UM5MRM16	TIME-SERIES ANALYSIS OF MARINE ECOSYSTEMS	
6 ECTS	*Keywords*	global change, time series, climate trends, seasonal variability, ecosystem change
M2	*Managers*	Audrey PRUSKI, Franck LARTAUD (LECOB, Banyuls)
Banyuls	*Professors*	Pauline ROUX (LOMIC, Banyuls)
	Tracks	Marine ecosystem functioning and global change

Description

Course Unit Format

Teaching Methods

The course unit combines interactive lectures and tutorials to introduce students to the analysis of time-series signals in marine sciences. Using scientific figures or results from publications, the lectures follow a flipped-classroom approach to encourage collective discussion and understanding of the concepts.
The teaching covers the entire analysis process: from setting up observational monitoring to data acquisition and processing (importing, cleaning, visualisation, analysis of anomalies, and extraction of trends and cycles at different scales).
Students work on practical case studies in R Studio and Matlab, using datasets from monitoring networks covering a range of ecosystems (coastal areas, deep-sea environments, etc.).
Seminars with specialists in environmental monitoring and marine management complement the course.
All course materials and scripts are available on the course unit Moodle platform.

Assessment Methods

Final examination on theoretical and methodological concepts (60%) + supervised group project on the analysis and interpretation of environmental time series (40%).

Summary

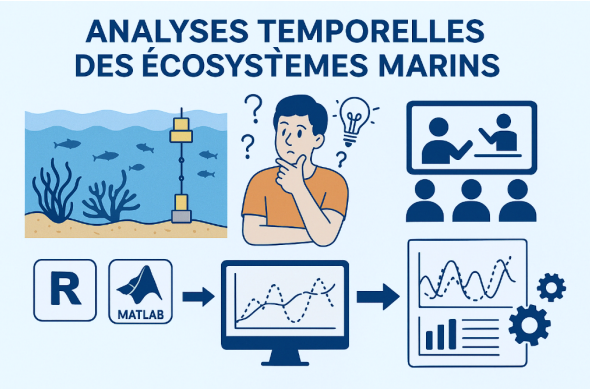
Time series are essential for understanding how marine ecosystems change in response to natural and human pressures. This module explores strategies for acquiring and analysing environmental and biological data, with an emphasis on natural and anthropogenic forcing processes. Students will learn to process and interpret time series in order to analyse marine ecosystem dynamics and derive knowledge useful for research and environmental management.

Why choose this course →

Learning objectives

By the end of this module, students will be able to:

1. Set up time-series monitoring of marine ecosystems by selecting an appropriate methodology.
2. Analyse and interpret time series using data-processing and visualisation tools in R Studio and Matlab.
3. Describe the temporal dynamics of marine physical and ecological processes.
4. Discuss the responses of marine ecosystems to multiple stressors over different timescales.



5. Explain the local and global factors influencing the evolution of coastal ecosystems.
6. Synthesise and communicate the results of time-series analyses in the form of scientific reports and ecological interpretations

Prerequisites

A basic grounding in marine ecology and statistics is required, together with elementary knowledge of R Studio.

References

Benway, Heather M. et al. "Ocean Time Series Observations of Changing Marine Ecosystems: An Era of Integration, Synthesis, and Societal Applications" 6 (2019)

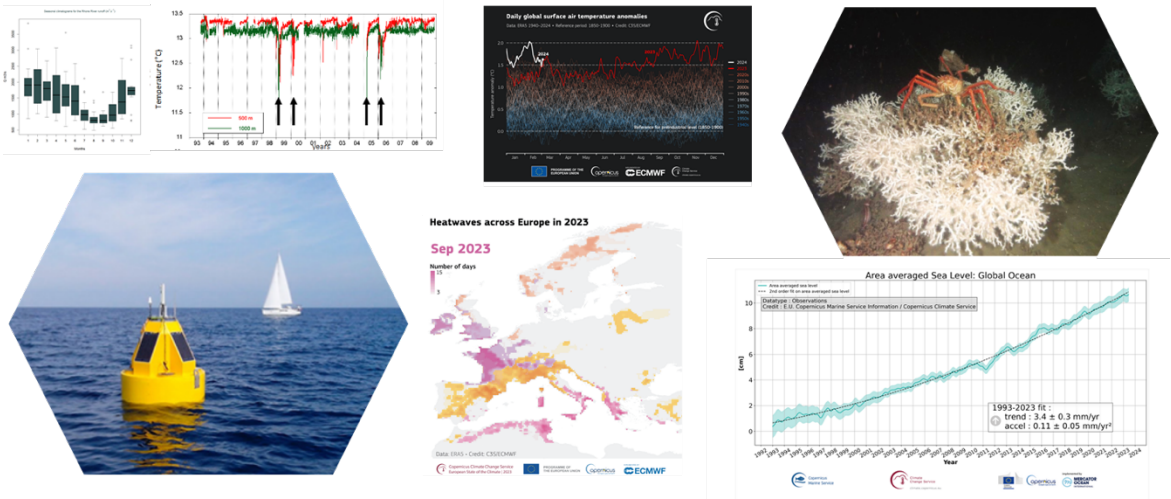
https://marine.copernicus.eu/access-data/ocean-monitoring-indicators/time-series-mean-sea-level-anomalies-over-global-ocean-and-associated-trend

https://www.seadatanet.org/

Course Organisation

Teaching is delivered in English.

Teaching is structured in three parts combining theoretical instruction and practical sessions.



Introduction (A. PRUSKI) – 1 h

Presentation of the course unit, learning outcomes and assessment methods. Explanation of how the course unit is organised and the skills to be acquired.

Part I : Tools (F. LARTAUD, A. PRUSKI, P. ROUX) – 10h lectures and 10h practical sessions

1. From observation series to enhanced observatories : Introduction to different approaches for collecting environmental data and setting up observatories that integrate advanced technologies.
2. Monitoring and biomonitoring : Exploration of environmental monitoring techniques and the measurement of biological indicators to assess the health of marine ecosystems
3. Methods for analysing time-series signals : Introduction to digital tools for analysing time series and identifying trends, periodicities or anomalies.

Part II : Environmental cycles and extreme events (F. LARTAUD, A. PRUSKI) – 8h lectures and 8h practical sessions

1. Main drivers of environmental rhythmicity : Study of the natural and anthropogenic factors influencing ecological rhythms in marine ecosystems.
2. Climate and palaeoclimate variability : Analysis of past and current climate changes and their impact on marine ecosystem dynamics.
3. Characterisation of extreme events : Identification and analysis of extreme events (floods, storms, marine heatwaves, etc.) and their impact on ecosystems.

Part III : Ecosystem responses and environmental monitoring. (F. LARTAUD, A. PRUSKI, P. ROUX) – 8h lectures, 6h practical sessions, 9h project supervision

1. Monitoring marine microbial communities: Use of time series to analyse microbial community responses to environmental variations, identify seasonal dynamics and long-term trends, and illustrate the value of coastal observation networks (REPHY, PhytOBS) for monitoring marine ecosystems.
2. Changes in marine food webs: Presentation of the causes of change, observed effects and monitoring indicators derived from the Marine Strategy Framework Directive (MSFD)
3. Applied analysis workshops: Case studies/seminars/discussions with environmental management professionals to address current issues related to ecosystem monitoring.
4. Projects (F. Lartaud and A. Pruski) – 9h of supervised group work. Application of acquired skills through the analysis of real time series, guided by the instructors, with a final presentation or report.

NB: This document is indicative. Details of the content and format of teaching and assessments may change from one year to the next.