

IOCCG Trevor Platt Memorial Scholarship

Research Training on Satellite Oceanography and Marine Bio-Optics



Scholar: Hellen Joseph Kizenga
Supervised by: Dr. Emmanuel Devred
Home Institutes: Institute of Marine Sciences, University of Dar es Salaam, Tanzania; University of Bologna. Italy.
Host Institute: Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada.

1st August 2025 – 30th September 2025

ACTIVITY SUMMARY

The research training was conducted in the Satellite Ocean Colour and Phytoplankton Ecology (SOPhyE) Laboratory at the Bedford Institute of Oceanography (BIO), led by Dr. Emmanuel Devred. The training aimed to enhance capacity and expertise in satellite oceanography and marine bio-optics. It focused on two main objectives: first, to provide training in remote sensing and other oceanographic data processing and analysis; and second, to conduct fieldwork and laboratory training in the use of various instruments for marine bio-optics and other oceanographic measurements. The details of the activities are provided below.

1.0 Activity Description

1.1 Satellite data processing and analysis

Satellite data processing and analysis formed a crucial part of this training, aimed at building expertise in working with satellite-derived data; from image processing to the study of oceanographic and biological processes. The Tanzanian coastal waters were used as a case study, serving as the main focus of all processing and analyses.

The first two weeks focused on processing and analysing phytoplankton phenology metrics along the Tanzanian coast, particularly in the Pemba Channel. During this phase, we modelled phytoplankton bloom metrics using the Shifted Gaussian Fit Model. The Gaussian model was applied to estimate bloom parameters, including chlorophyll-a concentration under the Gaussian peak, bloom initiation and termination, and maximum chlorophyll-a as amplitude.

The Ocean Colour Climate Change Initiative (OC-CCI) dataset, developed under the European Space Agency (ESA) Climate Change Initiative, was used for this activity. OC-CCI provides one of the most consistent and long-term multi-sensor merged ocean colour products covering global ocean regions. It combines data from several satellite missions, including MODIS-Aqua, SeaWiFS, VIIRS, MERIS, and Sentinel-3A and 3B. OC-CCI variables include chlorophyll-a concentration, reflectance, and primary productivity, with available spatial resolutions of 1 km and 4 km. These datasets have previously been used to study biological and oceanographic processes along the Tanzanian coast. Although OC-CCI data tend to slightly underestimate chlorophyll-a values, validation models have shown strong correlations with in-situ data.

The training also focused on deriving temporal and spatial distributions of phytoplankton through time-series analyses, particularly along the Pemba Channel. Climatological and interannual variabilities were examined, showing trends in phytoplankton biomass and phenology over the past ~30 years along the Tanzanian coast. We further aimed to establish the influence of phytoplankton phenology and other environmental variables on small pelagic fish in the Pemba Channel. Small pelagic species such as anchovies, sardines, scads, herrings, and mackerel feed directly on phytoplankton or indirectly through zooplankton. Previous studies have indicated a close relationship between these groups and phytoplankton biomass (food abundance). Therefore, this activity aimed to determine whether similar patterns occur along the Tanzanian coastal waters.

Additional oceanographic variables including sea surface temperature, currents, mixing as well as winds were also considered in the analysis to assess their influence on phytoplankton productivity and small pelagic fish distributions.

1.2 Fieldwork and laboratory analysis

To complement the satellite data processing and analysis, training was also provided on the use of several instruments for marine bio-optics, including fluorometric determination of chlorophyll-a concentration, High-Performance Liquid Chromatography (HPLC) to retrieve sample pigment composition and concentration, flow cytometry to retrieve phytoplankton abundance and particulate absorption. The training placed particular emphasis on fluorometric techniques, especially the use of Turner fluorometers for measuring chlorophyll fluorescence. This included calibration of the instruments and performing actual measurements using two different types of Turner fluorometers. Data processing was carried out using R packages to ensure the quality and reliability of the measurements. Other methods covered included the measurement of Coloured Dissolved Organic Matter (CDOM), which is a crucial component in marine bio-optics.

Field activities primarily involved the deployment of a CTD equipped with additional sensors such as dissolved oxygen, fluorometer, and pH probes, as well as the deployment of zooplankton nets and water collection using Niskin bottles. These activities were conducted weekly in the Bedford Basin. The fieldwork provided valuable hands-on experience in operating various instruments and preparing samples for different analyses, including filtration for chlorophyll and nutrient analysis, as well as treatment for dissolved oxygen and salinity measurements.

2.0 Future Plans

After the two-month research stay and training, I have gained valuable expertise in working with remote sensing data, particularly in analysing phytoplankton bloom metrics and trends. Building on this experience, I am currently working on a manuscript titled *“Phytoplankton Phenology and Physical Forcing in the Pemba Channel: Disentangling Their Roles in Small Pelagic Fish Dynamics”*. This work began during my training at BIO with Dr. Emmanuel Devred and his team. With the guidance and mentorship of Drs. Devred and Kyewalyanga, I plan to submit the manuscript for publication by January 2026. I will be presenting this work at the International Ocean Colour Science (IOCS) Meeting in Darmstadt, Germany.

The knowledge gained in data processing will make a valuable contribution to my PhD research, as I intend to apply it in validating remote sensing data and studying oceanographic processes in the European Union Seas and the Western Indian Ocean. Dr. Devred has generously agreed to continue mentoring me in satellite data processing, and we plan to hold regular online sessions for this purpose.

3.0 Personal Experience

“This fellowship has been one of the most valuable training experiences of my career. It offered a unique opportunity to work with Dr. Devred and his team at the Bedford Institute of Oceanography (BIO), where I gained advanced skills in ocean colour remote sensing and other oceanographic methods. As an oceanographer from a developing region, I was deeply inspired by the infrastructure, professionalism, and research culture at BIO. Learning directly from such

dedicated scientists was a rare and transformative experience. Opportunities like this are vital for early-career researchers from developing regions to strengthen their capacity and contribute meaningfully to coastal and ocean research. I am sincerely grateful to IOCCG for this fellowship and for their continued commitment to supporting and empowering early-career ocean scientists worldwide."



Hellen Joseph Kizenga