

## Introduction to the Dynamics of Atmospheres (C001427)

**Course size** *(nominal values; actual values may depend on programme)*

**Credits 6.0**

**Study time 180 h**

**Course offerings and teaching methods in academic year 2025-2026**

A (semester 1)

Dutch

Gent

independent work

lecture

seminar

**Lecturers in academic year 2025-2026**

Termonia, Piet

WE05

lecturer-in-charge

**Offered in the following programmes in 2025-2026**

[Master of Science in Teaching in Science and Technology\(main subject Mathematics\)](#)

**crdts**

6

**offering**

A

[Master of Science in Teaching in Science and Technology\(main subject Physics and Astronomy\)](#)

6

A

[Master of Science in Mathematics](#)

6

A

[Master of Science in Physics and Astronomy](#)

6

A

[Master of Science in Physics and Astronomy](#)

6

A

**Teaching languages**

Dutch

**Keywords**

Meteorology, atmosphere, dynamics, equations of motion, quasi geostrophic analysis, linear perturbation theory, wave solutions, baroclinic instabilities, general circulation, numerical techniques

**Position of the course**

The behaviour of the atmosphere is treated as a problem of applied fluid mechanics, starting from scratch. The equations are derived. These equations are too complex to be solved analytically. Two techniques to gain insight are introduced: (a) linear perturbation theory to study the wave solutions and (b) quasi geostrophic analysis to explain and understand the origin of baroclinic disturbances. Besides applying such simplifying techniques one can also rely on modelling to gain insight in atmospheric dynamics. The current popular numerical techniques are briefly discussed. The advantages and disadvantages of both approaches (analytic vs. numerical) are compared.

**Contents**

1. Forces on air parcels
2. The dynamical equations
3. Elementary properties of atmospheric motion (geostrophic wind, potential temperature, adiabatic temperature gradient, static stability, gradient wind, thermal wind, barotropic vs. baroclinic atmosphere)
4. Circulation and vorticity
5. Quasi geostrophic analysis
6. Linear perturbation theory
7. Baroclinic instabilities
8. The influence of the planetary boundary layer
9. General circulation
10. Numerical modelling

**Initial competences**

Basic knowledge from Bachelor on classical mechanics, vector calculus, partial differential equations

### **Final competences**

- 1 Apply continuum mechanics to atmospheres in general.
- 2 Notion of the problems in atmospheric dynamics.
- 3 Connect concepts in thermodynamics to meteorology.
- 4 Give a mathematical formulation for phenomena of dynamics of fluids.
- 5 Investigate flows in the atmosphere by application of physical laws and principles.
- 6 Distinguish and explain various types of flows in the atmosphere.
- 7 Explain and interpret graphs and diagrams related to the dynamics of atmospheres.
- 8 Understand the importance of mathematical analytical and numerical modeling in the context of meteorology.
- 9 Identifying and applying the right approach to gain the insight in synoptic-scale disturbances and energy transfers in the general circulation.

### **Conditions for credit contract**

Access to this course unit via a credit contract is determined after successful competences assessment

### **Conditions for exam contract**

This course unit cannot be taken via an exam contract

### **Teaching methods**

Seminar, Lecture, Independent work

### **Extra information on the teaching methods**

Classroom problem solving sessions: the students solve a list of exercises and the solutions are then discussed

### **Study material**

Type: Slides

Name: Slides'

Indicative price: € 10

Optional: no

Additional information: Slides (hand outs for the students) based on "An introduction to Dynamics Meteorology", J. R. Holton, 1992, ISBN 0-12-354355-X

### **References**

An Introduction to Dynamic Meteorology, J.R. Holton, 1992, ISBN 0-12-354355-X, Academic Press

### **Course content-related study coaching**

The lecturer is available for extra coaching if necessary

### **Assessment moments**

end-of-term assessment

### **Examination methods in case of periodic assessment during the first examination period**

Oral assessment

### **Examination methods in case of periodic assessment during the second examination period**

Oral assessment

### **Examination methods in case of permanent assessment**

### **Possibilities of retake in case of permanent assessment**

not applicable

### **Calculation of the examination mark**

Exam determines 100% of the final mark.