UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Paleoclimatology and Paleoceanography

2627-2-F7402Q028

Aims

Provide knowledge of climate variations and climate forcing factors at different timescales through the analysis of proxies from different archives and the understanding of the main oceanographic processes in the present and in the past.

D1 – Knowledge and understanding:
During lectures, students will learn about the different palaeoclimatic archives and the proxies used for the reconstruction of palaeoclimatic and paleoceanographic variations. They will learn the timescales of climate variability and the palaeoclimatic and paleoceanographic history of the Earth, from its origins to the present day.

D2 – Applying knowledge and understanding:
During interactive lectures, students will be able to develop and use quantitative indicators to analyse climatic and environmental changes that have affected marine ecosystems over the last decades, centuries, millennia, and on million-year timescales, contributing to the prediction of future scenarios. During laboratory activities, students will apply the acquired knowledge to the analysis of a case study (Eastern Mediterranean anoxic events) in order to independently perform a paleoceanographic reconstruction under the guidance of the lecturer. During field excursions, students will carry out field observations and relate them to the paleoceanographic processes learned during the course.

D3 – Making judgements:
During interactive lectures, students will learn how to critically evaluate the approaches described in the analysed scientific papers and compare different interpretations. During laboratory activities, students will interact with each other to discuss the provided data and interpret them independently. For the preparation of the final laboratory presentation, students will work in groups and will evaluate the most relevant information to be presented, synthesising and integrating the interpretations obtained. During the preparation of the laboratory report, students will improve their critical thinking skills in providing an interpretation of the analysed data. During field excursions, students will critically evaluate case studies and learn how to reconstruct processes independently. For the preparation of the fieldwork report, students will be able to independently elaborate observations and integrate them into an interpretation of the processes analysed.

D4 – Communication skills:
During interactive lectures, students will be able to collaborate within working groups, contributing to the discussion of the analysed scientific papers and to the exchange of ideas with other students and the lecturer, using appropriate scientific terminology. During the laboratory activities, students will learn how to discus the data using an appropriate terminology; at the end of the laboratory activities, they will be able to present the analysed data and the interpretations obtained as a group, discussing them clearly and effectively; they will also be able to summarise the identified paleoceanographic processes in an individual written report. During field excursions, students will learn how to clearly present their observations and interact with other students; during the preparation of the report of the field-work, they will be able to decribe the observations and synthesize the case-studies.

D5 – Learning skills:
Students will develop their learning skills throughout all phases of the course and will be able to independently expand their knowledge through research and critical reading of scientific papers related to the topics covered.

Contents

Bases of Paleoclimatology and Paleoceanography: climate system, chronology, proxies.
Climatic variability and climate variations: timescales of changes. Paleoclimaticand paleoceanographic variations reconstructed through proxy data at different time scales. The paleoclimatic and paleoceanographic history of the Earth, from its origins to the present day. Variations of CO2 concentration through the Earth's history.

Detailed program

Lectures
The climate system, time scales of change (climatic variability vs. variation) and forcing factors.
Paleoclimatic proxies: examples and applications in the marine, ice and terrestrial record.
Paleoclimatic evolution in the geological past: early Earth climate states and climate evolution; greenhouse and icehouse states; the Cenozoic mid-house; climate variations and Milankovitch cycles; millennial, centennial and decadal-scale variability in the recent past.
Paleoceanographic applications; climate and sea level; paleocirculation and paleoproductivity

Practical classes
Case study: eastern Mediterranean sapropels. Description and analysis of a sediment core in the lab; sample analysis under the microscope; processing and interpretation of paleoclimatic and paleoceanographic data; analysis and discussion of literature data; final interpretation.

Field work
Two day excursion on the following paleoceanographic themes: a) the Messinian salinity crisis as preserved in the Appennines; b) the oceanic anoxic events in marine sedimentary successions.

Prerequisites

Course of Safety on the Field

Teaching form

All classes will be taught in English

- 14 two-hour Lectures in person (4 ETCS, 28 hours), all as Delivered Didactics but with a final phase as Interactive Teaching (8 hours). DD: 21 hours; IT: 7 hours
- 4 three-hour Practical classes, in person, Interactive Teaching (1 ETCS, 12 hours)
- 1 twelve-hour Field activity, in person, Interactive Teaching (1 ETCS, 12 hours)

Textbook and teaching resource

Bradley - Quaternary Paleoclimatology

Slides provided by the teacher through the e-learning page

Semester

First semester

Assessment method

The assessment of students' achievement will be **based on**:

- Group oral presentation at the end of the practical activities, aimed at evaluating: the acquired skills, the ability to select the most relevant information to present for the case study, the ability to work in a group, and the ability to communicate information using appropriate scientific terminology.
- Individual written report on the activities carried out during the practical sessions concerning the analysis of a case study. The assessment will focus on the knowledge acquired, the ability to analyse data, and the ability to interpret, summarise, and communicate the results of the case study in written form. The report must be submitted at least 3 days before the oral examination.
- Individual written report on the activities carried out during the field excursion, aimed at evaluating the understanding and mastery of the topic, the ability to synthesise information, the ability to integrate different sources of information, and the ability to independently reflect on the topics addressed. The report must be submitted at least 3 days before the oral examination.
- Oral examination at the end of the course: three open-ended questions related to the topics covered during the course, including:
  a) one question on a proxy selected by the student;
  b) one question aimed at assessing knowledge of proxies, mechanisms, and timescales of climate changes;
  c) one question concerning changes that occurred over a specific time interval among those presented during lectures and in the slides; students will be asked to approximately draw the related graph.

During the oral examination, the assessment will focus on the knowledge of the relevant information addressed during the course, the ability to link information obtained from different archives, and the ability to clearly present

the topics using appropriate scientific terminology.

Final assessment:
Group oral presentation and report on practical activities (15%) + fieldwork report (15%) + oral examination (70%).

The final grade is expressed on a 30-point scale and will be based **on the following criteria**:

D1 – Knowledge and understanding
D2 – Applying knowledge and understanding
D3 – Making judgements
D4 – Communication skills
D5 – Learning skills

Assessment below 18/30
D1: The student demonstrates fragmented theoretical knowledge.
D2: The student is unable to integrate knowledge into a complete analysis of case studies.
D3: The student processes information inaccurately and incompletely and is unable to critically elaborate on the concepts.
D4: During the presentation and/or oral examination, the student does not use appropriate scientific terminology and communicates in an unclear and ineffective way.
D5: The student does not demonstrate awareness of their learning process and is unable to identify the essential connections among the topics addressed.

Assessment 18–22/30
D1: The student demonstrates fairly complete theoretical knowledge, although with some inaccuracies.
D2: The student integrates knowledge into the analysis of case studies, but in an incomplete way.
D3: The student is able to discuss concepts critically at a basic level, with some inaccuracies.
D4: During the presentation and/or oral examination, the student uses appropriate scientific terminology, although with some inaccuracies, and communicates in a reasonably clear way.
D5: The student demonstrates a basic awareness of their learning process and is able to identify some essential connections among the topics addressed.

Assessment 23–27/30
D1: The student demonstrates complete and in-depth theoretical knowledge.
D2: The student satisfactorily integrates knowledge into the analysis of case studies.
D3: The student is able to critically and coherently discuss concepts, showing good ability to elaborate information.
D4: During the presentation and/or oral examination, the student demonstrates good command of scientific terminology and communicates clearly and effectively.
D5: The student demonstrates good awareness of their learning process and is able to highlight the connections among the different cases analysed.

Assessment 28–30/30
D1: The student demonstrates complete, in-depth, and rigorous theoretical knowledge.
D2: The student demonstrates an advanced ability to integrate knowledge for the analysis of case studies and the interpretation of the analysed data.
D3: The student is able to critically and coherently discuss concepts, elaborating information in a solid and articulated way, with a well-structured logical approach.
D4: During the presentation and/or oral examination, the student demonstrates excellent command of scientific terminology and communicates clearly and effectively.
D5: The student demonstrates advanced awareness of their learning process and is able to connect the different cases analysed in an effective, coherent, and rigorous way.

Office hours

Upon appointment by e-mail: elisa.malinverno@unimib.it

Sustainable Development Goals

QUALITY EDUCATION | CLIMATE ACTION | LIFE BELOW WATER