Ocean Acidification Principal Investigators' Meeting
Breakout group topics and discussion questions

Topic #III. Scaling and modeling across time and space. *Hypothesis- or inquiry-based scientific research yields conclusions that are most conservatively applied in specific, spatially or temporally limited forecasts. (For example, an individual species' calcification response to monotonically changing pH in an aquarium study may be difficult to relate directly to the natural environment.) However, the overall motivation behind ocean acidification research is to determine how marine ecosystems will respond to future conditions. How can we conduct individual research projects so that the conclusions will feed into the development of models and general forecasts, spanning relevant time and space scales, and including multiple stressors?*

A. **What are the main scientific approaches to understanding how ocean biology, ecosystems, and biogeochemistry will change in the future. What are the shortcomings of these approaches (e.g., mismatch between observations and modeling; need for more paleo data; better constraints on biological responses)**
    1. Biogeochemical modeling
    2. Predicting Physiological/Ecosystem responses
    3. Paleo research
    4. Socioeconomic modeling
    5. Evolutionary approaches

B. **Will observational research focusing on mechanistic biological responses provide information that can be scaled over space, time, and multiple stressors? What are the ways we can use new research to improve our current approaches?**

C. **What must be included in experimental designs to allow scaling from individuals to populations and/or ecosystems?** (e.g. adaptation, multiple strains, ecosystem studies)

D. **Multiple stressors –** an old question but an ongoing problem (oxygen, nutrients, T, toxic chemicals, etc.)

E. **Natural OA gradients and OA fertilization – how far can we trade space for time? What are the time/space limitations of regional CO2 fertilization experiments?**

F. **Environments that need more study and what do they mean to scaling?**
    1. Heterogeneous environments (e.g. coastal zones)
    2. Frontier environments (deep sea, midwater)

G. **Are there statistical or analytical approaches that can be used to best help estimate answers when scaling, extrapolating, or layering?**

H. **How can OCB facilitate improvements in this important aspect of understanding ocean acidification and its impacts?**