

#### SCIENCES, TECHNOLOGIES AND HEALTH

Master in Earth, planetary and environmental sciences

Sciences de la Terre et des planètes, environnement

0

ECTS 120 credits



Duration 2 years



Component UFR PhITEM (physique, ingénierie, terre, environnement, mécanique)



### Subprograms

**Target level** 

+5

**Baccalaureate** 

- > Geodynamics
- > Georesources
- > Georisks
- > Geophysics
- > Hydro-resources
- > Atmosphere-Climate-Continental landmass

# Presentation



The master in Earth, planetary and environmental sciences is a two-year course (for students having completed 3 years of higher education) that teaches high-level skills in the study of processes operating at all scales in the Earth-Environment system.

This master is co-accredited by the Université Grenoble Alpes and the National Polytechnic Institute of Grenoble.

The master is organised around eight programmes (two of which are formally identified as international programs). All the programs are defined over the two years of the master, and students choose a program when registering for the 1st year. Nevertheless, progressive specialisation is planned, with a foundation program for the specialisation, foundation modules for each major of the master 1st year (Solid earth ; Water-climate-environment) and most of the modules (UEs) common to several programs. It is therefore possible to change program right up to the end of the 1st year's master ; the final choice of program is made when entering the 2nd year.

The master in Earth, planetary and environmental sciences aims to train students in the modern tools of mechanical physics, chemistry and geology that enable a quantitative approach to be applied to Earth and environmental studies, whether regarding geodynamics, climate, natural hazards, soil and water pollution, geological and geophysical exploration, etc., and to draw on a very solid field knowledge when using these tools. A major challenge is to apply science and new technologies, in particular through the use of modelling, to society's current problems.





None of the programs specifically has a vocational or research goal ; the principle is rather to stress their objectives in terms of skills acquired. Nevertheless, the Geodynamics and Atmosphere-climate-continental landmass programs mainly prepare students for doctoral studies. The others are mixed programs (research, development and innovation) that help prepare students for the labour market after either five or eight years of higher education. The opportunities are:

- After five years (bac + 5) engineering jobs in large energy and mining companies ; consultants in geology, geophysics, environment ; local and regional authorities ; non-governmental organisations
- After eight years (bac + 8) teaching / research in stateowned scientific, technological, industrial or commercial establishments (EPST, EPIC) ; R&D in large energy and mining companies, environmental research centres, international and national organisations

**International education :** Internationally-oriented programmes, Education with formalized international partnerships, Double degrees, joint degrees, Erasmus Mundus

### International dimension

The master includes two international courses: Erasmus Mundus in Earthquake engineering and engineering seismology (MEEES) and the international course Hydrohasards for which an application for Erasmus Mundus label is in progress.

We actively welcome foreign students from all backgrounds, including from Asia, Africa and South America, partly through IRD research collaboration agreements (Peru, Indonesia) or through the Program. Master Grenoble China. We offer a part of the curriculum in English and adopt the policy of teaching in English in case of presence of non-French speakers among the students; we therefore ask for a good level (B2) of English at the entrance of the master.

We have multiple Erasmus + and transatlantic partnerships allowing us to offer semesters abroad to a growing number of students (on average 5 starters and 5 students hosted per year). We strongly support internships abroad and help our students find funding to do them.

# Organisation

## Knowledge check

In each case : written report + oral defence (public except in cases of confidentiality)

Abroad intership : In France or abroad

**Internship period :** master 1st year : june-july ; master 2nd year : february- june

# Admission

## Access conditions

- The 1st year is open to students who have obtained a national diploma equivalent to a bachelor degree (licence) in a field compatible with that of the master, or via a validation of their studies or experience
- Entry to the 2nd year may be selective. It is open to candidates who have completed the first year of a master in the field, subject to a review of their application

Public continuing education : You are in charge of continuing education :

• if you resume your studies after 2 years of interruption of studies

• or if you followed training under the continuous training regime one of the previous 2 years

• or if you are an employee, job seeker, self-employed

If you do not have the diploma required to integrate the training, you can undertake a 🗹 validation of personal and professional achievements (VAPP)

## Candidature / Application



You want to apply and sign up for a master ? Please be aware that the procedure differs depending on the diploma you want to take, the diploma you have already obtained and, for foreign students, your place of residence.Let us be your guide – simply follow this **C** link

## Target

- Students in initial training with a bachelor's degree in Earth sciences, Physics, or Mechanics
- Foreign students wishing to pursue their studies in Earth sciences and the Environment in France
- Students in continuing education wishing to improve in the field of Earth sciences and the environment

## Fees

Tuition fees 2019-2020 : 243 €

## Prerequisites

The master focuses on the tools to quantitatively address the Earth and environmental sciences (whatever the course), a good level in mathematics and physics is required. This is particularly true for the Geophysics course, which is primarily aimed at students with a degree in physics or mechanics.

## Recommended prerequisites

- For the Geodynamic and Georessources programs, a good level in Geology (including with field experiments) is highly recommended
- The teaching is given partly in English, a good level of English is required at the entrance of the master (preferably level B2). The B2 level in English is compulsory at the end of the master's degree to obtain the diploma. There is no integrated English course in the master, but English lessons. It is the responsibility of the students to reach the B2 level at least at the end of the master

# And after

## **Targeted trades**

- At the end of the master's degree (bac + 5) : engineering positions in the major energy and mining companies ; engineering offices in geology, geophysics, environment ; local and territorial authorities ; nongovernmental organizations

- After graduation (bac + 8): teaching-research in EPST, EPIC; research and development in major energy and mining companies, environmental research centers, international and national organizations

## Additional information

The course is supported by the research laboratories associated with the OSUG (C Grenoble Universe Sciences Observatory) and the following in particular :

- Institute of Earth Sciences ISTerre (Geodynamics, Georesources, Georisks, Geophysics, MEEES programs)
- Institute of Environmental Geosciences IGE (Atmosphere-Climate-Continental landmass and Hydroressources programs)

There are also close links with the other laboratories and teams of the OSUG. The OSUG@2020 excellence laboratory includes a training component and supports this course.

The training is very focused on field teaching ; up to 24 ECTS of field modules can be selected in some courses. The field is a fundamental aspect of a training in Earth sciences and the environment. The privileged location of Grenoble makes field training a strong "brand image" of the master. The Alps offer a very rich geological terrain, but also the possibility to study hydro-meteorology and cryosphere-atmosphere exchanges, as part of the OSUG Observation services.

This field practice is complemented by important digital teaching activities, carried out in the form of practical work or projects. We place a strong emphasis on the most modern tools for quantitative exploration of the Earth and its environment. Geophysical measurement





tools ('environmental monitoring') are supplemented by interpretation tools, such as numerical modeling, signal processing, remote sensing and seismic interpretation. The support of the OSUG @ 2020 Labex has been essential for setting up or renewing a large number of these tools.

Most of the "tools" (i.e., digital modeling, remote sensing / GIS) modules are organized as projects, so that students can apply these tools to a mini-problem in accordance with their choice of course and interests. Several disciplinary UEs are also partly in the form of a tutored project, where the students will work in a small group to solve a societal problem.

The 3 UEs are taught in English as well as at least 1 module of the year of master 1. Our policy is to present teaching in English in case of presence of non-French speakers in the student public, both in 1st year than in 2nd year.

# Useful info

## Contacts

#### **Program director**

Christophe Basile

#### Program director

Ghislain Picard Ghislain.Picard@univ-grenoble-alpes.fr

#### Program administration

Registrar's Office of the Master in Earth, planetary and environmental sciences phitem.master.stpe@univ-grenoble-alpes.fr

#### Program administration

Application Solution phitem.candidature.etudiant@univ-grenoble-alpes.fr

## Partner schools

National Polytechnic Institute of Grenoble - (G-INP)

C http://www.grenoble-inp.fr/masters/le-master-sciencesde-la-terre-et-de-l-environnement-343011.kjsp#pagepresentation

## Partner laboratories

Laboratory of Glaciology and Environmental Geophysics - LGGE

Institute of Earth Sciences - ISTerre https://www.isterre.fr

Laboratory of the Study of Transfers in Hydrology and Environment - LTHE

## Course location(s) - City

Grenoble

## Campus

Grenoble - University campus





# Program

## Geodynamics

### Solid earth portal 1st year

#### Semester 7

|  | Nature                | СМ | TD  | TP | Crédits   |
|--|-----------------------|----|-----|----|-----------|
| UE Numerical analysis project            | Teaching<br>Unit (UE) |    | 12h |    | 3 credits |
| UE Physics and chemistry of the earth    | Teaching<br>Unit (UE) |    |     |    | 6 credits |
| UE Geomechanics                          | Teaching<br>Unit (UE) |    |     |    | 3 credits |
| UE Dynamics of the Lithosphere           | Teaching<br>Unit (UE) |    |     |    | 6 credits |
| UE Petrology                             | Teaching<br>Unit (UE) |    |     |    | 6 credits |
| UE Geochemical evolution of the earth    | Teaching<br>Unit (UE) |    |     |    | 6 credits |
| UE Data and models in earth sciences     | Teaching<br>Unit (UE) |    |     |    | 6 credits |
| UE Earth Surface Dynamics                | Teaching<br>Unit (UE) |    |     |    | 6 credits |
| UE Field workshop tectonics-metamorphism | Teaching<br>Unit (UE) |    |     |    | 3 credits |
| UE Field course Petrology                | Teaching<br>Unit (UE) |    |     |    | 3 credits |
| UE Intro workshop - professional project | Teaching<br>Unit (UE) |    | 6h  |    | 3 credits |

|  | Nature    | СМ | TD | TP | Crédits   |
|--|-----------|----|----|----|-----------|
| UE Scientific and professional communication | Teaching  |    |    |    | 3 credits |
|  | Unit (UE) |    |    |    |           |



| UE Remote sensing and GIS project   | Teaching<br>Unit (UE) | 24h | 24h | 6 credits |
|-------------------------------------|-----------------------|-----|-----|-----------|
| UE Exploration geophysics           | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Basin analysis                   | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Multidisciplinary field workshop | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Mineral resources                | Teaching<br>Unit (UE) |     |     | 3 credits |
| UE Subsurface modelling             | Teaching<br>Unit (UE) |     | 30h | 3 credits |
| UE Dynamics and volcanic risk       | Teaching<br>Unit (UE) |     |     | 3 credits |
| UE Sedimentary field workshop       | Teaching<br>Unit (UE) |     |     | 3 credits |
| UE Marine geophysical workshop      | Teaching<br>Unit (UE) |     |     | 3 credits |

|  | Nature                | СМ | TD | TP | Crédits   |
|--|-----------------------|----|----|----|-----------|
| UE Dynamics of the lithosphere                   | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Petrology                                     | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Tectonic field workshop-metamorphism          | Teaching<br>Unit (UE) |    |    |    | 3 credits |
| UE Petrology field workshop                      | Teaching<br>Unit (UE) |    |    |    | 3 credits |
| UE Active faults and remote sensing              | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Geochemical evolution of the Earth            | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Deep earth-surface coupling in mountain belts | Teaching<br>Unit (UE) |    |    |    | 3 credits |





| UE Planetology                              | Teaching<br>Unit (UE)    | 3 credits |
|---|--------------------------|-----------|
| UE International field school               | Teaching<br>Unit (UE)    | 6 credits |
| UE Dynamics of the Earth's surface          | Teaching<br>Unit (UE)    | 6 credits |
| UE Numerical modeling workshop              | Teaching 8h<br>Unit (UE) | 6 credits |
| UE Predoctoral school on the internal Earth | Teaching<br>Unit (UE)    | 6 credits |
| UE Predoc school / seminar 1                | Teaching<br>Unit (UE)    | 3 credits |
| UE Predoc school / seminar 2                | Teaching<br>Unit (UE)    | 3 credits |

#### Semester 10 - Research internship

|                     | Nature    | СМ | TD | TP | Crédits    |
|---------------------|-----------|----|----|----|------------|
| UE Short internship | Teaching  |    |    |    | 6 credits  |
|                     | Unit (UE) |    |    |    |            |
| UE Long internship  | Teaching  |    |    |    | 24 credits |
|                     | Unit (UE) |    |    |    |            |

### Semester 10 - Company internship

|                              | Nature CM TI | ) TP | Crédits    |
|------------------------------|--------------|------|------------|
| UE Short internship          | Teaching     |      | 6 credits  |
|                              | Unit (UE)    |      |            |
| UE Long corporate internship | Teaching     |      | 24 credits |
|                              | Unit (UE)    |      |            |

#### Georesources

Semester 7

#### Solid earth portal 1st year

# Nature CM TD TP Crédits





| UE Numerical analysis project                        | Teaching<br>Unit (UE) | 12h |     | 3 credits |
|--|-----------------------|-----|-----|-----------|
| UE Physics and chemistry of the earth                | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Geomechanics                                      | Teaching<br>Unit (UE) |     |     | 3 credits |
| UE Dynamics of the Lithosphere                       | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Petrology   | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Data and models in earth sciences                 | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Geophysical prospecting                           | Teaching<br>Unit (UE) |     | 15h | 6 credits |
| UE Geochemical and mineralogical exploration methods | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Field workshop tectonics-metamorphism             | Teaching<br>Unit (UE) |     |     | 3 credits |
| UE Field course Petrology                            | Teaching<br>Unit (UE) |     |     | 3 credits |
| UE Intro workshop - professional project             | Teaching<br>Unit (UE) | 6h  |     | 3 credits |
| UE Geochemistry of pollution                         | Teaching<br>Unit (UE) |     | 6h  | 3 credits |

|  | Nature                | СМ  | TD | TP  | Crédits   |
|--|-----------------------|-----|----|-----|-----------|
| UE Scientific and professional communication | Teaching<br>Unit (UE) |     |    |     | 3 credits |
| UE Remote sensing and GIS project            | Teaching<br>Unit (UE) | 24h |    | 24h | 6 credits |
| UE Mineral resources                         | Teaching<br>Unit (UE) |     |    |     | 3 credits |
| UE Exploration geophysics                    | Teaching<br>Unit (UE) |     |    |     | 6 credits |
| UE Basin analysis                            | Teaching<br>Unit (UE) |     |    |     | 6 credits |





| UE Multidisciplinary field workshop | Teaching<br>Unit (UE) |     | 6 credits |
|-------------------------------------|-----------------------|-----|-----------|
| UE Subsurface modelling             | Teaching<br>Unit (UE) | 30h | 3 credits |
| UE Sedimentary field workshop       | Teaching<br>Unit (UE) |     | 3 credits |
| UE Marine geophysical workshop      | Teaching<br>Unit (UE) |     | 3 credits |
| UE Induced seismicity               | Teaching<br>Unit (UE) |     | 3 credits |

|  | Nature                | CM | TD | TP | Crédits   |
|--|-----------------------|----|----|----|-----------|
| UE Field geology workshop                            | Teaching<br>Unit (UE) |    |    |    | 3 credits |
| UE Geomechanics in reservoir and basin systems       | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Dynamics of the lithosphere                       | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Petrology   | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Geochemical and mineralogical exploration methods | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Drilling and borehole geophysics                  | Teaching<br>Unit (UE) |    |    |    | 3 credits |
| UE Tectonic field workshop-metamorphism              | Teaching<br>Unit (UE) |    |    |    | 3 credits |
| UE Petrology field workshop                          | Teaching<br>Unit (UE) |    |    |    | 3 credits |
| UE Tutored project in mineral resources              | Teaching<br>Unit (UE) |    | 6h |    | 3 credits |
| UE Advanced mineral ressources                       | Teaching<br>Unit (UE) |    |    |    | 3 credits |
| UE Energy markets and geopolitics of resources       | Teaching<br>Unit (UE) |    |    |    | 3 credits |



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|-------------------------------------|-----------------------|------------|
| UE Transition énergétique           | Teaching<br>Unit (UE) | 3 credits  |
| Semestre 10                         | Nature CM TD          | TP Crédits |
| UE Research internship              | CHOICE                |            |
| UE Company internship               | CHOICE                |            |

## Georisks

## Solid earth portal 1st year

#### Semester 7

|  | Nature                | СМ | TD  | TP  | Crédits   |
|--|-----------------------|----|-----|-----|-----------|
| UE Data and models in earth sciences       | Teaching<br>Unit (UE) |    |     |     | 6 credits |
| UE Geophysical prospecting                 | Teaching<br>Unit (UE) |    |     | 15h | 6 credits |
| UE Numerical analysis project              | Teaching<br>Unit (UE) |    | 12h |     | 3 credits |
| UE Physics and chemistry of the earth      | Teaching<br>Unit (UE) |    |     |     | 6 credits |
| UE Geomechanics                            | Teaching<br>Unit (UE) |    |     |     | 3 credits |
| UE Scientific & professional communication | Teaching<br>Unit (UE) |    |     |     | 3 credits |
| UE Intro workshop - professional project   | Teaching<br>Unit (UE) |    | 6h  |     | 3 credits |

|                                   | Nature    | CM  | TD | TP  | Crédits   |
|-----------------------------------|-----------|-----|----|-----|-----------|
| UE Instrumentation and metrology  | Teaching  |     |    |     | 6 credits |
|                                   | Unit (UE) |     |    |     |           |
| UE Remote sensing and GIS project | Teaching  | 24h |    | 24h | 6 credits |
|                                   | Unit (UE) |     |    |     |           |





| UE Movements of land, avalanches, protective works | SUBJECT 18h           |     | 3 credits |
|--|-----------------------|-----|-----------|
| UE Exploration geophysics                          | Teaching<br>Unit (UE) |     | 6 credits |
| UE Wave physics                                    | Teaching<br>Unit (UE) |     | 6 credits |
| UE Passive seismic site characterization           | Teaching<br>Unit (UE) |     | 3 credits |
| UE Dynamics and volcanic risk                      | Teaching<br>Unit (UE) |     | 3 credits |
| UE Induced seismicity                              | Teaching<br>Unit (UE) |     | 3 credits |
| UE Subsurface modelling                            | Teaching<br>Unit (UE) | 30h | 3 credits |

#### Semester 9

|   | Nature                | СМ  | TD | TP  | Crédits   |
|---|-----------------------|-----|----|-----|-----------|
| UE Quantitative seismology                                | Teaching<br>Unit (UE) |     |    |     | 6 credits |
| UE Engineering seismology                                 | Teaching<br>Unit (UE) |     |    |     | 6 credits |
| UE Active faults and remote sensing                       | Teaching<br>Unit (UE) |     |    |     | 6 credits |
| UE Dynamics of the Earth's surface                        | Teaching<br>Unit (UE) |     |    |     | 6 credits |
| UE Advanced gravitational risk                            | Teaching<br>Unit (UE) |     |    |     | 3 credits |
| UE Project on seismic hazard assessment                   | Teaching<br>Unit (UE) |     |    |     | 3 credits |
| UE Risk management: regulatory and alternative approaches | Teaching<br>Unit (UE) | 26h |    | 24h | 6 credits |
| UE Signal processing                                      | Teaching<br>Unit (UE) |     |    |     | 6 credits |
| UE Near surface geophysics                                | Teaching<br>Unit (UE) |     |    |     | 6 credits |

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|-------------------------------------|-----------------------|----|----|----|-----------|
| UE Numerical modeling workshop      | Teaching<br>Unit (UE) | 8h |    |    | 6 credits |
| Semester 10                         |                       |    |    |    |           |
|                                     | Nature                | СМ | TD | TP | Crédits   |
| UE Research internship              | CHOICE                |    |    |    |           |
| UE Company internship               | CHOICE                |    |    |    |           |

## Geophysics

### Solid earth portal 1st year

#### Semester 7

|  | Nature                | СМ | TD  | TP  | Crédits   |
|--|-----------------------|----|-----|-----|-----------|
| UE Numerical analysis project            | Teaching<br>Unit (UE) |    | 12h |     | 3 credits |
| UE Physics and chemistry of the earth    | Teaching<br>Unit (UE) |    |     |     | 6 credits |
| UE Geomechanics                          | Teaching<br>Unit (UE) |    |     |     | 3 credits |
| UE Data and models in earth sciences     | Teaching<br>Unit (UE) |    |     |     | 6 credits |
| UE Fluid mechanics                       | Teaching<br>Unit (UE) |    |     |     | 3 credits |
| UE Dynamics of the Lithosphere           | Teaching<br>Unit (UE) |    |     |     | 6 credits |
| UE Geophysical prospecting               | Teaching<br>Unit (UE) |    |     | 15h | 6 credits |
| UE Intro workshop - professional project | Teaching<br>Unit (UE) |    | 6h  |     | 3 credits |

|  | Nature    | СМ | TD | TP | Crédits   |
|--|-----------|----|----|----|-----------|
| UE Scientific and professional communication | Teaching  |    |    |    | 3 credits |
|  | Unit (UE) |    |    |    |           |





| UE Remote sensing and GIS project        | Teaching<br>Unit (UE) | 24h | 24h | 6 credits |
|--|-----------------------|-----|-----|-----------|
| UE Wave physics                          | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Exploration geophysics                | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Instrumentation and metrology         | Teaching<br>Unit (UE) |     |     | 6 credits |
| UE Marine geophysical workshop           | Teaching<br>Unit (UE) |     |     | 3 credits |
| UE Passive seismic site characterization | Teaching<br>Unit (UE) |     |     | 3 credits |
| UE Internal geodynamics                  | Teaching<br>Unit (UE) |     |     | 3 credits |
| UE Dynamics and volcanic risk            | Teaching<br>Unit (UE) |     |     | 3 credits |

|                                     | Nature                | СМ | TD | TP | Crédits   |
|-------------------------------------|-----------------------|----|----|----|-----------|
| UE Quantitative seismology          | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Signal processing                | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Frontiers in Earth physics       | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Dynamics of geophysical fluids   | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Active faults and remote sensing | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Numerical modeling workshop      | Teaching<br>Unit (UE) | 8h |    |    | 6 credits |
| UE Inverse methods and assimilation | Teaching<br>Unit (UE) |    |    |    | 6 credits |
| UE Near surface geophysics          | Teaching<br>Unit (UE) |    |    |    | 6 credits |



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|---|-----------------------|-----------|
| UE Predoctoral school on the internal Earth | Teaching<br>Unit (UE) | 6 credits |
| Semester 10                                 |                       |           |
|   | Nature CM TD TF       | P Crédits |
| UE Research internship                      | CHOICE                |           |
| UE Company internship                       | CHOICE                |           |

## Hydro-resources

## Atmosphere-Climate-Continental landmass

### Water, climate, environment portal 1st year

#### Semester 7

|   | Nature                | CM | TD | TP  | Crédits   |
|---|-----------------------|----|----|-----|-----------|
| UE Climate and environmental variability      | Teaching<br>Unit (UE) |    |    |     | 6 credits |
| UE Organic geochemistry: pollutants, modeling | Teaching<br>Unit (UE) |    |    | 18h | 6 credits |
| UE Scientific & professional communication    | Teaching<br>Unit (UE) |    |    |     | 3 credits |
| UE Hydrology and hydraulics                   | Teaching<br>Unit (UE) |    |    |     | 6 credits |
| UE Meteorology: 1D and synoptic               | Teaching<br>Unit (UE) |    |    |     | 3 credits |
| UE Fluid mechanics                            | Teaching<br>Unit (UE) |    |    |     | 3 credits |
| UE Intro workshop - professional project      | Teaching<br>Unit (UE) |    | 6h |     | 3 credits |

|                                   | Nature    | СМ  | TD | TP  | Crédits   |
|-----------------------------------|-----------|-----|----|-----|-----------|
| UE Remote sensing and GIS project | Teaching  | 24h |    | 24h | 6 credits |
|                                   | Unit (UE) |     |    |     |           |





| UE Pollution atmosphérique : principes et méthodes expérimentales | Teaching<br>Unit (UE) |     |     | 24h | 6 credits |
|---|-----------------------|-----|-----|-----|-----------|
| UE Lautaret field workshop: snow & atmosphere interface           | Teaching<br>Unit (UE) |     |     |     | 6 credits |
| UE Field workshop hydrology and hydrometeorology                  | Teaching<br>Unit (UE) |     |     |     | 6 credits |
| UE Instrumentation and metrology                                  | Teaching<br>Unit (UE) |     |     |     | 6 credits |
| UE Climate archives   | Teaching<br>Unit (UE) |     |     |     | 3 credits |
| UE Environmental flows  | Teaching<br>Unit (UE) | 15h | 12h | 3h  | 3 credits |

|  | Nature                | СМ  | TD | TP | Crédits   |
|--|-----------------------|-----|----|----|-----------|
| UE Models for the physico-chemistry of the atmosphere              | Teaching<br>Unit (UE) |     |    |    | 6 credits |
| UE Atmospheric boundary layer : from fundamentals to air quality 1 | Teaching<br>Unit (UE) | 24h |    |    | 3 credits |
| UE Atmospheric boundary layer : from fundamentals to air quality 2 | Teaching<br>Unit (UE) | 24h |    |    | 3 credits |
| UE Cryosphere  | Teaching<br>Unit (UE) |     |    |    | 6 credits |
| UE Climate and anthropogenic impact                                | Teaching<br>Unit (UE) |     |    |    | 6 credits |
| UE Hydrology of continental systems                                | Teaching<br>Unit (UE) |     |    |    | 6 credits |
| UE Dynamics of geophysical fluids                                  | Teaching<br>Unit (UE) |     |    |    | 6 credits |
| UE Radiative transfer and remote sensing                           | Teaching<br>Unit (UE) |     |    |    | 6 credits |
| UE Numerical modeling workshop                                     | Teaching<br>Unit (UE) | 8h  |    |    | 6 credits |
| UE Wave dynamics   | Teaching<br>Unit (UE) |     |    |    | 3 credits |



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|-------------------------------------|------------|------------------|-----|--------|
| UE Ocean dynamics                   | Tea<br>Uni | iching<br>t (UE) | 3 c | redits |
| UE Inverse methods and assimilation | Tea<br>Uni | iching<br>t (UE) | 6 c | redits |
| UE Geostatistical                   | Tea<br>Uni | iching<br>t (UE) | 6 c | redits |
| Semester 10                         |            |                  |     |        |

|                        | Nature | СМ | TD | TP | Crédits |
|------------------------|--------|----|----|----|---------|
| UE Research internship | CHOICE |    |    |    |         |
| UE Company internship  | CHOICE |    |    |    |         |

