France

Master's Program in Environmental Fluid Mechanics
2018-2019

Second year : « M2 Environmental Fluid Mechanics »

Each student should choose courses amounting to 30 ECTS.
Note that 6 ECTS already correspond to two mandatory courses.

LECTURES

Atmospheric Boundary Layer I : fundamentals

Duration: 24h, 3 ECTS
Lecturers: Dr. Jean-Martial Cohard, LTHE, Grenoble
Dr. Paolo Laj, LGGE, Grenoble
Summary : Physics of the Atmospheric Boundary Layer: role in the climate system, vertical structure and simple models. Microphysics of cloud formation and of aerosols. Impact of aerosols on air quality and climate.

Atmospheric Boundary Layer II : mountain meteorology and air quality

Duration: 24h, 3 ECTS
Lecturers: Dr. Eric Chaxel, engineer in air quality
Pr. Chantal Staquet, LEGI, Grenoble
Summary : The atmospheric boundary layer in complex terrain, for stable (wintertime) and unstable (summertime) conditions. Application to air quality from an operational view point.

Buoyancy driven flows and mixing

Duration: 24h, 3 ECTS
Lecturers: Dr. Achim Wirth, LEGI, Grenoble
Summary : Flows produced by density effects, plumes, convection, gravity currents. Formation of atmospheric and oceanic fronts. Entrainment processes and induced mixing.

Exchanges across air-water interface

Duration: 24h, 3 ECTS
Lecturers: Pr. Sergey Gulev, P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences
Summary : Why study exchanges across air-water interface. Common models of the scalar fluxes involved. The role of sea surface satellite measurements. Dissolved gas transfer across air / water interface.

Ocean dynamics*

Duration: 24h, 3 ECTS
Lecturers: Dr. Achim Wirth, LEGI, Grenoble
Summary: After a short introduction to the observations of the worlds oceans in the past and present, the forces acting on the ocean are discussed. We will then see how the forcing put the water masses of the ocean into motion. An important question is: how can the forcing, which acts on the surface of the ocean influence the motion in the deep ocean? This leads to a discussion of the two principal types of basin scale ocean circulation: the gyre and the overturning circulation. We then discuss small scale processes of the ocean dynamics including their importance on the large scale ocean circulation.

Renewable wind and marine energy *

Duration: 26h, 3 ECTS (14h lectures, 12h lab)
Lecturers: Dr. Thierry Maître, LEGI, Grenoble
Dr. Béatrice Janiaud, LEGI, Grenoble
Summary: This course aims at understanding marine and wind energy systems, from design to the computation of performance. It will also involve a review of marine energies. Three tutorials /labs will complement the course.

Sediment transport

Duration: 24h, 3 ECTS
Lecturers: Dr. Philippe Larroudé, LEGI, Grenoble
Dr. Philippe Frey, Cemagref, Grenoble
Summary : Scope of sediment transport processes (from steep mountain flow to coastal waters); models of flow / sediment coupling processes; transport processes of sediment mixtures (mud / sand mixtures, gravel beds). Focus on steep mountain flows and coastal waters.

Turbulence in fluids
(mandatory course)

Duration: 42h, 6 ECTS
Lecturer: Dr. Joël Sommeria, LEGI , Grenoble
Summary : Fundamentals of fluid mechanics, vector analysis and tensor analysis. General questions on turbulence, multi-scale statistical description. Models of turbulent transport and turbulent mixing. Influence of rotation and density stratification effects. Numerical modeling of turbulence: first and second-order closure models, Reynolds averaged equations.

Waves in fluids and applications*

Duration: 24h, 3 ECTS
Lecturers: Pr. Eric Barthelemy, LEGI, Grenoble (Surface gravity waves)
Pr. Chantal Staquet, LEGI, Grenoble (Internal gravity waves)
Summary: Introduction to surface and internal gravity waves in fluids. Nonlinear and dissipative effects and associated wave impact on the medium. Wave-current interaction. Examples in natural media (such as coastal waters).

TOOLS AND METHODS

Data assimilation*

Duration: 23h + 4h practical work, 3 ECTS
Main lecturer: Dr. Eric Blayo, Lab. Jean Kuntzman, Grenoble
Summary : This course provides an overview of the most popular data assimilation methods in geophysics, based on estimation theory and control theory. A 4h practical work on computers comes in support of the lectures.

Foreign language

(mandatory course)

Duration: 24h, 3 ECTS
Professor responsible for the English class : Mrs Margaret Jameson
Professor responsible for the French class : Mrs Anne-Marie Monceaux
Each student will be proposed to follow either an English class or a French class depending upon his/her level in English (< B2 or > B2, respectively).

Flow measurement science and technology

Duration: 20h + 8h practical work, 3 ECTS
Lecturers: Dr. David Hurther, LEGI, Grenoble
Dr. Laure Vignal, LEGI, Grenoble
Summary : -Context and objectives of flow measuring science
-Point-wise measuring probes (hot wire, hot film probes, Pitot tubes)
-Acoustical measuring systems (Acoustic Backscattering Systems, Ac. Doppler Profiler, Ac. Concentration and Velocity Profilers)
-Optical measuring systems (LDA, LDV, PIV, PTV, LIF, OBS)
The class ends with a 4h practical work to compare different measurement techniques on a test flow.

Numerical techniques and models*

Duration: 24h+personal project, 6 ECTS
Main lecturer: Dr. Emmanuel Cosme, LGGE, Grenoble
Summary : Introduction to numerical techniques used to simulate fluid dynamics (finite difference method, finite volume method, spectral element method, SPH method, etc.). This class is composed of a series of lectures, followed by individual projects where students study one method more thoroughly.

Signal and information processing in fluid mechanics*

Duration: 24h, 3 ECTS
Lecturers: Pr. Christophe Baudet, LEGI, Grenoble
Summary : Description of the main tools for data analysis : Correlation, image processing, signal transformation, correlation function, filtering.

***Joint course with another Master's program**