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Collaborative Research: GLOBEC Pan-regional Synthesis: Pacific Ocean Boundary Ecosystems: Response to Natural and Anthropogenic Climate Forcing

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Cover

Federal Agency and Organization Element to Which Report is Submitted:	4900
Federal Grant or Other Identifying Number Assigned by Agency:	0815051
Project Title:	Collaborative Research:GLOBEC Pan-regional Synthesis: Pacific Ocean Boundary Ecosystems: response to natural and anthropogenic climate forcing
PD/PI Name:	Andrew C Thomas, Principal Investigator
Recipient Organization:	University of Maine
Project/Grant Period:	09/01/2008 - 08/31/2014
Reporting Period:	09/01/2013 - 08/31/2014
Submitting Official (if other than PD\PI):	Andrew C Thomas Principal Investigator
Submission Date:	10/02/2014
Signature of Submitting Official (signature shall be submitted in accordance with agency specific instructions)	Andrew C Thomas

Accomplishments

* What are the major goals of the project?

This is a Collaborative project POBEX (www.POBEX.org) under the the overall direction of M. DiLorenzo, GaTech. A separate FINAL report was submitted by DiLorenzo for the overall project in 2013. Using US and international

observational datasets combined with physical and biological models, this project investigates the mechanisms of climate-related variability in three Pacific boundary ecosystems: Gulf of Alaska (GOA) and California Current System (CCS) referred to as the Northeast Pacific (NEP), the Humboldt or Peru-Chile Current System (PCCS), and the Kuroshio-Oyashio Extension (KOE) region. The research goals of this project can be summarized as follows: (1) Assess to what extent, and by what mechanisms, large-scale climate modes (e.g. PDO, NPGO, ENSO, and potentially others) drove coherent changes across Pacific boundary ecosystems over the period 1960-2009. (2) Quantify and explain how changes in regional ocean processes (e.g. upwelling, transport dynamics, mixing and mesoscale structure) at each boundary control phytoplankton and zooplankton dynamics. Then, use those results to test the degree to which changes in each study region intraseasonal oscillation, timing of spring transitions) during different phases of the-period climate modes (e.g. PDO, NPGO and others) determine the climate state of boundary-current ecosystems. (3) Quantify the extent to which changes in the statistics of shorter-period events (e.g. intraseasonal oscillation, timing of spring transitions) during different phases of the longer-period climate modes (e.g. PDO, NPGO and others) determine the climate state of boundary-current ecosystems. (4) Explore the range of uncertainties in the response of regional ocean dynamics and their ecosystems to climate change using forcing scenarios from selected climate model integrations that are part of the IPCC 2007 report. This last objective begins an assessment of the potential impacts of climate change on regional ocean ecosystems, a topic poorly addressed in the latest IPCC report, but the chief instrument for most fisheries and coastal management.

This report covers the final, no-cost extension year from efforts at the University of Maine.

*** What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?**

Major Activities: In the final year, analysis of seasonal cycles of satellite-measured phytoplankton biomass in the California Current were undertaken.

Specific Objectives: Quantify and map the seasonal cycles and phenology of phytoplankton biomass over the entire California Current.

Significant Results: 1) Multivariate statistical analysis showed the California Current region is appropriately divided into 4 regions according to overall phytoplankton seasonal cycles

2) Two of these are in the coastal upwelling region, two are offshore.

3) Known specific interannual events (El Niño in 1997-98, delayed spring transition in 2005) were evident in the coastal regions.

4) Trends in the timing (phenology) of specific events showed that in the coastal upwelling regions, the spring start date is delaying by over 1 day per year.

Key outcomes or Other achievements: Work over the final year resulted in 1 talk at a major international meeting and 1 additional manuscript published.

*** What opportunities for training and professional development has the project provided?**

The final year provided the completion of an MS thesis for Nicholas Foukal at the University of Maine.

*** How have the results been disseminated to communities of interest?**

Work over the final year resulted in 1 talk at a major international meeting and 1 additional manuscript published.

Products

Books

Book Chapters

Conference Papers and Presentations

Foukal and Thomas (2014). *Biogeography and phenology of satellite-measured phytoplankton seasonality in the California current*. Ocean Sciences Meeting. Honolulu, HI. Status = OTHER; Acknowledgement of Federal Support = Yes

Thomas, Mendelssohn and Weatherbee (2014). *SATELLITE VIEWS OF EXTREME CHLOROPHYLL EVENTS IN THE CALIFORNIA CURRENT*. Ocean Sciences Meeting. Honolulu, HI. Status = OTHER; Acknowledgement of Federal Support = Yes

Andrew C. Thomas, P. Ted Strub, Ryan Weatherbee and Corinne James (2012). *Satellite views of Pacific chlorophyll and physical variability: comparisons of basin-scale with eastern boundary current patterns and links to climate indices*. Eastern Pacific Oceanographic Conference. Oregon. Status = OTHER; Acknowledgement of Federal Support = Yes

Nicholas Foukal, Andrew Thomas (2012). *Satellite-measured phytoplankton phenology in the California Current: time and space patterns and a comparison of metrics*. Eastern Pacific Oceanographic Conference. Oregon. Status = OTHER; Acknowledgement of Federal Support = Yes

Kerstin Cullen, Andrew Thomas, Rob Campbell (2012). *Temporal and spatial variability of chlorophyll and turbidity on the Alaska shelf: links to dominant forcing*. Eastern Pacific Oceanographic Conference. Oregon. Status = OTHER; Acknowledgement of Federal Support = Yes

Inventions

Journals

Di Lorenzo, E., V. Combes, J.E. Keister, T.P. Strub, A.C. Thomas, P.J. S. Franks, M.D. Ohman, J. Furtado, A. Bracco, S.J. Bograd, W.T. Peterson, F.B. Schwing, S. Chiba, B. Taguchi, S. Hormazabal and C. Parada (2013). *Synthesis of Pacific Ocean Climate & Ecosystems Dynamics*. *Oceanography*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Nicholas Foukal and Andrew Thomas (2014). *Biogeography and phenology of satellite-measured phytoplankton seasonality in the California current*. *Deep-Sea Research I*. 92 11. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: <http://dx.doi.org/10.1016/j.dsr.2014.06.008>

Thomas, A.C., R. Weatherbee, and R. Mendelssohn (2013). *Background trends in California Current surface chlorophyll concentrations: a state-space view*. *Journal of Geophysical Research*. . Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes

Xiu, P. A.C. Thomas, F. Chai (2014). *Remote sensing of phytoplankton blooms induced by natural and artificial iron addition in the Gulf of Alaska*. *Remote Sensing of the Environment*.. 145 38. Status = PUBLISHED; Acknowledgment of Federal Support = Yes ; Peer Reviewed = Yes ; DOI: <http://dx.doi.org/10.1016/j.rse.2014.02.004>

Licenses

Other Products

Databases.

The research and results funded by this award consisted of analyses of subsets of global satellite data sets. These data are archived, and served to the international community by NASA Goddard Space Flight Center DAAC, NASA JPL PODAAC, and various other national space agency-sponsored organizations (e.g. AVISO). As all these data are already in the public domain, no data from this project were uploaded to BCO-DMO. No new ship or field data were collected during this project.

Other Publications

Patents

Technologies or Techniques

Thesis/Dissertations

Nicholas Foukal. *Biogeography and phenology of satellite-measured phytoplankton seasonality in the California Current*. (2013). University of Maine. Acknowledgement of Federal Support = Yes

Websites

Participants/Organizations

What individuals have worked on the project?

Name	Most Senior Project Role	Nearest Person Month Worked
Thomas, Andrew	PD/PI	1

Full details of individuals who have worked on the project:

Andrew C Thomas

Email: thomas@maine.edu

Most Senior Project Role: PD/PI

Nearest Person Month Worked: 1

Contribution to the Project: PI: data analysis & synthesis, manuscript preparation

Funding Support: NSF

International Collaboration: No

International Travel: Yes, Chile - 0 years, 0 months, 21 days

What other organizations have been involved as partners?

Name	Type of Partner Organization	Location
Georgia Tech University	Academic Institution	Atlanta
NOAA NMFS	Other Organizations (foreign or domestic)	Pacific Grove, CA

Full details of organizations that have been involved as partners:

Georgia Tech University

Organization Type: Academic Institution

Organization Location: Atlanta

Partner's Contribution to the Project:

Collaborative Research

More Detail on Partner and Contribution: data analysis and manuscript collaboration

NOAA NMFS

Organization Type: Other Organizations (foreign or domestic)

Organization Location: Pacific Grove, CA

Partner's Contribution to the Project:

Collaborative Research

Personnel Exchanges

More Detail on Partner and Contribution:

What other collaborators or contacts have been involved?

NO

Impacts

What is the impact on the development of the principal discipline(s) of the project?

The findings of the final year provide the first quantitative assessment of the degree to which seasonality in phytoplankton biomass is shifting in the California Current, and maps its locations.

What is the impact on other disciplines?

Nothing to report.

What is the impact on the development of human resources?

The research provided the foundation of an MS training and research for Nicholas Foukal at the University of Maine in oceanography, data analysis and remote sensing. He has since moved on to a PhD program at Duke University.

What is the impact on physical resources that form infrastructure?

Nothing to report.

What is the impact on institutional resources that form infrastructure?

Nothing to report.

What is the impact on information resources that form infrastructure?

Nothing to report.

What is the impact on technology transfer?

Nothing to report.

What is the impact on society beyond science and technology?

Nothing to report.

Changes/Problems

Changes in approach and reason for change

Nothing to report.

Actual or Anticipated problems or delays and actions or plans to resolve them

Nothing to report.

Changes that have a significant impact on expenditures

Nothing to report.

Significant changes in use or care of human subjects

Nothing to report.

Significant changes in use or care of vertebrate animals

Nothing to report.

Significant changes in use or care of biohazards

Nothing to report.