Laurea Magistrale
Atmospheric Science and Technology (LMAST)

SUBJECT TITLE	
TEACHER NAME(S)	Domenico Cimini (6 CFU)
Teacher e-mail (s)	Domenico.cimini@imaa.cnr.it
Teacher phone	3311706062
Teacher meeting	Thursday, 15:00-16:00
Teacher office address	room 39, ground floor, Coppito 1, Via Vetoio, Coppito, L'Aquila
DISCIPLINE (SSD)	FIS/06 – GEO/12
Semester (1-4)	3, Coppito (AQ)
Credits (CFU/ECTS)	6
Lecture hours (h)	60 (45 lecturers + 15 exercise/laboratory)
Prerequisite and learning activity	Electromagnetics fundamentals, Elements of meteorology
Teaching language and method	English & Lectures, exercises and homeworks
Assessment method	Oral examination and critical discussion of the laboratory assignment results
SUBJECT WEBSITE	http://www.disim.univaq.it/didattica/content.php?corso=609&pid=86&did=0&lid=en

OBJECTIVES

Main goals are to:
- provide a general background on the remote sensing systems for Atmospheric sounding
- review wave-matter interactions and provide a background on Atmospheric radiative transfer
- explain a general approach to extract Atmospheric profile information from remote sensing observations
- review the most important applications of Atmospheric sounding (including meteorology and climate)
- illustrate and apply data processing techniques for Atmospheric sounding applications using state-of-the-science tools

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

On successful completion of this course, the student should:
- be able to describe the main principles and applications of Atmospheric sounding.
- know the main techniques and technologies exploited for Atmospheric sounding.
- understand the fundamental of forward and inverse methods for Atmospheric sounding.
- understand the data processing steps and product levels.
- manage data archives and processing techniques to extract Atmospheric sounding information.
- be able to conceive simple but independent solutions for Atmospheric sounding.

PROGRAM CONTENT

PRINCIPLES OF ATMOSPHERIC SOUNDING. Composition, thermodynamics, and vertical structure of the Atmosphere. Gas, aerosols, and hydrometeors. In situ measurements. Needs for Atmospheric sounding in weather prediction, climate studies, composition monitoring, Atmospheric process studies.
FORWARD AND INVERSE PROBLEMS IN ATMOSPHERIC SOUNDING. Fundamentals of electromagnetic radiation. Wave-matter interaction mechanisms. Radiative transfer theory. Emitting, absorbing, and scattering Atmosphere. Solution for ground-based and space-borne remote sensing platforms. Forward and inverse problems. Forward models. Inverse methods. Solutions for inverse problems. Estimation methods.
ATMOSPHERIC SOUNDING SENSORS. Earth observation system basics. Platforms and orbits. Microwave and infrared radiometers. Radio occultation and limb sounding. Review of main remote sensing platforms and Atmospheric sounders.
ATMOSPHERIC SOUNDING APPLICATIONS. Meteorology: data assimilation, verification of weather prediction, weather hazards. Climate studies: monitoring of essential climate variables, refinement of climate model parametrization. Composition monitoring: air pollution, green-house forcing. Atmospheric process studies: aerosol-cloud-precipitation interactions.
DATA PROCESSING. Handling real observations from ground-based and space-borne instruments. Big data portals. Levels of data processing. Quality control and data analysis. Design and development of simple retrieval algorithms (regression, optimal estimation).

REFERENCES AND MATERIAL

- Texts and slides provided by the teacher
- Elachi, van Zyl, *Introduction to physics and techniques of remote sensing*. Wiley (2nd Edition), 2006.
- Rodgers, *Inverse Methods for Atmospheric Sounding*, World Scientific, 2000.
- Solimini, *Understanding Earth Observation*. Springer, 2016.