Austral Summer Institute XV (ASI XV)
Organic chemistry, genomics and equations as tools to understanding the oceans

Department of Oceanography & COPAS Sur-Austral Program
University of Concepcion, Chile
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Course: Biogeochemistry and modeling particulate carbon fluxes

Part 1: Particle Biogeochemistry

Dr. Cindy Lee

The export of many elements from the surface ocean to the deep sea is mediated by the flux of sinking particles. Heterotrophic remineralization of particulate organic carbon in the open ocean is usually very efficient, and >90% of the POC produced in surface waters is returned to inorganic form in the euphotic zone or during transit through the upper water column. Similarly, the flux and composition of inorganic material also vary during transport to the sea floor. However, a small fraction of the particles produced in surface waters survives transit to the deep ocean or seafloor. The flux and composition of both particulate organic and inorganic matter that reaches the deep sea and sediments depend not just on their source in the surface waters, but also on alteration, supplementation, and selective removal that occurs during vertical transit. Exchange between sinking material and suspended particles or dissolved organic matter via aggregation/disaggregation and solution/dissolution can also influence composition.

The aims of the course will include:

1) discuss the general chemical composition of particles, and the physical and biological controls on that composition
2) read, discuss, and evaluate published papers

The course will consist of six 4-h sessions. Each session will include 2 h of lecture and 2 h of discussion of papers from the literature.

Lecture topics will include:

- Global carbon cycle
- Particulate inorganic carbon composition
- Particulate organic carbon and carbon export
- Decomposition of organic matter
- Preservation of organic matter
- Future ocean changes in carbon fluxes

Discussions of papers drawn from the literature, especially those from the MedFlux project, will cover the scientific questions being asked in the paper, how the authors approached the problem, and what further research could be done to answer unfinished questions. Papers will be distributed as pdfs.

Students will give a short oral presentation on a topic of their choice from the material presented in the course.

Part 2: Modeling Particles and Particulate Carbon Fluxes

Dr. Robert Armstrong

Modeling the production, sinking, interactions, and fate of particles and particulate carbon in the ocean is of obvious importance to our understanding of the oceanic carbon cycle; but unfortunately the data from which to infer patterns is sparse in spatial resolution, in temporal resolution, in size resolution, in taxonomic resolution, and in many other qualities. These data limitations beg for the use of powerful (though conceptually simple) computer-based statistical techniques to coax the maximum information from these limited data.

In this course, I will emphasize examples from recent studies conducted in the Mediterrean Sea (MedFlux), which for the first time allowed direct separation of sinking particulate material into sinking velocity classes. Characteristics of each class (e.g., mass fluxes, thorium fluxes, pigment fluxes, etc.) were then analyzed using custom-designed modeling and statistical techniques. The aims of this course are:

1) To develop basic concepts of analyses of particle flux dynamics; the level of this will be based on the level of preexisting student understanding;
2) To read and discuss several papers from the MedFlux study and from related literature, to develop an understanding of why additional statistical approaches were needed;
3) To read and discuss additional papers and/or data sets of interest to students.

Requirements: class participation; a final examination, most probably oral

Prerequisites: this is an advanced course; previous exposure to statistics will make the ideas presented in this course more easily assimilated.