Laurea Magistrale
Atmospheric Science and Technology (LMAST)

SUBJECT TITLE	Climate: Regional scale and Downscaling
TEACHER NAME(S)	Lorenzo Sangelantoni
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Teacher meeting	Wednesday, h. 15-16
Teacher office address	"Laboratorio di modellistica climatica ed idrologica" (ground floor Coppito1)
DISCIPLINE (SSD)	GEO/12 (Oceanography and Atmospheric Physics)
Semester (1-4)	2
Credits (CFU/ECTS)	6
Lecture hours (h)	60 (40 lectures + 20 exercise/laboratory)
Prerequisite and learning activity	Background in meteorology/climatology; basic training in statistics; knowledge in Linux shell scripting
Teaching language and method	English & Lectures, exercises and homeworks
Assessment method	Oral examination and optional dissertation on a selected course topic

OBJECTIVES

Main goals are:
- to introduce components and phenomena in the climate system;
- to describe elements of climate predictability at different temporal and spatial scales;
- to illustrate different regional-scale climate change patterns;
- to provide fundamentals of regional climate modeling;
- to describe the basics of dynamical and statistical downscaling approaches to define a regional climate information;
- to illustrate statistical methods to elaborate and analysing outputs of regional climate models.

OUTCOMES (Dublin descriptors: knowledge, understanding, explain, skill, ability)

After the successful completion of this module, the student should be able to:
- know the principles of climate change and variability;
- understand the different processes involved in determining different regional-scale responses to global warming;
- explain different approaches (dynamical and statistical) to refine climate predictions from the global to the regional scale;
- show skills for reading and understanding main scientific literature and texts on related topics;
- demonstrate the ability to process and to analyse large climatological datasets through the development of dedicated algorithms.

PROGRAM CONTENT

- **The climate system.** Components and phenomena in the climate system.
- **Modeling the climate system.** Model and Simulation Types, Global-scale Climate Models (GCMs). Dynamical core of General Circulation Model. Parameterizations. Performance of climate models.
- **The temporal dimension.** Providing climate information at different temporal scale from weather forecast to climate change projections.
- **Downscaling.** Approaches to increase spatial resolution of climate simulations for regional scale climate change applications.
- **Regional climate models.** Theoretical and technical principles on regional scale climate modeling.
- **Elements of statistical methods applied to atmospheric sciences.** Parametric and empirical distributions. Exploratory data analysis. Graphical summary techniques. Trend and signal analysis.
- **Laboratory.** Analysis of regional climate model projections over different European regions. Implementation of data analysis algorithms (Linux shell and MatLab scripting).

REFERENCES AND MATERIAL

- *Texts and slides provided by the teacher and available on the course web site.*
- *Wilks D.S., Statistical methods in the Atmospheric Sciences, Elsevier, 2006.*
- *Von Storch H. and Zwiers F.W., Statistical Analysis in Climate Research, Cambridge University Press, 1999.*
- *Neelin D.J., Climate change and climate modeling, Cambridge University Press, 2011.*
- *Wallace J.M. and P.V. Hobbs, Atmospheric Science, Second Edition, Academic Press, 2006.*