Laurea Magistrale
Atmospheric Science and Technology (LMAST)

SUBJECT TITLE	
TEACHER NAME(S)	Marco Cacciani – Annalisa Di Bernardino
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Teacher phone	+39 06 49913522
Teacher meeting	Monday 10:00-12:00 and by appointment
Teacher office address	University Campus, Sapienza Università di Roma, Fermi Building, room 501
DISCIPLINE (SSD)	FIS06 Physics for Earth and Atmospheric Sciences
Semester (1-4)	2
Credits (CFU/ECTS)	6
Lecture hours (h)	60 (15 lectures, 45 laboratory)
Prerequisite and learning activity	fundamentals of classical physics
Teaching language and method	English
Assessment method	Laboratory report and final oral exam
SUBJECT WEBSITE	

OBJECTIVES

Main goals:

- to introduce to ground based remote sensing of atmosphere
- to introduce to atmospheric aerosol
- to train at to the use of the standard equipment of an atmospheric laboratory
- to build a simple LIDAR system for atmospheric aerosol measurements

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

After the successful completion of this module the student should be able to:

- know the principal characteristics of the atmospheric aerosol
- use the basic knowledge of optics and electronics to design a LIDAR system
- work in a team to set up and operate a simple LIDAR system
- retrieve the vertical distribution of atmospheric aerosol scattering from a LIDAR observation
- analyse SODAR observations and compare data to numerical outputs

PROGRAM CONTENT

REMOTE SENSING OBSERVATIONS. Process of remote sensing, applications, active and passive sensors. Remote sensing of wind and turbulence, retrieval of wind and turbulence profiles
AEROSOL MICROPHYSICS. Properties of atmospheric aerosol: composition, spatial distribution, size distribution. Dynamics of an aerosol particle: Stokes law, Brownian motion, gravitational sedimentation. Thermodynamics of aerosols: Kelvin and Koehler equations. Nucleation: homogeneous and heterogeneous, homomolecular and heteromolecular. Mass diffusion. Coagulation. Dry and wet deposition. Evolution of an aerosol population.
LIDAR SENSOR. Fundamental of Lidar technique. Single scattering LIDAR Equation. LIDAR setup: laser source, telescope, optical analyser, detectors, data acquisition. Analytical solution of the LIDAR Equation.
LABORATORY. Laboratory activity: Alignment of a telescope in Cassegrain configuration, evaluation of the noise of a photomultiplier, acquisition and analysis of a LIDAR profile, analysis of SODAR profiles and comparison with numerical simulations.

REFERENCES AND MATERIAL

- Slides provided by the teacher.
- J. H. Seinfeld and S. N. Pandis, Atmospheric Chemistry and Physics, 2006.
- V.A.Kovalev and W.E, Eichinger, Elastic Lidar, 2004
- C. Weitkamp, Lidar, 2005