Fiche UE Master Sciences de la Mer

SCIENCES SORBONNE UNIVERSITÉ

DESCRIPTIF DE L'UE

MU4MRM94	**TITRE DE L'UE** CONCEPTS IN BIOLOGICAL OCEANOGRAPHY, PART 1: MARINE ENVIRONMENTS AND BIOGEOCHEMISTRY
6 ECTS **M1**	**MOTS CLES** : environment characterization, water column, sediment, quantification, experimental design, quality control. **RESPONSABLES** : **Laurence MEJANELLE,** LECOB (Banyuls), SU **François LANTOINE,** LECOB (Banyuls), SU **AUTRES INTERVENANTS :** **Pascal CONAN,** LOMIC (Banyuls), SU **Fabien JOUX,** LOMIC (Banyuls), SU **Franck LARTAUD,** LECOB (Banyuls), SU **Nadine LE BRIS,** LECOB (Banyuls), SU **Audrey PRUSKI,** LECOB (Banyuls), SU **David PECQUEUR,** FR 3724 BioPIC (banyuls), SU/CNRS

FORMAT DE L'UE

MODALITES D'ENSEIGNEMENT.

About 19h of classes including presentation of the methods to be applied during tutorial labs, about 30h of practical tutorials in subgroups of 4 to 6 students, 2h of sampling at sea.

Students are required to be present on site.

MODALITÉS D'ÉVALUATION.

Students are grouped by 2 to 4 (according to their number) and do an oral presentation on a group of variables of the experiment; they are evaluated on the presentation of the method, the results and on discussing the results. The jury is composed by 3 students, and the maximum grade is 60%.

A written exam (3 hours) is graded on 40%. It has more or less 4 questions, on the analytical methods used for NH_4^+, for chlorophyll a, for hydrocarbons, on the calibration of microelectrodes for O2 profile,….

RESUME DE L'UE

The course is the first part of a 3 courses package, and sets the ground for addressing marine biodiversity (Concepts and Practices in Biological Oceanography and Marine Ecology -Part 2) and ecological relationships (Concepts and Practices in Biological Oceanography and Marine Ecology -Part 3).

The course provides a methodological approach to biological and geochemical characteristics of the coastal environment. It is designed to give keys to practice good quantification, to be able to question quantification significance (limits of detection, repeatability, blanks and human errors).

To achieve this goal, various bulk parameters and trace concentrations of pollutants will be measured in 2 contrasted coastal benthic habitats. Bulk parameters characterizing the pelagic environment are addressed in a learning experience in microcosms designed by students themselves to test how nutrients shape phytoplankton productivity and community.

OBJECTIFS D'APPRENTISSAGE

Students will be able
- to select adequate parameters for marine environment surveys targeting water or benthic environments, with concerns on productivity, eutrophication and pollution.
- to design experiments or observations that test hypotheses.

- to set-up an analytical strategy following a described analytical method.
- to dilute a stock solution into several working solution for building a calibration curve.
- to calculate concentration using external and internal calibration with or without response factors, with or without blank correction
- to report results and basic quality controls of the data (reproducibility of replicates), to present them in a scientific manner (powerpoint support and oral presentation) and discuss them (comparison to initial hypothesis, comparison of various conditions to a control).

PREREQUIS

Basic (highschool) knowledge on biology (definition of eukaryotes, prokaryotes, autotrophy/heterotrophy) . Basic knowledge on photosynthesis (chemical reaction), cycle of nitrogen (uptake of nitrate and amonium by primary producers, recycling by heterotrophs).

BIBLIOGRAPHIE / SITOGRAPHIE

FONCTIONNEMENT DE L'UE

The class is based on **intensive laboratory work** and mentoring to carry out an experiment and analyze the samples.

A. Mentoring is provided to the students while **they design an experimental approach** to show the links between primary productivity and nutrients and between primary productivity and pollutants (François Lantoine). The experiment is carried out during the first week of the course. The 18 samples issuing from the experiment are used to illustrate various analytical techniques used in oceanography to characterize environmental status : nutrients, chlorophyll, bacterial activity, flow cytometry.

Field trip Seawater is collected at SOLA (Francois Lantoine) and sampling techniques (CTD, Niskin bottle) are presented.

Laboratory The samples are split in 1L volumes by the students to perform in situ experiments in bottles (François Lantoine). The students amend the samples with various nutrients and/or pollutants in concentrations decided during the mentoring design. They set the bottle into seawater again for one week. At the end of the week, they recover the bottles and they carry the filtrations and the sampling necessary for the analysis to come. The results of the experiments will be evaluated in an oral presentation.

B. During the class on primary productivity and nutrients, P. Conan presents nutrient spatial variability, concentration ranges typical of the Mediterranean Sea, and seasonal variability, in relationship to productivity.

C. A **class** on phytoplanktonic pigments (François Lantoine).presents how chlorophyll a concentration supplies information on the abundance of phytoplankton, one of the key indices in monitoring the health of any natural systems. Natural ranges of chlorophyll concentration in coastal waters are presented to help understanding typical values of oligotrophic environments up to eutrophic ones. Temporal variation is also

discussed. Analytical aspects of the measurements of chl a by fluorimetry (influences of accessory pigments and of degrdatain pigments) are presented.

Practical lab work (François Lantoine).

- Calibration of the Turner spectrometer. The students learn how to calculate dilution factors, and how to make the proper dilutions using the available volumetric tools.

- extraction with acetone. The students extract the filters they got by filtering seawater (from SOLA) and by filtering the water of their experiments. Then they analyse the cholrophyl of the extracts. They dilute the sample if necessary.

Tutorial class (François Lantoine)., the students calculate the chlorophyll a concentration in mg/L. They correct the raw results from dilution factors, and by filtered volume.

D. A **class** presents various techniques to measure bacterial activity, respiration, exoenzymatic activity (Fabien Joux)

Practical lab work (Fabien Joux).

- four types of exoenzymatic activity are measured by the students (hydrolysis of proteins, cellulose, hemicellulose) in a samples from SOLA and in the samples of their experiments

E. The technique of flow cytometry to quantify different groups of microorganism and different groups of microeukaryotes is presented by a class and the visit of the flow cytometry platform (David Pecqueur).The analytical platform BioPic analyses the samples of the students, and send them the raw results.

F. During a **class** on the geological setting of the area, the geological history of the Gulf of Lion will be presented. The land sources and rock formation history are mirrored by the submarine landscapes (Franck Lartaud).
A **field trip** will illustrate this class where students will recognize the mineral phases both inland and on the beach sediments. The structure of Mediterranean lagoons, their connection to the sea through openings in the Lido will also be observed.

G. A **class** (Audrey Pruski) presents the characterization of sedimentary habitats by bulk charactristics of the sediments, like granulometry, porosity and organic matter content. The classification of sediment types using these parameters is discussed and technical aspect of laser diffusion granulometry is presented.

Practical work (Audrey Pruski)

- The students measure the granulometry profile of 4 slices of sediments from contrasted coastal zones (Sites MESO and SOLA) using laser granulometry. They measure the abundance of each size class in triplicate, they export the rsuslt to excel.
- Tutorial work. The results obtained during the practical measurement session are used to calculate the abundance of 5 size fractions typically used to classify the sediment type (from < 4 μm to 500-1000 μm).

H. A **class** (Nadine e Bris) presents the characterization of sedimentary habitats by the oxygen availability, environmental risks associated to reduced oxygenation in coastal and lagoon ecosystems.

Practical work (Nadine Le Bris)

- The students measure the O2 and HS- concentration in interstitial water of a core from MESO by microelectrodes.

I. **Class** on the analysis of selected characteristics of the marine environment (Laurence Méjanelle)

-the regulations related to pollutants in the EU conventions, protocols, WD and MSFD).
-3 analytical strategies (to be applied during tutorial labs):
- direct measurements of sedimentary bulk characteristic (porosity and organic matter) by weighting after freeze drying, and combustion.
- fluorescence detection ammonium after fluorescent reactive addition, optimization of the reaction time, correction for matrix effects, use of a linear calibration curve.
- trace analysis of polycyclic aromatic hydrocarbons. Several analytical steps required: extraction, clean-up by adsorption chromatography (theory of relative affinity with mobile phase and sorbent), calibration curve for multiple components using response factor, quality controls (recovery using PAH surrogates). Presentation of gas chromatography and mass spectrometry detection. Explanation of Single Ion Mode to enhance detection level.

Practical work (Laurence Méjanelle)

- The students measure [NH4+} in seawater collected at SOLA, in the 18 samples of the experiment and in 2 calibration curves. The working solutions for the calibration curves and the reagent are previously made by LM. The students add the reagents, control the reaction, make the fluorescence readings and calculate the concentrations,
- Measurement of porosity and organic matter content in sediment horizons of 2 cores sampled in the coastal environment (Sites MESO and SOLA). The students do all the weightings, subsampling to transfer sediment to boat in triplicate, burning, re-weighting and final calculation to get the porosity in % of sediment volume and the OC in % of sediment mass.
-Measurement of hydrocarbons (PAHs) in 2 sediment slices (surficial MESO and surficial SOLA). Extraction by sonication, clean-up on a dual column of silica-alumina – volume reduction- GC-MS quantification (the calibration curve and the blanks are measured beforehand by LM).The students make the peak identification, peak integration and weight calculations with the MS quantification programme, and they calculate the hydrocarbon concentration in ng/g of dry sediment.