NF-POGO Visiting Fellowship for

Ship-board Training on the PIRATA F-35 cruise

Fellowship Report

Name of Trainee: Mr Victor Ebolo Nkongo

Name of Supervisor (Parent Institution): Dr. Cecilia Chapa Balcorta

Supervisor (Host Institution): Dr. Jérôme LLIDO

Dates of Training: 26 February to 03 April 2025

Topic of Training: Ship-board Training on PIRATA-FR35 cruise on-board RV THALASSA

Section A

(To be completed by the fellow and returned to the POGO Secretariat)

Please note that this form should be passed on to the host and parent supervisor and when complete it will be made publicly available on the OTP website;

1) Please provide a brief description of activities during the training period:

The PIRATA-FR35 oceanographic mission provided me with hands-on training at sea aboard the R/V Thalassa, as part of the Prediction and Research Moored Array in the Tropical Atlantic (PIRATA) program, launched in 1997 by the United States, Brazil, and France. PIRATA is based on a network of 18 metocean buoys (ATLAS/TFLEX) designed to study ocean-atmosphere interactions and improve climate forecasting in the tropical Atlantic. The French component of the program (SNO PIRATA) is responsible for the annual maintenance of six metocean buoys and three current meter moorings located along the equator.

During this campaign, I carried out various activities, which I grouped into three main areas:

a. Laboratory Activities in Hydrology and Physics

As part of this, I participated in:

- Acquiring hydrological and current profiles (CTDO2/LADCP stations);
- Conducting bathythermographic profiles using XBT probes;
- Deploying SVP-type drifting buoys and ARGO profilers;
- Sampling seawater at the surface and at depth for chemical parameter analysis;
- Recovering and deploying metocean buoys and an ADCP mooring.

b. Laboratory Activities in Chemistry

I took part in an onboard exercise in the chemistry laboratory on pH measurement by spectrophotometry and alkalinity determination by potentiometry, allowing me to gain additional expertise in the carbonate system. This enabled me to validate the estimation of total alkalinity in the absence of direct total carbon measurements, which I would have preferred to use to estimate air-sea CO_2 fluxes.

c. Volunteer Activities and Additional Training

- Aboard the *Thalassa*, my main volunteer activity involved collecting tissue samples from tuna caught around the buoys. We gathered 55 samples for LEMAR in Brest.
- I also took part in safety drills covering procedures in case of shipwreck, pirate attacks, and precautions to be observed during an oceanographic campaign to prevent workplace accidents and health issues at sea.
- In my free time, I helped clean sensors and buoys and began drafting my first article. Additionally, I presented my Master's thesis to the entire crew, titled: *"Study of Air-Sea CO_2 Fluxes Derived from Satellite and In Situ Data in the Gulf of Guinea."*

Furthermore, through the supervision of laboratory activities and the utilisation of PIRATA datasets, I significantly enhanced my proficiency in Python and MATLAB programming, while deepening my understanding of physical oceanography. I focused in particular on the validation of the LIAR estimator developed by Carter et al. (2016), which enables the estimation of total alkalinity (TA) from sea surface temperature, salinity, latitude, longitude, and depth. This work required a solid grasp of key oceanographic principles, notably the spatial variability of seawater properties and their links to ocean circulation. The results obtained in the tropical Atlantic revealed a spatial distribution of total alkalinity that aligns well with regional ocean dynamics, such as salinity-driven water mass formation and surface current patterns. These findings are visualised in the maps produced from observational data collected during the PIRATA mission. Figure 1 compares the TA values estimated by the LIAR model (red curve) with in situ measurements from CTD profiles (green curve) across 39 stations of the PIRATA-FR35 cruise. The strong agreement between modelled and observed data confirms the reliability of the LIAR estimator for this region. Figure 2 illustrates the spatial validation of the model using thermosalinograph (TSG) data. The consistency between high TA estimates and areas of elevated surface salinity further demonstrates a sound understanding of the physical processes influencing carbonate chemistry in the tropical Atlantic.

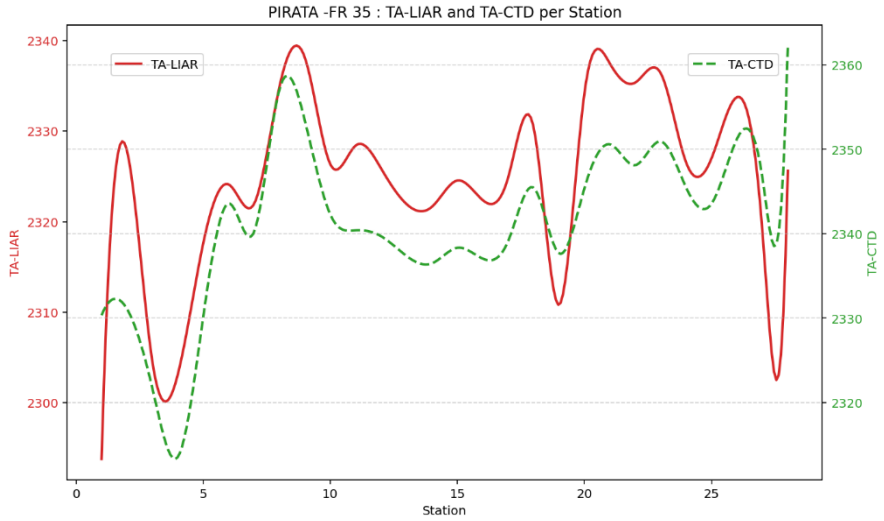

Figure 1. Validation of the LIAR Model for Total Alkalinity Estimation – PIRATA-FR35 Mission Based on CTD Data

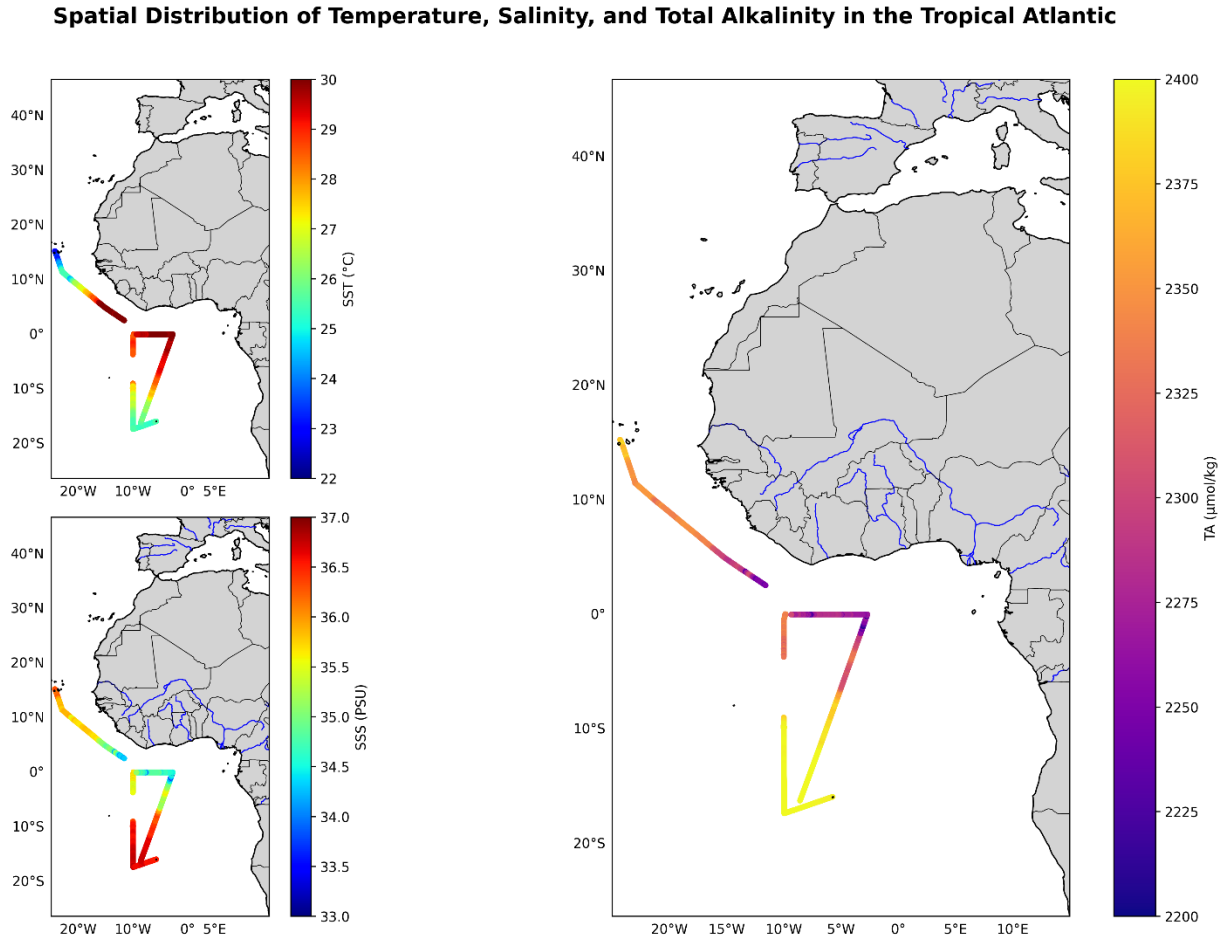

Figure 2. Distribution of Temperature, Salinity, and Total Alkalinity Estimated Using the LIAR Estimator (Thermosalinograph Data).

This campaign has strengthened my skills in:

- Physical and chemical oceanography;
- Data analysis with Python;
- Interpretation of hydrographic profiles;
- Validating a predictive regression model applied to a large set of real-world data.

2) What applications of the training received do you envision at your parent institution?

Firstly, this training allowed me to complete the activities related to my master's degree, which I recently defended. It enabled me to finish writing my scientific paper on CO_2 fluxes and the variability of the carbonate system in the Gulf of Guinea, with a particular focus on the seasonal influence of the Harmattan and the African monsoon. For this project, I used data collected by PIRATA, in collaboration with LOCEAN (Laboratoire d'Océanographie et du Climat: Expérimentations et Approches Numériques), to validate *FCO2v2* (Victor Ebolo, 2024), a MATLAB function I developed to calculate air-sea CO_2 fluxes.

I now feel ready to pursue a PhD in physical oceanography and/or biogeochemistry, particularly focused on air-sea dynamics. This training has provided me with a solid foundation of knowledge and skills, which I plan to apply to further my research in this field.

3) Please provide your comments on the Fellowship Programme.

This programme provides a solid foundation for the scientific development of early-career researchers, particularly in developing countries. Through this programme, I was able to expand my network by interacting with experienced researchers and engineers, which allowed me to learn immensely. It marks the beginning of an exciting journey with the PIRATA-FR35 scientific team. Additionally, it gave me the opportunity to present my research and further refine my work. It was also a valuable opportunity to share experiences with students and senior researchers from diverse backgrounds, making this training enriching both scientifically and personally. Furthermore, thanks to the crew members, both scientific and non-scientific, I gained insights into various aspects of marine life and the environment.

PRINT NAME

Victor Ebolo Nkongo

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Date : 11/04/2025

Section B

(To be completed by host supervisor and returned to the POGO Secretariat)

Please note that this form will be passed on to the parent supervisor and trainee and when complete will be made publicly available on the OTP website;

1) Please provide your comments on the performance of the trainee.

Victor actively took part in the PIRATA-FR35 oceanographic cruise, demonstrating an excellent attitude, strong motivation, and eager to learn about the preparation, deployment and use of instruments to observe the ocean.

Despite the sometimes demanding conditions of working on board, Victor quickly adapted to the pace and constraints of life at sea. Committed and curious, he made the most of this experience to develop both his technical and scientific skills. During his watch period, Victor participated actively to the preparation and deployment of CTDO2/LADCP, XBT, Argo floats and others surface drifters. He also learned how to collect water samples from the CTD bottles for several types of measurements (O2, pH/TA, nutrients, salinity ….) and demonstrated a remarkable professionalism throughout the mission. He also contributed to the recovery and deployment operations of meteo-oceanographic PIRATA buoy with the scientific team, while strictly adhering to safety protocols highly appreciated by both the scientific and crew members. Victor was also very enthusiastic to present and explain his master's work on the air-sea CO2 fluxes in the Gulf of Guinea to all crew and to interact with all the scientists on board and in particular, he trained on the chemical analyses of pH and Total Alkalinity carried out on board during his time off.

Finally, Victor showed great team spirit, contributing to the positive atmosphere on board. We thank him for his contribution to this cruise and wish him all the best in his future.

2) Is this exchange likely to lead to future collaboration with the trainee's parent institution? If so please give example(s) of how this collaboration may be pursued.

During his master's thesis, Victor worked on CO2 fluxes at the air-sea interface in the Gulf of Guinea, partly using data collected by some buoys of the PIRATA network. The CO2 sensors installed on the meteo-oceanic buoys and associated data from the cruise are the responsibility of LOCEAN and we have provided Victor with the information in our possession concerning the CO2 data as well as the contact information at LOCEAN.

Victor would like to continue with as thesis but we currently have no funding available for a PhD. We are keeping his CV and will also pass it on to our colleagues at LOCEAN and LEGOS who could be interested.

3) Please provide your comments on the Fellowship Programme.

The NF-POGO fellowship for Ship-board Training is a very nice initiative to enable early-career scientists as Master's, PhD's students … from developing countries to participate in significant oceanographic cruises. The fellowhip program gives them the opportunity to gain experience on several points such as the cruise preparation and practical training including equipment operation, sea water sample collection and/or analysis as well as data acquisition and data pre-processing. The program puts the fellow in contact with researchers, engineers and technicians from different horizons, and this sharing of both scientific and human experience will be highly beneficial to the fellow's career.

PRINT NAME

J. LLIDO

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Date: 14/04/2025

SECTION C

(To be completed by parent supervisor and returned to the POGO Secretariat)

Please note that this form will be passed on to the host supervisor and trainee and when complete will be made publicly available on the OTP website;

1) Do you agree with the above comments and do you have any additional feedback you wish to provide?

I agree with Dr. Llido, when he comments that Victor Ebolo is a highly motivated and committed person. I noted these characteristics when supervising his master's thesis. From his participation in the Ship-board Training on the PIRATA F-35 cruise, Victor could acquire more field experience, from the basic activities to the collection and analysis of water samples. These are important skills that he will need and further develop when pursuing a doctoral degree.

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Cecilia Chapa-Balcorta

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Date: April 15th, 2025