



Marine Research and
MaRIHE
High Education Center



Mapping Technologies and Monitoring Techniques in Coral Reef Environments

II Edition

13-21 March 2023

MaRHE Center, Magoodhoo, Faafu Atoll (Republic of the Maldives)



For registration and information:
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Introduction

Why this workshop?

Coral reefs are a complex and productive ecosystem that encompasses the highest biodiversity of any marine ecosystem. They are unique as they depend on a strong interaction between geomorphic and ecological processes. Investigating the formation and morphological change of coral reefs and reef-associated landforms contributes to a deeper understanding of a number of geomorphological, environmental and ecological issues, such as sediment and nutrient transport processes, larval dispersion mechanisms, estimation of their carrying capacity as habitat, etc. Moreover, it is crucial to improve coral reef conservation with a view of changing environmental conditions resulting from an increased stress by both anthropogenic and climate changes. To date, we have lost most of the global coral reef systems worldwide due to several impacts, such as overfishing, coastal development, sedimentation, marine-based pollution (e.g. plastic pollution).

Until less than a decade ago, geomorphological mapping in coral reef environments was carried out using satellite data ground-truthed by field studies. Because of this, geomorphological mapping lacked a 3D representation at high spatial resolution. As a consequence, geomorphological and habitat mapping, together with monitoring investigations, were challenging topics. Nowadays, detailed mapping of coral reef environments is possible thanks to the use of both acoustic equipment (e.g. Multibeam Echosounder - MBES) and Uncrewed Aerial Vehicles (UAVs or drones), thus we are able to map, study and plan monitoring actions to be carried out to preserve such productive ecosystems.

The **II Edition of the Mapping Technologies and Monitoring Techniques in Coral Reef Environments** is your opportunity to gain hands-on experience on data acquisition and post-processing techniques by using different equipment, focusing on the importance of cutting-edge monitoring techniques for mapping coastal and nearshore environments.

Introduction

About the workshop

During the previous edition of Mapping Technologies in Coral Reef Environments in 2019, the main goal of the practical training was to provide an overview of the most advanced technique used to collect elevation data in coral reef environments and to integrate multi-scale elevation datasets to obtain seamless Digital Terrain Models (DTMs).

The **II Edition** of this practical training is called **Mapping Technologies and Monitoring Techniques in Coral Reef Environments**, and it also aims at providing advanced knowledge on how to plan and carry out multiscale and multisensor monitoring activities in nearshore environments.

This course will entail an overview of the most advanced techniques used to collect remote sensing data in coral reef environments (UAV and MBES) and to ground-truth them (ROV, Photogrammetry). We will present post-processing procedures for both MBES data (Bathymetry and Backscatter) and UAV imagery (Structure for Motion - SfM), and data interpretation thanks to the use of Computer Vision techniques, Object-Based Image Analysis (OBIA) and GIS toolboxes (ArcMap).

Lessons will be held at the **Marine Research and High Education Center (MaRHE Center)** of **Milano-Bicocca University** in **Magoodhoo Island, Faafu Atoll**, which is about three hours by speedboat from Malé airport.

Field activities will be carried out either onboard a traditional Dhoni (wooden sailing vessel) or in snorkelling.

Practical activities will include the use of dedicated software for processing collected data and performing their integration and interpretation.

Introduction

The Team

The workshop will be coordinated by **Dr. Luca Fallati, Melissa Anne Schiele, Andrea Giulia Varzi, and Ocean Unmanned NGO.**

Dr. Luca Fallati is a Researcher in the Department of Earth and Environmental Sciences (DISAT) at the University of Milano-Bicocca. His research is mainly centered on marine geomorphology and habitat mapping in coastal and submarine environments, with a particular focus on innovative remote sensing technologies for multiscale approach in changing environments, together with underwater photogrammetry and reconstruction of 3D models for immersive Virtual Reality (VR) scenarios.

Melissa Anne Schieleis a senior international project manager and conservation technologist who is working towards a PhD in Engineering at Loughborough University and the Zoological Society of London. Her research focuses on developing fixed-wing drones and creating methods and protocols for their use in remote locations, for wildlife monitoring, plastics detection and illegal fishing surveillance. She is also developing augmented technology acceptance models to understand long-term use of systems in the hands of end-users in developing nations.

Andrea Giulia Varzi is a PhD candidate in the DISAT at the University of Milano-Bicocca. Her scientific interests are towards geomorphological and habitat mapping, together with habitat and restoration suitability models. Her research is focused on the “white ribbon” area, the land-sea continuum, to define a reference workflow to integrate high-resolution multi-scale and multi-source geospatial datasets for creating seamless models to bridge the gap.

Oceans Unmanned is an NGO created to facilitate the use and harness the power of unmanned technology to foster marine research and conservation. Founded in 2016, Oceans Unmanned (OU) is dedicated to protecting our ocean and coastal environments and inspiring an optimistic mindset that can address long standing challenges through the use of cutting-edge technology. OU provides operational and research support to scientists and resource managers worldwide to address a wide variety of environmental issues including: climate change, sea level rise, marine debris, wildlife surveys, habitat mapping and more.

Introduction

What to expect

The course will consist of a series of **frontal lessons and field activities**. It will be coordinated by researchers with experience in the **use of aerial drones and underwater instruments** for coastal and seafloor mapping (bathymetric and habitat) and photogrammetry techniques.

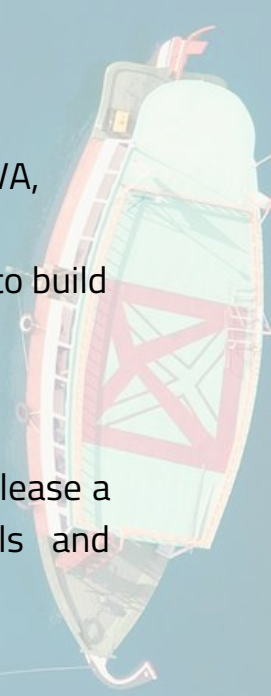
After completion of this training course, you will be able to:

- plan drone surveys with the ground station software and conducts the survey with different platforms (fixed wings and multicopter);
- perform the survey and georeference models with GPS ground control points;
- recognise main carbonate producers in coral reef environments;
- plan a geomorphological survey in coral reef environments;
- collect terrestrial and submarine topographic data using different technologies (UAV, MBES, ROV);
- process MBES bathymetric and backscatter with specific software (EIVA, Qimera, FMGT);
- process imagery data with Structure from Motions (SfMs) algorithms to build orthomosaics and/or 3D models (Agisoft Metashape);
- create geomorphological and habitat maps (ArcMap);

At the end of the Training Course the University of Milano-Bicocca will release a digital certificate (**Open Badge**) to recognize the participant's skills and achievements in **Mapping Technologies and Monitoring Techniques**.

For more details, please visit:

www.openbadges.org and <https://best.it/badge/show/400?ln=en>



Daily Program*

* The program may be subject to changes, due to weather conditions or other problems

DAY 1

- Arrival at Malé International Airport, Maldives
- Transfer by speedboat to MaRHE Center, Magoodhoo Island
- Arrival in Magoodhoo island and accommodation
- Dinner
- Briefing on the next day's activities

DAY 2

- Classroom Session: **Remote sensing and coral reefs**
- On-field Activity Session: **Topographic survey**
- Lab activity Session: **GPS Data processing and implementation into a Geographical Information System**
- Recap & Briefing on the next day's activities

DAY 3

- Classroom Session: **How to plan a UAV survey for monitoring and mapping activities**
- Classroom Session: **Mission Planner - ArduPilot open source ground station**
- On-field Activity Session: **Fixed Wings and Quadcopter drone data acquisition**
- Lab activity Session: **UAV data processing with Structure from Motion Software**
- Recap & Briefing on the next day's activities

DAY 4

- On-field Activity Session: **Fixed Wings and Quadcopter drone data acquisition**
- Classroom Session: **Geomorphological mapping in coral reef environments: An introduction**
- Lab activity Session: **UAV Data processing and generation of a DEM (Structure from Motion technique)**
- Lab activity Session: **Geomorphometric analysis and investigation of coral reef structural complexity**
- Recap & Briefing on the next day's activities



DAY 5

- Classroom Session: **Underwater Photogrammetry, instruments and techniques for seafloor 3D modelling**
- On-field Activity Session: **Underwater Photogrammetry survey on coral reef**
- Lab activity Session: **Underwater images processing with Structure from Motion Software**
- Recap & Briefing on the next day's activities

DAY 6

- Classroom Session: **Acoustic survey in shallow water environments, Multi-Beam EchoSounder (MBES)**
- On-field Activity Session: **MBES survey (patch reefs and lagoon)**
- Lab activity Session: **MBES data processing**
- Recap & Briefing on the next day's activities

DAY 7

- Classroom Session: **Acoustic survey in shallow water environments, Backscattering**
- On-field Activity Session: **MBES survey (reef slope)**
- Recap & Briefing on the next day's activities

DAY 8

- Lab activity Session: **Generation of a multi-scale geomorphological map of the Magoodhoo Island and its surrounding reef**
- Group presentation of monitoring results
- Final Recap

DAY 9

- **Departure from Magoodhoo to Malé airport**



Useful information

DOCUMENTS

Travelling to the Maldives requires a passport, with at least 6 months of validity from your departure from the Maldives and at least 2 empty pages.

CLOTHING AND EQUIPMENT

The air temperature is around 28-29°C. The weather is always pleasant, even during the rainy months (Fig. 1). Please note that most of the day will be occupied by field activities, seminars and exercises, it is, therefore, advisable to wear comfortable sportive clothes.

It is recommended to avoid too skimpy clothing, as the island of Magoodhoo is not a tourist destination and local costumes are those of an Islamic country.

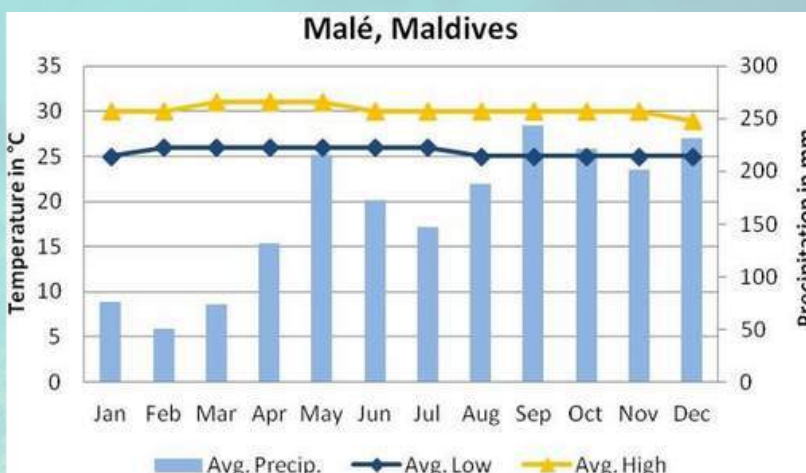


Fig1. Monthly air temperature (°C) recorded in Maldives and monthly averages of sunny and rainy hours recorded in Maldives.

For field activities in the sea it is necessary to have - in addition to a bathing suit and a towel - the following equipment:

- mask;
- snorkel;
- fins (booties);

It is possible to rent snorkeling equipment on-site, depending on size and availability. Please inform us in advance in case you need this.



ACCOMMODATION AND MEALS

The accommodation is organized at the Centre, in multiple rooms with bathroom, full board (breakfast, lunch and dinner). Sheets and towels are provided. The food is prepared according to the local customs and consists, for the most part, of fish, chicken, rice and vegetables prepared in different ways. Special dietary requirements and allergies are to be mentioned in the application form.

HEALTH

No vaccination is required for travellers coming to Maldives from Europe. However, each participant should take care of this aspect in order to enter the country.

SAFETY

Any field activity presents risks and dangers, and there are some basic rules to be observed in order to minimize them.

In the water it is necessary to respect the buddy system: working groups will be settled, and, within the group, working couples will be established.

CURRENCY

The Maldivian currency is the Maldivian Rufiyaa (MVR). Euros and dollars are accepted in any bank and exchange office.

1 Euro = about 17 Rufyiaa ; 1 US \$ = about 15 rufyiaa;

INSURANCE

The **insurance included with the Business Visa** (for those who apply for Business Visa, see Fee & Registration chapter for more details) **does not cover COVID-related costs and has a cover limit of 100.000 Maldivian Rufiyaa (MVR)**, approximately 6.500 USD \$, for health issues. It is therefore up to you to decide whether to buy an additional private health insurance to have a greater coverage.



Costs and registration

COSTS

The cost of the II° Edition of Mapping Technologies and Monitoring Techniques in Coral Reef Environments is:

- 1200 Euro for students (regularly registered at any university course)
- 1400 Euro for non-students

The above amount includes:

- boat transfer from/to Malé airport;
- transfers for all the activities envisaged under the internship program;
- room and food at the MaRHE Center of Magoodhoo: full board treatment and accommodation in multiple rooms (single rooms are not available);
- lessons and activities provided for the internship program.

The above amount does NOT include:

- flight to/from Malé;
- passport renewal expenses;
- entry business visa (if required) to the Maldives (200€)
- anything else not specified above.

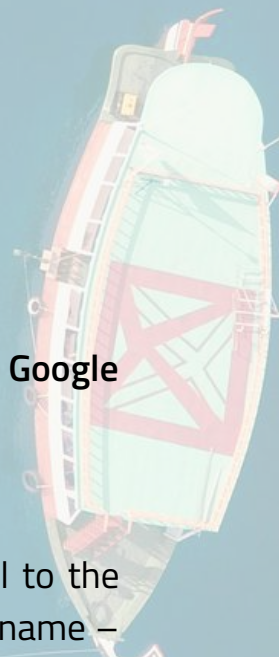
REGISTRATION

To proceed with the registration, you will have to fill in the following Google Form:

<https://forms.gle/kFkB7pS2APg4y3bi7>

After completing the above questionnaire, we ask you to send an email to the address workshop.marhe@unimib.it specifying in the subject: "Name Surname – Registration Mapping Technologies and Monitoring Techniques" and attach a .jpg colour copy of your passport naming the file MTCR23_Surname_Name_PPT.

IMPORTANT: YOU WILL HAVE TO WAIT FOR OUR CONFIRMATION BEFORE PURCHASING YOUR FLIGHTS.



The workshop will be activated once a minimum number of participants has been reached, thereafter we will give you the green light to purchase the flights and we will send you the invoice, after which you can proceed with the payment of the workshop fee.

The registration deadline is fixed for 31 January 2023. The maximum number of participants is set to 16-20 people.

FLIGHTS

You will be responsible for purchasing the flight. The choice of the airline is yours, the important thing is to be at the airport on the day and at the time established (we will share with you the necessary information once registered). Pay attention while purchasing the flight tickets as your mistakes (incorrect flight dates or other) cannot be reimbursed.

Furthermore, **it is necessary to send us a copy of the air ticket by 15 February 2023 to be able to proceed, if necessary, to the entry visa request, of which we will deal entirely.**

IMPORTANT NOTES

Please wait for our confirmation before purchasing the flights.

There will be a **recognition of training credits for students** on the International master's programme in **Marine Sciences (University of Milano-Bicocca).**

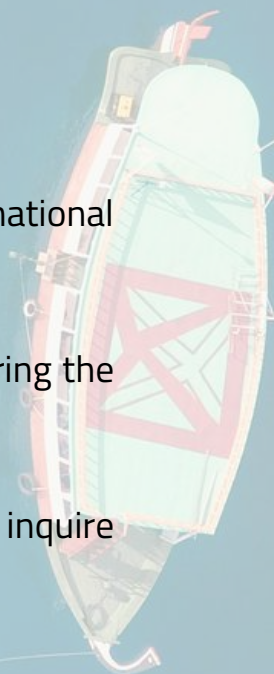
In particular, for such students, the set of all the activities carried out during the workshop can reach a **total of 4 CFU (practical training).**

Students enrolled in other degree programmes and/or universities must inquire at their teaching secretary.

For any information, please contact us at **workshop.marhe@unimib.it**

CANCELLATION

Following the payment of the fee, reimbursement for any cancellation will be subject to 10% admin fee.



COVID-19 Health and Safety Protocol

Safety measures at MaRHE Center

- It is recommended to wear face masks correctly in the Center classroom
- Hand hygiene: hand washing should occur after touching anything, after using the restroom, prior to eating, and after touching one's face or blowing one's nose.
- It is recommended to possess adequate health insurance

Testing and positive cases

The local doctor will test individuals with concerning symptoms (rapid antigen test) for Covid-19.

Individuals who test positive for Covid-19 will have to abide by the Maldivian HPA protocol, which is constantly evolving.

A MaRHE Center staff member will remain on the island so long as anyone is subject to isolation.

All medical and logistical costs incurred by the person who tested positive for Covid-19 are his/her responsibility.

Please note that Covid-19 rules could change through time due to the global health situation, which is constantly evolving.

MaRHE Center Director

