UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Scienze della Terra e del Mare
ACADEMIC YEAR	2022/2023
MASTER'S DEGREE (MSC)	GEORISK AND GEORESOURCES
SUBJECT	CLIMATE CHANGE
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	21015-Attività formative affini o integrative
CODE	22590
SCIENTIFIC SECTOR(S)	GEO/01
HEAD PROFESSOR(S)	INCARBONA ALESSANDRO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	94
COURSE ACTIVITY (Hrs)	56
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**INCARBONA ALESSANDRO** Tuesday 14:00 15:00 studio docente

DOCENTE: Prof. ALESSANDRO INCARBONA

PREREQUISITES	Not mandatory
LEARNING OUTCOMES	1)Knowledge and comprehension Paleontology, geochemistry, geophysical methodologies, on which climate change reconstructions are based on. The knowledge of mechanisms and forcings that drive climate change and that impact ecosystems. Case studies for Mediterranean Sea and Oceans . 2)Applying knowledge Interpretation of paleontological, geochemical and geophysical data used for climate change reconstructions. 3)Autonomy of judgment Comparison of different datasets for climate change reconstructions. 4)Communication skills Adoption of an appropriate language and comment on climate change events. 5)Learning ability Understanding of specialistic literature.
ASSESSMENT METHODS	The examination will include: 1) The discussion of a scientific paper on climate change issues, with a special focus on methodologies. 2) Two questions on paleoceanographic and paleoclimatic topics, to evaluate the adoption of a appropriate language and the interplay among issues.
EDUCATIONAL OBJECTIVES	Understanding of methodologies, results and conclusion of scientific papers on climate change issues. Understanding of needed geochemical, geophysical and micropaleontological analysis for climate change research.
TEACHING METHODS	Lectures and laboratory with paleoceanographic and paleoclimatic parameter calculations.
SUGGESTED BIBLIOGRAPHY	•Ruddimann, W.F., 2001. Earth's Climate — Past and Future, W.H. Freeman and Company, New York, USA, 1-465. Tutte le edizioni, ISBN:9781429255257 •Hillaire-Marcel, C., De Vernal, A., 2007. Proxies in Late Cenozoic Paleoceanography, Elsevier, Amsterdam, 1-843. Tutte le edizioni, ISBN: 9780444527554

SYLLABUS

Hrs	Frontal teaching
4	Introduction to Climate evolution. The Snowball Earth Theory. Paleocene/Eocene Thermal Maximum. The Middle Pleistocene Transition.
4	Methodology. Oxygen and carbon stable isotopes.
4	Paleothermometers. Alkenones. Mg/Ca. SST reconstructions by planktonic foraminifera.
2	Paleoproductivity estimates by coccoliths and Ba/Al. Physical properties and elemental proxies.
4	The Mediterranean thermohaline circulation.Surface circulation and meso-scale gyres. intermediate and deep-water formation. Atmospheric patterns that affect the Mediterranean circulation. Distribution of nutrients. Seasonal variability in the water column.
6	Suborbital climatic fluctuations in the last glacial period in sedimentary records and ice cores. The Salt Oscillator theory and the see-saw effect. Suborbital climatic fluctuations in earlier glacials.
2	Productivity variations and sapropelic layers in the eastern Mediterranean Sea.
2	Introduction to Anthropocene, greenhouse effect and global warming. The radiative budget. Greenhouse gases. Antropogenic emission rate estimates. IPCC reports.
2	Greenhouse effect. CO2 and CH4 instrumental and ice core records. Natural variability before the Second industrial Revolution. CO2 record in the Pleistocene, Pliocene and Eocene.
4	Global Warming. Temperature estimates from instrumental and proxy data. The 2k window and the trend inversion. Temperatures in the Holocene and the new Mediterranean stack. Climate change events in the late Holocene: Little Ice Age and Medieval Warm Anomaly. Temporal and spatial coherence of Little Ice Age and Medieval Warm Anomaly.
4	Climate models. Prediction models. Predicted scenarios for sea-level fluctuations, climate extremes, desertification and hydroclimate, ocean acidification and Atlantic Meridional Overturning Circulation strength.
2	Global warming mitigation. Policy makers and COP21. Outreach and public opinion.

Hrs	Workshops
8	Search for climatic and paleoclimatic publicly available dataset. Understanding and selection of dataset for numerical exercises.
8	Climatic and Paleoceanographic data compilation. Graphical plot and analysis of Climatic and Paleoceanographic data.