Université de Bretagne Occidentale

MASTER PHYSIQUE

PARCOURS PHYSIQUE OCÉAN ET CLIMAT

semestre 7 Physique POC

Initiation Océan et Climat

Présentation

This course introduces the basics of the large-scale dynamics of the atmosphere and ocean. The developed theoretical concepts are used to understand some aspects of climate, such as the origin of the temperature decrease with height, the structure of the zonal mean winds in the atmosphere or the stability of the Atlantic thermohaline circulation. English friendly course.

4 crédits ECTS

Volume horaire

Cours Magistral : 15h
Travaux Pratiques : 10h
Travaux Dirigés : 17h

Objectifs

On completing this course, students will be able to solve both analytically and numerically simple problems related to the large-scale dynamics of the atmosphere or ocean, such as the determination of the large-scale circulation from a given temperature or density distribution. Students will also be able to build simple mathematical models of climate and solve them for applications to the stability of linear and nonlinear systems.

Pré-requis nécessaires

vector calculus, basics of fluid mechanics and applied mathematics.

Compétences visées

- Use atmospheric and oceanic theories to understand the physics of the Earth's climate and the global warming
- Apply analytical and numerical methods to analyse and interpret oceanic and atmospheric data

Descriptif

The course is divided into 3 parts. Lecture notes (120pp, written in English) are available for this course.

Chap1. Energy balance of the Earth's climate system

- Distribution of insolation at the top of the atmosphere
- Basics of radiative transfer
- Emission temperature
- Radiation balance at the top of the atmosphere
- Simple models of the greenhouse effect
- A short introduction on dynamical systems (fixed points, and stability)
- Climate feedbacks
- Multiple equilibria in the climate system

Chap2. Large-scale atmospheric circulation

- Atmospheric composition
- Mean state of the atmosphere (temperature, water vapour, winds, clouds, etc)
- Equation of state
- Hydrostatic balance (and its validity)
- Dry adiabatic lapse rate and convection
- Geopotential height / Hypsometric equation
- Geostrophic balance
- Thermal wind balance in pressure coordinates

Chap3. Large-scale ocean circulation

- Mean state of the ocean (temperature, salinity, circulation)
- Geostrophy and thermal wind balance in height coordinates

- Energetics of the circulation and the importance of mixing (Sandstrom theorem)
- Multiple equilibria of the oceanic overturning circulation

The course is completed with about 10 hours of computer classes where students use simple energy balance climate models to study the sensitivity of the atmospheric mean state to changes in external forcings or parameters, learn how to build bifurcation diagrams and interpret them, develop python scripts to compute (among other things) geostrophic currents based on observed atmospheric and oceanics temperature/ density distributions.

Modalités de contrôle des connaissances

Session 1 ou session unique - Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Ecrit - devoir surveillé	120	50%	
	CC	Autre nature		50%	

Session 2 : Contrôle de connaissances

Nature de l'enseignement	Modalité	Nature	Durée (min.)	Coefficient	Remarques
	CT	Oral	30		