University of Victoria | Graduate Studies

Notice of the Final Oral Examination for the Degree of Doctor of Philosophy

of

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"Comparing Marine Primary Production and Carbon Export Methods in the Arctic and NE Subarctic Pacific"

School of Earth and Ocean Sciences

Friday September 13, 2019
10:00 A.M.
Clearihue Building
Room B019

Supervisory Committee:
Dr. Roberta Hamme, School of Earth and Ocean Sciences, University of Victoria (Supervisor)
Dr. Diana Varela, School of Earth and Ocean Sciences, UVic (Member)
Dr. Debby Ianson, School of Earth and Ocean Sciences, UVic (Member)
Dr. Jim Gower, School of Earth and Ocean Sciences, UVic (Additional Member)
Dr. Lauren Juranek, Ocean Ecology and Biogeochemistry, Oregon State University (Outside Member)

External Examiner:
Dr. Adrian Marchetti, Department of Marine Sciences, University of North Carolina

Chair of Oral Examination:
Dr. Tim Stockwell, Department of Psychology, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

Abstract

Primary production and carbon export connect biogeochemical cycles in the surface waters to the deep. Quantifying rates of production and carbon export are important to understanding the global carbon cycle. There are multiple productivity rate methods, but each measures a different fraction of production. The first type of method is in vitro methods that involve removing water samples from the environment and incubating with an isotopically labelled tracer, such as a nutrient. At the end of the incubation, the amount of enrichment in either the particulates (phytoplankton) or the dissolved oxygen are measured to determine productivity. The second type of method is in situ methods that measure the natural environmental parameters instead of incubations. In this study, the natural isotopic composition and the ratio of gases in the surface water are measured. Comparing in situ versus in vitro methods in the Arctic on a GEOTRACES cruise (July 2015), we identified five reasons methods do not agree: time of integration, depth of integration, recently shoaled mixed layer, mixing at the base of the mixed layer, and methodological issues. When comparing in vitro methods to each other, filter handling and some as yet unidentified issue causes differences. Comparing methods along Line P (over three years), we hypothesize that excretion of dissolved organic nitrogen, upwelling, bottle effects, mixing, and time of integration are the most important factors that cause disagreement between methods. End of bloom dynamics created an extreme case where method disagreement was most severe.

Applying method comparison in the NE subarctic Pacific helps to understand what drives variability in primary production. Historical data show that chlorophyll-a is low and invariant offshore in the high nutrient low chlorophyll area (HNLC), where iron is limiting. We used satellites and models, which compare well with shipboard data, to expand our spatial and temporal coverage of the offshore HNLC area. Increased chlorophyll is associated with higher production, higher salinity, and lower temperature. We hypothesize that iron can be supplied to surface waters by offshore fronts, using June 2015 and June 2016 as specific examples. We identified locations where fronts were located based on Mercator model sea surface temperatures and compared these features to satellite chlorophyll patterns. Our hypothesis is also supported by data from June 2017 where there were no fronts and chlorophyll was uniformly low. Future research should consider fronts as a possible mechanism for increasing productivity in the area.