



ALMA MATER STUDIORUM  
UNIVERSITA DI BOLOGNA

# FRONTIERS

FUTURE EARTH, CLIMATE CHANGE AND SOCIAL CHALLENGES

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

Total number of hours: 24

Type of Lectures: frontal

Lead: Oddo

Lecturers: Oddo (UNIBO), Di Sabatino (UNIBO), Spada (UNIBO), Athanasiadis (CMCC)

### 6 hours – The climate system ---- P. Athanasiadis CMCC)

An overview on the atmospheric general circulation with a description of the main processes determining Earth's mean climate and its variability on interannual and longer timescales, including natural and anthropogenic factors that affect climate variability and change.

### 6 hours – The Solid Earth – G. Spada (UNIBO)

The course is organized into three parts. The first is an overview of the Solid Earth, with a discussion of its shape, structure, and internal dynamics. The second part is focused on the interactions between the Solid Earth and the other components of the Earth System, with a discussion of the sea level change problem from the standpoint of the Solid Earth. The third part deals with the geodetic variations induced by surface mass redistribution, also discussing 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 – P. Oddo (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.**



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## 2. Thematic Course B: Impacts, adaptation and vulnerability

Total number of hours: 24

Type of Lectures: frontal

Lead: Bovo Marco

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

Lecturers: Elisa Franzoni (4 h), Alessio Domeneghetti (4 h) and Serena Ceola (4 h) (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 articulate 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 h)

Lecturers: Giovanni Dinelli (4h); Federico Magnani (2h); Barbara Padalino (4h); Marco Bovo (2h) (UNIBO)

-Plant production systems: Dinelli (4 h) 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 (2 h) 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 (4 h) 'One Health' and 'One Welfare': the impact of climate change on the principles of 'good feeding', 'good health', 'good housing' and 'good behavior' in animal production. New housing solutions to ensure animals' wellbeing. Solutions to improve intensive animal farming and reduce the adverse effects of climate change.

-Biosystems and mechanical engineering: Bovo (2 h) biosystems engineering in rural, peri- urban areas. Knowledge frameworks and territorial and landscape plans, strategies related to



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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.**



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## **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 CO<sub>2</sub> 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.**



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## 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: Marc Andrew Brightman, Emanuele Campiglio, Annalisa Furia, Alessandra Landi, Massimiliano Musi, Paul Matthew Loveless, Matteo Mura, Mario Angelo Neve, Massimiliano Trentin, Cimini Giulia

### Departments Contributions:

Department of Political and Social Sciences

Department of Sociology and Business Law

Department of Cultural Heritage

Department of Management

Department of Economics

### Contents

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

1. Title: *Public Opinion on Climate Change* by Paul Matthew Loveless, 2 hrs
2. Title: *Climate Change in International Relations*: by Giulia Cimini, 2 hrs
3. Title: *International Political Economy and the Global Governance of Climate Change*: by Eugenia Baroncelli, 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 Massimiliano Musi, 2 hrs

#### Module 3, Department of Economics: 4 hrs

1. Title: *The Sustainability of Economic Development*, by Emanuele Campiglio, 2 hrs
2. Title: *Social Tipping Interventions to Accelerate Climate Action*, by Alessandro Tavoni. 2hrs

#### 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



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2. Title: *Climate Change and Environment: from political ecology to ecofeminism*, by Annalisa Furia, 2 hrs
3. Title: *Landscapes' Memory*, by Mario Angelo Neve, 2 hrs

List of Readings: [Link Readings List](#)

Readings Folder: [Link Readings Folder](#)

## Student Assessment

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

Guidelines for Editing:

As for Notes 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.





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## 5. Thematic Course E: One Health

Total number of hours: 24 Type of  
Lectures: frontal LEAD: Alessandra  
Scagliarini

Lecturers: Alessandra Scagliarini (DIMEC), Piera Versura (DIMEC), Mariana Roccaro (QUVI)  
Viviana Cocchi (SDE), Marta Gibin (SDE).

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 complexity paradigms of sustainability and health (4 hrs Alessandra Scagliarini)**- 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. Case studies will be explored for interactive discussion

**Module 2 – Environment related diseases from the post infective era to the zoonosicene (4 hrs Alessandra Scagliarini)** 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. Case studies will be explored for interactive



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discussion.

**Module 3- Exposed mucosa and epithelia as indicators for health hazard assessment in humans and animals – (4hrs Piera Versura)** 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 4: Urbanization and Health - (2 hrs Alessandra Scagliarini)** 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. Microbial communities can be transferred between both humans and animals through close contact these concepts will be illustrated through case studies. Case studies will be explored for interactive discussion.

**Module 5 –The One Health inter and transdisciplinary approach- (4 hrs)**

**Seminar 1 The NGO perspective (2 hrs Viviana Cocchi)** – the seminar will illustrate some of the most successful community-based solutions in the Horn of Africa that apply the One Health approach to prevent and mitigate the effects of climate change on the health of people, their livestock and the environment in which they live. A demonstration of how the fusion of local knowledge and new technologies is necessary to protect global health.

**Seminar 2 The importance of sociology in the One Health approach – (2hrs Marta Gibin)** the seminar will illustrate the role of sociology in One Health and how social sciences can be applied to one health research.

**Module 6- Healthy and sustainable food systems– (4hrs Mariana Roccaro)**

A sustainable food system delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised. To realise the SDGs, the global food system needs to be reshaped to be more productive, more inclusive of poor and marginalized populations, environmentally sustainable and resilient, and able to deliver healthy and nutritious diets to all. These are complex and systemic challenges that require the combination of interconnected actions at the local, national, regional and global levels.

The module will focus on the concept of sustainability specifically applied to food systems and livestock farming, will present the EU policy aiming to make food systems fair, healthy and environmentally friendly and will explore the relationship between environmental impact, animal health and animal welfare. In the second part of the course the students will be asked to do a practical exercise on sustainable food solutions



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