LAMONT-DOHERTY EARTH OBSERVATORY
THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

Mini-Workshop Abstract
Carbon productivity responses to increased dissolved inorganic carbon concentrations in surface ocean:
Exploring the feasibility of an *in situ* mesoscale carbon addition experiment.
Monday – Tuesday, 23-24 March 2009

ABSTRACT

Surface oceans are taking up a proportion of the increasing atmospheric pCO_2. Two consequences of this increased flux are 1) an increase in dissolved inorganic carbon concentration and 2) a decrease in pH. Both of these consequences can affect phytoplankton, the organisms which transform inorganic carbon to organic carbon using light energy and are responsible for generating the carbon gradient between the surface mixed layer and the deep ocean referred to as the "biological pump". Phytoplankton will also be impacted by indirect effects of potential changes in the bioavailability of macro- and micro-nutrients. Although the role of biology in the overall global carbon cycle may be proportionately small, it is significant because of its capacity to contribute to negative feedbacks and non-steady state conditions. Therefore, a question of major environmental importance is, "How will biological responses to increased concentrations of dissolved inorganic carbon and decreased pH contribute to the oceanic carbon cycle?" To probe beyond the constraints of enclosed experimental systems (i.e. laboratory cultures, on-deck bottle incubations and more sophisticated mesocosm experiments) and quantify the ultimate impact to ecosystem function and C export This LDEO Climate Center mini-workshop will explore the feasibility of implementing an *in situ* mesoscale ocean carbon addition experiment. Such an undertaking would be extraordinarily logistically challenging, however the reward would be a significant leap in understanding of the effects of increased carbon on the surface ocean biology and subsequent carbon export. Issues which should be addressed including the following as well as others:

> How much CO_2 would be required? How many injections would be required and over what time scale? How long would the CO_2-enriched patch need to be maintained? How long *could* the CO_2-enriched patch be maintained? Can we get the desired test of biological response from a study with the duration of a cruise, or of a series of cruises that span the lifetime of a patch enriched in CO_2? What key physiological parameters will indicate phytoplankton response and what other biological observations are desirable to account for the surface ocean biology "box"? What flux observations are desirable to account for the adjoining atmosphere and deep ocean "boxes"? In what ocean/region should this be done?

This meeting is an opportunity to document the scientific feasibility for and expectations from an *in situ* CO_2 addition experiment. Appropriate technologies (i.e. ship logistics, method of delivery and sampling) may not currently exist. Financial costs may not fit the standard NSF funding model. This exercise will inform us where scientific efforts will need to be concentrated, what lab experiments have yet to be done, what technologies need to be developed. It is expected worthwhile projects and collaborations will be developed that will ultimately bring us closer to understanding the effects of increasing atmospheric CO_2 on ocean ecosystems, regardless of the near-term financial or logistical feasibility of an *in situ* experiment.