Collaborative Research: Biogeochemical Modeling of Carbon Partitioning in the Pacific: the Role of Si and Fe in Regulating Production by Siliceous and Calcifying Phytoplankton

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Principal Investigator: Chai, Fei
Organization: University of Maine

Title:
Collaborative Research: Biogeochemical Modeling of Carbon Partitioning in the Pacific: the Role of Si and Fe in Regulating Production by Siliceous and Calcifying Phytoplankton

Project Participants

Senior Personnel
Name: Chai, Fei
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc
Graduate Student
Undergraduate Student
Technician, Programmer
Other Participant

Research Experience for Undergraduates

Organizational Partners

Duke University Marine Laboratory
San Francisco State University
University of Miami Rosenstiel School of Marine & Atmospheric Sci

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:
This project incorporated the silicate pump hypothesis and Fe limitation into an ecosystem model to simulate air-sea CO2 fluxes in the Pacific Ocean. A 1-D version of this model was constructed for the equatorial Pacific that was based upon the US JGOFS EqPac field program. The tested 1-D model then was embedded into a 3-D ocean circulation model for the Pacific Ocean. The 1-D model can be run and manipulated through a website with different parameters (http://rocky.umeoce.maine.edu/1deco-new/run-model/), and the 3-D model results can be accessed with the Live Access Server (LAS) (http://
Both 1-D and 3-D ecosystem models were used to test ideas about silicate and iron regulation on phytoplankton productivity for various regions in the Pacific Ocean, as well as the ecosystem response to interannual and decadal climate variability in the Pacific. This project provided partial salary support and/or research opportunities for 3 graduate students, 3 post-docs and several undergraduates. To date, there are more than 10 publications and 20 presentations have been made.

Findings:
The major findings from above listed activities are: 1) silicate regulates diatoms productivity in the equatorial Pacific; 2) iron also modifies diatom growth rate in the equatorial Pacific; 3) tropical instability waves, El Nino and Pacific decadal oscillation alter silicate and iron supply to the upper ocean, therefore, the diatom productivity and Si export are highly related to physical processes in the equatorial Pacific; 4) Carbon cycle is tightly linked with diatom productivity and physical processes in the equatorial Pacific; air-sea CO2 flux is mainly controlled by physical processes ranging from tropical instability waves, seasonal cycle, to El Nino and PDO time scale.

Training and Development:
There were two postdocs involved in this research project. They have learned ecosystem model development, biogeochemical and physical dynamics in the equatorial Pacific. There are no teaching activities related to this project.

Outreach Activities:
We have put 1D ecosystem model online, which allows public to access the website and run the ecosystem model and obtain results. We hosted a workshop to present some modeling materials to a group of middle and high school teachers. During the workshop, I showed the teachers how to access to the online 1D ecosystem model and conduct experiments. I also developed an ecosystem model with Excel, which most middle and high school students can do with some help from their teachers.

Journal Publications


Processes on Si Deposition and Atmospheric CO2 Cycles

Chai, F., M. Jiang, R.T. Barber, R.C. Dugdale, and Y. Chao, "Interdecadal Variation of the Transition Zone Chlorophyll Front, A Physical-Biological Model


Dugdale, R.C., R. T. Barber, F. Chai, T.H. Peng, and F.P. Wilkerson, "One Dimensional Ecosystem Model of the Equatorial Pacific Upwelling System, Part II:

**Books or Other One-time Publications**

**Web/Internet Site**

**Other Specific Products**

**Contributions within Discipline:**
The research activities and publications resulted from this project have advanced our understanding on physical and biological regulations on air-sea CO2 flux in the equatorial Pacific. The modeling results and observational data showed clear silicate and iron co-limitation on diatom growth, therefore direct impacts on carbon cycle in the region.

**Contributions to Other Disciplines:**
The modeling project also advanced our numerical modeling techniques by conducting many ecosystem model simulations on serveral supercomputers.

**Contributions to Human Resource Development:**
The project trained two postdocs by developing and conducting model simulations. The project also involved in two graduate students indirectly, which they have used the models for other modeling projects.

**Contributions to Resources for Research and Education:**

**Contributions Beyond Science and Engineering:**

**Categories for which nothing is reported:**

Any Book
Any Web/Internet Site
Any Product
Contributions: To Any Resources for Research and Education
Contributions: To Any Beyond Science and Engineering