

The physiology of phytoplankton in fluctuating light

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October 17, 2018

11:00 a.m. – Pacific Forum

Light fluxes in natural conditions vary in time scales of seconds to days. I will focus on two areas of research that are being used to generate new hypotheses about how algae and cyanobacteria maintain growth and photosynthetic efficiency in fluctuating light. We have used systems biology tools to uncover novel aspects of diatom biology that occur during acclimation to low light. This exposed the importance of heterotrophic metabolism for facilitating major changes to the photosynthetic apparatus, including an unusual mitochondria-based beta oxidation of fatty acids. I will then talk about the application of computational fluid dynamics to characterize the light environment of a cyanobacteria growing in conditions similar to those proposed for industrial scale biofuel production. This technique revealed unexpected complexity in the light environment over a day. Replicating this light environment ex situ revealed that cells “waste” a considerable amount of captured light energy to light dependent oxygen consumption, suggesting alternate pathways for the engineering of photosynthetic efficiency.

