Laurea Magistrale
Atmospheric Science and Technology (LMAST)

SUBJECT TITLE	Space Weather
TEACHER NAME(S)	Patrizia Francia (4 CFU), Massimo Vellante (2 CFU)
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Teacher meeting	
Teacher office address	DSFC – Coppito 1, L'Aquila
DISCIPLINE (SSD)	FIS/06
Semester (1-4)	4 (fourth), L'Aquila at DSFC
Credits (CFU/ECTS)	6
Lecture hours (h)	56
Prerequisite and learning activity	Physics, Algebra, basic concepts of the plasma state and magnetohydrodinamic approximation.
Teaching language and method	English. Lectures, seminars.
Assessment method	Oral exam
SUBJECT WEBSITE	

OBJECTIVES

Space weather is largely the result of solar activity, including sunspots, solar flares and solar wind and their interaction with the Earth's magnetic field.
This course is designed to provide the fundamentals of the Earth's magnetosphere structure and dynamics, in particular the main aspects of the solar wind-magnetospheric interaction, also introducing students to the recent scientific literature. At the end, the student should know magnetospheric theory and phenomenology and should be able to examine magnetic and plasma data and discuss current problems.

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

On successful completion of this module, the student should:
- acquire knowledge and understanding of the solar wind - magnetosphere/ionosphere interaction processes.
- apply knowledge and understanding of the course topics for the identification of the different magnetospheric phenomena and their sources.
- demonstrate capacity in the use of satellite data and geomagnetic measurements.
- demonstrate skills for reading and understand scientific literature and texts on related topics.

PROGRAM CONTENT

Solar wind geoeffective structures: solar wind, slow and fast streams, coronal mass ejections. Magnetosphere: Geomagnetic field, the dipole approximation, solar wind-geomagnetic field interaction, bow shock and magnetosheath, magnetopause, magnetospheric cavity, geomagnetic tail, boundary layers: cusps, entry layers (HLBL, LLBL), plasma mantle, plasma sheet, plasmasphere, ring current, radiation belts, tail current, field aligned currents. Motion of charged particles in the geomagnetic field: adiabatic invariants, magnetic trapping, mirror points, gradient and curvature drift. Magnetic reconnection: magnetic diffusion, Parker-Sweet model, Petschek model, Walen relations. Plasma convection in the magnetosphere: Axford-Hines and Dungey models, convection electric field, high latitude electrodynamics, polar cap convection, ionospheric convection. Ionosphere: general characteristics of the ionosphere, ionospheric radio sounding, ionospheric conductivities and currents. Magnetospheric dynamics: magnetic storms, partial ring current, Dessler-Parker-Sckopke relation, substorms, auroral electrojets, geomagnetic activity indices (Dst, AE, AL, AU, Kp). Space Weather: effects in the upper atmosphere at middle/low and high latitudes, thermospheric and ionospheric storms, particle precipitation, auroral phenomena, galactic cosmic rays, interstellar ions, anomalous cosmic rays.

REFERENCES AND MATERIAL

T.I. Gombosi, Physics of the Space Environment, Cambridge University Press (1998)
M.G. Kivelson and C.T. Russell, Introduction to Space Physics, Cambridge University Press (1992)
K. Scherer et al., Space Weather, Springer (2005)