Phosphate Profile Data Comparison between Programmable Flow Injection (pFI) and AA3 Autoanalyzer Methods from R/V Kilo Moana KM2210 in the North Pacific Subtropical Gyre during September 2022 (pFI-SI-LOV project)

Website: https://www.bco-dmo.org/dataset/931765
Data Type: Cruise Results
Version: 1
Version Date: 2024-07-05

Project
» Collaborative Research: Developing Automated Nutrient and Trace Metal Methodology using Programmable Flow Injection (pFI-SI-LOV)

Contributors	Affiliation	Role
Grand, Maxime	Moss Landing Marine Laboratories (MLML)	Principal Investigator
Lebrec, Marine	Moss Landing Marine Laboratories (MLML)	Student
Newman, Sawyer	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
These data represent a full depth profile collected at the Hawaii Ocean Time Series station ALOHA in September 2022. The pFI_PO4 column shows phosphate concentrations from unfiltered samples analyzed onboard the RV Kilo Moana using a programmable Flow Injection (pFI) analyzer, calibrated with phosphate standards prepared in Milli-Q water. The SIO_PO4 column contains data from replicate samples taken from the same depths. These samples were frozen, shipped on dry ice to the Scripps Institution of Oceanography (SIO) Nutrient Facility, and analyzed there using an AA500 nutrient auto analyzer.

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Coverage

Location: North Pacific Subtropical Gyre
Spatial Extent: **Lat**:22.75 **Lon**:158
Temporal Extent: 2022-09-01

Methods & Sampling

We collected unfiltered seawater samples directly from the Niskin bottles. One set was analyzed in triplicate for phosphate using the pFI analyzer calibrated with MQ standards (0-3 µmol L-1). The duplicate samples were frozen, shipped to Scripps Institution of Oceanography (SIO) Ocean Data Facility chemistry laboratory on dry ice and analyzed at SIO's lab using an AA3 autoanalyzer.

The pFI analyzer was calibrated with working phosphate standards prepared in MQ water (0-3 µmol L-1). To

calculate phosphate concentrations at each depth, we took the mean of the baseline corrected absorbance at 880 nm minus the reference absorbance at 1050 nm. Phosphate concentrations were then calculated using the slope and intercept of the MQ calibration curve.

pFI LOD: 0.06 umol/L

pFI precision: 4.1%

Data Processing Description

Quality flags represented in the primary data file

- 1 = good
- 2 = bad*
- 3 = below detection limit

Data were flagged when the data were inconsistent with adjacent depths and visual observation of the absorbance spectra confirmed an issue during the analysis.

BCO-DMO Processing Description

- Units and format details removed from parameter names
- Special characters removed from parameter names
- Spaces in character names replaced with underscores ("_")
- Latitude and longitude values rounded to 6 degrees of precision
- Date format converted from %m%d%y to %Y-%m-%d
- A datetime column was added to the data file by merging the original separate date and time columns (the original date and time columns have also been retained)
- Time format converted from %H%M%S to %H:%M:%S

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Related Publications

Lebrec, M., & Grand, M. M. (2024). Programmable flow injection: a versatile technique for benchtop and autonomous analysis of phosphate and silicate in seawater. Frontiers in Marine Science, 11. https://doi.org/10.3389/fmars.2024.1354780
Results

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Parameters

Parameter	Description	Units
Latitude	Water sample latitude in decimal degrees; a positive value indicates a Northern coordinate.	decimal degrees
Longitude	Water sample longitude in decimal degrees; a negative value indicates a Western coordinate.	decimal degrees
ISO_DateTime_UTC	Water sample date time in UTC.	unitless
Date_UTC	Water sample date in UTC.	unitless
Time_UTC	Water sample time in UTC.	unitless
Depth	Water sample depth in the water column in meters.	meters (m)
pFI_PO4	Phosphate concentration from pFI analyzer.	umol/L
pFI_flag	pFI flag. 1 = good, 2 = bad, 3 = below detection limit.	unitless
SIO_PO4	Phosphate concentration from AA3 analyzer (SIO).	umol/L
SIO_flag	SIO flag. 1 = good, 2 = bad, 3 = below detection limit.	unitless

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Instruments

Dataset-specific Instrument Name	pFI analyzer (miniSIA2, GlobalFIA, USA)
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	One set of samples was analyzed using a pFI analyzer (miniSIA2, GlobalFIA, USA). This instrument was furnished with two High Flow milliGAT pumps with stainless steel heads, a plexiglass 8-port Lab-On-Valve, a 20 cm Long Path Linear Flow cell equipped with a Tungsten-Halogen lamp and a VIS-NIR Flame spectrophotometer (Ocean Insight, USA).
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	SIO's AA3 analyzer (Seal Analytical, USA)
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	Samples not analyzed with the mini SIA2 pFI analyzer were analyzed using a SIO's AA3 analyzer (Seal Analytical, USA) following the vendor's established GO-SHIP protocols.
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	VIS-NIR Flame spectrophotometer (Ocean Insight, USA)
Generic Instrument Name	Spectrometer
Dataset-specific Description	One set of samples was analyzed using a pFI analyzer (miniSIA2, GlobalFIA, USA). This instrument was furnished with two High Flow milliGAT pumps with stainless steel heads, a plexiglass 8-port Lab-On-Valve, a 20 cm Long Path Linear Flow cell equipped with a Tungsten-Halogen lamp and a VIS-NIR Flame spectrophotometer (Ocean Insight, USA).
Generic Instrument Description	A spectrometer is an optical instrument used to measure properties of light over a specific portion of the electromagnetic spectrum.

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Deployments

KM2210

Website	https://www.bco-dmo.org/deployment/931768
Platform	R/V Kilo Moana
Start Date	2022-08-30
End Date	2022-09-04
Description	Start port: Honolulu, Hawaii End port: Honolulu Hawaii Operator: University of Hawaii Project: HOT 2022 - 339

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Project Information

Collaborative Research: Developing Automated Nutrient and Trace Metal Methodology using Programmable Flow Injection (pFI-SI-LOV)

NSF Award Abstract:

Progress and discovery in the understanding of the chemical processes that regulate the growth of phytoplankton in the marine environment is limited by the ability of oceanographers to measure nutrients and trace metals at relevant spatial and temporal scales. This project aims to develop a new generation of autonomous and highly sensitive nutrient and trace metal analyzers for shipboard use and deployment at coastal monitoring stations, with potential for incorporation into existing autonomous observing platforms (e.g., gliders, autonomous underwater vehicles). Such a development will generate new insights into nutrient dynamics at a range of spatial and temporal scales and provide a new capability to obtain high resolution data sets for nutrients and trace metals in remote areas and environments where sample volumes are limited (e.g., brines, pore waters).

This project will develop novel automated methods for nutrients (phosphate and silicate) and trace metals (aluminium, manganese) using a technology called programmable Flow Injection (pFI). pFI is a microfluidic technique, which allows to automate conventional wet chemical analysis using microliter volumes of sample and reagents while significantly reducing the generation waste. In order to bring low levels of trace metals and nutrients that characterize remote ocean regions into the analytical window of pFI, concentration techniques will also be developed and coupled to spectrophotometric and fluorescence detection. The developed

methodologies will be intercalibrated with standard oceanographic methods by participating in a GO-SHIP research cruise and a Hawaii Ocean Time-series cruise of opportunity. The long-term, unattended operation of the pFI analyzers will be evaluated at the Central California Ocean Observing System (CenCOOS) Moss Landing Shore station, where autonomous pFI analyzers will be deployed to undertake a year-long, hourly time series of phosphate and silicate. The data obtained from the shore station will be made publicly available and will complement existing monitoring data from this location, illuminating the connection between deep ocean nutrient dynamics and biological activity in coastal upwelling systems. The newly developed pFI analyzers will be assembled using commercially available components and open source software to facilitate uptake of this new methodology by the chemical oceanography community at large. This project will also support the training and exchange of at least two graduate students at the University of Hawaii at Mānoa and the Moss Landing Marine Laboratories, who will represent the next generation of specialists in the development and application of pFI methodologies to chemical oceanography.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1924539

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