkalinity (A_T), and dissolved inorganic carbon (DIC) have been of particular interest because of the ocean's role in the uptake of atmospheric CO_2 and the ocean acidification that is occurring as a consequence. These measurements must be made with very good precision and accuracy in order to be useful for modeling and for guiding policy decisions. Our research has focused the development and commercialization of autonomous pH, pCO_2, and A_T sensors as well as their applications in carbon cycle research. The sensors all utilize pH indicators with a simple optical detection system. In the pH sensor, pH indicator is mixed directly with seawater; whereas, in the pCO_2 sensor, the indicator is contained within a gas permeable membrane in contact with seawater. The A_T system uses an in situ titration methodology – a pH indicator tracks the pH of the seawater as acid titrant is added. Both through commercialization of the sensors by Sunburst Sensors, LLC and our own NSF and NOAA supported research, the pCO_2 and pH sensors have been utilized in many different mooring and drifter-based studies. The A_T sensor is currently undergoing field testing. I will present a brief overview of recent studies using these autonomous sensors.