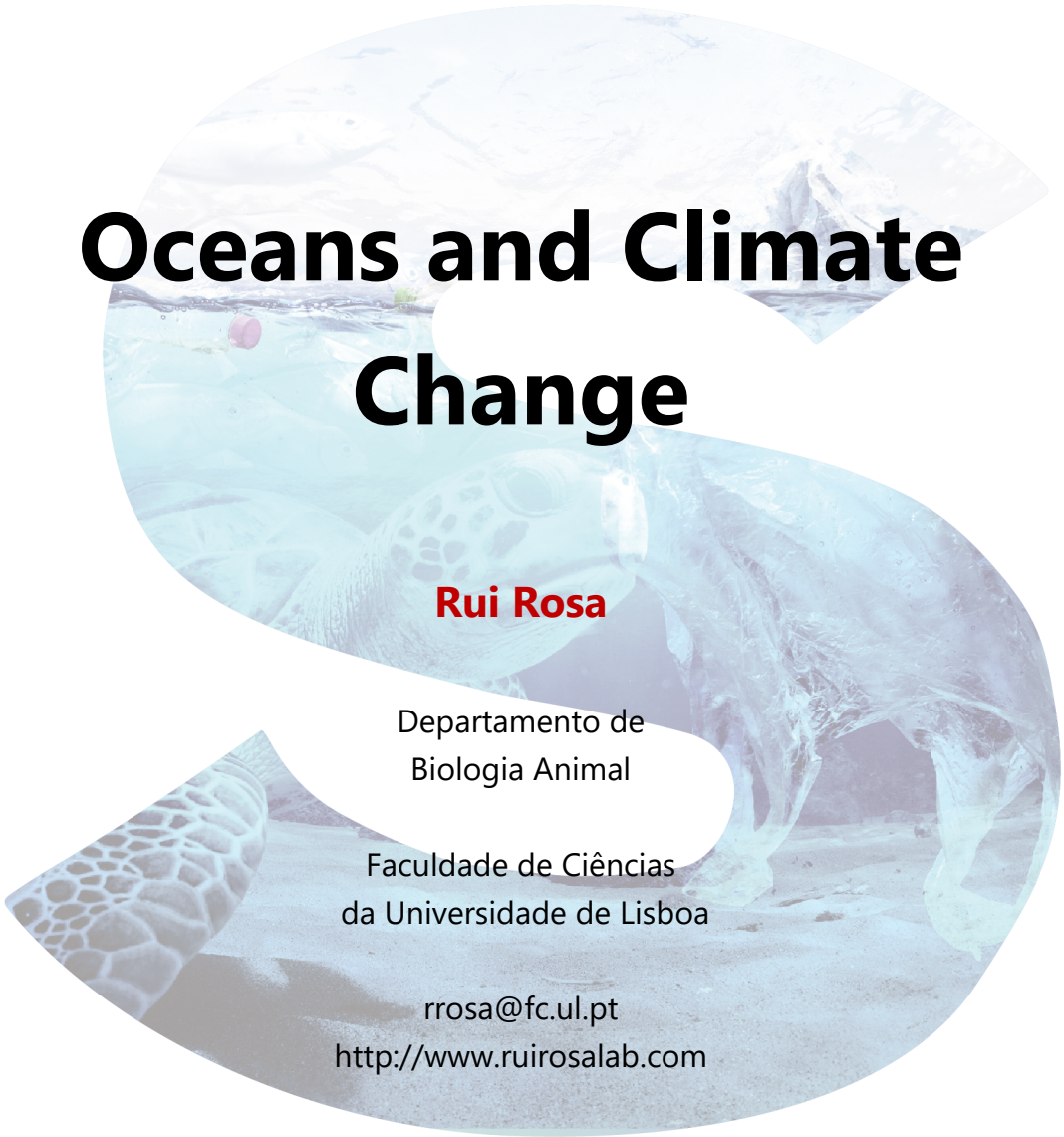
UNIVERSITY OF LISBON
INTERDISCIPLINARY STUDIES
ON SUSTAINABLE ENVIRONMENT AND SEAS



Oceans and Climate Change

Rui Rosa

Departamento de
Biologia Animal

Faculdade de Ciências
da Universidade de Lisboa

rrosa@fc.ul.pt
http://www.ruirosalab.com

unite! University Network for Innovation, Technology and Engineering

U LISBOA | UNIVERSIDADE DE LISBOA

Co-funded by the Erasmus+ Programme of the European Union

Oceans and Climate Change

Brief Introduction

Over the last millennia humankind has operated to harvest ocean resources but, in recent decades, technological breakthroughs have greatly accelerated our ability to extract marine resources and alter oceanic and neritic environments through: i) pollution (e.g., hydrocarbons, chemical and organic pollutants, nutrients, plastics), ii) habitat destruction, iii) bio-invasions, and iv) climate change, among other drivers of global change. As a result, marine fisheries have collapsed, and marine ecosystems have greatly changed in the past decades. The scale and rate of global change are unprecedented in human history, and mostly driven by increases in the concentration of greenhouse gases in the atmosphere.

The ocean plays a critical role in Earth's climate by storing and transferring large amounts of heat and carbon, and by exchanging them with the atmosphere. Circa 93% of the excess heat energy stored over the last 5 decades is found in the ocean and, presently, it is slowing down the rate of climate change by absorbing about 30% of human emissions of carbon dioxide (CO_2). The large inertia of the oceans allows them to naturally integrate over short-term variability and, at the same time, provide a clearer picture of longer-term change in comparison to other components of the climate system. Thus, present ocean monitoring is of paramount importance to track the evolution of climate change (e.g., ocean warming, acidification, and deoxygenation – also known as the "Deadly Trio") and makes a crucial standard for climate models.

Within this multidisciplinary and integrative context, the goal of the section "**Oceans and Climate Change**" is to provide to the students a brief analysis of the climate system (and the role of the oceans in Earth's climate), global circulation patterns, the carbon cycle, the biological and ecological aspects of climate change (namely related to the "Deadly Trio"), and the responses of the marine ecosystems to these anthropogenic changes.

Materials available for students

1. **POWERPOINT – "The climate system, circulation patterns and carbon cycle".** Includes the following movies:

   A. **"What is global circulation? | Part One | Differential heating"** (**slide 3**). See also in: **https://www.youtube.com/watch?v=7fd03fBRsuU**

   B. **"What is global circulation? | Part Two | The three cells"** (**slide 5**). See also in: https://www.youtube.com/watch?v=xqM83_og1Fc&t=2s

   C. **"What is global circulation? | Part Three | The Coriolis effect and winds"** (**slide 7**). See also in: https://www.youtube.com/watch?v=PDEcAxfSYaI&t=79s

   D. **"El Nino - What is it?"** (**slide 8**). See also in: **https://www.youtube.com/watch?v=WPA-KpldDVc&t=14s**

   E. **How do ocean currents work?** (**slide 11**). See also in: **https://www.youtube.com/watch?v=p4pWafuvdrY**

   F. **"What is the carbon cycle?"** (**slide 14**). See also in:

   https://www.youtube.com/watch?v=0-DtXqr-gPQ

   G. **"CO_2, ocean monitoring and climate modelling"** (**slide 15**). See also in: **https://www.youtube.com/watch?v=8r-oPRaUKLA**

2. **POWERPOINT – "Ocean warming".** Includes the following movies:

A. "Where's the Heat? (**slide 2**). See also in:

https://www.youtube.com/watch?v=lQK2iKn3YkA

B. "A Changing Ocean: Warm Pacific Temperatures Could Signal a Return of 'The Blob". slide 8). See also in: https://www.youtube.com/watch?v=t5ugEwvct3c

C. "Coral Bleaching Animation" (slide 10). See also in:

https://www.youtube.com/watch?v=_ZfGlKiSwwQ

D. Yes, we can save the world's coral reefs | Terry Hughes | TEDxJCUCairns (slide 11). See also in: https://www.youtube.com/watch?v=x5LshSZn5RA

3. **POWERPOINT – "Ocean acidification - "the other CO2 problem".** Includes the following movies:

   A. **"What Is Ocean Acidification?** (**slide 7**). See also in:

   https://www.youtube.com/watch?v=daUQg-WHDIM&t=4s

   B. **Acid Test (short documentary)** (**slide 8**). See also in:

   https://www.youtube.com/watch?v=5cqCvcX7buo

4. **POWERPOINT – "Ocean deoxygenation".** Includes the following movies:

   A. **"A Breathless Ocean"** (**slide 8**). See also in:

   https://www.youtube.com/watch?v=chp3rtJLJtk