UCLouvain

# lphys2163 — Atmosphere and ocean : physics and dynamics

*2020*

Due to the COVID-19 crisis, the information below is subject to change, in particular that concerning the teaching mode (presential, distance or in a comodal or hybrid format).

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| 10 credits | 52.5 h + 7.5 h | Q1 |

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| Teacher(s) | Fichefet Thierry ;Massonnet François ; |
| Language : | English |
| Place of the course | Louvain-la-Neuve |
| Main themes | Teaching unit of general interest and of preparation to research for students interested in physical climatology. The following topics are addressed : general characteristics of the atmosphere ; radiative transfer in the atmosphere, atmospheric greenhouse effect and global energy balance of the Earth system ; vertical and meridional structures of the atmosphere ; thermodynamics of dry air, moist air and saturated air ; vertical stability/ instability of the atmosphere, convection and other processes of condensation of atmospheric water vapor ; general equations of geophysical fluid dynamics ; large-scale circulation of the atmosphere ; general characteristics of the ocean and physical properties of seawater ; large-scale circulation of the ocean. |
| Aims | 1 **a. Contribution of the teaching unit to the learning outcomes of the programme (PHYS2M and PHYS2M1)**<br>1.1, 1.2, 1.5<br>2.3, 2.5<br>3.1, 3.2, 3.3<br>4.2<br>5.1, 5.2, 5.3, 5.4<br>6.1, 6.2, 6.3, 6.5<br>7.1, 7.2, 7.3, 7.4, 7.5, 7.6<br>8.1<br>**b. Specific learning outcomes of the teaching unit**<br>At the end of this teaching unit, the student will be able to :<br>1. describe the main characteristics of the atmosphere and ocean ; 2. describe the energy fluxes and balances that characterize the atmosphere and relate them to the underlying theories of large-scale atmospheric and ocean motions ; 3. derive the conditions of atmospheric stability (dry and wet atmosphere) ; 4. develop physical models of large-scale circulation of the atmosphere and ocean ; 5. use and develop the physical theories of the atmosphere and ocean in a multidisciplinary environment ; 6. communicate the relevant elements of a physical theory of an atmospheric or oceanic process to a multidisciplinary audience ; 7. use this knowledge within an integrative project.<br>- - - -<br>*The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled “Programmes/courses offering this Teaching Unit”.* |
| Evaluation methods | **Due to the COVID-19 crisis, the information in this section is particularly likely to change.**<br>Oral exam with written preparation (65% of the final mark).<br>Writing of a report of about 15 pages on each integrative project and oral presentation of the report on the second project during the last week of the semester (15% + 20% = 35% of the final mark). This part of the mark will be used for each session and cannot be updated.<br>In the event of a health crisis, the evaluation methods may be reviewed during the semester and will be communicated to the students. |
| Teaching methods | **Due to the COVID-19 crisis, the information in this section is particularly likely to change.**<br>Lectures illustrated by experiments on a rotating table.<br>Two integrative projects to be executed by groups of 2 to 3 students. |
| Content | 1. General characteristics of the atmosphere<br>2. The radiative transfer in the atmosphere and the global energy balance of the Earth<br>3. The vertical structure of the atmosphere<br>4. Convection and other condensation processes<br>5. The meridional structure of the atmosphere<br>6. The equations of fluid motion |

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| | 7. Balanced flow<br>8. The general circulation of the atmosphere<br>9. The World Ocean cean and its circulation<br>10. The wind-induced ocean circulation<br>11. The thermohaline ocean circulation |
| Inline resources | The slides projected during lectures are available on MoodleUCL. |
| Bibliography | Gordon, A., W. Grace, P. Schwerdtfeger and R. Byron-Scott, 1998: Dynamic Meteorology: A basic course. Arnold, London, U.K., 325 pp.<br>Hartmann, D.L., 2016: Global Physical Climatology, Second Edition. Elsevier Science, 498 pp.<br>Houghton, J., 2002: The physics of atmospheres, Third Edition. Cambridge University Press, Cambridge, U.K., 340 pp.<br>Mellor, G.L., 1996: Introduction to Physical Oceanography. AIP Press, Woodbury, New York, U.S.A., 260 pp.<br>Pedlosky, J., 1996: Ocean Circulation Theory. Springer-Verlag, Berlin, Germany, 453 pp.<br>Petty, G.W., 2008: A first Course in Atmospheric Thermodynamics. Sundog Publishing, Madison, Wisconsin, U.S.A.? 337 pp.<br>Pond, S., and G. Pickard, 1983: Introductory Dynamical Oceanography. Pergamon Press, Oxford, U.K., 329 pp.<br>Salby, M.L., 2012: Physics of the Atmosphere and Climate. Cambridge University Press, New York, U.S.A., 666 pp.<br>Steward, R.H., 2007: Introduction to Physical Oceanography. Available for free as a PDF on the web.<br>Wallace, J.M., and P.V. Hobbs, 2006 : Atmospheric Science : An introductory Survey. Elsevier Academic Press, Burlington, U.S.A., 483 pp. |
| Other infos | Course of general interest preparing students to research in physical climatology. Desired (but not essential) prerequisites: basic training in thermodynamics and fluid physics. |
| Faculty or entity in charge | PHYS |

## Programmes containing this learning unit (UE)

| Program title | Acronym | Credits | Prerequisite | Aims |
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| Master [120] in Geography : Climatology | CLIM2M | 10 | | |
| Master [60] in Physics | PHYS2M1 | 10 | | |
| Master [120] in Physics | PHYS2M | 10 | | |