ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

FRONTIERS
FUTURE EARTH, CLIMATE CHANGE AND SOCIAL CHALLENGES

Table of Contents

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1. Thematic Course A: The Earth System structure and dynamics

Total number of hours: 24
Type of Lectures: frontal
Lead: Pinardi
Lecturers: Pinardi (UNIBO), Di Sabatino (UNIBO), Spada (UNIBO), Navarra (UNIBO)

6 hours – The climate system---- Antonio Navarra (CMCC)
An overview on the atmospheric general circulation with a description of the main processes responsible for the forcing and variability of the climate on interannual and longer time-scales, including natural and anthropogenic factors that affect the main issues regarding climate change.
6 hours – The solid Earth – G. Spada (UNIBO)
The short course is organized into three parts. The first is an overview of the Solid Earth, with a discussion about its shape, structure, and internal dynamics. The second part is focussed on the interactions between the Solid Earth and the other components of the Earth System, with a discussion of the Sea Level problem form a Solid Earth standpoint. The third part shall deal with the geodetic variations induced by surface mass redistribution in response to climate change, also covering a few case studies.
6 hours – The atmosphere and hydrology – S. Di Sabatino (UNIBO)
Overview of the Earth System components and their role in the atmospheric circulation at meso and local scale. The hydrological cycle and its connection with meteorology and climate.
6 hours – Oceans and ice – N. Pinardi (UNIBO)
The short course is subdivided into three parts: the first is an overview of the recent progress in the observational and modelling global ocean infrastructure, ocean forecasting, the issue of limit of predictability and uncertainties. The second part concern an overview on what sea level is in the ocean and the latest assessment of sea level trends and the reasons for this. The third is a lecture on the energetics of the general circulation from the climatological scales to mesoscales.

Final Test:

The students should elaborate, in written form, answers to four different questions on the four parts of the Thematic A course.

2. Thematic Course B: Impacts, adaptation and vulnerability

Total number of hours: 24
Type of Lectures: frontal

Module 1: Climate impact on tangible cultural heritage and water resources (12 hr)

Instructors: Elisa Franzoni (4 hrs), Alessio Domeneghetti (4 hrs) and Serena Ceola (4 hrs) (UNIBO)

Climate changes include variations in rainfall, air relative humidity and temperature, soil moisture, flooding and extreme events, which may have a strong impact on the deterioration of materials in cultural heritage. The course will focus on water resources availability, flood risk for civil structures (including ancient constructions and monuments) as well as the physical-mechanical, chemical and biological deterioration processes connected to climate change and affecting the materials of historic buildings and artefacts.
In detail, the course will articulated along the following main topics:
- Climate change impact on water resources;
- Flood risk assessment for tangible cultural heritage and civil structures;
- Innovative materials for the conservation and restoration of tangible cultural heritage;
- Engineering strategies for climate change adaptation.

Module 2: Climate change mitigation and adaptation in Agriculture (12 hr)

Instructors: Giovanni Dinelli; Federico Magnani; Barbara Padalino; Marco Bovo (UNIBO)

-Plant production systems: Dinelli (3 hr) Resource management to enhance farming adaptive capacity and resilience to/from abiotic and biotic stresses. Precision management vs. agroecosystems for efficient use of renewable resources. Mitigation via growing/generating systems.

-Forests Production systems: Magnani (3 hr) Consequences of climate change on long lifespan forests: growth enhancement/dieback. Forests as C sinks, opportunities by adaptive forest management, as well as through afforestation and reduced tropical deforestation.

-Animal productions systems: Padalino (3 hr) 'One Health' and 'One Welfare': the impact of climate change on the principles of 'good feeding', 'good health', 'good housing' and 'good behaviour' in animal production. New housing solutions to ensure animals' well being. Solutions to improve intensive animal farming and reduce the adverse effects of climate change.

-Biosystems and mechanical engineering: Torreggiani (3 hr) biosystems engineering in rural, peri-urban areas. Knowledge frameworks and territorial and landscape plans, strategies related to the innovative design of farm, agroindustrial and livestock buildings and of green structures and infrastructures. The design of energy efficient and nearly zero-energy agricultural, agroindustrial,

and livestock buildings. Increased sustainability through alternative fuels (i.e. methane and battery) and autonomous vehicles.

Final Test:

The students should elaborate, in written form, answers to four different questions, two on the module 1 and two on module 2 of the Thematic Course B.

3. Thematic Course C: Technological innovations for a decarbonized society

Total number of hours: 24
Type of Lectures: frontal
Lead: Francesco Melino
Teachers: Francesco Melino, Nikolaos Dimitratos, Ernesto Salzano

Syllabus

2 hours – Introduction to energy sources – Francesco Melino
12 hours – Low CO2 industrial processes – Nikolaos Dimitratos
10 hours – New technological and industrial risks - Ernesto Salzano (2 hours) + Gianmaria Pio (8 hours)
- 5 hr Innovative fuels and technologies
- 5 hr Natural-technological interactions (NATECH)

Final Test:

The final test consists of one or more answers (in written form) for each module of the Thematic C course.

4. Thematic Course D: Socio-economic and legal studies for mitigation of climate change

Total number of hours: 24
Type of Lectures: frontal
Lead: Riccardo Prandini
Lecturers: Beatrice Bertarini, Marc Andrew Brightman, Mauro Buonocore, Annalisa Furia, Alessandra Landi, Paul Matthew Loveless, Matteo Mura, Mario Angelo Neve, Massimiliano Trentin, Anastasios Xepapadeas

Departments Contributions:
Department of Political and Social Sciences
Department of Sociology and Business Law
Department of Cultural Heritage
Department of Management
Department of Economics
The Euro-Mediterranean Center on Climate Change - CCMC

Contents

Module 1, Department of Political and Social Sciences, 6 hrs

1. Title: *Science and Communication*, by Mauro Buonocore (CMCC), 2 hrs
2. Title: *Public Opinion on Climate Change* by Paul Matthew Loveless, 2 hrs
3. Title: *Climate Change and International Studies: history, frameworks and politics*, by Massimiliano Trentin, 2 hrs

Module 2, Department of Sociology and Business Law, 4 hrs

1. Title: *Sociology and Climate Change: an overview* by Alessandra Landi, 2 hrs
2. Title: *Legal Dimensions of Climate Change*, by Beatrice Bertarini, 2 hrs

Module 3, Department of Economics: 4 hrs

1. Title: *The Economics of Climate Change*, by Anastasios Xepapadeas, 4 hrs

Module 4, Department of Management: 4 hrs

1. Title: *Business Sustainability*, by Matteo Mura, 4 hrs

Module 5, Department of Cultural Heritage: 6 hrs

1. Title: *Sustainability and Diversity: ontological challenges for collaboration*, by Marc Andrew Brightman, 2 hrs

2. Title: *Climate Change, Environment and Migration: politics at crossroads*, by Annalisa Furia, 2 hrs
3. Title: *Which Milieus Are We Talking About?*, by Mario Angelo Neve, 2 hrs

Student Assessment

The students should elaborate, in written form, a Literature Review concerning the topics of the Course. Maximum 5 pages.

Guidelines for Editing:
As for Nots and Bibliography, see, "Notes and Bibliography: Simple Citations", Chicago Manual of Style
1 page = 2500 signs, footnotes and everything else included. 12 points font; 1,5 space between the lines.

5. Thematic Course E: One Health

Total number of hours: 24
Type of Lectures: frontal
LEAD: Alessandra Scagliarini
Lecturers: Carla Cacciotto, Silvana Hrelia, Andrea Tarozzi, Alessandra Scagliarini, Piera Versura Marco Malaguti

Assessment: Final written report

Module intro: **From One medicine to One Health** (2hrs Scagliarini) -Humans and animals live and share the same ecosystems and share natural resources, the environment, food, air and water. Many of the major health challenges stem from the complex interactions between humans, animals and the ecosystems in which they live. This module will introduce the One medicine and One health concepts and discuss the importance of a multi and transdisciplinary approach to health.

Module 1- The importance of a healthy and sustainable Nutrition – 4hrs (Malaguti 2hrs - Hrelia 2 hrs) Sustainable healthy diet promotes all dimensions of individuals' health and well-being. The course will provide the knowledge of Food-based dietary guidelines to decrease risk factors for the global burden of chronic diseases and of the health enhancing compounds contained in many plant foods (nutraceuticals) in disease prevention.

Module 2 - **The complexity paradigms of sustainability and health** 2 hrs (Carla Cacciotto)- All the systems on our planet are connected and interacting with each other. Anthropocene is characterized by the inextricable interconnection of humans, pet animals, livestock and wildlife and their social and ecological environment requiring integrated approaches to health and their respective social and environmental contexts. The increase in human population and its ramifications of rapid urbanisation, intensified livestock production, encroachment of ecosystems and globalised trade lead to the so called global health challenges. The SDGs provide a key entry point for the OH approach to drive a paradigm shift in policy and practice towards a fully integrated approach to Health in social ecological systems.

Module 3 – Environment related diseases from the post infective era to the zoonosicene (4 hrs Scagliarini Carla Cacciotto) Humans and animals live and share the same ecosystems and share natural resources, the environment, food, air and water. Modern human activities fuelled by economic development is profoundly altering our relationship with microorganisms. This altered interaction with microbes is believed to be the major driving force behind the increased rate of emerging infectious diseases from animals the so called zoonoses. Cultural and industrial development has led to human being the most efficient predator, but has helped to disrupt the fragile balance between the micro-world and the macro-world. This has favored the creation of new ecological niches for viruses, bacteria and parasites and facilitated so-called spillovers. The module will particularly focus on the distal determinants of health acting through causal linkages and anthropogenic changes affecting landscape ecology and natural perturbation.

Module 4- **Exposed mucosa and epithelia as indicators for health hazard assessment in humans and animals** - Versura 4hrs The conjunctival, nasal and oral mucosa, skin and adnexa (hairs, nails, eyelashes) represent the first line of defense of the body, and are all tissues exposed to external environment. The course will provide the fundamental knowledge on innate immunity and to understand how these structures work and react to stressful events, including microbiome and pollution.

Module 5: Urbanization and Health - (Tarozzi 4 hrs Scagliarini 4 hrs) Sources of outdoor and indoor pollution and impact on human wellbeing and health will be presented and discussed, as well as sustainable relationships between environment (i.e. air, water, soil and food chain) and lifestyle in age and gender.The emerging health challenges linked to urbanisation and the drivers that enhanced the emergence of new diseases in humans will be discussed through case studies. Microbial communities can be transferred between both humans and animals through close contact. More urbanized and walled-in built environments have a greater content of human-associated microbes compared to more rural and open dwellings. It will be illustrated how introducing pets into a household may lead to significant changes in the house dust microbiome