



DEPARTMENT OF COMMERCE RESEARCH PERFORMANCE PROGRESS REPORT (RPPR)

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AWARD INFORMATION	
1. Federal Agency: Department of Commerce / NOAA	2. Federal Award Number: NA21OAR4310260
3. Project Title: Biogeochemical Argo synthesis products of oxygen, nitrate, and pH for increased community utilization of a	
4. Award Period of Performance Start Date: 09/01/2021	5. Award Period of Performance End Date: 08/31/2024
PRINCIPAL INVESTIGATOR/PROJECT DIRECTOR	
6. Last Name and Suffix: ,	7. First and Middle Name: ,
8. Title:	
9. Email:	10. Phone Number:
AUTHORIZING OFFICIAL	
11. Last Name and Suffix: TRIMBLE , null	12. First and Middle Name: AMY ,
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REPORTING INFORMATION	
Signature of Submitting Official: Max Weber	
16. Submission Date and Time Stamp: 07/31/2023	17. Reporting Period End Date: 05/31/2023
18. Reporting Frequency: <input checked="" type="radio"/> Annual <input type="radio"/> Semi-Annual <input type="radio"/> Quarterly	19. Report Type: <input checked="" type="radio"/> Not Final <input type="radio"/> Final
RECIPIENT ORGANIZATION	
20. Recipient Name: UNIVERSITY OF HAWAII	
21. Recipient Address: 2425 CAMPUS RD SINCLAIR RM 1, HONOLULU, HI 96822-2247 USA	
22. Recipient UEI: NSCKLFSSABF2	23. Recipient EIN: 996000354

ACCOMPLISHMENTS

24. What were the major goals and objectives of this project?

The goal of this project is to perform a secondary quality check on all available Biogeochemical Argo (profiling float) oxygen, nitrate, pH, and derived dissolved inorganic carbon data, determine appropriate adjustments to address systematic biases and individual offsets, and create and disseminate adjusted datasets. The adjusted datasets will include individual float profiles with raw and adjusted data, realistic uncertainties for each measurement, 1x1 degree temporally and spatially bin-averaged data, and mapped monthly climatological fields. The binned and mapped datasets will merge existing shipboard and float data to better utilize both data sources. We will use this dataset to investigate oxygen loss and anthropogenic carbon penetration in the ocean, targeting regions with high concentrations of float data. All code will be shared publicly at the time of dataset publication and we will work with user groups to make sure the data are both useable and useful.

25. What was accomplished under these goals?

Graduate student Zachary Nachod started at UH Manoa this academic year and has taken over the float bias analysis and creation of the adjusted dataset from the USF team. Nachod has developed a test of the crossover analysis approach by using the float oxygen dataset and conducting crossover comparisons between multiple profiles from the same float (Figure 1). This has allowed us to refine the density, spice, distance, and pressure criteria for crossover comparisons and assess the level of environmental variability (Figure 2) that will contribute to variance in float-ship crossovers at depth. One of the complications we have found in interpreting and adjusting the float oxygen dataset is that there is no standard format for the "scientific calibration comment" entered into the float data files stored at the DAC. These comments describe how the oxygen data have been adjusted/calibrated. Many comments say the same thing in different ways and most do not provide enough detail to clearly understand or replicate the calibration procedure.

We are drafting a manuscript describing the impact of oxygen biases at depth on derived parameters and understanding of long-term oxygen changes. Using the crossover criteria determined in Figures 1 and 2 we assess a median bias between 1500 and 2000 m of $-2.1 \mu\text{mol kg}^{-1}$ for all oxygen floats with GLODAP crossovers within 50km (Figure 3). The bias is higher ($-2.8 \mu\text{mol kg}^{-1}$) for air-calibrated floats that are only corrected at the surface.

This bias filters through to nitrate, which is adjusted according to a 1500 m multiple linear regression trained on shipboard data that uses float oxygen measurements as one of the inputs (Figure 4, top). pH is impacted by both the nitrate measurement and the oxygen measurement (Figure 4, bottom). pH biases then translate into a bias in derived pCO₂ estimates, with a fleet-wide median impact of $3.0 \mu\text{atm pCO}_2$ (Figure 5, corrected float pCO₂ will be lower than unadjusted pCO₂). This is of a similar magnitude to most of the float/shipboard pCO₂ biases documented in the literature (Fay et al., 2018; Gray et al., 2018; Williams et al., 2017).

ACCOMPLISHMENTS (cont'd)

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

Graduate student Nachod meets weekly with PI Bushinsky to discuss analysis and code and periodically with co-PI Fassbender to discuss progress on the project. Prior to her departure, weekly meetings included Dr. Tamsitt as well. Nachod has been learning to analyze data and present analysis in these weekly meetings.

27. How were the results disseminated to communities of interest?

Initial project results were shared during a UH Manoa marine geochemistry and division seminar in April 2023. Nachod is preparing a presentation for the 2024 Ocean Sciences meeting. The deep oxygen bias manuscript is outlined, with a goal of completing a draft in August 2023 and a submitted manuscript in Fall 2023. This manuscript will outline the basic problem and highlight the need for an adjusted dataset.

The issues relating to oxygen sensor adjustment/calibration comments in the data files has been communicated to the Argo data management team and we will work to provide support and suggestions for fixes. This type of interaction is one way that we are improving the utility of the biogeochemical Argo data beyond the product development. Changes to quality control infrastructure will provide lasting benefits to the Argo program.

ACCOMPLISHMENTS (cont'd)

28. What do you plan to do during the next reporting period to accomplish the goals and objectives?

Over the next year we plan to: 1) Finish the deep oxygen bias manuscript and submit it for publication, 2) adjust oxygen data according to the biases found and produce a draft dataset, 3) test and use the adjusted dataset, 4) Draft and submit manuscript describing adjusted and bin-averaged dataset, and 5) Archive dataset in NCEI and code in Zenodo.

PRODUCTS

29. Publications, conference papers, and presentations

Marine Geology and Geochemistry Seminar, University of Hawaii at Manoa, Bushinsky presenting. April 2023.

PRODUCTS (cont'd)

30. Technologies or techniques

Nothing to Report

31. Inventions, patent applications, and/or licenses

Nothing to Report

Attach a separate document if more space is needed for #6-10, or #24-50.

PRODUCTS (cont'd)

32. Other products

Nothing to Report

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

33. What individuals have worked on this project?

Name: Seth Bushinsky

Total Number of Months: 1

Project Role: PI

Contribution to project: Overall coordination, recruitment and selection of graduate student, assisted in code migration from original

Matlab code to Python, code development and testing

Collaborated with individual in foreign country: No

Travelled to foreign country: No

Name: Andrea Fassbender

Total Number of Months: 0.5

Project Role: Co-PI

Contribution to project: Scientific input on analysis, assisted with project coordination and direction.

Collaborated with individual in foreign country: No

Travelled to foreign country: No

Name: Veronica Tamsitt

Total Number of Months: 2

Project Role: Co-PI

Contribution to project: Code and analysis of shipboard crossover data. Let the project/academia partway through the year.

Collaborated with individual in foreign country: No

Travelled to foreign country: No

Attach a separate document if more space is needed for #6-10, or #24-50.

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS (cont'd)

34. Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

Proposal Title: Advancing satellite-constrained modeled air-sea CO₂ fluxes with a focus on the strength of the Southern Ocean carbon sink
NASA/Sub-award from Univ. of Maryland, Baltimore County
NASA Award: 80NSSC23K1231
Project Support Start Date: 06/2023 to 06/2026
Total Award Amount: \$106,808 (1.2 Mon/year)

35. What other organizations have been involved as partners?

Nothing to Report

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS (cont'd)

36. Have other collaborators or contacts been involved?

Nothing to Report

IMPACT

37. What was the impact on the development of the principal discipline(s) of the project?

Nothing to Report

IMPACT (cont'd)

38. What was the impact on other disciplines?

Nothing to Report

39. What was the impact on the development of human resources?

Nothing to Report

IMPACT (cont'd)

40. What was the impact on teaching and educational experiences?

Nothing to Report

41. What was the impact on physical, institutional, and information resources that form infrastructure?

Nothing to Report

Attach a separate document if more space is needed for #6-10, or #24-50.

IMPACT (cont'd)

42. What was the impact on technology transfer?

Nothing to Report

43. What was the impact on society beyond science and technology?

Nothing to Report

IMPACT (cont'd)

44. What percentage of the award's budget was spent in foreign country(ies)?

0 , null

CHANGES/PROBLEMS

45. Changes in approach and reasons for change

Nancy Williams and Veronica Tamsitt have left their positions at the University of South Florida. In response, we USF is creating a subaward to move funds to the University of Hawaii at Manoa to fund more time for graduate student Zachary Nachod and part of a postdoc who will be coming to UH Manoa and testing / using the new dataset. Dr. Williams and Dr. Tamsitt will remain involved in the paper describing the new dataset and are available for consultation as needed.

CHANGES/PROBLEMS (cont'd)

46. Actual or anticipated problems or delays and actions or plans to resolve them

We anticipate that it will take longer to complete the initial adjusted oxygen dataset due to the change in personnel. However, this also gives graduate student Nachod the chance to develop more responsibility for dataset creation and code/data sharing. With the shift in funding and an expected no cost extension we will be able to complete the project.

47. Changes that had a significant impact on expenditures

In addition to graduate student Nachod taking on more responsibility, the funding of a new postdoc here at UH Manoa will enable us to more thoroughly test the new dataset as we make it available to the community. The shift in funding from USF to UHM will change how the funds are spent, but not the total amount.

CHANGES/PROBLEMS (cont'd)

48. Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

Nothing to Report

49. Change of primary performance site location from that originally proposed

Nothing to Report

PROJECT OUTCOMES

50. What were the outcomes of the award?

We have communicated problems with the Argo oxygen dataset to the Argo data management team. One publication is outlined, with a draft soon to be finished, and the dataset creation / publication paper is in the planning stages.

DEMOGRAPHIC INFORMATION FOR SIGNIFICANT CONTRIBUTORS (VOLUNTARY)

Gender:

- Male
- Female
- Do not wish to provide

Ethnicity:

- Hispanic or Latina/o Not
- Hispanic or Latina/o Do not
- wish to provide

Race:

- American Indian or Alaska Native Asian
- Black or African American
- Native Hawaiian or other Pacific Islander
- White
- Do not wish to provide

Disability Status:

- Yes
 - Deaf or serious difficulty hearing
 - Blind or serious difficulty seeing even when wearing glasses
 - Serious difficulty walking or climbing stairs
 - Other serious disability related to a physical, mental, or emotional condition
- No
- Do not wish to provide

Attach a separate document if more space is needed for #6-10, or #24-50.