

Building Capacity in Physical Chemistry Methods, Measurements and Modelling for Chemical Oceanography

The fundamental physical chemistry of natural waters, e.g., acid-base speciation, trace metal complexation, and mineral solubility, is central to chemical oceanographic problems such as:

- Resolving uncertainties and inconsistencies in the relationships of the parameters of the marine carbonate system.
- Developing calibrations and standards for pH and other quantities.
- Understanding the relationship between atmospheric CO₂ and the carbonate and silicate cycles in past oceans, which have different compositions from the present day (paleoceanography).
- Marine carbon dioxide removal (mCDR), in particular the effects of electrochemical methods and mineral additions close to the areas of application where seawater composition and chemistry may be disturbed from normal values.
- The biological availability and fate of trace metals (complexed by inorganic and organic seawater components).

The above are examples related to our own work, and are not exclusive. Many of these and other applications are relevant not just to the oceans, which have a largely invariant composition with respect to major inorganic components, but also to enclosed seas, estuaries, and pore waters, which have different compositions and a different physical chemistry.

We are concerned about dwindling expertise in the physical chemistry of aqueous solutions that is so foundational to the field of chemical oceanography. We are writing to you in order to gauge the level of interest and solicit ideas from the oceanography community to catalyze capacity building and continued research in this area. This, we believe, should begin with an international workshop to bring together chemical oceanographers across sub-disciplines and applications with leading scientists from other fields with relevant expertise (e.g., other areas of geochemistry, chemical engineering, etc.). It would aim to:

1. **Assess the science:** Share knowledge of experimental methods and modeling tools and theory, and highlight opportunities for community-wide activities (intercomparison, synthesis, development of best practices, etc.) that can make the best use of our current capabilities.
2. **Identify opportunities:** Determine the subject areas within chemical oceanography that are impacted by the lack of physical chemistry skills in both modeling and experimental methods, and what is needed to address this skills gap including, for example, strengthening collaborations with scientists in other disciplines.

3. **Support the next generation:** Strategize curricular, training, and capacity building mechanisms to increase and then maintain the skills and expertise required to carry this field forward.

4. **Build community:** Explore ways of developing a more cohesive and collaborative network of aqueous geochemistry practitioners working in the field of chemical oceanography.

During the 2024 Ocean Sciences Meeting, we initiated discussions with national funding agencies and various oceanographic organizations and networks regarding the concerns and ideas laid out here. There is recognition that we have identified a real problem. **To be successful, the workshop needs to foster discussions, planning, and knowledge transfer across career stages and disciplines, especially with those outside the field of oceanography. It also needs to develop clear recommendations.** We are willing to spearhead a workshop proposal and lead such an activity, with the intention that it will strengthen our community and, particularly, generate new initiatives in training and research in physical chemistry measurements and models for applications in oceanography. We would aim for such a workshop to take place in late 2024 or early 2025.

How can you get involved?

Community support is critical for securing funding for this activity and its outcomes. **To express your interest in a potential workshop and provide feedback on ideas summarized here, please either email one of us or [CLICK HERE](https://forms.gle/ztqhatTZXLU8tW8p6)** (<https://forms.gle/ztqhatTZXLU8tW8p6>). Even short comments outlining your needs and experience will be valuable and will help shape a proposal.

Please share this document with colleagues you think might be interested.

Thank you for your time,

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