Laurea Magistrale
Atmospheric Science and Technology (LMAST)

SUBJECT TITLE	Atmospheric Dynamics. Module 1: Meteorological modelling
TEACHER NAME(S)	Rossella Ferretti
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Teacher meeting	
Teacher office address	Coppito 1 building, ground floor, room 40B, Via Vetoio, Coppito, 67100 L'Aquila
DISCIPLINE (SSD)	GEO/12
Semester (1-4)	3-4 (third-fourth) at Coppito, L'Aquila
Credits (CFU/ECTS)	6
Lecture hours (h)	56
Prerequisite and learning activity	Basic knowledge of general physics and mathematical analysis and a good background in atmospheric physics and dynamics are needed to follow the course.
Teaching language and method	English. Lectures, problems and tests to be solved during the lectures.
Assessment method	Final oral exam
SUBJECT WEBSITE	

OBJECTIVES

The meteorological modelling module illustrates the fundamentals of atmospheric motion as solution of fundamental equations of hydrodynamics and thermodynamics. The module provides the scientific basis for the understanding of the physical role of the atmospheric motion in determining the observed weather at all scales.

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

Here the list of topics and the expected results according the 5 parameters

- Acquiring knowledge and understanding on the equation of motion in terms of forces and frame of reference.
- Applying knowledge and understanding on characteristics and limitation of numerical weather prediction (NWP) for short, medium and long range forecasting.
- Making informed judgments and choices on the suitability of models approximations and on the applications of NWP.
- Communicating the results of their studies in the course with seminars
- Capacities to continue learning in this rapidly growing specific field (keep on track with the scientific literature

On successful completion of this module, the student should:

- have a deep knowledge of dynamical meteorology at global and regional scale
- have knowledge and understanding of mesoscale models and their applications
- have a deep knowledge of climate at global and regional scale

PROGRAM CONTENT

- LARGE SCALE CIRCULATION. Circulation and vorticity, the vorticity equation. Potential Vorticity. The vorticity equation, the barotropic potential Vorticity. The quasi geostrophic Vorticity equation
- BASIC WAVES IN THE ATMOSPHERE wave properties, sound wave, Shallow water waves, pure gravity waves, Inertial-gravity waves.
- MESOSCALE DYNAMICS Definition. Extratropical Cyclones, Fronts and surface weather. Orographic effects. Deep convection. Mesoscale wave generation mechanisms, mesoscale instabilities. Wave maintenance mechanisms: linear wave ducting mechanism, solitary wave, wave-CISK. Orographically forced flows, thermally forced flows: heat island circulation, sea and land breeze.
- NUMERICAL WEATHER PREDICTION grid system and vertical coordinates, boundary conditions. Initial Conditions and Data Assimilation. Parameterization of physical processes: planetary boundary layer parameterization, moist process parameterization, radiative transfer parameterization. Predictability, ensemble forecasting.

REFERENCES AND MATERIAL

- Markowski, P. and Y. Richardson, 2010: Mesoscale Meteorology in Midlatitudes, Wiley-Blackwell, ISBN: 978-0-470-74213-6 (67)
- Lin, Y.-L., 2007: Mesoscale Dynamics, Cambridge University Press, ISBN: 978-0-521-80875-0 (61)
- Kalnay E., "Atmospheric Modeling, Data Assimilation and Predictability", 2002.
- Holton, J.R., 2004: An Introduction to Dynamic Meteorology, Elsevier Academic Press, ISBN 0-12- 354015-1 (28)