**Postdoctoral Scholar in Chemical Oceanography/Metrology**

The University of Delaware (UD) College of Earth, Ocean, and Environment invites applications for a Postdoctoral Research Scientist position in chemical oceanography and metrology. The successful candidate will work on a NOAA funded project to aid in development of a reference material for ocean pH by establishing traceability of pH indicator dyes to the International System of Units (SI). The scholar will make use of state-of-the-art analytical and experimental facilities at the National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland. Candidates must have a PhD in either chemical oceanography, analytical chemistry, or a closely related field. Demonstrated skills with spectrophotometry, potentiometry, nuclear magnetic resonance spectroscopy, and/or physical chemistry are preferred. The position will be located at the NIST facility in Gaithersburg, MD, but the appointment will be made through the University of Delaware. The postdoc will also attend field test cruises with the UD group. The appointment will be for one year, with continuation pending funding and progress.
Please contact Wei-Jun Cai (wcai@udel.edu) and Regina Easley <regina.easley@nist.gov> for additional information.

Project title: **Establishing the traceability of pH measurements for long-term carbon system monitoring from coastal waters to open ocean**
<funded by NOAA-Ocean Acidification Program for 3 years>

## Project Summary

As a master variable in aquatic systems, pH has been widely measured for various purposes. However its foundation in seawater and estuarine waters with variable ionic strength has not been solidly established. *The two challenges we are facing today are (1) oceanographic definitions of seawater pH do not extend to aquatic systems with salinity less than 20 g $kg^{-1}$, (2) commercial meta-cresol purple (mCP) shows large batch-to-batch variations in composition that yield unacceptable differences in the measured pH and the current supply of purified mCP is limited and is not traceable to primary pH measurements*. The current scientific and societal attention to ocean acidification, due to the uptake of anthropogenic $CO_2$ from the atmosphere, and its effects on organisms, biogeochemistry and ecosystem functions in open ocean and coastal ocean waters has highlighted the urgent need to benchmark a purified pH dye (mCP) to the International System of Units (SI) via a traceable, primary measurement of pH and to characterize the pH response over the salinity and temperature ranges of natural systems in order to establish a rigorous foundation to support the assessment of carbon dioxide levels and acidification status in global aquatic systems.

The research plan unites the primary metrological pH capabilities of the National Institute of Standards and Technology (NIST) with the coastal ocean inorganic carbon and pH measurement experience, capabilities and opportunities that exist at the University of Delaware (UD). This team proposes to achieve the following objectives:
1. Extend the primary measurements of pH, using the hydrogen gas electrode (Harned cell), to seawater buffer solutions (Tris buffers) in the salinity range of 5 to 45 g $kg^{-1}$ and pH values that cover the range observed from open-ocean waters to estuarine and coastal waters.
2. Commercially obtain a large batch of purified mCP, and characterize the pH response of the material as a function of temperature and salinity by direct measurement in the value assigned

artificial seawater buffers. These values for mCP can be used to benchmark field seawater and estuarine pH measurements.

3. Evaluate the robustness of the mCP reference material to spectrophotometric pH measurements in seawater and estuarine waters with different conditions including medium buffer capacity waters of the Chesapeake and Delaware Bay, high buffer capacity Mississippi River plume waters, and low buffer Georgia estuaries.

4. Evaluate how well the popularly used glass pH electrode, Durafet pH electrode and the NBS buffers can be used in conjunction with the purified mCP reference material. This will (a) allow us to assess the quality of the vast amount of past and current pH data collected using electrodes calibrated on the NBS or total scale and (b) enable users such as aquatic scientists and aquaculture industry professionals to achieve improved accuracy and reduced uncertainty with the low cost, ease-of-use approach.

5. Evaluate the uncertainties of the above approaches according to recommendations in the *Guide to the Expression of Uncertainty in Measurement* (JCGM 2008) report to advise the community on best practice of pH measurements based on both spectrophotometric and electrochemical methods.