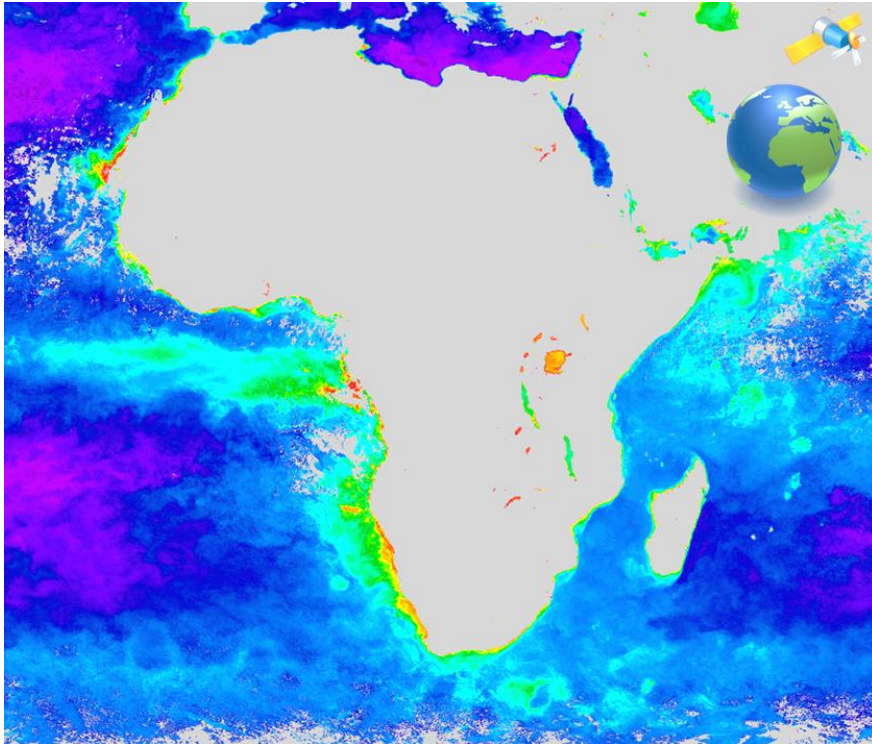


OCEAN COLOUR REMOTE SENSING AND DATA ANALYSIS TRAINING FOR EARLY CAREER OCEAN PROFESSIONALS (ECOP) PROGRAMME

A training report by ECOP Africa and NOWPAP CEARAC



Online: Monday, 6 - 25 June, 2022



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Introduction

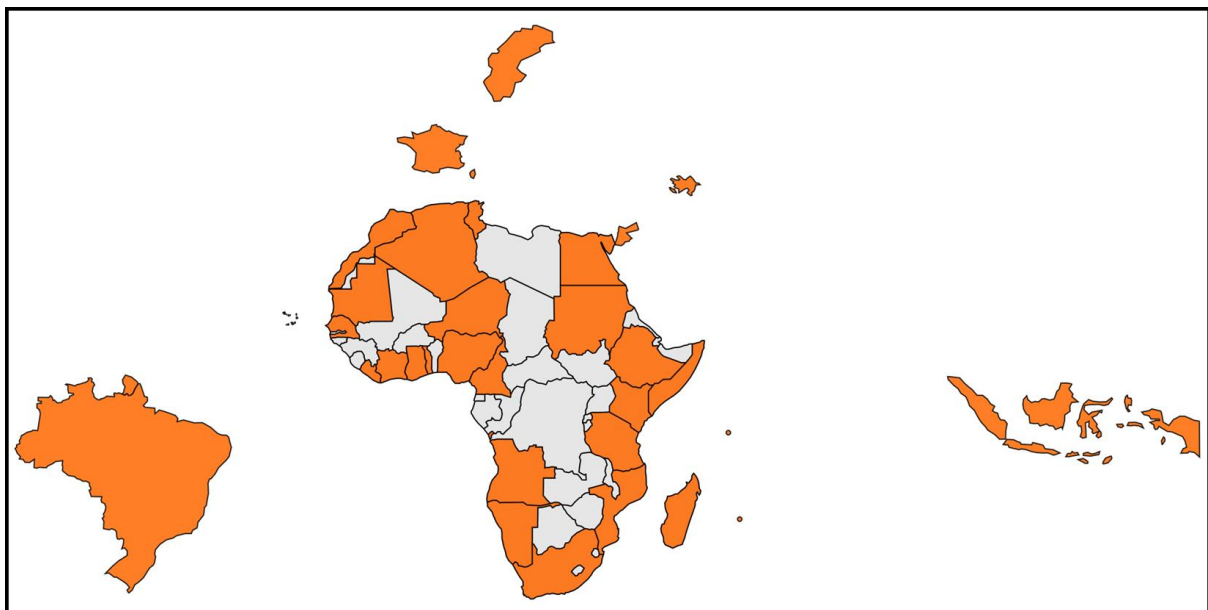
Overview

The online training course on Ocean Colour Remote Sensing and Data Analysis was envisioned to be an introductory course for marine environment conservation for African Early Career Ocean Professionals (ECOPs) leveraging the use of ocean colour remote sensing as a tool for marine environment protection and conservation. With this initiative our aim was to contribute to the call for Decade Actions from the United Nations Decade of Ocean Science for Sustainable Development by focussing on addressing the Ocean Challenges 1 and 7. The online course consisted of a series of webinars introducing topics on water quality monitoring by ocean colour remote sensing. The webinars included lectures by invited experts and hands-on tutorial sessions on analysis of satellite data for the African ECOPs to gain useful skills and knowledge in utilising remote sensing data for monitoring and assessing the coastal and marine environment. The objectives of the training were as follows:

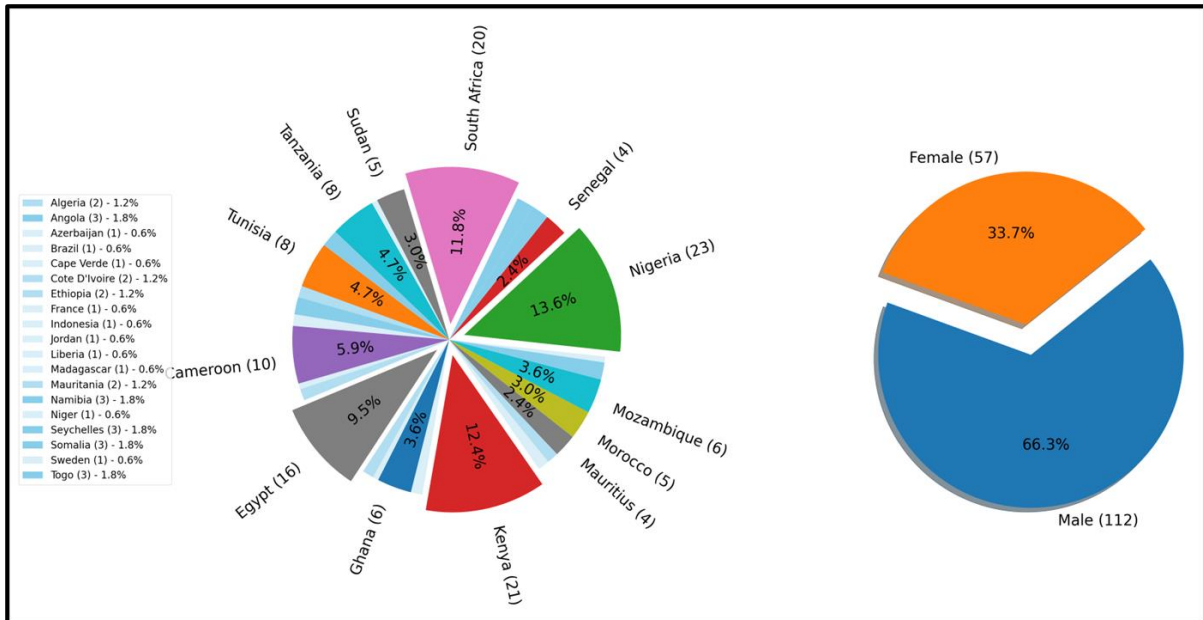
- Understand satellite-derived parameters used in water quality monitoring.
- Learn to search and retrieve satellite data from data providers like NASA, JAXA, etc.
- Analyse and apply satellite data for water quality monitoring and other marine related activities for ocean conservation.

Participant Demographics

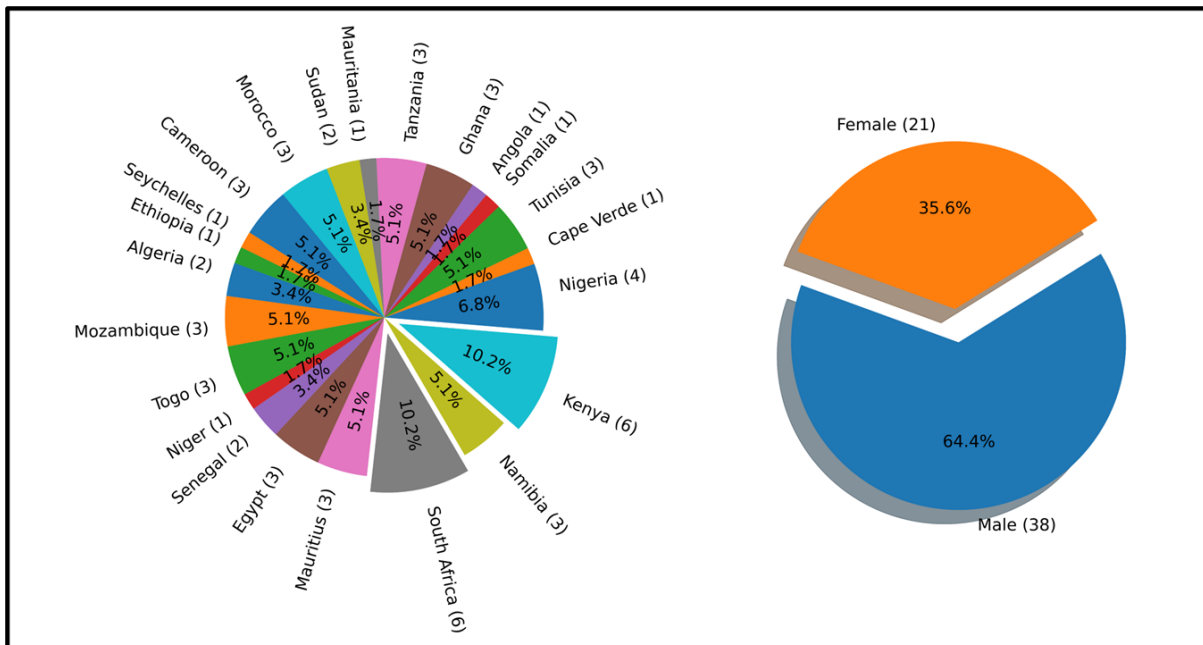
Applications from all over the world were received with 176 applicants—most from Africa and a few from beyond, a clear sign of the importance and interest people have on the kind of training courses. Since the training placed emphasis on hands-on and active engagement during and off the live sessions, only 59 were selected with others (10) in the waiting list in case of drop outs. The map below shows the geographical distribution of the applicants' nationalities.



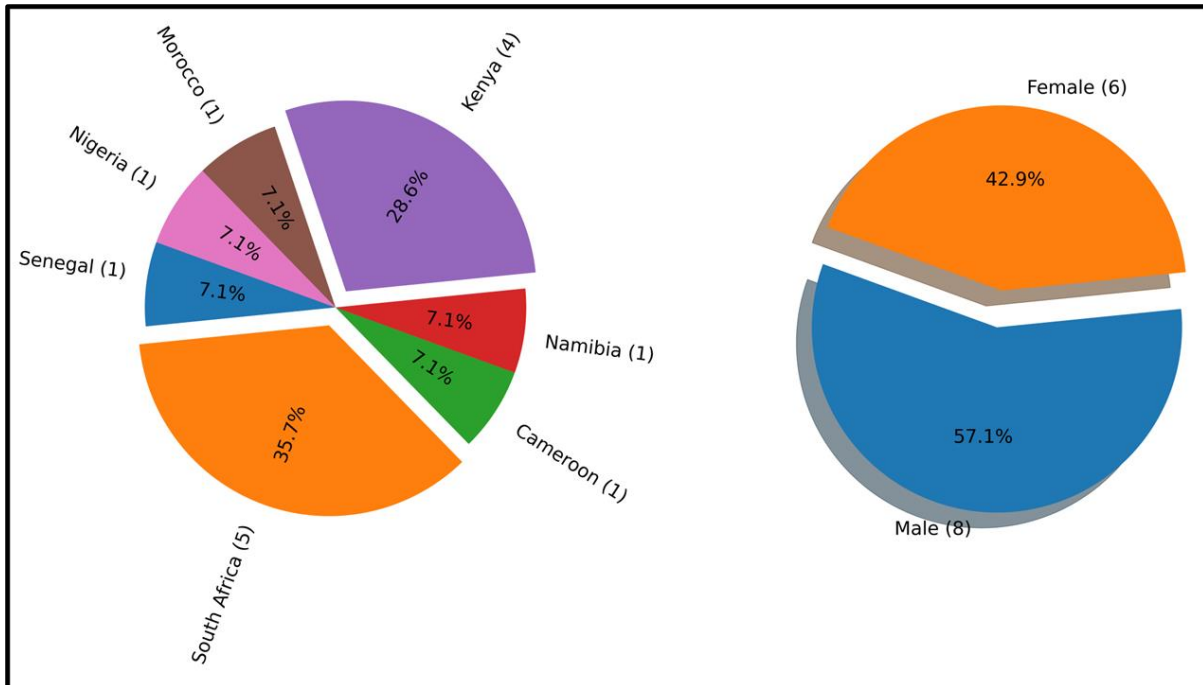
The percent distribution of applications per nationality and the gender ratio of all applicants are shown below. Most of the applications were received from South Africa and Kenya.



From the list of 59 selected participants came from 23 countries, namely, Algeria, Angola, Cameroon, Cape Verde, Egypt, Ethiopia, Ghana, Kenya, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Senegal, Seychelles, Somalia, South Africa, Sudan, Tanzania, Togo, and Tunisia. The ratio among countries and gender are shown below. Please see the List of Participants for the listing of participants per nationality.



Among the selected to join the training, only a few took the challenge and completed the hands-on training. The training required significant commitment from the trainees. Those who completed had a great sense of achievement. We started with males in a larger proportion but completed the training with a nearly equal ratio with South Africa leading in the number of successful trainees.



Duration

The online course consisted of a series of webinars, hands-on, Q&A and presentation sessions held within a period of three weeks. Active sessions (with trainees and trainers) were run for a maximum of 2 hours according to the programme while trainees had other individual time to work on their projects.

Tools

The training was held online whereby OTGA (Ocean Teacher Global Academy) platform was the main communication tool used. As for the hands-on, they were based on Jupyter notebooks and Python programming language to process and analyse satellite data. The Jupyter Notebooks interface is a web-based application that allows the combination of live-code with narrative text, equations, and visualisations. The Python programming language is an interpreted high-level general-purpose programming language design to emphasise code readability. Python contains a vast array of packages freely available that do all sorts of things that oceanographers, marine sciences, and the like scientists do.

Course Outline and Learning Outcomes

The aim of the training was to equip the learners with useful skills and knowledge to utilise remote sensing data for monitoring and assessing the coastal and marine environment. By the end of the training, the learners would demonstrate their understanding of satellite data acquisition and utilisation in addressing a selected topic of choice. Since the training was divided into modules, the outcomes for each module are detailed in the Appendix 2.

Module 1: Introduction to satellite data concepts and applications

In this section we introduced ocean colour data products, a brief overview of satellite data levels, the associated derived geophysical parameters and applications of these parameters in water quality monitoring. Moreover, trainees learnt satellite data search and download methods.

As for the satellite data application in water quality monitoring, the [Global Eutrophication Watch](#), an Earth Engine based tool for coastal eutrophication assessment on the global ocean was introduced as an example.

Additionally, lectures were given to students on applications of ocean colour remote sensing and data analysis. The topics covered included use of R.S and satellite imagery in:

1. Assessment of primary productivity
2. Coastal water quality monitoring (nutrient, Chlorophyll a)
3. Challenges in applications of satellite imagery

Module 2: Data manipulation and analysis: reading and visualisation

In this second module trainees learned how to manipulate ocean colour data. This included reading, visualising, and reprojecting satellite swath into evenly gridded maps. Trainees also learned how to interpret the generated visualisation maps. This included time series analysis relevant, e.g., for understanding seasonal variations of a given water quality parameter.

Module 3: Project work and presentations

Trainees worked on a select of topics that include, but not limited to:

1. Interpretation of water quality image from satellite data
2. Understanding Seasonal variation in water quality parameters
3. Understanding chlorophyll and temperature signature in upwelling zones

The students were required to submit a word document mini report (maximum 500 words) to evaluate their understanding of the course concept. The mini project included a title of the project, the objective, a brief methodology, results and a brief conclusion. There was no limit to the number of pages as this was guided by the number of figures generated. After the submission of the mini report (by Wednesday of the third week), participants were then required to prepare a 10 min presentation which they presented during the course's final live session. The mini report and the presentation were used to assess and grade the learners.

Assessment

The assessment was based on participation and group work. Going through all the course contents, including the live sessions, as well as the submission of the assignments, Mini Project and its presentation, were the minimum pre-requirements for receiving a certificate. If attending the live sessions was impossible, watching the recording was an alternative. Participants were required to

work on a given topic that was distributed during the training or a different topic of their own choosing.

Lessons learnt

As an outcome of this project, we launched a project to create the first hands-on manual that introduces the concepts learned during this seminal course. The manual will focus on Python data analysis for scientists leveraging the use of oceanic colour data for ocean conservancy. It is built on the experience of this training course and involves the successful trainees of this seminal course. The manual is being created by ECOPs for ECOPs.

Feedback

Through course evaluation, the learners expressed that their expectations were met and that the course content and delivery was in line with the call. They also provided areas for improvement. A summary of a select feedback is illustrated in the following tables. The tables include the questions on the left and colour coded responses based on the number of responses per each category of 5 possible answers.

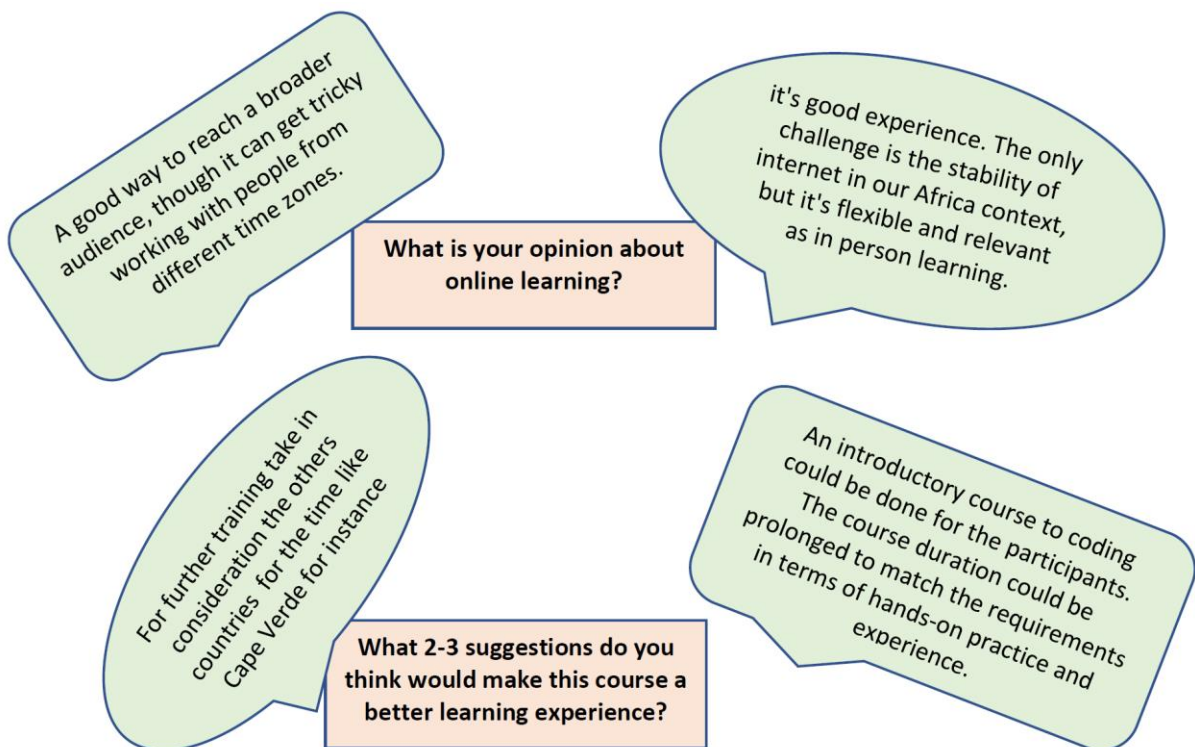
	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
The learning outcomes are clearly stated, measurable and are appropriate to the level of the target audience	5	7	2	0	0
Expectations for student learning were clearly defined	5	8	1	0	0
The course covered the content announced/expected	7	4	2	1	0
I achieved the course stated aims and objectives	7	4	3	0	0
 					
The course content is appropriate to the goals of the course	8	5	1	0	0
The learning activities helped me achieve the stated learning outcomes	5	5	4	0	0
The course facilitators provided effective guidance and feedback	7	4	1	2	0
During this course, I had the opportunity to interact with the instructor as often as needed	9	1	4	0	0

	Very good	Good	Neutral	Poor	Very poor	Does not apply (self-paced course)
How do you rate the response from the course facilitators to your questions or issues raised?	8	4	1	1	0	0
How do you rate the response from the OTGA Secretariat to your questions or issues raised regarding the use of the OceanTeacher e-Learning Platform?	5	7	2	0	0	0

Suggestions for improvement

Do you have any further comments?

- I think it is difficult to try to produce a non-coding technical course but this was well done.
- I suggest that course materials could have been provided prior to the course so that we could've read to familiarise ourselves with the course and the software programs.
- I loved the training because the course focused on the outputs.
- In the future the course should be conducted face to face



I would like to apply the skills I gained by investigating water quality at important fishing grounds or marine protected areas using a time-series analysis to identify whether any of these systems have deteriorated over time. I would also like to share what I've learnt with colleagues and other students.

I will use it to acquire some valuable data on water parameters for my project which is currently about ocean pollution.

How do you plan to apply what you've learned during the training in your work or studies?

Testimonials



It was a challenging course but we had the best teachers and the best squad. We spent most of the time discussing Data acquisition, interpretation of phenomena like upwelling, algae blooms, and phytoplankton, and understanding what different remote sensing reflectance values mean for the water quality in particular regions. Ocean color remote sensing is a convenient way to generate useful insights for projects involving the study of marine ecosystems and the mitigation of climate change.

Simwa, Patricia
Bsc Geospatial Engineering (University of Nairobi)
(GIS, Remote sensing, and Research)
Nairobi, Kenya



The Ocean Colour Remote Sensing and Data Analysis course was challenging but incredibly useful. I enjoyed learning about satellite data, the background of Ocean Colour and how to use Python to download and visualise satellite data. The project that we were tasked with at the end helped us further understand the content and its application. Further, the material provided and produced during the course are valuable and I have already been able to apply it to my current work.

Malange, Mathabo
Marine Environmental Scientist (MSc.)
Cape Town, South Africa

Class Photos

Live sessions

1. Group photo at the closing of Module 1



2. Mini projects presentations

Live session 8: Friday 24 June 2022: 10-12 Nairobi time | 130:16

Gabriel Akoko Juma | Eligio Maure | Mathabo Malange

Results: Rrs comparison between coastal and offshore locations in January 2010

550 nm = Green

$R_{rs}(\text{coastal}) [sr^{-1}]$

$R_{rs}(\text{offshore}) [sr^{-1}]$

$\lambda [nm]$

lon=18.1, lat=-32.7

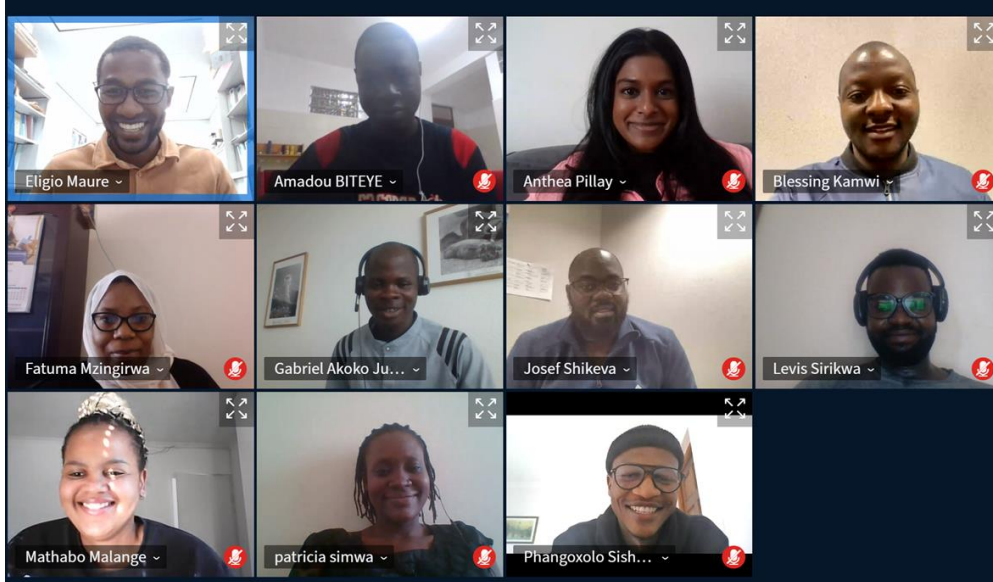
lon=17.7, lat=-32.7

Blue

2022/06/24

7

3. Training course closing



List of Participants

Below is the list of 59 approved trainees out of which 14 completed the training. Please see the pie graph of successful trainees.

	Name	Last	Gender	Nationality		Name	Last	Gender	Nationality
0	Abdelghani	NEDDJAR	Mr	Algeria	20	Hassan	Mao	Mr	Somalia
1	Adelina	Langa	Ms / Mrs	Mozambique	21	Housseem	Smeti	Mr	Tunisia
2	Agnessa	Tadouna	Mr	Togo	22	Ibrahima	Diack	Mr	Senegal
3	Almoustapha	Amadou Malam Lacho	Mr	Niger	23	Josef	Shikeva	Mr	Namibia
4	Amadou	Biteye	Mr	Senegal	24	Josemar	Pedro	Mr	Angola
5	Amira	Hotaiba	Ms / Mrs	Egypt	25	Josphat	Nguu	Mr	Kenya
6	Anishta	Audit-Manna	Ms / Mrs	Mauritius	26	Jude	Ofosu	Mr	Ghana
7	Anselmo	Cháuque	Mr	Mozambique	27	kahramana	taileb	Ms / Mrs	Algeria
8	Anthea	Pillay	Ms / Mrs	South Africa	28	Kodjo Olivier	ASSOKPA	Mr	Togo
9	Blessing	Kamwi	Mr	Namibia	29	Levis	Sirikwa	Mr	Kenya
10	Bonventure	Makhaya	Mr	Kenya	30	Lovelace Nii Kotey	Neequaye	Mr	Ghana
11	Brishan	Kalyan	Mr	South Africa	31	Mahmoud Mohammed	El-Mezayen	Mr	Egypt
12	BUBELE	RASMENI	Mr	South Africa	32	Malika	Beji	Ms / Mrs	Tunisia
13	Carolina Marcela	Mutatisse	Ms / Mrs	Mozambique	33	Mathabo	Malange	Ms / Mrs	South Africa
14	Chinomso	Onwubiko	Ms / Mrs	Nigeria	34	Mathew	Silas	Mr	Tanzania
15	Edafe	Odioko	Mr	Nigeria	35	Mohamed	Mohamed Mahmoud	Mr	Mauritania
16	Eder	Cruz	Ms / Mrs	Cape Verde	36	Mohammed	Hamed	Mr	Sudan
17	Fadoua	Ben Salah	Ms / Mrs	Tunisia	37	Mohammed	BOUCHKARA	Mr	Morocco
18	Fatuma	Mzingirwa	Ms / Mrs	Kenya	38	Nada	Sayed ELAhl	Ms / Mrs	Egypt
19	Gabriel	Kornelius	Mr	Namibia	39	NJUTAPVOUI	Nourdi	Mr	Cameroon
	Name	Last	Gender	Nationality		Name	Last	Gender	Nationality
40	Patricia	Simwa	Ms / Mrs	Kenya					
41	Phangoxolo	Sishuba	Mr	South Africa					
42	Prerna	Roy	Ms / Mrs	Mauritius					
43	Prsicilla	Mensah	Ms / Mrs	Ghana					
44	Regan	Nicholaus	Mr	Tanzania					
45	Ritesh	Soobhug	Mr	Mauritius					
46	Rodney	Bonne	Mr	Seychelles					
47	Serah	Akojenu	Ms / Mrs	Nigeria					
48	Tausi	Khityentya	Ms / Mrs	Tanzania					
49	Ulrich Joel Felicien	Bilounga	Mr	Cameroon					
50	WALEED	BABIKERR	Mr	Sudan					
51	Widad	Natify	Ms / Mrs	Morocco					
52	Willy Karol	ABOUGA BODO	Mr	Cameroon					
53	Winnie	Onyango	Ms / Mrs	Kenya					
54	Yawo	konko	Mr	Togo					
55	Zaahid	Khan	Mr	South Africa					
56	zahra	okba	Ms / Mrs	Morocco					
57	ZAKARIYAU	IBRAHIM	Mr	Nigeria					
58	Zenebe	Ageru	Mr	Ethiopia					



Training Schedule

Time	Activity	Mode	Time
Module 1	Introduction to satellite data concepts and applications		
Day 1	- Introduction and housekeeping	D	10 min
(Lesson 1)	- Overview of Jupyter Notebook environment setting	L	30 min
	- Break	-	10 min
	- Downloading materials and installing software	H	30 min
	- Access to open ocean colour data - NASA and JAXA data archive active centres	D	30 min
	- Q&A (10 mins)	-	10 min
Day 2	- Introduction to satellite data concepts and applications	L	30 min
(Lesson 2)	- Introduction to satellite data search and download methods	H	90 min
Day 3	- Application of satellite imagery in oceanography and ocean conservation (1 h)	L	55 min
(Lesson 3)	- Break	-	10 min
	- Coastal water quality monitoring	L	55 min
Day 4	- Students work on software download		
Day 5	- Students work on data download		
Module 2	Data manipulation and analysis: reading and visualisation		
Day 1	- Data manipulation and analysis: reading and visualisation	H	45 min
(Lesson 1)	- Time-series analysis	H	45 min
	- Introduction of group works and Q&A	D	30 min
	Topical suggestions (a) Interpretation of water quality image from satellite data (b) Understanding Seasonal variation in water quality parameters (c) Understanding chlorophyll and temperature signature in upwelling zones		
Day 2	Data interpretation	D	120 min
(Lesson 2)	- Progress sessions and Q&A		
Day 3-5	- Students work on projects		
Module 3	Project work and presentations		
Day 1	- Discussion of findings	D	120 min

(Lesson 1)	- Progress session and Q&A		
Day 2	- Students work on projects		
Day 3	- Hand in reports		
Day 4	- Working on slides for presentations		
Day 5	- Group presentations		180 min
	- Course wrap-up and course evaluation		20 min

Course Organisers and Lecturers

The training course was devised by Gabriel Juma and Elígio Maúre and organised with the support of the Ocean Teacher Global Academy Secretariat. The training was delivered with contributions from Deepeeka Kaullysing, Anthony B. Ndah, and Kirsty McQuaid
See below the short bio of all contributors.

 <p>Gabriel Akoko Juma <i>Coordinator: ECOP Africa</i></p>	<p>Bio</p> <ul style="list-style-type: none"> ● PhD Candidate in Coastal Ecology at Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research – Germany ● Holds a Postgraduate Diploma in Oceanography from Alfred Wegener Institute and MSc in Environmental Science from Chuka University-Kenya ● Interests in Coastal Ecology with focus on Role of terrestrial runoff on nearshore environment, as well as Ocean Literacy <p>Role</p> <ul style="list-style-type: none"> ● Development of course concept and workplan ● Review of training modules on OTGA platform ● Course moderation and co-hosting ● Evaluation of assignments ● Feedback and report writing ● Course coordinator
 <p>OTGA Secretariat</p>	<p>Ocean Teacher Global Academy (OTGA) delivers customised training for ocean experts and professionals to increase national and regional capacity in coastal and marine sciences, services and management.</p> <p>Role</p> <ul style="list-style-type: none"> ● Hosting of e-learning platform ● Provision of pedagogic support ● Provision of administrative support



Elígio de Raús Maúre
Researcher
Northwest Pacific Region
Environmental Cooperation
Center ([NPEC](#)) Toyama, Japan

Bio

- Applies ocean colour remote sensing data to monitoring of [coastal eutrophication](#).
- Develops data analysis tools in [Python](#) and [Google Earth Engine](#) focusing on the use of ocean colour data.
- Holds a PhD in environmental studies (oceanography) and postgraduate degree in clinical environmental studies from Nagoya University-Japan.
- Interests in coastal ecosystem dynamics, [physical-biological interactions](#), and teaching

Role

- Development of course concept and workplan
- Development of training materials
- Review of training modules on OTGA platform
- Course moderation and co-hosting
- Design and evaluation of assignments
- Feedback and report writing
- Course coordinator
- Principal lecturer



Deepeeka Kaullysing
Senior Lecturer
Department of Biosciences and
Ocean Studies
Faculty of Science, University of
Mauritius
Republic of Mauritius

Bio

- Holds a PhD in Marine Malacology and Ecology, MSc in Marine Science (specialisation: Marine Biology) (India), and BSc (Hons) in Marine Science and Technology (Mauritius)
- Mauritius Research Council Postgraduate Award in 2016
- Commonwealth Scholarship/Fellowship awardee in 2011
- Member of the Sustainable Marine Biodiversity Pole of Research Excellence at the University of Mauritius, leading the research thrust “Applications and Utilisation of Marine Biodiversity”
- Country Coordinator (Mauritius) for the Western Indian Ocean Early Career Scientist Network (WIO-ECSN)
- Vice-President of the NGO Biodiversity and Environment Institute
- Main research areas: Marine Malacology, Marine Ecology, Corallivory, Corallivorous gastropod reproductive ecology, Marine plankton

Role

- Development of course content and training materials for “Coastal Water Quality Monitoring”
- Resource Person



Anthony B. Ndah
Post-doctoral researcher
Alfred-Wegener-Institut
Helmholtz-Zentrum für Polar-
und Meeresforschung

Shelf Sea System Ecology,
Biologische Anstalt Helgoland,
Germany

Bio

- PhD in Environmental Studies with focus on Marine Biogeochemistry and Air-Sea CO₂ Fluxes from the University of Brunei Darussalam
- Post-grad diploma in observational oceanography from Alfred Wegener Institute for Polar & Marine Research,
- MSc. in Marine Affairs from Xiamen University, China (Integrated Coastal Management), and a BSc. (Hons) in Geography from the University of Buea, Cameroon.
- Current work: The development of zooplankton-based indicators and methods of ecological assessment in the German North Sea under the EU Marine Strategy framework Directive

Role

- Development of course material
- Delivery of lecture entitled: Application of satellite remote sensing to a spatial-comparative assessment of primary productivity between three Western African Large Marine Ecosystems (LMEs)



Kirsty McQuaid
Postdoctoral Research Fellow
University of Plymouth, UK
South African National
Biodiversity Institute, South
Africa

Bio

- PhD in Deep-sea Ecology (UK), MSc in Applied Marine Science (South Africa), and BSc (Hons) in Marine Biology (South Africa)
- 2022 Awardee of the International Seabed Authority Secretary General's Award for Excellence in Deep-sea Research
- Co-coordinator of the Central & South Atlantic Regional Scientific Research Working Group and Early Career Ocean Professional focal point of the UN Decade of Ocean Science endorsed [Challenger 150 Programme](#)
- Member of the [Deep Ocean Stewardship Initiative](#) Minerals and BBNJ working groups
- Member of the South African National Biodiversity Institute National Marine Ecosystem Classification Committee
- Main research areas: Deep-sea benthic ecology, habitat mapping, marine spatial planning

Role

- Guest lecture on the application of remote sensing data to management of deep-sea ecosystems