LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Module Catalogue

Master's Programme: Meteorology

(Master of Science, M.Sc.)

(120 ECTS credits, start of studies in the winter semester)

Based on the *Prüfungs- und Studienordnung*

adopted by the Senate of LMU Munich on June 22, 2023

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Abbreviations and annotations

CP	Credit Points, ECTS credits
ECTS	European Credit Transfer and Accumulation System
h	hours
SoSe	summer semester
SWS	contact hours
WiSe	winter semester
WP	compulsory elective course/module
P	mandatory course/module

1. The ECTS credits assigned in the Module Catalogue are designated as follows: Credit Points not listed in parentheses are awarded when the pertinent examination of the module or module parts have/has been completed successfully. Credit Points in parentheses are listed for calculatory purposes only.

2. The semester for taking a module can either be binding or may be considered as a recommendation, depending on the applicable data in Anlage 2 of the Prüfungs- und Studienordnung for your Programme. In this Module catalogue, the options are indicated as „scheduled semester“ and „recommended semester“.

3. Please note: The Module Catalogue is merely intended to serve as an orientation whereas the provisions of the applicable version of the Prüfungs- und Studienordnung (in German only) of your Programme are legally binding. See: www.lmu.de/studienangebot and select your Programme.

Module: P 1 Advanced Atmospheric Physics

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	P 1.1 Advanced Atmospheric Physics (Lecture)	WiSe	60 h (4 SWS)	120 h	(6)
Exercise course	P 1.2 Advanced Atmospheric Physics (Exercise Course)	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 9 ECTS credits have to be acquired. Class attendance averages about 6 contact hours. Including time for self-study, 270 hours have to be invested.

Module type	Mandatory module with mandatory courses
Usability of the module in other programmes	MSc Physics
Elective guidelines	None
Entry Requirements	None
Semester	Recommended semester: 1
Duration	The successful completion of the module takes 1 semester.
Content	In order to gain an understanding of the physical basis of climate and climate change, the students will develop a climate model. The course aims for (1) an understanding of the basic elements of climate; (2) an introduction to radiative/convective equilibrium models; (3) a thorough understanding of solar and thermal radiative transfer including trace gases, molecules, and clouds, multiple scattering, and interaction with the Earth's surface; (4) the radiation budget of the Earth; (5) forcing and feedback mechanisms; (6) temperature change by a doubling/quadrupling of the CO2 concentration as well as modifications of other trace gas concentrations or surface properties.
Learning outcomes	To gain an understanding of the greenhouse effect and of climate change by developing a simple but quantitative climate model using only elementary physics; at the end of the lecture the students will be able to predict the temperature change caused by a changing CO2 or CH4 concentration, including water vapor, surface albedo, and cloud feedbacks.
Type of examination	Written exam or oral examination

Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bernhard Mayer
Language(s)	English
Additional information	None

Module: P 2 Advanced Atmospheric Dynamics

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	P 2.1 Advanced Atmospheric Dynamics (Lecture)	WiSe	60 h (4 SWS)	120 h	(6)
Exercise course	P 2.2 Advanced Atmospheric Dynamics (Exercise Course)	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 9 ECTS credits have to be acquired. Class attendance averages about 6 contact hours. Including time for self-study, 270 hours have to be invested.

Module type	Mandatory module with mandatory courses
Usability of the module in other programmes	MSc Physics
Elective guidelines	None
Entry Requirements	None
Semester	Recommended semester: 1
Duration	The successful completion of the module takes 1 semester.
Content	This module aims to provide a rigorous and intuitive treatment of mid-latitude weather systems, yielding fundamental theoretical insights into their formation and development. The approach is modern, beginning with simple linear models, but going on to emphasize the role of fundamental conservation laws and similarity relationships that give insight even into complicated nonlinear systems. The module covers aspects as balanced flow, PV-thinking, invertibility, quasi-geostrophic theory of atmospheric disturbances, baroclinic and barotropic instability, wave-mean flow interactions as well as turbulence and predictability.
Learning outcomes	Students can explain well-founded dynamical principles and apply relationships in the atmosphere on the basis of physical laws and solve meteorological problems mathematically.
Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.

Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. George Craig
Language(s)	English
Additional information	None

Module: WP 1 Key Qualifications I

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 1.1 Key Qualifications for Master's Students 1	WiSe and SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: One compulsory elective module must be chosen from the compulsory elective modules WP 1 to WP 3. For the compulsory elective module WP 3, at least the following languages are available for selection at different levels: Arabic, Chinese, French, Italian, Japanese, Dutch, Norwegian, Portuguese, Spanish, Swedish, Thai and Turkish.
Entry Requirements	None
Semester	Recommended semester: 1
Duration	The successful completion of the module takes 1 semester.
Content	The module teaches content that goes beyond the subject of study and is particularly relevant to the profession of physicist, e.g. programming, science communication, patents, founding a business.
Learning outcomes	Students gain insights into the topics mentioned; depending on the chosen topic, skills for application are practiced.
Type of examination	Written exam or oral examination or presentation
Type of assessment	The successful completion of the module will not be graded.

Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Dean of Studies
Language(s)	English
Additional information	None

Module: WP 2 Key Qualifications II

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Seminar	WP 2.1 Key Qualifications for Master's Students 2	WiSe and SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: One compulsory elective module must be chosen from the compulsory elective modules WP 1 to WP 3. For the compulsory elective module WP 3, at least the following languages are available for selection at different levels: Arabic, Chinese, French, Italian, Japanese, Dutch, Norwegian, Portuguese, Spanish, Swedish, Thai and Turkish.
Entry Requirements	None
Semester	Recommended semester: 1
Duration	The successful completion of the module takes 1 semester.
Content	The module teaches content that goes beyond the subject of study and is particularly relevant to the profession of physicist, e.g. programming, science communication, patents, founding a business.
Learning outcomes	Students gain insights into the topics mentioned; depending on the chosen topic, skills for application are practiced.
Type of examination	Written exam or oral examination or presentation
Type of assessment	The successful completion of the module will not be graded.

Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Dean of Studies
Language(s)	English
Additional information	None

Module: WP 3 Modern Foreign Languages

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Exercise course	WP 3.1 Modern Foreign Language Course	WiSe and SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: One compulsory elective module must be chosen from the compulsory elective modules WP 1 to WP 3. For the compulsory elective module WP 3, at least the following languages are available for selection at different levels: Arabic, Chinese, French, Italian, Japanese, Dutch, Norwegian, Portuguese, Spanish, Swedish, Thai and Turkish.
Entry Requirements	None
Semester	Recommended semester: 1
Duration	The successful completion of the module takes 1 semester.
Content	The module teaches knowledge of a modern foreign language. Students can choose from a variety of language courses at different levels.
Learning outcomes	Students acquire foreign language skills in a modern foreign language.
Type of examination	Written exam or oral examination or presentation
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and

	potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Dean of Studies
Language(s)	English
Additional information	None

Module: WP 4 Atmospheric Observation Methods

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 4.1 Atmospheric Observation Methods (Lecture)	WiSe	45 h (3 SWS)	75 h	(4)
Exercise course	WP 4.2 Atmospheric Observation Methods (Exercise Course)	WiSe	15 h (1 SWS)	45 h	(2)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Compulsory elective module with mandatory courses
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 1
Duration	The successful completion of the module takes 1 semester.
Content	Measurement methods and evaluation procedures for determination of various parameters that describe the state of the atmosphere. These can be basic parameters such as temperature, air pressure or radiation, but also other specific parameters such as pollutant concentrations, emissions, clouds, aerosols or land use classifications.
Learning outcomes	Students should acquire knowledge of the scientific basis of the observations to interpret and classify results, the ability to develop and apply atmospheric measurement methods and to use scientific evaluations to determine the state of the atmosphere.

Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Mark Wenig
Language(s)	English
Additional information	None

Module: WP 5 Earth System Modeling

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 5.1 Earth System Modeling (Lecture)	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 1
Duration	The successful completion of the module takes 1 semester.
Content	This module is concerned with the physical basis of both idealized and comprehensive numerical climate models. Underlying physical conservation laws, their representation in models, and necessary parametrizations as well as fundamental concepts of climate change such as radiative forcing, climate feedbacks, scenarios for future climate projections for the different Earth system components, general circulation aspects of climate change or chemistry-climate interactions can be aspects included in this module.
Learning outcomes	Familiarity and ability to interpret and critically assess outcomes from the IPCC reports and the climate change literature in general.

Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Thomas Birner
Language(s)	English
Additional information	None

Module: WP 6 Components of the Climate System

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 6.1 Components of the Climate System (Lecture)	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 1
Duration	The successful completion of the module takes 1 semester.
Content	The morphology of climate system components (e.g. land-surface, cryosphere, oceans, troposphere, stratosphere) and suited observation techniques are covered in this module. This can include the underlying physical principles of drivers of mean state, natural variability, and long-term changes of each component, as well as fundamentals of climate dynamics within, as well as across climate system components.
Learning outcomes	Ability to describe and explain core characteristics of climate system components and how they are coupled, and the dynamics that give rise to climate variability and long-term change.

Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Thomas Birner
Language(s)	English
Additional information	None

Module: WP 7 Atmospheric Processes

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 7.1 Atmospheric Processes (Lecture)	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 1
Duration	The successful completion of the module takes 1 semester.
Content	In this module individual atmospheric processes will be discussed in more detail in contrast to modules evaluating their role in relation to other parts of or the complete Earth-Atmosphere system. This includes a focus on the interfaces to Earth surface or space, specific cloud processes or aerosol gas-chemistry aspects, and specific aspects of upper atmosphere height layers (e.g., mesosphere, stratosphere).
Learning outcomes	Students can explain well-founded principles of the field and apply this knowledge on various spatial and temporal scales in the atmosphere on the basis of physical laws and are enabled to assess validity and relevance of research in this field.

Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bernhard Mayer
Language(s)	English
Additional information	None

Module: WP 8 Current Research Topics in Experimental Meteorology

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 8.1 Current Research Topics in Experimental Meteorology (Lecture)	WiSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 1
Duration	The successful completion of the module takes 1 semester.
Content	The module provides an in-depth discussion of current research topics in Experimental Meteorology. Special attention is paid to recent developments in research.
Learning outcomes	Students acquire in-depth knowledge and gain an understanding of current research topics in Experimental Meteorology.
Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.

Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bernhard Mayer
Language(s)	English
Additional information	None

Module: P 3 Discussion of Current Research Questions on Advanced Meteorology

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Seminar	P 3.1 Discussion of Current Research Questions on Advanced Meteorology (Seminar)	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Mandatory module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	None
Entry Requirements	None
Semester	Recommended semester: 2
Duration	The successful completion of the module takes 1 semester.
Content	Students work on a topic in the field of Meteorology, present it to the class and discuss conclusions.
Learning outcomes	Students develop their skills to learn a new topic independently by reviewing scientific literature. They deepen their abilities to present content in a clear and comprehensible way.
Type of examination	Presentation
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bernhard Mayer
Language(s)	English
Additional information	None

Module: WP 9 Atmospheric Modeling

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 9.1 Atmospheric Modeling (Lecture)	SoSe	45 h (3 SWS)	75 h	(4)
Exercise course	WP 9.2 Atmospheric Modeling (Exercise Course)	SoSe	15 h (1 SWS)	45 h	(2)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Compulsory elective module with mandatory courses
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 2
Duration	The successful completion of the module takes 1 semester.
Content	This module is designed to provide students with an overview of important dynamical, physical and chemical processes on various scales in the atmosphere. This can include fundamental insights into numerical methods for Numerical Weather Prediction (NWP) and an understanding of its different components. The basics on how climate on Earth is determined by thermodynamic and dynamical processes (Energy balance, and redistribution of Energy by dynamical circulations) are included. Methods how to model the Earth's climate are introduced spanning a hierarchy of models from simple models to coupled Atmosphere-Ocean Models (GCMs).

Learning outcomes	Students can explain well-founded dynamical principles and apply relationships on various spatial and temporal scales in the atmosphere on the basis of physical laws and solve meteorological problems mathematically and numerically.
Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. George Craig
Language(s)	English
Additional information	None

Module: WP 10 Theoretical Meteorology from the Weather to the Climate Scale

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 10.1 Theoretical Meteorology from the Weather to the Climate Scale (Lecture)	SoSe	45 h (3 SWS)	75 h	(4)
Exercise course	WP 10.2 Theoretical Meteorology from the Weather to the Climate Scale (Exercise Course)	SoSe	15 h (1 SWS)	45 h	(2)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Compulsory elective module with mandatory courses
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 2
Duration	The successful completion of the module takes 1 semester.
Content	This module is designed to provide students with an overview of important dynamical, physical and chemical processes on various scales in the atmosphere. This can include fundamental insights into numerical methods for Numerical Weather Prediction (NWP), the basics on how climate on Earth is determined by thermodynamic and dynamical processes.
Learning outcomes	Students can explain well-founded dynamical principles and apply relationships on various spatial and temporal

	scales in the atmosphere on the basis of physical laws and solve meteorological problems mathematically and numerically.
Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. George Craig
Language(s)	English
Additional information	None

Module: WP 11 Experimental Meteorology - Clouds, Aerosols, Gases

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 11.1 Experimental Meteorology - Clouds, Aerosols, Gases (Lecture)	SoSe	45 h (3 SWS)	75 h	(4)
Exercise course	WP 11.2 Experimental Meteorology - Clouds, Aerosols, Gases (Exercise Course)	SoSe	15 h (1 SWS)	45 h	(2)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Compulsory elective module with mandatory courses
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 2
Duration	The successful completion of the module takes 1 semester.
Content	In this module the roles and interaction of trace gases, clouds, precipitation and aerosol are introduced and analysed. General physical backgrounds are covered as well as the in-depth examination of these aspects in observational data and the related data analysis approaches.
Learning outcomes	Students can explain well-founded principles of the field and apply this knowledge on various spatial and temporal scales in the atmosphere on the basis of physical laws and

	are enabled to assess validity and relevance of research in this field.
Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bernhard Mayer
Language(s)	English
Additional information	None

Module: WP 12 Atmospheric Data Analysis Methods

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 12.1 Atmospheric Data Analysis Methods (Lecture)	SoSe	45 h (3 SWS)	75 h	(4)
Exercise course	WP 12.2 Atmospheric Data Analysis Methods (Exercise Course)	SoSe	15 h (1 SWS)	45 h	(2)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Compulsory elective module with mandatory courses
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 2
Duration	The successful completion of the module takes 1 semester.
Content	In this module methods for the interpretation of remote sensing data and environmental measurements of the atmospheric different constituents are introduced and applied to real data. Methods include mathematical and statistical optimization procedures as well as data processing methods. Observation data and its theoretical background covered can include clouds, aerosol, soil properties or pollutant and greenhouse gas distributions as observed from different measurement platforms (satellite, ground based, airborne), provided by lab-experiments, in-situ or remote sensing sensors.

Learning outcomes	The learning objectives are to gain an in-depth understanding of various data analysis methods that enable the evaluation and analysis of extensive and complex measurement data sets. This way students will be able to assess the relevance of derived results and drawn conclusions based on scientific theory and state-of-the-art techniques.
Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Mark Wenig
Language(s)	English
Additional information	None

Module: WP 13 Current Research Topics in Theoretical Meteorology

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 13.1 Current Research Topics in Theoretical Meteorology (Lecture)	SoSe	45 h (3 SWS)	75 h	(4)
Exercise course	WP 13.2 Current Research Topics in Theoretical Meteorology (Exercise Course)	SoSe	15 h (1 SWS)	45 h	(2)

For successful completion of the module, 6 ECTS credits have to be acquired. Class attendance averages about 4 contact hours. Including time for self-study, 180 hours have to be invested.

Module type	Compulsory elective module with mandatory courses
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 2
Duration	The successful completion of the module takes 1 semester.
Content	The module provides an in-depth discussion of current research topics in Theoretical Meteorology. Special attention is paid to recent developments in research.
Learning outcomes	Students acquire in-depth knowledge and gain an understanding of current research topics in Theoretical Meteorology.

Type of examination	Written exam or oral examination
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. George Craig
Language(s)	English
Additional information	None

Module: WP 14 Radiative Transfer

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 14.1 Radiative Transfer (Lecture)	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 2
Duration	The successful completion of the module takes 1 semester.
Content	In this module all aspects of radiative transfer are covered. This can be theoretical mathematical aspects, modelling approaches and model application, retrieval theory and methods for active and passive remote sensing as well as observation or more general discussions of its role in weather and climate.
Learning outcomes	Students can explain well-founded principles of the field and apply this knowledge on various spatial and temporal scales in the atmosphere on the basis of physical laws and are enabled to assess validity and relevance of research in this field as well as to apply the methods of the field.
Type of examination	Written exam or oral examination

Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bernhard Mayer
Language(s)	English
Additional information	None

Module: WP 15 Specific Aspects of Climate Change

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 15.1 Specific Aspects of Climate Change (Lecture)	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 2
Duration	The successful completion of the module takes 1 semester.
Content	Different aspects of future changes of the Earth's climate system composed of its parts land surface, atmosphere and its specific height layers, as well as ocean circulation are considered. Also included can be aspects of interaction of these nature components and human society (e.g. economy, technology, land use).
Learning outcomes	Students can explain well-founded principles of the field and apply this knowledge on various spatial and temporal scales in the atmosphere on the basis of physical laws and are enabled to assess validity and relevance of research in this field.
Type of examination	Written exam or oral examination

Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Georg Craig
Language(s)	English
Additional information	None

Module: WP 16 Applied Meteorology

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 16.1 Applied Meteorology (Lecture)	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 2
Duration	The successful completion of the module takes 1 semester.
Content	In this module applied aspects of meteorology are covered, be it application for neighboring fields of science or society: e.g. traffic, energy production, energy market, insurance industry, biology, medicine, but also application of its mathematical and physical basis for all types of evaluation or modelling approaches.
Learning outcomes	Students can explain well-founded principles of the field and apply this knowledge on various spatial and temporal scales in the atmosphere on the basis of physical laws and are enabled to assess validity and relevance of research in this field.
Type of examination	Written exam or oral examination

Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bernhard Mayer
Language(s)	English
Additional information	None

Module: WP 17 Meteorology, Climate, Society

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Lecture	WP 17.1 Meteorology, Climate, Society (Lecture)	SoSe	30 h (2 SWS)	60 h	(3)

For successful completion of the module, 3 ECTS credits have to be acquired. Class attendance averages about 2 contact hours. Including time for self-study, 90 hours have to be invested.

Module type	Compulsory elective module with mandatory course
Usability of the module in other programmes	MSc Physics
Elective guidelines	The module can be selected in compliance with the following rules: From the compulsory elective modules WP 4 to WP 17, compulsory elective modules with a total of 36 ECTS credits must be selected. At least three compulsory elective modules must be selected from the compulsory elective modules WP 9 to WP 13. In the 1st semester compulsory elective modules with a total of 27 ECTS credits and in the 2nd semester compulsory elective modules with a total of 9 ECTS credits are to be selected.
Entry Requirements	None
Semester	Recommended semester: 2
Duration	The successful completion of the module takes 1 semester.
Content	All aspects of interaction over different time and spatial scales of meteorology and climate and the interaction with society and economy are part of this module. The atmosphere shapes the environment of human life and, at the same time, is shaped by human activities. This interplay is focus here.
Learning outcomes	Students can explain well-founded principles of the field and apply this knowledge on various spatial and temporal scales in the atmosphere on the basis of physical laws and are enabled to assess validity and relevance of research in this field.
Type of examination	Written exam or oral examination

Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bernhard Mayer
Language(s)	English
Additional information	None

Module: P 4 Research Project in Meteorology: Phase I

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Training	P 4.1 Scientific Training in Meteorology: Literature Search	WiSe and SoSe	-	90 h	(3)
Training	P 4.2 Scientific Training in Meteorology: Induction into the Field of Research	WiSe and SoSe	-	360 h	(12)

For successful completion of the module, 15 ECTS credits have to be acquired. Class attendance averages about 0 contact hours. Including time for self-study, 450 hours have to be invested.

Module type	Mandatory module
Usability of the module in other programmes	None
Elective guidelines	None
Entry Requirements	None
Semester	Recommended semester: 3
Duration	The successful completion of the module takes 1 semester.
Content	Students get familiar with a physical problem, research approaches and their adequate presentation within Meteorology. The topic of Research Project: Phase 1 is agreed between the student and a lecturer according to the area of his/her research group.
Learning outcomes	Students develop skills for the self-directed acquisition of in-depth knowledge and of concepts and methods relating to the discussed research topic. Competences in scientific work, e.g. for literature search and the presentation of content are acquired.
Type of examination	Oral examination or presentation or term paper or scientific protocol
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and

	potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. George Craig
Language(s)	English
Additional information	None

Module: P 5 Research Project in Meteorology: Phase II

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Training	P 5.1 Scientific Work in Meteorology: Selection and Application of Scientific Methods within the Scope of the Research Project	WiSe and SoSe	-	90 h	(3)
Training	P 5.2 Scientific Work in Meteorology: Self-directed Research	WiSe and SoSe	-	360 h	(12)

For successful completion of the module, 15 ECTS credits have to be acquired. Class attendance averages about 0 contact hours. Including time for self-study, 450 hours have to be invested.

Module type	Mandatory module
Usability of the module in other programmes	None
Elective guidelines	None
Entry Requirements	None
Semester	Recommended semester: 3
Duration	The successful completion of the module takes 1 semester.
Content	Students continue the work on a physical problem started in Research Project: Phase I. The focus is on the selection and development of suitable research methods and scientific research activity.
Learning outcomes	Students develop skills, for scientific documentation and writing, for structured scientific work and for critical evaluation of results.
Type of examination	Oral examination or presentation or term paper or scientific protocol
Type of assessment	The successful completion of the module will not be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.

Responsible contact	Prof. Dr. Bernhard Mayer
Language(s)	English
Additional information	None

Module: P 6 Final Module

Programme	Master's Programme: Meteorology (Master of Science, M.Sc.)

Related module parts

Course type	Course (mandatory)	Rotation	Contact hours	Self-study hours	ECTS
Master's thesis	P 6.1 Master's Thesis	WiSe and SoSe	-	900 h	(30)

For successful completion of the module, 30 ECTS credits have to be acquired. Class attendance averages about 0 contact hours. Including time for self-study, 900 hours have to be invested.

Module type	Mandatory module
Usability of the module in other programmes	None
Elective guidelines	None
Entry Requirements	Successful participation in P 4 and P 5
Semester	Recommended semester: 4
Duration	The successful completion of the module takes 1 semester.
Content	Within the chosen research area, the student completes the Master's thesis as a continuation of the Research Project: Phase I and II. The Master's thesis is an independent research project.
Learning outcomes	In the Master's thesis, students independently apply the conceptual and methodological knowledge acquired during their studies, develop it further, find their own questions, gain new insights, evaluate them critically, communicate them and present them in accordance with the scientific standards.
Type of examination	Master's thesis
Type of assessment	The successful completion of the module will be graded.
Requirements for the gain of ECTS credits	ECTS credits will be granted when the module examination (or the examination of pertinent mandatory and potential elective compulsary module parts) has/have been completed successfully.
Responsible contact	Prof. Dr. Bernhard Mayer
Language(s)	English

Additional information	None