**Title:** **Improving biogeochemical models through single cell-based analyses of marine plankton physiological plasticity, genetic diversity and evolutionary processes**

**BREAKOUT GROUPS:**

Breakout Group #1:

What are the single cell-specific and population-level traits required for parameterizing microbial “plasticity” in marine biogeochemical models of the current ocean?

1. Many modelers view microbial “traits” as size, do they utilize silica etc., can we develop a common language that brings these simplistic ideas to a more physiologically/genetically correct assignment of traits to major plankton groups.

Abbreviated list of traits to start the conversation

Cell size

Inorganic nutrient half-saturation concentrations

Optimum growth temperature (and temperature range, Q10)

Optimal growth irradiance

Maximum growth rates

Biomass-specific respiration rates

Element quotas (mol element per cell, or mol element per cell biovolume)

pigment types

Ability to do mixotrophy (autotrophs)

1. How does the desired list of traits compare to the trait data collected now, and can we recommend improvements?
2. What type of organized research program might be proposed to most efficiently and effectively address these science needs?

Breakout Group #2

Do genetic diversity, evolution and physiological plasticity have similar or different impacts on ocean biogeochemistry, particularly the production and export of particulate organic matter from the surface ocean?

1. What are the methods for quantifying physiological plasticity, genetic diversity and evolution?
2. How are the 'omic' approaches facilitating our understanding of marine biogeochemistry and how do we begin to couple omic approaches with more traditional methods and measurements of rate processes?
3. What are the interactive effects of biogeography and genetic diversity vs. physiological plasticity and its effects on biogeochemistry?
4. What aspects of diversity and/or plasticity need to be (or “are useful to be”?) included in biogeochemical models?
5. What type of an organized research program might be proposed to most efficiently and effectively address these science needs?

Breakout Group #3

What roles do taxonomic diversity and physiological plasticity play in controlling the response of microbial communities to current and future environmental stressors, for example, oxygen minimum zones, ocean acidification, ocean warming, stratification and changing nutrient concentrations or supply rates?

1. How to parameterize acclimation and adaptation?
2. What can current omic information tell us about plankton niche separation and the potential for evolution?
3. How should multiple simultaneous effects of different stressors be included experimental design?
4. How should these multiple stressors (and which) be included in models to predict changing biogeochemistry?
5. What type of organized research program might be proposed to most efficiently and effectively address these science needs?