Data Management Plan

"Collaborative Research: Elucidating algal host-virus dynamics in different nutrient regimes—mechanistic interactions and biogeochemical impact"

This collaborative project aims to bridge an existing gap in our quantitative understanding of the importance of viruses as mortality agents of phytoplankton and their contribution to biogeochemical cycles. We propose to elucidate the tradeoffs influencing viral succession and replication under different nutrient regimes and infection scenarios. Using lab-based experiments with a coccolithophore host-virus model system, as well as an extensive suite of samples from natural, virus infected coccolithophore blooms in the North Atlantic, this proposal aims to elucidate: **1)** the effect of nutrient limitation on the fitness of phytoplankton hosts, and their defenses during viral infection; **2)** the effect of different nutrient regimes on the ability of viruses to successfully infect, and propagate within, compromised hosts; and 3) the influence of viral infection on the large scale biogeochemistry and biogeography of a globally significant phytoplankton species. Our interdisciplinary approach will combine grounded molecular- and flow cytometry-based diagnostic techniques with theoretical models of infection to understand the primary mechanisms underlying observed host-virus dynamics. We will also merge our findings with extant ecosystem models and observational datasets to understand the ecological significance of phytoplankton infection by viruses and its dependence on nutrient supply on large spatial scales.

Using an array of calcifying versus noncalcifying and sensitive versus resistant host strains, the proposed work will combine laboratory- and field-based measurements with a theoretical modeling approach to elucidate key dynamic controls on Coccolithovirus (EhV) infection of globally important *Emiliania huxleyi* host cells in different physicochemical states. These include the nutrient sensitivity of key infection parameters: viral absorption rates into hosts, virus replication efficiency and latent period, and the production of infectious viruses and their excretion into the surrounding medium. We hypothesize that: 1) nutrient driven changes in host cell fitness and physiological state critically repress the ability of EhVs to function as mortality agents; and 2) nutrient driven changes in host-virus interactions drive the distribution of *E. huxleyi* and the fate of new production in the ocean.

Much of the proposed research consists of lab-based experiments using model *E. huxleyi* host-virus systems in order to assess the role that nutrients play on the physiology of host cells, cellular and sub-cellular interactions of viruses with host cells, and the fate of nutrients during viral infection. Analytical methods include Fluorescence Induction and Relaxation (FIRe), diagnostic fluorescence staining and flow cytometry, coulter counter measurements, plaque assays for quantifying infectious virus particles, bacterial production via radioisotope (3H) incubations, quantitative PCR, and Western blot analysis. In order to ascertain the biogeochemical impact of EhV infection and its coupling to microbial processes, we will also measure bulk respiration using non-invasive oxygen sensor spots (i.e. optodes) and a Fibox4 probe detector, total dissolved and particulate nutrients (e.g. P and N), dissolved and particulate organic and inorganic carbon (DOC/DIC/POC/PIC), ectohydrolytic enzyme activity (via fluorogenic substrates) and TEP. **The experimental data from these experiments will be openly shared between project-related research teams at Rutgers and MIT, in order facilitate integration of mechanistic controls into computer models. Otherwise, the experimental data and observations will be of no practical use beyond providing supporting data for information reported in publications.**

The measured physical, chemical, biological, and biogeochemical parameters in each experiment will be linked to the physiological state and viral infection dynamics data. We will also be linking these lab-based parameter measurements with extensive datasets from previous field campaigns [including the *North Atlantic Virus Infection of Coccolithophore Expedition* (NA-VICE; R/V Knorr; KN207-03; 13 June – 16 July 2012; http://www.bco-dmo.org/project/2136)], whereby similar parameters of host-virus dynamics were measured for natural assemblages. **Hydrographic and oceanographic data from CTD hydrographic casts on the NA-VICE cruise, as well as from surface samples collected by the ship's underway system, have been submitted and are available through the Biological and Chemical Oceanography Data Management Office (BCO-DMO).**

In order to facilitate the availability and access of project data by project team member from Rutgers and MIT, we will create an internal data depository system in which we will upload processed data upon completion of experiments and model simulations. **This data/information will be posted on the PIs' project website, as developed by IT personnel within the Department of Marine and Coastal Sciences at Rutgers University and the Marine Biogeochemical Modeling Group at MIT.**