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Collaborative Proposal: Cascadia Slope Circulation Study

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Perry, Mary - Principal Investigator
Title:
Collaborative Proposal: Cascadia Slope Circulation Study

Project Participants

Senior Personnel

Name: Perry, Mary
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Graduate Student

Name: Carder, Caleb
Worked for more than 160 Hours: Yes
Contribution to Project:
Not supported but worked on data for his Master's

Undergraduate Student

Name: Irby, Ike
Worked for more than 160 Hours: Yes
Contribution to Project:
Assisted with laboratory data for calibration of fluorescence and absorption

Name: Brisson, Nicole
Worked for more than 160 Hours: Yes
Contribution to Project:
assisted in laboratory measurements of chlorophyll

Technician, Programmer

Name: Briggs, Avery
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Kallin, Emily
Worked for more than 160 Hours: Yes
Contribution to Project:
Calibrated fluorescence sensors

Other Participant

Name: Sackmann, Brandon
Worked for more than 160 Hours: Yes
Contribution to Project:

data analysis and manuscript preparation

Research Experience for Undergraduates

Organizational Partners

University of Washington

Charles Eriksen and Craig Lee are collaborators on this project. They operate the gliders from University of Washington and collaborate on data interpretation.

Monterey Bay Aquarium Research Institute

Washington State Department of Ecology

Brandon Sackmann continued collaboration after graduating from UMaine and moving to Washington State Department of Ecology

Other Collaborators or Contacts

Activities and Findings

Research and Education Activities:

The major activity for the University of Maine component of this collaborative research project was analysis and interpretation of optical data collected by Seagliders on a multi-year survey line off the Washington coast. From September 2003 through 2008 a Seaglider visited the offshore terminus of a V-shaped transect off Washington, measuring temperature, conductivity, dissolved oxygen, chlorophyll a fluorescence and particulate optical backscatter. One complete section of the transect took approximately one month to complete. Specific research activities included vicarious inter-calibration of optical sensors; development of methodology to mitigate the effects of fluorescence quenching; and analysis of multi-year data. Specific educational activities included mentoring of a Ph.D. student and a Master?s student whose dissertation and thesis, respectively, were based on this dataset; providing research experience for one undergraduate, two newly graduated college students, and one high school teacher through a RET supplement; and incorporating research results from the project in college level classes.

Findings:

From September 2003 through 2008, a Seaglider visited the offshore terminus of a V-shaped transect off Washington, measuring temperature, conductivity, dissolved oxygen, chlorophyll a fluorescence and particulate optical backscatter. 1) Distinct interannual variation was documented in: maximal depth of the wintertime pycnocline; timing of transition to a shallow summertime pycnocline; timing and magnitude of the spring bloom; depth of the subsurface chlorophyll a maximum; and timing of onset of mixed-layer erosion in autumn and dispersion of the subsurface chlorophyll a maximum. 2) Chlorophyll a concentrations estimated from fluorescence were directly comparable among seven laboratory-calibrated sensors used over the observation period, indicating that different sensors could be used to measure relative changes in phytoplankton over time. However, the magnitude of chlorophyll estimated from these sensors exceeded satellite-derived concentrations and historical measurements by a factor of three. The impact of these findings is that ground-truthing is essential, although in practice difficult to do.

3) Seaglider optical profiles were used to interpret ocean color satellite imagery and showed how a presumptive autumn bloom as observed from space was actually a vertical redistribution of phytoplankton following autumn destratification.
4) Phytoplankton thin layers, on the order of 1 to several meters, were occasionally observed in offshore waters. Between 9 June and 9 July 2004, thin layers were present for almost 100 km and for over two weeks, suggesting that this feature was actually a thin 'sheet' of phytoplankton, albeit with some holes.
5) Satellite and Seaglider optical data were merged (data fusion) to study the effect of an eddy on enhanced biological productivity in slope waters in autumn 2004.
6) Additional data mining and analysis and manuscript preparation is continuing, although the grant has ended.

Training and Development:

The UMaine component of this collaborative project provided the opportunity for several interns (college undergraduates and recent graduates), a Master?s student and Ph.D. student to gain computational skills by working on this unique data set. Through an RET supplement a high school teacher from Westbrook High School was able to work on the data set during one summer, giving him a realistic assessment of the challenges of research which he could then incorporate into his teaching.

Outreach Activities:

The PI and members of her lab gave an average of 10 presentations per year to school groups (Wiscasset and South Bristol 7th grades, Hermit Island Montessori School, Lincoln Academy, Westbrook High School, home-schooled students, and Augusta Community College) who came to the Darling Center on field trips.

Journal Publications

Paul,J., C. Scholin, G. Van Den Engh, and M.J. Perry, "A Sea of Microbes: In situ instrumentation", Oceanography, p. 70, vol. 20 (3), (2007). Published,

B. Segee, M.J. Perry, C. Carter, R. Blanchette, and S. Winchenbach., "Visualization of large scientific data sets on a parallel system with a tiled display", Proceedings of International Association of Science and Technology for Development: Parallel and Distributed Computing and Systems, p. 590-049, vol. PDCS 20, (2007). Published,

Perry, M. J., B. S. Sackmann, C. C. Eriksen, C. M. Lee, "Seaglider observations of subsurface chlorophyll maxima off the Washington coast", Limnology and Oceanograhy, p. 216, vol. 53, (2008). Published,

Sackmann, B. M. J. Perry, and C. C. Eriksen, "Using Seaglider to quantify variability in mid-day fluorescence quenching off the Washington coast", Biogeosciences Discussion, p. , vol. <http:/, (2008). Submitted,

Eriksen, C. C., and M. J. Perry, "The Nurturing of Seagliders", Oceanography, p. 96, vol. 22, (2009). Published,

K.S. Johnson, W.M. Berelson, E.S. Boss, Z. Chase, H. Claustre, S.R. Emerson, N.??Gruber, A. K??rtzinger, M.J. Perry, and S.C. Riser, "Observing Biogeochemical Cycles at Global Scales with Profiling Floats and Gliders: Prospects for a Global Array", Oceanography, p. 216, vol. 22, (2009). Published,

Dickey, T. D., E. C. Itsweire, M. A. Moline, and M. J. Perry, "Introduction to the Limnology and Oceanography Special Issue on Autonomous and Lagrangian Platforms and Sensors (ALPS)", Limnology and Oceanograhy, p. 2057, vol. 53, (2009). Published,

Books or Other One-time Publications

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

Our work has shown that autonomous gliders can provide valuable information on phytoplankton processes. Our work on chlorophyll fluorescence quenching has provided a method for correcting chlorophyll data for other autonomous applications.

Contributions to Other Disciplines:

Our time series of phytoplankton, using underwater gliders, has provided a basis for autonomous ocean observing.

Contributions to Human Resource Development:

One UMaine graduate student based his Ph.D. research on the data collected by this project and another gained experience working on autonomous data for his Master's degree. One undergraduate student and two very recent graduates worked on aspects of this project and gained experience with modern oceanographic tools.

Contributions to Resources for Research and Education:

A high school teacher, Dennis Levandoski, worked at UMaine's Darling Marine Center one summer as an RET fellow. Through working on glider data, he gained a deeper appreciation for oceanography that he could share with his students..

Contributions Beyond Science and Engineering:

One of the major accomplishments of this five year time series of autonomous measurements is the demonstration of how time series can be successfully carried out autonomously with gliders. This project demonstrates how a glider survey program can observe interannual changes in the timing and magnitude of stratification and destratification events and their effect on phytoplankton blooms. The implication is that similar surveys could be implemented in key regions to observe the effects of climate change and variability on the response of phytoplankton, the base of marine food webs, to changes in physical forcings.

Conference Proceedings

Categories for which nothing is reported:

Any Book

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