



2SL1100 – Climate science and climate change issues

Instructors: Didier Paillard

Department: DÉPARTEMENT MÉCANIQUE ENERGÉTIQUE PROCÉDÉS

Language of instruction: FRANCAIS, ANGLAIS

Campus: CAMPUS DE PARIS - SACLAY, CAMPUS DE METZ, CAMPUS DE RENNES

Workload (HEE): 20

On-site hours (HPE): 12,00

Description

The objective of the "Climate Sciences" course is to provide the scientific basis for understanding the issues and challenges of current climate change. A first step is to situate the current transition in the more general context of climate changes that already occurred in the past. Indeed, it is only through the evocation of these past crises that we can draw a picture of the various consequences of the current crisis (climate, sea level, acidification, ecosystem changes, etc.). In addition, it is necessary to present the main physical principles which determine climate, in particular the planet's radiation balance and its geographical and seasonal variations, but also the basic ingredients of the greenhouse effect, in particular the carbon cycle which modifies and regulates climate on various time scales.

Beyond these general points, the objective of the course is also to present the modeling tools that are used today, both to better understand and quantify the processes involved, but also to simulate possible future climates. For this, it is important to specify what is the physical and geochemical content of these models by detailing the respective role of the conservation equations and that of the parametrizations. In the end, as there is no perfect tool integrating all the processes, it is necessary to establish various modeling strategies to answer different scientific or societal questions.

Quarter number

ST5

Prerequisites (in terms of CS courses)

No prerequisites.

Syllabus

- observation of natural climate variability and its phenomenology: forcings, feedbacks, threshold effects, flip-flops, and hysteresis.



- the main physical and chemical principles: the greenhouse effect (radiation), energy and water transport (balance equations, heat transfer, thermodynamics), the carbon cycle.
- numerical simulations of the climate.
- anthropogenic impact factors: greenhouse gas emissions, aerosols, land use, and future scenarios.

Class components (lecture, labs, etc.)

Lectures: 6h30

Tutorials: 4h30

Exam: 1h00

Grading

Online Quiz (mandatory)

Course support, bibliography

- Course slideshow
- About climate change: the IPCC reports (including "summaries for policymakers") from groups 1 ("climat": <https://www.ipcc.ch/report/ar6/wg1/>), 2 ("impacts": <https://www.ipcc.ch/report/ar6/wg2/>) and 3 ("mitigation/adaptation": <https://www.ipcc.ch/report/ar6/wg3/>):
- About climate and related research: see the IPSL links: <https://www.ipsl.fr/Pour-tous>

Resources

Responsible of the course: Didier Paillard.

Teaching Team (LSCE): Masa Kageyama, Didier Paillard.

Lectures in French

Tutorials in French or English.

Learning outcomes covered on the course

At the end of this teaching, the student will be able to :

- anchor the questions relating to climate change currently under way in the familiar physical principles of engineering (thermodynamics; mass, energy and momentum balance,...).
- understand the orders of magnitude for energy, the natural carbon cycle and their anthropogenic disturbances.
- implement the notions of feedback, threshold, hysteresis, complex system, in the context of the functioning of planet Earth.



Description of the skills acquired at the end of the course

C1.1 Examine a problem in full breadth and depth, within and beyond its immediate parameters, thus understanding it as a whole. This whole weaves the scientific, economic and social dimensions of the problem.

C2.1 Thoroughly master a domain or discipline based on the fundamental sciences or the engineering sciences.

C2.2 Import knowledge from other scientific fields or disciplines

C9.4 Demonstrate rigour and critical thinking in approaching problems from all angles, scientific, human and economic.