



**COCOBRAZ TRAINING COURSE 2023,
Base de Pesquisa Clarimundo de Jesus**

Ubatuba, SP

08-16 July 2023

Background:

A joint Call for Collaborative Research Proposals was announced by FAPESP Brazil and the Agence Nationale de la Recherche (ANR), France's national research funding agency in 2021 under the FAPESP-ANR joint agreement. INPE, IOUSP from Brazil and LOG from France submitted the proposal "COCOBRAZ: Characterization of Brazilian coastal waters biogeochemical quality evolution over the last two decades from satellite observation: impact of natural and anthropogenic forcings" that was granted in April 2022.

Under the auspices of COCOBRAZ, a training course will be offered on "Marine Optics and Ocean Color Remote Sensing", in July 2023. The objective of these lectures is to provide fundamental and practical information on these topics in order to promote and facilitate the use of the potential now offered by "ocean color" observations to support a variety of scientific (applied or fundamental) research projects and activities dedicated to a diversity of fields from ocean biogeochemistry to coastal management or fisheries monitoring.

Format of the course:

The first part of the proposed lectures will provide theoretical knowledge on marine optics allowing the trainees to understand how light is interacting with the optically significant components of seawater and how the assessment of water bio-optical properties can provide quantitative and qualitative information on the marine particulate and dissolved matter pools.

These fundamentals will be complemented by practical sessions dedicated to the measurement of marine inherent optical properties and to computer-based exercises that will allow the trainees to understand the theoretical concepts previously presented and better comprehend the natural variability of marine optical properties as well as the interests of using these optical proxies for deriving biogeochemical information on marine environments.

The second part of the lectures (that will take advantage of the optical fundamentals introduced in the first lectures) will provide a comprehensive overview of ocean color remote sensing science including the most recent developments. Specifically, these lectures will provide knowledge on the different steps required for developing and exploiting the information provided by ocean color remote observation, from the fundamental principles of ocean color to the possible applications of ocean color data in both open ocean waters and optically complex environments such as the coastal waters.

Practical sessions will allow the trainees to learn how to gather ocean color data from the different international data bases, how to visualize and perform basics and advanced spatial and temporal analyses for exploiting ocean color archives. Small research projects will be proposed to the trainees in order to apply the information provided for realistic scientific problematic.

Course content:

I – Marine Optics

A) Lectures

Introduction: what is light and how it interacts with water?

- 1) Water Inherent Optical Properties (IOPs):
 - Definition of the optically significant components of water ecosystems
 - What are IOPs, absorption and scattering properties of seawater constituents: definition, factors driving IOPs natural variability:
 - How to measure IOPs ?
- 2) Link between IOPs and « biogeochemical » parameters
 - How IOPs can be used for deriving a variety of biogeochemical information at different spatial and temporal scales?
- 3) How light is propagating within the water column
 - Definition of the radiometric quantities (radiances and irradiances)
 - The radiative transfer equation
 - The vertical attenuation coefficient and the above water reflectance, two Apparent Optical Properties (AOPs)
 - Link between AOPs and IOPs

B) Practical sessions

- 1) Introduction to radiative transfer: use of a simple tool for playing with light and IOPs
- 2) Characterization of the natural variability of IOPs in marine waters, algorithm development and validation from realistic in situ measurements.
- 3) On-board demonstration of ocean color measurements

II - Ocean color remote sensing

A) Lectures

Introduction: What is ocean color and which information can we derive from it?

- 1) Definition of Ocean Color Radiometry (OCR)
 - The principle of OCR observation
 - Oceanic vs. optically complex waters
- 2) Ocean color sensors: past present and future of ocean color radiometry satellites
 - What is an ocean color satellite (observation geometry, acquisition...)
 - Ocean color satellite spatial, temporal, spectral, radiometric resolutions: definition and evolution from the pioneer sensors
- 3) Assessing the ocean color from space: the different steps for interpreting the color of the sea
 - Extracting the marine signal from the satellite measurements: atmospheric correction of the top-of-atmosphere signal
 - From the ocean color to biogeochemical parameters: bio-optical algorithm developments

- 4) Applications of ocean color remote sensing in open ocean and coastal waters
 - OCR and phytoplankton: from the Chl_a to phytoplankton diversity (phytoplankton functional types and harmful algal blooms biomass and diversity)
 - Carbon dynamics
 - Coastal morphodynamical processes monitoring
 - Fisheries and emblematic species monitoring
 - Ocean color remote sensing as a tracer of global/regional physical forcings
 - Synergy between OCR and modeling, OCR and other satellite observations

B) Practical sessions

- 1) Where to get ocean color data?
- 2) How to visualize and map ocean color data? (SeaDAS NASA, SNAP ESA softwares)
- 3) Online visualization and basic processing of ocean color data time series (NASA Giovanni)
- 4) Tools for analyzing ocean color data archives
- 5) “Research project” based on the exploitation of ocean data (small groups)

Eligibility and prospects:

The course is open to a limited number of participants (20) from Brazil. Travel and subsistence costs will be defrayed for the successful candidates. Depending on the availability, other candidates could be also accepted. The course is aimed at Master/Doctoral students and young researchers with interests in the use of marine and ocean color remote sensing data.

Application and selection procedure:

Applications are invited from research institutes, universities, governmental and non-governmental organizations in Brazil. Candidates to the course are requested to forward their CV's, along with a statement of their current activities, reasons for requesting training in this field, the candidate's own research interests, and the relevance of the training to the activities of the trainee's home institute and/or work.

In the selection of participants, preference will be given to young researchers starting their scientific careers. All participants will be expected to be present in Ubatuba, São Paulo, Brazil for the entire duration of the course. The intention is to transfer knowledge to researchers who will continue to study coastal/marine ecosystems around Brazil into the future, and who will also help train the next generation of local scientists in remote sensing, biological oceanography, and biogeochemistry.

Recommended format for application:

- Name
- Designation
- Affiliation and mailing address
- Phone, e-mail

- RG and CPF (Passport details in case of foreign applicants)
- Qualifications (Degree, Subjects, Specialisation, Grade)
- Professional experience (Designation, From, To, Organization)
- Summary of the work being carried out currently (100 words max.)
- Reason for requesting training (200 words max.)
- Research interests (100 words max.)
- Relevance (100 words max.)
- List of publications (including papers, reports, proceedings, dissertation, articles)
- Signature (with date)
- Recommendation of the Head of the Institute/Dept. (including any partial/complete financial support offered)

Application:

The applications may be forwarded to:

Dr. Milton Kampel, National Institute for Space Research (INPE)

e-mail: milton.kampel@inpe.br

And

Dr. Vincent Vantrepotte, Laboratoire d'Océanologie et de Géosciences (LOG/CNRS)

e-mail: Vincent.Vantrepotte@univ-littoral.fr

Deadline:

Applications will be accepted until **15/04/2023** 2023.

Applicants will be notified if they have been selected or not, by the **03/05/2023**.

Remark Practical Requirements:

- Classes will be provided in English language
- Trainees are expected to attend the whole classes staying at the IOUSP-Ubatuba station during the entire duration of the training course (Rodovia Manoel Hyppolito Rego, n. 11165 Saco da Ribeira - CEP 11.685-700 - Ubatuba - São Paulo) [<https://www.io.usp.br/index.php/infraestrutura/bases-de-pesquisa.html>](https://www.io.usp.br/index.php/infraestrutura/bases-de-pesquisa.html)
- Trainees must bring their own personal computers
- Software and data will be provided
- Students will have to make a short presentation (12 MIN) of their current research work