

## PhD programme in Earth, Environmental and Resources Sciences

Instructor(s)	Nicola Scafetta, DiSTAR - UNINA
Course Title	Advanced Climatology and Climate Change
Total Number of Hours	12
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### Course Description

Advanced Climatology and Climate Change offers a rigorous exploration of the physical processes governing the climate system and the mechanisms driving contemporary and future climate change. The course integrates atmospheric dynamics, ocean-atmosphere interactions, radiative forcing, and feedbacks with advanced methods for detecting and attributing climate trends. Students engage with state-of-the-art datasets, reanalyses, and model outputs to evaluate variability across scales and assess uncertainties in projections.

### Course Contents

1. Climate System Dynamics – Foundations and Advanced Concepts: Core physical processes shaping the atmosphere–ocean system, including energy balance, large-scale circulation, and dominant modes of natural variability.
2. Radiative Forcing, Feedbacks, and Climate Sensitivity: Key drivers of climate change, with emphasis on greenhouse forcing, cloud and albedo feedbacks, and quantitative approaches to climate sensi.
3. Detection and Attribution of Climate Change: Methods to identify long-term climate signals and attribute observed changes to anthropogenic or natural causes using observations, reanalyses, and model ensembles.
4. Future Climate Scenarios, Risks, and Adaptation Frameworks: Evaluation of emission pathways, climate projections, and risk frameworks, linking physical changes to impacts and adaptation strategies relevant for research.

### Learning Outcomes

By the end of the course, doctoral students will be able to:

- Develop a deep understanding of climate system components and their coupling.
- Analyze observational and model-based evidence of climate change.



- Critically assess attribution studies, scenario design, and risk frameworks.
- Strengthen quantitative skills for interpreting climate diagnostics.

### **Teaching Format**

Lectures.

### **Essential Bibliography**

Nicola Scafetta, "The Frontier of Climate Science: Solar variability, natural cycles and model uncertainty", 2026. ISBN: 9791298617605.

### **Assessment Method**

Active participation.